



International Fédération of Surveyors  
Fédération Internationale des Géomètres  
Internationale Vereinigung der Vermessungsingenieure

**FIG Commission 5 Position and Measurement  
Conference Report**

**General Assembly for the International Union of Geodesy and  
Geophysics  
Earth on Edge: Science for a Sustainable Planet  
June 28 –July 7, Melbourne, Australia**

FIG Commission 5 Report

By Rob Sarib, Mikael Lilje, Graeme Blick and Allison Kealy

**General**

The 2011 International Union of Geodesy and Geophysics (IUGG) General Assembly was held in Melbourne (Australia) between June 28 and July 7, 2011. The event attracted some 4500 delegates from numerous countries, and there were 1891 posters and 3208 oral presentations. The symposium was held at the Melbourne Convention and Exhibition Centre.

The International Association of Geodesy (IAG) is one of the eight scientific associations comprising the IUGG, and is the association which has a Memorandum of Understanding (MoU) with FIG Commission 5. Mikael Lilje (Chair of FIG Commission 5), Rob Sarib (Vice Chair of Administration), Graeme Blick (Working Group Chair of FIG WG 5.2) and Allison Kealy (Working Group Chair of FIG WG 5.5) attended primarily the IAG component of the conference, and related business meetings. Consequently, this combined report focuses on their observations at these proceedings.

Generally, the IUGG and IAG events are a high level scientific symposium with presenters from either an academic background or agency that deals with the presenter's research or topic. This event was no different. Like previous IAG events, papers are not yet available in the proceedings, only the abstracts. This is because the process to "peer review" the final paper and its results / findings has not started. Presently, IAG is endeavouring to improve their review process so as to enhance the scientific status of their association. The review process is also an integral part of their publishing strategy, as such papers will be published both as paper in the "Springer" IAG symposia series as well as on the Internet (IAG web site). Consequently, with this rigorous review process it may take some time before the final papers are published and available to participating delegates to purchase.

In addition, since the general assembly was held in Asia Pacific region, and because of recent natural disasters in the region, such as earthquakes, flooding, and tsunamis, many presentations and research has focused on the science, measurement and analysis relating to such natural phenomena.

## **Observations from the IAG Opening Ceremony and Sessions**

- Three IAG awards were presented in the opening session. Ruth Neilan was presented with the Levallois Medal for distinguished service to IAG and Geodesy in general; Johannes Boehm received the Guy Bomford Prize which is for the young scientist who has achieved outstanding geodetic studies; and Elizabeth Petrie was awarded the young authors award for an excellent publication in the Journal of Geodesy. From a FIG perspective we were very pleased that Ruth received this award as she has been integral to the cooperation between FIG and IAG for many years, and has often taken an active part in FIG conferences.
- FIG was mentioned several times by several of the speakers in the opening session. The cooperation and discussions between the two associations appears to have become even stronger and recognized also within IAG.
- The new IAG Council will consist of Chris Rizos (President), Hermann Drewes (Secretary General), Mike Sideris (Past President), Harald Shuh (Vice President), Tonie van Dam (Commission 1), Urs Marti (Commission 2), Richard Gross (Commission 3) and Dorota Grejner-Brzezinska (Commission 4). Also members from the IAG services (Ruth Neilan, Riccardo Barzaghi and Tom Herring), general membership (Claudio Brunini and Richard Wonnacott), as well as Chair of GGOS (Hansjoerg Kutterer) are in the IAG Council.
- The budget for IAG is about 150 000 Euro in total for the four year period.
- IAG have about 180 individual members and the member fee is 50 USD per year or 150 USD for four years. Otherwise the IAG Council is comprised of country representations (typically from the academies of science).
- GIAC (GGOS Inter-Agency Committee) has been established as a result of a meeting in Frankfurt (Germany) in 2010 and its purpose is to ensure long term commitment for establishment, management and maintenance of geodetic infrastructure to support the goals of the Global Geodetic Observing System (GGOS).

## **Observation from the Technical Program and Sessions**

The IAG technical program format was divided into seven IAG symposia and six joint symposia with other associations. Two conveners were appointed to each symposia topic and their job was to invite speakers, select papers for oral presentation as well as posters and then also make sure that there were chairs / rapportuers for each of the sessions. Typically each symposia topic had oral presentations in several sessions. Posters were not seen as “second class” presentations within IAG, and the advertisement of posters were well highlighted in the program and at the event location. Also, if an oral presentation was cancelled then a poster was given the opportunity to be an oral presentation.

There were hundreds of interesting presentations as well as several business meetings that took place at the same time, thus it was impossible to cover everything. Nevertheless here are some highlights of the technical program;

- The development of VLBI 2010 policy and strategy was discussed by several presenters. Funding for such a program as well as covering on-going running costs seems to be a global issue.

- There were several VLBI and SLR presentations that referred to the new VLBI network and facilities in Australia, the associated initial results / solutions and their impact to the global solutions. The next schedule observing campaign for the Southern Hemisphere will occur on 8-9 August 2011. This observing session will involve the new telescopes and facilities in Australia and New Zealand, and also the VLBI observatory South Africa.
- The need for a universal data policy was discussed with respect to the availability of GNSS data in real time to IGS. Countries that could benefit from such a policy, both practically and politically would be those from the northern Africa region, China, and India.
- The Real Time Service provided by IGS has progressed rapidly! Main points to note were -
  - The development of real time streaming of precise ephemeris data is very promising. IGS is clear that this service is not to be seen as a “competitor” in the commercial market but as an alternative. How this service could have an impact on PPP or national / regional GNSS CORS and more, needs to be addressed and discussed in the near future. FIG should consider this as an excellent opportunity to arrange a workshop / panel discussion for the FIG WW in Rome.
  - Provision of performance reports weekly (positions) and rapid (clocks).
  - Provision of a combination solution (1 m = 1 hour) OR direct access to each individual data stream via NTRIP from participating data analysis centres.
  - Should the product only be in ITRF latest epoch or should users be able to get the product in regional realizations?
- With respect to reference frames there was interesting discussion concerning the frequency of the realization of the ITRF. Recent and significant seismic events have resulted in major deformations of the earth i.e. New Zealand, Chile, Japan etc. Such events have instigated the notion of a “semi dynamic reference frame” and one presenter has suggested that “monthly” realizations of the ITRF need to be considered, at least from a scientific perspective. This of course means the regional and global observing networks (i.e. VLBI, SLR, GNSS measuring facilities), that are used to determine the ITRF, need to be
  - managed with greater integrity and reliability,
  - more homogenous, that is an observing network which is evenly distributed across the globe
  - at locations where there is a high probability of seismic activity, and
  - other associated infrastructure needs to have the capability to produce more frequent realizations.
- The implications of a semi dynamic reference frame concept for national agencies will also be related to management of the “changing” mathematical relationship between the semi dynamic ITRF and the local/national geodetic datum. That is, the production and maintenance of rigorous transformations and implementation of solutions to the end user. From a user perspective however, regular realizations of the ITRF can be an annoyance if realized locally.

- Numerous papers on how agencies managed the modelling of recent seismic events and their relationship to downstream land datasets. Such dynamic velocity models will also be crucial to the “semi dynamic ITRF” concept.
- It was noted how governments from countries reacted to the ongoing “funding” of geodetic infrastructure after natural disasters. In New Zealand funding has increased substantially whilst in Japan they have received a 10% cut to cover the damage costs. This may be indicative of the scale of the disaster, pending high level inquiries/audits and associated politics.
- All regional reference frame projects are progressing well, except for AFREF – the issues here are well known but are difficult to overcome and will require perseverance.
- The issue of managing ‘signals’ in a multi-GNSS environment was presented during the High Precision GNSS sessions. In particular the analysis / examination of these multiple signals / observations from several constellations in deformation applications and also how they will be processed in future GNSS receivers.
- Numerous presentations on how to ‘improve’ precise point positioning (PPP) for either real time or static observations. Researchers investigated ambiguity resolution for PPP for single and dual frequency receivers, integration of Network RTK or GNSS CORS network data for PPP determination, and derivatives of existing PPP algorithms. It appears the intent is to reduce the satellite orbit and clock biases associated with PPP however ultimately standard positioning techniques and reductions are still applicable to ensure the integrity of PPP results. From presentation results it appears that it takes approximately 15 to 30 minutes for PPP ambiguity resolution for single frequency and dual frequency receivers respectively.
- Several interesting presentations from Australia, Thailand, Iran, Sweden, and Germany on the use of GNSS CORS, atmospheric models, deformation modelling techniques, and reference frames to measure and model the 3-dimensional motion of tectonic plates over time, and also after seismic events.
- World Height System (WHS) was an initiative that was discussed on several occasions during the congress with numerous participants from various agencies and organizations. Such dialogue was instigated by Mikael Lilje’s invited presentation titled “Are there any practical applications of a WHS?” Mr Lilje’s thought provoking presentation stated that there are NO practical survey applications for a WHS but acknowledged there are possible applications of a WHS for regional / global scientific research studies i.e. climate change, sea level rise and for integrating local datums. As a result of this presentation there was much discussion amongst the WHS community about the need to deliver an outcome. It also needs to be acknowledged that FIG representatives Graeme Blick, Rob Sarib and Matt Higgins assisted Mr Lilje with the preparation of this presentation.
- Many papers demonstrated that countries are managing vertical height systems in different ways, however there are common issues –
  - Having consistency between h, N, and H.
  - Defining the geometric and physical components.

- Defining the  $W_0$  – which geopotential / gravity model shall be used; effects of ocean and crustal influences; use of tide gauges and / or terrestrial information.
  - Datum unification – both horizontal and vertical reference frames, non geo-eccentricity of datums, use of terrestrial leveling networks.
  - Creation of velocity models of the geoid and other surfaces to cater for undulations both linear and non linear (seasonal).
  - Mathematical definitions or relationships between the different vertical surfaces.
- From a technical perspective the WHS has yet to be realized however it appears the realization will be a combination of gravimetric model (EGM08?) and a GRS80 based ellipsoid. Most of the major scientific issues appear to be resolved however it is the finer technical details that need to be agreed upon by the experts. It was clear that there is some frustration among some delegates that they were not able to set a definition and a first realization in Melbourne. The expectation now is that there will be a realization in two years time and a resolution at the next IUGG assembly in 2015.
  - Chris Pigram, the CEO of national surveying and mapping agency of Australia - Geoscience Australia (GA), provided an interesting perspective and overview of their organisation and the challenges ahead. The following highlights may be of interest to other similar agencies –
    - Once present issues concerning the measurement of climate change and providing useful information relating to ‘under covered’ on / off shore resources are addressed, the more strategic issue of ground water resource management needs to be dealt with.
    - 10% of GA personnel (total 850 plus) are involved with Geophysics or Geodesy.
    - GA need to assist with the discovering of new, alternate and “pipeline” energy resources through the provision of numerous land related models and datasets.
    - Upper lithosphere is the “hot spot” for geo-science activity ie < 500 m below the earth’s crust.
    - GA need to fix, organize, and translate geophysical data to a spherical co-ordinate system which is pushing towards a high performance computing base given the demands on processing.
    - GA needs to create a multi-GNSS environment, understand the strain and neo-tectonic faulting – to assist with the management of natural hazards.
    - GA need to ensure an effective visualization is accessible and has integrity for users.

### **Business Meetings during the Congress**

Mikael Lilje and Rob Sarib participated at the **IGS Bureau** meeting and below are relevant FIG issues –

- The next IGS Workshop will be held in Poland 23-27 July 2012. There will be workshops and sessions on GNSS, analysis / network centres, real time services, multi-GNSS environment, international scene / status, future activities. The format / frame work / structure for this event is still being developed.

- IGS / RTCM committee - The new RTCM v3 protocol has been endorsed and will now also include; precise ephemeris data - satellite orbits, and clocks biases. This will impact PPP and Network RTK and positioning service providers.
- FIG to consider promoting IGS real time services via a workshop or open forum at the Rome WW in 2012.
- IGS to be more proactive in the examination of a multi-GNSS environment – analysis of the numerous signals via long term or episodic (campaign) observations at IGS or similar sites.
- IGS to support the deployment of multi-GNSS receivers and to issue a call for participation for an IGS multi-GNSS experiment.

Mikael Lilje and Rob Sarib participated at the **GGOS Inter-Agency Committee (GIAC)** meeting and below are some reflections that have FIG relevance –

- Presently GIAC has its web portal at the GGOS website. Information about GIAC, its terms of reference etc can be found there.
- GIAC role is primarily an advocacy one.
- GIAC is not an official sub-committee of GGOS or IAG, that is, it is independent and not governed by these organizations. It does however have “strong links” with respect to advocating the objectives and outcomes from such organizations.
- Membership is made up of agencies who manage geodetic infrastructure.
- GIAC is expected to meet twice a year and the next meeting is at AGU (American Geophysics Union) - San Francisco, USA 5 - 9<sup>th</sup> December 2011.
- Considerations for FIG –
  - Support next call for participation through FIG membership once GIAC services / role / benefits of participation have been clarified.
  - Endorsement of this committee.
  - Facilitate a meeting and / or session at the Rome FIG WW 2012.
  - Placement of FIG logo on website.
  - Can FIG participate with GIAC through the existing IAG / FIG MoU?
  - Prepare a spiel about FIG, their support for GIAC and encouraging agencies to participate.
  - Examine if GIAC has communicated with PCGIAP, and IGS members.
- GGOS TORS were revised by Ruth Neilan; points to note –
  - New vision statement,
  - Preamble changed,
  - New mission / goals,
  - More referencing to GGOS 2020 publication, and
  - Streamlining the GGOS management / steering committee / board / bureau / working group structure, and also addressing issues of governance, protocols, administration, appointments, voting, etc.
- GGOS ‘network bureau’ will consider issuing a call for participation and expanding it to include all geodetic infrastructures and other. There is possibly a role for FIG.

Mikael Lilje and Rob Sarib had a meeting with Larry Hothem re **ISO TC211 and FIG**. Points and issues for consideration are –

- There are 3 working groups that require participation of a FIG member and they are Geodetic Registry Network, Sub-commission of Geodetic References, and Terminology Maintenance Group.
- Geodetic Registry Network; A group chaired by Mike Craymer is looking into a geodetic registry. A suitable program has been chosen and will be run by the Norwegian Mapping Authority. The controlling body is interested in having a member from FIG to participate.
- A sub-commission on Geodetic References will soon be established. One important work item will be to make ITRS an ISO standard.
- The terminology maintenance group is led by Andrew Jones and is looking into the use of symbols, abbreviations, etc. This working group will have strong links to the Geodetic Registry Network.
- Larry Hothem will email the terms of references and other related documents. Upon receipt of this information FIG needs to discuss and decide on who will be involved in these work items.
- The next ISO TC211 meeting is in Cape Town, South Africa – Nov 2011.

Graeme Blick had an informal meeting with a group of interested participants to discuss issues around the implementation of dynamic datums and setting up an interest group. It was agreed that the group should work through both the IAG (Commission 1) and FIG (Commission 5) as there were both scientific and operational issues to consider. It was also agreed that a special session on Dynamic Datum implementation be proposed for the FIG WW in Rome.

### **IAG / FIG Liaison meetings**

There were numerous formal and informal meetings with various IAG, IGS and other related agency representatives. Participants included Chris Rizos, Ruth Neilan, Matt Higgins, Zuheir Altamimi, Graham Blick, Rob Sarib, Mikael Lilje, Allison Kealy, Guenther Retscher, John Dawson and Gary Johnston. The following items were discussed –

- Joint technical seminars / workshop on reference frame issues. There is a need in the South East Asia region to raise the level among the surveyors within the scope of APREF.
- Proposals for three different types of technical seminars / workshops were discussed:
  - FIG to consider taking the lead in organizing a two day ‘technical seminar’ at FIG WW in Rome. Graeme Blick, Rob Sarib and Mikael Lilje to discuss a preliminary agenda as well as start contacting potential presenters. It is preferable that this technical meeting is held in conjunction with the Young Surveyors Conference (YSC) and as an “add-on” to the participants who will participate at the FIG WW. FIG to consider approaching UNOOSA for funding to bring surveyors from developing countries to the meeting.
  - IAG and APREF to possibly take the lead in organizing a ‘workshop’ in Australia - maybe late in 2011(?). It was proposed that John Dawson could be responsible for setting the agenda and that funding from UN OOSA could be obtained. FIG should consider endorsing such a proposal.
  - IAG to consider organizing a reference frame or geoid ‘school’, and FIG to consider facilitate it at the South East Asian Surveyors Conference (organised by ASEAN Flag) in 2013 in the Philippines.

- At the closing session, Mikael Lilje was asked by Joao Torres about the possibility of arranging a technical meeting also at the IAG Commission 1 meeting during the term 2011-2015 of IAG.