UNAVCO's Community Planning for real-time GPS in Earthscope's Plate Boundary Observatory

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UNAVCO

Current Real Time System

UNAVCO PBO RTGPS Network
348 Real-time stations

243 are Archiving data

Network Latency is 570ms

Network Completeness is 86%

724 Active Connections

1044 Mount Points

Target Real Time System

- 500+ Real-time stations
- 10 servers with 30-40 VMs
- Efficient load distribution
- Network Latency is 570ms
- Network Completeness is 95%
- 1000+ Active Connections
- 1600 Mount Points
- Synchronized Databases
- Redundant Casters
- Positions and Archiving data
- Expansion capability to 1000 stations

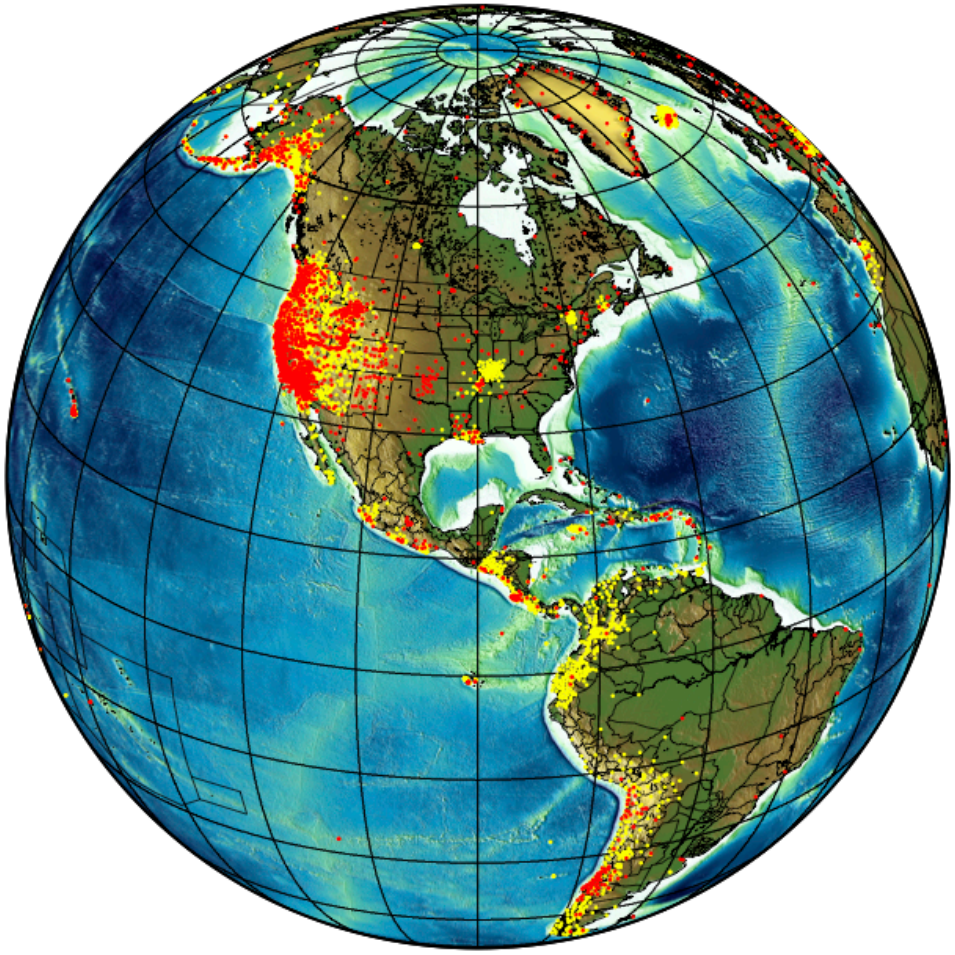
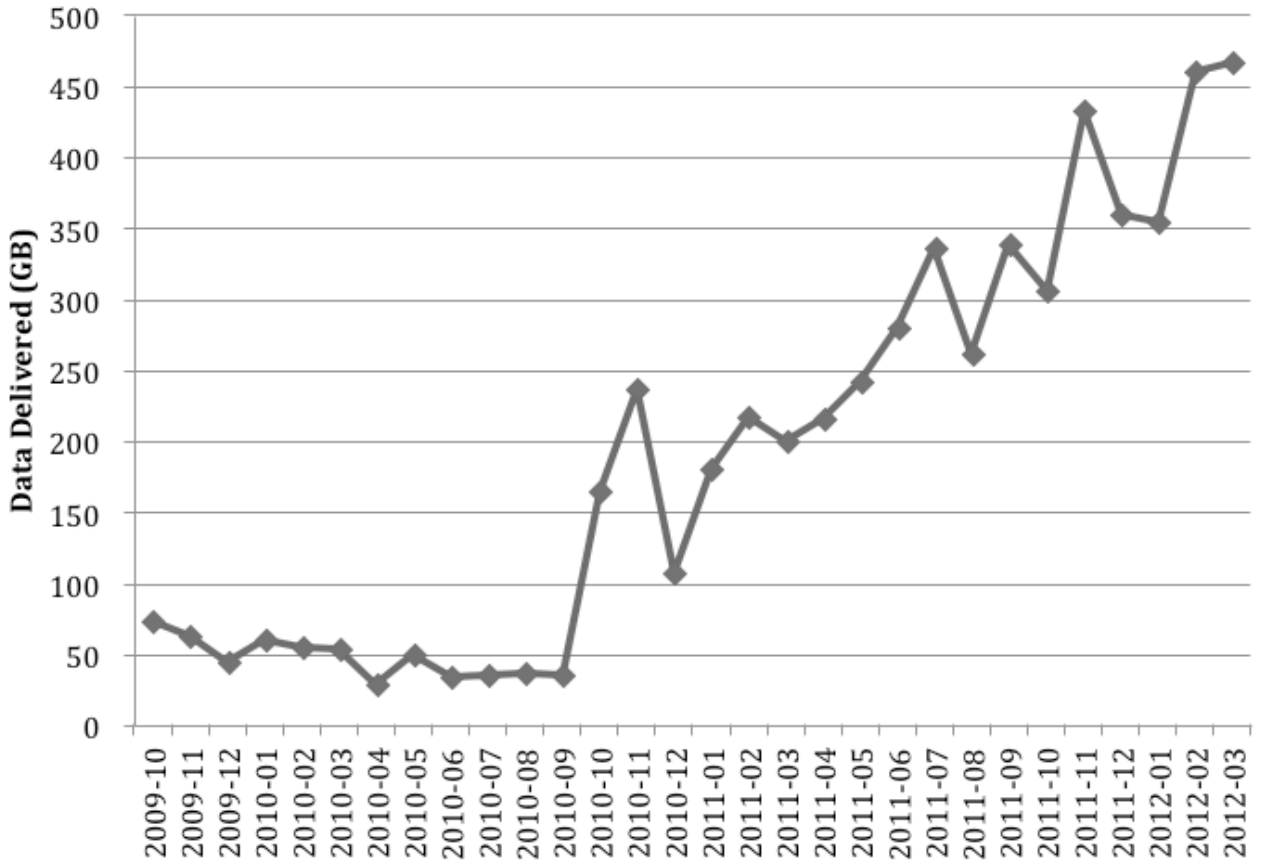
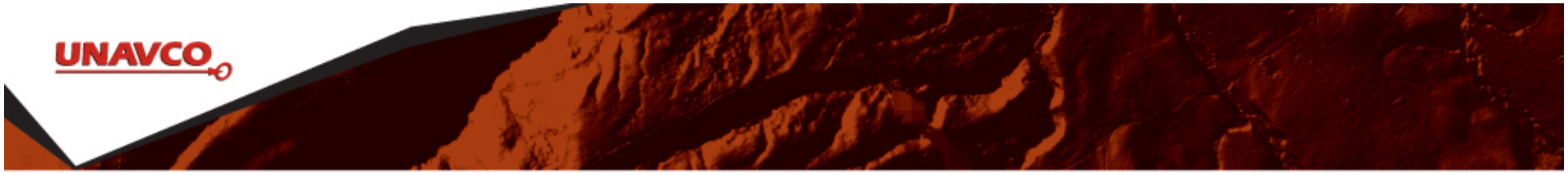


*image is only representative

Real-time High-rate PBO GPS data.



- In March, 2012 42 unique domains have downloaded 467 Gb of real-time high-rate data, 6.5 Tb since Jan 2009.



PBO
About PBO
Instruments
Network Information
Data Products
· Overview
· GPS
· Realtime GPS
· Borehole Strainmeter
· Laser Strainmeter

Realtime GPS Data

UNAVCO publicly broadcasts streaming GPS data from a subset of Plate Boundary Observatory (PBO) stations. Real?time 1Hz streams from selected PBO stations are available in BINEX, RTCM 2.3 and RTCM 3.1 formats via the Networked Transport of RTCM via Internet Protocol (NTRIP). See the "Instructions" link at right for information about accessing these streams.

BINEX is an open-source binary format that contains both standard GPS observable data and other metadata and data timeseries from the receiver. Streaming BINEX data can be translated to RINEX in real time using UNAVCO's teqc utility. The various RTCM formats are typically less comprehensive than BINEX, but RTCM is more common and is translated by most NTrip Client software.

Realtime GPS Network

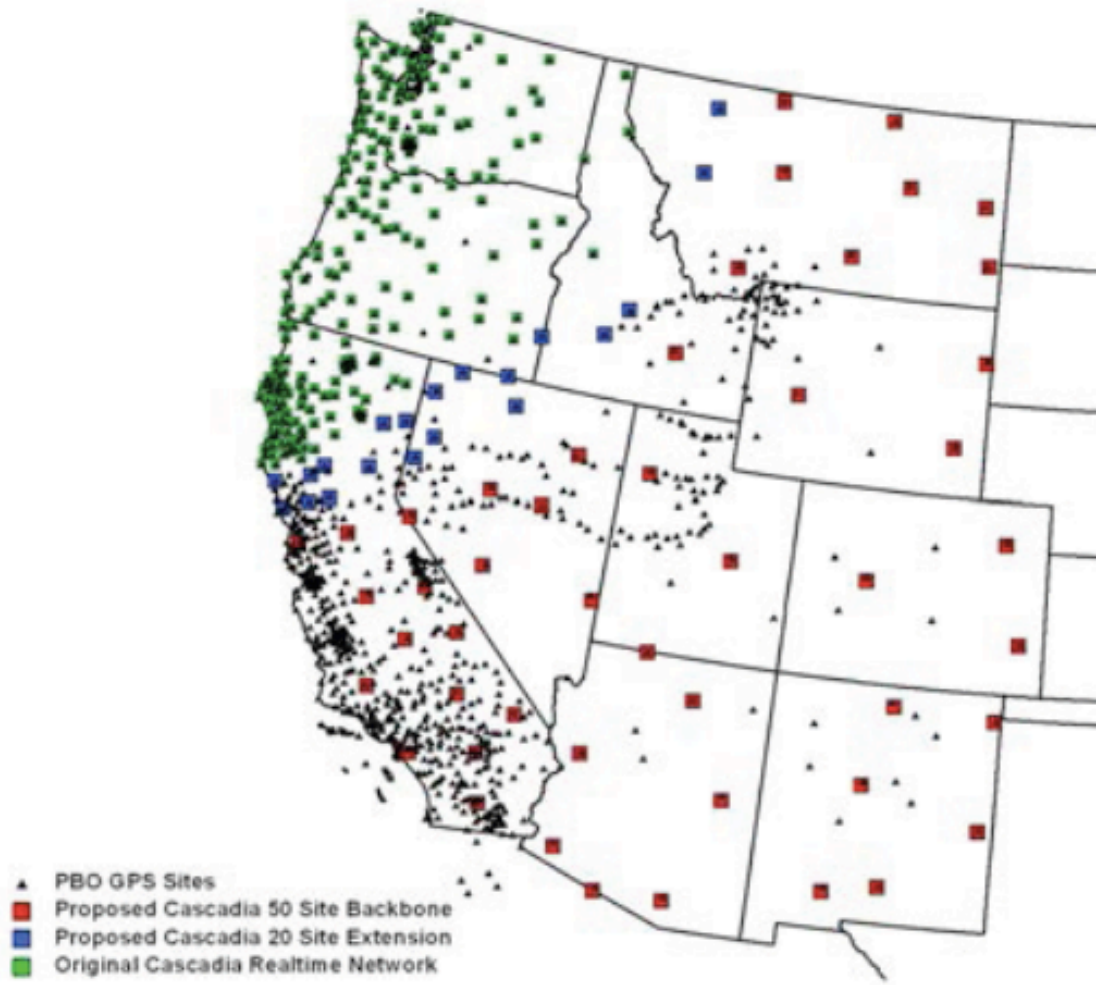
Realtime Data
Instructions for Use
Real-time GPS Plotting
Email Us For Realtime Access

Realtime Resources
Ntrip Sourcetable
Streaming BINEX Translation
Usage Policy

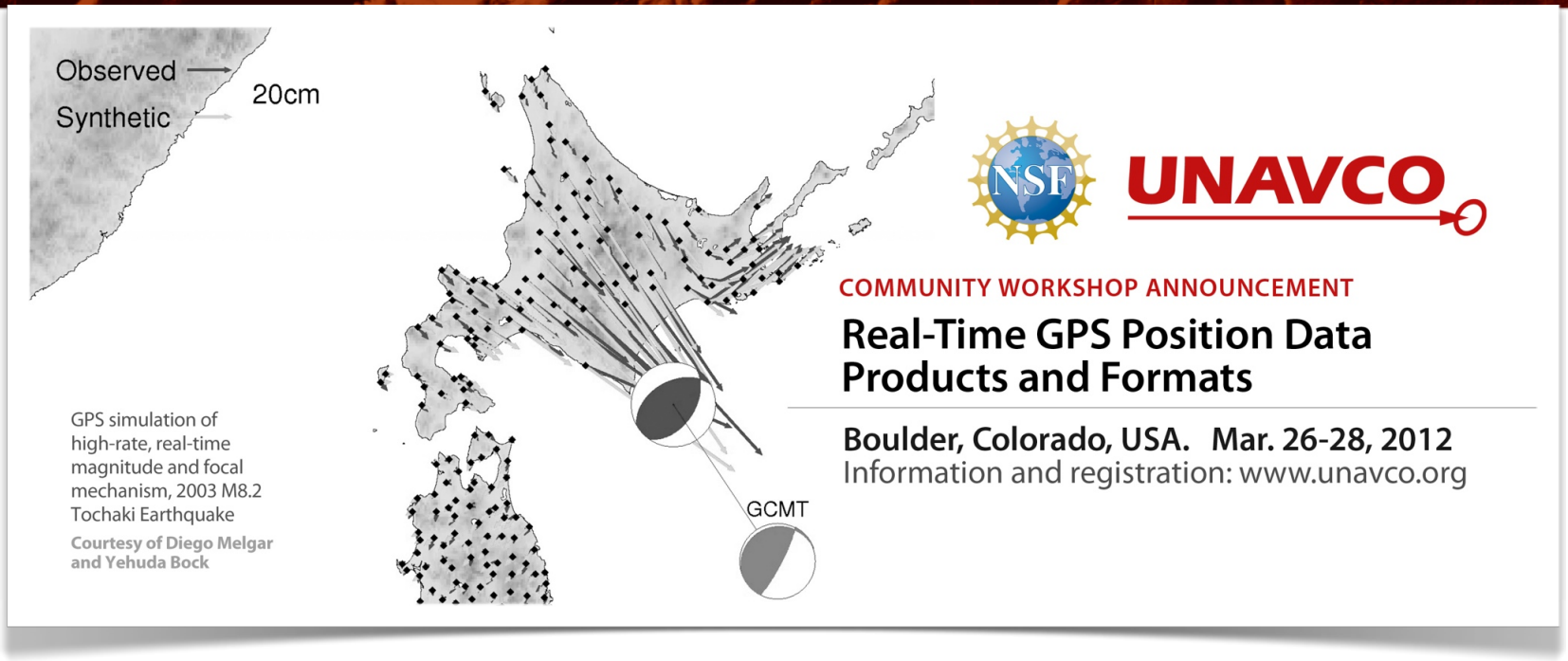
External Resources
BKG Ntrip
Ntrip.org
RTCM
IGS Working Group

UNAVCO

ARRA-Funded (PBO Supplement) Real-time GPS Network in Cascadia Region



RTGPS GPS Position Data and Formats Workshop



- Workshop successfully concluded on March 28th, 2012 with nearly 80 participants from multiple sub-disciplines. Participating institutions included many universities, plus IRIS, NSF, USGS, NASA, JPL, IGS, NOAA, NR-CAN, in addition to representatives from private companies.
- Submitted an EOS Meeting Report May, 2012.
- White Paper, with community review by August, 2012.

Summary of RT-GPS Workshop

Meeting Agenda:

Session I: Data Users and Applications

Session II: Data Processing Strategies

Session III: Data Formats

Session IV: Data Archiving and Distribution

Session V: Technology Requirements & Network Design

•For details:
http://www.unavco.org/community/meetings-events/2012/realtime/realtime.html

Multiple Applications of RT-GPS

- Science applications include: earthquakes (~1/yr causes offsets in PBO) and pre/post-seismic effects, tsunamis, volcanos, lahars, landslides, cryosphere, hydrosphere including soil moisture & snow levels, oceanography and sea level, troposphere/weather and ionosphere/space weather.
- Operational or societal applications/considerations: natural disaster early warning, qc (ambiguities), station integrity monitoring, emergency response, nuclear test monitoring, positioning aircraft (e.g UAV). Real time networks are more efficient to operate. These support science or are supported by science.
- Commercial applications: land surveying, navigation, effects of land/sea bottom motion on navigation, structural monitoring e.g. in oceans (platforms), radio-frequency interference monitoring, autonomous vehicles, probably many more.
- **The above are not separable. One system supports them all.**

Recommendations from RT-GPS Workshop

- Acknowledge that NSF and NASA supported research in real time GPS benefits the hazard community. This is a positive outcome that is supported by basic research in geophysics, GPS data processing, network development, etc.
- Common ground exists between interested agencies (e.g. NSF/NASA/USGS/ NOAA), open discussion about support of networks should continue.
- Start with requirements. From the list of science applications determine the range of needed rate, latency, baselines, level of completeness and state these in our report.
- Rigorously determine, through research, how the system performs during large displacement events.
- Study the effects of different processing strategies/paradigms on real-time solutions, characterize the differences and similarities between real time GPS time series. A community-based evaluation of outliers, RMS, effect of station motion, when stations come back online, when satellites go down, baseline vs. global frame, effect of station quality, environmental conditions, to name a few. UNAVCO should coordinate

Recommendations from RT-GPS Workshop

- Study the problem of combing solutions into a ‘community product’ analogous of the 24 hour solutions at UNAVCO. Is it possible? Use experience of IGS in this process.
- Research needs to continue on improving GPS data processing at high rate and low latency (degree of readiness for prime time in terms of precision and reliability likely depends on application).
- Research needs to continue in estimating displacement waveforms from combinations of geodetic, seismic and other data streams.
- Get something out there that is easily used. Start linking the pieces together to get provisional streams available, so that they can be evaluated by various user groups.
- A long term goal is for RT-GPS solutions vetted by the community distributed by UNAVCO. (Processing model to be determined.)
- Geodesists need to make files that can be easily converted to SEED. Formats are available (.e.g RYO & ERYO, BINEX, RTCM)

Recommendations from RT-GPS Workshop

- SEED files need to be made. Tools exist to convert files into SEED. Extremely important that metadata is included.
- UNAVCO could help by adopting specific (probably multiple) formats and help support community standards.
- Rethink the 4 character naming convention.
- Apply the guiding principals of

- interoperability
  - open easy access
  - reliability
- provision for user feedback (government, public, scientists)
- open standards
  - preservation of data, products, and metadata

- Use modern methods for tracking use and citation of the data itself and derived products.

Next Steps from RT-GPS Workshop

Form two working groups:

1. Committee to focus on standardization of formats for data, time series and meta-data. Needs may vary by community but establishing standards is needed.

2. Committee to critically evaluate the robustness of real-time GPS solutions. They will coordinate a community exercise where solutions are generated by multiple analysis groups from common data, and evaluated independently.

Publish Reports:

1. A brief summary as an EOS article (Mencin et al.) has been published.

2. Workshop report coming soon. Circulate draft to all participants in August 2012. Will be a posted as a white paper on the UNAVCO web site.

PPP-RTK & Open Standards Symposium hosted by BKG Germany

Symposium Website: http://igs.bkg.bund.de/ntrip/symp
Presentations: http://igs.bkg.bund.de/ntrip/symp

- http://www.eurogeographics.org/news/ppp-rtk-open-standards-symposium-outcomes

PPP-RTK & Open Standards Symposium was held on 12 – 13 March [2012] in Frankfurt, Germany, hosted by Federal Agency for Cartography and Geodesy BKG Germany. The organizers were n icely surprised with the enormous interest of the participants - 180 experts from 30 countries took part at a two-day symposium on Precise Point Positioning (PPP) for Real-Time Kinematic (RTK) GNSS applications. It's obvious, that PPP is really the hot topic in surveying these days!

Under the auspices of RTCM, IAG and FIG, the symposium's aim was to share knowledge, experiences and innovative ideas concerning the development of Open Standards for PPP toward RTK accuracy. The symposium provided information on the development of associated real-time GNSS services for PPP support.

Mr. Peter Teunissen, representing the CRCSI as its Positioning Program's Science Director wrote an interesting report bringing the review of the symposium with the highlights of the programme. Please find the report and learn about the PPP-RTK &Open Symposium outcomes.