

Date: October 15, 2008

Prof. Markus Rothacher
GeoForschungsZentrum Potsdam
Depart. "Geodesy and Remote Sensing"
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Germany

Dear Markus,

Enclosed is a proposal in response to the Call for Proposals for the GGOS Bureau for Networks and Communications from NASA GSFC.

I look forward to future cooperation in these activities.

Sincerely,

A handwritten signature in blue ink that reads "Michael R. Pearlman". The signature is written in a cursive, flowing style.

Michael Pearlman

cc: J. LaBrecque/NASA HQ
C. Noll/NASA GSFC
E. Pavlis/JCEET
Z. Altamimi/IGN

**PROPOSAL SUBMITTED IN RESPONSE TO THE CALL FOR PROPOSALS FOR THE
GGOS BUREAU FOR NETWORKS AND COMMUNICATIONS**

PROPOSAL TITLE: NASA GSFC Response to the GGOS Call for
Proposals for the GGOS Bureau for Networks and
Communications

PROPOSING ORGANIZATION: NASA GSFC

PRINCIPAL POINT OF CONTACT:

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**Response to the GGOS Call for Proposals for
The GGOS Bureau for Networks and Communications**

Primary Organization:

National Aeronautics and Space Administration (NASA)
Goddard Space Flight Center
Greenbelt MD

Supporting Organizations: The International Laser Ranging Service (ILRS), the International VLBI Service for Geodesy and Astrometry (IVS), the International GNSS Service (IGS), the International DORIS Service (IDS), and the International Gravity Field Service (IGFS).

Name of Proposed Bureau Director:

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Other Key People

Associate Director:

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Co-location Coordinator

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IAG Service Representatives:

The Bureau has asked the IAG Services to each designate a Coordinator to the Bureau; representatives will be provided in the near future.

Expertise:

Dr. Michael Pearlman has worked in NASA supported Satellite Geodesy Programs for 40 years. He was the manager of the SAO Satellite Tracking Program from 1972 to 1983. Since that time he has been Special Consultant to NASA on Satellite Ranging and other space geodesy techniques. He was the NASA representative to WEGENER from 1985 through 1995 and a NASA Consultant to the APSG at its inception. He is presently the Director on the ILRS Central Bureau and a member of the GGOS Executive Committee.

Ms Carey Noll has worked at NASA GSFC since 1981. She serves as Manager of the Crustal Dynamics Data Information System (CDDIS), NASA's active archive of space geodesy data and products and a key data center supporting the IGS, ILRS, IVS, and IDS. Ms. Noll is Secretary of the ILRS Central Bureau and a member of the IGS, ILRS, and IDS Governing Boards and GGOS Steering Committee as co-chair of the Data and Information Systems Working Group.

Dr. Erricos C. Pavlis has been involved with NASA Satellite Geodesy Programs for over 30 years. He participated in the LAGEOS, LAGEOS 2, the Crustal Dynamics and WEGENER Projects, the TOPEX/POSEIDON and JASON Missions, and the development of EGM96. Currently a science team member of the GRACE and OST missions, and a co-PI of the LARES mission; member of the GGOS Steering Committee, IERS Directing Board, ILRS' Governing Board, Central Bureau, and Coordinator for Analysis and Modeling, chairman of the ILRS Refraction Study group, member of IAG's Sub-Commission 3.3, and associate editor for the journal of Celestial Mechanics and Dynamical Astronomy.

Dr. Zuheir Altamimi is head of the Terrestrial Reference Systems Research Group at the Laboratoire de Recherche en Géodésie of the Institut Géographique National (IGN), France. He is also a member of the International Earth Rotation and Reference Systems Service (IERS) Directing Board and of the Governing Board of the International Laser Ranging Service (ILRS). He is President of Commission 1 (Reference Frames), 2007-2011, of the International Association of Geodesy (IAG), and he is head of the International Terrestrial Reference System (ITRS) Product Center of the IERS. His principal research focus is the theory and realization of terrestrial reference systems and has more than 20 years of experience.

Goals:

The goals of the proposed Bureau are to implement the Charter delineated in the Call for Proposals:

- 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 such a strategy would be the sensors and the observatories situated around the world providing the timely, precise, and fundamental data essential for creating the GGOS products.
- Primary emphasis would be placed 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;
- The strategy would exploit 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.

Work Plan

The work of the Bureau of Networks and Communications will be a follow-on activity to the work of the current GGOS Working Group on Ground Networks and Communications. It is recognized from the onset, that although the Bureau will provide coordination among the Services, it is really an entity that helps to represent the Services within GGOS and requires their support in order to function.

Initially the Bureau will focus on the tasks below. It is assumed that other tasks will be undertaken as the need arises.

1. Communication and integration among the Services;

The Bureau will promote communication and integration among the Services through biannual meetings at the EGU and Fall AGU, periodic telecons and maintenance of web pages on the Bureau web site. At meetings and telecons, progress on each of the tasks below will be reviewed, inter-service activities will be coordinated, issues of common interest will be discussed and each of the Services will be given an opportunity to keep the others abreast of projects and activities underway. Coordinators have been identified for each of the Services. These coordinators will act as the conduit to their respective services helping to bring the resources necessary to address the tasks below. The Services will also seek identifiable coordination with the relevant IAG Commissions;

2. Develop and maintain a ground network station information base and data product directory;

Under the previous Working Group activity, the CDDIS under Carey Noll developed a database of ground network station information and a directory of data products for the ILRS,

IVS, IGS and IDS. Reports from this database can currently be found at <http://indigo.nasa.gov/>; in the future, this information will be available from the Bureau's Web site. The next step will be the inclusion of absolute and cryogenic gravimetric stations and the gravity field products, and tides gauge locations. A Web site dedicated to the Bureau's activities will be maintained at NASA GSFC and integrated into the GGOS Portal and Web site.

3. 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; utilize the model to provide guidelines for the design of the core ITRF network;

Work will continue under the direction of Erricos Pavlis and with the support of the contributing techniques (SLR, VLBI, GNSS and DORIS), on the development of a simulation capability based on GEODYN to examine the quality of the reference frame and possibly other parameters such as precision orbit determination (POD) for future missions. This simulation could derive POD metrics based on network size and distribution, systems capabilities, operational schedules and conditions, ground survey vector quality, additional satellites, etc. The simulation system has now been hosted on NASA's Columbia Cluster and it is being exercised with initial network configurations. The activity will demonstrate the improvement in product quality that can be anticipated with parametric improvements and should provide a means with which to optimize the future network.

The US National Research Council has a study underway to recommend a network strategy for geodetic ground stations. This study is striving to provide input to their deliberations, which are scheduled to culminate in a final report in April 2009.

4. Estimate the size and distribution of the GNSS network necessary to provide reference frame access globally, commensurate with GGOS requirements;

The Bureau will organize a study group that will: (1) define quantitative requirements for reference-frame accessibility; (2) use the results from Task 3 above and undertake additional studies to determine optimal strategies to be used in accessing the reference frame; (3) develop a systematic approach to improving global access to the reference frame; and (4) make recommendations for a realistic and practical modification to the existing GNSS network to best realize this goal. The Bureau will seek wider community input on such issues as network scope, accuracy tradeoffs, and network composition by organizing a workshop (assuming availability of funds) once preliminary results are available from the study group. We have already spoken to several prominent researchers in this area already who are interested in supporting this activity.

5. Work with the Satellite Missions Bureau to establish the design of the ground network needed to meet mission POD requirements;

Analysis groups within the Services already have relevant experience at orbital computations for a wide variety of satellites, satellite orbits, and network configurations. Eventually, we anticipate that simulation capability will be available to examine POD quality as a function of

different network configurations and capability. The Bureau will work with the GGOS Bureau for Space Missions to provide support to new missions.

6. Work with the IGFS to define its network requirements and to scope the size and geometry of the IGFS ground network;

The IGFS is in the process of defining its network requirements and scoping the size and geometry of its ground-based network. The Bureau will work with the IGFS to harmonize these activities with those of the other techniques. We will also consider the extension of the simulation software to incorporate the constraints available through the IGFS stations and products.

7. Establish and maintain a database of co-location survey vectors, data and procedures used to infer these vectors, and a database of misclosures between the co-location vectors and the analysis results;
 - a. Provide quality control for survey procedures and analysis,
 - b. Facilitate surveys at critical co-location stations as necessary,
 - c. Work with the IERS and the technique services to resolve the misclosures;

IGN under Zuheir Altamimi will continue to maintain an up-to-date database on (1) co-location survey information and (2) misclosures between co-location vectors and analysis results and make this information web accessible, together with survey reports. The IGN will also contribute whenever possible to the adjustment of ground surveys by other groups and perform reanalysis and an examination of ground network geometry. The Bureau will work with IERS Working Group on Ground Survey Procedures, with the IGN, with NASA, and with other groups with ground survey capability to facilitate ground surveys, stressing those sites that would be most beneficial for the quality of the reference frame and other key products. The Bureau will seek more effective ways to involve/encourage survey agencies to conduct surveys in dubious or new co-location sites. The Bureau will encourage new survey groups to participate in these survey activities in order to broaden the resource capability. The Bureau will also work with the IERS Working Group on Ground Survey Procedures to encourage the communication among survey groups and to support standardization of survey procedures.

8. Seek more effective ways to monitor inter-technique vectors at co-location sites;

A fundamental aspect of co-location is the measurement of intersystem vectors between invariant points (intersection of axes, phase centers, etc.) on measurement systems. GGOS and NASA have supported several events to bring experts together to examine techniques to improve the measurement of intersystem vectors, in terms of accuracy, increased use of automation, and ease of implementation. These include (1) a joint meeting with the GGOS Working Group on Ground Networks and Communications and the IERS Working Group 2 at EGU 2008, (2) The Lisbon FIG/IAG Symposium, "Measuring the changes" in May 2008, and (3) Workshop on Laser Terrestrial Scanners (and other modern geodetic survey instruments) at GSFC on September 8 – 10, 2008. Participants in the workshop came from NASA, JPL, NOAA, UNAVCO, INAF (Italy), University of Bonn (Germany), University of Texas, and the University of Hawaii. A short report on the Workshop is in preparation and a

presentation on the conclusions is planned for the 2008 Fall AGU. These participants appear eager to continue exploring the survey issue

The Bureau, with support from NASA, will continue to encourage dialog and organize a task force to examine to new survey options.

JPL is also examining a scheme in which several dedicated satellites would provide space platforms for all of the measurement techniques to support an inverse co-location concept.

9. Maintain a database for co-location-vector time series;

The IGN will maintain the co-location survey database and will make it available on line. If the transition can be made to continuous or near continuous survey operations, the IGN will establish and implement a database for co-location vector time series.

10. Identify and facilitate the communications services necessary to support data flow from the stations through to archiving of data and data products;

The Bureau will maintain a database of the communication modes used by each of the Services. The Bureau will identify a focal point with communication expertise to provide consulting advice to field stations

11. Establish a database of the meteorological instruments, measurements, and procedures at all network stations; review the information for consistency and establish standards for meteorological measurements.

The Bureau will work with the Services to develop (1) a database of meteorological instruments, procedures and calibration techniques used at the GGOS geodetic stations and (2) a database of all of the meteorological data by location at the GGOS Sites. The Bureau will establish a task force to work with the Services to establish a template for these databases and a recommended set of standard for consideration by the stations. The databases will be created and maintained by the CDDIS. Arthur Niell has offered to provide some guidance in setting this up. The Bureau will work through the CDDIS and the Services to get the information from the field stations and make the standards and procedures available to the field stations. The Bureau will seek automated means of reviewing the information and highlighting anomalies.

Organization:

The Bureau will be operated at NASA GSFC. It will be headed by a Director, an Associate director to attend to administrative, communications, support functions; a Coordinating Scientist to provide in-house technical expertise, a Co-location Coordinator to provide coordination and guidance on the intersystem vector realization, and an Information Technology Specialist to attend to database and web support. The Bureau will have representatives from all of the relevant IAG Services and liaisons with the IAG Commissions.

Tasks of a permanent nature will reside within the Bureau; tasks of temporal nature maybe delegated to task forces or standing committees;

Yearly manpower to support Bureau operations (man years):

Position/skill	Percentage of full time
Director	20%
Bureau Secretary	20%
Coordinating Scientist	20%
Database/web Specialist	50%
Co-location Coordinator	20%
IGS Representative	10%
IVS Representative	10%
IDS Representative	10%
ILRS Representative	10%
IGFS Representative	10%

Total	1.8 my