QUARTERLY NETWORK REPORT 2004-D

on

Seismicity of Washington and Oregon

October 1 through December 31, 2004

Pacific Northwest Seismograph Network

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This report is prepared as a preliminary description of the seismic activity in Washington State and Oregon. Information contained in this report should be considered preliminary, and not cited for publication without checking directly with network staff. The views and conclusions contained in this document should not be interpreted as necessarily representing the official policies, either express or implied, of the U.S. Government**.**

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INTRODUCTION

This is the fourth quarterly report of 2004 from the Pacific Northwest Seismograph Network (PNSN), at the University of Washington Dept. of Earth and Space Sciences, covering seismicity of Washington and western Oregon.

Comprehensive quarterlies have been produced by the PNSN since the beginning of 1984. Prior to that we published quarterly reports for western Washington in 1983 and for eastern Washington from 1975 to 1983. Annual technical reports covering seismicity in Washington since 1969 are available from the U.W. Dept. of Earth and Space Sciences. The complete PNSN earthquake catalog is available on-line, both through our web-site and through the ANSS earthquake catalog. In these reports we provide special coverage (figures, counts, listings, etc.) of earthquake swarms, aftershock sequences, etc.

This quarterly report discusses network operations, seismicity of the region, unusual events or findings, and our educational and outreach activities. This report is preliminary, and subject to revision. The PNSN routinely records signals from selected stations in adjoining networks. This improves our ability to locate earthquakes at the edges of our network. However, our earthquake locations may be revised if new data become available. Findings mentioned in these quarterly reports should not be cited for publication.

Prior to 2004, each quarterly included station tables and maps. Beginning in 2004, station tables and maps will be included only in the 4th quarter report. Lists of currently operating stations are available on-line through web page http://www.pnsn.org/OPS/stations.html.

NETWORK OPERATIONS

Maps and lists of station locations are in Appendix 1 of this report. Lists of currently operating stations are available on-line through web page http://www.pnsn.org/OPS/stations.html. Table 1 gives approximate periods of time when individual stations were inoperable. Data for Table 1 are compiled from weekly plots of network-wide teleseismic arrivals and automated and manual digital and analog signal checks, plus records of maintenance and repair visits.

TABLE 1 - Station outages and installations

Station	Outage Dates	Comment
ALKI	08/02/04-11/02/04	Bad timing prior to installation of GPS
BHW	03/14/04-End	Very noisy
BLIS	10/12/05	INSTALLED – Mt. St. Helens
BRKS	12/23/04-End	No communications
BULL	05/21/04-End	Intermittent
BURN	11/23/04-End	Dead
ERW	10/20/04-12/06/04	No communications
ERW	12/13/04-End	No communications
EYES	06/26/04-12/21/04	No communications, swapped sensor
FL2	11/28/04-End	Dead
GL2	10/21/04-End	Dead
GLK	11/26/04-End	Noisy
GPW	03/16/04-End	Dead
HDW	12/28/04-End	Dead
HSR	10/05/04	Gain lowered by 20 db
JBO	10/15/04-End	Noisy
JCW	09/16/04-09/29/04	Dead; construction at site
JRO	10/30/04	INSTALLED – Mt. St. Helens
KEEL	08/18/04-End	No communications
KICC	10/14/04-11/01/04	No communications
KICC	11/10-04-12/07/04	No communications
KNEL	08/12/04-10/18/04	No communications; firewall config.
KNEL	10/19/04-10/28/04	Bad timing; moved GPS
LTY	08/16/04-11/04/04	Dead horizontal components
MBKE	10/15/04-11/17/04	Dead; sensor voltage problem
MBKE	11/18/04-End	K2 removed for repair
MBW	12/07/04-End	Dead; shut down relay site due to radio interference
MCW	08/31/04-10/20/04	Dead because of radio interference

TABLE 1 - Station outages and installations

Station	Outage Dates	Comment
MCW	12/07/04-End	Dead. No telemetry because of radio interference
MPL	09/01/04-11/15/04	Removed K2 for repair
MPL	11/16/04-12/06/04	Removed—needed new GPS antenna
NED	11/04/04	INSTALLED – Mt. St. Helens
NLO	08/20/04-End	Dead; aircells died
OBH	01/31/02-End	Temp. removed for logging
OHC	11/24/04-12/07/04	No communications
OSR	01/06/04-11/05/04	VCO may be off-frequency
PAYL	10/21/04-12/06/04	Intermittent communications
PAYL	12/13/04-End	Intermittent communications
PGW	10/08/03-End	Dead
PSNS	09/13/04-10/07/04	Bad timing; needs GPS
RCS	10/25/04-12/05/04	Dead
RCS	12/25/04-End	Noisy
RER	10/20/04-End	Noisy
RMW	12/07/04-End	Dead
RVC	12/05/03-End	Noisy
RVW	10/05/04-11/08/04	Dead
SEA.HH?	12/05/03-End	Disconnected for renovation
SEAS	11/01/04-12/20/04	Dead; replaced K2
SEP	10/1/04	DESTROYED by Mt. St. Helens eruption
SEP	11/04/04	INSTALLED – Mt. St. Helens
SFER	09/01/04-End	Short period dead; needs removal
SFER	10/18/04-11/03/04	No communications
SHIP	11/05/04-End	Removed due to building demolition
SMW	06/20/03-End	Intermittent
SOPS	08/27/02-End	K2 flash problem
SP2	04/23/04-10/13/04	No telemetry
SSS1	9/23/04-End	INSTALLED, communication intermittent
SSS2	10/25/04-End	INSTALLED, communication intermittent
SSO	08/28/04-End	Intermittent
STD	10/21/04	INSTALLED (additional components)
SVOH	12/30/04-End	No communications
TBPA	09/01/04-12/06/04	Bad N component; removed for repair
TDL	11/28/04-End	Dead
TOLO	10/15/04-End	No communications
VGB	09/23/04-End	Intermittent; usually very noisy
WPW	05/02/04-End	Intermittent
YEL	10/22/04	Gain lowered by 12 db

Mt. St. Helens eruption, 2004-2005

Beginning on September 23, 2004 a series of small earthquakes at Mount St. Helens signaled the beginning of the first dome-building eruption at the volcano since 1986. The small earthquakes soon escalated into the most vigorous seismic activity at Mount St. Helens since the catastrophic eruption of 1980. Continuous seismic data from short-period stations near Mt. St. Helens are archived at the PNSN and streamed to the IRIS BUD archive. New procedures were implemented to rapidly handle the large volume of data so the PNSN and Cascade Volcanoes Observatory could assess the significance of the rapidly changing seismicity.

Equipment; gain changes, destruction, replacement, and new installations

Station SEP was destroyed during the ash and steam eruption of Oct. 1. SEP was replaced on Nov. 4 with a six-component station (3 high-gain components and 3 low-gain). New stations BLIS (EHZ and ELZ components installed Oct. 12), NED (EHZ and ELZ components installed Nov. 4),and JRO (3 component broad-band installed Oct. 30) were installed in the crater (BLIS and NED) or in the vicinity of Mt. St. Helens (JRO). Station STD (previously a short period vertical only) had an additional three-component broad-band instrument installed on Oct. 21.

Gain changes were made at stations HSR (turned down 20 dB on Oct. 5), and YEL (turned down 12 db on Oct. 22). The gain changes were made to improve the usefulness of these stations. The volcano signals were nearly continuous and energetic enough to saturate the stations at their initial gains.

24 Hour Volcano Watch and pager alert changes

For most of the quarter, scientists at the PNSN and CVO shared 24-hour volcano watch duties. During the night, scientists would check seismic monitors, webcams and debris flow monitors every 2 hours for unusual activity.

Daytime (7 AM – 11 PM) pager triggering for Mt. St. Helens events had to be desensitized. Normal procedure for daytime pages has been to page for events larger than magnitude 1.8. In late September, daytime pages from Mt. St. Helens began to occur continuously. Therefore, the daytime paging script was modified in early October to page only on Mt. St. Helens events with preliminary magnitudes of 2.0 or greater with 8 or more stations triggering. The daytime paging threshold has been adjusted over the course of the sequence to page on events of higher-than-average magnitude. Alert event pages, normally for earthquakes larger than 2.8, were adjusted to exclude St. Helens events from early Oct. to early November.

Rapid automatic analysis of earthquake data -

Our traditional method of analyzing earthquake data in the Pacific Northwest, i.e. using a triggering algorithm to detect earthquakes and manually processing every earthquake, quickly became unmanageable. To get rapid information on the ongoing sequence, we implemented automatic analysis of selected channels of continuously recorded seismic data. Near-real-time results of these analyses are being updated every 30 minutes at http://www.pnsn.org/WEBICORDER/RMS/

One of the most useful parameters we compute is a Real Time Seismic Amplitude Monitor (RSAM). RSAM is the root mean square (RMS) amplitude of ground motion at a station averaged over a time period. We have found averaging times of 10 minutes and 1 minute to be useful. It is necessary to monitor the RSAM at several stations because the data at close stations may be clipped. The RSAM provides an important parameter to consider in determining the hazard alert level at the volcano. See the "Earthquake Data" section for additional details.

In addition to the RSAM we implemented an event detection algorithm to automatically determine earthquake times from the continuous seismic data. For each earthquake detected we determine the (trigger) time, duration of the signal, maximum amplitude, maximum RMS amplitude, and the frequency of the maximum spectral amplitude. Using this automated procedure, we detected about 500,000 earthquakes during first 110 days of the seismic activity (September 23, 2004- January 11, 2005).

Standard analysis of earthquake data

Beginning in late September, Mount St. Helens began producing thousands of earthquake triggers per day, with each trigger containing numerous earthquakes. Although triggering was mostly due to activity at Mount St. Helens, small earthquakes from elsewhere in the network were also embedded in the same files.

Each triggered event file contained many minutes of data for 500 channels, sampled at 100 samples/sec, and our disk storage quickly began filling, as we had no automated way to sort out the events that were not-at Mount. St. Helens, and thus could not automatically identify unwanted seismic traces. Although the rate of energy release peaked in early October, activity continued at a fairly brisk pace. During the early part of the sequence we focused on providing rapid information on ongoing changes in seismic activity. Currently, seismicity continues at a higher-than-normal level (100-200 events/hour).

Data analysts are now systematically going through the backlog of unprocessed or partially processed data, "slashing out" and processing "non-Mt. St. Helens" earthquakes, locating selected Mount St. Helens events, and flagging pickfiles of unlocated Mt. St. Helens events "g". Because of the large volume of data, pickfiles flagged "g" and their associated data files will be archived as a separate data set for research.

On November 20 we desensitized the triggering at Mount St. Helens so that only the largest events recorded automatically. All non-Mount St. Helens events still produce triggers. To capture significant events at Mount St. Helens, we review continuous data from stations near the mountain, and retrieve data in selected time windows containing especially interesting events and a sample of the seismicity (usually only a few events/hr.), particularly events with large amplitude, impulsive arrivals, or unusual depth, frequency, location , or signal characteristics. These events are processed in the traditional way, i.e. determine a hypocenter, magnitude, and fault plane solution if possible. Less than 1 percent of the detected events were processed in this way and we tended to favor the larger events. Since desensitizing, unlocated Mt. St. Helens events continue to occasionally be flagged “g”, but the number of such events is far fewer, due to the change in procedures.

Disk Space

This sequence required emergency acquisition of additional disk space. See last quarter’s report for details.

Archiving and Tape-Drive Issues

The PNSN normally archives all triggered events on exabyte tapes. Normally an exabyte tape will last between 2 weeks and a month. However, the eruption caused almost continuous triggering, and the exabyte tapes began filling up at a much faster rate, requiring replacement of the exabyte around every 2 days. The exabyte tape drive broke down, and another exabyte drive and a DLT drive also proved inoperable. Eventually, replacement drives were scavenged from elsewhere in the department. In the interim, data were backed up either to IRIS or a backup hard drive. See last quarter’s report for details.

Strong Motion Instrumentation Update

The Duwamish Valley borehole array installation (stations SSS1 and SSS2) was completed at Seattle School District's John Stanford Center at 4th and Lander. A total of 4 tri-axial Kinematics Episensors are deployed at various depths. Deployment depths are 0. 11.5, 43.9 and 50.6 m. Depths were chosen by the ANSS Regional Advisory Committee after review of bore logs collected by Washington State DNR. The two lower sensors are located just above and below the interface of a gravel layer.

At the Duwamish Valley borehole array, a Kinemetrics K2 with an internal Episensor is located on grade. Data streams from the three subsurface Kinemetrics SB Episensors are digitized by a second K2. The sensor at grade has station code SSS2 and channels ENZ, ENE, ENN. The subsurface channels have station code SSS1. Because the EARTHWORM data acquisition system has no protocol for identifying sensors at different depths, we distinguish the sensor streams by modifying station and channel codes. Channels names are EN[ZNE] for the sensor at 50.6m, GN[ZNE] for 43.9m, and FN[ZNE] for 11.5m. The K2 firmware limits the real-time data collection to 2 of the 3 subsurface sensors, so channels GN[ZNE] are not collected in real time..

Station ALKI, initially installed last summer, was finalized with the installation of a GPS antenna for data timing, as well as the installation of an L-4 short period sensor. An additional Kinemetrics K2, from the USGS Seattle Urban Array, will continue to co-occupy the site.

Computer Hardware Update

In early October, *scossa,* our main data collection and processing computer, experienced a major problem which took several hours to resolve. The reasons for the failure are not well understood, but *scossa* was clearly severely overloaded. Fortunately, backup data acquisition system *milli* continued to trigger and no significant data were lost. Because of the critical and volatile situation at Mount St. Helens, the USGS provided funds to purchase a new computer, *tremito*, which was brought on-line about the third week in October. *Scossa* continues to be our main data collection computer, and *tremito* provides additional computational power for manual processing of earthquake data and acts as a fileserver for all the other networked computers in the group.

Automatically generated Web-pages: Webicorder Update

The processes that generate Webicorders (on-line real-time trace data displays), were moved to *grasso*. This allowed us to provide webicorders for more stations and reduced the load on our main real-time system, *scossa*. Currently 92 PNSN stations are available on webicorders through six index pages. Webicorders indexes are grouped by type (short-period, broad-band, and strong motion), plus a special index for stations located on volcanoes. Webicorder pages were redesigned to improve navigation between the six webicorder index pages.

Use of PNSN Data

The IRIS Data Management Center reports 1,028 requests for PNSN trace-data this quarter. Nearly 982,000 traces were requested. This represents an order of magnitude increase over a typical quarter.

EARTHQUAKE DATA - 2004-D

About 22,000 events were digitally recorded and processed at the University of Washington between October 1 and December 31, 2004. This is about 10 times the number of events the PNSN typically processes in a quarter, due to the eruption of Mount St. Helens. Locations in Washington, Oregon, or southernmost British Columbia were determined for 2,602 of these events; 2,524 were classified as earthquakes and 78 as known or suspected blasts. The remaining processed events include teleseisms (162 events), regional events outside the PNSN (65), and unlocated events within the PNSN, mostly at Mt. St.

Helens. Due to the extremely large number of events (automatic counting routines indicate about 500,000 Mount St. Helens events this quarter), only a representative sample of Mount St. Helens seismicity was located. Other unlocated events within the PNSN normally include surficial events on Mt. St. Helens and Mt. Rainier, very small earthquakes, and blasts. Frequent mining blasts occur near Centralia, Washington and we routinely locate them.

Table 2 lists earthquakes reported to have been felt during this quarter. Events with ShakeMaps or Community Internet Intensity Maps (CIIM) are indicated. This quarter, no events generated ShakeMaps. Two events produced "CIIM" maps (**http://pasadena.wr.usgs.gov/shake/pnw/**), which convert "felt" reports sent by the general public (via Internet) into numeric intensity values. CIIM maps show the average intensity by zip code.

Table 3 is this quarter's catalog of earthquakes M 2.0 or greater, located within the network - between 42-49.5 degrees north latitude and 117-125.3 degrees west longitude.

Figure 1. Earthquakes with magnitude greater than or equal to 0.0 (M_c >=0).

Figure 2. Blasts and probable blasts (M_c >=0).

Figure 3a. Mt. St. Helens, station JUN, signal RMS amplitude minima and maxima over the course of the quarter.

Figure 3b. Mt. St. Helens, magnitudes as a function of time over the course of the quarter.

Figure 3c. Earthquakes located near Mt. St. Helens (M_c >=0).

Figure 4. Earthquakes located near Mt. Rainier (M_c >=0).

TABLE 2 - Felt Earthquakes during the 4thQuarter of 2004

DATE-(UTC)-TIME	LAT(N)	LON(W)	DEP	MAG	COMMENTS	CIIM	Shake Map
yy/mm/dd hh:mm:ss	deg.	deg.	km				
04/10/30 06:47:03	42.06	120.29	12.2	3.1	15.0 km SSE of Lakeview, OR	✔	
04/11/16 18:21:28	42.06	120.27	12.0	3.5	15.5 km SSE of Lakeview, OR	✔	

OREGON

During the fourth quarter of 2004, 95 earthquakes were located in Oregon between 42.0 degrees and 45.5 degrees north latitude, and between 117 degrees and 125 degrees west longitude. The most notable earthquakes in Oregon were two felt earthquakes, M 3.1 and 3.5 near Lakeview Oregon, near the California border, where swarm activity began in June. The swarm continued this quarter, with 39 earthquakes located in the area including 3 earthquakes of magnitude 3.0 or larger.

The Lakeview area is between the Pacific Northwest and California networks, and few seismometer stations are nearby. The PNSN and California Integrated Seismic Network **(http://www.cisn.org/**) are exchanging data for these events. Each organization analyzes the earthquakes independently. The USGS assigned magnitudes of 3.3 and 3.6 to the two felt events this quarter, Oct. 30 and Nov. 16th (UTC), while the UW computed 3.1 and 3.5 respectively. Another earthquake in the area, on Oct. 7, had a UW-determined magnitude of 3.5, but was not reported felt.

WESTERN WASHINGTON SEISMICITY

During the second quarter of 2004, 2,365 earthquakes were located between 45.5 degrees and 49.5 degrees north latitude and between 121.0 degrees and 125.3 degrees west longitude. Most western Washington seismicity this quarter was in the Mount St. Helens area, see discussion below. No earthquakes were felt this quarter in western Washington.

Excluding Mt. St. Helens, the largest earthquake in western Washington this quarter was a magnitude 3.2 event on Nov. 7 (UTC), located beneath the summit of Mt. Rainier at shallow depth (less than 2 km). The deepest earthquake in western Washington this quarter was a magnitude -0.2 event at about 70 km depth located beneath Hyak, WA on Dec. 24 (UTC).

WASHINGTON CASCADE VOLCANOES

Mount St. Helens

Mount St. Helens began an eruptive episode with a vigorous sequence of seismic activity starting on September 23. Activity accelerated into early October. The most energetic seismicity occurred on Oct. 1-5 when several phreatic explosions and half-hour to hour-long periods of harmonic tremor interrupted and temporarily calmed extremely high rates of magnitude 3+ seismicity. Seismicity fell following after Oct. 5, with a second, but less intense peak occurring Oct 7-9. Frequent, but smaller, earthquakes continued to occur throughout the quarter. Figures 3a and 3b summarize Mount St. Helens activity over the fourth quarter, based on automatic analysis procedures developed to manage the extremely high rate of seismicity (see operations section for details).

Because of the high rates of seismicity, only a representative sample (less than 1%) of Mount St. Helens events was located using conventional manual processing. Figure 3c shows located volcano-tectonic earthquakes near Mount St. Helens. Low frequency (L) and avalanche or rockfall events (S) are not shown. Seismograph stations operating during the fourth quarter are shown in the Appendix. See the operations section for details on destruction, replacement and new instrument installation during the fourth quarter.

Estimates of Mount St. Helens seismicity using automated counting procedures suggest that about 500,000 earthquakes occurred during the 4th quarter of 2004. Only a small subset was manually processed. At the time this report was written, 2,184 earthquakes (113 with magnitudes between 3.0 and 3.6) had been were located in the area shown in Fig. 3c using conventional manual processing procedures. An additional 15,000 events have been saved as a research data set, and 5,000 events still await processing. All locatable earthquakes in the 2004/2005 sequence are relatively shallow. No events occurred at depths exceeding 2 km. Most of the epicenters did not occur under what eventually became a new lava dome located just south of the 1980-86 (old) dome. Instead, the epicenters tended to be located on the boundary between the old and new domes near the vent that first appeared in early October, 2004. This conclusion may change when a more refined model of seismic velocity is developed for Mt. St. Helens.

One of the most remarkable aspects of the earthquake signals in 2004/2005 is the regularity of the frequency of occurrence for many months. Typically the earthquakes occurred every 30 seconds, although the inter-event time changed slowly with time. In addition, the sizes of the earthquakes over hours or days are usually very uniform with occasional, larger events. This observation seems to correlate well with observed deformation rates of the dome that were linear for days at a time. Event frequencies varied slightly, with higher-frequency tectonic-type events in the early part of the sequence giving way to events with somewhat lower frequency following the ash emissions and tremor episodes in early October.

Chronology of eruptive seismicity

See also CVO eruption chronology
http://vulcan.wr.usgs.gov/Volcanoes/MSH/Eruption04/Chronology/msh_eruption_chronology_20040923-20041014.html
and PNSN Webicorder archives:
http://www.ess.washington.edu/SEIS/PNSN/WEBICORDER/HELENS/september2004.html

September 23-25: unrest began with a swarm of small earthquakes starting on Sept. 23. The swarm accelerated on Sept. 24, and declined on Sept. 25.

September 26: Seismicity increased, including 10 events of magnitude 2.0-2.8. An official Notice of Volcanic Unrest was issued by the Cascades Volcano Observatory (CVO) at 3:00 p.m., the first since October 1986. Alert Level was 1, "Code Yellow."

September 29: Seismicity increased substantially overnight. Earthquakes occurred at the rate of four per minute. The largest events approached M 2.5 and became more frequent. All earthquakes originated at shallow levels in and below the 1980-86 lava dome. Based on the increased seismicity, at 10:40 a.m. CVO issued a Volcano Advisory--Alert Level 2, "Code Orange." Overflights found deformation on the crater floor south of the 1980-86 dome.

October 1: Beginning at 11:57 a.m. and lasting about 25 minutes, a small steam eruption, with minor ash, issued from a vent just south of the 1980-86 lava dome in the part of the crater-floor glacier that had become increasingly crevassed and uplifted over the past few days. The eruption was not accompanied by any noticeable seismic signal, but immediately following the eruption, seismicity dropped markedly and remained at a low level for about five hours, then gradually increased. A seismic station (SEP) and GPS receiver on the 1980-86 dome were destroyed by ballistics propelled by this eruption.

October 2. At 12:15 p.m., a small steam emission, not accompanied by any significant seismic signal, lasted for 1-2 minutes. Immediately following it, seismic activity changed from principally volcano-tectonic events to continuous low-frequency tremor that lasted 50 minutes. This tremor episode was very energetic and seen on seismometers as far away as JCW in northwestern Washington. During and for about an hour following the tremor episode, few volcano-tectonic events occurred. Activity then began to increase again. At 2:00 p.m., CVO issued a Volcano Alert (Alert Level 3, "Code Red"), and the U.S. Forest Service evacuated its visitor center at Johnston Ridge, which lies 8 km north-northwest of the volcano. (The Johnston Ridge Observatory has remained closed since October 2). Thermal measurements made with forward-looking infrared (FLIR) camera showed only low-temperature rock surfaces.

October 3 At 2:57 a.m., an episode of low-frequency tremor persisted for 25 minutes. No eruptive plume was detected, nor was there a significant change in seismicity. At 10:40 p.m., a small steam (and possibly ash) eruption occurred without a noticeable seismic signal, eventually reaching about 4,600 m altitude (15,000 ft, officially) .

Oct. 4 At 9:43 AM a steam and ash emissions reached elevations of 12,000 feet.. Large-scale uplift of the crater floor was again observed by a CVO overflight.

Oct. 5 At 9:03 a.m. (local time) a vigorous ash eruption (to 12,000 feet) occurred, lasting a full hour, and was followed by an abrupt change to lower frequency, lower amplitude seismicity

Oct. 6 Lower rates of seismicity and weak steam plume. Alert level was lowered to “Volcano Advisory” (Alert level 2, "Code Orange").

Oct. 7 - 13 Lower rates of seismicity, venting of steam, and minor ash emissions continued. On Oct. 11, new extruded material was seen in the crater.
Oct 14 - Oct. 16 Seismicity increased slightly, then fell off again without venting. Extrusion continued.
Oct 16 - Dec. 31 Seismicity continued at rates similar to Oct 7-13 and extrusion of material also continued.

St. Helens event magnitudes

Magnitudes computed for earthquakes at Mount St. Helens often over estimate the true earthquake size. Routine processing of PNSN data uses a coda duration magnitude scale, magnitudes shown in Figure 3b were determined this way. However, shallow earthquakes at Mount St. Helens usually have extended coda durations. This can be due to a complex, multiple-event source as well as very inhomogeneous local velocity structure which causes rapid dispersion of the strongly generated surface waves from shallow events. We have run tests on 60 St. Helens earthquakes with coda duration magnitudes ranging from 0.8 to 3.2, comparing these magnitudes to those computed using a synthetic Wood-Anderson peak amplitude from calibrated broad-band stations. These equivalent "local" magnitudes are always the same or smaller than the coda duration ones. The discrepancy varies from 0.0 to 1.2 magnitude units. For the larger earthquakes (Md >2.7) the discrepancy was no more than 0.4 magnitude units. Thus one must interpret with care any of the magnitudes reported in the PNSN catalog during the current Mount St. Helens sequence.

Mount Rainier

The number of events in close proximity to the cone of Mt. Rainier varies over the course of the year, since the source of much of the shallow activity is presumably ice movement or avalanching at the surface, which is seasonal in nature. Events with very low frequency signals (1-3 Hz) believed to be icequakes are assigned type "L" in the catalog. Emergent, very long duration signals, probably due to rockfalls or avalanches, are assigned type "S" (see Key to Earthquake Catalog). Two events flagged "L" or "S" were located at Mount Rainier this quarter and 106 "L" or "S" events were recorded, but were too small or too emergent to locate reliably. Type L and S events are not shown in Fig. 4.

A total of 99 tectonic events (43 of these were smaller than magnitude 0.0, and thus are not shown in Fig. 4) were located within the region shown in Fig. 4. The largest tectonic earthquake located near Mt. Rainier this quarter was a magnitude 3.2 event on Nov. 7 (UTC), located beneath the summit at shallow depth (less than 2 km).This quarter, 32 tectonic earthquakes were located in the "Western Rainier Seismic Zone" (WRSZ), a north-south trending lineation of seismicity approximately 15 km west of the summit of Mt. Rainier (for counting purposes, the western zone is defined as 46.6-47.0 degrees north latitude and 121.83-122 west longitude). Within 5 km of the summit, there were 59 (23 of them smaller than magnitude 0.0 and thus not shown in Fig. 4) higher-frequency tectonic-style earthquakes, and the remaining events were scattered around the cone of Rainier as shown in Fig. 4.

EASTERN WASHINGTON SEISMICITY

During the fourth quarter of 2004, 60 earthquakes were located in eastern Washington in the area between 45.5 - 49.5 degrees north latitude and 117 - 121 degrees west longitude. The largest earthquake recorded in eastern Washington this quarter was a magnitude 2.9 event on Nov. 2. It occurred at about 3 km depth and was located about 10 km south- southwest-of Chelan.

OTHER SOURCES OF EARTHQUAKE INFORMATION

We provide automatic computer-generated alert messages about significant Washington and Oregon earthquakes by e-mail, FAX or via the pager-based RACE system to institutions needing such information, and we regularly exchange phase data via e-mail with other regional seismograph network operators.

Other regional agencies provide earthquake information. These include the Geological Survey of Canada (Pacific Geoscience Centre), Sidney, B.C. **http://www.pgc.nrcan.gc.ca/seismo/table.htm** ; and other regional networks in the United States **http://earthquake.usgs.gov/regional/** The US Geological Survey coordinates earthquake information nationally; **http://earthquake.usgs.gov**.

Complete catalog listings are available on-line through **http://www.pnsn.org/CATDAT/catalog.html** Key to earthquake catalog can be found in the last quarterly report of each year, or at:
http://www.pnsn.org/INFO_GENERAL/PNSN_QUARTERLY_EQ_CATALOG_KEY.htm

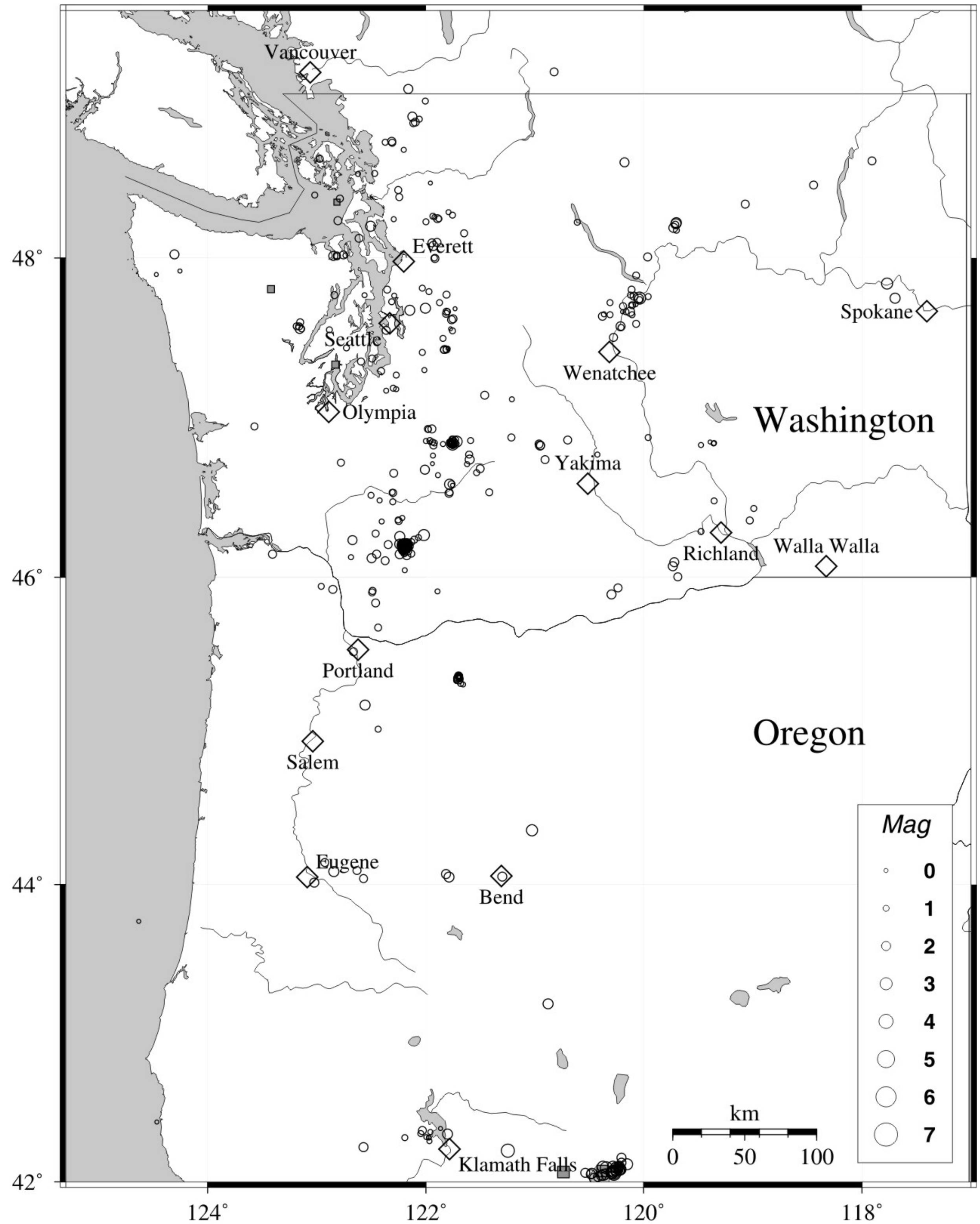


Figure 1 Earthquakes with magnitude greater than or equal to 0.0 (Mc>=0.0). Unfilled diamonds represent cities. Quakes shallower than 30 km are indicated by circles, and deeper quakes by filled squares.

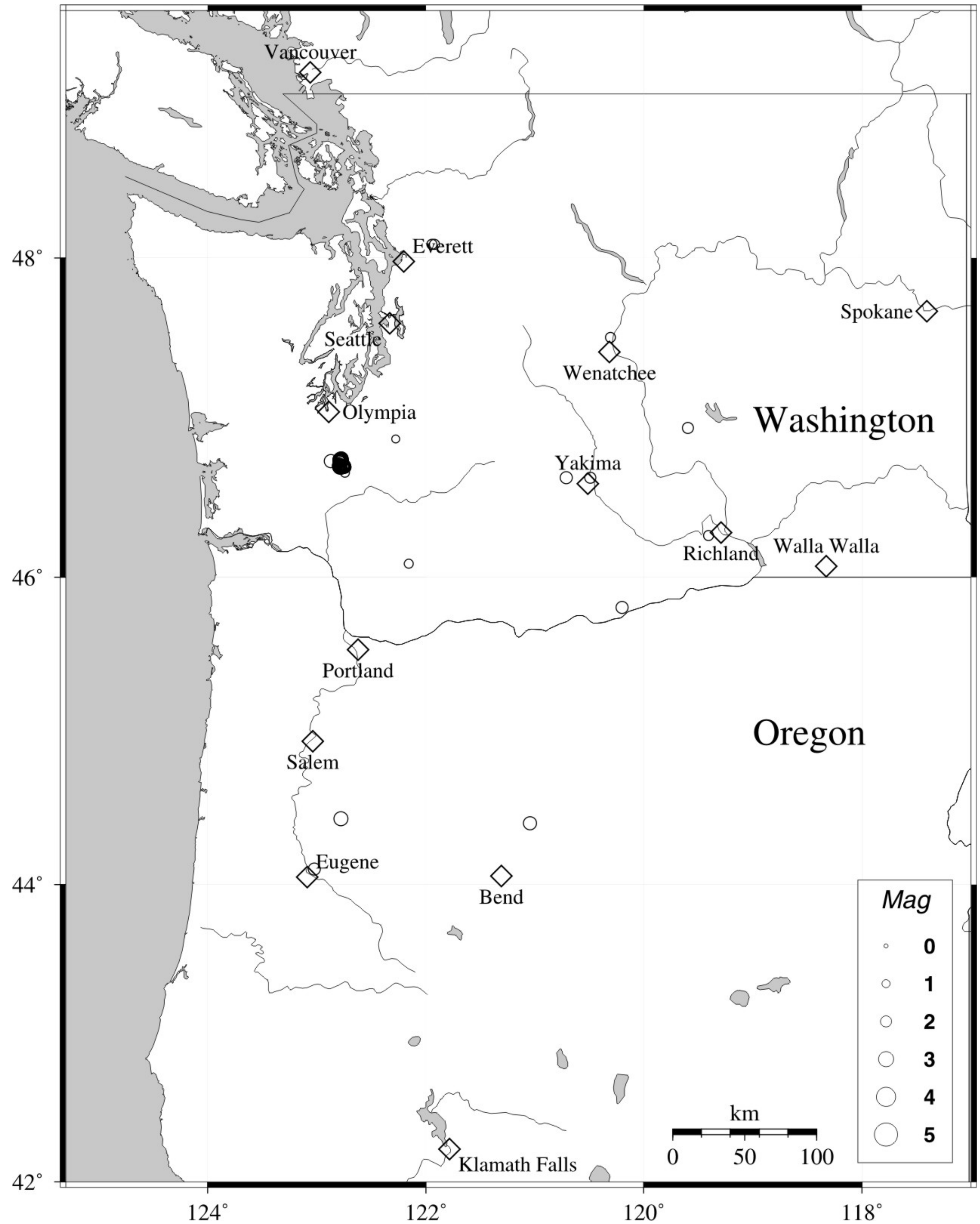


Figure 2. Blasts and probable blasts. Unfilled diamonds represent cities.

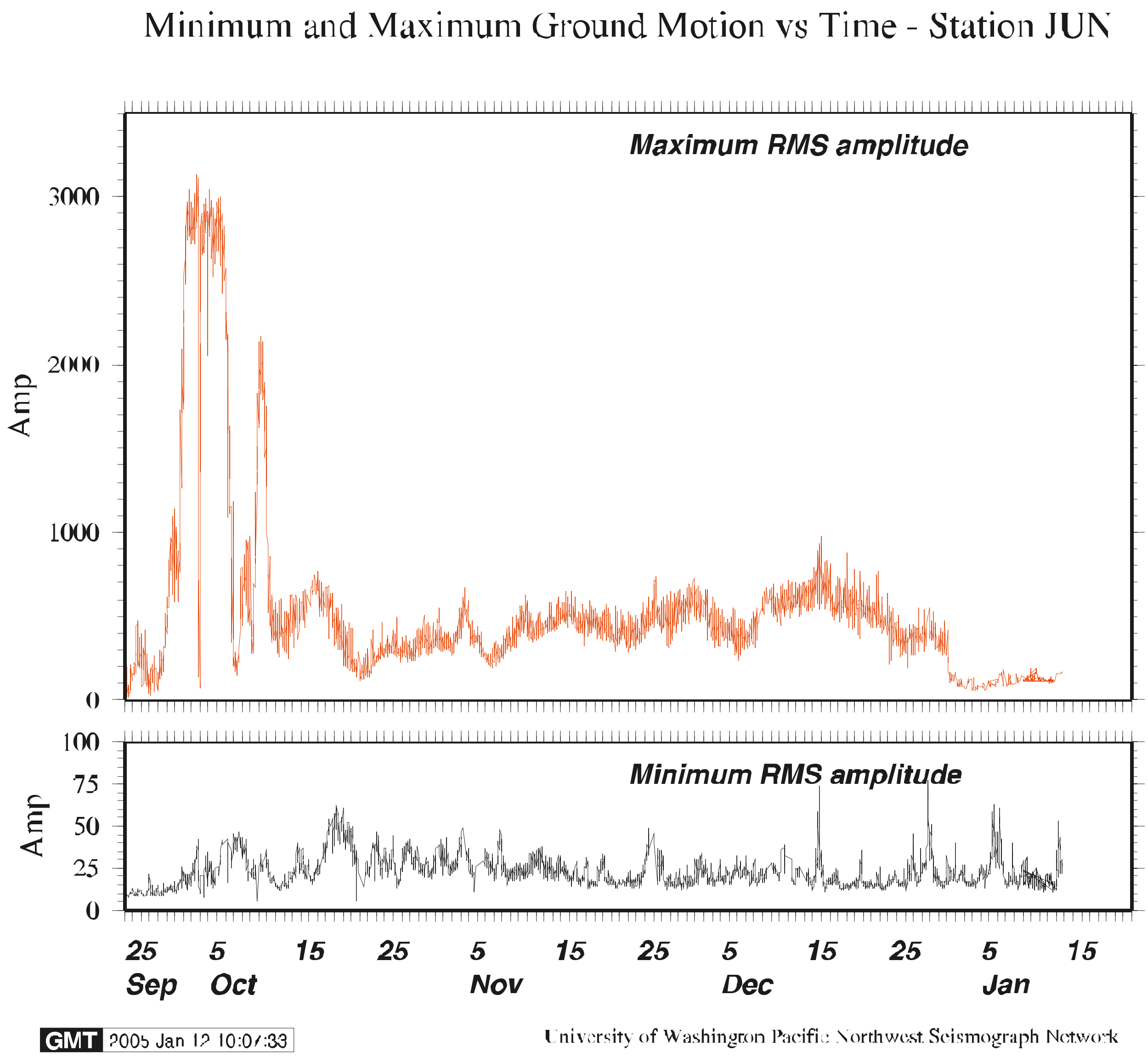


Figure 3 a   History of average signal amplitudes at Mt. St. Helens

The upper panel shows maximum recorded RMS amplitude and the lower panel shows the minimum RMS amplitude. Each half-hour period produces one point on the RMS amplitude graphs. The amplitude of the point is the maximum (or minimum) RMS amplitude in the half hour period of values computed for successive 5-second windows during the half-hour period. In effect, the upper panel tracks the average size of the large earthquakes and the lower panel tracks the amount of ambient noise (background vibrations) between earthquakes. Dates on the horizontal axes are given in Universal Time (UT). Most of the "bad" data points have been removed by an automatic algorithm. Such points are caused by data telemetry problems and calibration signals unrelated to earthquakes. Station JUN is south of the crater.

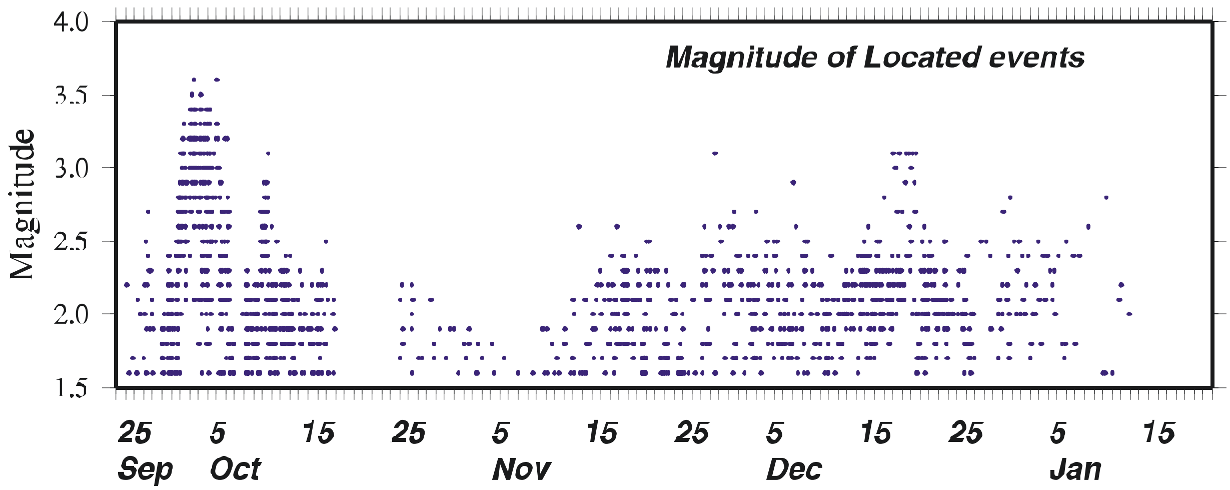


Figure 3 b Magnitudes of manually located events.
The gap in mid-October reflects a time period where manual processing of data is still backlogged. One day can have many earthquakes of the same magnitude, so each dot may represent multiple events. The plot shows maximum magnitudes of 3.5 or greater at the end of September and in early October. Magnitudes since then have varied, but not exceeded 3.0.

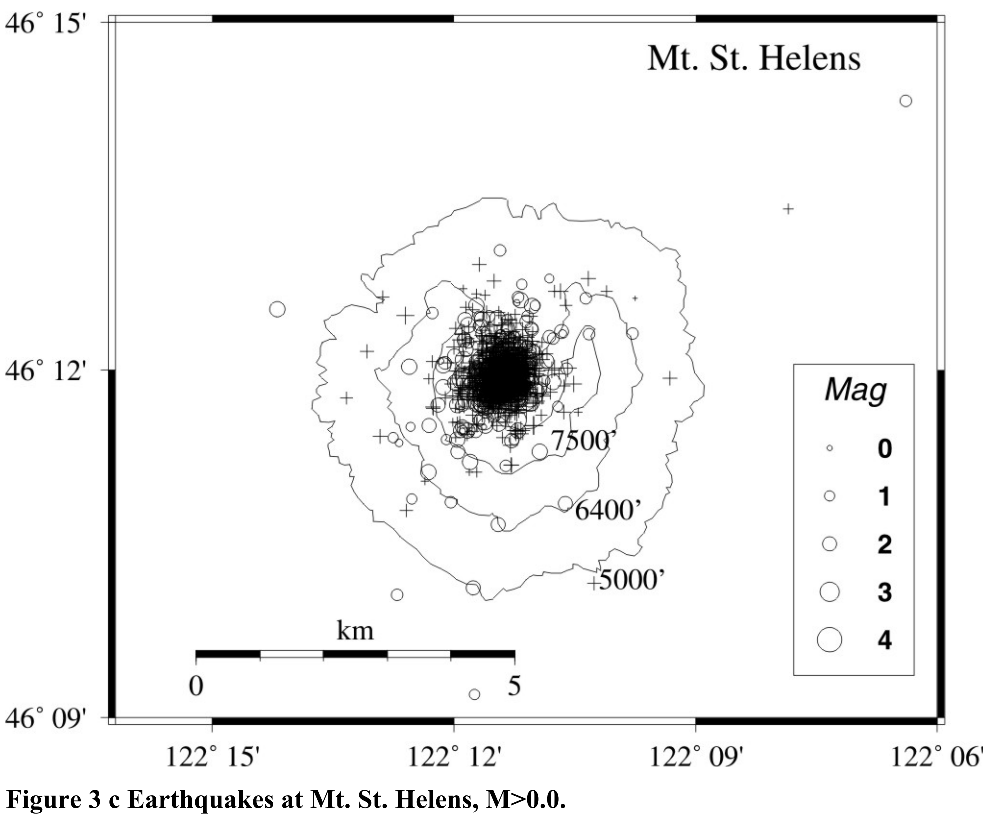


Figure 3 c Earthquakes at Mt. St. Helens, M>0.0.

Plus' symbols indicate depth less than 1 km. Circles indicate depth greater than 1 km. Elevation contours shown in feet

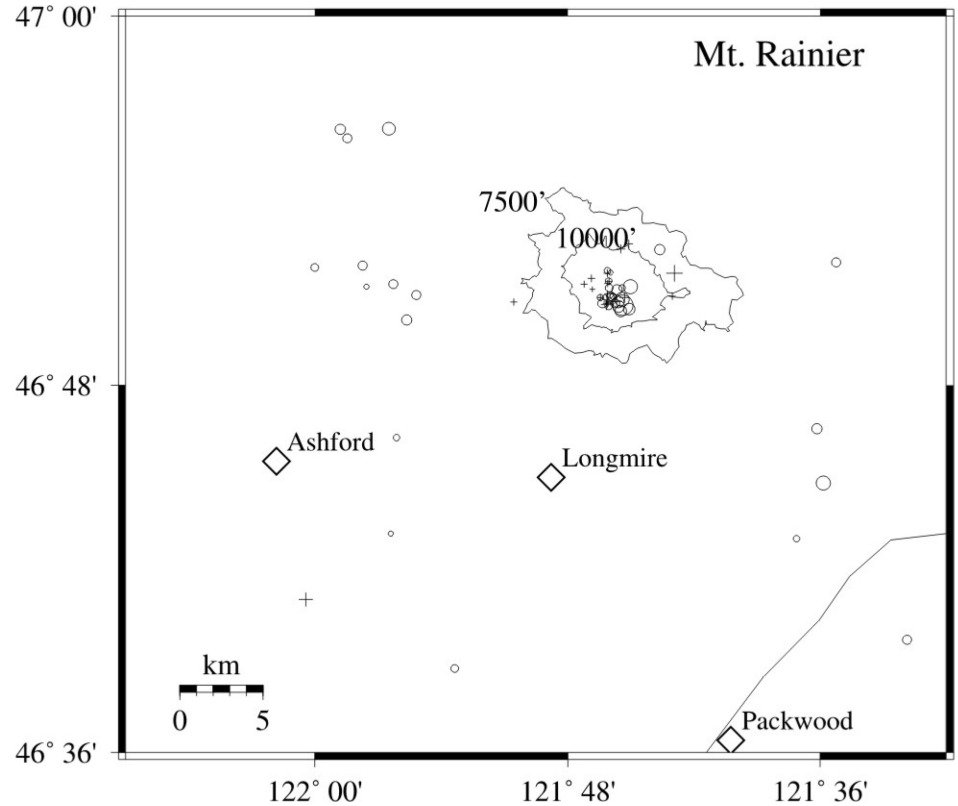


Figure 4. Earthquakes at Mt. Rainier, M>0.0.

EARTHQUAKE CATALOG, 2004-D

This quarter's catalog lists earthquakes of magnitude 2.0 or larger, but **DOES NOT INCLUDE *any*** events at Mount St. Helens. Complete catalog listings are available on-line through **http://www.pnsn.org/CATDAT/catalog.html** Key to earthquake catalog can be found in the last quarterly report of each year, or at:
http://www.pnsn.org/INFO_GENERAL/PNSN_QUARTERLY_EQ_CATALOG_KEY.htm

Oct. 2004

DAY	TIME	LAT	LON	DEPTH	M	NS/NP	GAP	RMS	Q	MOD	TYP
2	03:36:32.01	47 41.46	122 00.11	8.99*	2.3	62/065	31	0.41	CA	P3	
2	12:05:33.72	46 15.99	122 01.00	0.03*	2.7	8/008	226	0.27	BD	S3	
4	13:59:39.98	45 20.53	121 42.03	4.94	2.1	9/014	102	0.17	BB	O0	
4	14:01:17.11	46 14.14	122 40.35	1.13	2.1	6/006	189	0.14	CD	C3	
7	08:23:32.28	42 03.35	120 16.45	3.35	3.5	8/009	264	0.15	CD	O0	
7	09:13:10.54	42 02.05	120 25.30	0.03*	2.0	7/007	273	0.30	BD	K3	
7	09:17:13.38	42 03.63	120 17.03	11.37$	2.7	13/014	155	0.27	BC	K3	
8	08:54:55.84	42 05.18	120 12.82	6.13	2.6	11/012	266	0.31	CD	K3	
9	03:46:56.22	42 12.85	121 14.83	0.02*	3.6	10/010	203	0.54	DD	K3	
15	22:44:20.76	46 35.43	121 46.96	8.69	2.4	45/048	30	0.24	BB	C3	
20	00:21:42.34	44 03.18	121 17.87	3.04	2.1	10/010	219	0.14	BD	O0	
22	04:16:59.89	42 03.99	120 16.91	12.08*	2.2	11/011	250	0.28	BD	K3	
23	16:52:46.58	42 02.79	120 22.37	0.04*	2.6	12/014	215	0.34	CD	K3	
23	17:08:47.30	42 04.80	120 13.35	8.32	2.2	8/009	280	0.11	BD	K3	
23	17:30:32.01	42 07.12	120 09.19	9.98*	2.5	8/008	291	0.17	BD	K3	
23	17:37:57.24	42 05.01	120 13.87	8.91	2.1	7/008	278	0.17	CD	K3	
23	20:08:50.13	42 06.06	120 14.25	0.02*	2.4	10/010	260	0.20	BD	K3	
30	06:47:03.28	42 03.83	120 17.48	12.24$	3.1	16/017	153	0.74	DC	K3	
30	06:57:58.96	42 05.05	120 12.71	6.81	2.3	6/007	282	0.11	BD	K3	

Nov 2004

DAY	TIME	LAT	LON	DEPTH	M	NS/NP	GAP	RMS	Q	MOD	TYP
1	14:30:50.87	46 50.77	121 45.42	1.46	2.0	31/032	78	0.16	BA	C3	
2	06:21:43.70	47 45.11	120 02.42	2.81	2.9	27/027	46	0.25	BB	N3	
7	15:45:48.62	42 04.04	120 15.54	0.02*	2.1	4/005	271	0.18	BD	K3	
7	19:23:59.73	46 50.58	121 45.37	1.60*	3.2	45/046	27	0.17	BA	C3	
8	17:39:01.73	44 04.18	121 48.85	2.74$	2.1	5/005	146	0.08	CD	O0	
9	18:23:40.62	42 04.31	120 16.90	0.45	2.2	8/009	250	0.14	CD	K3	
11	20:12:13.86	42 19.53	121 48.07	0.02*	2.2	8/008	188	0.11	AD	K3	
15	06:53:55.34	42 04.60	120 15.41	0.05*	2.3	6/006	272	0.30	BD	K3	
16	18:21:28.52	42 03.70	120 16.73	11.98$	3.5	18/019	157	0.48	CC	K3	
16	18:46:53.40	42 05.12	120 15.16	1.57*	2.1	6/007	273	0.21	BD	K3	
20	20:20:12.40	44 21.51	121 01.49	0.04*	2.6	18/018	153	0.20	BC	O0	
20	20:56:51.85	48 11.74	122 30.39	29.45	2.2	40/040	49	0.27	BA	P3	
23	00:50:14.34	49 01.79	122 09.66	0.04*	2.0	4/004	224	0.10	AD	P3	
23	09:43:24.51	48 00.79	122 50.87	20.84	2.1	23/024	65	0.20	BA	P3	
26	19:26:06.79	42 04.60	120 16.91	13.88	2.6	14/014	199	0.57	DD	K3	
26	19:45:02.91	42 04.31	120 22.71	32.3	2.8	14/014	173	0.47	CC	K3	
26	21:49:42.73	42 06.28	120 16.86	0.04*	2.6	7/007	233	0.14	AD	K3	
26	23:24:38.94	42 04.79	120 15.82	0.06*	2.1	6/007	270	0.33	CD	K3	
26	23:59:09.83	42 06.57	120 13.41	0.02*	2.0	9/009	262	0.26	BD	K3	
27	00:07:02.35	42 07.80	120 12.27	23.5	2.0	6/006	297	0.33	DD	K3	
27	01:33:22.96	42 05.86	120 20.52	20.24*	2.9	9/009	231	0.22	BD	K3	
27	03:25:59.80	42 03.41	120 28.67	14.47	2.3	8/008	271	0.17	DD	K3	
27	10:09:09.87	42 04.11	120 44.34	42.81	2.9	13/013	246	0.71	DD	K3	
27	13:35:38.63	42 06.15	120 22.58	0.03*	2.6	9/009	241	0.44	CD	K3	
27	22:28:17.51	42 03.64	120 32.17	16.16	2.0	7/007	269	0.46	DD	K3	
28	11:22:01.67	42 05.89	120 15.43	1.80$	2.3	9/010	256	0.18	DD	K3	
29	23:49:53.16	45 10.67	122 33.32	22.04	2.2	28/029	109	0.38	CB	O0	

Dec 2004

DAY	TIME	LAT	LON	DEPTH	M	NS/NP	GAP	RMS	Q	MOD	TYP
7	00:45:25.34	46 12.10	122 11.21	0.05#	2.0	9/009	104	0.15	AB	R0	
12	01:08:24.22	47 45.24	117 41.90	0.04*	2.3	7/007	178	0.25	BC	N3	
12	13:56:16.15	47 50.51	117 46.33	19.07$	2.7	6/006	180	0.57	DC	N3	
15	00:43:21.69	48 12.97	119 42.03	0.04*	2.2	14/014	217	0.08	AD	N3	
15	10:09:12.83	42 01.46	120 27.30	14.88#	2.3	8/008	271	0.28	BD	K3	
15	22:38:13.58	48 12.74	119 42.26	0.04*	2.2	16/016	187	0.16	BD	N3	
16	20:07:24.49	44 05.15	122 50.63	0.04*	2.3	9/009	128	0.15	AC	O0	
17	19:20:07.57	44 00.73	123 01.34	2.17	2.0	5/005	136	0.06	BD	O0	
17	22:14:50.82	48 01.40	124 18.34	20.17#	2.1	13/013	108	0.08	AB	P3	
18	02:24:46.30	46 50.14	120 57.14	0.53$	2.1	20/021	80	0.34	CC	C3	
20	18:28:19.20	42 02.73	120 23.48	13.1	2.3	10/010	274	0.31	DD	K3	
22	22:57:07.46	47 34.66	120 12.84	2.73	2.1	19/021	62	0.18	BB	N3	
28	01:01:36.75	47 40.70	122 08.82	25	2.2	44/047	37	0.26	BA	P3	

OUTREACH ACTIVITIES

The PNSN staff and faculty participate in an educational outreach program designed to better inform the public, educators, businesses, policy makers, government agencies, engineers, and the emergency management community about earthquake, volcano and related hazards. Our program offers lectures, classes, lab tours, workshops, consultations, and electronic and printed information products. Special attention is paid to the information needs of the media. We provide information directly to the public through information sheets, an audio library, email, and via the Internet at http://www.pnsn.org.

Audio Library, Phone

Public interest in the continuing eruption of Mt. St. Helens resulted in very high volumes of calls in October, gradually dropping close to "normal" as the quarter progressed. The Seismology Lab responded to over 250 calls from the general public, Emergency Managers and government agencies, and ~150 calls from the Media. In addition, the PNSN audio library system received 350 calls this quarter. The audio library provides several recordings. We have a regularly updated message concerning current seismic activity, and there are also recordings describing seismic hazards in Washington and Oregon and earthquake prediction. Callers to the audio library have the option of being transferred to the Seismology Lab for additional information. The report from last quarter describes a temporary expansion of the PNSN phone system, which extended into early October.

Internet outreach: www.pnsn.org

At the end of September, the PNSN moved the www.pnsn.org URL from the departmental server to a higher-capacity University server. See last quarter's report for details. The University server was able to handle the extremely high volumes of traffic that occurred as seismic activity intensified in late September and early October. Between Sept. 28th and Oct. 21st, the University server absorbed 23 million "hits", and the departmental server had 14 million hits, for a total of 37 million hits, corresponding to about 12 million pages of information.

By December the load on our web services had eased, but after the Dec. 26th Sumatra & Andaman Islands earthquake and tsunami, the load again peaked. "**Tsunami!**", a site hosted by the UW Dept. of Earth and Space Sciences since 1995 is the #1 tsunami link on google and other popular search engines. The departmental server was overwhelmed by demand, and many hours of intervention were required to keep the server up and running. **Tsunami!** was originally developled by graduate student Ben Cook under the supervison of Dr. Catherine Petroff of UW's Civil Engineering. Although it has not been kept up to date, many other sites link to it, accounting for it's high search-engine ranking. Professors Catherine Petroff and Jody Borgeois are leading a major overhaul of **Tsunami!** . The PNSN is participating in the overhaul, and the renewed site will contain information about paleotsunami research and Cascadia Subduction Zone Tsuanmis as well as a major reorganization of links to other tsunami resources.

Mike Brown, the chair of the Dept. of Earth and Space Sciences, declared PNSN, Tsunami! and department web sites essential departmental services. A memorandum of understanding with the University's Computer & Communications unit (C&C) was develop and signed. C&C will provide dual separated web servers located in different UW Gigabit backbone locations and will implement a round-robin-type dynamic network service (DNS) to these machines with "fail-over" redundancy to maximize availability and reliability. The total cost of these services and necessary hardware is about $3,000 a year which is being paid by the Dept. of Earth and Space Sciences, a significant new contribution to PNSN operations. The transition to the new system is expected in March, 2005.

E-mail Communications

PNSN staff replied to about 1,000 e-mail messages from the public seeking information on a variety of topics via the ***seis_info@ess.washington.edu*** email address. This level of activity has created a substantial new work load carried primarily by Ruth Ludwin. Routine questions are typically responded to within a day; complex or sensitive questions are routed to the appropriate staff person for a more in-depth response. Requests may include complex scientific inquiries, assistance with hazard assessments and legal issues, consultations with government agencies, and support for engineering issues related to strong motion data.

Information Products

CIIM maps were generated for two events this quarter, and no ShakeMaps were generated. See "Earthquake Data" section for details.

CISN Display servers are receiving PNSN recent earthquake data and now provide links to our ShakeMaps, automatically generated following significant earthquakes. The CISN Display beta version was distributed for testing to select users who provide feedback to PNSN staff. Anticipation of the release of version 1 of the CISN Display is growing in our region and, depending on demand, new servers may be required to augment those in Pasadena and Berkeley to ensure data delivery in 2005. PNSN staff will also face demands for development of additional data layers of interest to clients within Washington and Oregon. This product will first supplement and later replace the CUBE based RACE (Rapid Alert for Cascadia Earthquakes) systems currently deployed.

K-20 Education Outreach: http://www.pnsn.org/EDHOME/index.html

PNSN and USGS staff gave 12 Seismology Lab tours and presentations for K-20 students and teachers, serving about 240 students this quarter. The PNSN also maintains an email list-service and distributed monthly newsletters to over 50 local K-20 educators and subscribers interested in earth-sciences education.

Bill Steele provided lectures and lab tours for about 30 teachers attending workshops in conjunction with the National Science Teachers' Association, Northwestern Region conference. In December, Bill Steele and Chris Newhall held a short workshop "How Mt. St. Helens works" for 30 educators at the Pacific Science Center. The Science Center sends educators into classrooms where they run science workshops.

Media Relations:

PNSN staff frequently provides interviews, research support, and referrals to radio, television, film, and print media. The PNSN organizes press conferences, contributes to TV and radio news programs and talk shows, and provides field opportunities linking reporters with working scientists. Staff members also assist news organizations, authors, television producers, and independent documentary makers to design accurate and informative stories and programs related to earthquake and volcano hazards. PNSN staff work to link reporters and producers developing stories with the appropriate research institutions, agencies, and scientists working in the areas to be covered by the piece. The PNSN coordinates the release of information and media relations with the USGS Western Region, the Cascades Volcano Observatory, and the Oregon Department of Geology and Mineral Industries (DOGAMI).

The eruption of Mount St. Helens (MSH) began at the end of September and increased very rapidly. MSH activity peaked in early October creating unprecedented demand for interviews, background information, and television appearances for PNSN staff and researchers. During the first few weeks in October, PNSN faculty, staff, and students held hundreds of interviews with regional, national and international media providers, sometimes at a rate of 25-50/day. National TV news programs served included ABC News Nightline, CNN, MSNBC, Fox News, and NBC Nightly News. International radio interviews included Swedish, German and Scottish radio. Newspapers covering the eruption included the New York Times, the Christian Science Monitor, National Geographic, and Japanese newspapers.

Throughout the quarter, PNSN scientists participated in early morning science conferences with CVO to share data and interpretations, and develop "talking points" for use in interviews. In early October the Seismology Lab was opened to the media from about 7 AM to 7 PM. Due to staff constraints, we declined most invitations for remote interviews, and also refused, for the most part, to keep the lab open for the 10 and 11 PM newscasts. Even with these restrictions, key PNSN staff and researchers were averaging 12 hour days, 7 days a week. After the first week of October everyone was asked to take at least one day off a week to prevent burn out.

National networks received audio and video feeds from their local affiliate stations via satellite uplinks. Two local television stations (KING 5 and KIRO 4) installed digital video links to the PNSN lab, freeing their transmission trucks to move to Coldwater Visitors Center near MSH and by mid-October, following the dramatic shift to smaller earthquakes that accompanied the start of new dome extrusion at MSH, the main media focus shifted to the Coldwater Visitors Center and the Joint Information Center established by the National Forest Service in Vancouver. With fewer television interviews PNSN staff was able to spend more time assisting writers to develop newspaper and magazine articles by providing background information, interviews, graphics, and referrals to CVO scientists monitoring the eruption and State and Federal agencies managing the hazard assessment.

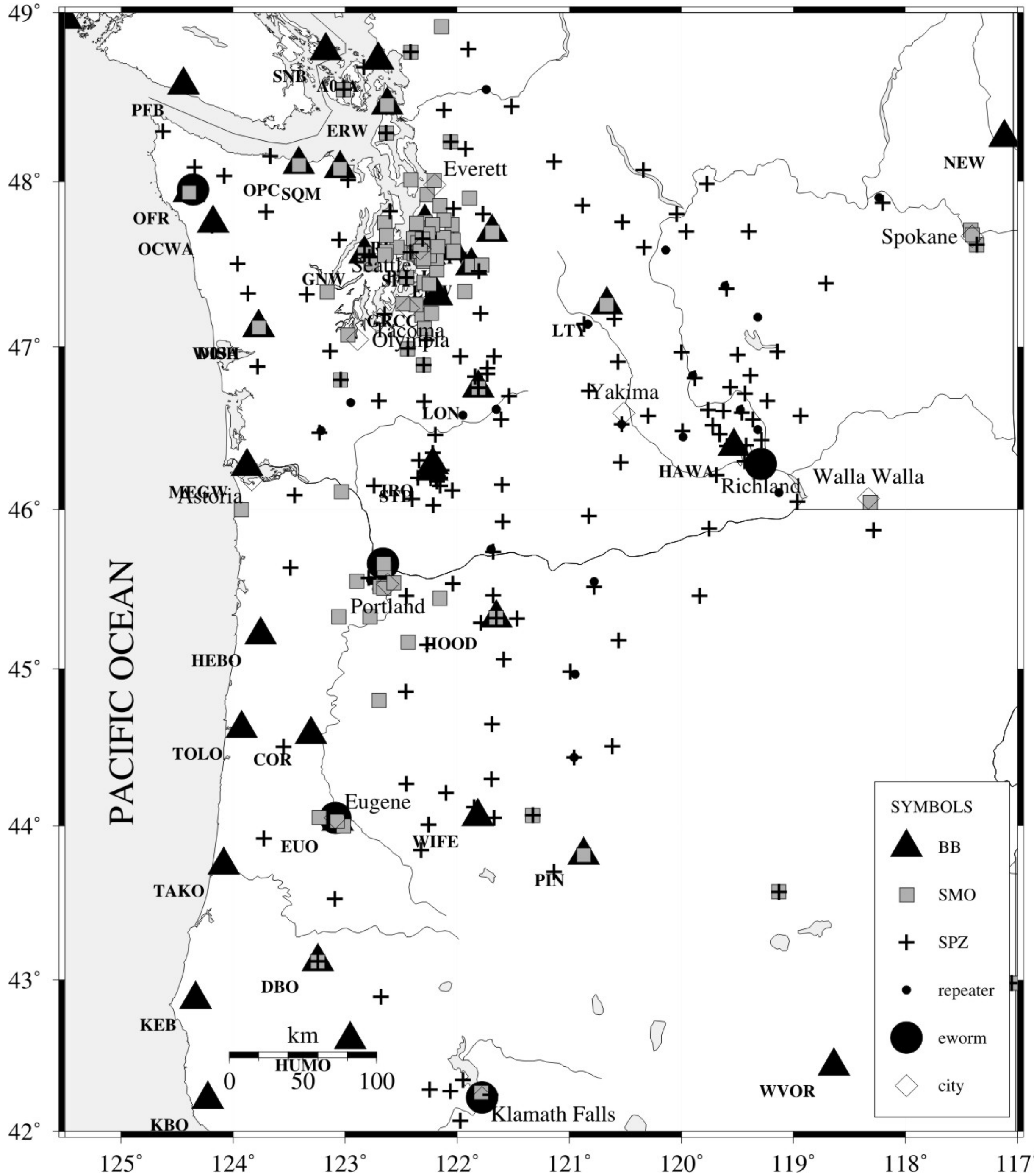
Despite geographical separation, USGS Scientists at CVO, National Forest Service personnel at the Joint Information Center near Vancouver and PNSN staff (with assistance from our colleagues in the USGS Seattle Field Office at UW) provided consistent information to the media. The PNSN and UW supported a telecommunications conference bridge used for daily science meetings with CVO. The 7 AM science meetings were initially conducted daily, but dropped to three days a week in mid-October. Although both seismic activity at Mount St. Helens and media frenzy declined significantly as the quarter went on, both continued at a higher-than-normal level through the end of the quarter.

Meetings, Presentations and Visitors:

A British film production company taped an interview with George Thomas about scientific research on the abilities of animals and pets to predict earthquakes. The show will be broadcast on the Animal Planet cable channel in April or May. Ruth Ludwin was interviewed in connection with an article being written for "Smithsonian" magazine on Cascadia and the Seattle Fault. Steve Malone gave a talk to the Seattle Surgeon's Professional Group. Wendy McCausland attended the US-Japan Conference on Earthquake Science in California and gave a presentation on deep tremor. Wendy McCausland, Guy Medema, George Thomas and Steve Malone made presentations at the fall AGU meeting, where Steve Malone also hosted a press conference on Mount St. Helens.

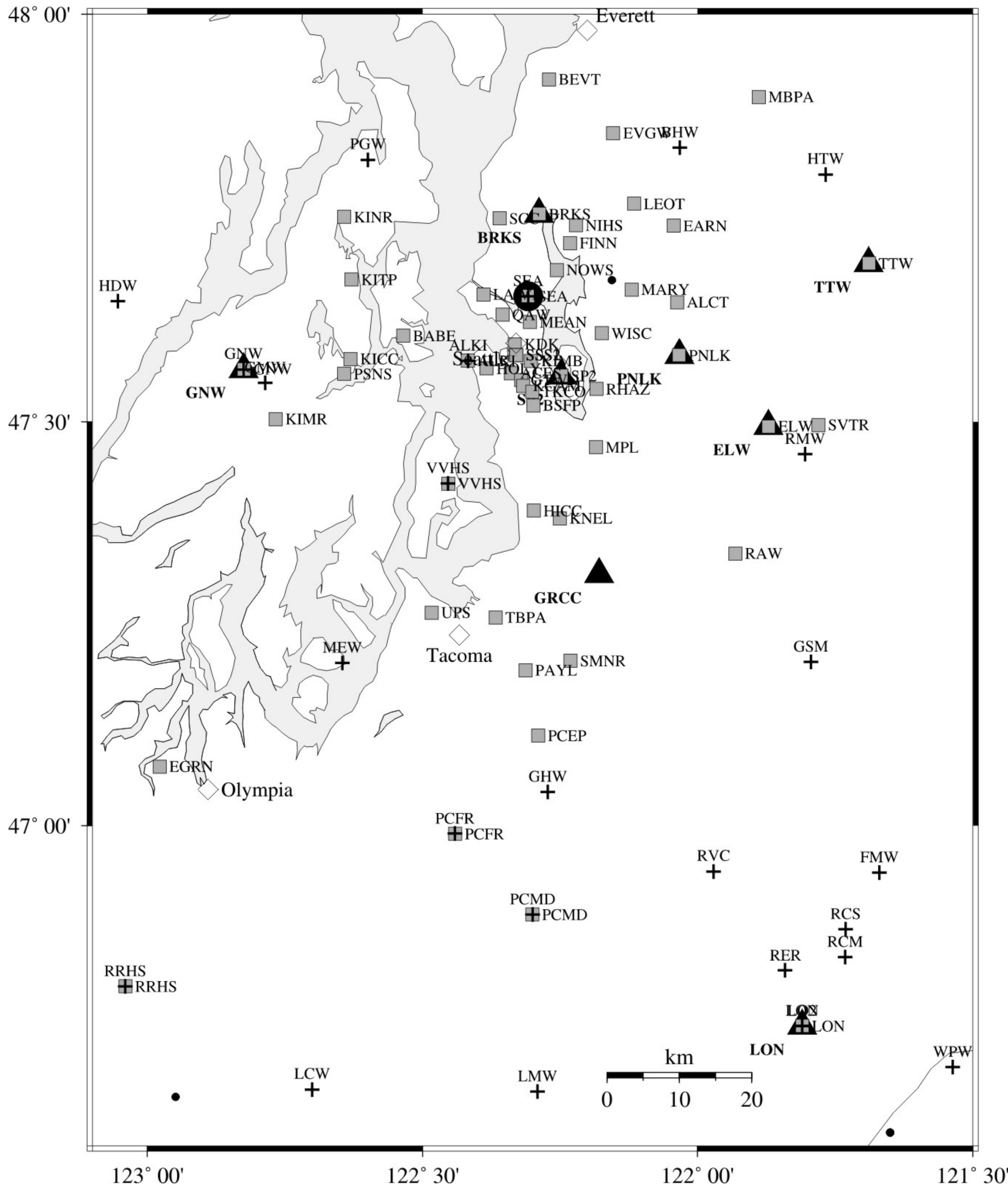
Bill Steele participated in meetings with CREW (Cascadia Regional Earthquake Workgroup), CPARM (Contingency Planners and Recovery Managers), and UW-EMPC (Emergency Management Planning Committee). The Seattle ShakeMap/ShakeCast working group met at the UW in October to finalize input to a proposal to FEMA to develop a high resolution ShakeMap for the greater Seattle Area and to implement ShakeCast for FEMA region X, Washington State Emergency Management Division and the City of Seattle. If funded, this project will result in additional products including automatic generation of HAZUS loss estimation models following potentially damaging earthquakes.

APPENDIX 1, PNSN Quarterly Report 2004-D – Station Maps and Locations

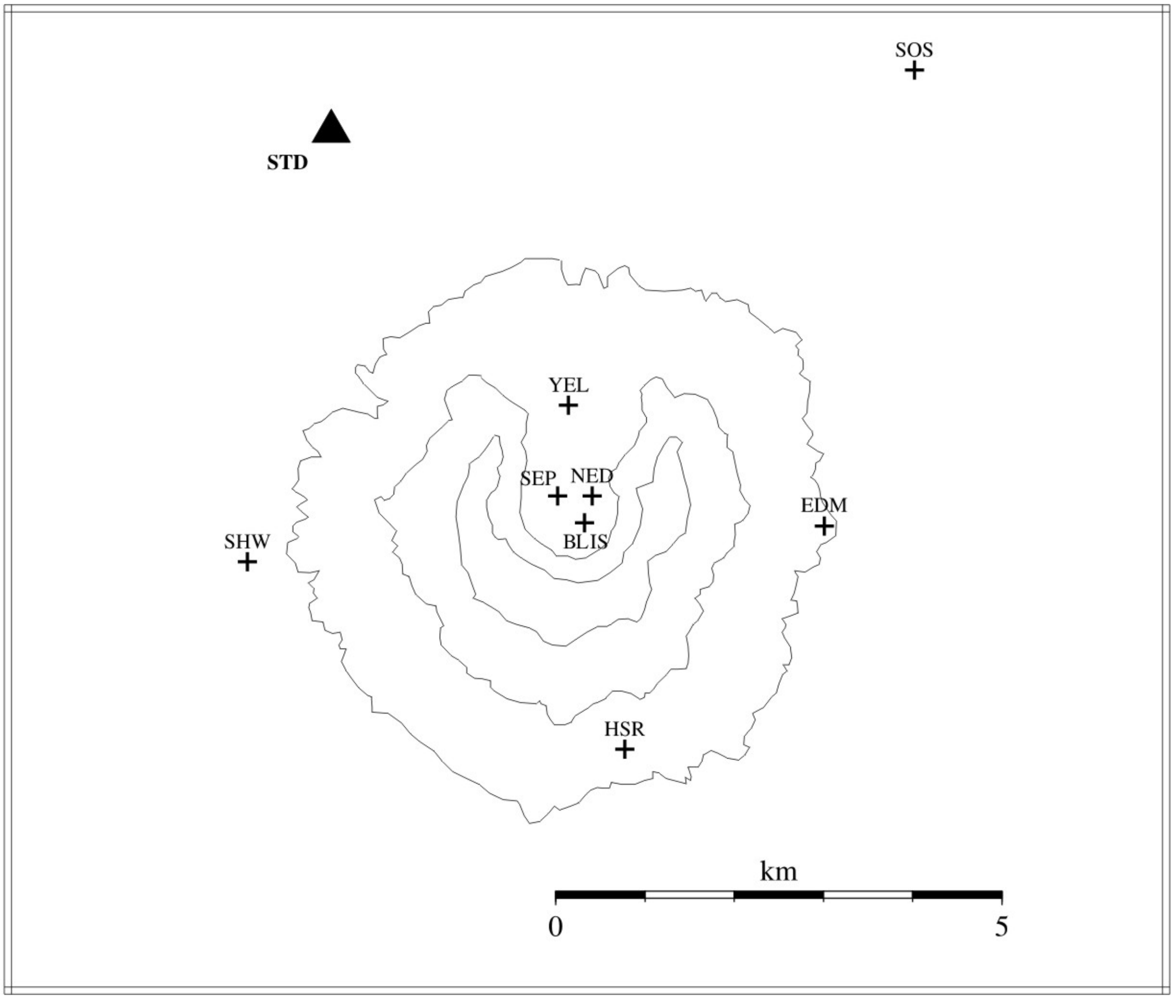


Appendix 1, Figure 1 A. Seismograph Stations.

"BB" indicates broadband stations (Table 2B), "SMO" indicates strong motion stations (Table 2C), and "SPZ" indicates short-period stations (usually vertical component only) (Table 2A). Repeaters are sites with radio receivers and transmitters used in the transmission of seismic data to the UW via FM telemetry. "eworm" represents sites where a "mini-earthworm" system is running on a local computer to collect data for transfer to the UW via the internet.



Appendix 1, Figure 1 B. Puget Sound seismograph stations, detail of Fig. 1 A



Appendix 1, Figure 1 C. Mount St. Helens seismograph stations, detail of Fig. 1 A

Appendix 1, Table 2A lists short-period, mostly vertical-component stations used in locating seismic events in Washington and Oregon. The first column in the table gives the 3-letter station designator, followed by a symbol designating the funding agency; stations marked by a percent sign (%) were supported by USGS joint operating agreement 04-HQ-AG-005. A plus (+) indicates support under Pacific Northwest National Laboratory, Battelle contract 259116-A-B3. Stations designated "#" are USGS-maintained stations recorded at the PNSN. Stations designated by letters are operated by other networks, and telemetered to the PNSN. "M" stations are received from the Montana Bureau of Mines and Geology, "C" stations from the Canadian Pacific Geoscience Center, "U" stations from the US Geological Survey (usually USNSN stations), "N" stations from the USGS Northern California Network, and "H" stations from the Hanford Reservation via the Pacific Northwest National Labs. “G” stations are contributed by other organizations, with some assistance from the PNSN. Other designations indicate support from other sources. Additional columns give station north latitude and west longitude (in degrees, minutes and seconds), station elevation in km, and comments indicating landmarks for which stations were named.

TABLE 2A - Short-period Stations

STA	F	LAT	LONG	EL	NAME
ALKI	%	47 34 30.4	122 25 03.4	0.001	Alki Wastewater Plant, ANSS-SM
ASR	%	46 09 09.9	121 36 01.6	1.357	Mt. Adams - Stagman Ridge
ATES	%	48 14 10.9	122 03 33.0	0.062	Arlington Trafton ES ANSS-SMO
AUG	%	45 44 10.0	121 40 50.0	0.865	Augspurger Mtn

TABLE 2A - Short-period Stations

STA	F	LAT	LONG	EL	NAME
BBO	%	42 53 12.6	122 40 46.6	1.671	Butler Butte, OR
BEN	H	46 31 12.0	119 43 18.0	0.335	PNNL station
BEND	%	44 04 00.8	121 19 36.0	1.141	UO Bend Office, DOGAMI SMO
BHW	%	47 50 12.6	122 01 55.8	0.198	Bald Hill
BKC	%	44 17 57.9	121 41 45.6	1.208	Black Crater, OR
BLIS	#	46 11 51.5	122 11 07.3	2.116	Blister St. Helens Dome
BLN	%	48 00 26.5	122 58 18.6	0.585	Blyn Mt.
BOW	%	46 28 30.0	123 13 41.0	0.87	Boistfort Mt.
BPO	%	44 39 06.9	121 41 19.2	1.957	Bald Peter, OR
BRO	%	44 16 02.5	122 27 07.1	0.135	Big Rock Lookout, OR
BRV	+	46 29 07.2	119 59 28.2	0.92	Black Rock Valley
BSMT	M	47 51 04.8	114 47 13.2	1.95	Bassoo Peak, MT
BUO	%	42 16 42.5	122 14 43.1	1.797	Burton Butte, OR
BURN		43 34 23.0	119 07 49.0	1.615	Burns, OR SMO
BVW	+	46 48 39.5	119 52 56.4	0.67	Beverly
CBS	+	47 48 17.4	120 02 30.0	1.067	Chelan Butte, South
CDF	%	46 07 01.4	122 02 42.1	0.756	Cedar Flats
CHMT	M	46 54 51.0	113 15 07.0	-	Chamberlain Mtn, MT
CMW	%	48 25 25.3	122 07 08.4	1.19	Cultus Mtns.
CPW	%	46 58 25.8	123 08 10.8	0.792	Capitol Peak
CRF	+	46 49 30.0	119 23 13.2	0.189	Corfu
DPW	+	47 52 14.3	118 12 10.2	0.892	Davenport
DY2	+	47 59 06.6	119 46 16.8	0.89	Dyer Hill 2
EDM	%	46 11 50.4	122 09 00.0	1.609	East Dome, Mt. St. Helens
ELK	%	46 18 20.0	122 20 27.0	1.27	Elk Rock
ELL	+	46 54 34.8	120 33 58.8	0.789	Ellensburg
EPH	+	47 21 22.8	119 35 45.6	0.661	Ephrata
ET3	+	46 34 38.4	118 56 15.0	0.286	Eltopia (replaces ET2)
ETW	+	47 36 15.6	120 19 56.4	1.477	Entiat
FHE	+	46 57 06.9	119 29 49.0	0.455	Frenchman Hills East
FL2	%	46 11 47.0	122 21 01.0	1.378	Flat Top 2
FMW	%	46 56 29.6	121 40 11.3	1.859	Mt. Fremont
FRIS	%	44 12 44.0	122 06 01.8	1.642	Frissel Point, OR
GBB	H	46 36 31.8	119 37 40.2	0.185	PNNL Station
GBL	+	46 35 54.0	119 27 35.4	0.33	Gable Mountain
GHW	%	47 02 30.0	122 16 21.0	0.268	Garrison Hill
GL2	+	45 57 35.0	120 49 22.5	1	New Goldendale
GLK	%	46 33 27.6	121 36 34.3	1.305	Glacier Lake
GMO	%	44 26 20.8	120 57 22.3	1.689	Grizzly Mountain, OR
GMW	%	47 32 52.5	122 47 10.8	0.506	Gold Mt.
GPW	%	48 07 05.0	121 08 12.0	2.354	Glacier Peak
GSM	%	47 12 11.4	121 47 40.2	1.305	Grass Mt.
GUL	%	45 55 27.0	121 35 44.0	1.189	Guler Mt.
H2O	H	46 23 44.5	119 25 22.7	0.175	Water PNNL Station
HAM	%	42 04 08.3	121 58 16.0	1.999	Hamaker Mt., OR
HBO	%	43 50 39.5	122 19 11.9	1.615	Huckleberry Mt., OR
HDW	%	47 38 54.6	123 03 15.2	1.006	Hoodsport
HOG	%	42 14 32.7	121 42 20.5	1.887	Hogback Mtn., OR
HSO	%	43 31 33.0	123 05 24.0	1.02	Harness Mountain, OR
HSR	%	46 10 28.0	122 10 46.0	1.72	South Ridge, Mt. St. Helens
HTW	%	47 48 14.2	121 46 03.5	0.833	Haystack Lookout
HUO	%	44 07 10.9	121 50 53.5	2.037	Husband OR (UO)
IRO	%	44 00 19.0	122 15 15.4	1.642	Indian Ridge, OR
JBO	+	45 27 41.7	119 50 13.3	0.645	Jordan Butte, OR

TABLE 2A - Short-period Stations

STA	F	LAT	LONG	EL	NAME
JCW	%	48 11 42.7	121 55 31.1	0.792	Jim Creek
JORV	%	42 58 40.0	117 03 10.0	1.338	Jorden Valley, OR SMO
JUN	%	46 08 50.0	122 09 04.4	1.049	June Lake
KMO	%	45 38 07.8	123 29 22.2	0.975	Kings Mt., OR
KOS	%	46 27 46.7	122 11 41.3	0.61	Kosmos
KTR	N	41 54 31.2	123 22 35.4	1.378	CAL-NET
LAB	%	42 16 03.3	122 03 48.7	1.774	Little Aspen Butte, OR
LAM	N	41 36 35.2	122 37 32.1	1.769	CAL-NET
LAS	N	41 35 57.6	121 34 36.0	-	CAL-NET
LBC	N	40 50 12.3	121 20 59.8	-	CAL-NET
LCCM	M	45 50 16.8	111 52 40.8	1.669	Lewis and Clark Caverns, MT
LCW	%	46 40 14.4	122 42 02.8	0.396	Lucas Creek
LHE	N	41 37 42.6	122 13 49.8	-	CAL-NET
LMW	%	46 40 04.8	122 17 28.8	1.195	Ladd Mt.
LNO	+	45 52 18.6	118 17 06.6	0.771	Lincton Mt., OR
LO2	%	46 45 00.0	121 48 36.0	0.853	Longmire
LOC	+	46 43 01.2	119 25 51.0	0.21	Locke Island
LON	%	46 45 00.0	121 48 36.0	0.853	Longmire CREST BB LONLZ SMO
LTI	N	41 10 34.0	121 29 19.6	-	CAL-NET
LVP	%	46 03 58.0	122 24 02.6	1.13	Lakeview Peak
MBW	%	48 47 02.4	121 53 58.8	1.676	Mt. Baker
MCMT	M	44 49 39.6	112 50 55.8	2.323	McKenzie Canyon, MT
MCW	%	48 40 45.1	122 49 52.9	0.693	Mt. Constitution
MDW	+	46 36 47.4	119 45 39.6	0.33	Midway
MEW	%	47 12 07.0	122 38 45.0	0.097	McNeil Island
MJ2	+	46 33 27.0	119 21 32.4	0.146	May Junction 2
MOON	%	44 03 06.2	121 40 06.0	2.24	Moon Mt, OR
MOX	+	46 34 38.4	120 17 53.4	0.501	Moxie City
MPO	%	44 30 17.4	123 33 00.6	1.249	Mary's Peak, OR
MTM	%	46 01 31.8	122 12 42.0	1.121	Mt. Mitchell
NAC	+	46 43 59.4	120 49 25.2	0.728	Naches
NCO	%	43 42 14.4	121 08 18.0	1.908	Newberry Crater, OR
NED	#	46 12 01.5	122 11 03.4	2.06	NE part of old Dome, St. Helen
NEL	+	48 04 12.6	120 20 24.6	1.5	Nelson Butte
NLO	%	46 05 21.9	123 27 01.8	0.826	Nicolai Mt., OR
OBC	%	48 02 07.1	124 04 39.0	0.938	Olympics - Bonidu Creek
OBH	%	47 19 34.5	123 51 57.0	0.383	Olympics - Burnt Hill
OCP	%	48 17 53.5	124 37 30.0	0.487	Olympics - Cheeka Peak
OD2	+	47 23 15.6	118 42 34.8	0.553	Odessa site 2
ON2	%	46 52 50.8	123 46 51.8	0.257	Olympics - North River
OOW	%	47 44 03.6	124 11 10.2	0.561	Octopus West
OSD	%	47 48 59.2	123 42 13.7	2.008	Olympics - Snow Dome
OSR	%	47 30 20.3	123 57 42.0	0.815	Olympics Salmon Ridge
OT3	+	46 40 08.4	119 13 58.8	0.322	New Othello (replaces OT2 8/26
OTR	%	48 05 00.0	124 20 39.0	0.712	Olympics - Tyee Ridge
PAT	+	45 52 55.2	119 45 08.4	0.262	Paterson
PCFR	%	46 59 23.3	122 26 27.4	0.137	PC Firing Range ANSS-SMO
PCMD	%	46 53 20.9	122 18 00.9	0.239	PC Mountain Detachment ANSS-SMO
PGO	%	45 27 42.6	122 27 11.5	0.253	Gresham, OR
PGW	%	47 49 18.8	122 35 57.7	0.122	Port Gamble
PRO	+	46 12 45.6	119 41 08.4	0.553	Prosser
RCM	%	46 50 08.9	121 43 54.4	3.085	Mt. Rainier, Camp Muir
RCS	%	46 52 15.6	121 43 52.0	2.877	Mt. Rainier, Camp Schurman
RED	H	46 17 51.0	119 26 15.6	0.33	Red Mountain PNNL Station

TABLE 2A - Short-period Stations

STA	F	LAT	LONG	EL	NAME
RER	%	46 49 09.2	121 50 27.3	1.756	Mt. Rainier, Emerald Ridge
RMW	%	47 27 35.0	121 48 19.2	1.024	Rattlesnake Mt. (West)
RNO	%	43 54 58.9	123 43 25.5	0.85	Roman Nose, OR
RPW	%	48 26 54.0	121 30 49.0	0.85	Rockport
RRHS	%	46 47 58.6	123 02 25.4	0.047	Rochester HS ANSS-SMO
RSW	+	46 23 40.2	119 35 28.8	1.045	Rattlesnake Mt. (East)
RVC	%	46 56 34.5	121 58 17.3	1	Mt. Rainier - Voight Creek
RVW	%	46 08 53.2	122 44 32.1	0.46	Rose Valley
SAW	+	47 42 06.0	119 24 01.8	0.701	St. Andrews
SBES	%	48 46 05.9	122 24 54.2	0.119	Silver Beach ES ANSS-SMO
SEA	%	47 39 15.8	122 18 29.3	0.03	UW, Seattle (Wood Anderson BB)
SEP	#	46 12 01.4	122 11 21.8	2.116	September lobe, Mt. St. Helens
SFER	%	47 37 10.4	117 21 55.7	0.715	Spokane Schools, Ferris High A
SHW	%	46 11 37.1	122 14 06.5	1.425	Mt. St. Helens
SLF	%	47 45 32.0	120 31 40.0	1.75	Sugar Loaf
SMW	%	47 19 10.7	123 20 35.4	0.877	South Mtn.
SNI	H	46 27 50.4	119 39 35.1	0.323	Snively PNNL station
SOS	%	46 14 38.5	122 08 12.0	1.27	Source of Smith Creek
SSO	%	44 51 21.6	122 27 37.8	1.242	Sweet Springs, OR
STD	%	46 14 16.0	122 13 21.9	1.268	Studebaker Ridge
STDM	%	46 14 16.0	122 13 21.9	1.268	Studebaker Ridge Microphone
STW	%	48 09 03.1	123 40 11.1	0.308	Striped Peak
SVOH	%	48 17 21.8	122 37 54.8	0.022	Skagit Valley CC ANSS-SMO
TBM	+	47 10 12.0	120 35 52.8	1.006	Table Mt.
TDH	%	45 17 23.4	121 47 25.2	1.541	Tom,Dick,Harry Mt., OR
TDL	%	46 21 03.0	122 12 57.0	1.4	Tradedollar Lake
TRW	+	46 17 32.0	120 32 31.0	0.723	Toppenish Ridge
TWW	+	47 08 17.4	120 52 06.0	1.027	Teanaway
UWFH	%	48 32 46.0	123 00 43.0	0.01	UW Friday Harbor ANSS-SMO
VBE	%	45 03 37.2	121 35 12.6	1.544	Beaver Butte, OR
VCR	%	44 58 58.2	120 59 17.4	1.015	Criterion Ridge, OR
VDB	C	49 01 34.0	122 06 10.1	0.404	Canada
VFP	%	45 19 05.0	121 27 54.3	1.716	Flag Point, OR
VG2	%	45 09 20.0	122 16 15.0	0.823	Goat Mt., OR
VGB	+	45 30 56.4	120 46 39.0	0.729	Gordon Butte, OR
VIP	%	44 30 29.4	120 37 07.8	1.731	Ingram Pt., OR
VLL	%	45 27 48.0	121 40 45.0	1.195	Laurance Lk., OR
VLM	%	45 32 18.6	122 02 21.0	1.15	Little Larch, OR
VSP	%	42 20 30.0	121 57 00.0	1.539	Spence Mtn, OR
VT2	+	46 58 02.4	119 59 57.0	0.385	Vantage2
VTH	%	45 10 52.2	120 33 40.8	0.773	The Trough, OR
VVHS	%	47 25 25.1	122 27 13.1	0.095	Vashon HS ANSS-SMO
WA2	+	46 45 19.2	119 33 56.4	0.244	Wahluke Slope
WAT	+	47 41 55.2	119 57 14.4	0.821	Waterville
WIW	+	46 25 45.6	119 17 15.6	0.128	Wooded Island
WPO	%	45 34 24.0	122 47 22.4	0.334	West Portland, OR
WPW	%	46 41 55.7	121 32 10.1	1.28	White Pass
WRD	+	46 58 12.0	119 08 41.4	0.375	Warden
WRW	%	47 51 26.0	120 52 52.0	1.189	Wenatchee Ridge
YA2	+	46 31 36.0	120 31 48.0	0.652	Yakima
YEL	#	46 12 35.0	122 11 16.0	1.75	Yellow Rock, Mt. St. Helens
YPT	+	46 02 55.8	118 57 44.0	0.325	Yellepit

Table 2B lists broad-band stations used in locating seismic events in Washington and Oregon, and Table 2C lists strong-motion stations. The format for station locations is the same for all station tables, as described above.

TABLE 2B - Broadband Stations

STA	F	LAT	LONG	EL	NAME
A04A	E	48 43 12.6	122 42 20.5	0.024	Lummi Island, WA
BRKS	%	47 45 19.1	122 17 17.9	0.02	Brookside ANSS-SMO BB
COR	U	44 35 08.5	123 18 11.5	0.121	Corvallis, OR (USNSN) BB
D03A	E	47 06 58.3	123 46 11.0	0.049	Wishkah, WA
DBO	%	43 07 09.0	123 14 34.0	0.984	Dodson Butte, OR (UO CREST BB)
ELW	%	47 29 39.4	121 52 17.2	0.267	EchoLakeBPA BB-SMO-IDS20
ERW	%	48 27 14.4	122 37 30.2	0.389	Mt. Erie SMO-IDS24 BB
EUO	%	44 01 45.7	123 04 08.2	0.16	Eugene,OR U0 CREST BB SMO
GNW	%	47 33 51.8	122 49 31.0	0.165	Green Mt CREST BB SMO
GRCC	G	47 18 42.5	122 10 46.0	0.13	Green River CC BB
HAWA	U	46 23 32.3	119 31 57.2	0.367	Hanford Nike USNSN BB
HEBO	%	45 12 49.2	123 45 15.0	0.875	Mt. Hebo, OR CREST BB SMO
HLID	U	43 33 45.0	114 24 49.3	1.772	Hailey, ID USNSN BB
HOOD	%	45 19 17.8	121 39 07.8	1.52	Mt Hood Meadows, OR CREST BB SMO
HUMO		42 36 25.6	122 57 24.1	0.555	Hull Mountain,OR BB from UCB
JRO		46 16 31.0	122 12 59.7	1.28	Johnston Ridge Observatory
KBO	N	42 12 45.0	124 13 33.3	1.008	Bosley Butte, OR CREST BB
KEB	N	42 52 20.0	124 20 03.0	0.818	Edson Butte, OR CREST BB
KRMB	N	41 31 22.6	123 54 28.7	1.265	CAL-NET Red Mtn, OR CREST BB
KSXB	N	41 49 49.4	123 52 36.8	-	CAL-NET Camp Six, OR CREST BB
LON	%	46 45 00.0	121 48 36.0	0.853	Longmire CREST BB LONLZ SMO
LTY	%	47 15 21.2	120 39 53.3	0.97	Liberty BB CREST SMO
MEGW	%	46 15 57.4	123 52 38.2	0.332	Megler, WA CREST BB SMO
MOD		41 54 08.9	120 18 10.6	1.555	Modoc Plateau, CA from UCB
NEW	U	48 15 50.0	117 07 13.0	0.76	Newport Observatory USNSN BB
OCWA	U	47 44 56.0	124 10 41.2	0.671	Octopus Mtn. USNSN BB
OFR	%	47 56 00.0	124 23 41.0	0.152	Olympics - Forest Resource Center
OPC	%	48 06 01.0	123 24 41.8	0.09	Olympic Penn College CREST BB
OZB	C	48 57 37.1	125 29 34.1	0.671	Canada BB
PFB	C	48 34 30.0	124 26 39.8	0.465	P.Renfrew, Canada BB
PIN	%	43 48 40.0	120 52 19.0	1.865	Pine Mt., OR (U0 CREST, BB, SMO)
PNLK	%	47 34 54.5	122 02 01.0	0.128	Pine Lake JH ANSS-SMO BB
PNT	C	49 18 57.6	119 36 57.6	0.55	Canada, BB
SNB	C	48 46 33.6	123 10 16.3	0.408	Canada BB
SP2	%	47 33 23.3	122 14 52.8	0.03	Seward Park, Seattle SMO-IDS24
SQM	%	48 04 39.0	123 02 44.0	0.03	Sequim, WA (CREST BB SMO)
STD	%	46 14 16.0	122 13 21.9	1.268	Studebaker Ridge
TAKO	%	43 44 36.6	124 04 52.5	0.046	Tahkenitch, OR CREST BB SMO
TOLO	%	44 37 19.3	123 55 16.6	0.021	Toledo BPA, OR CREST BB SMO
TTW	%	47 41 40.7	121 41 20.0	0.542	Tolt Res, WA CREST BB SMO
WIFE		44 03 35.4	121 48 58.7	1.955	Wife at 3-Sisters from CVO
WISH	%	47 07 01.8	123 46 11.6	0.045	Wishkah CREST BB SMO
WVOR	U	42 26 02.0	118 38 13.0	1.344	Wildhorse Valley, OR (USNSN BB)
YBH		41 43 55.3	122 42 37.4	1.06	Yreka, CA from UCB BB

Table 2C lists strong-motion, three-component stations operating in Washington and Oregon that provide data in real or near-real time to the PNSN. Several of these stations also have broad-band instruments, as noted.

The "SENSOR" field designates what type of seismic sensor is used:

A = Terra-Tech SSA-320 SLN triaxial accelerometer/Terra-Tech IDS24
A20 = Terra-Tech SSA-320 triaxial accelerometer/Terra-Tech IDS20 recording system
FBA23 = Kinemetrics FBA23 accelerometers and Reftek recording system
EPI = Kinemetrics Episensor accelerometers and Reftek recording system
BB = Guralp CMG-40T 3-D broadband velocity sensor
BB3 = Guralp CMG3T 3-D broadband velocity sensor
BBZ = Broad Band sensor, PMD 2024, vertical component only
K2 = Kinemetrics Episensor accelerometers and K2 recording system

The "TELEMETRY" field indicates the type of telemetry used to recover the data:
D = dial-up,
E = continuously telemetered via Internet from a remote EARTHWORM system
I = continuously telemetered via Internet
L = continuously telemetered via dedicated lease-line telephone lines
P = continuously telemetered via dedicated lease-line telephone lines using PPP protocol
M = continuously telemetered via BPA microwave
R = continuously telemetered via spread-spectrum radio

TABLE 2C - Strong-motion three-component stations

STA	F	LAT	LONG	EL	NAME	SENSOR	TEL.
ACES	%	47 33 35.0	122 20 23.6	0	Army Corps of Engineers Seattle	CMG5T	I
ALCT	%	47 38 48.8	122 2 15.7	0.055	Alcott Elementary	K2	I
ALKI	%	47 34 30.4	122 25 3.4	0.001	Alki	K2	L
ALST	%	46 6 32.3	123 1 58.5	0.198	Alston	A20	E,M
ALVY	%	43 59 53.2	123 0 57.0	0.155	Alvey	K2	E,M
ATES	%	48 14 10.9	122 3 33.0	0.062	Trafton Elementary	K2	I
BABE	%	47 36 21.0	122 32 7.0	0.083	Blakely Elementary	K2	I
BEND	%	44 4 0.8	121 19 36.0	1.141	U of O Bend Field Office	K2	I
BEVT	%	47 55 12.0	122 16 12.0	0.17	Boeing Plant Everett	K2	I
BRKS	%	47 45 19.1	122 17 17.9	0.02	Brookside Elementary	K2,BBZ	I
BSFP	%	47 31 12.0	122 17 54.0	0.005	Boeing Fire Protection	CMG5T	I
BULL	*	45 26 45.8	122 9 16.9	0.222	Bull Run Dam	A	I
BURN	#	43 34 23.0	119 7 49.0	1.615	Burns Butte Radio Building	K2	M,I
COLT	%	45 10 13.1	122 26 12.8	0.213	Colton High School	CMG5T	I
CSEN	%	47 48 4.5	122 13 6.5	0.055	Crystal Springs Elementary	K2	I
CSO	#	45 31 1.0	122 41 22.5	0.036	Canyon	FBA23	D
DBO	%	43 7 9.0	123 14 34.0	0.984	Dodson Butte (CREST)	EPI,BB3	E,L-PPP
EARN	%	47 44 27.2	122 2 37.7	0.159	East Ridge Elementary	K2	I
EGRN	%	47 4 24.0	122 58 41.0	0.057	Evergreen State College	K2	I
ELW	%	47 29 39.4	121 52 17.2	0.267	Echo Lake	A,BB	D,M,L
ERW	%	48 27 14.4	122 37 30.2	0.389	Mount Erie	A,BB	D,L,M
EUO	%	44 1 45.7	123 4 8.2	0.16	Eugene Golf Course (CREST)	EPI,BB	E,L-PPP
EVCC	%	48 0 27.0	122 12 15.3	0.03	Everett Community College	K2	I
EVGW	%	47 51 15.8	122 9 12.2	0.122	Gateway Middle School	K2	I
EYES	%	45 19 46.5	123 3 23.5	0.061	Ewing Young Elementary	CMG5T	I
FINN	%	47 43 10.2	122 13 55.9	0.121	Finn Hill Junior High	K2	I
GNW	%	47 33 51.8	122 49 31.0	0.165	Green Mountain (CREST)	EPI,BB3	L-PPP
GTWN	%	47 33 4.8	122 19 14.8	0.025	Georgetown Playfield	CMG5T	I,Wireless
HAO	#	45 30 33.1	122 39 24.0	0.018	Harrison	FBA23	D
HEBO	%	45 12 49.2	123 45 15.0	0.875	Mt. Hebo (CREST)	EPI,BB	M,E
HICC	%	47 23 24.4	122 17 52.4	0.115	Highline Community College	K2	I
HOLY	%	47 33 55.4	122 23 1.0	0.106	Holy Rosary School	K2	I
HOOD	%	45 19 17.8	121 39 7.8	1.52	Hood Meadows (CREST)	EPI,BB	L-PPP,I
HUBA	%	45 37 51.0	122 39 4.9	0.023	Hudson's Bay High School	CMG5T	I
JORV	%	42 58 40.0	117 3 10.0	1.338	Jordan Valley High School	K2	I
KCAM	%	47 32 39.0	122 19 2.1	0.005	King County Airport Maintenance	CMG5T	I
KDK	%	47 35 42.7	122 19 56.0	0.004	King Dome	K2	I

TABLE 2C - Strong-motion three-component stations

STA	F	LAT	LONG	EL	NAME	SENSOR	TEL.
KFAL	%	42 15 27.7	121 47 6.5	1.326	Klamath Falls	CMG5T	Serial
KEEL	%	45 33 0.8	122 53 42.4	0.067	Keeler	A20	D,E,M
KICC	%	47 34 37.9	122 37 52.4	0.017	Kitsap County Central Commun.	K2	I
KIMB	%	47 34 29.3	122 18 10.1	0.069	Kimball Elementary	K2	I
KIMR	%	47 30 11.0	122 46 2.0	0.123	Moderate Risk Waste Collection Fac.	K2	I
KINR	%	47 45 6.0	122 38 35.0	0.008	North Road Shed	K2	I
KITP	%	47 40 30.0	122 37 47.0	0.076	Wastewater Treatment Plant	K2	I
KNEL	%	47 22 50.5	122 15 2.5	0.014	Kent Elementary School	K2	I
KNJH	%	47 23 5.0	122 13 42.0	0.014	Kent Junior High	K2	I
LANE	%	44 3 6.5	123 13 54.8	0.12	Lane	K2	E,M
LAWT	%	47 39 23.4	122 23 21.9	0.05	Lawton Elementary	SLN-320	I
LEOT	%	47 46 4.4	122 6 56.2	0.115	Leota Junior High	K2	I
LON	%	46 45 0.0	121 48 36.0	0.853	Longmire Springs (CREST)	EPI,BB3	L-PPP
LTY	%	47 15 21.2	120 39 53.4	0.97	Liberty Heights Mine (CREST)	EPI,BB3	I
MARY	%	47 39 45.7	122 7 11.6	0.011	Marymoor Park	K2	I
MBKE	%	48 55 2.0	122 8 29.0	1.01	Kendall Elementary	K2	I
MBPA	%	47 53 54.7	121 53 20.2	0.186	Monroe	A20	D,M,L
MEAN	%	47 37 21.7	122 18 18.7	0.037	Meany Middle School	K2	I
MEGW	%	46 15 57.4	123 52 38.2	0.332	Megler (CREST)	EPI,BB	M,E
MPL	%	47 28 7.0	122 11 4.5	0.122	Maple Valley	A	D,M,L
MRIN	%	44 48 1.4	122 41 53.8	0.187	Marion	K2	M,E
MURR	%	47 7 12.0	122 33 36.0	0.082	Camp Murray	K2	None
NIHS	%	47 44 29.2	122 13 17.1	0.137	Inglemoore High School	K2	I
NOWS	%	47 41 12.0	122 15 21.2	0.002	NOAA Sand Point	A20	I
OFR	%	47 56 0.0	124 23 41.0	0.152	Olympic Natural Resources Center (CREST)	EPI,BB	I,E
OHC	%	47 20 2.0	123 9 29.0	0.006	Hood Canal Junior High	K2	I
OPC	%	48 6 1.0	123 24 41.8	0.09	Peninsula College (CREST)	EPI,BB	I
PAYL	%	47 11 34.0	122 18 46.0	0.009	Aylen Junior High	K2	I
PCEP	%	47 6 41.8	122 17 24.0	0.16	Puyallup East Sheriff Precinct	K2	I
PCFR	%	46 59 23.3	122 26 27.4	0.137	Roy Training Center	K2	I
PCMD	%	46 53 20.9	122 18 0.9	0.239	Mountain Detachment	K2	I
PERL	%	45 19 42.0	122 46 40.2	0.068	Pearl	K2	M,E
PIN	%	43 48 40.0	120 52 19.0	1.865	Pine Mtn. (CREST)	EPI,BB3	E,L-PPP
PNLK	%	47 34 54.5	122 2 1.0	0.128	Pine Lake Middle School	K2	I
PSNS	%	47 33 32.0	122 38 35.0	0.006	Puget Sound Naval Shipyard	A20	I
QAW	%	47 37 54.3	122 21 15.5	0.14	Queen Anne	A20	L
RAW	%	47 20 14.0	121 55 53.2	0.208	Raver	A20	M,L
RBEN	%	47 26 6.7	122 11 10.0	0.152	Benson Hill Elementary	K2	I
RBO	#	45 32 27.0	122 33 51.5	0.158	Rocky Butte	FBA23	D
RHAZ	%	47 32 24.7	122 11 1.3	0.108	Hazelwood Elementary	A20	I
ROSS	%	45 39 43.0	122 39 25.0	0.061	Ross	A20	E
RRHS	%	46 47 58.6	123 2 25.4	0.047	Rochester High School	K2	I
RWW	%	46 57 53.7	123 32 31.7	0.015	Ranney Well (CREST)	EPI,BB3	L-PPP
SBES	%	48 46 5.9	122 24 54.2	0.119	Silver Beach Elementary School	K2	I
SCC	%	47 44 59.4	122 21 35.3	0	Shoreline Community College	CMG5T	I
SEA	%	47 39 15.8	122 18 29.3	0.03	University of Washington	A20,PMD2023	L
SEAS	%	45 59 51.3	123 55 28.2	0.005	Seaside	K2	I
SFER	%	47 37 10.4	117 21 55.7	0.715	Ferris High School	K2	I
SGAR	%	47 40 37.8	117 24 50.3	0.579	Garfield Elementary	K2	I
SHIP	%	47 39 19.0	122 19 14.4	0.005	WashDOT Lake Union Shop	CMG5T	I,Wireless
SHLY	$	47 42 30.4	117 24 57.7	0.626	Spokane Temp	K2	None
SMNR	%	47 12 16.6	122 13 53.4	0.022	Sumner High School	K2	I
SNIO	$	47 40 46.0	117 24 18.0	0.584	Spokane NIOSH	K2	None

TABLE 2C - Strong-motion three-component stations

STA	F	LAT	LONG	EL	NAME	SENSOR	TEL.
SOPS	$	47 43 40.8	117 18 46.5	0.707	Orchard Prairie Elementary	K2	I
SP2	%	47 33 23.3	122 14 52.8	0.03	Seward Park	A,BB	L
SQM	%	48 4 39.0	123 2 44.0	0.03	Sequim Battelle Properties (CREST)	EPI,BB	I,R
SSS1	%	47 34 55.1	122 19 47.5	0.005	John Stanford Center 1	K2	I
SSS2	%	47 34 55.1	122 19 47.5	0.005	John Stanford Center 2	K2	I
SVOH	%	48 17 21.8	122 37 54.8	0.022	Skagit Valley College Oak Harbor	K2	I
SVTR	%	47 29 45.4	121 46 49.3	0.146	Two Rivers School	CMG5T	I
SWES	%	47 42 51.0	117 27 53.2	0.623	Westview Elementary	K2	I
SWID	%	48 0 31.0	122 24 42.0	0.062	South Whidbey Primary School	K2	I
TAKO	%	43 44 36.6	124 4 52.5	0.046	Tahkenitch (CREST)	EPI,BB	M,E
TBPA	%	47 15 29.0	122 22 1.0	0.002	Tacoma	A20	M,L,D
TKCO	%	47 32 12.7	122 18 1.5	0.005	King County Airport	A20	I
TOLO	%	44 37 19.3	123 55 16.6	0.021	Toledo (CREST)	EPI,BB	M,E
TTW	%	47 41 40.7	121 41 20.0	0.542	Tolt Reservoir (CREST)	EPI,BB3	I
UPS	%	47 15 50.2	122 29 1.1	0.113	University of Puget Sound	K2	I
UWFH	%	48 32 46.0	123 0 43.0	0.01	Friday Harbor Laboratories	K2	I
VVHS	%	47 25 25.1	122 27 13.1	0.095	Vashon High School	K2	I
WISC	%	47 36 32.0	122 10 27.8	0.056	Wilburton Inst. Services Center	K2	I
WWHS	%	46 2 43.5	118 19 2.0	0.01	Walla Walla High School	CMG5T	I