



**IUGG**



**International Association  
of Geodesy**

# Newsletter

## January 2017

Editor: Gyula Tóth

*IAG Communication and Outreach Branch*  
Department of Geodesy and Surveying  
Budapest University of Technology and Economics  
H-1521 Budapest, Hungary

Information Service of the International Association of Geodesy

<http://www.iag-aig.org>

[newsletter@iag-aig.org](mailto:newsletter@iag-aig.org)

## Contents

<b>General Announcements</b> .....	<b>3</b>
International Association of Geodesy Commission 4 "Positioning and Applications" .....	3
IAG-IASPEI Scientific Assembly, Kobe, Japan, July 30 – August 4, 2017.....	4
<b>Meeting Announcements</b> .....	<b>5</b>
Journées 2017 - First Announcement.....	5
International Workshop on the inter-comparison of space and ground gravity and geometric spatial measurements.....	6
LAPIS 2017 School.....	7
<b>Meetings Calendar</b> .....	<b>7</b>
10 <sup>th</sup> Coastal Altimetry Workshop.....	7
Munich Satellite Navigation Summit .....	7
Fourth SWARM Science Meeting and Geodetic Missions Workshop.....	7
North-American CryoSat Science Meeting and Geodetic Missions Workshop.....	7
GEODATA 2017 .....	7
EGU General Assembly 2017 .....	8
IAU Symposium "Astrometry and Astrophysics in the Gaia Sky" .....	8
Ninth IVS Technical Operations Workshop .....	8
ENC 2017.....	8
23rd Working Meeting of the European VLBI Group for Geodesy and Astrometry (EVGA) .....	8
EUREF 2017 Symposium .....	8
JpGU-AGU Joint Meeting 2017 .....	8
FIG Working Week 2017 .....	8
TransNav 2017 .....	8
Baltic Geodetic Congress 2017 .....	8
ICC 2017 .....	8
IGS Workshop 2017.....	8
1st IUGG Symposium on Planetary Science (IUGG-PS2017).....	8
IAG/GGOS/IERS Unified Analysis Workshop (UAW).....	8
WCRP/IOC Conference 2017: Regional Sea Level Changes and Coastal Impacts .....	9
IAG and IASPEI Joint Scientific Assembly.....	9
AOGS 14 <sup>th</sup> Annual Meeting.....	9
EUGEO 2017.....	9
Workshop on Glacial Isostatic Adjustment and Elastic Deformation .....	9
COSPAR 2017 .....	9
IAG Workshop: Satellite Geodesy for Climate Studies .....	9
Journées 2017.....	9
ION GNSS+ 2017.....	9
International Workshop on the inter-comparison of space and ground gravity and geometric spatial measurements .....	9
LAPIS 2017 School .....	9
AGU 2017 Fall Meeting .....	9
EGU General Assembly 2018 .....	10
AOGS 15 <sup>th</sup> Annual Meeting.....	10
10 <sup>th</sup> IVS General Meeting.....	10
42nd COSPAR Scientific Assembly.....	10
IAU XXXth General Assembly .....	10
21 <sup>st</sup> International Workshop on Laser Ranging.....	10
AGU 2018 Fall Meeting .....	10
EGU General Assembly 2019 .....	10
27th IUGG General Assembly .....	10
AOGS 16 <sup>th</sup> Annual Meeting.....	10
<b>Reports</b> .....	<b>10</b>
2016 SIRGAS Symposium .....	10

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](mailto: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

### *International Association of Geodesy Commission 4 "Positioning and Applications"*

The International Association of Geodesy (IAG) is structured based on several entities, being Scientific Committees and Services. There are a total of four Scientific Committees dedicated to the various aspects of Geodesy. Commission 1 deals with reference frames, Commission 2 with gravity field, Commission 3 with Earth rotation and geodynamics, and Commission 4 with positioning and applications. This article is about Commission 4.

Commission 4 is dedicated to the various aspects dealing with positioning and applications. It is also concerned with the remote sensing and modelling of the atmosphere. The main topics, as defined by IAG's By Laws are related to terrestrial and satellite-based positioning systems development, including sensor and information fusion, navigation and guidance of platforms, interferometric laser and radar applications (e.g., Synthetic Aperture Radar), applications of geodetic positioning using three dimensional geodetic networks (passive and active networks), including monitoring of deformations, applications of geodesy to engineering and atmospheric investigations using space geodetic techniques.

Commission 4 is concerned with signals of various types, collected by various sensors, that are used for positioning, in different applications, at different levels of accuracy. Those signals can be used separately but have been increasingly integrated. The Commission 4 is interested with theoretical developments and applications of single- and multi-signal positioning dealing with, but not excluded to, manned or unmanned, multi-sensor systems navigation and guidance, transportation, personal mobility, industrial and indoor positioning applications environmental monitoring, used of low-cost sensors including GNSS systems and smartphone navigation sensors, geospatial mapping and engineering, ranging from construction work, geotechnical and structural health monitoring, mining, to natural phenomena such as landslides and ground subsidence, geodetic applications and high-precision GNSS technologies and applications and the use of multi-signals stemming from modernized signals and issues and opportunities coming from multi-constellation signals.

Commission 4 is also concerned with research dealing with the use of geodetic tools of any kind for atmospheric remote sensing, comprising the atmosphere (including, e.g., troposphere and ionosphere) monitoring, space weather studies as well as GNSS reflectometry. From the geodetic point of view the atmosphere is nowadays not only seen as a disturbing quantity which has to be corrected but also as a target quantity, since almost all geodetic measurement techniques provide valuable information about the atmospheric state. Important examples for these developments include the operational use of ground- and space-based GNSS measurements to improve global and regional weather forecasts since 2006, as well as the study of space weather and the use of important geodetic remote sensing techniques in GNSS reflectometry (GNSS-R).

Commission 4 is composed of four Sub-Commissions. Sub-Commission 4.1 (Chair: Vassilis Gikas) focus with emerging positioning technologies and GNSS augmentation. Sub-commission 4.2 (Chair: Jinling Wang) deals with geo-spatial mapping and geodetic engineering. Sub-Commission 4.3 (Chair: Michael Schmidt) is dedicated to atmosphere remote sensing. And, finally, Sub-Commission 4.4 (Chair: Pawel Wielgosz) studies multi-constellation GNSS. Commission 4 is presided by Marcelo Santos and vice-presided by Allison Kealy.

There is also joint research carried out in collaboration with other IAG Commissions, other IAG Services and linkage with other sister organizations, such as the FIG.

The Commission 4 website is at <http://iag-comm4.gge.unb.ca/>. The Commission 4 Symposium took place in September 4-7, 2016, at the Institute of Geodesy and Geoinformatics, Wrocław University of Environmental and Life Sciences, and its program, and most of the presentations, are available at <http://www.igig.up.wroc.pl/IAG2016/>.



Picture: participants of the IAG Commission 4 Positioning and Applications Symposium, held in Wroclaw, Poland, September 4-7, 2016.

MARCELO SANTOS

*IAG-IASPEI Scientific Assembly, Kobe, Japan, July 30 – August 4, 2017*



The International Association of Geodesy (IAG) holds its Scientific Assemblies traditionally midterm between two IUGG-IAG General Assemblies. The next one will be held middle of the General Assemblies 2015 (Prague, Czech Republic) and 2019 (Montreal, Canada) together with the International Association of Seismology and Physics of the Earth (IASPEI) in Kobe, Japan, from July 30 to August 4, 2017. There will be nine joint symposia of IAG and IASPEI, and seven IAG specific symposia. The titles are:

**Joint Symposia**

- J01 Monitoring of the cryosphere
- J02 Recent large and destructive earthquakes
- J03 Deformation of the lithosphere: Integrating seismology and geodesy through modelling
- J04 Geohazard early warning systems
- J05 Crustal dynamics: Multidisciplinary approach to seismogenesis
- J06 The spectrum of fault-zone deformation processes (from slow slip to earthquake)

J07 Tracking the sea floor in motion  
J08 Imaging and interpreting lithospheric structures using seismic and geodetic approaches  
J09 Geodesy and seismology general contributions

### **IAG Symposia**

G01 Reference frames  
G02 Static gravity field  
G03 Time variable gravity field  
G04 Earth rotation and geodynamics  
G05 Multi-signal positioning: Theory and applications  
G06 Geodetic remote sensing  
G07 Global Geodetic Observing System (GGOS) and Earth monitoring services

Most important dates for contributions to the symposium are:

December 7, 2016: Abstract submission and registration open;  
**February 8, 2017: Deadline for abstract submission and travel support application;**  
April 5, 2017: Notification of acceptance;  
May 10, 2017: Closure of early bird registration;  
July 7, 2017: Closure of pre-registration.

All interested persons are invited to submit abstracts for oral presentations or posters. For more details of the assembly please visit the Homepage <http://www.iag-iaspei-2017.jp>.

HERMANN DREWES, IAG Secretary General

## **Meeting Announcements**

### *Journees 2017 - First Announcement*

The Observatoire de Paris and the Universidad de Alicante are pleased to announce that the "Journées des Systemes de Reference et de la Rotation Terrestre"\* will take place from 25 to 27 September 2017 at the University of Alicante, Spain. The Journées are supported by the International Astronomical Union (IAU) and the International Association of Geodesy (IAG).

In the interest of enhancing the interactions between Astronomy and Geodesy these Journées are devoted to the study of the space-time celestial and terrestrial reference systems and their evolution with time, with the emphasis on the rotation of the Earth. The scope of the meeting will range from concepts and theoretical solutions to observational techniques and data analysis.

The sub-title of this meeting is "Furthering our knowledge of Earth Rotation" and addresses the challenges brought by the accuracy requirements of the Horizon 2020 project. Therefore, our discussions will help to develop the tasks of the IAU/IAG Joint Working Group on "Theory of Earth rotation and validation", among others.

The topics of interest include, but are not limited to:

1. Theory of Earth rotation variations: precession/nutation, polar motion, LOD/UT1
2. Observation methods of Earth rotation variations: Earth Orientation Parameters (EOP) determination
3. Celestial and terrestrial reference systems and frames: improvements
4. Modelling of Earth rotation variations: solar system dynamics and global geophysical fluid mass transports
5. Relativity and new concepts in Earth rotation theory

Scientific Organizing Committee:

Co-Chairs:

José M. Ferrándiz (Spain) and Christian Bizouard (France)

---

\* This meeting intends to keep the format and cover similar topics as the successful series of Journées "Systemes de Reference spatio-temporels" headed by Nicole Capitaine, whose concluding edition was held in 2014.

Members:

Aleksander Brzezinski (Poland)  
Benjamin Chao (Taiwan)  
Alberto Escapa (Spain)  
Richard S. Gross (USA)  
Robert Heinkelmann (Germany)  
Catherine Hohenkerk (UK)  
Cheng-li Huang (China)  
Sergei Klioner (Germany)  
Sébastien Lambert (France)  
Zinovy Malkin (Russia)  
Cyril Ron (Czech Rep.)  
Yaroslav Yatskiv (Ukraine)

Local Organizing Committee:

Tomás Baenas,  
M. Carmen Martínez-Belda,  
Juan A. Martínez,  
Juan F. Navarro,  
Isabel Vigo.

Registration, submission of abstracts, proceedings and practical information:

The web page of the Journées 2017 will be available soon at <http://web.ua.es/journees2017/>. It will provide additional information, instructions for on-line registration and abstract submission and other useful information. Proceedings will be published at least on-line.

Hope to see you in Alicante!

Best regards

Jose Ferrandiz and Christian Bizouard (on behalf of the SOC)

*International Workshop on the inter-comparison of space and ground gravity and geometric spatial measurements*

*16-18 October 2017 Strasbourg, France*

Three main themes will be discussed during this workshop:

1. Comparing gravity with geometrical space technique (like VLBI, LLR, SLR, DORIS or GNSS) to determine more precisely the surface deformation

This session will focus on the intercomparison of techniques to monitor and understand various deformation mechanisms of the Earth occurring at different spatial and temporal scales. We can quote for instance post-glacial rebound, present-day ice mass changes, tidal deformation, surficial loading, co- and post-seismic deformation and volcanic deformation. The involved temporal scales range from seconds to years and the spatial scales range from millimeters to continental dimension. Large-scale deformation monitored by space geodetic measurements (e.g. GRACE, GOCE) as well as local deformation monitored by space techniques and gravimeters at a site are encouraged in this session.

2. Transfer function of the Earth at various time-scales related to the elastic and visco-elastic properties of the Earth

This session will deal with studies of the gravity-to-height changes ratio in order to discriminate vertical motion from mass transfer. The influence of topography, rheology and lateral heterogeneities of the Earth makes the intercomparison of gravity and height changes more difficult to interpret in terms of Earth's structure and properties. So this session will help to understand such effects. Studies on Love numbers determination and computation are welcome in this session, as well as rheological constraints from observations.

3. From the modeling of geophysical layers to the realization of a terrestrial reference frame: geocenter motions, modeling accuracy, ... State of the art and next step towards the millimeter accuracy?

Thanks to ever-improving measurement techniques and computation methods, reaching a millimeter or even a sub-millimeter level precision has become the new challenge of the geodetic community. In that purpose, all the processes involved in the quantification of the Earth's surface deformation must be identified and the associated errors reduced. This session deals with modeling of the surface layers (oceans, atmosphere, continental

hydrosphere) that strongly influence the space and ground measurements of surface deformation and the realization of the terrestrial reference frame. Studies on the geocenter motion are encouraged in this session.

Website of the workshop: <http://geodesy.sciencesconf.org>

SEVERINE ROSAT

## *LAPIS 2017 School*

Dear Geodesists,

We cordially invite you to the 5th La Plata International School on Astronomy and Geophysics (LAPIS): "Space geodesy applied to geodynamics and atmospheric research" to be held on October 29<sup>th</sup> – November 4<sup>th</sup>, 2017, in the Facultad de Ciencias Astronómicas y Geofísicas de la Universidad Nacional de La Plata, in the city of La Plata, Argentina.

The School

- addresses post-graduate and doctoral students in Astronomy, Geophysics, Geodesy, Engineering and related disciplines of Geosciences and Atmospheric science; advanced graduate students may also be admitted.
- comprises lectures and exercises which familiarize the participants with the geometrical space-geodetic observation techniques (GNSS, SLR, VLBI) as data sources for research related to geodynamics and the atmosphere.
- is free of charge for the participants. Course language is English.

Each participant has to bring an own notebook.

Pre-inscription and further information are available at:

<http://www.maggia.unlp.edu.ar/lapis2017>  
[school2017@fcaglp.unlp.edu.ar](mailto:school2017@fcaglp.unlp.edu.ar)

Sincerely,

LAPIS 2017 Local Organizing Committee  
Laboratorio MAGGIA  
Facultad de Ciencias Astronómicas y Geofísicas  
Universidad Nacional de La Plata, Argentina

## *Meetings Calendar*

### *10<sup>th</sup> Coastal Altimetry Workshop*

*February 21-24, 2017, Florence, Italy*

URL: <http://www.coastalaltimetry.org/>

### *Munich Satellite Navigation Summit*

*March 14-16, 2017, Munich, Germany*

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

### *Fourth SWARM Science Meeting and Geodetic Missions Workshop*

*March 20-24, 2017, Banff, Alberta, Canada*

URL: <http://www.swarm2017.org/>

### *North-American CryoSat Science Meeting and Geodetic Missions Workshop*

*March 20-24, 2017, Banff, Alberta, Canada*

URL: <http://www.cryosat2017.org/>

### *GEODATA 2017*

*April 3-7, 2017, Rosario - Santa Fe, Argentina*

URL: [www.geodata2017.com.ar](http://www.geodata2017.com.ar)

EGU General Assembly 2017

April 23-28, 2017, Vienna, Austria

URL: <http://www.egu2017.eu/>

IAU Symposium "Astrometry and Astrophysics in the Gaia Sky"

April 24-28, 2017, Nice, France

URL: <http://iaus330.sciencesconf.org/>

Ninth IVS Technical Operations Workshop

April 30 – May 4, 2017, Westford, MA, USA

URL: <https://www.iers.org/ IERS/EN/NewsMeetings/ForthcomingMeetings/forthcoming.html>

ENC 2017

May 9-12, 2017, Lausanne, Switzerland

URL: <http://www.enc2017.eu/>

23rd Working Meeting of the European VLBI Group for Geodesy and Astrometry (EVGA)

May 15-19, 2017, Gothenburg, Sweden

URL: <https://www.chalmers.se/en/conference/EVGA2017>

EUREF 2017 Symposium

May 17 – 19, 2017, Wroclaw, Poland

URL: [http://www.euref.eu/euref\\_symposia.html](http://www.euref.eu/euref_symposia.html)

JpGU-AGU Joint Meeting 2017

May 20 – 25, 2017, Makuhari Messe, Chiba, Japan

URL: [http://www.jpгу.org/meeting\\_e2017/](http://www.jpгу.org/meeting_e2017/)

FIG Working Week 2017

May 29 – June 2, 2017, Helsinki, Finland

URL: <http://www.fig.net/fig2017/>

TransNav 2017

June 21 – 23, 2017, Gdynia, Poland

URL: <http://transnav2017.am.gdynia.pl>

Baltic Geodetic Congress 2017

June 22 – 25, 2017, Gdańsk, Poland

URL: <http://www.bgc.geomatyka.eu/2017/>

ICC 2017

July 2 – 7, 2017, Washington, DC, USA

URL: <http://icc2017.org/>

IGS Workshop 2017

July 3 – 7, 2017, Paris, France

URL: <http://kb.igs.org/hc/en-us/articles/216574478-IGS-Workshop-2017>

1st IUGG Symposium on Planetary Science (IUGG-PS2017)

July 3 – 5, 2017, Berlin, Germany

URL: <http://www.dlr.de/iugg-ps2017>

IAG/GGOS/IERS Unified Analysis Workshop (UAW)

July 10 – 12, 2017, Paris, France



URL: <http://ggosdays.com/en/conferences/unified-analysis-workshop/>

WCRP/IOC Conference 2017: Regional Sea Level Changes and Coastal Impacts

July 10 – 14, 2017, New York, USA

URL: <http://www.sealevel2017.org>

IAG and IASPEI Joint Scientific Assembly

July 30 – August 4, 2017, Kobe, Japan

URL: <http://iag.dgfi.tum.de/index.php?id=291>

AOGS 14<sup>th</sup> Annual Meeting

August 6-11, 2017, Singapore, Singapore

URL: <http://www.asiaoceania.org/aogs2017/>

EUGEO 2017

September 4-6, 2017, Brussels, Belgium

URL: <https://eugeo2017.sciencesconf.org/>

Workshop on Glacial Isostatic Adjustment and Elastic Deformation

September 5-7, 2017, Reykjavik, Iceland

URL: <http://www.polar.dtu.dk/english/Workshop-on-Glacial-isostatic-adjustment-and-elastic-deformation-2017>

COSPAR 2017

September 18-22, 2017, Jeju Island, South Korea

3rd Symposium of the Committee on Space Research (COSPAR): Small Satellites for Space Research

URL: <http://cospar.kasi.re.kr/cospar-symposium-2017/>

IAG Workshop: Satellite Geodesy for Climate Studies

September 19-21, 2017, Bonn, Germany

URL: <http://www.igg.uni-bonn.de/apmg/index.php?id=ws2017>

Journees 2017

September 25-27, 2017, University of Alicante, Spain

URL: <http://web.ua.es/journees2017/>

ION GNSS+ 2017

September 25-29, 2017, Portland, Oregon, USA

URL: <http://www.ion.org/gnss/index.cfm>

International Workshop on the inter-comparison of space and ground gravity and geometric spatial measurements

October 16-18, 2017, Strasbourg, France

URL: <http://geodesy.sciencesconf.org>

6<sup>th</sup> International Colloquium on Scientific and Fundamental Aspects of GNSS / Galileo

October 25-27, 2017, Valencia, Spain,

URL: <http://esaconferencebureau.com/2017-events/17a08>

LAPIS 2017 School

October 29 – November 4, 2017, La Plata, Argentina

URL: <http://www.maggia.unlp.edu.ar/lapis2017>

AGU 2017 Fall Meeting

December 11-15, 2017, New Orleans, LA, USA

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

### EGU General Assembly 2018

April 8-13, 2018, Vienna, Austria

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

### AOGS 15<sup>th</sup> Annual Meeting

June 3-8, 2018, Hawaii, USA

URL: [http://www.asiaoceania.org/society/public.asp?view=up\\_coming](http://www.asiaoceania.org/society/public.asp?view=up_coming)

### 10<sup>th</sup> IVS General Meeting

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

URL: <http://www.iers.org/IERS/EN/NewsMeetings/ForthcomingMeetings/forthcoming.html>

### 42<sup>nd</sup> COSPAR Scientific Assembly

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

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

### IAU XXX<sup>th</sup> General Assembly

August 20-31, 2018, Vienna, Austria

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

### 21<sup>st</sup> International Workshop on Laser Ranging

October 27-31, 2018, Canberra, Australia

URL: <http://www.iers.org/IERS/EN/NewsMeetings/ForthcomingMeetings/forthcoming.html>

### 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/>

### 27<sup>th</sup> IUGG General Assembly

July 8 – 17, 2019, Montreal, Canada

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

### AOGS 16<sup>th</sup> Annual Meeting

July 28 – August 2, 2019, Singapore, Singapore

URL: [http://www.asiaoceania.org/society/public.asp?view=up\\_coming](http://www.asiaoceania.org/society/public.asp?view=up_coming)

## Reports

### *2016 SIRGAS Symposium*

*Quito, Ecuador, November 16 to 18, 2016*

The IAG SC 1.3b had recently conducted two major activities: the SIRGAS Symposium and Working Group III Workshop 2016 on Vertical Reference Systems, held in Quito, Ecuador, between November 16 to 18 and 21 to 25, 2016, respectively. Both activities were hosted by the Instituto Geográfico Militar of Ecuador, and supported by the IAG and the Pan American Institute of Geography and History (PAIGH).

The Symposium was attended by 217 participants (Fig. 1), from 14 countries (Germany, Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Ecuador, United States, Mexico, Panama, Dominican Republic, Uruguay and Venezuela). Fifty six oral and twelve poster presentations were discussed. Main topics were: maintenance of the continental reference frame (3 presentations); detection and evaluation of geodynamic effects on the reference frame (9 presentations); reports of the analysis and combination centres (5 presentations); studies of the neutral atmosphere (5 presentations); progress in the implementation and maintenance of national frameworks (14 presentations); SIRGAS in real time (6 presentations); aspects of the practical application of SIRGAS products (3 presentations); height systems (11 presentations); gravimetry and geoid (8 presentations) and various reports (4 presentations).



**Figure 1.** Participants of the 2016 SIRGAS Symposium, Quito, Ecuador, November 16 to 18, 2016, jointly hosted by the Instituto Geográfico Militar of Ecuador and supported by the IAG and the Pan-American Institute of Geography and History (PAIGH).

WILLIAM MARTÍNEZ  
VIRGINIA MACKERN

### *Report on the SIRGAS Working Group III “Vertical Datum” Workshop 2016 Quito, Ecuador, November 21 to 25, 2016*

The main objective of the SIRGAS (Sistema de Referencia Geocéntrico para las Américas, Geocentric Reference System for the Americas) Working Group III Workshop 2016 was to face the challenges associated with the unification of vertical networks in the SIRGAS region by promoting each member country as a protagonist in the related activities. This Workshop is in the sequence of the SIRGAS WG III capacity building held as the SIRGAS School on Vertical Reference Frames in Rio de Janeiro, Brazil, 2012, and as Workshops in La Paz, Bolivia, 2014, and Curitiba, Brazil, 2015. The Workshop 2016 took place in Quito, Ecuador from November 21 to November 25, with the support of the Military Geographic Institute, Ecuador, the Pan-American Institute of Geography and History (PAIGH) and the International Association of Geodesy (IAG). It involved 44 persons from 10 countries of South America, Central America and the Caribbean (Argentina, Brazil, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, Panama, Peru and Uruguay). Most of the participants are working in institutes in charge of the national vertical networks. The main motivation of the Workshop 2016 was in the context of the new IHRS (International Height Reference System) conception, its realization (IHRF), and the future Global Geodetic Reference Frame (GGRF) proposed by the United Nations Resolution (A/RES/69/266) in February 26, 2015. The specific objectives involved the classical and modern aspects related to the realization of vertical reference networks and gravity networks. In this context are the following protocols of SIRGAS WG III related to the national vertical networks of member countries:

- Strategies to realize vertical networks by physical heights [ $H_p = f(C_p)$ ];
- Link of national vertical networks to the SIRGAS GNSS continuous stations;
- Integration of national vertical networks of members countries in the geopotential space;
- Approaches for referring the SIRGAS Vertical Network to the  $W_0$  value of IHRS;
- Association to a specific epoch by considering the realization epoch and temporal variations of coordinates;

- Planning of activities for establishing a GGRF station profile in the SIRGAS region;
- Future link of the SIRGAS Vertical Network to a profile of GGRF stations.

The Workshop coordinated by Prof. Dr. Sílvio R.C. de Freitas, Chair of the SIRGAS WG III, involved two parts. The 16 hours first part was directed to the foundations and data processing strategies related to vertical reference systems/frames as well as gravity reference systems/frames. The 24 hours second part was directed to the analysis of databases and data processing of the national vertical network realization in the geopotential space by introducing the geopotential numbers. The basis of data processing was a software package developed by Prof. Dr. Hermann Drewes and Dr. Laura Sánchez. They acted as instructors in the Workshop. Preliminary analyses of the consistency of national nets were done by using a software package developed by Prof. Dr. Roberto Teixeira Luz who also acted as instructor in the Workshop. All software was furnished freely for all participants.

A series of activities were coordinated for the solution of problems related to the national networks involving original data, data completion, temporal deformations, vertical datum and the link of networks of neighboring countries. The integration of gravity data was an important subject along with the activities. Other aspects were discussed as the planning for the future profile of GGRF stations in the SIRGAS context.

Different stages of development among the countries may be mentioned. Argentina and Uruguay concluded the geopotential differences adjustment of their nodal vertical networks points. Most of the countries have got partial or preliminary results. However, there was gain for each country when considering the positive results related to the understanding of problems related to their networks and the increase of their capability in data processing. No doubts, the ongoing IAG activities related to the IHRS/GGRF are now diffusing in the SIRGAS community.



Photo of participants of the 2016 SIRGAS Workshop

Prof. Dr. SÍLVIO R.C. DE FREITAS  
Chair of the SIRGAS WG III