NASA's Next Generation Space Geodesy Network

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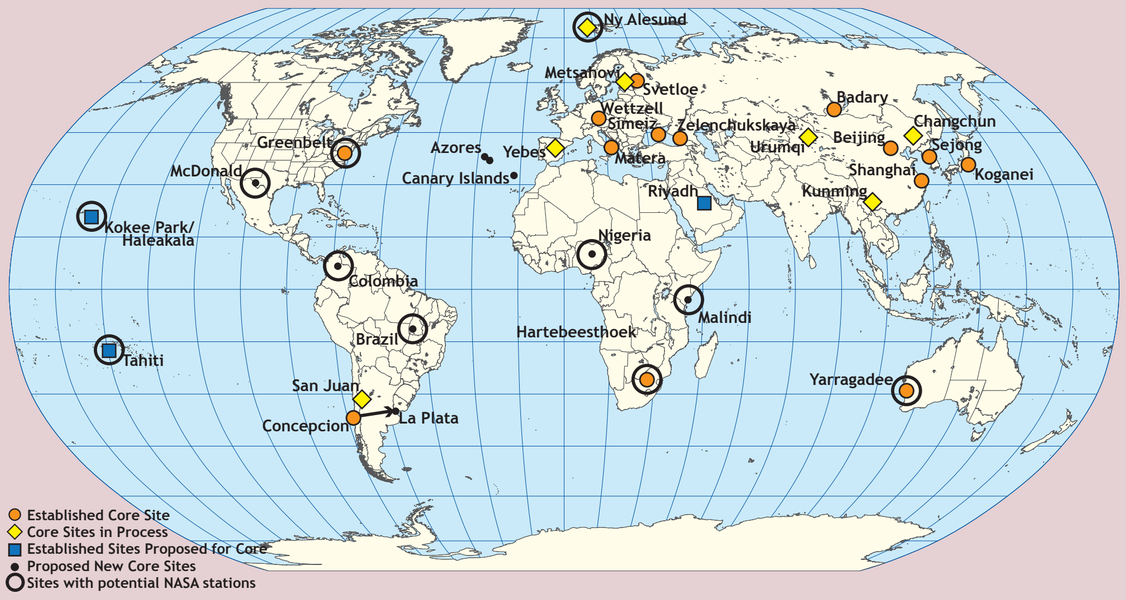
Abstract: NASA's Space Geodesy Program supports the geodetic needs of current and future Earth Observations by maintaining and operating a global network of Very Long Baseline Interferometry (VLBI), Satellite Laser Ranging (SLR), and Global Navigation Satellite Systems (GNSS) ground stations. Much of the current geodetic infrastructure is decades old and is not capable of meeting future requirements. In particular, measurement of changes in the mean sea level will require a Terrestrial Reference Frame with an accuracy of 1 millimeter and stability of 0.1 millimeters per year, a factor of 10-20 beyond current capabilities. To meet this future need, NASA is implementing plans to deploy a "Next Generation Space Geodesy Network" that will replace the legacy NASA VLBI and SLR networks with up to ten globally distributed sites with co-located VLBI, SLR, GNSS, and Doppler Orbitography and Radiopositioning Integrated by Satellite (DORIS) stations. NASA recently completed the first phase of this deployment with the demonstration of the prototype core site at NASA's Geophysical and Astronomical Observatory at Goddard Space Flight Center. The second phase is now underway with the development of new multi-technique sites in Texas and Hawaii. NASA is also working with its international partners to develop the plans for implementing additional new international next-generation geodetic sites as part of the new NASA geodetic network and the Global Geodetic Observing System (GGOS).

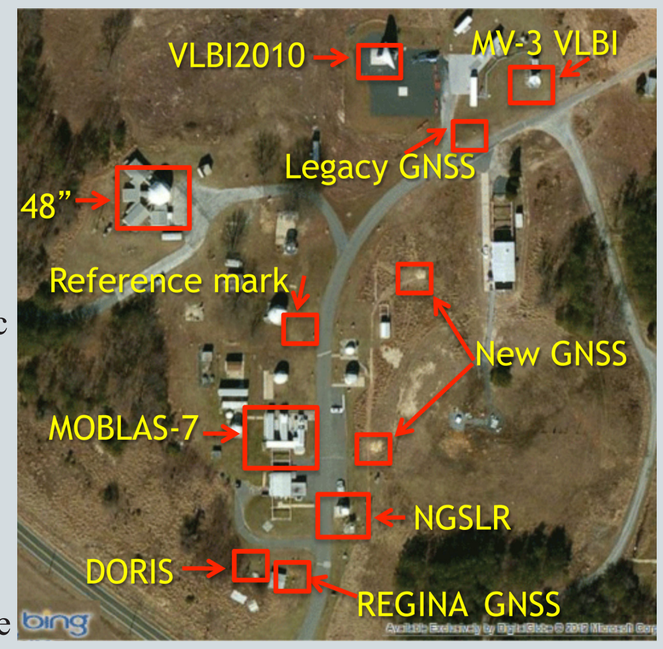
SUPPORTING FUTURE REQUIREMENTS

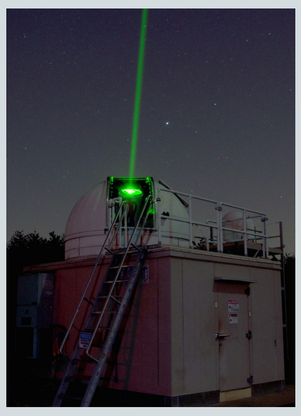


- Space geodetic networks provide the measurements for defining and maintaining the International Terrestrial Reference Frame (ITRF).
- The most stringent requirement on the ITRF comes from sea level studies:
  - Accuracy of 1 mm (decadal scale) with stability at 0.1 mm/ year (annual scale),
  - Requires a factor 10-20 improvement over current capability.
- About 30 modern integrated (multi-technique) sites are required to meet these requirements.
- National Research Council Recommendations for NASA:
  - Upgrade U.S. stations with modern SLR, VLBI, and GNSS;
  - Work with international partners to deploy additional stations;
  - Make a long-term commitment to maintaining the ITRF.

NEXT GENERATION SITE AT GGAO

- Goddard Geophysical and Astronomical Observatory (GGAO) is located 5 km from Goddard Space Flight Center in the middle of the Beltsville Agricultural Research Center. GGAO is one of the few sites in the world to have all four geodetic techniques co-located at a single location.
- A Vector Tie System is implemented at GGAO that combines precision local-tie surveys and monitoring measurements for determining site stability.





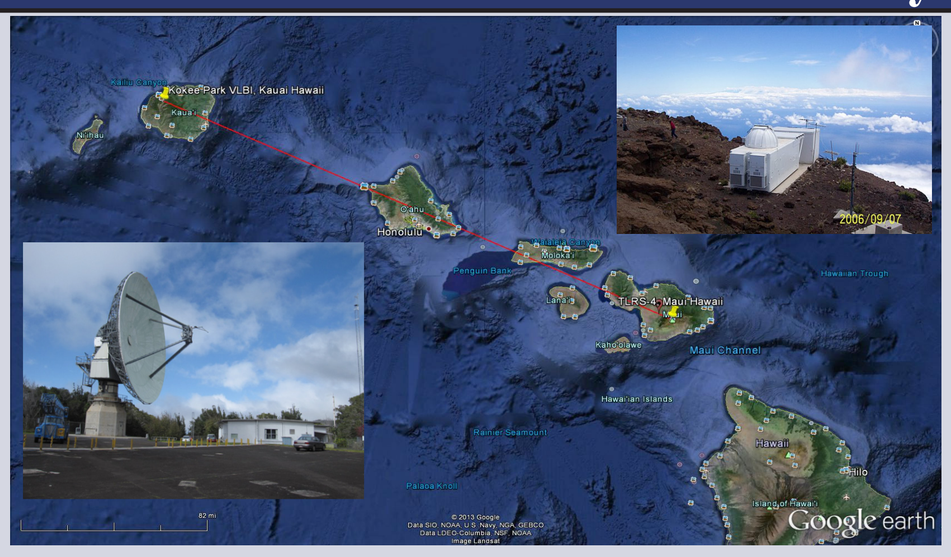
Next Generation SLR

Broadband VLBI

Multi-Constellation GNSS

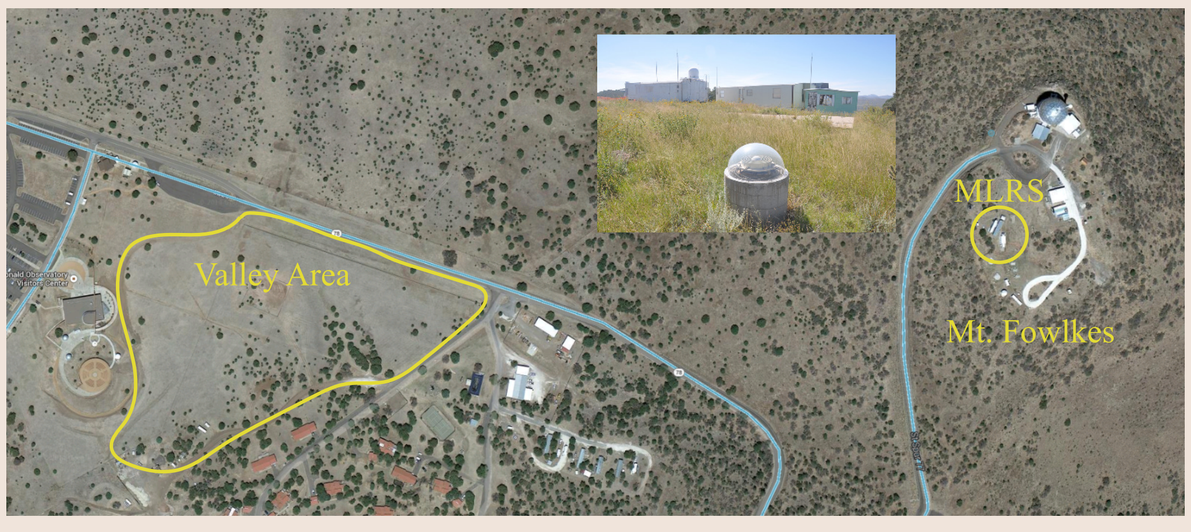
DORIS

Hawaii: Kōke'e Park & Haleakala Observatory



- Kōke'e Park Geophysical Observatory on Kauai:
  - Long history of VLBI, DORIS, and GNSS.
  - Current operational site of the USNO 20-meter VLBI station,
  - Very cloudy skies, bad candidate for new SLR station,
  - Partnership established with USNO to implement new VGOS station; operational in early 2016.
- Haleakala Observatory on Maui:
  - Long history of SLR, GNSS, and previous lunar laser ranging,
  - Current operational site of the TLRS-4 legacy NASA SLR station,
  - Clear skies; great candidate for new SLR station.
- Multiple GNSS stations with state-of-the-art monuments for baseline monitoring between sites.

Texas: McDonald Observatory



- Located in the Davis Mountains, 700 km west of Austin, Texas.
- Operational site of the McDonald Laser Ranging System (MLRS).
- Low Radio Frequency Interference environment.
- Long history of lunar and satellite laser ranging.
- Several possible sites for new VLBI and SLR stations available within the Observatory.
- Observatory operated by the University of Texas at Austin. Strong ties with the dedicated Space Geodesy group at the Center for Space Research.