

## SLR, GNSS, VLBI, and DORIS Networks: ILRS+IGS+IVS+IDS

Carey Noll

NASA Goddard Space Flight Center, USA

Carey.Noll@nasa.gov/Fax: 301-614-6015

### Abstract

*The global networks of the International Laser Ranging Service (ILRS), the International GNSS Service (IGS), the International VLBI Service for Geodesy and Astrometry (IVS), and the International DORIS Service (IDS) are the backbone of GGOS. The observations obtained from these global networks provide a continuous monitoring of the International Terrestrial Reference Frame (ITRF). Co-location of two or more techniques at sites is an important aspect for generation of the ITRF as well as providing an assessment of the observation quality, accuracy, and validation of results. As of mid-2008, these networks consisted of 42 laser ranging sites, 407 GNSS sites, 45 VLBI sites, and 58 DORIS sites. The data generated by the stations in these networks, and the products derived from these data, are available from the Crustal Dynamics Data Information System (CDDIS). This poster will illustrate the global coverage of these networks, highlighting inter-technique co-locations.*

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

The global networks of the IAG's geometric services, the International Laser Ranging Service (ILRS), the International GNSS Service (IGS), the International VLBI Service for Geodesy and Astrometry (IVS), and the International DORIS Service (IDS) are one of the most important components of the Global Geodetic Observing System (GGOS), the observing system of the IAG. It is through these networks that observations are obtained to generate an International Terrestrial Reference Frame (ITRF). These networks currently consist of 42 laser ranging sites, 407 GNSS sites, 45 VLBI sites, and 58 DORIS sites. The networks of the ILRS, IGS, IVS, and IDS are shown in Figure 1.

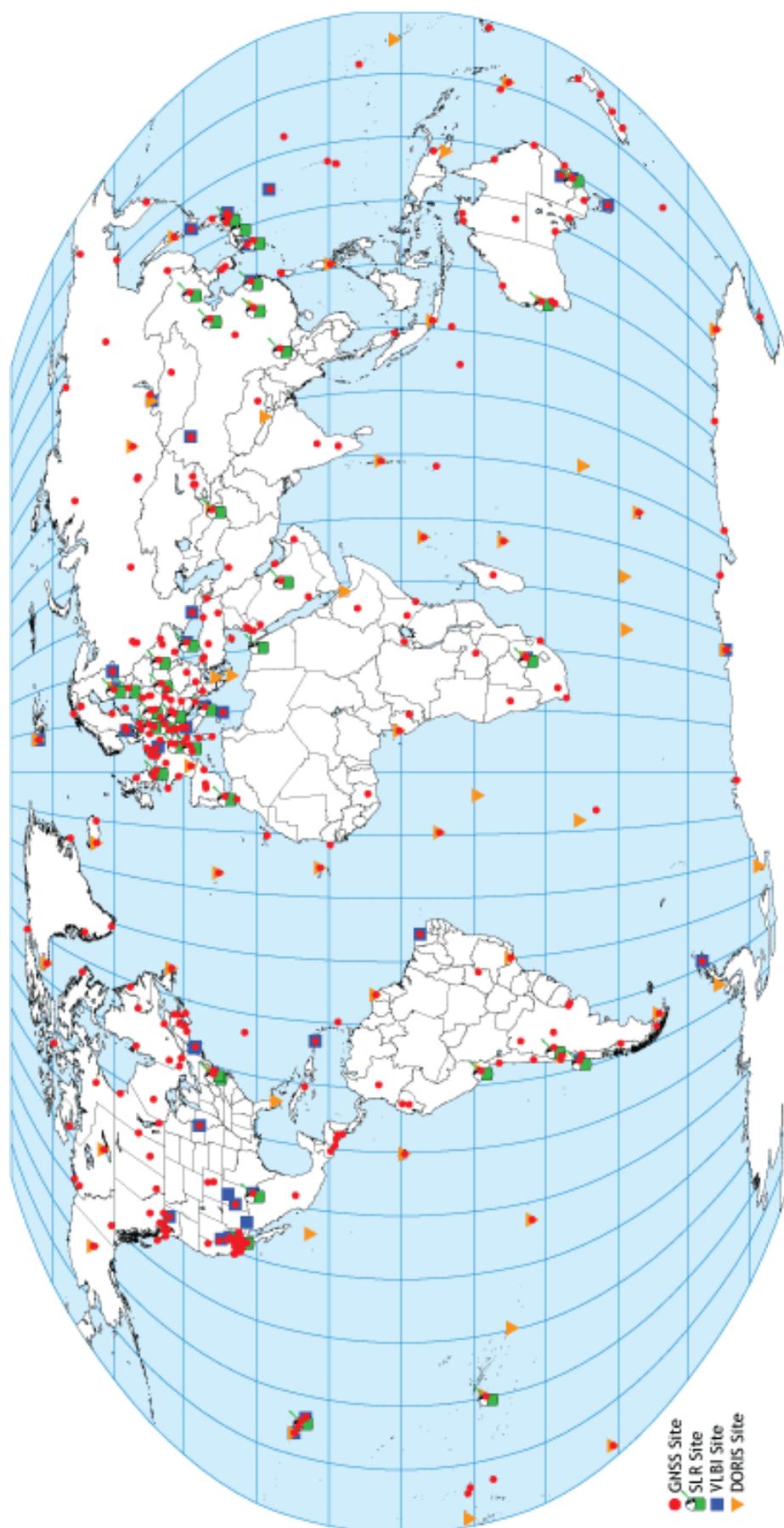
In addition to the TRF, the ILRS, IGS, IVS, and IDS contribute to many scientific areas:

- Terrestrial Reference Frame (TRF):
  - Station positions and velocities: SLR, GNSS, VLBI, DORIS
  - TRF scale and temporal variations: SLR, VLBI
  - Network densification: GNSS
  - Homogenous network distribution: DORIS
- Celestial Reference Frame: VLBI
- Precise Orbit Determination (POD):
  - Accurate satellite ephemerides: SLR, GNSS, DORIS
  - Calibration and validation for remote sensing missions and instruments: SLR, GNSS
  - Sea level monitoring: SLR, GNSS, DORIS
- Earth Orientation Parameters (EOP):
  - Polar motion and rates: SLR, VLBI, GNSS, DORIS
  - Length-of-day: SLR, GNSS, 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: SLR, DORIS
  - 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

The co-location of two or more techniques at a single site is important for the computation of this TRF. A co-location site is defined as an installation where two or more instruments are positioned within hundreds of meters of each other. Through co-location, analysts can assess and validate the quality and accuracy of the measurements. As of the fall 2008, over 80 global sites have co-locations of two or more of these space geodesy instruments (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.



**Figure 1.** The networks supporting the ILRS, IGS, IVS, and IDS.