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The Global GNSS, SLR, VLBI, and DORIS Networks and their Support of GGOS:

IGS+ILRS+IVS+IDS

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Greenbelt MD, USA: *SLR+DORIS+GNSS+VLBI*


Hartebeesthoek, S. Africa: *DORIS+SLR+VLBI+GNSS*


Concepción, Chile: *GNSS+VLBI+SLR*


Yarragadee, Australia: *SLR+GNSS+DORIS*


Wettzell, Germany: *VLBI+SLR+GNSS*


Shanghai, China: *GNSS+VLBI+SLR*

- IGS (GNSS) Network Site (414 sites)
- ILRS (SLR) Network Site (42 sites)
- IVS (VLBI) Network/Cooperating Site (27/18 sites)
- IDS (DORIS) Network Site (58 sites)

- Co-location of 4 Techniques (2 sites)
- Co-location of 3 Techniques (14 sites)
- Co-location of 2 Techniques (69 sites)

Sites in Europe

Sites in Califorina

Matera, Italy: *SLR+VLBI+GNSS*

Syowa, Antarctica: *VLBI+DORIS+GNSS*

Summary:

The global networks of the IAG's geometric services, the International GNSS Service (IGS), the International Laser Ranging Service (ILRS), the International VLBI Service for Geodesy and Astrometry (IVS), and the International DORIS Service (IDS), are part of the ground-based infrastructure for GGOS. The observations obtained from these global networks provide for the determination and maintenance of the International Terrestrial Reference Frame (ITRF), an accurate set of positions and velocities that provides a stable coordinate system allowing scientists to link measurements over space and time. As of fall 2008, these networks consisted of 414 GNSS sites, 42 laser ranging sites, 45 VLBI sites, and 58 DORIS sites. This poster illustrates the global coverage of these networks, highlighting inter-technique co-locations, and showing the importance of these networks to the underlying goals of GGOS including providing the observational basis to maintain a stable, accurate, global reference frame.

Many of these sites offer co-location of two or more techniques. Co-location provides integration of technique-specific networks into the ITRF as well as an assessment/validation of the quality and accuracy of the resulting measurements. A co-location site consists of two or more space geodesy instruments installed within hundreds of meters of each other. A survey in three dimensions with adequate precision is required to inter-relate the measurements derived from each of the co-located instruments. These differential coordinates are measured through classical or GPS survey methods. Today, over 80 global sites have co-locations of two or more of these space geodesy instrumentation (2 sites with four techniques, 14 sites with three techniques, and 69 sites with two techniques). Unfortunately, however, not all of these inter-technique co-location vectors are measured with sufficient accuracy for intercomparison/combination purposes.

The data generated by these networks, as well as products derived from these data, are available from the Crustal Dynamics Data Information System (CDDIS, *http://cddis.nasa.gov*). The CDDIS is NASA's active archive and information service of space geodesy data and products and currently serves as a key global data center for the IGS, ILRS, IVS, and IDS as well as GGOS. For over 25 years, the CDDIS has provided continuous, long term, public access to the data and product records required for the terrestrial reference frame to the global Earth Science community.

Scientific Contributions of the IGS, ILRS, IVS, and IDS:

- **Terrestrial Reference Frame (TRF):**
  - + Station positions and velocities: GNSS, SLR, VLBI, DORIS
  - + TRF scale and temporal variations: VLBI, SLR
  - + Network densification: GNSS
  - + Homogenous network distribution: DORIS
- **Celestial Reference Frame:** VLBI
- **Precise Orbit Determination (POD):**
  - + Accurate satellite ephemerides: GNSS, SLR, DORIS
  - + Calibration/validation for remote sensing missions, instruments: SLR, GNSS
  - + Sea level monitoring: GNSS, SLR, DORIS
- **Earth Orientation Parameters (EOP):**
  - + Polar motion and rates: VLBI, SLR, GNSS, DORIS
  - + Length-of-day: GNSS, SLR, DORIS
  - + UT1-UTC and long-term stability of nutation: VLBI
- **Atmosphere:**
  - + Tropospheric zenith delays: **GNSS**, **VLBI**
  - + Global maps of ionosphere mean electron content: **GNSS**, DORIS
  - + Limb sounding for global profiles of water vapor: **GNSS**
- **Gravity:**
  - + Static and time-varying coefficients of the Earth's gravity field: DORIS, **SLR**
  - + Total Earth mass: **SLR**
  - + Temporal variations of network origin with respect to Earth center of mass: **SLR**
- **Timing:**
  - + Station and satellite clock solutions: **GNSS**
  - + Time and frequency transfer between time laboratories: **GNSS**
- **Fundamental Physics:**
  - + General relativity and alternative theories: **SLR/LLR**
  - + Light bending, time dilation: **VLBI**

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Photos courtesy of the IGS, ILRS, IVS, and IDS and their supporting agencies

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