2017 SCEC Annual Report

Assembly of the Community Geodetic Model and GPS Survey of the Cerro Prieto Fault

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Work Statement

Continued Assembly of the CGM – In 2017 we propose to continue to update and improve the CGM. This will involve the following 3 activities: (1) We will ask scientists in the InSAR community to add their LOS compilations to the CGM. In addition, we hope that a SCEC funded scientists will perform a comprehensive re-analysis of the interferometry from the (1992-2010) ERS-1/2 and Envisat archives. We will encourage this activity and work to bring all the LOS velocity data into the SNARF coordinate system so it can be used by modelers in combination with the CGP velocity compilation. (2) We will ask scientists from the campaign GPS community to add their velocity compilations to the CGM; of course, all the raw RINEX files should be archived at UNAVCO. (3) We will work with the CXM group to move the hosting of the CGM from the beta version at UCSD to the permanent home at USC. Sandwell and a UCSD grad student will perform these tasks in collaboration with the CGM and CXM scientists. In addition, Wayne Thatcher will work with Sandwell and a UCSD grad student on incorporating new methods of strain rate mapping being developed at USGS into analysis of Southern California GPS and InSAR data.

Continued GPS and InSAR Analysis of the Cerro Prieto and Imperial Faults - A second focus of our 2017 research will be to refine our combined GPS/InSAR analysis of the crustal deformation in northern Baja California, MX. This will involve the following 2 activities: (1) We will re-survey all the monuments in the CC (17+12) and DD (19+20) lines. This will be accomplished in two or more field surveys performed by CICESE and UCSD participants. The results will reduce the uncertainties in the velocities recorded by the eastern monuments of the CC and DD lines and provide the second epoch of surveying for the new western monuments of these lines. All RINEX data are and will continue to be archived at UNAVCO. The velocity estimates will be

contributed to the CGM to help reduce the uncertainties in this area of high seismic hazard. (2) The second activity will be to refine the InSAR time series of the region using a third year of data being provided by the Sentinel-1A and B satellites. Part of this InSAR effort is being funded by the NASA Earth Surface and Interior program. The ascending and descending LOS deformation time series will be contributed to the CGM.

Publications citing this SCEC funding

SCEC 8007 Sandwell, D., & Smith-Konter, B. (2018). Maxwell: A semi-analytic 4D code for earthquake cycle modeling of transform fault systems. Computers & Geosciences, 114, 84-97.

SCEC 8242 González-Ortega, J. A., González-García, J. J., & Sandwell, D. T. (2018). Interseismic velocity field and seismic moment release in northern Baja California, Mexico. Seismological Research Letters, 89(2A), 526-533.

SCEC 8243 Xiaohua Xu, David T Sandwell, Dan Bassett; A spectral expansion approach for geodetic slip inversion: implications for the downdip rupture limits of oceanic and continental megathrust earthquakes, Geophysical Journal International, Volume 212, Issue 1, 1 January 2018, Pages 400–411, https://doi.org/10.1093/gji/ggx408

Progress

A. Assembly of the Community Geodetic Model

The main activity on the Community Geodetic Model was to work with the community to further develop a time-dependent geodetic model at 500 spatial resolution. We hosted a workshop at Scripps on March 12 and 13. The full report can be found at the CGM web page http://topex.ucsd.edu/CGM/CGM_html/ . The highlights of the report were presented at the SCEC leadership meeting in June 2018.

Recent Work

- SCEC CGM Workshop held March 12 – 13, 2018 at SIO
- GPS and InSAR groups each held 2 virtual meetings prior to the workshop.
- GPS component of the CGM
    - produced consensus cGPS time series for SCEC region, 1996-2018
    - preprocessed campaign GPS data between 1986 and 2014 and generating time series
    - participants applied six different time series analysis methods and compared results
- InSAR component of the CGM
    - assembled Sentinel-1 SAR images (asc and des, 2015 - 2018) for time series analysis using ISCE and GMTSAR
    - compared individual interferograms and time series
- Explored combination of GPS and InSAR time series

Future Plans

- Combination of GPS and InSAR time series
    - InSAR scientists would like vector GPS time series with all tectonic and hydrological signals included but equipment signals removed.

- The groups will explore several integration methods to minimize tropospheric artifacts in the InSAR time series.

- Cyberinfrastructure issues for the CGM
  - web page needs updating and transition to SCEC
  - add time series products to existing velocity and strain products

B. GPS Survey of the Cerro Prieto Fault

GPS and Sentinel-1 InSAR Analysis the Cerro Prieto Fault - The second aspect of our research (past and present) is to perform and analyze campaign GPS measurements of the Imperial and Cerro Prieto Faults in northern Baja California, MX. In February 2018 Researchers at SIO and CICECE (Figure 1) performed a campaign GPS survey of 38 monuments across the Cerro Prieto and Indiviso Faults (Figure 2). These data are being combined with Sentinel-1 InSAR measurements to estimate the moment accumulation rate along these major faults [*Gonzalez-Ortega et al.,* 2018]. Preliminary GPS velocity field for extended CC and DD monuments starts to delineate the velocity gradients across Indiviso and Tulecheck faults (Figure 3). More surveys are needed in order to have better constrains for this velocity gradient.

Figure 1: Participants from CICESE and SIO in a 2018 campaign GPS survey in Norththern Baja, MX.

Figure 2: Locations of 38 GPS monuments (red dots) that were surveyed in 2018. Traces of the Cerro Prieto and Indiviso (lower left) faults are shown in green.

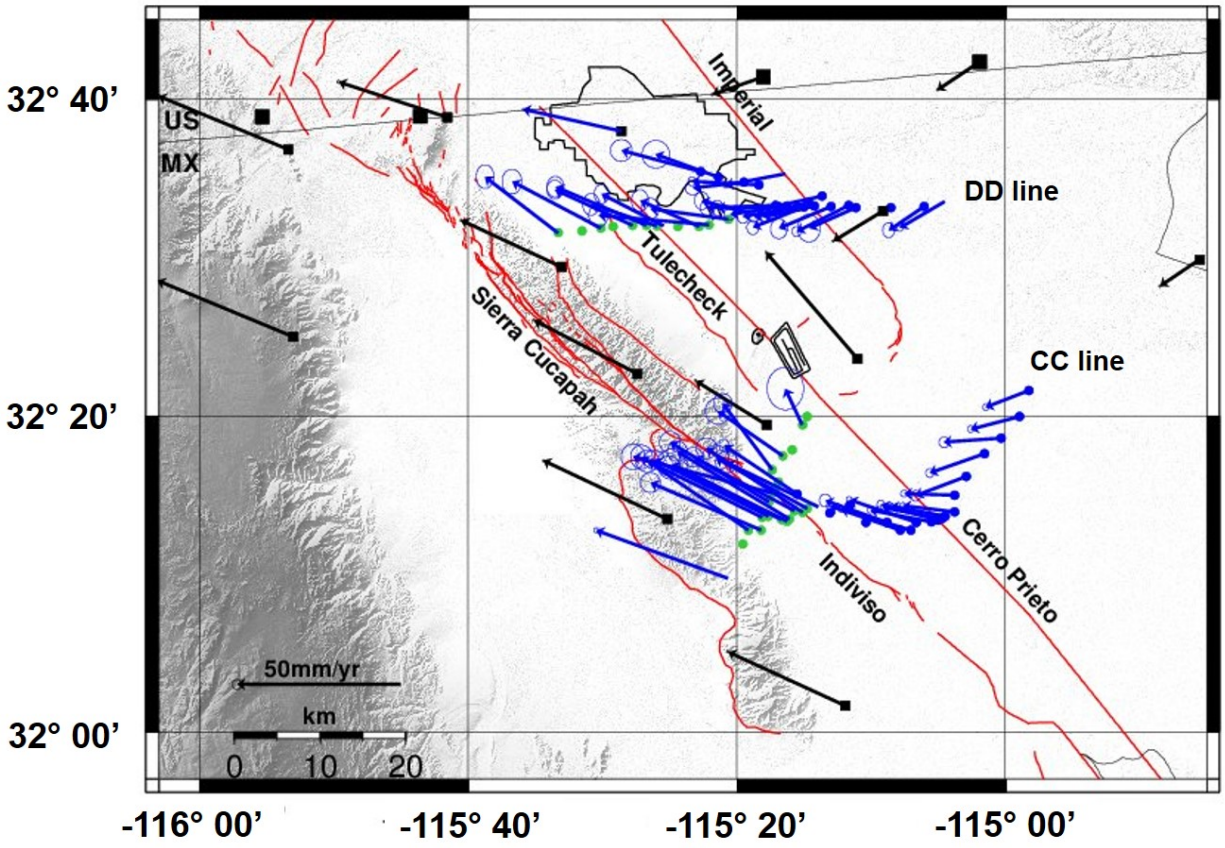

Figure 3: Preliminary GPS velocity in northern Baja California in ITRF2008. Black arrows are continuous GPS data. Blue arrows are GPS survey mode data, and green dots represents new sites recently survey during this time project.