IGS

EXECUTIVE REPORTS

IGS Governing Board in 2000

Christoph Reigber

GeoForschungsZentrum Potsdam,
Germany

Introduction

Over the past year, the IGS again experienced great success in many areas. The IGS continues to thrive as new applications emerge and fundamental IGS systems and processes continually improve. This vitality is due to the concerted effort of each of our contributing organizations and individuals. On behalf of the Governing Board, I would like to sincerely thank each contributor.

The year 2000 was also a new experience for the Board, beginning with important changes in membership. December 1999 saw the departure of Ivan Mueller, Bill Melbourne, Jan Kouba, and Yehuda Bock. Each of these individuals had been members of the Board since the inception of the IGS and their collective talents greatly helped to shape the organization.

The main activities this past year addressed by the Governing Board include the development of a strategic plan for the IGS for the coming years and a focus on IGS working group activities.

IGS Strategic Planning Summary

With the tremendous growth of IGS and an increase in demanding applications, the Board appointed a planning committee in June to coordinate a strategic planning process for the IGS. The IGS is mature and diverse enough to warrant a close look at the organization's focus over the next five years, how to achieve the key goals and objectives that are identified, and how best to continue the success and benefits accomplished to date. The Governing Board is committed to completing the IGS strategic plan in 2001.

The planning group approved by the Board includes:

- Norman Beck, Natural Resources Canada
- Gerhard Beutler, University of Bern, Switzerland
- John Manning, Australian Survey and Land Information Group
- Bill Melbourne, Jet Propulsion Laboratory, California Institute of Technology
- Angelyn Moore, IGS Central Bureau, Jet Propulsion Laboratory, California Institute of Technology
- Ivan Mueller, Professor Emeritus, Ohio State University

- Ruth Neilan, IGS Central Bureau, Jet Propulsion Laboratory, California Institute of Technology
- Jim Ray, United States Naval Observatory
- Christoph Reigber, GeoForschungsZentrum Potsdam
- Robert Serafin, National Center for Atmospheric Research

The Central Bureau retained an excellent planning consultant, Haig Bazoian, to facilitate the strategic planning process.

The planning committee was involved in preparation of materials with Bazoian throughout the summer of 2000, and met as a smaller group at Bundesamt für Kartographie und Geodäsie (BKG) in Frankfurt during early September. This initial meeting was a two-day session aimed at preparing material for a retreat with the entire Governing Board in December. The main points discussed were the strengths and challenges of the IGS, the three most important strategies that should be adopted, the IGS mission, and long-term objectives. This preliminary material was distributed to the Governing Board in October. Additional input was solicited from each Board member and we met as a large group in Napa Valley, California, on 12–13 December, just prior to the AGU. Additional invitees to this meeting were Werner Gurtner (Astronomical Institute, University of Bern/AIUB), Gordon Johnston (RACAL), David Simpson (Incorporated Research Institutions for Seismology/IRIS), and Pascal Willis (Institut Géographique National/IGN).

This was a very good meeting with refinement of the strategies and identification of actions that need to be taken over the next few years. The next steps are to complete the meeting summary and develop the draft document of the strategic plan by March. The Governing Board plans its next meeting in conjunction with the European Geophysical Society (EGS) in Nice, France, on 25 March 2001. The document will be reviewed and the IGS hopes to make a future presentation to the International Association of Geodesy (IAG) Executive Committee and gain approval of the plan.

The strategic plan discussions resulted in a broadening of the stated missions of the IGS specifying our “long-term commitment to provide the highest quality global navigation satellite systems data and products,” reflecting IGS inclusion of GLONASS and future global navigation satellite systems (GNSS) such as Galileo into the IGS GPS infrastructures.

Much discussion centered on consideration of the establishment of the IGS as an “official” or legal international entity, the benefits of such action, and how this could improve the ability of the IGS to conduct its tasks. Recommitment to IGS participation is envisioned and strategies for stabilizing and acquiring agency sponsorships will be explored.

Two key strategies identified by the Board include that the IGS affirms to continuously provide users with the highest quality, reliable data and products in a readily accessible

manner and to achieve worldwide acceptance of IGS products as the "world standard" for data and products — the provider of choice.

These two strategies address the vital interest in keeping the IGS on the leading edge of this technology and encouraging broader recognition and use of IGS data products. This is especially important with regards to the global reference systems and the utility of GPS and GLONASS to provide access to the international terrestrial reference frame. Of course, many other issues and considerations were addressed in addition to these topics. The detailed plan will be will be made available in the next few months.

IGS Governing Board Business Meeting Summary

On 14 December, following the two days of strategy meetings, the Governing Board met for its 15th official meeting. The agenda began with a wrap-up of the two-day strategy session, defining the schedule for completing the documents as described above.

A pivotal event this past year was the decision by Tim Springer to resign his position as Analysis Center Coordinator. Tim was able to attend the Governing Board meeting and provided an excellent report on the state of IGS products. He was presented with the IGS certificate of appreciation, noting his long involvement and commitment to the IGS since pre-IGS days. The IGS is most fortunate that Prof. Beutler and his staff at the University of Bern were able to provide an excellent candidate as Tim's replacement, Prof. Robert Weber. The Analysis Center representatives and the Governing Board unanimously accepted Robert. This demonstrates Bern's remarkable commitment to complete the next two years of the Analysis Center Coordinator term. Many thanks again to AIUB for this perfect solution. Robert, in his new position, was also welcomed to the Governing Board and will represent the IGS on analysis issues. Tim was congratulated on his new position with wishes for success being expressed by the Board.

The issue concerning data centers for the IGS was also discussed at length, while noting the increased pressure on the data flow and access as a result of IGS sub-daily "ultra" products and moving closer to real-time processes. It was agreed that a solution must be found to ensure redundant capabilities and provide more efficient and timely access by the Analysis Centers to network data. Carey Noll agreed to work with the Analysis Center Coordinator and the Central Bureau to redefine data center requirements and processes. The IGS components and the Governing Board will review this in 2001 in anticipation of acquiring additional data centers and realizing enhancements at our existing data centers.

The remainder of the time was devoted to the IGS working groups and pilot projects. The current projects of the IGS are:

- IGS/BIPM Precise Time and Frequency Project — Jim Ray, U.S. Naval Observatory and Felicitas Arias, Bureau International des Poids et Mesures, Co-Chairs
- LEO Pilot Project — Mike Watkins, Jet Propulsion Laboratory, Chair

- Ionosphere Working Group — Joachim Feltens, European Space Operations Center, Chair
- Atmospheric Working Group — Gerd Gendt, GeoForschungsZentrum, Chair
- Reference Frame Working Group — Remi Ferland, Natural Resources Canada, Chair
- International GLONASS Service Pilot Project (IGLOS PP) — Jim Slater, National Imagery and Mapping Agency, Chair

According to IGS policy, each working group must be reviewed every two years to determine its status and continuance or dissolution of the activity. The IGS/BIPM timing project had been extended through 2001 previously, and the IGLOS-PP was approved at the June meeting of the Governing Board. All groups provided an update and it was decided to continue the working groups, with additional technical and organizational details to be considered at the next Board meetings. Reports on the progress of these groups are contained in the IGS Annual Report and in the Technical Reports. Progress is described generally in the IGS Report series or details may be obtained via the IGS website (*http://igscb.jpl.nasa.gov*). The organizational meeting of the IGS LEO Project will take place on 6–8 February at GFZ Potsdam; for more information, visit *http://op.gfz-potsdam.de/D1/LEOW/LEOW_index.html*.

The Central Bureau noted that, due to budgetary challenges, the finalization of the 1999 report series had been delayed since midsummer, but should be completed very soon, with electronic versions becoming available first.

Mike Bevis and I discussed the formalization of a working group on sea-level monitoring with continuous GPS measurements at tide gauges and tide gauge benchmarks. This has been a “seed” initiative of the IGS since the joint Permanent Service for Mean Sea Level (PSMSL)/IGS “Workshop on Methods for Monitoring Sea Level” in 1997 (see the proceedings, subtitled GPS and Tide Gauge Benchmark Monitoring and GPS Altimeter Calibration, in the “Publications” section at the IGS website). A proposal will be prepared for the next meeting of the IGS Governing Board. Mike is the responsible chair for the International Association for the Physical Sciences of the Ocean (IAPSO) Commission on Mean Sea Level and Tides and has established a website to further discussion of this activity at *http://www.soest.hawaii.edu/cgps_tg*. The Sea Level Change Project (SEAL), carried out by a number of German research institutions — GeoForshungsZentrum Potsdam (GFZ), GKSS Research Center Geesthacht (GKSS), and Alfred Wegener Institute for Polar and Marine Research (AWI). The project will put a concerted effort into GPS monitoring of global tide gauges. An introduction to the complete program can be found at *http://op.gfz-potsdam.de/seal/*. Additional recommendations at the meeting were to form two additional committees, reinstate the Infrastructure Committee, and create a new IGS Real Time Working Group.

The next meeting of the Governing Board is scheduled for 25 March 2001 in Nice, France, during the 26th General Assembly of the EGS.

One further note — it was decided to plan the next IGS workshop based on a theme as opposed to having separate analysis and network workshops. This is tentatively planned for early in 2002. Proceedings from the Network workshop in Oslo in July 2000 and the Analysis Center workshop at U.S. Naval Observatory in September will be published and available in spring 2001. The Network Workshop proceedings will be published by Elsevier in the peer-reviewed journal publication *Physics and Chemistry of the Earth*; the Analysis Center workshop proceedings will be published by the GPS *Solutions* journal.

Important IGS-related events and influences in 1999 and 2000

1999

9–11 March	Low-Earth Orbiter Workshop, Potsdam, Germany
8–10 June	Analysis Center Workshop, La Jolla, California
July	International Union of Geodesy and Geophysics General Assembly, Birmingham, UK
27 July	12th IGS Governing Board Meeting, Birmingham, UK
August	IGS Adopts ITRF97
15 August	GPS Week Roll-over
13 December	13th IGS Governing Board Meeting

2000

January	Call for Participation in IGS Low-Earth Orbiter Project announced
2 May	Selective Availability – removed!
March	IGS Tutorials in Capetown and Hartebeesthoek, South Africa
27 April	AFREF Planning Meeting, Nice, France
June	14th Governing Board Meeting, USNO, Washington, DC
12–14 July	IGS Network Workshop, joint with COST 716: “Towards Operational Meteorology,” Oslo, Norway
15 July	Successful CHAMP launch
13–14 September	IGS Strategic Planning Committee meets in Frankfurt, Germany
19–22 September	Institute of Navigation GPS2000 Annual Meeting, Salt Lake City, Utah; IGS User Forum conducted
25–29 September	IGS Analysis Center Workshop, USNO; two days devoted to the IGS-BIPM Precise Time Transfer Project

IGS Central Bureau - Status in 2000

Ruth Neilan

Jet Propulsion Laboratory,
Pasadena, California

Introduction

After the quiet and uneventful passage of "Y2K," the year 2000 for the Central Bureau was marked by significant outreach for the IGS organization, as described below. The IGS exhibit display and materials were completely redesigned to reflect the continuous IGS technical advancements and growth of projects. The exhibit is easily transportable and quite cost effective. The IGS tutorial, first developed in 1999 for the International Symposium on GPS (GPS99 Tsukuba) was revised, updated, and integrated into a single document available both as hardcopy and via the IGS website. The tutorial is an important tool for promoting the straightforward use of IGS data and products and outlines the IGS conventions as the accepted international standard.

A key task of the Central Bureau was the support for the organization of the IGS strategic planning committee, as addressed by Christoph Reigber in this Annual Report. The Central Bureau worked to prepare materials with the very experienced facilitator, Haig Bazoian, to organize interim documents, as well as managing the logistics for the various meetings of the planning groups and the Governing Board throughout the year. One of the factors resulting from the planning process is a critical consideration of the organization, staffing, and resources of the Central Bureau, and how this should be structured to properly support the IGS in the future. Resource issues of the Central Bureau delayed the publications of the 1999 and 2000 report series; however, the issues have largely been resolved at present and these important annual records should resume normal preparation and publication schedules.

The Central Bureau was very much involved in the preparation of the Call for Participation in the Low-Earth Orbiter (LEO) Pilot Project, as described in the reports by Christoph Reigber and Mike Watkins (this Annual Report). This is an IGS project with appropriate structure involving every component of the IGS (station, data centers, analysis centers, etc.). This activity is expected to have a significant effect on the IGS and to bring substantial enhancements technically and in terms of broadening partnerships.

IGS Outreach and Tutorial

The new IGS booth was first displayed in March 2000 at Capetown, South Africa, at the 28th International Symposium on Remote Sensing of the Environment entitled "Information for Sustainable Development." The IGS sponsored a tutorial during the venue of this symposium hosted by Richard Wonnacott, Director of Survey Services,

Chief Directorate of Surveys and Mapping, and Prof. Charles Merry, University of Capetown. The following week, the tutorial was again offered outside of Johannesburg at the Hartebeesthoek Radio Astronomy Observatory (HARTRAO) hosted by Ludwig Combrinck. HARTRAO is recognized as a fundamental station for geodetic positioning, where a number of techniques are collocated: very long baseline interferometry (VLBI), Global Positioning System (GPS), satellite laser ranging (SLR), and precise range and range-rate experiment (PRARE). The tutorial was well received in both locations and there was valuable feedback from attendees for making the IGS products more accessible to the user community. The IGS tutorial and product details were updated after the removal of selective availability on 2 May .

Expanding Partnership of IGS

The Chinese Seismological Bureau (CSB) is the designated project head for the Crustal Motion Observation Network of China (CMONOC), a newly implemented state-of-the-art national GPS network collocated with their existing seismic network. The CMONOC sent a letter to the Governing Board outlining their intention to participate in the IGS. The Governing Board responded very favorably to this with hopes to develop significant collaboration with CMONOC and its contributing organizations, while pursuing an open data policy as advocated by IGS values. Discussions with the CSB took place in China during January, where the U.S. National Science Foundation coordinators delegation negotiated the renewal of the 20-year U.S.–China protocol agreement on earthquake science research.

AFREF

A meeting on developing and implementing an African Reference System (AFREF), was held in Nice, France, organized by Claude Boucher as head of the International Association of Geodesy (IAG) Commission X devoted to Global and Regional Geodetic Networks. About 13 people attended, including representatives from and United Nations Food and Agricultural Organization (UN–FAO), the IGS Central Bureau, the Norwegian Mapping Authority, the European Reference Frame (EUREF), Sistema de Referencia Geocéntrico para América del Sur (SIRGAS), and the U.S. National Imagery and Mapping Agency. Lamentably, none present were African due to the ad hoc nature of the meeting. A meeting is expected to occur in Africa to encourage broad-based African participation in generating a project plan and structure. An e-mail list service was subsequently established by the Central Bureau to facilitate contacts between IAG, IGS, Africans, and people from the global community interested in such an activity. The IGS and International Earth Rotation Service (IERS), as IAG services and with IAG endorsement, have pledged strong support. It was noted that GPS is a truly viable and sustainable technology that can be adopted by the African organizations and maintained in the future for continental and national infrastructures. The Central Bureau has been invited to the Congress on South African Surveyors Meeting (CONSAS) to be held in March 2001 in Capetown where an AFREF planning meeting will be conducted. A regional realization based on IGS conventions may be the more practical approach given the numerous nations within Africa and the extensive infrastructure of the IGS. A

previous activity known as ADOS (African Doppler Survey) was initiated in 1981 and based on the TRANSIT satellite system. This was organized within the IAG International Coordination of Space Techniques of Geodesy and Geodynamics (CSTG), in cooperation with the IAG Commission for Geodesy in Africa.

International Geodynamics Research Center in Kyrgyz Republic

In June 2000, a dedication of the International Research Center–Geodynamic Proving Ground (IRC-GPG), took place in Bishkek, Kyrgyz Republic, followed by a four-day workshop on the geodynamics of the Tien Shan. This occasion was to dedicate new facilities collocated with the scientific station research facility of the Institute of High Temperatures, Russian Academy of Sciences (IVTAN). It was well attended by the international science community. The purpose of the new center is to facilitate not only regional but international collaborative research in geodynamics. Since 1992, a GPS network has been established through collaborations with Indiana University and Massachusetts Institute of Technology, consisting of more than 300 stations in the region and an impressive nine-station permanent GPS network. Two of these stations are recognized as global stations of the IGS and therefore of great importance for analysis and global network stability. One of these is located at IRC-GPG and known as the Poligan GPS station, and one is at Selezaschita, Almaty, Kazakhstan. A subsequent geological field trip included exploring various locations, some measured by GPS, revealing the intriguing geology and spectacular beauty of the Tien Shan region. The facility was the vision of Yuri Trapeznikov, former director of the IVTAN scientific station. The IRC-GPG was presented an IGS certificate of appreciation for outstanding contributions. For more information on this center and its activities see *http://tiger.gdirc.ru/irc/* or *http://helios.gdirc.ru/*.

Workshops

Network Workshop

The second major IGS Network Workshop was hosted by the Norwegian Mapping Authority, 10–14 July 2000 in Oslo, Norway. The purpose of this workshop was to focus on aspects of the network targeted at improving the infrastructure and network operations in support of the quality and timeliness of IGS products. Angelyn Moore, IGS Network Coordinator and Deputy Director of the IGS Central Bureau at the Jet Propulsion Laboratory in Pasadena, California, convened this workshop, which was considered a great success by all who attended. The local organization and logistics were excellently managed by the Norwegian Mapping Authority's Hans-Peter Plag, within the Geodesy Division under the direction of Bjorn Engen, a member of the IGS Governing Board. The workshop was held at the beautiful Soria Moria Hotel on a hill overlooking Oslo and provided a unique atmosphere enjoyed by all, which will be long remembered.

This was the first occasion that the IGS Network Workshop was convened as a multidisciplinary meeting. It was co-organized with "COST Action 716"– "European Cooperation in the Field of Scientific and Technical Research." Action 716 is

"Exploitation of Ground-Based GPS For Climate and Numerical Weather Prediction Applications." COST is a framework for scientific and technical cooperation, allowing the coordination of national research on a European level. The main objective of COST 716 is assessment on an international scale of the operational potential for exploiting ground-based GPS networks to provide near real-time observations for numerical weather prediction and climate applications. In parallel, the IGS has a dedicated Tropospheric Working Group estimating total zenith path delays (ZPD) and precipitable water vapor (PWV) at a number of the IGS stations (see Gerd Gendt's report in this Annual Report). Also, a number of the IGS agencies and their networks have either implemented or are moving towards real-time processing activities, many pursuing similar applications in terms of ground-based meteorology.

The Network workshop proceedings were published in the peer reviewed journal publication *Physics and Chemistry of the Earth* by Elsevier.

Analysis Center Workshop and IGS/BIPM Precise Time and Frequency Project

The IGS Analysis Center Workshop 2000 was held in September at the U.S. Naval Observatory, where Jim Ray and his USNO Earth Orientation Department colleagues did an outstanding job in organizing and hosting this superb workshop. This was a very good occasion for many interesting presentations and fruitful discussions. The first two days were devoted to the IGS/BIPM Timing Project (see Jim Ray's account in this Annual Report). The remaining days focused on IGS near-real-time products and their applications, and the potential interactions between the IGS and various Global Navigation Satellite Systems (GNSS, e.g., GPS, Galileo, GLONASS). A subset of the presented papers has been published as a special issue of the journal *GPS Solutions*.

The next IGS workshop will be based on the theme "Towards Real-Time" and will be hosted by the Natural Resources Canada Geodetic Division. This will be a comprehensive IGS workshop addressing all components, projects, and working groups. It is planned for early 2002.