Final Technical Report
USGS Cooperative Agreement for Geodetic Monitoring Operations

Cooperative Agreement Number: 07HQAG0029
C.A. Start Date & End Date: 03/01/07 through 2/28/10
Geodetic Monitoring Project Name: **Partnership with real-time networks in the Pacific Northwest**

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ftp://ftp.panga.cwu.edu

Major Goal(s) & Activities of the Geodetic Project:
We continue to operate the Pacific Northwest Geodetic Array in conjunction with a variety of other state, county, city and privately-funded GPS networks, to download the data, to publically archive it, and to process and disseminate rinex and sinex solutions via the www.panga.org web site. Additionally, we are using data from real-time Global Navigation Satellite System (GNSS) networks in the Pacific Northwest (figure 1) to complement and augment the information yielded by the Plate Boundary Observatory (PBO) and pre-existing PANGA stations (including those operated by the USGS). These activities include daily downloading, public archiving, and processing, with the goal of making the sub-daily and real-time routines used by surveying professionals useful for tectonic monitoring.

The resulting denser station spacing in the Puget-Willamette lowland (and especially on the west flank of the Cascade Range) has considerably improved the slip models and identification of the transient slip itself on the deeper Cascadia subduction zone (figures 2,3) and should provide better resolved surface strain maps. Where PBO coverage was necessarily bare-bones (for example east of the Cascades) the addition of these stations provides tighter bracketing of known seismogenic zones (e.g., Chelan area,Olympic Wallowa line, Brothers fault zone).

Also the networks are built and maintained with robust real-time monitoring in mind, which should allow quicker and better informed response to very large ground motions both locally and remotely. “GNSS seismology” is critical for quickly and fully determining the energy release of great earthquakes because it directly measures ground motions, without problems of instrument saturation.

CWU Publications:

Slow-slip phenomena in Cascadia from 2007 and beyond: A review
Gomberg, J., and the Cascadia 2007 and Beyond Work Group
Geological Society of America Bulletin, July/August 2010
March 29, doi10.1130/B30287.1, 2010

Future Cascadia megathrust rupture delineated by episodic tremor and slip
Chapman, J., T. Melbourne
Geophysical Research Letters, vol.36, L22301, doi:101029/2009GL040465, 2009

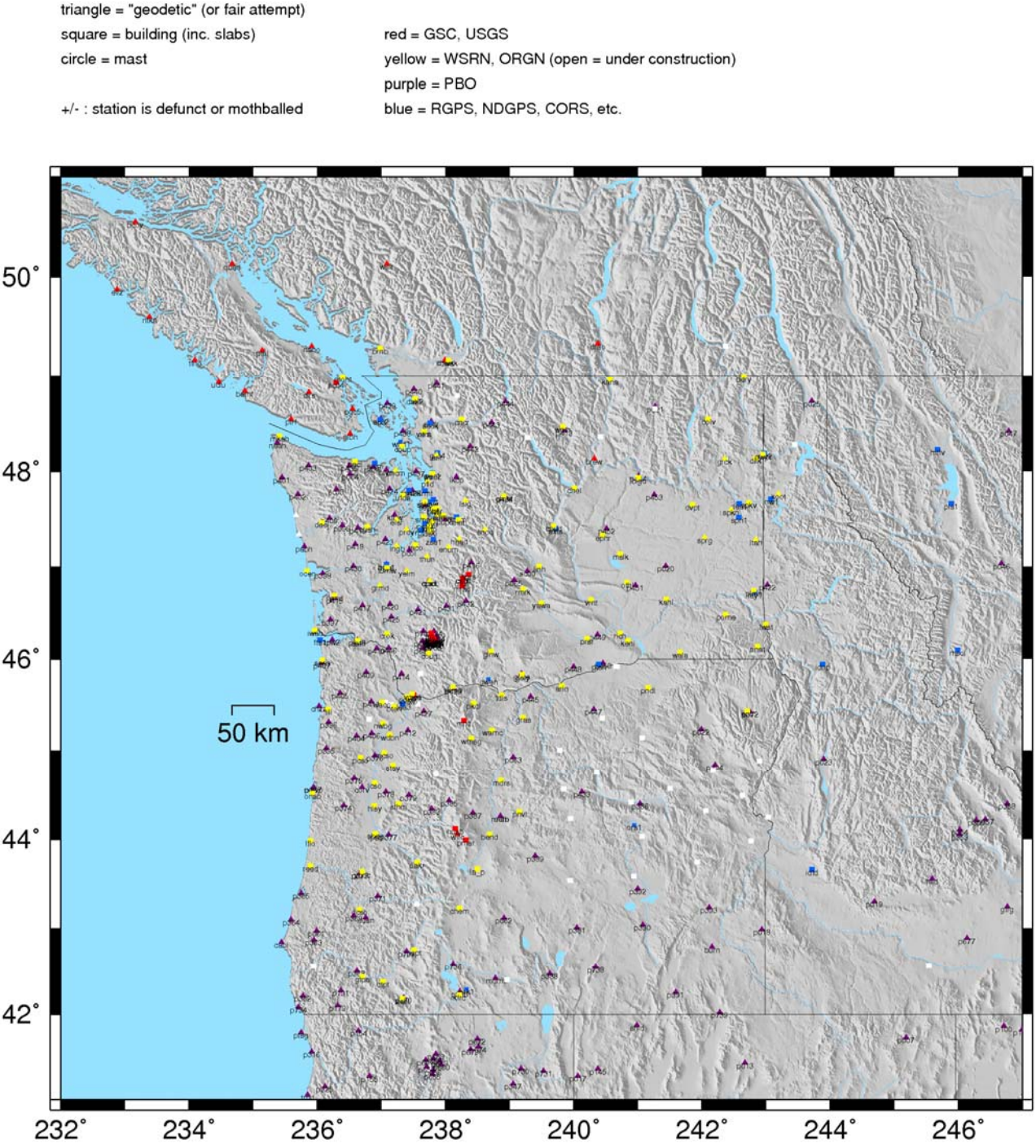
Moment release rate of Cascadia tremor constrained by GPS
Aguiar, A., T. Melbourne, C. Scrivner
Journal of Geophysical Research, VOL. 114, B00A05, doi:10.1029/2008JB005909, 2009

Seismic and geodetic constraints on Cascadia slow slip

Wech, A., K. Creager, T. Melbourne

Journal of Geophysical Research, VOL. 114, B10316, doi:10.1029/2008JB006090, 2009

Figure 1. GNSS stations archived for the Pacific northwest.



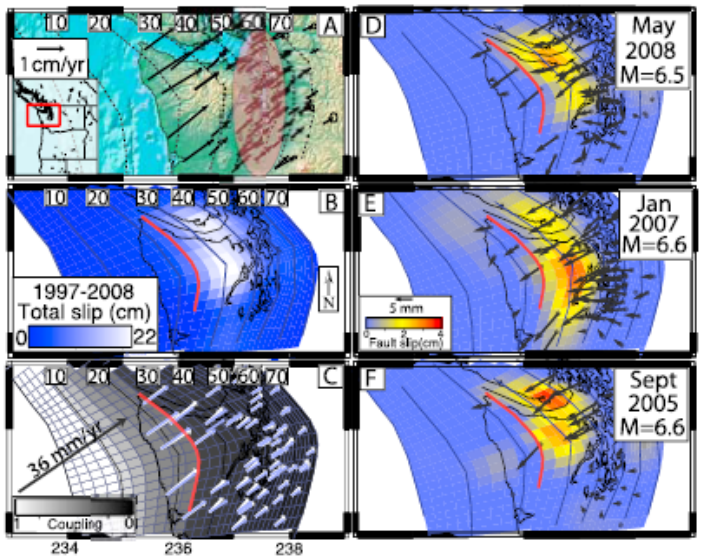


Figure 2. (a) Northern Cascadia long-term interseismic velocity vectors with respect to stable North America. Dashed lines indicate isodepth contours of the Juan de Fuca - North American plate interface fault, labeled in km. Red ellipse denotes greater Puget Sound metropolitan region (Seattle, Tacoma, Olympia). (b) Cumulative thrust fault slip recorded during 15 distinct episodic creep events (Mw = 6.3–6.7) along the deeper Cascadia plate interface over the 11-year period between April 1997 and June 2008. Slip and tremor dissipate 80–100% of convergence-related stress accumulation down-dip of 25 km, whereas little moment release is found up-dip of 25 km depth, thus interpreted as the lower limit of seismogenic coupling (red line). The southerly and northerly decrease in inferred slip is due to inadequate GPS instrumentation prior to 2005. (c) Plate interface coupling profile derived from the observed 25 km up-dip limit of cumulative episodic slow slip. Full coupling offshore diminishes gradually eastwards (down dip) over 100 km towards the 25 km depth contour and the onset of episodic creep, where it drops quickly to near zero (red line in Figures 1a and 1b). Interseismic deformation based on this coupling model (blue vectors) cannot replicate continuous GPS measurements (white vectors) without the break in seismogenic coupling near 25 km depth. Assuming a 550-year recurrence interval, nine meters of slip is expected along the 25 km depth profile, and diminishing down-dip towards the east. (d–f) Transient surface deformation vectors and inferred thrust faulting from three recent Cascadia slow slip events, September 2005 – June 2008. Magnitudes average Mw = 6.6, produce 5 mm of static deformation, and last between 2–4 weeks total duration across the network. For slip distributions of individual events and their aggregate, little slip is imaged up-dip of the 25 km isodepth contour or down-dip of the 40 km contour. Note vector scale differs between Figures 1a and 1c. *[Figure 1 of Chapman and Melbourne, 2009]*

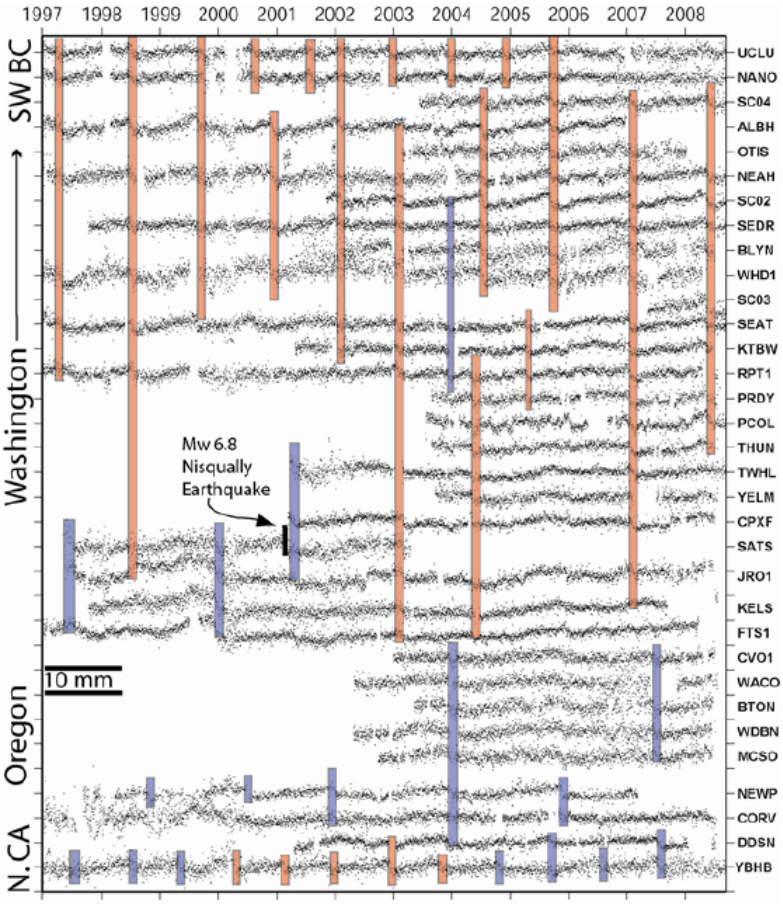


Figure 3. The 11 years of GPS longitude measurements from the Cascadia subduction zone show evidence of 39 slow slip events. Vertical axis tick marks are 10 mm. Transparent blue and red lines indicate slip events well recorded with GPS or corroborated by observations of subduction zonetremor; red lines denote events for which tremor duration could be estimated either with available digital data or via published reports based on analog data. Maximum geodetic offsets observed to date measure 6 mm and correspond to the spatially largest event in early 2003. The February 2001 Mw 6.7 Nisqually earthquake (depth = 52 km) appears on station SATS. Station map can be found at http://www.geodesy.org. *[Figure 3 of Aguiar et al, 2009]*

Network status:

We archive RINEX files from approximately 142 real-time GNSS stations in the Pacific northwest (besides those operated by PBO or the USGS). These comprise the Washington State Reference Network (WSRN; 84 stations), Oregon Real-time GPS Network (ORGN; 36 stations), and the privately run Real-Time GNSS Network (RGPS; 22 stations). Also we cooperate in efforts to monitor significant manmade structures, including the Alaska Way Viaduct and a number of dams (Tolt, Ross, Howard Hanson, and Boundary). We process static data from most of these stations, along with those from PBO and the Cascades Volcano Observatory (CVO) in global and North American reference frames using the Jet Propulsion Laboratory's GIPSY-OASIS software package.

Consistent processing of data in real time is a work in progress, but we have achieved some promising results. We have developed a javascript/htlm5 based web interface to show the calculated positions of a subset of real-time stations. The baseline derived positions are the output of commercial software (Trimble Integrity Manager/VRS3Net) but we are are working towards implementing the real-time capabilities of both GIPSY and MIT's GAMIT-GLOBK.

WSRN:

longitude	*latitude*	*col*	*site*	*yyyy*	*ddd*	*receiver(s)*	*antenna(s)*	*dome*	*symb*
-122.1410	48.1740	2	arli	2004	333	TRIMBLE NETRS	TRM29659.00	SCIT	t0.05
-120.1827	45.7080	2	arln	2007	353	LEICA GRX1200	LEIAT504GG	LEIS	s0.05
-117.3494	48.9848	2	bdry	2005	347	TRIMBLE 5700	TRM33429.00+GP	NONE	s0.05
#				2006	318	TRIMBLE 5700	TRM41249.00	TZGD	
-122.1913	47.6142	2	bcit	2008	161	TPS ODYSSEY_E	TPSCR3	CONE	s0.05
-122.4779	48.7555	2	beli	2005	277	TRIMBLE 5700	TRM33429.00+GP	NONE	s0.05
#				2007	119	TRIMBLE NETR5	TRM55971.00	NONE	
-122.1254	47.6174	2	bfir	2008	161	TPS ODYSSEY_E	TPSCR3	CONE	s0.05
-122.1320	47.5541	2	bsum	2008	161	TPS ODYSSEY_E	TPSCR3	CONE	s0.05
-118.9884	47.9333	2	bigd	2006	200	TRIMBLE 4700	TRM33429.00+GP	NONE	s0.05
-122.1816	47.5992	2	blvu	2004	202	TRIMBLE 4700	TRM22020.00+GP	NONE	s0.05
-123.0214	49.2754	2	brnb	2007	124	TRIMBLE NETR5	TRM55971.00	TZGD	s0.05
-123.3672	46.1972	2	cath	2007	124	TRIMBLE NETRS	TRM41249.00	NONE	s0.05
-122.7760	48.0110	2	chcm	2004	223	TRIMBLE 5700	TRM41249.00	SCIT	t0.05
-119.9896	47.8314	2	chel	2006	324	TRIMBLE NETRS	TRM41249.00	????	s0.05
-121.7450	48.5390	2	cncr	2007	146	LEICA GRX1200GGPRO	LEIAX1202GG	NONE	s0.05
-117.9030	48.5448	2	colv	2007	124	JPS ODYSSEY	TPSCR3_GGD	CONE	s0.05
-122.2604	46.0592	2	coug	2007	315	JPS ODYSSEY	TPSCR3_GGD	CONE	s0.05
-122.6738	48.2613	2	coup	2005	223	TRIMBLE 5700	TRM41249.00	NONE	s0.05
-120.3140	47.4304	2	cpud	2005	157	TRIMBLE NETRS	TRM41249.00	TZGD	s0.05
-122.2565	46.8401	2	cpxf	2001	068	ASHTECH Z-XII3	ASH701945B_M	SCIT	t0.05
#				2002	177	ASHTECH UZ-12	ASH701945B_M	SCIT	
#				2004	100	LEICA RS500	LEIT504	LEIS	
#				2007	205	LEICA GRX1200GGPRO	LEIT504GG	LEIS	
-122.2354	47.3806	2	cski	2006	023	TRIMBLE 4700	TRM33429.00+GP	NONE	s0.05
#				2007	173	JPS ODYSSEY	TPSCR3_GGD	CONE	
-122.9122	46.2746	2	crok	2007	125	JPS ODYSSEY	TPSCR3_GGD	CONE	s0.05
-123.2197	47.4232	2	cush	2008	238	TRIMBLE NETR5	TRM55971.00	NONE	s0.05
-121.9535	49.1529	2	cwak	2006	011	TRIMBLE NETRS	TRM441249.00	TZGD	s0.05
-123.9261	47.4688	2	deej	2009		*under construction*			s0.05
-117.1628	48.1380	2	dilk	2006		*under construction*			s0.05
-118.1476	47.6559	2	dvpt	2006	324	TRIMBLE 5700	TRM33429.00+GP	NONE	s0.05
-122.7620	47.4930	2	elsr	2004	202	TRIMBLE 5700	TRM41249.00	SCIT	t0.05
-121.9540	47.2080	2	enum	2004	202	TRIMBLE 4700	TRM41249.00	SCIT	t0.05
#				2007	202	TRIMBLE NETR5	TRM55971.00	SCIT	
-119.5446	47.3294	2	ephr	2006	200	TRIMBLE NETRS	TRM41249.00	TZGD	s0.05
-121.2924	46.0773	2	glnw	2007	322	TRIMBLE 5700	TRM41249.00	????	s0.05
-120.8020	45.8288	2	goly	2007	315	JPS ODYSSEY	TPSCR.G3	TPSH	s0.05
-117.6500	48.1300	2	grck	2006	320	TRIMBLE 5700	TRM41249.00	SCIT	t0.05
-123.0250	46.7916	2	grmd	2005	210	TRIMBLE 4700	TRM33429.00-GP	SCIT	t0.05
#				2007	218	TRIMBLE 4700	TRM41249.00	SCIT	
-121.7884	47.2910	2	hhad	2010	078	TRIMBLE NETR5	TRM55971.00	NONE	t0.05
-124.0389	46.3057	2	iwac	2007	341	JPS ODYSSEY	TPSCR.G3	TPSH	s0.05
-118.5550	46.6430	2	kahl	2007	131	TRIMBLE 4700	TRM33429.00+GP	NONE	s0.05

-119.4358	48.9554 2	kana	2009	079	TRIMBLE 4700	TRM22020.00+GP	NONE	s0.05
-119.1583	46.1979 2	keni	2007	315	TRIMBLE 4700	TRM33429.00+GP	NONE	s0.05
#			2008	309	JPS LEGACY	TPSCR.G3	TPSH	
-122.2576	47.4250 2	kntp	2008	006	JPS ODYSSEY	TPSPG_A1+GP	????	s0.05
-116.8092	47.7708 2	koot	2007	043	TRIMBLE 4700	TRM41249.00	SCIT	t0.05
WSRN (continued):								
-120.5385	47.0003 2	linh	2002	114	TRIMBLE 4000SSI	TRM29659.00	NONE	s0.05
#			2005	336	TRIMBLE 4700	TRM29659.00	NONE	
#			2009	030	TRIMBLE NETRS	TRM29659.00	NONE	
-122.7590	47.2190 2	lngb	2004	160	LEICA RS500	LEIAT504	LEIS	t0.05
#			2007	199	LEICA GRX1200GGPRO	LEIAT504	LEIS	
#			2007	274	LEICA GRX1200GGPRO	LEIAX1202	NONE	
#			2007	309	LEICA GRX1200GGPRO	LEIAT504GG	LEIS	
-121.6900	47.6950 2	lsig	2004	212	TRIMBLE 5700	TRM41249.00	SCIT	t0.05
-117.1600	47.2830 2	ltah	2006	200	TRIMBLE NETRS	TRM41249.00	SCIT	t0.05
-117.0022	46.3731 2	lwst	2008	210	TRIMBLE NETR5	TRM55971.00	NONE	s0.05
-124.5892	48.3707 2	mkah	2008	210	TRIMBLE NETRS	TRM41249.00	TZGD	s0.05
-123.6034	48.9826 2	mont	2009	208	TRIMBLE 5700	TRM41249.00	NONE	s0.05
-119.2736	47.1306 2	mslk	2008	005	JPS ODYSSEY	TPSPG_A1+GP	????	s0.05
-121.7970	47.4950 2	nint	2005	347	TRIMBLE NETRS	TRM41249.00	NONE	s0.05
#			2007	316	TRIMBLE NETR5	TRM55971.00	NONE	
-117.0477	48.1779 2	nwpt	2007	147	TRIMBLE NETRS	TRM29659.00	????	s0.05
-124.1595	46.9523 2	ocen	2009	209	TRIMBLE NETR5	TRM55971.00	SCIT	s0.05
-119.1677	46.8226 2	othl	2007	218	TRIMBLE 4700	TRM33429.00+GP	NONE	s0.05
-122.3366	48.4178 2	otis	2001	045	TRIMBLE 4700	TRM22020.00+GP	NONE	s0.05
-122.2040	47.4760 2	oylr	2002	305	TRIMBLE 5700	TRM41249.00	NONE	s0.05
#			2008	212	TRIMBLE NETR3	TRM55971.00	TZGD	
-122.5975	45.5887 2	pdxa	2007	032	TRIMBLE 5700	TRM41249.00	TZGD	s0.05
-122.5813	45.5665 2	pdxb	2007	125	JPS ODYSSEY	TPSCR3_GGD	CONE	s0.05
-122.2820	47.8980 2	pfld	2005	091	TRIMBLE NETRS	TRM25659.00	SCIT	t0.05
#			2009	016	TRIMBLE NETR3	TRM55971.00	SCIT	
-123.4148	48.1015 2	pncl	2006	245	TRIMBLE NETRS	TRM41249.00	NONE	s0.05
-118.8418	45.6889 2	pndl	2007	032	TRIMBLE NETRS	TRM41249.00	????	s0.05
-117.1929	46.7339 2	plmn	2007	304	TRIMBLE NETRS	TRM41249.00	????	s0.05
#-122.6660	47.7550 2	poul	2003	071	-GEOTRACER-	-GEOTRACER-	NONE	s0.05
-122.6090	47.3910 2	prdy	2003	240	LEICA RS500	LEIAT504	LEIS	t0.05
#			2007	199	LEICA GRX1200GGPRO	LEIAT504	LEIS	
#			2007	279	LEICA GRX1200GGPRO	LEIAX1202	NONE	
#			2007	310	LEICA GRX1200GGPRO	LEIAT504GG	LEIS	
-119.7906	46.2157 2	prsr	2007	218	TRIMBLE 4000SSi	TRM33429.00+GP	NONE	s0.05
#			2008	126	TRIMBLE 4700	TRM33429.00+GP	NONE	
-121.0891	47.7459 2	qmar	2007	040	TRIMBLE NETRS	TRM41249.00	TZGD	s0.05
#			2008	268	TRIMBLE NETR3	TRM55971	TZGD	
-119.2776	46.2774 2	rich	2008	100	TRIMBLE NETR5	TRM55971.00	NONE	s0.05
-120.7922	46.7495 2	rmrk	2008	236	LEICA GRX1200	LEIAT504	LEIS	s0.05
-123.7301	46.6840 2	rymd	2007	365	JPS ODYSSEY	TPSCR.G3	TPSH	s0.05
-122.0323	47.5399 2	samm	2008	310	TPS NETG3	TPSCR.G3	TPSH	s0.05
-121.8837	45.6943 2	skma	2006	087	TRIMBLE NETRS	TRM41249.00	TZGD	s0.05
			2008	192	JPS ODYSSEY	TPSCR.G3	TPSH	
-122.3440	47.5250 2	smai	2002	210	TRIMBLE 4700	TRM29659.00	UNAV	s0.05
#			2008	204	TRIMBLE NETR3	TRM55971.00	NONE	
-121.3880	47.3913 2	snoq	2007	319	LEICA GRX1200	LEIAT504	LEIS	t0.05
-117.5500	47.6000 2	spkn	2006	125	TRIMBLE NETRS	TRM41249.00	SCIT	t0.05
-117.2712	47.6774 2	spkv	2007	319	SOK GSR2700 RS	SOK702	????	s0.05
-117.9600	47.3080 2	sprg	2006	258	TRIMBLE 5700	TRM41249.00	SCIT	t0.05
-122.3180	47.6830 2	ssho	2003	051	TRIMBLE 4700	TRM29659.00	UNAV	s0.05
#			2008	284	TRIMBLE NETRS	TRM29659.00	UNAV	
-122.4713	47.2290 2	taco	2008	150	TPS NETG3	TPSCR.G3	TPSH	s0.05
-121.1291	45.6074 2	tdls	2007	353	LEICA GRX1200	LEIAT504	LEIS	s0.05
-122.2880	47.1060 2	thun	2003	205	LEICA RS500	LEIAT504	LEIS	t0.05
#			2007	185	LEICA RS500	LEIAT504GG	LEIS	
#			2007	205	LEICA GRX1200GGPRO	LEIAT504GG	LEIS	
-122.9112	46.9843 2	tumw	2007	134	TRIMBLE NETR5	TRM55971.00	TZGD	s0.05
-122.6670	47.7548 2	ufda	2007	279	TRIMBLE 5700	TRM41249.00	????	s0.05
#			2008	166	TPS NETG3	TPSCR.G3	TPSH	
-122.5161	45.6176 2	vcwa	2008	008	JPS ODYSSEY	TPSLEGANT2	NONE	s0.05
			2008	210	JPS LEGACY	TPSLEGANT2	NONE	
-122.3370	48.4178 2	vern	2007	148	LEICA GRX1200	LEIAX1202	NONE	s0.05
-119.7319	46.6368 2	vrnt	2007	279	LEICA GRX1200	LEIAT504	LEIS	s0.05
-118.3412	46.0669 2	wala	2007	125	LEICA GRX1200	LEIAT504	LEIS	s0.05
-122.2046	47.9769 2	weez	2008	285	TRIMBLE NETR3	TRM55971.00	NONE?	s0.05
-120.1727	48.4632 2	wnth	2007	218	JPS ODYSSEY	TPSPG_A1+GP	????	s0.05
#		yaki	2006	212	*same as yawa* (*high rate)*			

-120.5051	46.6049	2	yawa	2001	044	TRIMBLE 4000SSi	TRM22020.00+GP	NONE	s0.05
#				2008	238	TRIMBLE NETR5	TRM55971.00	NONE	
-122.6050	46.9490	2	yelm	2003	261	LEICA RS500	LEIAT504	LEIS	t0.05
#				2007	185	LEICA GRX1200GGPRO	LEIAX1202	NONE	
#				2007	309	LEICA GRX1200GGPRO	LEIAT504GG	LEIS	

ORGN:

ongitude	*latitude*	*col*	*site*	*yyyy*	*ddd*	*receiver(s)*	*antenna(s)*	*dome*	*symb*
-122.6701	42.1807	2	ashl	2007	093	LEICA GRX1200PRO	LEIAT504	LEIS	s0.05
-121.3149	44.0572	2	bend	2005	312	LEICA GRX1200PRO	LEIAT504	LEIS	s0.05
-122.7974	45.4855	2	bton	2003	131	ASHTECH Z-X113	ASH700718B	NONE	s0.05
-121.7858	43.2245	2	chem	2008	356	LEICA GRX1200GGPRO	LEIAT504GG	LEIS	s0.05
-122.9773	42.3767	2	ctpt	2007	075	LEICA GRX1200PRO	LEIAT504	LEIS	s0.05
-123.3416	43.2110	2	dcso	2005	020	TRIMBLE NETRS	TRM41249.00	TZGD	s0.05
-117.2878	45.4324	2	entr	2008	364	LEICA GRX1200GGPRO	LEIAT504GG	LEIS	s0.05
-120.7874	45.3644	2	gras	2009	302	LEICA GRX1200GGPRO	LEIAT504GG	LEIS	s0.05
-123.2974	42.4345	2	gtps	2007	093	LEICA GRX1200PRO	LEIAT504	LEIS	s0.05
-123.1091	44.3776	2	hlsy	2007	060	TRIMBLE NETRS	TRM41249.00	NONE	s0.05
-121.7838	42.2243	2	kfrc	2008	356	TRIMBLE NETRS	TRM41249.00	TZGD	s0.05
-121.5059	43.6643	2	la_p	2007	136	LEICA GRX1200PRO	LEIAT504	NONE	s0.05
-123.1066	44.6343	2	lcso	2005	313	TRIMBLE NETRS	TRM41249.00	NONE	s0.05
-124.1076	43.9835	2	lflo	2006	215	LEICA GRX1200PRO	LEIAT504	LEIS	c0.04
-123.0901	44.0512	2	lpsb	2002	182	LEICA RS500	LEIAT504	LEIS	s0.05
-122.9557	44.9739	2	mcso	2002	270	LEICA RS500	LEIAT504	LEIS	c0.04
#				2007	198	LEICA GRX1200PRO	LEIAT504	LEIS	
-121.1301	44.6640	2	mdrs	2009	272	LEICA GRX1200GGPRO	LEIAT504GG	LEIS	s0.05
-122.9755	45.3001	2	nwbg	2005	093	TRIMBLE NETRS	TRM41249.00	TZGD	s0.05
-122.4440	43.7380	2	oakr	2009	302	LEICA GRX1200GGPRO	LEIAT504GG	LEIS	s0.05
-123.0981	44.0658	2	obec	2002	183	TRIMBLE 7400MSI	TRM22020.00+GP	NONE	s0.05
#				2006	139	TRIMBLE NETRS	TRM41249.00	NONE	
-124.0743	44.5145	2	onab	2008	235	LEICA GRX1200GGPRO	LEIAT504GG	LEIS	s0.05
-121.5640	45.5184	2	pkdl	2008	356	LEICA GRX1200GGPRO	LEIAT504GG	LEIS	s0.05
-123.3275	44.9191	2	pcso	2007	001	TRIMBLE 5700	TRM41249.00	TZGD	s0.05
-120.8464	44.3128	2	pnvl	2009	289	LEICA GRX1200GGPRO	LEIAT504GG	LEIS	s0.05
-122.4895	42.7459	2	pspt	2007	094	LEICA GRX1200PRO	LEIAT504	LEIS	s0.05
-124.1074	43.7009	2	reed	2009	220	LEICA GRX1200GGPRO	LEIAT504GG	LEIS	s0.05
-121.148	44.2597	2	rmdb	2005	320	LEICA GRX1200PRO	TRM29659.00	NONE	
-123.9222	45.9842	2	seas	2008	237	LEICA GRX1200GGPRO	LEIAT504GG	LEIS	s0.05
-122.8208	44.8307	2	stay	2005	001	LEICA RS500	LEIAT504	LEIS	s0.05
#				2007	198	LEICA GRX1200PRO	LEIAT504	LEIS	
-122.7342	44.3962	2	sthm	2007	100	TRIMBLE NETRS	TRM41249.00	????	s0.05
-123.8305	45.4548	2	till	2008	237	LEICA GRX1200PRO	LEIAT504GG	LEIS	s0.05
-122.9906	45.5316	2	waco	2002	121	LEICA RS500	LEIAT503	LEIC	s0.05
-121.2733	45.2238	2	wamc	2009	091	LEICA GRX1200GGPRO	LEIAT504GG	LEIC	s0.05
-122.8700	45.1708	2	wdbn	2002	117	LEICA RS500	LEIAT504	LEIS	c0.04
#				2007	006	LEICA GRX1200PRO	LEIAT504	LEIS	
-121.5972	45.1312	2	wmsg	2009	265	LEICA GRX1200GGPRO	LEIAT504GG	LEIC	s0.05
-123.2972	43.6340	2	yonc	2009	215	LEICA GRX1200GGPRO	LEIAT504GG	LEIS	s0.05

RGPS:

ongitude	*latitude*	*col*	*site*	*yyyy*	*ddd*	*receiver(s)*	*antenna(s)*	*dome*	*symb*
-117.1350	46.1326	2	anat	2008	260	LEICA GRX1200PRO	LEIAT504	NONE	s0.05
-120.2847	47.4045	3	axis	2008	248	LEICA GRX1200GGPRO	LEIAX1202GG	NONE	s0.05
-121.8259	47.5264	3	ch2m	2007	025	LEICA GRX1200PRO	LEIAX1202	NONE	s0.05
-117.4201	47.6659	3	dea1	2006	219	LEICA GRX1200PRO	LEIAX1202	NONE	s0.05
-122.4796	48.7529	3	dea2	2006	219	LEICA GRX1200PRO	LEIAX1202	NONE	s0.05
-122.6723	45.5070	3	dea3	2006	278	LEICA GRX1200PRO	LEIAX1202	NONE	s0.05
-122.5689	47.8035	3	esm1	2006	219	LEICA GRX1200PRO	LEIAX1202	NONE	s0.05
-123.0177	48.5352	3	frid	2007	010	LEICA GRX1200PRO	LEIAX1202	NONE	s0.05
-122.1270	48.1946	3	grp4	2006	219	LEICA GRX1200PRO	LEIAX1202	NONE	s0.05
-122.9207	47.0193	3	hgp1	2007	218	LEICA GRX1200PRO	LEIAX1202	NONE	s0.05
-116.9295	47.7144	3	inw1	2006	219	LEICA GRX1200PRO	LEIAX1202	NONE	s0.05
-117.0296	48.1880	3	inw2	2007	287	LEICA GRX1200PRO	LEIAX1202	NONE	s0.05
-122.3207	47.8028	3	krmt	2006	219	LEICA GRX1200PRO	LEIAX1202	NONE	s0.05
-122.2078	47.9818	3	per1	2006	219	LEICA GRX1200PRO	LEIAX1202	NONE	s0.05
-117.6314	46.4800	2	pome	2008	268	LEICA GRX1200PRO	LEIAT504	LEIS	s0.05
-122.3199	47.4514	3	psea	2006	219	LEICA GRX1200PRO	LEIAX1202	NONE	s0.05
-119.6094	45.9390	3	ptsn	2008	284	LEICA GRX1200PRO	LEIAT504	NONE	s0.05
-122.2386	48.5039	3	sedk	2007	010	LEICA GRX1200PRO	LEIAX1202	NONE	s0.05
-124.1799	40.7919	3	shn1	2008	238	LEICA GRX1200PRO	LEIAX1202	NONE	s0.05
-123.1017	48.0823	3	sqim	2007	137	LEICA GRX1200PRO	LEIAX1202	NONE	s0.05
-117.1758	46.7147	3	tay1	2006	219	LEICA GRX1200PRO	LEIAX1202	NONE	s0.05

-122.1872	47.7087	3	tri1	2006	219	LEICA GRX1200PRO	LEIAX1202	NONE	s0.05