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PRELIMINARY SEISMIC CODA WAVE ATTENUATION STUDY OF PACAYA VOLCANO, GUATEMALA

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PRELIMINARY SEISMIC CODA WAVE ATTENUATION STUDY OF PACAYA VOLCANO, GUATEMALA

By

Maximilian Guettinger

A THESIS

Submitted in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

In Geophysics

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This thesis has been approved in partial fulfillment of the requirements for the Degree of MASTER OF SCIENCE in Geophysics.

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Abstract

Pacaya volcano is a basaltic complex in the Central American Volcanic Arc in Guatemala. Pacaya has been in an open vent condition since 1961. During January 2015 we deployed 19 short period seismometer stations on Pacaya at distances less than 1.5 kilometers from the summit. The resulting data consisted of tremor and thousands of discrete events associated with ongoing outgassing. Where possible, individual events were identified and located. They were found to be high in the edifice near the vent. We used the decaying codas of these events to model the attenuation structure of the Pacaya edifice, following the energy density decay method of *Aki and Chouet* [1975]. We attempted to model the attenuation coda quality factor, Q_c, at 482 events that were well recorded by the temporary network. After investigating a range of frequencies, we found a range of 2-10 Hz to be the best frequency range in terms of the frequency ranges analyzed. We found that there was not a significant dependence of Q_c on P or S wave amplitude, so did not attempt to include a source term correction. Median Q_c, selected using thresholds, ranged from as low as 146 at station PS12 to 194 at station PS06. In general, attenuation was lower at the western-most stations. We also interpreted that higher attenuation to the north and on the north summit may result from fracturing or magmatic sources and that the lower attenuation to the west may be related to the slide and subsidence that occurred.

Chapter 1

Introduction

Attenuation is the loss of energy over time and distance due to factors such as geometrical spreading, scattering, and absorption. Seismic attenuation studies can provide insight into elastic properties of the media between sources and receivers. In volcanic environments, high attenuation is typically attributed to hot and/or highly fractured rock. When attenuation data are mapped into a model of the volcano, they can provide information about the structure of magmatic features.

Pacaya volcano is an active system that consists of a basaltic cone constructed upon an older edifice. Observations and models have shown that the flank can slip, posing a major hazard to the local population. In this study, we used seismic attenuation modeling to investigate the structure of the cone. We assume in our study that we are observing intrinsic attenuation in that most of the energy is lost to inelastic processes and heat generation. We study the energy decay of the seismic coda to determine the coda quality factors (Q_c), which represent the ratio of stored versus dissipated energy as a seismic wave passes through a material [Lees, 2007], and use these values to find parameters, such as the median values of Q_c for certain stations, that we use to create plots to better understand attenuation at Pacaya.

1.1 Pacaya Geology and Partial Eruptive History

Pacaya is a basaltic complex [Schafer et al., 2016 citing Eggers, 1971 and Conway et al., 1992] located in the Central American Volcanic Arc in Guatemala (Figure 1.1, copyright: Gregory Waite, 2016, see appendix for permissions) [Schafer et al., 2016 citing Eggers, 1971 and Conway et al., 1992] and is at least several thousand years old [Rose et al., 2013 citing Eggers, 1971 and Conway et al., 1992]. The currently active feature, the Mackenney Cone, is seen in Figure 1.2. While the current eruptive products are basalt [Rose et al., 2013], the composition of ancestral Pacaya deposits varies somewhat. An ancestral andesitic Pacaya stratovolcano, tephra and flows, rhyodacitic through andesite cones, and the modern Pacaya volcano all are positioned upon Tertiary volcaniclastics and volcanics [Conway, 1992 citing Eggers, 1971 and Williams, 1960]. The history has generally been divided into three eruptive phases [e.g., Kitamura and Matias, 1995; Eggers 1971], the first having the growth of the andesitic ancestral volcano. This was followed by a period of voluminous eruptions of dacite in the second phase. The last phase formed the modern basaltic composite Pacaya volcano and continues today. Pacaya may be mostly or completely younger than 23 thousand years [Rose et al., 2013]. Eruptive activity possibly occurred in 1585, ca. 1651-1678, and 1775 A.D at Pacaya [Rose et al., 2013 citing Conway et al., 1992] and a large edifice collapse of ~0.6 km^3 [Vallence et al., 1995] that occurred between 595+/-70 and 1555+/-80 years before present produced a collapse scarp in which Mackenney cone has grown [Kitamura and Matias, 1995]. The conical features of Pacaya may have been formed during bouts activity occurring over less than one to several centuries [Rose et al., 2013].

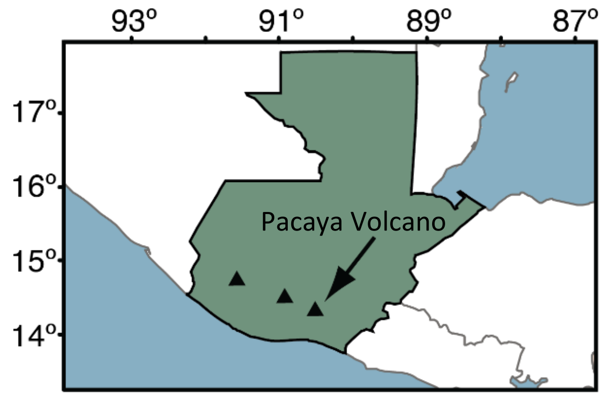

Figure 1.1. Above-left. Location of Pacaya Volcano in Guatemala. Copyright Gregory Waite, 2016.

Figure 1.2. Above-right. Makenney Cone, Pacaya Volcano.

Pacaya is currently active as of the writing of this paper with activity starting in 1961 [Rose et al., 2013]. From 1961 to 2010 the activity occurred generally in the form of lava flows of a'a and pahoehoe [Rose et al., 2013] and this continues to today [Greg Waite personal communication]. Flows have originated at the summit and multiple locations on the Mackenney cone [Rose et al., 2013]. Pyroclastic eruptions also occurred with instances of fire fountaining occurring such as during the May 27th, 2010 eruption which produced a 21 kilometer high ash column [Rose et al., 2013]. From 1965-present, the Mackenney cone has grown on the west flank of Pacaya cone which was growing on the collapse scar of Pacaya Viejo [Rose et al., 2013]. Lava flows and Strombolian activity are typical of the basaltic Pacaya Complex [Rose et al., 2013].

1.2 Previous geophysical work done on Pacaya

Geophysical studies at Pacaya volcano have included microgravity, leveling, GPS, InSAR, and seismic surveys. They have revealed a dynamic environment that requires continued detailed work to fully understand. We provide summaries of some the key studies, beginning with the gravity and vertical deformation studies of Eggers [1983]. Eggers [1983] documented concurrent gravity and elevation changes on the volcano from June 1979 to June 1980, as well as gravity change data from earlier dates. During acquisition of the data, activity at the volcano altered to strombolian explosions from fumarolic emissions [Eggers, 1983]. Eggers [1983] concluded that increases in the gravity field were indicated during dominantly fumarolic activity and decreases before larger magmatic events. Leveling surveys indicated that deflation occurred during fumarolic activity, with minor inflation occurring before major magmatic events, but Eggers [1983] concluded that only density changes in the subsurface could reasonably account for the gravity changes. Gravity changes were observed in areas lacking elevation changes in some instances [Eggers, 1983]. Eggers [1983] proposed two models, the first of which was a magma body with vesicles accumulating near the top reducing density, but causing small or no inflation, then being degassed and devesiculated thus increasing density and producing deflation. The second model involved a low density magma body moving upward and replacing denser country rock without losing or gaining volume or causing much if any inflation [Eggers, 1983]. The body later devesiculating, increasing in density, and then deflation occurring [Eggers, 1983].

Schaefer et al. [2013] used engineering methodologies that were standard for studying non-volcanic slopes to examine the southwest flank of Pacaya's active cone in order to assess the stability of Pacaya and to determine the potential for the occurrence of another lateral collapse [Schaefer et al., 2013]. Schaefer et al. [2013] developed a geomechanical model using both field and laboratory analysis of Pacaya's rocks and rock mass characteristics. They found that under gravity alone the edifice maintains its stability, but magma pressure or peak ground acceleration above a threshold could initiate a collapse on a large scale [Schaefer et al., 2013]. Schaefer et al. [2013] also suggested that the ancestral sector collapse might have been controlled by a layer of pyroclastics beneath the structure.

A much more detailed deformation analysis was made possible through RADAR interferometry studies. Schaefer et al. [2016] used InSAR from ALOS-1 and UAVSAR data acquired between 31 May 2010 and 10 April 2014 to measure post eruptive deformation events after the VEI-3 May 2010 eruptions. They found that several months of consolidation occurred after the 3 m co-eruptive displacement [Schaefer et al., 2016]. Localized deformation occurred near the summit and a 5.4 km lava flow was erupted outside of the ancestral collapse scarp and subsided [Schaefer et al., 2016]. Schaefer et al. [2016] attributed the eruption location to the zone of structural weakness caused by the southwest displacement of the flank and to the local transtensional stress regime. Schaefer et al. [2016] suggest that the recurrence of flank eruptions of high volume lava flows may indicate the cyclical draining of high-level magma systems into lower vents.

In another deformation study, a network of GPS benchmarks was installed around Pacaya in 2009 [see Hetland, 2014]. Repeat occupations of these sites have been used to measure deformation [Hetland, 2014; Lechner et al., 2015] and have captured a complex deformation field. Hetland [2014] also used data collected by the Instituto Geográfico Nacional to extend the dataset to eight years before the 27 May 2010 eruption and three years after. Up to 40 cm of total vertical displacement was found between 2009 and 2014 [Lechner et al., 2015]. Using forward modeling of 3-D displacements, Hetland [2014] found a vertical dike or planar surface in the cone trending NNW-SSE to be a plausible source for the observed deformation with the volcano, most likely experiencing a combination of inflation and slip. Down the northern flank of the volcano this created a large scar at the surface (Figure 1.2). The possibility of a westward collapse is supported by the models. Lechner et al. [2015] also found a fairly shallow deformation source which appears to agree with a hypothesized shallow magma reservoir and a dike that trends NNW-SSE.

Dalton et al. [2010] used infrasound data and similarly timed 0.25 Hz sample rate SO_2 emission data from a UV camera to study the link between infrasound events and varied emission rates at Pacaya. They found two scales of degassing with variations on a scale of 1 to 3 minutes superimposed on larger changes over 30 minutes to an hour in length [Dalton et al., 2010]. They also found that the record of acoustic signals was dominated by signals characteristic of Strombolian explosions [Dalton et al., 2010]. They calculated gas masses of individual explosions from both datasets and found that the estimates agreed within an order of magnitude [Dalton et al., 2010]. The short-term variations were attributed to small outgassing pulses, while the longer-term trends were indicative of deeper processes [Dalton et al., 2010].

Prandi [2015] measured both diffuse CO_2 emissions, and SO_2 emissions from the vent. The diffuse gas samples were collected with a CO_2 accumulation chamber and SO_2 data were collected with the same system used by Dalton et al. [2010]. Prandi's [2015] study, which was coincident in time with the seismic deployment used in the present work, allowed for mapping the spatial distribution of CO_2 efflux [Prandi, 2015]. The study resulted in emission rate values for CO_2 and SO_2 and mapped a new possible system of faults. On the SE side of the volcano, the opening of a new eruptive fissure was mapped using Google Earth Pro [Prandi, 2015]. The study suggested a NNW orientation of the outgassing pathways, similar the NNW feature in the deformation studies [Prandi 2015].

1.3 Attenuation Studies

Attenuation is the loss of energy over time and distance due to factors such as scattering and absorption. Attenuation studies have been used both on volcanic and non-volcanic structures. Attenuation can be measured in several ways. Most techniques use discrete sources (i.e., earthquakes) recorded at multiple stations. In the case of Pacaya, as in other volcanic environments [e.g., De Siena et al., 2010] where the source spectrum is not well characterized in the frequency range of interest, the decay of the seismic coda can be used to measure attenuation. The coda represents indirect arrivals that have scattered off of one or more discontinuities and arrive after the direct P or S arrivals. Aki and Chouet [1975] provided the cornerstone description of coda wave decay, from which other authors follow. Attenuation is typically described quantitatively with the quality factor, Q. In some cases, the notation Q^{-1} for the inverse of Q, is used for convenience. In the case of coda attenuation, the notation Q_c is used. Large Q_c values correspond to low attenuation.

1.3.1 Mechanisms of seismic attenuation

Lees [2007] defines the quality factor, *Q* as the ratio of stored versus dissipated energy with the passage of a seismic wave through a material. Lees [2007] describe that usual forms of attenuation result from intrinsic processes such as heat loss and to scattering process which diffract wave energy. In our attempt to discern the properties of attenuation at Pacaya volcano we first must determine what phenomena could cause higher or lower attenuation and how we can interpret our eventual results. To determine what can be interpreted with seismic attenuation it is useful to know some of the fundamental properties. Rodd et al. [2016] state that attenuation is useful in studying volcanic material as it is linked to thermal state and cite Kampfmann and Berckhammer [1985] and Jackson [1993] in that it is strongly dependent on temperature and fluid content. Johnston et al. [1979] state that *Q* for metamorphic and igneous rocks ranges from 100-1000 in laboratory tests that, as Lees [2007] state, do not take into account large mixtures, structures, or fractures. Several orders of magnitude of variation can be seen in the quality factor when melt is present in a system [Lees, 2007]. High attenuation with low velocity has been attributed to magma accumulations and low attenuation with high velocity has been attributed to cooled plugs, conduits, and other lithologic phenomena [Lees, 2007]. Citing Eberhart-Philips et al. [2005], De Sienna et al. [2010] state that attenuation is most affected by temperature and fractures which are usually fluid filled.

Water and gas filled reservoirs can be distinguished by Q_p^{-1}, the inverse of the P wave quality factor [De Siena et al., 2010 citing Hansen et al., 2004]. De Siena et al. [2010] have interpreted high attenuation structures to be water vapor and CO_2 conduits toward the Mt. Nuovo area in Italy. Ito et al. [1979] performed studies on sandstone samples using high frequencies (ultrasonic) and stated that the inverse P and S quality factors are low for room dried sandstone rocks, but when fully saturated the rocks gain much more shear wave attenuation than compressional attenuation. It should be noted that in partially saturated rock, Ito et al. [1979] state that the attenuation to compressional waves is greater than that of shear in either the partially or fully saturated case [Ito et al., 1979]. Ito et al. [1979] state that rock saturated in steam should exhibit both low compressional and shear wave attenuation. Attenuation of compressional waves should be very large in the transition state between steam and fluid filled rocks, while shear wave attenuation should be greatest in fluid filled rocks [Ito et al., 1979]. Compressional wave attenuation is highest in the partially saturated state and then declines in the fully saturated state [Ito et al., 1979]. Hansen et al. [2004] cite Sengupta and Rendleman [1989] in stating that studies show that the presence of gas increases S wave attenuation. Hansen et al. [2004] cite O'Connell and Budiansky [1997] and Peacock et al. [1994] in stating that theoretical and empirical studies reveal that increased attenuation is associated with increased fracture and crack density.

Frequencies obtained at a receiver depend in part on the attenuation of a signal along a wavepath [Lees, 2007]. It should be noted that seismic raypaths bend and may form "shadow zones" around low velocity areas that have been bypassed [Lees, 2007] this could affect attenuation results in that changing raypaths will sample different materials thus producing differing attenuation. Higher levels of noise affect attenuation studies more than those of travel time [Lees, 2007]. Scherbaum [1990] state that dissipative attenuation and purely elastic effects may cause strong attenuation near the receiver/site or decoupling masses of fractured rock may cause the attenuation. They indicate that the shallow attenuation structure is desired to be known to prevent incorrect back projecting [Scherbaum 1990].

To summarize we can see that increase fractures may increase attenuation [Hansen et al., 2004 citing O'Connell and Budiansky, 1997, and Peacock et al., 1994] and that attenuation may vary depending on the state of fluid/gas saturation of a medium in that the quality factor for S-waves is highest in the fully saturated case and that it increases in the presence of gas [Ito et al., 1979; Hansen et al. [2004] citing Sengupta and Rendleman, 1989]. The presence of melt and higher heat will increase the attenuation of a material [Lees, 2007; Rodd et al., 2016]. These phenomena will help us to interpret our final results in that we can begin to understand what may cause areas of higher attenuation in the volcano and when coupled with other geologic evidence such as gas emission maps and vent locations will allow us to further solidify our hypothesis.

1.3.2 Seismic attenuation studies at volcanoes

We highlight a few key studies of attenuation at volcanoes to provide some background for the current study. Rodd et al. [2016] utilized 3-D attenuation methods to analyze the structure of the Sierra Negra Caldera. They modeled the amplitude spectra of earthquake ground displacement and for each raypath estimated the amplitude operator t^*, using the spectral decay method to determine the 3-D attenuation structure [Rodd et al., 2016]. Earthquake source, site response, effects of path, and instrument response create the observed spectrum [Scherbaum, 1990]. Rodd et al. [2016] model the amplitude spectra with the formulae:

$$\mathrm{A(f)} = \frac{\Omega_0 e^{-\pi \mathrm{f} t^*}}{(1 + (\frac{f}{fc})^{n\gamma})^{1/n}}$$

$$t^* = t_0^* f^{-\alpha}$$

with t^* being the attenuation operator, the frequency as f, the frequency dependence of attenuation as α, the source corner frequency as fc, the low frequency plateau amplitude as Ω_0, and the displacement spectra's falloff above *fc* as *γ* [Rodd et al., 2016]. The f^2 Brune source model is the same as this if n=1 and *γ=2* [Rodd et al., 2016 citing Brune 1970]. Rodd et al. [2016] use a modification of the model with n=2. They were able to use the multitaper method to determine amplitude spectra [Rodd et al., 2016 citing Lees and Park, 1995]. Rodd et al. [2016] determined α by finding the right values that allowed for minimizing the mean residual RMS and maximizing the useable t*. Rodd et al. [2016] used the Levenburg-Marquardt method to model amplitude spectra. They determined attenuation (in this case the inverse quality factor Q^{-1}) from t* by using the following relation:

$$t^* = \int_{raypath} \frac{Q^{-1}(x,y,z)}{v(x,y,z)} dr(x,y,z)$$

with Q^{-1} being the inverse quality factor and *v* being the 3D velocity model [Rodd et al., 2016]. They inverted for Q^{-1} using a P wave velocity model to produce a 3D attenuation model [Rodd et al., 2016]. Rodd et al. [2016] were able to test the model using spike and checkerboard tests in which a perturbation of $Q_p^{-1}$is added to a data point in a homogenous set and then recovered by computing and inverting for synthetic t* tests for all raypaths for the spike test and in which checker board patterns of high and low perturbations were recovered in the checkerboard test [Rodd et al., 2016]. They were able to determine areas of higher attenuation and were able to interpret high attenuation anomalies as zones of magma accumulation [Rodd et al., 2016].

Zucca and Evans [1992] used compressional wave attenuation to produce a tomographic map of structures in the Newbury Caldera. They used the Aki, Christofferson, and Husebeye method extended to attenuation tomography [Zucca and Evans 1992; Aki et al. 1977]. They invert for the variation in t^* which is presented in the equation:

$$\delta t^* = \pi \int_{ray\ path} \delta Q^{-1} v_0^{-1} ds$$

with the distance along the ray path as *ds* and, for the inversion, v_0 being the initial velocity model [Zucca and Evans, 1992]. They stated that a low velocity, average attenuation property of a feature that they observed suggested the presence of many dry cracks [Zucca and Evans, 1992 further citing Ito et al., 1979, and Evans and Zucca, 1988]. They concluded that at the Newbury II drill hole and the west flank the presence of a two phase fluid is indicated [Zucca and Evans, 1992].

Hansen et al. [2004] used both seismic velocity tomography and attenuation tomography to discern whether a deep magma body was beneath Kilauea's East Rift zone. They fitted P and S wave amplitude spectra for t^* and used this value and the velocity model to find Q structure [Hansen et al., 2004]. They used the following equation to relate attenuation and the source parameters to the amplitude spectra:

$$\ln(A(f)) = \ln(\Omega_0) - \ln\left(1 + \left(\frac{f}{fc}\right)^{\gamma}\right) + (-\pi f t^*)$$

with, the amplitude being $A(f)$ for a particular frequency f, fc being the corner frequency, Ω_0-the asymptote of amplitude at the zero frequency, the source spectral fall off being γ, and the attenuation parameter again being t^* [Hansen et al., 2004 citing Lees and Lindley, 1994]. Hansen et al. [2004] used a Brune source model and the methods they used to find the unknown parameters were a Levenburg-Marquardt or iterative DLS methods. They determine the Q structure and interpreted an anomalous feature with high Q_p, low Q_s, low V_p, low V_p/V_s as a reservoir of trapped CO_2. They determined that if a deep magma body exists it was relatively small.

De Siena et al. [2010] used passive high-resolution attenuation tomography to image the first upper 4 km of the shallow crust's geological structure underneath the Campi Flegrei caldera in Italy. They used the slope decay method (P and S waves) and the coda normalization method (S-waves) to estimate the inverse of Q for each source-receiver path [De Siena et al., 2010]. De Siena et al. [2010] ensured a minimum cell size of 500 meters by using a method that employed multiple resolutions. They studied the synthetic tests as well as the resolution matrix so that the input anomalies at the caldera's center, between 0 to 3.5 km deep, would be guaranteed to be optimally reproduced [De Siena et al., 2010]. The image of the Campi Flegrei that was retrieved was jointly interpreted using geological, seismological, geochemical, and volcanological evidence [De Siena et al., 2010]. The analysis recognized vertically extending high attenuation structures, and allowed a view of the feeding systems in the area that was unprecedented [De Siena et al., 2010]. Passive data recorded during the seismic crisis of 1983-1984 during a small interval was used to obtain all of the attenuation images in the study [De Siena et al., 2010]. Comparisons were carried out instead using images derived from a data set that spanned a larger interval of time [De Siena et al., 2010]. The authors found that consequently they could not image possible changes in geologic structure originating from dynamics that were ongoing at Campi Flegrei [De Siena et al., 2010].

De Siena et al. [2014] presented a model of combined 2D S coda attenuation, 3D P-wave attenuation, and 3D S coda scattering tomography that models feeding systems, fluid pathways, and sediments from 0 to 18 kilometers beneath Mount Saint Helens volcano. They interpret the results of Q_c mapping, P wave attenuation tomography, and scattering tomography on seismic data from the time frame of 2000-2006 to be associated with the plumbing system of Mount Saint Helens [De Siena et al., 2014]. An anomaly of high P attenuation, high coda attenuation, and high-scattering area beneath the cone locates the zone feeding the volcano with magma/fluid and generating the seismic activity within the cone [De Siena et al., 2014]. They state that some of their interpretations of some structures could be improved with the joint inversion of different geophysical data with scattering parameters and both the separation and mapping of scattering and intrinsic attenuation from coda waveforms [De Siena et al., 2014]. De Siena et al. [2014] state that reliable images both far from and near to the theoretical direct ray between station and source can be obtained from the addition of attenuation tomography and scattering tomography to velocity tomography [De Siena et al., 2014].

In summary Rodd et al. [2016] modeled the amplitude spectra of earthquake ground displacement and for each raypath estimated the amplitude operator t^*, using the spectral decay method to determine the 3-D attenuation structure of the Sierra Negra Caldera [Rodd et al., 2016]. They were able to interpret high attenuation anomalies as zones of magma accumulation [Rodd et al., 2016]. Zucca and Evans [1992] used compressional wave attenuation to produce a tomographic map of structures in the Newbury Caldera and concluded that a two-phase fluid is present at the Newbury II drill hole and at the west flank. Hansen et al. [2004] used both seismic velocity tomography and attenuation tomography to conclude that if there was a deep magma body beneath the Eastern Rift zone then it would have to be small and that a trapped reservoir of CO_2 may exist. De Siena et al. [2010] used passive high-resolution attenuation tomography to image the first upper 4 km of the shallow crust's geological structure underneath the Campi Flegrei caldera in Italy and recognized vertically extending high attenuation structures as well as viewing the feeding systems in the area. They used the slope decay method and the coda normalization method in their study. De Sienna et al. [2014] used 3D attenuation, 2D S coda attenuation, and 3D S coda scattering tomography to model the fluid pathways, sediments, and feeding systems from 0 to 18 kilometers beneath Mount Saint Helens volcano and located the zone feeding the volcano.

In this work we found the coda quality factors Q_c using the decay of the energy envelope of seismic coda waves as a means of finding Q_c through linear fitting. We used the power spectral density equation to find Q_c. We then could use these values to determine parameters such as the median Q_c for certain stations which would give us an idea of the attenuation of areas near the stations. We did not use the Brune source model as it was deemed that the events that we were analyzing were not conducive to its use nor did we use P wave attenuation as the S wave attenuation was decided to be more conducive to analysis. We did not have a 3-D velocity model or a method of weighting the stations for a 2-D attenuation model so we chose to base our interpretations from plots that utilized best fit Qc values judged by the coefficient of determination and thresholds for maximum Qc. As Havskov et al. [2016] show, the use of differing modeling (lapse time, coda window length) parameters will affect the Q_c results differently. Thus comparing the Q_c values with those of other studies might not be useful if the effects of choosing the differing models and their parameters (even just choosing differing coda start time and lapse times, as demonstrated by Calvet et al. [2013]) are unknown. We therefore look at the Q_c values, in such forms as their medians per certain stations, within the context of the parameters that we used and not drawing comparisons to other volcanoes.

Chapter 2.

Data Collection and Field Work

The data obtained for this study was acquired during a field campaign in January of 2015. A 19 station seismic network was established on Pacaya volcano and run for two weeks (depending on the station) before removal [Lanza et al., 2015]. We used three component, short period, L22 seismometers that were digitized at 125 samples per second with RefTek 130 digitizers [Lanza et al. 2015]. The seismometers were calibrated in situ and were provided by the IRIS PASSCAL consortium. A table listing deployment times, notes, locations, and other data is included in the appendix (see appendix: Appendix table A.1. deployment table). Figures 2.1 and 2.2 show seismometer set up. Figure 2.3 shows the location of the seismometers on Pacaya (see appendix: stationplot for the code which generated this plot). Figure 2.4 shows a sample trace that has had the instrument response removed.


Figures 2.1 (above left) and 2.2 (above-right) show locations and set up of two of the seismometers.

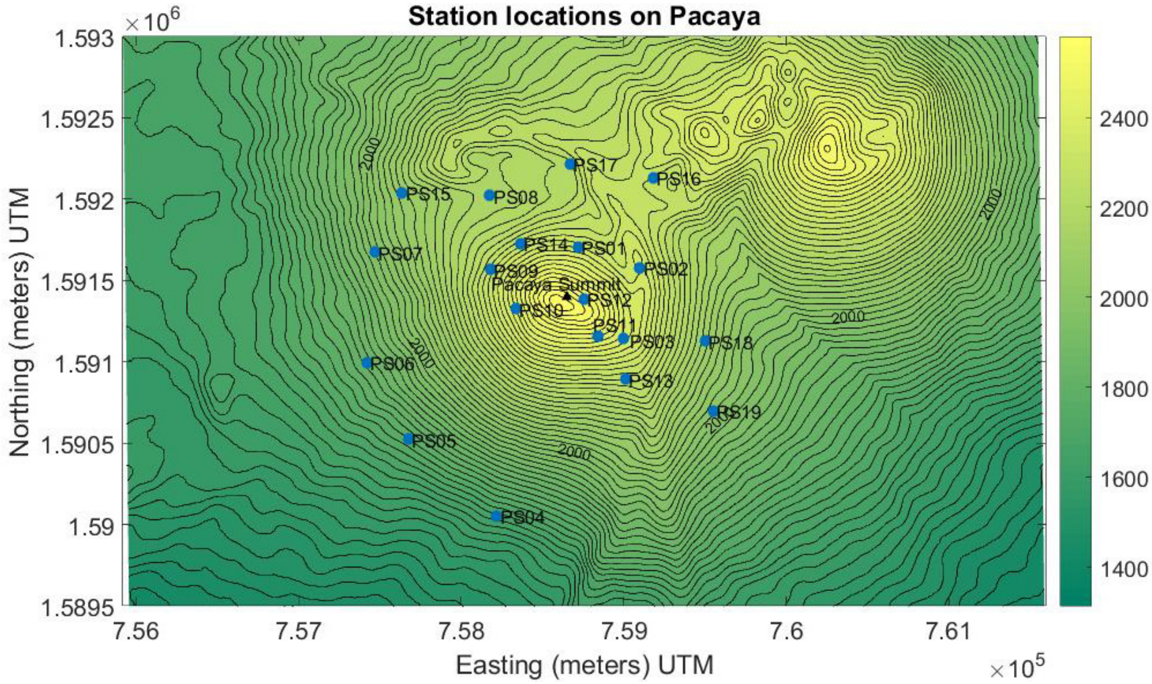

Figure 2.3. Map of Pacaya with stations as blue circles and the summit as a black triangle. The stationplot code (see appendix) was used to generate this map.

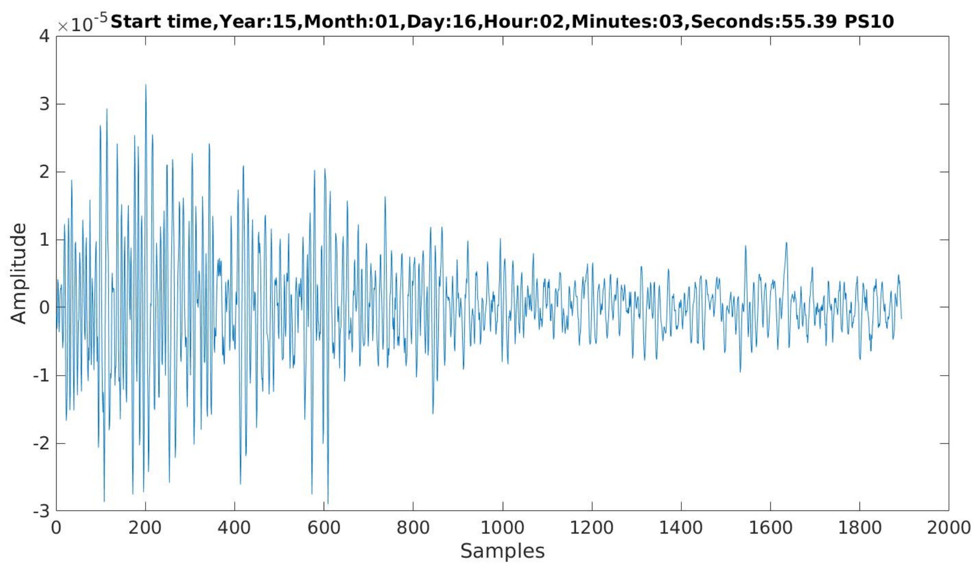

Figure 2.4. A trace for a station and event that had been passed through the deconvolution code.

Chapter 3

Methods and Results

3.1 Equations and Summary of Codes

We modeled attenuation using the coda quality factors Q_c, using the decay of the energy envelope of seismic coda waves as a means of finding Q_c through linear fitting. The power spectral density equation is as follows:

$$E(t,f)=S(f)t^{-\alpha}e^{-2\pi f\frac{t}{Qc(f)}}$$

from Calvet et al. [2013] citing Aki and Chouet [1975], with α being a positive exponent, t being the lapse time, f being the frequency, Q_c being the frequency-dependent quality factor of coda waves, $S(f)$ being the frequency dependent source and/or site term, and E being the power spectral density [Calvet et al., 2013 citing Aki and Chouet, 1975]. We follow Calvet et al. [2013] and De Siena et al. [2014] in choosing α as 3/2 and pursuing the multiple scattering approach. Although we are constrained to using very short lapse times given short inter-event times, the multiple scattering approach is valid given the highly scattering volcanic environment and short source to station distances [see Sato et al., 2012]. Sato et al. [2012] show that after a few mean free times the multiple-scattered waves approximate a diffusion regime in a uniform half space [Calvet et al., 2013]. If we assume a P-wave velocity of 3000 meters per second [Gary Mavko, Stanford Rock Physics Laboratory] in basalt it would take less than half of a second for the body waves to reach the furthest station from the summit, so a 10 second coda window should allow for some scattering at least. We use only the vertical component data and following Calvet et al. [2013] we use a Butterworth bandpass filter. We chose a coda lapse time of 4 times the predicted S wave arrival time ($\sqrt{3}\ x\ P\ wave\ travel\ time\ x\ 4$) for the start of the coda analysis, and a 10 second coda window over which to analyze. While other authors such as Calvet et al. [2013] and De Siena et al. [2014] use longer coda window lengths that start later in the coda, the dense seismic deployment and high rate of seismicity required that we investigate a coda window much closer to the origin time.

We determined Q_c for a total of 482 events with a bandpass frequency range of 2 to 10 Hz. The ultimate products of our endeavors were finding the suitable frequency range over which to filter, finding if the frequency dependent source and/or site term required calculation or could be set to 1 for the power spectral density equation used to find coda Q_c, plotting histograms of Qc values that had passed certain thresholds, a contour map of Pacaya with certain stations plotted with the median of certain Q_c values attributed to them, and a plot of median Q_c values versus distance from the summit.

The process proceeded first with deconvolution of the data, then with spectral plotting of some of the deconvolved data to determine which frequencies had the greatest amplitudes. Using some of the deconvolved data, we found Q_c using the power spectral density equation (findingQcode) and taking the runs for various frequency ranges we were able to find which frequency range gave the best fits under the selected parameters by finding which Q_c values and their coefficients of determination fit certain thresholds (SortandplotQ). We then found the Q_c values using the power spectral density equation as well as finding the maximum of the absolute values of the amplitudes of windowed portions of traces of some of the deconvolved and filtered data in an attempt to find the maximum P and S wave amplitudes that corresponded to the Q_c values (findingQcodeamplitudes). This data was analyzed to find which Q_c values had best fits (SortandplotQandamplitudes, judged by the corresponding determination coefficients and other thresholds that were chosen), and in turn the best fit Q_c values and corresponding amplitudes were sorted by station. We then plotted scatter plots of Q_c values versus amplitudes and generated fits and boundary lines to allow us to interpret if the frequency dependent source and/or site term required having a value set to other than 1. Then we found Q_c again using the power spectral density equation (findingQcode) and then found which Q_c values had a coefficient of determination within a certain threshold and had Q_c values less than 100,000 (SortandplotQmedian), to generate a series of plots such as a histogram of values. We also plotted the histograms of the Q_c values that had passed the thresholds for each station (see appendix: SortandplotQmedianhistogrm for code). We obtained the medians of certain Q_c and used those values, as well as coordinates, and a DEM to (see contour&distanceplot in the appendix) plot the median Q_c values on a contour map of the volcano and then we plotted the median Q_c values versus the distance from the summit in a separate plot.

The data was first deconvolved, water-leveled, had its mean removed, and also the results of processing were plotted if desired. Only the vertical components of the stations were deconvolved and the data for the 19 stations stored for later use (see appendix: deconvolve for code). We then took two pathways to determine which frequency range we would filter over, the first being to plot the spectrums of twelve chosen events using a Fast Fourier Transform method. The second path being to ultimately find which frequency range had the most Q_c values that passed certain thresholds. The code used in the first path uses the deconvolved data, but does not filter it. The first path and its findings are as follows with the second method being detailed after.

3.2 Spectral analysis of twelve event-station pairs.

To help determine the proper frequency range to bandpass filter we first plotted several spectra and looked for the areas of highest amplitude. We plotted the frequency versus absolute value amplitude spectra of selected possible coda time windows for twelve event-station pairs to discern which frequencies had the highest magnitudes and would be used for Q_c analysis (see appendix: spectralplots for code). We analyzed twelve chosen events, each time selecting a coda window start time (in samples) generated by a multiplier of four times the square root of 3, multiplied by the picked P wave arrival time (special thanks to Ms. Federica Lanza for the picks), further multiplied by the sample rate and then added to the start of the samples of the event in the data. The coda window was 10 seconds long (the code was run on MATLAB R2016a on a linux os computer) and the following output plots are shown in Figures 3.1, 3.2, 3.3.

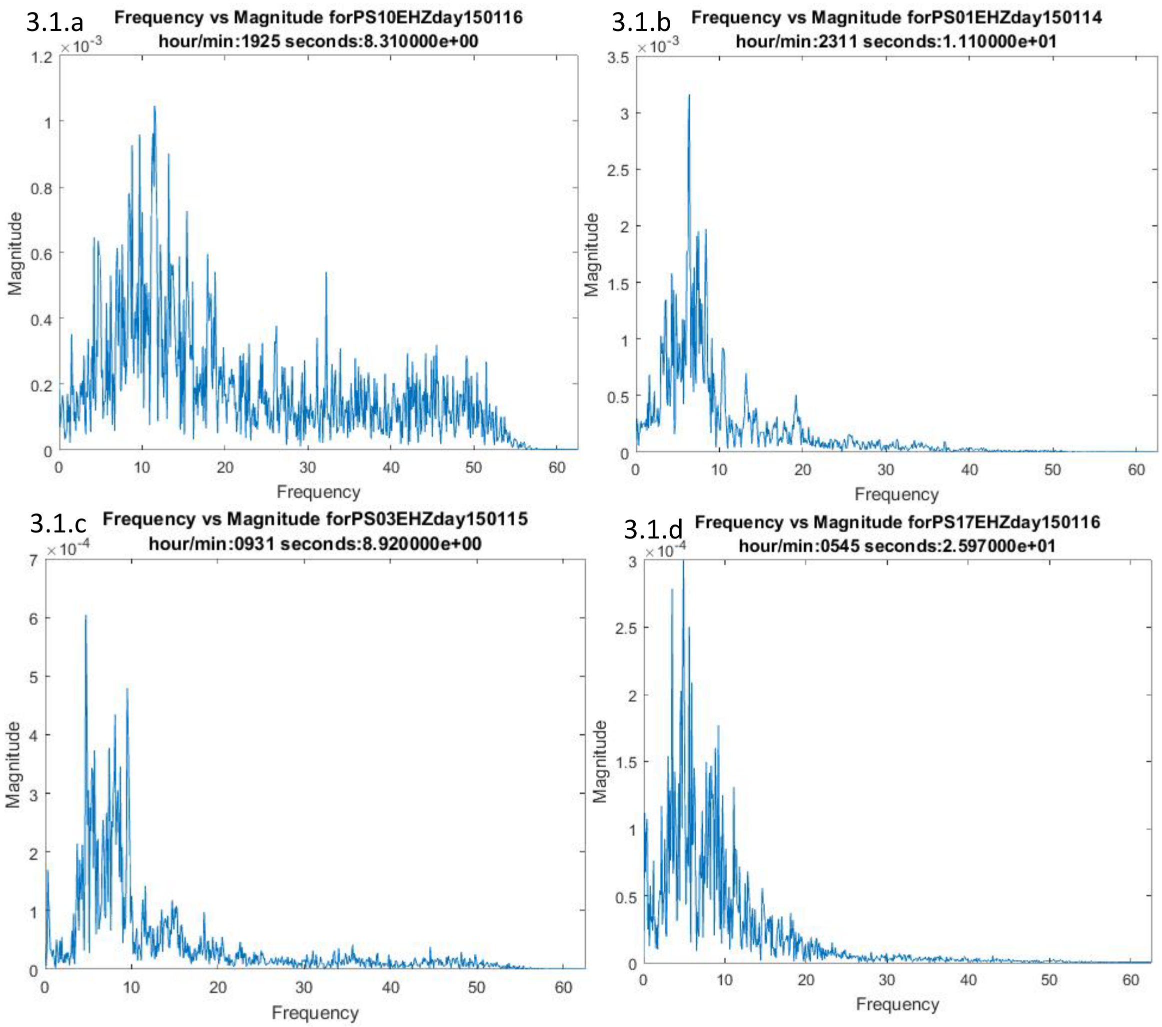

Figure 3.1.a-d. Frequency vs. Magnitude plots

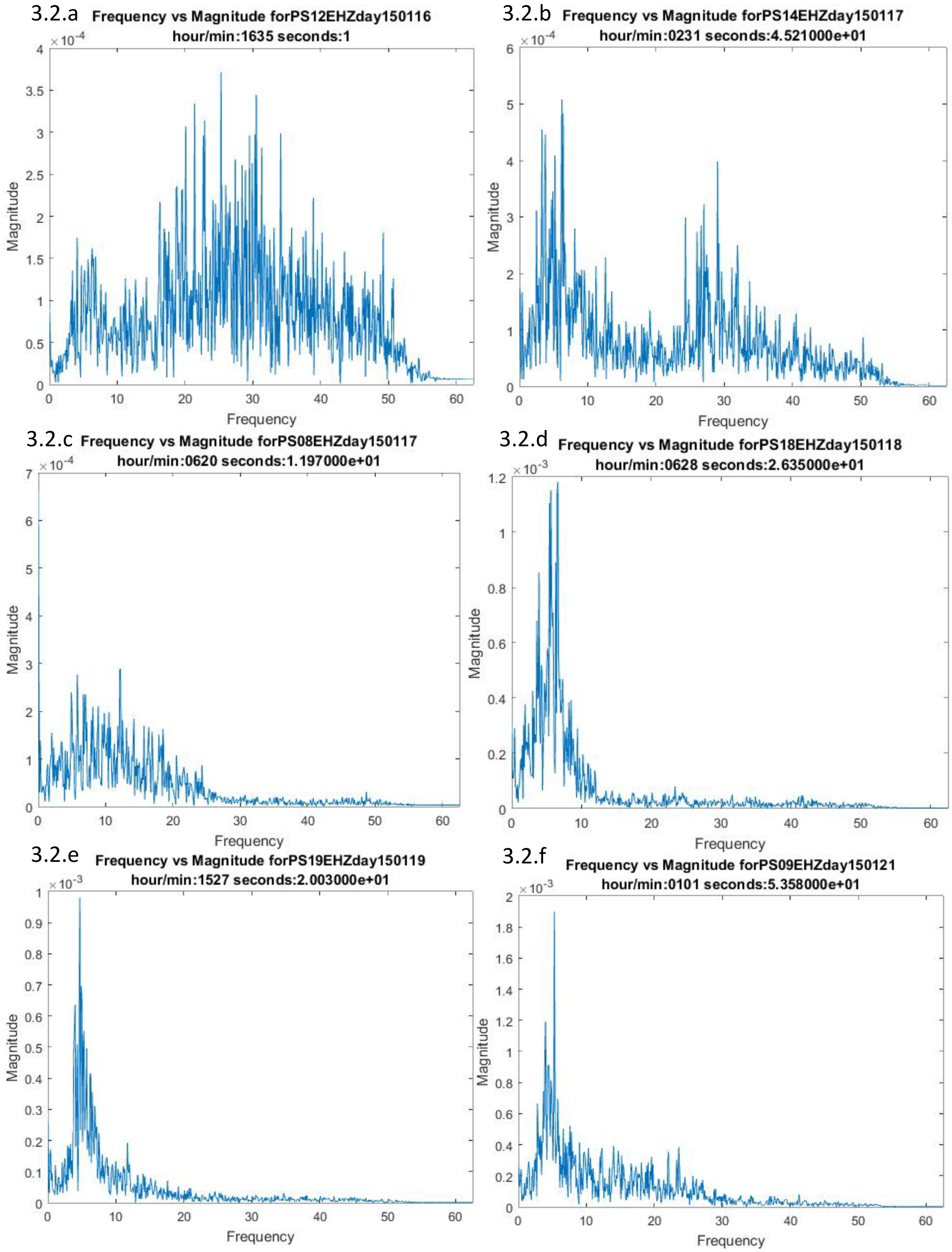

Figure 3.2.a-f. Frequency vs. Magnitude plots

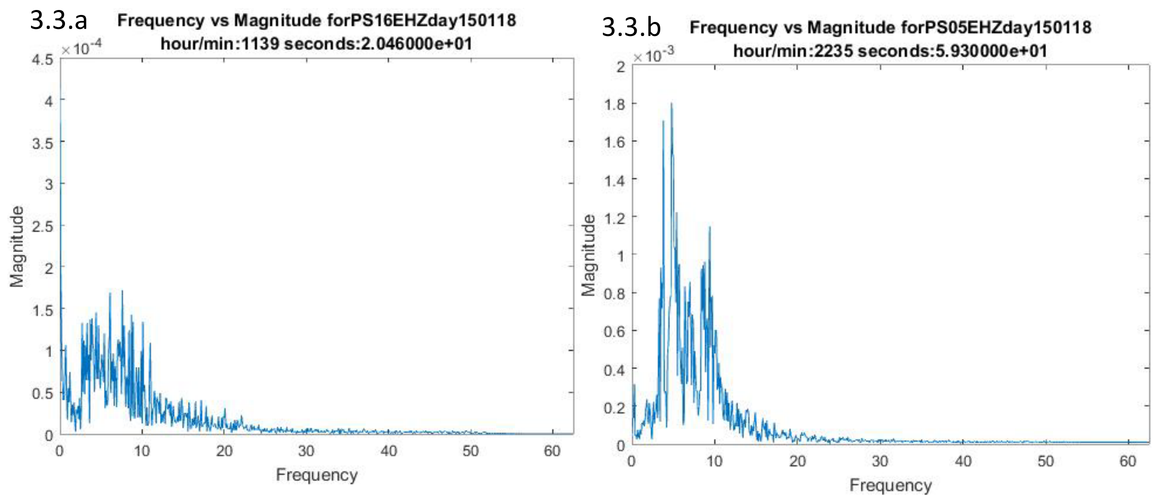

Figure 3.3.a-b. Frequency vs. Magnitude plots

From these images we can see that larger magnitudes are dominantly around or below 10 Hz with some occurring around 30Hz or between 20-30 Hz. The Nyquist frequency is 62.5 Hz. The recorded maximums for each plot as observed by picking peaks is summarized below in Table 3.1 (note observations may not have included possible but not noted multiple maxima). This gives us an idea that a frequency range below 10 Hz may work.

Table 3.1. Maximum magnitudes and associated frequencies for Event-Station pairs

Year	Month	Day	Station number	Hours	Minutes	Seconds	Frequency of Maximum Magnitude (Hz)
2015	January	16	PS10	19	25	8.31	11.5
2015	January	14	PS01	23	11	11.1	6.4
2015	January	15	PS03	09	31	8.92	4.7
2015	January	16	PS17	05	45	25.97	4.9
2015	January	16	PS12	16	35	1	25.3
2015	January	17	PS14	02	31	45.21	6.2
2015	January	17	PS08	06	20	11.97	0
2015	January	18	PS18	06	28	26.35	6.6
2015	January	18	PS16	11	39	20.46	0
2015	January	18	PS05	22	35	59.3	4.8
2015	January	19	PS19	15	27	20.03	4.7
2015	January	21	PS09	01	01	53.58	5.3

3.3 Appropriate bandpass determination

To further investigate which frequency range we would use for our eventual filtering we first obtained the Q_c values and then found out which frequency range had the greatest number of best fits according to our thresholds. First we found the Q_c values using the power spectral density equation (see appendix: findingQcode for code) and first processed some of the deconvolved data by looping through some of the events and attempting to find Q_c by finding the best linear fit to the natural logarithm of the product of the now filtered and processed (by functions of the code) data that had been multiplied element-wise to the 3/2 power of the time. Q_c is then found from the slope coefficient of the fit by multiplying the inverse of the slope by -2, multiplied further by Pi, and then by the center frequency. The coefficient of determination is found and we checked for NaNs as well as positive slopes which void the energy decay. We saved the Q_c values as well as the resultant data, the coefficient of determination, and other data. We used a bandpass butterworth filter and to find which frequency ranges gave the best fits we analyzed the data 9 times with the lower frequencies being 2,3, and 4 and the upper frequencies being 6,8,10 (so ranges would be such as 2-6, 2-8, 2-10, 3-6, etc.). These data sets would become the input for the second process used to find the best frequency range. The first process and its derivative modifications (findingQcode, findingQcodeamplitudes) smooth the traces (hence smoothingwindow variables) before processing as well as they filter the deconvolved data. Figures 3.4 and 3.5 show two examples of the linear fits to the natural log of the product of the power spectral density (the processed data) multiplied by the three halves power of the lapse time.

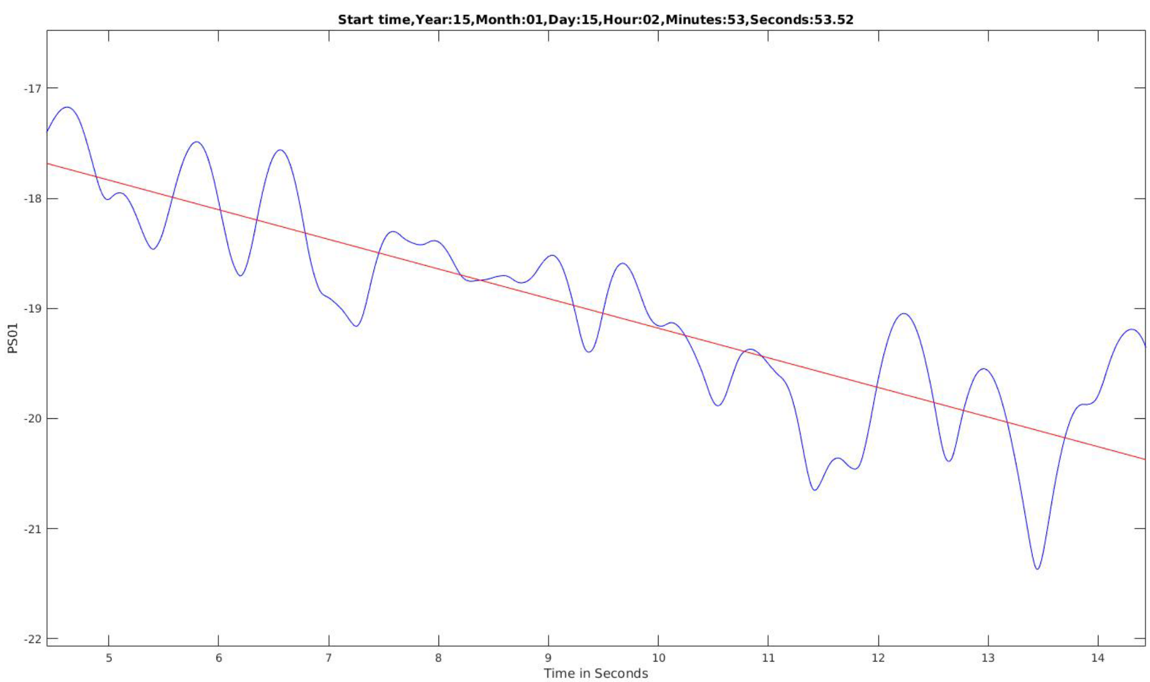

Figure 3.4. Plot of the natural log of the product of the power spectral density multiplied by the three halves power of the lapse time (in blue), with the linear fit (in red). The coefficient of determination being 0.7345.

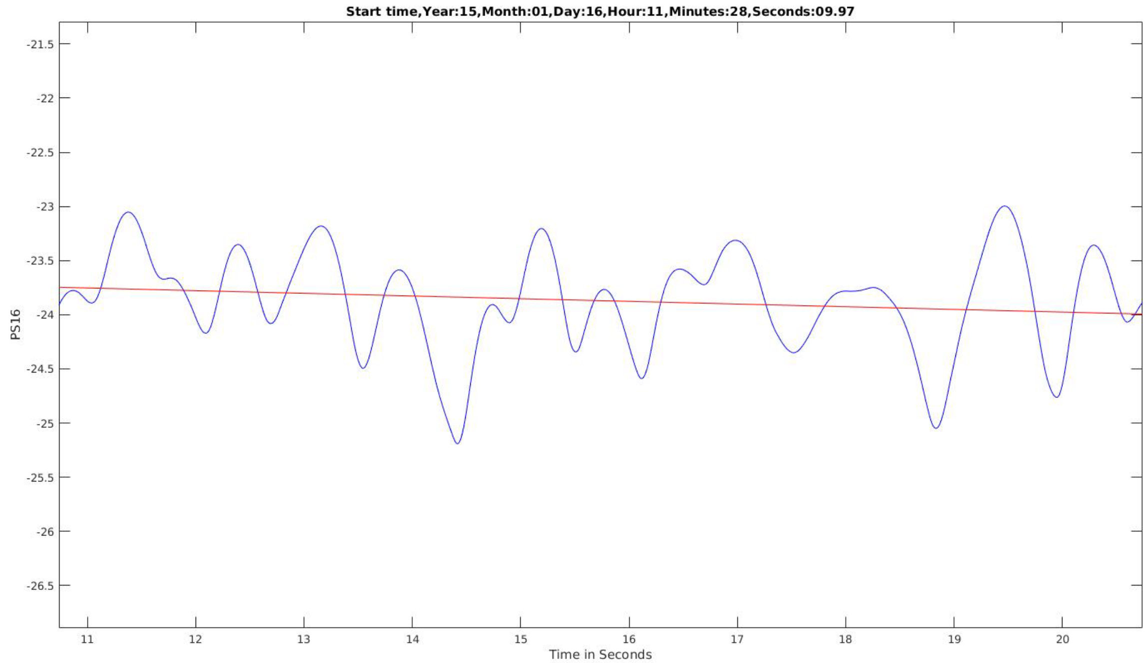

Figure 3.5. Plot of the natural log of the product of the power spectral density multiplied by the three halves power of the lapse time (in blue), with the linear fit (in red). The coefficient of determination being 0.0244**.**

We found the Q_c values, over the events being analyzed, under 100,000 whose corresponding coefficients of determination values were greater than 0.5 but less than or equal 1 and stored them in a variable called "Qgood" and the corresponding station names in a variable called "sta" (station names variable, see appendix: SortandplotQ for code). The Q_c values that passed the thresholds were then sorted and plotted (not included in this work) and a histogram of the Q_c values was also plotted (shown later, produced by a modified code). We then organized the Qgood values by station name and then found the median and mean of those values. The station numbers were then plotted against mean and the median values (shown later, produced by a modified code). We plotted the stations according to their position given by a location file (latitude and longitude) and plotted markers of appropriate color corresponding to their mean Q_c values (plot not shown in this work for it is not projected as the later contour plot is). For the purpose of finding the frequency range that gave the best fits out of the 9 datasets we obtained the number of Qgood (values that have corresponding coefficients of determination greater than 0.5 but less than or equal to 1, and Q_c values under 100,000) values for each loading and running of each of the nine data sets and generated Table 3.2.

Table 3.2. Frequency range vs. number of good Q_c values.

Frequency range	Qgood size
3 to 10 Hertz	142
2 to 3 Hertz	44
2 to 6 Hertz	75
2 to 8 Hertz	108
2 to 10 Hertz	153
3 to 6 Hertz	65
3 to 8 Hertz	105
4 to 6 Hertz	61
4 to 8 Hertz	91
4 to 10 Hertz	135

The table indicates that for a lapse time multiplier of 4, a smoothing window of 4, a coda window length of 10 seconds (which was set for all of the runs, see code), and a frequency range of 2 to 10 Hz (6 Hz center frequency) there is the highest number of values that meet the threshold of having a determination coefficient between 0.5 and 1 as well as Q_c values under 100,000. Thus the frequency was decided upon as 2-10 Hz for subsequent analysis.

3.4 The source/site term

After having found the frequency range that we would use and before we proceeded further we wished to test if S(f), which represented the frequency dependent source/site term was a significant part of the power spectral density equation or whether it could be allotted the value of 1. We did this by first finding the maximum absolute values of the amplitudes of the P wave and S wave components of the traces which corresponded to Q_c values (appendix: findingQcodeamplitudes). We did this by finding the maximum of the absolute values of windowed data in traces for each station of the chosen events and saving the values in a format that corresponded to the saved Q_c values. We selected a coda window time of 10 seconds, a smoothing window variable of 4, a coda lapse time multiplier of 4 (Snumber), a frequency of 2 Hz for the lower bound of the Butterworth bandpass filter, and a frequency of 10 Hz for the upper bound of the Butterworth bandpass filter (giving a center frequency of 6 Hz).

We then sorted Q_c using thresholds (SortandplotQandamplitudes in the appendix) and found the P and S wave amplitudes that corresponded to saved coefficients of determination greater than 0.5 but less than or equal to 1, and to Q_c values that corresponded to those coefficients of determination, but also were less than 100,000. We then organized the chosen amplitudes by station and plotted the chosen Q_c values against the amplitudes for each station. For each station prior to plotting we sorted the Q_c values in ascending order and reorganized the amplitude values to correspond to their correct Q_c values. We then created plots with two subplots; the top for Q_c versus the P wave amplitudes, and the bottom for Q_c versus the S wave amplitudes. The subplots were scatter plots, and to determine if there was a significant relationship between Q_c and the amplitudes we followed the following procedure: for each subplot we used polyfit and polyval in MATLAB to fit a first degree polynomial to the data to generate a line. We then took the polyval results and plotted boundary lines from the fitted line that were a distance of one to two standard deviations of the data above and below the fitted line (depending on the run). We plotted the mean of the data as a line and with this plot we could see if the mean was equivalent to the fitted line within a threshold of one to two standard deviations. For the first run we set the boundary to 1 standard deviation and obtained the following plots shown in Figure 3.6 (more are shown in the "source/site term-figures-one standard deviation boundaries" portion of the appendix, see Appendix figures A.1 and A.2). Please note that stations 11 and 13 were not used in determining if the frequency dependent source term can be allotted the value of 1.

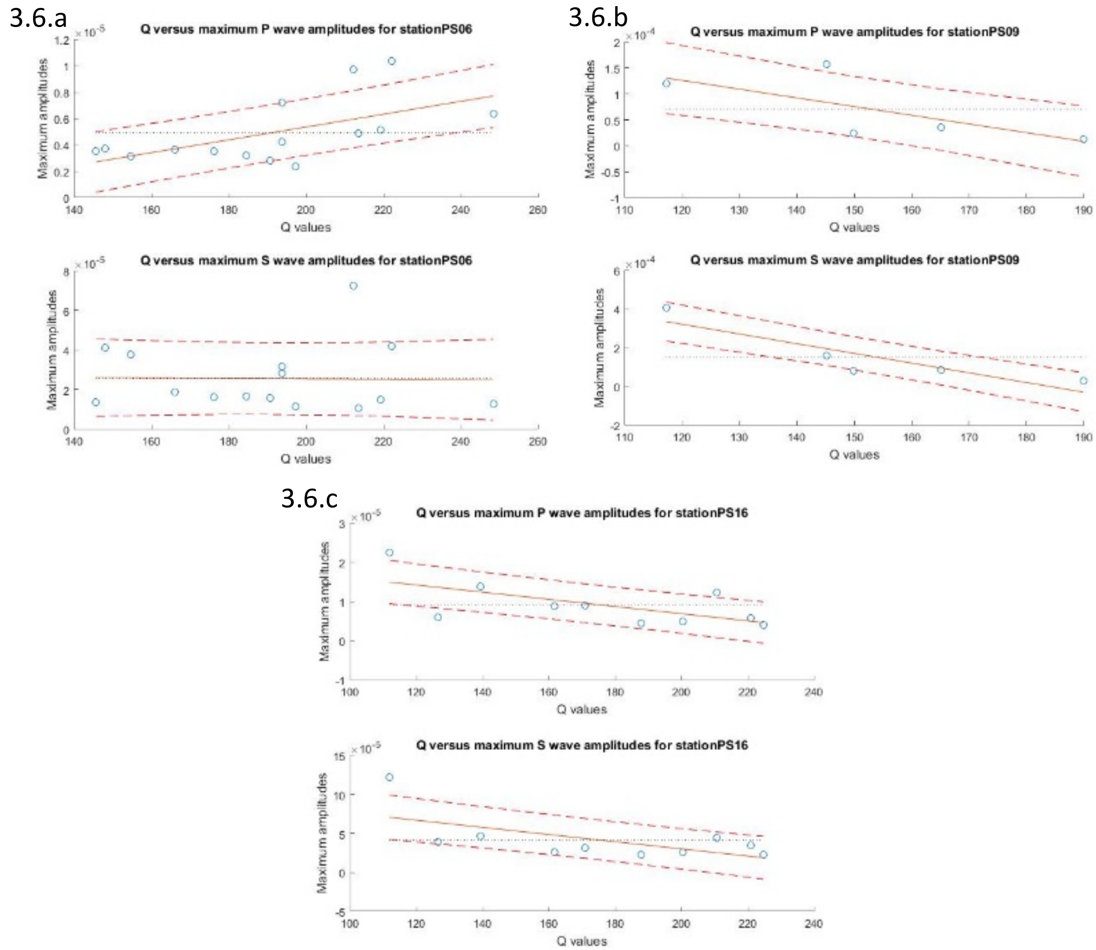

Figure 3.6.a-c. Scatter plots of Q_c versus maximum absolute value amplitudes with fitted line in dark red, one standard deviation boundaries as hashed lines, mean line plotted as small dotted line. Some plots were not considered due to lack of points. Notice plots for stations 6, 9, and 16 show intersecting mean lines with boundary lines.

From the Figure 3.6.a-c we can see that stations 6, 9, and 16 all had intersections of their boundary lines with at least one of their mean lines (the other 14 stations plots are included as “source/site term-figures-one standard deviation boundaries” in the appendix, see Appendix figures A.1 and A.2). This may show that a trend in the data exists and that S(f) is significant but since the trend would be in opposite directions for station 6 and 9 we deemed these intersections as being not significant to warrant calculation of S(f). We felt more evidence of the need to change the value of S(f) from its assigned value of 1 would be given if the mean lines predominantly intersect the boundaries of the plots, which we interpreted that they did not. We disregarded plots with only two data points or less.

Even fewer of the data lie outside two standard deviations from the best fit line (see appendix: "source/site term-figures-two standard deviation boundaries", see Appendix figures A.3 and A.4). Based on this test, we determined that the S(f) was not significant in the power spectral density equation.

Chapter 4
Results and Discussion

Using the parameters we deemed best for the dataset: a coda lapse time multiplier of 4 (S=4); smoothing window=4, a coda window length of 10 s; and 2-10 Hz bandpass, we obtained 153 values for Q_c that met the quality criteria (coefficients of determination greater than 0.5 but less than or equal to 1 and had Q_c values less than 100,000). We plotted a histogram of the Q_c values that had passed the previous thresholds (Figure 4.1) as well as plotting the mean and median Q_c values of the stations that had said Q_c values (Figure 4.2). The maximum value of the median of the stations' Q_c values was 194 (station 6) while the minimum was 146 (station 12), giving a range of 48. The maximum value of the mean of the stations' Q_c values was 197 (station 5) while the minimum was 146 (station 12), giving a range of 51. Please note that we did not follow Calvet et al. [2013] or De Siena et al. [2014] exactly. We produced histograms of the Q_c values per station (see appendix: SortandplotQmedianhistogrm for code, and "Histograms of Q values per station" in the appendix for histograms, see Appendix figures A.5. and A.6.). Stations 11 and 13 were not used in producing the plots of Figure 4.2, the "Histograms of Q values per station" in the appendix (Appendix figures A.5. and A.6), nor in the contour plotting in the next section with the station medians or the distance versus median plot as they required corrections.

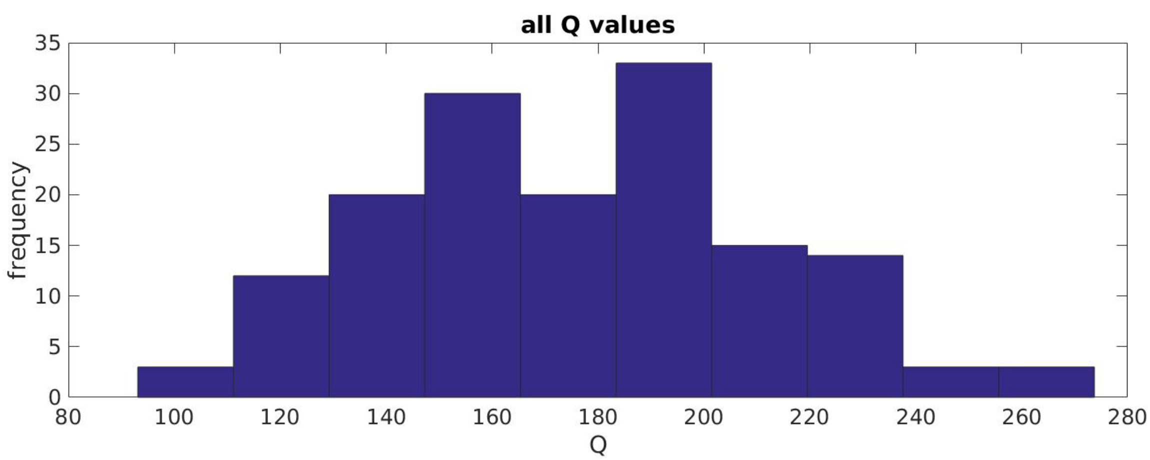

Figure 4.1. Histogram of Q_c values that are under 100,000 and had coefficients of determination greater than 0.5, but less than or equal to 1.

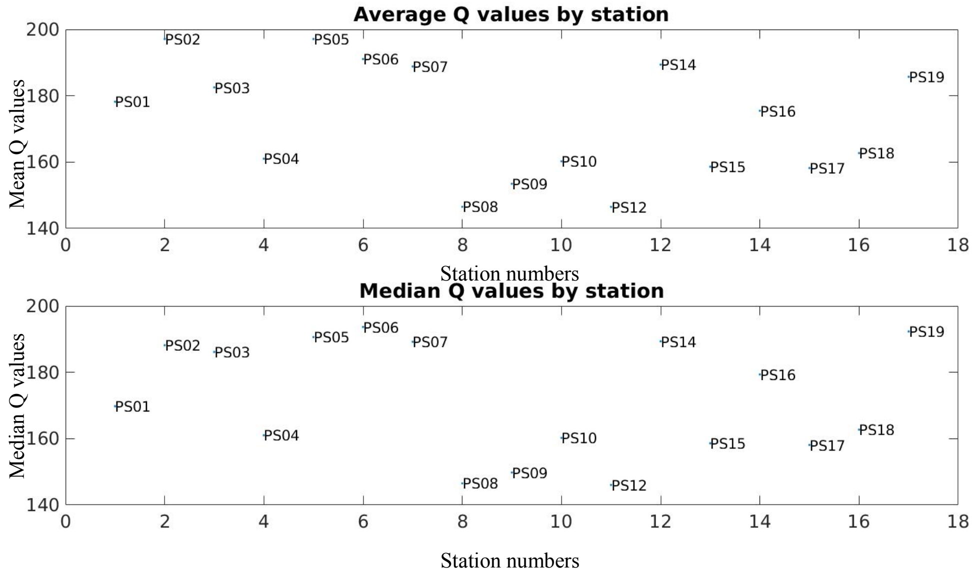

Figure 4.2. Average and median Q_c values by station.

4.1 Spatial Distribution of Median Q values

In order to examine the spatial distribution of the modeled attenuation values, we plotted the median Q_c values at each station location over a representation of the topography. We obtained a resized UTM DEM from Ms. Lanza that originated from the contours of elevation “obtained from photogrammetric surveys done in 2006 by Pasco-Finnmap for the Guatemalan "Instituto Geografico Nacional" and the "Ministerio de Agricultura, Ganaderia y Alimentacion"” [Rudiger Escobar-Wolf personal communication]. Interpolations from ArcGIS generated the elevation contours [Rudiger Escobar-Wolf personal communication] (see appendix for further description). Table 4.1 is a list of station locations and the summit location both in decimal degrees and in UTM.

Table 4.1. Station and Summit Locations (not including stations 11 and 13)

	Decimal Degrees WGS 84		UTM			
Station Name	Latitude	Longitude	Easting	Northing	Zone	Hemisphere
'PS01'	14.3855	-90.6008	758720.5	1591707.7	15	North
'PS02'	14.3843	-90.5973	759099.5	1591578.8	15	North
'PS03'	14.3804	-90.5983	758996.1	1591146.0	15	North
'PS04'	14.3706	-90.6056	758219.7	1590053.2	15	North
'PS05'	14.3749	-90.6106	757675.3	1590523.5	15	North
'PS06'	14.3792	-90.6129	757422.2	1590996.9	15	North
'PS07'	14.3853	-90.6124	757469.2	1591672.6	15	North
'PS08'	14.3884	-90.6058	758177.7	1592023.1	15	North
'PS09'	14.3843	-90.6058	758182.4	1591569.3	15	North
'PS10'	14.3821	-90.6044	758336	1591327.4	15	North
'PS12'	14.3826	-90.6005	758756.2	1591387.1	15	North
'PS14'	14.3857	-90.6041	758364.2	1591726.2	15	North
'PS15'	14.3886	-90.6108	757638	1592039.6	15	North
'PS16'	14.3893	-90.5965	759180	1592133.2	15	North
'PS17'	14.3901	-90.6012	758672	1592216.4	15	North
'PS18'	14.3802	-90.5936	759503.4	1591129.2	15	North
'PS19'	14.3763	-90.5932	759551.1	1590698.0	15	North
Pacaya Summit	14.3827	-90.6015	758648.2	1591397	15	North

The DEM, the UTM station and summit coordinates, and the median Q_c values would be used to plot the stations on the volcano with their rounded respective median Q_c values as labels and as circles with corresponding colors (based off unrounded values) that can be observed on a color bar in Figure 4.3. The distances from the summit of the stations versus their respective median Q_c values would be plotted as a scatter plot to give a better idea of the attenuation locations (stationlocs see appendix). Figures 4.3 and 4.4 present the plots.

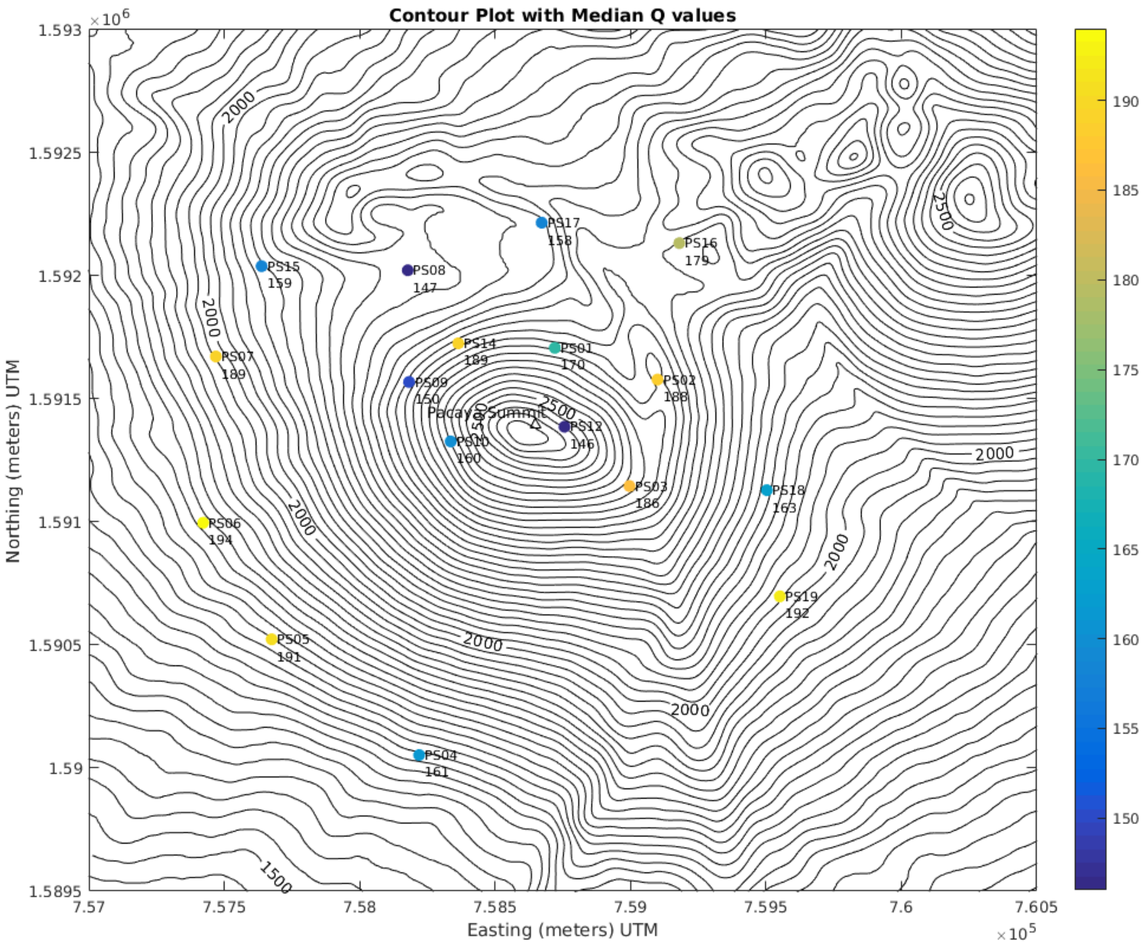

Figure 4.3. median Q_c values of stations plotted on a contour map of Pacaya. Summit noted with a triangle. Stations noted with colored circles with the name above the rounded median Q_c value on the right and colors corresponding (with a rounded colormap and text values, but unrounded data) to median Q_c values. Contours every 20 meters.

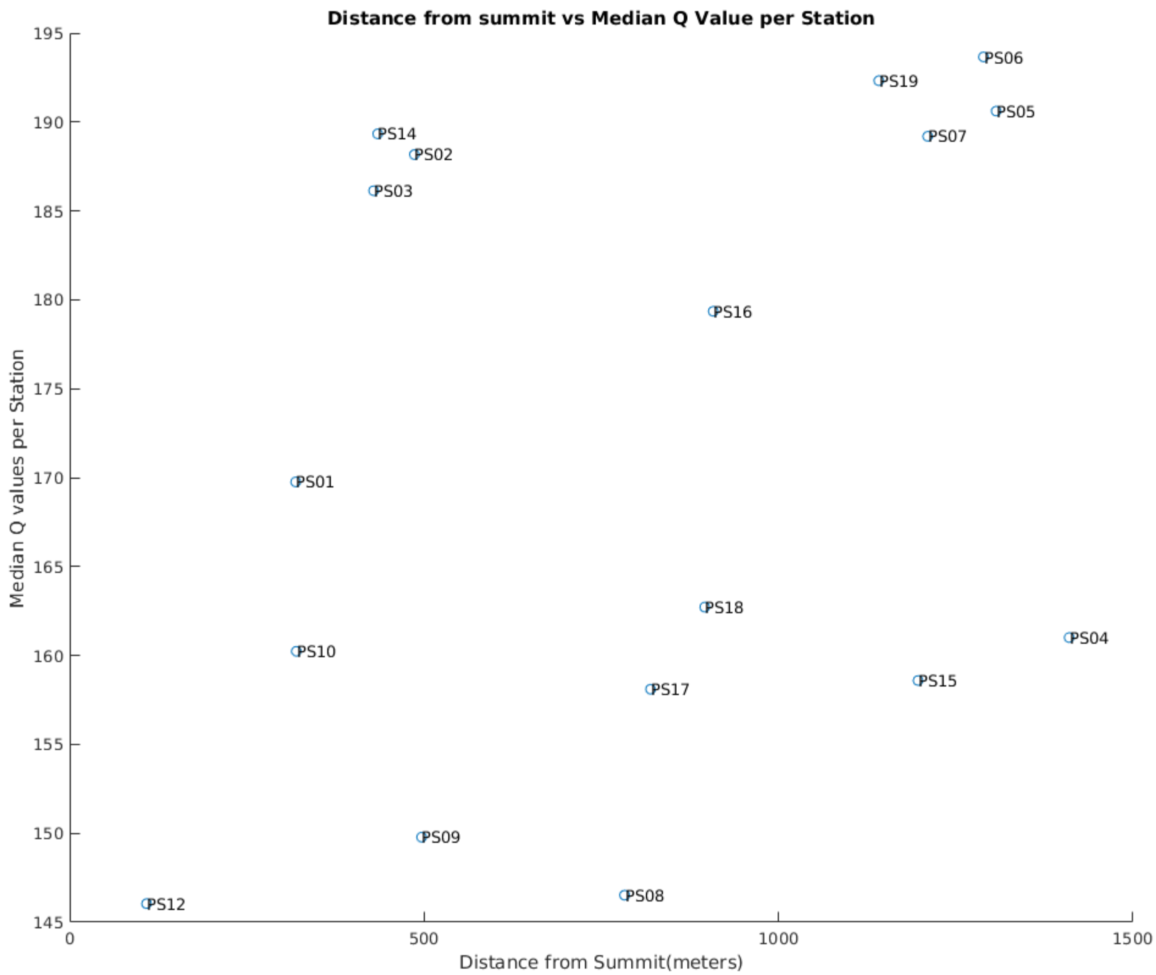

Figure 4.4. Distance from summit (meters) versus median Qc values of stations.

From the plots we can see that there may be relatively higher attenuation near the summit although there are also points of lower relative attenuation. There does not seem to be readily visible trends in the distance from the summit versus median Q plot. Due to the nature of the range of the data as well as the limited points, further study is needed for an interpretation to be valid. Looking at a table of station number versus Q values attributed to said stations (see Table 4.2) may allow us to weight the points and might highlight lower attenuation to the west and higher to the north summit and north of the summit, although this is influenced by knowledge of previous works and structures. Some of the numbers such as for station 3, 4, 8, 10 are based off low numbers of Q_c values so making valid interpretations of this map is something for future studies with larger data sets.

Figure 4.5 is a replot of the distance from summit versus median Q_c values with the weights from Table 4.2 determining circle size. When we replotted the contour map with the weights in Table 4.2 acting to determine the size of the station markers, and the vents from 1961 into 2010 determined by Gomez et at. 2012 (Geological Society of America Digital Map and Chart Series 10) plotted as red diamonds (Figure 4.6, see appendix “Gomez et al. 2012 vent locations methods” for a description of how the data was handled, and “ventcontour” in the appendix for the code) we can possibly discern a loose correlation with higher attenuation and vent density. Vents that are active conduits or have high temperatures may cause increased attenuation. Also vents may act as conduits for gasses and hydrothermal fluids which may cause higher attenuation. An interesting point was brought up by a fellow colleague working on Pacaya, Simone Puel mentioned that there might be a structural factor affecting the attenuation as he referred to Lauren Schaefer et al’s [2013] paper that describes the NNW-SSE pattern that they deemed as an expression of a weakness zone favoring magma ascension [Puel personal comm., Lauren Schaefer et al. 2013].

Future study is needed to determine if this trend is evidenced by the attenuation. When looking at Prandi [2015]’s map of CO_2 efflux we see some correlation between the higher attenuation near station 12 and high CO_2 efflux south of it. We observe a lower efflux with lower station attenuation near stations 2 and 3. This may point to a relationship between attenuation and the CO_2 efflux in that cracked and hot higher attenuating areas release CO_2 because they either are permeable or are magmatic sources. We naturally expect higher attenuation near the summit and the lower attenuation to the west may be a product of the 3 meters of deformation that Schaefer et al. [2016] describes. Possible closing of conduits due to subsidence might be the cause for this although it is possible that such a movement might result in more fractures. The western section of the edifice also has lower vent density than the summit.

Table 4.2. Number of selected Q values per selected station

Station number	Number of Q values
1	24
2	10
3	4
4	1
5	7
6	15
7	16
8	1
9	5
10	2
12	17
14	5
15	1
16	10
17	19
18	2
19	5

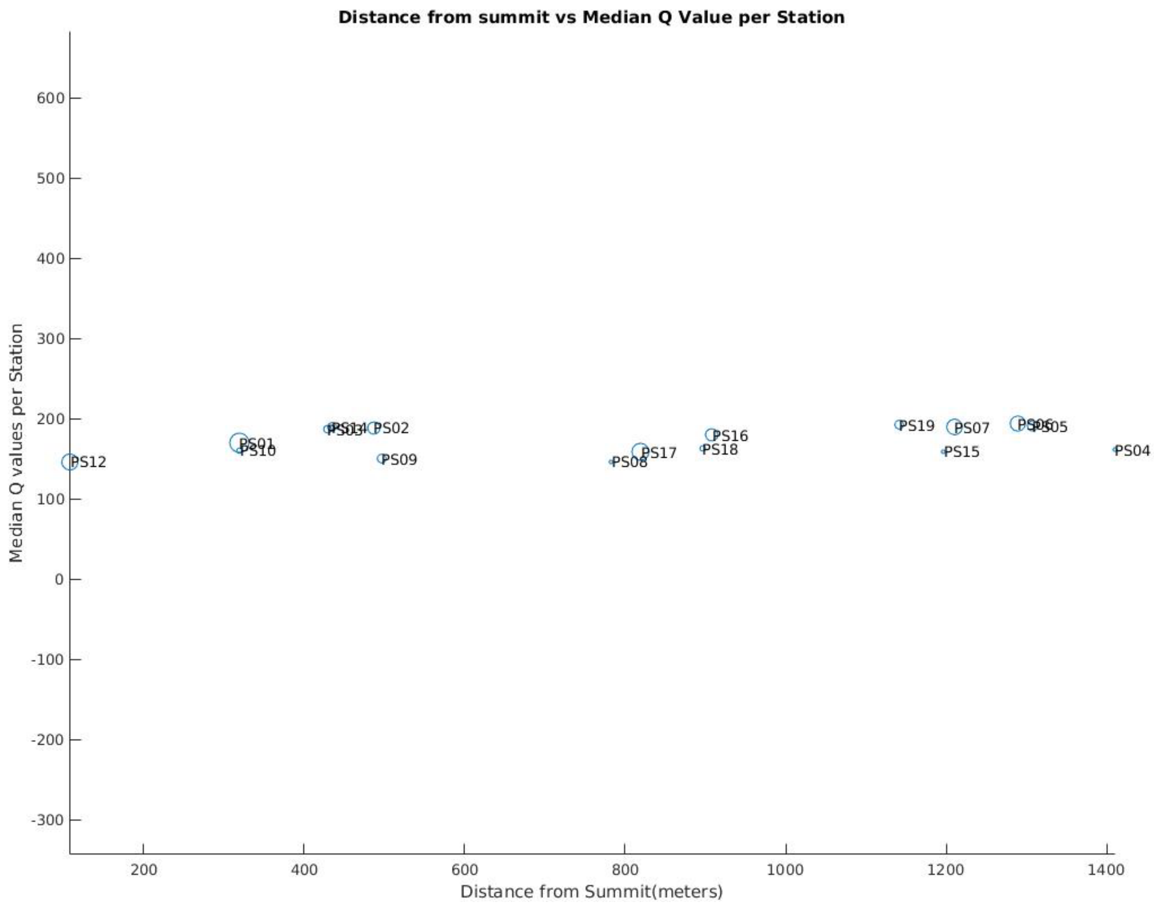

Figure 4.5. Distance from summit versus median Q_c values with Table 4.2 weights determining marker size and "axis equal" enabled.

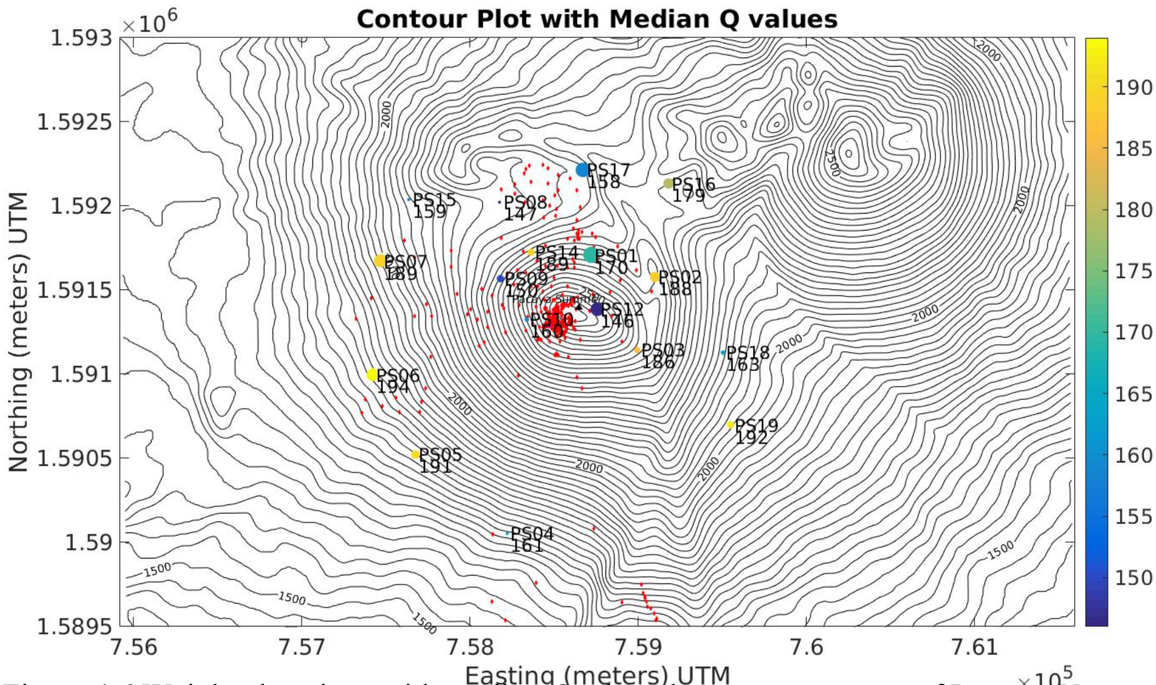

Figure 4.6 Weighted stations with median Q_c plotted on a contour map of Pacaya. Vents 1961-2010 plotted as red diamonds. Pacaya summit plotted as a black triangle.

Chapter 5

Future studies

Possible future studies using attenuation at Pacaya could involve the use of a 3D velocity model with attenuation data to produce a 3D attenuation map which would demonstrate areas of higher or lower attenuation, which may point to thermally contrasting areas or to different scatterer content. Further work on determining the appropriate frequencies for study at this volcano have already begun and can be followed through to completion. Other models are being developed as of the time of writing, such as a surface wave tomography model [Simone Puel personal communication]. The volcano is currently active so all sorts of geophysical techniques could be employed, such as further gravity or gps surveys. Members from Michigan Tech and Geoscientists Without Borders have installed three permanent stations and so future study will be benefited. The volcano poses a hazard to local communities as well as being a threat in case of slope destabilization [Lauren Schaefer et al. 2013] so further work illustrating the internal structure of the volcano is desired.

Chapter 6

Conclusion

In conclusion we interpreted that the best frequency range of those that were tested was between 2-10 Hz. We interpreted that the frequency dependent source/site term could be allotted a value of 1 in the power spectral density equation. We interpreted that there was no general trend in the distance from summit versus median Q plot that was generated and that although structural influences may exist on the attenuation more study is needed to produce clearer results. Higher attenuation to the north and on the north summit is interpreted to be due to fracturing and magmatic origin. While it is considered that lower attenuation to the west is resultant of structural causes, possibly associated with the collapse and subsidence mentioned in Schaefer et al. [2016].

Disclaimer

Please note that this work is preliminary and that due to the nature of the data as well as the aspects of studying volcanic attenuation there are errors, omissions, misstatements, and mistakes in this work that hopefully further studies will alleviate. This work is to serve as a preliminary step to the study of attenuation at Pacaya. It is with all hope that future researchers benefit from this and find the supplemental material useful but keep in mind that the understanding of a complex system like Pacaya will require the work of many authors and that this is but a step to understanding attenuation at this volcano.

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Figure Credits

Figure 1.1 created by Dr. Greg Waite for use in this work please see the copywrite permissions page at the final page of the appendix for the permission granting documents. The image was created in 2016 using the GMT. It has been slightly modified for the purpose of this work in that Pacaya is labeled.

Figure 1.2 image taken by Max Guettinger (author), 2015.

Figure 2.1 and 2.1 images taken by Max Guettinger (author), 2015.

Figure 2.3 to end generated through this work.

Appendix

Description of UTM DEM

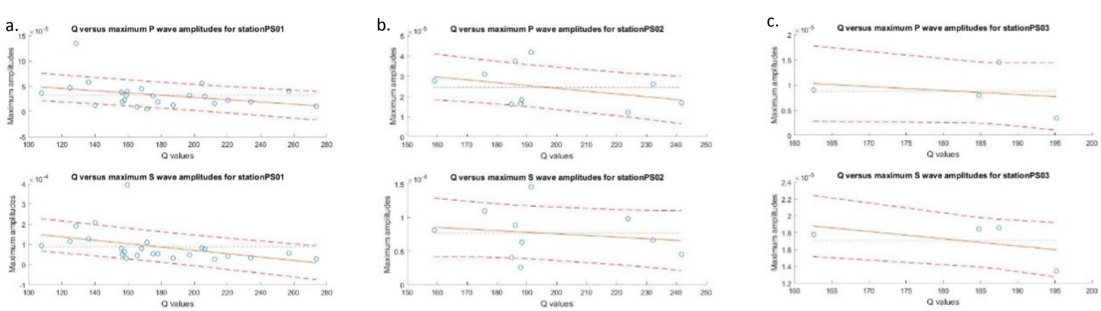
It was a 2006 DEM and its resolution was 10 meters. The DEM spans 4x4 kilometers and includes all of the stations and the summit. The DEM has elevation as its vertical components and UTM values as its x and y components. It is based off of WGS 84 data as are our station locations and the summit location. We first used the interactive Convert Geographic Units converter on the Montana State University website to convert our station locations and the summit value given by Ms. Lanza to UTM coordinates. The converter uses the javascript adapted from Professor Steven Dutch at UW Green Bay. It was set to convert from decimal degrees (WGS 84) to standard UTM. Table 3.3 lists the conversions for each station (minus 11 and 13) and the summit location.

Description of the methods that produced the contour plot and distance versus Q plot

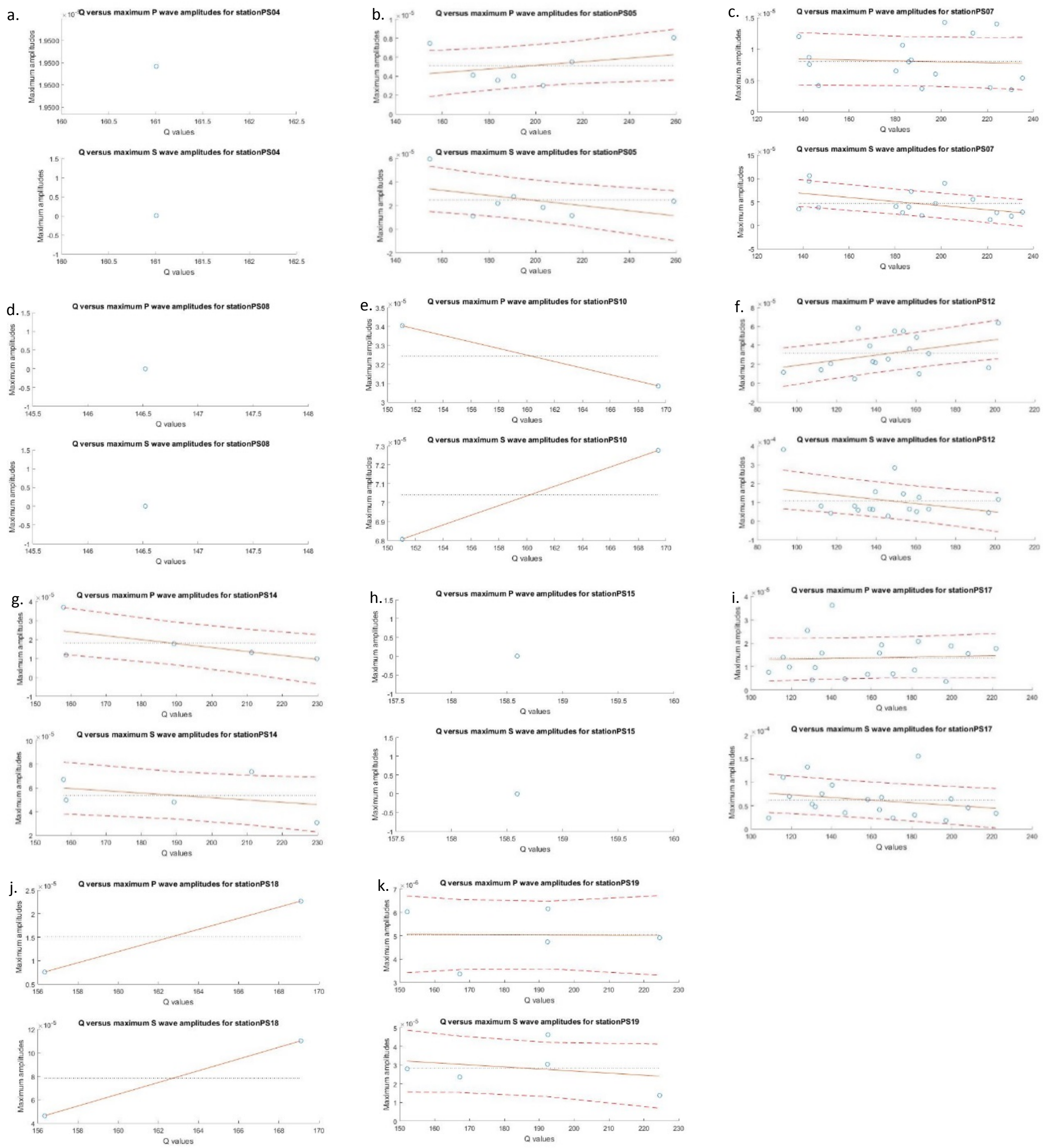
We obtained the medians of the Q_c values that had passed the thresholds, sorted by station (not including stations 11 and 13). We saved the medians as a vector (see medianQ_2016_06_28 in the appendix) that would be used as data values to help plot the selected stations and their median Q_c values on the contour map (see appendix: contour&distanceplot) generated from the DEM (see MATLAB Documentation: contour, for how the MATLAB contour works as it might affect the data) as well as plot, in a separate figure, the distance from the summit (summit location as determined by Ms. Lanza) versus median Q_c values…….

The colormap limits of the contour plot were set by the maximum and minimum rounded median Q_c values while the colors for the circles themselves are based off unrounded values and the text values are rounded values.

source/site term-figures-one standard deviation boundaries

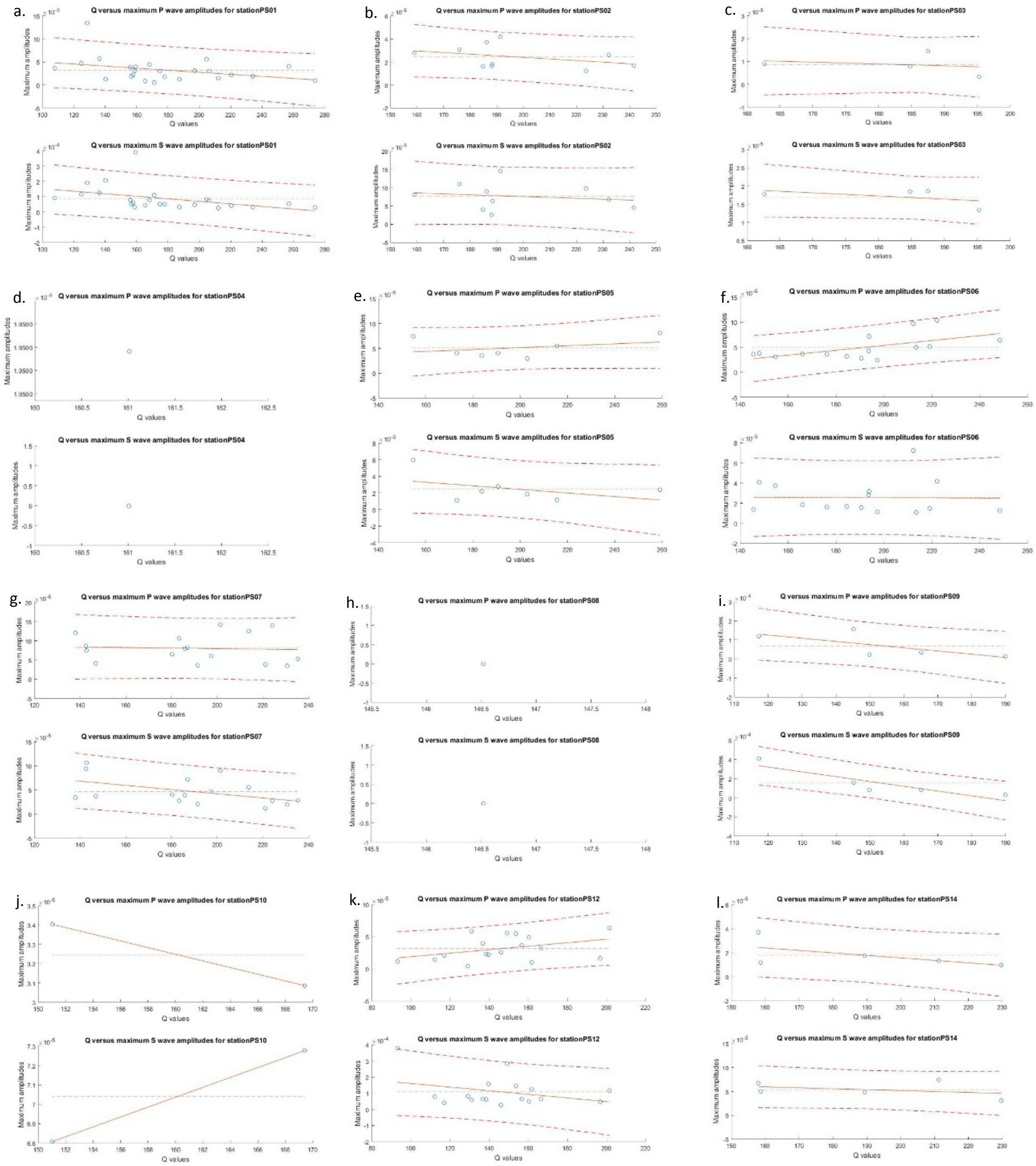


Appendix figure A.1.a-c. Scatter plots of Q versus maximum absolute value amplitudes with fitted line in dark red, one standard deviation boundaries as hashed lines, mean line plotted as small dotted line. Some plots were not considered due to lack of points.

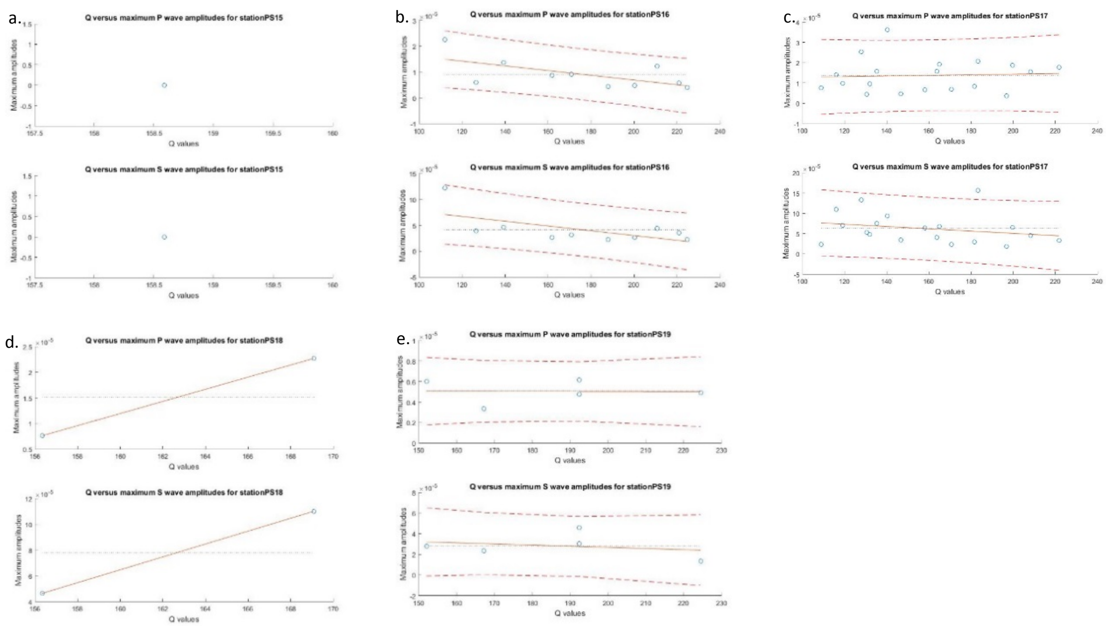


Appendix figure A.2.a-k. Scatter plots of Q versus maximum absolute value amplitudes with fitted line in dark red, one standard deviation boundaries as hashed lines, mean line plotted as small dotted line. Some plots were not considered due to lack of points.

source/site term-figures-two standard deviation boundaries

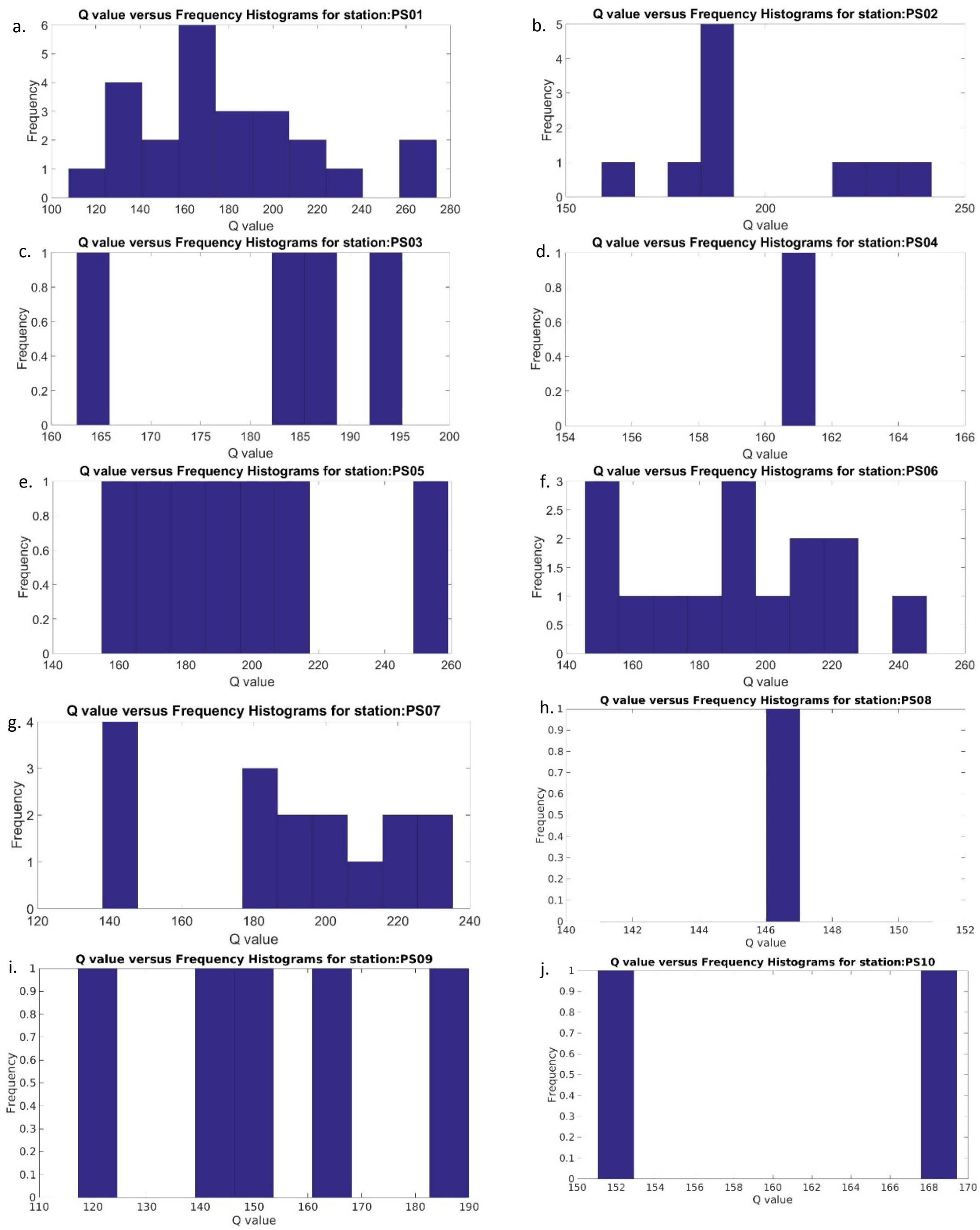


Appendix figure A.3.a-l. Scatter plots of Q versus maximum absolute value amplitudes with fitted line in dark red, double standard deviation boundaries as hashed lines, mean line plotted as small dotted line. Some plots were not considered due to lack of points. Notice no intersecting boundary lines and means other than in limited data point scenarios.

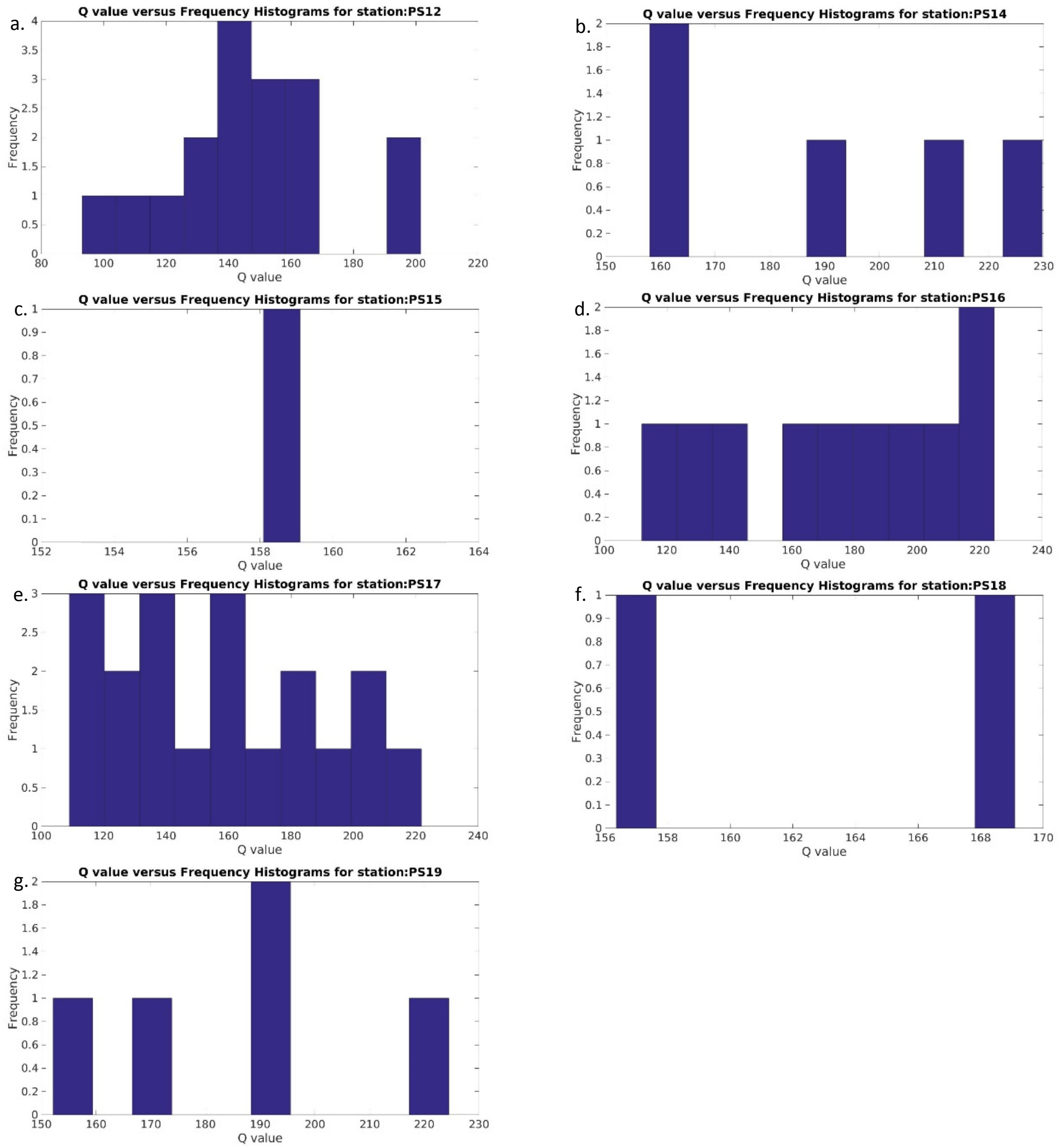


Appendix figure A.4.a-e. Scatter plots of Q versus maximum absolute value amplitudes with fitted line in dark red, double standard deviation boundaries as hashed lines, mean line plotted as small dotted line. Some plots were not considered due to lack of points. Notice no intersecting boundary lines and means other than in limited data point scenarios.

Histograms of Q values per station.



Appendix figure A.5.a-j. Q values versus frequency histograms



Appendix figure A.6.a-g. Q values versus frequency histograms

Gomez et al. 2012 vent locations methods

We derived the vent locations from Appendix B downloaded from the Geologic Society of America Maps page (Notes on a Map of the 1961-2010 eruptions of Volcan de Pacaya, Guatemala. Gomez et al. 2012), which were in Guatemalan transverse Mercator format, and plotted them on our contour map after Rudiger Escobar Wolf converted the locations to UTM.

Code credits

The deconvolution code is adapted from one originating from Dr. Greg Waites earthquake seismology course (Michigan Technological University). The hanningsmooth code and the plot_Q_results code as well as significant portions of the march2ndfinalqplot_2016_06_9final, the grid search method used, and its derivatives were created by Dr. Greg Waite.

The extraction code to index data from the cnv was inspired/aided from Dr. Gregory Waites extractpickfiles.m code.

Special thanks to Calvet et al. 2013 for their help on smoothing, of the possible filter ranges, bandpass filtering, and of finding the coda start. Linear regression method from Calvet et al 2013 as well as the use of coefficients of correlation (interpreted as what they meant).

MATLAB internal help documentation and online documentation provided fundamental aid in the creating of the codes.

Stackoverflow contributors provided fundamental aid in the creating of the codes.

MATLAB answers provided helpful insight and methodologies.

Special thanks to 'YYC' answering 'bit-questions' question regarding cells in Stackoverflow that presented regexp as an option to find the cell values with the [12] in the string http://stackoverflow.com/questions/8056131/strfind-for-string-array-in-matlab. Also special thanks to the internal MATLAB help for the R2015a program used at school for helping with its detail on regexp and how to use it to find patterns in strings, %special thanks to Jonas answering N.C.Rolly's question about finding empty cell arrays on stackoverflow http://stackoverflow.com/questions/3400515/how-do-i-detect-empty-cells-in-a-cell-array

Special thanks to reve_etrange and answered by gnovice on Stackoverflow http://stackoverflow.com/questions/5349470/matlab-index-a-cell-array-with-cell-array-of-arrays-and-return-a-cell-array

Special thanks to Andrey Rubshtein's answer to Benjamin/Dennis Jaheruddin from Stackoverflow http://stackoverflow.com/questions/8061344/how-to-search-for-a-string-in-cell-array-in-matlab

Special thanks to Lane community college's web pdf for the refresher on DMS to decimal degrees conversion. http://gis.lanecc.edu/gtft/gtft_readings/gtft_reading_wk2/Working_with_Geographic_Coordinates.pdf. Special thanks to google maps for confirming the general location with gps values

We follow De Siena et al. 2014 (Attentuation and scattering tomography of the deep plumbing system of Mount Saint Helens) in using the vertical components.
Starting the model with the proper lapse time as measured from the origin time was derived from De. Siena et al. 2014 (MSH).

The concept and implementation of the butterworth filters was derived from Dr. Gregory Waite's filt_traces.m function which was based off a function written by Derek Schutt.

Creating multidimensional vectors method was found in MATLAB help. More can be found on Stackoverflow asked by Theodoros Theodoridis http://stackoverflow.com/questions/23376111/multidimensional-arrays-multiplication-in-matlab

Special thanks to user4402918 for his post and kkuilla's answer regarding MATLAB Correlation coefficiants http://stackoverflow.com/questions/28995650/correlation-coefficients-in-matlab.

Wolfram Mathworld helped with the concepts of regression as well as the correlation coefficients, others http://mathworld.wolfram.com/CorrelationCoefficient.html? etc.

Special thanks to Marc for answering Graviton's question on Stackoverflow regarding finding NaN values for it demonstrated how to perform this action with Graviton's method used in this code http://stackoverflow.com/questions/1713724/find-all-nan-elements-inside-an-array

Special thanks to Dan for answering potAito's questions regarding creating variables with names from strings in that it inspired me to use cell arrays for Qscan and the other final scan variables http://stackoverflow.com/questions/16099398/create-variables-with-names-from-strings

Thanks to Matlab Answers: Dan Ryan and Jill Reese: http://www.mathworks.com/matlabcentral/answers/62382-matrix-multiply-slices-of-3d-matricies?s_tid=srchtitle,

Special Thanks to those who contributed to the Stackoverflow and the Mathworks help site for their insight into code functionality and term usage. The process of learning about new methods of coding frequently referenced the works found in Stackoverflow and Mathworks with the knowledge of code functionality then applied in this work.

Special thanks to other MATLAB help sites such as blogs.Mathworks and answers.MATHWORKS for helping to instruct the author in the use of MATLAB and by providing coding examples.

Special thanks to the MathWorks MATLAB help library, both online and included with the program as many of its examples were learnt form and used in this code. Please note that adaptations of codes displayed in MATLAB help sites were used in this work.

Special thanks to Federica Lanza for her help with the coding and by providing the data from which the results of this code were derived.

The method of finding Q such as the equation used in the grid search was derived from De Siena and Calvet.

The codes used methods from De Siena et al. and Calvet al.'s papers.

Special thanks to further internet help with the code and the materials.

Special thanks to tehslax and Walter Robinson's conversation on "plotting 2d intensity maps" for its insight
http://www.mathworks.com/matlabcentral/newsreader/view_thread/289546

Special thanks to Hossein and the members who answered his question on Stackoverflow regarding "Extracting data from a matrix and saving them in different matrixes in MATLAB"
http://stackoverflow.com/questions/2938775/extracting-data-points-from-a-matrix-and-saving-them-in-different-matrixes-in-ma

Further reading-code influences?

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Kumagai, H., Nakano, M., Maeda, T., Yepes, H., Palacios, P., Ruiz, M., Arrais, S., Vaca, M., Molina, I., and Tadashi Yamashima, 2010, Broadband seismic monitoring of active volcanoes using determinitstic and stochastic approaches, Journal of Geophysical Research, VOL. 115, B08303-did we use?

Appendix table A.1. deployment table

			GPS Handle				GPS Clock										
STATION #	SENSOR S/N	DAS S/N	LAT	LON	ALT (m)	ALT (new datum/velest)	LAT	LON	ALT (m)	# of positions	std (m)	Diff		STARTTIME	ENDTIME	Notes	GPS
PS01	1004278; 1490	92A9	14.385540	-90.600790	2386	886	14.3855	-90.6008	2386	188	2.94	0.000010	-0.000010	2015:013:22:55:23	2015:021:18:32:46	Disk operations disabled - Voltage too low	cycled
PS02	1005633; 463L	9FFE	14.384270	-90.597290	2369	869	14.3843	-90.5973	2369	88	8.42	-0.000010	0.000010	2015:010:18:49:35	2015:019:12:00:00	low battery, dead at site	cycled
	PM2C1		14.384133	-90.597217													
	PM2S2		14.384317	-90.597250													
	PM2W3		14.384417	-90.597467													
PS03	1002556; 971L	981B	14.380420	-90.598330	2418	918	14.3804	-90.5984	2411	193	9.68	0.000040	0.000080	2015:010:21:06:35	2015:018:21:00:00	Disk operations suspended, low voltage	cycled
PS04	1003590; 963L	9344	14.370610	-90.605600	1711	211	14.3706	-90.6057	1700	126	2.6	0.000060	0.000050	2015:013:20:59:30	2015:020:18:06:41	STOP requested	cycled
PS05	1003795; 967L	A0D6	14.374890	-90.610620	1772	272	14.3748	-90.6106	1774	126	3.26	0.000080	0.000010	2015:013:19:43:57	2015:019:00:58:05	STOPPED - RAM FULL	Continuous
PS06	1008618; 251L	990D	14.379190	-90.612900	1867	367	14.3801	-90.613	1866	169	9.64	-0.000930	0.000110	2015:013:15:13:52	2015:020:16:40:02	STOP requested	cycled
PS07	1008601; 242L	947A	14.385280	-90.612370	1979	479	14.3853	-90.6124	1985	141	1.94	0.000030	0.000030	2015:013:17:55:19	2015:020:15:27:17	STOP requested	cycled
PS08	1008609; 243L	9489	14.388440	-90.605810	2210	710	14.3884	-90.6058	2211	129	1.65	0.000020	0.000000	2015:015:22:02:22	2015:022:17:28:41	STOP requested	cycled
PS09	1003504; 448L	9343	14.384350	-90.605800	2318	818	14.3844	-90.6058	2313	145	1.32	0.000000	-0.000020	2015:013:20:05:32	2015:021:17:31:35	STOP requested	cycled
PS10	1000831; 506L	952A	14.382090	-90.604430	2437	937	14.3821	-90.6046	2439	137	8.99	0.000000	0.000160	2015:013:17:37:26	2015:020:15:00:00	Dead at site, low battery (11.4V)	Continuous
PS11	1006052; 968L	9261	14.380550	-90.599683	2477	977	14.3805	-90.5997	2463	153	2.21	0.000030	0.000017	2015:014:20:44:02	2015:021:21:23:12	STOP requested	cycled
PS12	1000844; 742L	9896	14.382633	-90.600517	2562	1062	14.3826	-90.6005	2564	131	3.52	0.000063	0.000013	2015:014:21:30:04	2015:021:20:28:15	STOP requested	cycled
PS13	1000839; 736L	947C	14.378060	-90.598220	2296	796	14.378	-90.5983	2289	138	1.8	0.000020	0.000030	2015:014:18:54:11	2015:021:18:29:22	STOP requested	cycled
PS14	1008620; 241L	9842	14.385733	-90.604100	2323	823	14.3857	-90.6041	2318	123	1.68	-0.000007	-0.000010	2015:016:18:22:10	2015:021:23:44:50	Disk operations suspended, low voltage	cycled
PS15	1001261; 490L	9140	14.388650	-90.610830	2110	610	14.3887	-90.6109	2099	159	7.27	-0.000010	0.000070	2015:014:23:27:33	2015:022:08:27:52	STOPPED - RAM FULL	cycled
PS16	1008623; 497L	9878	14.389300	-90.596517	2298	798	14.3893	-90.5965	2299	113	1.32	0.000030	0.000003	2015:015:20:16:25	2015:021:22:16:25	STOP requested	cycled
PS17	1002839; 1493	9259	14.390080	-90.601220	2266	766	14.3901	-90.6012	2265	118	1.23	0.000010	-0.000010	2015:015:19:16:48	2015:022:18:41:56	STOP requested	cycled
PS18	1003753; 977L	9490	14.380230	-90.593630	2153	653	14.3802	-90.5936	2136	127	2.54	0.000050	-0.000030	2015:014:21:05:05	2015:020:02:27:19	STOPPED - RAM FULL	cycled
PS19	1007094; 495L	9239	14.376330	-90.593250	2055	555	14.3766	-90.5933	2047	115	1.66	-0.000280	0.000010	2015:014:22:24:22	2015:021:10:26:16	Disk operations disabled - Voltage too low	cycled
PM1	PM1S1	9449	14.391350	-90.603000	2267	767	14.3914	-90.603	2264	118	2.28	-0.000090	-0.000010	2015:015:18:44:13	2015:021:12:58:49	STOPPED - RAM FULL	cycled
	PM1C2		14.391550	-90.602967°	2260	760											
	PM1E3		14.391250	-90.602733	2267	767											

deconvolve

```
%deconvolve all of the data in the Pacaya_2015_mat folder for the stations
%and events given by stn and dates cells
clear, close all
%%% This is done by complete day, from the 10th to the 21st. It is only
%%% designed to deconvolve the vertical components.

%%% This flag can be set to 1 if you want to plot each record
plot_flag=1;

%%% Since the data are GISMO Waveform Object files, they can be loaded
%%% using the waveform function. If startup_gismo has not been run, then
%%% simply load the files and treat them as structure variables.
if exist('waveform')==2
   disp('gismo has been loaded, so wo will be recognized as a waveform object')
   gismo_flag=1;
else
   gismo_flag=0;
end

%%% the digitizer gain has to be removed as well. We used 32 for the gain
%%% and the counts to volts
reftekgain=6.291456E+5*32;

%welcome to the restart
stn={'PS01','PS02','PS03','PS04','PS05','PS06','PS07','PS08','PS09','PS10','PS12','PS14','P
S15','PS16','PS17','PS18','PS19'};
dates={'150110','150111','150112','150113','150114','150115','150116','150117','150118','
150119','150120','150121'};
stacompvec={'PS01EHZ','PS01EHN','PS01EHE','PS02EHZ','PS02EHN','PS02EHE','PS0
3EHZ','PS03EHN','PS03EHE','PS04EHZ','PS04EHN','PS04EHE','PS05EHZ','PS05EHN',
'PS05EHE','PS06EHZ','PS06EHN','PS06EHE','PS07EHZ','PS07EHN','PS07EHE','PS08E
HZ','PS08EHN','PS08EHE','PS09EHZ','PS09EHN','PS09EHE','PS10EHZ','PS10EHN','P
S10EHE','PS11EHZ','PS11EHN','PS11EHE','PS12EHZ','PS12EHN','PS12EHE','PS13EH
Z','PS13EHN','PS13EHE','PS14EHZ','PS14EHN','PS14EHE','PS15EHZ','PS15EHN','PS1
5EHE','PS16EHZ','PS16EHN','PS16EHE','PS17EHZ','PS17EHN','PS17EHE','PS18EHZ','
PS18EHN','PS18EHE','PS19EHZ','PS19EHN','PS19EHE'};

mwgdir='/Users/gpwaite/Documents/Advising/Max_Guettinger';
load([mwgdir,filesep,'p.mat']);
load([mwgdir,filesep,'s.mat']);
% these sensitivities are in V/cm/s so we must multiply by 100 to get to
% V/m/s - L22 nominal sensitivity is 88 V/m/s - and must multiply by
% the reftekgain as well
Sensitivity=Sensitivity*reftekgain*100;
```

```
load([mwgdir,filesep,'z.mat']);

%%%% these have already been corrected? -gpw
corstn={'PS11','PS13'};
for luv=1:2
    if luv==1
        e=1:17;
        er=1:12;
    else
        e=1:2;
        er=1:12;
    end
    for i=e
        for j=er
            if luv==1

filnm=strcat('/Volumes/gpwaite_grp/Pacaya_2015_mat/',char(stn(i)),'/',char(stn(i)),'EHZ2
0',char(dates(j)),'.mat');
            end
            if luv==2
                %%% start times are not correct in the _corr files, so we
                %%% have to load the other ones

filnm=strcat('/Volumes/gpwaite_grp/Pacaya_2015_mat/',char(corstn(i)),'/',char(corstn(i)),
'EHZ20',char(dates(j)),'.mat')
                if exist(filnm)==2
                    load(filnm);
                    if gismo_flag
                        actstartreal=get(wo,'start');
                        datestr(actstartreal)
                    else
                        actstartreal=wo.start;
                    end
                end

filnm=strcat('/Volumes/gpwaite_grp/Pacaya_2015_mat_corr/',char(corstn(i)),'/',char(corst
n(i)),'EHZ20',char(dates(j)),'.mat');
            end
            if exist(filnm)>0 % exist function usage found on the MATLAB online help
documentation.
http://www.mathworks.com/help/matlab/ref/exist.html?s_tid=gn_loc_drop
                disp(['loading file: ',filnm]);
                load(filnm);
                compnm='EHZ20';
                if luv==1
```

```
    ldnm=strcat(char(stn(i)),compnm,char(dates(j)));
end
if luv==2
    ldnm=strcat(char(corstn(i)),compnm,char(dates(j)));
end
namd=ldnm(1:7);
%reference the name with the properly ordered (with respect
%to the Poles Zeros, and Sensitivity arrays) stacompvec to
%obtain an the array location which corresponds to that of
%the correct poles, zeros, and sensitivity
nmind=strcmp(stacompvec,namd);
nmind=find(nmind==1);

if gismo_flag
    d=double(wo);
    fs=get(wo,'freq');
    actstart=get(wo,'start')
    datestr(actstart)
else
    d=wo.data;
    fs=wo.Fs;
    actstart=wo.start;
end
if luv==2
    actstart=actstartreal;
end
disp(['file ',ldnm,' actually starts at ',datestr(actstart)])


clear wo
%subtract the data set's mean from the values of the dataset
d=d-mean(d,'omitnan');
%%% fill NANS with 0 otherwise we lose the whole day of
%%% data!
indnans=isnan(d);
if sum(indnans)>0
    d(indnans)=0;
end


%%% now add d to the begininng and the end to minimize edge
%%% effects during deconvolution
if size(d,1)>size(d,2)
    dlarge=[fliplr(d);d;fliplr(d)];
else
```

```
    error('data vector is not a column vector')
end
%finding the length of the data and expanded vector
lz=length(d);
lzL=length(dlarge);

%perform a tukey window on the expanded data-
% the tukey window produces a taper based of an equation
% utilizing a cosine-tukey win help found on matlab help
%documetation that comes with the program
win=tukeywin(lzL,.5);

%multiplying each element in the data set by its tukey correspondent
dlarge=dlarge.*win;

% finding the nyquist of the data for a later line that
% avoids aliasing
nyquist=(fs/2);

%finding the value that would be the next power of 2 greater than the length of
the data for the fft (allows fft to operate faster)
nn=2^nextpow2(lzL);
%Load the poles and zeros from the imported .mat files
% provided by Federica Lanza
% load the poles and construct a matrix with columns
% corresponding to picks/components
poles=p(:,nmind);
%load the zeros and construct a matrix with columns
% corresponding to picks/components
% use a variable name that is distinct from the zeros command
zeroes=z(:,nmind);

ff=linspace(0,fs,nn); %changed from nn to nn %creates a vector of freqequencies
from 0 to the sample rate
ww=ff*2*pi; %transforms the values of the ff frequency vector into angular
frequencies

% by greg waite, poly creates a polynomial with the poles
% and zeros as roots of the coeficients and then polyval
% evaluates it over 2*pi*li, this gives the inverse of the
% magnitude of the ratio of the zero polynomial to the pole
% polynomial
normalization = 1/abs(polyval(poly(zeroes),ww)/polyval(poly(poles),ww))
sensitivity=Sensitivity(nmind); %obtain a sensitivity value for the
pick/component
```

```
        [B,A]=zp2tf(zeroes,poles,normalization); %this takes the zeros, poles, and
normalization value, and then find a numerator polynomial (B) and a denominator
polynomial (A) which are the product of the foil multiplication method of the
independent variable and the poles/zeros values
        hh=freqs(B,A,ww)*sensitivity; %this is used to compute the frequency
response of the system with the knowledge of how the poles and zeros would affect the
frequencies generated for the ww vector                    %check this max check
complex
        if plot_flag
           figure(7)
           subplot(211)
           loglog(ff,abs(hh)/(sensitivity))
           title(ldnm)

           subplot(212)
           semilogx(ff,angle(hh))
        end

        %deconvolve
        %create a waterlevel to smooth
        % waterlevel constant, used to fill in zones of low amplitude
        % in the frequency spectrum. A value of 10^-7 corresponds
        % to about 30 s period in this case
        waterlevel=1e-7;
        zft=fft(dlarge,nn); %changed from nn to nn %performing the fourier transform
allows for the spectrum to be generated so that the amplitude of various frequencies can
be observed
        if ~iscolumn(zft), zft=zft'; end %if zft is not arranged in columns then do so
        if ~iscolumn(hh), hh=hh'; end %if the frequency response is not arranged in
columns then do so
        tmp=hh.*conj(hh); %multiply each element in the frequency response by its
conjugate to remove the complex portions?
        gam=max(tmp)*waterlevel; %taking the maximum of tmp (once the complex
aspect has been removed) and then multiplying it by the waterlevel constant
        lowamp=find(tmp<gam);
        tmp(lowamp)=gam;
        if plot_flag
           figure(6)
           loglog(ff,tmp)
           hold on
           loglog([ff(2),ff(end)],[gam,gam],'r')
           hold off
        end
```

```
            newzft=(zft.*conj(hh))./tmp; %taking the conjugate of the frequency response
and multiplying it by the fourier transform and then dividing it by the maximum of the
tmp*waterlevel this gives us the amplitudes
            newz=ifft(newzft,'symmetric');
            deconvolvedd(:,1)=newz(lz+1:2*lz,1)';
            filenm=char(strcat('dcnvlv',namd,'day',char(dates(j)),'.mat'));
            %%% keep track of the actual start time too
            save(filenm,'deconvolvedd','actstart')

            if plot_flag
               %check it out to make sure it looks ok
               figure(8)
               ax(1)=subplot(311);
               tvec=(0:length(d)-1);tvec=tvec/fs;
               plot(tvec,d)
               ylabel('velocity in counts')
               title(datestr(actstart));

               ax(2)=subplot(312);
               plot(tvec,deconvolvedd)
               ylabel('velocity in m/s')

               ax(3)=subplot(313);
               plot(tvec,d/range(d),tvec,deconvolvedd/range(deconvolvedd))
               legend('raw','deconvolved')
               linkaxes(ax,'x')

               drawnow
               %pause

            end
         end
         clearvars -except stn dates i corstn j p z Sensitivity stacompvec luv e er
gismo_flag plot_flag reftekgain
      end
   end
end

%
% load('handel.mat')
% sound(y)
```

spectralplots

```
for iq=1:12
```

```
    S=4;
    Codawin=10;

    %create arrays of the dates, times and, p wave arival times of the
    %events- note to avoid the dates in which the times need to be corrected

Dates={'150116','150114','150115','150116','150116','150117','150117','150118','150118','
150118','150119','150121'};

hourmin={'1925','2311','0931','0545','1635','0231','0620','0628','1139','2235','1527','0101'}
;
    secnds=[8.31,11.10,8.92,25.97,1.00,45.21,11.97,26.35,20.46,59.30,20.03,53.58];
    pwavearrival=[0.39,0.16,0.91,1.28,0.33,1.17,1.60,1.04,1.56,1.51,1.42,0.81];

    %create a cell array of the stations of th events

Stations={'PS10','PS01','PS03','PS17','PS12','PS14','PS08','PS18','PS16','PS05','PS19','PS
09'};

    %create the event begin time variable

eventbegin=(str2double(char(hourmin{iq}(1:2)))*3600)+(str2double(char(hourmin{iq}(3
:4)))*60)+secnds(iq);

    %create the loadpath name

named=strcat('/run/media/mwguetti/THESIS/greggoogledrive2016_6_6/deconvolvedgreg
/dcnvlv',Stations{iq},'EHZday',Dates{iq},'.mat')

    %load the deconvolved data
    load(named)
    data=deconvolvedd;
    Fs=125;
    eventbeginsample=eventbegin*Fs;
    codastart=eventbeginsample+(pwavearrival(iq)*sqrt(3)*S)*125;
    windowedcoda=data(codastart:codastart+(Codawin*125));
    fftcoda=fft(windowedcoda);
    fxaxis=linspace(0,Fs,length(fftcoda));
    figure(iq)
    plot(fxaxis,abs(fftcoda))
    xlim([0,Fs/2]);
    xlabel('Frequency')
    ylabel('Magnitude')
```

```
   title({strcat('Frequency vs Magnitude
for',Stations{iq},'EHZday',Dates{iq});(strcat('hour/min:',hourmin{iq},'
seconds:',sprintf('%d',secnds(iq))))})
end
   clearvars -except iq
```

findingQcode

```
%final awesome Q code
%see feb15th code for citations if not included here

%%% added a clear command
clear, close all

%%% This flag can be set to 1 if you want to plot each record
plot_flag=1;

%obtain the sample rate from the currently loaded data structure
fs=125;
nyquist=fs/2;

S=4; %%% this is the coda lapse time multiplier
smoothingwindow=4; %%% this is the width of the smoothing window
codawindow=10; %%% length of the coda window
Snumber=S;
nancount=1;

%%% define these kinds of things outside the loop
wn1a=2; %lower filter ranges  filters ranges from calvert
wn2a=10; %upper filter ranges
centerfreq=mean([wn1a,wn2a]);

%begin code copied from the feb 15th code
% fid=fopen('E:\active\thesismatlab\f24','r') %use fopen to open the file/produce a file
identifier-special thanks to Federica Lanza for providing the f4 file and picked data.-
method can be found from from mathworks help documentaion textscan fopen online and
off
fid=fopen('f24','r'); %use fopen to open the file/produce a file identifier-special thanks to
Federica Lanza for providing the f4 file and picked data.-method can be found from from
mathworks help documentaion textscan fopen online and off
C=textscan(fid,'%s %s %s %s %s %s %s %s %*[^\n]');% scan the text for the data to be
placed in a cell array %-this and the next 2 lines methods obtained from the MATLAB
R2015a program's internal documentation on textscan
frewind(fid);
Cd=textscan(fid,'%s','Delimiter','/n');
fclose(fid);
```

```
%%% find date should have the line numbers of all the event header lines
finddate=find(cellfun('isempty',regexp(C{1,1},'1501[12]'))==0);%this should find the dates assuming that nothing else contains the '15011' or '15012' sequences.-special thanks to 'YYC' answering 'bit-questions' question regarding cells in Stackoverflow that presented regexp as an option to find the cell values with the [12] in the string http://stackoverflow.com/questions/8056131/strfind-for-string-array-in-matlab. Also special thanks to the internal MATLAB help for the R2015a program used at school for helping with its detail on regexp and how to use it to find patterns in strings,  %special thanks to Jonas answering N.C.Rolly's question about finding empty cell arrays on stackoverflow http://stackoverflow.com/questions/3400515/how-do-i-detect-empty-cells-in-a-cell-array

% start a for loop to correct for incomplete hour/minute times and seconds
%-the next 10 lines i created

for ij=1:length(finddate)
   if isequal(Cd{1,1}{finddate(ij)}(9),char(32))==1 ||
isequal(Cd{1,1}{finddate(ij)}(10),char(32))==1 %find if there are blank values between the HHMM value digits-citaion?
      C{1,4}{finddate(ij)}=C{1,5}{finddate(ij)}; %reorder the cell to accommidate the unecessary cell offset that blanks in the HHMM cell would cause, as the program figures that values seperated by blanks to be seperate values and so assigns them extra cells
      C{1,5}{finddate(ij)}=C{1,6}{finddate(ij)};
      C{1,6}{finddate(ij)}=C{1,7}{finddate(ij)};
      C{1,7}{finddate(ij)}=C{1,8}{finddate(ij)};
      C{1,8}{finddate(ij)}=[];
   end
   C{1,2}{finddate(ij)}=strrep(Cd{1,1}{finddate(ij)}(8:11),char(32),'0'); %-concept of finding blanks in matlab, does this need citation
   C{1,3}{finddate(ij)}=strrep(Cd{1,1}{finddate(ij)}(13:17),char(32),'0');
end
%%
for I=1:8 %create a for loop that will be used to reorder the components of C into a more useful cell array-method from Stackoverflow, or myself with cell array indexing, matlab documentaion on accessing cell array. A method can be found as asked by reve_etrange and answered by gnovice on Stackoverflow http://stackoverflow.com/questions/5349470/matlab-index-a-cell-array-with-cell-array-of-arrays-and-return-a-cell-array
   Aw(I,:)=C{1,I}; %this reorders the rows of the f24 into columns of cells
end
%
%skip a few lines
Aw(:,finddate(2:end)-1)=[];%this removes the zero columns (columns with a single zero value at their begining) that acted as buffers at the end of events-method from the internal program documetation for MATLAB R2015a titled Deleting Data from a Cell Array
```

```
Aw(:,end)=[];
%end code copied from the feb 15th code
%%

%%
% import stations locations
load('stationlocs.mat')

%
tic
finddateC=finddate;
clear finddate
% loop over all events

%%% preallocate cell arrays
Q = cell(1,length(finddateC)-1);
Q{1,length(finddateC)-1} = [];
linefit = cell(1,length(finddateC)-1);
linefit{1,length(finddateC)-1} = [];
pickdat = cell(1,length(finddateC)-1);
pickdat{1,length(finddateC)-1} = [];
logdat = cell(1,length(finddateC)-1);
logdat{1,length(finddateC)-1} = [];
r = cell(1,length(finddateC)-1);
r{1,length(finddateC)-1} = [];
titles = cell(1,length(finddateC)-1);
titles{1,length(finddateC)-1} = [];
freqc = cell(1,length(finddateC)-1);
freqc{1,length(finddateC)-1} = [];
stnnm = cell(1,length(finddateC)-1);
stnnm{1,length(finddateC)-1} = [];
edist = cell(1,length(finddateC)-1);
edist{1,length(finddateC)-1} = [];
eazim = cell(1,length(finddateC)-1);
eazim{1,length(finddateC)-1} = [];
elon = cell(1,length(finddateC)-1);
elon{1,length(finddateC)-1} = [];
elat = cell(1,length(finddateC)-1);
elat{1,length(finddateC)-1} = [];




for mg=1:length(finddateC)-1 %this loop should loop from 1 to the length of finddate
```

```
   finddate=find(cellfun('isempty',regexp(Aw(1,:),'1501[12]'))==0);%this should find the dates assuming that nothing else contains the '15011' or '15012' sequences.-special thanks to 'YYC' answering 'bit-questions' question regarding cells in Stackoverflow that presented regexp as an option to find the cell values with the [12] in the string http://stackoverflow.com/questions/8056131/strfind-for-string-array-in-matlab. Also special thanks to the internal MATLAB help for the R2015a program used at school for helping with its detail on regexp and how to use it to find patterns in strings,  %special thanks to Jonas answering N.C.Rolly's question about finding empty cell arrays on stackoverflow http://stackoverflow.com/questions/3400515/how-do-i-detect-empty-cells-in-a-cell-array
   if length(finddateC)~=length(finddate') || isequal(finddateC,([1:483]+finddate(1:end)-1)')==0
       error('find dates are not of the same length/are not equal')
   end
   eventday=Aw(1,finddate(mg)); %use finddate with the mg variable as an index to obtain the event date values in Aw in the order observed in the f24 file----check
   timea=Aw(2,finddate(mg)); %use the same method as the previous line but to find the timea variables in Aw(2,)-check
   timeachksec=char(Aw(3,finddate(mg)));          %start time seconds for each event
   Aqt=finddate(mg); %set Aqt equal to finddate(mg)
   eventdaychk=char(eventday);       %check that the day number for the event is ok-char method can be found in matlab documentaion

   %begin code copied from the feb 15th code
   yearst=eventdaychk(1:2);      %year of the event
   monthst=eventdaychk(3:4);     %month of the event
   dayst=eventdaychk(5:6);       %day of the event
   %end code copied from the feb 15th code

   timeachk=char(timea); %find the time of the event
   %%% add a comment here to describe which event is being analyzed
   disp(['working on ',eventdaychk,timeachk,timeachksec])

   %begin code copied from the feb 15th code
   strhr=timeachk(1:2);            %start time hour for event
   strmin=timeachk(3:4);           %start time minutes for each event
   %end code copied from the feb 15th code

   %begin code copied from the feb 15th code
   strtstr=strcat('Start time,','Year:',yearst,', ','Month:',monthst,', ','Day:',dayst,', ','Hour:',strhr,', ','Minutes:',strmin,', ','Seconds:',timeachksec);%strcat can be found in matlab documentation
   disp(strtstr);
   %%% eventbegin is the earthquake origin time
```

```
eventbegin=(str2double(strhr)*3600)+(str2double(strmin)*60)+str2double(timeachksec);
%calculate the total seconds until the event start (origin time)
   %define samples for start time---the following text is not necessary?
   % this assumes that all loaded data will be in phase with the same start time for the
data recording
   eventbeginsample=eventbegin*fs;

   eventlat=char(Aw(4,Aqt));  %find the latitude of the event
   if length(eventlat)>8 || length(eventlat)<8 %error prompts documetation can be found
in the mathworks help documetation, greg mentioned to use error thresholds to keep lat
long values in check
      error('latitude reading scheme malfunctioned')
   end
   eventlat=str2double(eventlat(1:2))+str2double(eventlat(4:end))/60; %convert it to
decimal degrees while removing the letter N component %method of eval can be found
on matlab documetation and can be found on Stackoverflow
http://stackoverflow.com/questions/15050437/eval-command-in-matlab, greg proposed
the method of lat/long conversion
   eventlong=char(Aw(5,Aqt));    %find the longitude of the event
   if length(eventlong)>8 || length(eventlong)<8
      error('longitude reading scheme malfunctioned')
   end
   eventlong=-(str2double(eventlong(1:2))+str2double(eventlong(4:end))/60); %convert
it to numerical while removing the letter W component and changing the value to
negative since we are in the western hemisphere
   if eventlat>14.5 || eventlat<14 %create a check to make sure that the latitude is within
reasonable bounds-this and the boundary conditions for the latitude were proposed by Dr.
Gregory Waite
      error('Latitude is out of reasonable bounds')
   end
   if eventlong<-91 || eventlong>-90 %create a check to make sure that the longitude is
within reasonable bounds
      error('Longitude is out of reasonable bounds')
   end
   disp(['event is at ',num2str(eventlong),', ',num2str(eventlat)])
   %special thanks to Lane community college's web pdf for the refresher on
   %DMS do decimal degrees conversion. The method was used to check the
   %conversions here.

%http://gis.lanecc.edu/gtft/gtft_readings/gtft_reading_wk2/Working_with_Geographic_C
oordinates.pdf.
   %Special thanks to google maps for confirming the general location with
   %gps values
```

```
   %length of columns needed to get to the next event in the cnv file
   gh=zeros(1,12); %%% preallocate array
   for Rt=1:12
      if Aqt+Rt<=length(Aw);
         gh(Rt)=strncmp(Aw(1,Aqt+Rt),Aw(1,Aqt),3); %compare the first three string
characters of the first cell in each column for Rt columns for similarity to find the next
event time
      elseif abs(Aqt+Rt-length(Aw))<0.1;%-------------------------------------------------------
----------------------------
         gh(Rt)=1;
      end
   end

   R=find(gh~=0); %find the cells in gh that have an instance of 1
   R=R(1,1); %use the first instance the find results to index the next event column
   count=1; %start the count
   countt=1;% and why is there a second count variable here?

   %%% there is no need to load the poles and zeros if you are using data
   %%% that has already been deconvolved
   %
   %     % sta=1;   %start the station count
   %     %load the poles
   %     load('p.mat')
   %     %load the zeros
   %     load('z.mat')
   %     %load the sensitivity values %choose all of the data that you want to load
   %     %for an event
   %     load('s.mat')

stacompvec={'PS01EHZ','PS01EHN','PS01EHE','PS02EHZ','PS02EHN','PS02EHE','PS0
3EHZ','PS03EHN','PS03EHE','PS04EHZ','PS04EHN','PS04EHE','PS05EHZ','PS05EHN',
'PS05EHE','PS06EHZ','PS06EHN','PS06EHE','PS07EHZ','PS07EHN','PS07EHE','PS08E
HZ','PS08EHN','PS08EHE','PS09EHZ','PS09EHN','PS09EHE','PS10EHZ','PS10EHN','P
S10EHE','PS11EHZ','PS11EHN','PS11EHE','PS12EHZ','PS12EHN','PS12EHE','PS13EH
Z','PS13EHN','PS13EHE','PS14EHZ','PS14EHN','PS14EHE','PS15EHZ','PS15EHN','PS1
5EHE','PS16EHZ','PS16EHN','PS16EHE','PS17EHZ','PS17EHN','PS17EHE','PS18EHZ','
PS18EHN','PS18EHE','PS19EHZ','PS19EHN','PS19EHE'};
   %create a for loop that runs from the column after the chosen event name/time
   %column to one column before the next event name/time column in the cnv derived
array
   %%% in order to get all the travel times
   for Ld=Aqt+1:Aqt+R-1
      wt=find(strncmp(Aw(:,Ld),'',2)); %find the index of each empty cell in the analysed
column
```

```
    qs=char(Aw(1,Ld)); %make sure the first cell in the column contains a string and keep the string as the first name, the travel time for this station is located in the cell below it (to be used later) before another station name which will be used later in the code. This cell should contain only staion names
    qs=qs(1:4);%when using real cnv change from 1:4 to 1:5 %cut the string name to give just the station and not the uncertianty
    for Ki=2:wt(1)-1 %create a for loop that runs from the 2nd cell of each station name column (the first cell being occupied by the string with only the station name and uncertainty, already accounted for) to the charachter of numeric string
        qsta=char(Aw(Ki,Ld)); %make sure that that the cell contents are in string form
        if isequal(length(qsta),12)==0 && isequal(length(qsta),4)==0 %isequal is found on matlab documentation
            error(['Travel time scheme malfunction. qsta is ',num2str(qsta),' for event ',num2str(mg)])
        end
        %%% qst is the P wave travel time
        qst=str2double(qsta(1:4)); %choose the time that is added to the event start time by first cutting and then evaluating the previously constructed string
        if qst>9 || qst<0 % make sure that the time jump is not over 3 digits and a decimal place, also that the qst value is not to small either
            error(['Arrival time too large or too small. qsta is ',num2str(qsta),' for event ',num2str(mg)'])
        end

        %%% get the source to station distane
        staind=find(strcmp(qs,staname));
        %%% specifying WGS84 as the spheroid (code 7030) means output
        %%% is in km and degrees

[epidists(count),eazims(count)]=distance(eventlat,eventlong,stala(staind),stalo(staind),7030);
        clear staind tmp

        %The following deconvolution code was taken and adapted from Dr. Gregory Waites earthquake seismology course
        % we are only using the vertical components so we will not even bother to
        % deconvolve the horizontal components-the idea of deconvolving first and
        % then filtering was proposed by Dr. Greg Waite
        compnm='EHZ20'; %since we are using only the vertical components this name addition is used for all stations. In this we are following De Sienna et al. 2014 (Attentuation and scattering tomography of the deep plumbing system of Mount Saitn Helens).
        %end copied section from feb 15th code
```

```
        ldnm=strcat('dcnvlv',qs,compnm(1:3),'day',eventdaychk); %use the current station
name +the vertical designation (compnm) and the event dat to create a load name with
the statement 'dcnvlv' added in
        %           ldnnm=strcat('E:\deconvolvedfiles\',ldnm,'.mat'); %create an overall
path-loadname for the data-this will differ based on where the data is stored

ldnnm=strcat('/run/media/mwguetti/THESIS/greggoogledrive2016_6_6/deconvolvedgreg
/',ldnm,'.mat');
        %begin code copied from the feb 15th code
        load(ldnnm); %load the data
        namd=strcat(qs,compnm); %make a name with just the currentr station name and
the vertical designation
        namd=namd(1:7); %cut the "20" out of the namd name
        nmind=strcmp(stacompvec,namd);  %reference the name with the properly
ordered (with respect to the Poles Zeros, and Sensitivity arrays) stacompvec to obtain an
the array location which corresponds to that of the correct poles, zeros, and sensitivity
        nmind=find(nmind==1);  %find the index value of the previously obtained array
location found in the last line

        %end copied section from feb 15th code
        data=deconvolvedd; %access the current loaded data structure and rename the
data into a new variable, knowledge of how to access data structures from Greg Waite
Earthquake seismology course and Mathworks MATLAB help doucmentation
        %%% clear unused variable
        clear deconvolvedd

        %begin code copied from the feb 15th code
        namdd(:,countt)=namd;
        %skip some lines in the feb 15th code

        %create a series of if statements to modify the eventbeginsample so that
        %the start of the recording is accomidated and the data is properly indexd-
        %time values provided by Ms. Federica lanza
        %%% these don't include fractionof a second. Instead you could
        %%% use the actstart variable I added to the dcnvlv...mat files

origin=datenum(2015,1,str2double(dayst),str2double(strhr),str2double(strmin),str2double
(timeachksec));
%           datestr(origin)
%           datestr(actstart)
        difftime=86400*fs*(origin-actstart);
        eventbeginsample2=difftime;
        if 1
        if strcmp(qs,'PS01') && round(str2double(dayst))==13
           %%% eventbeginsample=eventbeginsample-((22*3600)+(55*60)+23)*fs;
```

```
    eventbeginsample=eventbeginsample-((22*3600)+(55*60)+33)*fs;
end
if strcmp(qs,'PS02') && round(str2double(dayst))==10
    %%% eventbeginsample=eventbeginsample-((18*3600)+(49*60)+35)*fs;
    eventbeginsample=eventbeginsample-((18*3600)+(49*60)+34)*fs;
end
if strcmp(qs,'PS03') && round(str2double(dayst))==10
    %%% eventbeginsample=eventbeginsample-((21*3600)+(6*60)+35)*fs;
    eventbeginsample=eventbeginsample-((21*3600)+(6*60)+45)*fs;
end
if strcmp(qs,'PS04') && round(str2double(dayst))==13
    %%% eventbeginsample=eventbeginsample-((20*3600)+(59*60)+30)*fs;
    eventbeginsample=eventbeginsample-((20*3600)+(59*60)+40)*fs;
end
if strcmp(qs,'PS05') && round(str2double(dayst))==13
    %%%eventbeginsample=eventbeginsample-((19*3600)+(43*60)+57)*fs;
    eventbeginsample=eventbeginsample-((19*3600)+(43*60)+56)*fs;
end
if strcmp(qs,'PS06') && round(str2double(dayst))==13
    %%% eventbeginsample=eventbeginsample-((15*3600)+(13*60)+52)*fs;
    eventbeginsample=eventbeginsample-((15*3600)+(14*60)+2)*fs;
end
if strcmp(qs,'PS07') && round(str2double(dayst))==13
    %%% eventbeginsample=eventbeginsample-((17*3600)+(55*60)+19)*fs;
    eventbeginsample=eventbeginsample-((17*3600)+(55*60)+29)*fs;
end
if strcmp(qs,'PS08') && round(str2double(dayst))==15
    %%% eventbeginsample=eventbeginsample-((22*3600)+(2*60)+22)*fs;
    eventbeginsample=eventbeginsample-((22*3600)+(2*60)+32)*fs;
end
if strcmp(qs,'PS09') && round(str2double(dayst))==13
    %%%eventbeginsample=eventbeginsample-((20*3600)+(5*60)+32)*fs;
    eventbeginsample=eventbeginsample-((20*3600)+(5*60)+42)*fs;
end
if strcmp(qs,'PS10') && round(str2double(dayst))==13
    %%%eventbeginsample=eventbeginsample-((17*3600)+(37*60)+26)*fs;
    eventbeginsample=eventbeginsample-((17*3600)+(37*60)+36)*fs;
end
if strcmp(qs,'PS11') && round(str2double(dayst))==14
    %%% I have the start time as 20:50:39
    %%% eventbeginsample=eventbeginsample-((20*3600)+(44*60)+2)*fs;
    eventbeginsample=eventbeginsample-((20*3600)+(50*60)+39)*fs;
end
if strcmp(qs,'PS12') && round(str2double(dayst))==14
    %%%eventbeginsample=eventbeginsample-((21*3600)+(30*60)+4)*fs;
```

```
    eventbeginsample=eventbeginsample-((21*3600)+(30*60)+14)*fs;
  end
  if strcmp(qs,'PS13') && round(str2double(dayst))==14
    %%% I have the start time as 18:54:21
    %%% eventbeginsample=eventbeginsample-((18*3600)+(54*60)+11)*fs;
    eventbeginsample=eventbeginsample-((18*3600)+(54*60)+21)*fs;
  end
  if strcmp(qs,'PS14') && round(str2double(dayst))==16
    %%% I have the start time as 18:22:20
    %%% eventbeginsample=eventbeginsample-((18*3600)+(22*60)+10)*fs;
    eventbeginsample=eventbeginsample-((18*3600)+(22*60)+20)*fs;
  end
  if strcmp(qs,'PS15') && round(str2double(dayst))==14
    %%%eventbeginsample=eventbeginsample-((23*3600)+(27*60)+33)*fs;
    eventbeginsample=eventbeginsample-((23*3600)+(27*60)+43)*fs;
  end
  if strcmp(qs,'PS16') && round(str2double(dayst))==15
    %%% eventbeginsample=eventbeginsample-((20*3600)+(16*60)+25)*fs;
    eventbeginsample=eventbeginsample-((20*3600)+(16*60)+35)*fs;
  end
  if strcmp(qs,'PS17') && round(str2double(dayst))==15
    %%% eventbeginsample=eventbeginsample-((19*3600)+(16*60)+48)*fs;
    eventbeginsample=eventbeginsample-((19*3600)+(16*60)+58)*fs;
  end
  if strcmp(qs,'PS18') && round(str2double(dayst))==14
    %%% this is off by 10 seconds too
    %%% eventbeginsample=eventbeginsample-((21*3600)+(5*60)+5)*fs;
    eventbeginsample=eventbeginsample-((21*3600)+(5*60)+15)*fs;
  end
  if strcmp(qs,'PS19') && round(str2double(dayst))==14
    %%%eventbeginsample=eventbeginsample-((22*3600)+(24*60)+22)*fs;
    eventbeginsample=eventbeginsample-((22*3600)+(24*60)+32)*fs;
  end
  if abs(eventbeginsample-eventbeginsample2)>fs,
    disp(['warning: start time is not the same as eventbeginsample:
',num2str((eventbeginsample-eventbeginsample2)/fs),' sec']);
  end
  eventbeginsample=eventbeginsample2;
  end
  %add the station time to the event start time-P wave arrival time
  %%% in samples
  stationstartevent=eventbeginsample+fs*qst;
  %S wave arrival time, assuming that P waves are 3^(1/2) times
  %faster than S waves * the multiplier for the coda window start
  %time (lapse time)then divided by 125 to convert back into
```

```
        %seconds-proposed by Dr. Gregory Waite? Calvert et al. 2013 mentions this
method.
        %%% why don't you simply use the qst here? qst is the P-wave
        %%% traveltime, right? I would use that number instead
        %%% codastart=(((stationstartevent-eventbeginsample)*sqrt(3))*Snumber)/fs
        codastart= qst*sqrt(3)*Snumber;

        codastartarch(countt)=codastart;



        %rename the data and add 10 seconds (should be) worth of data
        % before and after the event begins that will later be cut to
        % act as a buffer against edge effects-greg
        begind=round(eventbeginsample-fs*10);
        endind=round(eventbeginsample+((codastart+codawindow)*fs)+fs*10);
        d=data(begind:endind);
        if any(isnan(d))
          disp('NaNs in the deconvolved data samples')
          nanfd=1;
          break
        else
          %%% need to set nanfd to 0 or there will be an error
          nanfd=0;
          %skip some lines in the feb 15th code



          filt=1; %this creates a filter loop which is used to filter the data-deconvolve it
and then pick the data according tot he coda window start time (laspe time) and coda
window length. It also plots the deconvolved and the picked data as well ast the sqaure of
the picked data-calvert?
          %end code copied from the feb 15th code
          deconvolved=d;

          %begin code copied from the feb 15th code
          wn1=wn1a(filt); %select the lower filter according to the loop progression
          wn2=wn2a(filt); % select the upper filter according to the loop progression
          [FB,FA]=butter(4,[wn1 wn2]/nyquist,'bandpass');  % the concept and
implimentation of the butterworth filters was derived from Dr. Gregory Waite's
filt_traces.m function which was based off a function written by Derek Schutt. -filter help
by mathworks matalb documetation- greg informed me to set the order to 4 but not really
higher to avoid edge effects

          %%% why not use filtfilt instead of filter
```

```
            deconvolved(:,1)=filtfilt(FB,FA,deconvolved); % we use a bandpass filter that
has variable frequency ranges as dictated by the for loop following the method by Calvert
et al. 2013
            %end copied section from feb 15th code

            dh=strcat('filt',ldnm,'frequencies',sprintf('%d',wn1),'-',sprintf('%d',wn2));

            %begin code copied from the feb 15th code
            clear FA FB
            %skip some lines in the feb15th code

            %%% the extra 10 seconds at the start gets removed here
            strtindex=round(codastart*fs+fs*10+1);
            stopindex=round(fs*10+1+(codastart+codawindow)*fs);
            vertdat=deconvolved(strtindex:stopindex,1).^2;

            if plot_flag
               tveca=(begind:endind)/fs;
               tveca=tveca-tveca(1);
               tvec=(strtindex:stopindex)/fs;
               figure(1)
               subplot(311)
               plot(tveca,d,tveca,deconvolved);
               hold on
               %%% remember that the data, d have an extra 10 sec
               plot([codastart+10,codastart+10],[min(d),max(d)])
               plot([10,10],[min(d),max(d)])
               title([strtstr,' ',qs])
               hold off


               subplot(312)
               plot(tvec,deconvolved(strtindex:stopindex,1))
               %

               subplot(313)
               plot(tvec,vertdat)
               drawnow
               %                    pause
            end
            %skip some lines in the feb15th code
            titlev=dh; %use the name and the event day to make the title for the first plot
which should be the vertical
            titleall{1,count}=titlev; %store the title in a cell array of titles that increase with
each count
```

```
%skip some lines in the feb 15th code
clear titlev dh
dhc=round(smoothingwindow*fs*1/centerfreq(filt));
if isequal((-
1)^round(smoothingwindow*fs*1/centerfreq(filt)),1^round(smoothingwindow*fs*1/cent
erfreq(filt)))==0 %we can find out if a number is odd by using it as an exponent of 1 and
fininding out if -1 raised to the number is equivalent to +1 raised to the same number, if it
is then the number is even.
    dhc=round(smoothingwindow*fs*1/centerfreq(filt))+1; %if the smoothing
window is odd then add 1
end
%       close Figure 1 %method seen on matlab help documetaion
%------------------------------should the smooth be applied to to the
%full-no
%traces or just the windowed coda?
vertdat=vertdat(fs*codastart:fs*(codastart+codawindow))
vertsave(1:length(vertdat),count)=vertdat; %save the unsmoothed squared data
for use later in the subplots
vertdat=hanningsmooth(vertdat,dhc); %uses the function hanning smooth by
Dr. Gregory Waite and uses the smoothing window multiplied by the center frequency of
the filtered range and 125 sample per second-suggested by Dr. Waite
%%% it seems that vertdat adn pA are exactly the same
%%%pA=vertdat(1:end);
%%% I can't understand the need for this pickevent
%%% variable, or pickeventa below
%%%pickevent(1:length(pA(:)),count)=pA;%add the picked event data to the
pickevent vector %-creating multidimensional vectors method found in matlab help.
More can be found on Stackoverflow asked by Theodoros Theodoridis
http://stackoverflow.com/questions/23376111/multidimensional-arrays-multiplication-in-
matlab
pickevent(:,count)=vertdat;%add the picked event data to the pickevent vector
%-creating multidimensional vectors method found in matlab help. More can be found on
Stackoverflow asked by Theodoros Theodoridis
http://stackoverflow.com/questions/23376111/multidimensional-arrays-multiplication-in-
matlab
%       pN=vertdat((floor(xn(1)-(stationstartevent-100))+1):(floor(xn(2)-
(stationstartevent-100))+1)); %pick from the vertical data
%       picknoise(1:length(pN(:)),count)=pN;%add the picked noise data to the
picknoise vector
count=count+1; %update the count
%end copied section from feb 15th code
clear deconvolved data namd nmind ldnnm
%begin copied code from feb 15th code

%%% now overwriting eventbeginsample before next run through the loop?
```

```
            eventbeginsample=eventbegin*fs;
            clear vertdat cell d
            countt=countt+1; %%% what is the point of this second countt variable?
            if Ki~=(wt(1)-1) %use this if statement to avoid using the last string cell of the column as a station names since it is the travel time of the station at wt-2
                qs=qsta(5:8); %obtain the station name for the next iteration (for the first iteration this replaces the name of the station found in the top cell of the column with the name in the current cell, to be use with the travel time in the next cell lower of the column)
            end
        end
    end
    clear qs %clear qs upon the end of the pick loop
    if nanfd==1
        break
    end
  end
  %disp('finished with Ld loop')
  count=count-1;
  %%% I changed this from ~= to == since nanfd should be 1 if there are
  %%% NaNs
  if nanfd==0
    %copy some of the reorganizing variables while removing those that are not
    %needed to obtain Q
    %%%for m=1:6 %-coding lines dealing with the possible S wave maximum (or maximum value between the event origin time and the start of the coda window) were proposed by Dr. Greg Waite.
    %%% since we only have 1 frequency
    for m=1 %-coding lines dealing with the possible S wave maximum (or maximum value between the event origin time and the start of the coda window) were proposed by Dr. Greg Waite.
        pickeventa(:,:,m)=pickevent(:,m:end); %-creating multidimensional vectors method found in matlab help. More can be found on Stackoverflow asked by Theodoros Theodoridis http://stackoverflow.com/questions/23376111/multidimensional-arrays-multiplication-in-matlab
        vertsavea(:,:,m)=vertsave(:,m:end);%reorganize the saved unsmoothed vertdat arrays in a similar fashion to the pickeventa
        titlealla(1,:,m)=titleall(1,m:end);
    end
    %%%nstns=length(pickeventa(1,:,1))
    nstns=size(pickeventa,2);
    kont1=1;

    %begin copied code from feb 15th code
    %%% this section of code loops over the frequencies, then over the
```

```
    %%% records, calculating Q for each station-frequency
    for freqsza=1:length(centerfreq)
      %%% centerfreq has already been defined
      %         centerfreq=[1.5,3,6,12,24,40];
      %         centerfreq=[1.5,3,6,12,24,40];
      kount1=1;

      for numstations=1:nstns;
        if numstations==1
          if exist('hf2','var'),
            close(2); clear hf2;
          end
        end
        K=1:length(pickeventa(:,numstations,freqsza));
        %start the model with the proper lapse time as measures
        % from the origin time-De. Sienna et al. 2014 (MSH) page 8227
        % -Coding lines (this and next) created by Dr, Greg Waite
        K2=(K'+(codastartarch(numstations)*fs)-1)/fs;
        %linear regression method from Calvert et al 2013., Wolfram
        %Mathworld helped with the concepts of regression as well
        %as the correlation coeficients others
http://mathworld.wolfram.com/CorrelationCoefficient.html? etc., matlab in program help
helped with the related code lines.-Greg suggested the use of the linear regression special
thanks to user4402918 for his post and kkuilla's answer regarding MATLAB Correlation
coefficiants http://stackoverflow.com/questions/28995650/correlation-coefficients-in-
matlab. I looked that the MATLAB online documentation as well for reference.
        Et=log(pickeventa(:,numstations,freqsza).*K2.^(3/2));
        %-matlab in program help, use polyfit to perform a linear
        % regression which will give us the coefficiant of the
        % slope that will be used to find Q
        polye=polyfit(K2,Et,1);
        if polye(1)<0
          %extract Q from the slope coefficient.
          Qc=(polye(1).^-1)*(-2*pi*centerfreq(freqsza));
          linfit=polyval(polye,K2); %evaluate the fit polynomial over the time K2-this
and the next three lines were taken from the internal matlab help on linear regression
          sr=sum((Et-linfit).^2); %sum the square of the residual values between the fit
and the data
          stot=(length(Et)-1)*var(Et); %multiply the length of the actual data-1 times
the variance of the actual data
          R2=1-sr/stot; %find the coefficient of determination by subtracting the ratio
of the sum of the squared residual values over the sum of the differences (squared)
between the data and its mean -MATLAB internal help documentaion R2015a "Linear
Regression", from 1
          %       frequencyusedstation(kount1)=freqsza;
```

```
%       StationQ(kount1)=tzQ(ind);
        Qtocheck(kount1)=Qc;
        pickcheck(:,kount1)=vertsavea(:,numstations,freqsza); %use the pickcheck variable to store the vertsavea data for a particular station and frequency
        pnan=find(isnan(pickcheck(:,kount1))==1); %for the particular station and frequency find the NaN values using isnan on pickcheck(:,kount1) and then using find(isnan(pickcheck(:,kount1))==1) to find the indicies of the NaN values and store them in a variable special thanks to Marc for
        %answering Graviton's question on Stackoverflow regarding finding NaN values for it
        %demonstrated how to perform this action with Graviton's method used in
        %this code http://stackoverflow.com/questions/1713724/find-all-nan-elements-inside-an-array
        pickcheck(pnan,kount1)=0; %set all of the NaN values to 0, repeat this method for the logpick and linfittocheck arrays
        logpick(:,kount1)=Et;
        lonan=find(isnan(logpick(:,kount1))==1);
        logpick(lonan,kount1)=0;
        linfittocheck(:,kount1)=linfit;
        linan=find(isnan(linfittocheck(:,kount1))==1);
        linfittocheck(linan,kount1)=0;
        %skip a few lines
        rsend(kount1)=R2;%save the R^2 value in an array which updates with each passing kount1, with the data ultimately being used in the subplots
        titlend(kount1)=titlealla(1,numstations,freqsza); %save the title for the particular station and frequency
        freqend(kount1)=freqsza; %save the frequency index
        stationend(:,kount1)=namdd(:,numstations); %for a particular station and frequncy save the stationname which will be used later in the subplots, since the namdd variable contains the names of the stations and components in the order in which they wer deconvolved they should be properly indexed by numstations per event
        %skip a few lines
        kount1=kount1+1; %update the kount1 variable

        if plot_flag
          tvec=(strtindex:stopindex)/fs;
          hf2=figure(2);
          subplot(nstns,1,numstations)
          plot(K2,Et)
          hold on
          plot(K2,linfit)
          ylabel(namdd(1:4,numstations)')
          hold off
          set(gcf,'Position',[877 13 560 793])
          drawnow
```

```
                subplot(nstns,1,1)
                title(strtstr)
                %                       pause(1)

            end

        else
            disp('positive slope for fit, data modified for station iteration')
            nname=strcat('S: ',sprintf('%d',S),', codawindow:
',sprintf('%d',codawindow),', Freq: ',sprintf('%d',freqsza),' ,stn: ',namdd(:,numstations)');
            nanproblem{nancount}=nname;
            nancount=nancount+1;
            Qtocheck(kount1)=123456789;
            pickcheck(:,kount1)=vertsavea(:,numstations,freqsza); %use the pickcheck
variable to store the vertsavea data for a particular station and frequency
            pnan=find(isnan(pickcheck(:,kount1))==1);
            pickcheck(pnan,kount1)=0;
            logpick(:,kount1)=repmat(123456789,[length(Et),1]);
            linfittocheck(:,kount1)=repmat(123456789,[length(K2),1]);
            rsend(kount1)=123456789;
            titlend(kount1)=titlealla(1,numstations,freqsza); %save the title for the
particular station and frequency
            freqend(kount1)=freqsza; %save the frequency index
            stationend(:,kount1)=namdd(:,numstations); %for a particular station and
frequncy save the stationname which will be used later in the subplots, since the namdd
variable contains the names of the stations and components in the order in which they
wer deconvolved they should be properly indexed by numstations per event
            %skip a few lines
            kount1=kount1+1;
        end


        clear R2 ploye Et Qc linfit sr stot K K2 lonan linan pnan nname% clear the
variabels that are no loger necessary after this iteration.
        %       close Figure 1
    end
    %skip a few lines
    Qtochecka(:,kont1)=Qtocheck;
    linfittochecka(:,:,kont1)=linfittocheck;
    pickchecka(:,:,kont1)=pickcheck;
    loggpick(:,:,kont1)=logpick;
    rsenda(:,kont1)=rsend;
    titlenda(:,kont1)=titlend;
    freqenda(:,kont1)=freqend;
```

```
            stationenda(:,:,kont1)=stationend;
            %skip a few lines
            clear kount1 Qtocheck rsend titlend freqend stationend laps windw logpick pickcheck linfittocheck
            kont1=kont1+1;
            %       close all %remmeber to disable the close alls when plotting
        end
        Q{mg}=Qtochecka;
        linefit{mg}=linfittochecka;
        pickdat{mg}=pickchecka;
        logdat{mg}=loggpick;
        r{mg}=rsenda;
        titles{mg}=titlenda;
        freqc{mg}=freqenda;
        stnnm{mg}=stationenda;
        edist{mg}=epidists;
        eazim{mg}=eazims;
        elon{mg}=eventlong;
        elat{mg}=eventlat;
    else
        Q{mg}='NaN found';
        linefit{mg}='NaN found';
        pickdat{mg}='NaN found';
        logdat{mg}='NaN found';
        r{mg}='NaN found';
        titles{mg}='NaN found';
        freqc{mg}='NaN found';
        stnnm{mg}='NaN found';
        edist{mg}='NaN found';
        eazim{mg}='NaN found';
        elon{mg}='NaN found';
        elat{mg}='NaN found';

    end
    clearvars -except edist eazim elon elat plot_flag fs nyquist finddateC Q linefit pickdat logdat Aw finddate r titles freqc stnnm S smoothingwindow codawindow Snumber nancount qs centerfreq wn1a wn2a staname stala stalo

end
toc

%%
% save some variables
dte = datestr(now,'yyyy_mm_dd_HH_MM_SS');
```

```
savefilename=sprintf('/run/media/mwguetti/THESIS/active/march2ndrun_active_2016_6_9/alleventQdata_%s_S%02d_fr%02d-%02d_coda%02d.mat',dte,Snumber,wn1a,wn2a,codawindow);
save(savefilename,'Q','linefit','pickdat','logdat','r','titles','freqc','stnnm',
'edist','eazim','elon','elat')
```

We modified lines 388-393 in the previous code for a run to plot a trace of the deconvolved data (these and the next modification are not included in the code as they were only used in these circumstances). The axis equal command may have been used on the image after it was plotted.

```
figure
        plot(d(fs*10:stopindex))
        xlabel('Samples')
        ylabel('Amplitude')
        title(([strtstr,' ',qs]))
        error('check')
```

modification to lines 531-548 in the findingQcode that allowed us to generate the best fit figures with the natural log of the product of the power spectral density multiplied by the three halves power of the lapse time plotted as well as the linear fit to it plotted. The axis equal command was used on the first figure after it was plotted and resized. Please note that both might not have been resized equally. The if R2<=0.3 **was originally** if R2>=0.7 **to find a coefficient of determination greater that 0.7.**

```
if R2<=0.3
            figure
            plot(K2,Et,'b')
            hold on
            plot(K2,linfit,'r')
            ylabel(namdd(1:4,numstations)')
            xlabel('Time in Seconds')
            hold off
            title(strtstr)
            %               pause(1)
            error('check')
          end
```

SortandplotQ

```
%
% clear, close all
% load('alleventQdata_2016_05_18_14_33_19_S04_fr06_coda10.mat');
%
% % load('alleventQdata_2016_05_19_14_14_42_S03_fr06_coda10.mat');
%
% load('alleventQdata_2016_05_19_17_17_54_S03_fr03-09_coda10.mat');
% % load('alleventQdata_2016_05_19_18_05_05_S04_fr03-09_coda10.mat');
% load('alleventQdata_2016_05_20_12_17_08_S04_fr03-10_coda10.mat');
cnt=0;
for n=1:length(r)
   rtmp=cell2mat(r(n));
   statmp=char(stnnm(n));

   ind1=find(rtmp>.5);
   ind2=find(rtmp(ind1)<=1);
   ind3=ind1(ind2);
   if ~isempty(ind3)
      %get Q
      Qtmp=cell2mat(Q(n));
      for m=1:length(ind3)
         if Qtmp(ind3(m))<1e5
            cnt=cnt+1;
            Qgood(cnt)=Qtmp(ind3(m));
            sta(cnt,1:4)=statmp(1:4,ind3(m))';

         end
      end
   end
   clear ind1 ind2 ind3 rtmp Qtmp
   %     pause
end
figure
plot(sort(Qgood),'.');
title('all Q values')
ylabel('Q')
xlabel('index')
figure
hist(Qgood)

title('all Q values')
xlabel('Q')
ylabel('frequency')
```

```
%%
stns={'PS01','PS02','PS03','PS04','PS05','PS06','PS07','PS08','PS09','PS10','PS12','PS14','
PS15','PS16','PS17','PS18','PS19'};
load('stationlocs.mat');
for n=1:length(stns)
   cnt=0;
   staQ=[];
   for i=1:size(sta,1);
      if strcmp(char(stns(n)),sta(i,:))
         cnt=cnt+1;
         staQ(cnt)=Qgood(i);
      end
   end
   meanQ(n)=mean(staQ);
   medianQ(n)=median(staQ);
end
%%
figure;
subplot(211)
plot(meanQ,'.')
text(1:length(meanQ),meanQ,char(stns));
title('Average Q values by station')

subplot(212)
plot(medianQ,'.')
text(1:length(medianQ),medianQ,char(stns));

Qrng=range(meanQ);
col=flipud(colormap(jet));
minQ=min(meanQ)-1;
coltmp=interp1(linspace(1,ceil(Qrng)+1,64),col,1:ceil(Qrng)+1);
col=coltmp; clear tmpcol

figure
for j=1:length(meanQ)
   if ~isnan(meanQ(j))
      colind=round(meanQ(j)-minQ);
      tmpcol=col(colind,:);
      plot(stalo(j),stala(j),'o','Color',tmpcol,'MarkerFaceColor',tmpcol,'MarkerSize',10);
      hold on
      text(stalo(j),stala(j),char(stns(j)));
   end
end
```

```
title('stations colored by Q')
hcb=colorbar('Ticks',([141,160,180,200]-
minQ)/length(col),'TickLabels',{'140','160','180','200'});
set(hcb,'colormap',col)
```

findingQcodeamplitudes

```
%final awesome Q code
%see feb15th code for citations if not included here

%%% added a clear command
clear, close all

%%% This flag can be set to 1 if you want to plot each record
plot_flag=1;

%obtain the sample rate from the currently loaded data structure
fs=125;
nyquist=fs/2;

S=4; %%% this is the coda lapse time multiplier
smoothingwindow=4; %%% this is the width of the smoothing window
codawindow=10; %%% length of the coda window
Snumber=S;
nancount=1;

%%% define these kinds of things outside the loop
wn1a=2; %lower filter ranges  filters ranges from calvert
wn2a=10; %upper filter ranges
centerfreq=mean([wn1a,wn2a]);

%begin code copied from the feb 15th code
% fid=fopen('E:\active\thesismatlab\f24','r') %use fopen to open the file/produce a file
identifier-special thanks to Federica Lanza for providing the f4 file and picked data.-
method can be found from from mathworks help documentaion textscan fopen online and
off
fid=fopen('f24','r'); %use fopen to open the file/produce a file identifier-special thanks to
Federica Lanza for providing the f4 file and picked data.-method can be found from from
mathworks help documentaion textscan fopen online and off
C=textscan(fid,'%s %s %s %s %s %s %s %s %*[^\n]');% scan the text for the data to be
placed in a cell array %-this and the next 2 lines methods obtained from the MATLAB
R2015a program's internal documentation on textscan
frewind(fid);
Cd=textscan(fid,'%s','Delimiter','/n');
```

```
fclose(fid);
%%% find date should have the line numbers of all the event header lines
finddate=find(cellfun('isempty',regexp(C{1,1},'1501[12]'))==0);%this should find the dates assuming that nothing else contains the '15011' or '15012' sequences.-special thanks to 'YYC' answering 'bit-questions' question regarding cells in Stackoverflow that presented regexp as an option to find the cell values with the [12] in the string http://stackoverflow.com/questions/8056131/strfind-for-string-array-in-matlab. Also special thanks to the internal MATLAB help for the R2015a program used at school for helping with its detail on regexp and how to use it to find patterns in strings,  %special thanks to Jonas answering N.C.Rolly's question about finding empty cell arrays on stackoverflow http://stackoverflow.com/questions/3400515/how-do-i-detect-empty-cells-in-a-cell-array

% start a for loop to correct for incomplete hour/minute times and seconds
%-the next 10 lines i created

for ij=1:length(finddate)
   if isequal(Cd{1,1}{finddate(ij)}(9),char(32))==1 ||
isequal(Cd{1,1}{finddate(ij)}(10),char(32))==1 %find if there are blank values between the HHMM value digits-citaion?
       C{1,4}{finddate(ij)}=C{1,5}{finddate(ij)}; %reorder the cell to accommidate the unecessary cell offset that blanks in the HHMM cell would cause, as the program figures that values seperated by blanks to be seperate values and so assigns them extra cells
       C{1,5}{finddate(ij)}=C{1,6}{finddate(ij)};
       C{1,6}{finddate(ij)}=C{1,7}{finddate(ij)};
       C{1,7}{finddate(ij)}=C{1,8}{finddate(ij)};
       C{1,8}{finddate(ij)}=[];
   end
   C{1,2}{finddate(ij)}=strrep(Cd{1,1}{finddate(ij)}(8:11),char(32),'0'); %-concept of finding blanks in matlab, does this need citation
   C{1,3}{finddate(ij)}=strrep(Cd{1,1}{finddate(ij)}(13:17),char(32),'0');
end
%%
for I=1:8 %create a for loop that will be used to reorder the components of C into a more useful cell array-method from Stackoverflow, or myself with cell array indexing, matlab documentaion on accessing cell array. A method can be found as asked by reve_etrange and answered by gnovice on Stackoverflow http://stackoverflow.com/questions/5349470/matlab-index-a-cell-array-with-cell-array-of-arrays-and-return-a-cell-array
   Aw(I,:)=C{1,I}; %this reorders the rows of the f24 into columns of cells
end
%
%skip a few lines
```

```
Aw(:,finddate(2:end)-1)=[];%this removes the zero columns (columns with a single zero value at their begining) that acted as buffers at the end of events-method from the internal program documetation for MATLAB R2015a titled Deleting Data from a Cell Array
Aw(:,end)=[];
%end code copied from the feb 15th code
%%

%%
% import stations locations
load('stationlocs.mat')

%
tic
finddateC=finddate;
clear finddate
% loop over all events

%%%% preallocate cell arrays
Q = cell(1,length(finddateC)-1);
Q{1,length(finddateC)-1} = [];
Pwavemax = cell(1,length(finddateC)-1);
Pwavemax{1,length(finddateC)-1} = [];
Swavemax = cell(1,length(finddateC)-1);
Swavemax{1,length(finddateC)-1} = [];
linefit = cell(1,length(finddateC)-1);
linefit{1,length(finddateC)-1} = [];
pickdat = cell(1,length(finddateC)-1);
pickdat{1,length(finddateC)-1} = [];
logdat = cell(1,length(finddateC)-1);
logdat{1,length(finddateC)-1} = [];
r = cell(1,length(finddateC)-1);
r{1,length(finddateC)-1} = [];
titles = cell(1,length(finddateC)-1);
titles{1,length(finddateC)-1} = [];
freqc = cell(1,length(finddateC)-1);
freqc{1,length(finddateC)-1} = [];
stnnm = cell(1,length(finddateC)-1);
stnnm{1,length(finddateC)-1} = [];
edist = cell(1,length(finddateC)-1);
edist{1,length(finddateC)-1} = [];
eazim = cell(1,length(finddateC)-1);
eazim{1,length(finddateC)-1} = [];
elon = cell(1,length(finddateC)-1);
elon{1,length(finddateC)-1} = [];
elat = cell(1,length(finddateC)-1);
```

```
elat{1,length(finddateC)-1} = [];



for mg=1:length(finddateC)-1 %this loop should loop from 1 to the length of finddate
    finddate=find(cellfun('isempty',regexp(Aw(1,:),'1501[12]'))==0);%this should find the dates assuming that nothing else contains the '15011' or '15012' sequences.-special thanks to 'YYC' answering 'bit-questions' question regarding cells in Stackoverflow that presented regexp as an option to find the cell values with the [12] in the string http://stackoverflow.com/questions/8056131/strfind-for-string-array-in-matlab. Also special thanks to the internal MATLAB help for the R2015a program used at school for helping with its detail on regexp and how to use it to find patterns in strings,  %special thanks to Jonas answering N.C.Rolly's question about finding empty cell arrays on stackoverflow http://stackoverflow.com/questions/3400515/how-do-i-detect-empty-cells-in-a-cell-array
    if length(finddateC)~=length(finddate') || isequal(finddateC,([1:483]+finddate(1:end)-1)')==0
        error('find dates are not of the same length/are not equal')
    end
    eventday=Aw(1,finddate(mg)); %use finddate with the mg variable as an index to obtain the event date values in Aw in the order observed in the f24 file----check
    timea=Aw(2,finddate(mg)); %use the same method as the previous line but to find the timea variables in Aw(2,)-check
    timeachksec=char(Aw(3,finddate(mg)));          %start time seconds for each event
    Aqt=finddate(mg); %set Aqt equal to finddate(mg)
    eventdaychk=char(eventday);       %check that the day number for the event is ok-char method can be found in matlab documentaion

    %begin code copied from the feb 15th code
    yearst=eventdaychk(1:2);      %year of the event
    monthst=eventdaychk(3:4);     %month of the event
    dayst=eventdaychk(5:6);       %day of the event
    %end code copied from the feb 15th code

    timeachk=char(timea); %find the time of the event
    %%% add a comment here to describe which event is being analyzed
    disp(['working on ',eventdaychk,timeachk,timeachksec])

    %begin code copied from the feb 15th code
    strhr=timeachk(1:2);              %start time hour for event
    strmin=timeachk(3:4);             %start time minutes for each event
    %end code copied from the feb 15th code

    %begin code copied from the feb 15th code
```

```
    strtstr=strcat('Start time,','Year:',yearst,', ','Month:',monthst,', ','Day:',dayst,',
','Hour:',strhr,', ','Minutes:',strmin,', ','Seconds:',timeachksec);%strcat can be found in
matlab documentation
    disp(strtstr);
    %%% eventbegin is the earthquake origin time

eventbegin=(str2double(strhr)*3600)+(str2double(strmin)*60)+str2double(timeachksec);
%calculate the total seconds until the event start (origin time)
    %define samples for start time---the following text is not necessary?
    % this assumes that all loaded data will be in phase with the same start time for the
data recording
    eventbeginsample=eventbegin*fs;

    eventlat=char(Aw(4,Aqt));  %find the latitude of the event
    if length(eventlat)>8 || length(eventlat)<8 %error prompts documetation can be found
in the mathworks help documetation, greg mentioned to use error thresholds to keep lat
long values in check
        error('latitude reading scheme malfunctioned')
    end
    eventlat=str2double(eventlat(1:2))+str2double(eventlat(4:end))/60; %convert it to
decimal degrees while removing the letter N component %method of eval can be found
on matlab documetation and can be found on Stackoverflow
http://stackoverflow.com/questions/15050437/eval-command-in-matlab, greg proposed
the method of lat/long conversion
    eventlong=char(Aw(5,Aqt));    %find the longitude of the event
    if length(eventlong)>8 || length(eventlong)<8
        error('longitude reading scheme malfunctioned')
    end
    eventlong=-(str2double(eventlong(1:2))+str2double(eventlong(4:end))/60); %convert
it to numerical while removing the letter W component and changing the value to
negative since we are in the western hemisphere
    if eventlat>14.5 || eventlat<14 %create a check to make sure that the latitude is within
reasonable bounds-this and the boundary conditions for the latitude were proposed by Dr.
Gregory Waite
        error('Latitude is out of reasonable bounds')
    end
    if eventlong<-91 || eventlong>-90 %create a check to make sure that the longitude is
within reasonable bounds
        error('Longitude is out of reasonable bounds')
    end
    disp(['event is at ',num2str(eventlong),', ',num2str(eventlat)])
    %special thanks to Lane community college's web pdf for the refresher on
    %DMS do decimal degrees conversion. The method was used to check the
    %conversions here.
```

```
%http://gis.lanecc.edu/gtft/gtft_readings/gtft_reading_wk2/Working_with_Geographic_C
oordinates.pdf.
   %Special thanks to google maps for confirming the general location with
   %gps values

   %length of columns needed to get to the next event in the cnv file
   gh=zeros(1,12); %%% preallocate array
   for Rt=1:12
      if Aqt+Rt<=length(Aw);
         gh(Rt)=strncmp(Aw(1,Aqt+Rt),Aw(1,Aqt),3); %compare the first three string
characters of the first cell in each column for Rt colunms for similarity to find the next
event time
      elseif abs(Aqt+Rt-length(Aw))<0.1;%-----------------------------------------------------
----------------------------
         gh(Rt)=1;
      end
   end

   R=find(gh~=0); %find the cells in gh that have an instance of 1
   R=R(1,1); %use the first instance the find results to index the next event column
   count=1; %start the count
   countt=1;% and why is there a second count variable here?

   %%% there is no need to load the poles and zeros if you are using data
   %%% that has already been deconvolved
   %
   %     % sta=1;   %start the station count
   %     %load the poles
   %     load('p.mat')
   %     %load the zeros
   %     load('z.mat')
   %     %load the sensitivity values %choose all of the data that you want to load
   %     %for an event
   %     load('s.mat')

stacompvec={'PS01EHZ','PS01EHN','PS01EHE','PS02EHZ','PS02EHN','PS02EHE','PS0
3EHZ','PS03EHN','PS03EHE','PS04EHZ','PS04EHN','PS04EHE','PS05EHZ','PS05EHN',
'PS05EHE','PS06EHZ','PS06EHN','PS06EHE','PS07EHZ','PS07EHN','PS07EHE','PS08E
HZ','PS08EHN','PS08EHE','PS09EHZ','PS09EHN','PS09EHE','PS10EHZ','PS10EHN','P
S10EHE','PS11EHZ','PS11EHN','PS11EHE','PS12EHZ','PS12EHN','PS12EHE','PS13EH
Z','PS13EHN','PS13EHE','PS14EHZ','PS14EHN','PS14EHE','PS15EHZ','PS15EHN','PS1
5EHE','PS16EHZ','PS16EHN','PS16EHE','PS17EHZ','PS17EHN','PS17EHE','PS18EHZ','
PS18EHN','PS18EHE','PS19EHZ','PS19EHN','PS19EHE'};
   %create a for loop that runs from the column after the chosen event name/time
```

```
    %column to one column before the next event name/time column in the cnv derived
array
    %%% in order to get all the travel times
    for Ld=Aqt+1:Aqt+R-1
        wt=find(strncmp(Aw(:,Ld),'',2)); %find the index of each empty cell in the analysed
column
        qs=char(Aw(1,Ld)); %make sure the first cell in the column contains a string and
keep the string as the first name, the travel time for this station is located in the cell below
it (to be used later) before another station name which will be used later in the code. This
cell should contain only staion names
        qs=qs(1:4);%when using real cnv change from 1:4 to 1:5 %cut the string name to
give just the station and not the uncertianty
        for Ki=2:wt(1)-1 %create a for loop that runs from the 2nd cell of each station name
column (the first cell being occupied by the string with only the station name and
uncertainty, already accounted for) to the charachter of numeric string
            qsta=char(Aw(Ki,Ld)); %make sure that that the cell contents are in string form
            if isequal(length(qsta),12)==0 && isequal(length(qsta),4)==0 %isequal is found
on matlab documentation
                error(['Travel time scheme malfunction. qsta is ',num2str(qsta),' for event
',num2str(mg)])
            end
            %%% qst is the P wave travel time
            qst=str2double(qsta(1:4)); %choose the time that is added to the event start time
by first cutting and then evaluating the previously constructed string
            if qst>9 || qst<0 % make sure that the time jump is not over 3 digits and a decimal
place, also that the qst value is not to small either
                error(['Arrival time too large or too small. qsta is ',num2str(qsta),' for event
',num2str(mg)'])
            end

            %%% get the source to station distane
            staind=find(strcmp(qs,staname));
            %%% specifying WGS84 as the spheroid (code 7030) means output
            %%% is in km and degrees

[epidists(count),eazims(count)]=distance(eventlat,eventlong,stala(staind),stalo(staind),70
30);
            clear staind tmp

            %The following deconvolution code was taken and adapted from Dr. Gregory
Waites earthquake seismology course
            % we are only using the vertical components so we will not even bother to
            % deconvolve the horizontal components-the idea of deconvolving first and
            % then filtering was proposed by Dr. Greg Waite
```

```
	compnm='EHZ20'; %since we are using only the vertical components this name addition is used for all stations. In this we are following De Sienna et al. 2014 (Attentuation and scattering tomography of the deep plumbing system of Mount Saitn Helens).
	%end copied section from feb 15th code

	ldnm=strcat('dcnvlv',qs,compnm(1:3),'day',eventdaychk); %use the current station name +the vertical designation (compnm) and the event dat to create a load name with the statement 'dcnvlv' added in
	%	ldnnm=strcat('E:\deconvolvedfiles\',ldnm,'.mat'); %create an overall path-loadname for the data-this will differ based on where the data is stored

ldnnm=strcat('/run/media/mwguetti/THESIS/greggoogledrive2016_6_6/deconvolvedgreg/',ldnm,'.mat');
	%begin code copied from the feb 15th code
	load(ldnnm); %load the data
	namd=strcat(qs,compnm); %make a name with just the currentr station name and the vertical designation
	namd=namd(1:7); %cut the "20" out of the namd name
	nmind=strcmp(stacompvec,namd);  %reference the name with the properly ordered (with respect to the Poles Zeros, and Sensitivity arrays) stacompvec to obtain an the array location which corresponds to that of the correct poles, zeros, and sensitivity
	nmind=find(nmind==1);  %find the index value of the previously obtained array location found in the last line

	%end copied section from feb 15th code
	data=deconvolvedd; %access the current loaded data structure and rename the data into a new variable, knowledge of how to access data structures from Greg Waite Earthquake seismology course and Mathworks MATLAB help doucmentation
	%%% clear unused variable
	clear deconvolvedd

	%begin code copied from the feb 15th code
	namdd(:,countt)=namd;
	%skip some lines in the feb 15th code

	%create a series of if statements to modify the eventbeginsample so that
	%the start of the recording is accomidated and the data is properly indexd-
	%time values provided by Ms. Federica lanza
	%%% these don't include fractionof a second. Instead you could
	%%% use the actstart variable I added to the dcnvlv...mat files

origin=datenum(2015,1,str2double(dayst),str2double(strhr),str2double(strmin),str2double(timeachksec));
%	datestr(origin)
```

```
%           datestr(actstart)
        difftime=86400*fs*(origin-actstart);
        eventbeginsample2=difftime;
        if 1
        if strcmp(qs,'PS01') && round(str2double(dayst))==13
           %%% eventbeginsample=eventbeginsample-((22*3600)+(55*60)+23)*fs;
           eventbeginsample=eventbeginsample-((22*3600)+(55*60)+33)*fs;
        end
        if strcmp(qs,'PS02') && round(str2double(dayst))==10
           %%% eventbeginsample=eventbeginsample-((18*3600)+(49*60)+35)*fs;
           eventbeginsample=eventbeginsample-((18*3600)+(49*60)+34)*fs;
        end
        if strcmp(qs,'PS03') && round(str2double(dayst))==10
           %%% eventbeginsample=eventbeginsample-((21*3600)+(6*60)+35)*fs;
           eventbeginsample=eventbeginsample-((21*3600)+(6*60)+45)*fs;
        end
        if strcmp(qs,'PS04') && round(str2double(dayst))==13
           %%% eventbeginsample=eventbeginsample-((20*3600)+(59*60)+30)*fs;
           eventbeginsample=eventbeginsample-((20*3600)+(59*60)+40)*fs;
        end
        if strcmp(qs,'PS05') && round(str2double(dayst))==13
           %%%eventbeginsample=eventbeginsample-((19*3600)+(43*60)+57)*fs;
           eventbeginsample=eventbeginsample-((19*3600)+(43*60)+56)*fs;
        end
        if strcmp(qs,'PS06') && round(str2double(dayst))==13
           %%% eventbeginsample=eventbeginsample-((15*3600)+(13*60)+52)*fs;
           eventbeginsample=eventbeginsample-((15*3600)+(14*60)+2)*fs;
        end
        if strcmp(qs,'PS07') && round(str2double(dayst))==13
           %%% eventbeginsample=eventbeginsample-((17*3600)+(55*60)+19)*fs;
           eventbeginsample=eventbeginsample-((17*3600)+(55*60)+29)*fs;
        end
        if strcmp(qs,'PS08') && round(str2double(dayst))==15
           %%% eventbeginsample=eventbeginsample-((22*3600)+(2*60)+22)*fs;
           eventbeginsample=eventbeginsample-((22*3600)+(2*60)+32)*fs;
        end
        if strcmp(qs,'PS09') && round(str2double(dayst))==13
           %%%eventbeginsample=eventbeginsample-((20*3600)+(5*60)+32)*fs;
           eventbeginsample=eventbeginsample-((20*3600)+(5*60)+42)*fs;
        end
        if strcmp(qs,'PS10') && round(str2double(dayst))==13
           %%%eventbeginsample=eventbeginsample-((17*3600)+(37*60)+26)*fs;
           eventbeginsample=eventbeginsample-((17*3600)+(37*60)+36)*fs;
        end
        if strcmp(qs,'PS11') && round(str2double(dayst))==14
```

```
    %%% I have the start time as 20:50:39
    %%% eventbeginsample=eventbeginsample-((20*3600)+(44*60)+2)*fs;
    eventbeginsample=eventbeginsample-((20*3600)+(50*60)+39)*fs;
  end
  if strcmp(qs,'PS12') && round(str2double(dayst))==14
    %%%eventbeginsample=eventbeginsample-((21*3600)+(30*60)+4)*fs;
    eventbeginsample=eventbeginsample-((21*3600)+(30*60)+14)*fs;
  end
  if strcmp(qs,'PS13') && round(str2double(dayst))==14
    %%% I have the start time as 18:54:21
    %%% eventbeginsample=eventbeginsample-((18*3600)+(54*60)+11)*fs;
    eventbeginsample=eventbeginsample-((18*3600)+(54*60)+21)*fs;
  end
  if strcmp(qs,'PS14') && round(str2double(dayst))==16
    %%% I have the start time as 18:22:20
    %%% eventbeginsample=eventbeginsample-((18*3600)+(22*60)+10)*fs;
    eventbeginsample=eventbeginsample-((18*3600)+(22*60)+20)*fs;
  end
  if strcmp(qs,'PS15') && round(str2double(dayst))==14
    %%%eventbeginsample=eventbeginsample-((23*3600)+(27*60)+33)*fs;
    eventbeginsample=eventbeginsample-((23*3600)+(27*60)+43)*fs;
  end
  if strcmp(qs,'PS16') && round(str2double(dayst))==15
    %%% eventbeginsample=eventbeginsample-((20*3600)+(16*60)+25)*fs;
    eventbeginsample=eventbeginsample-((20*3600)+(16*60)+35)*fs;
  end
  if strcmp(qs,'PS17') && round(str2double(dayst))==15
    %%% eventbeginsample=eventbeginsample-((19*3600)+(16*60)+48)*fs;
    eventbeginsample=eventbeginsample-((19*3600)+(16*60)+58)*fs;
  end
  if strcmp(qs,'PS18') && round(str2double(dayst))==14
    %%% this is off by 10 seconds too
    %%% eventbeginsample=eventbeginsample-((21*3600)+(5*60)+5)*fs;
    eventbeginsample=eventbeginsample-((21*3600)+(5*60)+15)*fs;
  end
  if strcmp(qs,'PS19') && round(str2double(dayst))==14
    %%%eventbeginsample=eventbeginsample-((22*3600)+(24*60)+22)*fs;
    eventbeginsample=eventbeginsample-((22*3600)+(24*60)+32)*fs;
  end
  if abs(eventbeginsample-eventbeginsample2)>fs,
    disp(['warning: start time is not the same as eventbeginsample:
',num2str((eventbeginsample-eventbeginsample2)/fs),' sec']);
  end
  eventbeginsample=eventbeginsample2;
  end
```

```
%add the station time to the event start time-P wave arrival time
%%% in samples
stationstartevent=eventbeginsample+fs*qst;
%S wave arrival time, assuming that P waves are 3^(1/2) times
%faster than S waves * the multiplier for the coda window start
%time (lapse time)then divided by 125 to convert back into
%seconds-proposed by Dr. Gregory Waite? Calvert et al. 2013 mentions this
method.
%%% why don't you simply use the qst here? qst is the P-wave
%%% traveltime, right? I would use that number instead
%%% codastart=(((stationstartevent-eventbeginsample)*sqrt(3))*Snumber)/fs
codastart= qst*sqrt(3)*Snumber;

codastartarch(countt)=codastart;



%rename the data and add 10 seconds (should be) worth of data
% before and after the event begins that will later be cut to
% act as a buffer against edge effects-greg
begind=round(eventbeginsample-fs*10);
endind=round(eventbeginsample+((codastart+codawindow)*fs)+fs*10);
d=data(begind:endind);
if any(isnan(d))
   disp('NaNs in the deconvolved data samples')
   nanfd=1;
   break
else
   %%% need to set nanfd to 0 or there will be an error
   nanfd=0;
   %skip some lines in the feb 15th code



   filt=1; %this creates a filter loop which is used to filter the data-deconvolve it
and then pick the data according tot he coda window start time (laspe time) and coda
window length. It also plots the deconvolved and the picked data as well ast the sqaure of
the picked data-calvert?
   %end code copied from the feb 15th code
   deconvolved=d;

   %begin code copied from the feb 15th code
   wn1=wn1a(filt); %select the lower filter according to the loop progression
   wn2=wn2a(filt); % select the upper filter according to the loop progression
```

```
		[FB,FA]=butter(4,[wn1 wn2]/nyquist,'bandpass');  % the concept and
implimentation of the butterworth filters was derived from Dr. Gregory Waite's
filt_traces.m function which was based off a function written by Derek Schutt. -filter help
by mathworks matalb documetation- greg informed me to set the order to 4 but not really
higher to avoid edge effects

		%%% why not use filtfilt instead of filter
		deconvolved(:,1)=filtfilt(FB,FA,deconvolved); % we use a bandpass filter that
has variable frequency ranges as dictated by the for loop following the method by Calvert
et al. 2013
		%end copied section from feb 15th code

		dh=strcat('filt',ldnm,'frequencies',sprintf('%d',wn1),'-',sprintf('%d',wn2));

		%begin code copied from the feb 15th code
		clear FA FB
		%skip some lines in the feb15th code

		%%% the extra 10 seconds at the start gets removed here
		strtindex=round(codastart*fs+fs*10+1);
		stopindex=round(fs*10+1+(codastart+codawindow)*fs);
		filterdata=deconvolved(strtindex-round(codastart*fs)-1:stopindex);
		if qst-0.5<=0
		   hf=abs(qst-0.0001);
		else hf=0.5;
		end
		Pmax(count)=max(abs(filterdata(round((qst-hf)*fs)+1:round((qst+0.5)*fs))));
		Smax(count)=max(abs(filterdata(round((qst*sqrt(3)-
hf)*fs+1):round((qst*sqrt(3)*Snumber+1)*fs))));
%		   xpmax=find(abs(filterdata)==Pmax(count));
%		   ypmax=Pmax(count);
%		   xsmax=find(abs(filterdata)==Smax(count));
%		   ysmax=Smax(count);
%		   txtp=strcat('\downarrow Maxmimum P-wave amplitude','
x:',sprintf('%d',xpmax),' amp:',sprintf('%d',ypmax));
%		   txts=strcat('\downarrow Maximum S-wave amplitude','
x:',sprintf('%d',xsmax),' amp:',sprintf('%d',ysmax));
%		   figure(27000+mg)
%		   plot(1:length(filterdata),filterdata)
%		   xlabel('Samples');
%		   ylabel('Amplitudes');
%		   text(xpmax,ypmax,txtp);
%		   text(xsmax,ysmax,txts);
%		   title('Plot of the trace with maximum P and S wave amplitudes plotted')
		vertdat=deconvolved(strtindex:stopindex,1).^2;
```

```
if plot_flag
    tveca=(begind:endind)/fs;
    tveca=tveca-tveca(1);
    tvec=(strtindex:stopindex)/fs;
    figure(1)
    subplot(311)
    plot(tveca,d,tveca,deconvolved);
    hold on
    %%% remember that the data, d have an extra 10 sec
    plot([codastart+10,codastart+10],[min(d),max(d)])
    plot([10,10],[min(d),max(d)])
    title([strtstr,' ',qs])
    hold off


    subplot(312)
    plot(tvec,deconvolved(strtindex:stopindex,1))
    %

    subplot(313)
    plot(tvec,vertdat)
    drawnow
    %                   pause
end
%skip some lines in the feb15th code
titlev=dh; %use the name and the event day to make the title for the first plot
which should be the vertical
titleall{1,count}=titlev; %store the title in a cell array of titles that increase with
each count
%skip some lines in the feb 15th code
clear titlev dh
dhc=round(smoothingwindow*fs*1/centerfreq(filt));
if isequal((-
1)^round(smoothingwindow*fs*1/centerfreq(filt)),1^round(smoothingwindow*fs*1/cent
erfreq(filt)))==0 %we can find out if a number is odd by using it as an exponent of 1 and
fininding out if -1 raised to the number is equivalent to +1 raised to the same number, if it
is then the number is even.
    dhc=round(smoothingwindow*fs*1/centerfreq(filt))+1; %if the smoothing
window is odd then add 1
end
%       close Figure 1 %method seen on matlab help documetaion
%------------------------------should the smooth be applied to to the
%full-no
```

```
        %traces or just the windowed coda?
vertdat=vertdat(fs*codastart:fs*(codastart+codawindow))
        vertsave(1:length(vertdat),count)=vertdat; %save the unsmoothed squared data for use later in the subplots
        vertdat=hanningsmooth(vertdat,dhc); %uses the function hanning smooth by Dr. Gregory Waite and uses the smoothing window multiplied by the center frequency of the filtered range and 125 sample per second-suggested by Dr. Waite
        %%% it seems that vertdat adn pA are exactly the same
        %%%pA=vertdat(1:end);
        %%% I can't understand the need for this pickevent
        %%% variable, or pickeventa below
        %%%pickevent(1:length(pA(:)),count)=pA;%add the picked event data to the pickevent vector %-creating multidimensional vectors method found in matlab help. More can be found on Stackoverflow asked by Theodoros Theodoridis http://stackoverflow.com/questions/23376111/multidimensional-arrays-multiplication-in-matlab
        pickevent(:,count)=vertdat;%add the picked event data to the pickevent vector %-creating multidimensional vectors method found in matlab help. More can be found on Stackoverflow asked by Theodoros Theodoridis http://stackoverflow.com/questions/23376111/multidimensional-arrays-multiplication-in-matlab
        %     pN=vertdat((floor(xn(1)-(stationstartevent-100))+1):(floor(xn(2)-(stationstartevent-100))+1)); %pick from the vertical data
        %     picknoise(1:length(pN(:)),count)=pN;%add the picked noise data to the picknoise vector
        count=count+1; %update the count
        %end copied section from feb 15th code
        clear deconvolved data namd nmind ldnnm
        %begin copied code from feb 15th code

        %%% now overwriting eventbeginsample before next run through the loop?
        eventbeginsample=eventbegin*fs;
        clear vertdat cell d
        countt=countt+1; %%% what is the point of this second countt variable?
        if Ki~=(wt(1)-1) %use this if statement to avoid using the last string cell of the column as a station names since it is the travel time of the station at wt-2
          qs=qsta(5:8); %obtain the station name for the next iteration (for the first iteration this replaces the name of the station found in the top cell of the column with the name in the current cell, to be use with the travel time in the next cell lower of the column)
        end
      end
    end
    clear qs %clear qs upon the end of the pick loop
    if nanfd==1
```

```
        break
      end
    end
    %disp('finished with Ld loop')
    count=count-1;
    %%% I changed this from ~= to == since nanfd should be 1 if there are
    %%% NaNs
    if nanfd==0
      %copy some of the reorganizing variables while removing those that are not
      %needed to obtain Q
      %%%for m=1:6 %-coding lines dealing with the possible S wave maximum (or maximum value between the event origin time and the start of the coda window) were proposed by Dr. Greg Waite.
      %%% since we only have 1 frequency
      for m=1 %-coding lines dealing with the possible S wave maximum (or maximum value between the event origin time and the start of the coda window) were proposed by Dr. Greg Waite.
        pickeventa(:,:,m)=pickevent(:,m:end); %-creating multidimensional vectors method found in matlab help. More can be found on Stackoverflow asked by Theodoros Theodoridis http://stackoverflow.com/questions/23376111/multidimensional-arrays-multiplication-in-matlab
        vertsavea(:,:,m)=vertsave(:,m:end);%reorganize the saved unsmoothed vertdat arrays in a similar fashion to the pickeventa
        titlealla(1,:,m)=titleall(1,m:end);
      end
      %%%nstns=length(pickeventa(1,:,1))
      nstns=size(pickeventa,2);
      kont1=1;

      %begin copied code from feb 15th code
      %%% this section of code loops over the frequencies, then over the
      %%% records, calculating Q for each station-frequency
      for freqsza=1:length(centerfreq)
        %%% centerfreq has already been defined
        %           centerfreq=[1.5,3,6,12,24,40];
        %           centerfreq=[1.5,3,6,12,24,40];
        kount1=1;

        for numstations=1:nstns;
          if numstations==1
            if exist('hf2','var'),
              close(2); clear hf2;
            end
          end
          K=1:length(pickeventa(:,numstations,freqsza));
```

```
%start the model with the proper lapse time as measures
% from the origin time-De. Sienna et al. 2014 (MSH) page 8227
% -Coding lines (this and next) created by Dr, Greg Waite
K2=(K'+(codastartarch(numstations)*fs)-1)/fs;
%linear regression method from Calvert et al 2013., Wolfram
%Mathworld helped with the concepts of regression as well
%as the correlation coeficients others
http://mathworld.wolfram.com/CorrelationCoefficient.html? etc., matlab in program help helped with the related code lines.-Greg suggested the use of the linear regression special thanks to user4402918 for his post and kkuilla's answer regarding MATLAB Correlation coefficiants http://stackoverflow.com/questions/28995650/correlation-coefficients-in-matlab. I looked that the MATLAB online documentation as well for reference.
Et=log(pickeventa(:,numstations,freqsza).*K2.^(3/2));
%-matlab in program help, use polyfit to perform a linear
% regression which will give us the coefficiant of the
% slope that will be used to find Q
polye=polyfit(K2,Et,1);
if polye(1)<0
    %extract Q from the slope coefficient.
    Qc=(polye(1).^-1)*(-2*pi*centerfreq(freqsza));
    linfit=polyval(polye,K2); %evaluate the fit polynomial over the time K2-this and the next three lines were taken from the internal matlab help on linear regression
    sr=sum((Et-linfit).^2); %sum the square of the residual values between the fit and the data
    stot=(length(Et)-1)*var(Et); %multiply the length of the actual data-1 times the variance of the actual data
    R2=1-sr/stot; %find the coefficient of determination by subtracting the ratio of the sum of the squared residual values over the sum of the differences (squared) between the data and its mean -MATLAB internal help documentaion R2015a "Linear Regression", from 1
    %       frequencyusedstation(kount1)=freqsza;
    %       StationQ(kount1)=tzQ(ind);
    Qtocheck(kount1)=Qc;
    pickcheck(:,kount1)=vertsavea(:,numstations,freqsza); %use the pickcheck variable to store the vertsavea data for a particular station and frequency
    pnan=find(isnan(pickcheck(:,kount1))==1); %for the particular station and frequency find the NaN values using isnan on pickcheck(:,kount1) and then using find(isnan(pickcheck(:,kount1))==1) to find the indicies of the NaN values and store them in a variable special thanks to Marc for
    %answering Graviton's question on Stackoverflow regarding finding NaN values for it
    %demonstrated how to perform this action with Graviton's method used in
    %this code http://stackoverflow.com/questions/1713724/find-all-nan-elements-inside-an-array
```

```
                pickcheck(pnan,kount1)=0; %set all of the NaN values to 0, repeat this method for the logpick and linfittocheck arrays
                logpick(:,kount1)=Et;
                lonan=find(isnan(logpick(:,kount1))==1);
                logpick(lonan,kount1)=0;
                linfittocheck(:,kount1)=linfit;
                linan=find(isnan(linfittocheck(:,kount1))==1);
                linfittocheck(linan,kount1)=0;
                %skip a few lines
                rsend(kount1)=R2;%save the R^2 value in an array which updates with each passing kount1, with the data ultimately being used in the subplots
                titlend(kount1)=titlealla(1,numstations,freqsza); %save the title for the particular station and frequency
                freqend(kount1)=freqsza; %save the frequency index
                stationend(:,kount1)=namdd(:,numstations); %for a particular station and frequncy save the stationname which will be used later in the subplots, since the namdd variable contains the names of the stations and components in the order in which they wer deconvolved they should be properly indexed by numstations per event
                %skip a few lines
                kount1=kount1+1; %update the kount1 variable

                if plot_flag
                   tvec=(strtindex:stopindex)/fs;
                   hf2=figure(2);
                   subplot(nstns,1,numstations)
                   plot(K2,Et)
                   hold on
                   plot(K2,linfit)
                   ylabel(namdd(1:4,numstations)')
                   hold off
                   set(gcf,'Position',[877 13 560 793])
                   drawnow

                   subplot(nstns,1,1)
                   title(strtstr)
                   %                      pause(1)

                end

             else
                disp('positive slope for fit, data modified for station iteration')
                nname=strcat('S: ',sprintf('%d',S),', codawindow: ',sprintf('%d',codawindow),', Freq: ',sprintf('%d',freqsza),' ,stn: ',namdd(:,numstations)');
                nanproblem{nancount}=nname;
                nancount=nancount+1;
```

```
                Qtocheck(kount1)=123456789;
                pickcheck(:,kount1)=vertsavea(:,numstations,freqsza); %use the pickcheck
variable to store the vertsavea data for a particular station and frequency
                pnan=find(isnan(pickcheck(:,kount1))==1);
                pickcheck(pnan,kount1)=0;
                logpick(:,kount1)=repmat(123456789,[length(Et),1]);
                linfittocheck(:,kount1)=repmat(123456789,[length(K2),1]);
                rsend(kount1)=123456789;
                titlend(kount1)=titlealla(1,numstations,freqsza); %save the title for the
particular station and frequency
                freqend(kount1)=freqsza; %save the frequency index
                stationend(:,kount1)=namdd(:,numstations); %for a particular station and
frequncy save the stationname which will be used later in the subplots, since the namdd
variable contains the names of the stations and components in the order in which they
wer deconvolved they should be properly indexed by numstations per event
                %skip a few lines
                kount1=kount1+1;
            end


            clear R2 ploye Et Qc linfit sr stot K K2 lonan linan pnan nname% clear the
variabels that are no loger necessary after this iteration.
            %       close Figure 1
        end
        %skip a few lines
        Qtochecka(:,kont1)=Qtocheck;
        linfittochecka(:,:,kont1)=linfittocheck;
        pickchecka(:,:,kont1)=pickcheck;
        loggpick(:,:,kont1)=logpick;
        rsenda(:,kont1)=rsend;
        titlenda(:,kont1)=titlend;
        freqenda(:,kont1)=freqend;
        stationenda(:,:,kont1)=stationend;
        %skip a few lines
        clear kount1 Qtocheck rsend titlend freqend stationend laps windw logpick
pickcheck linfittocheck
        kont1=kont1+1;
        %       close all %remmeber to disable the close alls when plotting
    end
%       figure(mg+3)
%       subplot(2,1,1)
%       scatter(Qtochecka,Pmax,1)
%       xlabel('Q values')
%       ylabel('Maximum P wave amplitude')
%       title('Q values versus maximum P-wave amplitude')
```

```
%       subplot(2,1,2)
%       scatter(Qtochecka,Smax,1)
%       xlabel('Q values')
%       ylabel('Maximum S wave amplitude')
%       title('Q values versus maximum S-wave amplitude')
%
saveas(gcf,sprintf('/run/media/mwguetti/THESIS/active/march2ndrun_active_2016_6_9/
MaximumampvsQ_%d',mg))
%       close(figure(mg+3))
        Q{mg}=Qtochecka;
        Pwavemax{mg}=Pmax';
        Swavemax{mg}=Smax';
        linefit{mg}=linfittochecka;
        pickdat{mg}=pickchecka;
        logdat{mg}=loggpick;
        r{mg}=rsenda;
        titles{mg}=titlenda;
        freqc{mg}=freqenda;
        stnnm{mg}=stationenda;
        edist{mg}=epidists;
        eazim{mg}=eazims;
        elon{mg}=eventlong;
        elat{mg}=eventlat;

    else
        Q{mg}='NaN found';
        Pwavemax{:,mg}='NaN found';
        Swavemax{:,mg}='NaN found';
        linefit{mg}='NaN found';
        pickdat{mg}='NaN found';
        logdat{mg}='NaN found';
        r{mg}='NaN found';
        titles{mg}='NaN found';
        freqc{mg}='NaN found';
        stnnm{mg}='NaN found';
        edist{mg}='NaN found';
        eazim{mg}='NaN found';
        elon{mg}='NaN found';
        elat{mg}='NaN found';

    end
    clearvars -except Pwavemax Swavemax edist eazim elon elat plot_flag fs nyquist
finddateC Q linefit pickdat logdat Aw finddate r titles freqc stnnm S smoothingwindow
codawindow Snumber nancount qs centerfreq wn1a wn2a staname stala stalo
```

```
end
toc

%%
% save some variables
dte = datestr(now,'yyyy_mm_dd_HH_MM_SS');

savefilename=sprintf('/run/media/mwguetti/THESIS/active/march2ndrun_active_2016_6
_9/alleventQdata_plusmaxamplitudes_%s_S%02d_fr%02d-
%02d_coda%02d.mat',dte,Snumber,wn1a,wn2a,codawindow);
save(savefilename,'Q','linefit','pickdat','logdat','r','titles','freqc','stnnm',
'edist','eazim','elon','elat','Pwavemax','Swavemax')
```

SortandplotQandamplitudes

```
%
% clear, close all
% load('alleventQdata_2016_05_18_14_33_19_S04_fr06_coda10.mat');
%
% % load('alleventQdata_2016_05_19_14_14_42_S03_fr06_coda10.mat');
%
% load('alleventQdata_2016_05_19_17_17_54_S03_fr03-09_coda10.mat');
% % load('alleventQdata_2016_05_19_18_05_05_S04_fr03-09_coda10.mat');
% load('alleventQdata_2016_05_20_12_17_08_S04_fr03-10_coda10.mat');
cnt=0;
for n=1:length(r)
    rtmp=cell2mat(r(n));
    statmp=char(stnnm(n));

    ind1=find(rtmp>.5);
    ind2=find(rtmp(ind1)<=1);
    ind3=ind1(ind2);
    if ~isempty(ind3)
        %get Q
        Qtmp=cell2mat(Q(n));
        pwavtemp=cell2mat(Pwavemax(n));
        swavtemp=cell2mat(Swavemax(n));
        for m=1:length(ind3)
            if Qtmp(ind3(m))<1e5
                cnt=cnt+1;
                Qgood(cnt)=Qtmp(ind3(m));
                sta(cnt,1:4)=statmp(1:4,ind3(m))';
                Pawa(cnt)=pwavtemp(ind3(m));
                Sawa(cnt)=swavtemp(ind3(m));
            end
```

```
        end
    end
    clear ind1 ind2 ind3 rtmp Qtmp
    %     pause
end
figure
plot(sort(Qgood),'.');
title('all Q values')
ylabel('Q')
xlabel('index')
figure
hist(Qgood)

title('all Q values')
xlabel('Q')
ylabel('frequency')



%%
stns={'PS01','PS02','PS03','PS04','PS05','PS06','PS07','PS08','PS09','PS10','PS12','PS14','
PS15','PS16','PS17','PS18','PS19'};
load('stationlocs.mat');
for n=1:length(stns)
    cnt=0;
    staQ=[];
    stapamp=[];
    stasamp=[];
    for i=1:size(sta,1);
        if strcmp(char(stns(n)),sta(i,:))
            cnt=cnt+1;
            staQ(cnt)=Qgood(i);
            stapamp(cnt)=Pawa(i);
            stasamp(cnt)=Sawa(i);
        end
    end
    figure
    subplot(2,1,1)
    [tmp,indx]=sort(staQ);
    staQ=staQ(indx);
    stapamp=stapamp(indx);
    scatter(staQ,stapamp);
    [P,S]=polyfit(staQ,stapamp,1);
    [b,delta]=polyval(P,staQ,S);
    hold on;
```

```
    plot(staQ,b);
    plot(staQ,b+delta*2,'r--')
    plot(staQ,b-delta*2,'r--');
    plot([min(staQ),max(staQ)],[mean(stapamp),mean(stapamp)],'k:')
    clear P S b delta
    xlabel('Q values');
    ylabel('Maximum amplitudes');
    tlt1=strcat('Q versus maximum P wave amplitudes for station',stns(n));
    title(tlt1);
    subplot(2,1,2)
    stasamp=stasamp(indx);
    scatter(staQ,stasamp)
        [P,S]=polyfit(staQ,stasamp,1);
    [b,delta]=polyval(P,staQ,S);
    hold on;
    plot(staQ,b);
    plot(staQ,b+delta*2,'r--')
    plot(staQ,b-delta*2,'r--');
    plot([min(staQ),max(staQ)],[mean(stasamp),mean(stasamp)],'k:')
    clear P S b delta

    xlabel('Q values');
    ylabel('Maximum amplitudes');
    tlt1=strcat('Q versus maximum S wave amplitudes for station',stns(n));
    title(tlt1);

    meanQ(n)=mean(staQ);
    medianQ(n)=median(staQ);
end
%%

figure;
subplot(211)
plot(meanQ,'.')
text(1:length(meanQ),meanQ,char(stns));
title('Average Q values by station')

subplot(212)
plot(medianQ,'.')
text(1:length(medianQ),medianQ,char(stns));

Qrng=range(meanQ);
col=flipud(colormap(jet));
minQ=min(meanQ)-1;
coltmp=interp1(linspace(1,ceil(Qrng)+1,64),col,1:ceil(Qrng)+1);
```

```
col=coltmp; clear tmpcol

figure
for j=1:length(meanQ)
   if ~isnan(meanQ(j))
       colind=round(meanQ(j)-minQ);
       tmpcol=col(colind,:);
       plot(stalo(j),stala(j),'o','Color',tmpcol,'MarkerFaceColor',tmpcol,'MarkerSize',10);
       hold on
       text(stalo(j),stala(j),char(stns(j)));
   end
end
title('stations colored by Q')
hcb=colorbar('Ticks',([141,160,180,200]-
minQ)/length(col),'TickLabels',{'140','160','180','200'});
set(hcb,'colormap',col)
```

SortandplotQmedian

```
%
% clear, close all
% load('alleventQdata_2016_05_18_14_33_19_S04_fr06_coda10.mat');
%
% % load('alleventQdata_2016_05_19_14_14_42_S03_fr06_coda10.mat');
%
% load('alleventQdata_2016_05_19_17_17_54_S03_fr03-09_coda10.mat');
% % load('alleventQdata_2016_05_19_18_05_05_S04_fr03-09_coda10.mat');
% load('alleventQdata_2016_05_20_12_17_08_S04_fr03-10_coda10.mat');
cnt=0;
for n=1:length(r)
   rtmp=cell2mat(r(n));
   statmp=char(stnnm(n));

   ind1=find(rtmp>.5);
   ind2=find(rtmp(ind1)<=1);
   ind3=ind1(ind2);
   if ~isempty(ind3)
       %get Q
       Qtmp=cell2mat(Q(n));
       for m=1:length(ind3)
           if Qtmp(ind3(m))<1e5
               cnt=cnt+1;
               Qgood(cnt)=Qtmp(ind3(m));
               sta(cnt,1:4)=statmp(1:4,ind3(m))';

           end
       end
```

```
    end
    clear ind1 ind2 ind3 rtmp Qtmp
    %     pause
end
figure
plot(sort(Qgood),'.');
title('all Q values')
ylabel('Q')
xlabel('index')
figure
hist(Qgood)

title('all Q values')
xlabel('Q')
ylabel('frequency')



%%
stns={'PS01','PS02','PS03','PS04','PS05','PS06','PS07','PS08','PS09','PS10','PS12','PS14','
PS15','PS16','PS17','PS18','PS19'};
load('stationlocs.mat');
for n=1:length(stns)
    cnt=0;
    staQ=[];
    for i=1:size(sta,1);
        if strcmp(char(stns(n)),sta(i,:))
            cnt=cnt+1;
            staQ(cnt)=Qgood(i);
        end
    end
    meanQ(n)=mean(staQ);
    medianQ(n)=median(staQ);
end
%%
figure;
subplot(211)
plot(meanQ,'.')
text(1:length(meanQ),meanQ,char(stns));
title('Average Q values by station')

subplot(212)
plot(medianQ,'.')
text(1:length(medianQ),medianQ,char(stns));
title('Median Q values by station')
```

```
Qrng=range(medianQ);
col=flipud(colormap(jet));
minQ=min(medianQ)-1;
coltmp=interp1(linspace(1,ceil(Qrng)+1,64),col,1:ceil(Qrng)+1);
col=coltmp; clear tmpcol

figure
for j=1:length(medianQ)
    if ~isnan(medianQ(j))
        colind=round(medianQ(j)-minQ);
        tmpcol=col(colind,:);
        plot(stalo(j),stala(j),'o','Color',tmpcol,'MarkerFaceColor',tmpcol,'MarkerSize',10);
        hold on
        text(stalo(j),stala(j),char(stns(j)));
        plot(-90.6015,14.3827,'k^')
        text(-90.6031,14.3828,'Pacaya Summit');
        %lat/long location of the summit courtesy Federica Lanza MTU
        %doctoral canidate
    end
end
title('stations colored by Q')
hcb=colorbar('Ticks',([141,160,180,200]-
minQ)/length(col),'TickLabels',{'140','160','180','200'});
set(hcb,'colormap',col)
```

SortandplotQmedianhistogrm

```
%
% clear, close all
% load('alleventQdata_2016_05_18_14_33_19_S04_fr06_coda10.mat');
%
% % load('alleventQdata_2016_05_19_14_14_42_S03_fr06_coda10.mat');
%
% load('alleventQdata_2016_05_19_17_17_54_S03_fr03-09_coda10.mat');
% % load('alleventQdata_2016_05_19_18_05_05_S04_fr03-09_coda10.mat');
% load('alleventQdata_2016_05_20_12_17_08_S04_fr03-10_coda10.mat');
cnt=0;
for n=1:length(r)
    rtmp=cell2mat(r(n));
    statmp=char(stnnm(n));

    ind1=find(rtmp>.5);
    ind2=find(rtmp(ind1)<=1);
    ind3=ind1(ind2);
    if ~isempty(ind3)
```

```
        %get Q
        Qtmp=cell2mat(Q(n));
        for m=1:length(ind3)
            if Qtmp(ind3(m))<1e5
                cnt=cnt+1;
                Qgood(cnt)=Qtmp(ind3(m));
                sta(cnt,1:4)=statmp(1:4,ind3(m))';

            end
        end
    end
    clear ind1 ind2 ind3 rtmp Qtmp
    %     pause
end
figure
plot(sort(Qgood),'.');
title('all Q values')
ylabel('Q')
xlabel('index')
figure
hist(Qgood)

title('all Q values')
xlabel('Q')
ylabel('frequency')



%%
stns={'PS01','PS02','PS03','PS04','PS05','PS06','PS07','PS08','PS09','PS10','PS12','PS14','
PS15','PS16','PS17','PS18','PS19'};
load('stationlocs.mat');
for n=1:length(stns)
    cnt=0;
    staQ=[];
    for i=1:size(sta,1);
        if strcmp(char(stns(n)),sta(i,:))
            cnt=cnt+1;
            staQ(cnt)=Qgood(i);
        end
    end
    figure
    hist(staQ)
    xlabel('Q value')
    ylabel('Frequency')
```

```
    th=strcat('Q value versus Frequency Histograms for station:',char(stns(n)));
    title(th);
    meanQ(n)=mean(staQ);
    medianQ(n)=median(staQ);
end
%%
figure;
subplot(211)
plot(meanQ,'.')
text(1:length(meanQ),meanQ,char(stns));
title('Average Q values by station')

subplot(212)
plot(medianQ,'.')
text(1:length(medianQ),medianQ,char(stns));
title('Median Q values by station')
Qrng=range(medianQ);
col=flipud(colormap(jet));
minQ=min(medianQ)-1;
coltmp=interp1(linspace(1,ceil(Qrng)+1,64),col,1:ceil(Qrng)+1);
col=coltmp; clear tmpcol

figure
for j=1:length(medianQ)
    if ~isnan(medianQ(j))
        colind=round(medianQ(j)-minQ);
        tmpcol=col(colind,:);
        plot(stalo(j),stala(j),'o','Color',tmpcol,'MarkerFaceColor',tmpcol,'MarkerSize',10);
        hold on
        text(stalo(j),stala(j),char(stns(j)));
        plot(-90.6015,14.3827,'k^')
        text(-90.6031,14.3828,'Pacaya Summit');
        %lat/long location of the summit courtesy Federica Lanza MTU
        %doctoral canidate
    end
end
title('stations colored by Q')
hcb=colorbar('Ticks',([141,160,180,200]-
minQ)/length(col),'TickLabels',{'140','160','180','200'});
set(hcb,'colormap',col)
```

contour&distanceplot

```
load('/run/media/mwguetti/THESIS/fedemap2016_6_27/Pacaya_resized_DEM.mat')
```

```
stns={'PS01','PS02','PS03','PS04','PS05','PS06','PS07','PS08','PS09','PS10','PS12','PS14','
PS15','PS16','PS17','PS18','PS19'};
load('utmstationsno11or13.mat')
load('stationlocs.mat')
load('medianQ_2016_06_28.mat')

if sum(sum(isnan(x)))>=1 || sum(sum(isnan(y)))>=1 || sum(sum(isnan(A)))>=1
error('NaNs found in the DEM')
end
%plot the stations on a contour map using the DEM
figure
contour(x,y,A,'LevelStep',20,'ShowText','on','TextStep',500,'LineColor',[0,0,0])
xlabel('Easting (meters) UTM')
ylabel('Northing (meters) UTM')
title('Contour Plot with Median Q values')
hold on
caxis([min(round(medianQ)),max(round(medianQ))])
scatter(unnamed1(1:17,1),unnamed1(1:17,2),60,medianQ,'filled')
scatter(unnamed1(18,1),unnamed1(18,2),'k','^')
for hl=1:17
text(unnamed1(hl,1)+20,unnamed1(hl,2),stns{hl},'FontSize',8)
text(unnamed1(hl,1)+20,unnamed1(hl,2)-70,num2str(round(medianQ(hl))),'FontSize',8)
end
text(unnamed1(18,1)-400,unnamed1(18,2)+50,'Pacaya Summit')
colorbar
ns=[1.5895 1.593]*1e6;
ew=[7.57 7.605]*1e5;
axis([ew ns])

hold off

hc=[1,2,3,4,5,6,7,8,9,10,12,14,15,16,17,18,19];
E=referenceEllipsoid(7030,'m');
for ts=1:17
   h=hc(ts);
   disth(ts)=distance(14.3827,-90.6015,stala(h),stalo(h),E);
end
figure
scatter(disth,medianQ)
ylabel('Median Q values per Station')
xlabel('Distance from Summit(meters)')
text(disth,medianQ,stns)
title('Distance from summit vs Median Q Value per Station')
```

stationplot

```
load('E:\fedemap2016_6_27\Pacaya_resized_DEM.mat')
stns={'PS01','PS02','PS03','PS04','PS05','PS06','PS07','PS08','PS09','PS10','PS11','PS12','
PS13','PS14','PS15','PS16','PS17','PS18','PS19'};
load('utmstationsall.mat')
load('stationlocs.mat')

if sum(sum(isnan(x)))>=1 || sum(sum(isnan(y)))>=1 || sum(sum(isnan(A)))>=1
error('NaNs found in the DEM')
end
%plot the stations on a contour map using the DEM
figure
contourf(x,y,A,'LevelStep',20,'ShowText','on','TextStep',1000,'LineColor',[0,0,0])
xlabel('Easting (meters) UTM')
ylabel('Northing (meters) UTM')
title('Station locations on Pacaya')
hold on
colormap(summer)
scatter(unnamed(1:19,1),unnamed(1:19,2),60,'filled')
scatter(unnamed(20,1),unnamed(20,2),'k','^','filled')
for hl=1:19
text(unnamed(hl,1)+20,unnamed(hl,2),stns{hl},'FontSize',8)
end
text(unnamed(20,1)-400,unnamed(20,2)+50,'Pacaya Summit')
colorbar
ns=[1.5895 1.593]*1e6;
ew=[7.57 7.605]*1e5;
axis([ew ns])
% axis equal
hold off
```

ventcontour

```
load('/run/media/mwguetti/THESIS/fedemap2016_6_27/Pacaya_resized_DEM.mat')
stns={'PS01','PS02','PS03','PS04','PS05','PS06','PS07','PS08','PS09','PS10','PS12','PS14','
PS15','PS16','PS17','PS18','PS19'};
weights=[24,10,4,1,7,15,16,1,5,2,17,5,1,10,19,2,5];
load('utmstationsno11or13.mat')
load('stationlocs.mat')
load('medianQ_2016_06_28.mat')
load('gomezventlocs.mat')
if sum(sum(isnan(x)))>=1 || sum(sum(isnan(y)))>=1 || sum(sum(isnan(A)))>=1
error('NaNs found in the DEM')
end
%plot the stations on a contour map using the DEM
figure
```

```
contour(x,y,A,'LevelStep',20,'ShowText','on','TextStep',500,'LineColor',[0,0,0])
xlabel('Easting (meters) UTM')
ylabel('Northing (meters) UTM')
title('Contour Plot with Median Q values')
hold on
caxis([min(round(medianQ)),max(round(medianQ))])
decstart=[1,27,69,213,245,301,338];
decend=[26,68,211,244,300,337,349];
%those that end in the 1960 are red, the 1970s are green, the 1980s are
%blue (watch for the 185 mislabel in gomex excel), the 1990s are magenta,
%the 2000s are cyan and the 2010s are white
for el=1:7
   hw=decstart(el);
   hd=decend(el);
   scatter(gomevent(hw:hd,1),gomevent(hw:hd,2),10,'r','filled','d')
end
scatter(gomevent(212,1),gomevent(212,2),10,'m','filled','d')
scatter(unnamed1(1:17,1),unnamed1(1:17,2),weights*9,medianQ,'filled')
scatter(unnamed1(18,1),unnamed1(18,2),'k','^','filled')
for hl=1:17
text(unnamed1(hl,1)+20,unnamed1(hl,2),stns{hl},'FontSize',16)
text(unnamed1(hl,1)+20,unnamed1(hl,2)-70,num2str(round(medianQ(hl))),'FontSize',16)
end
text(unnamed1(18,1)-400,unnamed1(18,2)+50,'Pacaya Summit')
colorbar
ns=[1.5895 1.593]*1e6;
ew=[7.57 7.605]*1e5;
axis([ew ns])

hold off
 axis equal
hc=[1,2,3,4,5,6,7,8,9,10,12,14,15,16,17,18,19];
E=referenceEllipsoid(7030,'m');
for ts=1:17
   h=hc(ts);
   disth(ts)=distance(14.3827,-90.6015,stala(h),stalo(h),E);
end
figure
scatter(disth,medianQ,weights*7)
ylabel('Median Q values per Station')
xlabel('Distance from Summit(meters)')
text(disth,medianQ,stns)
title('Distance from summit vs Median Q Value per Station')
axis equal
% note that 212 and 185 in the excel sheet provided by gomez might have
```

% errors.

medianQ_2016_06_28

169.760837111781 188.166892896866 186.134344718164
161.009223779986 190.614291719082
193.660043409231 189.197022473100
146.520900992563 149.782789551528
160.235736216275 146.045548018381
189.334809609553 158.590457933002
179.353211944286 158.097802248219
162.720325902035 192.324059873952

stationlocs

stala (station locations: latitude)

1. 14.3855000000000
2. 14.3843000000000
3. 14.3804000000000
4. 14.3706000000000
5. 14.3749000000000
6. 14.3792000000000
7. 14.3853000000000
8. 14.3884000000000
9. 14.3843000000000
10. 14.3821000000000
11. 14.3805000000000
12. 14.3826000000000
13. 14.3781000000000
14. 14.3857000000000
15. 14.3886000000000
16. 14.3893000000000
17. 14.3901000000000
18. 14.3802000000000
19. 14.3763000000000

stalo(station locaions: longitude)

1. -90.6008000000000
2. -90.5973000000000
3. -90.5983000000000
4. -90.6056000000000
5. -90.6106000000000
6. -90.6129000000000
7. -90.6124000000000
8. -90.6058000000000
9. -90.6058000000000

10. -90.6044000000000
11. -90.5997000000000
12. -90.6005000000000
13. -90.5982000000000
14. -90.6041000000000
15. -90.6108000000000
16. -90.5965000000000
17. -90.6012000000000
18. -90.5936000000000
19. -90.5932000000000

utmstationsno11or13

758720.500000000	1591707.70000000
759099.500000000	1591578.80000000
758996.100000000	1591146
758219.700000000	1590053.20000000
757675.300000000	1590523.50000000
757422.200000000	1590996.90000000
757469.200000000	1591672.60000000
758177.700000000	1592023.10000000
758182.400000000	1591569.30000000
758336	1591327.40000000
758756.200000000	1591387.10000000
758364.200000000	1591726.20000000
757638	1592039.60000000
759180	1592133.20000000
758672	1592216.40000000
759503.400000000	1591129.20000000
759551.100000000	1590698
758648.200000000	1591397

utmstationall.mat

758720.500000000	1591707.70000000
759099.500000000	1591578.80000000
758996.100000000	1591146
758219.700000000	1590053.20000000
757675.300000000	1590523.50000000
757422.200000000	1590996.90000000
757469.200000000	1591672.60000000
758177.700000000	1592023.10000000
758182.400000000	1591569.30000000
758336	1591327.40000000
758844.900000000	1591155.50000000
758756.200000000	1591387.10000000
759009.500000000	1590891.60000000

758364.200000000	1591726.20000000
757638	1592039.60000000
759180	1592133.20000000
758672	1592216.40000000
759503.400000000	1591129.20000000
759551.100000000	1590698
758648.200000000	1591397

hanningsmooth

```
function [z] = hanningsmooth(A,NPTS)
% [z] = hanningsmooth_JL(A,NPTS)
% smooths a vector, A,  using a hanning window with NPTS points
%
if mod(NPTS,2)
NPTS=NPTS+1;
end
[aa,bb]=size(A);
if bb>aa, A=A';end
lf=length(A);
% z=zeros(1,lf);
fullwin=hann(NPTS+1);
fullsum=sum(fullwin);
z=zeros(lf,1);
for i=1:NPTS/2
%     i
   z(i)=sum(flipud(fullwin(1:i+NPTS/2)).*A(1:i+NPTS/2))/sum(fullwin(1:i+NPTS/2));
end
for i=1+NPTS/2:lf-NPTS/2-1
   z(i)=sum(fullwin.*A(i-NPTS/2:i+NPTS/2))/fullsum;
end
for i=lf-NPTS/2:lf
%     i
%     size(fullwin(1:lf-i+NPTS/2+1))
%     size(A(i-NPTS/2:lf))
   z(i)=sum(fullwin(1:lf-i+NPTS/2+1).*A(i-NPTS/2:lf))/sum(fullwin(1:lf-i+NPTS/2+1));
end
```

p.mat

```
p =

  Columns 1 through 2
```

-9.665046966905496 + 8.265180288602620i -9.367494160318380 + 9.637244744646692i
-9.665046966905496 - 8.265180288602620i -9.367494160318380 - 9.637244744646692i

Columns 3 through 4

-10.083306046441123 + 9.746869624504855i-10.214096831801216 + 7.341790080262437i
-10.083306046441123 - 9.746869624504855i-10.214096831801216 - 7.341790080262437i

Columns 5 through 6

-9.240196826009790 + 7.388975142339904i -9.738170677513789 + 8.353664845978456i
-9.240196826009790 - 7.388975142339904i -9.738170677513789 - 8.353664845978456i

Columns 7 through 8

-9.881534116673327 + 8.847812436869905i -9.254912045994246 + 8.639320641040774i
-9.881534116673327 - 8.847812436869905i -9.254912045994246 - 8.639320641040774i

Columns 9 through 10

-9.209233288805743 + 9.580494080189908i -9.863218631499517 + 8.303544372578458i
-9.209233288805743 - 9.580494080189908i -9.863218631499517 - 8.303544372578458i

Columns 11 through 12

-8.793255005551682 + 9.021246706389565i -8.842100488115158 + 6.125870563830258i
-8.793255005551682 - 9.021246706389565i -8.842100488115158 - 6.125870563830258i

Columns 13 through 14

-8.328613452073775 + 8.640336407121010i-10.410484071762097 + 9.321428166558711i

-8.328613452073775 - 8.640336407121010i-10.410484071762097 - 9.321428166558711i

Columns 15 through 16

-9.504417334533921 + 8.924422274222639i -9.369511062806138 + 8.875155780583958i
-9.504417334533921 - 8.924422274222639i -9.369511062806138 - 8.875155780583958i

Columns 17 through 18

-9.069903654623214 + 9.409371584726618i -9.701791034589185 + 7.074412556333154i
-9.069903654623214 - 9.409371584726618i -9.701791034589185 - 7.074412556333154i

Columns 19 through 20

-10.320917265204349 + 8.470442509068143i -9.654761392585293 + 7.974696961002997i
-10.320917265204349 - 8.470442509068143i -9.654761392585293 - 7.974696961002997i

Columns 21 through 22

-9.517693705094610 + 9.928900705397595i -9.636609270201703 + 8.706713887854292i
-9.517693705094610 - 9.928900705397595i -9.636609270201703 - 8.706713887854292i

Columns 23 through 24

-9.216019128944058 + 7.032105794200062i -9.179482406371520 + 8.443396873065256i
-9.216019128944058 - 7.032105794200062i -9.179482406371520 - 8.443396873065256i

Columns 25 through 26

-9.493830167283223 + 7.942227624230902i -9.848289783218654 + 6.669339130065177i
-9.493830167283223 - 7.942227624230902i -9.848289783218654 - 6.669339130065177i

Columns 27 through 28

-8.707238198686492 +10.179889479365883i -9.487622380204353 + 9.223942787781102i
-8.707238198686492 -10.179889479365883i -9.487622380204353 - 9.223942787781102i

Columns 29 through 30

-9.669068205518322 +10.655415984197854i -9.036100117662873 +10.285622978896978i
-9.669068205518322 -10.655415984197854i -9.036100117662873 - 10.285622978896978i

Columns 31 through 32

-9.165294973955554 + 8.987453581519343i-10.480108048149809 + 8.711828688762534i
-9.165294973955554 - 8.987453581519343i-10.480108048149809 - 8.711828688762534i

Columns 33 through 34

-9.083016662363345 + 8.528737045689221i -9.096010289570401 + 8.441155103420767i
-9.083016662363345 - 8.528737045689221i -9.096010289570401 - 8.441155103420767i

Columns 35 through 36

-9.514979369039326 +10.599819099316433i -8.924435348391203 + 7.584329750552930i
-9.514979369039326 -10.599819099316433i -8.924435348391203 - 7.584329750552930i

Columns 37 through 38

-8.172162137933334 + 7.450108211475639i -8.697838553467129 + 8.431853103676026i
-8.172162137933334 - 7.450108211475639i -8.697838553467129 - 8.431853103676026i

Columns 39 through 40

-9.524774854932804 + 5.777561300084333i -9.579331752961942 +
8.268530869511219i
-9.524774854932804 - 5.777561300084333i -9.579331752961942 -
8.268530869511219i

Columns 41 through 42

-9.340935136028120 + 6.981379314232108i -9.424878491732795 +
6.431625127682130i
-9.340935136028120 - 6.981379314232108i -9.424878491732795 -
6.431625127682130i

Columns 43 through 44

-9.905083495197856 + 8.496847152351480i-10.159759845263158 +
7.937960116236227i
-9.905083495197856 - 8.496847152351480i-10.159759845263158 -
7.937960116236227i

Columns 45 through 46

-10.042163749058730 + 7.924939988353252i -9.498875565099812 +
9.076458461341170i
-10.042163749058730 - 7.924939988353252i -9.498875565099812 -
9.076458461341170i

Columns 47 through 48

-9.398840971832904 + 5.874233782580162i-10.029509413840515 +
7.339456256419317i
-9.398840971832904 - 5.874233782580162i-10.029509413840515 -
7.339456256419317i

Columns 49 through 50

-10.346408147998085 + 8.792777141063903i-11.112378702407419 +
4.932658282125894i
-10.346408147998085 - 8.792777141063903i-11.112378702407419 -
4.932658282125894i

Columns 51 through 52

-9.970258976406026 + 4.941220854520138i -9.312623103035698 +
8.898488687587843i

-9.970258976406026 - 4.941220854520138i -9.312623103035698 - 8.898488687587843i

Columns 53 through 54

-9.606437414376622 + 8.523770429577676i -9.075784716064865 + 8.472107983464186i
-9.606437414376622 - 8.523770429577676i -9.075784716064865 - 8.472107983464186i

Columns 55 through 56

-10.086246577167181 + 8.251248137565522i -9.005538704337734 +10.783337109988466i
-10.086246577167181 - 8.251248137565522i -9.005538704337734 - 10.783337109988466i

Column 57

-9.510160165898569 + 5.968752680870541i
-9.510160165898569 - 5.968752680870541i

s.mat

0.919000000000000

0.936000000000000

0.982000000000000

0.952000000000000

0.857000000000000

0.934000000000000

0.926000000000000

0.854000000000000

0.843000000000000

0.929000000000000

0.864000000000000

0.843000000000000

0.863000000000000

0.960000000000000

0.924000000000000
0.907000000000000
0.881000000000000
0.849000000000000
0.974000000000000
0.878000000000000
0.876000000000000
0.911000000000000
0.835000000000000
0.860000000000000
0.914000000000000
0.887000000000000
0.824000000000000
0.928000000000000
0.980000000000000
0.867000000000000
0.889000000000000
0.911000000000000
0.831000000000000
0.924000000000000
0.872000000000000
0.880000000000000
0.863000000000000
0.857000000000000
0.843000000000000
0.904000000000000
0.883000000000000
0.857000000000000
0.952000000000000

0.983000000000000

0.956000000000000

0.909000000000000

0.887000000000000

0.968000000000000

0.964000000000000

0.957000000000000

0.890000000000000

0.880000000000000

0.898000000000000

0.892000000000000

0.957000000000000

0.943000000000000

0.858000000000000

z.mat

z =

1.0e-05 *

Columns 1 through 2

0.000001045775156 + 0.618886674584384i 0.000000545457354 + 0.527493436385089i

0.000001045775156 - 0.618886674584384i 0.000000545457354 - 0.527493436385089i

Columns 3 through 4

0.000000313914534 + 0.359249174887754i -0.000000271924974 + 0.042051263599655i

0.000000313914534 - 0.359249174887754i -0.000000271924974 - 0.042051263599655i

Columns 5 through 6

-0.513170291988107 + 0.000000000000000i 0.000000711080852 + 0.464830664228177i

0.513168402442533 + 0.000000000000000i 0.000000711080852 - 0.464830664228177i

Columns 7 through 8

0.000000147789594 + 0.237993398385358i -0.437293241933777 + 0.000000000000000i

0.000000147789594 - 0.237993398385358i 0.437292346271546 + 0.000000000000000i

Columns 9 through 10

0.000000084314026 + 0.222731584981019i 0.000000487034826 + 0.469771977393337i

0.000000084314026 - 0.222731584981019i 0.000000487034826 - 0.469771977393337i

Columns 11 through 12

-0.430775938429355 + 0.000000000000000i 0.000000762531364 + 0.575282057401124i

0.430774549664662 + 0.000000000000000i 0.000000762531364 - 0.575282057401124i

Columns 13 through 14

0.000000506562203 + 0.478245546398227i -0.380345890884583 + 0.000000000000000i

0.000000506562203 - 0.478245546398227i 0.380345413521491 + 0.000000000000000i

Columns 15 through 16

0.000000396635923 + 0.454390895898806i 0.000000128520283 + 0.293616110731006i

0.000000396635923 - 0.454390895898806i 0.000000128520283 - 0.293616110731006i

Columns 17 through 18

-0.202782460098160 + 0.000000000000000i 0.000000312876051 + 0.459259535567997i

0.202781790063990 + 0.000000000000000i 0.000000312876051 - 0.459259535567997i

Columns 19 through 20

0.000000152136190 + 0.416672027145116i -0.760305990591390 + 0.000000000000000i

0.000000152136190 - 0.416672027145116i 0.760302539344242 + 0.000000000000000i

Columns 21 through 22

-0.306497949050224 + 0.000000000000000i 0.000001396060872 + 0.735431933671737i

0.306497416955835 + 0.000000000000000i 0.000001396060872 -
0.735431933671737i

Columns 23 through 24

-0.321138112325641 + 0.000000000000000i 0.000000557680413 +
0.563376917655526i

0.321136965680789 + 0.000000000000000i 0.000000557680413 -
0.563376917655526i

Columns 25 through 26

0.000001208355538 + 0.748419456859207i -0.312835071435542 +
0.000000000000000i

0.000001208355538 - 0.748419456859207i 0.312834241441808 +
0.000000000000000i

Columns 27 through 28

0.000000298572900 + 0.444302640661971i 0.000000745566969 +
0.566561728893200i

0.000000298572900 - 0.444302640661971i 0.000000745566969 -
0.566561728893200i

Columns 29 through 30

-0.444504234321467 + 0.000000000000000i 0.000000439095462 +
0.460135509369134i

0.444503069843037 + 0.000000000000000i 0.000000439095462 -
0.460135509369134i

Columns 31 through 32

-0.372628158023919 + 0.000000000000000i -0.000000124286343 + 0.205449006881349i

0.372627742636711 + 0.000000000000000i -0.000000124286343 - 0.205449006881349i

Columns 33 through 34

-0.437637719433975 + 0.000000000000000i 0.000000080519534 + 0.301568024241783i

0.437636238776877 + 0.000000000000000i 0.000000080519534 - 0.301568024241783i

Columns 35 through 36

-0.060623368192467 + 0.000000000000000i -0.459869616511200 + 0.000000000000000i

0.060623352451846 + 0.000000000000000i 0.459868987591976 + 0.000000000000000i

Columns 37 through 38

-0.044617242780378 + 0.000000000000000i 0.000000280497859 + 0.420791793778393i

0.044616586456014 + 0.000000000000000i 0.000000280497859 - 0.420791793778393i

Columns 39 through 40

0.000000033883592 + 0.136162812056169i -0.472541548783083 + 0.000000000000000i

0.000000033883592 - 0.136162812056169i 0.472540233300948 + 0.000000000000000i

Columns 41 through 42

0.000000225835574 + 0.301934519453205i 0.223570752866252 + 0.000000000000000i

0.000000225835574 - 0.301934519453205i -0.223570451969446 + 0.000000000000000i

Columns 43 through 44

0.000000827005131 + 0.588391948625826i -0.216355138944555 + 0.000000000000000i

0.000000827005131 - 0.588391948625826i 0.216354910464387 + 0.000000000000000i

Columns 45 through 46

-0.434476137058689 + 0.000000000000000i -0.331260464370208 + 0.000000000000000i

0.434474957397718 + 0.000000000000000i 0.331259890112017 + 0.000000000000000i

Columns 47 through 48

-0.585359871012861 + 0.000000000000000i 0.000000368270260 + 0.472177612900686i

0.585357555121811 + 0.000000000000000i 0.000000368270260 - 0.472177612900686i

Columns 49 through 50

-0.261332840682541 + 0.000000000000000i 0.000001736438404 + 0.735977454789697i

0.261332643162538 + 0.000000000000000i 0.000001736438404 - 0.735977454789697i

Columns 51 through 52

-0.545419096096213 + 0.000000000000000i 0.000000051836589 + 0.245843654959531i

0.545417383866977 + 0.000000000000000i 0.000000051836589 - 0.245843654959531i

Columns 53 through 54

-0.489263833549157 + 0.000000000000000i 0.000000254284697 + 0.359322645844057i

0.489262617190290 + 0.000000000000000i 0.000000254284697 - 0.359322645844057i

Columns 55 through 56

0.000000083629843 + 0.379691122738804i -0.450106272729789 + 0.000000000000000i

0.000000083629843 - 0.379691122738804i 0.450105349614369 + 0.000000000000000i

Column 57

0.000001008776977 + 0.605292042564060i

0.000001008776977 - 0.605292042564060i

f24 (opened in MATLAB then copied to Excel and then to Word for this presentation)

150116 2 3 55.39 14N23.00 90W36.09 -0.86 0.00 computed
PS10IP-1 0.74PS08IP-1 0.98PS13IP-1 1.08PS16IP-1 1.55PS11IP-1
0.04PS01IP-1 0.09
PS09IP-1 0.58PS02IP-1 0.66PS03IP-1 0.85PS17IP-1 1.06
0
150116 1128 9.97 14N22.99 90W36.14 -0.72 0.00
PS02IP-1 0.81PS15IP-1 1.47PS16IP-1 1.55PS07IP-1 1.67PS10IP-1
0.71PS11IP-1 0.51
PS05IP-1 1.83PS01IP-1 0.29PS12IP-1 0.17PS03IP-1 0.96PS08IP-1
1.03PS17IP-1 1.07
PS13IP-1 1.23PS06IP-1 1.42PS09IP-1 0.83
0
150116 1424 31.68 14N23.00 90W36.17 -0.98 0.00
PS17IP-1 1.12PS08IP-1 1.24PS10IP-1 0.22PS11IP-1 0.94PS09IP-1
0.43PS01IP-1 0.59
PS02IP-1 0.55PS12IP-1 0.35
0
150116 1925 8.31 14N22.99 90W36.12 -1.02 0.00
PS10IP-1 0.39PS11IP-1 0.57PS15IP-1 1.67PS12IP-1 0.25PS09IP-1
0.79PS08IP-1 0.96
PS17IP-1 1.32PS16IP-1 1.39PS01IP-1 0.49PS03IP-1 0.79PS14IP-1
0.67PS02IP-1 0.63
0
150116 1929 21.46 14N22.96 90W36.07 -1.01 0.00
PS17IP-1 1.58PS02IP-1 0.88PS14IP-1 0.68PS09IP-1 0.60PS10IP-1
0.72PS12IP-1 0.06
PS11IP-1 0.41PS01IP-1 0.17PS03IP-1 0.53
0
150117 114 11.97 14N22.89 90W36.18 -0.81 0.00
PS16IP-1 1.33PS08IP-1 0.97PS03IP-1 0.93PS14IP-1 0.68PS09IP-1
0.67PS15IP-1 1.80
PS10IP-1 0.33PS01IP-1 0.52PS02IP-1 1.31PS06IP-1 1.59PS17IP-1
1.66PS11IP-1 0.39
0
150117 213 51.19 14N23.05 90W36.16 -0.97 0.00
PS02IP-1 0.72PS03IP-1 1.14PS01IP-1 0.40PS12IP-1 0.31PS14IP-1
0.18PS13IP-1 1.44
PS09IP-1 0.63PS11IP-1 0.44PS08IP-1 1.01PS16IP-1 1.26PS17IP-1 1.26
0
150117 7 8 20.54 14N22.86 90W36.18 -0.56 0.00
PS09IP-1 0.75PS06IP-1 1.41PS03IP-1 0.87PS12IP-1 0.65PS01IP-1

0.28PS16IP-1 1.66
PS13IP-1 1.64PS17IP-1 1.54PS08IP-1 1.34PS14IP-1 1.18PS02IP-1
0.98PS11IP-1 0.94
0

150117 845 53.23 14N22.95 90W36.07 -0.94   0.00
PS07IP-1 1.50PS18IP-1 1.31PS08IP-1 1.26PS12IP-1 0.00PS16IP-1
1.70PS15IP-1 1.99
PS04IP-1 2.03PS11IP-1 0.30PS02IP-1 0.61PS10IP-1 0.83PS13IP-1
1.06PS03IP-1 0.98
PS09IP-1 0.90PS01IP-1 0.35PS14IP-1 0.54PS19IP-1 1.40PS17IP-1 1.18
0

150118 1412 44.25 14N23.06 90W36.21 -0.96   0.00
PS08IP-1 1.08PS17IP-1 0.95PS09IP-1 0.38PS02IP-1 1.10PS01IP-1
0.31PS10IP-1 0.20
PS14IP-1 0.15PS11IP-1 0.96PS12IP-1 0.13PS15IP-1 1.57PS03IP-1 1.42
0

150120 614 47.90 14N23.04 90W36.14 -1.26   0.00
PS10IP-1 0.57PS11IP-1 0.66PS09IP-1 0.96PS17IP-1 1.35PS16IP-1
1.40PS13IP-1 1.55
PS01IP-1 0.71PS12IP-1 0.49PS14IP-1 0.74
0

150114 231 4.32 14N23.00 90W36.12 -0.16   0.00
PS01IP-1 1.12PS03IP-1 1.20PS02IP-1 1.22PS10IP-1 1.10PS09IP-1
1.22PS07IP-1 1.56
PS06IP-1 1.74PS04IP-2 2.47
0

150114 238 28.80 14N23.04 90W36.14 -0.15   0.00
PS10IP-1 1.10PS03IP-1 1.30PS02IP-1 1.21PS01IP-1 1.09PS07IP-1
1.57PS09IP-1 1.24
PS04IP-1 2.29PS05IP-1 1.72PS06IP-1 1.71
0

150114 341 11.04 14N22.94 90W36.15 -0.36   0.00
PS07IP-2 1.41PS03IP-1 1.09PS09IP-1 0.98PS10IP-1 0.77PS01IP-1
0.87PS02IP-1 1.11
PS05IP-2 1.45PS04IP-3 2.24PS06IP-2 1.99
0

150114 545 10.16 14N22.90 90W36.10 -0.13   0.00
PS03IP-1 1.23PS01IP-1 1.18PS05IP-1 1.75PS06IP-1 1.74PS09IP-1
1.34PS04IP-3 2.62
PS07IP-1 1.71PS02IP-1 1.27PS10IP-1 1.12
0

150114 643 21.26 14N23.01 90W36.17 -0.42   0.00
PS09IP-1 0.88PS07IP-1 1.43PS03IP-1 0.99PS05IP-1 2.04PS06IP-1

1.38PS01IP-1 0.77
PS02IP-1 1.09PS10IP-1 0.73
0

150114 729 28.56 14N22.92 90W36.09 -0.24   0.00
PS04IP-1 1.80PS06IP-1 1.62PS09IP-1 1.14PS05IP-1 2.19PS02IP-0
1.16PS01IP-1 1.04
PS03IP-0 1.03PS10IP-0 1.08PS07IP-1 1.59
0

150114 1110 30.74 14N22.91 90W36.09 -0.06   0.00
PS07IP-0 1.74PS06IP-1 1.77PS02IP-0 1.33PS05IP-1 1.79PS04IP-1
1.94PS10IP-0 1.26
PS01IP-0 1.30PS03IP-0 1.26PS09IP-0 1.38
0

150114 1234 14.94 14N22.99 90W36.12 -0.11   0.00
PS07IP-0 1.62PS04IP-1 2.35PS09IP-0 1.28PS03IP-1 1.16PS10IP-0
1.16PS01IP-0 1.17
PS06IP-1 1.74PS05IP-1 1.68PS02IP-0 1.25
0

150114 1357 6.09 14N23.02 90W36.14 -0.22   0.00
PS04IP-1 2.21PS10IP-1 0.98PS02IP-1 1.14PS03IP-1 1.16PS07IP-1
1.49PS06IP-2 1.52
PS09IP-1 1.16PS05IP-2 1.55PS01IP-1 1.05
0

150114 16 3 55.49 14N22.96 90W36.10 -0.54   0.00
PS06IP-2 1.82PS04IP-2 2.13PS01IP-0 0.69PS03IP-2 1.08PS10IP-0
0.67PS09IP-0 0.81
PS07IP-2 1.16PS02IP-0 0.81
0

150114 1637 5.96 14N22.93 90W36.12 -0.08   0.00
PS10IP-0 1.18PS04IP-0 1.87PS01IP-1 1.23PS03IP-1 1.22PS09IP-0
1.33PS07IP-0 1.66
PS06IP-0 1.72PS05IP-0 1.72PS02IP-1 1.34
0

150114 1652 52.18 14N22.91 90W36.09 -0.45   0.00
PS01IP-0 0.81PS05IP-1 1.86PS03IP-0 0.83PS10IP-0 0.80PS09IP-0
0.93PS07IP-2 1.28
PS06IP-2 1.46PS02IP-0 0.94
0

150114 1932 44.62 14N23.02 90W36.12 -0.31   0.00
PS05IP-1 1.70PS02IP-1 1.01PS01IP-1 0.64PS03IP-1 1.16PS10IP-1
1.05PS04IP-1 2.08
PS09IP-1 0.89PS13IP-0 1.29PS07IP-0 1.66PS06IP-0 1.72
0

150114 1947 50.79 14N22.91 90W36.06 -0.54 0.00
PS05IP-1 1.83PS01IP-2 0.73PS03IP-3 0.71PS13IP-2 0.85PS10IP-2 0.73PS09IP-1 0.91
PS07IP-1 1.77PS06IP-1 1.85PS04IP-1 1.91PS02IP-1 0.81
0

150114 2133 0.07 14N22.94 90W36.14 -0.58 0.00
PS07IP-1 1.21PS11IP-1 0.63PS10IP-1 0.68PS03IP-1 0.87PS09IP-1 0.84PS13IP-1 1.45
PS18IP-1 1.15PS06IP-1 1.51PS05IP-1 2.03PS01IP-0 0.78PS12IP-0 0.61PS02IP-1 0.86
0

150114 2135 48.50 14N22.96 90W36.12 -0.64 0.00
PS13IP-1 1.24PS12IP-1 0.51PS02IP-1 0.78PS01IP-1 0.62PS11IP-1 0.58PS03IP-1 0.77
PS10IP-1 0.61PS09IP-1 0.77PS18IP-1 1.24PS07IP-1 1.65PS06IP-1 1.69PS05IP-1 1.78
0

150114 2140 20.64 14N22.91 90W36.35 -1.86 0.00
PS13IP-1 2.41PS01IP-1 1.60PS12IP-1 1.46PS02IP-1 1.69PS10IP-1 1.55PS09IP-1 1.71
PS18IP-1 2.44PS07IP-1 2.26PS06IP-1 2.52PS11IP-1 1.51PS03IP-1 1.71
0

150114 2155 50.56 14N22.98 90W36.13 -0.67 0.00
PS13IP-1 1.16PS07IP-1 1.36PS12IP-1 0.48PS01IP-1 0.62PS10IP-1 0.58PS11IP-1 0.66
PS09IP-1 0.72PS02IP-1 0.84PS03IP-1 0.72PS18IP-1 1.33PS06IP-1 1.90PS05IP-1 1.83
0

150114 2212 23.78 14N23.17 90W36.32 -3.32 0.00
PS12IP-0 3.53PS10IP-0 3.64PS09IP-0 3.78PS01IP-1 3.78PS11IP-1 3.60PS03IP-1 3.90
PS02IP-0 3.89PS13IP-1 4.20
0

150114 2217 8.66 14N22.97 90W36.10 -0.72 0.00
PS12IP-1 0.40PS02IP-0 0.75PS10IP-0 0.53PS13IP-1 1.21PS11IP-1 0.59PS03IP-1 0.56
PS09IP-1 0.83PS18IP-1 1.16PS07IP-1 1.56PS01IP-1 0.54PS06IP-1 1.79
0

150114 2246 52.37 14N22.89 90W36.04 -0.70 0.00
PS12IP-1 0.40PS04IP-1 1.86PS11IP-1 0.61PS10IP-2 0.55PS03IP-2 0.58PS09IP-2 0.00
PS01IP-2 0.00PS02IP-1 0.71PS07IP-1 2.00
0

150114 23 3 12.35 14N22.99 90W36.13 -0.61 0.00

PS12IP-1 0.54PS02IP-1 0.90PS09IP-1 0.73PS10IP-1 0.57PS11IP-1
0.71PS13IP-1 1.53
PS18IP-1 1.11PS06IP-2 1.57PS03IP-3 0.75PS07IP-3 1.07PS01IP-1
0.63PS19IP-2 1.89
0

150114 2311 11.10 14N22.63 90W36.09 -0.62   0.00
PS06IP-1 1.55PS03IP-1 0.84PS01IP-1 0.16PS12IP-2 0.31PS02IP-1
0.76PS11IP-1 0.58
PS10IP-1 0.35PS09IP-1 0.85PS13IP-1 0.85PS18IP-1 1.04PS07IP-0
2.20PS05IP-1 1.25
PS04IP-3 1.71
0

150114 2326 13.85 14N23.15 90W36.19 -3.31   0.00
PS19IP-2 4.46PS10IP-1 3.60PS12IP-1 3.51PS01IP-1 3.62PS02IP-1
3.74PS11IP-1 3.55
PS03IP-1 3.71PS09IP-1 3.69PS13IP-2 4.22PS18IP-2 4.45PS07IP-1
4.51PS06IP-1 4.72
0

150114 2332 1.93 14N22.96 90W36.10 -0.93   0.00
PS03IP-2 0.46PS10IP-1 0.44PS06IP-3 1.69PS12IP-1 0.31PS13IP-3
1.12PS01IP-1 0.48
PS02IP-2 0.55PS09IP-1 0.62PS18IP-1 1.38PS19IP-2 2.00PS07IP-2
2.05PS11IP-1 0.41
0

150114 2339 38.80 14N22.99 90W36.12 -0.53   0.00
PS03IP-1 0.74PS01IP-1 0.76PS11IP-1 0.72PS18IP-3 1.08PS10IP-1
0.76PS13IP-1 1.28
PS09IP-1 0.89PS02IP-1 0.87PS07IP-1 1.38PS06IP-1 1.83PS12IP-1
0.60PS04IP-3 1.86
0

150115 0 1 55.34 14N23.08 90W36.19 -0.86   0.00
PS15IP-1 1.48PS07IP-1 1.46PS12IP-1 0.41PS01IP-1 0.50PS10IP-0
0.48PS02IP-1 0.86
PS09IP-2 0.61PS03IP-2 1.60
0

150115 051 52.17 14N22.98 90W36.16 -0.73   0.00
PS11IP-2 0.41PS15IP-1 1.41PS12IP-1 0.33PS01IP-0 0.57PS10IP-0
0.45PS09IP-1 0.54
PS03IP-2 0.67PS02IP-2 0.75PS13IP-1 1.20PS06IP-1 1.68
0

150115 126 14.72 14N22.94 90W36.11 -0.52   0.00
PS11IP-0 0.76PS03IP-0 0.92PS02IP-0 0.90PS01IP-1 0.79PS10IP-0
0.73PS13IP-1 1.08
PS09IP-0 0.84PS18IP-1 1.29PS19IP-1 1.40PS15IP-0 1.73PS06IP-1

1.80PS07IP-1 1.32
PS12IP-0 0.67

0

150115 131 19.90 14N23.16 90W36.18 -1.42 0.00
PS12IP-0 0.86PS11IP-1 0.94PS01IP-1 0.96PS02IP-1 1.10PS10IP-1
0.90PS09IP-1 1.06
PS18IP-2 1.84PS15IP-1 1.86PS07IP-1 1.92PS13IP-1 2.10PS03IP-1
1.96PS06IP-3 2.27

0

150115 143 6.94 14N22.95 90W36.09 -0.76 0.00
PS10IP-1 0.57PS05IP-3 1.71PS12IP-1 0.37PS06IP-3 1.84PS15IP-2
1.68PS02IP-1 0.73
PS03IP-1 0.65PS01IP-1 0.55PS11IP-1 0.58PS13IP-1 0.85PS09IP-1
0.69PS07IP-3 1.67

0

150115 239 49.84 14N22.97 90W36.11 -0.57 0.00
PS06IP-2 1.82PS15IP-1 1.54PS02IP-1 0.84PS01IP-1 0.73PS03IP-1
1.03PS11IP-1 0.68
PS18IP-1 1.23PS10IP-1 0.67PS09IP-1 0.78PS07IP-2 1.66PS05IP-2
1.80PS12IP-1 0.54
PS04IP-2 2.09

0

150115 253 53.52 14N22.95 90W36.21 -0.50 0.00
PS11IP-1 1.02PS05IP-1 2.52PS06IP-1 1.47PS15IP-1 2.66PS07IP-2
2.64PS13IP-2 1.90
PS03IP-1 1.10PS19IP-2 2.70PS18IP-2 2.66PS12IP-0 0.91PS02IP-1
2.43PS10IP-0 0.64
PS01IP-1 0.64PS09IP-1 0.77PS04IP-3 2.98

0

150115 3 5 29.05 14N22.94 90W36.11 -0.57 0.00
PS04IP-2 2.16PS07IP-2 1.51PS03IP-1 0.84PS02IP-1 0.87PS11IP-1
0.71PS13IP-1 0.90
PS12IP-1 0.61PS01IP-1 0.72PS10IP-1 0.70PS09IP-1 0.82PS05IP-2
2.62PS15IP-2 1.50
PS06IP-2 1.54

0

150115 3 6 55.57 14N23.11 90W35.95 -0.11 0.00
PS06IP-1 2.76PS02IP-2 1.68PS03IP-1 1.89PS19IP-2 2.58PS11IP-1
1.28PS12IP-1 1.04
PS13IP-1 2.10PS01IP-1 1.45PS10IP-0 1.29PS09IP-1 1.60PS04IP-1
3.14PS15IP-1 2.79
PS07IP-1 2.66PS05IP-1 2.77PS18IP-1 2.08

0

150115 311 9.21 14N23.02 90W36.11 -0.97 0.00

PS05IP-1 2.09PS07IP-1 2.09PS06IP-2 1.95PS15IP-1 1.63PS03IP-3
0.63PS11IP-1 0.00
PS13IP-1 0.99PS09IP-2 0.42PS18IP-1 1.67PS02IP-3 0.66PS12IP-3
0.00PS01IP-1 0.00
PS10IP-2 0.32

0

150115 315 34.34 14N22.95 90W36.09 -0.65   0.00
PS07IP-2 1.76PS12IP-1 0.51PS01IP-1 0.64PS10IP-1 0.63PS11IP-1
0.66PS02IP-1 0.74
PS09IP-1 0.74PS15IP-2 1.51PS06IP-2 1.82

0

150115 439 1.94 14N22.97 90W36.06 -0.88   0.00
PS01IP-1 0.51PS03IP-1 0.40PS10IP-1 0.52PS05IP-2 2.25PS18IP-1
0.94PS06IP-3 1.84
PS15IP-1 1.61PS04IP-2 3.00PS12IP-1 0.33PS11IP-1 0.45PS02IP-1
0.74PS13IP-1 1.72
PS19IP-1 1.86PS07IP-1 2.13PS09IP-1 0.60

0

150115 440 20.38 14N22.92 90W36.13 -0.61   0.00
PS19IP-1 1.54PS12IP-1 0.56PS11IP-1 0.78PS01IP-1 0.75PS03IP-1
0.88PS02IP-1 0.76
PS10IP-1 0.61PS13IP-1 0.75PS09IP-1 0.74PS18IP-1 1.48PS15IP-3
1.62PS07IP-3 1.22
PS06IP-3 1.68PS04IP-2 2.72

0

150115 5 5 7.91 14N22.96 90W36.12 -0.25   0.00
PS12IP-1 0.94PS03IP-1 1.11PS04IP-1 2.06PS10IP-1 1.07PS13IP-1
1.21PS02IP-1 1.21
PS18IP-1 1.40PS09IP-1 1.22PS15IP-1 1.54PS07IP-2 1.59PS06IP-1
1.74PS05IP-1 1.64
PS01IP-1 1.08PS11IP-1 1.00

0

150115 5 8 42.69 14N22.99 90W36.10 -0.90   0.00
PS18IP-1 1.42PS05IP-3 2.38PS09IP-1 0.60PS15IP-3 1.61PS01IP-1
0.51PS10IP-1 0.44
PS02IP-1 0.59PS11IP-1 0.54PS03IP-1 0.61PS07IP-3 1.93PS13IP-1
1.02PS06IP-3 2.34
PS12IP-1 0.34

0

150115 531 22.63 14N22.93 90W36.11 -0.52   0.00
PS01IP-1 0.76PS10IP-2 0.57PS15IP-1 1.52PS02IP-2 1.13PS09IP-1
1.08PS12IP-1 0.56
PS11IP-2 0.89PS03IP-2 0.97

0

150115 658 1.99 14N22.92 90W36.11 -0.50   0.00
PS12IP-1 0.63PS02IP-1 0.97PS01IP-1 0.75PS11IP-1 0.88PS03IP-1
0.90PS10IP-1 0.73
PS13IP-1 0.95PS06IP-3 1.74PS18IP-1 1.37PS09IP-1 0.85PS19IP-1
1.38PS15IP-1 1.76
PS07IP-2 1.56PS05IP-2 1.85
0

150115 718 29.84 14N22.91 90W36.11 -0.79   0.00
PS09IP-1 0.67PS02IP-1 0.78PS13IP-1 0.70PS01IP-1 0.60PS03IP-1
0.57PS11IP-1 0.49
PS10IP-1 0.58PS12IP-1 0.39PS07IP-2 1.67PS06IP-2 1.85PS15IP-3
1.28PS18IP-1 1.43
0

150115 737 0.15 14N22.98 90W36.13 -0.82   0.00
PS15IP-1 1.62PS12IP-1 0.35PS19IP-2 0.80PS09IP-2 0.75PS18IP-2
1.36PS13IP-1 1.26
PS11IP-1 0.46PS02IP-1 0.85PS03IP-1 0.61PS10IP-1 0.53PS01IP-1
0.46PS06IP-1 1.64
0

150115 8 4 40.23 14N23.03 90W36.12 -1.89   0.00
PS10IP-2 1.52PS07IP-3 2.84PS06IP-3 2.57PS05IP-2 3.04PS04IP-1
3.40PS13IP-1 1.89
PS11IP-2 1.43PS09IP-2 1.70PS03IP-2 1.55PS01IP-2 1.45PS12IP-1
1.32PS02IP-2 1.83
0

150115 8 5 19.85 14N23.12 90W36.14 -1.37   0.00
PS02IP-1 1.05PS10IP-1 0.78PS12IP-1 0.72PS09IP-2 1.22PS01IP-2
0.91PS11IP-1 1.08
PS03IP-1 1.15PS18IP-3 1.52PS06IP-3 2.25PS13IP-1 1.72PS15IP-3 1.96
0

150115 911 24.85 14N22.99 90W36.10 -0.76   0.00
PS01IP-1 0.48PS07IP-2 1.46PS11IP-2 0.41PS10IP-1 0.53PS15IP-2
1.54PS12IP-2 0.22
PS09IP-1 0.76PS02IP-2 0.56PS06IP-3 1.59PS13IP-1 1.01PS18IP-3
1.29PS03IP-2 0.84
0

150115 918 44.31 14N23.43 90W36.09 -2.06   0.00
PS15IP-2 2.88PS09IP-1 2.33PS02IP-2 2.30PS10IP-1 2.05PS03IP-2
2.57PS11IP-1 2.13
PS12IP-1 1.74PS01IP-2 2.20
0

150115 931 8.92 14N23.03 90W36.14 -0.43   0.00
PS18IP-1 1.37PS05IP-2 2.05PS04IP-2 2.05PS11IP-1 0.83PS12IP-1
0.76PS01IP-1 0.89

PS10IP-1 0.76PS02IP-1 0.99PS03IP-1 0.91PS09IP-1 0.99PS13IP-1 1.56PS15IP-2 1.34
PS07IP-1 1.33PS06IP-2 2.18
0

150115 935 54.58 14N22.98 90W36.11 -0.96 0.00
PS02IP-2 0.50PS10IP-1 0.42PS13IP-1 1.11PS09IP-1 0.70PS15IP-3 1.09PS03IP-2 0.59
PS12IP-1 0.30PS11IP-1 0.42PS01IP-1 0.48
0

150115 940 27.45 14N22.90 90W36.07 -0.65 0.00
PS01IP-1 0.69PS03IP-1 0.52PS09IP-1 0.83PS02IP-1 0.81PS13IP-3 1.55PS18IP-3 1.51
PS07IP-3 1.14PS04IP-3 1.94PS05IP-2 1.81PS12IP-1 0.54PS11IP-1 0.62PS10IP-1 0.71
0

150115 10 1 28.39 14N22.89 90W36.19 -0.97 0.00
PS06IP-3 2.01PS05IP-2 2.15PS07IP-3 1.70PS15IP-2 1.88PS09IP-1 0.61PS10IP-2 0.33
PS13IP-1 0.98PS01IP-3 0.11PS18IP-1 1.56PS12IP-2 0.00PS11IP-2 0.00PS03IP-1 0.78
PS02IP-1 1.09
0

150115 10 2 12.34 14N22.92 90W36.17 -0.73 0.00
PS09IP-1 0.73PS10IP-1 0.49PS05IP-1 1.50PS02IP-1 0.83PS12IP-1 0.35PS01IP-1 0.58
PS15IP-1 1.69PS03IP-1 1.08PS13IP-1 1.16PS18IP-1 1.57PS11IP-1 0.46PS19IP-1 1.61
0

150115 1117 32.71 14N22.90 90W36.15 -1.78 0.00
PS06IP-3 2.64PS13IP-2 1.80PS01IP-1 1.52PS09IP-2 1.63PS11IP-1 1.25PS12IP-1 1.11
PS10IP-1 1.25PS18IP-3 2.27PS02IP-2 1.44PS03IP-2 1.42
0

150115 1130 0.13 14N22.99 90W36.14 -0.98 0.00
PS06IP-3 1.71PS04IP-3 2.23PS10IP-1 0.28PS07IP-3 2.18PS02IP-1 0.70PS01IP-2 0.50
PS12IP-1 0.18PS03IP-2 1.07PS11IP-2 0.46PS18IP-1 1.62PS13IP-1 1.15PS09IP-1 0.76
PS19IP-3 1.69
0

150115 1221 34.25 14N23.04 90W36.16 -1.10 0.00
PS07IP-2 1.63PS09IP-1 0.66PS01IP-2 0.69PS11IP-1 0.81PS03IP-1 0.97PS02IP-1 0.83
PS13IP-2 1.14PS15IP-3 2.02PS10IP-1 0.44PS12IP-1 0.41

0

150115 1241 39.50 14N22.97 90W36.14 -0.77 0.00
PS10IP-1 0.46PS03IP-2 1.15PS01IP-1 0.56PS02IP-1 0.77PS11IP-1
0.62PS09IP-1 0.62
PS18IP-2 1.18PS13IP-2 1.44PS06IP-2 1.46PS12IP-1 0.37

0

150115 1311 15.84 14N23.06 90W36.18 -0.97 0.00
PS11IP-1 0.54PS15IP-1 1.88PS12IP-1 0.20PS09IP-1 0.82PS10IP-1
0.32PS05IP-3 2.02
PS07IP-2 1.94PS06IP-2 1.49PS19IP-1 2.27PS13IP-1 2.13PS02IP-1
0.72PS03IP-1 0.56
PS18IP-1 2.22PS01IP-1 0.41

0

150115 14 3 46.41 14N22.82 90W36.17 -0.59 0.00
PS04IP-1 1.46PS11IP-1 0.71PS19IP-1 1.84PS05IP-3 1.43PS18IP-3
1.63PS06IP-3 2.54
PS13IP-3 0.83PS03IP-1 0.91PS02IP-1 1.01PS12IP-1 0.65PS10IP-1
0.77PS01IP-1 0.87
PS09IP-1 0.96

0

150115 1430 5.82 14N22.92 90W36.10 -0.23 0.00
PS10IP-1 1.08PS09IP-1 1.24PS18IP-1 1.50PS19IP-1 1.45PS01IP-1
1.16PS15IP-1 1.64
PS07IP-1 1.65PS05IP-2 1.78PS06IP-1 1.84PS13IP-1 1.19PS12IP-1
0.93PS11IP-1 1.02
PS03IP-1 1.13PS02IP-1 1.19

0

150115 1433 15.42 14N22.94 90W36.08 -0.84 0.00
PS03IP-1 0.40PS09IP-1 0.65PS10IP-1 0.51PS12IP-1 0.37PS01IP-1
0.59PS11IP-1 0.46
PS02IP-1 0.64PS13IP-1 0.98PS19IP-3 1.98

0

150115 1448 18.55 14N22.93 90W36.11 -0.74 0.00
PS02IP-1 0.85PS13IP-2 1.37PS09IP-1 0.69PS18IP-3 1.28PS19IP-3
1.40PS07IP-3 1.38
PS06IP-3 1.53PS10IP-1 0.56PS11IP-1 0.52PS12IP-1 0.46PS01IP-1
0.57PS03IP-1 0.58

0

150115 1453 9.47 14N22.99 90W36.13 -0.82 0.00
PS03IP-1 0.71PS13IP-2 1.18PS06IP-2 1.70PS07IP-3 1.95PS18IP-3
1.61PS05IP-3 1.56
PS15IP-3 1.45PS11IP-1 0.67PS02IP-1 0.71PS01IP-1 0.48PS12IP-1
0.38PS10IP-1 0.44
PS09IP-1 0.62

0

150115 15 1 35.34 14N22.91 90W36.15 -0.20 0.00
PS15IP-1 1.68PS09IP-3 1.19PS13IP-1 1.30PS01IP-1 1.19PS19IP-1
1.56PS02IP-2 1.38
PS10IP-1 1.15PS18IP-1 1.61PS11IP-2 1.35PS04IP-3 2.30PS12IP-1
0.84PS03IP-1 1.21

0

150115 1516 44.76 14N22.94 90W36.13 -0.63 0.00
PS06IP-2 1.82PS13IP-2 1.49PS01IP-1 0.65PS11IP-1 0.57PS12IP-1
0.49PS05IP-1 1.68
PS07IP-1 1.47PS15IP-1 1.81PS10IP-1 0.64PS02IP-1 0.76PS03IP-1
1.05PS09IP-2 0.79

0

150115 1530 6.06 14N22.94 90W36.15 -0.57 0.00
PS01IP-1 0.67PS12IP-1 0.55PS11IP-1 0.68PS02IP-1 0.93PS03IP-1
1.06PS06IP-1 1.58
PS09IP-1 0.78PS10IP-1 0.67

0

150115 1538 50.04 14N22.90 90W36.16 -0.25 0.00
PS05IP-1 1.49PS07IP-1 1.93PS13IP-1 1.33PS10IP-1 0.96PS11IP-2
0.87PS12IP-2 0.86
PS09IP-1 1.13PS15IP-1 1.49

0

150115 1549 12.10 14N22.98 90W36.15 -0.51 0.00
PS18IP-1 1.31PS13IP-1 1.31PS11IP-1 0.95PS09IP-1 0.76PS10IP-1
0.67PS02IP-1 0.97
PS12IP-1 0.58PS01IP-1 0.67PS03IP-1 1.01PS05IP-2 1.59PS06IP-3
1.47PS19IP-2 1.43
PS07IP-1 1.32PS15IP-1 1.80

0

150115 1717 57.34 14N22.94 90W36.19 -0.41 0.00
PS10IP-1 0.94PS13IP-1 1.69PS18IP-2 1.30PS15IP-1 1.45PS07IP-1
1.38PS06IP-1 1.58
PS05IP-1 1.52PS12IP-1 0.48PS19IP-1 1.97PS09IP-1 0.97PS01IP-1
0.98PS02IP-1 1.13
PS11IP-1 0.76PS03IP-1 0.90

0

150115 1729 44.17 14N23.01 90W36.13 -0.95 0.00
PS13IP-1 1.16PS01IP-1 0.45PS12IP-1 0.36PS02IP-1 0.73PS11IP-2
0.51PS09IP-1 0.57
PS10IP-1 0.44PS03IP-1 0.75

0

150115 1754 1.40 14N22.98 90W36.15 -0.69 0.00
PS12IP-1 0.48PS09IP-1 0.68PS02IP-1 0.88PS01IP-1 0.58PS11IP-2

0.56PS15IP-1 1.44
PS03IP-1 0.88PS10IP-1 0.51

0

150115 1812 40.65 14N22.98 90W36.16 -0.66 0.00
PS13IP-1 1.71PS15IP-1 1.59PS18IP-1 1.42PS09IP-1 0.72PS10IP-1
0.56PS06IP-1 1.20
PS07IP-1 1.47PS02IP-1 0.89PS03IP-2 1.17PS01IP-1 0.58PS11IP-1
0.68PS12IP-1 0.47
PS05IP-1 1.91

0

150115 1820 12.39 14N22.97 90W36.10 -0.99 0.00
PS10IP-2 0.46PS01IP-1 0.38PS12IP-1 0.11PS02IP-1 0.90PS13IP-2
1.16PS11IP-1 0.21
PS03IP-1 0.83PS09IP-1 0.88

0

150115 1848 42.29 14N23.06 90W36.12 -0.26 0.00
PS15IP-1 1.52PS07IP-1 1.47PS04IP-3 2.23PS19IP-3 2.23PS06IP-3
2.06PS11IP-1 1.02
PS01IP-1 1.05PS12IP-1 0.93PS05IP-3 2.17PS09IP-1 1.15PS03IP-1
1.18PS02IP-1 1.19
PS10IP-2 0.97PS13IP-1 1.66PS18IP-1 1.39

0

150115 1851 48.87 14N22.93 90W36.13 -0.60 0.00
PS15IP-1 1.65PS11IP-1 0.74PS12IP-1 0.57PS01IP-1 0.66PS02IP-1
0.99PS03IP-1 0.83
PS10IP-1 0.64PS09IP-1 0.76PS13IP-3 1.18PS18IP-1 1.40PS19IP-1
1.50PS07IP-3 1.62
PS06IP-2 1.52PS04IP-2 2.12

0

150115 19 6 38.89 14N22.94 90W36.14 -0.12 0.00
PS03IP-1 1.31PS13IP-1 1.36PS05IP-1 1.70PS18IP-1 1.65PS15IP-1
1.65PS19IP-1 1.66
PS07IP-1 1.64PS06IP-1 1.80PS04IP-1 1.81PS12IP-3 0.67PS01IP-3
0.98PS02IP-1 1.33
PS11IP-1 1.18PS10IP-1 1.19PS09IP-1 1.19

0

150115 1913 30.38 14N23.09 90W36.10 -0.44 0.00
PS02IP-2 1.16PS09IP-1 1.04PS03IP-1 0.97PS13IP-1 1.64PS18IP-2
1.78PS15IP-2 1.50
PS19IP-1 1.71PS07IP-1 1.43PS06IP-2 2.14PS10IP-1 0.94PS05IP-2
2.05PS12IP-1 0.78
PS01IP-2 0.92PS11IP-1 0.88

0

150115 1916 43.54 14N22.95 90W36.14 -0.71 0.00

PS11IP-1 0.62PS04IP-2 1.86PS01IP-1 0.70PS02IP-1 0.79PS03IP-1
0.68PS10IP-1 0.54
PS09IP-1 0.78PS13IP-1 1.32PS19IP-1 1.67PS15IP-1 1.67PS07IP-1
1.10PS05IP-2 1.73
PS12IP-1 0.32PS18IP-3 1.75PS06IP-2 1.91
0
150115 1942 7.51 14N22.94 90W36.15 -0.49   0.00
PS10IP-1 0.77PS15IP-1 1.84PS19IP-1 1.66PS17IP-1 1.15PS18IP-1
1.58PS13IP-1 1.06
PS06IP-1 1.63PS12IP-1 0.69PS11IP-1 0.78PS01IP-1 0.81PS03IP-1
0.86PS02IP-2 0.94
PS09IP-1 0.93PS07IP-1 1.23
0
150115 2020 36.11 14N22.99 90W36.13 -0.71   0.00
PS11IP-2 0.72PS12IP-1 0.48PS13IP-3 1.11PS03IP-2 1.03PS01IP-1
0.63PS02IP-1 0.71
PS09IP-1 0.61PS17IP-1 1.07PS10IP-1 0.50
0
150115 2033 38.00 14N23.00 90W36.17 -0.66   0.00
PS11IP-1 0.83PS10IP-1 0.54PS16IP-1 1.58PS01IP-1 0.60PS02IP-3
0.81PS13IP-2 1.25
PS09IP-1 0.72PS17IP-1 0.92PS07IP-1 1.23PS15IP-1 1.63PS12IP-1
0.43PS03IP-2 1.12
0
150115 2041 49.26 14N22.92 90W36.14 -0.80   0.00
PS01IP-1 0.74PS13IP-2 1.12PS16IP-1 1.52PS03IP-1 0.61PS19IP-2
1.47PS06IP-1 1.73
PS12IP-1 0.36PS18IP-1 1.50PS17IP-2 1.33PS07IP-2 1.02PS02IP-1
0.71PS10IP-1 0.49
PS09IP-1 0.57PS11IP-1 0.57
0
150115 2042 17.82 14N22.91 90W36.16 -0.30   0.00
PS11IP-1 1.08PS13IP-1 1.24PS10IP-3 1.11PS09IP-3 1.28PS19IP-1
1.60PS15IP-1 1.56
PS07IP-1 1.60PS06IP-1 1.61PS04IP-1 1.81PS16IP-3 1.91PS02IP-3
1.24PS17IP-3 1.88
PS01IP-1 1.16PS12IP-1 0.85PS18IP-1 1.42PS03IP-1 1.14PS05IP-1 1.60
0
150115 2045 14.13 14N22.96 90W36.10 -0.21   0.00
PS15IP-1 1.63PS07IP-1 1.63PS05IP-1 1.74PS12IP-1 0.98PS02IP-1
1.27PS01IP-1 1.14
PS11IP-1 1.08PS03IP-1 1.12PS10IP-1 1.12PS13IP-1 1.23PS18IP-1
1.48PS06IP-1 1.73
PS04IP-1 2.12PS16IP-1 1.48PS09IP-1 1.28PS17IP-1 1.41PS19IP-1 1.56

0

150115 2138 21.69 14N22.92 90W36.11 -0.68 0.00
PS09IP-1 0.73PS11IP-1 0.57PS03IP-1 0.73PS12IP-1 0.50PS01IP-1 0.63PS10IP-1 0.60
PS17IP-1 1.31PS15IP-2 1.71PS07IP-1 1.64

0

150115 2217 15.88 14N23.12 90W36.24 -1.79 0.00
PS09IP-1 1.41PS11IP-1 1.72PS07IP-3 2.62PS18IP-1 2.38PS16IP-1 1.84PS15IP-1 2.09
PS17IP-1 2.21PS13IP-1 2.34PS02IP-1 1.64PS03IP-1 1.64PS10IP-1 1.28PS12IP-1 1.24
PS01IP-1 1.56

0

150115 2220 0.17 14N22.95 90W36.12 -0.46 0.00
PS15IP-1 1.78PS11IP-1 0.81PS12IP-1 0.73PS03IP-1 0.89PS13IP-1 1.65PS10IP-1 0.75
PS02IP-1 0.95PS09IP-2 0.93PS18IP-1 1.22PS08IP-2 1.24PS17IP-1 1.45PS16IP-1 1.25
PS04IP-1 2.03PS07IP-1 1.33PS01IP-1 0.93

0

150115 2236 54.63 14N22.97 90W36.14 -1.02 0.00
PS03IP-2 1.25PS17IP-1 1.39PS08IP-1 0.84PS01IP-1 0.59PS10IP-1 0.31PS11IP-1 0.53
PS12IP-1 0.32PS09IP-1 0.84PS02IP-1 0.73

0

150115 2237 30.40 14N23.02 90W36.16 -1.13 0.00
PS02IP-1 0.87PS09IP-1 0.70PS17IP-1 1.27PS13IP-1 1.21PS11IP-1 0.70PS01IP-1 0.60
PS03IP-1 0.91PS08IP-1 0.94PS10IP-1 0.50PS12IP-1 0.41

0

150115 2310 57.24 14N22.88 90W36.19 -0.36 0.00
PS10IP-1 0.96PS09IP-1 1.16PS18IP-1 1.69PS17IP-1 1.58PS08IP-1 1.22PS06IP-3 2.12
PS12IP-1 0.84PS07IP-1 1.33PS11IP-1 0.95PS03IP-1 1.08PS02IP-1 1.09PS01IP-1 0.99

0

150116 011 11.96 14N22.89 90W36.10 -0.64 0.00
PS15IP-2 1.96PS01IP-0 0.75PS10IP-1 0.58PS12IP-1 0.51PS09IP-1 0.86PS02IP-1 0.80
PS08IP-1 1.08PS17IP-2 1.29PS11IP-1 0.65

0

150116 033 5.05 14N22.99 90W36.16 -0.51 0.00
PS04IP-2 2.08PS02IP-1 0.89PS13IP-2 1.22PS17IP-1 1.02PS16IP-1 1.62PS18IP-2 1.54

PS15IP-1 1.76PS07IP-1 1.24PS10IP-1 0.73PS12IP-1 0.64PS09IP-1
0.85PS01IP-1 0.75
PS11IP-1 0.88PS03IP-3 1.41PS08IP-1 0.86
0

150116 036 59.73 14N23.06 90W36.18 -1.67   0.00
PS18IP-1 2.15PS06IP-1 2.31PS05IP-1 3.09PS04IP-2 3.16PS01IP-1
1.19PS12IP-1 0.85
PS10IP-1 1.22PS09IP-1 1.39PS02IP-1 1.34PS11IP-2 1.11PS03IP-1
1.53PS17IP-1 1.92
PS08IP-1 1.74PS13IP-1 1.91PS15IP-1 1.93
0

150116 046 9.04 14N22.93 90W36.14 -0.79   0.00
PS11IP-1 0.58PS07IP-2 1.70PS15IP-1 1.48PS16IP-1 1.67PS01IP-1
0.59PS02IP-1 0.87
PS06IP-1 1.69PS09IP-0 0.66PS18IP-0 1.40PS08IP-1 0.78PS17IP-1
1.48PS10IP-0 0.47
PS03IP-1 0.54PS12IP-0 0.39PS13IP-1 0.92
0

150116 1 1 23.36 14N23.01 90W36.13 -0.81   0.00
PS08IP-1 0.81PS17IP-2 0.90PS09IP-1 0.76PS13IP-1 1.24PS02IP-2
0.91PS10IP-1 0.49
PS01IP-1 0.55PS03IP-1 0.63PS11IP-1 0.55PS12IP-1 0.38PS07IP-1 1.54
0

150116 1 3 9.71 14N22.98 90W36.07 -0.98   0.00
PS16IP-1 1.62PS17IP-1 1.26PS08IP-2 0.82PS07IP-1 2.04PS15IP-1
2.08PS12IP-1 0.00
PS02IP-1 0.42PS01IP-1 0.19PS10IP-1 0.46PS09IP-2 0.31PS11IP-2
0.05PS03IP-2 1.04
PS13IP-1 1.12
0

150116 119 21.70 14N23.07 90W36.18 -1.40   0.00
PS08IP-1 1.17PS02IP-2 1.30PS01IP-1 0.83PS09IP-1 1.08PS11IP-1
0.97PS12IP-1 0.72
PS10IP-1 0.83PS16IP-2 1.78PS17IP-1 1.36
0

150116 152 59.82 14N22.97 90W36.14 -0.57   0.00
PS02IP-1 0.90PS12IP-1 0.57PS11IP-1 0.68PS03IP-1 0.93PS04IP-1
2.18PS06IP-1 1.83
PS05IP-1 1.58PS07IP-1 1.49PS15IP-1 1.50PS10IP-1 0.65PS19IP-1
1.52PS16IP-1 1.37
PS18IP-1 1.26PS08IP-1 0.94PS17IP-1 1.46PS13IP-1 1.27PS09IP-1
0.80PS01IP-1 0.64
0

150116 2 1 9.28 14N23.00 90W36.16 -1.15   0.00

PS09IP-1 0.62PS13IP-1 1.33PS08IP-3 1.05PS17IP-3 1.38PS02IP-1
0.79PS12IP-1 0.35
PS10IP-1 0.45PS11IP-1 0.49PS01IP-1 0.71PS03IP-1 0.90
0

150116 2 7 44.18 14N22.97 90W36.08 -0.85   0.00
PS01IP-1 0.47PS09IP-1 0.74PS17IP-1 0.70PS08IP-1 1.30PS11IP-1
0.42PS12IP-1 0.36
PS02IP-1 0.78PS10IP-1 0.44
0

150116 247 25.83 14N22.99 90W36.15 -0.39   0.00
PS19IP-1 1.84PS07IP-1 1.47PS15IP-1 1.43PS18IP-1 1.52PS13IP-3
1.72PS16IP-1 1.42
PS03IP-2 1.06PS01IP-1 0.58PS12IP-1 0.88PS10IP-1 0.95PS09IP-1
0.96PS02IP-1 1.13
PS11IP-1 0.94PS17IP-1 1.18PS08IP-1 1.28PS05IP-1 1.50PS06IP-1 1.90
0

150116 348 37.65 14N22.95 90W36.25 -1.51   0.00
PS10IP-1 0.00PS08IP-1 1.63PS12IP-1 0.00PS16IP-1 1.67PS03IP-1
1.06PS11IP-1 0.16
PS18IP-1 1.95PS17IP-1 1.01PS13IP-1 1.77PS09IP-1 0.50PS01IP-1
0.00PS07IP-1 2.16
PS06IP-1 1.46PS05IP-1 2.03PS02IP-1 0.97
0

150116 444 23.28 14N22.93 90W36.09 -0.56   0.00
PS15IP-2 1.68PS08IP-2 1.01PS17IP-1 1.33PS09IP-1 0.84PS10IP-1
0.75PS02IP-1 0.85
PS01IP-1 0.70PS11IP-1 0.70PS12IP-1 0.66
0

150116 455 46.27 14N22.95 90W36.18 -0.77   0.00
PS08IP-1 0.88PS02IP-1 0.75PS10IP-1 0.58PS11IP-1 0.64PS01IP-2
0.71PS03IP-1 0.65
PS13IP-3 1.65PS17IP-1 1.67PS18IP-1 1.41PS16IP-1 1.67PS07IP-1
1.60PS06IP-1 1.66
PS15IP-1 1.17PS12IP-1 0.39PS19IP-1 2.04PS05IP-3 2.17
0

150116 5 0 56.02 14N22.90 90W36.11 -0.67   0.00
PS12IP-1 0.42PS08IP-1 1.04PS02IP-1 0.90PS09IP-1 1.00PS10IP-1
0.54PS01IP-1 0.75
PS06IP-1 1.70PS16IP-1 1.45PS17IP-1 1.38PS11IP-1 0.64
0

150116 5 2 50.87 14N22.93 90W36.15 -0.56   0.00
PS15IP-1 1.38PS03IP-1 0.78PS11IP-1 0.69PS12IP-1 0.60PS13IP-1
0.89PS01IP-1 0.75
PS07IP-1 1.25PS02IP-1 0.85PS09IP-1 1.01PS18IP-1 1.68PS08IP-1

1.07PS17IP-1 1.60
PS16IP-1 1.33PS05IP-1 1.37PS04IP-1 2.10PS06IP-1 2.02PS10IP-1 0.77
0

150116 538 6.01 14N23.02 90W36.12 -0.86 0.00
PS11IP-1 0.76PS12IP-1 0.18PS08IP-1 0.74PS17IP-2 1.17PS09IP-1
0.68PS10IP-1 0.45
PS02IP-1 0.58PS01IP-0 0.38
0

150116 545 25.97 14N22.98 90W36.10 -0.94 0.00
PS17IP-1 1.28PS13IP-1 1.02PS10IP-3 0.30PS09IP-1 0.64PS08IP-1
1.11PS06IP-3 1.16
PS12IP-1 0.27PS11IP-1 0.46PS03IP-1 0.74PS02IP-1 0.55PS01IP-2 0.61
0

150116 651 58.02 14N22.94 90W36.10 -0.31 0.00
PS05IP-1 1.52PS12IP-1 0.76PS01IP-1 0.91PS06IP-1 2.02PS02IP-1
1.03PS03IP-1 1.36
PS11IP-1 1.04PS13IP-3 1.14PS18IP-2 1.35PS10IP-2 0.90PS16IP-1
1.39PS09IP-1 1.07
PS17IP-1 1.44PS08IP-1 1.21PS15IP-1 1.99PS07IP-1 1.44
0

150116 653 43.28 14N22.99 90W36.16 -1.13 0.00
PS08IP-1 1.04PS01IP-1 0.48PS13IP-1 1.95PS11IP-1 0.35PS12IP-1
0.16PS15IP-1 1.58
PS16IP-1 1.57PS03IP-1 1.07PS09IP-1 0.81PS10IP-1 1.33PS17IP-1
1.23PS02IP-1 0.88
0

150116 7 0 26.20 14N22.92 90W36.12 -0.59 0.00
PS07IP-2 1.58PS01IP-1 0.80PS12IP-1 0.52PS08IP-1 1.04PS11IP-2
0.88PS09IP-1 0.79
PS17IP-1 1.36PS15IP-2 1.68PS10IP-1 0.68
0

150116 7 5 14.58 14N22.99 90W36.15 -0.75 0.00
PS15IP-2 1.77PS01IP-1 0.51PS10IP-1 0.48PS12IP-1 0.41PS11IP-1
0.66PS09IP-1 0.68
PS02IP-1 0.92PS17IP-1 0.95PS16IP-1 1.43PS07IP-1 1.46
0

150116 728 52.82 14N22.97 90W36.15 -0.79 0.00
PS06IP-1 1.73PS18IP-1 0.88PS16IP-1 1.52PS02IP-1 1.06PS17IP-1
1.16PS01IP-3 0.17
PS12IP-2 0.23PS13IP-1 1.29PS08IP-1 1.05PS10IP-1 0.51PS15IP-1
1.29PS07IP-1 2.04
PS04IP-3 1.86PS05IP-3 1.88PS03IP-1 0.56PS11IP-1 0.55PS09IP-1 0.46
0

150116 741 50.77 14N22.93 90W36.11 -0.74   0.00
PS08IP-2 0.93PS10IP-1 0.67PS07IP-1 1.65PS05IP-1 1.75PS06IP-1
1.80PS03IP-1 0.90
PS17IP-2 1.38PS02IP-1 0.72PS16IP-1 1.60PS01IP-1 0.47PS12IP-1
0.13PS11IP-1 0.58
PS13IP-1 0.77PS09IP-1 0.83
0

150116 840 6.02 14N22.91 90W36.12 -0.54   0.00
PS09IP-1 1.11PS06IP-1 1.57PS07IP-1 1.57PS15IP-2 1.88PS19IP-1
1.58PS17IP-1 1.34
PS16IP-1 1.28PS08IP-1 1.31PS11IP-1 0.54PS03IP-1 0.68PS18IP-1
1.42PS01IP-1 0.78
PS10IP-1 0.68PS02IP-2 0.82PS13IP-1 1.20PS12IP-2 0.47PS04IP-1
1.89PS05IP-1 1.57
0

150116 841 27.44 14N22.83 90W36.13 -0.56   0.00
PS06IP-1 1.50PS07IP-1 1.75PS08IP-3 1.10PS15IP-3 1.87PS12IP-1
0.63PS11IP-1 0.70
PS03IP-1 0.88PS02IP-1 0.85PS10IP-1 0.78PS01IP-2 0.99PS18IP-1
1.39PS09IP-1 0.94
PS16IP-2 1.85
0

150116 848 23.57 14N22.92 90W36.17 -0.98   0.00
PS09IP-2 0.82PS11IP-2 0.60PS12IP-1 0.30PS02IP-2 0.98PS01IP-2
0.01PS10IP-2 0.10
PS16IP-2 2.01PS17IP-1 1.32PS08IP-2 1.42PS06IP-1 1.85
0

150116 854 6.33 14N23.06 90W36.13 -1.13   0.00
PS11IP-1 0.76PS02IP-1 0.24PS10IP-1 0.46PS03IP-1 0.98PS09IP-1
0.45PS17IP-1 0.96
PS16IP-1 2.25PS18IP-1 3.30PS15IP-1 2.10PS07IP-1 1.82PS06IP-1
2.40PS13IP-1 1.33
PS08IP-1 1.50PS12IP-1 0.00PS01IP-1 0.33
0

150116 9 8 9.73 14N22.99 90W36.13 -1.02   0.00
PS11IP-2 0.53PS03IP-1 0.89PS17IP-1 1.50PS01IP-1 0.43PS08IP-1
0.97PS09IP-2 0.48
PS10IP-1 0.44PS02IP-1 0.66PS12IP-1 0.21
0

150116 912 16.72 14N22.81 90W36.17 -0.99   0.00
PS02IP-1 0.90PS13IP-2 1.40PS09IP-3 1.26PS16IP-1 1.65PS17IP-3
1.96PS03IP-1 0.55
PS10IP-1 0.72PS15IP-1 1.92PS06IP-1 2.00PS04IP-1 2.05PS01IP-2
0.64PS18IP-2 1.72

PS05IP-1 1.38PS08IP-2 1.69PS12IP-1 0.20PS19IP-1 1.90PS11IP-1 0.69
0

150116 917 45.93 14N23.10 90W36.29 -1.41   0.00
PS12IP-1 0.77PS06IP-1 2.04PS17IP-2 1.65PS08IP-1 1.16PS16IP-1
1.90PS09IP-1 1.04
PS01IP-1 0.91PS02IP-1 1.19PS10IP-1 0.91PS11IP-2 1.25PS03IP-1
1.66PS13IP-1 1.94
0

150116 923 0.73 14N22.92 90W36.07 -0.73   0.00
PS10IP-1 0.57PS17IP-2 1.37PS08IP-2 1.12PS11IP-1 0.51PS12IP-1
0.45PS02IP-1 0.68
PS01IP-1 0.62PS09IP-2 0.73
0

150116 940 52.21 14N22.94 90W36.22 -2.12   0.00
PS08IP-1 2.38PS07IP-1 2.75PS11IP-1 1.91PS12IP-0 1.65PS10IP-1
1.75PS02IP-1 1.89
PS01IP-1 1.80PS09IP-1 2.01PS17IP-1 2.53PS16IP-2 2.75
0

150116 1025 59.78 14N22.95 90W36.20 -0.72   0.00
PS18IP-1 1.66PS06IP-1 1.46PS10IP-1 0.54PS12IP-1 0.38PS11IP-1
0.65PS03IP-1 0.90
PS02IP-1 1.00PS01IP-1 0.56PS09IP-1 0.64PS16IP-1 1.81PS17IP-1
1.09PS08IP-1 0.95
PS15IP-1 1.48PS07IP-1 1.50
0

150116 1041 10.68 14N23.01 90W36.14 -0.43   0.00
PS17IP-1 1.51PS16IP-1 1.20PS15IP-1 1.34PS07IP-1 1.29PS06IP-1
1.47PS05IP-1 2.09
PS04IP-1 2.16PS13IP-1 1.57PS08IP-1 1.13PS12IP-1 0.65PS11IP-1
0.83PS01IP-1 0.85
PS03IP-1 0.98PS02IP-1 1.05PS10IP-1 0.81PS09IP-1 0.96PS18IP-1 1.22
0

150116 1142 36.35 14N23.02 90W36.13 -1.14   0.00
PS02IP-1 0.90PS17IP-1 1.12PS16IP-1 1.22PS18IP-1 1.74PS10IP-1
0.46PS09IP-1 0.64
PS12IP-1 0.34PS11IP-1 0.29PS01IP-1 0.50PS03IP-1 0.71PS13IP-1
1.35PS08IP-1 1.32
0

150116 1144 0.62 14N22.97 90W36.13 -0.94   0.00
PS10IP-1 0.42PS08IP-1 1.12PS12IP-1 0.25PS11IP-1 0.53PS09IP-1
0.64PS01IP-1 0.62
PS13IP-2 1.22PS02IP-1 0.80PS17IP-1 1.27PS16IP-1 1.20PS07IP-1 1.56
0

150116 1151 24.57 14N22.94 90W36.01 -0.54   0.00

PS11IP-1 0.69PS13IP-1 1.11PS02IP-2 1.04PS18IP-1 0.88PS03IP-1
0.51PS10IP-1 0.77
PS09IP-1 1.05PS16IP-1 1.33PS17IP-1 1.22PS08IP-1 1.41PS07IP-1
1.77PS06IP-1 2.02
PS15IP-1 1.87
0

150116 1244 14.47 14N23.00 90W36.16 -0.79   0.00
PS07IP-1 1.55PS06IP-3 1.82PS16IP-1 1.45PS02IP-1 0.55PS12IP-2
0.00PS01IP-2 0.00
PS03IP-1 0.98PS11IP-2 0.51PS13IP-1 1.01PS17IP-1 1.23PS08IP-1 0.77
0

150116 1417 41.68 14N23.00 90W36.22 -1.25   0.00
PS09IP-1 0.89PS16IP-1 1.91PS11IP-1 0.76PS12IP-1 0.52PS01IP-0
0.77PS08IP-1 0.99
PS02IP-1 1.19PS17IP-1 1.34PS10IP-1 0.60
0

150116 1433 34.34 14N22.98 90W36.11 -0.64   0.00
PS03IP-1 0.86PS01IP-1 0.80PS09IP-1 0.71PS02IP-1 0.93PS08IP-1
1.07PS17IP-1 1.04
PS16IP-1 1.13PS06IP-2 1.80PS07IP-3 1.80PS12IP-1 0.40PS10IP-1
0.62PS11IP-1 0.63
0

150116 1513 28.10 14N22.95 90W36.12 -0.16   0.00
PS01IP-1 1.14PS16IP-1 1.51PS12IP-1 1.06PS11IP-1 1.13PS02IP-1
1.30PS03IP-1 1.22
PS10IP-1 1.17PS13IP-1 1.32PS09IP-1 1.31PS18IP-1 1.58PS17IP-1
1.42PS08IP-1 1.42
PS15IP-1 1.68PS07IP-1 1.67PS06IP-1 1.74PS05IP-1 1.72PS04IP-1 1.85
0

150116 1557 37.74 14N22.90 90W36.10 -0.71   0.00
PS01IP-0 0.68PS11IP-1 0.55PS10IP-1 0.58PS12IP-1 0.40PS03IP-1
0.65PS09IP-1 0.79
PS02IP-1 0.75PS08IP-0 1.17PS17IP-2 1.45
0

150116 1621 19.38 14N22.97 90W36.12 -0.49   0.00
PS18IP-1 1.09PS06IP-1 1.68PS05IP-1 2.02PS04IP-1 2.04PS19IP-1
1.52PS02IP-1 1.02
PS17IP-2 1.56PS16IP-1 1.60PS12IP-1 0.31PS08IP-1 1.05PS11IP-1
0.95PS09IP-1 0.83
PS10IP-1 0.78PS03IP-1 0.97PS13IP-1 1.06PS15IP-1 1.49PS07IP-1 1.52
0

150116 1632 29.58 14N23.05 90W36.07 -1.20   0.00
PS19IP-1 1.78PS02IP-1 0.80PS10IP-1 0.73PS09IP-2 0.94PS12IP-1
0.30PS01IP-1 0.56

PS08IP-2 1.66PS11IP-1 0.50PS03IP-1 1.03PS17IP-1 0.90PS13IP-1 1.52PS16IP-1 1.86
PS18IP-1 1.49

0

150116 1635 1.00 14N22.94 90W36.06 -0.90 0.00
PS01IP-1 0.29PS09IP-1 0.76PS17IP-1 1.40PS11IP-1 0.17PS12IP-1 0.33PS10IP-1 0.59
PS13IP-1 0.95PS02IP-1 0.70

0

150116 1643 23.54 14N22.96 90W36.15 -0.56 0.00
PS17IP-1 1.18PS19IP-1 1.58PS06IP-1 1.59PS07IP-1 1.53PS01IP-1 0.78PS12IP-1 0.59
PS02IP-1 0.82PS10IP-1 0.65PS11IP-1 0.79PS09IP-1 0.75PS03IP-1 0.85PS08IP-1 0.88
PS16IP-1 1.61PS13IP-1 1.55PS15IP-1 1.71

0

150116 1652 23.81 14N22.99 90W36.16 -1.10 0.00
PS09IP-1 0.62PS12IP-1 0.35PS11IP-1 0.67PS01IP-1 0.61PS08IP-1 1.24PS02IP-2 0.78
PS17IP-1 1.19PS13IP-3 1.51PS10IP-1 0.38

0

150116 1719 45.26 14N22.95 90W36.15 -0.98 0.00
PS09IP-1 0.59PS12IP-1 0.32PS11IP-1 0.52PS01IP-1 0.75PS03IP-1 0.58PS13IP-1 1.11
PS08IP-1 0.96PS02IP-1 0.89PS10IP-1 0.43

0

150116 1723 18.84 14N22.98 90W36.11 -0.74 0.00
PS10IP-1 0.51PS03IP-1 0.68PS11IP-1 0.60PS12IP-1 0.43PS02IP-1 0.78PS01IP-1 0.55
PS09IP-1 0.79PS08IP-1 0.96PS16IP-1 1.42PS17IP-1 0.92

0

150116 1736 32.09 14N23.06 90W36.13 -1.54 0.00
PS10IP-2 0.91PS09IP-2 1.30PS08IP-2 2.10PS13IP-2 2.17PS17IP-1 1.50PS03IP-2 1.79
PS02IP-1 1.29PS11IP-1 0.96PS12IP-2 1.03PS01IP-1 1.09

0

150116 1759 2.76 14N22.99 90W36.07 -0.90 0.00
PS09IP-2 0.71PS13IP-2 0.93PS11IP-2 0.31PS03IP-1 0.82PS10IP-2 0.42PS02IP-2 0.53
PS01IP-1 0.10PS08IP-3 0.70PS17IP-1 1.44PS12IP-2 0.00

0

150116 1819 21.19 14N22.99 90W36.14 -0.87 0.00
PS12IP-1 0.35PS10IP-1 0.39PS09IP-1 0.58PS01IP-1 0.50PS08IP-1

0.91PS02IP-1 0.66
PS17IP-1 1.30PS11IP-1 0.64PS03IP-1 0.79
0

150116 1819 34.59 14N23.00 90W36.08 -0.92 0.00
PS02IP-1 0.56PS10IP-1 0.52PS12IP-1 0.31PS09IP-2 0.68PS11IP-1
0.40PS01IP-1 0.41
PS03IP-2 0.85PS08IP-2 1.01PS13IP-1 1.08
0

150116 1824 16.85 14N22.96 90W36.11 -0.63 0.00
PS01IP-1 0.62PS11IP-2 0.51PS10IP-2 0.75PS12IP-2 0.45PS09IP-0
0.74PS14IP-1 0.57
PS02IP-1 0.84PS08IP-1 0.99PS17IP-2 1.31
0

150116 1842 17.76 14N22.96 90W36.10 -0.56 0.00
PS01IP-1 0.74PS17IP-2 1.26PS10IP-1 0.65PS09IP-1 0.92PS08IP-1
0.94PS14IP-1 0.71
PS02IP-2 0.91PS12IP-1 0.57PS11IP-1 0.78
0

150116 1859 51.21 14N22.97 90W36.12 -0.72 0.00
PS11IP-2 0.56PS10IP-2 0.52PS12IP-2 0.38PS09IP-2 0.86PS14IP-1
0.51PS01IP-1 0.59
PS02IP-1 0.81PS17IP-1 1.10
0

150116 1926 10.04 14N22.94 90W36.12 -0.60 0.00
PS10IP-1 0.63PS14IP-1 0.68PS13IP-1 0.90PS09IP-1 0.76PS18IP-1
1.32PS17IP-1 1.13
PS08IP-1 1.34PS19IP-1 1.55PS15IP-1 1.59PS07IP-1 1.46PS06IP-1
1.64PS05IP-1 2.00
PS16IP-1 1.58PS02IP-1 0.79PS12IP-1 0.58PS11IP-1 0.80PS03IP-1
0.76PS01IP-1 0.67
0

150116 20 6 50.58 14N22.94 90W36.11 -0.54 0.00
PS12IP-1 0.56PS11IP-1 0.73PS03IP-1 0.92PS10IP-1 0.68PS07IP-3
1.95PS02IP-1 1.07
PS14IP-1 0.72PS09IP-1 0.82PS13IP-1 0.95PS17IP-1 1.24PS08IP-1
1.06PS18IP-1 1.15
PS16IP-1 1.33PS19IP-1 1.58PS06IP-1 1.77PS15IP-2 1.86PS01IP-1 0.79
0

150116 2031 9.82 14N23.03 90W36.14 -1.17 0.00
PS14IP-3 0.68PS01IP-2 0.59PS08IP-2 1.23PS17IP-2 1.12PS16IP-2
1.30PS13IP-2 1.58
PS10IP-2 0.30PS11IP-2 0.59PS12IP-2 0.35PS09IP-2 0.76PS03IP-2 0.87
0

150116 21 5 2.95 14N22.95 90W36.11 -0.62   0.00
PS08IP-1 0.92PS17IP-1 1.24PS12IP-1 0.54PS11IP-1 0.61PS03IP-2
0.75PS01IP-0 0.66
PS02IP-1 0.77PS10IP-1 0.64PS13IP-2 1.31PS14IP-1 0.71PS09IP-1
0.79PS16IP-1 1.43
0

150116 2113 49.52 14N22.96 90W36.10 -0.86   0.00
PS17IP-2 1.19PS10IP-2 0.43PS12IP-2 0.34PS09IP-2 0.71PS11IP-2
0.53PS14IP-1 0.60
PS01IP-1 0.47PS02IP-1 0.69PS08IP-2 1.22
0

150116 2125 34.48 14N22.93 90W36.12 -0.55   0.00
PS07IP-2 1.60PS12IP-1 0.61PS11IP-2 0.74PS03IP-2 0.84PS10IP-1
0.71PS01IP-1 0.75
PS14IP-1 0.78PS09IP-1 0.84PS08IP-1 1.03PS17IP-3 1.30PS02IP-1 0.95
0

150116 2139 31.88 14N23.01 90W36.12 -0.59   0.00
PS08IP-1 0.94PS13IP-1 1.14PS15IP-3 1.58PS07IP-2 1.21PS01IP-2
0.46PS12IP-2 0.40
PS14IP-2 0.75PS02IP-2 0.83PS10IP-1 0.74PS11IP-1 0.69PS09IP-2
0.78PS17IP-1 1.16
0

150116 22 7 50.05 14N22.93 90W36.09 -0.88   0.00
PS16IP-1 1.44PS15IP-1 2.01PS01IP-1 0.62PS17IP-1 1.26PS11IP-1
0.38PS13IP-3 1.03
PS03IP-2 0.53PS12IP-1 0.30PS10IP-1 0.47PS02IP-2 0.61PS09IP-2
0.74PS14IP-2 0.53
PS08IP-1 0.70
0

150116 2236 6.08 14N22.97 90W36.14 -0.41   0.00
PS18IP-2 1.66PS07IP-1 1.23PS16IP-2 1.67PS15IP-1 1.79PS04IP-1
2.02PS14IP-1 0.90
PS10IP-1 0.82PS12IP-1 0.73PS11IP-2 1.01PS09IP-1 0.97PS01IP-1
0.85PS03IP-2 1.01
PS13IP-2 1.09PS02IP-2 0.97PS08IP-2 1.08PS17IP-1 1.10
0

150116 2237 7.51 14N23.06 90W36.16 -0.50   0.00
PS10IP-2 0.96PS03IP-3 0.68PS12IP-2 0.70PS01IP-2 0.63PS14IP-3
0.84PS09IP-2 0.64
PS16IP-2 1.27PS17IP-2 1.44PS08IP-2 0.66PS15IP-1 1.33PS07IP-2 1.77
0

150116 2357 38.53 14N22.93 90W36.14 -0.95   0.00
PS15IP-2 1.53PS12IP-1 0.31PS16IP-1 1.67PS01IP-1 0.49PS11IP-1
0.44PS03IP-2 0.69

PS13IP-2 1.06PS02IP-2 0.50PS10IP-2 0.61PS09IP-1 0.72PS17IP-1
1.46PS08IP-1 0.99

0

150117 038 45.14 14N23.01 90W36.12 -0.80   0.00
PS14IP-1 0.58PS08IP-0 0.94PS11IP-2 0.57PS12IP-0 0.41PS10IP-0
0.50PS02IP-1 0.78
PS09IP-1 0.64PS01IP-1 0.52

0

150117 041 20.39 14N22.99 90W36.11 -0.48   0.00
PS01IP-1 0.94PS09IP-1 0.91PS10IP-1 0.76PS12IP-1 0.59PS11IP-1
0.78PS14IP-1 0.81
PS03IP-1 0.86PS02IP-1 1.02PS13IP-1 1.08PS08IP-1 1.07PS17IP-1
1.09PS18IP-1 1.37
PS16IP-1 1.25PS15IP-1 1.34PS06IP-1 1.93

0

150117 110 47.93 14N22.94 90W36.14 -0.70   0.00
PS02IP-3 1.08PS10IP-1 0.52PS12IP-1 0.48PS09IP-1 0.68PS14IP-1
0.59PS11IP-1 0.64
PS01IP-1 0.71PS17IP-1 1.22PS08IP-2 0.87

0

150117 131 21.49 14N23.02 90W36.09 -0.81   0.00
PS03IP-3 0.79PS13IP-3 1.06PS04IP-1 2.28PS18IP-1 1.09PS16IP-3
1.37PS15IP-1 1.52
PS02IP-1 0.77PS06IP-1 2.19PS10IP-1 0.56PS09IP-1 0.27PS14IP-2
0.61PS07IP-1 1.98
PS11IP-3 0.51PS01IP-1 0.47PS08IP-1 0.91

0

150117 138 3.63 14N23.03 90W36.13 -1.03   0.00
PS14IP-1 0.44PS11IP-1 0.70PS01IP-1 0.42PS02IP-3 0.61PS08IP-2
1.15PS17IP-2 1.18
PS10IP-1 0.38PS12IP-1 0.30PS09IP-1 0.77

0

150117 144 27.15 14N22.95 90W36.21 -0.68   0.00
PS06IP-1 1.53PS12IP-2 0.25PS11IP-1 0.81PS07IP-3 1.45PS01IP-2
0.45PS03IP-1 1.07
PS13IP-3 1.09PS08IP-1 1.01PS15IP-2 1.36PS02IP-1 0.95PS18IP-2
1.37PS17IP-1 1.32
PS10IP-3 0.19PS09IP-1 0.54PS14IP-1 0.53

0

150117 231 45.21 14N22.75 90W36.27 -0.37   0.00
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1.01PS09IP-1 1.11
PS05IP-3 2.25PS01IP-1 0.00PS12IP-1 0.00PS11IP-1 0.91PS14IP-1
1.17PS10IP-1 1.03

PS13IP-1 1.27PS17IP-1 2.03
0

150117 237 52.93 14N22.91 90W36.14 -0.69 0.00
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PS16IP-1 1.69PS07IP-1 1.22PS14IP-1 0.72PS01IP-0 0.66PS09IP-1 0.91PS02IP-1 0.76
PS10IP-1 0.67PS12IP-0 0.52PS06IP-1 1.64
0

150117 3 1 9.95 14N22.94 90W36.11 -0.23 0.00
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PS10IP-1 1.08PS09IP-1 1.23PS17IP-1 1.35PS16IP-1 1.40PS08IP-1 1.31PS13IP-1 1.22
PS18IP-1 1.49PS19IP-1 1.54PS15IP-1 1.58PS07IP-1 1.60PS06IP-1 1.59PS05IP-1 1.65
PS01IP-0 1.10
0

150117 337 41.67 14N23.00 90W36.09 -0.75 0.00
PS08IP-1 1.18PS17IP-1 0.88PS11IP-2 0.50PS12IP-2 0.44PS10IP-2 0.50PS01IP-2 0.60
PS02IP-1 0.74PS14IP-1 0.58PS09IP-1 0.66
0

150117 337 57.54 14N22.94 90W36.09 -0.88 0.00
PS08IP-1 1.12PS11IP-1 0.42PS02IP-2 0.71PS01IP-1 0.44PS10IP-1 0.47PS14IP-2 0.46
PS09IP-2 0.77PS17IP-1 1.44PS12IP-1 0.30
0

150117 350 13.74 14N22.99 90W36.08 -1.02 0.00
PS02IP-1 0.56PS08IP-1 0.59PS17IP-1 1.20PS16IP-1 1.81PS19IP-1 1.80PS15IP-1 2.18
PS06IP-1 2.38PS05IP-1 2.44PS04IP-1 2.24PS18IP-1 1.50PS13IP-1 1.01PS07IP-1 1.93
PS12IP-1 0.32PS11IP-1 0.34PS10IP-1 0.37PS01IP-1 0.39PS03IP-1 0.46PS14IP-1 0.50
PS09IP-1 0.57
0

150117 355 59.27 14N23.00 90W36.15 -0.64 0.00
PS03IP-1 0.78PS01IP-1 0.64PS02IP-1 0.89PS12IP-1 0.51PS11IP-1 0.60PS10IP-1 0.61
PS14IP-1 0.65PS13IP-1 1.22PS09IP-1 0.75PS17IP-1 0.92PS16IP-1 1.57PS08IP-1 0.85
PS15IP-1 1.58PS07IP-1 1.10PS06IP-1 1.69PS05IP-1 2.00
0

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PS12IP-1 0.36PS01IP-0 0.56PS10IP-1 0.41PS11IP-2 0.37PS09IP-1
0.57PS17IP-1 1.21
PS08IP-1 1.50PS14IP-1 0.28
0

150117 452 35.60 14N22.99 90W35.99 -0.92 0.00
PS15IP-1 2.26PS01IP-2 0.00PS03IP-1 0.49PS11IP-2 0.45PS02IP-2
0.45PS12IP-2 0.00
PS10IP-3 0.04PS16IP-2 1.01PS14IP-3 0.38PS09IP-1 0.07PS17IP-1
1.09PS08IP-2 1.16
PS07IP-1 1.95
0

150117 5 2 15.90 14N22.96 90W36.07 -0.91 0.00
PS13IP-2 1.23PS12IP-1 0.30PS02IP-1 0.57PS10IP-1 0.48PS01IP-1
0.12PS09IP-1 0.86
PS14IP-1 0.55PS16IP-1 1.47PS17IP-1 1.37PS08IP-1 1.27PS03IP-2
0.53PS11IP-1 0.35
0

150117 5 5 23.42 14N22.95 90W36.15 -0.47 0.00
PS14IP-1 0.85PS05IP-1 1.92PS04IP-1 1.96PS01IP-1 0.84PS12IP-1
0.67PS09IP-1 0.91
PS02IP-1 0.96PS17IP-1 1.41PS10IP-1 0.80PS08IP-1 1.08PS11IP-1
0.85PS16IP-1 1.61
PS03IP-1 0.89PS13IP-2 1.05PS15IP-1 1.40PS18IP-1 1.28PS07IP-1
1.30PS19IP-1 1.75
PS06IP-1 1.53
0

150117 515 6.29 14N23.12 90W36.10 -1.21 0.00
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1.08PS16IP-1 2.58
PS02IP-1 0.79PS03IP-1 0.93PS13IP-1 1.35PS06IP-2 2.16PS01IP-1
0.53PS18IP-3 2.78
PS05IP-2 2.83PS15IP-3 2.62PS08IP-1 0.99PS09IP-1 0.95PS14IP-2
0.83PS07IP-3 2.37
0

150117 534 26.08 14N22.88 90W36.17 -0.72 0.00
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1.25PS10IP-1 0.50
PS01IP-1 0.77PS09IP-1 0.71PS16IP-2 1.89PS17IP-2 1.41PS08IP-2
1.03PS05IP-2 1.97
PS07IP-1 1.48PS11IP-2 0.54
0

150117 543 30.13 14N22.94 90W36.11 -1.04 0.00
PS08IP-1 1.23PS17IP-2 1.43PS16IP-2 0.81PS18IP-2 1.21PS12IP-1

0.00PS10IP-1 0.23
PS09IP-1 0.49PS14IP-1 0.74PS01IP-1 0.18PS03IP-2 0.73PS02IP-2 0.86
0
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PS08IP-1 1.38PS12IP-1 0.37PS11IP-1 0.75PS13IP-1 0.88PS02IP-1
0.75PS18IP-1 1.23
PS01IP-1 0.85PS10IP-1 0.97PS19IP-1 1.71PS14IP-1 1.02PS09IP-1
1.12PS16IP-1 1.44
PS17IP-1 1.41PS06IP-1 1.49PS07IP-1 1.63PS15IP-1 1.87PS03IP-1 0.83
0
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PS17IP-1 1.34PS12IP-2 0.45PS01IP-1 0.61PS10IP-1 0.59PS14IP-1
0.78PS11IP-1 0.52
PS09IP-1 0.73PS08IP-1 1.04PS15IP-2 2.08PS02IP-1 0.78
0
150117 554 28.83 14N22.98 90W36.11 -0.89 0.00
PS09IP-1 0.69PS01IP-1 0.59PS02IP-2 0.51PS17IP-1 1.11PS11IP-1
0.54PS12IP-1 0.29
PS10IP-1 0.44PS14IP-1 0.48
0
150117 611 40.65 14N22.96 90W36.12 -0.84 0.00
PS14IP-1 0.57PS09IP-1 0.67PS08IP-1 1.17PS15IP-1 1.59PS06IP-1
1.73PS17IP-1 1.25
PS12IP-1 0.36PS11IP-1 0.44PS10IP-1 0.50PS03IP-1 0.58PS01IP-1
0.55PS02IP-1 0.68
PS13IP-1 1.18
0
150117 617 11.51 14N22.91 90W36.14 -0.63 0.00
PS02IP-1 0.97PS04IP-1 1.95PS03IP-1 0.74PS12IP-1 0.52PS13IP-1
0.98PS10IP-1 0.66
PS01IP-1 0.69PS18IP-1 1.17PS14IP-1 0.74PS09IP-1 0.82PS16IP-1
1.65PS17IP-1 1.43
PS08IP-1 1.10PS07IP-1 1.67PS15IP-1 1.29PS11IP-1 0.59
0
150117 618 11.47 14N22.95 90W36.20 -0.93 0.00
PS10IP-2 0.31PS09IP-2 0.56PS14IP-2 0.57PS12IP-1 0.44PS11IP-1
0.67PS07IP-2 1.48
PS01IP-1 0.60PS08IP-1 0.95PS02IP-1 0.82PS13IP-2 1.23PS17IP-1
1.34PS16IP-1 1.72
0
150117 618 32.23 14N23.00 90W36.15 -0.98 0.00
PS10IP-1 0.50PS12IP-1 0.02PS09IP-2 0.66PS01IP-2 0.45PS02IP-1
0.89PS14IP-1 0.48
PS11IP-1 0.62PS08IP-1 1.04PS17IP-1 1.35PS03IP-1 0.78

0

150117 620 11.97 14N23.10 90W36.13 -1.62 0.00
PS09IP-1 1.33PS13IP-1 2.00PS12IP-1 0.97PS10IP-1 1.05PS01IP-1 1.30PS14IP-1 1.20
PS11IP-1 1.24PS03IP-1 1.30PS02IP-0 1.31PS08IP-1 1.60

0

150117 621 13.68 14N22.92 90W36.12 -0.59 0.00
PS16IP-3 1.49PS12IP-1 0.57PS11IP-1 0.66PS03IP-1 0.80PS01IP-1 0.72PS02IP-1 0.93
PS10IP-1 0.69PS14IP-1 0.76PS17IP-1 1.42PS08IP-1 0.95PS15IP-1 1.76PS07IP-1 1.59
PS09IP-1 0.82

0

150117 641 47.52 14N23.05 90W36.21 -0.91 0.00
PS17IP-2 1.01PS12IP-1 0.65PS10IP-2 0.14PS09IP-2 0.21PS14IP-2 0.00PS01IP-2 0.10
PS08IP-2 1.26PS11IP-2 0.66PS15IP-2 1.72PS03IP-2 0.93PS13IP-2 1.72PS02IP-2 1.01
PS16IP-1 1.48

0

150117 647 44.46 14N22.94 90W36.12 -0.71 0.00
PS14IP-1 0.65PS01IP-1 0.61PS08IP-1 1.02PS17IP-2 1.32PS02IP-2 1.01PS10IP-1 0.57
PS11IP-1 0.54PS12IP-1 0.48PS03IP-1 0.72PS09IP-2 0.72

0

150117 733 26.05 14N22.98 90W36.12 -0.77 0.00
PS13IP-1 1.08PS08IP-1 0.83PS17IP-2 1.12PS18IP-2 1.47PS12IP-1 0.43PS10IP-1 0.53
PS11IP-1 0.50PS01IP-1 0.58PS03IP-1 0.66PS14IP-1 0.60PS09IP-1 0.66PS02IP-1 0.77

0

150117 734 49.90 14N22.98 90W36.12 -0.55 0.00
PS12IP-1 0.59PS04IP-1 2.21PS17IP-2 1.10PS02IP-1 0.92PS14IP-1 0.77PS16IP-1 1.26
PS08IP-1 1.08PS09IP-1 0.73PS10IP-1 0.65PS11IP-1 0.74PS03IP-1 0.90PS18IP-1 1.26
PS15IP-1 1.40PS19IP-2 1.57PS06IP-2 1.69PS05IP-1 1.85PS01IP-1 0.84

0

150117 735 32.55 14N22.94 90W36.13 -0.49 0.00
PS09IP-1 0.82PS14IP-1 0.73PS01IP-1 0.83PS02IP-1 0.90PS17IP-2 1.23PS12IP-2 0.61
PS11IP-1 0.88PS10IP-2 0.61

0

150117 748 26.32 14N22.91 90W36.08 -0.92 0.00

PS01IP-1 0.46PS16IP-1 1.63PS10IP-1 0.48PS11IP-1 0.46PS09IP-1
0.37PS13IP-1 0.72
PS12IP-3 0.00PS03IP-3 0.87PS14IP-3 0.90PS07IP-1 2.04PS02IP-1
0.58PS08IP-1 1.24
PS19IP-3 2.12PS18IP-1 1.23PS15IP-3 2.05PS17IP-1 1.50PS05IP-1 2.05
0

150117 852 18.35 14N22.95 90W36.15 -0.58   0.00
PS06IP-1 1.75PS12IP-1 0.54PS11IP-1 0.79PS01IP-1 0.68PS03IP-1
0.78PS17IP-1 1.03
PS02IP-1 0.92PS10IP-1 0.61PS14IP-1 0.79PS13IP-1 1.08PS09IP-1
0.85PS18IP-1 1.54
PS16IP-1 1.63PS08IP-1 0.95PS19IP-1 1.62PS15IP-1 1.72PS07IP-1 1.11
0

150117 911 40.56 14N23.01 90W36.10 -0.50   0.00
PS10IP-1 0.75PS05IP-1 2.05PS12IP-1 0.61PS14IP-1 0.81PS02IP-1
0.84PS11IP-1 0.67
PS09IP-1 0.88PS03IP-1 1.01PS17IP-1 0.98PS08IP-1 1.01PS16IP-1
1.21PS13IP-1 1.14
PS18IP-1 1.30PS15IP-1 1.48PS19IP-1 1.77PS06IP-1 1.54PS07IP-1
1.87PS01IP-1 0.96
0

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PS18IP-1 1.42PS05IP-1 1.66PS19IP-1 1.62PS04IP-1 1.70PS07IP-1
1.91PS06IP-1 1.89
PS12IP-2 0.16PS14IP-2 0.54PS09IP-3 0.78PS08IP-3 1.18PS01IP-2
0.67PS10IP-2 0.81
PS17IP-1 1.14PS11IP-1 0.92PS02IP-1 0.72PS03IP-1 1.24PS16IP-1
1.55PS13IP-1 1.30
0

150117 952 22.67 14N22.96 90W36.12 -0.61   0.00
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0.54PS10IP-1 0.62
PS09IP-1 0.77PS02IP-1 0.82PS14IP-1 0.72PS18IP-1 1.23PS05IP-2
1.88PS06IP-1 1.95
PS08IP-1 0.92PS17IP-1 1.42PS16IP-1 1.34PS07IP-1 1.24PS11IP-1 0.68
0

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0.98PS17IP-1 1.38
PS13IP-2 1.22PS10IP-2 0.30PS11IP-2 0.54PS16IP-1 1.42PS03IP-1
0.66PS09IP-1 0.63
0

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2.31PS10IP-2 0.34
PS03IP-1 0.59PS11IP-2 0.60PS13IP-1 1.07PS09IP-2 0.63PS01IP-2
0.51PS14IP-1 0.74
PS02IP-1 0.43PS08IP-1 1.34
0
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PS16IP-2 1.59PS06IP-2 2.43PS07IP-3 1.68PS10IP-1 0.67PS13IP-1
0.77PS11IP-1 0.62
PS12IP-1 0.54PS03IP-2 1.24PS01IP-1 0.75PS02IP-1 0.77PS09IP-1
0.82PS14IP-1 0.77
PS08IP-1 1.01PS17IP-2 1.49
0
150117 1127 15.24 14N22.97 90W36.11 -0.86 0.00
PS10IP-1 0.41PS01IP-1 0.51PS12IP-1 0.35PS17IP-1 1.22PS03IP-1
0.67PS08IP-1 1.01
PS14IP-1 0.50PS09IP-1 0.76
0
150117 1136 45.82 14N22.94 90W36.10 -0.93 0.00
PS10IP-1 0.32PS12IP-1 0.28PS11IP-1 0.49PS01IP-1 0.53PS02IP-1
0.65PS14IP-2 0.49
PS09IP-2 0.75PS17IP-2 1.22PS08IP-1 1.39
0
150117 12 3 12.98 14N23.02 90W36.16 -0.98 0.00
PS09IP-1 0.86PS12IP-1 0.00PS11IP-1 0.36PS01IP-1 0.36PS03IP-1
0.90PS08IP-1 1.20
PS02IP-1 1.12PS13IP-1 1.22PS10IP-1 0.17PS17IP-1 1.11
0
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PS11IP-1 0.65PS12IP-1 0.52PS10IP-1 0.54PS02IP-1 0.71PS01IP-1
0.76PS09IP-1 0.69
PS14IP-1 0.63PS08IP-1 1.24
0
150117 1221 24.84 14N22.98 90W36.15 -0.70 0.00
PS16IP-1 1.36PS02IP-1 0.70PS10IP-1 0.56PS09IP-1 0.68PS12IP-1
0.45PS14IP-1 0.60
PS01IP-1 0.59PS11IP-1 0.67PS03IP-1 0.65PS08IP-1 0.82PS13IP-1
1.23PS17IP-1 1.30
PS07IP-2 1.07PS15IP-2 1.07PS19IP-3 1.43PS18IP-1 1.54PS05IP-1 1.81
0
150117 1222 55.61 14N22.99 90W36.13 -0.92 0.00
PS01IP-1 0.44PS09IP-1 0.56PS12IP-0 0.33PS17IP-1 1.17PS11IP-2
0.52PS14IP-0 0.49
PS08IP-1 1.28PS10IP-1 0.43

0

150117 1223 33.35 14N22.99 90W36.12 -0.89 0.00
PS08IP-3 0.92PS17IP-2 1.01PS02IP-1 0.71PS10IP-1 0.45PS12IP-1
0.32PS11IP-1 0.57
PS09IP-1 0.62PS01IP-1 0.48PS14IP-1 0.50

0

150117 1224 8.26 14N22.96 90W36.11 -0.84 0.00
PS02IP-2 0.75PS01IP-2 0.45PS17IP-1 1.10PS16IP-1 1.49PS11IP-1
0.52PS10IP-1 0.44
PS08IP-2 1.25PS09IP-1 0.71PS03IP-1 0.59PS12IP-1 0.36PS14IP-1 0.51

0

150117 1231 14.36 14N22.85 90W36.36 -2.17 0.00
PS17IP-3 2.46PS05IP-1 2.78PS07IP-1 2.77PS15IP-2 3.13PS04IP-1
3.45PS09IP-1 2.26
PS11IP-1 1.96PS03IP-1 2.18PS12IP-1 1.70PS13IP-1 2.67PS02IP-1
2.35PS10IP-1 2.09
PS01IP-1 2.22PS14IP-1 2.01PS16IP-1 3.02PS08IP-1 2.52

0

150117 1250 31.55 14N22.93 90W36.14 -0.55 0.00
PS01IP-1 0.72PS15IP-2 1.71PS12IP-1 0.62PS10IP-1 0.67PS02IP-1
0.99PS09IP-1 0.79
PS14IP-1 0.92PS08IP-1 0.91PS17IP-1 1.25PS16IP-1 1.59PS11IP-1 0.78

0

150117 1254 11.58 14N22.96 90W36.16 -0.38 0.00
PS04IP-1 2.15PS11IP-2 0.80PS03IP-1 0.98PS01IP-1 0.86PS02IP-2
1.00PS10IP-1 0.86
PS14IP-1 0.91PS18IP-1 1.48PS13IP-1 1.24PS09IP-1 1.07PS17IP-1
1.48PS08IP-1 1.15
PS16IP-1 1.41PS19IP-2 1.46PS15IP-1 1.49PS07IP-1 1.35PS05IP-1
1.69PS06IP-1 1.40
PS12IP-1 0.70

0

150117 13 3 49.28 14N22.98 90W36.12 -0.63 0.00
PS09IP-1 0.79PS05IP-1 1.92PS14IP-1 0.72PS11IP-1 0.51PS17IP-1
1.13PS01IP-1 0.57
PS16IP-1 0.75PS10IP-2 0.39PS08IP-1 1.02PS13IP-1 1.16PS19IP-1
1.72PS07IP-1 1.62
PS06IP-1 1.63PS12IP-2 0.09PS02IP-1 0.99

0

150117 1311 41.90 14N22.97 90W36.05 -0.52 0.00
PS08IP-1 1.24PS15IP-1 1.83PS10IP-1 0.98PS14IP-1 0.56PS12IP-1
0.63PS01IP-2 0.71
PS11IP-1 0.64PS03IP-1 0.93PS02IP-1 0.99PS17IP-1 1.18PS13IP-1
1.09PS18IP-1 1.04

PS19IP-1 1.33PS07IP-1 1.92PS09IP-1 0.62
0

150117 1331 33.71 14N22.94 90W36.11 -0.80 0.00
PS08IP-2 1.06PS12IP-1 0.44PS11IP-1 0.44PS10IP-1 0.49PS01IP-1 0.55PS02IP-1 0.80
PS13IP-2 1.03PS09IP-1 0.64PS14IP-2 0.59
0

150117 1410 28.73 14N22.97 90W36.12 -0.86 0.00
PS01IP-1 0.57PS03IP-1 0.52PS09IP-1 0.68PS02IP-1 0.67PS14IP-1 0.55PS13IP-1 1.41
PS08IP-1 1.23PS17IP-1 1.31PS16IP-1 1.19PS07IP-1 1.43PS12IP-1 0.34PS11IP-1 0.51
PS10IP-1 0.45
0

150117 1417 38.74 14N23.00 90W36.13 -0.69 0.00
PS16IP-2 1.22PS06IP-1 1.80PS09IP-1 0.69PS08IP-1 0.83PS19IP-2 1.44PS10IP-1 0.55
PS12IP-1 0.44PS01IP-1 0.60PS11IP-1 0.63PS03IP-1 0.75PS02IP-1 0.70PS17IP-1 1.17
PS13IP-1 1.33PS07IP-2 1.07PS14IP-1 0.61PS15IP-2 1.07
0

150117 1419 38.57 14N22.93 90W36.15 -0.46 0.00
PS16IP-1 1.63PS01IP-1 0.72PS12IP-1 0.58PS14IP-1 0.88PS10IP-1 0.82PS11IP-1 0.80
PS02IP-1 0.96PS09IP-1 0.95PS03IP-1 0.96PS17IP-1 1.39PS08IP-1 1.15PS13IP-1 1.53
PS18IP-1 1.27PS07IP-1 1.29PS04IP-1 1.89
0

150117 1422 46.81 14N23.01 90W36.08 -0.98 0.00
PS01IP-1 0.41PS10IP-1 0.43PS09IP-2 0.92PS17IP-1 1.22PS08IP-2 1.31PS12IP-2 0.00
PS11IP-2 0.25PS03IP-1 0.84PS02IP-1 0.55
0

150117 1427 16.61 14N22.90 90W36.14 -0.56 0.00
PS10IP-1 0.68PS11IP-2 0.76PS12IP-1 0.61PS03IP-2 0.88PS09IP-1 0.86PS14IP-1 0.78
PS01IP-1 0.85PS02IP-1 1.00PS07IP-1 1.60PS08IP-1 1.10PS17IP-2 1.44
0

150117 1446 11.73 14N22.98 90W36.12 -0.74 0.00
PS11IP-1 0.66PS14IP-1 0.58PS08IP-1 0.91PS17IP-1 1.15PS12IP-1 0.43PS10IP-1 0.50
PS01IP-1 0.55PS09IP-2 0.80
0

150117 1527 35.51 14N22.98 90W36.12 -0.83   0.00
PS10IP-1 0.51PS08IP-1 0.80PS09IP-1 0.64PS14IP-1 0.56PS12IP-1
0.39PS11IP-1 0.46
PS01IP-1 0.67PS03IP-1 0.55PS02IP-1 0.64PS13IP-1 1.18PS17IP-1
1.16PS16IP-1 1.28
PS18IP-1 1.41
0

150117 16 5 32.51 14N23.02 90W36.19 -0.97   0.00
PS19IP-1 2.09PS09IP-1 0.29PS13IP-1 1.25PS10IP-1 0.00PS07IP-1
1.67PS06IP-1 2.35
PS05IP-1 2.25PS15IP-2 1.62PS16IP-2 1.89PS17IP-1 1.09PS02IP-1
1.21PS01IP-1 0.00
PS08IP-1 1.36PS14IP-1 0.17PS03IP-1 0.73PS11IP-1 0.31
0

150117 16 7 33.17 14N22.94 90W36.16 -0.95   0.00
PS05IP-3 1.83PS04IP-3 2.22PS12IP-1 0.13PS14IP-1 0.66PS02IP-2
0.88PS17IP-2 1.37
PS10IP-1 0.41PS09IP-1 0.77PS11IP-1 0.51PS03IP-1 0.96PS08IP-2
1.20PS16IP-1 1.53
PS13IP-2 1.09PS18IP-2 1.33PS15IP-2 1.52PS07IP-1 1.43PS06IP-1
1.76PS01IP-1 0.59
0

150117 1623 1.08 14N22.96 90W36.16 -0.85   0.00
PS12IP-1 0.36PS17IP-2 0.90PS11IP-1 0.43PS06IP-1 1.53PS02IP-1
0.90PS03IP-1 1.18
PS16IP-2 0.99PS13IP-1 0.99PS05IP-1 1.92PS09IP-1 0.54PS18IP-2
1.40PS15IP-1 1.81
PS14IP-1 0.50PS19IP-1 1.86PS10IP-1 0.37PS08IP-3 1.42PS01IP-1 0.55
0

150117 1736 16.23 14N22.96 90W36.11 -0.85   0.00
PS03IP-1 0.91PS14IP-1 0.49PS10IP-1 0.48PS12IP-1 0.32PS09IP-1
0.62PS11IP-1 0.41
PS01IP-1 0.51PS02IP-1 0.51PS08IP-2 1.28PS17IP-1 1.41PS07IP-1
1.59PS16IP-1 1.33
PS15IP-2 1.87
0

150117 1748 47.55 14N22.99 90W36.13 -0.83   0.00
PS10IP-1 0.46PS02IP-2 0.60PS12IP-1 0.33PS11IP-1 0.67PS03IP-1
0.74PS09IP-1 0.68
PS14IP-1 0.52PS01IP-1 0.48PS08IP-1 0.79PS17IP-1 1.26PS06IP-1
1.86PS16IP-3 0.89
0

150117 1817 49.48 14N22.97 90W36.06 -0.88   0.00
PS14IP-1 0.58PS12IP-1 0.26PS03IP-2 0.46PS19IP-1 1.75PS11IP-1

0.37PS15IP-1 1.67
PS09IP-1 0.75PS13IP-1 0.88PS10IP-1 0.71PS07IP-1 1.93PS05IP-1 1.90PS04IP-1 2.42
PS16IP-2 1.36PS17IP-2 1.54PS02IP-1 0.72PS01IP-1 0.35PS18IP-1 1.10PS08IP-2 1.75

0

150117 1921 24.45 14N22.96 90W36.17 -0.99 0.00
PS12IP-1 0.34PS11IP-1 0.67PS01IP-1 0.56PS03IP-1 1.08PS02IP-1 0.66PS14IP-1 0.55
PS09IP-1 0.63PS13IP-1 1.06PS08IP-1 1.30PS18IP-1 1.47PS17IP-1 1.23PS16IP-1 1.54
PS07IP-1 1.60PS10IP-1 0.14

0

150117 1929 36.38 14N23.01 90W36.02 -0.61 0.00
PS01IP-1 0.75PS03IP-1 0.97PS11IP-1 0.79PS16IP-1 1.15PS14IP-1 0.66PS10IP-1 0.55
PS09IP-1 1.01PS15IP-2 1.73PS02IP-1 0.24PS12IP-1 0.58

0

150117 1934 50.65 14N22.98 90W36.15 -0.96 0.00
PS01IP-1 0.41PS02IP-2 0.77PS10IP-1 0.41PS09IP-1 0.50PS14IP-1 0.44PS08IP-1 1.02
PS11IP-1 0.54PS03IP-1 0.72PS13IP-1 1.23PS17IP-1 1.40PS16IP-0 1.43PS18IP-1 1.36
PS12IP-1 0.28

0

150117 1941 55.59 14N23.03 90W36.20 -1.61 0.00
PS12IP-1 1.01PS18IP-2 1.78PS01IP-1 1.29PS11IP-1 1.07PS14IP-0 1.19PS10IP-1 1.14
PS02IP-1 1.31PS03IP-1 1.48PS08IP-2 1.42PS17IP-1 1.84PS16IP-2 1.68PS13IP-1 1.84
PS09IP-1 1.18

0

150117 1951 59.58 14N23.02 90W36.07 -1.05 0.00
PS02IP-1 0.73PS08IP-1 0.82PS05IP-1 2.20PS07IP-1 2.16PS06IP-1 2.29PS17IP-1 1.32
PS18IP-1 1.29PS15IP-1 1.94PS16IP-1 1.00PS19IP-1 2.01PS10IP-1 0.50PS12IP-1 0.31
PS11IP-1 0.52PS09IP-1 0.67PS14IP-1 0.60PS03IP-1 0.57PS01IP-1 0.56

0

150117 20 6 26.30 14N22.95 90W36.13 -0.77 0.00
PS01IP-1 0.57PS02IP-2 0.73PS08IP-1 1.10PS18IP-1 1.25PS17IP-2 1.38PS16IP-2 1.54
PS07IP-2 1.67PS10IP-1 0.44PS11IP-2 0.50PS12IP-1 0.41PS03IP-1 0.83PS09IP-1 0.62

PS14IP-1 0.54
0

150117 2011 54.58 14N23.00 90W36.18 -0.99   0.00
PS13IP-1 0.99PS18IP-1 1.92PS01IP-1 0.32PS14IP-1 0.31PS12IP-1 0.12PS09IP-1 0.66
PS02IP-1 0.39PS11IP-1 0.50PS08IP-1 1.25PS17IP-1 0.93PS03IP-1 1.00PS16IP-1 1.97
PS15IP-1 1.71PS07IP-1 1.94PS19IP-1 2.22PS06IP-1 1.75
0

150117 2021 57.87 14N22.91 90W36.06 -0.68   0.00
PS11IP-1 0.54PS10IP-1 0.79PS01IP-1 0.83PS18IP-1 1.31PS14IP-1 0.56PS09IP-1 0.98
PS19IP-1 1.30PS16IP-1 1.32PS17IP-1 1.46PS08IP-1 1.14PS06IP-1 1.97PS07IP-1 1.79
PS15IP-1 1.64PS12IP-1 0.35PS03IP-1 0.59PS02IP-1 0.75
0

150117 2030 0.50 14N22.95 90W36.14 -0.75   0.00
PS05IP-2 2.51PS15IP-1 1.59PS12IP-1 0.40PS11IP-1 0.59PS10IP-1 0.45PS03IP-1 0.72
PS01IP-1 0.61PS02IP-1 0.73PS14IP-1 0.62PS09IP-1 0.85PS08IP-1 1.08PS18IP-1 1.26
PS17IP-1 1.14PS16IP-1 1.40PS19IP-1 1.99PS06IP-1 1.51
0

150117 2053 17.87 14N23.03 90W36.13 -0.76   0.00
PS15IP-1 1.37PS12IP-1 0.25PS11IP-1 0.78PS10IP-1 0.50PS14IP-1 0.65PS09IP-1 0.64
PS02IP-1 0.91PS08IP-1 0.86PS17IP-1 0.94PS16IP-1 1.17PS01IP-1 0.45
0

150117 21 2 34.05 14N22.94 90W36.08 -0.14   0.00
PS14IP-1 1.35PS15IP-1 1.73PS11IP-1 1.14PS12IP-1 0.48PS03IP-1 1.19PS13IP-1 1.37
PS09IP-1 1.30PS01IP-1 0.92PS02IP-1 1.33PS08IP-1 1.52PS18IP-1 1.57PS17IP-1 1.49
PS19IP-1 1.42PS06IP-1 1.80PS16IP-1 1.55PS04IP-1 1.94PS07IP-1 1.75PS10IP-1 1.14
0

150117 2121 10.37 14N23.07 90W36.14 -1.01   0.00
PS02IP-1 0.61PS03IP-1 1.16PS17IP-1 1.06PS01IP-1 0.39PS12IP-1 0.44PS10IP-1 0.44
PS14IP-1 0.48PS09IP-1 0.59PS11IP-1 0.67
0

150117 2124 47.47 14N22.97 90W36.16 -0.84   0.00
PS16IP-1 1.58PS10IP-1 0.50PS09IP-1 0.63PS14IP-1 0.40PS12IP-1 0.33PS11IP-1 0.50

PS01IP-1 0.49PS03IP-1 0.67PS08IP-1 0.93PS13IP-1 1.27PS17IP-1
1.23PS06IP-1 1.59
0

150117 2138 13.74 14N22.98 90W36.14 -0.77   0.00
PS01IP-1 0.61PS11IP-2 0.57PS02IP-0 0.79PS16IP-1 1.51PS03IP-2
0.90PS12IP-1 0.39
PS08IP-1 0.75PS14IP-1 0.53PS09IP-1 0.73PS10IP-1 0.46
0

150117 22 6 23.87 14N22.95 90W36.14 -0.70   0.00
PS14IP-1 0.57PS11IP-1 0.39PS01IP-1 0.65PS03IP-1 0.94PS08IP-1
1.03PS17IP-2 1.03
PS12IP-1 0.59PS10IP-1 0.50PS09IP-1 0.70
0

150117 2215 54.48 14N23.05 90W36.20 -0.98   0.00
PS01IP-1 0.40PS09IP-1 0.40PS11IP-1 0.50PS03IP-1 1.30PS08IP-1
1.01PS14IP-1 0.24
PS12IP-1 0.03PS17IP-1 1.27PS10IP-1 0.55
0

150117 2216 55.37 14N22.97 90W36.06 -0.95   0.00
PS08IP-1 1.37PS17IP-2 1.18PS15IP-1 2.44PS11IP-1 0.48PS10IP-1
0.43PS03IP-2 0.65
PS12IP-1 0.00PS09IP-2 0.50PS14IP-1 0.70PS01IP-1 0.04PS02IP-1 1.02
0

150117 2221 42.43 14N23.03 90W36.22 -0.98   0.00
PS13IP-1 1.41PS17IP-1 1.35PS11IP-1 0.63PS12IP-1 0.26PS10IP-1
0.37PS01IP-1 0.56
PS09IP-1 0.52PS14IP-1 0.44PS08IP-2 0.60
0

150117 2226 2.08 14N22.95 90W36.18 -0.83   0.00
PS19IP-1 1.87PS08IP-1 1.08PS14IP-1 0.61PS17IP-1 1.40PS09IP-1
0.58PS01IP-1 0.49
PS10IP-1 0.37PS15IP-1 1.62PS12IP-1 0.38PS16IP-1 1.52PS07IP-1
1.06PS11IP-1 0.65
PS03IP-1 0.84PS13IP-1 1.03PS18IP-1 1.65PS05IP-1 1.80PS02IP-1 0.66
0

150117 2229 43.50 14N22.97 90W36.10 -0.86   0.00
PS11IP-2 0.62PS02IP-2 0.56PS16IP-3 0.92PS03IP-1 0.66PS08IP-1
1.26PS10IP-2 0.65
PS12IP-1 0.33PS09IP-1 0.57PS01IP-1 0.49PS14IP-1 0.51
0

150117 2238 41.31 14N22.76 90W36.21 -0.51   0.00
PS17IP-2 1.79PS09IP-1 1.18PS12IP-1 0.77PS18IP-1 1.52PS14IP-1
1.08PS11IP-1 0.90

PS01IP-1 1.06PS08IP-2 1.30PS07IP-1 1.46PS05IP-1 1.36PS02IP-1
1.53PS10IP-1 0.88
0

150117 2248 6.12 14N23.04 90W36.13 -0.77   0.00
PS07IP-1 1.43PS03IP-1 0.80PS10IP-1 0.62PS13IP-1 1.55PS11IP-1
0.67PS02IP-1 0.83
PS12IP-1 0.23PS01IP-1 0.45PS14IP-1 0.40PS09IP-1 0.89PS17IP-1
0.79PS08IP-1 1.39
PS06IP-1 1.63PS15IP-1 1.47
0

150117 2250 47.40 14N22.95 90W36.15 -0.26   0.00
PS04IP-1 1.86PS01IP-1 1.08PS12IP-1 0.88PS14IP-1 1.10PS02IP-1
1.11PS10IP-1 1.01
PS11IP-1 0.97PS09IP-1 1.17PS03IP-1 1.16PS08IP-1 1.27PS16IP-1
1.48PS13IP-1 1.34
PS18IP-1 1.71PS15IP-1 1.50PS07IP-1 1.57PS19IP-1 1.70PS06IP-1
1.66PS05IP-1 1.62
PS17IP-1 1.36
0

150117 2251 24.36 14N23.02 90W36.11 -0.97   0.00
PS13IP-1 1.19PS08IP-1 1.17PS10IP-1 0.31PS17IP-1 1.03PS09IP-1
0.71PS11IP-1 0.52
PS12IP-1 0.23PS14IP-1 0.68PS03IP-1 0.78
0

150117 2258 3.66 14N22.96 90W36.06 -0.62   0.00
PS18IP-1 1.14PS17IP-1 1.45PS08IP-1 0.97PS06IP-0 1.90PS09IP-1
0.79PS14IP-1 0.72
PS12IP-1 0.52PS11IP-1 0.65PS03IP-1 0.79PS02IP-1 0.69PS01IP-1
0.73PS13IP-3 1.07
PS10IP-1 0.68PS16IP-1 1.13
0

150117 2259 29.77 14N22.97 90W36.20 -0.59   0.00
PS01IP-1 0.61PS03IP-1 1.21PS09IP-1 0.71PS14IP-1 0.55PS10IP-1
0.50PS12IP-2 0.37
PS11IP-1 0.78PS02IP-1 0.88PS16IP-1 1.60PS06IP-1 1.48
0

150117 2326 46.02 14N22.97 90W36.16 -1.07   0.00
PS03IP-1 0.94PS11IP-1 0.38PS10IP-1 0.42PS13IP-2 1.40PS12IP-1
0.29PS09IP-2 0.82
PS14IP-1 0.50PS01IP-1 0.58PS02IP-2 1.05PS08IP-1 1.03PS17IP-1
1.38PS16IP-2 2.00
0

150117 2338 42.30 14N23.00 90W36.24 -1.56   0.00
PS10IP-1 1.06PS09IP-1 1.23PS12IP-1 0.94PS14IP-1 1.16PS11IP-1

1.25PS01IP-1 1.19
PS03IP-1 1.24PS08IP-1 1.36PS02IP-3 1.21PS17IP-1 1.91PS13IP-2 2.11
0

150117 2344 56.04 14N22.92 90W36.12 -0.56   0.00
PS18IP-2 1.14PS11IP-1 0.68PS12IP-1 0.56PS01IP-1 0.75PS03IP-1
0.87PS10IP-1 0.73
PS02IP-1 1.03PS14IP-1 0.70PS09IP-1 0.90PS17IP-1 1.39PS08IP-1 0.94
0

150117 2353 44.65 14N22.96 90W36.17 -1.66   0.00
PS12IP-0 0.97PS10IP-1 1.25PS09IP-1 1.40PS03IP-1 1.54PS14IP-2
1.43PS06IP-1 2.45
PS13IP-1 1.77PS01IP-1 1.20PS02IP-2 1.28PS08IP-1 1.71PS18IP-1
2.17PS17IP-1 1.89
PS11IP-0 1.06
0

150118 019 5.82 14N22.85 90W36.35 -2.19   0.00
PS09IP-1 2.39PS12IP-2 1.84PS03IP-1 2.20PS13IP-1 2.43PS10IP-1
1.98PS01IP-1 2.14
PS02IP-1 2.19PS14IP-1 2.02PS18IP-1 3.13PS15IP-1 2.68PS07IP-1
2.78PS06IP-1 2.92
PS16IP-1 2.98PS17IP-1 2.94PS08IP-1 2.47PS11IP-1 2.08
0

150118 020 53.46 14N23.03 90W36.19 -1.12   0.00
PS08IP-1 1.09PS11IP-1 0.83PS10IP-1 0.45PS12IP-1 0.41PS09IP-1
0.59PS01IP-1 0.63
PS17IP-2 1.17PS14IP-1 0.51
0

150118 047 30.77 14N22.98 90W36.13 -0.83   0.00
PS01IP-1 0.51PS10IP-1 0.48PS12IP-1 0.41PS14IP-1 0.56PS02IP-1
0.73PS17IP-1 1.21
PS18IP-1 1.41PS16IP-1 1.46PS13IP-1 1.14PS03IP-1 0.64PS08IP-1
0.77PS11IP-1 0.50
PS09IP-1 0.62
0

150118 114 13.93 14N22.90 90W36.19 -0.72   0.00
PS03IP-1 0.65PS15IP-1 1.62PS02IP-1 0.89PS12IP-1 0.47PS11IP-1
0.64PS01IP-1 0.56
PS13IP-1 1.41PS10IP-1 0.55PS16IP-1 1.93PS06IP-1 1.47PS14IP-1
0.61PS09IP-1 0.65
PS17IP-1 1.28PS08IP-1 1.35PS07IP-1 1.44
0

150118 130 30.31 14N22.99 90W36.11 -0.52   0.00
PS13IP-1 1.04PS18IP-1 1.52PS17IP-1 1.41PS16IP-1 1.03PS08IP-1
0.94PS19IP-1 1.60

PS15IP-1 1.69PS07IP-1 1.31PS05IP-1 1.98PS09IP-1 0.86PS06IP-1
1.78PS12IP-1 0.66
PS11IP-1 0.72PS01IP-1 0.75PS03IP-1 0.88PS02IP-1 0.88PS10IP-1
0.73PS14IP-1 0.78
0

150118 131 58.40 14N22.92 90W36.16 -0.37   0.00
PS04IP-1 2.00PS01IP-1 1.02PS12IP-1 0.79PS02IP-1 1.04PS14IP-1
0.92PS11IP-1 0.96
PS10IP-1 0.86PS17IP-1 1.28PS03IP-1 1.08PS09IP-1 1.02PS16IP-1
1.96PS08IP-1 1.25
PS13IP-1 1.21PS15IP-1 1.50PS19IP-1 1.45PS07IP-1 1.49PS06IP-1
1.54PS05IP-1 1.57
PS18IP-1 1.42
0

150118 143 48.20 14N22.98 90W36.15 -0.74   0.00
PS08IP-1 1.22PS05IP-1 1.82PS02IP-1 1.03PS11IP-1 0.95PS03IP-1
0.45PS16IP-1 1.65
PS17IP-1 0.88PS14IP-1 0.49PS12IP-1 0.43PS10IP-1 0.55PS09IP-2
0.25PS18IP-1 1.35
PS01IP-1 0.00
0

150118 212 44.67 14N22.98 90W36.12 -0.82   0.00
PS17IP-1 1.11PS16IP-1 1.63PS18IP-1 1.16PS10IP-1 0.47PS09IP-1
0.63PS12IP-1 0.38
PS14IP-1 0.55PS11IP-1 0.56PS01IP-1 0.51PS03IP-1 0.61PS08IP-1
0.93PS02IP-1 0.60
PS13IP-1 1.23
0

150118 229 11.01 14N22.95 90W36.14 -0.70   0.00
PS01IP-1 0.61PS02IP-1 0.78PS18IP-1 1.47PS08IP-1 0.86PS14IP-1
0.66PS17IP-1 1.37
PS15IP-1 1.54PS12IP-1 0.47PS11IP-1 0.64PS10IP-1 0.59PS03IP-1
0.68PS09IP-1 0.70
0

150118 238 56.04 14N22.98 90W36.14 -0.94   0.00
PS10IP-2 0.50PS11IP-1 0.54PS12IP-1 0.32PS03IP-1 0.80PS09IP-1
0.67PS14IP-2 0.63
PS01IP-1 0.54PS02IP-1 0.77PS08IP-1 0.86PS15IP-3 1.41PS16IP-2
1.23PS17IP-1 1.32
0

150118 248 22.11 14N22.99 90W36.12 -0.96   0.00
PS08IP-1 0.89PS01IP-1 0.51PS05IP-1 2.24PS12IP-1 0.29PS17IP-1
1.34PS11IP-2 0.59
PS02IP-1 0.70PS16IP-1 1.36PS03IP-2 0.51PS09IP-1 0.70PS13IP-1

1.24PS06IP-2 1.37
PS14IP-1 0.50PS10IP-1 0.38PS19IP-1 1.61
0

150118 249 5.60 14N22.95 90W36.11 -0.21 0.00
PS07IP-1 1.59PS06IP-1 1.72PS05IP-1 1.56PS04IP-1 2.12PS19IP-1 1.94PS13IP-1 1.20
PS01IP-1 1.09PS12IP-1 0.94PS02IP-1 1.20PS14IP-0 1.18PS11IP-1 0.92PS03IP-1 1.11
PS10IP-1 1.08PS09IP-1 1.23PS17IP-1 1.35PS16IP-1 1.38PS08IP-1 1.35PS18IP-1 1.36
PS15IP-1 1.59
0

150118 250 54.70 14N22.99 90W36.13 -0.73 0.00
PS12IP-1 0.44PS14IP-1 0.49PS09IP-2 0.68PS10IP-1 0.54PS03IP-2 0.80PS02IP-1 0.79
PS17IP-2 0.95PS16IP-2 1.50PS08IP-1 0.95PS13IP-1 0.96PS01IP-1 0.55PS15IP-2 1.69
PS11IP-1 0.70
0

150118 257 19.55 14N23.06 90W36.19 -0.98 0.00
PS01IP-1 0.34PS15IP-1 1.59PS02IP-2 0.77PS17IP-2 1.32PS16IP-1 1.49PS10IP-2 0.62
PS09IP-2 0.69PS14IP-2 0.64PS12IP-1 0.08PS11IP-2 0.95PS03IP-2 1.02PS08IP-1 0.76
0

150118 3 0 52.85 14N22.93 90W36.14 -0.57 0.00
PS08IP-1 1.01PS16IP-1 1.45PS19IP-1 1.62PS15IP-1 1.66PS07IP-1 1.61PS05IP-1 1.83
PS18IP-1 1.32PS06IP-1 1.59PS12IP-1 0.55PS01IP-1 0.88PS11IP-1 0.85PS10IP-1 0.62
PS14IP-1 0.75PS02IP-1 0.95PS03IP-1 0.77PS09IP-1 0.73PS13IP-1 0.99PS17IP-1 1.28
0

150118 313 15.50 14N22.98 90W36.09 -0.88 0.00
PS02IP-1 0.64PS10IP-1 0.47PS01IP-1 0.49PS11IP-1 0.46PS12IP-1 0.31PS03IP-1 0.68
PS09IP-1 0.73PS08IP-1 0.74PS17IP-1 1.20PS14IP-1 0.53PS15IP-1 2.01
0

150118 315 14.15 14N22.93 90W36.15 -0.37 0.00
PS12IP-1 0.79PS03IP-1 1.19PS01IP-1 0.94PS11IP-1 0.91PS10IP-1 0.79PS14IP-1 0.89
PS02IP-1 1.18PS09IP-1 0.97PS13IP-1 1.23PS08IP-1 1.24PS17IP-1 1.36PS16IP-1 1.35
PS18IP-1 1.46PS19IP-1 1.67PS15IP-1 1.60PS07IP-1 1.69PS05IP-1 1.51

0

150118 315 48.93 14N23.03 90W36.09 -0.97 0.00
PS02IP-3 0.48PS01IP-3 0.14PS17IP-1 1.03PS03IP-3 0.49PS16IP-1
1.09PS12IP-2 0.00
PS13IP-3 1.13PS11IP-2 0.37PS09IP-2 0.36PS07IP-1 2.03PS10IP-1
0.18PS04IP-1 2.59
PS05IP-1 2.51PS14IP-3 0.29PS08IP-3 1.21PS18IP-3 1.57

0

150118 349 27.17 14N22.75 90W36.05 -0.16 0.00
PS14IP-1 1.42PS09IP-1 1.63PS17IP-1 2.02PS08IP-1 1.68PS07IP-1
2.03PS15IP-1 2.04
PS01IP-1 1.25PS12IP-1 1.27PS02IP-1 1.44PS11IP-1 1.19PS10IP-1 1.35

0

150118 4 4 3.85 14N22.95 90W36.11 -0.72 0.00
PS08IP-1 0.86PS17IP-1 1.40PS01IP-1 0.54PS11IP-1 0.57PS12IP-1
0.45PS10IP-1 0.57
PS09IP-1 0.78PS14IP-1 0.61

0

150118 418 55.88 14N23.02 90W36.09 -0.46 0.00
PS13IP-1 1.39PS02IP-1 0.88PS14IP-1 0.80PS10IP-0 0.73PS09IP-0
1.00PS08IP-1 1.00
PS19IP-1 1.49PS15IP-1 1.28PS07IP-1 1.53PS06IP-1 1.90PS05IP-1
1.94PS04IP-1 2.17
PS18IP-1 1.43PS11IP-1 0.73PS03IP-1 0.97PS12IP-1 0.63PS01IP-1
0.79PS16IP-1 1.31
PS17IP-1 0.99

0

150118 439 3.47 14N22.98 90W36.16 -0.97 0.00
PS10IP-2 0.41PS03IP-1 0.83PS08IP-1 1.10PS09IP-2 0.63PS12IP-2
0.00PS11IP-2 0.00
PS01IP-1 0.53PS14IP-1 0.48

0

150118 443 44.82 14N22.95 90W36.12 -0.98 0.00
PS02IP-1 0.73PS08IP-1 1.23PS17IP-1 1.32PS11IP-1 0.47PS14IP-1
0.60PS12IP-1 0.25
PS10IP-1 0.40PS03IP-1 0.74PS13IP-1 0.93PS01IP-1 0.60PS09IP-1 0.65

0

150118 458 44.97 14N22.85 90W36.08 -0.60 0.00
PS01IP-1 0.78PS09IP-1 1.07PS17IP-1 1.52PS08IP-1 1.07PS06IP-1
1.78PS07IP-1 1.80
PS12IP-1 0.49PS15IP-1 0.59PS13IP-1 0.64PS11IP-1 0.73PS02IP-1
0.97PS10IP-1 0.68
PS14IP-1 1.05PS16IP-1 1.56

0

150118 534 0.96 14N22.91 90W36.13 -0.41 0.00
PS08IP-1 1.10PS19IP-1 1.87PS03IP-1 0.86PS11IP-1 0.79PS13IP-1
0.98PS02IP-1 0.87
PS18IP-1 1.30PS01IP-0 0.87PS10IP-0 0.90PS14IP-0 0.92PS09IP-1
1.02PS16IP-1 1.76
PS17IP-2 1.62PS06IP-2 1.42PS07IP-1 1.47PS15IP-2 1.38PS12IP-1 0.72
0

150118 534 22.04 14N22.94 90W36.17 -0.59 0.00
PS02IP-1 0.87PS09IP-1 0.82PS13IP-1 1.43PS18IP-1 1.40PS17IP-1
1.13PS16IP-1 1.48
PS14IP-1 0.81PS08IP-1 1.14PS15IP-1 1.52PS10IP-1 0.66PS07IP-1
1.39PS06IP-1 1.69
PS05IP-1 1.41PS19IP-1 2.06PS11IP-1 0.53PS01IP-1 0.74PS03IP-1
0.84PS12IP-1 0.54
0

150118 539 53.97 14N22.90 90W36.13 -0.83 0.00
PS16IP-1 1.67PS14IP-1 0.75PS09IP-1 0.77PS17IP-1 1.51PS08IP-1
1.13PS06IP-1 1.83
PS03IP-1 0.74PS11IP-1 0.43PS12IP-1 0.26PS02IP-1 0.86PS01IP-1
0.48PS10IP-1 0.58
PS07IP-1 1.24
0

150118 624 0.36 14N22.92 90W36.14 -0.68 0.00
PS10IP-1 0.61PS17IP-1 1.38PS12IP-1 0.47PS01IP-1 0.62PS11IP-1
0.51PS02IP-1 0.78
PS03IP-1 0.71PS14IP-1 0.68PS09IP-1 0.76PS13IP-1 1.29PS16IP-1
1.52PS08IP-1 0.84
PS19IP-1 1.51PS07IP-1 1.68PS04IP-1 1.51PS18IP-1 1.63PS06IP-1 1.86
0

150118 628 26.35 14N22.90 90W36.05 -0.61 0.00
PS07IP-2 1.76PS14IP-1 0.83PS09IP-1 0.97PS10IP-1 0.80PS18IP-1
1.04PS08IP-1 1.22
PS17IP-1 1.43PS01IP-1 0.77PS11IP-2 0.71PS12IP-1 0.36PS02IP-1
0.91PS03IP-1 0.75
PS13IP-1 0.75PS16IP-1 1.29PS15IP-2 1.71
0

150118 630 31.85 14N22.94 90W36.09 -0.55 0.00
PS12IP-0 0.62PS18IP-1 1.23PS03IP-0 0.74PS10IP-0 0.74PS09IP-0
0.89PS02IP-1 0.93
PS14IP-0 0.82PS01IP-1 0.76PS07IP-1 1.74PS08IP-0 0.98PS15IP-2
1.33PS17IP-1 1.48
PS16IP-1 1.52PS19IP-2 1.68PS11IP-0 0.74
0

150118 641 13.13 14N22.92 90W36.13 -0.38 0.00

PS12IP-2 0.88PS02IP-1 1.18PS03IP-1 1.10PS11IP-1 0.98PS18IP-1
1.32PS13IP-1 1.18
PS16IP-1 1.50PS19IP-1 1.40PS15IP-1 1.60PS04IP-1 1.93PS07IP-1
2.07PS05IP-1 1.58
PS06IP-1 1.59PS10IP-1 0.65PS14IP-3 0.78
0
150118 7 1 36.03 14N23.03 90W36.16 -1.23 0.00
PS08IP-2 1.29PS10IP-2 0.41PS14IP-0 0.83PS09IP-0 0.72PS12IP-1
0.32PS16IP-2 1.35
PS03IP-2 1.47PS17IP-3 1.65PS11IP-1 0.97PS15IP-2 1.75PS01IP-1 0.46
0
150118 715 55.28 14N22.92 90W36.16 -0.65 0.00
PS15IP-1 1.64PS01IP-1 0.66PS12IP-1 0.43PS14IP-1 0.67PS02IP-1
1.06PS10IP-1 0.61
PS09IP-1 0.75PS17IP-1 1.45PS11IP-1 0.61PS08IP-1 0.86PS03IP-1
0.78PS16IP-1 1.50
PS13IP-1 1.29PS18IP-1 1.40PS06IP-1 1.60PS19IP-1 1.52PS07IP-1
1.68PS05IP-1 1.67
PS04IP-1 1.92
0
150118 722 35.86 14N22.92 90W36.09 -1.04 0.00
PS17IP-1 1.52PS02IP-1 0.69PS12IP-1 0.14PS03IP-2 0.65PS13IP-2
1.58PS10IP-1 0.42
PS11IP-2 0.49PS01IP-1 0.58PS09IP-1 0.82
0
150118 735 42.54 14N22.94 90W36.11 -0.83 0.00
PS15IP-3 1.62PS14IP-2 0.63PS11IP-1 0.45PS03IP-1 0.69PS12IP-1
0.33PS13IP-2 0.67
PS02IP-1 0.65PS01IP-1 0.45PS10IP-1 0.48PS07IP-3 1.61PS08IP-1
0.86PS17IP-1 1.32
PS16IP-1 1.66PS09IP-1 0.84
0
150118 755 33.98 14N22.99 90W36.08 -0.57 0.00
PS09IP-0 0.79PS15IP-2 1.72PS07IP-2 1.64PS17IP-1 0.91PS05IP-2
1.03PS16IP-1 1.42
PS06IP-2 1.75PS12IP-1 0.54PS11IP-1 0.60PS03IP-1 0.75PS02IP-1
0.82PS01IP-1 0.66
PS18IP-1 1.11PS10IP-1 0.68PS13IP-1 1.34PS14IP-0 0.72PS08IP-1 0.91
0
150118 756 38.06 14N22.96 90W36.10 -0.81 0.00
PS08IP-1 1.09PS09IP-1 0.57PS15IP-1 1.75PS17IP-1 1.12PS14IP-1
0.81PS01IP-1 0.43
PS02IP-1 0.73PS10IP-1 0.46PS12IP-1 0.39PS11IP-1 0.55PS03IP-2 0.64
0

150118 810 11.67 14N23.06 90W36.36 -1.95   0.00
PS01IP-2 1.67PS10IP-1 1.91PS03IP-1 1.96PS12IP-1 1.45PS11IP-2
1.61PS02IP-1 2.39
PS17IP-2 2.21PS14IP-1 1.62PS09IP-1 1.65
0
150118 833 9.42 14N22.95 90W36.04 -0.71   0.00
PS09IP-1 0.92PS11IP-1 0.64PS02IP-1 0.78PS14IP-1 0.50PS12IP-1
0.36PS01IP-2 0.58
PS10IP-1 0.64PS06IP-1 1.82PS07IP-1 1.95PS15IP-1 2.23PS18IP-1
1.00PS16IP-1 2.27
PS08IP-1 1.01
0
150118 834 3.78 14N22.84 90W36.17 -0.47   0.00
PS11IP-1 0.98PS10IP-1 0.83PS09IP-1 0.94PS14IP-1 0.90PS17IP-1
1.30PS12IP-1 0.73
PS01IP-1 0.86PS08IP-1 1.44PS13IP-1 0.90PS05IP-1 1.45PS16IP-1
2.03PS03IP-1 1.76
PS02IP-1 1.08
0
150118 916 56.89 14N22.95 90W36.09 -0.91   0.00
PS02IP-0 0.59PS01IP-0 0.52PS14IP-1 0.66PS09IP-1 0.62PS10IP-1
0.40PS12IP-1 0.21
PS11IP-1 0.62PS16IP-1 1.60PS08IP-1 1.30
0
150118 937 16.31 14N22.96 90W36.17 -0.87   0.00
PS16IP-2 1.71PS09IP-1 0.61PS14IP-1 0.66PS12IP-1 0.40PS11IP-1
0.63PS01IP-1 0.62
PS03IP-1 0.94PS08IP-2 0.70PS02IP-1 0.79PS13IP-1 1.01PS17IP-1
1.09PS05IP-2 1.70
PS10IP-1 0.23
0
150118 943 7.10 14N23.03 90W36.19 -0.97   0.00
PS17IP-2 1.16PS13IP-1 1.34PS11IP-2 0.01PS12IP-2 0.09PS09IP-1
0.59PS01IP-2 0.38
PS10IP-1 0.20PS14IP-1 0.33PS16IP-2 1.71
0
150118 947 7.19 14N23.00 90W36.14 -0.32   0.00
PS12IP-1 0.87PS19IP-1 1.97PS05IP-1 1.56PS06IP-1 1.61PS07IP-1
1.47PS15IP-1 1.45
PS18IP-1 1.43PS08IP-1 1.29PS16IP-1 1.23PS13IP-1 1.70PS09IP-1
1.12PS17IP-1 1.30
PS10IP-2 0.84PS14IP-1 0.95PS03IP-1 0.94PS11IP-1 0.94PS02IP-1
1.06PS01IP-1 0.96
PS04IP-1 2.23

0

150118 951 46.39 14N22.82 90W36.14 -0.40   0.00
PS02IP-2 1.17PS18IP-1 1.30PS15IP-1 1.69PS06IP-1 1.64PS05IP-1
2.51PS08IP-1 1.27
PS17IP-1 1.74PS16IP-1 1.89PS11IP-1 0.92PS03IP-1 1.00PS12IP-1
0.86PS09IP-1 1.13
PS10IP-1 0.97PS01IP-1 0.99PS14IP-1 1.05

0

150118 1035 30.60 14N23.02 90W36.08 -0.67   0.00
PS14IP-1 0.62PS06IP-1 1.92PS12IP-1 0.40PS11IP-1 0.57PS01IP-1
0.58PS03IP-1 0.71
PS10IP-1 0.70PS13IP-1 1.26PS09IP-1 0.83PS18IP-1 1.14PS17IP-1
0.97PS02IP-1 0.87
PS08IP-1 0.95PS16IP-1 1.18PS15IP-1 1.28PS07IP-1 1.88

0

150118 1057 38.46 14N23.00 90W36.03 -1.02   0.00
PS14IP-1 0.57PS09IP-1 0.72PS08IP-1 1.58PS17IP-1 1.05PS03IP-1
0.63PS11IP-1 0.43
PS12IP-1 0.13PS10IP-1 0.76PS01IP-1 0.51

0

150118 1111 32.02 14N23.00 90W36.02 -0.69   0.00
PS02IP-1 0.51PS09IP-1 0.92PS01IP-1 0.51PS12IP-1 0.56PS03IP-1
0.75PS11IP-1 0.41
PS16IP-1 2.42PS14IP-1 0.66PS17IP-2 1.58PS13IP-2 0.99PS10IP-1
0.79PS08IP-1 0.97
PS07IP-1 1.93PS06IP-1 2.04

0

150118 1119 24.31 14N22.94 90W36.13 -0.40   0.00
PS11IP-1 1.10PS12IP-1 0.57PS01IP-1 0.83PS03IP-1 1.02PS08IP-1
0.94PS02IP-1 1.19
PS13IP-1 1.07PS17IP-1 1.34PS07IP-1 1.53PS15IP-1 1.79PS16IP-2
1.40PS18IP-2 1.43
PS19IP-1 1.52PS10IP-1 0.63PS09IP-0 0.96PS14IP-1 0.77

0

150118 1128 58.54 14N23.03 90W36.20 -0.98   0.00
PS09IP-1 0.37PS08IP-1 1.24PS13IP-1 1.56PS17IP-1 1.16PS16IP-2
1.48PS10IP-1 0.23
PS14IP-1 0.44PS01IP-1 0.41PS11IP-1 0.52

0

150118 1139 20.46 14N22.92 90W36.07 -0.97   0.00
PS14IP-1 0.35PS12IP-1 0.10PS10IP-1 0.46PS09IP-1 0.99PS16IP-1
1.56PS18IP-1 1.01
PS17IP-1 1.43PS02IP-1 0.69PS13IP-1 0.86PS01IP-1 0.69PS11IP-1 0.51

0

150118 1140 9.76 14N23.08 90W36.14 -1.53   0.00
PS11IP-1 1.06PS14IP-1 1.04PS17IP-2 2.06PS08IP-1 1.38PS01IP-1 1.04PS09IP-1 1.18
PS02IP-1 1.33PS10IP-1 1.18PS12IP-1 0.73
0
150118 1140 41.87 14N22.88 90W36.04 -0.37   0.00
PS14IP-1 1.03PS09IP-1 1.36PS17IP-1 1.37PS19IP-1 1.33PS08IP-1 1.18PS15IP-1 2.14
PS05IP-1 1.23PS12IP-1 0.78PS02IP-1 1.02PS06IP-1 1.91PS03IP-1 0.91PS11IP-1 0.88
PS01IP-2 0.96PS13IP-1 0.90PS18IP-1 1.28PS10IP-1 0.96PS04IP-1 1.84
0
150118 1229 22.55 14N22.98 90W36.16 -0.61   0.00
PS19IP-1 1.90PS10IP-1 0.68PS12IP-1 0.52PS09IP-1 0.69PS11IP-1 0.60PS14IP-1 0.73
PS01IP-1 0.67PS03IP-1 0.77PS02IP-1 0.90PS13IP-1 1.23PS08IP-1 0.90PS17IP-1 1.25
PS16IP-1 1.43PS07IP-1 1.14PS15IP-1 1.38PS06IP-1 1.87PS05IP-1 1.79PS18IP-1 1.35
0
150118 1232 32.74 14N22.97 90W36.06 -0.51   0.00
PS11IP-1 0.69PS09IP-1 0.91PS04IP-1 1.91PS06IP-1 1.99PS15IP-1 1.85PS07IP-1 1.74
PS08IP-1 1.03PS17IP-1 1.08PS16IP-1 1.17PS12IP-1 0.62PS03IP-1 0.84PS01IP-1 0.76
PS02IP-1 0.97PS10IP-1 0.77PS13IP-1 1.00PS14IP-1 0.84PS18IP-1 1.20
0
150118 1241 26.24 14N22.93 90W36.14 -0.55   0.00
PS12IP-1 0.61PS03IP-1 0.74PS13IP-1 1.18PS02IP-1 0.85PS07IP-1 1.49PS01IP-1 0.77
PS10IP-1 0.72PS14IP-1 0.81PS16IP-1 1.47PS09IP-1 0.86PS17IP-1 1.41PS15IP-1 1.72
PS04IP-1 2.11PS05IP-1 1.25PS11IP-1 0.68PS08IP-1 0.97PS06IP-3 1.63
0
150118 1312 33.27 14N22.98 90W36.27 -1.23   0.00
PS06IP-1 2.01PS12IP-1 0.33PS09IP-1 0.62PS10IP-1 0.49PS11IP-1 1.01PS01IP-1 0.72
PS03IP-1 1.35PS08IP-1 1.35PS02IP-1 1.33PS07IP-1 2.60PS17IP-1 1.37PS15IP-1 3.04
PS05IP-1 1.66PS13IP-1 2.17PS16IP-1 2.80PS18IP-1 2.83PS19IP-1 3.45PS14IP-2 0.91
0
150118 1335 34.77 14N22.89 90W36.14 -0.60   0.00
PS03IP-1 0.78PS11IP-1 0.68PS12IP-1 0.59PS10IP-1 0.80PS13IP-3

0.92PS02IP-1 0.83
PS14IP-1 0.81PS09IP-1 0.59PS18IP-1 1.47PS08IP-1 1.24PS17IP-1
1.40PS07IP-1 1.31
PS15IP-1 2.08
0

150118 1351 55.71 14N22.94 90W36.08 -0.90   0.00
PS15IP-1 1.66PS12IP-1 0.28PS13IP-1 0.69PS11IP-1 0.37PS02IP-1
0.72PS10IP-1 0.49
PS14IP-1 0.61PS09IP-1 1.04PS19IP-1 1.73PS08IP-1 0.89PS04IP-1
2.25PS07IP-1 1.85
PS17IP-1 1.47PS03IP-1 0.57
0

150118 1355 46.23 14N22.99 90W36.11 -0.99   0.00
PS09IP-1 0.59PS16IP-2 1.77PS11IP-2 0.34PS12IP-2 0.01PS18IP-3
1.74PS14IP-2 0.34
PS01IP-2 0.43PS02IP-3 0.51PS08IP-3 1.13PS17IP-1 1.25PS10IP-1 0.57
0

150118 1358 58.73 14N23.21 90W35.98   0.15   0.00
PS16IP-2 2.96PS11IP-1 1.78PS10IP-1 1.78PS09IP-1 1.92PS14IP-1
1.85PS01IP-1 1.82
PS08IP-1 2.18PS17IP-1 2.39PS12IP-0 1.70
0

150118 1359 30.96 14N22.99 90W36.10 -0.63   0.00
PS14IP-1 0.68PS10IP-1 0.61PS09IP-1 0.75PS11IP-1 0.65PS16IP-1
1.15PS17IP-1 1.29
PS08IP-1 0.86PS07IP-1 1.61PS15IP-1 1.65PS06IP-1 1.84PS03IP-1
0.95PS12IP-1 0.50
PS02IP-1 0.71PS01IP-1 0.64
0

150118 1428 58.91 14N22.95 90W36.14 -0.54   0.00
PS11IP-1 0.67PS10IP-1 0.72PS04IP-1 2.06PS06IP-1 1.64PS07IP-1
1.52PS15IP-1 1.02
PS18IP-3 1.61PS09IP-1 0.83PS08IP-1 0.92PS03IP-1 0.96PS14IP-0
0.77PS12IP-1 0.59
PS17IP-1 1.28PS16IP-1 1.59PS01IP-1 0.72PS02IP-1 0.83
0

150118 1517 46.91 14N22.89 90W36.12 -0.60   0.00
PS11IP-1 0.67PS02IP-1 0.74PS12IP-2 0.57PS01IP-1 0.70PS10IP-1
0.67PS15IP-1 1.78
PS07IP-1 1.61PS08IP-2 0.98PS17IP-2 1.41PS09IP-0 0.81PS14IP-1
0.75PS16IP-1 1.73
PS03IP-2 0.80
0

150118 1519 42.48 14N22.96 90W36.20 -0.61   0.00

PS07IP-1 1.18PS03IP-1 1.07PS14IP-1 0.79PS12IP-1 0.51PS11IP-1
0.64PS01IP-1 0.58
PS08IP-1 0.95PS02IP-1 1.04PS13IP-1 1.37PS17IP-1 1.19PS16IP-1
1.58PS18IP-1 1.49
PS10IP-1 0.48PS09IP-1 0.82
0

150118 1528 57.82 14N22.94 90W36.14 -0.60   0.00
PS12IP-0 0.63PS08IP-1 0.98PS05IP-1 1.90PS06IP-1 1.77PS10IP-1
0.73PS11IP-1 0.73
PS09IP-1 0.87PS13IP-1 1.00PS03IP-1 0.80PS14IP-1 0.76PS07IP-1
1.22PS01IP-1 0.77
PS02IP-1 0.88PS15IP-1 1.33PS18IP-1 1.23PS17IP-1 1.49PS16IP-1
1.61PS04IP-1 1.96
0

150118 1547 19.66 14N22.86 90W36.22 -0.26   0.00
PS12IP-2 0.92PS11IP-1 1.16PS01IP-1 1.06PS16IP-2 2.22PS15IP-1
1.58PS17IP-2 1.72
PS13IP-2 1.96PS02IP-2 1.46PS03IP-1 1.25PS08IP-1 1.33PS10IP-2
1.00PS09IP-1 1.16
PS14IP-2 1.09
0

150118 16 6 5.76 14N22.96 90W36.11 -0.47   0.00
PS15IP-1 1.77PS06IP-1 1.84PS12IP-1 0.67PS11IP-1 1.02PS01IP-1
0.84PS03IP-1 0.97
PS02IP-1 0.81PS10IP-1 0.75PS14IP-1 0.80PS13IP-1 0.94PS09IP-1
0.80PS18IP-1 1.60
PS17IP-2 1.45PS16IP-1 1.36PS08IP-1 1.03PS19IP-1 1.35PS07IP-1 1.51
0

150118 1649 4.30 14N22.99 90W36.07 -0.99   0.00
PS10IP-1 0.55PS09IP-2 0.48PS07IP-2 2.22PS17IP-2 1.93PS02IP-1
0.60PS18IP-1 1.57
PS01IP-1 0.35PS14IP-3 0.55PS11IP-1 0.41
0

150118 17 7 41.65 14N22.76 90W36.37 -0.97   0.00
PS06IP-1 1.23PS10IP-1 1.02PS09IP-1 1.22PS12IP-1 1.00PS14IP-1
1.14PS11IP-1 1.07
PS05IP-1 2.19PS01IP-1 1.13PS03IP-1 1.10PS13IP-1 1.80PS02IP-1
1.20PS08IP-1 1.34
PS17IP-1 1.84PS07IP-1 1.56
0

150118 1743 15.39 14N22.98 90W36.06 -0.39   0.00
PS11IP-1 0.83PS03IP-1 0.95PS09IP-0 1.02PS08IP-0 1.17PS10IP-0
0.89PS13IP-0 1.10
PS18IP-1 1.31PS19IP-1 1.32PS15IP-1 1.36PS07IP-1 1.48PS06IP-1

2.12PS05IP-1 2.02
PS04IP-1 2.01PS01IP-1 0.91PS02IP-1 1.00PS12IP-1 0.64PS16IP-1
1.25PS17IP-1 1.48
PS14IP-1 0.91
0

150118 1848 48.33 14N22.97 90W36.15 -0.59   0.00
PS13IP-1 1.47PS02IP-1 0.82PS03IP-1 0.90PS18IP-1 1.33PS17IP-1
1.23PS14IP-1 0.70
PS15IP-1 1.46PS07IP-1 1.69PS01IP-1 0.77PS09IP-1 0.76PS06IP-1
1.45PS12IP-1 0.53
PS11IP-1 0.66PS08IP-1 0.96PS19IP-1 1.80PS16IP-1 1.37PS10IP-1 0.60
0

150118 1915 17.21 14N22.93 90W36.11 -0.52   0.00
PS18IP-1 1.24PS17IP-1 1.53PS19IP-1 1.47PS16IP-1 1.56PS06IP-1
2.01PS15IP-1 1.31
PS04IP-1 2.01PS07IP-1 1.38PS12IP-1 0.64PS10IP-1 0.78PS11IP-1
0.70PS03IP-1 0.77
PS01IP-1 0.81PS09IP-1 0.93PS13IP-1 1.02PS14IP-1 0.85PS02IP-1
0.87PS08IP-1 1.01
0

150118 1927 56.66 14N23.05 90W36.11 -0.73   0.00
PS12IP-2 0.38PS11IP-2 0.56PS06IP-2 1.99PS07IP-1 1.54PS15IP-1
1.56PS08IP-2 0.89
PS01IP-2 0.60PS17IP-2 0.88PS09IP-2 0.70PS13IP-1 1.26PS14IP-2
0.66PS10IP-1 0.59
PS02IP-1 0.66PS03IP-2 0.66
0

150118 1943 43.74 14N23.08 90W36.16 -1.37   0.00
PS14IP-0 0.84PS15IP-2 1.86PS11IP-2 0.78PS08IP-2 1.22PS17IP-2
1.43PS02IP-1 1.03
PS13IP-1 1.43PS10IP-1 0.79PS09IP-1 0.93PS01IP-1 0.81PS06IP-1
2.38PS12IP-0 0.70
0

150118 1953 49.94 14N22.98 90W36.12 -0.86   0.00
PS02IP-2 0.70PS14IP-2 0.01PS10IP-1 0.52PS09IP-1 0.52PS12IP-1
0.33PS11IP-2 0.65
PS01IP-2 0.60PS03IP-1 0.62PS13IP-2 1.14PS08IP-2 1.13PS17IP-1
1.18PS16IP-2 1.46
0

150118 2046 43.25 14N22.97 90W36.13 -0.95   0.00
PS13IP-2 0.78PS16IP-1 1.65PS17IP-1 1.36PS19IP-1 2.01PS15IP-1
1.59PS08IP-1 0.71
PS07IP-1 1.82PS05IP-1 2.69PS12IP-2 0.21PS11IP-2 0.41PS03IP-2
0.94PS01IP-1 0.47

PS02IP-1 0.58PS10IP-2 0.56PS14IP-1 0.59PS09IP-1 0.71PS04IP-1
2.10PS18IP-1 1.27
0

150118 2047 29.62 14N23.00 90W36.04 -0.98 0.00
PS12IP-1 0.17PS11IP-1 0.26PS03IP-1 0.74PS01IP-1 0.54PS10IP-1
0.94PS14IP-1 0.54
PS09IP-1 0.73PS17IP-1 1.13PS08IP-1 1.11
0

150118 2058 1.12 14N23.07 90W36.16 -1.14 0.00
PS17IP-1 1.30PS02IP-1 0.94PS03IP-1 0.99PS11IP-1 0.72PS14IP-1
0.43PS09IP-1 0.81
PS01IP-1 0.56PS08IP-1 0.81PS10IP-1 0.70PS12IP-1 0.38
0

150118 21 6 6.72 14N23.09 90W36.23 -1.23 0.00
PS03IP-1 1.48PS12IP-1 0.50PS11IP-2 0.66PS01IP-2 0.82PS10IP-2
0.61PS14IP-0 0.61
PS09IP-0 0.68PS17IP-1 1.10PS08IP-1 1.09
0

150118 2110 15.35 14N22.88 90W36.10 -0.87 0.00
PS15IP-1 1.74PS11IP-1 0.35PS10IP-1 0.66PS02IP-1 0.83PS13IP-1
0.82PS03IP-1 0.74
PS14IP-1 0.82PS09IP-1 0.91PS18IP-1 1.01PS08IP-1 0.92PS17IP-1
1.56PS16IP-1 1.61
PS19IP-1 1.75PS12IP-1 0.01PS04IP-1 1.63PS05IP-1 1.96PS07IP-1
1.86PS06IP-1 2.03
PS01IP-1 0.74
0

150118 2130 51.58 14N22.95 90W36.06 -0.26 0.00
PS04IP-1 2.00PS12IP-1 0.87PS01IP-1 0.79PS11IP-1 1.01PS02IP-1
1.17PS03IP-1 1.07
PS10IP-1 1.07PS14IP-1 1.22PS13IP-1 1.20PS09IP-1 1.36PS18IP-1
1.35PS16IP-1 1.50
PS17IP-1 1.38PS08IP-1 1.37PS19IP-1 1.51PS15IP-1 1.64PS06IP-1
2.29PS05IP-1 1.63
PS07IP-1 1.60
0

150118 2144 30.74 14N22.97 90W36.14 -0.77 0.00
PS17IP-1 1.17PS07IP-1 1.38PS16IP-1 1.35PS10IP-1 0.43PS12IP-1
0.29PS11IP-1 0.55
PS09IP-1 0.80PS14IP-1 0.52PS01IP-1 0.59PS03IP-1 1.00PS02IP-1 0.72
0

150118 2146 11.39 14N22.98 90W36.11 -0.95 0.00
PS09IP-1 0.61PS08IP-1 1.24PS12IP-1 0.18PS11IP-1 0.42PS01IP-1
0.31PS10IP-1 0.33

PS03IP-1 0.85PS14IP-1 0.53
0

150118 22 7 1.04 14N23.04 90W36.23 -1.27   0.00
PS11IP-1 0.84PS12IP-1 0.59PS02IP-1 1.14PS14IP-1 0.75PS15IP-1
1.69PS09IP-1 0.81
PS07IP-1 1.70PS13IP-1 1.56PS16IP-1 2.13PS17IP-1 1.26PS01IP-1
0.70PS08IP-1 0.96
PS10IP-1 0.67
0

150118 22 8 2.87 14N22.98 90W36.02 -0.56   0.00
PS15IP-1 1.43PS07IP-1 1.88PS05IP-1 2.24PS02IP-1 0.76PS17IP-1
1.07PS12IP-1 0.29
PS11IP-1 0.80PS01IP-1 0.84PS10IP-1 0.83PS14IP-1 1.03PS13IP-1
0.83PS09IP-1 0.71
PS18IP-1 1.23PS16IP-1 1.13PS08IP-1 1.26PS19IP-1 1.33
0

150118 2222 12.07 14N23.01 90W36.10 -0.80   0.00
PS10IP-2 0.66PS19IP-1 2.02PS02IP-3 0.78PS01IP-3 0.26PS14IP-3
0.58PS09IP-1 0.45
PS04IP-1 2.10PS16IP-1 1.02PS17IP-1 1.35PS08IP-1 0.94PS05IP-1
2.06PS06IP-3 1.86
PS15IP-1 1.92PS07IP-2 1.28PS13IP-1 1.15PS11IP-3 0.62PS12IP-3
0.00PS18IP-1 1.01
0

150118 2227 11.76 14N23.04 90W36.18 -1.55   0.00
PS11IP-1 1.04PS13IP-1 1.79PS09IP-1 1.23PS01IP-1 1.13PS14IP-1
1.13PS02IP-1 1.20
PS08IP-1 1.37PS06IP-3 2.30PS10IP-1 1.02PS17IP-1 1.74PS07IP-3
1.98PS12IP-1 0.91
0

150118 2235 59.30 14N23.00 90W36.14 -0.26   0.00
PS02IP-1 1.08PS15IP-1 1.41PS11IP-1 0.92PS14IP-0 1.03PS10IP-0
0.99PS09IP-1 1.01
PS17IP-1 1.24PS16IP-1 1.36PS13IP-1 1.48PS08IP-1 1.23PS18IP-1
1.38PS07IP-1 1.42
PS06IP-1 1.96PS19IP-1 2.09PS05IP-1 1.51PS04IP-1 2.06PS01IP-1
1.13PS12IP-1 0.82
0

150118 23 2 32.15 14N23.00 90W36.13 -0.94   0.00
PS02IP-2 0.70PS17IP-2 1.31PS10IP-1 0.39PS11IP-1 0.61PS12IP-1
0.31PS09IP-1 0.60
PS14IP-1 0.52PS01IP-1 0.38
0

150118 2312 20.93 14N22.88 90W36.16 -0.53   0.00

PS16IP-1 1.66PS07IP-1 1.24PS13IP-1 1.01PS19IP-1 1.77PS10IP-1 0.79PS11IP-1 0.71
PS09IP-1 0.90PS12IP-1 0.64PS18IP-1 1.28PS14IP-1 0.84PS15IP-1 1.90PS01IP-1 0.80
PS02IP-1 0.96PS08IP-1 1.04PS17IP-1 1.54
0

150119 113 58.86 14N23.00 90W36.12 -0.87 0.00
PS08IP-1 0.81PS12IP-1 0.32PS01IP-1 0.51PS10IP-1 0.41PS09IP-1 0.79PS14IP-1 0.47
PS17IP-1 1.11PS11IP-1 0.57
0

150119 127 50.06 14N22.96 90W36.15 -0.95 0.00
PS11IP-1 0.50PS08IP-1 0.97PS07IP-3 1.88PS12IP-1 0.16PS10IP-1 0.27PS01IP-1 0.34
PS16IP-2 1.69PS09IP-1 0.77PS14IP-1 0.66PS02IP-1 0.97PS17IP-1 1.48
0

150119 138 41.63 14N22.99 90W36.13 -0.45 0.00
PS15IP-2 1.57PS16IP-2 1.69PS11IP-1 0.92PS10IP-1 0.71PS09IP-1 0.85PS01IP-1 0.72
PS14IP-1 0.77PS17IP-1 1.07
0

150119 145 19.72 14N22.99 90W36.14 -0.49 0.00
PS04IP-1 1.95PS17IP-1 1.08PS08IP-1 1.23PS14IP-1 0.89PS01IP-2 0.20PS09IP-1 0.92
PS16IP-1 1.16PS12IP-2 0.62PS02IP-1 1.01PS10IP-1 0.52PS15IP-1 1.40PS11IP-2 0.82
PS18IP-1 1.35PS06IP-1 1.63PS19IP-1 2.05
0

150119 237 46.84 14N22.91 90W36.10 -0.68 0.00
PS06IP-1 1.72PS16IP-1 1.59PS12IP-1 0.49PS11IP-1 0.54PS01IP-1 0.64PS02IP-1 0.88
PS10IP-1 0.62PS04IP-2 3.11PS14IP-1 0.69PS09IP-1 0.87PS17IP-1 1.10PS08IP-1 1.20
0

150119 241 0.46 14N22.97 90W36.12 -0.75 0.00
PS08IP-1 0.96PS12IP-1 0.42PS11IP-1 0.60PS10IP-1 0.53PS01IP-1 0.55PS14IP-1 0.60
PS09IP-1 0.67PS02IP-1 0.79PS17IP-1 1.16
0

150119 311 11.79 14N23.04 90W36.14 -0.88 0.00
PS08IP-1 1.20PS10IP-3 0.51PS01IP-1 0.00PS14IP-2 0.09PS09IP-1 0.00PS17IP-1 1.33
PS15IP-1 2.52PS13IP-1 1.83PS11IP-1 0.33PS12IP-1 0.14PS02IP-1 0.94
0

150119 322 38.24 14N22.98 90W36.08 -0.98   0.00
PS10IP-1 0.57PS09IP-1 0.70PS17IP-2 0.88PS13IP-2 1.18PS02IP-1
0.66PS11IP-1 0.39
PS12IP-1 0.21PS01IP-1 0.54
0
150119 328 27.44 14N22.95 90W36.15 -1.05   0.00
PS12IP-1 0.15PS08IP-1 1.41PS13IP-1 1.03PS17IP-1 1.36PS16IP-1
1.70PS18IP-1 1.33
PS15IP-1 1.48PS10IP-2 0.50PS09IP-1 0.70PS14IP-1 0.53PS01IP-1
0.57PS11IP-1 0.86
PS02IP-1 0.80
0
150119 330 9.13 14N22.95 90W36.12 -0.87   0.00
PS08IP-2 1.10PS12IP-1 0.34PS11IP-1 0.50PS02IP-2 0.52PS01IP-1
0.57PS10IP-1 0.43
PS14IP-1 0.49PS09IP-1 0.68PS16IP-1 1.49PS17IP-1 1.21
0
150119 333 3.13 14N22.96 90W36.11 -0.57   0.00
PS06IP-1 1.96PS16IP-1 1.34PS12IP-1 0.58PS01IP-1 0.70PS11IP-1
0.73PS02IP-1 0.79
PS10IP-1 0.62PS14IP-1 0.69PS09IP-1 0.81PS13IP-1 1.32PS17IP-1
1.40PS08IP-1 0.97
PS18IP-1 1.16PS07IP-1 1.15PS04IP-1 1.83PS15IP-1 1.81
0
150119 341 6.36 14N22.92 90W36.10 -0.66   0.00
PS17IP-1 1.42PS12IP-1 0.49PS10IP-1 0.62PS02IP-1 0.80PS01IP-1
0.71PS09IP-1 0.89
PS07IP-1 1.72PS14IP-1 0.68PS08IP-1 0.93PS16IP-3 1.27PS11IP-1 0.58
0
150119 413 59.47 14N22.94 90W36.12 -0.98   0.00
PS01IP-1 0.50PS14IP-2 0.41PS11IP-1 0.37PS12IP-1 0.28PS17IP-2
1.03PS10IP-1 0.35
PS02IP-1 0.94PS09IP-1 0.86PS08IP-2 1.12
0
150119 420 49.12 14N22.97 90W36.31 -1.22   0.00
PS16IP-1 1.73PS09IP-1 0.63PS14IP-1 0.00PS08IP-1 0.99PS01IP-1
0.00PS12IP-1 0.00
PS07IP-1 1.44PS15IP-1 1.66PS11IP-1 0.00PS17IP-1 1.50PS02IP-1
1.19PS06IP-1 1.73
PS13IP-1 1.56PS10IP-1 0.00
0
150119 450 10.33 14N23.17 90W36.16 -1.61   0.00
PS17IP-1 1.43PS10IP-1 1.17PS02IP-1 1.30PS01IP-1 1.21PS09IP-1
1.30PS14IP-1 1.24

PS08IP-1 1.45PS16IP-3 1.87PS11IP-1 1.12PS12IP-1 1.08PS13IP-1 2.27
0

150119 450 35.13 14N22.94 90W36.10 -1.02 0.00
PS09IP-1 0.76PS16IP-1 1.70PS17IP-1 1.35PS08IP-2 1.29PS07IP-2
1.63PS11IP-1 0.31
PS12IP-1 0.20PS13IP-1 1.14PS10IP-1 0.45PS02IP-1 0.46PS01IP-2
0.49PS14IP-1 0.66
0

150119 5 8 37.13 14N22.97 90W36.11 -0.94 0.00
PS12IP-1 0.27PS15IP-1 1.97PS11IP-1 0.34PS01IP-1 0.45PS10IP-1
0.50PS02IP-1 0.90
PS14IP-1 0.52PS09IP-1 0.59PS08IP-1 0.90PS17IP-1 1.27PS06IP-1 1.98
0

150119 514 20.36 14N22.97 90W36.11 -0.88 0.00
PS11IP-1 0.50PS08IP-1 0.91PS13IP-1 1.11PS12IP-1 0.30PS10IP-0
0.42PS02IP-0 0.65
PS01IP-0 0.55PS09IP-1 0.69PS14IP-2 0.59PS17IP-1 1.13
0

150119 546 16.95 14N22.92 90W36.15 -0.75 0.00
PS16IP-1 1.67PS11IP-1 0.53PS13IP-2 1.33PS01IP-1 0.72PS02IP-1
0.81PS17IP-2 1.08
PS10IP-1 0.52PS07IP-1 1.53PS09IP-2 0.67PS14IP-1 0.57PS12IP-1 0.43
0

150119 558 28.73 14N22.92 90W36.13 -0.51 0.00
PS08IP-1 1.01PS12IP-1 0.66PS10IP-1 0.75PS09IP-1 0.87PS02IP-1
1.06PS14IP-1 0.88
PS01IP-1 0.77PS11IP-1 0.77
0

150119 627 25.33 14N22.94 90W36.12 -0.68 0.00
PS08IP-1 0.96PS07IP-1 1.60PS16IP-1 1.36PS17IP-1 1.32PS10IP-1
0.57PS11IP-1 0.64
PS12IP-1 0.45PS09IP-1 0.83PS14IP-1 0.63PS01IP-1 0.62PS02IP-1 0.88
0

150119 712 22.73 14N22.96 90W36.15 -0.78 0.00
PS15IP-2 1.63PS07IP-1 1.59PS06IP-1 1.71PS12IP-1 0.39PS11IP-1
0.58PS01IP-1 0.55
PS02IP-1 0.63PS10IP-1 0.50PS14IP-1 0.58PS13IP-1 1.07PS09IP-1
0.64PS17IP-1 1.28
PS16IP-1 1.72PS08IP-1 0.80
0

150119 756 45.92 14N23.00 90W36.10 -1.02 0.00
PS16IP-1 2.00PS17IP-1 1.30PS09IP-1 0.92PS13IP-1 1.19PS14IP-1
0.55PS10IP-1 0.45

PS02IP-1 0.61PS01IP-1 0.41PS11IP-1 0.46PS12IP-1 0.18PS15IP-1
1.78PS08IP-1 0.80
0

150119 759 32.98 14N23.02 90W36.13 -0.67 0.00
PS12IP-1 0.47PS16IP-2 1.38PS15IP-1 1.56PS17IP-1 0.88PS08IP-1
0.87PS02IP-1 0.91
PS01IP-1 0.61PS14IP-1 0.47PS09IP-1 0.69PS11IP-1 0.69PS10IP-1 0.59
0

150119 8 2 36.32 14N22.93 90W36.12 -0.32 0.00
PS06IP-1 1.49PS12IP-1 0.80PS01IP-1 0.99PS11IP-1 1.00PS02IP-1
1.14PS10IP-1 0.92
PS14IP-1 1.01PS13IP-1 1.29PS17IP-1 1.28PS16IP-1 1.56PS08IP-1
1.26PS18IP-1 1.34
PS19IP-1 1.53PS15IP-1 1.92PS07IP-1 1.51PS09IP-1 1.10PS04IP-1 2.00
0

150119 8 5 5.92 14N23.00 90W36.15 -1.05 0.00
PS10IP-1 0.46PS12IP-1 0.33PS14IP-1 0.52PS11IP-1 0.47PS01IP-1
0.52PS02IP-1 0.78
PS09IP-1 0.70PS13IP-1 1.21PS08IP-1 0.92PS17IP-1 1.23PS16IP-1 1.61
0

150119 813 44.59 14N22.96 90W36.09 -0.78 0.00
PS02IP-1 0.74PS17IP-2 0.79PS08IP-2 1.05PS12IP-1 0.39PS11IP-1
0.48PS10IP-1 0.54
PS01IP-1 0.57PS14IP-1 0.60PS09IP-1 0.78
0

150119 820 58.38 14N23.04 90W36.19 -1.28 0.00
PS02IP-1 1.15PS10IP-1 0.64PS09IP-1 0.79PS12IP-1 0.59PS11IP-1
0.87PS14IP-1 0.76
PS01IP-1 0.71PS08IP-1 1.14PS17IP-1 1.31
0

150119 839 45.60 14N23.00 90W36.13 -0.32 0.00
PS07IP-1 1.45PS06IP-1 1.59PS04IP-1 2.19PS01IP-1 0.97PS10IP-1
0.96PS14IP-1 1.02
PS09IP-1 1.09PS11IP-1 0.93PS02IP-1 1.08PS08IP-1 1.24PS17IP-1
1.22PS13IP-1 1.14
PS16IP-1 1.38PS18IP-1 1.33PS15IP-1 1.40PS19IP-1 2.00PS12IP-1 0.87
0

150119 847 9.08 14N22.96 90W36.09 -0.87 0.00
PS10IP-1 0.46PS14IP-1 0.71PS02IP-1 0.63PS11IP-1 0.52PS12IP-1
0.29PS09IP-1 0.64
PS01IP-1 0.51PS17IP-2 1.16
0

150119 853 21.11 14N23.01 90W36.18 -1.14 0.00

PS08IP-2 0.86PS17IP-2 1.08PS12IP-1 0.43PS11IP-1 0.66PS01IP-1
0.68PS10IP-1 0.39
PS14IP-1 0.59PS09IP-1 0.77
0

150119 921 26.69 14N22.95 90W36.02 -0.52 0.00
PS01IP-1 0.12PS17IP-1 1.22PS02IP-1 1.02PS16IP-1 1.07PS18IP-1
1.26PS12IP-2 0.24
PS11IP-1 0.71PS13IP-2 0.98PS19IP-1 1.31PS14IP-1 0.91PS10IP-2
0.82PS09IP-1 1.03
PS08IP-1 1.48PS15IP-1 1.63PS07IP-1 2.10PS04IP-1 1.99PS06IP-1 1.84
0

150119 922 35.55 14N22.96 90W36.15 -0.78 0.00
PS17IP-1 1.19PS01IP-1 0.61PS13IP-2 0.82PS11IP-1 0.72PS10IP-1
0.39PS12IP-1 0.39
PS09IP-1 0.58PS14IP-1 0.59PS08IP-1 0.95
0

150119 927 59.60 14N22.98 90W36.15 -0.31 0.00
PS12IP-1 0.82PS15IP-1 1.45PS11IP-1 0.85PS07IP-1 1.46PS13IP-1
1.58PS18IP-1 1.34
PS19IP-1 1.89PS04IP-1 1.97PS10IP-1 0.96PS06IP-1 1.58PS17IP-1
1.56PS01IP-2 1.03
PS08IP-1 1.11PS14IP-1 1.02PS16IP-1 1.31PS02IP-1 1.11PS09IP-1 1.07
0

150119 959 58.08 14N22.99 90W36.05 -0.86 0.00
PS12IP-1 0.29PS10IP-1 0.59PS01IP-1 0.48PS02IP-1 0.58PS11IP-1
0.49PS14IP-2 0.42
PS09IP-1 0.85PS17IP-1 1.01
0

150119 1026 50.03 14N22.97 90W36.09 -0.44 0.00
PS15IP-1 1.83PS07IP-1 1.46PS13IP-3 1.89PS11IP-1 0.76PS12IP-2
0.69PS10IP-1 0.79
PS18IP-1 1.41PS02IP-1 0.97PS01IP-2 0.85PS09IP-1 1.01PS14IP-1
0.84PS16IP-1 1.17
PS08IP-1 1.18PS17IP-1 1.21
0

150119 1034 24.70 14N22.96 90W36.17 -1.23 0.00
PS04IP-1 1.55PS14IP-1 0.76PS09IP-1 0.61PS10IP-1 0.52PS12IP-1
0.02PS08IP-1 1.61
PS11IP-1 0.14PS02IP-1 0.34PS17IP-1 1.16PS13IP-1 1.36PS15IP-1
1.83PS16IP-1 1.60
PS07IP-1 1.84PS18IP-1 2.16PS19IP-1 2.11
0

150119 1058 15.96 14N22.98 90W36.12 -0.62 0.00
PS02IP-1 0.68PS08IP-1 0.89PS17IP-1 0.93PS16IP-1 1.60PS10IP-1

0.62PS09IP-1 0.75
PS14IP-1 0.68PS12IP-1 0.52PS01IP-1 0.66PS11IP-1 0.78
0

150119 1137 37.19 14N23.00 90W36.12 -0.90 0.00
PS12IP-1 0.35PS10IP-1 0.45PS14IP-1 0.56PS11IP-1 0.49PS01IP-1
0.47PS08IP-1 0.84
PS13IP-1 1.13PS02IP-1 0.56PS17IP-1 1.20PS07IP-1 1.74PS16IP-1
1.40PS09IP-1 0.60
0

150119 1144 18.33 14N22.97 90W36.10 -0.85 0.00
PS16IP-1 1.48PS14IP-1 0.53PS11IP-1 0.57PS12IP-1 0.34PS02IP-1
0.54PS10IP-1 0.44
PS01IP-1 0.46PS09IP-1 0.72PS17IP-1 1.16PS08IP-2 1.03
0

150119 1148 28.98 14N23.02 90W36.12 -0.75 0.00
PS10IP-1 0.55PS16IP-1 1.10PS14IP-1 0.63PS09IP-1 0.71PS19IP-1
2.04PS17IP-1 1.01
PS04IP-1 2.15PS15IP-1 1.57PS07IP-1 1.56PS08IP-1 0.81PS12IP-1
0.46PS11IP-1 0.50
PS02IP-1 0.83PS01IP-1 0.48PS13IP-1 0.99
0

150119 1152 30.01 14N22.96 90W36.12 -1.01 0.00
PS17IP-1 1.44PS10IP-1 0.51PS13IP-1 0.94PS09IP-1 0.85PS08IP-1
1.04PS07IP-1 1.89
PS11IP-1 0.33PS01IP-1 0.39PS02IP-1 1.18PS14IP-1 0.34PS12IP-1 0.16
0

150119 1223 19.01 14N22.94 90W36.07 -0.79 0.00
PS13IP-1 0.66PS04IP-1 1.85PS06IP-1 1.97PS07IP-1 1.70PS15IP-1
1.46PS09IP-1 0.32
PS10IP-2 0.18PS16IP-1 1.38PS02IP-1 0.14PS17IP-1 0.81PS18IP-1
0.70PS01IP-1 0.00
PS12IP-1 0.00PS14IP-1 0.20PS11IP-0 0.00PS08IP-1 0.90PS19IP-1 1.47
0

150119 1315 18.27 14N23.01 90W36.13 -0.84 0.00
PS02IP-1 0.70PS08IP-1 0.99PS17IP-1 1.15PS11IP-1 0.71PS10IP-1
0.55PS12IP-1 0.31
PS09IP-1 0.44PS01IP-1 0.44PS14IP-1 0.55PS15IP-1 1.52
0

150119 1350 29.41 14N23.01 90W36.09 -0.43 0.00
PS18IP-1 1.36PS07IP-1 1.34PS15IP-1 1.41PS19IP-1 1.72PS06IP-1
2.13PS12IP-1 0.71
PS10IP-1 0.88PS01IP-1 0.86PS14IP-1 0.93PS11IP-1 0.81PS04IP-1
2.08PS09IP-1 1.01
PS13IP-1 1.02PS08IP-1 1.13PS17IP-1 1.18PS16IP-1 1.27

0

150119 1449 2.94 14N23.01 90W36.08 -0.55   0.00
PS14IP-1 0.52PS08IP-1 1.17PS09IP-1 0.84PS10IP-1 0.82PS11IP-1
0.65PS18IP-1 1.19
PS13IP-1 1.07PS15IP-1 1.43PS07IP-1 1.85PS19IP-1 1.95PS06IP-1
1.84PS04IP-1 1.99
PS12IP-2 0.17PS17IP-1 1.21PS01IP-1 0.76PS16IP-1 0.95

0

150119 1524 6.70 14N22.91 90W36.11 -0.45   0.00
PS09IP-1 0.98PS14IP-1 0.87PS18IP-1 1.28PS15IP-2 1.77PS08IP-1
0.99PS12IP-1 0.72
PS01IP-1 0.86PS11IP-1 0.90PS17IP-1 1.57PS16IP-1 1.49PS10IP-1 0.84

0

150119 1527 20.03 14N22.91 90W36.08 -0.33   0.00
PS19IP-1 1.42PS09IP-1 1.23PS13IP-1 1.13PS17IP-1 1.55PS12IP-1
0.89PS11IP-1 0.92
PS01IP-1 0.99PS06IP-1 1.79PS07IP-1 1.62PS15IP-1 1.91PS18IP-1
1.36PS08IP-1 1.13
PS16IP-1 1.41PS14IP-1 1.04PS10IP-1 0.88

0

150119 1533 36.55 14N22.93 90W36.28 -1.68   0.00
PS17IP-1 2.12PS06IP-1 2.26PS14IP-2 1.45PS09IP-1 1.44PS16IP-1
2.11PS01IP-1 1.33
PS13IP-1 2.01PS11IP-1 1.28PS12IP-1 1.06PS10IP-1 1.11PS08IP-2 1.92

0

150119 1550 48.63 14N23.03 90W36.25 -1.45   0.00
PS16IP-1 1.95PS13IP-1 1.72PS11IP-1 0.95PS01IP-1 1.02PS12IP-1
0.75PS14IP-1 0.98
PS09IP-1 1.02PS10IP-1 0.91PS17IP-1 1.54PS08IP-1 1.18

0

150119 1610 12.59 14N22.99 90W36.17 -0.71   0.00
PS01IP-1 0.56PS12IP-1 0.45PS14IP-1 0.60PS09IP-1 0.63PS10IP-1
0.53PS18IP-1 1.58
PS16IP-1 1.55PS07IP-1 1.42PS17IP-1 1.04PS13IP-1 1.12PS08IP-1
0.73PS11IP-1 0.61

0

150119 1831 33.71 14N22.99 90W36.14 -1.04   0.00
PS08IP-2 0.90PS11IP-1 0.53PS12IP-1 0.29PS10IP-1 0.44PS01IP-0
0.53PS14IP-1 0.49
PS09IP-1 0.71PS17IP-2 1.21

0

150119 1841 31.20 14N23.07 90W36.20 -1.45   0.00
PS10IP-1 0.87PS08IP-1 1.33PS15IP-1 1.80PS13IP-1 1.65PS17IP-1
1.43PS11IP-1 1.08

PS12IP-0 0.79PS01IP-1 0.93PS09IP-1 1.03PS14IP-1 0.94

0

150119 1845 9.62 14N22.97 90W36.13 -0.59 0.00
PS08IP-1 0.94PS14IP-1 0.65PS17IP-1 1.32PS07IP-1 1.66PS11IP-1 0.66PS04IP-1 1.84
PS06IP-1 1.83PS15IP-1 1.14PS16IP-1 1.27PS10IP-1 0.66PS12IP-1 0.52PS09IP-1 0.87
PS01IP-1 0.66PS19IP-1 1.79PS18IP-2 1.63PS13IP-1 1.76

0

150119 1849 9.59 14N23.02 90W36.16 -0.98 0.00
PS17IP-1 1.19PS13IP-1 1.46PS16IP-1 1.42PS12IP-1 0.25PS14IP-1 0.39PS01IP-1 0.47
PS11IP-1 0.43PS10IP-1 0.40PS09IP-1 0.57

0

150119 1855 35.06 14N22.96 90W36.08 -0.53 0.00
PS01IP-1 0.75PS07IP-1 1.81PS12IP-1 0.62PS11IP-1 0.70PS14IP-1 0.77PS10IP-1 0.72
PS16IP-1 1.25PS17IP-1 1.50PS09IP-1 0.88PS08IP-1 1.01PS13IP-1 1.43PS18IP-1 1.00
PS19IP-1 1.70PS15IP-1 1.18PS06IP-1 1.91PS04IP-1 1.88

0

150119 19 9 11.14 14N23.04 90W36.16 -1.31 0.00
PS17IP-1 1.31PS01IP-1 0.81PS13IP-1 1.49PS11IP-1 0.79PS12IP-1 0.53PS14IP-1 0.73
PS09IP-1 0.93PS10IP-1 0.67

0

150119 1951 10.55 14N22.95 90W36.08 -0.54 0.00
PS04IP-1 1.95PS16IP-1 1.51PS01IP-1 0.77PS12IP-2 0.58PS11IP-1 0.66PS14IP-1 0.79
PS08IP-1 0.97PS13IP-2 1.77PS09IP-1 0.87PS10IP-1 0.73PS15IP-1 1.82PS07IP-2 1.69
PS06IP-2 1.99PS17IP-1 1.00

0

150119 20 4 47.06 14N22.95 90W36.16 -1.07 0.00
PS16IP-1 1.92PS12IP-1 0.29PS09IP-1 0.75PS01IP-1 0.50PS15IP-1 1.71PS13IP-1 1.08
PS11IP-1 0.53PS07IP-1 1.44PS14IP-1 0.57PS06IP-1 2.11PS08IP-1 1.61PS17IP-1 1.15
PS10IP-1 0.38

0

150119 20 8 6.96 14N23.01 90W36.11 -1.04 0.00
PS11IP-1 0.35PS17IP-1 1.18PS13IP-1 1.27PS09IP-1 0.81PS14IP-1 0.50PS01IP-1 0.42
PS10IP-1 0.43PS12IP-1 0.29PS07IP-1 1.81PS15IP-1 1.81

0
150119 2038 32.99 14N22.95 90W36.09 -0.76 0.00
PS17IP-1 1.12PS08IP-1 1.42PS11IP-1 0.62PS12IP-1 0.34PS10IP-1
0.51PS01IP-1 0.61
PS09IP-1 0.76PS14IP-1 0.57PS16IP-1 1.27PS07IP-1 1.59
0
150119 2055 1.17 14N23.01 90W36.12 -0.91 0.00
PS15IP-2 1.42PS14IP-1 0.48PS10IP-1 0.39PS01IP-1 0.45PS12IP-1
0.32PS11IP-1 0.57
PS08IP-2 0.74PS17IP-2 0.93PS09IP-1 0.78
0
150119 21 3 38.29 14N23.00 90W36.14 -0.98 0.00
PS01IP-1 0.30PS14IP-2 0.95PS16IP-2 1.88PS08IP-1 1.10PS13IP-1
1.14PS11IP-1 0.40
PS18IP-2 1.96PS12IP-2 0.08PS10IP-2 0.43PS09IP-1 0.73PS17IP-1 1.27
0
150119 21 4 51.45 14N22.95 90W36.12 -0.84 0.00
PS14IP-1 0.52PS10IP-1 0.44PS11IP-1 0.50PS12IP-1 0.38PS09IP-1
0.64PS01IP-2 0.62
PS08IP-2 1.33PS17IP-2 1.29
0
150119 2141 35.17 14N22.95 90W36.15 -0.93 0.00
PS01IP-1 0.46PS08IP-2 1.25PS10IP-1 0.28PS12IP-1 0.36PS17IP-1
1.37PS09IP-1 0.68
PS14IP-1 0.45PS11IP-1 0.54
0
150119 2146 4.31 14N23.05 90W36.23 -1.37 0.00
PS13IP-1 1.85PS06IP-1 2.13PS11IP-1 0.88PS19IP-1 2.29PS14IP-1
0.85PS12IP-1 0.70
PS16IP-1 1.67PS01IP-1 0.89PS09IP-1 0.88PS17IP-1 1.44PS08IP-1 1.22
0
150119 2220 50.09 14N22.94 90W36.12 -0.63 0.00
PS12IP-1 0.56PS11IP-2 0.85PS01IP-2 0.64PS10IP-1 0.61PS14IP-1
0.82PS09IP-1 0.61
PS17IP-1 1.26PS08IP-0 1.11PS15IP-2 1.68
0
150119 2237 37.54 14N23.00 90W36.07 -0.98 0.00
PS01IP-1 0.29PS11IP-1 0.52PS12IP-1 0.00PS10IP-1 0.71PS14IP-1
0.74PS17IP-1 1.47
PS09IP-1 0.59PS08IP-2 1.27
0
150119 2239 28.66 14N22.97 90W36.17 -0.98 0.00
PS10IP-1 0.26PS11IP-1 0.25PS13IP-1 1.38PS01IP-1 0.39PS17IP-1

1.15PS16IP-1 1.78
PS08IP-1 1.28PS14IP-1 0.61PS09IP-1 0.60PS12IP-1 0.13
0

150119 2249 44.00 14N22.98 90W36.13 -1.02 0.00
PS16IP-1 1.45PS09IP-1 0.79PS10IP-2 0.23PS11IP-2 0.57PS12IP-2 0.29PS17IP-2 1.19
PS08IP-2 1.26PS01IP-2 0.40PS14IP-1 0.47
0

150120 011 41.29 14N22.99 90W36.11 -0.69 0.00
PS12IP-1 0.39PS09IP-1 0.79PS16IP-1 1.14PS17IP-1 1.09PS08IP-1 0.99PS06IP-1 1.69
PS15IP-1 1.47PS11IP-1 0.44PS13IP-1 1.34PS10IP-1 0.57PS01IP-1 0.65PS18IP-1 1.36
PS14IP-1 0.75
0

150120 055 15.65 14N22.98 90W36.14 -0.70 0.00
PS01IP-1 0.45PS18IP-1 1.40PS06IP-1 1.73PS16IP-1 1.34PS13IP-1 1.54PS07IP-1 1.44
PS17IP-1 1.28PS11IP-1 0.51PS08IP-1 0.71PS12IP-1 0.44PS14IP-0 0.62PS09IP-1 0.68
PS10IP-1 0.54
0

150120 057 3.01 14N22.93 90W36.09 -0.47 0.00
PS01IP-1 0.86PS12IP-1 0.71PS14IP-1 0.85PS09IP-1 0.91PS10IP-1 0.81PS11IP-1 0.85
PS17IP-1 1.29PS08IP-1 1.17
0

150120 123 56.62 14N23.02 90W36.08 -0.86 0.00
PS17IP-1 1.18PS04IP-1 2.27PS11IP-1 0.63PS09IP-1 0.69PS12IP-1 0.28PS14IP-1 0.49
PS08IP-1 0.95PS01IP-1 0.27PS10IP-1 0.70
0

150120 156 30.85 14N23.01 90W36.12 -0.74 0.00
PS18IP-1 1.67PS08IP-1 0.84PS07IP-2 1.73PS17IP-1 1.21PS10IP-1 0.56PS14IP-1 0.43
PS11IP-1 0.67PS01IP-1 0.56PS12IP-1 0.41PS16IP-1 1.04PS19IP-1 1.54PS09IP-1 0.67
0

150120 3 1 53.42 14N22.96 90W36.12 -0.77 0.00
PS01IP-1 0.60PS09IP-1 0.71PS12IP-1 0.42PS11IP-1 0.61PS16IP-1 1.28PS17IP-1 1.21
PS10IP-1 0.40PS08IP-1 1.04PS14IP-1 0.63
0

150120 3 3 8.82 14N22.99 90W36.06 -0.93   0.00
PS09IP-1 0.76PS12IP-1 0.13PS10IP-1 0.49PS11IP-1 0.57PS16IP-1
1.28PS17IP-1 1.18
PS14IP-1 0.71PS01IP-1 0.22
0
150120 313 58.27 14N22.99 90W36.12 -0.71   0.00
PS01IP-1 0.58PS16IP-2 1.30PS07IP-2 1.54PS09IP-1 0.66PS08IP-1
0.88PS10IP-1 0.53
PS14IP-1 0.60PS12IP-1 0.44PS15IP-1 1.64PS17IP-1 1.11PS11IP-1
0.69PS13IP-3 1.24
0
150120 318 13.59 14N23.10 90W36.21 -1.85   0.00
PS14IP-2 1.44PS09IP-1 1.60PS17IP-1 2.07PS10IP-1 1.37PS16IP-1
1.89PS08IP-1 1.73
PS15IP-1 2.27PS07IP-1 2.49PS12IP-1 1.35PS11IP-1 1.56PS01IP-2
1.64PS13IP-1 2.14
0
150120 330 13.00 14N23.05 90W36.11 -0.98   0.00
PS07IP-1 2.37PS14IP-1 0.09PS08IP-2 1.13PS17IP-1 1.09PS16IP-1
1.45PS01IP-1 0.34
PS09IP-1 0.63PS12IP-1 0.13PS10IP-1 0.56PS11IP-1 0.22PS13IP-1 1.58
0
150120 4 5 12.78 14N22.96 90W36.10 -0.16   0.00
PS12IP-1 0.82PS15IP-1 1.58PS01IP-1 1.04PS11IP-1 1.19PS08IP-1
1.38PS16IP-1 1.56
PS17IP-1 1.50PS13IP-1 1.45PS09IP-1 1.27PS14IP-1 1.30PS10IP-1
1.10PS07IP-1 1.70
PS04IP-1 1.93PS06IP-1 1.78PS19IP-1 1.63
0
150120 4 6 52.22 14N22.93 90W36.12 -0.68   0.00
PS12IP-1 0.46PS14IP-1 0.70PS16IP-1 1.54PS11IP-1 0.57PS13IP-1
0.84PS09IP-1 0.75
PS19IP-1 1.66PS17IP-1 1.41PS08IP-1 0.88PS15IP-1 1.10PS07IP-1
1.70PS04IP-2 1.86
PS06IP-1 1.84PS01IP-1 0.63PS10IP-1 0.65
0
150120 422 7.57 14N22.96 90W36.12 -0.46   0.00
PS09IP-1 0.80PS14IP-1 0.71PS11IP-1 0.90PS01IP-1 0.89PS10IP-1
0.81PS08IP-1 1.14
PS17IP-1 1.20PS12IP-1 0.73
0
150120 435 14.56 14N22.95 90W36.07 -0.04   0.00
PS11IP-1 1.28PS12IP-1 1.19PS10IP-1 1.30PS01IP-1 1.32PS14IP-1
1.38PS09IP-1 1.46

PS13IP-1 1.44PS08IP-1 1.55PS17IP-1 1.57PS16IP-1 1.61PS19IP-1 1.69PS07IP-1 1.79
PS15IP-1 1.80PS06IP-1 1.82PS04IP-1 1.96
0

150120 5 5 23.34 14N22.88 90W36.14 -1.10   0.00
PS12IP-1 0.30PS19IP-1 1.85PS11IP-1 0.37PS16IP-1 1.72PS17IP-1 1.49PS01IP-1 0.83
PS14IP-1 0.92PS08IP-1 1.25PS13IP-1 1.73PS10IP-1 0.55PS09IP-1 0.37PS15IP-1 1.98
PS07IP-1 1.93PS06IP-1 2.02PS04IP-1 2.07
0

150120 538 0.77 14N22.97 90W36.08 -0.24   0.00
PS10IP-1 1.03PS09IP-1 1.23PS12IP-1 0.95PS01IP-1 1.03PS11IP-1 1.10PS14IP-1 1.09
PS13IP-1 1.23PS17IP-1 1.36PS16IP-1 1.47PS08IP-1 1.36PS19IP-1 1.60PS15IP-1 1.65
PS07IP-1 1.66PS06IP-1 1.75PS04IP-1 2.04
0

150120 554 2.70 14N22.93 90W36.13 -0.61   0.00
PS16IP-1 1.93PS17IP-1 1.24PS09IP-1 0.79PS14IP-1 0.73PS10IP-1 0.66PS01IP-1 0.68
PS11IP-1 0.65PS12IP-1 0.55PS06IP-1 1.77PS07IP-1 1.73PS15IP-1 1.38PS19IP-1 1.58
PS08IP-1 0.93
0

150120 554 55.24 14N22.90 90W36.15 -0.59   0.00
PS17IP-1 1.41PS10IP-1 0.70PS12IP-1 0.59PS11IP-1 0.67PS15IP-3 1.70PS14IP-1 0.77
PS07IP-1 1.59PS09IP-1 0.83PS16IP-1 1.69PS01IP-1 0.74PS08IP-1 0.91PS13IP-1 0.91
0

150120 621 48.52 14N22.95 90W36.10 -0.06   0.00
PS14IP-1 1.31PS16IP-1 1.62PS13IP-1 1.41PS08IP-1 1.48PS19IP-1 1.80PS15IP-1 1.64
PS07IP-1 1.76PS06IP-1 1.87PS04IP-1 1.86PS11IP-1 1.28PS10IP-1 1.26PS12IP-1 0.79
PS01IP-1 1.31PS17IP-1 1.56PS09IP-1 1.40
0

150120 641 10.16 14N22.91 90W36.06 -0.68   0.00
PS11IP-1 0.53PS12IP-1 0.36PS01IP-1 0.75PS10IP-1 0.78PS14IP-1 0.81PS17IP-1 1.42
PS09IP-1 0.89PS08IP-1 1.04PS07IP-1 1.76PS15IP-1 1.85PS13IP-3 1.51
0

150120 714 3.38 14N22.93 90W36.12 -0.58   0.00

PS07IP-2 1.59PS08IP-1 0.98PS17IP-1 1.47PS01IP-1 0.65PS14IP-1
0.72PS09IP-1 0.89
PS11IP-1 0.78PS12IP-1 0.59PS10IP-1 0.66PS19IP-1 1.60PS15IP-1
1.65PS16IP-1 1.42
0
150120 821 21.70 14N23.05 90W36.23 -1.25   0.00
PS16IP-1 1.68PS07IP-1 1.85PS13IP-1 1.77PS08IP-1 0.93PS11IP-1
0.79PS09IP-1 0.80
PS01IP-1 0.71PS12IP-1 0.59PS14IP-1 0.75PS17IP-1 1.19PS10IP-1
0.54PS06IP-1 1.88
PS15IP-1 1.71
0
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PS01IP-1 0.61PS08IP-1 0.87PS12IP-1 0.42PS14IP-1 0.65PS09IP-1
0.68PS07IP-2 1.62
PS17IP-1 1.32PS16IP-1 1.34PS10IP-1 0.54PS11IP-1 0.55PS13IP-2 1.10
0
150120 852 47.65 14N22.92 90W36.12 -0.42   0.00
PS14IP-1 0.80PS01IP-1 0.89PS08IP-1 1.17PS17IP-1 2.02PS16IP-1
1.44PS15IP-1 1.60
PS10IP-1 0.80PS11IP-1 1.01PS12IP-1 0.72PS09IP-1 1.08
0
150120 913 19.55 14N22.93 90W36.11 -0.67   0.00
PS06IP-1 1.97PS04IP-1 1.95PS10IP-1 0.63PS12IP-1 0.46PS09IP-1
0.80PS11IP-1 0.60
PS14IP-1 0.73PS01IP-1 0.65PS13IP-1 0.85PS08IP-1 0.92PS17IP-1
1.53PS07IP-1 1.69
PS15IP-1 1.25PS16IP-1 1.37PS19IP-1 1.59
0
150120 1041 45.58 14N22.89 90W36.21 -0.51   0.00
PS11IP-1 0.77PS08IP-1 1.12PS10IP-1 0.80PS15IP-1 1.47PS07IP-1
1.35PS17IP-1 1.39
PS16IP-1 1.85PS19IP-1 1.90PS09IP-1 0.98PS14IP-1 0.86PS01IP-1
0.84PS12IP-1 0.65
0
150120 1047 40.49 14N23.01 90W36.10 -0.55   0.00
PS14IP-1 0.78PS07IP-1 1.59PS15IP-1 1.20PS16IP-1 1.29PS17IP-1
1.02PS08IP-1 1.03
PS06IP-1 2.07PS11IP-1 0.74PS10IP-1 0.71PS09IP-1 0.77PS01IP-1
0.77PS12IP-1 0.58
0
150120 1123 26.37 14N23.04 90W36.08 -1.28   0.00
PS09IP-1 0.97PS08IP-1 1.17PS11IP-1 0.77PS10IP-1 0.95PS17IP-1
1.36PS14IP-1 0.78

PS12IP-1 0.03PS01IP-1 0.74

0

150120 1139 58.20 14N23.00 90W36.14 -1.01   0.00
PS14IP-1 0.50PS17IP-1 1.05PS10IP-1 0.35PS12IP-1 0.32PS09IP-1
0.59PS01IP-1 0.48
PS08IP-1 1.23PS11IP-1 0.64

0

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PS06IP-1 1.85PS16IP-1 1.64PS17IP-1 1.39PS08IP-1 0.90PS09IP-1
0.75PS14IP-1 0.70
PS12IP-1 0.51PS10IP-1 0.64PS11IP-1 0.48PS01IP-1 0.63PS15IP-1 1.26

0

150120 1222 43.81 14N22.92 90W36.20 -0.23   0.00
PS14IP-3 1.20PS10IP-3 0.59PS06IP-1 1.54PS16IP-1 1.76PS17IP-1
1.46PS13IP-1 1.33
PS01IP-2 0.83PS11IP-2 0.97PS12IP-2 0.60PS08IP-1 1.50PS15IP-1
1.34PS09IP-1 1.05

0

150120 14 3 7.13 14N22.93 90W36.14 -0.50   0.00
PS10IP-1 0.73PS01IP-1 0.79PS17IP-1 1.34PS09IP-1 0.87PS16IP-1
1.52PS11IP-1 0.83
PS12IP-1 0.66PS08IP-1 1.01PS15IP-1 1.69PS07IP-1 1.36PS06IP-1
1.76PS14IP-1 0.78

0

150120 1426 34.06 14N22.97 90W36.30 -0.98   0.00
PS16IP-2 2.00PS11IP-2 0.47PS12IP-2 0.17PS09IP-1 0.39PS13IP-2
2.26PS01IP-1 0.57
PS14IP-1 0.59PS17IP-1 1.57

0

150120 1516 54.39 14N22.99 90W36.27 -1.35   0.00
PS17IP-1 1.79PS01IP-1 1.03PS12IP-1 0.57PS16IP-1 1.91PS13IP-1
1.62PS08IP-1 1.07
PS11IP-1 0.98PS07IP-1 1.66PS15IP-1 1.70PS06IP-1 2.16PS09IP-1
1.03PS14IP-1 0.82

0

150120 1858 54.10 14N22.97 90W36.07 -0.54   0.00
PS16IP-1 1.32PS14IP-1 0.81PS01IP-1 0.79PS09IP-1 0.88PS17IP-1
1.09PS15IP-1 1.78
PS08IP-1 1.03PS11IP-1 0.75PS12IP-1 0.61PS13IP-1 0.96

0

150120 1953 18.49 14N23.05 90W36.22 -1.24   0.00
PS01IP-1 0.85PS17IP-1 1.23PS12IP-1 0.71PS11IP-1 0.75PS14IP-1
0.49PS13IP-1 1.53
PS09IP-1 0.82PS08IP-1 1.12

0

150120 2011 1.45 14N22.97 90W36.26 -0.97 0.00
PS09IP-1 0.19PS08IP-1 1.54PS17IP-2 1.76PS16IP-1 1.94PS12IP-1
0.22PS13IP-1 1.57
PS14IP-1 0.51PS01IP-1 0.36PS15IP-2 1.76

0

150121 1 1 53.58 14N23.06 90W36.11 -0.58 0.00
PS15IP-1 1.24PS11IP-1 0.69PS13IP-1 1.47PS14IP-1 0.66PS09IP-1
0.81PS17IP-1 1.00
PS08IP-1 1.01PS16IP-1 1.07PS12IP-1 0.50PS01IP-1 0.65

0

150121 129 3.69 14N22.93 90W36.11 -0.96 0.00
PS11IP-1 0.42PS09IP-1 0.73PS14IP-1 0.53PS01IP-1 0.53PS08IP-1
1.41PS17IP-1 1.31
PS16IP-2 1.52PS12IP-1 0.27

0

150121 136 35.67 14N22.96 90W36.12 -1.02 0.00
PS09IP-1 0.90PS16IP-1 1.56PS14IP-1 0.51PS01IP-1 0.56PS12IP-1
0.24PS08IP-1 1.12
PS11IP-1 0.45PS17IP-1 1.18

0

150121 250 15.16 14N23.09 90W36.16 -1.27 0.00
PS14IP-1 0.73PS11IP-1 0.79PS12IP-1 0.56PS09IP-1 0.85PS13IP-1
1.59PS01IP-1 0.67
PS08IP-1 0.95PS17IP-1 1.29PS16IP-1 1.33PS15IP-1 1.79

0

150121 3 8 17.83 14N22.91 90W36.05 -1.09 0.00
PS17IP-1 1.48PS15IP-1 1.83PS08IP-1 2.05PS14IP-1 0.73PS11IP-1
0.28PS12IP-1 0.01
PS13IP-1 0.85PS01IP-1 0.70PS09IP-1 1.04PS16IP-1 1.43

0

150121 451 11.71 14N23.05 90W36.17 -1.19 0.00
PS01IP-1 0.62PS14IP-1 0.59PS09IP-1 0.72PS08IP-1 1.09PS11IP-1
0.64PS13IP-1 1.55
PS17IP-1 1.22PS12IP-1 0.45

0

150121 738 29.96 14N22.95 90W36.15 -0.70 0.00
PS11IP-1 0.60PS15IP-2 1.65PS09IP-1 0.75PS08IP-1 0.87PS01IP-1
0.64PS14IP-1 0.66
PS12IP-1 0.52PS13IP-1 0.96PS16IP-1 1.62PS17IP-1 1.06

0

150121 1026 24.06 14N23.02 90W36.16 -1.17 0.00
PS16IP-1 1.46PS17IP-1 1.26PS12IP-1 0.36PS09IP-1 0.75PS14IP-1

0.59PS11IP-1 0.66
PS01IP-1 0.64PS13IP-1 1.37PS08IP-3 1.22
0

150121 1233 13.66 14N23.15 90W36.10 -1.23   0.00
PS01IP-1 0.59PS12IP-1 0.48PS11IP-1 0.50PS15IP-1 1.78PS16IP-1
1.17PS13IP-1 1.64
PS09IP-1 1.04PS14IP-1 0.57
0

150121 1241 49.86 14N22.95 90W36.12 -0.74   0.00
PS08IP-1 1.01PS17IP-2 1.11PS15IP-2 1.66PS01IP-1 0.59PS11IP-1
0.59PS09IP-1 0.71
PS14IP-1 0.65PS16IP-1 1.37PS12IP-1 0.44
0

150121 1254 47.16 14N23.02 90W36.19 -0.98   0.00
PS01IP-1 0.45PS08IP-1 1.00PS17IP-1 1.31PS11IP-1 0.55PS13IP-1
1.40PS09IP-1 0.55
PS12IP-1 0.24PS14IP-1 0.42
0

150121 1349 58.29 14N22.95 90W36.09 -0.96   0.00
PS13IP-1 0.96PS17IP-1 1.35PS11IP-1 0.34PS12IP-1 0.23PS09IP-1
0.83PS01IP-1 0.47
PS14IP-1 0.55PS08IP-1 1.27PS16IP-1 1.35
0

150121 1414 42.70 14N22.95 90W36.14 -0.95   0.00
PS14IP-1 0.62PS15IP-1 1.67PS09IP-1 0.68PS13IP-1 1.01PS11IP-1
0.47PS12IP-1 0.36
PS01IP-1 0.54PS17IP-2 1.34
0

150121 1545 57.33 14N22.97 90W36.06 -0.18   0.00
PS08IP-1 1.40PS09IP-1 1.32PS01IP-1 1.01PS12IP-1 1.04PS13IP-1
1.30PS11IP-1 1.15
PS14IP-1 1.19PS15IP-1 1.64PS17IP-1 1.44PS16IP-1 1.51
0

150121 1647 39.14 14N23.01 90W36.11 -0.61   0.00
PS13IP-1 1.09PS01IP-1 0.64PS11IP-1 0.78PS17IP-1 0.97PS16IP-2
1.83PS09IP-1 0.74
PS08IP-1 0.86PS12IP-1 0.52PS14IP-1 0.67PS15IP-1 1.59
0

150121 1719 30.59 14N23.00 90W36.12 -0.83   0.00
PS08IP-1 0.93PS13IP-1 1.06PS11IP-1 0.56PS14IP-1 0.56PS12IP-1
0.40PS09IP-1 0.71
PS15IP-1 1.52PS17IP-1 1.13
0

Please note that some values had MATLAB "format long" used on the while others didn't. The lane community colleges pdf was not used. in the findingQcode.

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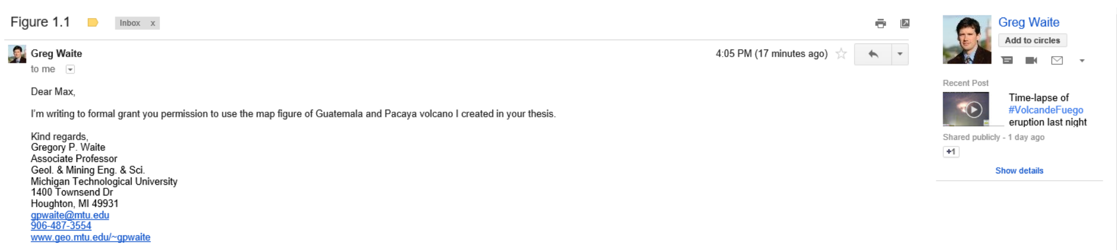

Figure 1.1 Inbox x

Greg Waite
to me

4:05 PM (17 minutes ago)

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Kind regards,
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Geol. & Mining Eng. & Sci.
Michigan Technological University
1400 Townsend Dr
Houghton, MI 49931
gpwaite@mtu.edu
906-487-3554
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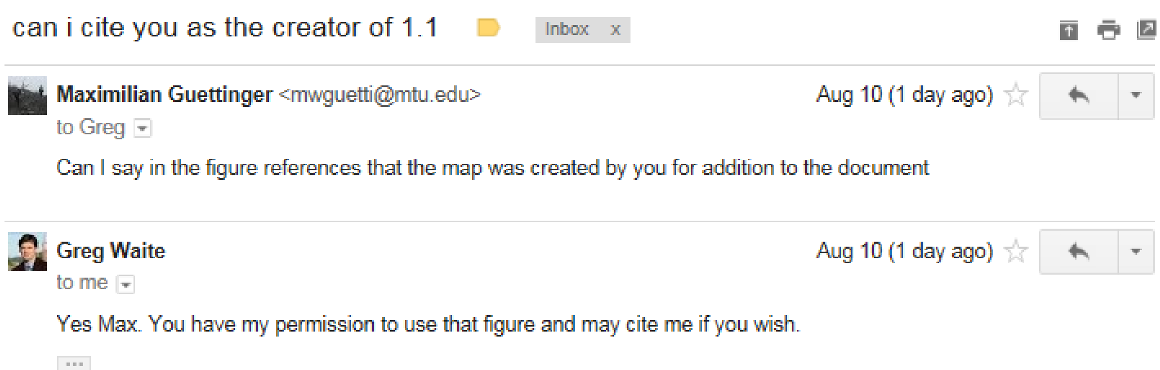

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