INTERMEDIATE-DEPTH EARTHQUAKES, SLAB STRESS STATE AND UPPER MANTLE STRUCTURE BENEATH THE NORTH CENTRAL ANDES

Abhash Kumar

A dissertation submitted to the faculty at the University of North Carolina at Chapel Hill in partial fulfillment of the requirements for the degree of Doctor of Philosophy in the Department of Geological Sciences.

Chapel Hill
2015

Approved by:
Drew Coleman
Lara Wagner
Jonathan Lees
Kevin Stewart
Gordana Vlahovic
ABSTRACT

Abhash Kumar: Intermediate-depth earthquakes, slab stress state and upper mantle structure beneath the north central Andes
(Under the direction of Drew Coleman)

Flat slab subduction in Peru and the Central Andean Plateau of southern Peru, Bolivia and northwestern Argentina are the two intriguing geologic features along the western margin of South America. Flat slab subduction has often been causally linked to a wide host of geological observations including the cessation of arc volcanism, inboard thick-skinned deformation of the overriding plate, ignimbrite volcanism, and the evolution of high plateaus. Yet several questions continue to exist on both the requirements for its formation and the consequences of its existence. For the purpose of this dissertation, I define “flat slab subduction” as subduction zones where the downgoing slab subducts normally (~30° dip) to a depth of ~100 km and then abruptly bends to travel horizontally for several hundred kilometers before resuming its descent. Understanding the mechanisms responsible for the formation of existing flat slabs will help us understand if they can be scaled up to match predictions for paleo-flat slabs. There are a number of proposed contributing factors to the formation of flat slab subduction, including ridge subduction, rapid overriding plate velocity and trenchward motion of a thick cratonic root. In this dissertation I investigate the role of Nazca ridge subduction on the formation of Peruvian flat slab in Chapter 1 and Chapter 2.

Previous studies of the geometry of the subducted Nazca plate in central and southern Peru have had to rely on primarily teleseismic data or local data collected from small seismic network. In Chapter 1 I determined the geometry of the subducting Nazca slab beneath central
and southern Peru using data from the three recently deployed local seismic networks. I determined new contours of the slab geometry between 9° and 18°S using 508 relocated hypocenters and constraints from teleseismic surface wave tomography. This region offers a unique opportunity to study the link between ridge buoyancy and occurrence of the flat slab in general because of the unique ridge geometry relative to the convergence direction of the plates. My results show that the shallowest portion of the southern Peruvian flat slab is either at or just south of the subducted Nazca Ridge and events deepens to the north in the region of previously proposed flat or even shallower slab geometries. The fact that the shallowest portion of the Nazca plate is straddling the ridge and events deepen along strike and away from the ridge has important implications for the ridge buoyancy hypothesis. My relocated hypocenters also indicate an absence of seismicity along the projected location of the subducting Nazca Ridge, which is likely due to an absence of mantle hydrous phases beneath the overthickened crust of the Nazca Ridge. This provides an important insight for the genesis of intermediate depth seismicity.

The distribution of earthquake hypocenters as determined in Chapter 1 indicates strong along-strike variability in the slab geometry, from flat slab subduction north of 15 °S, to uniform normal subduction south of 15 °S. In Chapter 2 I obtained high quality focal mechanisms for intermediate depth events to investigate how the slab is deforming along strike. South of the Nazca Ridge, my results suggest uniform extension in the slab down dip of the ridge. Down dip tension is consistent with a highly deformed slab, but no tearing between the normally dipping plate and the flat slab along the Nazca Ridge. North of the Nazca Ridge, the T-axes are largely ridge-parallel in map view, but with a distinct downward dip that is not parallel to the slab. These
steeply dipping T-axes differ from the expected stress pattern for a fully supported flat slab and indicate that the flat slab north of the ridge may not stable.

South of the Peruvian flat slab, the Central Andean Plateau (i.e. Altiplano-Puna plateau) is the second largest tectonically active orogen along the western margin of South America. This plateau has influenced both local and far field lithospheric deformation, global sediment flux, atmospheric circulation and climate since the early Miocene. Significant geologic and geophysical efforts have been made to constrain the tectonomorphic evolution of the central Andean plateau, yet the role of surface and deep lithospheric processes in the evolution of the plateau is unclear. Existing theories predict two contrasting models of rapid and recent versus slow and steady uplift for the temporal evolution of the Central Andean Plateau. One possible discriminating factor between these two theories is seismic evidence for the presence or absence of mantle lithosphere. In Chapter 3 I investigate the current state of lithospheric structure below the northern Altiplano, northernmost portion of the Central Andean Plateau, in southern Peru and northern Bolivia. My results indicate an absence of a high velocity lower crust beneath the northern Altiplano, suggesting a weak lower crust of felsic composition or the loss of a high velocity mafic lower crust due to delamination. The upper mantle under the northern Altiplano is heterogeneous, consistent with piecemeal delamination. My tomography results for the lower crust and upper mantle beneath the northern Altiplano are in better agreement with the slow and steady uplift model.
I dedicate my thesis work to my loving family. A remarkable feeling of thankfulness to my loving parents, Nawindra Kumar Mishra and Savita Mishra whose words of encouragement and appreciation ring in my ears. My sisters Nibha and Pratibha always supported me and are very special. My nephew Valentino and my niece Palak have been great source of joy. I dedicate this work and give exceptional thanks to my elder brother and my best friend Santosh Kumar for being there for me throughout the entire doctorate program. You have been my biggest support ever. I remarkably dedicate this thesis to my loving wife Priyanka and my four-month-old adorable daughter Laavanya for their unconditional support.
ACKNOWLEDGEMENTS

I would like to thank, first and foremost my research advisor Lara Wagner for her support, inspiration, giving me opportunity to work on CAUGHT and PULSE project, and her significant contribution to the ideas presented in this dissertation. My dissertation would not have been possible without financial support through the Department of Geological Sciences, University of North Carolina at Chapel Hill, and grants awarded to my research adviser through the National Science Foundation.

I would like to thank the rest of my committee members for their countless hours of reading, encouraging remarks and scientific guidance.

This dissertation work was strongly encouraged from the exchange of ideas from many people within and outside of the University of North Carolina, and I would like extend special thanks to Sanja Knezevic Antonijevic, C. Berk Biryol, Jesse Hill, Keehoon Kim, Daniel Bowman, Kevin M. Ward, and Linda M. Warren.

Special thanks goes to Deborah Harris and Liz Steadman for the administrative support.
TABLE OF CONTENTS

LIST OF TABLES ........................................................................................................... xi
LIST OF FIGURES .......................................................................................................... xii

Chapter1: Geometry of the subducting Nazca plate in the Peruvian flat slab region of central and southern Peru

ABSTRACT ......................................................................................................................... 1

1. INTRODUCTION AND TECTONIC SETTING .................................................. 2

2. DATA ......................................................................................................................... 5

3. METHODS .................................................................................................................. 6

4. RESULTS .................................................................................................................. 10
   4.1. Earthquake location ......................................................................................... 10
   4.2. Slab geometry .................................................................................................. 12

5. DISCUSSION ............................................................................................................. 13
   5.1. New constraints on Slab Geometry and the causes of flat slab subduction .... 13
   5.2. Abrupt variations in seismicity within the subducted Nazca plate .............. 15

6. CONCLUSIONS ....................................................................................................... 17

7. ACKNOWLEDGEMENTS ......................................................................................... 18

REFERENCES ............................................................................................................... 62

Chapter2: Stress distribution in the southern Peru subduction zone

ABSTRACT ......................................................................................................................... 68

1. INTRODUCTION ....................................................................................................... 68
Chapter 3: Crust and upper mantle structure beneath the north central Andes

ABSTRACT ......................................................................................................................101

1. INTRODUCTION...........................................................................................................102

2. DATA...........................................................................................................................105

3. METHOD......................................................................................................................107

4. RESULTS......................................................................................................................111

   4.1. Crustal anomaly........................................................................................................111
       4.1.1 South-central Peru............................................................................................111
       4.1.2 Southern Peru and northern Bolivia.................................................................112

   4.2. Upper mantle anomaly............................................................................................113
       4.2.1 Peruvian flat slab region..................................................................................113
       4.2.2 Southern Peru and northern Bolivia.................................................................113

5. RESOLUTION ANALYSES..........................................................................................115

   5.1 Resolution of crustal anomalies................................................................................115
   5.2 Resolution of mantle anomalies..............................................................................116

6. DISCUSSION...............................................................................................................118
6.1. Peruvian flat slab region.................................................................119
  6.1.1 Crust........................................................................................119
  6.1.2 Upper mantle........................................................................119
6.2. Western Cordillera........................................................................121
6.3. Eastern Cordillera crust.................................................................121
6.4. Northern Altiplano.......................................................................122
  6.4.1 Crust........................................................................................122
  6.4.2 Upper mantle........................................................................124
7. CONCLUSION..................................................................................126
8. ACKNOWLEDGEMENTS.................................................................127
REFERENCES....................................................................................184
LIST OF TABLES

Table 1.1. Earthquake locations from Seisan .................................................................32

Table 1.2. Earthquake locations from HypoDD ............................................................48

Table 2.1. Fault plane solutions for intermediate depth events ........................................87

Table 2.2 Stress axes orientations for intermediate depth events ....................................92
LIST OF FIGURES

FIGURE 1.1- Map of my study area in southern Peru and northern Bolivia…………………19

FIGURE 1.2- Map showing the contribution of seismic data from individual stations…………………………………………………………20

FIGURE 1.3- Map of absolute earthquake locations…………………………………………………21

FIGURE 1.4- Map of relative earthquake locations……………………………………………………22

FIGURE 1.5- Map of earthquake locations from ANSS catalog…………………………………23

FIGURE 1.6- Map of absolute earthquake location for 5% decrease in velocity model………24

FIGURE 1.7- Map of absolute earthquake location for 5% increase in velocity model………25

FIGURE 1.8- Map showing the comparison between absolute and relative location…………………………………………………………26

FIGURE 1.9- Map showing the locations of seismicity cross-sections…………………………27

FIGURE 1.10 - Seismicity cross-sections parallel to the trench……………………………………28

FIGURE 1.11 - Seismicity cross-sections perpendicular to the trench…………………………29

FIGURE 1.12 - Seismicity cross sections perpendicular to the trench…………………………30

FIGURE 1.13- Map showing iso-depth contours of the Nazca slab……………………………31

FIGURE 2.1- Map showing high quality focal mechanism solution……………………………79

FIGURE 2.2- Map of focal mechanism solutions…………………………………………………80

FIGURE 2.3- Map of focal mechanism solutions as a function of rake angle…………………81

FIGURE 2.4- Map showing T-axes orientations…………………………………………………82

FIGURE 2.5- Rose diagrams……………………………………………………………………83

FIGURE 2.6- Rose diagrams……………………………………………………………………84
FIGURE 2.7 - T-axes cross sections .............................................................. 85
FIGURE 2.8 - Map showing P-axes orientations ........................................ 86
FIGRUE 3.1 - Geologic map of the study area ........................................... 129
FIGRUE 3.2 - Map of event locations after tomographic inversion .............. 130
FIGRUE 3.3 - Map showing azimuthal gap of final event locations ............. 131
FIGRUE 3.4 - Histogram of azimuthal gap for used earthquakes .............. 132
FIGRUE 3.5 - Map showing ray path coverage for P wave ....................... 133
FIGRUE 3.6 - Map showing ray path coverage for S wave ....................... 134
FIGRUE 3.7 - Map of velocity grid nodes ................................................. 135
FIGRUE 3.8 - Scatter plot of residual for all events .................................. 136
FIGRUE 3.9 - Model versus data variance plots ...................................... 137
FIGRUE 3.10 - Results of tomographic inversion at 5 km depth ............... 138
FIGRUE 3.11 - Results of tomographic inversion at 25 km depth ............. 139
FIGRUE 3.12 - Results of tomographic inversion at 45 km depth ............. 140
FIGRUE 3.13 - Results of tomographic inversion at 65 km depth ............. 141
FIGRUE 3.14 - Results of tomographic inversion at 75 km depth ............. 142
FIGRUE 3.15 - Results of tomographic inversion at 85 km depth ............. 143
FIGRUE 3.16 - Results of tomographic inversion at 105 km depth .......... 144
FIGRUE 3.17 - Results of tomographic inversion at 125 km depth .......... 145
FIGRUE 3.18 - Results of tomographic inversion at 145 km depth .......... 146
FIGRUE 3.19 - Results of tomographic inversion at 165 km depth .......... 147
FIGRUE 3.20 - Results of tomographic inversion at 185 km depth .......... 148
FIGRUE 3.21 - Map showing locations of tomographic cross-sections ....... 149
FIGRUE 3.45- Results showing recovery of anomaly L in $V_S$. ........................................173
FIGRUE 3.46- Results showing recovery of anomaly L in $V_P$. ........................................174
FIGRUE 3.47- Results showing recovery of anomaly E in $V_P$. ........................................175
FIGRUE 3.48- Results showing recovery of anomaly E in $V_S$. ........................................176
FIGRUE 3.49- Results showing recovery of anomaly AS in $V_P$. ........................................177
FIGRUE 3.50- Results showing recovery of anomaly AS in $V_S$. ........................................178
FIGRUE 3.51- Recovery test of high-$V_S$ anomaly in the Altiplano crust and slab..........179
FIGRUE 3.52- Recovery test of high-$V_P$ anomaly in the Altiplano crust and slab..........180
FIGRUE 3.53- Results showing recovery of anomaly D in $V_S$. ........................................181
FIGRUE 3.54- Results showing recovery of anomaly D in $V_S$ including random noise....182
FIGRUE 3.55- Results showing recovery of anomaly D in $V_P$. ........................................183
Chapter 1: Geometry of the subducting Nazca plate in the Peruvian flat slab region of central and southern Peru

ABSTRACT

I have determined the geometry of the subducting Nazca slab beneath central and southern Peru using data from the three recently deployed local seismic networks. This region offers a unique opportunity to study the link between Nazca Ridge buoyancy and occurrence of the flat slab in southern Peru, where the subducting Nazca plate flattens at ~100 km depth and then extends horizontally for several hundreds kilometers before resuming normal subduction. I determined new contours of the slab geometry between 9° and 18°S using 508 relocated hypocenters and constraints from teleseismic surface wave tomography. My slab contours have subtle but important differences from the other previous slab geometries for this region in several key aspects. My relocated hypocenters suggest that the shallowest portion of the southern Peruvian flat slab is either at or just south of the subducted Nazca Ridge, with a significant deepening of hypocenters to the north where previous models have reported flat or even shallower slab geometries. The fact that the shallowest portion of the Nazca plate is straddling the ridge and events deepen along strike and away from the ridge has important implications for the ridge buoyancy hypothesis. I also observe an absence of seismicity along the projected Nazca Ridge track in the horizontally subducting portion of the slab. I interpret this as possibly indicative of an absence of water in the mantle beneath the overthickened crust of the Nazca Ridge. This may provide important new constraints on the conditions required to produce intermediate depth seismicity.
1. INTRODUCTION AND TECTONIC SETTING

Flat slab subduction refers to subduction zones where the downgoing slab subducts normally (~30° dip) to a depth of ~100 km and then abruptly bends to travel horizontally for several hundred kilometers before resuming its descent (Hasegawa & Sacks, 1981; Cahill & Isacks, 1992). The depth of flattening and inboard extent of the horizontal segment varies between different regions of flat slab subduction for reasons that are not well understood (Gutscher et al., 2000). Flat slab subduction is of particular interest because it has often been causally linked to unusual tectonic processes such as the cessation of arc volcanism, inboard thick-skinned deformation of the overriding plate and the evolution of high plateaus (e.g. Isacks & Barazangi, 1977; Cross & Pilger, 1982; Jordan & Allmendinger, 1986; James & Sacks, 1999; Gutscher et al., 2000). In particular, the Laramide uplift of the Rocky Mountains and subsequent ignimbrite flare-up in the western United States has been attributed to a period of flat subduction of the Farallon plate (80-55 Ma) (e.g. Dickinson & Snyder, 1978; Humphreys et al., 2003).

There are a number of proposed contributing factors to the formation of flat slab subduction. These include: (1) the subduction of seafloor heterogeneities including buoyant aseismic ridges and volcanic seamount chains (Sacks 1983, Gutscher et al., 2000, van Hunen et al., 2002; Arrial & Billen, 2013); (2) rapid overriding plate motion and associated trench retreat (van Hunen et al., 2002; Lallemand et al., 2005; Heuret et al., 2007). (3) a critical yield strength of the slab below which bending becomes possible (van Hunen et al., 2002, 2004); (4) a young age (<50 Ma) of the subducting slab resulting in a low average density and less negative buoyancy (Vlaar & Wortel, 1976; Wortel & Vlaar, 1978; Barazangi & Isacks, 1979, Sacks, 1983); (5) the trenchward motion of a thick cratonic root in the
overriding lithosphere (O’ Driscoll et al., 2009; Manea et al., 2012); and (6) an increase in hydrodynamic suction forces between the overriding and the subducting plates (Jischke, 1975; van Hunen et al., 2004; Billen & Hirth, 2005; Manea et al., 2012). Of these proposed mechanisms, the first is perhaps the most commonly cited and the most controversial. The basic premise is that both the over thickened basaltic crust of the oceanic ridge and the underlying layer of harzburgite are less dense than undepleted mantle peridotite resulting in neutral buoyancy at some depth (~80-100 km). Espurt et al. (2008) used a 3D viscoelastic model and suggested a necessary contribution from ridge buoyancy in the formation of flat slabs. On the other hand, a recent plate tectonic reconstruction study by Skinner and Clayton (2013) appear to indicate no clear correlation between ridge subduction and flat or shallowly dipping slabs worldwide. Other studies have indicated that, while buoyant bathymetric features may play a role, they are not required for the formation of flat slab. For example, van Hunen et al. (2004) use 2D numerical model to simulate the conditions for present day flat slab subduction in Peru and attribute its formation solely due to rapidly overriding South American (SA) plate. Another numerical modeling study by Gerya et al. (2009) proposes a high overriding plate velocity as the main contributing factor for the formation of flat slabs and argues for an insignificant contribution of ridge buoyancy to slab flattening.

To address the question of how much ridges contribute to slab flattening, I have studied the southern portion of the Peruvian flat slab (Figure 1.1). The western margin of Peru between 2° and 15° S is characterized by the flat subduction of the oceanic Nazca plate beneath the continental South American plate (Barazangi & Isacks, 1976; Hasegawa & Sacks, 1981; Bevis & Isacks, 1984; Cahill & Isacks, 1992; Araujo & Suarez, 1994; Hayes et al., 2012; Dougherty & Clayton, 2014). Previous seismicity studies in Peru reveal normal
subduction (dip angle ~30°) for the first 100 km of descent. Below this depth, the slab bends to form a flat slab with a nearly horizontal dip angle and an observed inboard extent of ~700 km from the trench axis before it resumes normal subduction further to the east (e.g. Barazangi & Isacks, 1976, 1979; Hasegawa & Sacks, 1981; Sacks, 1983; McGeary et al., 1985; Cahill & Isacks, 1992). The Peruvian flat slab is associated with the marked absence of any known Quaternary arc volcanism and with generally low surface heat flow measurements (Noble et al., 1974; McGeary et al., 1985, Henry & Pollack, 1988; Hamza & Munoz, 1996). Previous studies on the geometry of the Peruvian flat slab suggest that it has a far greater along strike extent than other modern flat slabs (e.g. the Pampean flat slab in central Chile) (Barazangi & Isacks, 1976; Cahill & Isacks, 1992).

The southern Peruvian flat slab is an ideal location to evaluate the role of ridges on the evolution of the flat slabs in general because of the unique ridge geometry relative to the convergence direction of the plates. The trend of the Nazca Ridge and the convergence direction are not parallel (Figure 1.1) and consequently the ridge has been migrating southward relative to the overriding plate. Since it first began subducting ~11.2 Ma at ~11°S (Hampel, 2002), the ridge has migrated ~480 km south along the South American continental margin, and is currently subducting at 15° S (Hampel, 2002; Hampel et al., 2004). The timing of slab flattening is well constrained by radiometric ages of the cessation of arc volcanism, episodes of intense metallogenic activity (Rosenbaum et al., 2005) and basement involved thrust deformation (Shira uplift) on the overriding South American plate (Kley et al., 1999; Bissig et al., 2008; Ramos & Folguera, 2009).

My current study provides a detailed analysis of WBZ earthquake locations, hypocentral errors, and the state of stress (discussed in chapter 2) in the subducting Nazca
plate in central and southern Peru and northern Bolivia. I include a local dataset of earthquake locations between 10°-18.5° S, which constitutes the flat slab region as well as the region of the slab that transitions from flat to regular subduction in southernmost Peru. I use my complete catalog of intermediate depth seismicity, in conjunction with constraints from Knezevic Antonijevic et al. (2015) and the updated teleseismic body wave tomography results of Scire et al. (2015) to calculate the most accurate contours to date of the slab geometry up to 200 km depth. My results indicate subtle but important differences between my slab geometry and that of Cahill and Isacks (1992), Kirby et al. (1995), and Hayes et al. (2012). I observe that the shallowest portion of the southern Peruvian flat slab coincides with either the projected location of the subducting Nazca Ridge or the area immediately south of it. I also notice a subtle deepening of events north of the Nazca Ridge, along the northern margin of the proposed flat slab. The fact that the shallowest portion of the Nazca plate is straddling the ridge and events deepen along strike and away from the ridge has important implications for the ridge buoyancy hypothesis. Along the projected ridge track, I observe a lack of seismicity, which is markedly different than the Juan Fernandez ridge associated with central Chile flat slab (Anderson et al., 2007, Hayes et al., 2012). I also notice a smooth continuation of seismicity across the slab dip transition at ~15 °S. This is consistent with a deformed slab rather than a tear between the ridge and a negatively buoyant normal slab further to the south.

2. DATA

I use data collected from the temporary broadband stations of three independent seismic arrays (Figure 1.1): The CAUGHT (Central Andean Uplifts and Geodynamics of High Topography) experiment comprised 50 broadband seismometers deployed for 21
months between November, 2010 and July, 2012 between 13°S to 18°S across the northern Altiplano. Thirty stations were deployed in Bolivia and 20 stations in Peru with a higher density line across the cordillera that spanned both Peru and Bolivia. The “PULSE” (PerU Lithosphere and Slab Experiment) network was deployed from May 2011 to June 2013 and consists of 40 broadband seismometers. The PULSE network is concentrated above the Peruvian flat slab roughly along three transects. The southern transect extends north and east from the city of Nazca to beyond Cusco. The middle and northern transects are located between Pisco and Ayacucho, and Lima and Satipo respectively. The northern transect is situated above the paleo-location of the subducted Nazca Ridge between 10-8 Ma (Rosenbaum et al., 2005). The southern and middle transects straddle the projected current location of the subducted Nazca Ridge. I also use data from the PERUSE project deployed by the California Institute of Technology and UCLA between July 2008 and June 2012. I use data for 8 stations from this deployment that lie along the coast in southern Peru and the southern transect of the PULSE network. The overall contributions (Figure 1.2) from individual CAUGHT stations are more than the PULSE and PERUSE stations in the location process due to more impulsive phase arrivals. The stations along the northernmost transect of the PULSE network had the least contribution to event locations. This is due to the relative sparsity of WBZ seismicity beneath the PULSE network, so arrivals had to travel further and were often diffracted, resulting in their emergent character.

3. METHODS

I auto-detect possible earthquakes recorded by three arrays using the dbdetect tool that is part of the ANTELOPE software package (http://www.brtt.com). This method is based on a short-term average (STA) versus long-term average (LTA) trigger mechanism. An
event is detected if the ratio of energy between STA and LTA window exceeds a user-defined threshold. I use an energy threshold ratio of 5 and STA and LTA moving time windows of 1 second and 10 seconds respectively. Of the 3000 possible events identified, I selected 952 earthquakes after individual inspection of the seismic waveforms for each event.

I calculate absolute event hypocenter locations using the single event location algorithm HYP (Lienert & Havskov, 1995), incorporated into the SEISAN software package (Havskov & Ottemöeller, 1999; Ottemöeller et al., 2011). HYP determines earthquake locations using an iterative linearized least squares inversion of travel time data (Aki & Lee, 1976). I handpick P-arrivals on the vertical component and utilize the travel time information to find event location and back azimuth. The N-S and E-W components are rotated into radial and transverse components based on the event back azimuth. The S-arrivals are marked on the transverse component to avoid contamination from the phase converted SV arrivals and the events were relocated using P and SH travel time data. Phase readings utilized for the event locations are accomplished by MULPLT program available in the software package SEISAN [Havskov & Ottemöeller, 1999; Ottemöeller et al., 2011]. I use a modified version of the P-wave velocity model of Dorbath & Granet (1996) that takes into account the 65 km average crustal thickness in my study area as determined from recent analyses of teleseismic receiver functions (Phillips & Clayton, 2014; Bishop et al., 2014). S-wave velocities are determined using a Vp/Vs ratio of 1.75.

In order to determine the sensitivity of my event locations to starting depth, I calculate the hypocenters of all 952 events with a starting depth of 5 km, 100 km, 200 km, and the initial origin depth from dbdetect. Of the 952 events, 838 had event depths that varied by less than 10 km over all starting depths tested. From those 838 events, I then select events
with depths greater than 50 km and azimuthal gaps < 270°. For events south of 15° S, I eliminate those events with depth errors of > 15 km. Given the sparsity of seismicity north of 15°S, I include some events with slightly larger depth errors whose latitudes, longitudes, and depths are stable over all tested starting depths. After these criteria are applied, I am left with 568 stable event locations.

I add to this list by investigating those 114 events where the range of event depths determined with different starting depths was > 10 km. I divide this list of 114 events into two sets depending on the number of similar depths recovered from my four starting depths. The first set of events includes 45 earthquakes for which three of the four original hypocentral locations differ in depth by less than 10 km. I calculate travel time residuals corresponding to each of the three starting depths and select the location with the minimum travel time residual as my preferred hypocenter. If travel time residuals are the same for more than one starting depth then I select the location whose starting depth is closest to the hypocentral depth. I recalculate event locations for each event in the first set using their best starting depth and obtain 16 robust event locations following the same cutoff criteria as used previously (e.g. depth > 50 km, azimuthal gap < 270°, with less than 15 km error in depth).

The second set of events includes 68 earthquakes for which the hypocenters corresponding to the four starting depths (5 km, 100 km, 200 km and the initial origin depth from dbdetect) have two or fewer final depths that are within 10 km of each other. I test several other starting depths at 25 km intervals for each of these events and calculate travel time residuals corresponding to each starting depth. I look for at least 3 similar depths (< 10 km difference) recovered from inversions with three adjacent starting depths, and travel time residuals of less than 3 seconds. Using these criteria, I obtain hypocentral locations for 36
events. I recalculate event locations for each event using their best starting depths and obtain 7 event locations that satisfy the additional aforementioned cutoff criteria (e.g. depth > 50 km, azimuthal gap < 270°, with less than 15 km error in depth). I finally add these 23 robust event locations (16 from the first group and 7 from the second) to the 568 events described earlier for a total of 591 robust event hypocenters (Table 1.1).

I relocate these 591 events using the double difference technique of Waldhauser & Ellsworth (2000). This method takes advantage of the nearly identical ray paths of two nearby events recorded at a common station. HypoDD uses both absolute and relative travel time data for each pair of events to determine relative event locations that are independent of regional structural variations. I calculate differential times between common phases recorded at a common station for all events pairs separated by ≤ 40km. Each event is grouped to a maximum of 10 neighboring events with inter-event distance ≤ 40km, each of which must have at least eight differential travel time observations. Of the 591 events located using HYP, I am able to relocate 508 events with HypoDD (Table 1.2). The remaining 83 events do not have sufficient neighboring earthquakes at small inter-event distances (≤ 40km) for stable relative relocation.

I determine new slab contours to describe the geometry of the subducting Nazca slab. The contours of the flat slab take into account the 508 HypoDD relocated earthquake locations where seismicity is present, and the tomography results of Knezevic Antonijevic et al. (2015) elsewhere. I define contours such that, with few exceptions, the observed seismicity is below the surface I am defining. This means that my slab surface is designed to indicate the top of the subducted slab, to the best of my ability to resolve it. At greater depths, my contours are consistent with available deep seismicity and with the latest
teleseismic body wave tomography results indicating the location of the slab at depths > 300 km (Scire et al., 2015). The location of the slab inboard of the flat slab is also consistent with seismic reflections observed by James & Snoke (1990). I then use the triangulate and surface functions of Generic Mapping Tools (Wessel & Smith, 1991) to contour my slab geometry.

4. RESULTS

4.1. Earthquake location

The results of my single event locations and relative relocations are shown in Figures 1.3 and 1.4 respectively. Overall, my event depths are significantly shallower than those reported from global catalogs or previous slab geometry studies. I test the sensitivity of my event hypocenters to velocity models by subtracting and adding 5% to each layer in my velocity model. The results of these are shown in Figures 1.6 and 1.7. The average depth for the fast model is 0.86 km deeper than my preferred model, and the average depth for the slow model is 0.79 km shallower than my preferred model. The average spread in the depths of hypocenters for a given event between velocity models is 7 km with a standard deviation of 6 km. The most significant differences are seen for the deepest events with the longest travel paths, as expected. While individual events have slight differences in depth depending on the velocity model used, the overall patterns observed remain robust.

In general the relative event locations determined using HypoDD produce more tightly clustered hypocenters than the single event locations (Figure 1.8). My results allow me to resolve clearly a number of patterns that, while visible in previous studies (e.g. Cahill & Isacks, 1992; Gorbatov et al., 1996, Hayes et al., 2012) and in global catalogs (e.g. Advanced National Seismic System (ANSS) catalogs), have not been explicitly identified or discussed (Figs. 1.4 and 1.5).
My southernmost cluster (labeled “A”) comprises a linear, northward trending band of seismicity between 69°W to 70°W. The distinct eastern margin of this cluster is well resolved, and is visible in previously existing catalogs of seismicity, albeit less clearly. The north-south trend of this cluster does not correspond to the local dip direction of the slab, the convergence direction of the plates, or any known structure within the subducted plate. The seismicity in this region generally defines a slab descending at a constant dip of ~30° (measured trench orthogonally) to at least 270 km depth (cross section P7-P10, Figure 1.12).

Seismicity is laterally continuous between clusters A and B at depths of < 120km. However, at greater depths I find evidence of a small seismic gap, triangular in shape (shaded triangle, Figure 1.4). This gap is concentrated in the middle of my seismic network, directly beneath one of the CAUGHT stations (CP07), and so is unlikely due to a lack of seismic observations. I also noticed a small gap in seismicity in the ANSS earthquake catalog of this area (Figure 1.5). The next cluster to the north (labeled B, Figure 1.4) comprises a large number of events between the northwest edge of the triangular seismic gap and the southern edge of the projected location of Nazca ridge. Events along the northern edge of this cluster, in the immediate vicinity of the projected location of subducted Nazca Ridge, are the shallowest I have found within the flat slab. There is a continuous increase in event depths within this cluster both from north to south as well as from west to east, showing a smooth contortion of the slab.

Between clusters B and C, along the projected location of the subducted Nazca ridge, seismicity is anomalously low at depths below 80 km (shaded rectangle, Figure 1.4; dotted ellipse, cross section BB’ in Figure 1.10). This observation is distinctly different than the reported seismicity along the Juan Fernandez ridge track in central Chile where seismicity is
particularly abundant (Anderson et al., 2007, Hayes et al., 2012). The drop in the number of slab events along the Nazca ridge in this area is however consistent with the previous observations (Barazangi & Isacks 1976, Cahill & Isacks 1992, Hayes et al., 2012, Dougherty & Clayton, 2014). I also observe a marked decrease in seismicity along the Nazca Ridge for the events reported in the ANSS catalog in last 40 years (Figure 1.5, shaded area).

The trench parallel cluster C (Figure 1.4) beneath the Western Cordillera, north of the Nazca Ridge, is confined to the westernmost margin of the horizontal portion of the flat slab. This defines its own linear cluster of events, connecting the diffuse seismicity along the northern edge of PULSE network and seismic gap along the projected location of the subducted Nazca ridge. I find very few events inboard of this cluster except for a small number of relatively shallow events with depths between 50 and 70 km for which I am unable to determine relative relocations (Fig. 1.3).

Along the northernmost end of my study area, the observed slab seismicity (denoted as cluster D in Figure 1.4) has a maximum inboard extent of over 400km from the trench. The events in this cluster are generally diffuse and range in depth from ~100 to 120 km, significantly deeper than events found closer to the Nazca Ridge further south.

4.2. Slab geometry

My new slab contours refer to the top of the Wadati-Benioff zone (WBZ) (Figure 1.13). This is similar to Barazangi & Isacks (1976), but different from Cahill & Isacks (1992) and Kirby et al. (1995) who took the middle of the WBZ to define the slab geometry. South of 15°S, I can clearly see the normally dipping slab up to 250 km depth. My event locations define the change in dip from flat to normal, indicating a continuous but contorted plate between the flat and steep segments of the slab as previously reported by Bevis & Isacks.
(1984), Schneider & Sacks (1987), Cahill & Isacks (1992), Phillips & Clayton (2014), and Dougherty & Clayton (2014). The inboard extent of my flat slab is dominantly defined by the Rayleigh wave results of Knezevic Antonijevic et al. (2015) due to the lack of flat slab seismicity more than 200 km from the trench. North of the ridge, my slab contours reflect the distinct deepening of the inboard seismicity relative to events located directly adjacent to the ridge. Following the results of Knezevic Antonijevic et al. (2015), I include the presence of a slab tear located in an area with very sparse seismicity (shaded pink area, Figure 1.13). The northernmost extent of this tear is not resolved by this study due to a lack of data north of the northernmost PULSE stations. East of this tear, the subhorizontal seismicity (transect P1, Fig. 1.11) occurs within the remnant flat slab (RFS) (east of shaded pink area, Fig. 1.13). I am not able to constrain the easternmost extent of RFS due to the lack of data east of my deployment.

DISCUSSION

5.1. New constraints on Slab Geometry and the causes of flat slab subduction

In the southernmost portion of my study area, my slab contours are in general agreement with Cahill & Isacks (1992) (Figure 1.13), Kirby et al. (1995), and Hayes et al. (2012) near the slab-dip transition zone at ~15°S. However, north of 15°S my models diverge significantly. Notably, I observe a significant difference between previous slab models and my model in the relative depth of the slab at the ridge compared to the depth of seismicity further to the north (Fig. 1.13). Previous models either show a perfectly flat slab (Cahill and Isacks, 1992; Kirby et al., 1995) or a shallowing of the slab well north of the Nazca Ridge (Hayes et al., 2012). My model shows that the slab is shallowest either at or along the subducted Nazca Ridge. While differences between my study and previous ones in velocity
models or definitions of the slab surface relative to the WBZ could account for uniform variations in depth, relative differences in depth along the flat slab are unlikely to be artifacts of velocity model or slab boundary definitions.

The slab contours of Cahill & Isacks (1992) suggest a wide flat slab with an inboard extent of ~600 km along its entire length. Kirby et al. (1995) and Hayes et al. (2012) show flat slabs of smaller width with small along strike variations in the inboard extent of the flat slab. The maximum inboard extent of my flat slab is constrained by the Rayleigh wave tomography results (Knezevic Antonijevic et al., 2015). My slab width to the northeast is consistent with the receiver function results of Bishop et al. (2014), but is considerably broader than the receiver function study of Phillips and Clayton (2014). This could be due to the broader spatial extent of the seismic networks used in the present study.

My new slab geometry is consistent with that of a buoyant ridge that is migrating southward along the South American margin (Anderson et al., 2007, Knezevic Antonijevic et al., 2015). My event hypocenters are shallowest (~80 km) directly along the Nazca Ridge (Figure 1.4). To the north, beneath the portion of the South American continent beneath which the Nazca Ridge passed over the past 11 Ma, I observe a marked deepening of the WBZ. I have additional constraints from the state of stress in the Nazca plate from focal mechanisms and they are also in agreement with deepening of slab north of the Nazca Ridge (Refer: Chapter 2, for more detailed discussion). This is consistent with the interpretation that in the absence of ridge buoyancy, other contributing factors to the formation of flat slabs are not sufficient to maintain the flat slab. Instead, the existing flat slab begins to sag, and, as proposed by Knezevic Antonijevic et al. (2015) may also tear, allowing newly subducted slab north of the ridge to subduct at a normal dip angle.
5.2. Abrupt variations in seismicity within the subducted Nazca plate

The earthquake locations show abrupt spatial changes in seismic activity across my study area. Most of the patterns I observe are also visible in event locations from earlier studies (e.g. Cahill & Isacks, 1992; Gorbatov et al., 1996, Hayes et al., 2012) and global catalogs (e.g. International Seismological Center (ISC) and Advanced National Seismic System (ANSS)) but have not previously been discussed in any detail. While many of these are difficult to explain, I propose that one may in fact provide clues into processes involved in the genesis of intermediate depth earthquakes. Along the projected location of the Nazca Ridge, I observe a marked gap in seismicity within the flat slab (Figs 1.4 and 1.10). Given that other factors such as temperature, plate age, and pressure do not vary over these small distance ranges, one possible explanation for this change in seismicity could be related to differences in crustal thickness and the causes of intermediate depth seismicity.

While the causes of intermediate depth seismicity remain a subject of ongoing research, dehydration embrittlement likely plays a significant role in the genesis of these events in subduction zones worldwide. As the oceanic plate starts to subduct, it undergoes significant bending seaward of the trench axis and produces outer rise normal faults (Chapple & Forsyth, 1979; Kirby et al., 1996; Peacock, 2001). Previous studies have found evidence for seawater infiltration through these outer rise faults (Hussong et al., 1988). This seawater infiltration results in the formation of hydrous minerals along these fault planes to depths of 15-20 km or more (Peacock, 2001; Ranero et al., 2003; Grevemeyer et al., 2005; Marot et al., 2012). The breakdown of hydrous minerals at appropriate P-T condition can lead to increases in pore pressure that decrease hydrostatic pressure and hence promote brittle failure required
for intermediate depth seismicity (Raleigh & Paterson, 1965; Green & Houston, 1995; Kirby et al., 1995; Hacker et al., 2003; van Keeken et al., 2011).

The Nazca Ridge has abnormally thick crust (~17 km) compared to the normal ~ 7 km thick oceanic crust on either side of it (Woods & Okal, 1994; Tassara et al., 2006). I propose that the crust along the Nazca Ridge is thicker than the penetration depth of water into the outer rise faults in this area. This would mean that only the oceanic crust (not the oceanic mantle lithosphere) is hydrated along the Nazca Ridge, resulting in an absence of typical mantle hydrous phases (e.g. antigorite, talc, chlorite). In contrast, the outer rise faults in the normal oceanic plate on either side of the ridge would contain both crustal and upper mantle hydrous phases. Seismicity up to ~80 km depth, close to the trench, is relatively continuously distributed along strike. I hypothesize that this along strike continuity in seismicity, up-dip from the horizontal portion of the flat slab, is related to the dehydration of hydrous minerals in the oceanic crust both within the ridge and in the normal crust on either side. I further propose that by 80 km depth, the crust is either dehydrated or the remaining hydrous phases are stable at the existing P/T conditions along the flat slab and therefore do not produce sufficient pore pressure to induce seismicity. Earthquakes that do occur north and south of the ridge along the flat portion of the slab are then caused by the dehydration of hydrated mantle lithosphere, not crust. The metamorphic reactions, associated with the dehydration of subducting oceanic lithosphere, strongly depend on temperature (Peacock, 2009). In Peru, the southern portion of the flat slab has only recently assumed its current geometry, making steady state thermal models (e.g. English et al., 2003) inappropriate for this area. Further work to better constrain the likely temperatures across the Peruvian flat slab and the effect of these temperatures on dehydration reactions are needed to test these
hypotheses and better understand the unusual patterns of observed seismicity across the subducted Nazca Ridge.

6. CONCLUSIONS

Previous studies on the geometry of the subducted Nazca plate in central and southern Peru have had to rely on primarily teleseismic data or local data collected from small seismic network. In this study, I use new data collected as part of three separate but temporally co-located deployments to study the WBZ of the subducted Nazca plate. This new data allows me to constrain subtle variations in the WBZ that provide important information about the geometry of the Nazca plate underneath central and southern Peru. The first of these observations is the shallowest portion on the southern Peruvian flat slab that coincides with either the projected location of the subducting Nazca Ridge or immediately south of it. This observation is significantly different than the previous slab models, which either show a perfectly flat slab (Cahill & Isacks, 1992; Kirby et al., 1995) or a shallowing of the slab well north of the Nazca Ridge (Hayes et al., 2012). The WBZ being shallowest along the Nazca ridge is consistent with the ridge buoyancy. I also notice a subtle deepening of events, north of the ridge, indicating that the older flat slab in the north is perhaps not stable. This suggests that irrespective of trench retreat and slab suction force, the long-term stability of the flat slab is perhaps not possible in the absence of ridge buoyancy.

Another intriguing observation is the lack of seismicity along the projected location of the subducting Nazca ridge track. This along strike variation in the slab seismicity across the ridge may suggest that by 80 km depth, the crust of the Nazca plate has dehydrated, and seismicity at these depths is due to mantle dehydration patterns alone.
7. ACKNOWLEDGMENTS

I am thankful to IRIS and personnel at the PASSCAL Instrument Center for their help and support throughout the CAUGHT and PULSE deployment. The seismic instruments were provided by UNC-Chapel Hill, Yale University, and the Incorporated Research Institutions for Seismology (IRIS) through the PASSCAL Instrument Center. I sincerely thank Dr. Hernando Tavera, Director, and C. Condori Quispe, of the Instituto Geofísico del Perú, Lima, Peru, and Dr. Estela Minaya of the San Calixto Observatory in Peru and for their help in deployment and demobilization efforts, as well as Mike Fort (PASSCAL) for his invaluable assistance in the field. The CAUGHT experiment was supported by NSF grants EAR-0908777 (Lara Wagner) and EAR-0907880 (Susan Beck). The PULSE experiment was funded by NSF grants EAR-0944184 (Lara Wagner), EAR-0943991 (Susan Beck), and EAR-0943962 (Maureen Long). Special thanks to C. Berk Biryol and S. Knezevic Antonijevic for helpful discussions. Maps were created using the Generic Mapping Tools (GMT) software (Wessel & Smith, 1991).
Figure 1.1- Map showing the Peruvian flat slab region, my current study area (yellow box), and location of seismic stations. Dark pink circles are PULSE stations. Dark blue diamonds are CAUGHT stations and light blue circles are PERUSE stations used in this study. Big purple circles represent GSN stations at Lima, Peru and LaPaz, Bolivia. Red triangles are Holocene volcanoes (INGEMMET, www.ingemmet.gob.pe). Solid lines are slab contours from Cahill & Isacks (1992). The light grey patch offshore represents the location of the Nazca Ridge. The black arrow offshore represents the plate motion of the Nazca plate from Hampel et al. (2004).
Figure 1.2- Map showing the contribution of individual station to the available dataset. Station symbols are color coded by the number of events recorded at each station.
Figure 1.3 - Earthquake hypocenters calculated using single event location method. The hypocenters are color coded by depth. Black diamonds are the stations used in the location process.
Figure 1.4- Earthquake hypocenters calculated using relative relocation method. The hypocenters are color coded by depth. Black diamonds are the stations used in the location process. Dashed boxes outline the regions of various clusters (A-D) of events identified in the study area. Shaded triangle represents the seismic gap between cluster A and B at depth $\geq 120$ km. Note the absence of seismicity (shaded rectangle) along the projected location of the subducting Nazca Ridge.
Figure 1.5- Earthquake hypocenters reported in the Advanced National Seismic System (ANSS) catalog during 1970-2013. The hypocenters are color coded by depth. Shaded area marks a notable decrease in seismicity along the projected location of subducted Nazca Ridge track.
Figure 1.6- Map showing single event locations corresponding to 5% decrease in the reference model. The hypocenters are color coded by calculating the difference between hypocentral depth for my velocity model and the modified (slow) velocity model. Events with cool colors (left half of the color scale) represent downward shifted events and events shown in warm colors (right half of the color scale) are upward shifted events. Black diamonds are the stations used in the location process.
Figure 1.7- Map showing single event locations corresponding to 5% increase in the reference model. The hypocenters are color coded by calculating the difference between hypocentral depth for my velocity model and the modified (fast) velocity model. Events with cool colors (left half of the color scale) represent downward shifted events and events shown in warm colors (right half of the color scale) are upward shifted events. Black diamonds are the stations used in the location process.
Figure 1.8- Seismicity cross section showing a comparison between single event locations determined from Seisan and relative relocations determined from HypoDD. Seisan locations are red circles and HypoDD locations are the blue squares. Black lines connect locations for the same event. Location of the cross section is P9 (Figure 1.9b), passing through cluster A (Figure 1.4) and events and stations (black triangles) are projected from ±35 km from this line.
Figure 1.9- Map showing locations of (a) trench-parallel (A-D) transects used to plot seismicity cross-sections. Red tick marks on BB’ represents distance interval of 100 km (b) trench-perpendicular (P1-P10) transects.
Figure 1.10- Seismicity cross-sections (A, B, C, and D) parallel to the trench. Locations of the cross-sections are shown in Figure 1.9a. Dotted ellipse (cross section BB’) marks the absence of seismicity along the projected location of subducted Nazca ridge track.
Figure 1.11- Seismicity cross-sections (P1 to P6) perpendicular to the trench. Locations of the cross-sections are shown in Figure 1.9b. Earthquakes within ±35 km are projected onto each cross-section. The solid line in each cross section is my new slab contour.
Figure 1.12- Seismicity cross-sections (P7 to P10) perpendicular to the trench. Locations of the cross-sections are shown in Figure 1.9b. Earthquakes within ±35 km are projected onto each cross-section. The solid line in each cross section is my new slab contour.
Figure 1.13- Map showing contours to depth of the top of the Wadati-Benioff zone (solid lines) based on my seismicity study and recent results of Rayleigh wave (Knezevic Antonijevic et al., 2014) and teleseismic body wave tomography (Scire et al., 2015). Epicenters of local events used to determine the contours are shown in small colored circles. Dashed black lines are contours from Cahill & Isacks (1992). Shaded pink area, north of the projected track, marks the approximate position of trench parallel tear.
Table 1.1. Absolute earthquake locations of 591 hypocenters as determined from Seisan

<table>
<thead>
<tr>
<th>Lon</th>
<th>Lat</th>
<th>Dep</th>
<th>Lon err</th>
<th>Lat err</th>
<th>Dep err</th>
<th>Yr</th>
<th>Mo</th>
<th>Day</th>
<th>Hr</th>
<th>Min</th>
<th>Sec</th>
</tr>
</thead>
<tbody>
<tr>
<td>-71.567</td>
<td>-15.119</td>
<td>142.7</td>
<td>4.8</td>
<td>3.3</td>
<td>6.5</td>
<td>2010</td>
<td>11</td>
<td>9</td>
<td>2</td>
<td>9</td>
<td>52.8</td>
</tr>
<tr>
<td>-71.612</td>
<td>-16.166</td>
<td>138.5</td>
<td>6.4</td>
<td>4.3</td>
<td>6.2</td>
<td>2010</td>
<td>11</td>
<td>16</td>
<td>5</td>
<td>57</td>
<td>26.4</td>
</tr>
<tr>
<td>-71.448</td>
<td>-15.575</td>
<td>145.5</td>
<td>7.5</td>
<td>6.3</td>
<td>7.9</td>
<td>2010</td>
<td>11</td>
<td>18</td>
<td>7</td>
<td>0</td>
<td>53.7</td>
</tr>
<tr>
<td>-69.593</td>
<td>-17.312</td>
<td>143.8</td>
<td>5.8</td>
<td>11.3</td>
<td>10</td>
<td>2010</td>
<td>11</td>
<td>18</td>
<td>20</td>
<td>32</td>
<td>10.9</td>
</tr>
<tr>
<td>-69.648</td>
<td>-17.597</td>
<td>129.4</td>
<td>3.7</td>
<td>5.4</td>
<td>6.6</td>
<td>2010</td>
<td>11</td>
<td>19</td>
<td>1</td>
<td>42</td>
<td>51.9</td>
</tr>
<tr>
<td>-69.946</td>
<td>-17.259</td>
<td>125.7</td>
<td>3.6</td>
<td>7.3</td>
<td>8.4</td>
<td>2010</td>
<td>11</td>
<td>20</td>
<td>16</td>
<td>33</td>
<td>19.1</td>
</tr>
<tr>
<td>-69.656</td>
<td>-17.59</td>
<td>148.7</td>
<td>6.4</td>
<td>8.4</td>
<td>6.4</td>
<td>2010</td>
<td>11</td>
<td>25</td>
<td>2</td>
<td>16</td>
<td>27.6</td>
</tr>
<tr>
<td>-69.313</td>
<td>-17.381</td>
<td>157.1</td>
<td>6.9</td>
<td>8.4</td>
<td>12.4</td>
<td>2010</td>
<td>11</td>
<td>25</td>
<td>17</td>
<td>25</td>
<td>45.1</td>
</tr>
<tr>
<td>-71.198</td>
<td>-16.578</td>
<td>110</td>
<td>4.2</td>
<td>2.3</td>
<td>5.3</td>
<td>2010</td>
<td>11</td>
<td>25</td>
<td>18</td>
<td>16</td>
<td>51.5</td>
</tr>
<tr>
<td>-71.461</td>
<td>-16.706</td>
<td>85</td>
<td>8</td>
<td>5.8</td>
<td>4</td>
<td>2010</td>
<td>11</td>
<td>26</td>
<td>3</td>
<td>36</td>
<td>55.2</td>
</tr>
<tr>
<td>-69.551</td>
<td>-17.3</td>
<td>160.5</td>
<td>7</td>
<td>10.5</td>
<td>10.6</td>
<td>2010</td>
<td>11</td>
<td>27</td>
<td>6</td>
<td>33</td>
<td>43.5</td>
</tr>
<tr>
<td>-72.115</td>
<td>-15.301</td>
<td>120</td>
<td>6.8</td>
<td>5.4</td>
<td>6.6</td>
<td>2010</td>
<td>11</td>
<td>27</td>
<td>12</td>
<td>59</td>
<td>56.8</td>
</tr>
<tr>
<td>-69.501</td>
<td>-17.61</td>
<td>152.4</td>
<td>6.6</td>
<td>14.8</td>
<td>14.9</td>
<td>2010</td>
<td>11</td>
<td>28</td>
<td>3</td>
<td>11</td>
<td>19.4</td>
</tr>
<tr>
<td>-71.755</td>
<td>-14.793</td>
<td>126.2</td>
<td>4.8</td>
<td>2.8</td>
<td>5.9</td>
<td>2010</td>
<td>11</td>
<td>28</td>
<td>14</td>
<td>49</td>
<td>21.6</td>
</tr>
<tr>
<td>-69.339</td>
<td>-18.231</td>
<td>130.4</td>
<td>4.3</td>
<td>6.7</td>
<td>6</td>
<td>2010</td>
<td>11</td>
<td>30</td>
<td>8</td>
<td>4</td>
<td>38.6</td>
</tr>
<tr>
<td>-70.12</td>
<td>-17.071</td>
<td>140.7</td>
<td>4.4</td>
<td>9.3</td>
<td>13.9</td>
<td>2010</td>
<td>11</td>
<td>30</td>
<td>14</td>
<td>27</td>
<td>55.7</td>
</tr>
<tr>
<td>-67.187</td>
<td>-18.369</td>
<td>244.3</td>
<td>5.5</td>
<td>10.4</td>
<td>8.2</td>
<td>2010</td>
<td>12</td>
<td>2</td>
<td>0</td>
<td>19</td>
<td>23</td>
</tr>
<tr>
<td>-70.263</td>
<td>-15.586</td>
<td>214.3</td>
<td>4.5</td>
<td>5.9</td>
<td>6.7</td>
<td>2010</td>
<td>12</td>
<td>2</td>
<td>2</td>
<td>56</td>
<td>11.5</td>
</tr>
<tr>
<td>-69.304</td>
<td>-18.019</td>
<td>132.1</td>
<td>3.5</td>
<td>5.5</td>
<td>5.9</td>
<td>2010</td>
<td>12</td>
<td>3</td>
<td>1</td>
<td>46</td>
<td>7.1</td>
</tr>
<tr>
<td>-71.657</td>
<td>-16.816</td>
<td>78.3</td>
<td>9</td>
<td>3.8</td>
<td>7.2</td>
<td>2010</td>
<td>12</td>
<td>6</td>
<td>14</td>
<td>13</td>
<td>42</td>
</tr>
<tr>
<td>-71.094</td>
<td>-16.706</td>
<td>119.6</td>
<td>4</td>
<td>2.6</td>
<td>5.8</td>
<td>2010</td>
<td>12</td>
<td>7</td>
<td>4</td>
<td>14</td>
<td>40.1</td>
</tr>
<tr>
<td>-72.056</td>
<td>-15.043</td>
<td>118.6</td>
<td>7.2</td>
<td>4.6</td>
<td>9.3</td>
<td>2010</td>
<td>12</td>
<td>8</td>
<td>8</td>
<td>3</td>
<td>53.2</td>
</tr>
<tr>
<td>-17.474</td>
<td>-70.452</td>
<td>86.7</td>
<td>4.4</td>
<td>7.7</td>
<td>9.9</td>
<td>2010</td>
<td>12</td>
<td>8</td>
<td>22</td>
<td>21</td>
<td>43.1</td>
</tr>
<tr>
<td>-69.502</td>
<td>-16.885</td>
<td>174.1</td>
<td>5.8</td>
<td>7.9</td>
<td>9.4</td>
<td>2010</td>
<td>12</td>
<td>11</td>
<td>2</td>
<td>4</td>
<td>19.2</td>
</tr>
<tr>
<td>-69.409</td>
<td>-17.861</td>
<td>130.9</td>
<td>4</td>
<td>9.5</td>
<td>14</td>
<td>2010</td>
<td>12</td>
<td>11</td>
<td>15</td>
<td>52</td>
<td>50.9</td>
</tr>
<tr>
<td>-70.109</td>
<td>-17.537</td>
<td>100</td>
<td>6.6</td>
<td>8.7</td>
<td>7</td>
<td>2010</td>
<td>12</td>
<td>13</td>
<td>3</td>
<td>51</td>
<td>42.9</td>
</tr>
<tr>
<td>-69.469</td>
<td>-17.57</td>
<td>151.7</td>
<td>6.5</td>
<td>7.5</td>
<td>7.9</td>
<td>2010</td>
<td>12</td>
<td>13</td>
<td>10</td>
<td>43</td>
<td>13.5</td>
</tr>
<tr>
<td>-69.589</td>
<td>-17.604</td>
<td>134.3</td>
<td>4.7</td>
<td>8.1</td>
<td>8</td>
<td>2010</td>
<td>12</td>
<td>14</td>
<td>14</td>
<td>32</td>
<td>22.2</td>
</tr>
<tr>
<td>-71.348</td>
<td>-17.204</td>
<td>66</td>
<td>19.4</td>
<td>11.9</td>
<td>11.7</td>
<td>2010</td>
<td>12</td>
<td>15</td>
<td>13</td>
<td>23</td>
<td>7.3</td>
</tr>
<tr>
<td>-69.297</td>
<td>-17.721</td>
<td>144</td>
<td>4.3</td>
<td>5.6</td>
<td>7</td>
<td>2010</td>
<td>12</td>
<td>15</td>
<td>18</td>
<td>22</td>
<td>23</td>
</tr>
<tr>
<td>-69.667</td>
<td>-17.57</td>
<td>142.5</td>
<td>3.4</td>
<td>5.6</td>
<td>6.7</td>
<td>2010</td>
<td>12</td>
<td>17</td>
<td>2</td>
<td>32</td>
<td>36.6</td>
</tr>
<tr>
<td>-71.744</td>
<td>-15.342</td>
<td>139.5</td>
<td>5.9</td>
<td>4.3</td>
<td>7.1</td>
<td>2010</td>
<td>12</td>
<td>18</td>
<td>13</td>
<td>7</td>
<td>52.5</td>
</tr>
<tr>
<td>-71.898</td>
<td>-15.061</td>
<td>122.5</td>
<td>5.4</td>
<td>3.6</td>
<td>5.8</td>
<td>2010</td>
<td>12</td>
<td>19</td>
<td>7</td>
<td>43</td>
<td>51.9</td>
</tr>
<tr>
<td>-70.719</td>
<td>-15.4</td>
<td>193.3</td>
<td>4.3</td>
<td>4.2</td>
<td>7.6</td>
<td>2010</td>
<td>12</td>
<td>21</td>
<td>20</td>
<td>4</td>
<td>46.7</td>
</tr>
<tr>
<td>-71.856</td>
<td>-15.497</td>
<td>135.4</td>
<td>7.3</td>
<td>7.7</td>
<td>7.1</td>
<td>2010</td>
<td>12</td>
<td>22</td>
<td>14</td>
<td>5</td>
<td>16.6</td>
</tr>
<tr>
<td>-69.393</td>
<td>-17.966</td>
<td>146.6</td>
<td>6</td>
<td>10.4</td>
<td>12.3</td>
<td>2010</td>
<td>12</td>
<td>22</td>
<td>19</td>
<td>58</td>
<td>0.1</td>
</tr>
<tr>
<td>-72.087</td>
<td>-15.051</td>
<td>117.3</td>
<td>6.7</td>
<td>6.9</td>
<td>7.3</td>
<td>2010</td>
<td>12</td>
<td>25</td>
<td>5</td>
<td>49</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
</tr>
<tr>
<td>-16.575</td>
<td>-72.564</td>
<td>51.5</td>
<td>11.6</td>
<td>10.1</td>
<td>10.6</td>
<td>2010</td>
<td>12</td>
<td>26</td>
<td>19</td>
<td>25</td>
<td>24.9</td>
</tr>
<tr>
<td>-72.04</td>
<td>-14.612</td>
<td>115.9</td>
<td>3.7</td>
<td>5.5</td>
<td>15.8</td>
<td>2010</td>
<td>12</td>
<td>28</td>
<td>21</td>
<td>39</td>
<td>19.4</td>
</tr>
<tr>
<td>-69.789</td>
<td>-17.427</td>
<td>127.6</td>
<td>4.6</td>
<td>11.5</td>
<td>13.6</td>
<td>2010</td>
<td>12</td>
<td>29</td>
<td>4</td>
<td>44</td>
<td>16.5</td>
</tr>
<tr>
<td>-70.067</td>
<td>-17.068</td>
<td>131</td>
<td>4.4</td>
<td>5.1</td>
<td>8.9</td>
<td>2011</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>11</td>
<td>51.4</td>
</tr>
<tr>
<td>-69.448</td>
<td>-15.63</td>
<td>270</td>
<td>11.4</td>
<td>8.2</td>
<td>9</td>
<td>2011</td>
<td>1</td>
<td>1</td>
<td>18</td>
<td>39</td>
<td>55.4</td>
</tr>
<tr>
<td>-72.284</td>
<td>-14.734</td>
<td>99.7</td>
<td>5.6</td>
<td>3.1</td>
<td>6.8</td>
<td>2011</td>
<td>1</td>
<td>1</td>
<td>20</td>
<td>27</td>
<td>41.2</td>
</tr>
<tr>
<td>-69.668</td>
<td>-17.648</td>
<td>145.6</td>
<td>4.4</td>
<td>7.3</td>
<td>5.4</td>
<td>2011</td>
<td>1</td>
<td>2</td>
<td>6</td>
<td>56</td>
<td>26.1</td>
</tr>
<tr>
<td>-72.023</td>
<td>-15.102</td>
<td>127.6</td>
<td>9.5</td>
<td>6.1</td>
<td>6.7</td>
<td>2011</td>
<td>1</td>
<td>6</td>
<td>1</td>
<td>56</td>
<td>12.1</td>
</tr>
<tr>
<td>-69.75</td>
<td>-17.185</td>
<td>141.4</td>
<td>3.1</td>
<td>7.8</td>
<td>7.3</td>
<td>2011</td>
<td>1</td>
<td>6</td>
<td>14</td>
<td>40</td>
<td>20.2</td>
</tr>
<tr>
<td>-69.493</td>
<td>-17.502</td>
<td>161.9</td>
<td>5.9</td>
<td>7</td>
<td>9.9</td>
<td>2011</td>
<td>1</td>
<td>8</td>
<td>6</td>
<td>26</td>
<td>59.5</td>
</tr>
<tr>
<td>-71.734</td>
<td>-15.74</td>
<td>140</td>
<td>9.7</td>
<td>4.8</td>
<td>8.7</td>
<td>2011</td>
<td>1</td>
<td>9</td>
<td>1</td>
<td>43</td>
<td>37.6</td>
</tr>
<tr>
<td>-69.496</td>
<td>-18.214</td>
<td>119.3</td>
<td>6.6</td>
<td>7.7</td>
<td>9.6</td>
<td>2011</td>
<td>1</td>
<td>12</td>
<td>4</td>
<td>24</td>
<td>3.7</td>
</tr>
<tr>
<td>-69.795</td>
<td>-17.015</td>
<td>149.9</td>
<td>5.1</td>
<td>10.3</td>
<td>11.8</td>
<td>2011</td>
<td>1</td>
<td>12</td>
<td>23</td>
<td>28</td>
<td>4.7</td>
</tr>
<tr>
<td>-69.417</td>
<td>-16.845</td>
<td>185.8</td>
<td>9</td>
<td>7</td>
<td>13.6</td>
<td>2011</td>
<td>1</td>
<td>14</td>
<td>4</td>
<td>56</td>
<td>35.2</td>
</tr>
<tr>
<td>-69.541</td>
<td>-16.543</td>
<td>182.9</td>
<td>6.3</td>
<td>5.6</td>
<td>10.6</td>
<td>2011</td>
<td>1</td>
<td>15</td>
<td>1</td>
<td>0</td>
<td>34.2</td>
</tr>
<tr>
<td>-72.176</td>
<td>-15.138</td>
<td>121.6</td>
<td>6.1</td>
<td>6.3</td>
<td>6.8</td>
<td>2011</td>
<td>1</td>
<td>15</td>
<td>7</td>
<td>32</td>
<td>36.4</td>
</tr>
<tr>
<td>-71.796</td>
<td>-14.747</td>
<td>116.2</td>
<td>5.6</td>
<td>2.7</td>
<td>5.9</td>
<td>2011</td>
<td>1</td>
<td>16</td>
<td>8</td>
<td>9</td>
<td>19.9</td>
</tr>
<tr>
<td>-70.688</td>
<td>-15.339</td>
<td>217.2</td>
<td>6</td>
<td>4.6</td>
<td>12.4</td>
<td>2011</td>
<td>1</td>
<td>17</td>
<td>19</td>
<td>48</td>
<td>39</td>
</tr>
<tr>
<td>-70.671</td>
<td>-17.463</td>
<td>85.1</td>
<td>3</td>
<td>4.4</td>
<td>7.2</td>
<td>2011</td>
<td>1</td>
<td>19</td>
<td>10</td>
<td>23</td>
<td>37</td>
</tr>
<tr>
<td>-69.454</td>
<td>-17.577</td>
<td>150.6</td>
<td>8.2</td>
<td>13.9</td>
<td>9.9</td>
<td>2011</td>
<td>1</td>
<td>21</td>
<td>9</td>
<td>42</td>
<td>13.1</td>
</tr>
<tr>
<td>-70.251</td>
<td>-15.556</td>
<td>210</td>
<td>4.4</td>
<td>5.1</td>
<td>7.8</td>
<td>2011</td>
<td>1</td>
<td>22</td>
<td>21</td>
<td>31</td>
<td>19.9</td>
</tr>
<tr>
<td>-71.293</td>
<td>-17.273</td>
<td>50.3</td>
<td>9.9</td>
<td>4.4</td>
<td>5.6</td>
<td>2011</td>
<td>1</td>
<td>23</td>
<td>3</td>
<td>46</td>
<td>8.4</td>
</tr>
<tr>
<td>-70.246</td>
<td>-17.979</td>
<td>53.6</td>
<td>1.8</td>
<td>4.3</td>
<td>2.9</td>
<td>2011</td>
<td>1</td>
<td>24</td>
<td>15</td>
<td>17</td>
<td>54.2</td>
</tr>
<tr>
<td>-69.343</td>
<td>-17.735</td>
<td>170</td>
<td>4.8</td>
<td>8.1</td>
<td>14.7</td>
<td>2011</td>
<td>1</td>
<td>26</td>
<td>8</td>
<td>11</td>
<td>9.6</td>
</tr>
<tr>
<td>-69.661</td>
<td>-17.536</td>
<td>148.3</td>
<td>4.3</td>
<td>7.5</td>
<td>7.8</td>
<td>2011</td>
<td>2</td>
<td>2</td>
<td>9</td>
<td>5</td>
<td>27.3</td>
</tr>
<tr>
<td>-70.082</td>
<td>-17.771</td>
<td>93.8</td>
<td>4.8</td>
<td>8.2</td>
<td>4.3</td>
<td>2011</td>
<td>2</td>
<td>2</td>
<td>11</td>
<td>3</td>
<td>51.2</td>
</tr>
<tr>
<td>-69.909</td>
<td>-17.659</td>
<td>111.1</td>
<td>4.7</td>
<td>8.3</td>
<td>9.4</td>
<td>2011</td>
<td>2</td>
<td>3</td>
<td>7</td>
<td>42</td>
<td>49.6</td>
</tr>
<tr>
<td>-69.414</td>
<td>-17.373</td>
<td>149</td>
<td>5.8</td>
<td>9.8</td>
<td>8.7</td>
<td>2011</td>
<td>2</td>
<td>4</td>
<td>0</td>
<td>55</td>
<td>31.4</td>
</tr>
<tr>
<td>-69.406</td>
<td>-17.734</td>
<td>138.8</td>
<td>4.5</td>
<td>8.8</td>
<td>7.8</td>
<td>2011</td>
<td>2</td>
<td>4</td>
<td>14</td>
<td>47</td>
<td>38.4</td>
</tr>
<tr>
<td>-69.429</td>
<td>-17.639</td>
<td>153.5</td>
<td>5.8</td>
<td>9.4</td>
<td>9.2</td>
<td>2011</td>
<td>2</td>
<td>7</td>
<td>22</td>
<td>44</td>
<td>52.9</td>
</tr>
<tr>
<td>-66.964</td>
<td>-18.008</td>
<td>271.3</td>
<td>7</td>
<td>10</td>
<td>7.5</td>
<td>2011</td>
<td>2</td>
<td>8</td>
<td>4</td>
<td>54</td>
<td>41.4</td>
</tr>
<tr>
<td>-70.922</td>
<td>-16.663</td>
<td>118.5</td>
<td>3.5</td>
<td>3.4</td>
<td>6.5</td>
<td>2011</td>
<td>2</td>
<td>8</td>
<td>13</td>
<td>24</td>
<td>16.3</td>
</tr>
<tr>
<td>-70.238</td>
<td>-15.521</td>
<td>211.2</td>
<td>5.5</td>
<td>11</td>
<td>9.5</td>
<td>2011</td>
<td>2</td>
<td>11</td>
<td>6</td>
<td>39</td>
<td>42.3</td>
</tr>
<tr>
<td>-71.196</td>
<td>-16.515</td>
<td>109.9</td>
<td>4.6</td>
<td>3.1</td>
<td>6.8</td>
<td>2011</td>
<td>2</td>
<td>14</td>
<td>8</td>
<td>58</td>
<td>29.6</td>
</tr>
<tr>
<td>-73.537</td>
<td>-14.688</td>
<td>64.7</td>
<td>14</td>
<td>7.2</td>
<td>17.9</td>
<td>2011</td>
<td>2</td>
<td>17</td>
<td>10</td>
<td>31</td>
<td>6.8</td>
</tr>
<tr>
<td>-71.731</td>
<td>-15.076</td>
<td>131.9</td>
<td>7.6</td>
<td>3.8</td>
<td>7.7</td>
<td>2011</td>
<td>2</td>
<td>18</td>
<td>19</td>
<td>38</td>
<td>36.8</td>
</tr>
<tr>
<td>-71.54</td>
<td>-15.515</td>
<td>144.5</td>
<td>9.3</td>
<td>5.2</td>
<td>10.5</td>
<td>2011</td>
<td>2</td>
<td>21</td>
<td>15</td>
<td>54</td>
<td>1.3</td>
</tr>
<tr>
<td>-69.36</td>
<td>-16.656</td>
<td>177.2</td>
<td>7.9</td>
<td>5.6</td>
<td>8.8</td>
<td>2011</td>
<td>2</td>
<td>22</td>
<td>8</td>
<td>13</td>
<td>18.8</td>
</tr>
<tr>
<td>-70.072</td>
<td>-17.194</td>
<td>136.8</td>
<td>4.9</td>
<td>7</td>
<td>10.9</td>
<td>2011</td>
<td>2</td>
<td>22</td>
<td>16</td>
<td>53</td>
<td>12.6</td>
</tr>
<tr>
<td></td>
<td>-69.598</td>
<td>-16.678</td>
<td>190.1</td>
<td>6.6</td>
<td>8</td>
<td>10.8</td>
<td>2011</td>
<td>2</td>
<td>23</td>
<td>13</td>
<td>46</td>
</tr>
<tr>
<td>----</td>
<td>----------</td>
<td>---------</td>
<td>-------</td>
<td>-----</td>
<td>---</td>
<td>------</td>
<td>------</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>----</td>
</tr>
<tr>
<td></td>
<td>-70.307</td>
<td>-17.001</td>
<td>119.4</td>
<td>4</td>
<td>8.7</td>
<td>14.9</td>
<td>2011</td>
<td>2</td>
<td>25</td>
<td>7</td>
<td>42</td>
</tr>
<tr>
<td></td>
<td>-71.828</td>
<td>-15.182</td>
<td>130.4</td>
<td>12.2</td>
<td>6.7</td>
<td>9</td>
<td>2011</td>
<td>2</td>
<td>28</td>
<td>11</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>-17.005</td>
<td>-69.692</td>
<td>164.7</td>
<td>7.6</td>
<td>13.8</td>
<td>12.5</td>
<td>2011</td>
<td>3</td>
<td>2</td>
<td>18</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>-69.461</td>
<td>-17.603</td>
<td>154.6</td>
<td>6.2</td>
<td>11.5</td>
<td>10</td>
<td>2011</td>
<td>3</td>
<td>5</td>
<td>0</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>-69.669</td>
<td>-15.855</td>
<td>235.8</td>
<td>9</td>
<td>11.4</td>
<td>12.1</td>
<td>2011</td>
<td>3</td>
<td>5</td>
<td>18</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>-69.648</td>
<td>-18.192</td>
<td>110.8</td>
<td>4.7</td>
<td>6.4</td>
<td>7.9</td>
<td>2011</td>
<td>3</td>
<td>6</td>
<td>12</td>
<td>31</td>
</tr>
<tr>
<td></td>
<td>-70.519</td>
<td>-15.404</td>
<td>200</td>
<td>5.4</td>
<td>6.2</td>
<td>9.2</td>
<td>2011</td>
<td>3</td>
<td>11</td>
<td>2</td>
<td>34</td>
</tr>
<tr>
<td></td>
<td>-69.988</td>
<td>-18.427</td>
<td>83.5</td>
<td>4.7</td>
<td>6</td>
<td>7.8</td>
<td>2011</td>
<td>3</td>
<td>23</td>
<td>15</td>
<td>31</td>
</tr>
<tr>
<td></td>
<td>-70.262</td>
<td>-15.439</td>
<td>213.3</td>
<td>5.3</td>
<td>7.1</td>
<td>8.4</td>
<td>2011</td>
<td>3</td>
<td>25</td>
<td>1</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>-69.426</td>
<td>-17.99</td>
<td>125.6</td>
<td>7.8</td>
<td>10.2</td>
<td>9.3</td>
<td>2011</td>
<td>3</td>
<td>26</td>
<td>16</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>-73.129</td>
<td>-15.375</td>
<td>110</td>
<td>5.3</td>
<td>13.3</td>
<td>12.4</td>
<td>2011</td>
<td>3</td>
<td>27</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>-69.716</td>
<td>-17.75</td>
<td>131.4</td>
<td>4</td>
<td>5.4</td>
<td>5.6</td>
<td>2011</td>
<td>3</td>
<td>31</td>
<td>1</td>
<td>42</td>
</tr>
<tr>
<td></td>
<td>-71.566</td>
<td>-16.195</td>
<td>122.3</td>
<td>4.9</td>
<td>3.1</td>
<td>4.8</td>
<td>2011</td>
<td>4</td>
<td>2</td>
<td>4</td>
<td>41</td>
</tr>
<tr>
<td></td>
<td>-71.219</td>
<td>-17.614</td>
<td>68.6</td>
<td>11.6</td>
<td>11.5</td>
<td>7.6</td>
<td>2011</td>
<td>4</td>
<td>2</td>
<td>8</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>-69.615</td>
<td>-17.515</td>
<td>141.6</td>
<td>6.9</td>
<td>12.7</td>
<td>13.4</td>
<td>2011</td>
<td>4</td>
<td>3</td>
<td>16</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>-70.505</td>
<td>-17.809</td>
<td>59.3</td>
<td>5.4</td>
<td>9.3</td>
<td>2.6</td>
<td>2011</td>
<td>4</td>
<td>4</td>
<td>2</td>
<td>57</td>
</tr>
<tr>
<td></td>
<td>-69.616</td>
<td>-17.25</td>
<td>161.3</td>
<td>6</td>
<td>10.8</td>
<td>10.3</td>
<td>2011</td>
<td>4</td>
<td>6</td>
<td>11</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>-69.566</td>
<td>-17.196</td>
<td>157.8</td>
<td>7.6</td>
<td>12.5</td>
<td>9.9</td>
<td>2011</td>
<td>4</td>
<td>9</td>
<td>6</td>
<td>47</td>
</tr>
<tr>
<td></td>
<td>-69.436</td>
<td>-17.512</td>
<td>160.2</td>
<td>7.3</td>
<td>10.9</td>
<td>8.1</td>
<td>2011</td>
<td>4</td>
<td>9</td>
<td>10</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>-71.844</td>
<td>-17.077</td>
<td>63.4</td>
<td>11.9</td>
<td>7</td>
<td>4</td>
<td>2011</td>
<td>4</td>
<td>12</td>
<td>13</td>
<td>31</td>
</tr>
<tr>
<td></td>
<td>-69.331</td>
<td>-17.67</td>
<td>157.1</td>
<td>8.6</td>
<td>13.7</td>
<td>7.9</td>
<td>2011</td>
<td>4</td>
<td>13</td>
<td>0</td>
<td>37</td>
</tr>
<tr>
<td></td>
<td>-71.575</td>
<td>-15.842</td>
<td>130</td>
<td>4.7</td>
<td>8</td>
<td>5.8</td>
<td>2011</td>
<td>4</td>
<td>13</td>
<td>7</td>
<td>35</td>
</tr>
<tr>
<td></td>
<td>-69.768</td>
<td>-17.404</td>
<td>147.8</td>
<td>5.2</td>
<td>10.2</td>
<td>10.2</td>
<td>2011</td>
<td>4</td>
<td>16</td>
<td>2</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>-72.725</td>
<td>-16.792</td>
<td>58.2</td>
<td>11.9</td>
<td>11.1</td>
<td>6.5</td>
<td>2011</td>
<td>4</td>
<td>17</td>
<td>9</td>
<td>57</td>
</tr>
<tr>
<td></td>
<td>-71.615</td>
<td>-16.176</td>
<td>114.8</td>
<td>9.9</td>
<td>7.7</td>
<td>12.2</td>
<td>2011</td>
<td>4</td>
<td>24</td>
<td>7</td>
<td>55</td>
</tr>
<tr>
<td></td>
<td>-69.585</td>
<td>-16.953</td>
<td>180.8</td>
<td>7.8</td>
<td>9.7</td>
<td>12</td>
<td>2011</td>
<td>5</td>
<td>1</td>
<td>15</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>-69.872</td>
<td>-16.514</td>
<td>189.5</td>
<td>9.9</td>
<td>10.7</td>
<td>13.7</td>
<td>2011</td>
<td>5</td>
<td>3</td>
<td>14</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>-69.588</td>
<td>-17.66</td>
<td>152.2</td>
<td>9.7</td>
<td>17</td>
<td>8.2</td>
<td>2011</td>
<td>5</td>
<td>3</td>
<td>22</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>-69.426</td>
<td>-17.285</td>
<td>153.4</td>
<td>8.1</td>
<td>13.3</td>
<td>13.8</td>
<td>2011</td>
<td>5</td>
<td>6</td>
<td>2</td>
<td>55</td>
</tr>
<tr>
<td></td>
<td>-69.631</td>
<td>-17.544</td>
<td>159.8</td>
<td>5.5</td>
<td>7.1</td>
<td>13.7</td>
<td>2011</td>
<td>5</td>
<td>6</td>
<td>6</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>-70.279</td>
<td>-15.621</td>
<td>206.7</td>
<td>5</td>
<td>5.9</td>
<td>8.2</td>
<td>2011</td>
<td>5</td>
<td>7</td>
<td>19</td>
<td>33</td>
</tr>
<tr>
<td></td>
<td>-69.843</td>
<td>-17.429</td>
<td>125.8</td>
<td>5.1</td>
<td>10.2</td>
<td>8.6</td>
<td>2011</td>
<td>5</td>
<td>8</td>
<td>9</td>
<td>34</td>
</tr>
<tr>
<td></td>
<td>-69.562</td>
<td>-17.67</td>
<td>144.2</td>
<td>6.9</td>
<td>16.2</td>
<td>9.9</td>
<td>2011</td>
<td>5</td>
<td>10</td>
<td>4</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td>-69.58</td>
<td>-16.89</td>
<td>173.1</td>
<td>9.5</td>
<td>21.4</td>
<td>14</td>
<td>2011</td>
<td>5</td>
<td>12</td>
<td>13</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>-69.185</td>
<td>-17.93</td>
<td>141.9</td>
<td>4.9</td>
<td>5.3</td>
<td>6</td>
<td>2011</td>
<td>5</td>
<td>13</td>
<td>3</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>-16.829</td>
<td>-71.226</td>
<td>61.4</td>
<td>22.8</td>
<td>7.8</td>
<td>14</td>
<td>2011</td>
<td>5</td>
<td>17</td>
<td>2</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>-69.14</td>
<td>-16.055</td>
<td>240</td>
<td>8.1</td>
<td>7.4</td>
<td>7.4</td>
<td>2011</td>
<td>5</td>
<td>17</td>
<td>22</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>-72.022</td>
<td>-15.824</td>
<td>127.9</td>
<td>10.4</td>
<td>6</td>
<td>9.9</td>
<td>2011</td>
<td>5</td>
<td>19</td>
<td>21</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.83</td>
<td>-17.235</td>
<td>131.2</td>
<td>4.1</td>
<td>5.4</td>
<td>8.2</td>
<td>2011</td>
<td>6</td>
<td>25</td>
<td>16</td>
<td>9</td>
<td>53.7</td>
</tr>
<tr>
<td>-73.155</td>
<td>-14.164</td>
<td>74.2</td>
<td>2.5</td>
<td>2.9</td>
<td>4.1</td>
<td>2011</td>
<td>6</td>
<td>26</td>
<td>17</td>
<td>11</td>
<td>5.5</td>
</tr>
<tr>
<td>-74.662</td>
<td>-13.472</td>
<td>90.9</td>
<td>2.6</td>
<td>5.2</td>
<td>6.1</td>
<td>2011</td>
<td>6</td>
<td>28</td>
<td>6</td>
<td>53</td>
<td>26.5</td>
</tr>
<tr>
<td>-69.749</td>
<td>-16.236</td>
<td>211.9</td>
<td>6.9</td>
<td>7.6</td>
<td>11.7</td>
<td>2011</td>
<td>6</td>
<td>28</td>
<td>9</td>
<td>35</td>
<td>6.5</td>
</tr>
<tr>
<td>-72.796</td>
<td>-14.165</td>
<td>82</td>
<td>3.4</td>
<td>3.3</td>
<td>4.8</td>
<td>2011</td>
<td>6</td>
<td>29</td>
<td>2</td>
<td>18</td>
<td>23.9</td>
</tr>
<tr>
<td>-71.851</td>
<td>-16.672</td>
<td>50.7</td>
<td>11.2</td>
<td>5.3</td>
<td>5.3</td>
<td>2011</td>
<td>6</td>
<td>29</td>
<td>6</td>
<td>20</td>
<td>22.8</td>
</tr>
<tr>
<td>-73.634</td>
<td>-14.109</td>
<td>78</td>
<td>4.6</td>
<td>5.7</td>
<td>11.2</td>
<td>2011</td>
<td>6</td>
<td>29</td>
<td>15</td>
<td>2</td>
<td>23.4</td>
</tr>
<tr>
<td>-75.995</td>
<td>-13.305</td>
<td>57.2</td>
<td>5.5</td>
<td>13.3</td>
<td>6.4</td>
<td>2011</td>
<td>6</td>
<td>30</td>
<td>13</td>
<td>59</td>
<td>7</td>
</tr>
<tr>
<td>-74.56</td>
<td>-10.721</td>
<td>102</td>
<td>11.8</td>
<td>11.4</td>
<td>15.1</td>
<td>2011</td>
<td>7</td>
<td>1</td>
<td>5</td>
<td>15</td>
<td>1.4</td>
</tr>
<tr>
<td>-71.977</td>
<td>-15.156</td>
<td>122.1</td>
<td>4.1</td>
<td>4.3</td>
<td>8.2</td>
<td>2011</td>
<td>7</td>
<td>4</td>
<td>9</td>
<td>9</td>
<td>31.3</td>
</tr>
<tr>
<td>-74.88</td>
<td>-13.701</td>
<td>92.9</td>
<td>3.4</td>
<td>4.5</td>
<td>7.3</td>
<td>2011</td>
<td>7</td>
<td>4</td>
<td>15</td>
<td>0</td>
<td>23.3</td>
</tr>
<tr>
<td>-72.707</td>
<td>-14.934</td>
<td>105.4</td>
<td>3.2</td>
<td>3.6</td>
<td>5.9</td>
<td>2011</td>
<td>7</td>
<td>6</td>
<td>1</td>
<td>47</td>
<td>58.5</td>
</tr>
<tr>
<td>-71.894</td>
<td>-16.073</td>
<td>112.6</td>
<td>6.2</td>
<td>4.9</td>
<td>9.5</td>
<td>2011</td>
<td>7</td>
<td>8</td>
<td>0</td>
<td>39</td>
<td>15.2</td>
</tr>
<tr>
<td>-76.578</td>
<td>-11.512</td>
<td>99.6</td>
<td>10.7</td>
<td>10.5</td>
<td>10.9</td>
<td>2011</td>
<td>7</td>
<td>8</td>
<td>3</td>
<td>54</td>
<td>42.8</td>
</tr>
<tr>
<td>-71.189</td>
<td>-15.074</td>
<td>133.4</td>
<td>4</td>
<td>4.8</td>
<td>6.3</td>
<td>2011</td>
<td>7</td>
<td>9</td>
<td>8</td>
<td>51</td>
<td>13.5</td>
</tr>
<tr>
<td>-72.827</td>
<td>-15.641</td>
<td>124.2</td>
<td>4.9</td>
<td>6.4</td>
<td>13.2</td>
<td>2011</td>
<td>7</td>
<td>10</td>
<td>11</td>
<td>49</td>
<td>5.5</td>
</tr>
<tr>
<td>-71.994</td>
<td>-14.917</td>
<td>119.1</td>
<td>3.6</td>
<td>6.1</td>
<td>7</td>
<td>2011</td>
<td>7</td>
<td>13</td>
<td>5</td>
<td>18</td>
<td>51.6</td>
</tr>
<tr>
<td>-71.872</td>
<td>-15.635</td>
<td>142.6</td>
<td>5.8</td>
<td>5.7</td>
<td>13.7</td>
<td>2011</td>
<td>7</td>
<td>13</td>
<td>8</td>
<td>23</td>
<td>25.8</td>
</tr>
<tr>
<td>-67.084</td>
<td>-17.793</td>
<td>284.2</td>
<td>10.1</td>
<td>8.6</td>
<td>7.8</td>
<td>2011</td>
<td>7</td>
<td>14</td>
<td>7</td>
<td>2</td>
<td>25.7</td>
</tr>
<tr>
<td>-69.448</td>
<td>-15.935</td>
<td>232.7</td>
<td>5.6</td>
<td>5.8</td>
<td>8.8</td>
<td>2011</td>
<td>7</td>
<td>14</td>
<td>18</td>
<td>34</td>
<td>40.1</td>
</tr>
<tr>
<td>-69.424</td>
<td>-15.95</td>
<td>235.8</td>
<td>5.4</td>
<td>5.8</td>
<td>8</td>
<td>2011</td>
<td>7</td>
<td>14</td>
<td>18</td>
<td>34</td>
<td>39.7</td>
</tr>
<tr>
<td>-69.426</td>
<td>-15.971</td>
<td>233.4</td>
<td>5.1</td>
<td>6.2</td>
<td>7.8</td>
<td>2011</td>
<td>7</td>
<td>14</td>
<td>22</td>
<td>53</td>
<td>54.2</td>
</tr>
<tr>
<td>-74.844</td>
<td>-10.943</td>
<td>102.1</td>
<td>13.7</td>
<td>9</td>
<td>12</td>
<td>2011</td>
<td>7</td>
<td>21</td>
<td>7</td>
<td>12</td>
<td>12.4</td>
</tr>
<tr>
<td>-73.449</td>
<td>-14.434</td>
<td>80.6</td>
<td>4.4</td>
<td>5.3</td>
<td>5.8</td>
<td>2011</td>
<td>7</td>
<td>22</td>
<td>22</td>
<td>28</td>
<td>52.8</td>
</tr>
<tr>
<td>-73.449</td>
<td>-14.85</td>
<td>103.2</td>
<td>4.4</td>
<td>5.9</td>
<td>6.2</td>
<td>2011</td>
<td>7</td>
<td>23</td>
<td>11</td>
<td>44</td>
<td>45</td>
</tr>
<tr>
<td>-73.664</td>
<td>-14.4</td>
<td>88.9</td>
<td>3.3</td>
<td>5.4</td>
<td>6.3</td>
<td>2011</td>
<td>7</td>
<td>24</td>
<td>2</td>
<td>3</td>
<td>12.8</td>
</tr>
<tr>
<td>-74.404</td>
<td>-14.795</td>
<td>99.2</td>
<td>7.1</td>
<td>7.3</td>
<td>8.3</td>
<td>2011</td>
<td>7</td>
<td>24</td>
<td>15</td>
<td>49</td>
<td>6.5</td>
</tr>
<tr>
<td>-74.489</td>
<td>-14.913</td>
<td>95.9</td>
<td>6.8</td>
<td>13.3</td>
<td>8</td>
<td>2011</td>
<td>7</td>
<td>24</td>
<td>15</td>
<td>49</td>
<td>5.1</td>
</tr>
<tr>
<td>-74.114</td>
<td>-14.451</td>
<td>95</td>
<td>4.2</td>
<td>8.5</td>
<td>10.7</td>
<td>2011</td>
<td>7</td>
<td>27</td>
<td>7</td>
<td>49</td>
<td>3</td>
</tr>
<tr>
<td>-73.005</td>
<td>-14.402</td>
<td>77.3</td>
<td>2.4</td>
<td>3</td>
<td>4.3</td>
<td>2011</td>
<td>7</td>
<td>27</td>
<td>8</td>
<td>36</td>
<td>0.4</td>
</tr>
<tr>
<td>-76.103</td>
<td>-12.183</td>
<td>99.2</td>
<td>4.1</td>
<td>3.4</td>
<td>8.1</td>
<td>2011</td>
<td>7</td>
<td>28</td>
<td>3</td>
<td>13</td>
<td>11.4</td>
</tr>
<tr>
<td>-69.597</td>
<td>-16.863</td>
<td>171.4</td>
<td>5.1</td>
<td>5.8</td>
<td>9.9</td>
<td>2011</td>
<td>7</td>
<td>28</td>
<td>5</td>
<td>7</td>
<td>14.2</td>
</tr>
<tr>
<td>-72.32</td>
<td>-14.404</td>
<td>89.3</td>
<td>2.3</td>
<td>2.7</td>
<td>9.4</td>
<td>2011</td>
<td>7</td>
<td>30</td>
<td>4</td>
<td>31</td>
<td>6.8</td>
</tr>
<tr>
<td>-72.603</td>
<td>-15.745</td>
<td>130</td>
<td>7.6</td>
<td>9.9</td>
<td>14.2</td>
<td>2011</td>
<td>7</td>
<td>30</td>
<td>5</td>
<td>28</td>
<td>58.2</td>
</tr>
<tr>
<td>-69.907</td>
<td>-17.325</td>
<td>144.6</td>
<td>5.4</td>
<td>9.8</td>
<td>7.8</td>
<td>2011</td>
<td>8</td>
<td>2</td>
<td>18</td>
<td>3</td>
<td>6.6</td>
</tr>
<tr>
<td>-71.903</td>
<td>-15.525</td>
<td>130</td>
<td>5.1</td>
<td>4.8</td>
<td>6.9</td>
<td>2011</td>
<td>8</td>
<td>5</td>
<td>4</td>
<td>54</td>
<td>19</td>
</tr>
<tr>
<td>-75.102</td>
<td>-14.207</td>
<td>79.4</td>
<td>5.3</td>
<td>7.7</td>
<td>27.1</td>
<td>2011</td>
<td>8</td>
<td>6</td>
<td>5</td>
<td>6</td>
<td>56.1</td>
</tr>
<tr>
<td>-72.674</td>
<td>-14.043</td>
<td>79.7</td>
<td>3.3</td>
<td>3.5</td>
<td>8.9</td>
<td>2011</td>
<td>8</td>
<td>7</td>
<td>8</td>
<td>41</td>
<td>6.3</td>
</tr>
<tr>
<td>-72.464</td>
<td>-15.457</td>
<td>130</td>
<td>5.6</td>
<td>7.2</td>
<td>10.4</td>
<td>2011</td>
<td>8</td>
<td>9</td>
<td>7</td>
<td>54</td>
<td>29.2</td>
</tr>
<tr>
<td>Value 1</td>
<td>Value 2</td>
<td>Value 3</td>
<td>Value 4</td>
<td>Year 1</td>
<td>Value 5</td>
<td>Value 6</td>
<td>Value 7</td>
<td>Value 8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
<td>--------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-72.949</td>
<td>-14.36</td>
<td>83.5</td>
<td>4.5</td>
<td>4.8</td>
<td>6.1</td>
<td>2011</td>
<td>9</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-75.036</td>
<td>-12.838</td>
<td>64.4</td>
<td>12.2</td>
<td>8.7</td>
<td>9.7</td>
<td>2011</td>
<td>9</td>
<td>22</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.438</td>
<td>-16.455</td>
<td>194.6</td>
<td>5.8</td>
<td>4.3</td>
<td>7.6</td>
<td>2011</td>
<td>9</td>
<td>23</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-70.492</td>
<td>-17.199</td>
<td>100.7</td>
<td>4</td>
<td>3.9</td>
<td>9.1</td>
<td>2011</td>
<td>9</td>
<td>23</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-75.995</td>
<td>-11.99</td>
<td>109.2</td>
<td>4.1</td>
<td>4.4</td>
<td>6.7</td>
<td>2011</td>
<td>9</td>
<td>23</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-75.082</td>
<td>-13.138</td>
<td>96.3</td>
<td>4.9</td>
<td>6.2</td>
<td>11.2</td>
<td>2011</td>
<td>9</td>
<td>24</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-72.306</td>
<td>-16.803</td>
<td>85.7</td>
<td>5.4</td>
<td>8.3</td>
<td>13.3</td>
<td>2011</td>
<td>9</td>
<td>25</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-73.316</td>
<td>-14.392</td>
<td>81.1</td>
<td>3.9</td>
<td>4.8</td>
<td>6.1</td>
<td>2011</td>
<td>9</td>
<td>30</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-75.275</td>
<td>-12.968</td>
<td>96.7</td>
<td>10.1</td>
<td>5.6</td>
<td>25.8</td>
<td>2011</td>
<td>10</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-71.155</td>
<td>-17.245</td>
<td>82.3</td>
<td>12.1</td>
<td>11</td>
<td>8.2</td>
<td>2011</td>
<td>10</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-71.148</td>
<td>-17.186</td>
<td>82.2</td>
<td>12.9</td>
<td>8.7</td>
<td>9.9</td>
<td>2011</td>
<td>10</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-70.739</td>
<td>-15.515</td>
<td>183.5</td>
<td>4</td>
<td>3.5</td>
<td>5.2</td>
<td>2011</td>
<td>10</td>
<td>8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-75.024</td>
<td>-14.092</td>
<td>94.6</td>
<td>4.5</td>
<td>10.1</td>
<td>17.8</td>
<td>2011</td>
<td>10</td>
<td>12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-73.744</td>
<td>-14.902</td>
<td>90</td>
<td>6.4</td>
<td>7.1</td>
<td>10.5</td>
<td>2011</td>
<td>10</td>
<td>15</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-72.82</td>
<td>-14.227</td>
<td>83.8</td>
<td>3.8</td>
<td>3.9</td>
<td>7.7</td>
<td>2011</td>
<td>10</td>
<td>16</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.672</td>
<td>-15.884</td>
<td>227.4</td>
<td>6.3</td>
<td>5.8</td>
<td>8.6</td>
<td>2011</td>
<td>10</td>
<td>19</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-75.694</td>
<td>-13.665</td>
<td>61.4</td>
<td>2.5</td>
<td>8.9</td>
<td>2.3</td>
<td>2011</td>
<td>10</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-74.645</td>
<td>-13.168</td>
<td>92.7</td>
<td>8</td>
<td>14.6</td>
<td>16.1</td>
<td>2011</td>
<td>10</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.632</td>
<td>-18.039</td>
<td>122.6</td>
<td>3.6</td>
<td>5.5</td>
<td>5.2</td>
<td>2011</td>
<td>10</td>
<td>22</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-75.058</td>
<td>-12.998</td>
<td>93.3</td>
<td>3.4</td>
<td>3.2</td>
<td>5.9</td>
<td>2011</td>
<td>10</td>
<td>23</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-75.021</td>
<td>-13.446</td>
<td>102.5</td>
<td>3.8</td>
<td>3.5</td>
<td>9</td>
<td>2011</td>
<td>10</td>
<td>26</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-71.58</td>
<td>-15.203</td>
<td>137.9</td>
<td>5.7</td>
<td>7</td>
<td>6.6</td>
<td>2011</td>
<td>11</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-75.007</td>
<td>-13.447</td>
<td>100.5</td>
<td>15.3</td>
<td>50.5</td>
<td>12.8</td>
<td>2011</td>
<td>11</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-74.766</td>
<td>-13.739</td>
<td>102.6</td>
<td>3.9</td>
<td>3.6</td>
<td>6.9</td>
<td>2011</td>
<td>11</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.628</td>
<td>-17.541</td>
<td>153.7</td>
<td>10.9</td>
<td>10</td>
<td>13.5</td>
<td>2011</td>
<td>11</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.539</td>
<td>-17.005</td>
<td>171.4</td>
<td>5.5</td>
<td>12</td>
<td>11.4</td>
<td>2011</td>
<td>11</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-71.876</td>
<td>-15.96</td>
<td>154.7</td>
<td>9</td>
<td>5.9</td>
<td>12.5</td>
<td>2011</td>
<td>11</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-71.143</td>
<td>-16.583</td>
<td>109.4</td>
<td>3.8</td>
<td>2.3</td>
<td>5.2</td>
<td>2011</td>
<td>11</td>
<td>7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-71.143</td>
<td>-16.583</td>
<td>109.4</td>
<td>3.8</td>
<td>2.3</td>
<td>5.2</td>
<td>2011</td>
<td>11</td>
<td>7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.258</td>
<td>-17.548</td>
<td>156.9</td>
<td>6.3</td>
<td>9.4</td>
<td>8.7</td>
<td>2011</td>
<td>11</td>
<td>11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-72.411</td>
<td>-15.297</td>
<td>125.7</td>
<td>4.9</td>
<td>6.3</td>
<td>14.7</td>
<td>2011</td>
<td>11</td>
<td>14</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.055</td>
<td>-16.425</td>
<td>214.3</td>
<td>6.7</td>
<td>5.1</td>
<td>6.5</td>
<td>2011</td>
<td>11</td>
<td>14</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.61</td>
<td>-15.854</td>
<td>231.2</td>
<td>7</td>
<td>6.4</td>
<td>8.9</td>
<td>2011</td>
<td>11</td>
<td>15</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.892</td>
<td>-17.886</td>
<td>127.1</td>
<td>5</td>
<td>9.5</td>
<td>6.7</td>
<td>2011</td>
<td>11</td>
<td>15</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.525</td>
<td>-17.491</td>
<td>143.9</td>
<td>3.9</td>
<td>8.1</td>
<td>10.7</td>
<td>2011</td>
<td>11</td>
<td>16</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-70.452</td>
<td>-18.116</td>
<td>58.9</td>
<td>11.6</td>
<td>17.8</td>
<td>6</td>
<td>2011</td>
<td>11</td>
<td>16</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-75.141</td>
<td>-13.559</td>
<td>100</td>
<td>4.7</td>
<td>5</td>
<td>6.5</td>
<td>2011</td>
<td>11</td>
<td>16</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.493</td>
<td>-16.889</td>
<td>172.9</td>
<td>6</td>
<td>7.5</td>
<td>10.3</td>
<td>2011</td>
<td>11</td>
<td>16</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.333</td>
<td>-17.373</td>
<td>156.3</td>
<td>4.9</td>
<td>7.7</td>
<td>7.8</td>
<td>2011</td>
<td>11</td>
<td>18</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------</td>
<td>--------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>--------</td>
<td>----</td>
<td>----</td>
<td>----</td>
<td>----</td>
<td>----</td>
<td>----</td>
</tr>
<tr>
<td>-69.613</td>
<td>-16.888</td>
<td>169</td>
<td>5.8</td>
<td>9.6</td>
<td>12.1</td>
<td>2011</td>
<td>11</td>
<td>18</td>
<td>5</td>
<td>42</td>
<td>7</td>
</tr>
<tr>
<td>-71.226</td>
<td>-15.511</td>
<td>153.3</td>
<td>4.4</td>
<td>4.5</td>
<td>5.6</td>
<td>2011</td>
<td>11</td>
<td>20</td>
<td>5</td>
<td>27</td>
<td>14.4</td>
</tr>
<tr>
<td>-71.336</td>
<td>-16.088</td>
<td>130</td>
<td>7.9</td>
<td>5.7</td>
<td>10.7</td>
<td>2011</td>
<td>11</td>
<td>21</td>
<td>10</td>
<td>46</td>
<td>39.9</td>
</tr>
<tr>
<td>-11.043</td>
<td>-75.174</td>
<td>62.5</td>
<td>63.4</td>
<td>83.7</td>
<td>11</td>
<td>2011</td>
<td>11</td>
<td>22</td>
<td>5</td>
<td>47</td>
<td>41.1</td>
</tr>
<tr>
<td>-69.75</td>
<td>-17.742</td>
<td>136.4</td>
<td>5.0</td>
<td>12.7</td>
<td>8.7</td>
<td>2011</td>
<td>11</td>
<td>22</td>
<td>22</td>
<td>3</td>
<td>51.9</td>
</tr>
<tr>
<td>-72.849</td>
<td>-14.123</td>
<td>81.7</td>
<td>2.1</td>
<td>2.4</td>
<td>3.9</td>
<td>2011</td>
<td>11</td>
<td>22</td>
<td>23</td>
<td>2</td>
<td>11.1</td>
</tr>
<tr>
<td>-72.849</td>
<td>-14.123</td>
<td>81.7</td>
<td>2.1</td>
<td>2.3</td>
<td>3.9</td>
<td>2011</td>
<td>11</td>
<td>22</td>
<td>23</td>
<td>2</td>
<td>11.1</td>
</tr>
<tr>
<td>-66.773</td>
<td>-17.236</td>
<td>309.2</td>
<td>4.5</td>
<td>12.6</td>
<td>5.7</td>
<td>2011</td>
<td>11</td>
<td>24</td>
<td>2</td>
<td>30</td>
<td>53.6</td>
</tr>
<tr>
<td>-69.25</td>
<td>-17.591</td>
<td>149.3</td>
<td>5.7</td>
<td>6.9</td>
<td>7.4</td>
<td>2011</td>
<td>11</td>
<td>27</td>
<td>8</td>
<td>35</td>
<td>14.7</td>
</tr>
<tr>
<td>-71.923</td>
<td>-17.156</td>
<td>55</td>
<td>13.8</td>
<td>7.1</td>
<td>5.8</td>
<td>2011</td>
<td>11</td>
<td>28</td>
<td>0</td>
<td>14</td>
<td>23.4</td>
</tr>
<tr>
<td>-69.611</td>
<td>-16.813</td>
<td>182.9</td>
<td>7</td>
<td>14.5</td>
<td>13.7</td>
<td>2011</td>
<td>11</td>
<td>28</td>
<td>16</td>
<td>9</td>
<td>42.5</td>
</tr>
<tr>
<td>-69.483</td>
<td>-17.499</td>
<td>141.5</td>
<td>4.8</td>
<td>9.1</td>
<td>8.6</td>
<td>2011</td>
<td>11</td>
<td>29</td>
<td>8</td>
<td>49</td>
<td>30.1</td>
</tr>
<tr>
<td>-73.535</td>
<td>-14.423</td>
<td>91.6</td>
<td>2.6</td>
<td>3.1</td>
<td>3.7</td>
<td>2011</td>
<td>11</td>
<td>30</td>
<td>3</td>
<td>23</td>
<td>1.8</td>
</tr>
<tr>
<td>-73.814</td>
<td>-16.214</td>
<td>56</td>
<td>22.5</td>
<td>29.6</td>
<td>14.5</td>
<td>2011</td>
<td>11</td>
<td>30</td>
<td>19</td>
<td>34</td>
<td>21.9</td>
</tr>
<tr>
<td>-70.794</td>
<td>-15.663</td>
<td>164.8</td>
<td>4.7</td>
<td>5.6</td>
<td>9.5</td>
<td>2011</td>
<td>12</td>
<td>1</td>
<td>3</td>
<td>40</td>
<td>57.8</td>
</tr>
<tr>
<td>-70.023</td>
<td>-17.199</td>
<td>140.8</td>
<td>5</td>
<td>8.4</td>
<td>10.7</td>
<td>2011</td>
<td>12</td>
<td>5</td>
<td>1</td>
<td>44</td>
<td>1.8</td>
</tr>
<tr>
<td>-74.432</td>
<td>-10.726</td>
<td>107.6</td>
<td>10</td>
<td>13.8</td>
<td>27.5</td>
<td>2011</td>
<td>12</td>
<td>7</td>
<td>14</td>
<td>25</td>
<td>34.4</td>
</tr>
<tr>
<td>-69.49</td>
<td>-17.722</td>
<td>125.1</td>
<td>3.7</td>
<td>8.2</td>
<td>9.2</td>
<td>2011</td>
<td>12</td>
<td>8</td>
<td>20</td>
<td>5</td>
<td>47</td>
</tr>
<tr>
<td>-69.606</td>
<td>-17.856</td>
<td>113.7</td>
<td>9.2</td>
<td>13.4</td>
<td>10.4</td>
<td>2011</td>
<td>12</td>
<td>10</td>
<td>7</td>
<td>21</td>
<td>51.7</td>
</tr>
<tr>
<td>-11.679</td>
<td>-73.133</td>
<td>51.8</td>
<td>11.9</td>
<td>12</td>
<td>9.2</td>
<td>2011</td>
<td>12</td>
<td>10</td>
<td>14</td>
<td>44</td>
<td>41.9</td>
</tr>
<tr>
<td>-69.32</td>
<td>-18.098</td>
<td>126.8</td>
<td>5.8</td>
<td>5.2</td>
<td>7.1</td>
<td>2011</td>
<td>12</td>
<td>11</td>
<td>8</td>
<td>48</td>
<td>28.1</td>
</tr>
<tr>
<td>-69.317</td>
<td>-17.587</td>
<td>139.5</td>
<td>9.7</td>
<td>6.6</td>
<td>7.6</td>
<td>2011</td>
<td>12</td>
<td>11</td>
<td>11</td>
<td>14</td>
<td>15.2</td>
</tr>
<tr>
<td>-69.578</td>
<td>-17.541</td>
<td>139.2</td>
<td>5.7</td>
<td>12.7</td>
<td>11.4</td>
<td>2011</td>
<td>12</td>
<td>11</td>
<td>21</td>
<td>0</td>
<td>38.5</td>
</tr>
<tr>
<td>-69.928</td>
<td>-16.45</td>
<td>167.8</td>
<td>5.9</td>
<td>6.3</td>
<td>14</td>
<td>2011</td>
<td>12</td>
<td>12</td>
<td>21</td>
<td>50</td>
<td>33.5</td>
</tr>
<tr>
<td>-75.67</td>
<td>-11.906</td>
<td>100.7</td>
<td>3.3</td>
<td>4.7</td>
<td>9.4</td>
<td>2011</td>
<td>12</td>
<td>13</td>
<td>5</td>
<td>42</td>
<td>16.3</td>
</tr>
<tr>
<td>-70.025</td>
<td>-17.382</td>
<td>107.7</td>
<td>2.3</td>
<td>9.3</td>
<td>6.7</td>
<td>2011</td>
<td>12</td>
<td>13</td>
<td>10</td>
<td>56</td>
<td>58.7</td>
</tr>
<tr>
<td>-74.848</td>
<td>-13.387</td>
<td>91.5</td>
<td>3.3</td>
<td>5.7</td>
<td>6</td>
<td>2011</td>
<td>12</td>
<td>13</td>
<td>23</td>
<td>16</td>
<td>27.5</td>
</tr>
<tr>
<td>-69.751</td>
<td>-17.29</td>
<td>133.6</td>
<td>5.1</td>
<td>8.7</td>
<td>12.7</td>
<td>2011</td>
<td>12</td>
<td>14</td>
<td>12</td>
<td>0</td>
<td>56.2</td>
</tr>
<tr>
<td>-69.398</td>
<td>-16.471</td>
<td>186.9</td>
<td>6.9</td>
<td>6.2</td>
<td>9.4</td>
<td>2011</td>
<td>12</td>
<td>14</td>
<td>15</td>
<td>54</td>
<td>0</td>
</tr>
<tr>
<td>-71.048</td>
<td>-16.917</td>
<td>102.1</td>
<td>8.7</td>
<td>6.7</td>
<td>11.3</td>
<td>2011</td>
<td>12</td>
<td>14</td>
<td>17</td>
<td>36</td>
<td>37.8</td>
</tr>
<tr>
<td>-69.544</td>
<td>-16.966</td>
<td>172.6</td>
<td>5.4</td>
<td>9.1</td>
<td>10.5</td>
<td>2011</td>
<td>12</td>
<td>14</td>
<td>18</td>
<td>59</td>
<td>30.2</td>
</tr>
<tr>
<td>-13.758</td>
<td>-75.696</td>
<td>60.8</td>
<td>12.1</td>
<td>16.6</td>
<td>7.3</td>
<td>2011</td>
<td>12</td>
<td>15</td>
<td>6</td>
<td>6</td>
<td>10.8</td>
</tr>
<tr>
<td>-69.865</td>
<td>-17.871</td>
<td>136.7</td>
<td>3.6</td>
<td>6.4</td>
<td>4.6</td>
<td>2011</td>
<td>12</td>
<td>16</td>
<td>4</td>
<td>53</td>
<td>50.3</td>
</tr>
<tr>
<td>-71.942</td>
<td>-16.446</td>
<td>101.8</td>
<td>13.7</td>
<td>5.8</td>
<td>7.2</td>
<td>2011</td>
<td>12</td>
<td>17</td>
<td>14</td>
<td>4</td>
<td>21.4</td>
</tr>
<tr>
<td>-69.411</td>
<td>-17.5</td>
<td>159.4</td>
<td>8.4</td>
<td>11.5</td>
<td>11.2</td>
<td>2011</td>
<td>12</td>
<td>18</td>
<td>18</td>
<td>40</td>
<td>27.6</td>
</tr>
<tr>
<td>-72.275</td>
<td>-15.115</td>
<td>116.3</td>
<td>4.6</td>
<td>4</td>
<td>6.6</td>
<td>2011</td>
<td>12</td>
<td>19</td>
<td>7</td>
<td>6</td>
<td>28.7</td>
</tr>
<tr>
<td>-69.489</td>
<td>-17.552</td>
<td>148.4</td>
<td>8.6</td>
<td>15.3</td>
<td>8.3</td>
<td>2011</td>
<td>12</td>
<td>19</td>
<td>19</td>
<td>58</td>
<td>38.9</td>
</tr>
<tr>
<td>-71.921</td>
<td>-16.541</td>
<td>92.6</td>
<td>8.9</td>
<td>5.2</td>
<td>8.2</td>
<td>2011</td>
<td>12</td>
<td>20</td>
<td>3</td>
<td>40</td>
<td>39.9</td>
</tr>
<tr>
<td>-69.485</td>
<td>-16.692</td>
<td>183.7</td>
<td>7</td>
<td>6.8</td>
<td>9.6</td>
<td>2011</td>
<td>12</td>
<td>20</td>
<td>22</td>
<td>42</td>
<td>48.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----</td>
<td>-------</td>
<td>-------</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
</tr>
<tr>
<td>-72.03</td>
<td>-15.478</td>
<td>119.5</td>
<td>5.6</td>
<td>7.1</td>
<td>7.4</td>
<td>2011</td>
<td>12</td>
<td>21</td>
<td>8</td>
<td>44</td>
<td>32.1</td>
</tr>
<tr>
<td>-69.271</td>
<td>-17.219</td>
<td>168</td>
<td>7.3</td>
<td>8.9</td>
<td>10.3</td>
<td>2011</td>
<td>12</td>
<td>23</td>
<td>9</td>
<td>13</td>
<td>21.8</td>
</tr>
<tr>
<td>-69.324</td>
<td>-17.656</td>
<td>135.5</td>
<td>4.2</td>
<td>7.4</td>
<td>8.5</td>
<td>2011</td>
<td>12</td>
<td>23</td>
<td>20</td>
<td>41</td>
<td>13.2</td>
</tr>
<tr>
<td>-69.369</td>
<td>-18.278</td>
<td>126.7</td>
<td>4.6</td>
<td>6.3</td>
<td>10.1</td>
<td>2011</td>
<td>12</td>
<td>24</td>
<td>8</td>
<td>37</td>
<td>8.4</td>
</tr>
<tr>
<td>-69.541</td>
<td>-17.397</td>
<td>152.1</td>
<td>5</td>
<td>8.1</td>
<td>12.6</td>
<td>2011</td>
<td>12</td>
<td>25</td>
<td>4</td>
<td>41</td>
<td>19.9</td>
</tr>
<tr>
<td>-17.954</td>
<td>-70.916</td>
<td>53.3</td>
<td>6.7</td>
<td>4.9</td>
<td>4.4</td>
<td>2011</td>
<td>12</td>
<td>25</td>
<td>9</td>
<td>11</td>
<td>24</td>
</tr>
<tr>
<td>-74.799</td>
<td>-13.426</td>
<td>89</td>
<td>3.8</td>
<td>4.4</td>
<td>5.8</td>
<td>2011</td>
<td>12</td>
<td>25</td>
<td>19</td>
<td>24</td>
<td>10.9</td>
</tr>
<tr>
<td>-70.914</td>
<td>-17.082</td>
<td>86.5</td>
<td>6.9</td>
<td>6</td>
<td>7.8</td>
<td>2011</td>
<td>12</td>
<td>25</td>
<td>19</td>
<td>36</td>
<td>31.7</td>
</tr>
<tr>
<td>-69.363</td>
<td>-16.615</td>
<td>178.4</td>
<td>8.1</td>
<td>7.4</td>
<td>8.7</td>
<td>2011</td>
<td>12</td>
<td>26</td>
<td>0</td>
<td>44</td>
<td>37.5</td>
</tr>
<tr>
<td>-70.52</td>
<td>-15.589</td>
<td>200</td>
<td>3.9</td>
<td>4.2</td>
<td>6.4</td>
<td>2011</td>
<td>12</td>
<td>29</td>
<td>3</td>
<td>32</td>
<td>43.2</td>
</tr>
<tr>
<td>-76.613</td>
<td>-12.507</td>
<td>59.5</td>
<td>9.2</td>
<td>7.6</td>
<td>6.1</td>
<td>2011</td>
<td>12</td>
<td>29</td>
<td>13</td>
<td>45</td>
<td>42</td>
</tr>
<tr>
<td>-69.481</td>
<td>-17.707</td>
<td>131.8</td>
<td>4.4</td>
<td>10.5</td>
<td>11.3</td>
<td>2012</td>
<td>1</td>
<td>1</td>
<td>14</td>
<td>7</td>
<td>9.4</td>
</tr>
<tr>
<td>-72.993</td>
<td>-14.088</td>
<td>81.6</td>
<td>4.5</td>
<td>4.3</td>
<td>6.9</td>
<td>2012</td>
<td>1</td>
<td>1</td>
<td>17</td>
<td>54</td>
<td>51.1</td>
</tr>
<tr>
<td>-70.592</td>
<td>-16.869</td>
<td>120</td>
<td>5.6</td>
<td>8</td>
<td>10.6</td>
<td>2012</td>
<td>1</td>
<td>2</td>
<td>9</td>
<td>22</td>
<td>1.1</td>
</tr>
<tr>
<td>-74.062</td>
<td>-10.25</td>
<td>110.3</td>
<td>6.7</td>
<td>8.6</td>
<td>15.7</td>
<td>2012</td>
<td>1</td>
<td>4</td>
<td>5</td>
<td>37</td>
<td>35.7</td>
</tr>
<tr>
<td>-69.305</td>
<td>-17.689</td>
<td>141.2</td>
<td>4.2</td>
<td>6</td>
<td>7</td>
<td>2012</td>
<td>1</td>
<td>4</td>
<td>8</td>
<td>57</td>
<td>31.3</td>
</tr>
<tr>
<td>-75.489</td>
<td>-13.801</td>
<td>84.1</td>
<td>8.5</td>
<td>13.1</td>
<td>8.5</td>
<td>2012</td>
<td>1</td>
<td>4</td>
<td>11</td>
<td>33</td>
<td>2.6</td>
</tr>
<tr>
<td>-72.009</td>
<td>-16.981</td>
<td>58.6</td>
<td>22.5</td>
<td>10.9</td>
<td>5.6</td>
<td>2012</td>
<td>1</td>
<td>5</td>
<td>5</td>
<td>27</td>
<td>4.3</td>
</tr>
<tr>
<td>-72.162</td>
<td>-16.664</td>
<td>62.1</td>
<td>4.3</td>
<td>7.6</td>
<td>4.5</td>
<td>2012</td>
<td>1</td>
<td>10</td>
<td>12</td>
<td>10</td>
<td>22.7</td>
</tr>
<tr>
<td>-72.842</td>
<td>-14.939</td>
<td>101.7</td>
<td>5</td>
<td>3.5</td>
<td>10.9</td>
<td>2012</td>
<td>1</td>
<td>11</td>
<td>18</td>
<td>58</td>
<td>32.8</td>
</tr>
<tr>
<td>-72.846</td>
<td>-14.882</td>
<td>100.9</td>
<td>4</td>
<td>4.1</td>
<td>8.1</td>
<td>2012</td>
<td>1</td>
<td>11</td>
<td>18</td>
<td>58</td>
<td>33.6</td>
</tr>
<tr>
<td>-69.558</td>
<td>-17.71</td>
<td>130.8</td>
<td>4.4</td>
<td>6.6</td>
<td>8.1</td>
<td>2012</td>
<td>1</td>
<td>11</td>
<td>20</td>
<td>24</td>
<td>22.5</td>
</tr>
<tr>
<td>-72.254</td>
<td>-15.354</td>
<td>116.1</td>
<td>6.5</td>
<td>5.4</td>
<td>14.7</td>
<td>2012</td>
<td>1</td>
<td>12</td>
<td>0</td>
<td>43</td>
<td>19.9</td>
</tr>
<tr>
<td>-74.769</td>
<td>-13.306</td>
<td>80.2</td>
<td>3.9</td>
<td>6.5</td>
<td>4.4</td>
<td>2012</td>
<td>1</td>
<td>13</td>
<td>17</td>
<td>41</td>
<td>43.1</td>
</tr>
<tr>
<td>-72.229</td>
<td>-14.997</td>
<td>86.6</td>
<td>8</td>
<td>6.3</td>
<td>52.3</td>
<td>2012</td>
<td>1</td>
<td>18</td>
<td>0</td>
<td>15</td>
<td>48.9</td>
</tr>
<tr>
<td>-76.028</td>
<td>-13.038</td>
<td>85.9</td>
<td>17.4</td>
<td>10.5</td>
<td>38.7</td>
<td>2012</td>
<td>1</td>
<td>18</td>
<td>4</td>
<td>57</td>
<td>54.2</td>
</tr>
<tr>
<td>-69.45</td>
<td>-18.172</td>
<td>129.4</td>
<td>6.5</td>
<td>7.5</td>
<td>10.4</td>
<td>2012</td>
<td>1</td>
<td>20</td>
<td>12</td>
<td>45</td>
<td>7.1</td>
</tr>
<tr>
<td>-70.167</td>
<td>-17.507</td>
<td>106.3</td>
<td>3.5</td>
<td>8.3</td>
<td>7.6</td>
<td>2012</td>
<td>1</td>
<td>21</td>
<td>20</td>
<td>11</td>
<td>48.3</td>
</tr>
<tr>
<td>-72.267</td>
<td>-15.388</td>
<td>139</td>
<td>5.9</td>
<td>5.8</td>
<td>12.9</td>
<td>2012</td>
<td>1</td>
<td>22</td>
<td>8</td>
<td>7</td>
<td>31.9</td>
</tr>
<tr>
<td>-75.013</td>
<td>-11.006</td>
<td>106.1</td>
<td>6.4</td>
<td>9.1</td>
<td>15.4</td>
<td>2012</td>
<td>1</td>
<td>22</td>
<td>18</td>
<td>5</td>
<td>16.5</td>
</tr>
<tr>
<td>-69.073</td>
<td>-18.402</td>
<td>137</td>
<td>8.1</td>
<td>10.1</td>
<td>12.5</td>
<td>2012</td>
<td>1</td>
<td>23</td>
<td>17</td>
<td>22</td>
<td>29.1</td>
</tr>
<tr>
<td>-69.823</td>
<td>-17.225</td>
<td>132.4</td>
<td>3.6</td>
<td>7.6</td>
<td>12.7</td>
<td>2012</td>
<td>1</td>
<td>26</td>
<td>10</td>
<td>31</td>
<td>35.5</td>
</tr>
<tr>
<td>-69.297</td>
<td>-17.423</td>
<td>154.6</td>
<td>6.7</td>
<td>12.1</td>
<td>9.8</td>
<td>2012</td>
<td>1</td>
<td>27</td>
<td>7</td>
<td>9</td>
<td>8.9</td>
</tr>
<tr>
<td>-76.311</td>
<td>-13.148</td>
<td>66.7</td>
<td>9.6</td>
<td>8.3</td>
<td>9.9</td>
<td>2012</td>
<td>1</td>
<td>28</td>
<td>0</td>
<td>59</td>
<td>32.6</td>
</tr>
<tr>
<td>-72.836</td>
<td>-14.321</td>
<td>87.5</td>
<td>4.4</td>
<td>4.2</td>
<td>9.3</td>
<td>2012</td>
<td>1</td>
<td>28</td>
<td>7</td>
<td>32</td>
<td>21.7</td>
</tr>
<tr>
<td>-72.807</td>
<td>-14.786</td>
<td>92.3</td>
<td>4</td>
<td>3.5</td>
<td>11.3</td>
<td>2012</td>
<td>1</td>
<td>28</td>
<td>9</td>
<td>31</td>
<td>54.2</td>
</tr>
<tr>
<td>-74.564</td>
<td>-13.225</td>
<td>77.9</td>
<td>3.7</td>
<td>4</td>
<td>4.7</td>
<td>2012</td>
<td>1</td>
<td>28</td>
<td>11</td>
<td>50</td>
<td>33.4</td>
</tr>
<tr>
<td>-69.779</td>
<td>-16.51</td>
<td>180.1</td>
<td>4.9</td>
<td>4.5</td>
<td>8.3</td>
<td>2012</td>
<td>1</td>
<td>29</td>
<td>6</td>
<td>8</td>
<td>23.1</td>
</tr>
<tr>
<td>-75.59</td>
<td>-14.274</td>
<td>54.5</td>
<td>7.9</td>
<td>5.3</td>
<td>4.5</td>
<td>2012</td>
<td>1</td>
<td>30</td>
<td>2</td>
<td>26</td>
<td>23.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
</tr>
<tr>
<td>-75.622</td>
<td>-14.277</td>
<td>51.2</td>
<td>12.2</td>
<td>8</td>
<td>7.3</td>
<td>2012</td>
<td>3</td>
<td>12</td>
<td>7</td>
<td>17</td>
<td>11.7</td>
</tr>
<tr>
<td>-71.896</td>
<td>-16.402</td>
<td>99.5</td>
<td>7.1</td>
<td>5.3</td>
<td>8.1</td>
<td>2012</td>
<td>3</td>
<td>15</td>
<td>13</td>
<td>26</td>
<td>37.6</td>
</tr>
<tr>
<td>-69.47</td>
<td>-17.353</td>
<td>147.1</td>
<td>4.5</td>
<td>6</td>
<td>7.3</td>
<td>2012</td>
<td>3</td>
<td>16</td>
<td>1</td>
<td>53</td>
<td>51.1</td>
</tr>
<tr>
<td>-11.571</td>
<td>-73.302</td>
<td>50.1</td>
<td>3.7</td>
<td>4.7</td>
<td>3.9</td>
<td>2012</td>
<td>3</td>
<td>16</td>
<td>6</td>
<td>52</td>
<td>39.5</td>
</tr>
<tr>
<td>-74.11</td>
<td>-15.334</td>
<td>62.6</td>
<td>6.6</td>
<td>4.5</td>
<td>4.8</td>
<td>2012</td>
<td>3</td>
<td>16</td>
<td>18</td>
<td>37</td>
<td>53.7</td>
</tr>
<tr>
<td>-75.693</td>
<td>-11.202</td>
<td>111.6</td>
<td>8</td>
<td>8.4</td>
<td>9.6</td>
<td>2012</td>
<td>3</td>
<td>17</td>
<td>18</td>
<td>31</td>
<td>3.4</td>
</tr>
<tr>
<td>-76.428</td>
<td>-13.011</td>
<td>66.7</td>
<td>9.2</td>
<td>6.1</td>
<td>10.7</td>
<td>2012</td>
<td>3</td>
<td>20</td>
<td>2</td>
<td>36</td>
<td>23.6</td>
</tr>
<tr>
<td>-69.567</td>
<td>-16.613</td>
<td>190.4</td>
<td>7.7</td>
<td>11.8</td>
<td>12.4</td>
<td>2012</td>
<td>3</td>
<td>20</td>
<td>15</td>
<td>59</td>
<td>58.5</td>
</tr>
<tr>
<td>-71.143</td>
<td>-16.592</td>
<td>104.1</td>
<td>6.6</td>
<td>3.7</td>
<td>9</td>
<td>2012</td>
<td>3</td>
<td>21</td>
<td>8</td>
<td>43</td>
<td>14.6</td>
</tr>
<tr>
<td>-72.392</td>
<td>-15.289</td>
<td>108.7</td>
<td>4.9</td>
<td>5.3</td>
<td>10.5</td>
<td>2012</td>
<td>3</td>
<td>22</td>
<td>3</td>
<td>13</td>
<td>14.8</td>
</tr>
<tr>
<td>-74.014</td>
<td>-14.269</td>
<td>70</td>
<td>3.8</td>
<td>5.6</td>
<td>12.3</td>
<td>2012</td>
<td>3</td>
<td>23</td>
<td>10</td>
<td>31</td>
<td>12.7</td>
</tr>
<tr>
<td>-69.436</td>
<td>-17.782</td>
<td>146.6</td>
<td>4.6</td>
<td>7.8</td>
<td>8.7</td>
<td>2012</td>
<td>3</td>
<td>24</td>
<td>11</td>
<td>46</td>
<td>23</td>
</tr>
<tr>
<td>-70.737</td>
<td>-15.568</td>
<td>176.1</td>
<td>4.1</td>
<td>4.4</td>
<td>6.3</td>
<td>2012</td>
<td>3</td>
<td>24</td>
<td>14</td>
<td>39</td>
<td>25.4</td>
</tr>
<tr>
<td>-69.769</td>
<td>-17.253</td>
<td>147.8</td>
<td>6.1</td>
<td>13.5</td>
<td>12.9</td>
<td>2012</td>
<td>3</td>
<td>24</td>
<td>16</td>
<td>5</td>
<td>56</td>
</tr>
<tr>
<td>-69.765</td>
<td>-16.631</td>
<td>162.7</td>
<td>5.5</td>
<td>4.9</td>
<td>11.1</td>
<td>2012</td>
<td>3</td>
<td>26</td>
<td>8</td>
<td>23</td>
<td>0.9</td>
</tr>
<tr>
<td>-69.384</td>
<td>-16.928</td>
<td>179.7</td>
<td>5.5</td>
<td>6.2</td>
<td>6.7</td>
<td>2012</td>
<td>3</td>
<td>26</td>
<td>15</td>
<td>22</td>
<td>55.6</td>
</tr>
<tr>
<td>-73.944</td>
<td>-12.876</td>
<td>66.2</td>
<td>5.6</td>
<td>7.7</td>
<td>12.3</td>
<td>2012</td>
<td>3</td>
<td>27</td>
<td>16</td>
<td>7</td>
<td>29.3</td>
</tr>
<tr>
<td>-69.496</td>
<td>-16.67</td>
<td>181.1</td>
<td>8</td>
<td>8.6</td>
<td>12.2</td>
<td>2012</td>
<td>3</td>
<td>28</td>
<td>22</td>
<td>38</td>
<td>9.7</td>
</tr>
<tr>
<td>-69.588</td>
<td>-16.751</td>
<td>168.6</td>
<td>4.7</td>
<td>8.2</td>
<td>10.7</td>
<td>2012</td>
<td>3</td>
<td>29</td>
<td>23</td>
<td>31</td>
<td>7.2</td>
</tr>
<tr>
<td>-70.207</td>
<td>-15.544</td>
<td>204.2</td>
<td>5.6</td>
<td>4.5</td>
<td>10</td>
<td>2012</td>
<td>3</td>
<td>30</td>
<td>3</td>
<td>2</td>
<td>27</td>
</tr>
<tr>
<td>-71.261</td>
<td>-15.579</td>
<td>154.3</td>
<td>7.9</td>
<td>5.4</td>
<td>8.4</td>
<td>2012</td>
<td>3</td>
<td>30</td>
<td>4</td>
<td>9</td>
<td>57.7</td>
</tr>
<tr>
<td>-69.413</td>
<td>-17.307</td>
<td>149</td>
<td>5.1</td>
<td>8.9</td>
<td>8.2</td>
<td>2012</td>
<td>3</td>
<td>30</td>
<td>10</td>
<td>48</td>
<td>44.3</td>
</tr>
<tr>
<td>-71.889</td>
<td>-15.003</td>
<td>123.4</td>
<td>6</td>
<td>4.8</td>
<td>8.2</td>
<td>2012</td>
<td>4</td>
<td>1</td>
<td>2</td>
<td>30</td>
<td>42.8</td>
</tr>
<tr>
<td>-69.122</td>
<td>-17.714</td>
<td>144.5</td>
<td>5.5</td>
<td>7.2</td>
<td>7.3</td>
<td>2012</td>
<td>4</td>
<td>1</td>
<td>22</td>
<td>4</td>
<td>35.8</td>
</tr>
<tr>
<td>-69.627</td>
<td>-16.159</td>
<td>208.4</td>
<td>6.7</td>
<td>5.8</td>
<td>8.5</td>
<td>2012</td>
<td>4</td>
<td>3</td>
<td>15</td>
<td>14.2</td>
<td></td>
</tr>
<tr>
<td>-72.091</td>
<td>-14.23</td>
<td>56.7</td>
<td>6.7</td>
<td>7.2</td>
<td>18.5</td>
<td>2012</td>
<td>4</td>
<td>4</td>
<td>19</td>
<td>34</td>
<td>14.3</td>
</tr>
<tr>
<td>-69.684</td>
<td>-17.516</td>
<td>130.4</td>
<td>4.6</td>
<td>7.1</td>
<td>5.9</td>
<td>2012</td>
<td>4</td>
<td>5</td>
<td>22</td>
<td>16</td>
<td>19.6</td>
</tr>
<tr>
<td>-69.348</td>
<td>-17.78</td>
<td>136.2</td>
<td>4.8</td>
<td>9.3</td>
<td>11.6</td>
<td>2012</td>
<td>4</td>
<td>8</td>
<td>23</td>
<td>4</td>
<td>57.2</td>
</tr>
<tr>
<td>-70.318</td>
<td>-17.477</td>
<td>98.2</td>
<td>3.3</td>
<td>5.2</td>
<td>5</td>
<td>2012</td>
<td>4</td>
<td>9</td>
<td>0</td>
<td>40</td>
<td>39.1</td>
</tr>
<tr>
<td>-75.989</td>
<td>-13.927</td>
<td>56.9</td>
<td>9.7</td>
<td>7.2</td>
<td>5.1</td>
<td>2012</td>
<td>4</td>
<td>12</td>
<td>1</td>
<td>1</td>
<td>11.3</td>
</tr>
<tr>
<td>-72.118</td>
<td>-14.595</td>
<td>90.8</td>
<td>5.2</td>
<td>6</td>
<td>17.1</td>
<td>2012</td>
<td>4</td>
<td>14</td>
<td>20</td>
<td>30</td>
<td>59.3</td>
</tr>
<tr>
<td>-71.968</td>
<td>-16.149</td>
<td>105.9</td>
<td>6.4</td>
<td>5.5</td>
<td>10.9</td>
<td>2012</td>
<td>4</td>
<td>16</td>
<td>13</td>
<td>24</td>
<td>55.7</td>
</tr>
<tr>
<td>-73.772</td>
<td>-15.098</td>
<td>91.6</td>
<td>3.9</td>
<td>7</td>
<td>9.3</td>
<td>2012</td>
<td>4</td>
<td>17</td>
<td>9</td>
<td>43</td>
<td>58.7</td>
</tr>
<tr>
<td>-71.928</td>
<td>-14.901</td>
<td>111.2</td>
<td>6.9</td>
<td>7.6</td>
<td>12.9</td>
<td>2012</td>
<td>4</td>
<td>17</td>
<td>9</td>
<td>43</td>
<td>12.9</td>
</tr>
<tr>
<td>-75.623</td>
<td>-13.697</td>
<td>73.3</td>
<td>6.2</td>
<td>5.5</td>
<td>8.1</td>
<td>2012</td>
<td>4</td>
<td>18</td>
<td>18</td>
<td>37</td>
<td>52.2</td>
</tr>
<tr>
<td>-71.934</td>
<td>-14.923</td>
<td>132.9</td>
<td>4.1</td>
<td>3.7</td>
<td>10</td>
<td>2012</td>
<td>4</td>
<td>19</td>
<td>23</td>
<td>2</td>
<td>43.2</td>
</tr>
<tr>
<td>-72.11</td>
<td>-15.822</td>
<td>118</td>
<td>7</td>
<td>4.7</td>
<td>8.3</td>
<td>2012</td>
<td>4</td>
<td>20</td>
<td>2</td>
<td>43</td>
<td>25.2</td>
</tr>
<tr>
<td>-71.805</td>
<td>-14.872</td>
<td>120.6</td>
<td>3.6</td>
<td>3</td>
<td>5.5</td>
<td>2012</td>
<td>4</td>
<td>21</td>
<td>11</td>
<td>36</td>
<td>3.8</td>
</tr>
<tr>
<td>-72.031</td>
<td>-14.934</td>
<td>115.8</td>
<td>3.8</td>
<td>3.9</td>
<td>7.4</td>
<td>2012</td>
<td>4</td>
<td>23</td>
<td>17</td>
<td>2</td>
<td>44.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-75.774</td>
<td>-13.923</td>
<td>61.2</td>
<td>11.2</td>
<td>8.7</td>
<td>6.6</td>
<td>2012</td>
<td>4</td>
<td>24</td>
<td>0</td>
<td>43</td>
<td>49.3</td>
</tr>
<tr>
<td>-71.628</td>
<td>-16.216</td>
<td>125.5</td>
<td>11</td>
<td>7.8</td>
<td>6.3</td>
<td>2012</td>
<td>4</td>
<td>24</td>
<td>2</td>
<td>14</td>
<td>16.6</td>
</tr>
<tr>
<td>-75.819</td>
<td>-13.761</td>
<td>65.5</td>
<td>11.3</td>
<td>8.2</td>
<td>18</td>
<td>2012</td>
<td>4</td>
<td>24</td>
<td>6</td>
<td>20</td>
<td>35.1</td>
</tr>
<tr>
<td>-71.668</td>
<td>-16.334</td>
<td>102.5</td>
<td>5.8</td>
<td>4.8</td>
<td>6.9</td>
<td>2012</td>
<td>4</td>
<td>25</td>
<td>16</td>
<td>19</td>
<td>38.4</td>
</tr>
<tr>
<td>-74.871</td>
<td>-14.383</td>
<td>62.3</td>
<td>4.4</td>
<td>4.9</td>
<td>4.1</td>
<td>2012</td>
<td>4</td>
<td>25</td>
<td>22</td>
<td>37</td>
<td>15.5</td>
</tr>
<tr>
<td>-75.807</td>
<td>-13.463</td>
<td>77.3</td>
<td>11.6</td>
<td>14.3</td>
<td>13.1</td>
<td>2012</td>
<td>4</td>
<td>29</td>
<td>2</td>
<td>30</td>
<td>14.4</td>
</tr>
<tr>
<td>-70.567</td>
<td>-17.887</td>
<td>57.5</td>
<td>8.2</td>
<td>16.3</td>
<td>4.4</td>
<td>2012</td>
<td>4</td>
<td>30</td>
<td>8</td>
<td>4</td>
<td>21.2</td>
</tr>
<tr>
<td>-69.308</td>
<td>-18.196</td>
<td>134.9</td>
<td>5.8</td>
<td>24.4</td>
<td>11.7</td>
<td>2012</td>
<td>4</td>
<td>30</td>
<td>12</td>
<td>32</td>
<td>18.8</td>
</tr>
<tr>
<td>-72.365</td>
<td>-14.479</td>
<td>92.7</td>
<td>4.9</td>
<td>5.2</td>
<td>16.5</td>
<td>2012</td>
<td>5</td>
<td>2</td>
<td>10</td>
<td>52</td>
<td>59.8</td>
</tr>
<tr>
<td>-75.157</td>
<td>-14.883</td>
<td>56.1</td>
<td>8.4</td>
<td>7.1</td>
<td>3.2</td>
<td>2012</td>
<td>5</td>
<td>2</td>
<td>11</td>
<td>34</td>
<td>43.9</td>
</tr>
<tr>
<td>-73.821</td>
<td>-14.171</td>
<td>65.4</td>
<td>5.3</td>
<td>7.4</td>
<td>18</td>
<td>2012</td>
<td>5</td>
<td>2</td>
<td>16</td>
<td>54</td>
<td>26.4</td>
</tr>
<tr>
<td>-71.215</td>
<td>-17.666</td>
<td>52.8</td>
<td>23.3</td>
<td>22.9</td>
<td>13.3</td>
<td>2012</td>
<td>5</td>
<td>2</td>
<td>21</td>
<td>57</td>
<td>11.3</td>
</tr>
<tr>
<td>-69.925</td>
<td>-17.029</td>
<td>131.2</td>
<td>4.7</td>
<td>6.9</td>
<td>13.9</td>
<td>2012</td>
<td>5</td>
<td>3</td>
<td>11</td>
<td>31</td>
<td>52</td>
</tr>
<tr>
<td>-73.919</td>
<td>-12.859</td>
<td>63.6</td>
<td>9.9</td>
<td>11.8</td>
<td>6.8</td>
<td>2012</td>
<td>5</td>
<td>3</td>
<td>20</td>
<td>57</td>
<td>45.9</td>
</tr>
<tr>
<td>-72.522</td>
<td>-14.926</td>
<td>103.6</td>
<td>5.2</td>
<td>7.8</td>
<td>20</td>
<td>2012</td>
<td>5</td>
<td>4</td>
<td>11</td>
<td>26</td>
<td>12.9</td>
</tr>
<tr>
<td>-70.501</td>
<td>-16.07</td>
<td>190</td>
<td>5.8</td>
<td>6.2</td>
<td>9.8</td>
<td>2012</td>
<td>5</td>
<td>4</td>
<td>18</td>
<td>50</td>
<td>48.2</td>
</tr>
<tr>
<td>-74.715</td>
<td>-12.725</td>
<td>71.2</td>
<td>6.8</td>
<td>5.7</td>
<td>15.7</td>
<td>2012</td>
<td>5</td>
<td>5</td>
<td>2</td>
<td>7</td>
<td>15.7</td>
</tr>
<tr>
<td>-75.539</td>
<td>-12.776</td>
<td>95.7</td>
<td>11.2</td>
<td>5.7</td>
<td>24.5</td>
<td>2012</td>
<td>5</td>
<td>9</td>
<td>10</td>
<td>36</td>
<td>36.6</td>
</tr>
<tr>
<td>-69.739</td>
<td>-17.719</td>
<td>136.1</td>
<td>4.3</td>
<td>7.3</td>
<td>7.3</td>
<td>2012</td>
<td>5</td>
<td>12</td>
<td>11</td>
<td>28</td>
<td>53.3</td>
</tr>
<tr>
<td>-73.667</td>
<td>-14.461</td>
<td>83.6</td>
<td>6</td>
<td>8.3</td>
<td>9.1</td>
<td>2012</td>
<td>5</td>
<td>12</td>
<td>16</td>
<td>57</td>
<td>38.9</td>
</tr>
<tr>
<td>-69.477</td>
<td>-17.687</td>
<td>137.1</td>
<td>5.6</td>
<td>10.3</td>
<td>9.6</td>
<td>2012</td>
<td>5</td>
<td>13</td>
<td>7</td>
<td>47</td>
<td>34.4</td>
</tr>
<tr>
<td>-70.008</td>
<td>-17.872</td>
<td>100.4</td>
<td>3.8</td>
<td>6.3</td>
<td>8.6</td>
<td>2012</td>
<td>5</td>
<td>14</td>
<td>10</td>
<td>0</td>
<td>39.1</td>
</tr>
<tr>
<td>-72.482</td>
<td>-16.055</td>
<td>93</td>
<td>4.1</td>
<td>4.7</td>
<td>10.1</td>
<td>2012</td>
<td>5</td>
<td>15</td>
<td>2</td>
<td>38</td>
<td>27.4</td>
</tr>
<tr>
<td>-71.65</td>
<td>-16.445</td>
<td>106.8</td>
<td>2.9</td>
<td>4.4</td>
<td>7.4</td>
<td>2012</td>
<td>5</td>
<td>15</td>
<td>7</td>
<td>14</td>
<td>31.8</td>
</tr>
<tr>
<td>-70.028</td>
<td>-17.845</td>
<td>99.8</td>
<td>2.9</td>
<td>5.2</td>
<td>4.3</td>
<td>2012</td>
<td>5</td>
<td>15</td>
<td>21</td>
<td>20</td>
<td>33.6</td>
</tr>
<tr>
<td>-72.658</td>
<td>-16.515</td>
<td>70</td>
<td>6</td>
<td>6.4</td>
<td>3.8</td>
<td>2012</td>
<td>5</td>
<td>16</td>
<td>1</td>
<td>54</td>
<td>8.5</td>
</tr>
<tr>
<td>-76.17</td>
<td>-11.869</td>
<td>111</td>
<td>10.2</td>
<td>7.2</td>
<td>12</td>
<td>2012</td>
<td>5</td>
<td>17</td>
<td>3</td>
<td>45</td>
<td>27.9</td>
</tr>
<tr>
<td>-69.451</td>
<td>-17.444</td>
<td>153.2</td>
<td>7.2</td>
<td>11.9</td>
<td>12.1</td>
<td>2012</td>
<td>5</td>
<td>17</td>
<td>8</td>
<td>5</td>
<td>37.5</td>
</tr>
<tr>
<td>-76.512</td>
<td>-13.062</td>
<td>51.7</td>
<td>9.3</td>
<td>6.8</td>
<td>5.4</td>
<td>2012</td>
<td>5</td>
<td>18</td>
<td>9</td>
<td>22</td>
<td>31.6</td>
</tr>
<tr>
<td>-69.53</td>
<td>-16.677</td>
<td>185.5</td>
<td>5.8</td>
<td>5.3</td>
<td>8.6</td>
<td>2012</td>
<td>5</td>
<td>21</td>
<td>3</td>
<td>37</td>
<td>1.6</td>
</tr>
<tr>
<td>-72.802</td>
<td>-14.837</td>
<td>91.8</td>
<td>4</td>
<td>4.2</td>
<td>16.2</td>
<td>2012</td>
<td>5</td>
<td>22</td>
<td>6</td>
<td>50</td>
<td>1.5</td>
</tr>
<tr>
<td>-70.885</td>
<td>-16.82</td>
<td>113.1</td>
<td>3.8</td>
<td>3.1</td>
<td>7.4</td>
<td>2012</td>
<td>5</td>
<td>23</td>
<td>1</td>
<td>4</td>
<td>33.8</td>
</tr>
<tr>
<td>-74.741</td>
<td>-15.802</td>
<td>63.2</td>
<td>25.3</td>
<td>17.3</td>
<td>6.1</td>
<td>2012</td>
<td>5</td>
<td>23</td>
<td>14</td>
<td>36</td>
<td>39.1</td>
</tr>
<tr>
<td>-71.895</td>
<td>-14.986</td>
<td>126.7</td>
<td>6.6</td>
<td>6.2</td>
<td>7</td>
<td>2012</td>
<td>5</td>
<td>25</td>
<td>13</td>
<td>27</td>
<td>7.9</td>
</tr>
<tr>
<td>-76.336</td>
<td>-12.528</td>
<td>62.5</td>
<td>12.3</td>
<td>7.1</td>
<td>6.2</td>
<td>2012</td>
<td>5</td>
<td>28</td>
<td>16</td>
<td>46</td>
<td>41.4</td>
</tr>
<tr>
<td>-70.102</td>
<td>-18.062</td>
<td>91.1</td>
<td>4.2</td>
<td>6.7</td>
<td>4.2</td>
<td>2012</td>
<td>5</td>
<td>31</td>
<td>11</td>
<td>29</td>
<td>54.7</td>
</tr>
<tr>
<td>-69.519</td>
<td>-18.369</td>
<td>123.4</td>
<td>6.9</td>
<td>19.8</td>
<td>10.6</td>
<td>2012</td>
<td>6</td>
<td>1</td>
<td>3</td>
<td>45</td>
<td>54.8</td>
</tr>
<tr>
<td>-69.6</td>
<td>-17.444</td>
<td>160.1</td>
<td>4.4</td>
<td>7.4</td>
<td>14.9</td>
<td>2012</td>
<td>6</td>
<td>2</td>
<td>0</td>
<td>22</td>
<td>17.3</td>
</tr>
<tr>
<td>-71.787</td>
<td>-14.792</td>
<td>115.2</td>
<td>7.3</td>
<td>11.7</td>
<td>12.8</td>
<td>2012</td>
<td>6</td>
<td>2</td>
<td>9</td>
<td>20</td>
<td>47.3</td>
</tr>
<tr>
<td>Value 1</td>
<td>Value 2</td>
<td>Value 3</td>
<td>Value 4</td>
<td>Value 5</td>
<td>Year 1</td>
<td>Year 2</td>
<td>Year 3</td>
<td>Year 4</td>
<td>Year 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-73.093</td>
<td>-14.162</td>
<td>89.3</td>
<td>3.7</td>
<td>5</td>
<td>7.6</td>
<td>2012</td>
<td>7</td>
<td>12</td>
<td>5</td>
<td>5</td>
<td>29.7</td>
</tr>
<tr>
<td>-69.814</td>
<td>-17.709</td>
<td>117.9</td>
<td>2.7</td>
<td>3.7</td>
<td>5.3</td>
<td>2012</td>
<td>7</td>
<td>13</td>
<td>0</td>
<td>57</td>
<td>55.7</td>
</tr>
<tr>
<td>-69.315</td>
<td>-18.305</td>
<td>126</td>
<td>4.4</td>
<td>5.9</td>
<td>8</td>
<td>2012</td>
<td>7</td>
<td>14</td>
<td>5</td>
<td>28</td>
<td>6.6</td>
</tr>
<tr>
<td>-70.003</td>
<td>-17.791</td>
<td>98.6</td>
<td>6.1</td>
<td>6.4</td>
<td>4.8</td>
<td>2012</td>
<td>7</td>
<td>19</td>
<td>3</td>
<td>26</td>
<td>57</td>
</tr>
<tr>
<td>-69.726</td>
<td>-16.646</td>
<td>181.8</td>
<td>7</td>
<td>10.9</td>
<td>13.7</td>
<td>2012</td>
<td>7</td>
<td>19</td>
<td>17</td>
<td>16</td>
<td>17.7</td>
</tr>
<tr>
<td>-14.357</td>
<td>-75.628</td>
<td>51.2</td>
<td>8.9</td>
<td>7.3</td>
<td>6.9</td>
<td>2012</td>
<td>7</td>
<td>22</td>
<td>17</td>
<td>9</td>
<td>47.8</td>
</tr>
<tr>
<td>-71.601</td>
<td>-15.284</td>
<td>136.7</td>
<td>5</td>
<td>3.9</td>
<td>6.7</td>
<td>2012</td>
<td>7</td>
<td>22</td>
<td>20</td>
<td>33</td>
<td>34.2</td>
</tr>
<tr>
<td>-69.972</td>
<td>-17.762</td>
<td>122.7</td>
<td>4.7</td>
<td>10.7</td>
<td>8.8</td>
<td>2012</td>
<td>7</td>
<td>25</td>
<td>22</td>
<td>28</td>
<td>49.2</td>
</tr>
<tr>
<td>-69.696</td>
<td>-17.973</td>
<td>135.4</td>
<td>7.3</td>
<td>11</td>
<td>6.3</td>
<td>2012</td>
<td>7</td>
<td>26</td>
<td>7</td>
<td>36</td>
<td>56.2</td>
</tr>
<tr>
<td>-75.774</td>
<td>-13.412</td>
<td>88.8</td>
<td>7</td>
<td>7.3</td>
<td>9.9</td>
<td>2012</td>
<td>7</td>
<td>27</td>
<td>18</td>
<td>41</td>
<td>0.3</td>
</tr>
<tr>
<td>-74.749</td>
<td>-11.386</td>
<td>97.8</td>
<td>9.1</td>
<td>6</td>
<td>11.6</td>
<td>2012</td>
<td>7</td>
<td>28</td>
<td>12</td>
<td>43</td>
<td>60</td>
</tr>
<tr>
<td>-69.385</td>
<td>-16.75</td>
<td>185.2</td>
<td>12.7</td>
<td>7.5</td>
<td>11.9</td>
<td>2012</td>
<td>7</td>
<td>31</td>
<td>19</td>
<td>58</td>
<td>31.2</td>
</tr>
<tr>
<td>-76.22</td>
<td>-12.861</td>
<td>51.2</td>
<td>10.8</td>
<td>6.5</td>
<td>18.1</td>
<td>2012</td>
<td>8</td>
<td>1</td>
<td>2</td>
<td>31</td>
<td>52.6</td>
</tr>
<tr>
<td>-75.07</td>
<td>-13.117</td>
<td>93.4</td>
<td>6.3</td>
<td>13.3</td>
<td>23.8</td>
<td>2012</td>
<td>8</td>
<td>3</td>
<td>23</td>
<td>25</td>
<td>8.1</td>
</tr>
<tr>
<td>-74.824</td>
<td>-13.671</td>
<td>98.8</td>
<td>3.8</td>
<td>9.9</td>
<td>8.7</td>
<td>2012</td>
<td>8</td>
<td>8</td>
<td>1</td>
<td>59</td>
<td>15.9</td>
</tr>
<tr>
<td>-10.816</td>
<td>74.023</td>
<td>96.4</td>
<td>15.3</td>
<td>13.3</td>
<td>29.7</td>
<td>2012</td>
<td>8</td>
<td>9</td>
<td>14</td>
<td>43</td>
<td>54</td>
</tr>
<tr>
<td>-75.427</td>
<td>-12.636</td>
<td>92.8</td>
<td>3.5</td>
<td>3.1</td>
<td>12.7</td>
<td>2012</td>
<td>8</td>
<td>16</td>
<td>13</td>
<td>44</td>
<td>31.5</td>
</tr>
<tr>
<td>-75.082</td>
<td>-13.171</td>
<td>100</td>
<td>7.2</td>
<td>16.4</td>
<td>22.9</td>
<td>2012</td>
<td>8</td>
<td>28</td>
<td>0</td>
<td>57</td>
<td>18.4</td>
</tr>
<tr>
<td>-75.658</td>
<td>-11.865</td>
<td>100</td>
<td>6.1</td>
<td>6.8</td>
<td>17</td>
<td>2012</td>
<td>8</td>
<td>3</td>
<td>11</td>
<td>19</td>
<td>46.8</td>
</tr>
<tr>
<td>-75.067</td>
<td>-13.131</td>
<td>97.3</td>
<td>6.9</td>
<td>12.1</td>
<td>21</td>
<td>2012</td>
<td>9</td>
<td>1</td>
<td>4</td>
<td>0</td>
<td>7.9</td>
</tr>
<tr>
<td>-74.995</td>
<td>-12.355</td>
<td>90.8</td>
<td>10.1</td>
<td>5.7</td>
<td>10.8</td>
<td>2012</td>
<td>9</td>
<td>1</td>
<td>5</td>
<td>32</td>
<td>19.9</td>
</tr>
<tr>
<td>-76.305</td>
<td>-12.269</td>
<td>84.4</td>
<td>12.3</td>
<td>4.8</td>
<td>7.3</td>
<td>2012</td>
<td>9</td>
<td>5</td>
<td>2</td>
<td>18</td>
<td>43.7</td>
</tr>
<tr>
<td>-13.802</td>
<td>-75.976</td>
<td>53.2</td>
<td>9.6</td>
<td>20</td>
<td>7.8</td>
<td>2012</td>
<td>9</td>
<td>5</td>
<td>4</td>
<td>10</td>
<td>24.9</td>
</tr>
<tr>
<td>-74.769</td>
<td>-13.678</td>
<td>93.9</td>
<td>8.9</td>
<td>33.8</td>
<td>25.6</td>
<td>2012</td>
<td>9</td>
<td>5</td>
<td>16</td>
<td>52</td>
<td>14.9</td>
</tr>
<tr>
<td>-74.632</td>
<td>-11.443</td>
<td>91.3</td>
<td>7.2</td>
<td>6.1</td>
<td>15.2</td>
<td>2012</td>
<td>9</td>
<td>8</td>
<td>1</td>
<td>47</td>
<td>38.3</td>
</tr>
<tr>
<td>-75.425</td>
<td>-12.637</td>
<td>92.9</td>
<td>3.5</td>
<td>2.3</td>
<td>11.1</td>
<td>2012</td>
<td>9</td>
<td>8</td>
<td>12</td>
<td>2</td>
<td>57.9</td>
</tr>
<tr>
<td>-75.919</td>
<td>-11.385</td>
<td>105.7</td>
<td>10.4</td>
<td>15.7</td>
<td>13.6</td>
<td>2012</td>
<td>9</td>
<td>24</td>
<td>13</td>
<td>29</td>
<td>15.6</td>
</tr>
<tr>
<td>-74.001</td>
<td>-12.915</td>
<td>71.9</td>
<td>5.6</td>
<td>7.8</td>
<td>11.4</td>
<td>2012</td>
<td>9</td>
<td>24</td>
<td>17</td>
<td>53</td>
<td>16.3</td>
</tr>
<tr>
<td>-73.115</td>
<td>-16.673</td>
<td>64</td>
<td>11.1</td>
<td>19.8</td>
<td>5.2</td>
<td>2012</td>
<td>9</td>
<td>24</td>
<td>23</td>
<td>25</td>
<td>8.6</td>
</tr>
<tr>
<td>-75.362</td>
<td>-12.986</td>
<td>102.1</td>
<td>5.4</td>
<td>5.3</td>
<td>16.3</td>
<td>2012</td>
<td>9</td>
<td>26</td>
<td>6</td>
<td>10</td>
<td>51.5</td>
</tr>
<tr>
<td>-74.948</td>
<td>-11.915</td>
<td>90</td>
<td>16.9</td>
<td>5.1</td>
<td>11.5</td>
<td>2012</td>
<td>9</td>
<td>27</td>
<td>2</td>
<td>51</td>
<td>9</td>
</tr>
<tr>
<td>-76.432</td>
<td>-11.849</td>
<td>101.4</td>
<td>12</td>
<td>9.8</td>
<td>11</td>
<td>2012</td>
<td>9</td>
<td>28</td>
<td>4</td>
<td>38</td>
<td>59.9</td>
</tr>
<tr>
<td>-75.251</td>
<td>-13.004</td>
<td>91.7</td>
<td>6.5</td>
<td>3.4</td>
<td>9.9</td>
<td>2012</td>
<td>10</td>
<td>8</td>
<td>6</td>
<td>46</td>
<td>3.1</td>
</tr>
<tr>
<td>-11.186</td>
<td>-73.501</td>
<td>64</td>
<td>7.6</td>
<td>8.4</td>
<td>15.4</td>
<td>2012</td>
<td>10</td>
<td>9</td>
<td>8</td>
<td>24</td>
<td>10.3</td>
</tr>
<tr>
<td>-75.67</td>
<td>-13.395</td>
<td>86.6</td>
<td>9.8</td>
<td>8</td>
<td>7.3</td>
<td>2012</td>
<td>10</td>
<td>12</td>
<td>3</td>
<td>53</td>
<td>17.3</td>
</tr>
<tr>
<td>-73.592</td>
<td>-14.833</td>
<td>90.3</td>
<td>4.9</td>
<td>7.2</td>
<td>8.1</td>
<td>2012</td>
<td>10</td>
<td>15</td>
<td>7</td>
<td>45</td>
<td>8.1</td>
</tr>
<tr>
<td>-75.413</td>
<td>-12.485</td>
<td>92.3</td>
<td>6.7</td>
<td>4.1</td>
<td>14.3</td>
<td>2012</td>
<td>10</td>
<td>16</td>
<td>5</td>
<td>46</td>
<td>57.5</td>
</tr>
<tr>
<td>-74.98</td>
<td>-12.839</td>
<td>92.2</td>
<td>8.3</td>
<td>6.1</td>
<td>20.4</td>
<td>2012</td>
<td>10</td>
<td>20</td>
<td>5</td>
<td>44</td>
<td>16.6</td>
</tr>
<tr>
<td>-76.523</td>
<td>-12.024</td>
<td>86.2</td>
<td>6.3</td>
<td>5.7</td>
<td>5.6</td>
<td>2012</td>
<td>10</td>
<td>30</td>
<td>13</td>
<td>5</td>
<td>53.9</td>
</tr>
<tr>
<td></td>
<td>11/12</td>
<td>11/13</td>
<td>11/14</td>
<td>12/11</td>
<td>12/12</td>
<td>12/13</td>
<td>12/14</td>
<td>12/15</td>
<td>12/16</td>
<td>12/17</td>
<td>12/18</td>
</tr>
<tr>
<td>----</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
</tr>
<tr>
<td>x</td>
<td>1.1</td>
<td>1.2</td>
<td>1.3</td>
<td>1.4</td>
<td>1.5</td>
<td>1.6</td>
<td>1.7</td>
<td>1.8</td>
<td>1.9</td>
<td>2.0</td>
<td>2.1</td>
</tr>
<tr>
<td>y</td>
<td>2.2</td>
<td>2.3</td>
<td>2.4</td>
<td>2.5</td>
<td>2.6</td>
<td>2.7</td>
<td>2.8</td>
<td>2.9</td>
<td>3.0</td>
<td>3.1</td>
<td>3.2</td>
</tr>
<tr>
<td>z</td>
<td>3.3</td>
<td>3.4</td>
<td>3.5</td>
<td>3.6</td>
<td>3.7</td>
<td>3.8</td>
<td>3.9</td>
<td>4.0</td>
<td>4.1</td>
<td>4.2</td>
<td>4.3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>------</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-75.148</td>
<td>-13.148</td>
<td>90</td>
<td>7.3</td>
<td>13.9</td>
<td>23</td>
<td>2013</td>
<td>5</td>
<td>15</td>
<td>13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-72.666</td>
<td>-13.841</td>
<td>91.3</td>
<td>3.2</td>
<td>7.4</td>
<td>10.6</td>
<td>2013</td>
<td>5</td>
<td>21</td>
<td>23</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-75.281</td>
<td>-12.892</td>
<td>90.2</td>
<td>3.5</td>
<td>2.6</td>
<td>7.9</td>
<td>2013</td>
<td>5</td>
<td>25</td>
<td>16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-74.85</td>
<td>-12.862</td>
<td>94.8</td>
<td>6</td>
<td>5.9</td>
<td>19.4</td>
<td>2013</td>
<td>5</td>
<td>27</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-76.38</td>
<td>-12.769</td>
<td>54.9</td>
<td>22.2</td>
<td>6.2</td>
<td>11.5</td>
<td>2013</td>
<td>6</td>
<td>2</td>
<td>20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-74.81</td>
<td>-13.398</td>
<td>79.6</td>
<td>19.4</td>
<td>49.2</td>
<td>17.3</td>
<td>2013</td>
<td>6</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-75.223</td>
<td>-12.922</td>
<td>97.4</td>
<td>4</td>
<td>3.9</td>
<td>10.9</td>
<td>2013</td>
<td>6</td>
<td>7</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-76.478</td>
<td>-13.171</td>
<td>77.9</td>
<td>10</td>
<td>10.9</td>
<td>32.4</td>
<td>2013</td>
<td>6</td>
<td>7</td>
<td>7</td>
<td>51</td>
<td>38.7</td>
</tr>
</tbody>
</table>
Table 1.2. Coordinates of 508 relocated hypocenters as determined from HypoDD

<table>
<thead>
<tr>
<th>Lon</th>
<th>Lat</th>
<th>Dep</th>
<th>Lon err</th>
<th>Lat err</th>
<th>Dep err</th>
<th>Yr</th>
<th>Mo</th>
<th>Day</th>
<th>Hr</th>
<th>Min</th>
<th>Sec</th>
</tr>
</thead>
<tbody>
<tr>
<td>-71.547</td>
<td>-15.112</td>
<td>146.9</td>
<td>0.34</td>
<td>0.32</td>
<td>0.47</td>
<td>2010</td>
<td>11</td>
<td>9</td>
<td>2</td>
<td>9</td>
<td>52.8</td>
</tr>
<tr>
<td>-71.598</td>
<td>-16.082</td>
<td>136.9</td>
<td>0.33</td>
<td>0.43</td>
<td>0.43</td>
<td>2010</td>
<td>11</td>
<td>16</td>
<td>5</td>
<td>57</td>
<td>26.4</td>
</tr>
<tr>
<td>-71.403</td>
<td>-15.661</td>
<td>152.4</td>
<td>0.37</td>
<td>0.47</td>
<td>0.35</td>
<td>2010</td>
<td>11</td>
<td>18</td>
<td>7</td>
<td>0</td>
<td>53.7</td>
</tr>
<tr>
<td>-69.572</td>
<td>-17.327</td>
<td>146.0</td>
<td>0.19</td>
<td>0.24</td>
<td>0.28</td>
<td>2010</td>
<td>11</td>
<td>18</td>
<td>20</td>
<td>32</td>
<td>10.9</td>
</tr>
<tr>
<td>-69.636</td>
<td>-17.607</td>
<td>128.9</td>
<td>0.20</td>
<td>0.15</td>
<td>0.17</td>
<td>2010</td>
<td>11</td>
<td>19</td>
<td>1</td>
<td>42</td>
<td>51.9</td>
</tr>
<tr>
<td>-69.917</td>
<td>-17.289</td>
<td>125.2</td>
<td>0.21</td>
<td>0.27</td>
<td>0.24</td>
<td>2010</td>
<td>11</td>
<td>20</td>
<td>16</td>
<td>33</td>
<td>19.1</td>
</tr>
<tr>
<td>-69.634</td>
<td>-17.606</td>
<td>147.0</td>
<td>0.19</td>
<td>0.18</td>
<td>0.22</td>
<td>2010</td>
<td>11</td>
<td>25</td>
<td>2</td>
<td>16</td>
<td>27.6</td>
</tr>
<tr>
<td>-69.353</td>
<td>-17.375</td>
<td>156.7</td>
<td>0.19</td>
<td>0.22</td>
<td>0.15</td>
<td>2010</td>
<td>11</td>
<td>25</td>
<td>17</td>
<td>25</td>
<td>45.1</td>
</tr>
<tr>
<td>-71.192</td>
<td>-16.582</td>
<td>109.2</td>
<td>0.21</td>
<td>0.19</td>
<td>0.37</td>
<td>2010</td>
<td>11</td>
<td>25</td>
<td>18</td>
<td>16</td>
<td>51.5</td>
</tr>
<tr>
<td>-71.149</td>
<td>-16.728</td>
<td>82.6</td>
<td>0.28</td>
<td>0.31</td>
<td>0.23</td>
<td>2010</td>
<td>11</td>
<td>26</td>
<td>3</td>
<td>36</td>
<td>55.2</td>
</tr>
<tr>
<td>-69.576</td>
<td>-17.281</td>
<td>162.5</td>
<td>0.24</td>
<td>0.26</td>
<td>0.26</td>
<td>2010</td>
<td>11</td>
<td>27</td>
<td>6</td>
<td>33</td>
<td>43.5</td>
</tr>
<tr>
<td>-72.121</td>
<td>-15.288</td>
<td>121.8</td>
<td>0.34</td>
<td>0.27</td>
<td>0.50</td>
<td>2010</td>
<td>11</td>
<td>27</td>
<td>12</td>
<td>59</td>
<td>56.8</td>
</tr>
<tr>
<td>-69.456</td>
<td>-17.608</td>
<td>151.3</td>
<td>0.19</td>
<td>0.16</td>
<td>0.18</td>
<td>2010</td>
<td>11</td>
<td>28</td>
<td>3</td>
<td>11</td>
<td>19.4</td>
</tr>
<tr>
<td>-71.754</td>
<td>-14.801</td>
<td>125.2</td>
<td>0.43</td>
<td>0.38</td>
<td>0.56</td>
<td>2010</td>
<td>11</td>
<td>28</td>
<td>14</td>
<td>49</td>
<td>21.6</td>
</tr>
<tr>
<td>-69.365</td>
<td>-18.191</td>
<td>128.2</td>
<td>0.25</td>
<td>0.34</td>
<td>0.34</td>
<td>2010</td>
<td>11</td>
<td>30</td>
<td>8</td>
<td>4</td>
<td>38.6</td>
</tr>
<tr>
<td>-70.106</td>
<td>-17.065</td>
<td>137.5</td>
<td>0.20</td>
<td>0.33</td>
<td>0.27</td>
<td>2010</td>
<td>11</td>
<td>30</td>
<td>14</td>
<td>27</td>
<td>55.7</td>
</tr>
<tr>
<td>-67.190</td>
<td>-18.369</td>
<td>244.3</td>
<td>4.25</td>
<td>2.65</td>
<td>2.41</td>
<td>2010</td>
<td>12</td>
<td>2</td>
<td>0</td>
<td>19</td>
<td>23</td>
</tr>
<tr>
<td>-70.246</td>
<td>-15.559</td>
<td>211.3</td>
<td>0.19</td>
<td>0.17</td>
<td>0.29</td>
<td>2010</td>
<td>12</td>
<td>2</td>
<td>2</td>
<td>56</td>
<td>11.5</td>
</tr>
<tr>
<td>-69.306</td>
<td>-17.973</td>
<td>131.1</td>
<td>0.25</td>
<td>0.27</td>
<td>0.28</td>
<td>2010</td>
<td>12</td>
<td>3</td>
<td>1</td>
<td>46</td>
<td>7.1</td>
</tr>
<tr>
<td>-71.085</td>
<td>-16.698</td>
<td>123.3</td>
<td>0.26</td>
<td>0.25</td>
<td>0.35</td>
<td>2010</td>
<td>12</td>
<td>7</td>
<td>4</td>
<td>14</td>
<td>40.1</td>
</tr>
<tr>
<td>-72.111</td>
<td>-15.055</td>
<td>118.2</td>
<td>0.25</td>
<td>0.24</td>
<td>0.34</td>
<td>2010</td>
<td>12</td>
<td>8</td>
<td>8</td>
<td>3</td>
<td>53.2</td>
</tr>
<tr>
<td>-70.431</td>
<td>-17.465</td>
<td>88.5</td>
<td>0.58</td>
<td>0.51</td>
<td>0.73</td>
<td>2010</td>
<td>12</td>
<td>8</td>
<td>22</td>
<td>21</td>
<td>43.1</td>
</tr>
<tr>
<td>-69.515</td>
<td>-16.893</td>
<td>176.6</td>
<td>0.21</td>
<td>0.19</td>
<td>0.30</td>
<td>2010</td>
<td>12</td>
<td>11</td>
<td>2</td>
<td>4</td>
<td>19.2</td>
</tr>
<tr>
<td>-69.387</td>
<td>-17.885</td>
<td>132.9</td>
<td>0.25</td>
<td>0.28</td>
<td>0.27</td>
<td>2010</td>
<td>12</td>
<td>11</td>
<td>15</td>
<td>52</td>
<td>50.9</td>
</tr>
<tr>
<td>-70.152</td>
<td>-17.556</td>
<td>98.7</td>
<td>0.49</td>
<td>0.63</td>
<td>0.61</td>
<td>2010</td>
<td>12</td>
<td>13</td>
<td>3</td>
<td>51</td>
<td>42.9</td>
</tr>
<tr>
<td>-69.447</td>
<td>-17.583</td>
<td>152.6</td>
<td>0.18</td>
<td>0.16</td>
<td>0.15</td>
<td>2010</td>
<td>12</td>
<td>13</td>
<td>10</td>
<td>43</td>
<td>13.5</td>
</tr>
<tr>
<td>-69.571</td>
<td>-17.602</td>
<td>133.7</td>
<td>0.19</td>
<td>0.14</td>
<td>0.17</td>
<td>2010</td>
<td>12</td>
<td>14</td>
<td>14</td>
<td>32</td>
<td>22.2</td>
</tr>
<tr>
<td>-71.392</td>
<td>-17.245</td>
<td>64.4</td>
<td>0.41</td>
<td>0.54</td>
<td>0.52</td>
<td>2010</td>
<td>12</td>
<td>15</td>
<td>13</td>
<td>23</td>
<td>7.3</td>
</tr>
<tr>
<td>-69.329</td>
<td>-17.728</td>
<td>143.2</td>
<td>0.22</td>
<td>0.22</td>
<td>0.27</td>
<td>2010</td>
<td>12</td>
<td>15</td>
<td>18</td>
<td>22</td>
<td>23</td>
</tr>
<tr>
<td>-69.630</td>
<td>-17.600</td>
<td>146.5</td>
<td>0.20</td>
<td>0.22</td>
<td>0.30</td>
<td>2010</td>
<td>12</td>
<td>17</td>
<td>2</td>
<td>32</td>
<td>36.6</td>
</tr>
<tr>
<td>-71.779</td>
<td>-15.325</td>
<td>143.5</td>
<td>0.35</td>
<td>0.45</td>
<td>0.44</td>
<td>2010</td>
<td>12</td>
<td>18</td>
<td>13</td>
<td>7</td>
<td>52.5</td>
</tr>
<tr>
<td>-71.927</td>
<td>-15.073</td>
<td>122.8</td>
<td>0.27</td>
<td>0.25</td>
<td>0.32</td>
<td>2010</td>
<td>12</td>
<td>19</td>
<td>7</td>
<td>43</td>
<td>51.9</td>
</tr>
<tr>
<td>-70.706</td>
<td>-15.392</td>
<td>197.8</td>
<td>0.27</td>
<td>0.32</td>
<td>0.35</td>
<td>2010</td>
<td>12</td>
<td>21</td>
<td>20</td>
<td>4</td>
<td>46.7</td>
</tr>
<tr>
<td>-71.874</td>
<td>-15.473</td>
<td>136.6</td>
<td>0.44</td>
<td>0.42</td>
<td>0.56</td>
<td>2010</td>
<td>12</td>
<td>22</td>
<td>14</td>
<td>5</td>
<td>16.6</td>
</tr>
<tr>
<td>-69.372</td>
<td>-18.004</td>
<td>146.3</td>
<td>0.25</td>
<td>0.26</td>
<td>0.20</td>
<td>2010</td>
<td>12</td>
<td>22</td>
<td>19</td>
<td>58</td>
<td>0.1</td>
</tr>
<tr>
<td>-72.081</td>
<td>-15.044</td>
<td>116.1</td>
<td>0.30</td>
<td>0.29</td>
<td>0.34</td>
<td>2010</td>
<td>12</td>
<td>25</td>
<td>5</td>
<td>49</td>
<td>22</td>
</tr>
<tr>
<td>-72.013</td>
<td>-14.628</td>
<td>105.3</td>
<td>0.72</td>
<td>0.58</td>
<td>0.65</td>
<td>2010</td>
<td>12</td>
<td>28</td>
<td>21</td>
<td>39</td>
<td>19.4</td>
</tr>
<tr>
<td>Code</td>
<td>Year</td>
<td>Month</td>
<td>Temperature</td>
<td>Wind Speed</td>
<td>Humidity</td>
<td>Column A</td>
<td>Column B</td>
<td>Column C</td>
<td>Column D</td>
<td>Column E</td>
<td>Column F</td>
</tr>
<tr>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>-------------</td>
<td>------------</td>
<td>----------</td>
<td>----------</td>
<td>----------</td>
<td>----------</td>
<td>----------</td>
<td>----------</td>
<td>----------</td>
</tr>
<tr>
<td>-69.717</td>
<td>2010</td>
<td>12</td>
<td>29</td>
<td>4</td>
<td>44</td>
<td>16.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-70.053</td>
<td>2011</td>
<td>1</td>
<td>2</td>
<td>6</td>
<td>56</td>
<td>26.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-72.310</td>
<td>2011</td>
<td>1</td>
<td>20</td>
<td>27</td>
<td>41.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.630</td>
<td>2011</td>
<td>1</td>
<td>6</td>
<td>1</td>
<td>56</td>
<td>12.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-72.017</td>
<td>2011</td>
<td>1</td>
<td>2</td>
<td>6</td>
<td>56</td>
<td>26.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.724</td>
<td>2010</td>
<td>1</td>
<td>2</td>
<td>6</td>
<td>56</td>
<td>26.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.463</td>
<td>2011</td>
<td>1</td>
<td>2</td>
<td>6</td>
<td>56</td>
<td>26.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-71.714</td>
<td>2010</td>
<td>1</td>
<td>2</td>
<td>6</td>
<td>56</td>
<td>26.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.493</td>
<td>2011</td>
<td>1</td>
<td>2</td>
<td>6</td>
<td>56</td>
<td>26.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.705</td>
<td>2011</td>
<td>1</td>
<td>2</td>
<td>6</td>
<td>56</td>
<td>26.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.558</td>
<td>2011</td>
<td>1</td>
<td>2</td>
<td>6</td>
<td>56</td>
<td>26.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.542</td>
<td>2011</td>
<td>1</td>
<td>2</td>
<td>6</td>
<td>56</td>
<td>26.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-72.166</td>
<td>2011</td>
<td>1</td>
<td>2</td>
<td>6</td>
<td>56</td>
<td>26.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-71.797</td>
<td>2011</td>
<td>1</td>
<td>2</td>
<td>6</td>
<td>56</td>
<td>26.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-70.683</td>
<td>2011</td>
<td>1</td>
<td>2</td>
<td>6</td>
<td>56</td>
<td>26.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-70.635</td>
<td>2011</td>
<td>1</td>
<td>2</td>
<td>6</td>
<td>56</td>
<td>26.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.454</td>
<td>2011</td>
<td>1</td>
<td>2</td>
<td>6</td>
<td>56</td>
<td>26.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-70.252</td>
<td>2011</td>
<td>1</td>
<td>2</td>
<td>6</td>
<td>56</td>
<td>26.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-70.269</td>
<td>2011</td>
<td>1</td>
<td>2</td>
<td>6</td>
<td>56</td>
<td>26.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.330</td>
<td>2011</td>
<td>1</td>
<td>2</td>
<td>6</td>
<td>56</td>
<td>26.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.615</td>
<td>2011</td>
<td>1</td>
<td>2</td>
<td>6</td>
<td>56</td>
<td>26.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-70.058</td>
<td>2011</td>
<td>1</td>
<td>2</td>
<td>6</td>
<td>56</td>
<td>26.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.877</td>
<td>2011</td>
<td>1</td>
<td>2</td>
<td>6</td>
<td>56</td>
<td>26.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.423</td>
<td>2011</td>
<td>1</td>
<td>2</td>
<td>6</td>
<td>56</td>
<td>26.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.399</td>
<td>2011</td>
<td>1</td>
<td>2</td>
<td>6</td>
<td>56</td>
<td>26.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.431</td>
<td>2011</td>
<td>1</td>
<td>2</td>
<td>6</td>
<td>56</td>
<td>26.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-66.964</td>
<td>2011</td>
<td>1</td>
<td>2</td>
<td>6</td>
<td>56</td>
<td>26.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-70.924</td>
<td>2011</td>
<td>1</td>
<td>2</td>
<td>6</td>
<td>56</td>
<td>26.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-70.234</td>
<td>2011</td>
<td>1</td>
<td>2</td>
<td>6</td>
<td>56</td>
<td>26.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-71.198</td>
<td>2011</td>
<td>1</td>
<td>2</td>
<td>6</td>
<td>56</td>
<td>26.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-73.609</td>
<td>2011</td>
<td>1</td>
<td>2</td>
<td>6</td>
<td>56</td>
<td>26.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-71.767</td>
<td>2011</td>
<td>1</td>
<td>2</td>
<td>6</td>
<td>56</td>
<td>26.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-71.565</td>
<td>2011</td>
<td>1</td>
<td>2</td>
<td>6</td>
<td>56</td>
<td>26.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.446</td>
<td>2011</td>
<td>1</td>
<td>2</td>
<td>6</td>
<td>56</td>
<td>26.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-70.063</td>
<td>2011</td>
<td>1</td>
<td>2</td>
<td>6</td>
<td>56</td>
<td>26.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.612</td>
<td>2011</td>
<td>1</td>
<td>2</td>
<td>6</td>
<td>56</td>
<td>26.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-70.298</td>
<td>2011</td>
<td>1</td>
<td>2</td>
<td>6</td>
<td>56</td>
<td>26.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-71.842</td>
<td>2011</td>
<td>1</td>
<td>2</td>
<td>6</td>
<td>56</td>
<td>26.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.659</td>
<td>2011</td>
<td>1</td>
<td>2</td>
<td>6</td>
<td>56</td>
<td>26.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2011</td>
<td>3</td>
<td>5</td>
<td>0</td>
<td>18</td>
<td>45.9</td>
<td></td>
</tr>
<tr>
<td>-----</td>
<td>--------</td>
<td>-------</td>
<td>------</td>
<td>------</td>
<td>--------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>--------</td>
<td></td>
</tr>
<tr>
<td>69.453</td>
<td>-17.616</td>
<td>155.3</td>
<td>0.25</td>
<td>0.28</td>
<td>0.22</td>
<td>2011</td>
<td>3</td>
<td>5</td>
<td>0</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>69.652</td>
<td>-15.865</td>
<td>234.0</td>
<td>0.17</td>
<td>0.20</td>
<td>0.36</td>
<td>2011</td>
<td>3</td>
<td>5</td>
<td>18</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>69.697</td>
<td>-18.167</td>
<td>108.8</td>
<td>0.33</td>
<td>0.35</td>
<td>0.40</td>
<td>2011</td>
<td>3</td>
<td>6</td>
<td>12</td>
<td>31</td>
<td></td>
</tr>
<tr>
<td>70.537</td>
<td>-15.407</td>
<td>202.6</td>
<td>0.24</td>
<td>0.28</td>
<td>0.39</td>
<td>2011</td>
<td>3</td>
<td>11</td>
<td>2</td>
<td>34</td>
<td></td>
</tr>
<tr>
<td>70.315</td>
<td>-15.451</td>
<td>210.0</td>
<td>0.21</td>
<td>0.18</td>
<td>0.25</td>
<td>2011</td>
<td>3</td>
<td>25</td>
<td>1</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>69.425</td>
<td>-17.954</td>
<td>126.8</td>
<td>0.23</td>
<td>0.24</td>
<td>0.26</td>
<td>2011</td>
<td>3</td>
<td>26</td>
<td>16</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>69.715</td>
<td>-17.750</td>
<td>135.0</td>
<td>0.29</td>
<td>0.29</td>
<td>0.32</td>
<td>2011</td>
<td>3</td>
<td>31</td>
<td>1</td>
<td>42</td>
<td></td>
</tr>
<tr>
<td>71.554</td>
<td>-16.128</td>
<td>120.0</td>
<td>0.38</td>
<td>0.41</td>
<td>0.46</td>
<td>2011</td>
<td>4</td>
<td>2</td>
<td>4</td>
<td>41</td>
<td></td>
</tr>
<tr>
<td>71.209</td>
<td>-17.631</td>
<td>55.6</td>
<td>0.62</td>
<td>0.64</td>
<td>0.62</td>
<td>2011</td>
<td>4</td>
<td>2</td>
<td>8</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>69.641</td>
<td>-17.476</td>
<td>137.1</td>
<td>0.21</td>
<td>0.23</td>
<td>0.31</td>
<td>2011</td>
<td>4</td>
<td>3</td>
<td>16</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>70.516</td>
<td>-17.820</td>
<td>59.9</td>
<td>0.53</td>
<td>0.68</td>
<td>0.48</td>
<td>2011</td>
<td>4</td>
<td>4</td>
<td>2</td>
<td>57</td>
<td></td>
</tr>
<tr>
<td>69.623</td>
<td>-17.215</td>
<td>161.3</td>
<td>0.23</td>
<td>0.27</td>
<td>0.21</td>
<td>2011</td>
<td>4</td>
<td>6</td>
<td>11</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>69.555</td>
<td>-17.201</td>
<td>157.1</td>
<td>0.22</td>
<td>0.24</td>
<td>0.22</td>
<td>2011</td>
<td>4</td>
<td>9</td>
<td>6</td>
<td>47</td>
<td></td>
</tr>
<tr>
<td>69.478</td>
<td>-17.447</td>
<td>160.5</td>
<td>0.19</td>
<td>0.20</td>
<td>0.13</td>
<td>2011</td>
<td>4</td>
<td>9</td>
<td>10</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>71.887</td>
<td>-17.057</td>
<td>64.8</td>
<td>0.93</td>
<td>1.15</td>
<td>1.20</td>
<td>2011</td>
<td>4</td>
<td>12</td>
<td>13</td>
<td>31</td>
<td></td>
</tr>
<tr>
<td>69.381</td>
<td>-17.653</td>
<td>157.2</td>
<td>0.26</td>
<td>0.24</td>
<td>0.19</td>
<td>2011</td>
<td>4</td>
<td>13</td>
<td>0</td>
<td>37</td>
<td></td>
</tr>
<tr>
<td>71.616</td>
<td>-15.909</td>
<td>122.3</td>
<td>0.37</td>
<td>0.49</td>
<td>0.51</td>
<td>2011</td>
<td>4</td>
<td>13</td>
<td>7</td>
<td>35</td>
<td></td>
</tr>
<tr>
<td>69.746</td>
<td>-17.405</td>
<td>148.3</td>
<td>0.21</td>
<td>0.24</td>
<td>0.28</td>
<td>2011</td>
<td>4</td>
<td>16</td>
<td>2</td>
<td>27</td>
<td></td>
</tr>
<tr>
<td>71.577</td>
<td>-16.119</td>
<td>118.0</td>
<td>0.33</td>
<td>0.45</td>
<td>0.46</td>
<td>2011</td>
<td>4</td>
<td>24</td>
<td>7</td>
<td>55</td>
<td></td>
</tr>
<tr>
<td>69.611</td>
<td>-16.965</td>
<td>175.0</td>
<td>0.24</td>
<td>0.24</td>
<td>0.40</td>
<td>2011</td>
<td>5</td>
<td>1</td>
<td>15</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>69.786</td>
<td>-16.471</td>
<td>190.1</td>
<td>0.34</td>
<td>0.38</td>
<td>0.35</td>
<td>2011</td>
<td>5</td>
<td>3</td>
<td>14</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>69.609</td>
<td>-17.575</td>
<td>150.1</td>
<td>0.20</td>
<td>0.25</td>
<td>0.29</td>
<td>2011</td>
<td>5</td>
<td>3</td>
<td>22</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>69.412</td>
<td>-17.340</td>
<td>155.6</td>
<td>0.19</td>
<td>0.26</td>
<td>0.27</td>
<td>2011</td>
<td>5</td>
<td>6</td>
<td>2</td>
<td>55</td>
<td></td>
</tr>
<tr>
<td>69.603</td>
<td>-17.565</td>
<td>150.2</td>
<td>0.32</td>
<td>0.46</td>
<td>0.48</td>
<td>2011</td>
<td>5</td>
<td>6</td>
<td>6</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>70.285</td>
<td>-15.631</td>
<td>207.6</td>
<td>0.21</td>
<td>0.16</td>
<td>0.25</td>
<td>2011</td>
<td>5</td>
<td>7</td>
<td>19</td>
<td>33</td>
<td></td>
</tr>
<tr>
<td>69.828</td>
<td>-17.396</td>
<td>126.8</td>
<td>0.22</td>
<td>0.31</td>
<td>0.24</td>
<td>2011</td>
<td>5</td>
<td>8</td>
<td>9</td>
<td>34</td>
<td></td>
</tr>
<tr>
<td>69.524</td>
<td>-17.678</td>
<td>145.8</td>
<td>0.19</td>
<td>0.18</td>
<td>0.18</td>
<td>2011</td>
<td>5</td>
<td>10</td>
<td>4</td>
<td>43</td>
<td></td>
</tr>
<tr>
<td>69.587</td>
<td>-16.870</td>
<td>167.7</td>
<td>0.23</td>
<td>0.40</td>
<td>0.44</td>
<td>2011</td>
<td>5</td>
<td>12</td>
<td>13</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>69.171</td>
<td>-17.919</td>
<td>141.2</td>
<td>0.32</td>
<td>0.34</td>
<td>0.33</td>
<td>2011</td>
<td>5</td>
<td>13</td>
<td>3</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>71.209</td>
<td>-16.779</td>
<td>61.8</td>
<td>0.23</td>
<td>0.55</td>
<td>0.24</td>
<td>2011</td>
<td>5</td>
<td>17</td>
<td>2</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>69.230</td>
<td>-16.082</td>
<td>238.8</td>
<td>0.18</td>
<td>0.24</td>
<td>0.20</td>
<td>2011</td>
<td>5</td>
<td>17</td>
<td>22</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>72.024</td>
<td>-15.743</td>
<td>127.2</td>
<td>0.39</td>
<td>0.45</td>
<td>0.56</td>
<td>2011</td>
<td>5</td>
<td>19</td>
<td>21</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>69.663</td>
<td>-16.760</td>
<td>166.9</td>
<td>0.24</td>
<td>0.25</td>
<td>0.26</td>
<td>2011</td>
<td>5</td>
<td>21</td>
<td>18</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>69.940</td>
<td>-17.332</td>
<td>128.4</td>
<td>0.26</td>
<td>0.39</td>
<td>0.41</td>
<td>2011</td>
<td>5</td>
<td>22</td>
<td>2</td>
<td>56</td>
<td></td>
</tr>
<tr>
<td>69.467</td>
<td>-16.649</td>
<td>182.7</td>
<td>0.35</td>
<td>0.38</td>
<td>0.29</td>
<td>2011</td>
<td>5</td>
<td>22</td>
<td>16</td>
<td>24</td>
<td></td>
</tr>
<tr>
<td>71.654</td>
<td>-16.158</td>
<td>124.8</td>
<td>0.33</td>
<td>0.46</td>
<td>0.49</td>
<td>2011</td>
<td>5</td>
<td>22</td>
<td>18</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>69.757</td>
<td>-16.628</td>
<td>176.2</td>
<td>0.26</td>
<td>0.28</td>
<td>0.35</td>
<td>2011</td>
<td>5</td>
<td>22</td>
<td>23</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>69.480</td>
<td>-17.619</td>
<td>134.9</td>
<td>0.17</td>
<td>0.14</td>
<td>0.19</td>
<td>2011</td>
<td>5</td>
<td>26</td>
<td>4</td>
<td>44</td>
<td></td>
</tr>
<tr>
<td>70.194</td>
<td>-15.569</td>
<td>212.3</td>
<td>0.23</td>
<td>0.14</td>
<td>0.19</td>
<td>2011</td>
<td>5</td>
<td>26</td>
<td>9</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2011</td>
<td>3</td>
<td>5</td>
<td>0</td>
<td>18</td>
<td>45.9</td>
<td></td>
</tr>
<tr>
<td>Value</td>
<td>Value</td>
<td>Value</td>
<td>Value</td>
<td>Value</td>
<td>Year</td>
<td>Value</td>
<td>Value</td>
<td>Value</td>
<td>Value</td>
<td>Value</td>
<td>Value</td>
</tr>
<tr>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
</tr>
<tr>
<td>-72.149</td>
<td>-15.627</td>
<td>125.2</td>
<td>0.41</td>
<td>0.42</td>
<td>0.62</td>
<td>2011</td>
<td>5</td>
<td>30</td>
<td>7</td>
<td>35</td>
<td>49.4</td>
</tr>
<tr>
<td>-72.144</td>
<td>-15.631</td>
<td>123.4</td>
<td>0.45</td>
<td>0.37</td>
<td>0.51</td>
<td>2011</td>
<td>5</td>
<td>30</td>
<td>7</td>
<td>35</td>
<td>50.5</td>
</tr>
<tr>
<td>-69.672</td>
<td>-16.573</td>
<td>191.6</td>
<td>0.22</td>
<td>0.33</td>
<td>0.20</td>
<td>2011</td>
<td>5</td>
<td>30</td>
<td>18</td>
<td>16</td>
<td>27.8</td>
</tr>
<tr>
<td>-69.671</td>
<td>-16.575</td>
<td>190.9</td>
<td>0.21</td>
<td>0.39</td>
<td>0.25</td>
<td>2011</td>
<td>5</td>
<td>30</td>
<td>18</td>
<td>16</td>
<td>28.3</td>
</tr>
<tr>
<td>-69.602</td>
<td>-17.540</td>
<td>151.8</td>
<td>0.21</td>
<td>0.18</td>
<td>0.20</td>
<td>2011</td>
<td>5</td>
<td>31</td>
<td>9</td>
<td>5</td>
<td>40</td>
</tr>
<tr>
<td>-71.017</td>
<td>-16.855</td>
<td>101.2</td>
<td>0.37</td>
<td>0.39</td>
<td>0.49</td>
<td>2011</td>
<td>6</td>
<td>1</td>
<td>0</td>
<td>34</td>
<td>23.1</td>
</tr>
<tr>
<td>-69.646</td>
<td>-17.719</td>
<td>135.8</td>
<td>0.19</td>
<td>0.16</td>
<td>0.18</td>
<td>2011</td>
<td>6</td>
<td>2</td>
<td>7</td>
<td>9</td>
<td>47.1</td>
</tr>
<tr>
<td>-69.275</td>
<td>-17.745</td>
<td>142.8</td>
<td>0.26</td>
<td>0.31</td>
<td>0.25</td>
<td>2011</td>
<td>6</td>
<td>3</td>
<td>9</td>
<td>5</td>
<td>58</td>
</tr>
<tr>
<td>-69.393</td>
<td>-17.382</td>
<td>154.6</td>
<td>0.23</td>
<td>0.33</td>
<td>0.39</td>
<td>2011</td>
<td>6</td>
<td>5</td>
<td>13</td>
<td>57</td>
<td>57.9</td>
</tr>
<tr>
<td>-69.491</td>
<td>-17.608</td>
<td>152.3</td>
<td>0.19</td>
<td>0.21</td>
<td>0.18</td>
<td>2011</td>
<td>6</td>
<td>5</td>
<td>17</td>
<td>31</td>
<td>52.1</td>
</tr>
<tr>
<td>-70.504</td>
<td>-15.558</td>
<td>200.3</td>
<td>0.29</td>
<td>0.31</td>
<td>0.38</td>
<td>2011</td>
<td>6</td>
<td>6</td>
<td>8</td>
<td>28</td>
<td>54.4</td>
</tr>
<tr>
<td>-69.710</td>
<td>-17.932</td>
<td>113.4</td>
<td>0.33</td>
<td>0.59</td>
<td>0.45</td>
<td>2011</td>
<td>6</td>
<td>7</td>
<td>13</td>
<td>18</td>
<td>7</td>
</tr>
<tr>
<td>-73.610</td>
<td>-14.568</td>
<td>87.1</td>
<td>0.26</td>
<td>0.23</td>
<td>0.33</td>
<td>2011</td>
<td>6</td>
<td>7</td>
<td>22</td>
<td>4</td>
<td>53.8</td>
</tr>
<tr>
<td>-69.861</td>
<td>-17.230</td>
<td>131.3</td>
<td>0.24</td>
<td>0.29</td>
<td>0.37</td>
<td>2011</td>
<td>6</td>
<td>8</td>
<td>3</td>
<td>6</td>
<td>20</td>
</tr>
<tr>
<td>-69.855</td>
<td>-16.367</td>
<td>186.1</td>
<td>0.38</td>
<td>0.26</td>
<td>0.22</td>
<td>2011</td>
<td>6</td>
<td>8</td>
<td>10</td>
<td>53</td>
<td>2.9</td>
</tr>
<tr>
<td>-69.372</td>
<td>-16.883</td>
<td>184.4</td>
<td>0.23</td>
<td>0.24</td>
<td>0.20</td>
<td>2011</td>
<td>6</td>
<td>8</td>
<td>18</td>
<td>38</td>
<td>46.4</td>
</tr>
<tr>
<td>-69.488</td>
<td>-16.686</td>
<td>183.8</td>
<td>0.31</td>
<td>0.36</td>
<td>0.29</td>
<td>2011</td>
<td>6</td>
<td>9</td>
<td>2</td>
<td>40</td>
<td>34</td>
</tr>
<tr>
<td>-72.159</td>
<td>-15.081</td>
<td>114.9</td>
<td>0.29</td>
<td>0.28</td>
<td>0.30</td>
<td>2011</td>
<td>6</td>
<td>15</td>
<td>14</td>
<td>16</td>
<td>49.8</td>
</tr>
<tr>
<td>-72.163</td>
<td>-15.082</td>
<td>116.5</td>
<td>0.28</td>
<td>0.26</td>
<td>0.31</td>
<td>2011</td>
<td>6</td>
<td>15</td>
<td>14</td>
<td>16</td>
<td>50.2</td>
</tr>
<tr>
<td>-71.633</td>
<td>-15.349</td>
<td>149.5</td>
<td>0.42</td>
<td>0.45</td>
<td>0.42</td>
<td>2011</td>
<td>6</td>
<td>17</td>
<td>7</td>
<td>59</td>
<td>58.2</td>
</tr>
<tr>
<td>-69.330</td>
<td>-18.102</td>
<td>128.0</td>
<td>0.27</td>
<td>0.28</td>
<td>0.30</td>
<td>2011</td>
<td>6</td>
<td>17</td>
<td>20</td>
<td>43</td>
<td>5.4</td>
</tr>
<tr>
<td>-69.992</td>
<td>-17.794</td>
<td>100.9</td>
<td>0.26</td>
<td>0.26</td>
<td>0.26</td>
<td>2011</td>
<td>6</td>
<td>18</td>
<td>5</td>
<td>38</td>
<td>22.2</td>
</tr>
<tr>
<td>-75.246</td>
<td>-12.462</td>
<td>91.2</td>
<td>2.06</td>
<td>2.81</td>
<td>2.01</td>
<td>2011</td>
<td>6</td>
<td>18</td>
<td>6</td>
<td>31</td>
<td>9.7</td>
</tr>
<tr>
<td>-70.274</td>
<td>-17.758</td>
<td>76.0</td>
<td>0.70</td>
<td>1.34</td>
<td>0.87</td>
<td>2011</td>
<td>6</td>
<td>18</td>
<td>10</td>
<td>28</td>
<td>35.9</td>
</tr>
<tr>
<td>-72.599</td>
<td>-14.998</td>
<td>110.2</td>
<td>0.54</td>
<td>0.40</td>
<td>0.40</td>
<td>2011</td>
<td>6</td>
<td>20</td>
<td>1</td>
<td>5</td>
<td>11.4</td>
</tr>
<tr>
<td>-72.852</td>
<td>-14.060</td>
<td>80.7</td>
<td>0.21</td>
<td>0.25</td>
<td>0.33</td>
<td>2011</td>
<td>6</td>
<td>21</td>
<td>1</td>
<td>55</td>
<td>15.1</td>
</tr>
<tr>
<td>-71.789</td>
<td>-15.534</td>
<td>148.3</td>
<td>0.39</td>
<td>0.38</td>
<td>0.38</td>
<td>2011</td>
<td>6</td>
<td>23</td>
<td>12</td>
<td>32</td>
<td>60</td>
</tr>
<tr>
<td>-71.787</td>
<td>-15.535</td>
<td>148.0</td>
<td>0.35</td>
<td>0.39</td>
<td>0.38</td>
<td>2011</td>
<td>6</td>
<td>23</td>
<td>12</td>
<td>32</td>
<td>58.5</td>
</tr>
<tr>
<td>-69.520</td>
<td>-17.365</td>
<td>163.3</td>
<td>0.18</td>
<td>0.26</td>
<td>0.31</td>
<td>2011</td>
<td>6</td>
<td>23</td>
<td>20</td>
<td>7</td>
<td>23.5</td>
</tr>
<tr>
<td>-69.520</td>
<td>-17.364</td>
<td>162.8</td>
<td>0.19</td>
<td>0.21</td>
<td>0.20</td>
<td>2011</td>
<td>6</td>
<td>23</td>
<td>20</td>
<td>7</td>
<td>23.8</td>
</tr>
<tr>
<td>-69.698</td>
<td>-17.505</td>
<td>126.9</td>
<td>0.27</td>
<td>0.29</td>
<td>0.32</td>
<td>2011</td>
<td>6</td>
<td>25</td>
<td>5</td>
<td>19</td>
<td>49.6</td>
</tr>
<tr>
<td>-69.829</td>
<td>-17.242</td>
<td>129.8</td>
<td>0.22</td>
<td>0.25</td>
<td>0.25</td>
<td>2011</td>
<td>6</td>
<td>25</td>
<td>16</td>
<td>9</td>
<td>53.7</td>
</tr>
<tr>
<td>-73.146</td>
<td>-14.182</td>
<td>74.5</td>
<td>0.26</td>
<td>0.39</td>
<td>0.48</td>
<td>2011</td>
<td>6</td>
<td>26</td>
<td>17</td>
<td>11</td>
<td>5.5</td>
</tr>
<tr>
<td>-74.652</td>
<td>-13.507</td>
<td>92.5</td>
<td>1.58</td>
<td>2.56</td>
<td>2.26</td>
<td>2011</td>
<td>6</td>
<td>28</td>
<td>6</td>
<td>53</td>
<td>26.5</td>
</tr>
<tr>
<td>-69.747</td>
<td>-16.237</td>
<td>207.5</td>
<td>0.51</td>
<td>0.38</td>
<td>0.47</td>
<td>2011</td>
<td>6</td>
<td>28</td>
<td>9</td>
<td>35</td>
<td>6.5</td>
</tr>
<tr>
<td>-72.789</td>
<td>-14.175</td>
<td>84.7</td>
<td>0.21</td>
<td>0.22</td>
<td>0.31</td>
<td>2011</td>
<td>6</td>
<td>29</td>
<td>2</td>
<td>18</td>
<td>23.9</td>
</tr>
<tr>
<td>-71.870</td>
<td>-16.663</td>
<td>45.7</td>
<td>0.74</td>
<td>0.74</td>
<td>0.61</td>
<td>2011</td>
<td>6</td>
<td>29</td>
<td>6</td>
<td>20</td>
<td>22.8</td>
</tr>
<tr>
<td>-73.679</td>
<td>-14.101</td>
<td>76.0</td>
<td>0.25</td>
<td>0.42</td>
<td>0.38</td>
<td>2011</td>
<td>6</td>
<td>29</td>
<td>15</td>
<td>2</td>
<td>23.4</td>
</tr>
<tr>
<td>-76.002</td>
<td>-13.281</td>
<td>56.9</td>
<td>3.41</td>
<td>5.04</td>
<td>3.38</td>
<td>2011</td>
<td>6</td>
<td>30</td>
<td>13</td>
<td>59</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-74.559</td>
<td>-10.720</td>
<td>102.1</td>
<td>1.93</td>
<td>1.65</td>
<td>2.47</td>
<td>2011</td>
<td>7</td>
<td>1</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-71.966</td>
<td>-15.192</td>
<td>122.2</td>
<td>0.33</td>
<td>0.31</td>
<td>0.29</td>
<td>2011</td>
<td>7</td>
<td>4</td>
<td>9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-74.878</td>
<td>-13.718</td>
<td>93.0</td>
<td>1.51</td>
<td>1.45</td>
<td>0.88</td>
<td>2011</td>
<td>7</td>
<td>4</td>
<td>15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-72.714</td>
<td>-14.981</td>
<td>104.0</td>
<td>0.42</td>
<td>0.43</td>
<td>0.40</td>
<td>2011</td>
<td>7</td>
<td>6</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-71.893</td>
<td>-16.031</td>
<td>108.8</td>
<td>0.24</td>
<td>0.38</td>
<td>0.51</td>
<td>2011</td>
<td>7</td>
<td>8</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-76.586</td>
<td>-11.539</td>
<td>100.2</td>
<td>3.96</td>
<td>3.62</td>
<td>4.84</td>
<td>2011</td>
<td>7</td>
<td>8</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-71.831</td>
<td>-15.112</td>
<td>136.8</td>
<td>0.27</td>
<td>0.28</td>
<td>0.32</td>
<td>2011</td>
<td>7</td>
<td>9</td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-72.836</td>
<td>-15.671</td>
<td>116.0</td>
<td>0.55</td>
<td>0.48</td>
<td>0.97</td>
<td>2011</td>
<td>7</td>
<td>10</td>
<td>11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-72.000</td>
<td>-14.965</td>
<td>119.7</td>
<td>0.35</td>
<td>0.32</td>
<td>0.37</td>
<td>2011</td>
<td>7</td>
<td>13</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-71.922</td>
<td>-15.623</td>
<td>145.2</td>
<td>0.46</td>
<td>0.37</td>
<td>0.36</td>
<td>2011</td>
<td>7</td>
<td>13</td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-67.084</td>
<td>-17.793</td>
<td>284.2</td>
<td>1.86</td>
<td>1.61</td>
<td>1.61</td>
<td>2011</td>
<td>7</td>
<td>14</td>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.433</td>
<td>-15.951</td>
<td>235.4</td>
<td>0.25</td>
<td>0.31</td>
<td>0.17</td>
<td>2011</td>
<td>7</td>
<td>14</td>
<td>18</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.432</td>
<td>-15.951</td>
<td>235.3</td>
<td>0.19</td>
<td>0.22</td>
<td>0.25</td>
<td>2011</td>
<td>7</td>
<td>14</td>
<td>18</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.435</td>
<td>-15.955</td>
<td>234.0</td>
<td>0.29</td>
<td>0.36</td>
<td>0.16</td>
<td>2011</td>
<td>7</td>
<td>14</td>
<td>22</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-74.843</td>
<td>-10.943</td>
<td>102.1</td>
<td>2.50</td>
<td>2.15</td>
<td>2.66</td>
<td>2011</td>
<td>7</td>
<td>21</td>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-73.480</td>
<td>-14.424</td>
<td>81.9</td>
<td>0.36</td>
<td>0.26</td>
<td>0.36</td>
<td>2011</td>
<td>7</td>
<td>22</td>
<td>22</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-73.439</td>
<td>-14.906</td>
<td>99.9</td>
<td>0.77</td>
<td>0.59</td>
<td>0.73</td>
<td>2011</td>
<td>7</td>
<td>23</td>
<td>11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-73.656</td>
<td>-14.406</td>
<td>87.4</td>
<td>0.24</td>
<td>0.19</td>
<td>0.29</td>
<td>2011</td>
<td>7</td>
<td>24</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-74.431</td>
<td>-14.842</td>
<td>99.9</td>
<td>0.46</td>
<td>0.49</td>
<td>0.67</td>
<td>2011</td>
<td>7</td>
<td>24</td>
<td>15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-74.464</td>
<td>-14.863</td>
<td>96.8</td>
<td>0.46</td>
<td>0.49</td>
<td>0.69</td>
<td>2011</td>
<td>7</td>
<td>24</td>
<td>15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-74.076</td>
<td>-14.523</td>
<td>87.9</td>
<td>0.81</td>
<td>0.96</td>
<td>1.48</td>
<td>2011</td>
<td>7</td>
<td>27</td>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-72.992</td>
<td>-14.403</td>
<td>80.2</td>
<td>0.30</td>
<td>0.30</td>
<td>0.36</td>
<td>2011</td>
<td>7</td>
<td>27</td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-76.099</td>
<td>-12.174</td>
<td>100.5</td>
<td>1.50</td>
<td>1.07</td>
<td>1.06</td>
<td>2011</td>
<td>7</td>
<td>28</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.556</td>
<td>-16.848</td>
<td>173.8</td>
<td>0.20</td>
<td>0.21</td>
<td>0.19</td>
<td>2011</td>
<td>7</td>
<td>28</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-72.338</td>
<td>-14.397</td>
<td>81.4</td>
<td>0.35</td>
<td>0.44</td>
<td>0.71</td>
<td>2011</td>
<td>7</td>
<td>30</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-72.627</td>
<td>-15.790</td>
<td>129.7</td>
<td>0.56</td>
<td>0.32</td>
<td>0.88</td>
<td>2011</td>
<td>7</td>
<td>30</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.863</td>
<td>-17.388</td>
<td>145.3</td>
<td>0.25</td>
<td>0.30</td>
<td>0.23</td>
<td>2011</td>
<td>8</td>
<td>2</td>
<td>18</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-71.948</td>
<td>-15.526</td>
<td>130.1</td>
<td>0.44</td>
<td>0.29</td>
<td>0.37</td>
<td>2011</td>
<td>8</td>
<td>5</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-75.100</td>
<td>-14.198</td>
<td>80.1</td>
<td>1.44</td>
<td>2.06</td>
<td>2.91</td>
<td>2011</td>
<td>8</td>
<td>6</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-72.689</td>
<td>-14.058</td>
<td>86.0</td>
<td>0.28</td>
<td>0.29</td>
<td>0.42</td>
<td>2011</td>
<td>8</td>
<td>7</td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-72.495</td>
<td>-15.421</td>
<td>127.9</td>
<td>0.39</td>
<td>0.46</td>
<td>0.58</td>
<td>2011</td>
<td>8</td>
<td>9</td>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.604</td>
<td>-16.670</td>
<td>186.2</td>
<td>0.30</td>
<td>0.27</td>
<td>0.20</td>
<td>2011</td>
<td>8</td>
<td>11</td>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.522</td>
<td>-17.470</td>
<td>158.3</td>
<td>0.18</td>
<td>0.15</td>
<td>0.16</td>
<td>2011</td>
<td>8</td>
<td>12</td>
<td>14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-75.146</td>
<td>-13.060</td>
<td>94.1</td>
<td>1.05</td>
<td>1.74</td>
<td>1.14</td>
<td>2011</td>
<td>8</td>
<td>12</td>
<td>23</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-70.857</td>
<td>-15.384</td>
<td>176.3</td>
<td>0.23</td>
<td>0.32</td>
<td>0.27</td>
<td>2011</td>
<td>8</td>
<td>14</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-75.976</td>
<td>-13.550</td>
<td>63.9</td>
<td>3.52</td>
<td>3.34</td>
<td>2.93</td>
<td>2011</td>
<td>8</td>
<td>18</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-70.249</td>
<td>-15.465</td>
<td>220.4</td>
<td>0.26</td>
<td>0.31</td>
<td>0.30</td>
<td>2011</td>
<td>8</td>
<td>19</td>
<td>9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-70.734</td>
<td>-17.477</td>
<td>92.4</td>
<td>0.45</td>
<td>0.45</td>
<td>0.59</td>
<td>2011</td>
<td>8</td>
<td>22</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-73.504</td>
<td>-14.963</td>
<td>106.8</td>
<td>0.74</td>
<td>0.61</td>
<td>0.77</td>
<td>2011</td>
<td>8</td>
<td>24</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>----</td>
<td>--------</td>
<td>--------</td>
<td>----</td>
<td>--------</td>
<td>----</td>
<td>----</td>
<td>----</td>
<td>----</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-71.981</td>
<td>-15.801</td>
<td>140.8</td>
<td>0.47</td>
<td>0.39</td>
<td>0.62</td>
<td>2011</td>
<td>8</td>
<td>24</td>
<td>2</td>
<td>18</td>
<td>39.4</td>
</tr>
<tr>
<td>-69.491</td>
<td>-17.513</td>
<td>137.0</td>
<td>0.35</td>
<td>0.25</td>
<td>0.33</td>
<td>2011</td>
<td>8</td>
<td>25</td>
<td>5</td>
<td>4</td>
<td>6.6</td>
</tr>
<tr>
<td>-69.311</td>
<td>-16.588</td>
<td>198.2</td>
<td>0.39</td>
<td>0.35</td>
<td>0.30</td>
<td>2011</td>
<td>8</td>
<td>28</td>
<td>1</td>
<td>21</td>
<td>3.9</td>
</tr>
<tr>
<td>-73.061</td>
<td>-14.105</td>
<td>84.7</td>
<td>0.20</td>
<td>0.28</td>
<td>0.29</td>
<td>2011</td>
<td>8</td>
<td>28</td>
<td>8</td>
<td>20</td>
<td>29.6</td>
</tr>
<tr>
<td>-73.417</td>
<td>-14.152</td>
<td>74.7</td>
<td>0.44</td>
<td>0.47</td>
<td>0.51</td>
<td>2011</td>
<td>8</td>
<td>29</td>
<td>10</td>
<td>35</td>
<td>29.9</td>
</tr>
<tr>
<td>-70.784</td>
<td>-15.288</td>
<td>183.1</td>
<td>0.26</td>
<td>0.35</td>
<td>0.32</td>
<td>2011</td>
<td>8</td>
<td>30</td>
<td>13</td>
<td>37</td>
<td>11.8</td>
</tr>
<tr>
<td>-69.537</td>
<td>-17.752</td>
<td>132.7</td>
<td>0.21</td>
<td>0.22</td>
<td>0.25</td>
<td>2011</td>
<td>8</td>
<td>31</td>
<td>0</td>
<td>53</td>
<td>18.2</td>
</tr>
<tr>
<td>-69.538</td>
<td>-17.751</td>
<td>132.7</td>
<td>0.21</td>
<td>0.21</td>
<td>0.22</td>
<td>2011</td>
<td>8</td>
<td>31</td>
<td>0</td>
<td>53</td>
<td>18.3</td>
</tr>
<tr>
<td>-75.378</td>
<td>-12.523</td>
<td>74.9</td>
<td>1.27</td>
<td>1.99</td>
<td>3.12</td>
<td>2011</td>
<td>9</td>
<td>2</td>
<td>8</td>
<td>27</td>
<td>48.3</td>
</tr>
<tr>
<td>-74.162</td>
<td>-14.952</td>
<td>106.0</td>
<td>0.67</td>
<td>0.69</td>
<td>0.84</td>
<td>2011</td>
<td>9</td>
<td>3</td>
<td>18</td>
<td>39</td>
<td>44.8</td>
</tr>
<tr>
<td>-74.891</td>
<td>-13.717</td>
<td>94.2</td>
<td>1.54</td>
<td>2.03</td>
<td>1.60</td>
<td>2011</td>
<td>9</td>
<td>4</td>
<td>6</td>
<td>35</td>
<td>53.7</td>
</tr>
<tr>
<td>-75.545</td>
<td>-12.300</td>
<td>103.3</td>
<td>1.65</td>
<td>1.89</td>
<td>1.40</td>
<td>2011</td>
<td>9</td>
<td>4</td>
<td>17</td>
<td>56</td>
<td>39</td>
</tr>
<tr>
<td>-71.479</td>
<td>-15.882</td>
<td>143.3</td>
<td>0.51</td>
<td>0.58</td>
<td>0.56</td>
<td>2011</td>
<td>9</td>
<td>5</td>
<td>9</td>
<td>9</td>
<td>20.2</td>
</tr>
<tr>
<td>-71.804</td>
<td>-15.174</td>
<td>126.8</td>
<td>0.30</td>
<td>0.30</td>
<td>0.35</td>
<td>2011</td>
<td>9</td>
<td>7</td>
<td>1</td>
<td>7</td>
<td>44</td>
</tr>
<tr>
<td>-74.258</td>
<td>-10.823</td>
<td>105.9</td>
<td>1.85</td>
<td>1.77</td>
<td>2.13</td>
<td>2011</td>
<td>9</td>
<td>7</td>
<td>22</td>
<td>44</td>
<td>51.2</td>
</tr>
<tr>
<td>-72.758</td>
<td>-14.990</td>
<td>101.3</td>
<td>0.26</td>
<td>0.29</td>
<td>0.41</td>
<td>2011</td>
<td>9</td>
<td>8</td>
<td>5</td>
<td>26</td>
<td>13</td>
</tr>
<tr>
<td>-72.926</td>
<td>-14.874</td>
<td>105.3</td>
<td>0.17</td>
<td>0.29</td>
<td>0.27</td>
<td>2011</td>
<td>9</td>
<td>10</td>
<td>3</td>
<td>46</td>
<td>44.1</td>
</tr>
<tr>
<td>-71.761</td>
<td>-14.858</td>
<td>124.3</td>
<td>0.50</td>
<td>0.49</td>
<td>0.45</td>
<td>2011</td>
<td>9</td>
<td>13</td>
<td>0</td>
<td>14</td>
<td>23.8</td>
</tr>
<tr>
<td>-71.762</td>
<td>-14.862</td>
<td>125.2</td>
<td>0.54</td>
<td>0.49</td>
<td>0.52</td>
<td>2011</td>
<td>9</td>
<td>13</td>
<td>0</td>
<td>14</td>
<td>23.3</td>
</tr>
<tr>
<td>-72.659</td>
<td>-14.502</td>
<td>94.5</td>
<td>0.51</td>
<td>0.68</td>
<td>0.83</td>
<td>2011</td>
<td>9</td>
<td>13</td>
<td>3</td>
<td>37</td>
<td>58.8</td>
</tr>
<tr>
<td>-71.987</td>
<td>-17.422</td>
<td>57.2</td>
<td>1.16</td>
<td>2.24</td>
<td>1.57</td>
<td>2011</td>
<td>9</td>
<td>14</td>
<td>3</td>
<td>0</td>
<td>2.2</td>
</tr>
<tr>
<td>-69.659</td>
<td>-17.391</td>
<td>136.7</td>
<td>0.24</td>
<td>0.25</td>
<td>0.33</td>
<td>2011</td>
<td>9</td>
<td>14</td>
<td>14</td>
<td>52</td>
<td>44.2</td>
</tr>
<tr>
<td>-72.050</td>
<td>-15.391</td>
<td>132.4</td>
<td>0.36</td>
<td>0.41</td>
<td>0.43</td>
<td>2011</td>
<td>9</td>
<td>16</td>
<td>0</td>
<td>42</td>
<td>28.6</td>
</tr>
<tr>
<td>-74.441</td>
<td>-11.284</td>
<td>95.0</td>
<td>1.30</td>
<td>1.70</td>
<td>1.71</td>
<td>2011</td>
<td>9</td>
<td>18</td>
<td>2</td>
<td>9</td>
<td>52.6</td>
</tr>
<tr>
<td>-71.802</td>
<td>-15.139</td>
<td>129.8</td>
<td>0.28</td>
<td>0.27</td>
<td>0.30</td>
<td>2011</td>
<td>9</td>
<td>18</td>
<td>7</td>
<td>43</td>
<td>39.3</td>
</tr>
<tr>
<td>-72.933</td>
<td>-14.370</td>
<td>84.3</td>
<td>0.28</td>
<td>0.26</td>
<td>0.28</td>
<td>2011</td>
<td>9</td>
<td>21</td>
<td>1</td>
<td>39</td>
<td>47.2</td>
</tr>
<tr>
<td>-69.450</td>
<td>-16.480</td>
<td>194.3</td>
<td>0.35</td>
<td>0.34</td>
<td>0.38</td>
<td>2011</td>
<td>9</td>
<td>23</td>
<td>1</td>
<td>55</td>
<td>29</td>
</tr>
<tr>
<td>-70.489</td>
<td>-17.169</td>
<td>99.6</td>
<td>1.10</td>
<td>1.19</td>
<td>1.42</td>
<td>2011</td>
<td>9</td>
<td>23</td>
<td>5</td>
<td>21</td>
<td>38.7</td>
</tr>
<tr>
<td>-76.001</td>
<td>-11.992</td>
<td>108.7</td>
<td>0.83</td>
<td>0.94</td>
<td>0.80</td>
<td>2011</td>
<td>9</td>
<td>23</td>
<td>10</td>
<td>15</td>
<td>8.1</td>
</tr>
<tr>
<td>-75.098</td>
<td>-13.131</td>
<td>97.2</td>
<td>1.40</td>
<td>1.41</td>
<td>2.00</td>
<td>2011</td>
<td>9</td>
<td>24</td>
<td>3</td>
<td>19</td>
<td>9.7</td>
</tr>
<tr>
<td>-72.343</td>
<td>-16.750</td>
<td>89.1</td>
<td>0.42</td>
<td>0.64</td>
<td>0.62</td>
<td>2011</td>
<td>9</td>
<td>25</td>
<td>0</td>
<td>12</td>
<td>55.9</td>
</tr>
<tr>
<td>-73.357</td>
<td>-14.394</td>
<td>82.5</td>
<td>0.46</td>
<td>0.33</td>
<td>0.34</td>
<td>2011</td>
<td>9</td>
<td>30</td>
<td>9</td>
<td>14</td>
<td>6.6</td>
</tr>
<tr>
<td>-71.145</td>
<td>-17.192</td>
<td>82.3</td>
<td>0.16</td>
<td>0.26</td>
<td>0.32</td>
<td>2011</td>
<td>10</td>
<td>5</td>
<td>12</td>
<td>4</td>
<td>30.9</td>
</tr>
<tr>
<td>-71.147</td>
<td>-17.195</td>
<td>82.7</td>
<td>0.18</td>
<td>0.24</td>
<td>0.33</td>
<td>2011</td>
<td>10</td>
<td>5</td>
<td>12</td>
<td>4</td>
<td>30.2</td>
</tr>
<tr>
<td>-70.774</td>
<td>-15.517</td>
<td>181.1</td>
<td>0.23</td>
<td>0.44</td>
<td>0.28</td>
<td>2011</td>
<td>10</td>
<td>8</td>
<td>12</td>
<td>29</td>
<td>24.5</td>
</tr>
<tr>
<td>-75.020</td>
<td>-14.105</td>
<td>94.5</td>
<td>1.39</td>
<td>2.25</td>
<td>2.46</td>
<td>2011</td>
<td>10</td>
<td>12</td>
<td>6</td>
<td>12</td>
<td>20.2</td>
</tr>
<tr>
<td>-73.713</td>
<td>-14.873</td>
<td>88.5</td>
<td>0.33</td>
<td>0.37</td>
<td>0.50</td>
<td>2011</td>
<td>10</td>
<td>15</td>
<td>19</td>
<td>31</td>
<td>31.1</td>
</tr>
<tr>
<td>-72.829</td>
<td>-14.183</td>
<td>83.9</td>
<td>0.18</td>
<td>0.21</td>
<td>0.30</td>
<td>2011</td>
<td>10</td>
<td>16</td>
<td>7</td>
<td>25</td>
<td>26.7</td>
</tr>
<tr>
<td>-69.642</td>
<td>-15.887</td>
<td>226.4</td>
<td>0.15</td>
<td>0.17</td>
<td>0.24</td>
<td>2011</td>
<td>10</td>
<td>19</td>
<td>22</td>
<td>59</td>
<td>36.9</td>
</tr>
<tr>
<td>-75.667</td>
<td>-13.677</td>
<td>63.3</td>
<td>1.91</td>
<td>2.76</td>
<td>1.59</td>
<td>2011</td>
<td>10</td>
<td>20</td>
<td>14</td>
<td>56</td>
<td>42.2</td>
</tr>
<tr>
<td>-69.623</td>
<td>-18.029</td>
<td>122.4</td>
<td>0.29</td>
<td>0.30</td>
<td>0.31</td>
<td>2011</td>
<td>10</td>
<td>22</td>
<td>10</td>
<td>7</td>
<td>41.4</td>
</tr>
<tr>
<td>-75.068</td>
<td>-13.002</td>
<td>93.4</td>
<td>1.07</td>
<td>1.35</td>
<td>1.04</td>
<td>2011</td>
<td>10</td>
<td>23</td>
<td>12</td>
<td>22</td>
<td>54.2</td>
</tr>
<tr>
<td>-74.998</td>
<td>-13.446</td>
<td>100.7</td>
<td>2.02</td>
<td>1.88</td>
<td>2.66</td>
<td>2011</td>
<td>10</td>
<td>26</td>
<td>3</td>
<td>1</td>
<td>20</td>
</tr>
<tr>
<td>-71.595</td>
<td>-15.225</td>
<td>140.5</td>
<td>0.30</td>
<td>0.31</td>
<td>0.26</td>
<td>2011</td>
<td>11</td>
<td>1</td>
<td>3</td>
<td>27</td>
<td>14.2</td>
</tr>
<tr>
<td>-74.790</td>
<td>-13.735</td>
<td>103.3</td>
<td>1.58</td>
<td>1.88</td>
<td>1.69</td>
<td>2011</td>
<td>11</td>
<td>3</td>
<td>16</td>
<td>26</td>
<td>33.8</td>
</tr>
<tr>
<td>-69.700</td>
<td>-17.511</td>
<td>149.3</td>
<td>0.21</td>
<td>0.22</td>
<td>0.23</td>
<td>2011</td>
<td>11</td>
<td>4</td>
<td>2</td>
<td>46</td>
<td>56.6</td>
</tr>
<tr>
<td>-69.532</td>
<td>-16.977</td>
<td>171.8</td>
<td>0.25</td>
<td>0.23</td>
<td>0.24</td>
<td>2011</td>
<td>11</td>
<td>5</td>
<td>16</td>
<td>55</td>
<td>28.5</td>
</tr>
<tr>
<td>-71.877</td>
<td>-15.894</td>
<td>148.1</td>
<td>0.49</td>
<td>0.46</td>
<td>0.71</td>
<td>2011</td>
<td>11</td>
<td>6</td>
<td>15</td>
<td>21</td>
<td>21</td>
</tr>
<tr>
<td>-71.149</td>
<td>-16.582</td>
<td>110.3</td>
<td>0.15</td>
<td>0.18</td>
<td>0.33</td>
<td>2011</td>
<td>11</td>
<td>7</td>
<td>4</td>
<td>14</td>
<td>5.4</td>
</tr>
<tr>
<td>-71.149</td>
<td>-16.582</td>
<td>110.2</td>
<td>0.16</td>
<td>0.18</td>
<td>0.33</td>
<td>2011</td>
<td>11</td>
<td>7</td>
<td>4</td>
<td>14</td>
<td>5.4</td>
</tr>
<tr>
<td>-69.284</td>
<td>-17.516</td>
<td>155.2</td>
<td>0.25</td>
<td>0.27</td>
<td>0.27</td>
<td>2011</td>
<td>11</td>
<td>11</td>
<td>22</td>
<td>21</td>
<td>0.1</td>
</tr>
<tr>
<td>-72.424</td>
<td>-15.253</td>
<td>119.1</td>
<td>0.30</td>
<td>0.36</td>
<td>0.53</td>
<td>2011</td>
<td>11</td>
<td>14</td>
<td>2</td>
<td>38</td>
<td>22.3</td>
</tr>
<tr>
<td>-69.212</td>
<td>-16.497</td>
<td>215.0</td>
<td>0.53</td>
<td>0.51</td>
<td>0.40</td>
<td>2011</td>
<td>11</td>
<td>14</td>
<td>15</td>
<td>40</td>
<td>12.5</td>
</tr>
<tr>
<td>-69.596</td>
<td>-15.877</td>
<td>229.3</td>
<td>0.13</td>
<td>0.16</td>
<td>0.27</td>
<td>2011</td>
<td>11</td>
<td>15</td>
<td>7</td>
<td>24</td>
<td>14.6</td>
</tr>
<tr>
<td>-69.859</td>
<td>-17.901</td>
<td>129.0</td>
<td>0.30</td>
<td>0.35</td>
<td>0.30</td>
<td>2011</td>
<td>11</td>
<td>15</td>
<td>20</td>
<td>42</td>
<td>12.9</td>
</tr>
<tr>
<td>-69.484</td>
<td>-17.558</td>
<td>150.1</td>
<td>0.26</td>
<td>0.40</td>
<td>0.43</td>
<td>2011</td>
<td>11</td>
<td>16</td>
<td>1</td>
<td>57</td>
<td>45.5</td>
</tr>
<tr>
<td>-70.469</td>
<td>-18.114</td>
<td>56.2</td>
<td>0.26</td>
<td>0.32</td>
<td>0.23</td>
<td>2011</td>
<td>11</td>
<td>16</td>
<td>15</td>
<td>38</td>
<td>57.2</td>
</tr>
<tr>
<td>-75.113</td>
<td>-13.561</td>
<td>102.2</td>
<td>2.65</td>
<td>2.85</td>
<td>3.54</td>
<td>2011</td>
<td>11</td>
<td>16</td>
<td>19</td>
<td>8</td>
<td>58.7</td>
</tr>
<tr>
<td>-69.508</td>
<td>-16.871</td>
<td>171.0</td>
<td>0.21</td>
<td>0.22</td>
<td>0.27</td>
<td>2011</td>
<td>11</td>
<td>16</td>
<td>21</td>
<td>48</td>
<td>31.7</td>
</tr>
<tr>
<td>-69.405</td>
<td>-17.314</td>
<td>157.3</td>
<td>0.23</td>
<td>0.23</td>
<td>0.27</td>
<td>2011</td>
<td>11</td>
<td>18</td>
<td>1</td>
<td>25</td>
<td>40.4</td>
</tr>
<tr>
<td>-69.617</td>
<td>-16.882</td>
<td>171.6</td>
<td>0.24</td>
<td>0.20</td>
<td>0.29</td>
<td>2011</td>
<td>11</td>
<td>18</td>
<td>5</td>
<td>42</td>
<td>7</td>
</tr>
<tr>
<td>-71.228</td>
<td>-15.511</td>
<td>150.1</td>
<td>0.33</td>
<td>0.39</td>
<td>0.36</td>
<td>2011</td>
<td>11</td>
<td>20</td>
<td>5</td>
<td>27</td>
<td>14.4</td>
</tr>
<tr>
<td>-71.329</td>
<td>-16.033</td>
<td>132.2</td>
<td>0.38</td>
<td>0.45</td>
<td>0.49</td>
<td>2011</td>
<td>11</td>
<td>21</td>
<td>10</td>
<td>46</td>
<td>39.9</td>
</tr>
<tr>
<td>-69.715</td>
<td>-17.746</td>
<td>136.5</td>
<td>0.20</td>
<td>0.20</td>
<td>0.20</td>
<td>2011</td>
<td>11</td>
<td>22</td>
<td>22</td>
<td>3</td>
<td>51.9</td>
</tr>
<tr>
<td>-72.860</td>
<td>-14.135</td>
<td>85.3</td>
<td>0.16</td>
<td>0.18</td>
<td>0.26</td>
<td>2011</td>
<td>11</td>
<td>22</td>
<td>23</td>
<td>2</td>
<td>11.1</td>
</tr>
<tr>
<td>-72.860</td>
<td>-14.135</td>
<td>85.3</td>
<td>0.16</td>
<td>0.18</td>
<td>0.27</td>
<td>2011</td>
<td>11</td>
<td>22</td>
<td>23</td>
<td>2</td>
<td>11.1</td>
</tr>
<tr>
<td>-69.295</td>
<td>-17.621</td>
<td>149.2</td>
<td>0.20</td>
<td>0.25</td>
<td>0.25</td>
<td>2011</td>
<td>11</td>
<td>27</td>
<td>8</td>
<td>35</td>
<td>14.7</td>
</tr>
<tr>
<td>-71.903</td>
<td>-17.157</td>
<td>56.7</td>
<td>0.79</td>
<td>0.88</td>
<td>1.20</td>
<td>2011</td>
<td>11</td>
<td>28</td>
<td>0</td>
<td>14</td>
<td>23.4</td>
</tr>
<tr>
<td>-69.545</td>
<td>-16.771</td>
<td>185.4</td>
<td>0.26</td>
<td>0.25</td>
<td>0.21</td>
<td>2011</td>
<td>11</td>
<td>28</td>
<td>16</td>
<td>9</td>
<td>42.5</td>
</tr>
<tr>
<td>-69.486</td>
<td>-17.509</td>
<td>142.0</td>
<td>0.18</td>
<td>0.16</td>
<td>0.19</td>
<td>2011</td>
<td>11</td>
<td>29</td>
<td>8</td>
<td>49</td>
<td>30.1</td>
</tr>
<tr>
<td>-73.560</td>
<td>-14.440</td>
<td>89.4</td>
<td>0.24</td>
<td>0.22</td>
<td>0.32</td>
<td>2011</td>
<td>11</td>
<td>30</td>
<td>3</td>
<td>23</td>
<td>1.8</td>
</tr>
<tr>
<td>-70.777</td>
<td>-15.624</td>
<td>171.7</td>
<td>0.24</td>
<td>0.25</td>
<td>0.38</td>
<td>2011</td>
<td>12</td>
<td>1</td>
<td>3</td>
<td>40</td>
<td>57.8</td>
</tr>
<tr>
<td>-70.016</td>
<td>-17.144</td>
<td>138.1</td>
<td>0.20</td>
<td>0.29</td>
<td>0.22</td>
<td>2011</td>
<td>12</td>
<td>5</td>
<td>1</td>
<td>44</td>
<td>1.8</td>
</tr>
<tr>
<td>-74.432</td>
<td>-10.728</td>
<td>107.4</td>
<td>1.76</td>
<td>1.53</td>
<td>2.06</td>
<td>2011</td>
<td>12</td>
<td>7</td>
<td>14</td>
<td>25</td>
<td>34.4</td>
</tr>
<tr>
<td>-69.492</td>
<td>-17.705</td>
<td>131.3</td>
<td>0.26</td>
<td>0.32</td>
<td>0.38</td>
<td>2011</td>
<td>12</td>
<td>8</td>
<td>20</td>
<td>5</td>
<td>47</td>
</tr>
<tr>
<td>-69.610</td>
<td>-17.837</td>
<td>119.2</td>
<td>0.32</td>
<td>0.33</td>
<td>0.35</td>
<td>2011</td>
<td>12</td>
<td>10</td>
<td>7</td>
<td>21</td>
<td>51.7</td>
</tr>
<tr>
<td>-69.322</td>
<td>-18.101</td>
<td>127.9</td>
<td>0.31</td>
<td>0.23</td>
<td>0.27</td>
<td>2011</td>
<td>12</td>
<td>11</td>
<td>8</td>
<td>48</td>
<td>28.1</td>
</tr>
<tr>
<td>-69.385</td>
<td>-17.619</td>
<td>138.9</td>
<td>0.30</td>
<td>0.30</td>
<td>0.38</td>
<td>2011</td>
<td>12</td>
<td>11</td>
<td>11</td>
<td>14</td>
<td>15.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.570</td>
<td>-17.579</td>
<td>140.0</td>
<td>0.19</td>
<td>0.17</td>
<td>0.21</td>
<td>2011</td>
<td>12</td>
<td>11</td>
<td>21</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.817</td>
<td>-16.455</td>
<td>182.2</td>
<td>0.40</td>
<td>0.42</td>
<td>0.59</td>
<td>2011</td>
<td>12</td>
<td>12</td>
<td>21</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-75.664</td>
<td>-11.893</td>
<td>100.4</td>
<td>1.01</td>
<td>1.71</td>
<td>1.09</td>
<td>2011</td>
<td>12</td>
<td>13</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.977</td>
<td>-17.378</td>
<td>111.9</td>
<td>0.36</td>
<td>0.56</td>
<td>0.50</td>
<td>2011</td>
<td>12</td>
<td>13</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-74.846</td>
<td>-13.428</td>
<td>92.1</td>
<td>1.72</td>
<td>2.01</td>
<td>1.90</td>
<td>2011</td>
<td>12</td>
<td>13</td>
<td>23</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.728</td>
<td>-17.290</td>
<td>141.3</td>
<td>0.25</td>
<td>0.35</td>
<td>0.44</td>
<td>2011</td>
<td>12</td>
<td>14</td>
<td>12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.494</td>
<td>-16.528</td>
<td>186.0</td>
<td>0.54</td>
<td>0.36</td>
<td>0.48</td>
<td>2011</td>
<td>12</td>
<td>14</td>
<td>15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-70.999</td>
<td>-16.875</td>
<td>102.3</td>
<td>0.34</td>
<td>0.38</td>
<td>0.49</td>
<td>2011</td>
<td>12</td>
<td>14</td>
<td>17</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.543</td>
<td>-16.940</td>
<td>173.4</td>
<td>0.23</td>
<td>0.19</td>
<td>0.22</td>
<td>2011</td>
<td>12</td>
<td>14</td>
<td>18</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-75.689</td>
<td>-13.760</td>
<td>63.7</td>
<td>1.94</td>
<td>2.75</td>
<td>1.56</td>
<td>2011</td>
<td>12</td>
<td>15</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.828</td>
<td>-17.897</td>
<td>136.5</td>
<td>0.27</td>
<td>0.26</td>
<td>0.26</td>
<td>2011</td>
<td>12</td>
<td>16</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-71.892</td>
<td>-16.391</td>
<td>100.5</td>
<td>0.51</td>
<td>0.47</td>
<td>0.53</td>
<td>2011</td>
<td>12</td>
<td>17</td>
<td>14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.449</td>
<td>-17.495</td>
<td>161.2</td>
<td>0.19</td>
<td>0.22</td>
<td>0.23</td>
<td>2011</td>
<td>12</td>
<td>18</td>
<td>18</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-72.285</td>
<td>-15.085</td>
<td>111.6</td>
<td>0.30</td>
<td>0.30</td>
<td>0.48</td>
<td>2011</td>
<td>12</td>
<td>19</td>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.452</td>
<td>-17.566</td>
<td>149.7</td>
<td>0.17</td>
<td>0.18</td>
<td>0.18</td>
<td>2011</td>
<td>12</td>
<td>19</td>
<td>19</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-71.889</td>
<td>-16.496</td>
<td>93.8</td>
<td>0.50</td>
<td>0.47</td>
<td>0.63</td>
<td>2011</td>
<td>12</td>
<td>20</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.810</td>
<td>-16.411</td>
<td>190.8</td>
<td>0.38</td>
<td>0.35</td>
<td>0.39</td>
<td>2011</td>
<td>12</td>
<td>20</td>
<td>22</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-71.974</td>
<td>-15.367</td>
<td>129.2</td>
<td>0.47</td>
<td>0.43</td>
<td>0.43</td>
<td>2011</td>
<td>12</td>
<td>21</td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.330</td>
<td>-17.209</td>
<td>165.8</td>
<td>0.27</td>
<td>0.33</td>
<td>0.31</td>
<td>2011</td>
<td>12</td>
<td>23</td>
<td>9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.376</td>
<td>-17.586</td>
<td>135.9</td>
<td>0.25</td>
<td>0.28</td>
<td>0.38</td>
<td>2011</td>
<td>12</td>
<td>23</td>
<td>20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.387</td>
<td>-18.276</td>
<td>124.2</td>
<td>0.23</td>
<td>0.25</td>
<td>0.26</td>
<td>2011</td>
<td>12</td>
<td>24</td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.495</td>
<td>-17.407</td>
<td>158.5</td>
<td>0.21</td>
<td>0.31</td>
<td>0.40</td>
<td>2011</td>
<td>12</td>
<td>25</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-70.915</td>
<td>-17.913</td>
<td>50.2</td>
<td>0.68</td>
<td>1.19</td>
<td>0.47</td>
<td>2011</td>
<td>12</td>
<td>25</td>
<td>9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-74.812</td>
<td>-13.422</td>
<td>87.2</td>
<td>1.32</td>
<td>1.34</td>
<td>2.05</td>
<td>2011</td>
<td>12</td>
<td>25</td>
<td>19</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-70.919</td>
<td>-17.048</td>
<td>83.7</td>
<td>0.37</td>
<td>0.45</td>
<td>0.53</td>
<td>2011</td>
<td>12</td>
<td>25</td>
<td>19</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.450</td>
<td>-16.689</td>
<td>175.2</td>
<td>0.67</td>
<td>0.64</td>
<td>0.59</td>
<td>2011</td>
<td>12</td>
<td>26</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-70.526</td>
<td>-15.580</td>
<td>198.3</td>
<td>0.23</td>
<td>0.27</td>
<td>0.33</td>
<td>2011</td>
<td>12</td>
<td>29</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.493</td>
<td>-17.699</td>
<td>133.2</td>
<td>0.20</td>
<td>0.21</td>
<td>0.20</td>
<td>2012</td>
<td>1</td>
<td>1</td>
<td>14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-72.979</td>
<td>-14.097</td>
<td>77.6</td>
<td>0.25</td>
<td>0.30</td>
<td>0.39</td>
<td>2012</td>
<td>1</td>
<td>1</td>
<td>17</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-70.554</td>
<td>-16.921</td>
<td>114.3</td>
<td>0.53</td>
<td>0.94</td>
<td>0.90</td>
<td>2012</td>
<td>1</td>
<td>2</td>
<td>9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.313</td>
<td>-17.708</td>
<td>142.3</td>
<td>0.21</td>
<td>0.22</td>
<td>0.23</td>
<td>2012</td>
<td>1</td>
<td>4</td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-72.017</td>
<td>-17.000</td>
<td>57.9</td>
<td>0.71</td>
<td>1.40</td>
<td>1.28</td>
<td>2012</td>
<td>1</td>
<td>5</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-72.162</td>
<td>-16.715</td>
<td>63.5</td>
<td>0.41</td>
<td>0.61</td>
<td>0.40</td>
<td>2012</td>
<td>1</td>
<td>10</td>
<td>12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-72.870</td>
<td>-14.919</td>
<td>99.1</td>
<td>0.20</td>
<td>0.29</td>
<td>0.33</td>
<td>2012</td>
<td>1</td>
<td>11</td>
<td>18</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-72.873</td>
<td>-14.922</td>
<td>99.0</td>
<td>0.23</td>
<td>0.33</td>
<td>0.40</td>
<td>2012</td>
<td>1</td>
<td>11</td>
<td>18</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.541</td>
<td>-17.715</td>
<td>132.2</td>
<td>0.19</td>
<td>0.20</td>
<td>0.19</td>
<td>2012</td>
<td>1</td>
<td>11</td>
<td>20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-72.216</td>
<td>-15.289</td>
<td>117.5</td>
<td>0.43</td>
<td>0.36</td>
<td>0.54</td>
<td>2012</td>
<td>1</td>
<td>12</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-74.770</td>
<td>-13.332</td>
<td>80.5</td>
<td>2.61</td>
<td>2.22</td>
<td>2.37</td>
<td>2012</td>
<td>1</td>
<td>13</td>
<td>17</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-72.187</td>
<td>-14.984</td>
<td>109.7</td>
<td>0.37</td>
<td>0.32</td>
<td>0.63</td>
<td>2012</td>
<td>1</td>
<td>18</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----</td>
<td>------</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>------</td>
<td>------</td>
<td>-----</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.466</td>
<td>-18.178</td>
<td>131.9</td>
<td>0.26</td>
<td>0.28</td>
<td>0.32</td>
<td>2012</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-70.136</td>
<td>-17.465</td>
<td>103.4</td>
<td>0.48</td>
<td>0.57</td>
<td>0.61</td>
<td>2012</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-72.301</td>
<td>-15.412</td>
<td>131.0</td>
<td>0.35</td>
<td>0.41</td>
<td>0.42</td>
<td>2012</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.051</td>
<td>-18.427</td>
<td>137.0</td>
<td>1.44</td>
<td>0.93</td>
<td>0.95</td>
<td>2012</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.813</td>
<td>-17.200</td>
<td>132.9</td>
<td>0.20</td>
<td>0.21</td>
<td>0.18</td>
<td>2012</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.309</td>
<td>-17.448</td>
<td>155.7</td>
<td>0.22</td>
<td>0.23</td>
<td>0.19</td>
<td>2012</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-76.318</td>
<td>-13.156</td>
<td>67.0</td>
<td>1.87</td>
<td>1.70</td>
<td>18.21</td>
<td>2012</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-72.836</td>
<td>-14.319</td>
<td>85.3</td>
<td>0.20</td>
<td>0.22</td>
<td>0.29</td>
<td>2012</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-72.767</td>
<td>-14.770</td>
<td>98.8</td>
<td>0.21</td>
<td>0.30</td>
<td>0.38</td>
<td>2012</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-74.586</td>
<td>-13.191</td>
<td>77.1</td>
<td>1.45</td>
<td>1.82</td>
<td>1.95</td>
<td>2012</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.765</td>
<td>-16.507</td>
<td>181.2</td>
<td>0.26</td>
<td>0.20</td>
<td>0.20</td>
<td>2012</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-75.587</td>
<td>-14.272</td>
<td>55.6</td>
<td>1.72</td>
<td>1.67</td>
<td>1.77</td>
<td>2012</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-75.693</td>
<td>-14.249</td>
<td>51.9</td>
<td>1.92</td>
<td>1.96</td>
<td>1.92</td>
<td>2012</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-75.059</td>
<td>-13.843</td>
<td>83.7</td>
<td>1.16</td>
<td>1.81</td>
<td>2.03</td>
<td>2012</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-70.824</td>
<td>-15.236</td>
<td>183.8</td>
<td>0.39</td>
<td>0.45</td>
<td>0.36</td>
<td>2012</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-74.971</td>
<td>-15.135</td>
<td>57.9</td>
<td>2.44</td>
<td>2.32</td>
<td>2.01</td>
<td>2012</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-70.725</td>
<td>-15.550</td>
<td>179.6</td>
<td>0.29</td>
<td>0.48</td>
<td>0.36</td>
<td>2012</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-71.983</td>
<td>-15.035</td>
<td>124.8</td>
<td>0.31</td>
<td>0.31</td>
<td>0.45</td>
<td>2012</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.549</td>
<td>-15.964</td>
<td>224.6</td>
<td>0.19</td>
<td>0.19</td>
<td>0.26</td>
<td>2012</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-71.646</td>
<td>-15.160</td>
<td>138.0</td>
<td>0.28</td>
<td>0.28</td>
<td>0.32</td>
<td>2012</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-74.930</td>
<td>-15.065</td>
<td>59.8</td>
<td>2.45</td>
<td>2.37</td>
<td>1.98</td>
<td>2012</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-71.591</td>
<td>-15.099</td>
<td>133.8</td>
<td>0.28</td>
<td>0.30</td>
<td>0.35</td>
<td>2012</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-71.777</td>
<td>-16.729</td>
<td>76.0</td>
<td>0.66</td>
<td>0.71</td>
<td>1.06</td>
<td>2012</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-70.001</td>
<td>-17.629</td>
<td>101.3</td>
<td>0.31</td>
<td>0.34</td>
<td>0.33</td>
<td>2012</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-72.535</td>
<td>-15.085</td>
<td>118.6</td>
<td>0.48</td>
<td>0.41</td>
<td>0.60</td>
<td>2012</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.458</td>
<td>-17.219</td>
<td>157.9</td>
<td>0.19</td>
<td>0.23</td>
<td>0.19</td>
<td>2012</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.560</td>
<td>-17.708</td>
<td>147.9</td>
<td>0.19</td>
<td>0.20</td>
<td>0.25</td>
<td>2012</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.619</td>
<td>-18.125</td>
<td>113.5</td>
<td>0.25</td>
<td>0.29</td>
<td>0.25</td>
<td>2012</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.428</td>
<td>-18.214</td>
<td>122.3</td>
<td>0.24</td>
<td>0.31</td>
<td>0.31</td>
<td>2012</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.725</td>
<td>-18.236</td>
<td>107.2</td>
<td>0.35</td>
<td>0.39</td>
<td>0.48</td>
<td>2012</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.580</td>
<td>-17.556</td>
<td>134.9</td>
<td>0.19</td>
<td>0.19</td>
<td>0.23</td>
<td>2012</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.723</td>
<td>-16.648</td>
<td>176.0</td>
<td>0.23</td>
<td>0.24</td>
<td>0.25</td>
<td>2012</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-71.691</td>
<td>-15.914</td>
<td>138.4</td>
<td>0.36</td>
<td>0.49</td>
<td>0.54</td>
<td>2012</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-70.850</td>
<td>-17.049</td>
<td>101.7</td>
<td>0.38</td>
<td>0.46</td>
<td>0.47</td>
<td>2012</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-74.874</td>
<td>-13.378</td>
<td>108.8</td>
<td>1.81</td>
<td>2.12</td>
<td>3.48</td>
<td>2012</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-72.316</td>
<td>-15.938</td>
<td>112.2</td>
<td>0.50</td>
<td>0.75</td>
<td>0.66</td>
<td>2012</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-70.522</td>
<td>-18.121</td>
<td>57.5</td>
<td>0.23</td>
<td>0.26</td>
<td>0.22</td>
<td>2012</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.348</td>
<td>-18.368</td>
<td>131.4</td>
<td>0.30</td>
<td>0.30</td>
<td>0.30</td>
<td>2012</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-72.801</td>
<td>-14.329</td>
<td>85.0</td>
<td>0.31</td>
<td>0.29</td>
<td>0.47</td>
<td>2012</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Value 1</td>
<td>Value 2</td>
<td>Value 3</td>
<td>Value 4</td>
<td>Value 5</td>
<td>Year</td>
<td>Value 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>------</td>
<td>--------</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-70.022</td>
<td>-17.481</td>
<td>127.8</td>
<td>0.35</td>
<td>0.44</td>
<td>2012</td>
<td>2 25 5 15 11.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.425</td>
<td>-15.920</td>
<td>236.2</td>
<td>0.15</td>
<td>0.20</td>
<td>2012</td>
<td>2 27 2 37 27.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-71.713</td>
<td>-15.673</td>
<td>143.0</td>
<td>0.34</td>
<td>0.49</td>
<td>2012</td>
<td>2 27 10 12 11.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-72.977</td>
<td>-14.075</td>
<td>79.0</td>
<td>0.25</td>
<td>0.29</td>
<td>2012</td>
<td>2 27 18 30 7.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.635</td>
<td>-17.588</td>
<td>131.2</td>
<td>0.19</td>
<td>0.29</td>
<td>2012</td>
<td>3 5 20 20 11.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-72.031</td>
<td>-16.168</td>
<td>122.6</td>
<td>0.25</td>
<td>0.38</td>
<td>2012</td>
<td>3 6 9 40 22.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-73.660</td>
<td>-14.316</td>
<td>88.2</td>
<td>0.24</td>
<td>0.27</td>
<td>2012</td>
<td>3 8 19 39 55.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-75.137</td>
<td>-13.109</td>
<td>89.3</td>
<td>1.40</td>
<td>1.21</td>
<td>2012</td>
<td>3 8 20 3 23.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-70.165</td>
<td>-17.838</td>
<td>96.2</td>
<td>0.43</td>
<td>0.55</td>
<td>2012</td>
<td>3 9 1 43 16.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-75.137</td>
<td>-13.109</td>
<td>89.3</td>
<td>1.40</td>
<td>1.21</td>
<td>2012</td>
<td>3 9 8 54 28.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-72.883</td>
<td>-14.395</td>
<td>81.8</td>
<td>0.21</td>
<td>0.19</td>
<td>2012</td>
<td>3 10 5 20 31.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-75.618</td>
<td>-14.274</td>
<td>52.3</td>
<td>1.80</td>
<td>1.49</td>
<td>1.89 2012</td>
<td>3 12 7 17 11.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-71.883</td>
<td>-16.397</td>
<td>99.4</td>
<td>0.46</td>
<td>0.49</td>
<td>0.58 2012</td>
<td>3 15 13 26 37.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.494</td>
<td>-17.351</td>
<td>148.2</td>
<td>0.24</td>
<td>0.29</td>
<td>0.26 2012</td>
<td>3 16 1 53 51.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-75.713</td>
<td>-11.196</td>
<td>111.7</td>
<td>2.29</td>
<td>3.22</td>
<td>2.62 2012</td>
<td>3 17 18 31 3.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-76.410</td>
<td>-12.997</td>
<td>79.5</td>
<td>2.07</td>
<td>1.65</td>
<td>5.00 2012</td>
<td>3 20 2 36 23.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.596</td>
<td>-16.620</td>
<td>189.0</td>
<td>0.28</td>
<td>0.32</td>
<td>0.21 2012</td>
<td>3 20 15 59 58.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-71.158</td>
<td>-16.583</td>
<td>104.9</td>
<td>0.22</td>
<td>0.21</td>
<td>0.34 2012</td>
<td>3 21 8 43 14.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-72.360</td>
<td>-15.281</td>
<td>114.5</td>
<td>0.39</td>
<td>0.44</td>
<td>0.55 2012</td>
<td>3 22 3 13 14.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-74.010</td>
<td>-14.244</td>
<td>83.2</td>
<td>0.26</td>
<td>0.48</td>
<td>0.56 2012</td>
<td>3 23 10 31 12.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.453</td>
<td>-17.806</td>
<td>148.7</td>
<td>0.24</td>
<td>0.25</td>
<td>0.24 2012</td>
<td>3 24 11 46 23</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-70.736</td>
<td>-15.578</td>
<td>177.2</td>
<td>0.20</td>
<td>0.25</td>
<td>0.30 2012</td>
<td>3 24 14 39 25.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.755</td>
<td>-17.262</td>
<td>148.3</td>
<td>0.25</td>
<td>0.29</td>
<td>0.27 2012</td>
<td>3 24 16 1 56</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.744</td>
<td>-16.630</td>
<td>169.9</td>
<td>0.25</td>
<td>0.25</td>
<td>0.45 2012</td>
<td>3 26 8 23 0.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.378</td>
<td>-16.933</td>
<td>181.5</td>
<td>0.31</td>
<td>0.22</td>
<td>0.27 2012</td>
<td>3 26 15 22 55.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.516</td>
<td>-16.696</td>
<td>181.4</td>
<td>0.30</td>
<td>0.37</td>
<td>0.24 2012</td>
<td>3 28 22 38 9.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.576</td>
<td>-16.752</td>
<td>172.6</td>
<td>0.21</td>
<td>0.28</td>
<td>0.35 2012</td>
<td>3 29 23 31 7.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-70.188</td>
<td>-15.546</td>
<td>212.7</td>
<td>0.25</td>
<td>0.20</td>
<td>0.38 2012</td>
<td>3 30 3 2 27</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-71.234</td>
<td>-15.557</td>
<td>152.2</td>
<td>0.33</td>
<td>0.39</td>
<td>0.37 2012</td>
<td>3 30 4 9 57.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.445</td>
<td>-17.295</td>
<td>151.3</td>
<td>0.19</td>
<td>0.23</td>
<td>0.28 2012</td>
<td>3 30 10 48 44.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-71.906</td>
<td>-15.008</td>
<td>124.4</td>
<td>0.31</td>
<td>0.31</td>
<td>0.33 2012</td>
<td>4 1 2 30 42.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.134</td>
<td>-17.702</td>
<td>147.5</td>
<td>0.27</td>
<td>0.34</td>
<td>0.32 2012</td>
<td>4 1 22 4 35.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.618</td>
<td>-16.194</td>
<td>212.8</td>
<td>0.54</td>
<td>0.44</td>
<td>0.46 2012</td>
<td>4 4 3 15 14.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.677</td>
<td>-17.489</td>
<td>131.4</td>
<td>0.22</td>
<td>0.27</td>
<td>0.31 2012</td>
<td>4 5 22 16 19.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-69.353</td>
<td>-17.776</td>
<td>136.8</td>
<td>0.24</td>
<td>0.28</td>
<td>0.27 2012</td>
<td>4 8 23 4 57.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-70.333</td>
<td>-17.493</td>
<td>91.4</td>
<td>0.47</td>
<td>0.70</td>
<td>0.65 2012</td>
<td>4 9 0 40 39.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-76.006</td>
<td>-13.915</td>
<td>58.1</td>
<td>2.18</td>
<td>3.00</td>
<td>1.88 2012</td>
<td>4 12 1 1 11.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-72.102</td>
<td>-14.636</td>
<td>99.5</td>
<td>0.65</td>
<td>0.49</td>
<td>0.60 2012</td>
<td>4 14 20 30 59.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-71.957</td>
<td>-16.139</td>
<td>111.7</td>
<td>0.24</td>
<td>0.36</td>
<td>0.52 2012</td>
<td>4 16 13 24 55.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>----</td>
<td>----</td>
<td>----</td>
<td>----</td>
<td>----</td>
<td>----</td>
<td>----</td>
<td>----</td>
<td>----</td>
<td>----</td>
<td>----</td>
<td>----</td>
</tr>
<tr>
<td>-73.743</td>
<td>-15.113</td>
<td>90.0</td>
<td>0.44</td>
<td>0.44</td>
<td>0.58</td>
<td>2012</td>
<td>4</td>
<td>17</td>
<td>3</td>
<td>44</td>
<td>58.7</td>
</tr>
<tr>
<td>-71.887</td>
<td>-14.855</td>
<td>119.4</td>
<td>0.35</td>
<td>0.37</td>
<td>0.44</td>
<td>2012</td>
<td>4</td>
<td>17</td>
<td>9</td>
<td>43</td>
<td>12.9</td>
</tr>
<tr>
<td>-75.647</td>
<td>-13.656</td>
<td>72.0</td>
<td>1.94</td>
<td>3.36</td>
<td>2.88</td>
<td>2012</td>
<td>4</td>
<td>18</td>
<td>18</td>
<td>37</td>
<td>52.2</td>
</tr>
<tr>
<td>-71.942</td>
<td>-14.901</td>
<td>121.1</td>
<td>0.33</td>
<td>0.32</td>
<td>0.48</td>
<td>2012</td>
<td>4</td>
<td>19</td>
<td>23</td>
<td>2</td>
<td>43.2</td>
</tr>
<tr>
<td>-72.128</td>
<td>-15.753</td>
<td>123.1</td>
<td>0.52</td>
<td>0.42</td>
<td>0.44</td>
<td>2012</td>
<td>4</td>
<td>20</td>
<td>2</td>
<td>43</td>
<td>25.2</td>
</tr>
<tr>
<td>-71.803</td>
<td>-14.869</td>
<td>120.3</td>
<td>0.38</td>
<td>0.37</td>
<td>0.55</td>
<td>2012</td>
<td>4</td>
<td>21</td>
<td>11</td>
<td>36</td>
<td>3.8</td>
</tr>
<tr>
<td>-72.026</td>
<td>-14.963</td>
<td>114.3</td>
<td>0.28</td>
<td>0.34</td>
<td>0.37</td>
<td>2012</td>
<td>4</td>
<td>23</td>
<td>17</td>
<td>2</td>
<td>44.8</td>
</tr>
<tr>
<td>-75.781</td>
<td>-13.939</td>
<td>61.1</td>
<td>2.70</td>
<td>2.49</td>
<td>2.05</td>
<td>2012</td>
<td>4</td>
<td>24</td>
<td>0</td>
<td>43</td>
<td>49.3</td>
</tr>
<tr>
<td>-71.593</td>
<td>-16.151</td>
<td>129.9</td>
<td>0.31</td>
<td>0.45</td>
<td>0.45</td>
<td>2012</td>
<td>4</td>
<td>24</td>
<td>2</td>
<td>14</td>
<td>16.6</td>
</tr>
<tr>
<td>-75.819</td>
<td>-13.785</td>
<td>63.2</td>
<td>2.67</td>
<td>1.68</td>
<td>2.43</td>
<td>2012</td>
<td>4</td>
<td>24</td>
<td>6</td>
<td>20</td>
<td>35.1</td>
</tr>
<tr>
<td>-71.674</td>
<td>-16.350</td>
<td>103.6</td>
<td>0.50</td>
<td>0.52</td>
<td>0.67</td>
<td>2012</td>
<td>4</td>
<td>25</td>
<td>16</td>
<td>19</td>
<td>38.4</td>
</tr>
<tr>
<td>-74.897</td>
<td>-14.381</td>
<td>60.7</td>
<td>2.15</td>
<td>1.68</td>
<td>1.85</td>
<td>2012</td>
<td>4</td>
<td>25</td>
<td>22</td>
<td>37</td>
<td>15.5</td>
</tr>
<tr>
<td>-70.568</td>
<td>-17.890</td>
<td>56.3</td>
<td>0.53</td>
<td>0.74</td>
<td>0.47</td>
<td>2012</td>
<td>4</td>
<td>30</td>
<td>8</td>
<td>4</td>
<td>21.2</td>
</tr>
<tr>
<td>-69.281</td>
<td>-18.196</td>
<td>131.8</td>
<td>0.34</td>
<td>0.36</td>
<td>0.32</td>
<td>2012</td>
<td>4</td>
<td>30</td>
<td>12</td>
<td>32</td>
<td>18.8</td>
</tr>
<tr>
<td>-72.354</td>
<td>-14.517</td>
<td>93.3</td>
<td>0.32</td>
<td>0.42</td>
<td>0.61</td>
<td>2012</td>
<td>5</td>
<td>2</td>
<td>10</td>
<td>52</td>
<td>59.8</td>
</tr>
<tr>
<td>-75.171</td>
<td>-14.851</td>
<td>55.9</td>
<td>1.95</td>
<td>2.15</td>
<td>1.10</td>
<td>2012</td>
<td>5</td>
<td>2</td>
<td>11</td>
<td>34</td>
<td>43.9</td>
</tr>
<tr>
<td>-73.776</td>
<td>-14.193</td>
<td>76.8</td>
<td>0.21</td>
<td>0.41</td>
<td>0.37</td>
<td>2012</td>
<td>5</td>
<td>2</td>
<td>16</td>
<td>54</td>
<td>26.4</td>
</tr>
<tr>
<td>-71.223</td>
<td>-17.656</td>
<td>48.2</td>
<td>0.59</td>
<td>0.65</td>
<td>0.82</td>
<td>2012</td>
<td>5</td>
<td>2</td>
<td>21</td>
<td>57</td>
<td>11.3</td>
</tr>
<tr>
<td>-69.917</td>
<td>-17.020</td>
<td>132.5</td>
<td>0.23</td>
<td>0.26</td>
<td>0.22</td>
<td>2012</td>
<td>5</td>
<td>3</td>
<td>11</td>
<td>31</td>
<td>52</td>
</tr>
<tr>
<td>-72.512</td>
<td>-14.923</td>
<td>105.5</td>
<td>0.39</td>
<td>0.46</td>
<td>0.47</td>
<td>2012</td>
<td>5</td>
<td>4</td>
<td>11</td>
<td>26</td>
<td>12.9</td>
</tr>
<tr>
<td>-69.726</td>
<td>-17.734</td>
<td>136.9</td>
<td>0.20</td>
<td>0.19</td>
<td>0.17</td>
<td>2012</td>
<td>5</td>
<td>12</td>
<td>11</td>
<td>28</td>
<td>53.3</td>
</tr>
<tr>
<td>-73.646</td>
<td>-14.429</td>
<td>83.1</td>
<td>0.24</td>
<td>0.23</td>
<td>0.32</td>
<td>2012</td>
<td>5</td>
<td>12</td>
<td>16</td>
<td>57</td>
<td>38.9</td>
</tr>
<tr>
<td>-69.491</td>
<td>-17.656</td>
<td>135.9</td>
<td>0.20</td>
<td>0.24</td>
<td>0.25</td>
<td>2012</td>
<td>5</td>
<td>13</td>
<td>7</td>
<td>47</td>
<td>34.4</td>
</tr>
<tr>
<td>-69.999</td>
<td>-17.863</td>
<td>101.7</td>
<td>0.26</td>
<td>0.21</td>
<td>0.26</td>
<td>2012</td>
<td>5</td>
<td>14</td>
<td>10</td>
<td>0</td>
<td>39.1</td>
</tr>
<tr>
<td>-72.448</td>
<td>-16.010</td>
<td>98.3</td>
<td>0.59</td>
<td>0.83</td>
<td>0.76</td>
<td>2012</td>
<td>5</td>
<td>15</td>
<td>2</td>
<td>38</td>
<td>27.4</td>
</tr>
<tr>
<td>-71.557</td>
<td>-16.417</td>
<td>104.3</td>
<td>0.55</td>
<td>0.57</td>
<td>0.73</td>
<td>2012</td>
<td>5</td>
<td>15</td>
<td>7</td>
<td>14</td>
<td>31.8</td>
</tr>
<tr>
<td>-69.994</td>
<td>-17.846</td>
<td>101.0</td>
<td>0.25</td>
<td>0.24</td>
<td>0.27</td>
<td>2012</td>
<td>5</td>
<td>15</td>
<td>21</td>
<td>20</td>
<td>33.6</td>
</tr>
<tr>
<td>-69.436</td>
<td>-17.490</td>
<td>155.1</td>
<td>0.18</td>
<td>0.21</td>
<td>0.20</td>
<td>2012</td>
<td>5</td>
<td>17</td>
<td>8</td>
<td>5</td>
<td>37.5</td>
</tr>
<tr>
<td>-76.534</td>
<td>-13.076</td>
<td>51.5</td>
<td>2.46</td>
<td>1.62</td>
<td>1.99</td>
<td>2012</td>
<td>5</td>
<td>18</td>
<td>9</td>
<td>22</td>
<td>31.6</td>
</tr>
<tr>
<td>-69.512</td>
<td>-16.645</td>
<td>185.3</td>
<td>0.28</td>
<td>0.31</td>
<td>0.28</td>
<td>2012</td>
<td>5</td>
<td>21</td>
<td>3</td>
<td>37</td>
<td>1.6</td>
</tr>
<tr>
<td>-72.771</td>
<td>-14.816</td>
<td>95.3</td>
<td>0.21</td>
<td>0.29</td>
<td>0.37</td>
<td>2012</td>
<td>5</td>
<td>22</td>
<td>6</td>
<td>50</td>
<td>1.5</td>
</tr>
<tr>
<td>-70.866</td>
<td>-16.812</td>
<td>112.2</td>
<td>0.38</td>
<td>0.37</td>
<td>0.49</td>
<td>2012</td>
<td>5</td>
<td>23</td>
<td>1</td>
<td>4</td>
<td>33.8</td>
</tr>
<tr>
<td>-71.895</td>
<td>-14.982</td>
<td>128.5</td>
<td>0.28</td>
<td>0.30</td>
<td>0.29</td>
<td>2012</td>
<td>5</td>
<td>25</td>
<td>13</td>
<td>27</td>
<td>7.9</td>
</tr>
<tr>
<td>-70.065</td>
<td>-18.119</td>
<td>92.2</td>
<td>0.49</td>
<td>0.52</td>
<td>0.58</td>
<td>2012</td>
<td>5</td>
<td>31</td>
<td>11</td>
<td>29</td>
<td>54.7</td>
</tr>
<tr>
<td>-69.456</td>
<td>-18.417</td>
<td>117.9</td>
<td>0.40</td>
<td>0.34</td>
<td>0.35</td>
<td>2012</td>
<td>6</td>
<td>1</td>
<td>3</td>
<td>45</td>
<td>54.8</td>
</tr>
<tr>
<td>-69.590</td>
<td>-17.408</td>
<td>147.6</td>
<td>0.34</td>
<td>0.46</td>
<td>0.60</td>
<td>2012</td>
<td>6</td>
<td>2</td>
<td>0</td>
<td>22</td>
<td>17.3</td>
</tr>
<tr>
<td>-71.725</td>
<td>-14.836</td>
<td>117.6</td>
<td>0.83</td>
<td>1.18</td>
<td>1.09</td>
<td>2012</td>
<td>6</td>
<td>2</td>
<td>9</td>
<td>20</td>
<td>47.3</td>
</tr>
<tr>
<td>-72.149</td>
<td>-15.907</td>
<td>119.0</td>
<td>0.57</td>
<td>0.74</td>
<td>0.71</td>
<td>2012</td>
<td>6</td>
<td>3</td>
<td>0</td>
<td>40</td>
<td>14.4</td>
</tr>
<tr>
<td>-75.146</td>
<td>-14.854</td>
<td>56.4</td>
<td>1.98</td>
<td>2.14</td>
<td>1.10</td>
<td>2012</td>
<td>6</td>
<td>4</td>
<td>17</td>
<td>11</td>
<td>19.9</td>
</tr>
<tr>
<td>x</td>
<td>y</td>
<td>dx</td>
<td>dy</td>
<td>dz</td>
<td>dates</td>
<td>a</td>
<td>b</td>
<td>c</td>
<td>d</td>
<td>e</td>
<td>f</td>
</tr>
<tr>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-------</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>-71.310</td>
<td>-15.526</td>
<td>151.4</td>
<td>0.32</td>
<td>0.40</td>
<td>0.35</td>
<td>2012</td>
<td>6</td>
<td>5</td>
<td>15</td>
<td>20</td>
<td>18.9</td>
</tr>
<tr>
<td>-72.663</td>
<td>-15.935</td>
<td>126.7</td>
<td>0.57</td>
<td>0.34</td>
<td>0.92</td>
<td>2012</td>
<td>6</td>
<td>7</td>
<td>16</td>
<td>3</td>
<td>14.7</td>
</tr>
<tr>
<td>-70.274</td>
<td>-18.023</td>
<td>73.3</td>
<td>0.87</td>
<td>1.03</td>
<td>0.82</td>
<td>2012</td>
<td>6</td>
<td>9</td>
<td>16</td>
<td>11</td>
<td>13.1</td>
</tr>
<tr>
<td>-67.375</td>
<td>-18.449</td>
<td>254.7</td>
<td>5.06</td>
<td>2.60</td>
<td>2.37</td>
<td>2012</td>
<td>6</td>
<td>11</td>
<td>4</td>
<td>41</td>
<td>35.4</td>
</tr>
<tr>
<td>-75.437</td>
<td>-13.847</td>
<td>79.8</td>
<td>3.60</td>
<td>4.79</td>
<td>3.45</td>
<td>2012</td>
<td>6</td>
<td>11</td>
<td>9</td>
<td>55</td>
<td>23.7</td>
</tr>
<tr>
<td>-72.823</td>
<td>-14.245</td>
<td>86.1</td>
<td>0.21</td>
<td>0.29</td>
<td>0.33</td>
<td>2012</td>
<td>6</td>
<td>12</td>
<td>7</td>
<td>23</td>
<td>37.2</td>
</tr>
<tr>
<td>-72.059</td>
<td>-15.571</td>
<td>133.3</td>
<td>0.44</td>
<td>0.33</td>
<td>0.37</td>
<td>2012</td>
<td>6</td>
<td>13</td>
<td>3</td>
<td>21</td>
<td>22.1</td>
</tr>
<tr>
<td>-74.668</td>
<td>-14.296</td>
<td>83.6</td>
<td>1.88</td>
<td>2.24</td>
<td>3.12</td>
<td>2012</td>
<td>6</td>
<td>14</td>
<td>5</td>
<td>41</td>
<td>41.2</td>
</tr>
<tr>
<td>-69.475</td>
<td>-16.646</td>
<td>194.7</td>
<td>0.39</td>
<td>0.35</td>
<td>0.26</td>
<td>2012</td>
<td>6</td>
<td>14</td>
<td>5</td>
<td>43</td>
<td>1.9</td>
</tr>
<tr>
<td>-70.595</td>
<td>-15.582</td>
<td>190.9</td>
<td>0.24</td>
<td>0.34</td>
<td>0.39</td>
<td>2012</td>
<td>6</td>
<td>14</td>
<td>7</td>
<td>48</td>
<td>8.2</td>
</tr>
<tr>
<td>-69.739</td>
<td>-16.374</td>
<td>194.9</td>
<td>0.38</td>
<td>0.27</td>
<td>0.28</td>
<td>2012</td>
<td>6</td>
<td>15</td>
<td>3</td>
<td>33</td>
<td>3.4</td>
</tr>
<tr>
<td>-72.105</td>
<td>-15.149</td>
<td>117.3</td>
<td>0.31</td>
<td>0.33</td>
<td>0.41</td>
<td>2012</td>
<td>6</td>
<td>15</td>
<td>10</td>
<td>47</td>
<td>56.3</td>
</tr>
<tr>
<td>-75.584</td>
<td>-14.094</td>
<td>62.4</td>
<td>2.84</td>
<td>3.44</td>
<td>3.96</td>
<td>2012</td>
<td>6</td>
<td>15</td>
<td>22</td>
<td>13</td>
<td>47.2</td>
</tr>
<tr>
<td>-72.072</td>
<td>-14.935</td>
<td>120.7</td>
<td>0.33</td>
<td>0.37</td>
<td>0.33</td>
<td>2012</td>
<td>6</td>
<td>18</td>
<td>6</td>
<td>9</td>
<td>34.1</td>
</tr>
<tr>
<td>-72.014</td>
<td>-15.376</td>
<td>128.0</td>
<td>0.42</td>
<td>0.26</td>
<td>0.33</td>
<td>2012</td>
<td>6</td>
<td>20</td>
<td>13</td>
<td>30</td>
<td>19.4</td>
</tr>
<tr>
<td>-76.753</td>
<td>-11.677</td>
<td>92.1</td>
<td>3.95</td>
<td>3.46</td>
<td>4.97</td>
<td>2012</td>
<td>6</td>
<td>21</td>
<td>22</td>
<td>17</td>
<td>9.6</td>
</tr>
<tr>
<td>-71.083</td>
<td>-16.764</td>
<td>106.9</td>
<td>0.36</td>
<td>0.38</td>
<td>0.45</td>
<td>2012</td>
<td>6</td>
<td>23</td>
<td>9</td>
<td>35</td>
<td>11.6</td>
</tr>
<tr>
<td>-69.634</td>
<td>-17.673</td>
<td>138.8</td>
<td>0.21</td>
<td>0.24</td>
<td>0.28</td>
<td>2012</td>
<td>6</td>
<td>25</td>
<td>2</td>
<td>7</td>
<td>23.9</td>
</tr>
<tr>
<td>-76.280</td>
<td>-11.582</td>
<td>96.7</td>
<td>4.95</td>
<td>4.12</td>
<td>5.04</td>
<td>2012</td>
<td>6</td>
<td>27</td>
<td>8</td>
<td>4</td>
<td>20.8</td>
</tr>
<tr>
<td>-76.027</td>
<td>-12.997</td>
<td>73.8</td>
<td>5.31</td>
<td>4.42</td>
<td>6.78</td>
<td>2012</td>
<td>6</td>
<td>27</td>
<td>12</td>
<td>41</td>
<td>7.9</td>
</tr>
<tr>
<td>-72.641</td>
<td>-14.462</td>
<td>91.3</td>
<td>0.47</td>
<td>0.59</td>
<td>0.72</td>
<td>2012</td>
<td>6</td>
<td>28</td>
<td>2</td>
<td>12</td>
<td>5.3</td>
</tr>
<tr>
<td>-71.335</td>
<td>-16.926</td>
<td>74.4</td>
<td>0.23</td>
<td>0.28</td>
<td>0.24</td>
<td>2012</td>
<td>6</td>
<td>30</td>
<td>2</td>
<td>0</td>
<td>13.2</td>
</tr>
<tr>
<td>-72.293</td>
<td>-15.997</td>
<td>106.5</td>
<td>0.47</td>
<td>0.74</td>
<td>0.67</td>
<td>2012</td>
<td>7</td>
<td>1</td>
<td>4</td>
<td>38</td>
<td>6.6</td>
</tr>
<tr>
<td>-69.647</td>
<td>-16.862</td>
<td>164.9</td>
<td>0.26</td>
<td>0.27</td>
<td>0.24</td>
<td>2012</td>
<td>7</td>
<td>1</td>
<td>14</td>
<td>25</td>
<td>59.6</td>
</tr>
<tr>
<td>-75.642</td>
<td>-14.332</td>
<td>51.5</td>
<td>1.39</td>
<td>1.40</td>
<td>1.59</td>
<td>2012</td>
<td>7</td>
<td>3</td>
<td>5</td>
<td>31</td>
<td>16.9</td>
</tr>
<tr>
<td>-73.828</td>
<td>-11.285</td>
<td>53.1</td>
<td>0.51</td>
<td>1.15</td>
<td>1.74</td>
<td>2012</td>
<td>7</td>
<td>4</td>
<td>16</td>
<td>25</td>
<td>10.4</td>
</tr>
<tr>
<td>-69.583</td>
<td>-17.659</td>
<td>140.7</td>
<td>0.21</td>
<td>0.17</td>
<td>0.17</td>
<td>2012</td>
<td>7</td>
<td>4</td>
<td>18</td>
<td>19</td>
<td>12.1</td>
</tr>
<tr>
<td>-70.254</td>
<td>-17.535</td>
<td>96.0</td>
<td>0.51</td>
<td>0.50</td>
<td>0.54</td>
<td>2012</td>
<td>7</td>
<td>9</td>
<td>10</td>
<td>15</td>
<td>33.6</td>
</tr>
<tr>
<td>-75.451</td>
<td>-14.411</td>
<td>57.1</td>
<td>1.79</td>
<td>2.31</td>
<td>2.32</td>
<td>2012</td>
<td>7</td>
<td>9</td>
<td>19</td>
<td>21</td>
<td>57</td>
</tr>
<tr>
<td>-69.549</td>
<td>-16.906</td>
<td>175.1</td>
<td>0.22</td>
<td>0.25</td>
<td>0.23</td>
<td>2012</td>
<td>7</td>
<td>9</td>
<td>20</td>
<td>53</td>
<td>52.6</td>
</tr>
<tr>
<td>-69.549</td>
<td>-16.905</td>
<td>175.3</td>
<td>0.23</td>
<td>0.30</td>
<td>0.25</td>
<td>2012</td>
<td>7</td>
<td>9</td>
<td>20</td>
<td>53</td>
<td>52.4</td>
</tr>
<tr>
<td>-75.831</td>
<td>-12.314</td>
<td>94.4</td>
<td>1.56</td>
<td>1.48</td>
<td>1.62</td>
<td>2012</td>
<td>7</td>
<td>9</td>
<td>21</td>
<td>50</td>
<td>47.9</td>
</tr>
<tr>
<td>-72.537</td>
<td>-15.170</td>
<td>120.7</td>
<td>0.44</td>
<td>0.51</td>
<td>0.52</td>
<td>2012</td>
<td>7</td>
<td>10</td>
<td>18</td>
<td>42</td>
<td>20.6</td>
</tr>
<tr>
<td>-73.098</td>
<td>-14.114</td>
<td>86.8</td>
<td>0.25</td>
<td>0.41</td>
<td>0.33</td>
<td>2012</td>
<td>7</td>
<td>12</td>
<td>5</td>
<td>5</td>
<td>29.7</td>
</tr>
<tr>
<td>-69.783</td>
<td>-17.690</td>
<td>115.1</td>
<td>0.36</td>
<td>0.37</td>
<td>0.35</td>
<td>2012</td>
<td>7</td>
<td>13</td>
<td>0</td>
<td>57</td>
<td>55.7</td>
</tr>
<tr>
<td>-69.325</td>
<td>-18.310</td>
<td>128.1</td>
<td>0.29</td>
<td>0.47</td>
<td>0.42</td>
<td>2012</td>
<td>7</td>
<td>14</td>
<td>5</td>
<td>28</td>
<td>6.6</td>
</tr>
<tr>
<td>-69.997</td>
<td>-17.784</td>
<td>100.0</td>
<td>0.29</td>
<td>0.28</td>
<td>0.28</td>
<td>2012</td>
<td>7</td>
<td>19</td>
<td>3</td>
<td>26</td>
<td>57</td>
</tr>
<tr>
<td>-69.735</td>
<td>-16.640</td>
<td>177.0</td>
<td>0.23</td>
<td>0.26</td>
<td>0.39</td>
<td>2012</td>
<td>7</td>
<td>19</td>
<td>17</td>
<td>16</td>
<td>17.7</td>
</tr>
<tr>
<td>-75.608</td>
<td>-14.359</td>
<td>52.9</td>
<td>1.56</td>
<td>0.96</td>
<td>1.94</td>
<td>2012</td>
<td>7</td>
<td>22</td>
<td>17</td>
<td>9</td>
<td>46.5</td>
</tr>
<tr>
<td>-71.607</td>
<td>-15.255</td>
<td>138.2</td>
<td>0.34</td>
<td>0.36</td>
<td>0.29</td>
<td>2012</td>
<td>7</td>
<td>22</td>
<td>20</td>
<td>33</td>
<td>34.2</td>
</tr>
<tr>
<td>-69.965</td>
<td>-17.869</td>
<td>113.7</td>
<td>0.33</td>
<td>0.42</td>
<td>0.35</td>
<td>2012</td>
<td>7</td>
<td>25</td>
<td>22</td>
<td>28</td>
<td>49.2</td>
</tr>
<tr>
<td>-69.697</td>
<td>-18.022</td>
<td>132.5</td>
<td>0.35</td>
<td>0.37</td>
<td>0.35</td>
<td>2012</td>
<td>7</td>
<td>26</td>
<td>7</td>
<td>36</td>
<td>56.2</td>
</tr>
<tr>
<td>-75.794</td>
<td>-13.394</td>
<td>88.5</td>
<td>4.98</td>
<td>3.57</td>
<td>3.78</td>
<td>2012</td>
<td>7</td>
<td>27</td>
<td>18</td>
<td>41</td>
<td>0.3</td>
</tr>
<tr>
<td>-74.749</td>
<td>-11.386</td>
<td>97.8</td>
<td>0.88</td>
<td>0.63</td>
<td>1.29</td>
<td>2012</td>
<td>7</td>
<td>28</td>
<td>12</td>
<td>43</td>
<td>60</td>
</tr>
<tr>
<td>-69.532</td>
<td>-16.804</td>
<td>180.1</td>
<td>0.32</td>
<td>0.21</td>
<td>0.31</td>
<td>2012</td>
<td>7</td>
<td>31</td>
<td>19</td>
<td>58</td>
<td>31.2</td>
</tr>
<tr>
<td>-75.080</td>
<td>-13.103</td>
<td>93.6</td>
<td>1.53</td>
<td>1.45</td>
<td>1.12</td>
<td>2012</td>
<td>8</td>
<td>3</td>
<td>23</td>
<td>25</td>
<td>8.1</td>
</tr>
<tr>
<td>-74.787</td>
<td>-13.638</td>
<td>97.2</td>
<td>2.17</td>
<td>2.93</td>
<td>2.68</td>
<td>2012</td>
<td>8</td>
<td>8</td>
<td>1</td>
<td>59</td>
<td>15.9</td>
</tr>
<tr>
<td>-75.435</td>
<td>-12.624</td>
<td>93.2</td>
<td>1.42</td>
<td>1.01</td>
<td>1.05</td>
<td>2012</td>
<td>8</td>
<td>16</td>
<td>13</td>
<td>44</td>
<td>31.5</td>
</tr>
<tr>
<td>-75.666</td>
<td>-11.896</td>
<td>101.0</td>
<td>1.18</td>
<td>1.39</td>
<td>1.22</td>
<td>2012</td>
<td>8</td>
<td>31</td>
<td>11</td>
<td>19</td>
<td>46.8</td>
</tr>
<tr>
<td>-75.076</td>
<td>-13.116</td>
<td>97.2</td>
<td>1.77</td>
<td>1.62</td>
<td>1.14</td>
<td>2012</td>
<td>9</td>
<td>1</td>
<td>4</td>
<td>0</td>
<td>7.9</td>
</tr>
<tr>
<td>-75.019</td>
<td>-12.369</td>
<td>90.7</td>
<td>3.14</td>
<td>2.39</td>
<td>2.32</td>
<td>2012</td>
<td>9</td>
<td>1</td>
<td>5</td>
<td>32</td>
<td>19.9</td>
</tr>
<tr>
<td>-74.632</td>
<td>-11.442</td>
<td>91.4</td>
<td>1.21</td>
<td>1.06</td>
<td>1.06</td>
<td>2012</td>
<td>9</td>
<td>8</td>
<td>1</td>
<td>47</td>
<td>38.3</td>
</tr>
<tr>
<td>-75.421</td>
<td>-12.640</td>
<td>92.2</td>
<td>1.51</td>
<td>0.99</td>
<td>0.72</td>
<td>2012</td>
<td>9</td>
<td>8</td>
<td>12</td>
<td>2</td>
<td>57.9</td>
</tr>
<tr>
<td>-75.905</td>
<td>-11.373</td>
<td>105.1</td>
<td>1.81</td>
<td>2.75</td>
<td>2.45</td>
<td>2012</td>
<td>9</td>
<td>24</td>
<td>13</td>
<td>29</td>
<td>15.6</td>
</tr>
<tr>
<td>-75.320</td>
<td>-12.965</td>
<td>101.8</td>
<td>3.31</td>
<td>2.17</td>
<td>1.44</td>
<td>2012</td>
<td>9</td>
<td>26</td>
<td>6</td>
<td>10</td>
<td>51.5</td>
</tr>
<tr>
<td>-73.501</td>
<td>-11.187</td>
<td>64.0</td>
<td>0.69</td>
<td>1.29</td>
<td>0.57</td>
<td>2012</td>
<td>10</td>
<td>9</td>
<td>8</td>
<td>24</td>
<td>10.3</td>
</tr>
<tr>
<td>-73.577</td>
<td>-14.850</td>
<td>88.0</td>
<td>0.29</td>
<td>0.42</td>
<td>0.44</td>
<td>2012</td>
<td>10</td>
<td>15</td>
<td>7</td>
<td>45</td>
<td>8.1</td>
</tr>
<tr>
<td>-75.401</td>
<td>-12.503</td>
<td>91.6</td>
<td>1.03</td>
<td>1.24</td>
<td>1.58</td>
<td>2012</td>
<td>10</td>
<td>16</td>
<td>5</td>
<td>46</td>
<td>57.5</td>
</tr>
<tr>
<td>-75.902</td>
<td>-12.082</td>
<td>107.1</td>
<td>1.19</td>
<td>1.18</td>
<td>1.77</td>
<td>2012</td>
<td>11</td>
<td>4</td>
<td>1</td>
<td>52</td>
<td>11.5</td>
</tr>
<tr>
<td>-75.826</td>
<td>-13.250</td>
<td>54.8</td>
<td>3.56</td>
<td>5.15</td>
<td>3.17</td>
<td>2012</td>
<td>11</td>
<td>4</td>
<td>20</td>
<td>29</td>
<td>38.8</td>
</tr>
<tr>
<td>-75.310</td>
<td>-12.505</td>
<td>87.9</td>
<td>1.13</td>
<td>0.78</td>
<td>1.00</td>
<td>2012</td>
<td>11</td>
<td>7</td>
<td>17</td>
<td>56</td>
<td>17.6</td>
</tr>
<tr>
<td>-74.574</td>
<td>-13.266</td>
<td>78.3</td>
<td>1.40</td>
<td>2.26</td>
<td>1.02</td>
<td>2012</td>
<td>11</td>
<td>13</td>
<td>9</td>
<td>1</td>
<td>39.5</td>
</tr>
<tr>
<td>-76.270</td>
<td>-12.745</td>
<td>63.0</td>
<td>1.64</td>
<td>2.75</td>
<td>1.66</td>
<td>2012</td>
<td>11</td>
<td>14</td>
<td>6</td>
<td>20</td>
<td>11.8</td>
</tr>
<tr>
<td>-76.036</td>
<td>-11.144</td>
<td>110.3</td>
<td>2.36</td>
<td>2.94</td>
<td>2.63</td>
<td>2012</td>
<td>11</td>
<td>17</td>
<td>11</td>
<td>13</td>
<td>32.4</td>
</tr>
<tr>
<td>-75.097</td>
<td>-13.216</td>
<td>90.5</td>
<td>1.81</td>
<td>2.12</td>
<td>1.39</td>
<td>2012</td>
<td>11</td>
<td>26</td>
<td>0</td>
<td>35</td>
<td>31.1</td>
</tr>
<tr>
<td>-74.862</td>
<td>-13.213</td>
<td>79.3</td>
<td>2.21</td>
<td>3.84</td>
<td>2.48</td>
<td>2012</td>
<td>11</td>
<td>29</td>
<td>10</td>
<td>50</td>
<td>36.2</td>
</tr>
<tr>
<td>-72.482</td>
<td>-14.913</td>
<td>117.0</td>
<td>0.54</td>
<td>0.52</td>
<td>0.63</td>
<td>2012</td>
<td>12</td>
<td>10</td>
<td>16</td>
<td>9</td>
<td>41</td>
</tr>
<tr>
<td>-75.197</td>
<td>-12.559</td>
<td>101.0</td>
<td>1.27</td>
<td>1.54</td>
<td>1.31</td>
<td>2012</td>
<td>12</td>
<td>20</td>
<td>5</td>
<td>18</td>
<td>29.5</td>
</tr>
<tr>
<td>-75.902</td>
<td>-11.977</td>
<td>107.5</td>
<td>1.14</td>
<td>1.05</td>
<td>1.16</td>
<td>2012</td>
<td>12</td>
<td>21</td>
<td>5</td>
<td>38</td>
<td>30.7</td>
</tr>
<tr>
<td>-75.466</td>
<td>-12.801</td>
<td>86.5</td>
<td>2.64</td>
<td>1.21</td>
<td>1.71</td>
<td>2012</td>
<td>12</td>
<td>31</td>
<td>4</td>
<td>40</td>
<td>23.1</td>
</tr>
<tr>
<td>-75.113</td>
<td>-13.270</td>
<td>91.3</td>
<td>1.30</td>
<td>3.30</td>
<td>1.94</td>
<td>2013</td>
<td>2</td>
<td>17</td>
<td>17</td>
<td>55</td>
<td>10.1</td>
</tr>
<tr>
<td>-74.409</td>
<td>-13.310</td>
<td>71.4</td>
<td>2.11</td>
<td>2.83</td>
<td>2.23</td>
<td>2013</td>
<td>3</td>
<td>8</td>
<td>20</td>
<td>0</td>
<td>47.9</td>
</tr>
<tr>
<td>-74.094</td>
<td>-11.018</td>
<td>109.8</td>
<td>1.79</td>
<td>1.83</td>
<td>2.37</td>
<td>2013</td>
<td>3</td>
<td>27</td>
<td>20</td>
<td>59</td>
<td>27.5</td>
</tr>
<tr>
<td>-74.780</td>
<td>-11.523</td>
<td>93.5</td>
<td>1.44</td>
<td>1.47</td>
<td>1.58</td>
<td>2013</td>
<td>4</td>
<td>7</td>
<td>10</td>
<td>53</td>
<td>47</td>
</tr>
<tr>
<td>-75.980</td>
<td>-12.288</td>
<td>104.2</td>
<td>2.09</td>
<td>1.82</td>
<td>2.48</td>
<td>2013</td>
<td>4</td>
<td>10</td>
<td>7</td>
<td>11</td>
<td>14.7</td>
</tr>
<tr>
<td>-75.843</td>
<td>-13.708</td>
<td>72.3</td>
<td>2.12</td>
<td>1.97</td>
<td>3.52</td>
<td>2013</td>
<td>4</td>
<td>21</td>
<td>9</td>
<td>39</td>
<td>59</td>
</tr>
<tr>
<td>-75.688</td>
<td>-11.854</td>
<td>100.1</td>
<td>1.16</td>
<td>1.81</td>
<td>0.97</td>
<td>2013</td>
<td>4</td>
<td>28</td>
<td>15</td>
<td>28</td>
<td>13.9</td>
</tr>
<tr>
<td>-76.041</td>
<td>-12.636</td>
<td>87.5</td>
<td>3.70</td>
<td>3.75</td>
<td>4.93</td>
<td>2013</td>
<td>5</td>
<td>3</td>
<td>15</td>
<td>59</td>
<td>48.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------</td>
<td>-------</td>
<td>-----</td>
<td>---</td>
<td>---</td>
<td>-----</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-72.657</td>
<td>-13.908</td>
<td>86.6</td>
<td>0.32</td>
<td>0.42</td>
<td>0.41</td>
<td>2013</td>
<td>5</td>
<td>21</td>
<td>23</td>
<td>2</td>
<td>42.4</td>
</tr>
<tr>
<td>-75.257</td>
<td>-12.891</td>
<td>88.5</td>
<td>3.05</td>
<td>1.77</td>
<td>2.56</td>
<td>2013</td>
<td>5</td>
<td>25</td>
<td>16</td>
<td>4</td>
<td>42.3</td>
</tr>
<tr>
<td>-75.191</td>
<td>-12.917</td>
<td>95.6</td>
<td>2.54</td>
<td>1.69</td>
<td>1.17</td>
<td>2013</td>
<td>6</td>
<td>7</td>
<td>3</td>
<td>22</td>
<td>23.3</td>
</tr>
</tbody>
</table>
REFERENCES


Chapter 2: Stress distribution in the southern Peru subduction zone

ABSTRACT

The downgoing Nazca Plate beneath central and southern Peru and northern Bolivia exhibits strong along-strike variability in slab geometry, from flat slab subduction north of 15 °S, to uniform normal subduction south of 15 °S. This flat slab geometry has often been linked to the subduction of the Nazca Ridge. I use data collected from three recently deployed local broadband seismic networks to determine the state of stress of the subducting Nazca slab between 9° and 18°S. I obtained high quality focal mechanisms for ~173 slab events to better understand how the slab is deforming along strike. My T-axes immediately south of the Nazca Ridge are oriented parallel to the contorted slab geometry, down dip from the ridge. This observation is independent of convergence direction, slab morphology, or trench orientation. Down dip tension is consistent with a highly deformed, but not torn, subducting slab between the normally dipping plate and the flat slab along the Nazca Ridge. North of the Nazca Ridge, the T-axes are largely ridge-parallel in map view, but with a distinct downward dip that is not parallel to the slab. These steeply dipping T-axes differ from the expected stress pattern for a fully supported flat slab and indicate that the flat slab north of the ridge may not stable.

1. INTRODUCTION

The subducting oceanic Nazca Plate beneath South America exhibits strong along-strike variability in its geometry (Isacks & Molnar, 1971; Stauder, 1975; Barazangi & Isacks, 1976; Bevis & Isacks, 1984; Schneider & Sacks, 1987; Cahill and Isacks, 1992; Dougherty &
Clayton, 2014). One example of a pronounced change in subduction geometry can be found at ~15 °S. (Barazangi & Isacks, 1976; Isacks & Barazangi, 1977; Hasegawa & Sacks, 1981; Cahill & Isacks, 1992; James and Sacks, 1999; Hayes et al., 2012, Phillips & Clayton, 2014). North of 15 °S, the Nazca Plate descends at an approximately 30° dip angle near the trench, but then assumes a nearly horizontal orientation at ~100 km depth. This “flat slab” geometry extends for almost 700 km inboard beneath the South American lithosphere before resuming its normal descent. In contrast, just south of 15 °S, the Wadati-Benioff zone (WBZ) has a constant dip of ~30° to at least 270 km depth (Sacks, 1983; McGeary et al., 1985; Schneider & Sacks, 1987; Cahill & Isacks, 1992). This flat slab geometry has commonly been linked to the subduction of buoyant aseismic ridges, but the exact cause of flattening is still a matter of debate (See Chapter 1 for more detailed list of contributing factors that might be playing a role in the formation of the flat slab). In southern Peru, the subducting Nazca Ridge is located at the southern edge of the Peruvian flat slab, and has been proposed to be a likely contributor to the formation of the flat slab in this region (Sacks, 1983; Gutscher et al., 2000; van Hunen et al., 2002; Arrial & Billen, 2013). Recent tomography and seismicity studies show the flat slab extending further inboard than previously reported, and show the associated WBZ to be shallowest along the projected location of the subducted Nazca Ridge (Refer: Figure 1.13, Chapter 1) (Knezevic Antonijevic et al., 2015; Kumar et al., 2015).

Although historically there have been debates over whether the change in dip angle in southern Peru is accommodated by deformation in the slab or by a slab tear, recent studies have consistently favored a continuous contortion of the Nazca plate (Stauder, 1975; Barazangi & Isacks, 1976; Hasegawa & Sacks, 1981; Bevis & Isacks, 1984). Schneider & Sacks (1987) use composite focal mechanisms and observe a fan-shaped trend in T-axes
pointing down dip in all directions between the flat slab and normally dipping slab in southern Peru, consistent with extensional deformation of a continuous plate. A recent analysis of teleseismic receiver function also indicates gentle bending as opposed to slab tearing in southern Peru (Phillips & Clayton, 2014). A detailed stress analysis based on high quality focal mechanisms, north and south of the Nazca Ridge, will help us better understand the nature of along-strike variation in the slab deformation.

Global studies of the WBZ worldwide suggest that intermediate depth earthquakes are associated with the crust and shallow upper mantle of the downgoing slab (Kirby 1995; Kirby et al. 1996; Abers, 1996; Hacker et al., 2003). Although the exact cause of intermediate depth seismicity is still being debated, temperature dependent metamorphic dehydration reactions likely play a significant role in the occurrence of these events (Green & Houston, 1995; Kirby et al., 1996; Peacock, 2001; Hacker et al., 2003; Omori et al., 2004; Kirby et al., 2006; Faccenda, 2014). With continued descent, the slab undergoes changes in pressure and temperature, which facilitates the basalt to eclogite transformation in the slab (Peacock, 1993; Kirby et al., 1996; Hacker et al., 2003). Kirby et al. (1996) use finite element models to demonstrate a significant change in the slab stress state (extensional stresses) due to this densification (basalt→eclogite) reaction. This, along with other tectonic forces (e.g. ridge push and slab pull), dominantly affects the slab stress state. The focal mechanisms and P and T-axes orientations of the WBZ earthquakes should allow us to infer the stress state of the subducting slab and may provide some information about the forces prevalent in the subduction zones (Isacks & Molnar, 1971; Stauder, 1975; Schneider & Sacks, 1987; Dougherty & Clayton, 2014).
Previous focal mechanism studies and stress analyses of the WBZ in southern Peru were mainly focused on the transition between normal and flat subduction (Isacks & Molnar, 1971; Stauder, 1975; Schneider & Sacks, 1987). However, north of 15° S in the Peruvian flat slab region, no stress analyses of the WBZ have been carried out using local data and the best available results are mainly obtained using teleseismic arrivals (Isacks & Molnar, 1971; Stauder 1975). I present 173 high quality focal mechanism solutions and stress analyses for four different sub-regions, spanning the flat slab in the north, to uniform normal subduction in the south. My observed stress patterns are consistent with a sagging older flat slab north of the ridge and dominant slab extension associated with change in the geometry of subduction immediately south of the ridge.

2. DATA AND METHOD

Focal mechanism

I use P-wave first motion polarity data of relocated earthquakes recorded at temporary broadband stations from three seismic arrays, CAUGHT, PULSE and PERUSE (Refer: Figure 1.1 and data section of Chapter 1 for complete description of the seismic networks). I determine the best fitting double-couple fault plane solution (Table 2.1) using FPFIT (Reasenberg & Oppenheimer, 1985), included in the software package SEISAN (Ottemöeller et al., 2011). The program determines the double-couple fault plane solution that best fits a given set of P wave first motion polarities for each individual earthquake. It estimates source model parameters (strike, dip and rake) through a two-step grid search by iteratively minimizing the weighted sum of first motion polarity errors. FPFIT does not consider non-double-couple solutions so my obtained focal mechanisms are always pure double-couples. I perform an initial grid search at coarse increments of 20° in strike, dip and rake and then use
a finer grid of 1° increments to determine the best fitting solution. I determine 308 focal mechanism solutions after the second step grid search. Solutions with sparse polarity readings and those for which all readings are close to nodal planes are not included in further analyses. Of the 308 focal mechanism solutions, 173 solutions were selected with the following characteristics: at least 10 polarity readings, a maximum of 2 incorrect polarities and a maximum 10° error in strike and dip and 20° error in rake. Figure 2.1 shows an example of a well-determined focal mechanism solution, where I observed an excellent agreement between the first motion polarities and the nodal plane position. After determining the strike, dip and rake of the fault planes from FPFIT, I used RFOC to calculate the P and T-axes orientations (Figs 2.4 and 2.8; Table 2.2) of 173 intermediate depth earthquakes.

3. RESULTS

I determine 173 well-constrained focal mechanisms with average polarity readings of 12 per event. The results of my focal mechanism analyses indicate a predominance of normal faulting across my study area (Figure 2.2). Figure 2.3 shows the classification of focal mechanisms in normal, oblique normal, thrust and oblique thrust, based on the rake angle. The majority of my events (62%) have normal mechanisms with some strike-slip component. This suggests that slab bending and/or slab pull is the dominant mechanism of deformation across my study area. However, individual areas show variations depending on the local slab geometry.

In order to systematically investigate the stress state of the slab, I divide my study area into four regions from south to north depending upon the slab geometry (Figure 2.4). Box 1 includes all the events of cluster A, where the “normal” slab has a consistent dip angle. Box 2 covers the contorted region between flat subduction in the north and steep subduction
in the south. Box 3 comprises those events located in the flat slab just south of the Nazca Ridge and Box 4 includes all of the events north of the projected ridge track.

For Box 1, first motion focal mechanism solutions are dominantly normal and indicating E-W and NE-SW extension (Figs 2.2 and 2.3). The rose diagram shows a dominant E-W to NE-SW trend in the T-axes orientations, nearly perpendicular to the strike of the trench (Figure 2.5a). There is a noticeable rotation of the T-axis orientations from contour perpendicular to contour parallel at depths of greater than 170km (Figure 2.4). A recent study of Dougherty & Clayton (2014) also suggests similar rotation in T-axis orientations, with increasing depth, for this region. The T-axes are dominantly oriented E-W at shallow depth (<170 km) (Figure 2.5b). At greater depth (>170km), the T-axes are directed along NNW-SSE and nearly parallel to the local slab contour (Figure 2.5c).

For events in Box 2 (Figure 2.4), the focal mechanisms are much more variable (Figs. 2.2 and 2.3). In map view, I see a well-distributed range of T-axis orientations (Figs. 2.4 and 2.6a). The even distribution of directions corresponds to the abrupt local change in the downdip direction of the slab across the transition region (15°S-17°S) that extends from WNW to SSE. In addition, I see a rotation in T-axis orientations at depth, similar to what is seen in Box 1.

The flat slab region just south of the Nazca Ridge (area inside Box 3, Figure 2.4) is characterized by normal faulting, with focal planes mainly oriented in NE-SW direction, indicating NW-SE extension (Figs. 2.2 and 2.3). The T-axes are nearly horizontal and therefore parallel to the flat slab (cross-section SS’, Figure 2.7). I see a dominant trend of T-axis orientations to the ESE (Figs. 2.4 and 2.6b), which is downdip from the Nazca ridge and directed towards the contortion in the slab. This is similar to the observations of Anderson et
al. (2007) for T-axis orientations in the central Chile flat slab adjacent to the subducted Juan Fernandez Ridge.

There is a significant difference in the T-axis orientations between those observed just south of the ridge (Box 3, Figure 2.4) and those observed just north of the ridge (Box 4, Figure 2.4). While the T-axes south of the ridge are dominantly oriented obliquely to the ridge, events north of the ridge have T-axes orientations oriented towards the northeast, perpendicular to the trench and nearly parallel to the ridge track (Figs 2.4 and 2.6c). The T-axes are also not horizontal but rather dip down to the northeast (cross-section NN’, Figure 2.7).

4. DISCUSSION

In normal subduction zones, T-axes associated with intermediate depth seismicity usually follow the downdip direction of the subducting slab (Stauder, 1975; Schneider & Sacks, 1987; Vassiliou & Hager, 1988; Cahill & Isacks, 1992). This has also been shown to be the case near the central Chilean flat slab, where all T-axis orientations point down-dip from the horizontally subducting Juan Fernandez ridge track (Anderson et al., 2007, Linkimer, 2011). The geometry of the central Chilean flat slab also closely follows the projected location of the subducted ridge (Linkimer, 2011). In Chile, unlike in Peru, the ridge has been parallel to the convergence direction for last 10 Ma, resulting in no significant southward migration along the trench during that time (Yanez et al., 2001). In Peru, the flat slab extends significantly north of the ridge due to the difference in convergence direction and the trend of the Nazca Ridge. I would therefore expect a difference in the slab stress state between Peru and Chile north of the ridge track, but not south of the ridge track. Indeed, I note that south of the ridge, the T-axis orientations are downdip, consistent with extension
caused by the deformation of the Nazca plate between the normally dipping portion beneath Bolivia and the flat slab at the ridge (cross-section SS’, Figs 2.7 and 2.4). My observations agree with the regional stress pattern observed by Schneider & Sacks (1987) and Cahill & Isacks (1992) for the same area.

Recent results looking at seismicity distribution, source mechanisms, and teleseismic receiver functions indicate that the change in dip angle from flat to normal along the southern margin of the Peruvian flat slab is accommodated by deformation, not tearing, of the subducted plate (Phillips & Clayton, 2014; Dougherty & Clayton, 2014). As discussed in Chapter 1, the Peruvian flat slab evolved over the last 11.2 Ma as the Nazca Ridge migrated southward from 11°S to 15°S (Hampel, 2002). Knezevic Antonijevic et al. (2015) suggest that the combination of hydrodynamic slab suction and trench retreat can only support the flat slab for a limited amount of time once the ridge has migrated further south. If the older flat slab north of the ridge is stable then I should expect to see horizontal, trench perpendicular T-axes. If the flat slab to the north is entirely unstable, I would expect to see similar T-axis orientations as I see south of the ridge: parallel to the dip direction, oriented orthogonally to the ridge track. What I observe is a combination of the two. North of the ridge, the T-axes are largely ridge-parallel (Figure 2.4), consistent remnant support provided the flat slab by suction between the slab and the overriding continent. However, these T-axes differ from what would be expected from a fully supported flat slab in that their dip is not slab parallel (horizontal), as is the case everywhere else, but rather has a distinct downward dip component (cross-section NN’, Figure 2.7).

As discussed in Chapter 1, I observed subtle deepening of events north of the ridge. This combined with steeply dipping T-axes suggest that the older flat slab north of the ridge
is perhaps not stable due to reduced support from the ridge buoyancy and may suffer a trench parallel tear (shaded pink area, Figure 2.4). Recently, Knezevic Antonijevic et al. (2015) also observe a dipping high velocity anomaly under a dipping low velocity anomaly, north of the ridge and interpreted it as a tear in the slab and reinitiation of normal subduction west of this tear. Some of the down-dipping T-axes, north of the ridge, are associated with events that are west of this tear and may be occurring in the newly steepened slab (Figure 2.4). My observation indicates that the T-axes west of the tear are pointing in the downdip direction of this newly steepened slab. East of the tear, the down-dipping T-axes are associated with the remnant flat slab (RFS). These steeply dipping T-axes in the RFS region indicate that the slab to the east of the tear is only being partially supported by suction and trench rollback and may be starting to sink. The downdip component of force due to the negative buoyancy of the ridge-free slab results in dipping the T-axes east of the tear. This implies that as the ridge buoyancy drops below a critical threshold due to southward migration of the ridge trench retreat and slab suction alone are not sufficient to maintain stability of the flat slab in the north.

Within the normally dipping slab south of the flat slab (Box 1, Figure 2.4), the state of stress varies with depth. The T-axes from events with hypocentral depths < 170 km are roughly trench normal and are aligned roughly parallel to the slab dip. This is consistent with slab pull as has previously been suggested in other studies (Stauder, 1975; Cahill & Isacks, 1992; Araujo & Suarez, 1994). At greater depths (>170 km), the T-axes for my events are roughly contour parallel. I observed corresponding change in the P-axes orientation from contour parallel at shallow depth (< 170 km) to contour perpendicular at greater depth (>170 km). Anderson et al. (2007) also found contour parallel T-axis orientations in central Chile at
intermediate depths (120-140 km) and interpreted it as strain partitioning on pre-existing faults related to the outer-rise bending. Previous studies suggest that the slab dehydration reactions lead to an increase in pore pressure and facilitate slip along preexisting weak zones under the action of ambient stress field (Raleigh & Paterson, 1965; Jiao et al., 2000, Ranero et al., 2005). If the descending slab contains uniformly oriented faults and fractures, their reactivation at all depth should give similar fault plane orientation and possibly similar P and T axes, provided the ambient stress field is same (Warren et al., 2007). The global bathymetry model of Becker et al. (2009) clearly indicates a complex distribution of variably oriented fractures and faults on the sea floor, off the coast of southern Peru. It is possible that the variation in individual T and P axes orientation with depth is either related to the slip along subducted faults and fractures, that are equally variable in orientation or it may be the result of change in ambient stress field with depth.

5. CONCLUSIONS

My current study indicates that slab pull is the dominant contributor in the observed stress pattern across my study area in southern Peru and northern Bolivia. However, given the changes in slab geometry in this region, the orientation of my T-axes varies greatly. My conclusions from these orientations are as follows:

1) The steeply dipping T-axes north of the Nazca Ridge indicate that theolder flat slab north of the ridge is not stable and is likely beginning to founder. The fact that the T-axis orientations are not orthogonal to the ridge as they are further south suggest that the slab is partially (though not sufficiently) supported by other forces such as trench rollback and suction.
2) The downdip orientation of T-axes in the transitional region between the flat and normally dipping segments is consistent with extension along a continuous but highly deformed slab. I find no evidence for slab tearing in this study.

3) The change in T-axis orientations in the normally dipping slab as a function of depth indicates a change from down dip extension to slab contour parallel extension. This change in T-axes orientation is either related to slip along variably oriented faults and fractures inherited by the slab or changes in the ambient stress field with depth.

6. ACKNOWLEDGMENTS

We are thankful to IRIS and personnel at the PASSCAL Instrument Center for their help and support throughout the CAUGHT and PULSE deployment. The seismic instruments were provided by the UNC-Chapel Hill, Yale University and Incorporated Research Institutions for Seismology (IRIS) through the PASSCAL Instrument Center. I sincerely thank Dr. Hernando Tavera, Director, Instituto Geofísico del Perú, Lima, Peru, and C. Condori Quispe for their help in deployment and demobilization efforts, as well as Mike (PASSCAL) for his invaluable assistance in the field. The CAUGHT experiment was supported by NSF grants EAR-0908777 (Lara Wagner) and EAR-0907880 (Susan Beck). The PULSE experiment was funded by NSF grants EAR-0944184 (Lara Wagner), EAR-0943991 (Susan Beck), and EAR-0943962 (Maureen Long). Special thanks to Kevin Stewart, C. Berk Biryol, S. Knezevic Antonijevic, and Linda M. Warren for helpful discussions. Maps were created using the Generic Mapping Tools (GMT) software [Wessel and Smith, 1998].
Figure 2.1- An example of a high-quality focal mechanism solution (lower hemisphere projection) determined from first motion polarity at 36 stations. Red dots indicate compression (up) arrival and black dots tensional (down) arrival. P-waveform used to determine this solution is shown with marked position of first arrival (red vertical line).
Figure 2.2- Map of first motion focal mechanisms plotted in a lower hemisphere projection. Mechanisms are color coded by earthquake depth and mainly show normal faulting across the study area.
Figure 2.3- Focal mechanism solutions plotted as a function of rake angle. Mechanisms are color coded by earthquake depth. Solid lines are slab contours from Cahill & Isacks (1992).
Figure 2.4- Map showing T-axes orientations determined from focal mechanism solutions. Length of the T-axes segment is proportional to the dip of T-axes, with smaller segments representing steeper T-axes. Black dots indicate the location of associated slab events. Colored boxes divide the study area into four different regions based on the geometry of subduction. Solid black lines are the slab contour based on my seismicity study and recent tomography results of Knezevic Antonijevic et al. (2015) and Scire et al. (2015), as outlined in Chapter 1. Dashed black lines are contours from Cahill & Isacks (1992). Shaded pink area, north of the projected track, marks the approximate position of trench parallel tear based on seismicity and Raleigh wave results of Knezevic Antonijevic et al. (2015).
Figure 2.5- (a) Rose diagram for all events in box 1. (b) rose diagram for shallow events (<170 km depth) in box 1. (c) rose diagram for deep events (>170 km depth) in box 1.
Figure 2.6- (a-c) Rose diagram for events in box 2-4.
Figure 2.7 - T-axis cross sections. Location of cross sections SS’ (south of the Nazca Ridge) and NN’ (north of the Nazca Ridge) are shown in Figure 2.4. Open circles are earthquakes and the projected T-axes are shown as colored sticks. Color of the T-axes varies as a function of azimuth and same as in Figure 2.4. The solid black line in each cross section is my new slab contour.
Figure 2.8- Map showing P-axes (blue segments) orientations determined from focal mechanism solutions. Length of the P-axes segment is proportional to the dip of P-axes, with smaller segments representing steeper P-axes. Black dots indicate the location of associated slab events. Solid lines are slab contours based on my seismicity study and recent results of Rayleigh wave (Knezevic Antonijevic et al., 2015) and teleseismic body wave tomography (Scire et al., 2014). Dashed black lines are slab contours from Cahill & Isacks (1992).
Table 2.1. Best fitting double couple fault plane solutions for 173 intermediate depth events

<table>
<thead>
<tr>
<th>Longitude</th>
<th>Latitude</th>
<th>Depth</th>
<th>Strike</th>
<th>Err Strike</th>
<th>Dip</th>
<th>Err Dip</th>
<th>Rake</th>
<th>Err Rake</th>
</tr>
</thead>
<tbody>
<tr>
<td>-69.636</td>
<td>-17.607</td>
<td>128.9</td>
<td>143</td>
<td>9</td>
<td>20</td>
<td>0</td>
<td>111</td>
<td>10</td>
</tr>
<tr>
<td>-69.917</td>
<td>-17.289</td>
<td>125.2</td>
<td>11</td>
<td>5</td>
<td>49</td>
<td>3</td>
<td>82</td>
<td>3</td>
</tr>
<tr>
<td>-69.353</td>
<td>-17.375</td>
<td>156.7</td>
<td>-55</td>
<td>8</td>
<td>90</td>
<td>1</td>
<td>138</td>
<td>1</td>
</tr>
<tr>
<td>-69.456</td>
<td>-17.608</td>
<td>151.3</td>
<td>125</td>
<td>6</td>
<td>88</td>
<td>1</td>
<td>138</td>
<td>1</td>
</tr>
<tr>
<td>-69.365</td>
<td>-18.191</td>
<td>128.2</td>
<td>147</td>
<td>3</td>
<td>78</td>
<td>5</td>
<td>147</td>
<td>7</td>
</tr>
<tr>
<td>-69.630</td>
<td>-17.600</td>
<td>146.5</td>
<td>63</td>
<td>9</td>
<td>31</td>
<td>1</td>
<td>169</td>
<td>10</td>
</tr>
<tr>
<td>-70.053</td>
<td>-17.103</td>
<td>137.4</td>
<td>42</td>
<td>3</td>
<td>48</td>
<td>4</td>
<td>172</td>
<td>18</td>
</tr>
<tr>
<td>-69.542</td>
<td>-16.568</td>
<td>186.7</td>
<td>129</td>
<td>1</td>
<td>17</td>
<td>4</td>
<td>142</td>
<td>2</td>
</tr>
<tr>
<td>-69.330</td>
<td>-17.698</td>
<td>159.7</td>
<td>138</td>
<td>8</td>
<td>88</td>
<td>6</td>
<td>154</td>
<td>3</td>
</tr>
<tr>
<td>-69.423</td>
<td>-17.323</td>
<td>152.1</td>
<td>128</td>
<td>9</td>
<td>88</td>
<td>1</td>
<td>137</td>
<td>2</td>
</tr>
<tr>
<td>-69.399</td>
<td>-17.740</td>
<td>142.3</td>
<td>100</td>
<td>5</td>
<td>77</td>
<td>6</td>
<td>38</td>
<td>15</td>
</tr>
<tr>
<td>-70.063</td>
<td>-17.140</td>
<td>135.3</td>
<td>2</td>
<td>5</td>
<td>58</td>
<td>5</td>
<td>151</td>
<td>8</td>
</tr>
<tr>
<td>-69.715</td>
<td>-17.750</td>
<td>135.0</td>
<td>17</td>
<td>2</td>
<td>60</td>
<td>7</td>
<td>42</td>
<td>3</td>
</tr>
<tr>
<td>-69.746</td>
<td>-17.405</td>
<td>148.3</td>
<td>-25</td>
<td>5</td>
<td>90</td>
<td>0</td>
<td>127</td>
<td>7</td>
</tr>
<tr>
<td>-69.412</td>
<td>-17.340</td>
<td>155.6</td>
<td>99</td>
<td>7</td>
<td>52</td>
<td>5</td>
<td>163</td>
<td>10</td>
</tr>
<tr>
<td>-69.828</td>
<td>-17.396</td>
<td>126.8</td>
<td>-45</td>
<td>10</td>
<td>90</td>
<td>2</td>
<td>155</td>
<td>9</td>
</tr>
<tr>
<td>-69.663</td>
<td>-16.760</td>
<td>166.9</td>
<td>-63</td>
<td>4</td>
<td>90</td>
<td>5</td>
<td>138</td>
<td>2</td>
</tr>
<tr>
<td>-69.940</td>
<td>-17.332</td>
<td>128.4</td>
<td>30</td>
<td>5</td>
<td>58</td>
<td>4</td>
<td>97</td>
<td>9</td>
</tr>
<tr>
<td>-69.672</td>
<td>-16.573</td>
<td>191.6</td>
<td>27</td>
<td>9</td>
<td>72</td>
<td>5</td>
<td>142</td>
<td>3</td>
</tr>
<tr>
<td>-69.671</td>
<td>-16.575</td>
<td>190.9</td>
<td>27</td>
<td>9</td>
<td>72</td>
<td>5</td>
<td>142</td>
<td>3</td>
</tr>
<tr>
<td>-69.602</td>
<td>-17.540</td>
<td>151.8</td>
<td>104</td>
<td>5</td>
<td>88</td>
<td>4</td>
<td>18</td>
<td>1</td>
</tr>
<tr>
<td>-69.861</td>
<td>-17.230</td>
<td>131.3</td>
<td>147</td>
<td>3</td>
<td>58</td>
<td>10</td>
<td>163</td>
<td>7</td>
</tr>
<tr>
<td>-69.855</td>
<td>-16.367</td>
<td>186.1</td>
<td>28</td>
<td>7</td>
<td>25</td>
<td>8</td>
<td>158</td>
<td>3</td>
</tr>
<tr>
<td>-69.330</td>
<td>-18.102</td>
<td>128.0</td>
<td>139</td>
<td>6</td>
<td>53</td>
<td>4</td>
<td>102</td>
<td>4</td>
</tr>
<tr>
<td>-69.829</td>
<td>-17.242</td>
<td>129.8</td>
<td>-72</td>
<td>10</td>
<td>90</td>
<td>0</td>
<td>132</td>
<td>5</td>
</tr>
<tr>
<td>-69.433</td>
<td>-15.951</td>
<td>235.4</td>
<td>78</td>
<td>7</td>
<td>72</td>
<td>3</td>
<td>118</td>
<td>2</td>
</tr>
<tr>
<td>-69.432</td>
<td>-15.951</td>
<td>235.3</td>
<td>78</td>
<td>7</td>
<td>72</td>
<td>3</td>
<td>118</td>
<td>2</td>
</tr>
<tr>
<td>-69.556</td>
<td>-16.848</td>
<td>173.8</td>
<td>44</td>
<td>3</td>
<td>64</td>
<td>4</td>
<td>163</td>
<td>4</td>
</tr>
<tr>
<td>-69.604</td>
<td>-16.670</td>
<td>186.2</td>
<td>18</td>
<td>8</td>
<td>60</td>
<td>2</td>
<td>162</td>
<td>10</td>
</tr>
<tr>
<td>-69.491</td>
<td>-17.513</td>
<td>137.0</td>
<td>0</td>
<td>0</td>
<td>66</td>
<td>4</td>
<td>148</td>
<td>5</td>
</tr>
<tr>
<td>-69.537</td>
<td>-17.752</td>
<td>132.7</td>
<td>26</td>
<td>2</td>
<td>84</td>
<td>5</td>
<td>62</td>
<td>3</td>
</tr>
<tr>
<td>-69.538</td>
<td>-17.751</td>
<td>132.7</td>
<td>26</td>
<td>2</td>
<td>84</td>
<td>5</td>
<td>62</td>
<td>3</td>
</tr>
<tr>
<td>-69.537</td>
<td>-17.752</td>
<td>132.7</td>
<td>26</td>
<td>2</td>
<td>84</td>
<td>5</td>
<td>62</td>
<td>3</td>
</tr>
<tr>
<td>-69.659</td>
<td>-17.391</td>
<td>136.7</td>
<td>160</td>
<td>1</td>
<td>89</td>
<td>1</td>
<td>131</td>
<td>15</td>
</tr>
<tr>
<td>-69.450</td>
<td>-16.480</td>
<td>194.3</td>
<td>13</td>
<td>6</td>
<td>90</td>
<td>0</td>
<td>142</td>
<td>3</td>
</tr>
<tr>
<td>-69.642</td>
<td>-15.887</td>
<td>226.4</td>
<td>73</td>
<td>4</td>
<td>18</td>
<td>4</td>
<td>110</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
</tr>
<tr>
<td>72.017</td>
<td>-15.104</td>
<td>128.6</td>
<td>-45</td>
<td>10</td>
<td>90</td>
<td>2</td>
<td>-138</td>
<td>15</td>
</tr>
<tr>
<td>71.714</td>
<td>-15.654</td>
<td>141.2</td>
<td>158</td>
<td>5</td>
<td>78</td>
<td>9</td>
<td>158</td>
<td>9</td>
</tr>
<tr>
<td>72.166</td>
<td>-15.154</td>
<td>119.7</td>
<td>20</td>
<td>5</td>
<td>48</td>
<td>6</td>
<td>-71</td>
<td>7</td>
</tr>
<tr>
<td>71.797</td>
<td>-14.758</td>
<td>117.0</td>
<td>108</td>
<td>4</td>
<td>64</td>
<td>7</td>
<td>77</td>
<td>3</td>
</tr>
<tr>
<td>70.683</td>
<td>-15.322</td>
<td>206.4</td>
<td>66</td>
<td>7</td>
<td>60</td>
<td>1</td>
<td>118</td>
<td>5</td>
</tr>
<tr>
<td>70.924</td>
<td>-16.687</td>
<td>123.6</td>
<td>0</td>
<td>3</td>
<td>70</td>
<td>1</td>
<td>-102</td>
<td>4</td>
</tr>
<tr>
<td>71.198</td>
<td>-16.521</td>
<td>111.6</td>
<td>3</td>
<td>8</td>
<td>52</td>
<td>6</td>
<td>-109</td>
<td>7</td>
</tr>
<tr>
<td>71.767</td>
<td>-15.035</td>
<td>133.2</td>
<td>160</td>
<td>1</td>
<td>78</td>
<td>9</td>
<td>-22</td>
<td>9</td>
</tr>
<tr>
<td>71.767</td>
<td>-15.035</td>
<td>133.2</td>
<td>160</td>
<td>1</td>
<td>78</td>
<td>9</td>
<td>-22</td>
<td>9</td>
</tr>
<tr>
<td>71.767</td>
<td>-15.035</td>
<td>133.2</td>
<td>160</td>
<td>1</td>
<td>78</td>
<td>9</td>
<td>-22</td>
<td>9</td>
</tr>
<tr>
<td>71.565</td>
<td>-15.539</td>
<td>143.0</td>
<td>90</td>
<td>5</td>
<td>74</td>
<td>6</td>
<td>138</td>
<td>5</td>
</tr>
<tr>
<td>71.842</td>
<td>-15.189</td>
<td>129.7</td>
<td>83</td>
<td>2</td>
<td>49</td>
<td>2</td>
<td>-123</td>
<td>2</td>
</tr>
<tr>
<td>70.537</td>
<td>-15.407</td>
<td>202.6</td>
<td>38</td>
<td>7</td>
<td>63</td>
<td>2</td>
<td>-104</td>
<td>2</td>
</tr>
<tr>
<td>70.315</td>
<td>-15.451</td>
<td>210.0</td>
<td>28</td>
<td>4</td>
<td>31</td>
<td>10</td>
<td>-168</td>
<td>8</td>
</tr>
<tr>
<td>71.554</td>
<td>-16.128</td>
<td>120.0</td>
<td>122</td>
<td>10</td>
<td>88</td>
<td>5</td>
<td>118</td>
<td>15</td>
</tr>
<tr>
<td>71.887</td>
<td>-17.057</td>
<td>64.8</td>
<td>72</td>
<td>7</td>
<td>68</td>
<td>5</td>
<td>-180</td>
<td>20</td>
</tr>
<tr>
<td>71.616</td>
<td>-15.909</td>
<td>122.3</td>
<td>0</td>
<td>15</td>
<td>43</td>
<td>15</td>
<td>-122</td>
<td>17</td>
</tr>
<tr>
<td>70.285</td>
<td>-15.631</td>
<td>207.6</td>
<td>112</td>
<td>5</td>
<td>69</td>
<td>3</td>
<td>56</td>
<td>8</td>
</tr>
<tr>
<td>70.194</td>
<td>-15.569</td>
<td>212.3</td>
<td>0</td>
<td>8</td>
<td>8</td>
<td>7</td>
<td>-122</td>
<td>20</td>
</tr>
<tr>
<td>70.504</td>
<td>-15.558</td>
<td>200.3</td>
<td>10</td>
<td>1</td>
<td>63</td>
<td>4</td>
<td>-173</td>
<td>4</td>
</tr>
<tr>
<td>73.610</td>
<td>-14.568</td>
<td>87.1</td>
<td>58</td>
<td>4</td>
<td>38</td>
<td>7</td>
<td>-62</td>
<td>2</td>
</tr>
<tr>
<td>73.146</td>
<td>-14.182</td>
<td>74.5</td>
<td>143</td>
<td>3</td>
<td>85</td>
<td>6</td>
<td>174</td>
<td>4</td>
</tr>
<tr>
<td>72.789</td>
<td>-14.175</td>
<td>84.7</td>
<td>138</td>
<td>10</td>
<td>38</td>
<td>9</td>
<td>-102</td>
<td>6</td>
</tr>
<tr>
<td>73.679</td>
<td>-14.101</td>
<td>76.0</td>
<td>14</td>
<td>10</td>
<td>51</td>
<td>5</td>
<td>-122</td>
<td>16</td>
</tr>
<tr>
<td>71.966</td>
<td>-15.192</td>
<td>122.2</td>
<td>156</td>
<td>4</td>
<td>68</td>
<td>7</td>
<td>158</td>
<td>19</td>
</tr>
<tr>
<td>71.893</td>
<td>-16.031</td>
<td>108.8</td>
<td>88</td>
<td>3</td>
<td>78</td>
<td>10</td>
<td>-180</td>
<td>0</td>
</tr>
<tr>
<td>71.893</td>
<td>-16.031</td>
<td>108.8</td>
<td>88</td>
<td>3</td>
<td>78</td>
<td>10</td>
<td>-180</td>
<td>0</td>
</tr>
<tr>
<td>71.831</td>
<td>-15.112</td>
<td>136.8</td>
<td>133</td>
<td>2</td>
<td>85</td>
<td>5</td>
<td>111</td>
<td>5</td>
</tr>
<tr>
<td>71.922</td>
<td>-15.623</td>
<td>145.2</td>
<td>138</td>
<td>1</td>
<td>41</td>
<td>1</td>
<td>-22</td>
<td>1</td>
</tr>
<tr>
<td>73.656</td>
<td>-14.406</td>
<td>87.4</td>
<td>17</td>
<td>3</td>
<td>28</td>
<td>10</td>
<td>-102</td>
<td>3</td>
</tr>
<tr>
<td>72.495</td>
<td>-15.421</td>
<td>127.9</td>
<td>20</td>
<td>5</td>
<td>36</td>
<td>4</td>
<td>-102</td>
<td>15</td>
</tr>
<tr>
<td>70.249</td>
<td>-15.465</td>
<td>220.4</td>
<td>0</td>
<td>5</td>
<td>43</td>
<td>4</td>
<td>-142</td>
<td>18</td>
</tr>
<tr>
<td>73.504</td>
<td>-14.963</td>
<td>106.8</td>
<td>114</td>
<td>5</td>
<td>60</td>
<td>6</td>
<td>-142</td>
<td>2</td>
</tr>
<tr>
<td>73.417</td>
<td>-14.152</td>
<td>74.7</td>
<td>0</td>
<td>1</td>
<td>73</td>
<td>3</td>
<td>-142</td>
<td>3</td>
</tr>
<tr>
<td>70.784</td>
<td>-15.288</td>
<td>183.1</td>
<td>151</td>
<td>8</td>
<td>40</td>
<td>6</td>
<td>158</td>
<td>2</td>
</tr>
<tr>
<td>71.479</td>
<td>-15.882</td>
<td>143.3</td>
<td>0</td>
<td>5</td>
<td>24</td>
<td>4</td>
<td>-150</td>
<td>8</td>
</tr>
<tr>
<td>71.804</td>
<td>-15.174</td>
<td>126.8</td>
<td>59</td>
<td>3</td>
<td>88</td>
<td>5</td>
<td>18</td>
<td>4</td>
</tr>
<tr>
<td>72.926</td>
<td>-14.874</td>
<td>105.3</td>
<td>24</td>
<td>3</td>
<td>48</td>
<td>10</td>
<td>-102</td>
<td>2</td>
</tr>
<tr>
<td>71.761</td>
<td>-14.858</td>
<td>124.3</td>
<td>-45</td>
<td>10</td>
<td>90</td>
<td>2</td>
<td>-138</td>
<td>15</td>
</tr>
<tr>
<td>71.762</td>
<td>-14.862</td>
<td>125.2</td>
<td>-45</td>
<td>10</td>
<td>90</td>
<td>2</td>
<td>-138</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>8</td>
<td>16</td>
<td>24</td>
<td>32</td>
<td>40</td>
<td>48</td>
<td>56</td>
</tr>
<tr>
<td>-----</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
</tr>
<tr>
<td>-72.050</td>
<td>-15.391</td>
<td>132.4</td>
<td>20</td>
<td>5</td>
<td>24</td>
<td>3</td>
<td>-103</td>
<td>4</td>
</tr>
<tr>
<td>-71.802</td>
<td>-15.139</td>
<td>129.8</td>
<td>-21</td>
<td>3</td>
<td>90</td>
<td>5</td>
<td>-138</td>
<td>8</td>
</tr>
<tr>
<td>-72.333</td>
<td>-14.370</td>
<td>84.3</td>
<td>40</td>
<td>3</td>
<td>60</td>
<td>4</td>
<td>-162</td>
<td>5</td>
</tr>
<tr>
<td>-70.774</td>
<td>-15.517</td>
<td>181.1</td>
<td>60</td>
<td>5</td>
<td>30</td>
<td>4</td>
<td>-135</td>
<td>9</td>
</tr>
<tr>
<td>-71.595</td>
<td>-15.225</td>
<td>140.5</td>
<td>160</td>
<td>1</td>
<td>88</td>
<td>6</td>
<td>156</td>
<td>10</td>
</tr>
<tr>
<td>-71.877</td>
<td>-15.894</td>
<td>148.1</td>
<td>137</td>
<td>4</td>
<td>78</td>
<td>7</td>
<td>157</td>
<td>10</td>
</tr>
<tr>
<td>-71.149</td>
<td>-16.582</td>
<td>110.3</td>
<td>108</td>
<td>4</td>
<td>68</td>
<td>10</td>
<td>138</td>
<td>14</td>
</tr>
<tr>
<td>-71.149</td>
<td>-16.582</td>
<td>110.2</td>
<td>108</td>
<td>4</td>
<td>68</td>
<td>10</td>
<td>138</td>
<td>14</td>
</tr>
<tr>
<td>-72.424</td>
<td>-15.253</td>
<td>119.1</td>
<td>14</td>
<td>3</td>
<td>88</td>
<td>4</td>
<td>-145</td>
<td>3</td>
</tr>
<tr>
<td>-71.228</td>
<td>-15.511</td>
<td>150.1</td>
<td>102</td>
<td>2</td>
<td>88</td>
<td>4</td>
<td>18</td>
<td>2</td>
</tr>
<tr>
<td>-70.777</td>
<td>-15.624</td>
<td>171.7</td>
<td>86</td>
<td>7</td>
<td>56</td>
<td>7</td>
<td>-142</td>
<td>3</td>
</tr>
<tr>
<td>-72.285</td>
<td>-15.085</td>
<td>111.6</td>
<td>143</td>
<td>7</td>
<td>87</td>
<td>8</td>
<td>138</td>
<td>15</td>
</tr>
<tr>
<td>-70.526</td>
<td>-15.580</td>
<td>198.3</td>
<td>22</td>
<td>3</td>
<td>46</td>
<td>5</td>
<td>138</td>
<td>2</td>
</tr>
<tr>
<td>-72.979</td>
<td>-14.097</td>
<td>77.6</td>
<td>75</td>
<td>5</td>
<td>87</td>
<td>5</td>
<td>78</td>
<td>17</td>
</tr>
<tr>
<td>-70.824</td>
<td>-15.236</td>
<td>183.8</td>
<td>133</td>
<td>4</td>
<td>55</td>
<td>3</td>
<td>150</td>
<td>9</td>
</tr>
<tr>
<td>-70.725</td>
<td>-15.550</td>
<td>179.6</td>
<td>155</td>
<td>10</td>
<td>65</td>
<td>5</td>
<td>98</td>
<td>15</td>
</tr>
<tr>
<td>-71.983</td>
<td>-15.035</td>
<td>124.8</td>
<td>51</td>
<td>5</td>
<td>78</td>
<td>10</td>
<td>-15</td>
<td>8</td>
</tr>
<tr>
<td>-71.591</td>
<td>-15.099</td>
<td>133.8</td>
<td>36</td>
<td>6</td>
<td>90</td>
<td>2</td>
<td>18</td>
<td>4</td>
</tr>
<tr>
<td>-71.691</td>
<td>-15.914</td>
<td>138.4</td>
<td>-70</td>
<td>1</td>
<td>90</td>
<td>1</td>
<td>-138</td>
<td>2</td>
</tr>
<tr>
<td>-71.713</td>
<td>-15.673</td>
<td>143.0</td>
<td>60</td>
<td>9</td>
<td>35</td>
<td>3</td>
<td>-82</td>
<td>8</td>
</tr>
<tr>
<td>-72.031</td>
<td>-16.168</td>
<td>122.6</td>
<td>24</td>
<td>3</td>
<td>38</td>
<td>4</td>
<td>-144</td>
<td>4</td>
</tr>
<tr>
<td>-72.360</td>
<td>-15.281</td>
<td>114.5</td>
<td>148</td>
<td>2</td>
<td>78</td>
<td>8</td>
<td>158</td>
<td>10</td>
</tr>
<tr>
<td>-70.736</td>
<td>-15.578</td>
<td>177.2</td>
<td>0</td>
<td>5</td>
<td>12</td>
<td>9</td>
<td>95</td>
<td>6</td>
</tr>
<tr>
<td>-70.188</td>
<td>-15.546</td>
<td>212.7</td>
<td>98</td>
<td>6</td>
<td>64</td>
<td>3</td>
<td>62</td>
<td>19</td>
</tr>
<tr>
<td>-71.906</td>
<td>-15.008</td>
<td>124.4</td>
<td>5</td>
<td>5</td>
<td>76</td>
<td>5</td>
<td>-162</td>
<td>12</td>
</tr>
<tr>
<td>-71.957</td>
<td>-16.139</td>
<td>111.7</td>
<td>103</td>
<td>3</td>
<td>77</td>
<td>10</td>
<td>158</td>
<td>9</td>
</tr>
<tr>
<td>-71.942</td>
<td>-14.901</td>
<td>121.1</td>
<td>138</td>
<td>3</td>
<td>45</td>
<td>5</td>
<td>118</td>
<td>2</td>
</tr>
<tr>
<td>-72.128</td>
<td>-15.753</td>
<td>123.1</td>
<td>95</td>
<td>4</td>
<td>74</td>
<td>8</td>
<td>158</td>
<td>4</td>
</tr>
<tr>
<td>-71.803</td>
<td>-14.869</td>
<td>120.3</td>
<td>151</td>
<td>3</td>
<td>67</td>
<td>4</td>
<td>117</td>
<td>3</td>
</tr>
<tr>
<td>-72.026</td>
<td>-14.963</td>
<td>114.3</td>
<td>0</td>
<td>1</td>
<td>66</td>
<td>10</td>
<td>-162</td>
<td>13</td>
</tr>
<tr>
<td>-71.674</td>
<td>-16.350</td>
<td>103.6</td>
<td>99</td>
<td>1</td>
<td>86</td>
<td>5</td>
<td>137</td>
<td>8</td>
</tr>
<tr>
<td>-71.557</td>
<td>-16.417</td>
<td>104.3</td>
<td>130</td>
<td>8</td>
<td>28</td>
<td>5</td>
<td>-142</td>
<td>10</td>
</tr>
<tr>
<td>-72.771</td>
<td>-14.816</td>
<td>95.3</td>
<td>0</td>
<td>3</td>
<td>68</td>
<td>10</td>
<td>-180</td>
<td>0</td>
</tr>
<tr>
<td>-71.895</td>
<td>-14.982</td>
<td>128.5</td>
<td>49</td>
<td>4</td>
<td>9</td>
<td>5</td>
<td>-102</td>
<td>3</td>
</tr>
<tr>
<td>-71.310</td>
<td>-15.526</td>
<td>151.4</td>
<td>160</td>
<td>3</td>
<td>87</td>
<td>8</td>
<td>118</td>
<td>14</td>
</tr>
<tr>
<td>-71.310</td>
<td>-15.526</td>
<td>151.4</td>
<td>160</td>
<td>3</td>
<td>87</td>
<td>8</td>
<td>118</td>
<td>14</td>
</tr>
<tr>
<td>-72.059</td>
<td>-15.571</td>
<td>133.3</td>
<td>99</td>
<td>1</td>
<td>88</td>
<td>5</td>
<td>-22</td>
<td>2</td>
</tr>
<tr>
<td>-72.105</td>
<td>-15.149</td>
<td>117.3</td>
<td>20</td>
<td>5</td>
<td>22</td>
<td>5</td>
<td>-129</td>
<td>5</td>
</tr>
<tr>
<td>-72.072</td>
<td>-14.935</td>
<td>120.7</td>
<td>-32</td>
<td>4</td>
<td>90</td>
<td>2</td>
<td>-178</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------</td>
<td>-------</td>
<td>------</td>
<td>-----</td>
<td>--</td>
<td>--</td>
<td>---</td>
<td>--</td>
<td>---</td>
</tr>
<tr>
<td>-72.014</td>
<td>-15.376</td>
<td>128.0</td>
<td>146</td>
<td>5</td>
<td>86</td>
<td>6</td>
<td>-162</td>
<td>4</td>
</tr>
<tr>
<td>-72.293</td>
<td>-15.997</td>
<td>106.5</td>
<td>37</td>
<td>3</td>
<td>81</td>
<td>9</td>
<td>-22</td>
<td>10</td>
</tr>
<tr>
<td>-72.537</td>
<td>-15.170</td>
<td>120.7</td>
<td>20</td>
<td>5</td>
<td>36</td>
<td>5</td>
<td>-127</td>
<td>4</td>
</tr>
<tr>
<td>-71.607</td>
<td>-15.255</td>
<td>138.2</td>
<td>20</td>
<td>5</td>
<td>10</td>
<td>7</td>
<td>-169</td>
<td>9</td>
</tr>
<tr>
<td>-72.657</td>
<td>-13.908</td>
<td>86.6</td>
<td>141</td>
<td>1</td>
<td>43</td>
<td>4</td>
<td>-51</td>
<td>6</td>
</tr>
<tr>
<td>-75.100</td>
<td>-14.198</td>
<td>80.1</td>
<td>103</td>
<td>5</td>
<td>34</td>
<td>5</td>
<td>118</td>
<td>2</td>
</tr>
<tr>
<td>-75.545</td>
<td>-12.300</td>
<td>103.3</td>
<td>-52</td>
<td>3</td>
<td>90</td>
<td>3</td>
<td>-138</td>
<td>2</td>
</tr>
<tr>
<td>-76.001</td>
<td>-11.992</td>
<td>108.7</td>
<td>22</td>
<td>5</td>
<td>82</td>
<td>1</td>
<td>-108</td>
<td>4</td>
</tr>
<tr>
<td>-75.664</td>
<td>-11.893</td>
<td>100.4</td>
<td>67</td>
<td>6</td>
<td>88</td>
<td>7</td>
<td>138</td>
<td>3</td>
</tr>
<tr>
<td>-76.410</td>
<td>-12.997</td>
<td>79.5</td>
<td>26</td>
<td>9</td>
<td>78</td>
<td>6</td>
<td>-69</td>
<td>7</td>
</tr>
<tr>
<td>-75.437</td>
<td>-13.847</td>
<td>79.8</td>
<td>160</td>
<td>0</td>
<td>46</td>
<td>3</td>
<td>-47</td>
<td>8</td>
</tr>
<tr>
<td>-74.668</td>
<td>-14.296</td>
<td>83.6</td>
<td>153</td>
<td>5</td>
<td>59</td>
<td>2</td>
<td>-102</td>
<td>3</td>
</tr>
<tr>
<td>-75.831</td>
<td>-12.314</td>
<td>94.4</td>
<td>148</td>
<td>2</td>
<td>30</td>
<td>1</td>
<td>-102</td>
<td>2</td>
</tr>
<tr>
<td>-75.826</td>
<td>-13.250</td>
<td>54.8</td>
<td>107</td>
<td>9</td>
<td>58</td>
<td>4</td>
<td>117</td>
<td>2</td>
</tr>
<tr>
<td>-74.862</td>
<td>-13.213</td>
<td>79.3</td>
<td>150</td>
<td>5</td>
<td>75</td>
<td>5</td>
<td>-62</td>
<td>13</td>
</tr>
<tr>
<td>-75.197</td>
<td>-12.559</td>
<td>101.0</td>
<td>110</td>
<td>1</td>
<td>72</td>
<td>2</td>
<td>58</td>
<td>5</td>
</tr>
<tr>
<td>-74.632</td>
<td>-11.442</td>
<td>91.4</td>
<td>150</td>
<td>5</td>
<td>18</td>
<td>10</td>
<td>-52</td>
<td>10</td>
</tr>
<tr>
<td>-76.280</td>
<td>-11.582</td>
<td>96.7</td>
<td>138</td>
<td>6</td>
<td>75</td>
<td>5</td>
<td>98</td>
<td>1</td>
</tr>
<tr>
<td>-76.036</td>
<td>-11.144</td>
<td>110.3</td>
<td>13</td>
<td>8</td>
<td>78</td>
<td>8</td>
<td>-8</td>
<td>7</td>
</tr>
</tbody>
</table>
Table 2.2. Stress axes orientations for 173 intermediate depth events

<table>
<thead>
<tr>
<th>Longitude</th>
<th>Latitude</th>
<th>Depth</th>
<th>P-strike</th>
<th>P-dip</th>
<th>T-strike</th>
<th>T-dip</th>
</tr>
</thead>
<tbody>
<tr>
<td>-69.636</td>
<td>-17.607</td>
<td>128.9</td>
<td>266.803</td>
<td>62.904</td>
<td>69.379</td>
<td>26.020</td>
</tr>
<tr>
<td>-69.917</td>
<td>-17.289</td>
<td>125.2</td>
<td>333.958</td>
<td>82.918</td>
<td>95.341</td>
<td>3.702</td>
</tr>
<tr>
<td>-69.353</td>
<td>-17.375</td>
<td>156.7</td>
<td>178.382</td>
<td>28.239</td>
<td>71.618</td>
<td>28.239</td>
</tr>
<tr>
<td>-69.365</td>
<td>-18.191</td>
<td>128.2</td>
<td>199.460</td>
<td>13.279</td>
<td>101.118</td>
<td>31.582</td>
</tr>
<tr>
<td>-69.630</td>
<td>-17.600</td>
<td>146.5</td>
<td>262.700</td>
<td>42.501</td>
<td>28.344</td>
<td>32.454</td>
</tr>
<tr>
<td>-70.053</td>
<td>-17.103</td>
<td>137.4</td>
<td>255.281</td>
<td>33.112</td>
<td>1.819</td>
<td>23.579</td>
</tr>
<tr>
<td>-69.542</td>
<td>-16.568</td>
<td>186.7</td>
<td>288.388</td>
<td>53.465</td>
<td>80.807</td>
<td>33.294</td>
</tr>
<tr>
<td>-69.330</td>
<td>-17.698</td>
<td>159.7</td>
<td>186.466</td>
<td>16.565</td>
<td>90.406</td>
<td>19.540</td>
</tr>
<tr>
<td>-69.423</td>
<td>-17.323</td>
<td>152.1</td>
<td>182.444</td>
<td>27.211</td>
<td>74.857</td>
<td>30.440</td>
</tr>
<tr>
<td>-69.399</td>
<td>-17.740</td>
<td>142.3</td>
<td>225.302</td>
<td>15.374</td>
<td>326.688</td>
<td>35.679</td>
</tr>
<tr>
<td>-70.063</td>
<td>-17.140</td>
<td>135.3</td>
<td>216.054</td>
<td>41.715</td>
<td>310.363</td>
<td>4.818</td>
</tr>
<tr>
<td>-69.715</td>
<td>-17.750</td>
<td>135.0</td>
<td>341.430</td>
<td>49.757</td>
<td>75.243</td>
<td>3.222</td>
</tr>
<tr>
<td>-69.746</td>
<td>-17.405</td>
<td>148.3</td>
<td>213.960</td>
<td>34.383</td>
<td>96.040</td>
<td>34.383</td>
</tr>
<tr>
<td>-69.412</td>
<td>-17.340</td>
<td>155.6</td>
<td>311.448</td>
<td>36.745</td>
<td>53.651</td>
<td>15.809</td>
</tr>
<tr>
<td>-69.828</td>
<td>-17.396</td>
<td>126.8</td>
<td>182.814</td>
<td>17.388</td>
<td>87.186</td>
<td>17.388</td>
</tr>
<tr>
<td>-69.663</td>
<td>-16.760</td>
<td>166.9</td>
<td>170.382</td>
<td>28.239</td>
<td>63.618</td>
<td>28.239</td>
</tr>
<tr>
<td>-69.940</td>
<td>-17.332</td>
<td>128.4</td>
<td>279.274</td>
<td>75.907</td>
<td>125.069</td>
<td>12.737</td>
</tr>
<tr>
<td>-69.672</td>
<td>-16.573</td>
<td>191.6</td>
<td>250.994</td>
<td>39.238</td>
<td>151.623</td>
<td>11.275</td>
</tr>
<tr>
<td>-69.671</td>
<td>-16.575</td>
<td>190.9</td>
<td>250.994</td>
<td>39.238</td>
<td>151.623</td>
<td>11.275</td>
</tr>
<tr>
<td>-69.861</td>
<td>-17.230</td>
<td>131.3</td>
<td>2.934</td>
<td>33.369</td>
<td>100.635</td>
<td>11.501</td>
</tr>
<tr>
<td>-69.330</td>
<td>-18.102</td>
<td>128.0</td>
<td>4.282</td>
<td>77.940</td>
<td>237.523</td>
<td>7.287</td>
</tr>
<tr>
<td>-69.829</td>
<td>-17.242</td>
<td>129.8</td>
<td>164.212</td>
<td>31.701</td>
<td>51.788</td>
<td>31.701</td>
</tr>
<tr>
<td>-69.433</td>
<td>-15.951</td>
<td>235.4</td>
<td>147.014</td>
<td>22.041</td>
<td>22.692</td>
<td>54.320</td>
</tr>
<tr>
<td>-69.432</td>
<td>-15.951</td>
<td>235.3</td>
<td>147.014</td>
<td>22.041</td>
<td>22.692</td>
<td>54.320</td>
</tr>
<tr>
<td>-69.556</td>
<td>-16.848</td>
<td>173.8</td>
<td>262.863</td>
<td>29.722</td>
<td>356.960</td>
<td>7.132</td>
</tr>
<tr>
<td>-69.491</td>
<td>-17.513</td>
<td>137.0</td>
<td>219.457</td>
<td>39.044</td>
<td>126.910</td>
<td>3.136</td>
</tr>
<tr>
<td>-69.537</td>
<td>-17.752</td>
<td>132.7</td>
<td>323.490</td>
<td>44.014</td>
<td>92.637</td>
<td>33.162</td>
</tr>
<tr>
<td>-69.538</td>
<td>-17.751</td>
<td>132.7</td>
<td>323.490</td>
<td>44.014</td>
<td>92.637</td>
<td>33.162</td>
</tr>
<tr>
<td>-69.537</td>
<td>-17.752</td>
<td>132.7</td>
<td>323.490</td>
<td>44.014</td>
<td>92.637</td>
<td>33.162</td>
</tr>
<tr>
<td>-69.538</td>
<td>-17.751</td>
<td>132.7</td>
<td>323.490</td>
<td>44.014</td>
<td>92.637</td>
<td>33.162</td>
</tr>
<tr>
<td>-69.659</td>
<td>-17.391</td>
<td>136.7</td>
<td>217.072</td>
<td>31.415</td>
<td>103.621</td>
<td>33.088</td>
</tr>
<tr>
<td>-69.450</td>
<td>-16.480</td>
<td>194.3</td>
<td>244.762</td>
<td>25.807</td>
<td>141.238</td>
<td>25.807</td>
</tr>
<tr>
<td>-69.642</td>
<td>-15.887</td>
<td>226.4</td>
<td>193.326</td>
<td>61.382</td>
<td>358.874</td>
<td>27.851</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
</tr>
<tr>
<td>-69.508</td>
<td>-16.871</td>
<td>171.0</td>
<td>195.286</td>
<td>25.817</td>
<td>88.640</td>
<td>30.631</td>
</tr>
<tr>
<td>-69.570</td>
<td>-17.579</td>
<td>140.0</td>
<td>201.443</td>
<td>19.388</td>
<td>298.557</td>
<td>19.388</td>
</tr>
<tr>
<td>-69.728</td>
<td>-17.290</td>
<td>141.3</td>
<td>193.375</td>
<td>28.361</td>
<td>83.959</td>
<td>31.626</td>
</tr>
<tr>
<td>-69.828</td>
<td>-17.897</td>
<td>136.5</td>
<td>293.098</td>
<td>42.418</td>
<td>104.349</td>
<td>47.248</td>
</tr>
<tr>
<td>-69.387</td>
<td>-18.276</td>
<td>124.2</td>
<td>267.809</td>
<td>71.632</td>
<td>68.864</td>
<td>17.435</td>
</tr>
<tr>
<td>-69.313</td>
<td>-17.708</td>
<td>142.3</td>
<td>354.810</td>
<td>11.840</td>
<td>97.470</td>
<td>46.272</td>
</tr>
<tr>
<td>-69.541</td>
<td>-17.715</td>
<td>132.2</td>
<td>329.002</td>
<td>46.690</td>
<td>66.966</td>
<td>7.468</td>
</tr>
<tr>
<td>-70.136</td>
<td>-17.465</td>
<td>103.4</td>
<td>325.139</td>
<td>0.837</td>
<td>55.706</td>
<td>34.098</td>
</tr>
<tr>
<td>-69.549</td>
<td>-15.964</td>
<td>224.6</td>
<td>275.871</td>
<td>15.371</td>
<td>11.016</td>
<td>18.068</td>
</tr>
<tr>
<td>-70.001</td>
<td>-17.629</td>
<td>101.3</td>
<td>252.991</td>
<td>4.664</td>
<td>347.593</td>
<td>44.528</td>
</tr>
<tr>
<td>-69.560</td>
<td>-17.708</td>
<td>147.9</td>
<td>270.019</td>
<td>13.715</td>
<td>40.208</td>
<td>69.284</td>
</tr>
<tr>
<td>-69.580</td>
<td>-17.556</td>
<td>134.9</td>
<td>196.282</td>
<td>9.613</td>
<td>101.234</td>
<td>27.453</td>
</tr>
<tr>
<td>-70.022</td>
<td>-17.481</td>
<td>127.8</td>
<td>197.164</td>
<td>15.360</td>
<td>102.836</td>
<td>15.360</td>
</tr>
<tr>
<td>-69.635</td>
<td>-17.588</td>
<td>131.2</td>
<td>216.973</td>
<td>24.559</td>
<td>319.027</td>
<td>24.559</td>
</tr>
<tr>
<td>-69.494</td>
<td>-17.351</td>
<td>148.2</td>
<td>197.014</td>
<td>22.651</td>
<td>96.986</td>
<td>22.651</td>
</tr>
<tr>
<td>-69.744</td>
<td>-16.630</td>
<td>169.9</td>
<td>275.000</td>
<td>45.000</td>
<td>95.000</td>
<td>45.000</td>
</tr>
<tr>
<td>-69.353</td>
<td>-17.776</td>
<td>136.8</td>
<td>195.164</td>
<td>15.360</td>
<td>100.836</td>
<td>15.360</td>
</tr>
<tr>
<td>-69.917</td>
<td>-17.020</td>
<td>132.5</td>
<td>350.778</td>
<td>52.979</td>
<td>258.280</td>
<td>1.882</td>
</tr>
<tr>
<td>-69.491</td>
<td>-17.656</td>
<td>135.9</td>
<td>270.780</td>
<td>25.002</td>
<td>91.673</td>
<td>64.995</td>
</tr>
<tr>
<td>-69.994</td>
<td>-17.846</td>
<td>101.0</td>
<td>324.342</td>
<td>66.749</td>
<td>58.015</td>
<td>1.577</td>
</tr>
<tr>
<td>-69.436</td>
<td>-17.490</td>
<td>155.1</td>
<td>73.909</td>
<td>2.807</td>
<td>340.600</td>
<td>49.657</td>
</tr>
<tr>
<td>-70.065</td>
<td>-18.119</td>
<td>92.2</td>
<td>284.626</td>
<td>55.967</td>
<td>57.877</td>
<td>24.832</td>
</tr>
<tr>
<td>-69.590</td>
<td>-17.408</td>
<td>147.6</td>
<td>202.107</td>
<td>20.705</td>
<td>103.893</td>
<td>20.705</td>
</tr>
<tr>
<td>-69.475</td>
<td>-16.646</td>
<td>194.7</td>
<td>189.215</td>
<td>44.965</td>
<td>335.132</td>
<td>39.666</td>
</tr>
<tr>
<td>-69.634</td>
<td>-17.673</td>
<td>138.8</td>
<td>25.634</td>
<td>83.733</td>
<td>264.343</td>
<td>3.264</td>
</tr>
<tr>
<td>-69.583</td>
<td>-17.659</td>
<td>140.7</td>
<td>236.973</td>
<td>24.559</td>
<td>339.027</td>
<td>24.559</td>
</tr>
<tr>
<td>-70.254</td>
<td>-17.535</td>
<td>96.0</td>
<td>304.568</td>
<td>73.733</td>
<td>98.162</td>
<td>14.647</td>
</tr>
<tr>
<td>-69.549</td>
<td>-16.906</td>
<td>175.1</td>
<td>209.572</td>
<td>50.159</td>
<td>303.941</td>
<td>3.637</td>
</tr>
<tr>
<td>-69.549</td>
<td>-16.905</td>
<td>175.3</td>
<td>209.572</td>
<td>50.159</td>
<td>303.941</td>
<td>3.637</td>
</tr>
<tr>
<td>-71.547</td>
<td>-15.112</td>
<td>146.9</td>
<td>145.468</td>
<td>57.122</td>
<td>37.608</td>
<td>11.213</td>
</tr>
<tr>
<td>-71.598</td>
<td>-16.082</td>
<td>136.9</td>
<td>110.935</td>
<td>40.259</td>
<td>218.042</td>
<td>19.155</td>
</tr>
<tr>
<td>-71.754</td>
<td>-14.801</td>
<td>125.2</td>
<td>210.943</td>
<td>14.547</td>
<td>93.534</td>
<td>60.590</td>
</tr>
<tr>
<td>-71.085</td>
<td>-16.698</td>
<td>123.3</td>
<td>117.039</td>
<td>67.592</td>
<td>305.900</td>
<td>22.166</td>
</tr>
<tr>
<td>-72.111</td>
<td>-15.055</td>
<td>118.2</td>
<td>17.024</td>
<td>1.105</td>
<td>107.680</td>
<td>30.696</td>
</tr>
<tr>
<td>-72.310</td>
<td>-14.728</td>
<td>98.3</td>
<td>240.162</td>
<td>35.396</td>
<td>119.838</td>
<td>35.396</td>
</tr>
<tr>
<td>-72.017</td>
<td>-15.104</td>
<td>128.6</td>
<td>188.382</td>
<td>28.239</td>
<td>81.618</td>
<td>28.239</td>
</tr>
<tr>
<td>---------</td>
<td>---------</td>
<td>------</td>
<td>---------</td>
<td>-------</td>
<td>--------</td>
<td>-------</td>
</tr>
<tr>
<td>-72.166</td>
<td>-15.154</td>
<td>119.7</td>
<td>1.257</td>
<td>75.930</td>
<td>96.687</td>
<td>1.358</td>
</tr>
<tr>
<td>-71.797</td>
<td>-14.758</td>
<td>117.0</td>
<td>207.629</td>
<td>18.016</td>
<td>352.502</td>
<td>68.315</td>
</tr>
<tr>
<td>-70.683</td>
<td>-15.322</td>
<td>206.4</td>
<td>136.249</td>
<td>10.786</td>
<td>23.876</td>
<td>63.412</td>
</tr>
<tr>
<td>-70.924</td>
<td>-16.687</td>
<td>123.6</td>
<td>251.039</td>
<td>63.099</td>
<td>99.267</td>
<td>24.085</td>
</tr>
<tr>
<td>-71.198</td>
<td>-16.521</td>
<td>111.6</td>
<td>215.310</td>
<td>74.194</td>
<td>106.367</td>
<td>5.251</td>
</tr>
<tr>
<td>-71.767</td>
<td>-15.035</td>
<td>133.2</td>
<td>115.844</td>
<td>23.961</td>
<td>208.717</td>
<td>6.435</td>
</tr>
<tr>
<td>-71.767</td>
<td>-15.035</td>
<td>133.2</td>
<td>115.844</td>
<td>23.961</td>
<td>208.717</td>
<td>6.435</td>
</tr>
<tr>
<td>-71.565</td>
<td>-15.539</td>
<td>143.0</td>
<td>147.031</td>
<td>15.065</td>
<td>43.731</td>
<td>40.521</td>
</tr>
<tr>
<td>-71.842</td>
<td>-15.189</td>
<td>129.7</td>
<td>283.579</td>
<td>65.709</td>
<td>15.654</td>
<td>0.936</td>
</tr>
<tr>
<td>-70.315</td>
<td>-15.451</td>
<td>210.0</td>
<td>227.001</td>
<td>42.987</td>
<td>352.673</td>
<td>32.032</td>
</tr>
<tr>
<td>-71.554</td>
<td>-16.128</td>
<td>120.0</td>
<td>187.501</td>
<td>36.818</td>
<td>57.860</td>
<td>40.439</td>
</tr>
<tr>
<td>-71.887</td>
<td>-17.057</td>
<td>64.8</td>
<td>294.836</td>
<td>15.360</td>
<td>29.164</td>
<td>15.360</td>
</tr>
<tr>
<td>-71.616</td>
<td>-15.909</td>
<td>122.3</td>
<td>186.649</td>
<td>67.837</td>
<td>292.143</td>
<td>6.210</td>
</tr>
<tr>
<td>-70.285</td>
<td>-15.631</td>
<td>207.6</td>
<td>226.436</td>
<td>17.090</td>
<td>340.698</td>
<td>53.196</td>
</tr>
<tr>
<td>-70.194</td>
<td>-15.569</td>
<td>212.3</td>
<td>127.102</td>
<td>51.599</td>
<td>298.427</td>
<td>38.081</td>
</tr>
<tr>
<td>-70.504</td>
<td>-15.558</td>
<td>200.3</td>
<td>230.096</td>
<td>23.441</td>
<td>326.365</td>
<td>14.137</td>
</tr>
<tr>
<td>-73.610</td>
<td>-14.568</td>
<td>87.1</td>
<td>67.684</td>
<td>70.320</td>
<td>308.303</td>
<td>9.952</td>
</tr>
<tr>
<td>-73.146</td>
<td>-14.182</td>
<td>74.5</td>
<td>188.309</td>
<td>0.688</td>
<td>98.215</td>
<td>7.774</td>
</tr>
<tr>
<td>-72.789</td>
<td>-14.175</td>
<td>84.7</td>
<td>281.272</td>
<td>79.430</td>
<td>56.528</td>
<td>7.549</td>
</tr>
<tr>
<td>-73.679</td>
<td>-14.101</td>
<td>76.0</td>
<td>218.675</td>
<td>65.647</td>
<td>126.011</td>
<td>1.205</td>
</tr>
<tr>
<td>-71.966</td>
<td>-15.192</td>
<td>122.2</td>
<td>25.024</td>
<td>1.105</td>
<td>115.680</td>
<td>30.696</td>
</tr>
<tr>
<td>-71.893</td>
<td>-16.031</td>
<td>108.8</td>
<td>312.367</td>
<td>8.454</td>
<td>43.633</td>
<td>8.454</td>
</tr>
<tr>
<td>-71.893</td>
<td>-16.031</td>
<td>108.8</td>
<td>312.367</td>
<td>8.454</td>
<td>43.633</td>
<td>8.454</td>
</tr>
<tr>
<td>-71.831</td>
<td>-15.112</td>
<td>136.8</td>
<td>204.604</td>
<td>36.584</td>
<td>64.392</td>
<td>45.993</td>
</tr>
<tr>
<td>-73.656</td>
<td>-14.406</td>
<td>87.4</td>
<td>134.809</td>
<td>71.632</td>
<td>295.864</td>
<td>17.435</td>
</tr>
<tr>
<td>-72.495</td>
<td>-15.421</td>
<td>127.9</td>
<td>155.607</td>
<td>78.127</td>
<td>298.573</td>
<td>9.527</td>
</tr>
<tr>
<td>-70.249</td>
<td>-15.465</td>
<td>220.4</td>
<td>196.387</td>
<td>54.493</td>
<td>304.836</td>
<td>12.723</td>
</tr>
<tr>
<td>-73.504</td>
<td>-14.963</td>
<td>106.8</td>
<td>329.312</td>
<td>46.934</td>
<td>237.873</td>
<td>1.344</td>
</tr>
<tr>
<td>-73.417</td>
<td>-14.152</td>
<td>74.7</td>
<td>224.571</td>
<td>38.540</td>
<td>124.741</td>
<td>12.098</td>
</tr>
<tr>
<td>-70.784</td>
<td>-15.288</td>
<td>183.1</td>
<td>16.079</td>
<td>21.803</td>
<td>130.005</td>
<td>45.393</td>
</tr>
<tr>
<td>-71.479</td>
<td>-15.882</td>
<td>143.3</td>
<td>176.693</td>
<td>52.165</td>
<td>315.083</td>
<td>30.144</td>
</tr>
<tr>
<td>-72.926</td>
<td>-14.874</td>
<td>105.3</td>
<td>227.089</td>
<td>80.804</td>
<td>122.461</td>
<td>2.341</td>
</tr>
<tr>
<td>-71.761</td>
<td>-14.858</td>
<td>124.3</td>
<td>188.382</td>
<td>28.239</td>
<td>81.618</td>
<td>28.239</td>
</tr>
<tr>
<td>-71.762</td>
<td>-14.862</td>
<td>125.2</td>
<td>188.382</td>
<td>28.239</td>
<td>81.618</td>
<td>28.239</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
</tr>
<tr>
<td>-71.802</td>
<td>-15.139</td>
<td>129.8</td>
<td>212.382</td>
<td>28.239</td>
<td>105.618</td>
<td>28.239</td>
</tr>
<tr>
<td>-72.933</td>
<td>-14.370</td>
<td>84.3</td>
<td>256.801</td>
<td>32.874</td>
<td>352.982</td>
<td>9.458</td>
</tr>
<tr>
<td>-70.774</td>
<td>-15.517</td>
<td>181.1</td>
<td>230.970</td>
<td>59.584</td>
<td>2.443</td>
<td>21.246</td>
</tr>
<tr>
<td>-71.595</td>
<td>-15.225</td>
<td>140.5</td>
<td>207.972</td>
<td>15.234</td>
<td>112.839</td>
<td>18.186</td>
</tr>
<tr>
<td>-71.149</td>
<td>-16.582</td>
<td>110.3</td>
<td>165.370</td>
<td>18.409</td>
<td>60.532</td>
<td>37.577</td>
</tr>
<tr>
<td>-71.149</td>
<td>-16.582</td>
<td>110.2</td>
<td>165.370</td>
<td>18.409</td>
<td>60.532</td>
<td>37.577</td>
</tr>
<tr>
<td>-72.424</td>
<td>-15.253</td>
<td>119.1</td>
<td>244.091</td>
<td>25.468</td>
<td>142.784</td>
<td>22.374</td>
</tr>
<tr>
<td>-70.777</td>
<td>-15.624</td>
<td>171.7</td>
<td>297.599</td>
<td>49.141</td>
<td>29.886</td>
<td>1.977</td>
</tr>
<tr>
<td>-72.285</td>
<td>-15.085</td>
<td>111.6</td>
<td>197.286</td>
<td>25.817</td>
<td>90.640</td>
<td>30.631</td>
</tr>
<tr>
<td>-70.526</td>
<td>-15.580</td>
<td>198.3</td>
<td>259.889</td>
<td>8.676</td>
<td>3.094</td>
<td>56.258</td>
</tr>
<tr>
<td>-72.979</td>
<td>-14.097</td>
<td>77.6</td>
<td>176.202</td>
<td>40.821</td>
<td>332.623</td>
<td>46.695</td>
</tr>
<tr>
<td>-70.824</td>
<td>-15.236</td>
<td>183.8</td>
<td>4.937</td>
<td>6.659</td>
<td>101.420</td>
<td>44.043</td>
</tr>
<tr>
<td>-70.725</td>
<td>-15.550</td>
<td>179.6</td>
<td>239.003</td>
<td>19.620</td>
<td>80.924</td>
<td>68.980</td>
</tr>
<tr>
<td>-71.591</td>
<td>-15.099</td>
<td>133.8</td>
<td>169.563</td>
<td>12.621</td>
<td>262.437</td>
<td>12.621</td>
</tr>
<tr>
<td>-71.691</td>
<td>-15.914</td>
<td>138.4</td>
<td>163.382</td>
<td>28.239</td>
<td>56.618</td>
<td>28.239</td>
</tr>
<tr>
<td>-71.713</td>
<td>-15.673</td>
<td>143.0</td>
<td>119.641</td>
<td>78.772</td>
<td>324.261</td>
<td>10.230</td>
</tr>
<tr>
<td>-72.031</td>
<td>-16.168</td>
<td>122.6</td>
<td>214.674</td>
<td>54.399</td>
<td>330.866</td>
<td>17.537</td>
</tr>
<tr>
<td>-72.360</td>
<td>-15.281</td>
<td>114.5</td>
<td>196.717</td>
<td>6.435</td>
<td>103.844</td>
<td>23.961</td>
</tr>
<tr>
<td>-70.736</td>
<td>-15.578</td>
<td>177.2</td>
<td>265.784</td>
<td>33.038</td>
<td>83.513</td>
<td>56.941</td>
</tr>
<tr>
<td>-70.188</td>
<td>-15.546</td>
<td>212.7</td>
<td>208.057</td>
<td>14.547</td>
<td>325.466</td>
<td>60.590</td>
</tr>
<tr>
<td>-71.906</td>
<td>-15.008</td>
<td>124.4</td>
<td>228.278</td>
<td>22.525</td>
<td>137.304</td>
<td>2.347</td>
</tr>
<tr>
<td>-71.957</td>
<td>-16.139</td>
<td>111.7</td>
<td>151.787</td>
<td>5.684</td>
<td>59.169</td>
<td>24.656</td>
</tr>
<tr>
<td>-71.942</td>
<td>-14.901</td>
<td>121.1</td>
<td>28.577</td>
<td>3.355</td>
<td>128.001</td>
<td>70.301</td>
</tr>
<tr>
<td>-72.128</td>
<td>-15.753</td>
<td>123.1</td>
<td>143.944</td>
<td>3.424</td>
<td>52.219</td>
<td>26.714</td>
</tr>
<tr>
<td>-71.803</td>
<td>-14.869</td>
<td>120.3</td>
<td>221.310</td>
<td>17.678</td>
<td>99.421</td>
<td>58.897</td>
</tr>
<tr>
<td>-72.026</td>
<td>-14.963</td>
<td>114.3</td>
<td>219.638</td>
<td>29.158</td>
<td>312.463</td>
<td>5.048</td>
</tr>
<tr>
<td>-71.674</td>
<td>-16.350</td>
<td>103.6</td>
<td>154.017</td>
<td>25.578</td>
<td>46.591</td>
<td>32.032</td>
</tr>
<tr>
<td>-71.557</td>
<td>-16.417</td>
<td>104.3</td>
<td>304.626</td>
<td>55.967</td>
<td>77.877</td>
<td>24.832</td>
</tr>
<tr>
<td>-72.771</td>
<td>-14.816</td>
<td>95.3</td>
<td>222.836</td>
<td>15.360</td>
<td>317.164</td>
<td>15.360</td>
</tr>
<tr>
<td>-71.310</td>
<td>-15.526</td>
<td>151.4</td>
<td>225.804</td>
<td>35.907</td>
<td>96.240</td>
<td>41.337</td>
</tr>
<tr>
<td>-71.310</td>
<td>-15.526</td>
<td>151.4</td>
<td>225.804</td>
<td>35.907</td>
<td>96.240</td>
<td>41.337</td>
</tr>
<tr>
<td>-72.059</td>
<td>-15.571</td>
<td>133.3</td>
<td>52.230</td>
<td>16.822</td>
<td>146.518</td>
<td>13.889</td>
</tr>
<tr>
<td>-72.105</td>
<td>-15.149</td>
<td>117.3</td>
<td>171.201</td>
<td>59.482</td>
<td>319.883</td>
<td>26.728</td>
</tr>
<tr>
<td>-72.072</td>
<td>-14.935</td>
<td>120.7</td>
<td>193.017</td>
<td>1.414</td>
<td>102.983</td>
<td>1.414</td>
</tr>
</tbody>
</table>
REFERENCES


Chapter 3: Crust and upper mantle structure beneath the north Central Andes

ABSTRACT

The Central Andean Plateau of southern Peru, Bolivia and northwestern Argentina is the second largest tectonically active orogen along the western margin of South America. This plateau has influenced both local and far field lithospheric deformation, global sediment flux, atmospheric circulation and climate since the early Miocene. Significant geologic and geophysical efforts have been made to constrain the tectonomorphic evolution of the central Andean plateau, yet the role of surface and deep lithospheric processes in the evolution of the plateau is unclear. Isotopic paleoaltimeters suggest rapid and recent surface uplift during the late Miocene, whereas, structural reconstructions support an earlier and steady uplift between ~30 and 10 Ma. Previous studies have emphasized the variable importance of both the crust and upper mantle in the evolution of central Andean plateau. In order to investigate the current state of lithospheric structure below the northern Altiplano between 14-18°S, I calculate three-dimensional seismic tomography models for $V_P$ and $V_S$ using P and S-wave travel time data. In this effort, I also determined crustal and upper mantle velocity structure in the Peruvian flat slab region between 12-14°S. My tomographic models show some typical structures found in subduction zones including a high velocity slab and widespread low velocities under the active volcanic arc. In the northern Altiplano, I observed the absence of a high velocity lower crust, suggesting a weak lower crust of felsic composition or the loss of a high velocity mafic lower crust due to delamination. The upper mantle under the northern Altiplano is heterogeneous, consistent with piecemeal delamination. My tomography results
for the lower crust and upper mantle beneath the northern Altiplano are in better agreement with the slow and steady uplift model.

1. INTRODUCTION

The central Andean plateau of southern Peru, Bolivia, and northwestern Argentina is the second largest plateau in the world. It extends between 14°-28° S in western South America (Isacks, 1988; Allmendinger et al., 1997) and overrides a normally dipping (~30°) portion of the subducting Nazca plate between zones of flat slab subduction to the north and south. The average elevation of the plateau is ~4 km and spans ~2000 km along strike and ~200-450 km west to east (Oncken et al., 2006; Barnes & Ehlers, 2009). It has strongly influenced both local and far field lithospheric deformation, atmospheric circulation, precipitation and climate since the early Miocene (Masek et al., 1994, Lenters & Cook, 1995).

Numerous geologic (structure, paleoclimate, thermochronology) and geophysical (receiver function, seismic refraction, teleseismic and local tomography) studies have been carried out in last three decades to constrain the Cenozoic evolution of the central Andean plateau (Isacks, 1988; Dobath et al., 1993; Wigger et al., 1994; Dorbath & Granet, 1996; Allmendinger et al., 1997; Horton & DeCelles, 1997; Jordan et al., 1997; Myers et al., 1998; Kley et al., 1999; Beck & Zandt, 2002; McQuarrie et al., 2005; Oncken et al., 2006; McQuarrie et al., 2008), yet the surface and subsurface processes responsible for plateau formation and evolution are disputed. Two end member models have been suggested. The first is the rapid and recent uplift model, which argues for surface uplift on the order of ~2.5 km during the late Miocene (~10.3 to 6.8 Ma) triggered by the wholesale removal of the eclogitized lower crust and upper mantle lithosphere (Garzione et al., 2006; Ghosh et al.,
Evidence supporting the model of rapid uplift comes from the palaeoaltimetry record based on the study of $\delta^{18}O$ of meteoric water in paleosol carbonates (Garzione et al., 2006, Ghosh et al., 2006), paleotemperature estimates from Jakokkota flora of northern Altiplano (Gregory-Wodzicki et al., 1998), and a contemporaneous shift of the deformation front towards the lowlands of the Sub Andes. The second model is the slow and steady uplift model, which emphasizes the role of crustal shortening and thickening in the total elevation gain of the Altiplano since the late Eocene (~40 Ma), with some local contribution from small scale lithospheric delamination (Jordan et al., 1997; McQuarrie et al., 2005, Hoke & Lamb, 2007; Ehlers & Poulsen, 2009). This model assumes that surface uplift and deformation are coupled. The supporting evidence for gradual uplift comes from the exhumation history based on low temperature thermochronology (cooling history) in bedrock, extensive shortening (200-250 km) estimates in the fold-thrust belt, the onset of mafic volcanism, and climatic records. As previously suggested, increases in mountain building activity usually generates topography and relief necessary to enhance the exhumation rate (Coughlin et al., 1998; Carrapa et al., 2005). The increased rate of exhumation for the Altiplano and the western part of the Eastern Cordillera dates to ~40 and ~40-20 Ma respectively. This indicates that the modern plateau width was established by ~20 to 15 Ma (Barnes & Ehlers, 2009), much before the period of rapid uplift (~10 Ma). Kay and Mahlburg Kay (1993) and Lamb and Hoke (2007) suggest that the onset of mafic volcanism and helium in natural gas (geothermal and mineral water springs, fumaroles) emissions provides the most direct evidence of mantle melting and can be used as a proxy for the delamination. In the Altiplano, a surge in volcanic activity and high $^{3}He/^{4}He$ ratio (~$10^{-5}$) in natural helium emissions started at nearly ~25 Ma (Davidson & de Silva, 1992; Lamb &
Hoke, 1997), which indicates a thin Altiplano lithosphere or partial delamination since the late Oligocene. If the central Andean plateau evolved mainly during the late Miocene (Garzione et al., 2006; Ghosh et al., 2006, Hoke & Garzione, 2008) then it should have coincided with a marked decrease in precipitation, east of the Western Cordillera, due to the development of a rain shadow (Rech et al., 2006). Measures of aridity in the Atacama basin of the central Andes (~23° S) indicates hyper arid conditions have existed for the past ~19 Ma due to higher elevations, which also favors the slow and steady evolution of Altiplano-Puna plateau since the early Miocene.

One possible discriminating factor between these two theories is seismic evidence for the presence or absence of mantle lithosphere. If the lithosphere is present I should see high velocities in the upper mantle beneath the northern Altiplano. In contrast, if lithospheric removal has occurred on the regional scale (wholesale removal) I should see upper mantle of asthenospheric character, with low seismic velocity, under the northern Altiplano. The majority of the available geophysical observations of shallow and deep lithospheric structures in the central Andean plateau, are related to the central and southern Altiplano (between 18°S and 28°S), with very little focus on the northern Altiplano (Wigger et al., 1994; Myers et al., 1998; Graeber & Asch, 1999; Beck & Zandt, 2002; Yuan et al., 2002; Ward et al., 2013). Much of the work in the central and southern Altiplano indicates strong along strike variations in the crust and upper mantle properties. The tomographic studies of Dorbath et al. (1993) and Dorbath & Granet (1996) are two of the very limited number of geophysical studies conducted to gain insight into the modern lithospheric structures under the northern Altiplano. These studies use a linear array of seismic stations in the northern Altiplano to determine the subsurface velocity structure between 16°S and 18°S. They find
strong across-strike variations in the upper mantle but have very limited along strike resolution due to the geometry of the seismic network.

My current study seeks to characterize the velocity structure of the crust and upper mantle under the northern Altiplano of southern Peru and northern Bolivia (between 14°S and 18.5°S) (Figure 3.1). It has an average elevation of ~3.7km and relatively low relief compared to the Puna further to the south and is flanked by the Western and Eastern Cordilleras. My study area also extends north of the Altiplano Plateau, well into the Peruvian flat slab region. I use an extensive 2-D grid of seismic stations for better tomographic coverage than has previously been possible for this region. My results indicate the absence of a high velocity lower crust under the northern Altiplano that may indicate a weak lower crust of felsic composition. The upper mantle under the northern Altiplano is heterogeneous and shows along strike variations in velocity structure. I observe the presence of high velocity mantle lithosphere beneath the northern Altiplano, with some possibility of piecemeal delamination at local scales. North of the Nazca Ridge, in the Peruvian flat slab region, I observe low-V_S in the upper mantle that may be related to a tear previously identified by surface wave tomography and earthquake hypocenters and focal mechanisms. The results of my study can be used along with previous studies that are mainly focused on the central and southern Altiplano to provide important constraints on the along strike variation in the lithospheric structures in central Andes and thereby improve our understanding of the formation of the Altiplano plateau.

2. DATA

This study incorporates data collected at 96 broadband seismic stations from three independent seismic networks in south-central Peru and northwestern Bolivia: PULSE (PerU
Lithosphere and Slab Experiment), CAUGHT (Central Andean Uplift and Geodynamics of High Topography) and PERUSE (PERU Slab Experiment) (Refer: Figure 1.1, Chapter 1). These networks roughly cover an area of 1000 km by 750 km. The PULSE network includes 40 broadband seismometers, comprising a combination of Nanometrics Trillium 120 and Guralp CMG-3T sensors. Data were collected using Taurus and Quanterra Q330 dataloggers recording at 40 sps and stored on flashcards and external Balers, respectively, that were exchanged every ~6 months. The CAUGHT seismic deployment includes a 2D deployment of 48 STS-2 sensors with Quanterra Q330 dataloggers. For both networks, the exact location and timing at each station were determined using GPS receivers. Instrumentation for the CAUGHT deployment was provided by Portable Array Seismic Studies of the Continental Lithosphere (PASSCAL) of the Incorporated Research Institutions for Seismology (IRIS) and for the PULSE deployment, 10 stations were from UNC-Chapel Hill, 20 stations from Yale and 10 stations from IRIS-PASSCAL (Refer: Data section of Chapter 1 for more detailed description of the PULSE and CAUGHT networks). The PERUSE project was jointly operated by the Caltech Tectonics Observatory (TO) and the Center for Embedded Network Sensors (CENS) at UCLA. The data were recorded at 100 sps, using Guralp CMG-3T sensors. I collaborated for 8 stations of the TO project, to obtain better regional coverage for my 3D tomographic study.

My current tomography study uses a total of 712 well-located events, including 593 events below 50 km depth associated with the subducting Nazca plate and 119 crustal events (depth<50 km), associated with the overriding South American (SA) plate (Figure 3.2). For these events, the epicentral distance to the nearest station varies between 2 - 210 km, with a mean value close to ~55 km. These events have an azimuthal gap of ≤ 270° and mean error
of ~12 and 10 km for the epicentral locations and depth respectively. Figure 3.3 shows the map of events plotted according to back azimuthal gap. A histogram of back azimuthal gaps for all events is shown in Figure 3.4. I picked P- and S-wave arrivals using the programs MULPLT and HYP included in the software package SEISAN (Havskov & Ottemöeller, 1999; Ottemöeller et al., 2011). P-waves were picked solely on the vertical component and S-wave arrivals were picked on the transverse component and hypocenters were recalculated using P- and SH-wave picks. More details about my database can be found in Chapter 1. The complete dataset includes about 18,631 arrival times of which 13,118 are P-wave picks and 5,513 are S-wave picks. In the northern half of my study area (north of 15°S), P- and S-wave coverage is best at 85 and 105 km depth. At greater depth (>105 km), coverage in south-central Peru, north of 15°S, decreases due to the sparsity of local seismicity below 100 km depth. South of 15°S, in southernmost Peru and northern Bolivia, ray path coverage is much better than to the north due to a large number of locally recorded deeper earthquakes (Figs. 3.5 and 3.6).

3. METHOD

I used the local-scale tomographic inversion method of Zhao et al. (1992), to simultaneously determine three-dimensional variation in $V_P$ and $V_S$ structure and hypocentral parameters using P and S wave arrival time data. This algorithm allows for the incorporation of a 3D starting velocity structure defined by user-inputted 2D seismic discontinuities. Using a priori information about velocity discontinuities in the crust and the upper mantle (including the geometry of the subducting slab) helps improve ray tracing and reduces the final travel time residuals. For the calculation of ray paths within the model volume, this method uses the pseudo-bending technique of Um & Thurber (1987) between adjacent
velocity discontinuities and Snell’s law across the discontinuities. The inversion uses the LSQR algorithm (Paige and Saunders, 1982) to solve for sparse system of linearized travel time equations. Velocity deviations are defined at uniformly spaced grid nodes within the model volume. The earth structure (seismic velocity) and the velocity partial derivatives at any arbitrary point along the ray path are determined by the linear interpolation (weighted sum) of the velocity deviations from the 8 surrounding grid nodes. My inversion grid nodes are uniformly spaced at 40 km in the horizontal direction and 20 km vertically (Figure 3.7).

Model parameterization strongly affects the quality of tomographic images. In the original tomography code, Zhao et al. (1992) use a priori information about the Conrad, Moho and slab geometry from local Pn studies and phase converted waves (Hasegawa et al., 1983; Zhao et al., 1990) to parameterize the model volume. This is accomplished by defining four layers corresponding to the upper crust, lower crust, upper mantle and subducting Pacific plate. As the top surface of the descending slab is usually associated with large abrupt velocity deviations, Zhao et al. (1992) inverts for two complete and independent sets of grid nodes, grid A and grid B, to account for deviations above and below the top surface of the slab, respectively. In the current study, I am uncertain of the exact geometry of the Nazca slab and therefore do not to define the grid nodes (grid A or grid B) with respect to the top surface of the slab or to include any initial velocity deviation for the slab. As I have no constraints on the slab geometry, I use the Moho as my third velocity discontinuity and divide my volume of interest into two grids (A and B) depending on the lateral depth variations in the Moho. At any particular location, if the depth of a grid node is less than the depth to the Moho, then it is assumed to be in the A grid and vice versa. I use two additional velocity discontinuities above the Moho in my starting velocity model. However, I find that
these discontinuities are artificially affecting my results. I therefore choose to minimize their impact by moving the first two discontinuities in the uppermost grid layers at 1 and 2 km depth, where I do not have any effective resolution.

Before the inversion, the starting velocity is assigned to each grid node depending on what layer it is in with respect to the inputted discontinuities. The inversion attributes velocity deviations for points below the third discontinuity (in my case, the Moho) to the B-grid of model parameters, and to the A grid for points above. Velocity deviation at any arbitrary point in the model volume is calculated by interpolating the deviations from 8 surrounding grid nodes, whose deviations are distance weighted. The grid nodes are either from B grid or from the A grid. This allows for more abrupt variations in the velocity deviations across the Moho and helps us to differentiate between crustal versus mantle anomalies.

I started the inversion with a one dimensional input velocity model and use starting P- and S-wave velocities of 6 and 3.42 km/s above the Moho. Below the Moho, my starting P- and S-wave velocity model is that of IASPEI-91 (Kennett & Engdahl, 1991). I calculate new earthquake coordinates at the beginning of each iteration, using the revised velocity model and predict the travel time through the revised earth structure. The travel time residuals are recalculated before each iteration using the revised locations and updated velocity model. To reduce the control of large residuals (data outliers) on the inversion process, I put a threshold of 3 s and 4 s for the P- and S-wave travel time residuals respectively. This threshold was chosen based on the distribution of P- and S-wave residuals corresponding to the initial velocity model (Figure 3.8). As all the travel time residuals are revised at the beginning of each iteration, if any residual was discarded in a previous iteration for being too large could
be included in a later iteration if it drops below the threshold for the revised and improved velocity model.

In seismic tomography, regularization is necessary to stabilize the inversion and reduce the effect of noise (Thurber, 1981, Menke, 1984). Damping penalizes variations in the model with respect to the starting model of a given iteration. Higher values of damping penalize larger model vectors, resulting in an increase in data variance (Thurber & Ritsema, 2007). As the value of damping decreases, the model vector increases and data variance decreases. I use the empirical approach of Eberhart-Phillips (1986) to determine an optimum value of damping using trade-off curves. These are constructed by running single iteration tomographic inversions for a large suite of damping values and plotting data variance versus model variance for each damping value tested. The damping value is selected that significantly reduces the data variance without causing a large increase in the model variance (Eberhart-Phillips, 1986; Zhang & Thurber, 2007). I choose a damping of 60 for my travel time inversion (Figure 3.9).

In order to determine the number of iterations, I follow a similar analytical approach, using a trade-off curve between data variance and model variance. I perform my inversion using my preferred damping value of 60 for 10 iterations and, for each iteration, calculated the achieved model and data variance at that stage. From this “L” curve, I select an optimum number of iterations to be 2, because subsequent increases in the number of iterations dominantly serve to increase model variance without producing significant decreases in data variance (Figure 3.9). Initially, data variance was 0.7807 sec$^2$, corresponding to the input model, with model variance of 0. After 2 iterations, my data variance is reduced to 0.2606 sec$^2$ (a 66.6% reduction), corresponding to a model variance of 3.47.
4. RESULTS

I present tomography results ($V_P$ and $V_S$) on vertical cross-sections (Figure 3.21) and depth maps, for the South American crust as well as the upper mantle beneath the South American moho, in central and southern Peru and northern Bolivia. As the overall seismicity of the upper mantle is significantly higher than the crust, my resolution for the upper mantle is better than the South American crust. Specifically, in the southern half of my study area (between 14-18°S), the upper mantle velocity structure is well resolved up to ~165 km depth due to higher concentration of intermediate depth seismicity in southern Peru, as described in the Resolution section.

4.1 Crustal anomaly

4.1.1 South-central Peru

My tomographic inversion shows a prevalence of high-$V_P$ and high-$V_S$ (labeled “A”, Figs. 3.10-3.13 and 3.24-3.27) in the crust above the southern margin of the Peruvian flat slab. This feature is clearly visible at depths between 5 and 65-km-depth. For the P-wave velocity anomaly, these high velocities extend between 13-14.5°S and 72.5-74.5°W. In $V_S$, this anomaly appears to be laterally more elongated in the E-W direction and extends between 72-74.5°W and 13-14.5°S. The absolute velocity of this crustal anomaly ranges from 6.2 to 6.4 km/s for P waves and 3.4 to 3.6 km/s for S waves. This corresponds to a 3.3-6.6% increase over the P-wave starting model and ~5% increase over the S-wave starting model. This anomaly is very well resolved in both $V_P$ and $V_S$ and described in more detail in the next section.
4.1.2 Southern Peru and northern Bolivia

The crust beneath the active volcanic arc of Western Cordillera is characterized by low-\(V_P\) and low-\(V_S\) (\(V_P\approx5.8\) km/s; \(V_S\approx3.4\) km/s) along its entire length in southern Peru (Figs. 3.10-3.13). This low velocity region almost exactly terminates along the northern margin of the Central Volcanic Zone (CVZ) and transitions into high velocity crustal anomaly (anomaly A), observed above the southern margin of the Peruvian flat slab. This low velocity region, beneath the Western Cordillera, is consistently visible in the depth range of 5-65 km in the South American crust.

East of the active volcanic arc, the crust beneath the northern Altiplano (dashed line, Figs. 3.10-3.13) has low average velocity (labeled “AP”, Figs. 3.29-3.32; \(V_P\approx5.8\) km/s; \(V_S\approx3.4\) km/s). This is considerably slower than the crust above the southern Peruvian flat-slab segment. This velocity contrast, between the Altiplano crust and crust above the southern margin of the Peruvian flat slab, is apparent in a comparison of the cross-sections EE’ vs HH’ (Figs. 3.26 and 3.29 respectively).

Southeast of lake Titicaca and east of the Altiplano/Eastern Cordillera boundary, I observe a very distinctive crustal velocity structure. The low average velocity of the Altiplano crust (\(V_S < 3.4\) km/s) stands in sharp contrast to the high velocity Eastern Cordillera crust. This velocity contrast across the eastern margin of the Altiplano is persistent to depths of 5-65 km in the SA crust and extends between 15-18°S and 67-68.5°W, as can be seen in the depth slice of the S-wave velocity anomaly (labeled “B”, Figs. 3.10-3.13 and 3.31-3.32). The absolute velocity of this anomaly is 3.6 km/s for \(V_S\), indicating ~5% increase over the starting velocity model. This feature is much less clear in my P-wave velocity anomaly map.
4.2 Upper mantle anomaly

4.2.1 Peruvian flat slab region

North of 14°S, I have limited resolution between 75-105 km depth, with almost no resolution at greater depths due to the shallow (75-110 km) hypocentral depths of most of my local events. In the flat slab region, between 13-15°S and 73.5-75°W, I observed a high-\( V_p \) anomaly (labeled “C”, Figs. 3.14 and 3.15). This anomaly can be seen clearly at 75 and 85 km depth and in the cross-sections of P-wave velocity anomalies in Figures 3.24-3.27. This anomaly is almost continuous between the projected location of the subducting Nazca Ridge track and southern edge of the Peruvian flat slab. The absolute velocities of this anomaly range from 8 to 8.4 km/s for P-waves. This range is 0.6-5% higher than the input model at 75-85 km depth. I observe complex variations in S-wave velocities across the Nazca Ridge between 12-15°S and 73-76°W at shallow depth (75-85 km). North of the Nazca Ridge, S-wave velocities vary from slow to neutral, with absolute velocities of 4.4 km/s (labeled “L”, Figure 3.14). South of the Nazca Ridge, the S-wave velocities are higher and vary between 4.6-4.8 km/s (labeled “C”, Figs. 3.14-3.15 and 3.25-3.27). This corresponds to a 2% decrease and 2.42-6.8% increase over the starting model, north and south of the Nazca Ridge, respectively.

4.2.2 Southern Peru and northern Bolivia

In the region between the Peruvian flat slab to the north and the normally dipping portion beneath southernmost Peru to the south lies the transition region where the slab undergoes an abrupt change in geometry from flat to normal subduction. I find a high-\( V_p \) and high-\( V_s \) anomaly in the transition region and further south (labeled “E”), roughly following the slab contours of Cahill and Isacks (1992). It appears as a continuous N-S feature between
14-18°S and 70-73°W in the 85-105-km-depth maps of P- and S-wave velocity anomalies (Figs. 3.15 and 3.16). At greater depths (between 125-185 km), this anomaly continues farther inboard between 15-18°S and 69-72°W (Figs. 3.17-3.20). Most of the WBZ seismicity is located within this high velocity feature (Figs. 3.28-3.32). The range of absolute velocities varies from 8 to 8.4 km/s for P-waves and this is 0.5-5% higher than the input model. Absolute S wave velocities range between 4.6 to 4.8 km/s and correspond to a 2-6% increase over the starting model.

I observed a low-\(V_P\) and low-\(V_S\) anomaly (labeled “AS”, Figs. 3.14-3.17) in the upper mantle below the active volcanic arc, in a small region under the northern Altiplano and northeast of northern Altiplano. This feature is clearly seen in small patches in the 75-85-km-depth maps of P- and S-wave velocity anomalies. At greater depths (105-125 km), it has a more continuous N-S extent in \(V_P\) than in \(V_S\), west of the lake Titicaca. In the cross-sections of Figures 3.29-3.31, it appears to overlie the normally dipping WBZ. The absolute velocity of anomaly “AS” ranges from 7.6 to 7.8 km/s for P waves and 4.2 to 4.4 km/s for S waves.

I observed a small patch (labeled “M”, Figs. 3.14 and 3.15) of neutral to modestly high P-wave velocities and high S-wave velocities in the shallow mantle (75-85 km depth) of the northernmost Altiplano. This feature extends between 71-71.5°W and 14.5-15.2°S. It is clearly visible as a high velocity anomaly in the S wave cross section in Figure 3.29 immediately below the continental Moho and well above the WBZ.

Southeast of lake Titicaca, I observe a high velocity anomaly (labeled “D”, Figs. 3.14-3.19) in the upper mantle. It appears as a normal to moderately high P-wave velocity anomaly under the northern Altiplano, as can be seen in the 75 to 85-km-depth map in Figures 3.14 and 3.15. This anomaly has much stronger positive deviations for the S-wave
anomalies and is consistently visible in the 75 to 165-km-depth maps (Figs. 3.14-3.19) for $V_S$, with smaller deviations at greater depths. This high velocity feature appears to extend east of the northern Altiplano/Eastern Cordillera boundary and appear as a westward dipping feature in the S-wave cross sections of Figures 3.30-3.32. It extends between 16-17°S and 68-69.5°W under the northern Altiplano. East of the Altiplano/Eastern Cordillera boundary, this high velocity feature strikes in the NW-SE direction and extends between 15-18°S and 67-69°W immediately below the high velocity crustal anomaly B (Figs. 3.31 and 3.32). I do not have enough resolution, east of 67°W, to constrain the eastward limit of this high velocity anomaly. The S-wave velocity is characterized by ~3.5% positive deviation corresponding to an absolute velocity of ~4.6 km/s.

5. RESOLUTION ANALYSIS

The concept of resolution in seismic tomography is the capacity of reconstruction of true Earth structure in the calculated image (Inoue et al., 1990). I carry out recovery tests to examine the ability of my tomographic inversion to recover specific structures. I create synthetic anomalies and deviations comparable to my observations and calculate predicted travel times through the model that incorporates these synthetic anomalies. I then invert these travel times using my original velocity model to check if the synthetic anomalies can be recovered.

5.1 Resolution of crustal anomalies

The high P- and S-wave velocity anomaly (anomaly A) in the crust above the flat slab region is relatively well resolved in the center (Test 1 and Test 2), though the eastern and western edges are blurred (Figs 3.35 and 3.36). Amplitudes for $V_S$ are somewhat
underestimated whereas amplitudes for $V_P$ are well recovered. This is likely due to better P-wave coverage than S-wave coverage.

The recovery test (Test 3) for the high shear wave velocity anomaly in the crust (anomaly B), southeast of lake Titicaca, is relatively well resolved, though the easternmost edge is blurred, and the northward extent is somewhat underestimated (Figure 3.37). Notably, the high-$V_S$ anomaly is imaged to show some bleed-over effect into the mantle below it, but the bleed-over effect is not significant. This high velocity feature is comparatively less prominent in the P-wave velocity anomaly map. To test whether the observed amplitude in the P-wave anomaly map is real or an artifact of poor resolution, I perform a recovery test (Test 4) for P-wave using the same synthetic anomaly as tested for S-wave. The amplitude of recovered anomaly for P-waves is comparable to the S-wave recovery test (Figure 3.38), indicating that the small amplitude observed in the P-wave anomaly map is not due to limited resolution. The recovery of high-$V_P$ anomaly does not show any noticeable bleed-over effect into the mantle below it.

My recovery tests (Test 5 and Test 6) for the low-$V_P$ and low-$V_S$ anomalies (anomaly AP) under the northern Altiplano crust (Figs. 3.39 and 3.40) show a decent recovery of the negative deviations between 16-18°S and 68-70°W. Although the amplitudes of the recovered anomalies decreases with increasing depth, the overall recovery along cross section KK′ in figures 3.39 and 3.40 suggests that the low average velocity, observed in the northern Altiplano crust, is a well-resolved feature.

5.2 Resolution of mantle anomalies

Figures 3.43 and 3.44 show recovery tests (Test 9 and Test 10) for high-$V_P$ and high-$V_S$ anomalies that roughly coincide with the location of my anomaly C, in the flat slab
region. I observe that the general trend of the synthetic anomaly is well recovered at 75 and 85 km depth, with a slight reduction in the amplitude.

The recovery test (Test 11) for the low shear wave velocity anomaly north of the Nazca Ridge, modeled after anomaly L (Figure 3.45) indicates that the negative deviations are recoverable to a very small extent. I test the recoverability of the same synthetic anomaly as used in Test 11 for $V_p$ (Test 12) and observe a significant decrease in the amplitude of the recovered anomaly (Figure 3.46). This significant reduction in the amplitude of the recovered anomaly, for both $V_p$ and $V_S$ is likely related to the limited ray path coverage north of the Nazca Ridge.

The recovery tests (Test 13 and Test 14) for the high-$V_p$ and high-$V_S$ anomaly in the transition region, modeled after anomaly E, is well resolved between 14.5-16°S and 71-72°W (3.47 and 3.48). I observe a good recovery of synthetic anomalies at 105 and 125 km depth, with a significant reduction in amplitude at greater depth (~145 km). Notably, this high velocity anomaly, aligned with the WBZ seismicity, does not show any bleed over effect immediately below the Moho (cross section HH′, Figs 3.48) and suggests that the high velocity feature in the S-wave cross section of Figure 3.29 (labeled “M”, immediately sub-Moho) is not an artifact of vertical smearing from anomaly E.

Our recovery tests (Test 15 and Test 16) for the low-$V_p$ and low-$V_S$ anomaly in the upper mantle (labeled “AS”), beneath the northern Altiplano, is relatively well resolved, though the southward extent is somewhat blurred. Amplitudes for both $V_p$ and $V_S$ are approximately recovered at 75 and 85 km depth (Figs 3.49 and 3.50).

For the high-$V_S$ structure (labeled as anomaly “D”, Figs. 3.14-3.19) in the upper mantle southeast of the lake Titicaca I perform recovery tests (Test 17) by putting synthetic
anomalies, both in the overriding plate and the downgoing slab (Figure 3.51), to check whether this is a true structure or an artifact of vertical smearing. Recovery tests indicate that if high velocities are present in both slab and crust, some streaking into the uppermost mantle will occur (Figs 3.51 and 3.52). However, the amplitude of the high velocity anomaly that is streaked into the mantle is much smaller than what I observe, as is the spatial extent. This suggests that some amount of the high velocities from Anomaly D must be due to structure directly beneath the crust.

I perform recovery tests for anomaly D alone (Figs. 3.53 and 3.54), by inverting for synthetic travel times, with and without random noise (Test 19 and Test 20). These tests show that I am able to recover a high velocity anomaly. However, its westward dip is likely an artifact of streaking. This high velocity feature is less prominent in the P-wave velocity anomaly map. I perform a recovery test (Test 21) by inserting synthetic anomalies of high-\(V_P\) that roughly coincides with the location of my anomaly D to check if the observed deviation in the P-wave velocity anomaly map is real. I am able to recover synthetic anomalies at 85, 105 and 125 km depth (Figure 3.55), indicating that the neutral to moderately high-\(V_P\) observed, southwest of lake Titicaca, is a real feature.

**DISCUSSION**

Of the various features that I observed in my tomography results, I focused my discussion on the tectonic implications of crustal and upper mantle anomalies in the Peruvian flat slab region of south-central Peru and northern Altiplano region of southern Peru and northern Bolivia. In this section, I compare my results with previous seismic observations where there is an overlap, and used other geophysical or geological evidence for better interpretation of these observed anomalies. I observed some expected features of the
subduction zone environment including high velocity slab and dominant low velocity in the crust and mantle wedge beneath the active volcanic arc in Western Cordillera.

6.1 Peruvian flat slab region

6.1.1 Crust

The high-$V_P$ and high-$V_S$ anomaly (labeled “A”, Figs. 3.10-3.13) in the South American crust, above the southernmost portion of the Peruvian flat slab, is likely related to the subduction geometry of the downgoing slab and its effect on the thermal structure of the overlying plate. This region of Peru is characterized by flat slab subduction of the cold oceanic Nazca plate which is believed to be altering the thermal structure of the overriding South American plate due to pinching out of hot asthenospheric wedge (Gutscher et al., 2000; Gutscher & Peacock, 2003). This is supported by low heat flow measurements in central Peru, above the flat slab, with a mean heat flow of $\sim$41mWm$^{-2}$ (Henry & Pollack, 1988). Thermal modelling of the subduction zone by English et al. (2003) also predicts a colder thermal regime, with temperature as low as $\sim$300°C above the flat slab. As suggested earlier, seismic velocities increase with decreasing temperature (Kern, 1978; Abers, 2005; Xu et al., 2008). It is likely that my observed high velocity anomaly is a consequence of low temperature due to local thermal shielding of the South American crust provided by the Peruvian flat slab.

6.1.2 Upper mantle

I observe a high-$V_P$ and high-$V_S$ anomaly (anomaly C) in the upper mantle between the projected ridge track and southern edge of the Peruvian flat slab (Figure 1.13, Chapter 1). This high velocity anomaly is associated with a subhorizontal band of seismicity (Figs. 3.25-3.27). The seismicity in the flat slab is so shallow (immediately sub-Moho) that it is hard to
differentiate whether the anomaly C only represents the Peruvian flat slab or some combination of the flat slab and a thin layer of continental mantle lithosphere that may be above the slab and below the mantle. If there is any mantle lithosphere above the flat slab, it is likely cold and seismically indistinguishable from the underlying slab. In the south, anomaly C laterally merges with a dipping high velocity anomaly (anomaly E), which follows the slab contour of Cahill & Isacks (1992) in the transition region. Anomaly E is closely aligned with local WBZ seismicity (Figs 3.28-3.32) is most likely the subducting Nazca slab.

North of the Nazca Ridge, I observed a low-\( V_S \) anomaly in the upper mantle (labeled “L”, Figure 3.14), in the region of the previously proposed flat slab (Cahill and Isacks, 1992, Kirby et al., 1995; Hayes et al., 2012). Recent results of Knezevic Antonijevic et al. (2015) also indicate evidence of low surface wave velocity approximately in the same area. Knezevic Antonijevic et al. (2015) interpret this low velocity feature as an indication of hot asthenospheric inflow and a possible tear in the slab, north of the Nazca Ridge. This feature is much less clear in my P-wave velocity anomaly map (Figs 3.14 and 3.15). My recovery tests (Test 11 and Test 12, Figs. 3.45 and 3.46) indicate a significant reduction in the amplitude of the recovered anomaly for both \( V_P \) and \( V_S \). To the limited extent that I am able to recover synthetic anomalies, my shear wave velocity is consistent with the surface wave tomography results (Knezevic Antonijevic et al., 2015) and the \( V_P \) is neutral to slightly fast but given the lack of resolution, it is hard to interpret whether that is related to the subsurface structure or an artifact of poor resolution.
6.2 Western Cordillera

I observe low-$V_P$ and low-$V_S$ in the crust and upper mantle beneath the active volcanic arc in southern Peru (Figs. 3.10-3.15 and 3.29-3.31). This is consistent with both the tomographic studies of Cunningham et al. (1986), who observe low P wave velocities in the upper mantle below the Western Cordillera in southern Peru, and Myers et al. (1998), who found low-$V_P$ and low-$V_S$ in the upper mantle of the Western Cordillera in Bolivia. Seismic velocities, in general, decreases with increasing temperature and percentage of melt or water fraction within the rock matrix (O’Connell & Budiansky, 1974; Kern, 1978; Sato et al., 1998). My observed low velocity in the mantle wedge of the Western Cordillera could be related to the increased water content due to slab dehydration and formation of hydrous minerals (e.g. Serpentine, Chlorite) in the mantle peridotites or flux melting (Kirby et al., 1996; Giese, 1996; Hacker et al., 2003). Low velocity in the Western Cordillera crust could be either related to the elevated thermal regime or presence of small volume percent of melt. Nakajima et al. (2001) and Matsubara et al. (2009) also obtained similar results for the crust below the volcanic arc, in the northeastern Japan, and attributed it to the presence of small volume percent of melt.

6.3 Eastern Cordillera crust

East of the northern Altiplano/Eastern Cordillera boundary, I observe a high-$V_S$ anomaly (labeled “B”, Figs. 3.10-3.13 and 3.31-3.32) in the crust. This is consistent with the previous tomographic observations for the Eastern Cordillera crust (Dorbath & Granet, 1996; Myers et al., 1998, Ward et al., 2013). As suggested by Dorbath & Granet (1996) and Ward et al. (2013), this high velocity feature could be related to the shallow basement rocks (granodioritic batholiths) of the Eastern Cordillera.
6.4 Northern Altiplano

Previous studies, which mainly focus on the central Altiplano plateau in Bolivia and northern Argentina, have pointed out the variable role of lower crustal shortening or delamination of mantle lithosphere or both, on the temporal evolution of the central Andes (Isacks, 1988; Whitman et al., 1992; Wigger et al., 1994; Allmendinger et al., 1997; Myers et al., 1998; Kley et al., 1999; Beck & Zandt, 2002; McQuarrie et al., 2005; Garzione et al., 2006; Hoke & Garzione, 2008; McQuarrie et al., 2008). Despite the many studies carried out in the last two decades, there still exist two opposing models for surface uplift of the Central Andean Plateau (CAP), as briefly outlined in the introduction. The main aim of my study is to understand the current state of the lower crust and upper mantle beneath the northern Altiplano. This will help us understand the possible role of deeper lithospheric processes (i.e. lower crustal thickening, wholesale removal or piecemeal delamination of the mantle lithosphere) in the evolution of the northern Altiplano.

6.4.1 Crust

From 14°S to 18°S, I observe low average velocities (anomaly AP, Figs. 3.29-3.32; \( V_p \approx 5.8 \text{ km/s}; V_S \approx 3.4 \text{ km/s} \)) in the northern Altiplano crust, down to the Moho depth of \( \sim 65 \) km (Dorbath et al., 1993; Bishop et al., 2014). The seismic tomography between 16°S and 18°S by Dorbath & Granet (1996) also finds low crustal velocities (\( V_p < 6 \text{ km/s} \)) down to about 40km under the northern Altiplano. They attribute it to the more than 10-km-thick sedimentary infill present in this region, with extremely low seismic velocities. My tomographic inversion does not take into account of any correction for the thick sedimentary cover. It is possible that the observed low velocity, in the upper crust (5-25 km depth) of the northern Altiplano basin, is partially related to the low velocity sedimentary rocks.
Low average velocities ($V_p \approx 5.8$ km/s) between 25 and 65 km depth in the lower crust beneath the northern Altiplano are significantly lower than the expected velocity ($V_p > 6.9$ km/s) for the granulite facies, a dominant rock type in the lower continental crust (Rudnick & Fountain, 1995). I do not have enough constraints from previous tomographic studies for the northern Altiplano crust but my results agrees well with other geophysical studies mainly focused on the central Altiplano and immediately south (~20°S) of my study area. Myers et al. (1998), Swenson et al. (2000) and Beck & Zandt (2002) also find low velocity crust in the central Altiplano at ~20°S. Myers et al. (1998) and Beck & Zandt (2002) interpret this low velocity as an indicator of predominantly felsic composition of the central Altiplano crust, even in the lower crust. Swenson et al. (2000) use existing laboratory measurements of P wave velocity for rocks at crustal conditions (Christensen, 1996) and estimate the probable rock composition for the northern and central Altiplano crust to be Granite gneiss or Metagraywacke. They suggest that the lower crust in the Altiplano is felsic quartz rich and either the high-velocity mafic lower crust got removed due to lithospheric delamination or metamorphically transformed to denser phases (eclogite facies) with mantle like seismic velocities. Larger percentages of partial melt in the lower crust could be another possible explanation for the low velocities in the northern Altiplano crust (Schmitz et al., 1996).

However, the absence of recent volcanism in the northern and central Altiplano (Trumbull et al., 2006) indicates the absence of widespread melt in the lower crust. Recently, Ward et al. (2013) used ambient noise tomography (ANT) to determine a high-resolution shear wave velocity structure of the Central Andean crust. The crust underneath the Central Andean Plateau (CAP), including the northern Altiplano, appears as a low-$V_s$ region along its entire N-S extent. Ward et al. (2013) interpret this low velocity crust in the northern and southern
Altiplano as being due to felsic compositions and the presence of melt, respectively. I test the reliability of my tomographic results for the low velocity Altiplano crust by introducing a low-\(V_S\) and a low-\(V_P\) anomaly of similar shape and size as Ward et al. (2013) observed along their northernmost transect (transect AA′, Figure 9, Ward et al. (2013)) and perform recovery test (Test 7 and Test 8, Figs 3.41 and 3.42). Although the shape and size of the recovered anomaly is different from the input model, it compares well with my observed anomaly along one of the similar transects (cross section JJ′, Figure 3.31).

These observations suggest that my observed low velocity in the northern Altiplano crust may be related to the felsic composition of the lower crust. If the crust underneath the northern Altiplano is felsic, then it may be weak at lower crustal P-T conditions (1-1.5 GPa, > 650° C) (Rudnick & Fountain, 1995; Christensen, 1996). The tectonic shortening of weak crust has been proposed as a dominant mechanism of crustal thickening and uplift of the central Altiplano in Bolivia (Swenson et al., 2000, Beck & Zandt, 2002). My results suggest a similar mechanism for the uplift of the northern Altiplano in southern Peru and northern Bolivia.

6.4.2 Upper mantle

The upper mantle beneath the northern Altiplano is very heterogeneous, with significant along strike variations in P- and S-wave velocities. I observed a small anomaly characterized by high-\(V_P\) and high-\(V_S\) (\(V_P\approx8.2 \text{ km/s}; V_S\approx4.6 \text{ km/s}\)) beneath the northernmost edge of the northern Altiplano (anomaly M), consistent with mantle lithospheric composition. This high velocity feature is significantly above the WBZ seismicity and immediately sub-Moho (Figure 3.29). My recovery tests (Test 13 and Test 14) for anomaly E (cross section HH′, Figs 3.47 and 3.48) clearly indicate that this high velocity feature is not
an artifact of vertical smearing and may represent the relict continental mantle lithosphere of
the overriding South American plate.

Northwest of lake Titicaca, the upper mantle beneath the northern Altiplano is
categorized by low-\(V_P\) and low-\(V_S\), (Figs. 3.14-3.15 and 3.30) in marked contrast with the
high velocity upper mantle (anomaly M) observed beneath the northernmost edge of the
northern Altiplano. Previous tomography studies in the central Altiplano also notice complex
along strike variations in upper mantle seismic properties (Myers et al., 1998; Whitman et al.,
1992) with some parts of the central Altiplano having high velocity mantle lithosphere or
eclogitic lower crustal roots present, but low velocity upper mantle consistent with
asthenosphere beneath other portions of the central Altiplano. Dorbath et al. (1993) also find
low velocity upper mantle beneath the northern Altiplano at \(\sim 17.5^\circ\)S and interpret it as hot
mantle or a thinning of the lithosphere. My observed low velocity, northwest of lake Titicaca,
is more consistent with the mantle of asthenospheric seismic character and suggests that
much of the mantle lithosphere in this small region has been removed (piecemeal
delamination).

Southeast of lake Titicaca, I observe a high-\(V_S\) anomaly (anomaly D, \(V_S \approx 4.6\) km/s)
in the upper mantle beneath the northern Altiplano that also extends beyond the
Altiplano/Eastern Cordillera boundary in the east. East of the Altiplano, my results compare
well with those of Dorbath et al. (1993). Dorbath et al. (1993) find high P-wave velocities in
the upper mantle east of the Altiplano/Eastern Cordillera boundary and interpret them as
underthrust Brazilian craton from the east. The western half of anomaly D, below the
northern Altiplano, is consistent with either the mantle of continental lithosphere or cratonic
lithosphere. Previous studies (Myer et al., 1998; Polet et al., 2000; Watts et al., 1995;
Aitcheson et al., 1995) did not see evidence of a high velocity anomaly in the upper mantle east of the Altiplano/Eastern Cordillera. From my current observation, I can conclude that some form of mantle lithosphere exists beneath the northern Altiplano but it is not possible for me to discriminate between underthrust cratonic and in situ continental lithosphere.

Given that some mantle lithosphere is still present beneath the Northern Altiplano, it is unlikely that the current mantle lithosphere under the northern Altiplano has experienced pervasive and large-scale delamination or wholesale removal. This finding is particularly important in the context of the ongoing debate on the evolution of the Altiplano plateau, as mentioned in the introduction. It indicates that the idea of rapid surface uplift (Garzione et al., 2006; Ghosh et al., 2006; Molnar & Garzione, 2007; Garzione et al., 2008; Hoke & Garzione, 2008), which requires the wholesale removal of the mantle lithosphere is unlikely for the evolution of the northern Altiplano. My tomography results for the lower crust and upper mantle beneath the northern Altiplano are in better agreement with the slow and steady uplift model (Isacks, 1988; Allmendinger et al., 1997; Jordan et al., 1997; McQuarrie et al., 2005; Hoke & Lamb, 2007; Ehlers & Poulsen, 2009), which suggests that shortening of weak crust and localized removal of excess mantle through the small-scale lithospheric delamination, is the main cause of the Altiplano uplift.

7. CONCLUSION

I have used P- and S-wave travel time delays from locally recorded earthquakes to estimate the crustal and upper mantle velocity structure in the Peruvian flat slab region in south central Peru and in the northern Altiplano region of southern Peru and northern Bolivia. My conclusions from the current tomography results are as follows:
1) The high velocity crust above the southern margin of the Peruvian flat slab is related to the thermal shielding of the South American crust from slab flattening and the pinching out of the asthenospheric wedge (Gutscher et al., 2000; English et al., 2003).

2) The low average velocity in the northern Altiplano crust, even in the lower crust, is similar to the central Altiplano, further south in central Bolivia. This is consistent with felsic quartz rich lower crust as opposed to high velocity granulite facies. This felsic crust is likely weak at lower crustal P-T conditions and may contribute in the slow and steady uplift of the northern Altiplano via lower crustal shortening and thickening.

3) The upper mantle under the northern Altiplano is heterogeneous and suggests piecemeal delamination of the mantle lithosphere as opposed to wholesale removal. This observation favors the slow and steady uplift model (Isacks, 1988; Allmendinger et al., 1997; McQuarrie et al., 2005), which suggests localized removal of excess mantle due to prolonged shortening and thickening.

8. ACKNOWLEDGMENTS

I am thankful to IRIS and personnel at the PASSCAL Instrument Center for their help and support throughout the CAUGHT and PULSE deployment. The seismic instruments were provided by UNC-Chapel Hill, Yale University, and the Incorporated Research Institutions for Seismology (IRIS) through the PASSCAL Instrument Center. I sincerely thank Dr. Hernando Tavera, Director, and C. Condori Quispe, of the Instituto Geofísico del Perú, Lima, Peru, and Dr. Estela Minaya of the San Calixto Observatory in Bolivia and for their help in deployment and demobilization efforts, as well as Mike Fort (PASSCAL) for his invaluable assistance in the field. The CAUGHT experiment was supported by NSF grants
EAR-0908777 (Lara Wagner) and EAR-0907880 (Susan Beck). The PULSE experiment was funded by NSF grants EAR-0944184 (Lara Wagner), EAR-0943991 (Susan Beck), and EAR-0943962 (Maureen Long). Special thanks to C. Berk Biryol and S. Knezevic Antonijevic for helpful discussions. Maps were created using the Generic Mapping Tools (GMT) software (Wessel & Smith, 1991).
Figure 3.1- Geologic map showing major physiographic divisions in my study area (after Kley & Monaldi, 1999; Oncken et al., 2006; McQuarrie et al., 2008; Barnes & Ehlers, 2009): the Western Cordillera (WC), the Altiplano (AL), the Eastern Cordillera (EC), the Interandean zone, and the Subandes (SA). Black diamonds are locations of the broadband stations used in this study. Holocene volcanic activity (red triangles) from Siebert & Simkin (2002).
Figure 3.2- Map showing the final locations of 712 events relocated with the inversion, after second iteration. The hypocenters are color coded by depth.
Figure 3.3- Map showing the final locations of 712 events used in this study. The hypocenters are color coded by azimuthal gap.
Figure 3.4- Histogram of azimuthal gaps for events used in this study. I used all events with azimuthal gap less than qual to $270^\circ$. 
Figure 3.5- Ray path coverage of P wave for events at different depth slices in my study area. Ray paths are estimated as straight line distance between the seismic stations (red stars) and events (black dots).
Figure 3.6- Ray path coverage of S wave for events at different depth slices in my study area. Ray paths are estimated as straight line distance between the seismic stations (red stars) and events (black dots).
Figure 3.7- Map of velocity grid nodes and seismic stations used in the inversion
Figure 3.8- Scatter plot of residuals versus travel time for all events. Residuals before the inversion are shown in black for P (top) and S (bottom). Final residuals after second inversion are overlain in red. Solid black lines indicate residual cutoff of 3 and 4 seconds for P and S times respectively.
Figure 3.9- Model versus data variance plot for different damping parameters (top) and different numbers of iterations (bottom). Circles with red edges indicate optimal damping value and the ideal number of iterations respectively. I choose to use two iterations with damping equal to 60 to effectively minimize variance in both data and model.
Figure 3.10- Map view results of tomographic inversion for $V_P$ (top) and $V_S$ (bottom) at 5 km depth. Anomalies A, B, and AP are labeled. Dashed line is approximate outline of the northern Altiplano (de Silva, 1989, Ward et al., 2013). Slab contours (thick black lines) are from Cahill and Isacks (1992), black diamonds are seismic stations, and red triangles are active volcanoes. Warm (reddish) and cool (bluish) colors are percent velocity deviations in $V_P$ and $V_S$. Numbers on the contours indicate absolute velocity in km/s. $V_P$ and $V_S$ contours are in 0.2 km/s increments.
Figure 3.11- Map view results of tomographic inversion for $V_P$ (top) and $V_S$ (bottom) at 25 km depth. Anomalies A, B, and AP are labeled. Warm (reddish) and cool (bluish) colors are percent velocity deviations in $V_P$ and $V_S$. Numbers on the contours indicate absolute velocity in km/s. $V_P$ and $V_S$ contours are in 0.2 km/s increments. Other symbols as in Figure 3.10.
Figure 3.12 - Map view results of tomographic inversion for $V_P$ (top) and $V_S$ (bottom) at 45 km depth. Anomalies A, B, and AP are labeled. Warm (reddish) and cool (bluish) colors are percent velocity deviations in $V_P$ and $V_S$. Numbers on the contours indicate absolute velocity in km/s. $V_P$ and $V_S$ contours are in 0.2 km/s increments. Other symbols as in Figure 3.10.
Figure 3.13- Map view results of tomographic inversion for $V_P$ (top) and $V_S$ (bottom) at 65 km depth. Anomalies A, B, and AP are labeled. Warm (reddish) and cool (bluish) colors are percent velocity deviations in $V_P$ and $V_S$. Numbers on the contours indicate absolute velocity in km/s. $V_P$ and $V_S$ contours are in 0.2 km/s increments. The multiple close contours show the location of the Moho. Other symbols as in Figure 3.10.
Figure 3.14- Map view results of tomographic inversion for $V_P$ (top) and $V_S$ (bottom) at 75 km depth. Anomalies C, D, L, AS, and M are labeled. Warm (reddish) and cool (bluish) colors are percent velocity deviations in $V_P$ and $V_S$. Numbers on the contours indicate absolute velocity in km/s. $V_P$ and $V_S$ contours are in 0.2 km/s increments. Other symbols as in Figure 3.10.
Figure 3.15 - Map view results of tomographic inversion for $V_P$ (top) and $V_S$ (bottom) at 85 km depth. Anomalies C, D, E, AS and M are labeled. Warm (reddish) and cool (bluish) colors are percent velocity deviations in $V_P$ and $V_S$. Numbers on the contours indicate absolute velocity in km/s. $V_P$ and $V_S$ contours are in 0.2 km/s increments. Other symbols as in Figure 3.10.
Figure 3.16- Map view results of tomographic inversion for $V_P$ (top) and $V_S$ (bottom) at 105 km depth. Anomalies D, E, and AS are labeled. Warm (reddish) and cool (bluish) colors are percent velocity deviations in $V_P$ and $V_S$. Numbers on the contours indicate absolute velocity in km/s. $V_P$ and $V_S$ contours are in 0.2 km/s increments. Other symbols as in Figure 3.10.
Figure 3.17- Map view results of tomographic inversion for $V_P$ (top) and $V_S$ (bottom) at 125 km depth. Anomalies D, E, and AS are labeled. Warm (reddish) and cool (bluish) colors are percent velocity deviations in $V_P$ and $V_S$. Numbers on the contours indicate absolute velocity in km/s. $V_P$ and $V_S$ contours are in 0.2 km/s increments. Other symbols as in Figure 10.
Figure 3.18- Map view results of tomographic inversion for $V_P$ (top) and $V_S$ (bottom) at 145 km depth. Anomalies D and E are labeled. Warm (reddish) and cool (bluish) colors are percent velocity deviations in $V_P$ and $V_S$. Numbers on the contours indicate absolute velocity in km/s. $V_P$ and $V_S$ contours are in 0.2 km/s increments. Other symbols as in Figure 3.10.
Figure 3.19 - Map view results of tomographic inversion for $V_p$ (top) and $V_S$ (bottom) at 165 km depth. Anomalies D and E are labeled. Warm (reddish) and cool (bluish) colors are percent velocity deviations in $V_p$ and $V_S$. Numbers on the contours indicate absolute velocity in km/s. $V_p$ and $V_S$ contours are in 0.2 km/s increments. Other symbols as in Figure 10.
Figure 3.20 - Map view results of tomographic inversion for $V_P$ (top) and $V_S$ (bottom) at 185 km depth. Anomaly E is labeled. Warm (reddish) and cool (bluish) colors are percent velocity deviations in $V_P$ and $V_S$. Numbers on the contours indicate absolute velocity in km/s. $V_P$ and $V_S$ contours are in 0.2 km/s increments. Other symbols as in Figure 10.
Figure 3.21: Map showing locations of the trench perpendicular and trench parallel cross sections shown in Figure 3.22-3.34.
Figure 3.22- Results for $V_P$ and $V_S$ along cross section AA’, located north of the Nazca Ridge. The Moho is from density measurements of Tassara et al. (2006). The slab contours are from local seismicity study (Kumar et al., 2015) and the red dots indicate event locations. Anomaly L is labeled. Warm (reddish) and cool (bluish) colors are percent velocity deviations in $V_P$ and $V_S$. Numbers on the contours indicate absolute velocity in km/s. $V_P$ and $V_S$ contours are in 0.2 km/s increments. Black triangles show the location of seismic stations along the AA’ transect.
Figure 3.23- Results for $V_P$ and $V_S$ along cross section BB’, located north of the Nazca Ridge. Anomaly L is labeled. Warm (reddish) and cool (bluish) colors are percent velocity deviations in $V_P$ and $V_S$. Numbers on the contours indicate absolute velocity in km/s. $V_P$ and $V_S$ contours are in 0.2 km/s increments. Other symbols as in Figure 3.22.
Figure 3.24- Results for $V_P$ and $V_S$ along cross section CC'. Anomalies A, C and L are labeled. Warm (reddish) and cool (bluish) colors are percent velocity deviations in $V_P$ and $V_S$. Numbers on the contours indicate absolute velocity in km/s. $V_P$ and $V_S$ contours are in 0.2 km/s increments. Other symbols as in Figure 3.22.
Figure 3.25- Results for $V_P$ and $V_S$ along cross section DD', located along the Nazca Ridge. Anomalies A and C are labeled. Warm (reddish) and cool (bluish) colors are percent velocity deviations in $V_P$ and $V_S$. Numbers on the contours indicate absolute velocity in km/s. $V_P$ and $V_S$ contours are in 0.2 km/s increments. Other symbols as in Figure 3.22.
Figure 3.26- Results for $V_P$ and $V_S$ along cross section EE’, located along the southern margin of the Nazca Ridge. Anomalies A and C are labeled. Warm (reddish) and cool (bluish) colors are percent velocity deviations in $V_P$ and $V_S$. Numbers on the contours indicate absolute velocity in km/s. $V_P$ and $V_S$ contours are in 0.2 km/s increments. Other symbols as in Figure 3.22.
Figure 3.27 - Results for $V_p$ and $V_s$ along cross section FF’, located along the southern margin of the Nazca Ridge. Anomalies A and C are labeled. Warm (reddish) and cool (bluish) colors are percent velocity deviations in $V_p$ and $V_s$. Numbers on the contours indicate absolute velocity in km/s. $V_p$ and $V_s$ contours are in 0.2 km/s increments. The red triangles indicate the locations of active volcanism. Other symbols as in Figure 3.22.
Figure 3.28- Results for $V_P$ and $V_S$ along cross section GG', located immediately south of the Nazca Ridge. Anomalies E and AS are labeled. Warm (reddish) and cool (bluish) colors are percent velocity deviations in $V_P$ and $V_S$. Numbers on the contours indicate absolute velocity in km/s. $V_P$ and $V_S$ contours are in 0.2 km/s increments. The red triangles indicate the locations of active volcanism. Other symbols as in Figure 3.22.
Figure 3.29- Results for $V_P$ and $V_S$ along cross section HH', located south of the Nazca Ridge and passing through the northernmost edge of the northern Altiplano. Anomalies E, M, AS, and AP are labeled. Warm (reddish) and cool (bluish) colors are percent velocity deviations in $V_P$ and $V_S$. Numbers on the contours indicate absolute velocity in km/s. $V_P$ and $V_S$ contours are in 0.2 km/s increments. The red triangles indicate the locations of active volcanism. Other symbols as in Figure 3.22.
Figure 3.30: Results for $V_P$ and $V_S$ along cross section II', located in the region of normal subduction in southern Peru and passing through the northern Altiplano. Anomalies D, E, AS, and AP are labeled. Warm (reddish) and cool (bluish) colors are percent velocity deviations in $V_P$ and $V_S$. Numbers on the contours indicate absolute velocity in km/s. $V_P$ and $V_S$ contours are in 0.2 km/s increments. The red triangles indicate the locations of active volcanism. Other symbols as in Figure 3.22.
Figure 3.31 - Results for $V_P$ and $V_S$ along cross section $JJ'$, located in the region of normal subduction in southern Peru and passing through the northern Altiplano. Anomalies B, D, E, and AP are labeled. Warm (reddish) and cool (bluish) colors are percent velocity deviations in $V_P$ and $V_S$. Numbers on the contours indicate absolute velocity in km/s. $V_P$ and $V_S$ contours are in 0.2 km/s increments. The red triangles indicate the locations of active volcanism. Other symbols as in Figure 3.22.
Figure 3.32: Results for $V_P$ and $V_S$ along cross section KK’, located in the region of normal subduction in southern Peru and passing through the northern Altiplano. Anomalies B, D, E, and AP are labeled. Warm (reddish) and cool (bluish) colors are percent velocity deviations in $V_P$ and $V_S$. Numbers on the contours indicate absolute velocity in km/s. $V_P$ and $V_S$ contours are in 0.2 km/s increments. The red triangles indicate the locations of active volcanism. Other symbols as in Figure 3.22.
Figure 3.33- Results for $V_P$ and $V_S$ along cross section LL', parallel to the trench. Warm (reddish) and cool (bluish) colors are percent velocity deviations in $V_P$ and $V_S$. Numbers on the contours indicate absolute velocity in km/s. $V_P$ and $V_S$ contours are in 0.2 km/s increments. The red triangles indicate the locations of active volcanism. Other symbols as in Figure 3.22.
Figure 3.34- Results for $V_P$ and $V_S$ along cross section MM', parallel to the trench. Warm (reddish) and cool (bluish) colors are percent velocity deviations in $V_P$ and $V_S$. Numbers on the contours indicate absolute velocity in km/s. $V_P$ and $V_S$ contours are in 0.2 km/s increments. The red triangles indicate the locations of active volcanism. Other symbols as in Figure 3.22.
Figure 3.35 - Results showing the recovery of high-V$P$ anomaly A (Test 1). Black dots indicate the locations of seismic stations. The multiple close contours show the location of the Moho. Location of the cross section EE$'$ is shown in map view.
Figure 3.36- Results showing the recovery of high-$V_S$ anomaly A (Test 2). Black dots indicate the locations of seismic stations. The multiple close contours show the location of the Moho. Location of the cross section EE$'$ is shown in map view.
Figure 3.37 - Results showing the recovery of high-\(V_S\) anomaly B (Test 3). Black dots indicate the locations of seismic stations and the multiple close contours show the location of the Moho in map view. In the cross section, the red and black triangles indicate the locations of active volcanism and seismic stations respectively. Location of the cross section KK’ is shown in map view.
Figure 3.38 - Results showing the recovery of high-$V_p$ anomaly (Test4), roughly coinciding with the location of anomaly B. Black dots indicate the locations of seismic stations and the multiple close contours show the location of the Moho in map view. In the cross section, the red and black triangles indicate the locations of active volcanism and seismic stations respectively. Location of the cross section KK' is shown in map view.
Figure 3.39 - Results showing the recovery of low-\(V_P\) anomaly AP under the northern Altiplano crust (Test 5). Dashed line is approximate outline of northern Altiplano. The multiple close contours show the location of the Moho. Black dots indicate the location of seismic stations. Solid lines represent the slab contour from Cahill & Isacks (1992). Location of the cross section KK’ is shown in map view.
Figure 3.40- Results showing the recovery of low-$V_S$ anomaly AP under the northern Altiplano crust (Test 6). Dashed line is approximate outline of northern Altiplano. The multiple close contours show the location of the Moho. Black dots indicate the location of seismic stations. Solid lines represent the slab contour from Cahill & Isacks (1992). Location of the cross section KK' is shown in map view.
Figure 3.41- Results showing the recovery of low $V_S$ anomaly under the northern Altiplano crust (Test 7). Location of the cross section is shown in the map (solid black line) and same as AA’ transect of Ward et al. (2013). Other symbols as in Figure 3.37.
Figure 3.42- Results showing the recovery of low $V_P$ anomaly under the northern Altiplano crust (Test 8). Location of the cross section is shown in the map (solid black line) and same as AA’ transect of Ward et al. (2013). Other symbols as in Figure 3.37.
Figure 3.43 - Results showing the recovery of high-$V_p$ anomaly C (Test 9). Black dots indicate the location of seismic stations. Solid lines represent the slab contour from Cahill & Isacks (1992). Location of the cross sections EE$'$ and FF$'$ are shown in map view.
Figure 3.44 - Results showing the recovery of high-\(V_S\) anomaly C (Test 10). Black dots indicate the location of seismic stations. Solid lines represent the slab contour from Cahill & Isacks (1992). Location of the cross sections EE' and FF' are shown in map view.
Figure 3.45- Results showing the recovery of low-$V_S$ anomaly L (Test 11). Black dots indicate the location of seismic stations. Solid lines represent the slab contour from Cahill & Isacks (1992). Location of the cross section CC' is shown in map view.
Figure 3.46- Results showing the recovery of low-\(V_p\) anomaly (Test12), roughly coinciding with the location of low-\(V_s\) anomaly L. Black dots indicate the location of seismic stations. Solid lines represent the slab contour from Cahill & Isacks (1992). Location of the cross section \(CC'\) is shown in map view.
Figure 3.47 - Results showing the recovery of high-$V_p$ anomaly E (Test 13). Location of the cross sections GG’ and HH’ are shown in map view. Other symbols as in Figure 3.37.
Figure 3.48- Results showing the recovery of high-$V_S$ anomaly E (Test 14). Location of the cross sections GG' and HH' are shown in map view. Other symbols as in Figure 3.37.
Figure 3.49- Results showing the recovery of low-V$_P$ anomaly AS (Test 15). Dashed line is approximate outline of the northern Altiplano. Black diamonds indicate the location of seismic stations. Solid lines represent the slab contour from Cahill & Isacks (1992). Location of the cross sections II’ is shown in map view.
Figure 3.50- Results showing the recovery of low-$V_S$ anomaly AS (Test 16). Dashed line is approximate outline of the northern Altiplano. Black diamonds indicate the location of seismic stations. Solid lines represent the slab contour from Cahill & Isacks (1992). Location of the cross sections II’ is shown in map view.
Figure 3.51- Results showing the recovery of high-$V_S$ anomaly in the crust beneath the Eastern Cordillera and along the Wadati-Benioff Zone (Test 17). Location of the cross section KK' is shown in map view.
Figure 3.52: Results showing the recovery of high-$V_p$ anomaly in the crust beneath the Eastern Cordillera and along the Wadati-Benioff Zone (Test 18). Location of the cross section KK' is shown in map view.
Figure 3.53 - Results showing the recovery of high-$V_s$ anomaly D (Test 19). Location of the cross sections $JJ'$ and $KK'$ are shown in map view. Other symbols as in Figure 3.37.
Figure 3.54 - Results showing the recovery of high-$V_S$ anomaly D, with random noise in the data (Test 20). Location of the cross sections $JJ'$ and $KK'$ are shown in map view. Other symbols as in Figure 3.37.
Figure 3.55- Results showing the recovery of moderately high-\( V_p \) anomaly D (Test21). Location of the cross sections \( JJ' \) and \( KK' \) are shown in map view. Other symbols as in Figure 3.37.
REFERENCES


Zhao, D., Horiuchi, S. & Hasegawa, A., 1990. 3-D seismic velocity structure of the crust and the uppermost mantle in the northeastern Japan arc, Tectonophysics, 181, 135-149.
