GPS Station NPAS: *New Pass Range looking toward the Clan Alpines*

Nevada Earthquake Response GPS Network (NEARNET)

The Nevada Bureau of Mines and Geology (NBMG), a statewide agency at the University of Nevada, has accepted the responsibility of responding to a Nevada earthquake by operating a Nevada post-earthquake technical information clearinghouse [*State of Nevada Standard Multi-Hazard Mitigation Plan*, Oct 2004]. The NSMHM Plan identifies the need to be prepared to rapidly study a major event within the first few days after an earthquake.

In preparation for a rapid earthquake response, the Nevada Geodetic Laboratory (NGL) at NBMG has designed and has begun to implement a statewide 400-station GPS geodetic network with spatial resolution of approximately 20 km:

- to provide existing, pre-earthquake geodetic control such that co-seismic displacements can be measured with 1 mm precision within days following any large earthquake that might affect anywhere in Nevada;
- to monitor post-seismic deformation related to transient processes and stress transfer between active faults from days to years following large earthquakes;
- to produce high resolution strain-rate maps toward improving neotectonic models of the Great Basin and seismic hazard assessment.

From January 2004 - November 2005, 149 GPS stations have been installed and measured precisely in western Nevada and eastern California, spanning the Walker Lane and Central Nevada Seismic Belt (CNSB), where crustal strain rates are highest. Approximately 10 new stations are being added and measured every month, with ~30 days of continuous data collected at each point to establish epoch coordinates.

NGL now has 48 Trimble 5700/R7 GPS receivers deployed in NEARNET at any given time. A 60-station core of the NEARNET network (known as "MAGNET") spans the northern Walker Lane and CNSB at the latitude of Reno and is occupied approximately 50% of the time so that strain rates can be more rapidly resolved in this region.

Aspects of the design, operation, and analysis of the NEARNET network enhance the precision of coordinate time series, and are proving to mitigate problems that often plague GPS campaigns.

Horizontal station coordinates repeat to 0.6 mm RMS every week, and vertical coordinates to 2 mm.

The preliminary velocity map below uses stations that have data for 0.6-1.8 years.

More About the Map...

Features

- Area covers most of the Great Basin plus the eastern part of the Sierra block
- 849 plotted GPS stations including
  - 149 NEARNET sites installed 2004-2005;
  - 52 planned NEARNET sites (for early 2006);
  - 368 campaign sites;
  - 113 current permanent sites mainly from BARGEN (Basin and Range GPS Network) and PBO (EarthScope's Plate Boundary Observatory), plus selected sites from SCIGN, EBRY, BARD, CORS, and PANGA networks;
  - 167 planned permanent sites mainly for PBO and some for BARGEN.
- Topographic relief, state-lines and interstate highways for geo-referencing
- Quaternary faults from the USGS database (see acknowledgements for details)
- Color-scale showing strain-rate magnitudes derived by GPS (details below)
- Arrows on grid showing velocity model derived by GPS (details below)

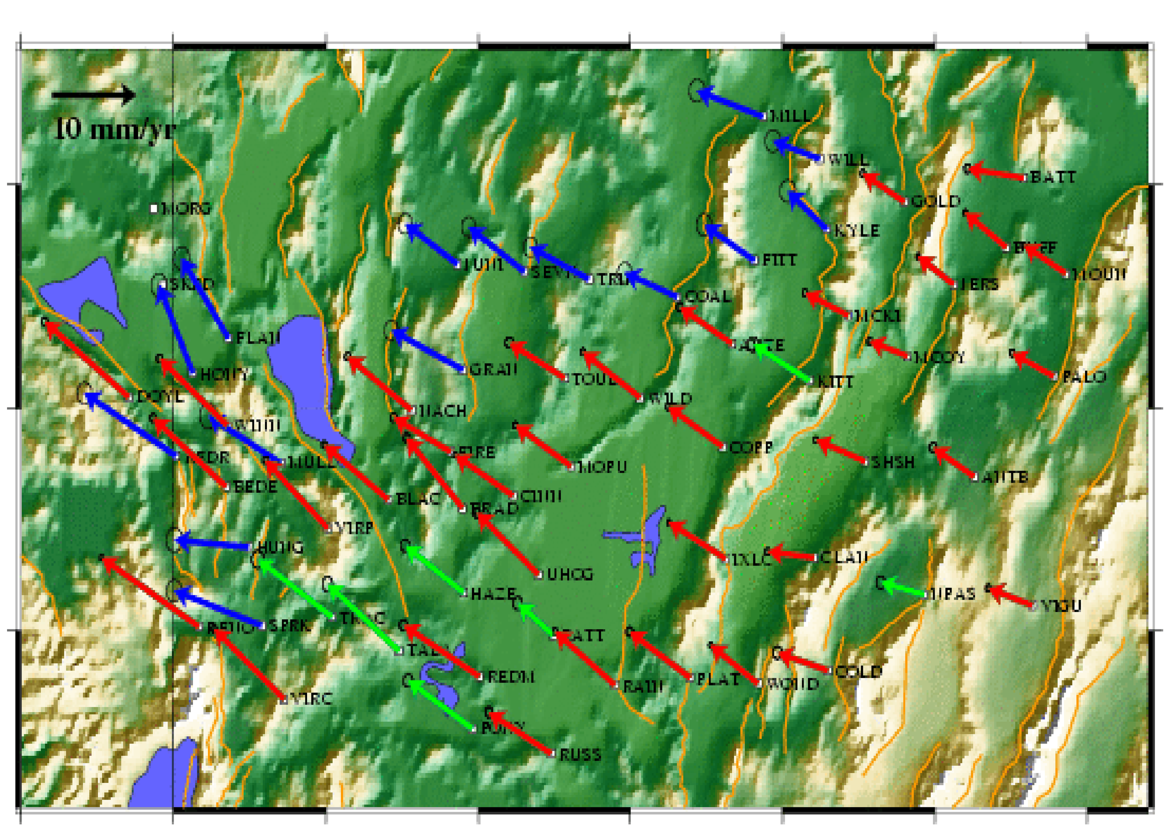
Strain-Rate and Gridded Velocity Model

We combine multiple GPS velocity solutions in the Great Basin area, including:

- our own BARGEN solution (Jan 2000 - Sep 2005) using GIPSY OASIS II
- various published solutions [*references given below*];
- EBRY solution (R. Smith, pers. comm., 2003);
- SCEC Crustal Motion Map v.3;
- USGS campaign solutions including the Hawthorne Profile, (part of) the Mammoth network, and networks presented by *Hammond et al.* [2004].
- the first NEARNET solutions will be ready to include in summer 2006.

We then derive a continuous velocity gradient tensor field through a spline interpolation technique [e.g., *Haines and Holt*, 1993; *Holt et al.*, 2000]. In this method model velocities are fitted to the observed geodetic velocities in a least-squares sense, using the full data covariance matrix. Model velocities are then interpolated using bi-cubic Bessel spline functions to derive a continuous velocity gradient tensor field, which provides estimates of strain rate and velocity anywhere in the model grid.

Preliminary NEARNET Velocity Map: data span < 1.8 yr



Years of data: 0.6 yr < blue < 0.9 yr < green < 1.2 yr < red < 1.8 yr

Contributing Published Solutions....

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Site WALK: *Wassuk Range looking across Walker Lake*

Site WILL: *East Range looking toward the Tobin Range*

Conclusions

- The State of Nevada is now prepared for rapid geodetic response to earthquakes M_w > 6.5 in the most seismically active areas of the western Great Basin
  - Rapid deployment field crew and equipment ready to go
  - Newly installed Nevada Earthquake Response GPS Network (NEARNET)
  - 149 stations now installed, aiming for ~400 stations across the Great Basin
  - 48 GPS units (Trimble 5700/R7) with solar panels always field-deployed
  - Can measure co-seismic movement with 1 mm precision within days
- NEARNET will soon contribute to improve the current strain-rate map
  - High resolution strain in northern Walker Lane/CNSB by summer 2006
  - Already delivering < 1-mm/yr velocity precision in < 2 yr of operation
  - 10 new stations added every month at spacing of ~20 km
  - High resolution strain-rate map is important for seismic hazard assessment