GGOS Bureau on Communication and Networks

GGOS Retreat

Bertinoro, Italy

March 25 – 28, 2007

Communication and Networks

- **Current activities associated with GGOS Working Group for Ground Networks and Communications**
- **Now that GGOS has permanent status with the IAG, the Working Group would be replaced by a Bureau;**
- **One option is to directly transition the WG into the Bureau**

Working Group Charter

- Develop a strategy to design, integrate and maintain the fundamental geodetic network of co-located instruments and supporting infrastructure in a sustainable way to satisfy the long term (10 - 20 years) requirements identified by the GGOS Science Council.
- At the base of GGOS are the sensors and the observatories situated around the world providing the timely, precise, and fundamental data essential for creating the GGOS products.
- Primary emphasis must be on sustaining the infrastructure needed to maintain the evolving global reference frames, while at the same time ensuring the broader support of the scientific applications of the collected data.
- Synergistic opportunities to better integrate or co-locate with the infrastructure and communications networks of the many other Earth Observation disciplines organized under GEOSS should be considered and exploited.

Membership

- IAG services would provide the backbone of the Bureau;
- IAG Services members would participate in tasks and activities and to provide two-way communications between the Bureau and the Services and to access knowledge and capability;
- The Bureau would seek representation from measurements, operations, analysis, science disciplines, as well as national representation and representation from GGOS management;
- Many of the current Working Group participants would continue within the Bureau.

High Level Tasks

- Promote communication and integration among the Services;
- Develop and maintain a ground network station and data product information base;
- Develop a model that predicts the accuracy and stability of the reference frame as a function of the number of co-located SLR, VLBI and GNSS stations, their geographic distribution, their data quality and yield, and other properties to address GGOS requirements;
- Estimate the size and distribution of the GNSS network necessary to provide reference frame access globally, commensurate with GGOS requirements;
- Seek an effective way to monitor inter-technique vectors at co-location sites to support the above tasks;
- Identify and facilitate the communications services necessary to support data flow from the stations through to archiving of data and data products for the users;
- Review the consistency of meteorological data and identify an activity to unify the procedures at all stations

Communication and Integration among the Services

- Semiannual (open) meetings to review progress on tasks, status and progress of Bureau-specific projects, and issues;
- Post material on the GGOS website;
- Periodic telephone conferences for interim communication of information and status reporting.
- The present Working Group holds meetings each year at EGU (April) and AGU (December)

Ground Station Data and Product Information Base

- Data base of network sites and co-location information.
  - Currently, lists of space geodesy (GNSS, SLR, VLBI, and DORIS) sites and co-location information are available on the CDDIS database and accessible through the GGOS web site and should be expanded to include gravity, tide gauge, and other relevant networks, and should be maintained by this Bureau;
- Data base of general information about the IAG services, including lists of available data and products.
  - Current compilations are linked through the GGOS website. The Bureau should pursue coordination with other GGOS metadata efforts;
- Best estimate of the anticipated evolution of the measuring capability for each of the techniques associated with the IAG Services and a commensurate prediction of the corresponding accuracy of the resulting ITRF.

Network Design

- Primary objective is sub-mm quality reference frame;
- The future “GGOS Network” will require new equipment, new observing strategies, better infrastructure, larger and faster data accommodations, larger satellite constellations, etc; which should provide a very significant improvement in performance, data quality and throughput;
- Fiducial network that we envision will be built on colocation of combinations of the space geodetic techniques (VLBI, SLR, GNSS, DORIS, etc.) and gravity field and tide gauge measurements;
- Scope the “optimal” number, mix and distribution of global network systems to ensure the best inter-connection of techniques and the best use of available resources, using the reference frame as our measure of quality.

Network Design Study to Scope the Future Network

- Focus first on networks of colocated SLR and VLBI since they define the origin, scale and orientation at a very high level of long-term accuracy (albeit with sparse geographic distribution);
- These network will provide the framework from which the other techniques (e.g. GNSS and DORIS) will distribute the reference frame globally in space and time to the user community.
- Examine globally distributed networks of 8, 16, 24 and 32 sites; the current situation is probably the equivalent of 6 or 7 co-located sites with uneven geographic distribution.
- Once the initial relationship among the four networks is defined, examine the influence of system improvements, data taking strategy and data yield, the quality of intersystem vectors, analysis models, etc., on the quality of the reference frame.
- The simulation studies are being conducted with the NASA GEODYN II program.

Global Dissemination of the Terrestrial Reference Frame (GNSS Network)

GNSS delivers its high-accuracy relative positioning and EOP based on precise orbit and clock states for the participating constellations. The accuracy of these states affects directly the accuracy with which GNSS disseminates the ITRF and its products.

- Scope the size (distribution) of the GNSS Network required to disseminate globally the TRF (origin and scale) with the required accuracy and stability;
- Verify that the accuracy of the origin and scale is preserved when connected to the GNSS frame through the local ties at co-located sites, and understand the dependence on the quality of local ties;
- Examine the potential improvements in the GNSS orbits and products from SLR (even VLBI) tracking of the GNSS Satellites.

Monitoring Inter-technique Vectors at Co-location Sites

- Understand how the RF quality depends on the inter- technique vectors;
- Objective: <1 mm, 3-D intersystem vector results are very ambitious;
- The ground survey is only one component of the problem; Offsets to the instrument reference points is also a major source of error;
- Transition in steps from the current systems to future better designed instrumentation;
- Present Network:
  - Address the instrument reference problem (how do we do better?);
  - identify where resurveys among the most productive stations would give most benefit; work with the Services/agencies to get these done.
- Develop intersystem vector (survey) monitoring procedures that can be accomplished in a practical manner;
  - Terrestrial Monitoring using the newest automated survey equipment;
  - Inverse co-location technique using an array of satellites (carrying all space geodetic techniques) for ground position navigation with an extremely precise connection of their reference points;
- Better design of future systems.

Data Communications

- Work with the Services to identify and facilitate the communications;
- Primary driver will be rapid wideband communication for e-VLBI, but other techniques will require real-time or near real-time data flow;
- Investigate use of economical communications services that exist for science areas;
- Investigate satellite communication techniques that are being used in other global networks for scientific applications such as seismological networks, tide gauge networks, atmospheric sensing networks, etc;
- Establish standard procedures by which users can be made aware of communication services that are available and receive guidance on determining applicability, access, and appropriate technologies and procedures;

  It is not intended that the Bureau get involved with the actual use of these networks or satellite links; but rather it should provide the mechanism and procedures to facilitate the process, and to help broker agreements with such networks in order to provide a standardized approach to economic data and product communication;

Recommendation

- Transition the WG into the Bureau