



CSRC Director's Report



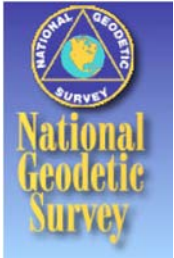
Yehuda Bock

Scripps Orbit and Permanent Array Center (SOPAC)

California Spatial Reference Center (CSRC)

Scripps Institution of Oceanography

La Jolla



CSRC Coordinating Council Fall Meeting

La Jolla

October 17, 2008

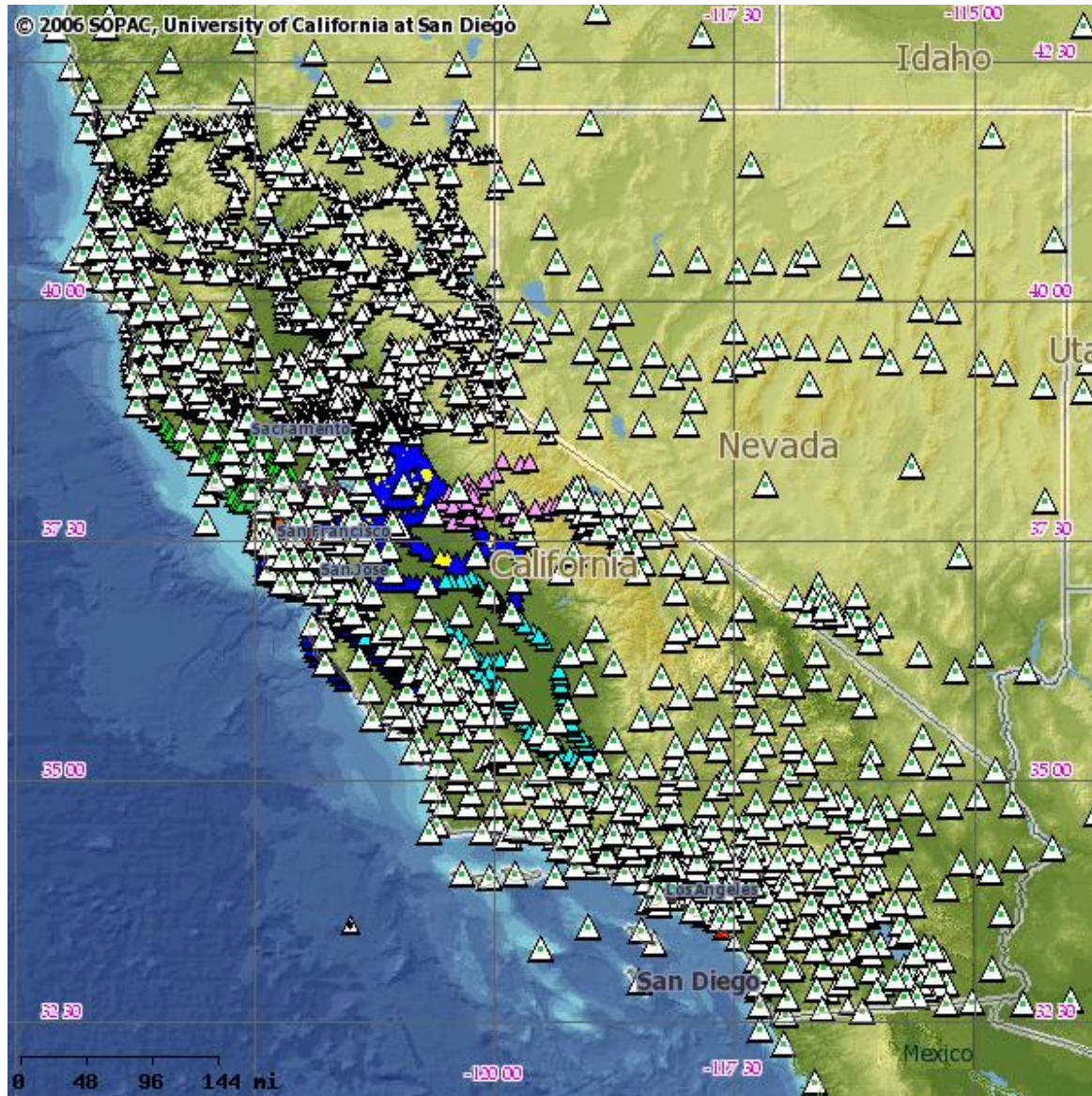
CSRC Mandate

- Establish and maintain the California Spatial Reference System - CSRS.
- Provide the necessary geodetic services to ensure the availability of accurate, consistent, and timely spatial referencing data.
- Monitor temporal changes in geodetic coordinates due to tectonic motion, earthquakes, volcanic deformation and land subsidence.
- Provide access to the legal spatial reference system for California.



Master Plan

California Spatial Reference Network



SOPAC/CSRC Staff: Onsite



- Director: Yehuda Bock
- Coordinator: Maria Turingan
- Analysis: Peng Fang, Linette Prawirodirdjo
- Web Administrator and Programmer: Paul Jamason
- System Administrator: George Wadsworth
- Programmer Analyst: Mindy Squibb
- GIS Programmer: Ian MacLeod
- SCIGN and CRTN Field Support Staff: Glen Offield
- PGM Technician: Ryan Sapinoso

CSRC Consultants



- CSRC Executive Manager: John Canas, PLS
- Geodetic Consultant: Cecilia Whitaker, PLS

CSRC Contractors



- Northern San Joaquin Valley Project 2006:
Johnson-Frank & Associates (Roger & Alan Frank)
- Southern California Height Mod Project 2006:
PSOMAS (Kari Launen)
- Central Coast Height Mod Project 2007:
Towill (John Bloodgood, Trevor Greening)
- On-Call Contractors (4 contract areas), 2007-
(Towill, PSOMAS, RBF, Penfield Smith)

CSRC Documents for this Report



- Annual Report to NOAA/NGS (2007-2008)
- 2008-2009 Proposal to NOAA/NGS
- Financial Report through August 2008
(presented by Maria Turingan)

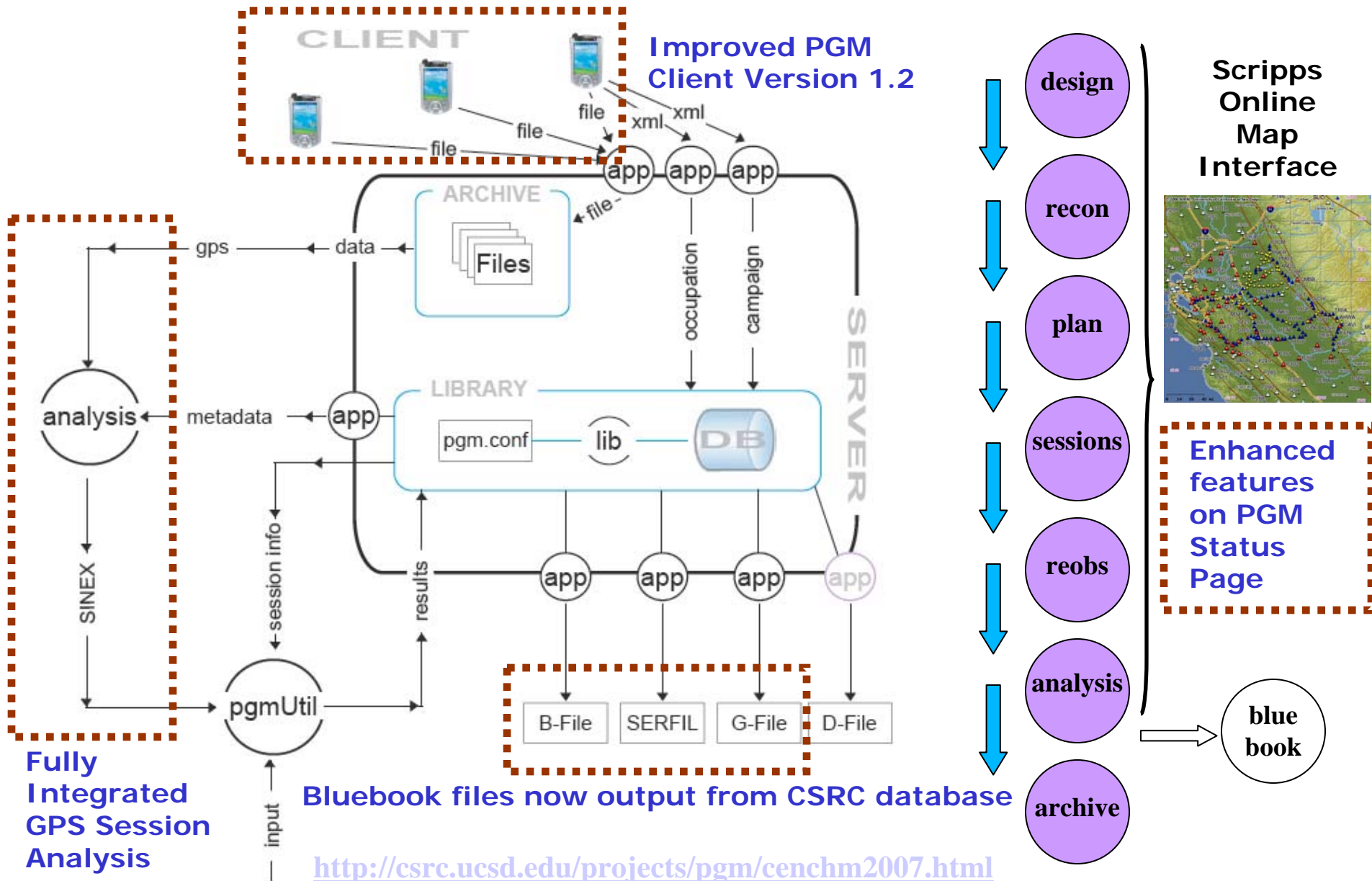
Highlights

- Completion of PGM development
- Central Coast Project
- SOPAC Reanalysis of Coordinate Time Series
- New Coordinate Epoch (2009.0) with errors at 95% confidence level
- CRTN Proposal version 5.0

See 2007-2008 CSRC Final Report to NGS:

http://csrc.ucsd.edu/input/csrc/reports/csrc200708_finalReport.pdf

Completion of PGM Development



PGM Client Version 1.2

- PGM Client 1.2 has been released:

http://troy.ucsd.edu/ubbcgi/ultimatebb.cgi?ubb=get_topic;f=35;t=000005

- Download site is:

<ftp://geopub.ucsd.edu/pub/public/PGM/2008/>

- Four versions:

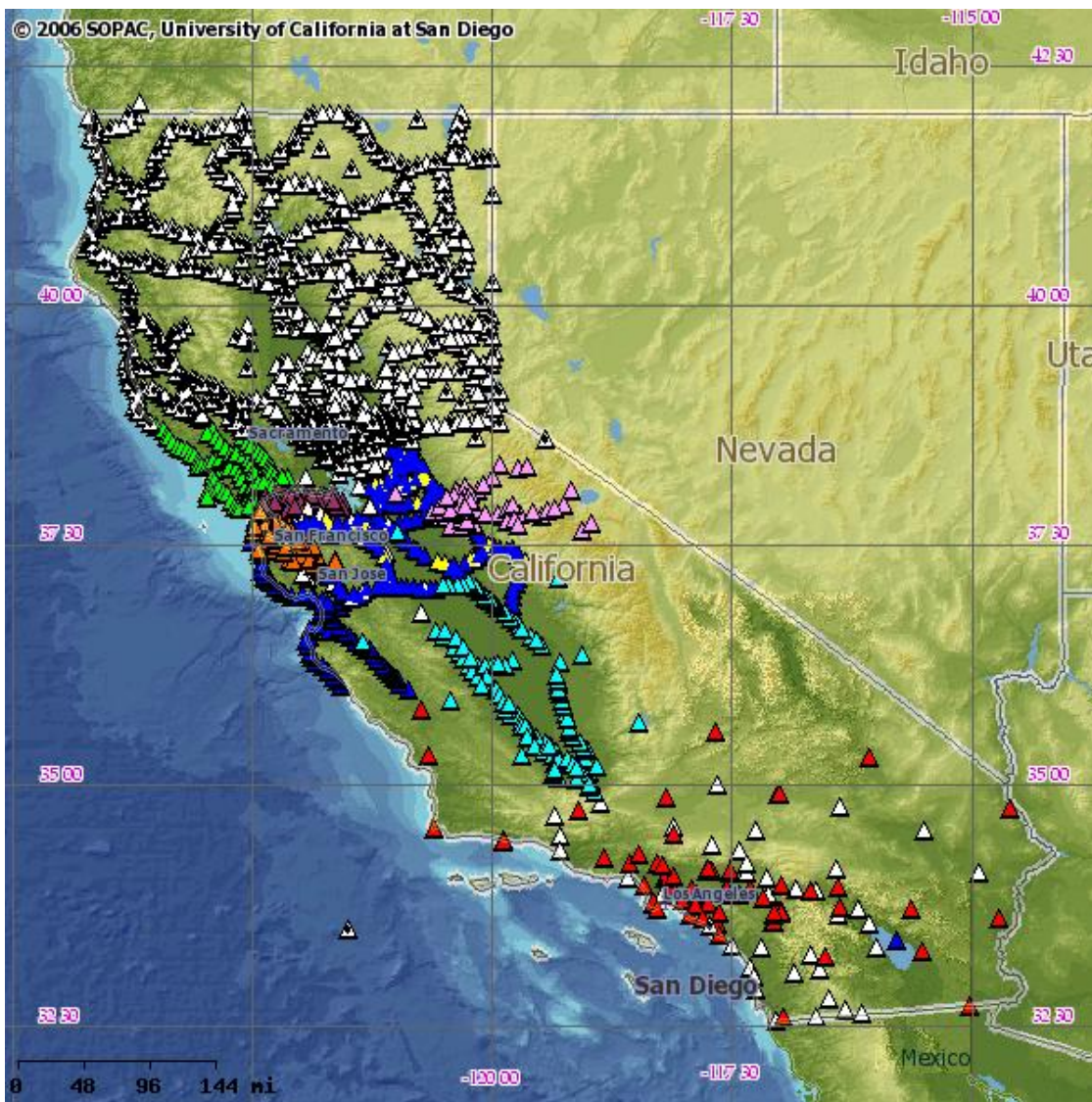
PGMClient-MM-20080428-Installer.exe - manager version for desktop/laptop

PGMClient-TM-20080428-Installer.exe - technician version for desktop/laptop

PGMClient-PDA-MM-20080428.CAB - manager version for PDA

PGMClient-PDA-TM-20080428.CAB - technician version for PDA

CSRC Field Surveys

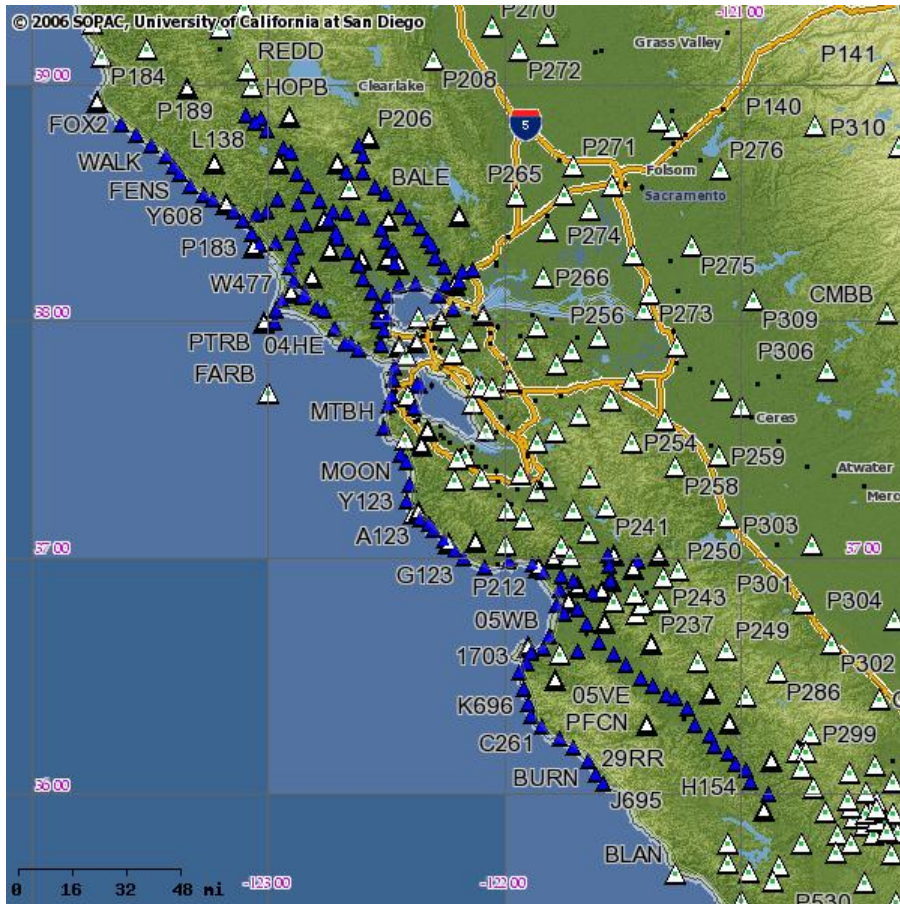


Goals:

- Height Modernization
- CSRS Densification
(CSRC Master Plan)
- Subsidence
- Co-/post-seismic deformation
- PGM demonstration
- CRTN demonstration

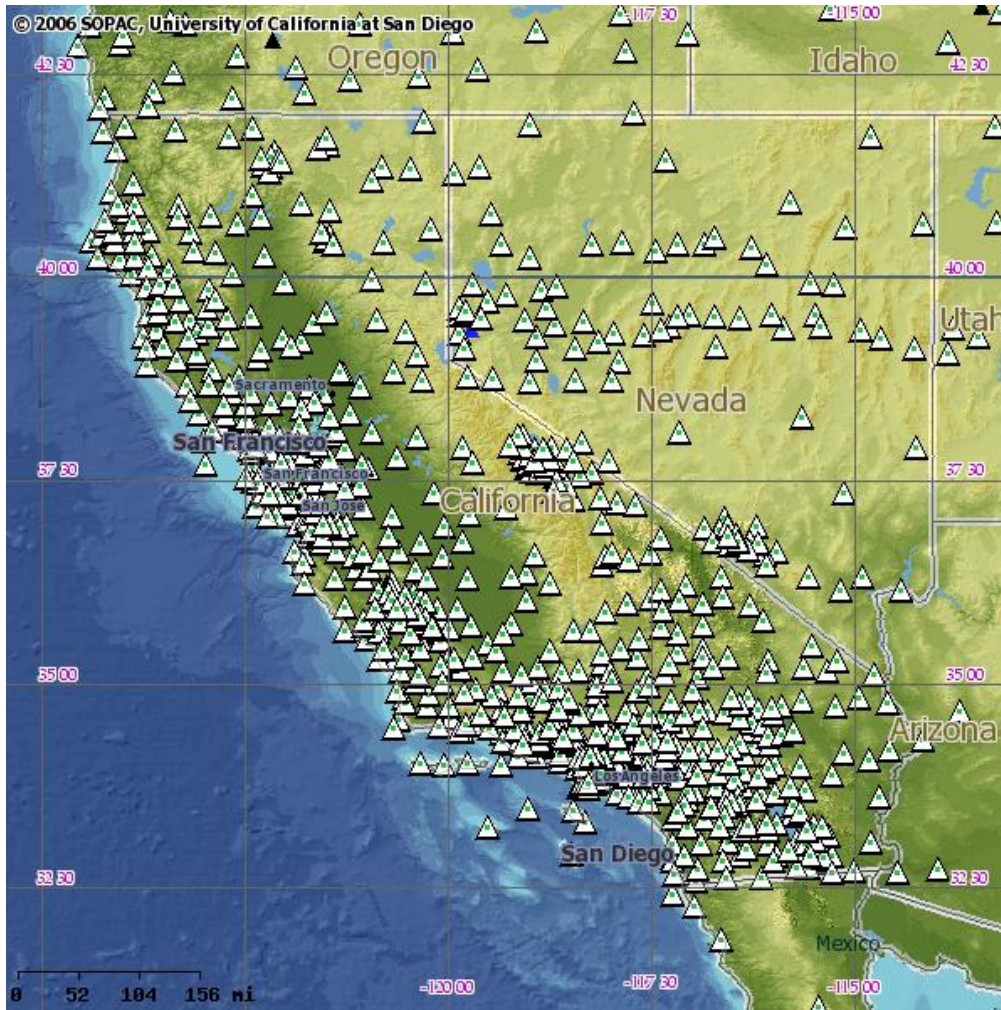


Status of Central Coast Height Mod Project 2007



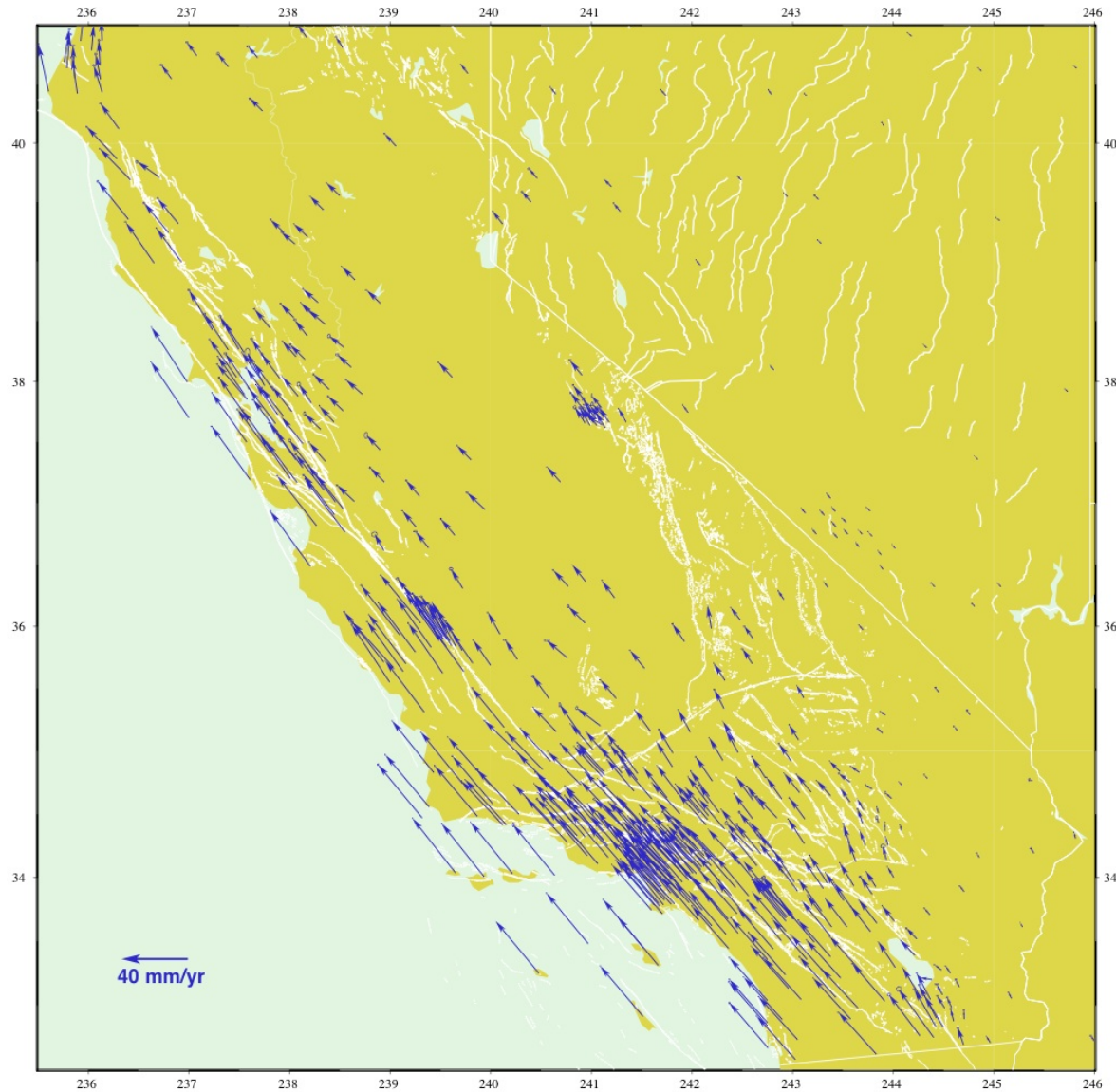
- CSRC staff (PGM)
- Towill, Inc., Contractor
- M. Ikehara (Proj. Manager)
- Contribution by Steve Sarsfield & colleagues
- Observations and network adjustments complete
- ADJUST checks of bluebook files almost completed
- Preparing Final Report
- Will be posted on CSRC Website and submit to NGS

New CSRS Coordinate Epoch (2009.0)

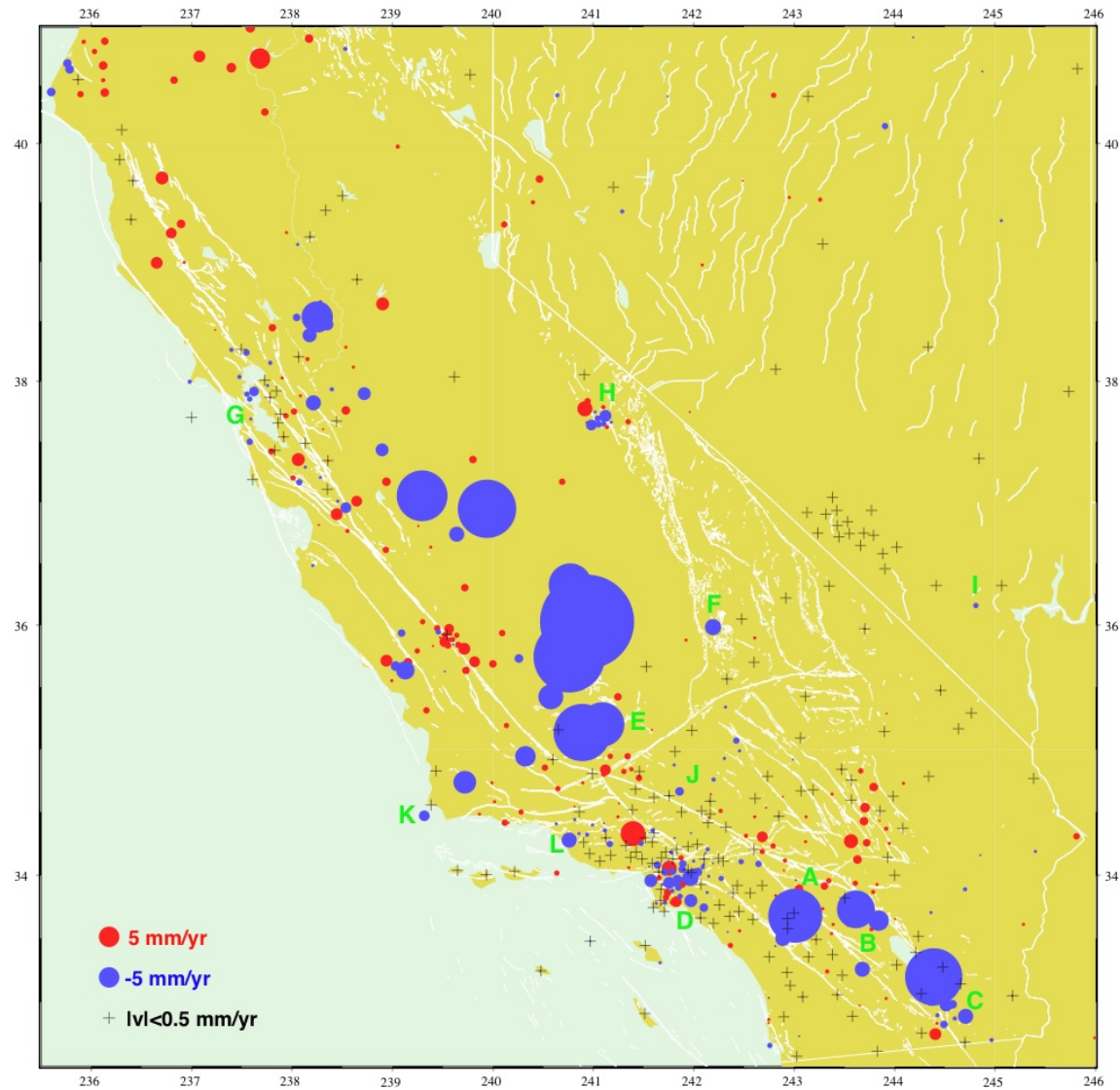


- 688 (551 @epoch 2007.0) CGPS stations
- ITRF2005 (ITRF2000) coordinates & velocities
- NAD83 (NSRS2007) coordinates & velocities
- Uncertainties provided at 95% confidence level
- To be published in early November

Horizontal Velocities: 2008 SOPAC Re-Analysis



Vertical Motion: 2008 SOPAC Re-Analysis



SECTOR Coordinates Utility

SECTOR: Scripps Epoch Coordinate Tool and Online Resource

Results: Coordinates for reference epoch 2004 117 (2004.3197)
Use the links for site information, maps, time series and model parameters

Time series problems? Try:
[Non-applet plots](#), or download the [Sun Java plug-in](#) (and restart your browser)

Site	X (m)	Y (m)	Z (m)	Latitude (deg.)	Longitude (deg.)	Height (m)	Time Series	Model terms
	ITRF 2000			WGS84				
pin1 (map)	-2369510.6094 +/- 0.0028	-4761206.9772 +/- 0.0044	3511396.2150 +/- 0.0035	33.61215600 +/- 0.0021	-116.45815941 +/- 0.0021	1256.1268 +/- 0.0056	view	terms
pin2 (map)	-2369466.6212 +/- 0.0032	-4761231.5529 +/- 0.0046	3511396.7305 +/- 0.0037	33.61214788 +/- 0.0022	-116.45761718 +/- 0.0025	1258.4135 +/- 0.0058	view	terms

Get Epoch-Specific Coordinates:

[**option:** reload site list below using only sites in [array](#):] [array maps](#)

Select [site code](#): Enter space-separated sites: [*choose one site option*]

Select year: Enter [day-of-year](#): Select filter type:

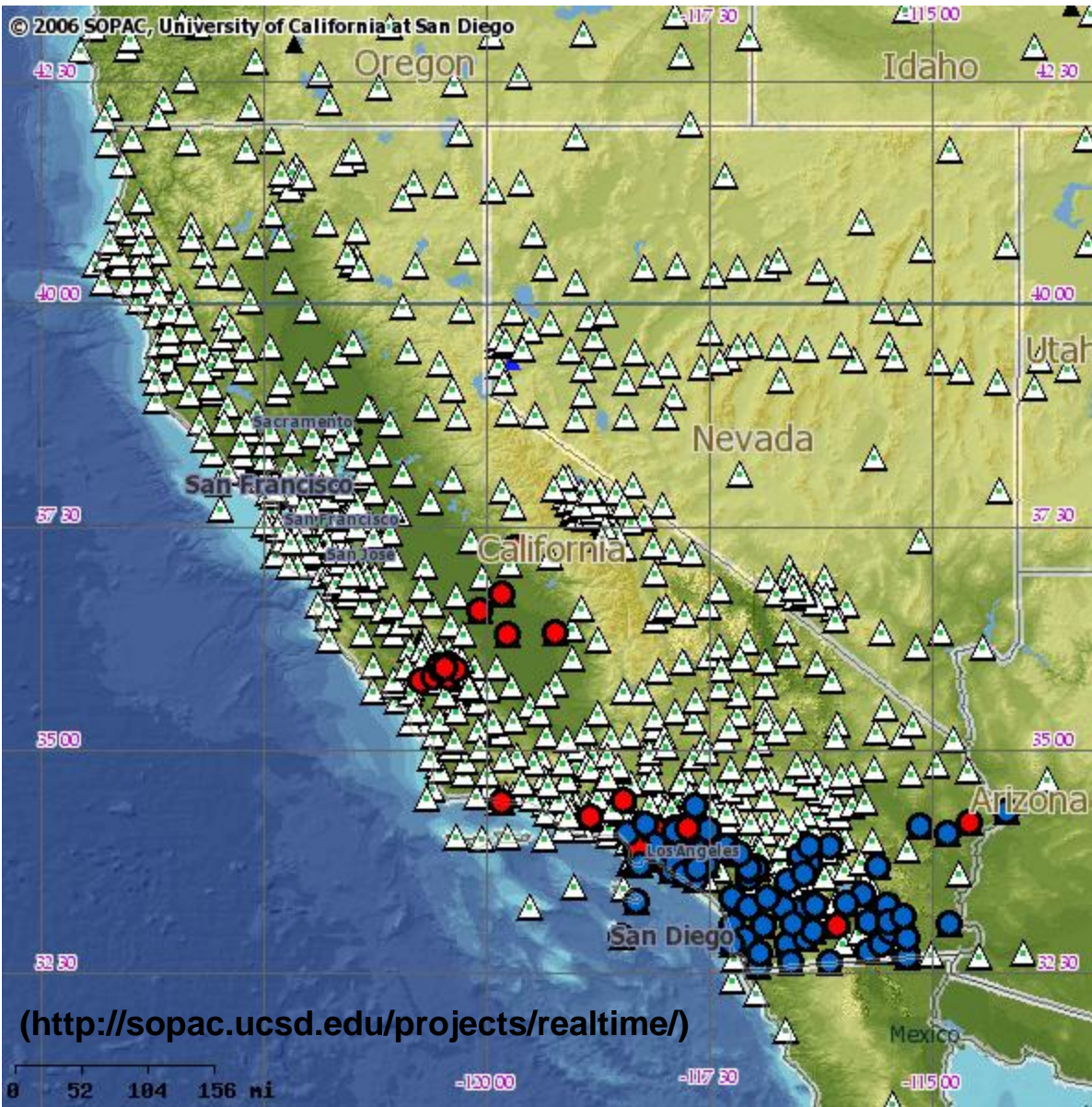
[**note:** filtered coordinates are available for western North America sites only]

Site coordinates resources:

- Get coordinates for all sites at any epoch, via e-mail
- Coordinates from the most recent SOPAC weekly globk run
- ITRF2000 IGS core site coordinates
- Help with this utility
- SCOUT - process your own RINEX data
- Site coordinate time series

California Real Time Network (CRTN)

- Test Bed for Early Warning Systems
- GPS Meteorology Applications (e.g., flood control)
- Real-Time Positioning & Navigation

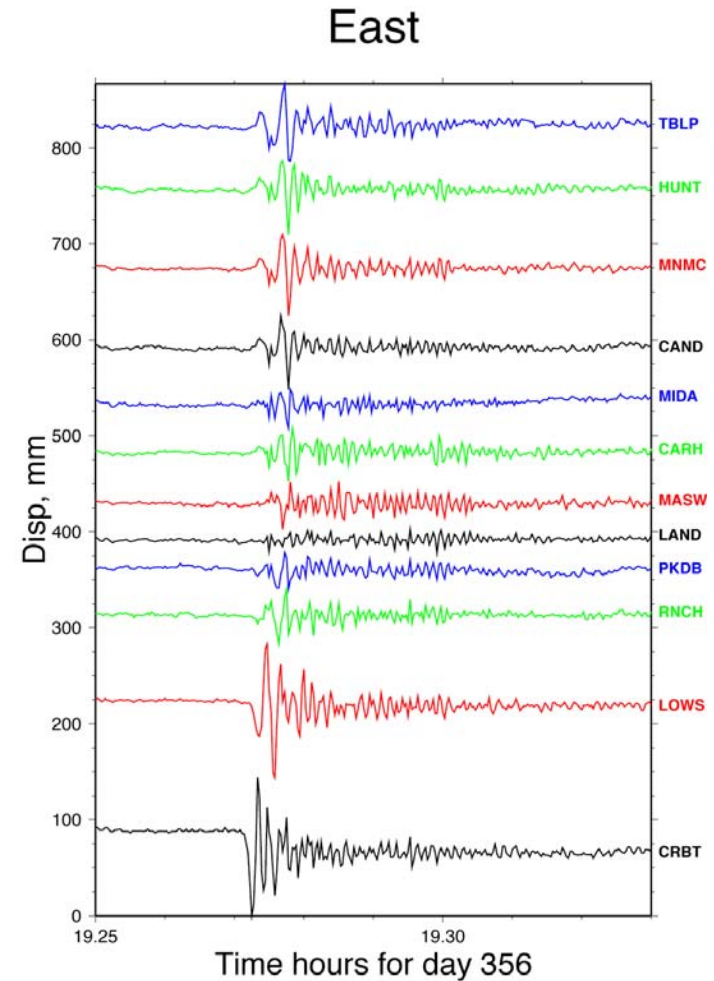


Test Bed for Early Warning Systems

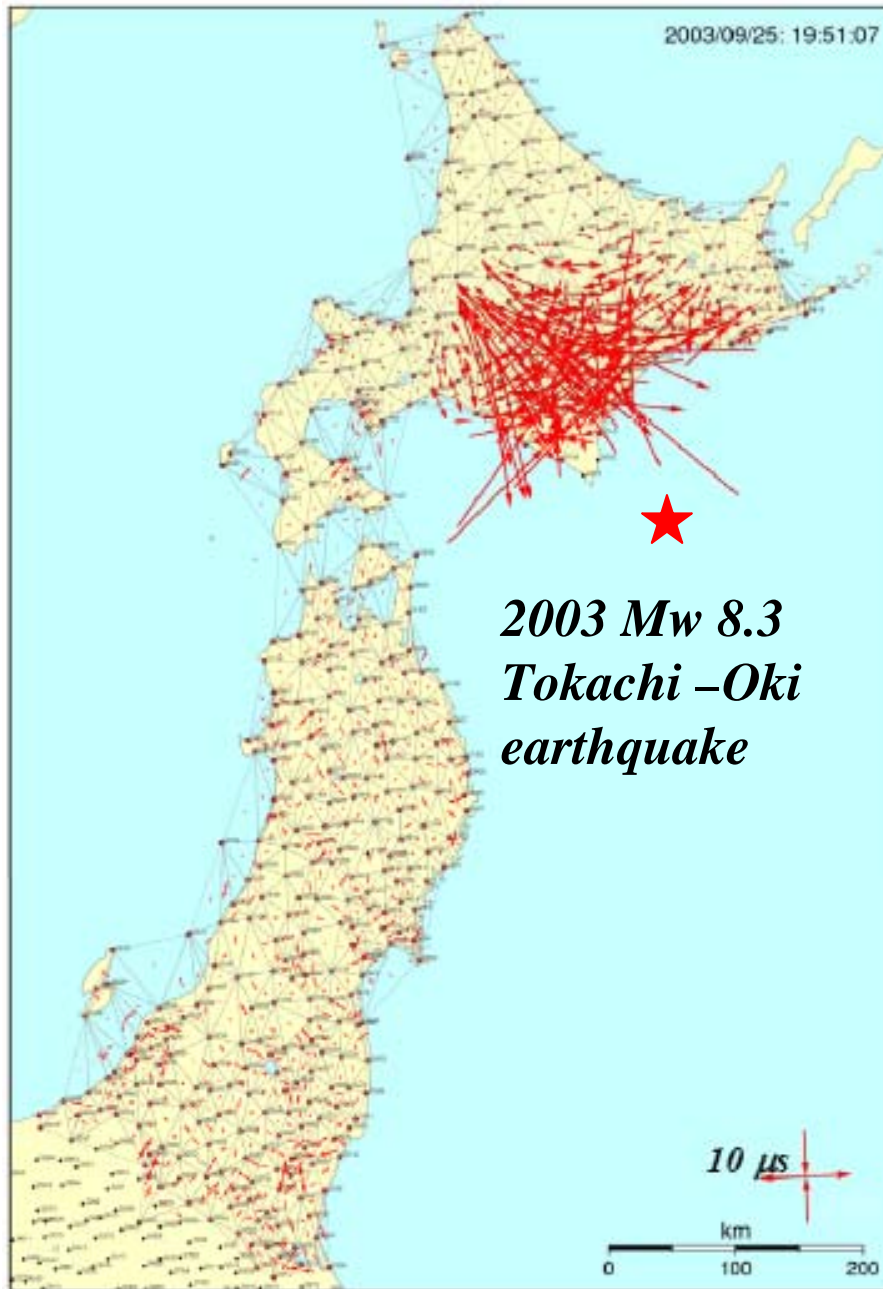
- Earthquake Geodesy (coseismic motions)
- GPS Seismology (dynamic motions)
- Volcano monitoring
- Landslide monitoring
- Tsunami warning
- Structural monitoring
- Flood Control



*LA freeway after 1994
Northridge earthquake*



*Displacement waveforms,
2004 Parkfield event*



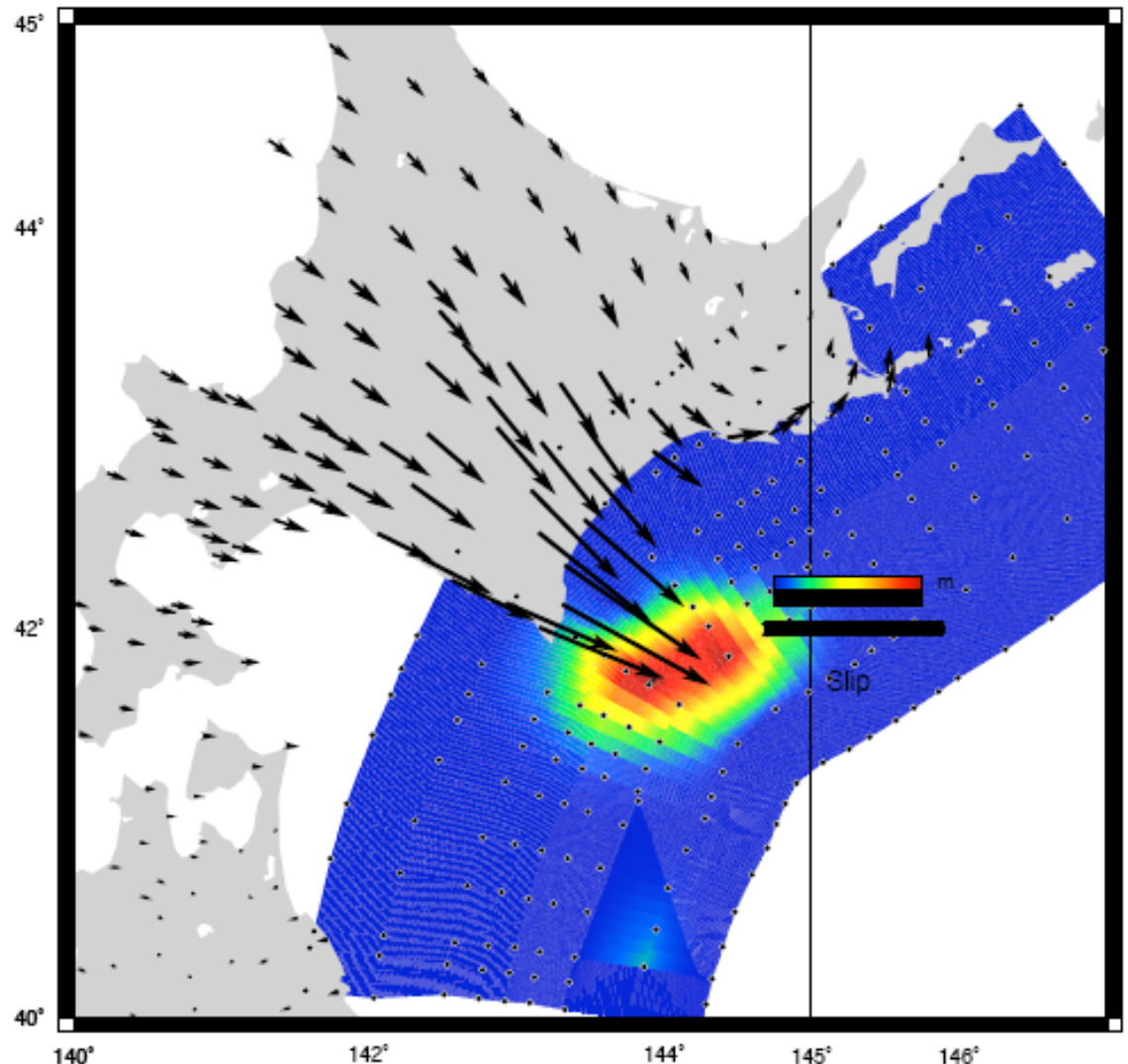
Japan's Geophysical Survey Institute (GSI) operates nationwide 1200-station continuous GPS network (GEONET), with ~ 20 km spacing. Of these, 1156 stations are streaming @ 1 Hz to a central facility in Tsukuba City.

Tokachi-Oki Earthquake Fault Model

Coseismic inversion
using DEFNODE with
922 GPS stations from
GEONET streaming at 1-
Hz and 90 slip vector
azimuths from previous
earthquakes

Maximum slip is ~6 m
near epicenter of
earthquake, Mw 8.1

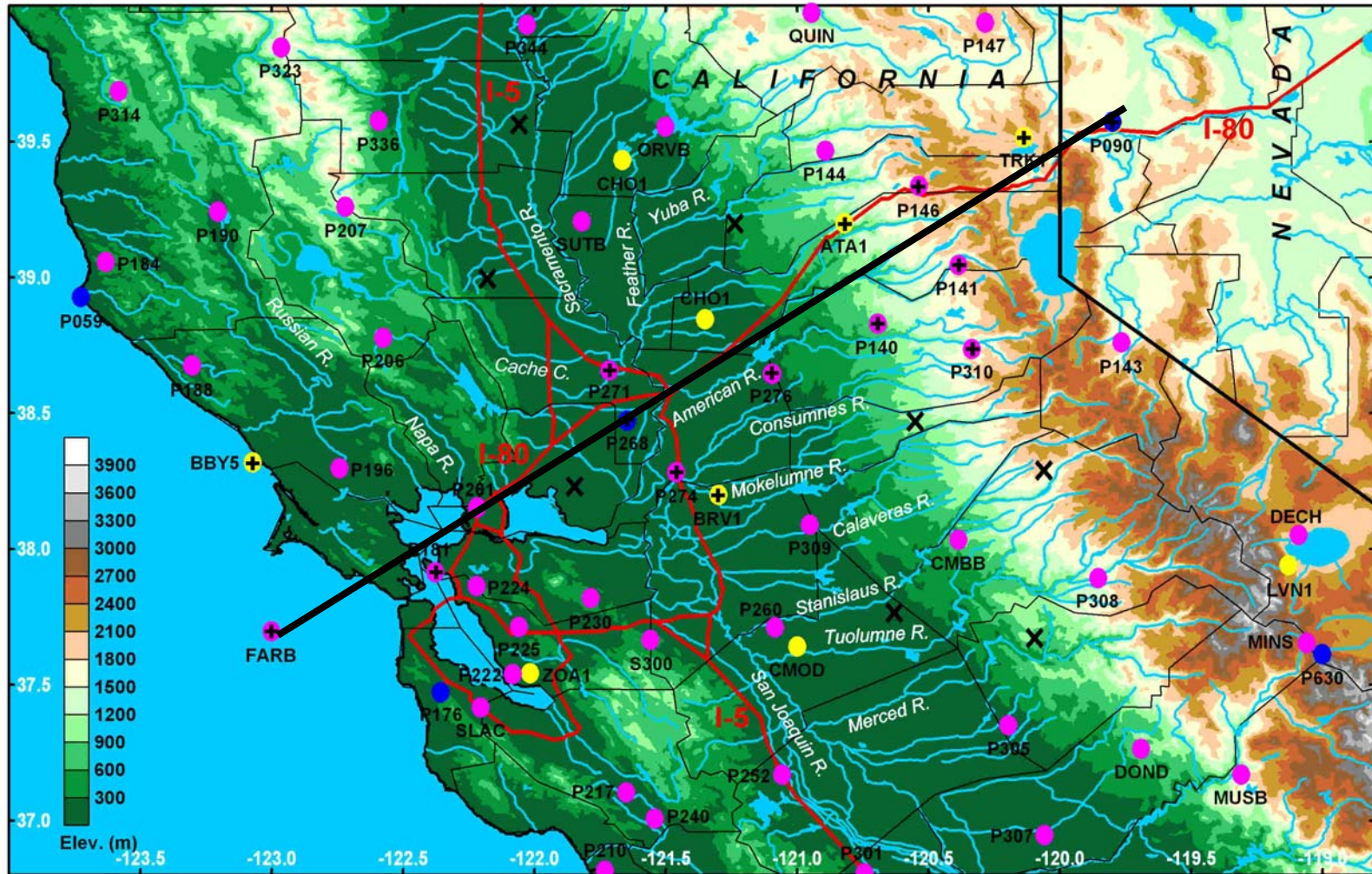
Full fault model
generation in 15 minutes



Prepared by Brendan Crowell



GPS Met Applications: DWR/NOAA/SIO Project, Integrated Precipitable Water Profile for Flood Control



Yellow dots = existing or planned GPS-met sites

Blue dots = backbone sites where UNAVCO has (P059, P268) or plans (P090, P176, P630) to install met packages

Pink dots = candidate PBO/CSRC-CRTN GPS sites to be upgraded to GPS-met sites (+ indicates YR1 considerations)

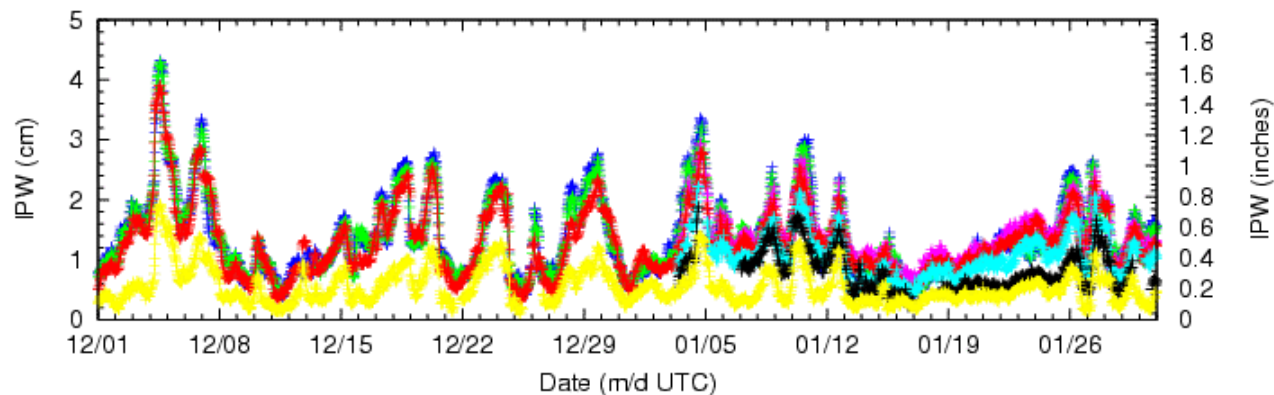
Alta (ATA1) is currently a part-year HMT GPS-met site. Making it full time would require purchasing a GPS receiver.

X's = Gaps in network that would require new receivers

December 01, 2007 to January 31, 2008 (07335 to 08031)

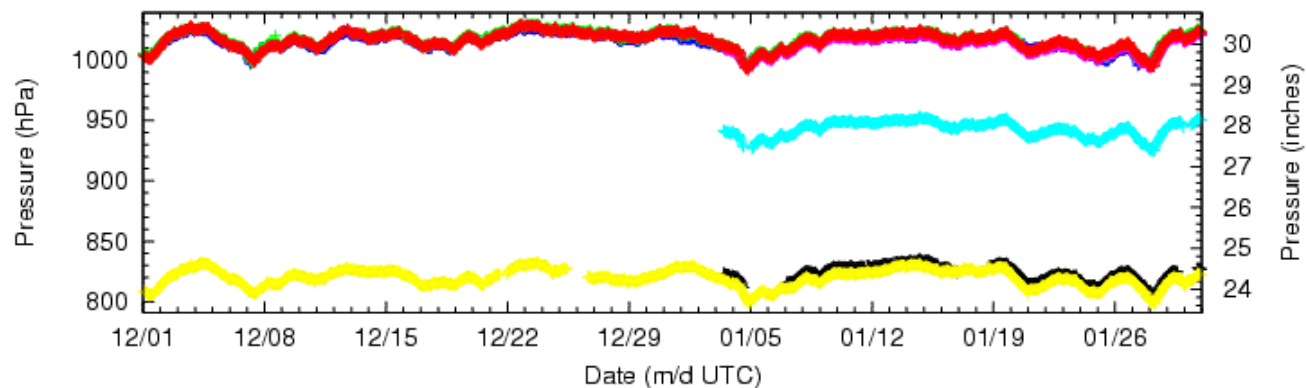
Pigeon Point, CA (PPT5)
Fremont WAAS, CA (ZOA1)
Sloughhouse, CA (SHS3)
Lincoln, CA (LNC1)
Colfax, CA (CFC3)
Big Bend, CA (BBD1)
Truckee, CA (TRK1)

IPW



PPT5 (median)	—	LNC1 (median)	—	TRK1 (median)	—
ZOA1 (median)	—	CFC3 (median)	—		
SHS3 (median)	—	BBD1 (median)	—		

Pressure



PPT5 (median)	—	LNC1 (median)	—	TRK1 (median)	—
ZOA1 (median)	—	CFC3 (median)	—		
SHS3 (median)	—	BBD1 (median)	—		

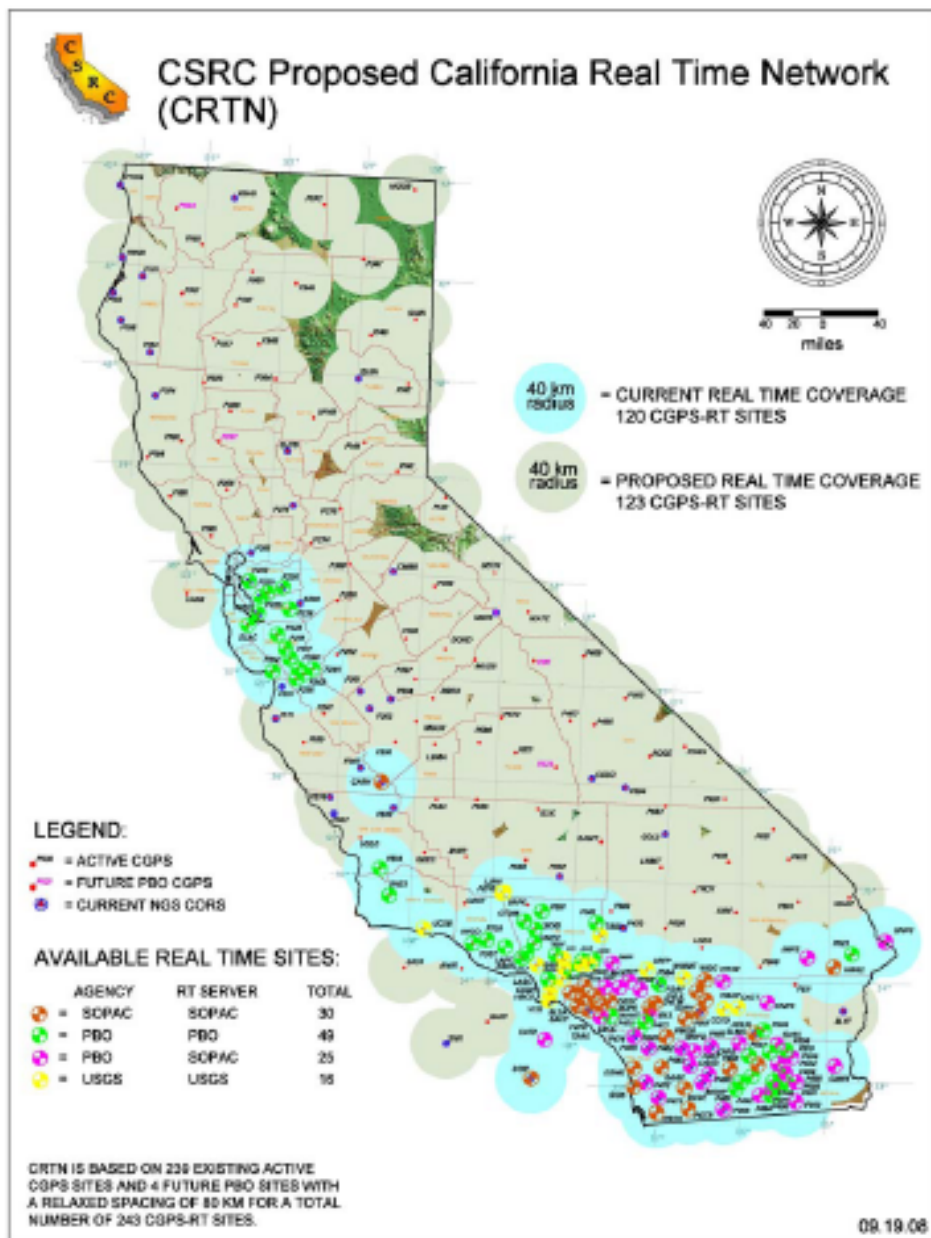


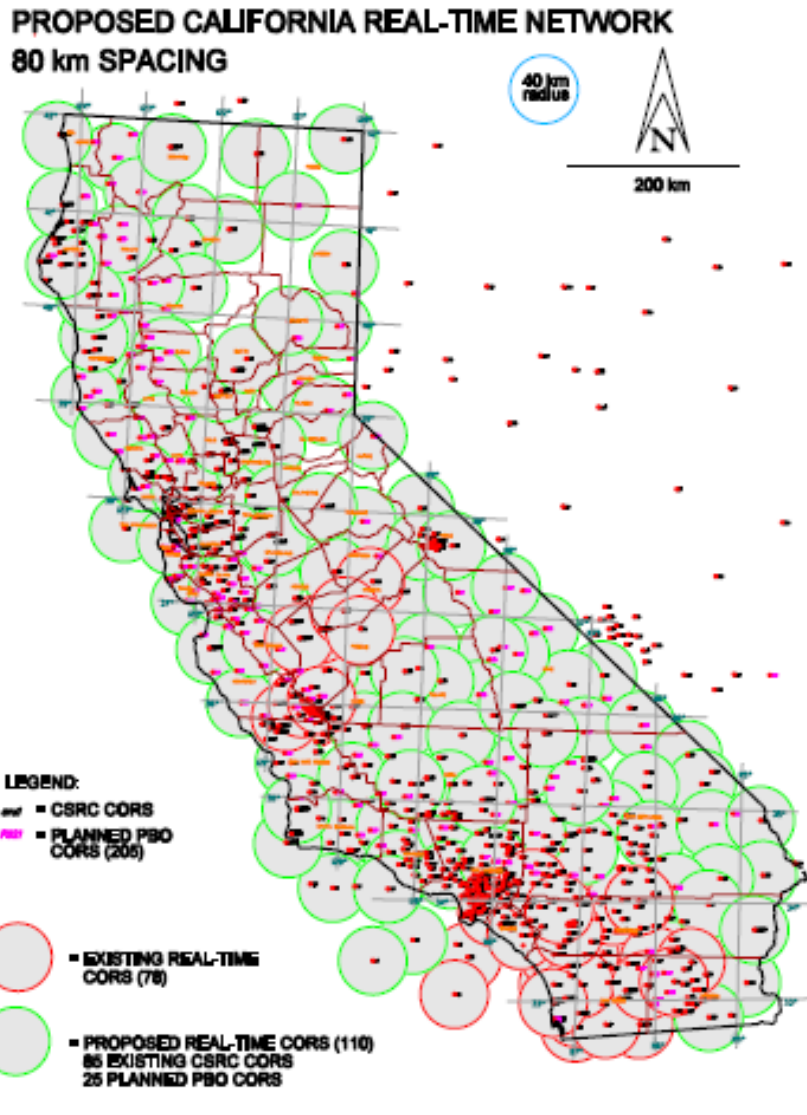
Figure 1. Map of proposed statewide CRTN with a nominal spacing of 80 km

CSRC's Proposal for a Statewide California Real Time Network has evolved after a series of discussions, comments and revisions. The current version is 5.0 and has been adopted by the CSRC Executive Committee. Details will be presented by Art Andrew this afternoon.

Proposed Statewide Expansion of CRTN (5.0)

Two related problems:

1. The lack of an open, uniform and seamless statewide real-time network in California. Our State with its size, population, unique spatial referencing environment, and despite the tremendous resources at its disposal is far behind in providing a real-time infrastructure for precise spatial referencing, a requirement for increased economic productivity and innovation in private and public sectors for a growing number of interrelated applications.

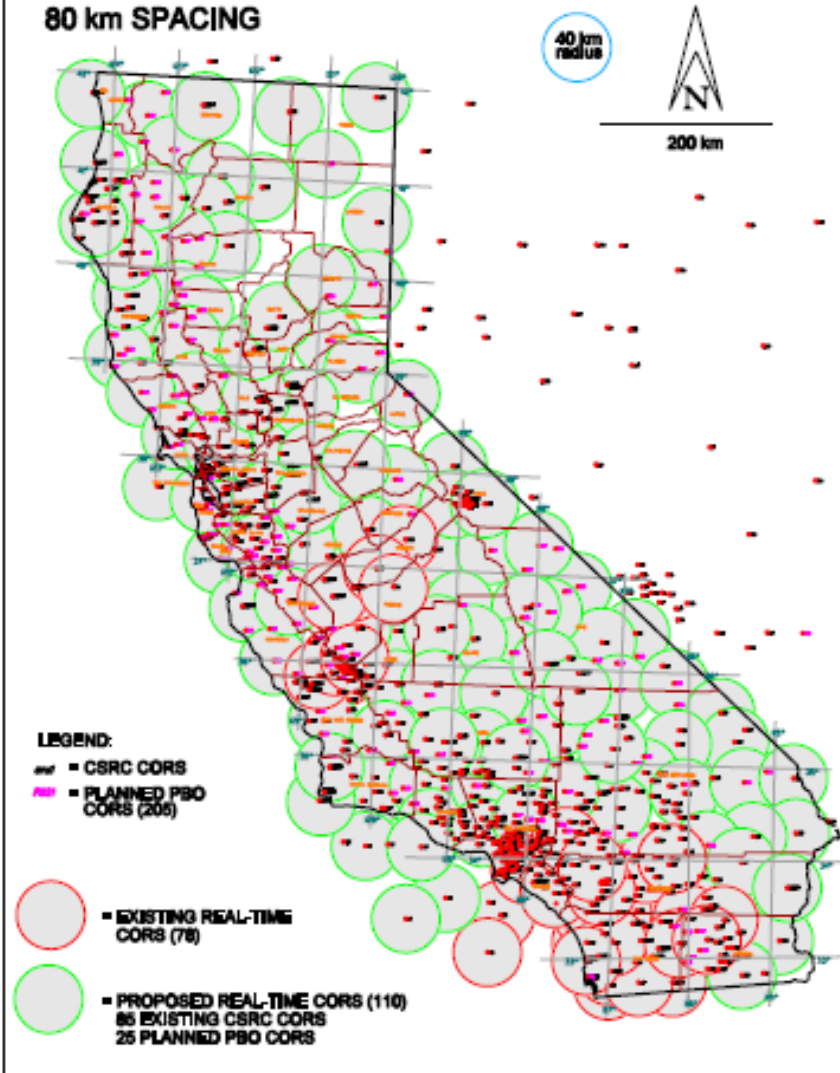


Proposed Statewide Expansion of CRTN

Two related problems:

2. The crisis in federal funding of the California Spatial Reference Center (CSRC) and the absence of State support and funding. The CSRC has essentially met its goals with respect to passive stations as outlined in its Master Plan for a Spatial Reference Network published in 2002 (with the endorsement of NGS in 2003), and is ready to tackle the long-term goals described in the Master Plan, specifically “real-time infrastructure systems.”

PROPOSED CALIFORNIA REAL-TIME NETWORK
80 km SPACING



Proposed Statewide Expansion of CRTN

- Builds upon the more than \$100 million dollars of existing geophysical infrastructure already invested in California
- Builds upon existing (~80) CRTN stations in southern California, operated since 2003 by SOPAC, USGS, PBO, Orange County, San Diego County, and MWD
- Requires a partnership with existing geophysical networks (SCIGN, PBO, BARD) to expand the network throughout the State - discussions ongoing with UNAVCO management
- Uses only CGPS stations that are part of the California Spatial Reference Network (CSRN), and built for high-accuracy, longevity, and geophysical stability

Proposed Statewide Expansion of CRTN

- Leverages existing metadata/archive infrastructure, web services, and software at SOPAC/CSRC including the SECTOR velocity model and HTDP crustal motion model, to provide seamless real-time epoch-date positioning (kinematic and dynamic) using standard GNSS formats
- Is directly tied to the California Spatial Reference System (CSRS) and National Spatial Reference System (NSRS), which fulfills the requirements of the California Public Resources Codes 8856(c)(e), 8857(c), and 8858(b) for GPS-derived geodetic coordinates and orthometric heights
- Provides on-the-fly orthometric heights through national geoid models supplemented with local corrections

Proposed Statewide Expansion of CRTN

- Is able to recover from large seismic events by instantaneous monitoring of changing site positions, followed by rapid geophysical modeling and updates to SECTOR and HTDP models
- Contributes to and uses national real-time atmospheric propagation models (troposphere and ionosphere)
- Takes advantage of other satellite constellations such as GLONASS and the European Galileo system, and new signals available from the GPS satellites

Proposed Statewide Expansion of CRTN

- Has a 20-80 km spacing, with 24/7 coverage and latency of 1 second
- Provides open access to single-base RTK (real time kinematic) positioning and to multiple station raw data streams in their streaming format
- Requires no user fees and provides unrestricted access to data and positioning service
- Provides redundant backup services at other locations

Proposed Statewide Expansion of CRTN

- Is operated by the CSRC operations center at SOPAC with management and governance provided by the CSRC Executive Committee and CRTN consortium operating through the existing UCSD Support Group
- Is funded by contracts between public agencies and the SOPAC recharge facility, overseen by the CSRC Executive Committee and CRTN consortium

CRTN Components

Network



GPS Station



Communications

Data

Data

Server

**SOPAC/CSRC
Database,
Web Services,
GNSS Server,
Utilities**

Models

- SECTOR coordinates
- HTDP Crustal Motion Model
- NGS Geoid Model
- Ionosphere Model
- IGS Precise Orbits
- NOAA Troposphere Model
- SOPAC Archive/Metadata

**Raw Data
User**

raw data
streams

RTCM
(CSRS)

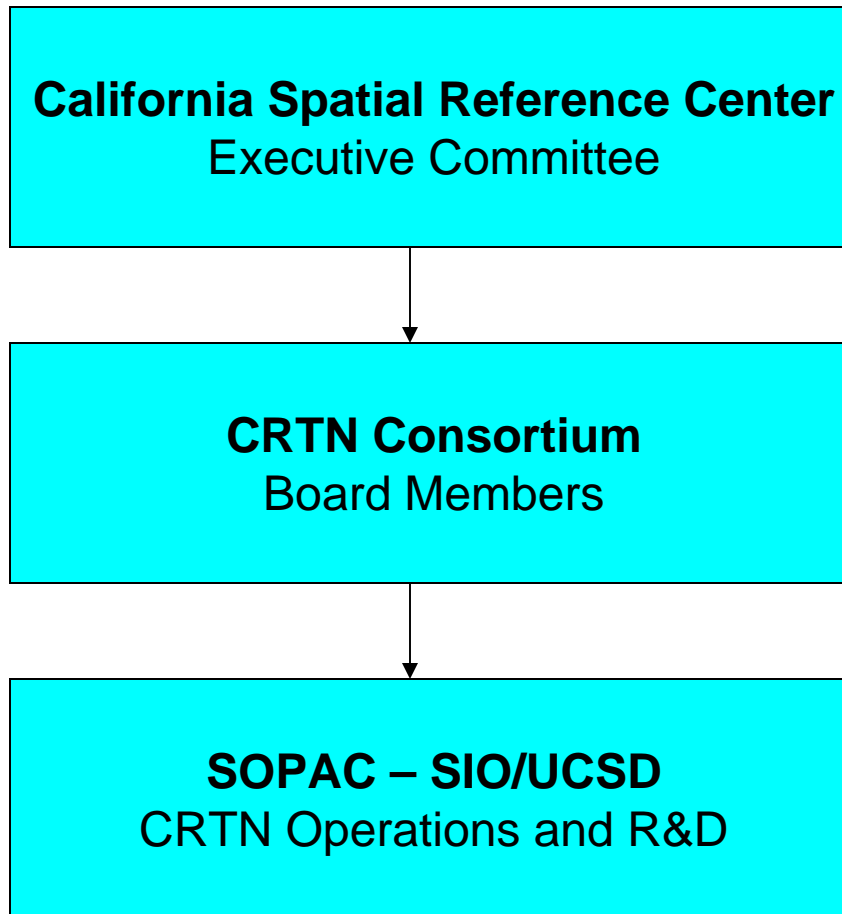
**Single-Base
RTK User**

NMEA
(CSRS)

RTCM

**Positioning
Service User**

CRTN Governance



DRAFT OF PROPOSED COSTS
California Real Time Network
Budget Period: October 1, 2008 to September 30, 2009

PERSONNEL	Monthly Salary	% Effort	# of Mos.	# Person Mos.	TOTAL
SALARIES & BENEFITS					
Yelinda Bock, Director		25%	12	3	
Maria Turingan, Admin		50%	12	6	
Paul Jamason, Programmer/Analyst III		50%	12	6	
TBD, Programmer/Analyst III		50%	12	6	
George Wadsworth, Programmer/Analyst III		50%	12	6	
Melinda Squibb, Programmer/Analyst III		50%	12	6	
Ian MacLeod, Programmer/Analyst II		50%	12	6	
Donald Glen Offield, Engineer		50%	12	6	
Eduardo Perez, Development Technician		100%	12	12	
TBN, Programmer/Analyst II	-----	50%	12	6	-----
TOTAL PERSONNEL				63	564,618
CONTRACTUAL PROFESSIONAL SERVICES					
Professional Services- PLS Consultants (2 FTEs)					208,800
Professional Services- Subcontract to UNAVCO for Site Maintenance (150 Sites)				150,000 *	
TOTAL CONTRACTUAL PROFESSIONAL SERVICES					358,800
SUPPLIES & EXPENSES					
Project Specific Computing & Network Costs					
Comp. & Network Supplies			2,500		
Workstations for Development & Testing (Quantity 4)			8,000		
Cisco Pix Firewall Hardware			2,000		
Oracle Software License & Support			3,900		
Red Hat Software License & Support			2,800		
APC UPS Support			3,000		
Software/Hardware Licenses- Miscellaneous			2,500		
SUBTOTAL				24,700	
Project Specific CRTN Vehicle Costs & Field Supplies					
CRTN Truck- Fuel Costs			5,083		
CRTN Truck- Maintenance & Repair Costs			1,575		
CRTN Truck- Insurance Costs			3,872		
CGPS Station Maintenance Supplies (80 in SC@ \$187.50/Station)			15,000		
SUBTOTAL				25,530	
Meeting & Education & Outreach Costs					
Consortium/Partnership Meeting Costs (2 large & 2 sm. meetings)			4,000		
Education & Outreach Materials & Costs for Booth at Conf			2,500		
SUBTOTAL				6,500	
TOTAL SUPPLIES & EXPENSES					56,730
EQUIPMENT					
Data Archive Equipment: RAID (Redundant Array of Independent Drives) Storage System				10,000	
TOTAL EQUIPMENT					10,000
TRAVEL					
Travel to Consortium/Partnership Meetings				2,000	
Outreach & Education: Seminars, Conferences, Trainings, etc.				3,000	
CGPS Stations Operations & Maintenance Fieldwork				3,500	
TOTAL TRAVEL					8,500
OTHER					
Project Specific Comm Costs: Phone, teleconf, mailing, copying				6,300	
IGPP Computer Support & Network Charges				11,514	
TOTAL OTHER					17,814
TOTAL DIRECT COSTS				1,016,462	
INDIRECT COSTS					
	Base	Rate			
	1,006,462	45%		452,908	
TOTAL COSTS					1,469,371

Draft Annual Budget for Operating and Maintaining Proposed Statewide CRTN

Note: The estimated full annual amount is \$1.47M. Once this amount is funded by partner(s), all data streams will be openly and freely available (network solution and raw data from multiple data streams).

* Amount not verified by UNAVCO