• Overview of UNAVCO GI program in NSF GAGE Facility: Infrastructure buildout, current status

• California Report: Current status, projects and vandalism

• Real Time: Latency, completeness, users

• Some Hope - NGEO: National Geophysical Observatory
EarthScope Background

- Funded by NSF
- Project started in 2003 - continues through 2018
- Three Components - Geodetic, Seismic, and Drilling
- Deploys thousands of seismic, GPS, and other geophysical instruments
- Purpose: To study the structure and evolution of the North American continent and the processes that cause earthquakes and volcanic eruptions.
- A collaboration between scientists, educators, policy makers, and the public to learn about and utilize exciting scientific discoveries as they are being made.
- **Total EarthScope Budget:** ~$500M over the lifetime of the project
The Plate Boundary Observatory

Focused, dense deployments of cGPS and strainmeter arrays
• 1100 continuous Global Positioning Systems around tectonic clusters
• 78 borehole strainmeters
• 5 long baseline strainmeters
• 26 tiltmeters
• 100 meteorological instruments

Portable GPS receivers
• Pool of 100 portable GPS receivers for temporary deployments to areas not sufficiently covered by continuous GPS

Geo-EarthScope
• InSAR imagery covering the western US
• LIDAR imagery covering the northern and southern San Andreas Fault, Yellowstone Caldera, and faults in Cascadia and Alaska

Network Costs
• $100M - Construction Phase (2003-2008)
• $54M - Operations and Maintenance Phase 1 (2009-2013)
• $46M - Operations and Maintenance Phase 2 (2014-2018)
As of 10:51 a.m. Today - Animations by D. Mencin, UNAVCO
UNAVCO Archived Data Product Volume (TB)
January 1, 2004 - June 30, 2016

PBO Delivered Data Product Volume (TB)
January 1, 2004 - June 30, 2016
Cumulative data return for the PBO network since the beginning of the O&M period (FY2009) is:

- 96% for GPS/Met (99% CA)
- 98% for seismic
- 99% for BSM
- 100% for LSM
- 94% for pore pressure
- 89% for tilt.

Metrics complete through June 30, 2016
Operational definition: a GPS station is considered “up” if less than 3 days have passed since data arrived in the archive.
Geodetic Infrastructure

Community & Continuously Observing Networks
Plate Boundary Observatory
  GPS/GNSS and Metpack Operations
  Borehole Geophysics Operations
NASA GGN
POLENET: GNET & ANET
COCONet, TLALOCNet, and Africa Array

Principal Investigator support
Campaign and longer term GPS deployments
Terrestrial Laser Scanning Projects
Development & Testing
NASA GGN OPERATIONS

Recent Highlights

- Permits approved for NASA SGP Installations at McDonald, TX and Haleakala, HI. Installations planned for Q1 2016
- Satellite communications restored at MBAR, Uganda
- Communications upgrades at ABPO, Madagascar, and GLPS, Galapagos in progress
- Data communications to Harvest Platform, CA, a shared NOAA Sea Level Facility, are now reconfigured from VSAT to radio link to VNDP with PBO collaboration

GGN Network Status
- 59 Global Stations - 88 Receivers
- 33 IGS Reference Frame Stations
- 28 Multi-GNSS capable
- 97% network health
• Seven Polar Services staff, including five engineers, one technician.
  • Most deploy to Antarctica for 2-3 mo/yr.
  • Field work in the Arctic occupies 2-3 weeks at a time.

• Twenty four Antarctic projects supported this quarter;
  • 3 in the next quarter.
  • 6 UNAVCO staff deployed to support the Antarctic effort.
  • 27 Antarctic projects in total scheduled for 2015-16

• Current Station count:
  • ANET=45 stations, GNET=42 stations.
  • 89% data return. 94% of sites operational.
COMPLETED BETWEEN JULY 2014 - DECEMBER 2015
— 22 NSF stations (green), 12 UNAM stations (red).
— Regional Data Center @ Guadalajara
Completed 2016
— Remaining 2 NSF stations (yellow), 1 UNAM station.
— Begin operations and maintenance.

BUDGET
— Projected to be 6% under budget at end of Year 3.
US Department of Transportation Adjacent Band GNSS Receiver Testing setup inside the anechoic chamber at the Army Research Laboratory, White Sands Missile Range, NM (response to Ligado Inc, formerly known as LightSquared)
CALIFORNIA PBO NETWORK

- 599 Stations ~50/50 DDBM/SDBM
- $27-32M Construction, $3M/yr Maint/Data
- 458 NetRS (GPS)
- 119 NetR9 (GLONASS)
- 22 PolaRx5 (GNSS)
- 406 Real-Time
- 53 Metpack
- 85%+ 5Hz, 98% 1Hz, 67%+ can stream 1Hz
CA GPS OPERATIONS GROUP

• Last 12m, ~3.75 FTE field engineering staff for 599 stations
• 2.25 FTE on other projects and management
• 160 stations / FTE
• 445 engineer-days in the field, 370+ onsite visits, 800+ issues
• 118 days/year per FTE (~50% of work year in the field)
• 95-100% uptime, >99% data return

Andre Basset
Shawn Lawrence
Doerte Mann
Ryan Turner
Chris Walls
Adam Woolace
Biller Hofferber
Highlights

• GPS/GNSS Uptime Declining - Decreased Budget since 2012, further cuts in 2017/2018

• All NetR9s activated with GLONASS (most stream) 119 in CA (thank you, Caltrans, for codes and receivers)

• Configured and activated 200 more RT stations in CA (testing in BKG). So 406 in CA.

• Receiver RFP, Review, Testing = Septentrio PolaRx5. Receivers being deployed ~40 planned for CA (Low Power; RFI Mitigation, Multipath Mitigation)

• Planned Continued Receiver and Communication Upgrades for Future Capabilities but at a lower rate in 2017/2018.

• Supported scores of airborne liar surveys all around the state
SEPENTRIO UPGRADES HAPPENING NOW

Binex streaming due in this month!
VANDALISM REGION-WIDE - 90+
P522 - A HISTORY OF ABUSE... AND ENDURANCE
SOLAR POWER = AUTONOMY = VULNERABILITY
COMMUNICATION UPGRADES
UPCOMING PROJECTS

- Modest expansion of Geodetic Module sites
- One station in San Diego County
- Menlo Park server upgrade
- Death Valley radio network upgrade
- LOS + radio testing with USGS for EEW
- Proposal for NGEO
Current Network

- ~650 Real-time stations
- Moving towards archiving all data at 1 Hz
- All sites producing RTX point positions
- UNAVCO also participating in initiative for open Pacific wide data, NASA is leading through the State Department
- Major upgrade to PIVOT is underway
- Test of archive quality streams in process (limited to NetR9)
- Amazon grant received to test ~250 sites with all resources in the cloud.

Concerns

- Network side capacity for > 1 Hz data
- Archiving multiple data sets for same sample rate and station. (How to present this).
- Very low dedicated resources
- Ill defined formats for processed real-time positions (UNAVCO will propose an EYRO/BNX hybrid - still need for SEED analog).
- Station Communication Costs!
Primary and secondary systems provide redundancy, both run simultaneously.
REAL-TIME DATA & USERS

RT-GPS Registered Data Users by Type GAGE Y3Q3

- Academic
- Commercial
- Government

Number

Year

RT-GPS Active Data Users by Type GAGE Y3Q3

- Academic: 8, 15%
- Commercial: 34, 61%
- National, State & Local Agencies plus Non-profit Consortia: 14, 24%

RT-GPS Data Accessed (GB) by User Type GAGE Y3Q3

- Academic: 587, 22%
- Commercial: 978, 37%
- National, State & Local Agencies plus Non-profit Consortia: 1093, 41%
ENGINEER DAYS IN FIELD

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<th>Fiscal Year</th>
<th>Days (station maintenance)</th>
<th>Days (meetings, training)</th>
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<tr>
<td>FY2018 (est)</td>
<td>700</td>
<td>1100</td>
</tr>
</tbody>
</table>

Budget reduction, no 5-year battery replacements, reduced staffing levels, government shutdown

Assuming 17% Cut in Travel Budget

Days (station maintenance)  
Days (meetings, training)
OPERATIONS AND MAINTENANCE COSTS: CONUS AND AK
100 MOST EXPENSIVE STATIONS
• 1-5 Awards, Universities/NonProfits, Support Mission goals of NASA, NOAA, USGS

• Letter of Intent submitted in August. Proposals Due Dec 28, 2016. Duration - 10 yrs

• Foundational - Maintain capabilities that are fundamental and essential to present and near-term science directions, including the continuation of currently funded NSF projects (NOTA, BSM, TLS, Seismic)

• Emergent Foundational - Components that incorporate current technologies would drive significant progress on major science challenges and were judged to be high priority for the 2018–2023 time frame. (GNSS processing, Multi-disciplinary environmental observatories)

• Frontier - Those capabilities that are, to varying degree, nascent, but are of significant interest to the community for their potential to enable transformative science and ensure continued scientific progress. (high risk/benefit experiments, seafloor/float seismic and geodetic networks)
• NGEO - What level of funding could be hoped for? Less than now and certainly less than needed to a) upgrade the network and b) ensure RT at high level

• What stations would be cut? None immediately. Thereafter, prioritize, or perhaps let clusters of stations go such as helicopter access-only volcanic sites. We are trying to keep the network whole

• Is there an Adopt-A-Station plan? No, Not yet

• Do you need partners? Yes, the need for significant sustaining partners remains paramount