



**International Association
of Geodesy**

Newsletter

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The *IAG Newsletter* is under the editorial responsibility of the *Communication and Outreach Branch* (COB) of the IAG.

It is an open forum and contributors are welcome to send material (preferably in electronic form) to the IAG COB (newsletter@iag-aig.org). These contributions should complement information sent by IAG officials or by IAG symposia organizers (reports and announcements). The *IAG Newsletter* is published monthly. It is available in different formats from the IAG new internet site: <http://www.iag-aig.org>

Each *IAG Newsletter* includes several of the following topics:

- I. news from the Bureau Members
- II. general information
- III. reports of IAG symposia
- IV. reports by commissions, special commissions or study groups
- V. symposia announcements
- VI. book reviews
- VII. fast bibliography

General Announcements

President's Annual Report 2017

2017 was another very successful year for IAG. The top highlight was the organization and effective running of the IAG/IASPEI Joint Scientific Assembly in Kobe, Japan, from July 30 through August 4, 2017, together with the IAG business meetings. Further highlights were the progress of the IAG strategic process and IAG's involvement in IUGG and ICSU activities. In the following, I would like to report briefly on some of my undertakings as IAG President in 2017.

I gave well-received talks on “IAG” and “GGOS” at several meetings and conferences, for instance, at the *1st IUGG Symposium on Planetary Science – Interdisciplinary observation and understanding of the Solar System* in Berlin, Germany, on July 5, 2017, at the *Workshop on GNSS and VLBI Geodesy* in Chiang Mai, Thailand, on August 17, 2017, at the *GGOS Days* in Vienna, Austria, on October 31, 2017, or at the *75th anniversary of the University of Architecture, Civil Engineering and Geodesy (UACEG)* in Sofia, Bulgaria, on November 1, 2017.



Fig. 1: Kobe city (photo: H. Schuh).



Fig. 2: Advertisement in a Kobe public train (photo: H. Schuh).



Fig. 3: Short statement during the IAG Social Dinner in Kobe (photo: H. Schuh).



Fig. 4: At the 75th anniversary of the University of Architecture, Civil Engineering and Geodesy (UACEG) in Sofia, Bulgaria, on November 1, 2017 (photo: H. Schuh).

Last year, I received invitations from all over Germany to give a talk on the occasion of the 100th anniversary of Friedrich Robert Helmert's passing. These were not official invitations to the IAG President, but nonetheless, when I gave those talks on “100 years after Helmert” in Aachen, Potsdam, or Dortmund, it was surely a good, or to be honest, a proud feeling to be embedded in IAG. At this point, I also have to mention again our anniversary

celebrations of Helmert and the 125 years anniversary of the Potsdam Geodetic Institute on April 7, 2017 (see the report in the IAG Newsletter of May 2017).

The business meetings during the IAG Scientific Assembly in Kobe comprised in particular three IAG Executive Committee (EC) Meetings, one IAG Bureau Meeting, and one IAG Council Meeting, and all went very efficiently. The EC's decision to establish new sub-components of IAG Commissions as inter-Association commissions, namely on *Volcano geodesy*, *Seismo-geodesy*, and *Cryospheric deformations*, and to establish the two new inter-Commission projects of IAG (on *New technologies in geodesy* and on *Marine geodesy*) are very timely.

On September 1, 2017, I had the pleasure to welcome the participants of the Steering Committee Meeting of the GeoUnions of the International Council for Sciences, ICSU, at the German Research Centre for Geosciences, GFZ. The meeting was hosted by the Secretariat of the International Union of Geodesy and Geophysics, IUGG, which is based at the GFZ. The GeoUnions are a consortium of nine international organizations of geosciences. The aim of the GeoUnions is to speak with one voice within the ICSU, of which it forms part. Their focus is on promoting geosciences and space sciences, and to coordinate joint interests against global organizations like the United Nations. During the meeting, issues like a potential fusion of the ICSU and the International Social Science Council, ISSC, were discussed. Further topics were the advancement of sciences as a global collective good as well as strengthening the cooperation of different interdisciplinary ICSU programs and networks. The participants further discussed the 32rd ICSU General Assembly in October 2017 in Taipei, Republic of China.



Fig. 5: Participants of the GeoUnions Steering Committee Meeting, Potsdam, Sep 1, 2017 (photo: GFZ).

Another highlight in September was the IUGG Executive Committee meeting in Montreal, Canada (September 19-21, 2017), which included a site inspection of the venue for the 27th IUGG General Assembly to be held in Montreal, Canada, from July 9-18, 2019. The Executive Committee acknowledged that all preparations are well on track and the next GA will be held in an expedient Convention Center in a beautiful environment.

I am pleased that we are well on schedule with the IAG strategic planning process. After the draft strategy document had been discussed and approved at the EC Meeting in Vienna on April 28, 2017, it was presented to the IAG Council delegates at the IAG Scientific Assembly in Kobe in July 2017. It is planned that the strategy document will be finalized still this year, to be approved at the IUGG General Assembly in Montreal 2019.

In closing, I would like to thank all colleagues in the Bureau and Executive Committee of IAG for their support and collaboration in 2017, and the Secretary General and his Assistant for their unwavering commitment to the Association.

HARALD SCHUH
IAG President

Meeting Announcements

Scientific Congress of the National Geodesy and Geophysics Union of Turkey

Dear Colleagues,

We would like to inform you that the Scientific Congress of the National Geodesy and Geophysics Union of Turkey (TUJJB-BK) will be held in Izmir, Turkey in *30 May – 2 June 2018*. This meeting will be organised under the auspices of General Command of Mapping by hosting two engineering departments from two different universities in Izmir; Department of Geophysics of the Dokuz Eylul University and Department of Geomatics of the Katip Celebi University (<http://www.tujjbkongre2018.org/>).

The deadline for abstract submission is pointed out in the web site. The Congress will be conducted in Turkish and English. Please visit the web site for more details related to the congress (hotels, restaurants serving local traditional food, visiting places, nontechnical touristic trips in Izmir, registration fee, etc). For further information, do not hesitate to contact with the congress secretariat. Necessary information can be found in <http://www.tujjbkongre2018.org/en/> .

In the frame of TUJJB-BK meeting, we look forward to hosting you in Izmir, the cultural and industrial capital of the Aegean region of Turkey.

Sincerely Yours,

Dr. O.Atila AKABALI
Head of Turkish National Geodesy Commission
On behalf of TUJJB-BK

Meetings Calendar

IAG Sponsored Meetings

International Review Workshop on Satellite Altimetry Cal/Val Activities and Applications

April 23-26, 2018, Chania, Greece

URL: <http://frm4alt.eu/int-cal-val-review>

UN GGIM AP / IAG / FIG Technical Seminar on Reference Frames in Practice

May 4-5, 2018, Istanbul, Turkey

URL: <https://iag.dgfi.tum.de/en/meetings-calendar/>

EUREF Symposium 2018

May 30 – June 1, 2018, Amsterdam, The Netherlands

URL: <http://euref2018.nl>

10th IVS General Meeting

June 3-8, 2018, Longyearbyen, Spitsbergen, Norway

URL: <http://www.ivs2018.no>

First Workshop on the International Geodynamics and Earth Tide Service (IGETS)

June 18-20, 2018, Potsdam, Germany

URL: <http://isdc.gfz-potsdam.de/igets-data-base/igets-workshop-2018/>

IX Hotine-Marussi Symposium on Mathematical Geodesy

June 18-22, 2018, Rome, Italy

URL: <https://sites.google.com/uniroma1.it/hotinemarussi2018/>

42nd COSPAR Scientific Assembly (with REFAG2018 and Panel on Satellite Dynamics)

July 14-22, 2018, Pasadena, CA, USA

URL: <http://cospar2018.org/>

IAU XXXth General Assembly

August 20-31, 2018, Vienna, Austria

URL: <http://astronomy2018.univie.ac.at/>

GGHS2018

September 17-21, 2018, Copenhagen, Denmark

“Gravity, Geoid and Height Systems 2” Symposium, 2nd joint meeting of the International Gravity Field Service and Commission 2 of the IAG

URL: <http://www.space.dtu.dk/gghs2018>

International DORIS Service (IDS) Workshop

September 24-29, 2018, Ponta Delgada, Azores

URL: <https://iag.dgfi.tum.de/en/meetings-calendar/>

IGS 2018 Workshop

October 29 – November 2, 2018, Wuhan, China

URL: <https://iag.dgfi.tum.de/en/meetings-calendar/>

21st International Workshop on Laser Ranging

November 5-9, 2018, Canberra, Australia

URL: <http://www.serc.org.au/iwlr-2018/>

27th IUGG General Assembly

July 8 – 17, 2019, Montreal, Canada

URL: <http://www.iugg.org/assemblies/>

IAG Related Meetings

Munich Satellite Navigation Summit 2018

March 15-17, 2018, Munich, Germany

URL: <http://www.munich-satellite-navigation-summit.org>

EGU General Assembly 2018

April 8-13, 2018, Vienna, Austria

URL: <http://www.egu2018.eu/>

Scientific Congress of the National Geodesy and Geophysics Union of Turkey

May 30 – June 2, 2018, Izmir, Turkey

URL: <http://www.tujjbkongre2018.org/en/>

AOGS 15th Annual Meeting

June 3-8, 2018, Hawaii, USA

URL: http://www.asiaoceania.org/society/public.asp?view=up_coming

Baltic Geodetic Congress 2018

June 21-23, 2018, Olsztyn, Poland

URL: <http://bgc2018.systemcoffee.pl>

IX International Symposium "Metrology of Time and Space"

September 12-14, 2018, Mendeleevo, Russia

URL: <http://www.vniiftri.ru/index.php/en/news/conferences/741-sym9>

ION GNSS+ 2018

September 24-28, 2018, Miami, Florida, USA

URL: <https://www.ion.org/gnss/>

GGOS Days 2018

October 2-4, 2018, Tsukuba, Japan

URL: <http://ggosdays.com/en/meetings/2018/ggos-days/general/>

EVN Symposium and Users' Meeting

October 8-11, 2018, Granada, Spain

URL: <http://evnsymp2018.iaa.es/>

AGU 2018 Fall Meeting

December 10-14, 2018, Washington, D.C., USA

URL: <https://meetings.agu.org/>

EGU General Assembly 2019

April 7-12, 2019, Vienna, Austria

URL: <http://www.egu2019.eu/>

AOGS 16th Annual Meeting

July 28 – August 2, 2019, Singapore, Singapore

URL: http://www.asiaoceania.org/society/public.asp?view=up_coming

Reports

2017 ILRS Technical Workshop

Riga, Latvia, October 2–5, 2017

Workshop Summary

Every two years the ILRS conducts Technical Workshops to focus on a few timely topics that impact the quality of our data products and our operations. These workshops are held in intervening years between the full International Workshops on Laser Ranging and are intended to provide time to articulate the issues carefully, allow for in-depth discussion, and formulate a path forward. The 2017 ILRS Technical Workshop, sponsored by the Institute of Astronomy at the University of Latvia and the ILRS, was held in Riga, Latvia, October 2-5, with the theme "Improving ILRS Performance to Meet Future GGOS Requirements". The workshop focused on addressing the following questions:

- What are the current and anticipated laser ranging requirements for the various satellites and have we defined them properly?
- How do we evaluate our current performance and is it adequate?
- What factors are currently limiting our network performance?
- What operational steps and tools would help us to better meet satellite ranging accuracy and scheduling requirements?
- What automation capabilities have been implemented or are planned for implementation, and what automation capabilities should stations consider?

Over 120 people from 21 countries participated in the meeting. The program included over 50 oral presentations, as well as many relevant posters.

The first day discussed user requirements and how well the ILRS is addressing these requirements. It started off with a reminder that laser ranging is one of the fundamental techniques for GGOS in its role of advancing our understanding of the dynamic Earth system by quantifying our planet's changes in space and time to:

- advance Earth science (Earth, oceans, ice, atmosphere, etc.)
- help us better understand the processes
- help us make intelligent societal decisions

The most stringent challenge for SLR comes from the mm reference frame requirement from GGOS, however other requirements such as altimetry and GNSS validation are not far behind.

Technologies are maturing; new technologies are on the horizon, and the core network is growing; international and political recognition (UN-GGIM) is increasing; and our space geodesy products (e.g., unified height systems, unified sea level model, natural hazard warning tools, etc.) require integration of measuring techniques.

A recent user survey revealed that that essentially all of the satellites on the ILRS tracking roster are being used in current research, but that data requirements varied greatly in terms of quantity and quality. Presentations

were given on the requirements of several user disciplines including the reference frame, ice and ocean altimetry, GNSS, CubeSat technology, time varying gravity field, and atmospheric drag.



(photo courtesy of Toms Grinbergs, University of Latvia)

Review of network output showed that some applications, in particular the reference frame and GNSS tracking, need better SLR global distribution of the stations and more uniform station performance. We also examined some ideas on how to rate station performance and task the stations in order to increase the total efficiency of the network. Several stations are supporting other applications such as tracking space debris and time transfer applications. These are certainly of interest and, at present, do not appear to have a significantly negative impact on the tracking schedule.

The second day of the workshop addressed how we evaluate our current performance. Work continues on the Station Systematic Errors Pilot Project and its conversion into an operational product later this year or early 2018. Examination of network data on SLR satellites over many years revealed interesting signatures correlated with the elevation and azimuth of the passes, day versus night-time conditions, and ascending vs. descending pass segments. These topics are under study, but the main focus is now on the primary sources of systematic errors that map directly onto geodetic products, such as errors in satellite center-of-mass models, data sampling issues, and incorrect modeling of system processing of return signals. Range measurement dependence on pulse length, rise time, signal strength, and detection system will need closer attention as we seek mm and sub-mm results.

T2L2 is providing an epoch standard for keeping track of timing errors throughout the network to levels of a few 10's of nsec. The new Russian "Tochka Station" configuration with two SLR systems offers greatly expanded satellite tracking coverage and frequent co-location to enhance quality control. Presentations and discussion also covered new web tools, websites and on-line forums to encourage communication and distribution/sharing of diagnostic information.

The third day focused on obstacles that are currently limiting network output and operational steps that could improve ranging performance. The usual culprits were equipment problems, budget, weather (the usual), and daylight tracking limitations. Language and culture issues may be a communications problem in some cases; regional telephone conferences might help. Event timer replacement of time interval units (TIUs) by NASA has demonstrated a parallel data flow technique that allowed data from both paths to be viewed simultaneously for very detailed performance comparisons. Comparisons of single and multiple photon operations led to considerable discussions on operational convenience, range bias elimination, and data stability.

Studies continue on using correlation techniques on the return signals to reduce range biases (particularly on the spherical passive satellite) and new potential methods for bias-free range measurements at the mm-level with MCP and silicon photomultiplier-type detectors. Recent timing experiments with T2L2 have shown that there are some uncompensated optical time and frequency distribution at the nsec level in the tested systems. This points out the need to continue this work with future timing missions and to develop methods at the stations to implement improvements made possible through active control and closure measurements. Several groups are studying the sensitivity of SLR observations to tropospheric horizontal gradients and atmospheric asymmetry, however, our low elevation data yield is still a very small fraction of the total for this to be of any consequence. There was some discussion on refining the definition of normal point durations to try to minimize the amount of data necessary to reach 1 mm normal point RMS. It was also noted that some stations that are geographically close could plan some shared tracking campaigns to help expand satellites' coverage and carry out tracking experiments.

The fourth day concentrated on automation and autonomous station operations. It was pointed out that Alexander Neidhardt's new book "Applied Computer Science for GGOS Observatories" provides a very nice reference on the topic including a thorough discussion on the relevant software issues.

Representatives from many of the stations described their activities underway and planned from automated scheduling through full operations and optimal automated operations using situational awareness from multi-sensor data. There was also a discussion on when automation make sense.

Automation of SLR stations has the potential for dramatically increasing the data volume while at the same time reducing the operating costs. However, full automation isn't for all stations as it involves development and implementation costs. It is probably most cost effective to fully automate a network of stations rather than a single station. Fortunately, automation can be implemented in stages and can range from supporting the operational manpower (making the station easier to operate) to full automation where there is no human operator at all.

There remain many challenges for full automation including personnel, system, and area safety and aircraft avoidance. Other challenges discussed included automating the signal determination, telescope pointing optimization, cloud considerations and weather considerations, and dynamic (real-time) scheduling. Finally, security remains a challenge, including both physical plant and IT security. A fully automated SLR system must protect against illegal physical and IT entry.

To promote automation at the stations, more effort should be made to share information and experience, including algorithms, relevant procedures and software, and commercially hardware. It was also suggested that the ILRS develop general guidelines and an overview of successful implementations to date.

The workshop concluded with summary presentations from the chairs of the four sessions as well as the chairs of the standing committees and study groups. In addition, the participants supported resolutions that (1) urged to the community to seek more SLR stations in the southern Hemisphere, (2) asked the relevant agencies in Argentina and China to make every effort to complete the upgrade of the San Juan SLR station, and (3) thanked the University of Latvia and the local Organizing Committee for all of their work in making the Workshop a great success. Finally, the closing session included a presentation on plans for the 21st International Workshop on Laser Ranging which will hosted by the Space Environment Research Centre (SERC) and will be held in Canberra Australia, November 05-09, 2018.

CAREY NOLL

Report on the Symposium SIRGAS2017, SIRGAS Workshop on real-time GNSS positioning, and SIRGAS Workshop on SLR in Latin America

SIRGAS (Sistema de Referencia Geocéntrico para las Américas), the Geocentric Reference System for the Americas, is the IAG Sub-commission 1.3b. Its current activities, advances, and new challenges are reported, discussed, and re-oriented (if required) in the annual SIRGAS Meetings being held since 1993. In this series, the Symposium SIRGAS2017 took place in Mendoza, Argentina, from November 27 to 30, 2017. It was organized by the Universidad Nacional de Cuyo and the Universidad Juan Agustín Maza, with the support of the International Association of Geodesy (IAG), the Pan-American Institute for Geography and History (PAIGH), the Consejo Nacional de Investigaciones Científicas y Técnicas of Argentina (CONICET) and the Agencia Nacional de Promoción Científica y Tecnológica of Argentina. In the frame of this symposium, two additional activities were programmed: A workshop on real-time GNSS positioning from November 22 to 24; and a workshop about SLR in Latin America from November 30 to December 1, 2017.

The symposium SIRGAS2017 was attended by 128 participants (Fig. 2) from 16 countries (Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, Germany, Guatemala, Mexico, Panama, Spain, USA, Uruguay, and Venezuela). The main topics addressed during the symposium included advances in the implementation and maintenance of national reference frames (8 presentations); real-time applications based on the SIRGAS infrastructure (6 presentations); vertical reference systems (9 presentations); gravity and geoid (8 presentations); improvement and maintenance of the SIRGAS reference frame (9 presentations); detection and assessment of geodynamic effects on the SIRGAS reference frame (9 presentations); atmosphere studies based on the SIRGAS infrastructure (3 presentations); other geodetic techniques in SIRGAS (8 presentations); and general reports (4 presentations). Five invited conferences were presented: Current activities of the IAG (Hermann Drewes, IAG Secretary General, Germany); Some applications of ionospheric and geodetic models supported by real-time GNSS measurements (Manuel Hernández-Pajares, Universidad Politècnica de Catalunya, Spain); SLR – An Overview and General Aspects (Daniela Thaller, Bundesamt für Kartographie und Geodäsie, Germany); SLR and the Gravity Field (Daniela Thaller, Bundesamt für Kartographie und Geodäsie, Germany); and SLR and the Global Terrestrial Reference

Frame (Daniela Thaller, Bundesamt für Kartographie und Geodäsie, Germany). In total, 51 oral contributions and 18 posters were presented.



Participants of the Symposium SIRGAS2017, Mendoza, Argentina, November 27 to 30, 2017

The workshop on real-time GNSS positioning was attended by 50 participants from 12 countries (Argentina, Brazil, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, Guatemala, Panama, Spain, Uruguay, and Venezuela). It was organized as an activity of the SIRGAS Working Group II “SIRGAS at national level”. Lectures were provided by Roberto Pérez-Rodino (Universidad de la República, Montevideo, Uruguay), chair of the SIRGAS-WGII, María Fernanda Camisay (Universidad Juan Agustín Maza, Mendoza, Argentina), Gustavo Noguera (Universidad Nacional de Rosario, Rosario, Argentina), and Manuel Hernández-Pajares (Universidad Politècnica de Catalunya, Barcelona, Spain). The main topics were: Real-time positioning systems and techniques (RTK, NetRTK, PPP), national real-time infrastructures, caster and real-time stream management, NTRIP and associated software (BNC, RTKLib, etc.), theoretical foundations of the European project AUDITOR (Improved GNSS ground-based augmentation system for precision agriculture services) with emphasis on the generation of reliable ionosphere products for the calculation of real-time corrections. Three practical exercises were developed: one for real-time measurements in the field and two for connectivity, configuration, and calculation in the cabinet.



Participants of the workshop on real-time GNSS positioning, Mendoza, Argentina, November 22 to 24, 2017

The workshop on SLR in Latin America was attended by 43 participants from 10 countries: Argentina, Brazil, Chile, Colombia, Costa Rica, Ecuador, Germany, Peru, Uruguay and Venezuela. The main objective of the workshop was to evaluate the possibility of extending the SIRGAS reference frame by means of SLR stations to improve the geocentric realization of the regional frame. Daniela Thaller (Bundesamt für Kartographie und Geodäsie, Germany) provided an overview about the SLR dataflow and analysis performed within the International Laser Ranging Service (ILRS), and representatives of the four SLR observatories installed in South America (Arequipa, AGGO, Brasilia and San Juan) reported about the status and future improvements at the different stations. Bernd Sierk of the European Spatial Agency (ESA) presented the ESA plans related to new SLR developments and applications. Finally, Daniela Thaller outlined some recommendations to start SLR data processing experiments within SIRGAS. Following these recommendations, the next activity is to prepare and

distribute an input data set to be processed by the different groups installed in Argentina, Brazil, Peru and Costa Rica. Results of this experiment will be discussed during the next SIRCAS symposium in 2018.



Participants of the workshop on SLR in Latin America, Mendoza, Argentina, November 30 to December 1, 2017

VIRGINIA MACKERN, Mendoza, Argentina,

LAURA SÁNCHEZ, Munich, Germany