

# The XXVI IUGG General Assembly, Prague, Czech Republic, 2015

## IAG Presidential Address

Chris Rizos<sup>1</sup>

### Distinguished Guests and Colleagues, Ladies and Gentlemen

It is my pleasure to welcome you to the IAG General Assembly, held here in Prague on the occasion of the 26<sup>th</sup> General Assembly of the International Union of Geodesy and Geophysics (IUGG). The IAG General Assembly marks the transition from the current Executive Committee to the new one. The new Executive Committee was elected by ballot prior to this General Assembly, and details will be provided later in my report. As outgoing IAG President my last responsibilities include chairing this Opening Ceremony. Before I proceed with some highlights of the last quadrennial period 2011-2015 I wish to thank all members of the IAG Executive Committee, and the many other colleagues who make vital contributions to the IAG Commissions, Services, and other components. Without your unstinting support and commitment the IAG would be a far poorer organisation, and it would not be able to provide the knowledge base, and products that now underpin many endeavours in geoscience, and society in general.

Let us first remind ourselves that the *Mission of the IAG is the advancement of geodesy*. The IAG implements its mission by furthering geodetic theory through research and teaching; by collecting, analysing, modelling and interpreting observational data; by stimulating technological development and by providing a consistent representation of the *figure, rotation, and gravity field of the Earth and planets*, and their temporal variations. The IAG shall pursue the following objectives:

- *Study*, at the highest possible level of accuracy, all geodetic problems related to Earth observation and global change.
- *Maintenance* of geodetic reference systems and frames.
- *Determination and study* of the Earth's gravity field.
- *Monitoring* the Earth's rotation and geodynamics.
- *Application* of geodetic studies to science and practice.

The IAG is structured into four Commissions, fourteen Scientific Services, the Global Geodetic Observing System (GGOS), the Communication and Outreach Branch (COB), and the Inter-Commission Committee on Theory (ICCT). The Commissions are divided into Sub-commissions, Projects, Study Groups and Working Groups. The administration is supervised by the Council, and managed by the Bureau, the Executive Committee and the Office. All these IAG components inform our community about their activities through such means as the IAG Newsletter and the biennial IAG Reports (Travaux de l'AIG).

The IAG Commissions are:

- Commission 1: Reference Frames
- Commission 2: Gravity Field
- Commission 3: Earth Rotation and Geodynamics
- Commission 4: Positioning and Applications

## 1 Activities

### Commission 1

Over the last quadrennial period Commission 1 organised several workshops, schools and conferences; conducted some focused studies; and coordinated reference frame activities at the regional level. Some highlights are:

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- Organisation of the *REFAG2014 Symposium*, in Luxembourg, 12-17 October 2014. Although intended to coincide with the release of the latest International Terrestrial Reference Frame ITRF2014, the delay in the completion of the computations underpinning the ITRF2014 meant that the conference covered a broad range of other global, regional and national reference frame topics. Tonie van Dam, President of Commission 1, did a tremendous job organising a successful REFAG symposium. (The REFAG symposia are one of a series of IAG symposia dealing with critical topics of interest to the IAG, and the wider community.)
- One extraordinary event took place on 26 February 2015, when the UN General Assembly adopted the resolution, *A Global Geodetic Reference Frame for Sustainable Development*, recognising the increasing role Geodesy plays in people's lives, and through its contributions to the geospatial discipline and to the geosciences, by provision of the fundamental mapping, geoscience and geospatial datum, and enabling easy connection to this datum using the GNSS technology through global services and infrastructure. The Working Group on the Global Geodetic Reference Frame (GGRF), established by the Committee of Experts of the UN Global Geospatial Information Management (UN-GGIM) initiative, is currently developing a Roadmap on how to progress the principles described in this UN-GA resolution.
- Validation of the Global Geophysical Fluids Centre (GGFC) models.
- Regional Reference Frame highlights:
  - Continuing increase in the number of GNSS Continuously Operating Reference Stations (CORS) within the six regional Sub-commissions.
  - Upgrade of CORS networks in the European Permanent Network, and elsewhere, to support multi-system GNSS capability.
  - Densification of the ITRF and IGS network is made by weekly combinations of five regional weekly solutions using different GNSS processing software.
  - Closer alignment of regional reference frame initiatives with those of the regional sub-groups of the UN-GGIM.
- Schools and Workshops:
  - Workshop on Site Surveys and Co-location, Paris, France, 21-22 May 2013.

Commission 1 was ably led by Tonie van Dam. I thank her, and her Commission Steering Committee for their hard work in managing the very important topic of Reference Frame definitions and realisations.

## Commission 2

Over the last quadrennial period Commission 2 organised a large number of successful workshops, schools and conferences; conducted some focused studies related to terrestrial and satellite-mapped gravity field parameters; analysed the products of recent gravity field mapping missions such as GRACE and GOCE, and coordinated activities that culminated in the proposal to establish an International Height Reference System and Frame. Some highlights are:

- Commission 2 organised another very successful *Gravity, Geoid & Height Systems (GGHS) Symposium*, Venice, Italy, 9-12 October 2012. (The GGHS symposia are one of a series of IAG symposia dealing with critical topics of interest to the IAG, and the wider community.)
- Project "Geoid in Africa" was one of the association projects supported by the IUGG.
- Conclusion of an agreement between Geodesy (IAG) and Metrology (CCM) concerning the future of the comparison of absolute gravimeters at BIPM, Paris.
- Release (5) of the final GOCE geopotential models.
- Many studies on sea level rise, ice melting, hydrological processes, etc, arising from the analysis of GRACE monthly solutions were reported at symposia and workshops.
- A pleasing outcome was the assurance of a GRACE follow-on mission, scheduled for launch in 2017.
- Progress in defining an International Height Reference System/Frame, which has led to an IAG resolution.
- Progress in defining a Global Gravity Reference Network, which has led to an IAG resolution.
- Improved models of the marine gravity field and ocean topography models from satellite altimetry were reported.

This Commission was ably led by Urs Marti. I thank him, and his Commission Steering Committee for their hard work in managing the many facets of Gravity Field mapping, modelling and services.

## Commission 3

Over the last quadrennial period Commission 3 organised a number of workshops and conferences, these included:

- *17<sup>th</sup> International Symposium on Earth Tides: Understand the Earth*, Warsaw, Poland, 15-19 April 2013.
- *International Symposium on Geodesy for Earthquake and Natural Hazards*, Matsushima, Miyagi, Japan, 22-26 July 2014.

- *International Symposium on Reconciling Observations and Models of Elastic and Viscoelastic Deformation due to Ice Mass Change*, Ilulissat, Greenland, 30 May - 2 June 2013.
- 16<sup>th</sup> General Assembly of WEGENER: *Earthquake Geodesy and Geodynamics: From Giant to Small Scale Events*, Strasbourg, France, 17-20 September 2012.
- 17<sup>th</sup> General Assembly of WEGENER: *Measuring and Modeling Our Dynamic Planet*, Leeds, United Kingdom, 1-4 September 2014.

Commission 3 was led by Richard Gross. I thank him, and his Commission Steering Committee for their hard work in making the geodesy community aware of the many exciting advances in studies into Earth Rotation and Geodynamics.

#### Commission 4

Over the last quadrennial period Commission 3 organised or participated in a large number of workshops, schools and conferences. Many of these were jointly organised with the IAG's sister organisations, the FIG (International Federation of Surveyors), ISPRS (International Society for Photogrammetry & Remote Sensing), ICA (International Cartographic Association), U.S. Institute of Navigation, and others. Many of the activities of the Sub-commissions and Working Groups are related to various aspects of GNSS precise positioning, and are therefore of a wider interest than just to the IAG and the IGS. Engineering Geodesy (deformation monitoring, etc), Atmospheric Effects on GNSS, Techniques of Precise GNSS Positioning, Geodetic Imaging (radar and lidar), are some of the topics under study. Some highlights are:

- Participation at many GNSS conferences, workshops and sessions, dealing with topics such as Precise Point Positioning (PPP), Real-Time Kinematic (RTK, and Network-RTK), Continuously Operating Reference Stations (CORS) infrastructure & services, kinematic, mapping & geodetic applications of GNSS.
- IAG/FIG/ISPRS cooperation in a number of symposia, field experiments, special journal issues, etc.
- Active participation and co-organisation of the *International Symposium on UAVs for Geomatics: UAV-g 2011*, Zurich, Switzerland, 14-16 September 2011; *UAV-g 2013*, Rostock, Germany, 4-6 September 2013.
- 8<sup>th</sup> *International Symposium on Mobile Mapping Technology (MMT)*, Tainan, Taiwan, 1-2 May 2013.

- 2<sup>nd</sup> *Joint International Symposium on Deformation Monitoring (JISDM)*, Nottingham, United Kingdom, 9-11 September 2013.
- Participation in a variety of focused conferences or sessions at larger conferences emphasising "Positioning & Applications": Location-Based Services, Imaging, Atmospheric Remote Sensing, Engineering Geodesy, and others.
- Schools and Workshops:
  - GNSS (HK, May 2012, 2014), Mobile Mapping (Taiwan, June 2012, April 2013; Xiamen, April 2015), AI in Engineering Geodesy (Munich, Sept 2012).

(The MMT, UAV-g and JISDM symposia are several of a series of IAG symposia dealing with critical topics of interest to the IAG, and to the wider geospatial community.)

Commission 4 was led by Dorota Brzezinska. I thank her, and her Commission Steering Committee for their hard work in promoting geodetic expertise in the fields of GNSS, Mobile Mapping/Imaging, and Atmospheric Remote Sensing, and others, to our sister organisations, and to the wider geospatial community.

#### Inter-Commission Committee on Theory (ICCT)

The mission of the ICCT is to interact actively and directly with other IAG entities, in particular Commissions and GGOS, in order to further the objectives of the ICCT:

- to be the international focal point of theoretical geodesy,
- to encourage and initiate activities to further geodetic theory in all branches of geodesy, and
- to monitor research developments in geodetic modelling.

During the last quadrennial period the highlights were:

- Transition of the ICCT to a permanent IAG entity.
- The work of nine Joint Study Groups (with the Commissions).
- Organisation of the *Hotine-Marussi Symposium*, in Rome, Italy, 17-21 June 2013 "in honour of Fernando Sansò". (The Hotine-Marussi symposia are one of the important IAG symposia dealing with topics of interest to the IAG.) The Chair of the ICCT was Nico Sneeuw.

#### Services

In many respects the IAG Services are the "engine room" of the IAG, and a significant differentiator of the IAG from its sister associations within the IUGG. There are fourteen IAG Services, which may be split into three general fields:

geometry (IERS, IDS, IGS, ILRS, and IVS), gravity (IGFS, ICGEM, IDEMS, IGeS, and BGI), and combination (IAS, BIPM, ICET, and PSMSL). All of them maintain their own Homepages and data servers, and have their governance structures. Details of their structures, products/services and work programs or priorities for the quadrennial 2011-2015 can be found in the Geodesists' Handbook 2012, and the progress reports 2011-2013 in the IAG Reports (Travaux de l'AIG). Most of the Services held international meetings, and participated in many symposia.

I would like to thank the Services representatives on the IAG Executive Committee: Riccardo Barzaghi, Ruth Neilan, Tom Herring. Some highlights:

- International Earth Rotation & Reference Systems Service (IERS)
  - Release of new International Terrestrial Reference Frame ITRF2014 is imminent (to update and replace ITRF2008).
- International GNSS Service (IGS):
  - 20<sup>th</sup> anniversary IGS Workshop, Pasadena, USA, 23-27 June 2014.
  - Continued engagement with many stakeholders and agencies, including GGOS, UN-GGIM, and the International Committee on GNSS.
- International VLBI Service for Geodesy and Astrometry (IVS):
  - General Meetings: Madrid, Spain, 2012; Shanghai, China, 2014.
- International Gravity Field Service (IGFS):
  - General Assembly, Shanghai, China, 30 June – 6 July 2014.

An assessment of the IAG Services is currently underway to facilitate strategic planning and to facilitate the improvement of their performance and their products, so as to better address the stringent requirements of GGOS 2020.

### **Global Geodetic Observing System (GGOS)**

The GGOS is IAG's observing system to monitor the geodetic and the global geodynamic properties of the Earth as a system. A new structure was set up during a retreat in 2011 and implemented in 2012. It includes a Consortium composed by representatives of the Commissions and Services, the Coordinating Board as the decision-making body, the Executive Committee, and the Science Panel. The scientific work of GGOS is structured by Themes, Working Groups and Bureaus. This new structure will be described in their separate report. The Chair of GGOS is Hansjoerg Kutterer. He has been reappointed for the next quadrennial period 2015-2019.

### **Coordination with Other Organisations**

IAG maintains close cooperation with several organisations beyond the associations of the IUGG. There were frequent meetings with the Advisory Board on the Law of the Sea (ABLOS, together with IHO), Group on Earth Observation (GEO, with IAG as a participating organisation), International Standards Organisation (ISO, TC211 Geographic Information / Geomatics), Joint Board of Geospatial Information Societies (JBGIS), United Nations Office for Outer Space Affairs (UN-OOSA), with participation in Space-based Information for Disaster Management and Emergency Response (UN-SPIDER); the International Committee on Global Navigation Satellite Systems (ICG); and the UN-GGIM.

## **2 Administration**

### **IAG Council**

The Council met twice during the IUGG General Assembly 2011 in Melbourne, Australia, and once at the IAG Scientific Assembly 2013 in Potsdam, Germany. The list of national correspondents forming the IAG Council was regularly updated with the assistance of the IUGG Secretary General. The Council was informed by email about activities of the Bureau and the Executive Committee.

### **IAG Executive Committee (EC)**

The EC comprises the IAG President, immediate Past-President, Vice-President, Secretary General, the four Commission Presidents, the Chairperson of GGOS, the President of the COB, three representatives of the Services, and two members-at-large. Seven EC meetings were held during the last quadrennial period: Melbourne, Australia, July 2011; San Francisco, USA, December 2011; Singapore, August 2012; Vienna, Austria, April 2013; Potsdam, Germany, September 2013; Vienna, Austria, April 2014, and San Francisco, USA, December 2014. The meeting summaries were published in the IAG Newsletter and are available online at the IAG Homepage (<http://www.iag-aig.org>) and in the IAG Office Homepage (<http://iag.dgfi.tum.de>). The EC meetings to be held at this IAG General Assembly will be the last for the current EC.

Main agenda items at the EC meetings were the regular reports of the Commissions, Services, GGOS, ICCT, COB, the Editor-in-Chief of the Journal of Geodesy, and the Editor of the IAG Symposia Series. They were typically followed by discussion on specific scientific issues,

changes in the structures of GGOS and Services, and IAG publications. Other important topics were the IAG Scientific Assembly 2013, the preparation of the IAG Symposia for the IUGG General Assembly 2015, the biennial IAG Reports (Travaux de l'AIG), sponsoring of symposia, and reports on engagement with other organisations, e.g. FIG, GEO, JBGIS, IHO, ISO, and UNOOSA.

### **IAG Bureau**

The IAG Bureau, consisting of the President, the Vice-President and the Secretary General, held monthly teleconferences and met regularly before each EC face-to-face meeting. The President and Secretary General participated in the IUGG Executive Committee meetings. The Bureau members represented the IAG at international scientific meetings, and at several anniversaries, as listed below under Awards, Anniversaries, and Obituaries.

### **IAG Office**

The IAG Office assists the Secretary General, responsible for administration of all IAG business, meetings and events, including the budget management, the record keeping of the individual IAG membership, and the preparation and documentation of all Council and EC meetings, with detailed minutes for the EC members and meeting summaries published in the IAG Newsletters and at the IAG Homepage. Important activities were the preparation and execution of the IAG Scientific Assembly 2013 together with the celebration of the 150<sup>th</sup> IAG anniversary and the IAG symposia of the IUGG General Assembly 2015. An important task was the publication of the Geodesist's Handbook 2012, providing an organisational guide to the IAG, with a complete description of the IAG structure (and reports, terms of reference, documents, etc); and of the Mid-Term Reports 2011–2013 (Travaux de l'AIG Vol. 38). Travel grants for young scientists to participate at IAG sponsored symposia were administered.

### **Communication and Outreach Branch (COB)**

The task of the COB includes maintenance of the IAG Homepage and publishing the monthly online Newsletter, and news items in the Journal of Geodesy. The COB also keeps track of all IAG-related events in the Meetings Calendar. The IAG Newsletter is sent to all IAG officers, individual members, the Presidents and Secretaries General of the IUGG Associations and liaison bodies. The COB designed, printed and distributed a new IAG leaflet and a comprehensive IAG brochure, and participated in the preparation of the Geodesist's Handbook 2012.

### **Awards, Anniversaries, Obituaries**

The following medals and prizes have been awarded during the past quadrennial period:

- Levallois Medal to Ruth Neilan, USA (2011)
- Bomford Prize to Johannes Boehm, Austria (2011)
- Young Author Award to Elizabeth Petrie, UK (2011)
- Young Author Award to Thomas Artz, Germany (2013)
- Young Author Award to Manuela Seitz, Germany (2013)

In addition, 53 Travel Awards were given to young scientists for participation at 15 IAG sponsored symposia.

The following anniversaries were celebrated with IAG participation:

- 150<sup>th</sup> anniversary of the Swiss Geodetic Commission, Zurich, Switzerland, 10 June 2011
- 150<sup>th</sup> anniversary of the Arc Measurement in the Saxony, Dresden, Germany, 1 June 2012
- 150<sup>th</sup> anniversary of the Central European Arc Measurement, Vienna Austria, 14 September 2012
- 150<sup>th</sup> anniversary of the Austrian Geodetic Commission, Vienna, Austria, 7 November 2013

Obituaries were written for former IAG officers and outstanding geodesists who passed away:

- 2011: A. Bjerhammar, Sweden; I. Fejes; Hungary; A. Finkelstein, Russia, S. Henriksen, USA.
- 2012: K.-P. Schwarz, Canada.
- 2014: C.C. Tscherning, Denmark; E. Kejlso, Denmark.
- 2015: B.E. Schutz, USA

## **3 Concluding Remarks**

Shortly after becoming President of the IAG on the 6<sup>th</sup> July 2011, I mused on what Geodesy “is” and how to explain this arcane field. During my period as IAG President I returned over and over again to this challenge. I have to explain not just what Geodesy is, but what its contribution to today’s “Grand Challenges” is. I did this in several news articles, and in keynote presentations at several international symposia. In order to define what Geodesy “is”, it is necessary to articulate what Geodesy is “not”.

I can remember I had a disturbing “eureka” moment in 2010. I had given a talk to an audience of surveyors on the theme “why Geodesy has a bad name”. I noted that the classical topics of Geodesy were no longer taught in many university surveying/geomatics programs. I rattled off the topics, which resonated with the audience. As I listed them, many members of the audience nodded their heads... geodetic control networks, atmospheric refraction, spherical harmonic models, geodetic boundary value

problem, deflections of the vertical, gravity anomalies and gravimetry, least-squares estimation, ellipsoidal computations, map projections, reference frame transformations, positional astronomy, and so on. What I had not appreciated until that moment was that all these were “hard” topics that few surveyors had fond memories of these subjects, and fewer would say they were better off by having studied them. Yet Modern Geodesy has progressed in the last decades in leaps and bounds.

A second revelation came to me also in 2010 as I participated in the centenary celebrations of the founding of the International Society of Photogrammetry & Remote Sensing (ISPRS) in Vienna by Eduard Dalezal. (The IAG and the ISPRS are two of the ten sister organisations making up the Joint Board of Geospatial Information Societies – JBGIS.) Speakers at the ISPRS 100 year anniversary conference celebrated the history of photogrammetry and remote sensing, but also enthused about the future of satellite technologies in helping address society’s environmental challenges. I sat there and thought, “that is what Modern Geodesy also seeks to do!” The goal of Modern Geodesy is nothing less than to monitor changes in a range of physical processes in the solid Earth, the atmosphere, and the oceans in order to improve our understanding of this fragile, precious and stressed planet. It was clear to me that Geodesy could be described as an *Earth Observation* (EO) discipline, or science. Certainly the classical definition of Geodesy does not make clear that it is an EO science which has broader functions and applications, and potentially more relevance, than just as a foundation for mapping and surveying.

So what sets Geodesy (and the IAG) apart from other EO disciplines? It is the fact that the IAG has fostered the establishment of Services to provide fundamental products for many geoscientific and geospatial end-users. No other IUGG or JBGIS organisation supports the number and range of Services that the IAG does. As IAG President I have been especially proud to acknowledge the important work of these services. The Services dealing with space (geometric) geodesy techniques include the International VLBI Service (IVS), the International Laser Ranging Service (ILRS), the International DORIS Service (IDS) and the best known, the International GNSS Service (IGS). The latter I knew very well, having been a member of its Governing Board since 2004.

Through another IAG service – the International Earth Rotation & Reference Systems Service (IERS) – these space geodetic techniques play a critical role in defining the fundamental reference frame in relation to which changes in the location of points on (or above) the Earth’s surface (including satellite orbits), or the shape of the land, or level of the ocean surface, can be monitored over many

years to sub-centimetre accuracy. Therefore special mention should be made of one of the IAG’s “flagship” products – the International Terrestrial Reference Frame (ITRF) – which also increasingly is the basis for modern national mapping datums. I am pleased that ITRF2014 is soon to be released. This IAG product together with the GNSS products of the IGS have raised the visibility of the IAG across the geoscience community, and beyond.

The IAG also established the International Gravity Field Service (IGFS) to measure and model the Earth’s gravity field to high accuracy using, for example, sophisticated gravity mapping satellite missions such as CHAMP, GRACE and GOCE. Gravimetric Geodesy can nowadays measure changes in gravity acceleration arising from mass transport (which changes gravity by tiny amounts) due to the global water cycle, atmospheric and ocean circulation, and solid earth processes such as volcanism and tectonics.

All of the IAG Services generate products on a continuous basis. These products may be the primary outputs of geodetic analysis, such as precise coordinates of GNSS monitor stations, or global meteorological values of humidity, temperature and pressure, or maps of ionospheric disturbances, rate of rotation of the Earth, orientation of its rotation axis, and many others. Such products can be used directly by many scientists. In addition, indirect products such as the reference frame, precise orbits of EO satellites, precise timing scales and high-accuracy GNSS-enabled navigation capability, support many other scientific and professional users. The IAG has commenced a „services assessment exercise“, but unfortunately it has not yet been concluded. The goal is to raise the quality and consistency of all geodetic products to support the Global Geodetic Observing System (GGOS).

During this past quadrennial we celebrated a very significant anniversary. The story is well known, but is worth repeating here. At the invitation of the Prussian General Johann Jacob Baeyer, representatives of the states of Prussia, Austria and Saxony met from 24<sup>th</sup> to 26<sup>th</sup> April 1862 in Berlin to discuss Baeyer’s “Proposal for a Central European Arc Measurement”. By the end of 1862, 16 nation states had agreed to participate in the project: Austria, Belgium, Denmark, France, seven German states (Baden, Bavaria, Hannover, Mecklenburg, Prussia, Saxony, Saxe-Gotha), Italy, The Netherlands, Poland, Sweden, Norway and Switzerland. The IAG counts this international scientific initiative, and the organisation it spawned, as its origin. Note that the primary motivation was to encourage national cooperation for a practical geodetic project, with the outcome being improved reference frame and geoid knowledge to support continent-wide mapping. Of course there were important science challenges that also had to be addressed, and hence from

the very beginning the IAG has fostered both operational geodetic practice as well as basic research. *This dual function continues to drive Modern Geodesy.*

In October 1864, the first “General Conference of the Representatives to the Central European Arc Measurement” took place in Berlin. The organisational structure was agreed upon and a research program was developed. The IAG considers this conference as its first General Assembly. Baeyer was appointed Director of the Central Bureau and Peter Andreas Hansen appointed President of the Permanent Commission. The project extended rapidly to other European states and consequently the name of the organisation was changed in 1867 to “Europäische Gradmessung”, and in 1886 to “Internationale Erdmessung” (“Association Internationale de Géodésie”) with additional member states Argentina, Chile, Japan, Mexico, and USA.

Baeyer died in 1885, and under his successor, Friedrich Robert Helmert, the Central Bureau moved from Berlin to Potsdam, together with the Geodetic Institute. Against all odds the IAG survived two World Wars, evolving in the process to focus more on the science of geodesy, becoming part of the International Union of Geodesy and Geophysics (IUGG) after that organisation’s establishment in 1919. In 1932 the name “International Association of Geodesy” was adopted. I was fortunate to be IAG President during this celebration, but acknowledge that I “stood on the shoulders of giants” (*nanos gigantum humeris insidentes*), a statement attributed to Isaac Newton, and most recently the motto of Google Scholar!

There are a number of reasons why Geodesy has in a comparatively short time transformed from an esoteric geoscience to valued geospatial discipline. Firstly, Modern Geodesy relies on *space technology*, and enormous strides have been made in accuracy, resolution and coverage due to advances in satellite sensors and an expanding portfolio of satellite missions. Secondly, Geodesy can measure Earth System parameters that no other remote sensing technique can, such as the position and velocity of points on the surface of the Earth, changes of sea level and the shape of the Earth’s ocean, ice and land surfaces, and map the spatial and temporal features of the gravity field. These geodetic parameters are in effect the “fingerprints” of many dynamic Earth phenomena, including those that we now associate with *global change* (due to anthropogenic or

natural causes) as well as responsible for devastating events such as earthquakes, tsunamis and volcanoes. The challenge is to invert the outward expressions of these dynamic Earth processes in order to measure and monitor over time the underlying physical causes. Finally what relentlessly drives geodesy into the future is the innovative use of signals transmitted by *Global Navigation Satellite Systems* (GNSS) such as the U.S.’s GPS and Russia’s GLONASS, E.U.’s Galileo, and China’s BeiDou – the latter two constellations currently being deployed and will be fully operational by the end of this decade.

However, GNSS is more than just another space geodetic technology. GNSS is today used for an enormous range of applications, from consumer uses such as for car navigation and in mobile phones to access location-based services, to professional applications such as machine automation (guidance of farm, mining and construction vehicles), emergency services, military operations, rapid mapping, surveying, transport management, and many more. However it is the special ultra-high accuracy form that is of geodetic interest. The IGS therefore deserves special mention. The IGS was established in 1994 as the first of the IAG’s geometric services, primarily by computing high accuracy GPS and GLONASS satellite orbit and clock data products, as well as open (and free) access to measurements made by a global ground network of continuously operating GNSS tracking stations. These hundreds of GNSS receivers on stable pillars or solid monuments operate continuously around the world also function as precise monitoring systems for ground movement due to global effects such as continental drift, local subsidence due to fluid extraction or underground mining, uplift due to volcanism or post-glacial rebound, and more. In 2014 the IGS celebrated its 20 year anniversary, and I was proud to participate in its celebration.

In summary, Geodesy is facing an increasing demand from Science, Engineering Applications, the Earth Observation community, and society at large for improved accuracy, reliability and access to geodetic services, measurements and products. My catch phrase as I stepped up four years ago to take on the presidency of the IAG still holds true “geodesy matters, now more than ever”. I am proud to have served the IAG, in a number of capacities over the last 20 years. I hope to continue to do so in the coming years.



**Fig. 1** IAG Presidents G. Beutler (2003-2007), W. Torge (1991-1995), I.I. Mueller (1987-1991), Ch. Rizos (2011-2015), M. Sideris (2007-2011); and Secretaries General H. Drewes (2007-...) and C. Boucher (1991-1995) at the IAG Scientific Assembly, Potsdam, Germany, 1-6 September 2013