VLBI2010 in NASA's Space Geodesy Project

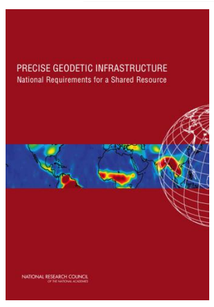
Chopo Ma
Code 698.2, NASA Goddard Space Flight Center,
Greenbelt, MD 20771, USA

Goals of the Space Geodesy Project

VLBI	NGSLR	GNSS	Vector Tie
			
• Antenna installed • Electronics upgraded • Software correlator	• Automated tracking • Co-location with MOBLAS-7	• Monuments installed • Antennas installed	• Range reflectors • AMS installed

- Establish and operate a prototype next generation space geodetic station with integrated next generation SLR, VLBI, GNSS (and DORIS) systems, along with a system that provides for accurate vector ties between them.
- Develop a Project Implementation Plan for the construction, deployment and operation of a NASA network of similar next generation stations that will become the core of a larger global network of modern space geodetic stations.

Nat. Res. Cncl. Recommendations



- Deploy the next generation of automated high-repetition rate SLR tracking systems at the four current U.S. tracking sites in Hawaii, California, Texas, and Maryland;
- Install the next-generation VLBI systems at the four U.S. VLBI sites in Maryland, Alaska, Hawaii and Texas;
- Deploy additional stations to complement and increase the density of the international geodetic network, in a cooperative effort with its international partners, with a goal of reaching a global geodetic network of fundamental stations;
- Establish and maintain a high precision GNSS/GPS national network constructed to scientific specifications, capable of streaming high rate data in real time;
- Make a long-term commitment to maintain the International Terrestrial Reference Frame (ITRF) to ensure its continuity and stability;
- Continue to support the activities of the GGOS;
- Make a long term commitment to the maintenance of ITRF.

SGP Schedule

- **Two year delivery schedule.**

- Task 1: Network Design Studies
  - Network simulations to determine operational and technical tradeoff based on LAGEOS, GNSS, VLBI.

- Task 2: Prototype Station Development
  - Complete prototypes of SLR and VLBI instruments.
  - Implement automated survey system to measure inter-technique vectors for co-location.
  - Develop generalized station layout considering RFI and operational constraints.

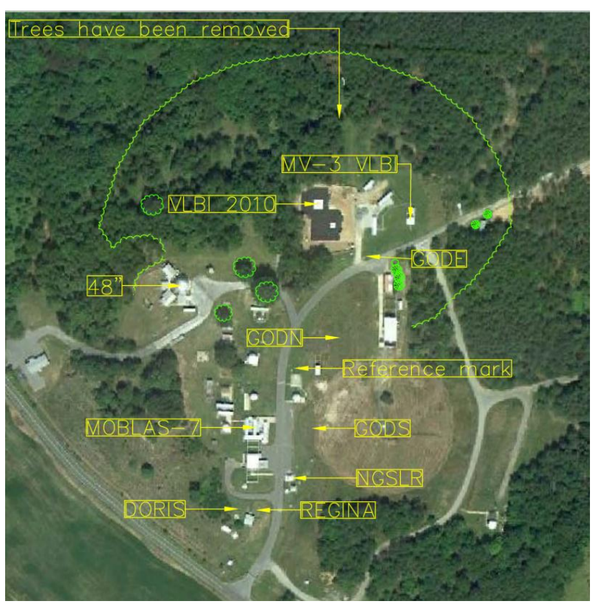
- Task 3: Implementation Plan
  - Begin site evaluation for network station development.

- **Major Milestones:**
  - Prototype Station Integrated: February 2013
  - Station Performance Verification: July 2013
  - Implementation Plan: July 2013

NASA Prototype Station at GGAO

Goddard Geophysical and Astronomical Observatory has four techniques on site:

- Legacy SLR, VLBI, GPS, DORIS
- NGSLR semi-operational
- VLBI2010 antenna installed and being equipped
- GGAO will be the location for the prototype next generation multi-technique station as developed by NASA.



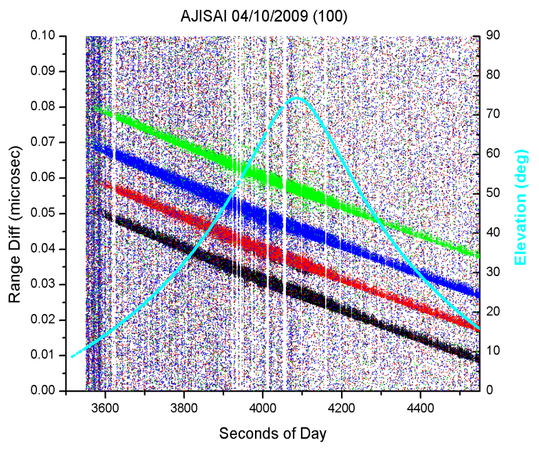
VLBI2010 at GGAO

Key characteristics of VLBI2010:
- Fast, small antennas.
- Unattended operations.
- More observations for troposphere and geometry.
- Broadband feed for multi-band observable.
- Higher speed recording for sensitivity.
- Modern digital backend electronics.

In place:
- 12-m Patriot antenna – 6 deg/sec azimuth rate.
- Cryogenic QRFH (QuadRidgeFlaredHorn) (Caltech)
- ORCA (Optical Receiver/Splitter/Amplifier)
- UDC (UpDown Converter) for flexible RF placement
- RDBE (ROACH-board Digital Back End)
- Mark 5C Recorder
- Sigma Tau maser
- Optical fiber for RF from antenna to rack

NGSLR at GGAO

NGSLR is a high repetition rate singe photon detection laser ranging system capable of tracking cube corner equipped satellites in Earth orbit. The concept of NGSLR was developed by J. Degnan (GSFC, retired) in the 1990s. Technical development continues at Goddard. The system has demonstrated tracking of Earth orbit satellites with altitudes from ~ 1000 km to 20000 km. Completion of the NGSLR prototype will occur during the Space Geodesy Project.



System Features:
- 1 to 2 arcsecond pointing/tracking accuracy
- Track CCR equipped satellites to 20,000 km altitude, 24/7 operation
- Reduced ocular, chemical, electrical hazards
- Semi automated tracking features
- Small, compact, low maintenance, increased reliability
- Lower operating/replication costs

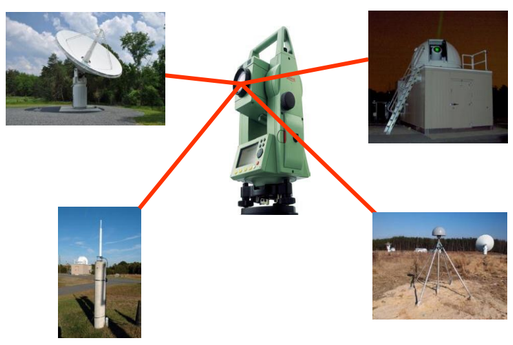
GNSS at GGAO

Javad Delta TRE_G3TH receivers for GPS, GLONASS, Galileo

Co-location Monitoring at GGAO

Key characteristics:
- System needs to be simple enough for site personnel to set up and operate.
- Automatic, rapid, computer-driven.
- Done regularly: daily or weekly.

Demonstrated:
- Automated VLBI reference point determination using Leica TCA2003 robotic total station.



Information Contact: Chopo Ma
NASA Goddard Space Flight Center