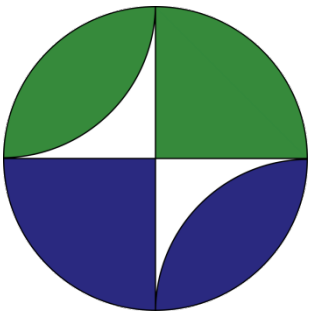
INTERNATIONAL UNION OF GEODESY AND GEOPHYSICS

UNION GEODESIQUE ET GEOPHYSIQUE INTERNATIONALE

Annual Report 2016



INTERNATIONAL UNION OF GEODESY AND GEOPHYSICS

UNION GEODESIQUE ET GEOPHYSIQUE INTERNATIONALE

Published by Secretary General

Alik Ismail-Zadeh

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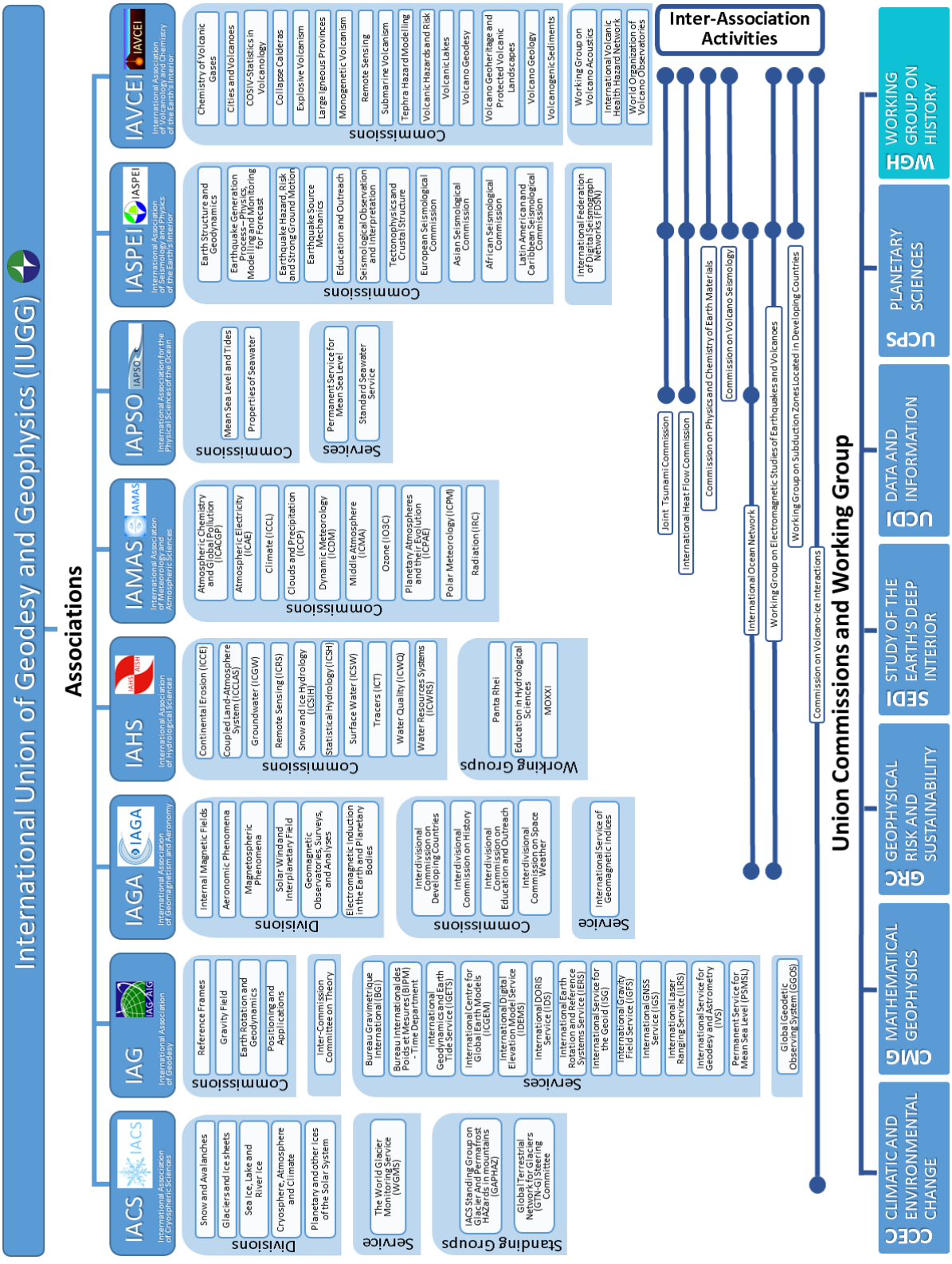
INTRODUCTION

Established in 1919, the International Union of Geodesy and Geophysics (IUGG) is the international, non-governmental, non-profit organization dedicated to advancing, promoting, and communicating knowledge of the Earth system, its space environment, and the dynamical processes causing change. Through its constituent associations, commissions, and services, IUGG convenes international assemblies and workshops, undertakes research, assembles observations, gains insights, coordinates activities, liaises with other scientific bodies, plays an advocacy role, contributes to education, and works to expand capabilities and participation worldwide. Data, information, and knowledge gained are made openly available for the benefit of society – to provide the information necessary for the discovery and responsible use of natural resources, sustainable management of the environment, reducing the impact of natural hazards, and to satisfy our need to understand the Earth's natural environment and the consequences of human activities. IUGG Associations and Union Commissions encourage scientific investigation of Earth science and especially interdisciplinary aspects. Each Association establishes working groups and commissions that can be accessed by using the links on our website (see also the IUGG chart on the following page).

IUGG is one of 31 scientific unions adhering to the International Council for Science (ICSU). ICSU provides a global forum for scientists to exchange ideas and information and to develop standard methods and procedures for all fields of research. IUGG brings expertise on Earth studies from researchers in its International and Inter-Association Commissions. As a member of ICSU, IUGG strongly supports its policy of non-discrimination by affirming the rights and freedom of scientists throughout the world to engage in international scientific activity without limitation by such factors as citizenship, religion, creed, political stance, ethnic origin, race, color, language, age or gender.



IUGG Structure

IUGG has initiated and/or vigorously supported collaborative efforts that have led to highly productive world-wide interdisciplinary programs and projects, such as the International Geophysical Year (1957-58), the Upper Mantle Project (1964-70), the International Hydrological Decade (1965-74), the Geodynamics Project (1972-79), the Global Atmospheric Research Program (1967-80), the International Lithosphere Program, the World Climate Research Programme, the International Decade

for Natural Disaster Reduction, Integrated Research on Risk Disasters, the International Heliophysical Year (2007-2009), the Electronic Geophysical Year (2007-2008), the International Year of Planet Earth (2007-2009), the International Polar Year (2007-2008), Extreme Natural Hazards and Societal Implications (2010-2014), International Year of Deltas (2013-2014), and the International Geosphere-Biosphere Programme (1987-2015). These programs have set a model for international, interdisciplinary cooperation. Representing all geophysical disciplines, IUGG is involved in the projects and programs related to climate change, global warming, and related environmental impacts.

Current	Past
• **International Lithosphere Program** (ILP, a joint IUGS-IUGG activity)	• **International Geosphere-Biosphere Programme** (IGBP, 1987-2015)
• **Global Geodetic Observing System** (GGOS, an IAG program)	• **International Year of Deltas** (IYD, 2013-2014)
• **World Climate Research Programme** (WCRP)	• **Extreme Natural Hazards and Societal Implications** (ENHANS, 2010-2014)
• **Integrated Research on Disaster Risk** (IRDR)	• **International Year of Planet Earth** (IYPE, 2007-2010)
• **International Year of Global Understanding** (IYGU)	• **Electronic Geophysical Year** (eGY, 2007-2008)
• **Mathematics of Planet Earth** (MPE)	• **International Polar Year** (IPY, 2007-2008)
• **World Data System** (WDS)	• **International Heliophysical Year** (IHY, 2007-2008)
	• **International Decade for Natural Disaster Reduction** (IDNDR, 1990-1999)
	• **Geodynamics Project** (1972-1979)
	• **Global Atmospheric Research Program** (1967-1980)
	• **International Hydrological Decade** (1965-1974)
	• **Upper Mantle Project** (1964-1970)
	• **International Geophysical Year** (IGY, 1957-1958)

Programs and Projects initiated and/or supported by IUGG

IUGG supported and supports initiatives by ICSU, especially those in which Earth sciences have a role to play. IUGG cooperates with the United Nations Educational, Scientific and Cultural Organization (UNESCO) in the study of hydrological (through IAHS) and oceanographic (through IAPSO) research; with the World Meteorological Organization (WMO) to promote studies in atmospheric sciences and meteorology (through IAMAS) as well as in hydrology (through IAHS). Together with the International Civil Aviation Organization (ICAO) and WMO, IUGG promotes the studies, the monitoring and the modelling of volcanic ashes (through IAMAS and IAVCEI). IUGG also cooperates with the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) in the studies related to seismology (through IASPEI), hydroacoustics, atmospheric transport modelling, and meteorology. In addition, IUGG places particular emphasis on the scientific problems of economically less-developed countries by sponsoring activities relevant to their scientific needs, e.g. Geosciences in Africa, eGY in Africa, Water Resources, Health and Well-Being etc.

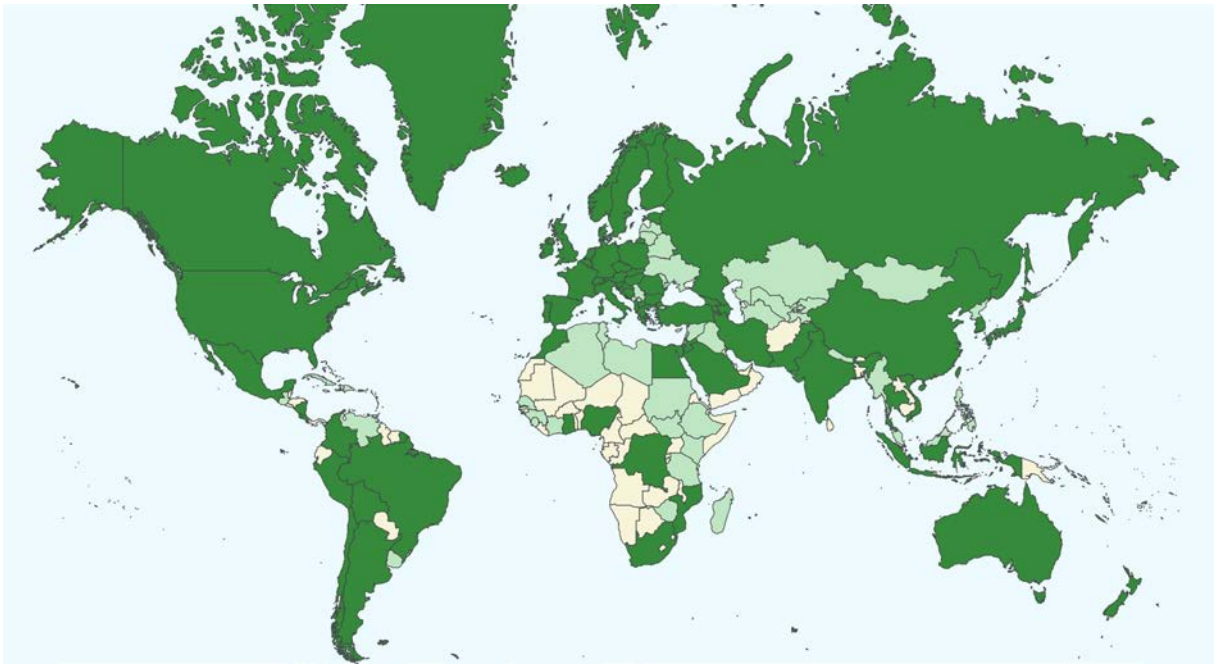
The website, available in English and French, can be found at www.iugg.org.

GENERAL INFORMATION

MEMBERSHIP & FINANCE

By their very nature, geodetic and geophysical studies require a high degree of international co-operation. IUGG is critically dependent on the scientific and financial support of its member Adhering Bodies. The list of present and past IUGG Adhering Bodies is published in the IUGG Yearbook and posted on the website. Each Adhering Body establishes a National Committee for IUGG, and names Correspondents to each Association (as appropriate).

As of 1 January 2017, IUGG has 69 National Members including 59 countries in paying status. The paying members are placed in categories from 1 to 14 depending on their financial contribution to the Union (the membership dues rise with increasing category number). At present, the highest category used is category 11. The members pay dues according to a number of units assigned to their category (in category 1 the number of units is 1, and in category 11 the number is 35). According to a decision of the XXII IUGG General Assembly (Boulder, USA, 1995), the price of 1 unit is determined every year using an inflator index obtained from the Bureau of Labor Statistics, U.S. Department of Labor. In 2017, the price of 1 unit will be US$ 1,935. The 59 paying members represent a total of 276 units, which is equivalent to a total income of US$ 534,060. The funds received as dues are the basis for IUGG's operations as a scientific union, although Union associations may have their own funds earned via book selling or donations. The funds are spent to support (i) international scientific programs, projects and services, (ii) general and scientific assemblies, symposia, workshops, and schools; (iii) travel of students, early career scientists, and scientists from developing countries to attend scientific meetings; (iv) scientific activities of Union Associations and Commissions, (v) the International Lithosphere Program, (vi) the International Council for Science, and (vii) administration and management.



Regional distribution of current (dark green) and former (light green) IUGG Member Countries (as of 01.01.2017)

STRUCTURE

Responsibility for directing the Union's affairs is vested in the IUGG Council by the Statutes and Bylaws. The IUGG Council consists of the Council Delegates, who are designated by the Adhering Body of their respective countries. The Council is convened at each quadrennial General Assembly but can make decisions by electronic voting in between General Assemblies. A Bureau, an Executive Committee and a Finance Committee administer IUGG affairs between Council meetings. The Executive Committee has the particular responsibility of overseeing the scientific programs of the Union. The IUGG Secretariat is located at the German Research Centre for Geosciences (GFZ) in Potsdam, Germany, and assists in the implementation of the decisions of of the Bureau, Executive Committee and the Council.

Associations

The Union brings together eight semi-autonomous Associations, each responsible for a specific range of topics or themes within the overall scope of the Union's activities and each with a sub-structure. The Associations convene their own assemblies and sponsor scientific symposia, often in partnership with one another. Within its own discipline each Association is responsible for determining its own program of investigations and for supporting the activities of its own component parts. All Earth scientists, worldwide, are eligible to participate in IUGG and Association activities, assemblies, workshops, and symposia, although only scientists from member countries with dues paid may serve as Association Presidents.

The eight International Associations are listed below, and short reports on their 2016 activities are included here. Additional information about each Association is given on their websites, which can be accessed from the IUGG website.

- International Association of Cryospheric Sciences (IACS)
- International Association of Geodesy (IAG)
- International Association of Geomagnetism and Aeronomy (IAGA)
- International Association of Hydrological Sciences (IAHS)
- International Association of Meteorology and Atmospheric Sciences (IAMAS)
- International Association for the Physical Sciences of the Oceans (IAPSO)
- International Association of Seismology and Physics of the Earth's Interior (IASPEI)
- International Association of Volcanology and Chemistry of the Earth's Interior (IAVCEI)

Union Commissions

Owing to the interactive nature of the subject fields addressed by the Union's Associations, a number of Union Commissions have been established that promote the study of particular interdisciplinary problems. In 2016, the following bodies were active:

- Commission on Climatic and Environmental Changes (CCEC)
- Commission on Mathematical Geophysics (CMG)
- Commission on Geophysical Risk and Sustainability (GRC)
- Commission on the Study of the Earth’s Deep Interior (SEDI)
- Commission on Planetary Sciences (UCPS)
- Working Group on History (WGH)

The Commission for Data and Information (UCDI) was inactive because of several reasons including non-response from the UCDI’s Officers.

Inter-Unions Commission

The International Lithosphere Program, guided by the Scientific Committee on the Lithosphere (SCL), was established in 1980 as the Inter-Unions Commission on the Lithosphere (ICL) by the International Council for Science (ICSU), at the request of IUGG and the International Union of Geological Sciences (IUGS). The name was formally changed to the Scientific Committee on the Lithosphere in 1999. According to Decision 8.4 from the 2005 ICSU General Assembly, ICSU decided "to withdraw ICSU sponsorship from SCL/ILP and to recommend that responsibility would then shift to IUGG and IUGS". Since that time, IUGG and IUGS have reaffirmed the ILP mission and have collaborated to re-define ILP as an Inter-Unions body.

GENERAL ASSEMBLIES OF THE UNION

General Assemblies have been held since 1922 and, since 1963, at 4-year intervals. These assemblies provide an extraordinary opportunity for Earth scientists from around the world to gather and share expertise, research data, and results. Past IUGG General Assemblies are listed in the IUGG Yearbook and on the website. The most recent General Assembly was held in Prague, Czech Republic, 22 June-2 July 2015. The next IUGG General Assembly will take place in Montreal, Canada, 8-19 July 2019.

OTHER SCIENTIFIC MEETINGS

Each Association organizes its own scientific assembly in the 4-year interval between Union General Assemblies in order to report scientific progress and conduct Association business. Associations sometimes meet jointly with the purpose of promoting interdisciplinary science. Topical and regional symposia and workshops are organized on other occasions by the Associations to provide opportunity for geodesists and geophysicists worldwide to discuss their respective methodologies, results and hypotheses and to plan collaborative research projects. The symposia, often held in less-visited, geophysically interesting locales, are intended to be attractive to the younger scientists from the developing countries of the world.

IUGG OFFICERS FOR 2015-2019

IUGG Bureau

President:	Michael Sideris	CANADA
Vice-President:	Kathryn Whaler	UK
Secretary General:	Alik Ismail-Zadeh	GERMANY/RUSSIA
Treasurer:	Aksel Hansen	DENMARK
Members:	Isabelle Ansorge	SOUTH AFRICA
	Pierre Hubert	FRANCE
	Chris Rizos	AUSTRALIA

IUGG Executive Committee

IUGG Bureau members		
Immediate Past President:	Harsh Gupta	INDIA
IACS President		
(2015-2017):	Charles Fierz	SWITZERLAND
(2017-2019):	Regine Hock	USA
IAG President:	Harald Schuh	GERMANY
IAGA President:	Eduard Petrovsky	CZECH REPUBLIC

IAHS President		
(2015-2017):	Hubert Savenije	THE NETHERLANDS
(2017-2019):	Günter Blöschl	AUSTRIA
IAMAS President:	John Turner	UK
IAPSO President:	Denise Smythe-Wright	UK
IASPEI President:	Thorne Lay	USA
IAVCEI President:	Donald Dingwell	GERMANY

IUGG Finance Committee

Chair:	Jan Krynski	POLAND
Members:	Nasser Abou-Assour	EGYPT
	Corina Risso	ARGENTINA
	Virendra Tiwari	INDIA

Association Presidents and Secretaries General

International Association of Cryospheric Sciences

President		
(2015-2017):	Charles Fierz	SWITZERLAND
(2017-2019):	Regine Hock	USA
Secretary General:	Andrew Mackintosh	NEW ZEALAND

International Association of Geodesy

President:	Harald Schuh	GERMANY
Secretary General:	Hermann Drewes	GERMANY

International Association of Geomagnetism and Aeronomy

President:	Eduard Petrovsky	CZECH REPUBLIC
Secretary General:	Mioara Mandea	FRANCE

International Association of Hydrological Sciences

President		
(2015-2017):	Hubert Savenije	THE NETHERLANDS
(2017-2019):	Günter Blöschl	AUSTRIA
Secretary General:	Christophe Cudennec	FRANCE

International Association of Meteorology and Atmospheric Sciences

President:	John Turner	UK
Secretary General:	Teruyuki Nakajima	JAPAN

International Association for the Physical Sciences of the Oceans

President:	Denise Smythe-Wright	UK
Secretary General:	Stefania Sparnocchia	ITALY

International Association of Seismology and Physics of the Earth's Interior

President:	Thorne Lay	USA
Secretary General:	Johannes Schweitzer	NORWAY

International Association of Volcanology and Chemistry of the Earth's Interior

President:	Donald Dingwell	GERMANY
Secretary General:	Roberto Sulpizio	ITALY

Union Commission and Working Group Officers

Union Commission on Climatic and Environmental Changes (CCEC)

Chair:	Tom Beer	AUSTRALIA
Secretary:	Keith Alverson	USA/JAPAN

Union Commission on Mathematical Geophysics (CMG)

Chair:	Yehuda Ben-Zion	USA
Secretary:	Ilya Zaliapin	USA

Union Commission on Geophysical Risk and Sustainability (GRC)

Chair:	Joan Marti	SPAIN
Secretary:	Paula Dunbar	USA

Union Commission on Studies of Earth's Deep Interior (SEDI)

Chair:	Jonathan Aurnou	USA
Secretary:	Michael Bergman	USA

Union Commission for Data and Information (UCDI)

Chair:	Peter Fox	USA
Vice Chair:	Charles Barton	AUSTRALIA

Union Commission on Planetary Sciences (UCPS)

Chair:	Shuanggen Jin	CHINA
Secretary:	Scot Rafkin	USA

Working Group on History (WGH)

Chair:	Hans Volkert	GERMANY
Vice-Chair:	Claude Boucher	FRANCE

Inter-Unions Commission: International Lithosphere Program (ILP)

President:	Sierd Cloetingh	THE NETHERLANDS
Secretary:	Magdalena Scheck-Wenderoth	GERMANY

MESSAGE FROM THE PRESIDENT

2016 was another successful year for IUGG. Our Associations started to prepare their 2017 Scientific Assemblies (many jointly organized), three Union Committees were renewed for the period 2016-2019 (Capacity Building and Education Committee, Honors and Recognition Committee, Statutes and By-Laws Committee), and the Bureau approved the membership of the Outreach Committee. I also appointed a Task Force to plan, coordinate and prepare the special events for the Centennial celebration of IUGG in 2019.

As per the IUGG Council decision in June 2015, work continued on the Union's 2016-2023 Strategic and Implementation plans, and the IUGG (standing) Council was formed for 2016-2019, with the task to consider, discuss and decide on major scientific proposals, initiatives, and urgent administrative issues of the Union. 2016 was also the International Year for Global Understanding (IYGU), which is co-sponsored by IUGG. The IUGG Secretary General (SG), Alik Ismail-Zadeh, attended the IYGU Opening Ceremony held in February in Jena, Germany.

In April 2016, Alik and I attended the ICSU Scientific Unions meeting in Paris, France, which focused on the development of a new strategic plan, the proposed changes to the election of ICSU's Executive Board, as well as the future of ICSU and its relationship with the International Social Sciences Council (ISSC). Immediately before that meeting, the Steering Committee of the nine GeoUnions also met in Paris, chaired by our SG, to discuss a common position on the above issues, the cooperation with Future Earth, the benefits of ICSU having Union members, and the benefits to GeoUnions being part of ICSU.

The 2016 meeting of the IUGG Bureau and Executive Committee (EC) took place in June in Paris, France, with main agenda items the Strategic Plan and its implementation, the proposed College of Fellows, the establishment of a network of Early Career Scientists, issues related to the 2019 IUGG General Assembly (GA) in Montreal, Canada, and the next meeting of the Bureau and the EC in the fall of 2017 also in Montreal. We were hosted by UNESCO's Earth Sciences and Geo-Hazard Risk Reduction (ESGHRR) Section. The ESGHRR Section Head, Dr. Patrick McKeever, addressed the IUGG EC and agreed to strive for closer cooperation between IUGG and the ESGHRR Section. We were also very pleased that ICSU's Executive Director, Dr. Heide Hackmann, accepted our invitation to attend the EC meeting and inform us about the recent ICSU activities, programs, and governance and structural plans, such as the proposed merger between ICSU and ISSC.

In October 2016, Alik and I attended the extraordinary ICSU General Assembly, which was held in Oslo, Norway, jointly with the ISSC, with the merger between ICSU and ISSC as its main topic. Despite IUGG's negative opinion about such a merger, the joint Assembly approved the merger in principle, tasking the two Councils to develop a strategy and transition plan for setting up a new international science council, with the final decision on the merger to be made, jointly with ISSC, at the General Assembly of ICSU in October 2017.

In 2016, I was elected a member of the newly established Program Board (PB) of the Group on Earth Observations (GEO). Although several IUGG components are members of GEO, having IUGG participate in the PB gives a much broader picture of the international GEO activities, and increases the prospects for collaboration and future IUGG involvement in many of them. I attended four PB meetings, the 2016 Work Programme Symposium in Geneva, Switzerland, and the XIII GEO Plenary, held in November in

St. Petersburg, Russia (representing ICSU). During the Plenary, our SG organized together with the Russian Agency on Hydro-Meteorology (RosHydroMet), a very well attended GEO Side Event on Earth and Space Observations for Disaster Risk Assessment. I gave a talk titled *Hazards/Risks Observations in the IUGG and the GEO Work Program: not fully linked*, and participated in the panel discussions.

In closing, I would like to also mention a couple of important IUGG-related educational/scientific activities I was involved in this year. The first is my teaching at the 12th International Geoid School, held in June in Ulaan Baatar, Mongolia. The second is the completion of my contribution, co-authored by Alberto Montanari and titled *Satellite Hydrology and Future Earth*, to the monograph *Global Change and Future Earth: The Geodetic and Geophysical Perspective* (tentative title), co-edited by Tom Beer, Jianping Li and Keith Alverson.

As always, I would like to acknowledge all members of the Bureau and EC of the IUGG for their support and collaboration, and to thank the Secretary General and the Secretariat of IUGG for their unwavering commitment to the Union.

Michael G. Sideris

MESSAGE FROM THE SECRETARY GENERAL

The year 2016 was a remarkable year in the IUGG history as the first ever *Strategic Plan of the Union* was adopted by the IUGG Council. The Union was involved in various activities during the last year and showed its strength in international cooperation and science promotion. Major activities and events are highlighted below.

– *Association major activities*. IUGG Associations were involved in the organization of their scientific assemblies to be held in 2017. Exciting scientific programs were developed for these events.

– *Union Commission major events*. Three Union Commissions, the Commission on Mathematical Geophysics (CMG), the Commission on the Study of the Earth's Deep Interior (SEDI), and the Commission on Climatic and Environmental Change (CCEC), organized their scientific meetings: the Conference on Mathematical Geophysics was held in Paris, France; the SEDI symposium in Nantes, France; and the CCEC workshop in Belval, Luxembourg.

– *Scientific meetings*. IUGG co-sponsored 21 international workshops and symposia around the world.

– *Research programs and projects*. IUGG together with the International Union of Geological Sciences (IUGS) supported the International Lithosphere Program (ILP). IUGG awarded grants to six interdisciplinary scientific projects within the framework of the IUGG Grants Program.

– *Publications*. The Comptes Rendus of the 26th IUGG General Assembly in Prague, Czech Republic, was published by the IUGG Secretariat. The second volume of the IUGG Special Publications "Dynamics and Predictability of Large-Scale, High-Impact Weather and Climate Events" was published.

– *IUGG Council*. Until 2015, the Union Council Delegates were appointed only for the duration of Council meetings held at IUGG General Assemblies and, therefore, major decisions could be taken only once every four years. To modernize the Union's practices and to improve flexibility in decision-making, the IUGG Council at its meeting in Prague, Czech Republic, in June 2015 decided to extend the term of office of Council Delegates to four years (the time between two consecutive General Assemblies) and to introduce electronic voting. In 2016, the Council reviewed a draft Strategic Plan for 2016-2023, accepted the final document, and voted for approval of the new Member of the IUGG Finance Committee.

– *Science education*. IUGG and the Abdus Salam International Centre for Theoretical Physics (ICTP) in Trieste, Italy, have continued their cooperation in geophysical and geodetic education and science collaboration. IUGG co-sponsored six geoscience education events in 2016.

– *Science policy*.

i) The IUGG/IAPSO together with the ICSU Scientific Committee on Oceanic Research (SCOR) developed a paper for science policymakers of seven economically developed countries on the topic of *Future of the Ocean and its Seas*. The paper was prepared towards the annual meeting of G7 Science Ministers (help in Tsukuba, Japan, in May 2016) as a response of non-governmental scientific organizations to the concern of the policymakers expressed at their meeting in Berlin, Germany, in September 2015.

ii) I met the WMO Secretary General, the Assistant Director General of UNESCO, and the Senior Officer of the UN Office for Disaster Risk Reduction (UNISDR) to discuss joint efforts toward formation of an international panel for disaster risk assessment.

- *Cooperation.* IUGG continued to strengthen cooperation with scientific unions and interdisciplinary bodies of the ICSU such as the World Data System Committee and CODATA, as well as with the World Meteorological Organization (WMO), the United Nations Education, Science and Culture Organization (UNESCO), the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO), the Group on Earth Observations (GEO), the World Climate Research Programme (WCRP), the Scientific Programme on Integrated Research on Disaster Risk (IRDR), Global Framework for Climate Services (GFCS), Future Earth and with some other international and intergovernmental organizations, professional societies of geoscientists, and international programs.
- *Business meetings.* The IUGG Bureau and Executive Committee met in Paris, France, in June and the meetings were hosted by the UNESCO Earth Science and Geohazards Risk Reduction Section. The IUGG President and Secretary General participated in the ICSU Unions Meeting in Paris and in the ICSU Extraordinary General Assembly in Oslo, Norway, to vote on a merger, in principal, of ICSU with the International Social Science Council (ISSC).

I published an article about the role of IUGG and other international geoscientific unions in the promotion of geosciences internationally. The development of international cooperation in geosciences is reviewed in the paper in the context of scientific and political changes over the last century, and scientific and organizational aspects of IUGG activities, including cooperation with international and intergovernmental institutions, are analyzed. Future development of scientific unions and their role in the changing global landscape of geosciences are discussed.

I thank the IUGG Adhering Bodies and National Committees, Union Associations and Commissions as well as all individuals who helped making the year 2016 exciting and productive in strengthening international cooperation in Earth and space sciences for the benefit of humanity.

Alik Ismail-Zadeh

IUGG ACTIVITIES

IUGG SECRETARIAT

The IUGG Secretariat is located at the German Research Centre for Geosciences in Potsdam (GFZ-Potsdam. The Secretariat is managed by the IUGG Secretary General Dr. A. Ismail-Zadeh and the Assistant Secretary General / Executive Secretary Dr. F. Kuglitsch, with a support from Mrs. K. Gundrum. The Secretariat is responsible for implementing the day-to-day operations of IUGG; this includes (i) maintenance of daily correspondence and communication with IUGG National Committees, Adhering Organizations, Union Associations, Executive and Financial Committees, Union Commissions and Committees; (ii) maintenance of IUGG electronic databases and technical documents; (iii) supervision of the IUGG webmaster and preparation of updates for the IUGG website and social media in timely fashion; (iv) development of IUGG Yearbooks and Annual Reports; (v) negotiations with companies for production of IUGG-related publications, medals, pins etc.; (vi) publication of the IUGG E-Journal (monthly issues); (vii) assistance in technical screening of IUGG grant applications, medal and awards nominations; (viii) preparation work for IUGG General Assemblies, Council, Executive Committee, and Bureau Meetings; and some other activities.

The Secretariat adopted a web-conferencing software, which provides a platform for business meetings of IUGG Bureau, Union Commission and other Union bodies across geographically dispersed locations through: text-based instant messages, voice and video chat, online presentations, web conferences, and desktop sharing enables participants to increase communication, reduce travel expenses and conserve time, increase productivity, and accelerate the decision-making process.

Sponsorship: The IUGG Secretariat is co-sponsored by *GFZ-Potsdam* and *German Research Foundation (DFG).* IUGG thanks the GFZ-Potsdam for the arrangement and financial support of the Secretariat, and DFG for generous support of the position of the Assistant to Secretary General and business trips of the Secretary General.

IUGG Yearbook: The Secretariat maintains the data related to the IUGG and its Associations and produces annually Yearbooks which are available at the IUGG website. The IUGG Yearbooks maintain the directory of Union and Association officials and the archive of IUGG memberships and General Assemblies.

IUGG Annual Report: The IUGG Annual Reports summarize the activities of the Union, IUGG Associations and Union and Inter-Unions Commissions. The Annual Reports are available at the IUGG website.

Comptes Rendus of the 26th IUGG General Assembly: The Comptes Rendus of the 26th IUGG General Assembly is now available at the IUGG website. Thanks to all who helped to compile the proceedings of the General Assembly! The Comptes Rendus were sent to the Council Delegates, National Committee officers, representatives of Adhering Bodies, Executive and Finance Committee, major libraries, and others.

IUGG website and social media: The IUGG website, in English and French, was maintained by Dr. D. Krupsky, IUGG webmaster, and permanently updated for 2016. To learn more about IUGG and to keep individuals updated on the Union's activities, the IUGG Secretariat maintains FACEBOOK, TWITTER, and YOUTUBE.

IUGG Electronic Journal: The E-Journal, an informal newsletter, was published and distributed monthly keeping IUGG Member National Committees informed about the activities of IUGG, its Associations and Commissions, and the actions of the IUGG Secretariat. Also the journal publishes feature articles, news from the International Council for Science (ICSU) and the GeoUnions, news and reports related to IUGG scientific programs and co-sponsored scientific meetings, and a calendar of scientific meetings.

IUGG Central Electronic Library (CEL): A web-based IUGG Central Electronic Library (CEL) for stimulating the exchange of scientific knowledge through (i) archiving, (ii) presenting, and (iii) publishing IUGG-related documents at one single platform is under construction. IUGG-related documents include reports, yearbooks, E-Journals, newsletters, conference abstracts, oral/poster presentations etc. originating from the IUGG and its Union Associations, Union Commissions, Committees, Liaisons, Research Programs, and Science Education Events.

New logos of the IUGG Associations: The IUGG Executive Committee (EC), at its 2016 meeting in Paris, France, decided to design joint IUGG-Association logos. The IUGG Secretariat in a contact with a professional designer prepared a set of the logos, which was approved by the EC in December 2016. The new joint logos are presented below.

IUGG
IACS
International Association of Cryospheric Sciences

IUGG
IAMAS
International Association of Meteorology and Atmospheric Sciences

IUGG
IAG AIG
International Association of Geodesy

IUGG
IAPSO
International Association for the Physical Sciences of the Oceans

IUGG
IAGA
International Association of Geomagnetism and Aeronomy

IUGG
IASPEI
International Association of Seismology and Physics of the Earth's Interior

IUGG
IAHS AISH
International Association of Hydrological Sciences

IUGG
IAVCEI
International Association of Volcanology and Chemistry of the Earth's Interior

IUGG BUSINESS MEETINGS

Bureau and Executive Committee meetings

The IUGG executives met in Paris, France, on 16-18 June to discuss the progress and activities since the 2015 IUGG General Assembly in Prague, Czech Republic, and to elaborate the work plan and new initiatives for the forthcoming years. The meeting was hosted by the UNESCO Earth Sciences and Geo-Hazard Risk Reduction (ESGHRR) Section. Besides the usual business related to reporting on the activities of the officers related to administrative and financial matters, the Bureau revised the Guidelines on IUGG Administration; discussed the grant applications, which were thoroughly analyzed by the Bureau Members, and approved the grant awards (see article 2, this issue); considered the proposal on administrative structuring and activities of the College of Fellows established by the Council in 2011; discussed the Strategic Plan and its Implementation for 2016-2023; analyzed the recent activities of the Union Commissions and Committees, and the International Lithosphere Program; discussed the news related to the International Council for Science (ICSU), especially associated with the proposed merger with the International Social Sciences Council (see article 5, this issue); and analyzed how to strengthen the relationship with international and intergovernmental organizations (see articles 3 and 4, this issue).

At the opening of the Executive Committee (EC) meeting, Dr. Patrick McKeever, Head of the ESGHRR Section, welcomed the participants and discussed recent changes in the structure and activities of this UNESCO Section. He called for closer cooperation between IUGG and the ESGHRR Section. Dr. Heide Hackmann, ICSU Executive Director, addressed the EC describing recent changes in ICSU programs, activities, joint initiatives, and a proposed major change in structure of the Council. IUGG Officers reported on the scientific, administrative, membership, and financial activities of the Union. Association Presidents reported on the activities of their associations for the last year and highlighted future work mostly associated with scientific assemblies in 2017. The EC discussed (i) Union-standard abstract and program management at IUGG general and Association scientific assemblies; (ii) Strategic Plan and draft Implementation Plan (2016-2023); (iii) a proposal related to structuring the College of Fellows; (iv) strengthening cooperation with early-career scientists via existing networks, e.g. APECS (polar researchers), MIRES (solid Earth researchers), YES (geoscientists), and YESS (Earth system scientists); (v) planning for the IUGG centennial event in 2019; and some other topics. The next meeting of the Bureau and EC will be held in September 2017 in Montreal, Canada.

At the Executive Committee meeting on 17 June 2016, UNESCO, Paris, France

On the occasion of the IUGG business meetings in Paris, the French National Committee for Geodesy and Geophysics (CNFGG) invited the Executive Committee Members for a cocktail party held at the UNESCO Headquarters. IUGG thanks the French National Committee for the wonderful party. IUGG is very grateful to the UNESCO ESGHRR Section for hospitality and cooperation.

IUGG COUNCIL (2016-2019) FORMED

IUGG's affairs are directed by the Union Council governed by the Statutes and By-Laws of the Union. Until 2015, the Union Council Delegates were appointed only for the duration of Council meetings held at IUGG General Assemblies and, therefore, major decisions could only be taken every four years. To modernize the Union's practices and to improve the flexibility in decision-making, the IUGG Council at its meeting in Prague in June 2015 decided to extend the term of office of Council Delegates to four years (the time between two consecutive General Assemblies). According to the IUGG Statutes, "between meetings of the Council, the direction of the affairs of the Union shall be vested in the Bureau and the Executive Committee" with specific responsibilities defined in the Statutes. The responsibilities of the Standing Council will be to consider, discuss and decide on major scientific proposals, initiatives, and urgent administrative issues of the Union, which the Bureau and the Executive Committee consider important, and a decision requires voting by the Council. The IUGG Council is composed of one credentialed delegate (and an alternate, if required) from each Adhering Body. The IUGG Council Delegates (2016-2019) are listed on the IUGG website.

IUGG FINANCE COMMITTEE RENEWED

Because of the vacancy occurring after the death of David Collins, Chair of the Finance Committee, and according to the Union By-Law 12c, the Executive Committee appointed Nasser Abou-Ashour (an IUGG Council Delegate) as a new Member of the Finance Committee for 2017-2019. The IUGG Council endorsed the appointment on 19 January 2017. The Finance Committee elected Jan Krynsky as Chair of the Committee. The Finance Committee consists now of four people: Nasser Abou-Assour (Egypt), Jan Krynsky (Poland), Corina Risso (Argentina), and Virendra Tiwari (India).

IUGG UNION COMMISSION ON DATA AND INFORMATION RENEWED

The Union Commission for Data and Information (UCDI) provides a focused and sustainable organizational structure supporting and strengthening IUGG science through integrated scientific information activities. As the Commission was inactive since the IUGG General Assembly in Prague in 2015, the IUGG Bureau decided to renew its membership in its mid-term and the Executive Committee endorsed the decision. Union Associations nominated several candidates for the Commission, and the IUGG Bureau selected the final list of the members including Commissioners who served for the previous term. The membership of UCDI for 2017-2019 is as follows:

Sateesh Shenoi, Chair, IAPSO, India
Anatoly Soloviev, Vice Chair, IAGA, Russia
Ellen Clarke (F), Member, IAGA, UK
Sonia M. A. Costa (F), Member, IAG, Brazil
Michelle Guy (F), Member, IASPEI, USA
Robert M. Key, Member, IAPSO, USA
Silvia Massaro (F, E), Member, IAVCEI, Italy
Yasuhiro Murayama, Member, IAMAS, Japan
Bruce H. Raup, Member, IACS, USA
Aude Chambodut, Co-opted Member, IUGG liaison to WDS
Alena Rybkina, Co-opted Member, IUGG liaison to CODATA
(F is female, E is an early career scientist)

TASK FORCE ON THE IUGG 100TH ANNIVERSARY FORMED

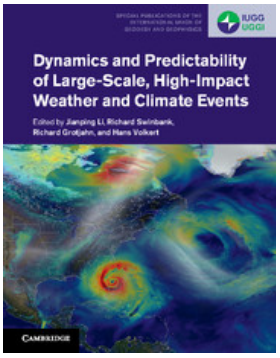
To prepare the Union for its centennial, the IUGG President Michael Sideris appointed the following people to serve on the Task Force for the IUGG 100th Anniversary (TF100) to be celebrated in 2019. The TF100 will prepare a program for celebration of the event, including activities related to publications, science and education, science policy and outreach, and the legacy of the centennial. The members of the TF100 are:

Chris Rizos, Chair of the Task Force, also Chair of the Visioning Committee;
Georges Balmino, former IUGG Secretary General;
Athena Coustenis, Chair of the Honor and Recognition Committee;
Johanna Salminen, Secretary General of the Finish National Committee for IUGG, an early-career scientist;
Denise Smyth-Wright, President of IAPSO;
Hans Volker, Chair of the IUGG working Group on History;
Gordon Young, Local Organizing Committee of the IUGG2019;
Michael Sideris, IUGG President (ex-officio);
Alik Ismail-Zadeh, IUGG Secretary General (ex-officio); and
Franz Kuglitsch, IUGG ASG/ES (IUGG Secretariat).

IUGG STRATEGIC PLAN FOR 2016-2023

Strategic planning is an important visioning process to determine a strategy, mission, goals, and major activities of the organization for the near future. In 2014, the IUGG Visioning Committee was asked to draft a Strategic Plan of the Union for 2016-2023. The draft Strategic Plan was presented and discussed at the IUGG Council Meeting in Prague, Czech Republic, in 2015. The Council recommended revision of the plan based on the comments from Council Delegates. After receiving feedback from the Council Delegates, the Visioning Committee finalized the plan, which was endorsed by the IUGG Executive Committee. In December 2016, the IUGG Council approved unanimously the Strategic Plan: 30 (71.4%) of 42 eligible Council Delegates have voted in favor of the plan. The work of the Visioning Committee on the Strategic Plan is greatly acknowledged by the IUGG Executive Committee. The text of the Strategic Plan 2016-2023 can be found in Appendix A of the Annual Report and on the IUGG website.

IUGG SPECIAL PUBLICATION SERIES



The new book "*Dynamics and Predictability of Large-Scale, High-Impact Weather and Climate Events*" was published by the Cambridge University Press. This volume, written by leading researchers in the field, covers a range of important research issues related to high-impact weather and extreme climate events. Dynamical linkages between these extremes and various atmospheric and ocean phenomena are examined, including Atlantic Multi-decadal, North Atlantic, and Madden–Julian Oscillations; Annular Modes; tropical cyclones; and Asian monsoons. This book also examines the predictability of high-impact weather and extreme climate events on multiple time scales, and enhances understanding of dynamical and physical processes associated with these events. A proposal for the book "*Global Change and Future Earth: The Geodetic and Geophysical Perspective*" as a part of the IUGG Series was approved by the Cambridge University Press Syndicate for publication. The book will be edited by Tom Beer, Jianping Li, and Keith Alverson.

IUGG GRANTS PROGRAM

The IUGG Grants Program aims to support projects, of importance to the international geophysical and geodetic community, which explore new scientific ideas, develop future international initiatives, and promote geoscience education. For 2016-2017, IUGG awarded grants to the following projects:

- *"Data Intensive Systems Analysis for Geohazard Studies"* (Lead Applicant: IAGA; Supporting Applicant: UCDI).
- *"Determination of the Earth's mathematical surface in Africa towards the realization of the International Height Reference System"* (Lead Applicant: IAG; Supporting Applicant: IASPEI).
- *"Marine Magnetics in Remote Areas: filling gaps together in education, research and observations"* (Lead Applicant: IAGA; Supporting Applicants: IASPEI, IAVCEI, SEDI).
- *"Seismological Contributions to Earthquake Risk Reduction"* (Lead Applicant: IASPEI; Supporting Applicant: GRC).
- *"Training School for Students and Early Career Atmospheric Scientists from Asian Monsoon Countries"* (Lead Applicant: IAMAS; Supporting Applicant: IAPSO).
- *"Training school on stratosphere-troposphere interactions"* (Lead Applicant: IAMAS; Supporting Applicants: IAGA, WCRP).

The total amount of funds allocated for the projects is US$ 40,000.

SCIENTIFIC MEETINGS SELECTED FOR IUGG SUPPORT IN 2016

IUGG co-sponsors symposia and workshops appropriate to Union disciplines of study. IUGG allocated US$20,000 to assist meetings in 2016 and especially to support the participation of young and female scientists and scientists from developing countries. Officers of the Union, Associations and Union Commissions proposed meetings to receive these awards. In 2016, IUGG supported 21 scientific meetings in 17 countries of Africa, Asia, the Caribbean, Europe, North America, and Oceania (the IUGG Association that endorsed the meetings is indicated in brackets):

- 2nd Snow Science Winter School, Preda and Davos, Switzerland, 14-20 February (IACS)
- International Summer School in Glaciology, McCarthy, Alaska, USA, 7-17 June (IACS)
- CCEC2016 - 2nd Workshop of the IUGG Union Commission on Climatic and Environmental Change, Luxembourg, Luxembourg, 24-25 October (IAG)
- 23rd International Workshop on Electromagnetic Induction in the Earth, Chiang Mai, Thailand, 14-20 August (IAGA)
- IAGA-IV Symposium: "Influence of short and long term solar variability on climate", Hurghada, Egypt, 20-24 March (IAGA)
- 7th workshop of the VLF/ELF Remote Sensing of Ionospheres and Magnetospheres (VERSIM) working group, Hermanus, South Africa, 19-23 September (IAGA)
- The Spatial Dimensions of Water Management - Redistribution of Benefits and Risks, Bochum, Germany, 18-20 May (IAHS)
- The International Radiation Symposium 2016, Auckland, New Zealand, 17-22 April (IAMAS)
- The 17th International Conference on Clouds & Precipitation, Manchester, UK, 25-29 July (IAMAS)
- International Ozone Commission Quadrennial Ozone Symposium 2016, Edinburgh, UK, 4-9 September (IAMAS)
- The SPARC Workshop on "Stratospheric Change and its Role for Climate prediction (SHARP)", Berlin, Germany, 16-19 February (IAMAS)
- 48th International Liège Colloquium on Ocean Dynamics: "Submesoscale Processes: Mechanisms, Implications and new Frontiers", Liege, Belgium, 23-27 May (IAPSO)

- “A Connected Ocean" - the Challenge of Observation Data Integration, Brest, France, 11-12 October (IAPSO)
- Arctic-Subarctic Ocean Fluxes (ASOF), Lerici, Italy, 30 March-1 April (IAPSO)
- Regional Assembly Latin American and Caribbean Seismological Commission (LACSC-2016), San Jose, Costa Rica, 20-22 June (IASPEI)
- FIRST General Assembly of the African Seismological Commission (AfSC 2016), Luxor-Aswan, Egypt, 2-5 April (IASPEI)
- 10th International Workshop “Physics and forecasting of rock destruction”, Apatity, Kola Peninsula, Russia, 30 May-5 June (IASPEI)
- 9th Workshop of the IAVCEI Commission on Volcanic Lakes (CVL9), Yaoundé, Cameroon, 13-23 March (IAVCEI)
- 3rd International Workshop on Volcano Geology, Mt. Etna, Aeolian Islands, Italy, 4-9 July (IAVCEI)
- Advanced International School on “Early Warning Systems for Geohazards”, Rhodes, Greece, 3-9 October (IAVCEI)
- 41st COSPAR Scientific Assembly, Istanbul, Turkey, 30 July-7 August (IAG, IAGA, IAMAS)

SCIENTIFIC MEETING REPORTS 2016

The Second Snow Science Winter School

The Second Snow Science Winter School (SSWS2) took place in Preda and Davos, Switzerland from 14 to 20 February 2016. It was organized by the WSL Institute for Snow and Avalanche Research SLF Davos, Switzerland, and the Finnish Meteorological Institute. The school aimed at teaching graduate students modern snow measurement techniques. In addition to the lectures, all traditional and modern field instruments were available for the students to get hands-on experience in the field. During the SSWS2, advanced techniques such as micro-tomography, measurement of specific surface area by reflection and spectroscopy, near-infrared photography and high-resolution penetrometry were taught.

The main purpose of the school was to allow students to learn current and emerging techniques for objective characterization of the snowpack for various applications. Traditional methods for snow quantification were also covered. The teaching method adopted was a hands-on approach in a real environment, supported by introductory lectures. Field exercises typically took place after morning lectures and in the afternoon. For the field exercises and subsequent reporting, the students were assigned to small groups of 3-4 people. The groups learned to study different kinds of snowpack (forest area, open area, above tree-line area) with different instruments. In addition, during the half-day trip to Davos, the students had the possibility to visit the cold lab. After each field day, students were required to use time with their group to summarize their measurements and to start analyzing the measured data. The groups of students operated independently, relying on skills acquired on the first day to operate instruments and apply correct field measurement protocols. Lecturers monitored the process correcting for possible errors, so a consistent field dataset from eight groups was acquired. The SSWS2 was supported by IUGG and IACS.

26 students were selected from 64 applicants. The number of male and female students was almost equal. Of the selected students, 4 were post-docs, 20 PhD students, and 2 advanced Master students. The students came from Asia, Europe, and North America. The high number of applications clearly shows a significant interest in the subject. The eight groups presented their results in written reports, which were reviewed by the lecturers. The reports showed a good understanding of the applicability of the methods in different environments, their ease of use and limitations. All students were very positive about the winter school, and expressed their satisfaction with the program. The main minor

concern was that time was too limited for working with the data during the winter school. This will be considered for the third School to be held in Finland from 12 to 18 February 2017. The lecturers are convinced that this school will form a well-educated base of snow scientists with in-depth knowledge of quantitative methods to measure snow properties (reported by Cecilia Cetti, SSWS2 organizer).

The Workshop of the IAVCEI Commission on Volcanic Lakes

On 21 August 1986, a lethal CO_2 cloud burst from the bottom waters of Lake Nyos in the Northwest Region of Cameroon killed 1,734 people and over 3,500 livestock. Intensive discussions on the physical and chemical processes behind this gas escape from Lake Nyos led to setting up the International Working Group on Crater Lakes (IWGCL), which became the IAVCEI Commission on Volcanic Lakes (CVL). To commemorate this event, CVL organized its 9th workshop (CVL9) in Cameroon's capital Yaounde from 14 to 16 March 2016. CVL9 was inaugurated by H.E. Madeleine Tchuinte, the Minister of Scientific Research and Innovation. CVL9 was organized by the Institute of Geological Research and Mining of Cameroon backed by the CVL steering committee. 32 talks were presented during the first three days of the workshop. The attendance of local researchers and students was impressive. CVL9 showed that the initial controversy on Lake Nyos has been replaced by harmony and agreement. The decades-long dedication and project management by the Japanese team is an example of international collaboration and capacity building, unique and exemplary, beyond any border or socio-economic limit. Currently, a self-sufficient team of Cameroonian experts has returned home after doing their PhDs in Japan.

Lake Nyos was visited on 19 March 2016 for a multi-disciplinary sampling and measurement campaign, and to learn about the impact the 1986-event had on society. On 22 March, Lake Barombi Mbo, the largest maar lake in Cameroon, was sampled at depth for the first time. The meeting showed that the CVL is an active group of passionate researchers assuring creative and socially responsible research. The CVL Steering Committee recognized Minoru Kusakabe for his role as the "CVL founding father" and career-long dedication to Lake Nyos and, especially, for his open-headedness towards local researchers. In his name and example, the CVL will award the "Kusakabe Award" every three years. The CVL Steering Committee was confirmed and recruitment of young researchers for future follow-up in the CVL guidance has started. The CVL Members should select the site for CVL10 in 2019. Bids have been received from Italy, Mexico, and New Zealand (reported by Dmitri Rouwet, CVL Chair).

The Symposium "Influence of Short- and Long-term Solar Variability on Climate"

The 4th IAGA Symposium on "*Influence of Short- and Long-term Solar Variability on Climate*" was held in Hurghada, Egypt, from 20 to 24 March 2016. The symposium was attended by about 70 scientists from nine countries: Cameroon, Egypt, France, Germany, Mali, Morocco, Russia, The Kingdom of Saudi Arabia, and the United Kingdom. The scientific program of the symposium was divided into six scientific sessions:

(1) Solar and space missions for space weather and solar variability observations
(2) Solar activity/variability effects on the lower, middle and upper atmosphere
(3) Modelling climate consequences of solar activity and suggested mechanisms
(4) Modelling and predicting large flares, super flares, CMEs and other extreme events
(5) Solar energetic particles and solar wind influence on the Earth's inner magnetosphere and atmosphere, and
(6) Societal impact of solar variability.

Peer-reviewed contributions based on the presentations will be published as a special issue of the Cairo University Journal of Advanced Research (an Elsevier publication). More information on the symposium can be found online.

Group photo of the Symposium's participants

The Workshop "Arctic Subarctic Ocean Flux Study"

The Atlantic sector of the northern hemisphere is a key area for the exchange of heat between the Subarctic and the Arctic, in both the atmosphere and the ocean. In particular, the oceanography and meteorology of the Nordic Seas, Fram Strait, and the Barents Sea exert pivotal constraints on heat exchange with the Arctic Ocean. This heat exchange influences the northern climate system, which is undergoing rapid and widespread change. The workshop "Arctic Subarctic Ocean Flux Study" (ASOF) was held on 30-31 March 2016 in Lerici, Italy, and was dedicated to the challenges associated with observing, modeling, understanding, and predicting these heat exchanges. The workshop addressed the questions: Where are we? What do we know?, and What needs to be done? In addition, the workshop featured other contributions relevant to ocean fluxes between the Arctic and Subarctic seas. The main topic was "Arctic–Subarctic Heat Exchange in the Atlantic sector: from Understanding Processes to Predicting Change." Three solicited presentations set the scene. They focused on the role of northward heat transport variability and its influence on climate predictability, the dynamics and variability of Atlantic Water flow in Fram Strait, and the coupling between the Atlantic Water inflow and the overflow in the Iceland-Scotland region. On a larger-scale perspective, an overview of the water mass transformation in the entire northern hemisphere ocean basins was given, the problems of transient tracers, the stability of the thermohaline flow regimes and thermobaricity issues were discussed, identifying ocean transition zones between Alpha and Beta Oceans relevant for vertical property exchange. Updates were provided on the US and international observational activities in Bering and Davis Strait, as well as in the Beaufort Sea. The meeting concluded with a discussion of building an Arctic observing system, in the face of funding squeezes to important long-term observational programs (e.g., the Faroe Island gateways, Davis Strait, Switchyard, and North Pole Observatory). The group resolved to write a position paper from the point of view of ASOF. IUGG/IAPSO supported financially the workshop. More detail about the workshop can be found online (reported by Michael Karcher and Thomas Haine).

The 48th International Liège Colloquium on Ocean Dynamics

The 48th International Liège Colloquium on Ocean Dynamics took place in the University of Liège (ULg), Liège, Belgium, 23-27 May 2016. Every year, the colloquium addresses a cutting edge topic in Ocean Science with the goal being to foster discussions and collaborations among scientists from all around the world. The 48th edition of the colloquium was a success with 200 participants from more than 40 countries.

Group photo of the colloquium participants (photo: courtesy of C. Troupin)

Eight keynotes, 72 talks, and 143 posters were presented at the colloquium at seven topical sessions: (1) Multiscale interactions - energy cascade, impact of submesoscales on other scales; (2) Mixed layer and frontal instabilities - dynamical understanding, Lagrangian view, lateral mixing; (3) Internal waves, and Wave-front/eddy interactions; (4) Remote sensing of submesoscale dynamics – surface topography, ocean temperature and color; (5) Impact of atmospheric surface forcing, sea ice, river plumes and waves on mixed layer and submesoscale turbulence; (6) Physical-biological interactions – implications for biogeochemistry, productivity, export, diversity and transport; and (7) Coastal submesoscale dynamics - interaction with topography and bottom boundary.

The best poster awards were bestowed on early career scientists: Jacob M. Steinberg received the *Jacques Nihoul Poster Award* for his work entitled "The Evolution of a California Undercurrent Submesoscale Eddy (Cuddy)", and Marina D. Moro received the *Public Poster Award* for her work on "3D reconstruction of mesoscale flows using observations of satellite high resolution data: twin experiments with a numerical model of the Solomon Sea".

Most of the talks were followed by discussions. In order to increase the interactions between the young scientists (Master, PhD students and early postdocs) and some of the members of the scientific committee, two lunches were organized in the poster room. Each time about 25 people gathered (among which were 20 young scientists), and the lunches received a very good response from all the participants. IUGG provided financial support to the colloquium (reported by Charles Troupin, co-organizer of 48th International Liège Colloquium).

The 10th International Workshop "Physics and Forecasting of Rock Destruction"

The 10th International Workshop "Physics and Forecasting of Rock Destruction" was held in Apatity, Murmansk region, Russia, 13-17 June 2016. This workshop was combined with the 6th Russia-China scientific seminar "*Challenges of non-Linear Geomechanics at Large Depths*", as both were thematically close to each other. Both events were organized by the Mining Institute of the Kola Scientific Center of the Russian Academy of Sciences (RAS). The meeting aimed at improving information exchange on achievements in geomechanics and engineering seismology, and it reflected the main goals of the IASPEI Commission on Earthquake Generation Process: Physics, Modeling and Monitoring for Forecast.

103 scientists and engineers participated in the meeting, and 15 plenary lectures were delivered. The submitted abstracts were published in the Abstract Volume and distributed to participants.

At a workshop session (photo: A. Zalyalov)

The workshop was conducted in sessions related to three scientific themes. The first theme was focused on the problems of the theory of rock destruction, mathematical and physical modeling of processes in the sources, the spatial-temporal patterns of earthquake source development, rock bursts, and the influence of trigger mechanisms on the processes of instability of rocks. The second theme was dedicated to the discussion of problems of catastrophe theory and phase transitions in energetically open systems under conditions of self-organized criticality, and collective behavior of cracks. The third theme was related to precursors of earthquakes and the methods of their separation from the background seismic noise, as well as new approaches to earthquake forecasting, prognostic methods and algorithms, as well as methods and software to identify precursory anomalies using a combination of seismological, geophysical, hydro-dynamical and geochemical parameters. It was noted that there is increased interest in studying processes of rock destruction in the upper part of the Earth's crust based on treating it as a non-linear dissipative system. Relating this to conditions in the Earth's crust requires a theory of dynamics of dissipative systems that should be developed based on the hierarchy-blocked structure of the lithosphere, the heterogeneity and discontinuity in its strength and stress state as well as the different scale of flow processes and multiple fluctuations of external and internal origin. The meeting led to a greater understanding of trigger effects resulting in instability of rocks. Laboratory and in-situ experiments are of great importance. For the first time, experts examined the interaction between geomechanical and physical-chemical gas and mass exchange processes in a coal field. The social program included an excursion to the Apatity Museum (in Kirovsk City) containing a rich collection of minerals and rocks of the Kola Peninsula as well as a visit to the world's first nuclear-powered icebreaker. The workshop was supported by IUGG/IASPEI and co-sponsored by the Russian Foundation for Basic Research and several Russian Joint Stock Mining Companies (reported by Alexey Zavyalov, Vice Chair of the workshop).

The Second General Assembly of LACSC

The Second General Assembly of the Latin America and Caribbean Seismological Commission (LACSC), an IASPEI Regional Commission, was held in San José, Costa Rica, 20-22 June 2016. This Assembly was organized by the Costa Rica Volcanological and Seismological Observatory, a research institute at the National University in Heredia, and by the Costa Rica National Academy of Science, the IUGG Adhering Organization in Costa Rica. Given the prestige that seismological institutions have in Costa Rica, this event was declared of Public Interest in an official decree by the President of Costa Rica and the

Minister of Science, Technology and Telecommunications. The Vice-President of Costa Rica, Ms. Ana Helena Chacón Echeverría, attended and officially opened the Assembly. Also present at the stage during the inauguration were the Acting Minister of Science and Technology of Costa Rica, the Chancellor of the National University, the President of the Costa Rica Academy of Sciences, and the President of the National Emergency Commission. A total of 207 participants from 37 countries submitted 283 abstracts to this assembly. The scientific program encompassed 16 sessions including a Forum on the Costa Rica Building Code and a special session on the Pedernales, Ecuador Earthquake, where for the first time data and results from this event were shared in an international meeting.

Taking advantage of the large and broad participation at the LACSC2016, two workshops were held in Costa Rica right after the assembly: (i) workshop on *Seismic Hazard in South America, Central America and the Caribbean*, organized by the U.S. Geological Survey and the University of Chile with support from the USAID's Office of U.S. Foreign Disaster Assistance (USAID/OFDA); and (ii) expert workshop on Tsunami Sources for Central America, funded by UNESCO. The LOC of the LACSC2016 Assembly supported all students and early career scientists, who requested a travel support. 53 students and 31 early career scientists have been funded; thanks to the support from IUGG/IASPEI, USAID/OFDA, Seismological Society of America, and the Incorporated Research Institutions for Seismology (IRIS).

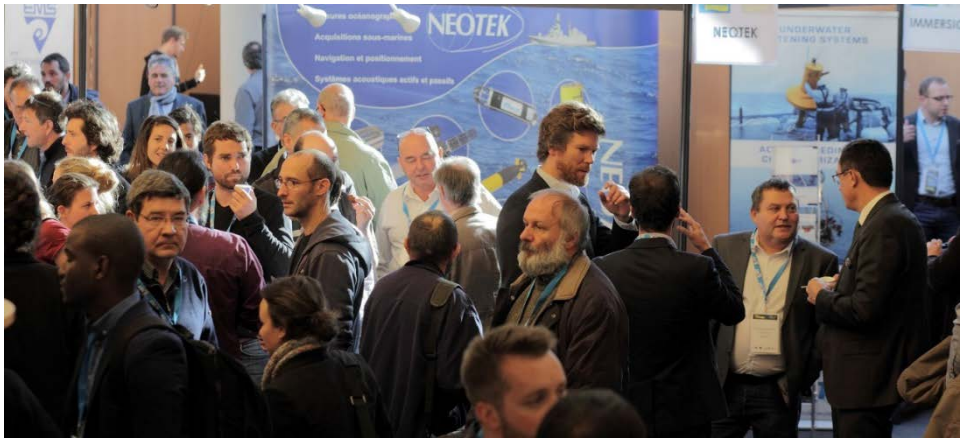
Two business meetings of LACSC were held during this assembly, one meeting of the Officers of the Executive Committee and Council, and a second meeting being a Plenary Session. An amendment to LACSC statutes was introduced to make them compatible with the new IASPEI statutes in terms of membership. A new Executive Committee was elected consisting of Victor Huérfano from Puerto Rico as President, Marino Protti (Costa Rica) as Past-President, Mario Ruiz (Ecuador) as Vice-President, Marcelo Assumpção (Brazil) as Executive Secretary, Patricia Alvarado (Argentina), Leandro Rodríguez (Peru), Sergio Barrientos (Chile), Franck Audemard (Venezuela), Eduardo Camacho (Panama), Xyoli Pérez-Campos (Mexico) and Lloyd Lynch (Trinidad and Tobago). Puerto Rico was chosen as the venue for the next LACSC2018 Assembly. That assembly will be held jointly with the Annual Meeting of the Seismological Society of America from 24-26 April 2018 (reported by Marino Protti, President of LACSC).

Conference "A Connected Ocean" (ACO2016)

The conference "A connected ocean: new approaches, new technologies, new challenges for knowledge of ocean processes" (ACO2016) was held in Brest, France, from 1 to 13 October 2016 and was the first opportunity to gather two scientific communities: the Ocean Engineering Society (OES) of the Institute of Electrical and Electronics Engineers (IEEE), and the IAPSO of IUGG. The sessions covered four themes: 1) Interoperability standards for the marine environment, 2) Multimodal synergies in ocean studies, 3) Big Data infrastructure and analytics in ocean science, 4) Biological rates, upwelling: new autonomous approaches and integrated observations. The conference started with a plenary, and hosted a special user engagement workshop co-organized with Eurogoos: "The power of open-access interoperable marine data for the maritime sector: An untapped resource?"

The "Big data" session gathered the largest crowd and was well attended by scientists and students. It was introduced by Stan Matwin, Chair of Excellence at the University of Dalhousie, Canada, who demonstrated the strength of machine learning solutions to tap into new sources of data, such as AIS (ship positioning) to fill gaps in satellite observations. A session covered the new synergies between the different sources of data now available to oceanographers of all disciplines: satellites, sensors, new radars, in-situ observations. The combined use of these data will lead to new discoveries (quoting one invitee, "sky is the limit"). Successful applications of deep learning techniques were shown, for example in the case of sea surface temperature (SST). It was noted that for the reconstruction of small scale (sub-mesoscale) features in SST images, such as filaments and sharp fronts, the standard tools (natural images models) available on the web do not work well. Ocean dynamics should be considered

to understand the information content of different variables (e.g., SST and sea surface height) and to find the best method to combine them into a coherent picture. Regarding in situ data, the pioneering ocean observatories in Canada are quite remarkable for the number of instruments in operation and the data flow produced. These data are now processed to create products, used by scientists but also other sectors of the society, for marine and public safety for example.



At the conference (photo: A.-M. Tréguier)

Other keywords of the conference are "interoperability and standards". While these concepts are well developed in the IEEE community, they are not often brought to the forefront and debated at IAPSO meetings. The development of standardization procedures is essential in many fields. Among the many related presentations, two examples are the “biodiversity information standard”, used to develop graph-based interactive databases of the ocean biodiversity; or the OGC (Open Geospatial Consortium) protocols which have been implemented by Ifremer (France) to facilitate access to its databases. Metadata must be further developed, as well as secure data communication protocols for deep sea observatories. Discussions and round tables raised many more interesting issues, for example, the automation of data collection and multidisciplinary ocean observations. The objective of the organizers is to propose a series of dedicated "A Connected Ocean" workshops to tackle these issues. A special issue of the IEEE-OES journal is under consideration (reported by Anne-Marie Tréguier, a conference organizer).

REPORTS OF IUGG LIAISON OFFICERS

The Fourth Session of the GFCS Partner Advisory Committee

The Fourth Session of the Partner Advisory Committee of the Global Framework for Climate Services (GFCS) was held on 11 and 12 February 2016 in the offices of the United Nations Development Programme in Geneva, Switzerland. It was attended by some 26 individuals representing 13 Members of the Committee and three Observers. As with the Third Session, the two days passed in very amicable and constructive discussion with all present recognizing the importance of working together to achieve the aims of the GFCS, not so much on paper but out in the field. Some of the Members, such as the World Bank, are spending billions of US$ on GFCS-related projects in developing countries while others, such as IUGG, have no budgets for such work but are still made welcome. The World Meteorological Organization (WMO) has clearly done an excellent job in promoting the concept of climate services and the need for such services is now widely recognized. As a consequence, well-funded projects are being implemented in many countries, but they all-too-often lack co-ordination. A key purpose of the PAC is to help resolve this problem. A number of GFCS Partners were actively involved in COP21 in Paris, France, in December 2015, and it was pleasing to see a reference to science for climate services being mentioned in paragraph 7, section 7c of the Paris Agreement as

"strengthening scientific knowledge on climate, including research, systematic observation of the climate system and early warning systems, in a manner that informs climate services and supports decision- making". The current El Niño is also helping to focus attention at national and international level on the need for climate services and many of the Partners are involved in actions to respond to the situation (reported by Arthur Askew, IUGG Principal Liaison to WMO and GFCS).

Report on the WCRP Joint Scientific Committee Meeting

At the 37th session of the World Climate Research Programme (WCRP) Joint Scientific Committee in Geneva, Switzerland, on 25-27 April 2016, Richard Essery (University of Edinburgh) stood in for Tom Beer as IUGG liaison (an outline of the history and structure of WCRP can be found in the IUGG Electronic Journal, Volume 15, Number 6, June 2015). The meeting consisted of presentations of reports from the WCRP core projects and grand challenges which can be viewed online. Common themes were moves towards higher resolution modelling (for convection, clouds, precipitation, gravity waves and sea surface temperature) and progress of the 6th Coupled Model Intercomparison Project (CMIP6), which is often thought of as part of IPCC but is actually a WCRP activity. It was decided that a working group should be set up to restructure the support for regional climate activities across WCRP. The meeting endorsed two new grand challenges on 'Carbon Feedbacks in the Climate System' and 'Near-Term Climate Predictions' in addition to the existing set of five. For the challenge of predicting regional sea-level change and coastal impacts, it was noted that there are strong contributions, such as vertical land motion, which require interaction with communities beyond WCRP. The WCRP core projects on climate and ocean variability (CLIVAR), the cryosphere (CliC), energy and water (GEWEX), stratosphere-troposphere processes (SPARC) and regional climate downscaling (CORDEX) clearly have strongly overlapping interests with IACS, IAHS, IAMAS and IAPSO but relatively few formal links. Upcoming joint WCRP and IUGG activities include the International Symposium on The Cryosphere in a Changing Climate (12-17 February in Wellington, New Zealand), which will bring together IACS with the WCRP Climate & Cryosphere project (CliC) and the International Glaciological Society. WCRP has noted that the IAPSO-IAMAS-IAGA 2017 Joint Assembly (27 August to 1 September 2017 in Cape Town, South Africa) will welcome submissions from the SPARC community, and SPARC has proposed a training school on atmospheric dynamics to follow the conference. A new GEWEX initiative on mountain hydrology is affiliated with IAHS. The Young Earth System Scientists (YESS) community supported by WCRP provides a collaborative platform for early career researchers and students with, as the name suggests, interests across the remits of all of the IUGG associations (reported by Richard Essery, IUGG Liaison to WCRP).

Report on the 34th SCAR Delegates Meeting

The Scientific Committee on Antarctic Research (SCAR) is an interdisciplinary committee of the International Council for Science (ICSU). SCAR is charged with initiating, developing and coordinating high quality international scientific research in the Antarctic region including the Southern Ocean, and on the role of the Antarctic region in the Earth system. IUGG has been one of the nine Union Members of SCAR since SCAR's inception in 1958, and it entitled to send a voting delegate to SCAR Meetings. The 34th Delegates' Meeting of SCAR was held in Kuala Lumpur, Malaysia, 29-30 August 2016. In the week prior to the Delegates Meeting (23-26 August), and at the same venue, the 7th SCAR Open Science Conference (OSC) was held on the theme "Antarctica in the Global Earth System: from the Poles to the Tropics". This attracted over 800 participants from 49 countries. Over 60 side meetings of SCAR and related scientific groups were also held in the margins of the OSC and over the weekends before and afterwards. A new feature of the OSC was a poster session on "SCAR Activities", which included activities of SCAR scientific groups and partners. A poster on the links between IUGG and SCAR was contributed to this session, with other ICSU Union contributions from IUA, IUBS and IUGS. These posters were kept on display for the whole of the OSC, as well as during the Delegates' Meeting, and received plenty of exposure.

SCAR had 31 full National Members, 9 Associate National Members and 9 ICSU Union members at the start of the meeting. At this 34th meeting, Austria, Thailand, Colombia and Turkey were accepted as new Associate Members. Associate members are those countries that are still developing an independent Antarctic research program or that are planning a research program in the future. The Czech Republic and Portugal intend to apply to move from Associate to full membership in 2018. SCAR Delegates' Meetings are held every two years to conduct administrative business and to formulate SCAR scientific policy and strategy. Ongoing SCAR science is managed by three Standing Scientific Groups (SSG) on Physical, Geo-, and Life Sciences. SCAR focuses its internationally collaborative science efforts on high priority topics through Scientific Research Programmes (SRPs), which are often multi-disciplinary and are approved by Delegates. These receive management funding (not implementation funding) from SCAR for four years, and can be extended for a further period. There are currently six SRPs, three of which are relevant to IUGG (broadly on: past ice sheet dynamics, present Antarctic climate evolution and ice sheet-solid earth interaction. Three of the SRPs were externally reviewed before the meeting, all receiving very high ranking for relevance and science excellence The existing SRPs are all continuing for at least several more years and this, because of funding limitations, precludes adoption of new research programs and directions until one or more of the existing ones are terminated.

The interaction between SCAR and the different Union members varies quite substantially. To help reinforce connections, the SCAR Secretariat reached out to all the Union members and asked for a short update on activities to be shared with the SCAR community. Only IUGG and IUBS responded and submitted reports which were included in an ICSU Unions paper submitted to Delegates. Four unions however did contribute to the "SCAR Activities" poster session; and five Unions were represented throughout the Delegates' Meeting (IUGG, IUGS, IAU, IUBS and URSI). The 2016 ICSU Review of SCAR recommended that stronger ties be formed amongst the ICSU Union members and the SCAR community. At the Association level, the IUGG International Association of Cryospheric Sciences has a three-party MoU on collaboration with SCAR and the International Arctic Science Committee (IASC) that was developed following the International Polar Year 2007-2008. This is due for renegotiation in 2018.

The 2014 SCAR Antarctic and Southern Ocean Science Horizon Scan identified the 80 most important scientific questions that should be addressed by research in and from the southern Polar Regions over the next two decades. Following this, the Council of Managers of National Antarctic Programs (COMNAP) undertook the Antarctic Roadmap Challenges (ARC) project that identified the critical requirements to enabling and delivering these key science objectives. Their report was considered at the meeting. Delegates also discussed and approved the draft SCAR Strategic Plan 2017-2022 in principle, agreed to suggest any necessary modifications in writing no later than the end of September 2016, and delegated to the Executive Committee the task of final approval.

A novel activity undertaken prior to and during the meeting was the promotion of the role of women in Antarctic science through a "Wikibomb". (*A Wikibomb is a coordinated effort to increase the number of Wikipedia entries on a specific topic. The SCAR effort saw the number of prominent female Antarctic scientists with bibliographic entries on Wikipedia increase from a handful to more than 115.*)

The newly elected President of SCAR for the next four years is Steven Chown, a conservation biologist from Australia. One new Vice President, Jefferson Simoes, a glaciologist from Brazil, was also elected. The 2018 SCAR Delegates' Meeting and Open Science Conference will take place in Davos, Switzerland. The Science Conference will be bi-polar, held in collaboration with IASC, which will hold its annual Arctic Science Summit Week at the same time. This will be the first major multidisciplinary conference covering both Arctic and Antarctic science since the 2012 International Polar Year Conference in Montreal, Canada. The 2020 SCAR Delegates' Meeting and Open Science Conference will be held in Hobart, Australia. Liaison activities prior to and additional to representing IUGG at the Delegates'

Meeting included commenting on the draft Strategic Plan 2017-2022, providing a report updating IUGG activities relevant to SCAR, nomination of several prominent female Antarctic scientists for the Wikibomb, and preparation of the IUGG poster (reported by Ian Allison, IUGG Liaison Officer to SCAR).

IUGG at the GEO Plenary XIII

The Plenary XIII of the Group on Earth Observations (GEO) was held in St. Petersburg, Russia, from 7 to 10 November 2016. Established in 2005, GEO is a voluntary partnership of governments and organizations that envisions "a future wherein decisions and actions for the benefit of humankind are informed by coordinated, comprehensive and sustained Earth observations and information." GEO Member governments include 102 nations, the European Commission, and 106 Participating Organizations comprised of international bodies with a mandate in Earth observations (including IUGG, IAG, GGOS, the International Ozone Commission of IAMAS, and the International Federation of Digital Seismograph Networks as an IAPSEI commission). Together, the GEO community is creating a Global Earth Observation System of Systems (GEOSS) that will link Earth observation resources world-wide across multiple Societal Benefit Areas - Biodiversity and Ecosystem Sustainability, Disaster Resilience, Energy and Mineral Resources Management, Food Security and Sustainable Agriculture, Infrastructure & Transportation Management, Public Health Surveillance, Sustainable Urban Development, Water Resources Management - and make those resources available for better informed decision-making.

GGOS booth at the GEO Plenary XIII (photo: A. Ismail-Zadeh)

Being Participating Organizations, IUGG, GGOS of IAG and the International Ozone Commission (IO3C) of IAMAS participated in the event organizing a panel session as a side event and participating in the GEO exhibition.

Panel on Earth & Space Observations for Disaster Risk Assessment

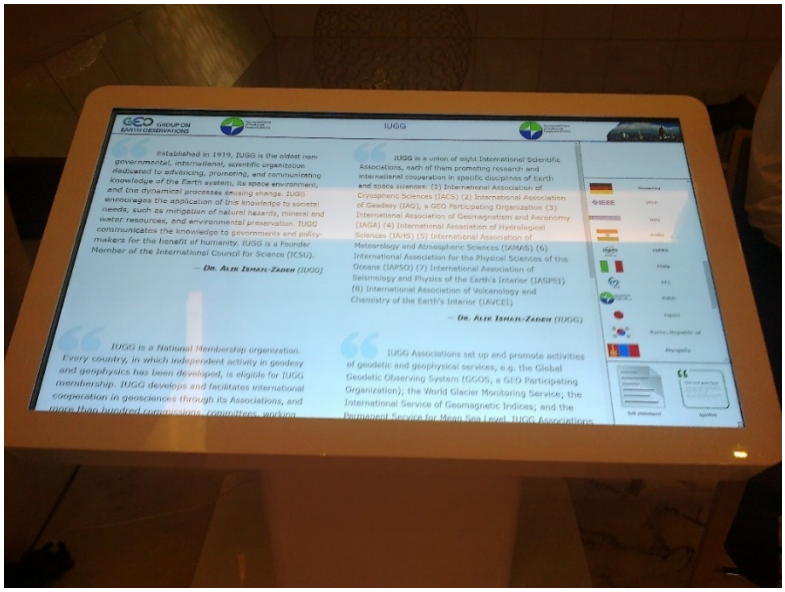
Together with the Russian Agency on Hydro-Meteorology (RosHydroMet), IUGG organized a GEO Side Event on Earth and Space Observation for Disaster Risk Assessment on 8 November 2016. The major motivation of the session was to alert the community to the importance of data observations for disaster risk reduction rather than only for disaster management after events have occurred. Despite major advances in knowledge of disaster risks and of disasters caused by natural hazards, the number and severity of disasters are increasing. Global Earth and space observations can significantly assist in reducing disasters by monitoring the Earth's surface and its space environment. Early warning systems augmented by real-time monitoring and observing hurricanes, severe storms, tornados, flooding,

landslides, volcanoes, earthquakes, and tsunamis as well as monitoring the mobility of people and development of infrastructure would help in scientific analysis and the assessment of disaster risks.

The panel was moderated by Alik Ismail-Zadeh (IUGG Secretary General) and Vladimir Kattsov (RosHydroMet and the Vice Chair of the Joint Scientific Committee of the World Climate Research Programme). The following panelists gave short talks:

- Shirish Ravan (India), Senior Program Officer, United Nations Office for Outer Space Affairs (UN-SPIDER)
- Lars-Peter Riishojgaard (USA), Project Manager, Observing and Information Systems Department, World Meteorological Organization (WMO)
- Michael Sideris (Canada), IUGG President, and GEO Programme Board Member
- Günter Stangl (Austria), Senior Expert, GGOS/IAG
- Christos Zerefos (Greece), Academy of Athens, and the IO3C Immediate Past President.

Major questions, which the panelists addressed in their talks were (i) how observations from space and ground can assist in disaster risk assessment, and (ii) how cooperation between countries and international/intergovernmental organizations should be strengthened to assist in disaster risk assessment and reduction? After the talks, panelists answered questions and comments from the participants. About 50 international experts attended the Panel, among them David Grimes, WMO President; Vladimir Frolov, RosHydroMet President; and Olga Gershenzon, President of the RBS Signal Company (dealing with disaster early warning). This side event highlighted the importance of Earth observations and risk assessments in disaster risk reduction.



IUGG E-Poster at the GEO Plenary XIII (photo: A. Ismail-Zadeh)

GEO Plenary

The GEO Plenary was held on 9 and 10 November 2016 and was one of the best attended plenaries of GEO. After the Opening ceremony and welcome addresses from the Russian organizers and GEO officers, two panel sessions were held, both dedicated to advancing the GEO vision. These sessions focused on progress towards GEO Strategic objectives and Ministerial commitments. They concerned the challenges and opportunities in ongoing and emerging GEO efforts in support of the GEO objectives and commitments – from user- and policy-driven initiatives to foundational efforts to build GEOSS. The first panel included representatives from GEO Initiatives and Flagships covering the full spectrum of

actors from policy and decision makers to those involved in advisory and implementation roles. The second panel included representatives of the Teams currently involved in the foundational components of GEOSS, including coordination of Earth observations; data sharing; and development of tools to improve delivery and use of Earth observation data and information. Each panelist addressed challenges and opportunities in the development and implementation of the activities. The final session of the day was dedicated to relationships with industry. This session included representatives from the commercial sector: data providers, providers of value-added services, and downstream-user sectors. The Panel discussed challenges and opportunities related to commercial sector engagement in GEO, from contributing or benefiting from existing GEO efforts to exploring opportunities for new collaborations.

On 10 November, the Plenary discussed ways of strengthening stakeholder engagement. IUGG intervened in the discussion proposing that ways should not only be limited to multidisciplinary cooperation, but also involve inter- and transdisciplinary co-produced approaches. The Chair of the Programme Board presented a report and discussed how UN Sustainable Development Goals have been analyzed with respect to the activities of GEO and GEOSS. The Plenary then continued with routine work and in accordance with the agenda. The next plenaries will be held in Washington, D.C., USA in 2017, and in Tokyo, Japan in 2018 (reported by Alik Ismail-Zadeh, IUGG Liaison to GEO).

COOPERATION WITH INTERNATIONAL AND INTERGOVERNMENTAL ORGANIZATIONS

United Nations Educational, Scientific and Cultural Organization (UNESCO)

The Intergovernmental Oceanographic Commission Executive Council Meeting

The 49th Session of the Executive Council (EC) of the Intergovernmental Oceanographic Commission (IOC) was held on 7-10 June 2016 in Paris, France. IUGG/IAPSO Liaison Eugene Morozov and IUGG Secretary General Alik Ismail-Zadeh attended the EC meeting. The EC meeting considered and discussed the IOC activities since the 28th session of the IOC Assembly in May 2016, which included among others (i) the work done in ocean observations, data/information management, and tsunami warnings; (ii) contribution to the decisions of the UN Framework Convention on Climate Change and Conference of the Parties (COP21) Information Centre; (iii) development of IOC Capacity Development and Communication strategies; (iv) contribution to the initial UN debates on the role of ocean science and observations in protection of biodiversity beyond areas of national jurisdiction and to the work of UN-Oceans; (v) a successful start to the 2nd International Indian Ocean Expedition; and (vi) progress on the Global Ocean Science Report. Also the EC discussed the activities related to Global Ocean Observing System (GOOS), Global Climate Observing System (GCOS), World Climate Research Programme (WCRP), Intergovernmental Coordination Group on Tsunami Warning Systems, General Bathymetric Chart of the Oceans (GEBCO), IOC-SCOR research program “Global Harmful Algal Bloom”, and Small Island Developing States. More information can be found online.

The 2016 *World Oceans Day* was held on 8 June 2016 in a conjunction with the IOC EC meeting. The UNESCO Campus, entitled “Healthy Ocean, Healthy Planet: Plastic Pollution”, opened the World Oceans Day. Its aim was to educate youth about current social, educational and environmental challenges. The debate “Climate – The ocean is part of the solutions”, organized by the *Ocean and Climate Platform*, an international think tank bringing together academic institutions, NGOs, foundations, and business associations, was dedicated to promotion of maritime solutions for climate change mitigation and adaptation. The central scientific event of the Day was the 2016 Roger Revelle Memorial Lecture (a lecture series in the memory of Roger Revelle, IAPSO President, 1963-1967) delivered by Ken Caldeira of the Carnegie Institution for Science, Stanford, USA, on ocean acidification.

The lecture was followed by a thematic round table "Mobilizing Society and Stakeholders for Effective Ocean Science Communication". The final point of the Day was a high-level panel representing UNESCO, WMO and some other intergovernmental, international and national organizations, which discussed how three major agreements reached by governments in 2015 (Sendai Framework for Disaster Risk Reduction, UN Sustainable Development Goals, and Paris Agreement on climate change) can be implemented through ocean science and governance. Well attended by National Members of UNESCO, the event showed the IOC National Members the strength of science in solving problems of the ocean.

The IUGG Secretary General met Vladimir Ryabinin, IOC Executive Secretary, and presented him with the IUGG/IAPSO – ICSU/SCOR Report on marine sustainability "*Future of the Ocean and its Seas"* prepared for the G7 Science and Technology Ministers meeting in Tsukuba, Japan in May 2016.

The International Hydrological Programme Intergovernmental Council meeting

The 22nd Session of the Intergovernmental Council of the International Hydrological Programme (IHP) was held in Paris, France, from 13 to 17 June 2016. The IUGG/IAHS Liaison Christophe Cudennec attended the Session. Major institutional developments were considered at the meeting, namely, (i) a report on developments in the Natural Sciences Sector and the Division of Water Sciences, (ii) consultation on the update to the IHP Statutes and to the Rules of Procedure of the IHP Council; (iii) a report on the consultation regarding the establishment of an Intergovernmental Panel on Water; (iv) a report on the celebration of the 50th anniversary of the UNESCO water programs. Also the meeting considered the IHP actions in the implementation and monitoring of the Sustainable Development Goal 6 relating to water and sanitation; the status and operation of UNESCO's Water Family, namely, the proposed centers under the auspices of UNESCO, UNESCO-IHE Institute for Water Education (category 1), and World Water Assessment Programme; cooperation with the UN System on freshwater issues; IHP's contribution to the UN World Water Development Report, and the role of IHP in the International Decade for Action – Water for Life (2005-2015).

Every two years, the International Hydrological Programme (IHP) of UNESCO and the International Association of Hydrological Sciences (IAHS) organize the Kovacs Colloquium, a series of international scientific meetings in the most challenging fields of water resources research. These meetings also commemorate the late George Kovacs, an established authority on hydrology, who served as Chairman of the Intergovernmental Council of IHP and as Secretary General and President of IAHS. The 12th Kovacs Colloquium was organized by the IHP and IAHS on 15 June 2016 in conjunction with the IHP Intergovernmental Council Meeting. The colloquium's program can be found at the IAHS website. The Colloquium focused on the inputs for implementation of water-related Sustainable Development Goals (SDGs) adopted by the 193 Member States of the United Nations in September 2015. It addressed methodological issues and challenges for SDGs implementation and monitoring using a set of global indicators.

The Earth Sciences and Geo-Hazards Risk Reduction Section

To strengthen the cooperation between IUGG and UNESCO in disaster risk reduction, IUGG Secretary General Alik Ismail-Zadeh met on 30 May 2016 with Flavia Schlegel, UNESCO Assistant Director General for Natural Sciences, and representatives of the Earth Science and Geohazard Risk Reduction Section. The main topic for discussion was negotiation on the intergovernmental science-based risk assessment initiative put forward by IUGG and endorsed by the 2014 ICSU General Assembly in Auckland, New Zealand.

The ICL-IPL-UNESCO Conference on landslides

The International Consortium on Landslides (ICL) and the International Programme on Landslides (IPL) co-sponsored by ICL and UNESCO held their joint meeting at UNESCO in Paris, France, from 16 to 18 November 2016. As an ICL Supporting Organization and one of the signatories of the Sendai Partnerships on Landslides Disaster Risk Reduction 2015-2025, IUGG was invited to participate in the conference. At the Opening Ceremony, Qunli Han (Director of Ecological and Earth Sciences of UNESCO), Irasema Alcantara-Ayala (Vice Chair of the ICSU-ISSC-UNISDR Integrated Research on Disaster Risk), Roland Oberhänsli (Immediate Past President of the International Union of Geological Sciences - IUGS); and Alik Ismail-Zadeh (IUGG Secretary General) welcomed the conference participants.

An open panel discussion on the Sendai Partnerships was organized during the Conference. The Panel was chaired by Qunli Han and moderated by Kaoru Takara (Director, Disaster Prevention Research Institute, Kyoto University). The following experts in disaster risks were invited as panelists: Irasema Alcantara-Ayala, ICSU and IRDR; Paolo Canuti / Nicola Casagli, Italy; Alik Ismail-Zadeh, IUGG; Dwikorita Karnawati, Indonesia; Snjezana Mihalic-Arbanas, Croatia; Matjaz Mikos, Slovenia; Badaoui Rouhban, Adviser to the UNESCO Assistant Director General on Natural Sciences; Dinh van Tien, Vietnam; Soichiro Yasukawa, Coordinator for the UNESCO Disaster Risk Reduction and Resilience Program.

In his talk and in answering several questions, Alik Ismail-Zadeh highlighted important areas and relevant IUGG bodies contributing to landslide disaster risk reduction. Namely, the IUGG GeoRisk and Tsunami Commissions as well as several scientific groupings of Union Associations can contribute to the Sendai Partnerships by promoting (i) scientific research related to understanding of landslide initiation and hazard; (ii) reliable forecasting of landslides and an early warning system of increased precision; (iii) multi-hazard risk identification; (iv) improved technologies for monitoring, testing, and analysis of landslides and their analogue and computer simulations; and by organizing teaching courses and tools on natural hazards including landslides.

The conference combined scientific talks with business meetings related to new proposals for World Centers of Excellence in Landslide Risk Reduction and new research proposals. The next ICL major event is the Fourth World Landslide Forum to be held Ljubljana, Slovenia, in 2017.

IUGG's 100th anniversary at UNESCO

In 2019, IUGG will celebrate its 100th anniversary. The Union was established by nine founding national members of the International Research Council in Brussels, Belgium, on 28 July 1919, and since that time more than 100 Member countries participated in Union's activities. To celebrate the IUGG centennial as an international event of science, education and culture, together with IUGG international partners and friends around the world, IUGG requested permission of the United Nations Educational, Scientific and Cultural Organization (UNESCO) to hold an event at the UNESCO Headquarters in Paris, France. Why at UNESCO? IUGG has developed a very fruitful cooperation with several UNESCO bodies, namely, with the Intergovernmental Oceanographic Commission (via IUGG/IAPSO and IUGG/Tsunami Commission), the International Hydrological Programme (via IUGG/IAHS, and IUGG/IACS), and the Earth Science and Geohazard Risk Section (via IUGG/IASPEI, IUGG/IAVCEI, and IUGG/GeoRisk Commission). IUGG will celebrate the Union's achievements in promotion of Earth and space sciences and geoscience education for the last century especially those achieved in cooperation with UNESCO's scientific programs. Recently, the UNESCO Assistant Director General for Natural Sciences informed the IUGG Secretary General that UNESCO agreed to host the event on Monday, 29 July 2019.

World Meteorological Organization (WMO)

WMO Executive Council Meeting

The Executive Council (EC) Meeting of the World Meteorological Organization (WMO) was held from 13 to 24 June 2016. It was dedicated to several important topics related to weather, climate, water, and cryosphere. Detailed information on the agenda and accepted resolutions can be found online. The 2016 WMO Prize was presented to Dame Julia Slingo, Chief Scientist of the UK MetOffice, who delivered a lecture on the history of meteorology and current challenges in atmospheric sciences. The presentation by Julia Slingo can be downloaded. IUGG Secretary General Alik Ismail-Zadeh attended the meeting from 21 to 23 June 2016.

Business meetings with the WMO leadership

During the meeting, the IUGG Secretary General met Petteri Taalas, WMO Secretary General, and Xu Tang, Director of the WMO Department "Weather and Disaster Risk Reduction Services". The main message was to assure the WMO leadership that IUGG wishes to continue and strengthen the productive cooperation with WMO, based on the Working Agreement adopted by the 10th IUGG General Assembly in Rome, Italy, in 1954, and the Second World Meteorological Congress in Geneva, Switzerland, in 1955, and also to develop cooperation in other WMO activities, such as disaster risk reduction and the Global Cryosphere Watch (GCW) project. It was noted that among about 15 major programs/commissions of WMO, IUGG contributes to about 10 programs in weather, climate and water. Particularly, the IUGG's initiative on an intergovernmental disaster risk assessment mechanism was discussed. Later, X. Tang arranged a discussion on the topic of disaster risk reduction with Alasdair Hainsworth, Chief, Disaster Risk Reduction Services Division of the Weather and Disaster Risk Reduction Services Department, and two experts from the Division. It was agreed to hold a meeting of potential UN and NGOs partners to discuss the topic of science-based risk assessments.

The IUGG Secretary General met Miroslav Ondráš, WMO Global Cryosphere Watch (GCW) Project Officer to formalize cooperation between IUGG/IACS and WMO/GCW. Namely, the collaboration will be conducted under the umbrella of the existing working agreement between WMO and IUGG; a contact will be established at the level of the IUGG Secretary General and the GCW Project Office / GCW Steering Group Chair; a focal point will be established between GCW Project Office and IUGG/IACS. IUGG appointed Charles Fierz (Switzerland) and Xiao Cunde (China) to liaise with the GCW Project Office on technical issues for the term of 2016-2019.

The Intergovernmental Panel on Climate Change (IPCC)

On 23 June 2016, IUGG Secretary General Alik Ismail-Zadeh met Mannava Sivakumar, IPCC Acting Secretary, and Abdallah Mokssit, IPCC Secretary-Elect (in office from 1 July 2016). The discussion was related to strengthening the cooperation and involvement of IUGG experts in the IPCC work on climate change assessment. As recently announced at a meeting in Nairobi, Kenya, IPCC will commission a special report on the oceans and the cryosphere, A. Ismail-Zadeh presented to A. Mokssit the Report on Future of the Seas and Oceans prepared by a group of IUGG/IAPSO - ICSU/SCOR experts on the occasion of the G7 Science Ministers meeting in Tsukuba, Japan in May 2016.

International Year for Global Understanding 2016

The increasingly noticeable global consequences of local action call attention to the fact that changing the world is everyone's business. Taking action on global issues locally involves an understanding of the manifold ways in which the local and the global are intertwined. This is the central idea of the 2016 "International Year of Global Understanding" (IYGU). The international year is supported by the

international scientific umbrella organizations ICSU (International Council for Science), ISSC (International Social Science Council), and CIPSH (International Council for Philosophy and Human Sciences). In cooperation with the International Geographical Union (IGU), Benno Werlen, a social geographer at the Friedrich-Schiller-University of Jena, Germany, initiated and developed the IYGU.

The International Year was officially inaugurated on 2 February 2016 in Jena, Germany. Klaus Töpfer, the former German Federal Minister for the Environment and the former Executive Director of the United Nations Environment Programme (UNEP), delivered the keynote address. A great number of high-level guests from all over the world participated in the opening ceremony. Jena University's President Walter Rosenthal, the Federal State's Minister of Economy and Science Wolfgang Tiefensee, the IGU President, representatives of the International Science Councils (CIPSH, ISSC, and ICSU), and the Executive Director of Future Earth welcomed the participants. The keynote presentations covered all of the main elements: education, (natural, social, and human) sciences, and information. Benno Werlen emphasized: "We wish to build bridges between global thinking and local action. IYGU will encourage people to make their everyday choices in the light of global challenges." IUGG is a co-sponsor of the IYGU. IUGG Secretary General Alik Ismail-Zadeh attended the IYGU Opening ceremony. More information on the IYGU can be found online.

SCIENCE POLICY

UNISDR Science and Technology Conference

The United Nations Office for Disaster Risk Reduction (UNISDR) organized the Science & Technology (S&T) Conference in Geneva, Switzerland, on 27-29 January 2016, which was attended by some 750 delegates. The Sendai Framework (SF) for Disaster Risk Reduction (DRR) 2015-2030 was adopted by its Member States on 18 March 2015 at the World Conference on DRR held in Japan, and endorsed by the UN General Assembly in June 2015. The SF promotes shifting the focus from managing disasters to managing risks. This requires a better understanding of risk in all its dimensions of vulnerability, exposure and hazards. It aims to ensure that the multi-hazard management of disaster risk is factored into the development at all levels as well as within and across all sectors. The SF recognizes the importance of science and technology for disaster risk reduction. The goal of the SF is to prevent new and reduce existing disaster risk through the implementation of integrated and inclusive economic, structural, legal, social, health, cultural, educational, environmental, technological, political and institutional measures that prevent and reduce hazard exposure and vulnerability to disaster, increase preparedness for response and recovery, and thus strengthen resilience. The aim of the Conference was to develop a S&T Roadmap of the SF implementation. This Roadmap presents the expected outcomes under each of the four priorities of actions outlined in the SF, and proposes key actions that the UNISDR S&T Partnership will undertake to fulfill the expected outcomes and to achieve the SF goal. It also highlights the ways for monitoring progress and reviewing needs. At the conference, many scientists and policymakers pledged to step up action on the SF.

At the Science & Technology (S&T) Conference in Geneva, Switzerland (photo: UNISDR)

The Conference included four Work Streams: (1) The S&T Partnership for the implementation of the SF; (2) Understanding disaster risk, risk assessment, and early warning; (3) Use of science, technology and innovation tools, methods and standards; and (4) Leveraging science through capacity development and research. Each Work Stream included a Plenary, followed by poster presentations, three parallel panel discussions and a wrap-up session. IUGG Secretary General Alik Ismail-Zadeh participated in the Conference and took part in three panel discussions: (i) Global science and technology networks and platforms; (ii) Multi-hazard risk assessment and management; and (iii) Leveraging science.

Milestone for global geodesy

The United Nations call for enhanced cooperation on global geodesy. At the sixth session of the U.N. Committee of Experts of Global Geospatial Information Management (UN-GGIM) in New York City, USA, in August 2016, the UN-GGIM endorsed the Roadmap of the Global Geodetic Reference Frame (GGRF) and decided to establish a permanent Sub-Committee on Geodesy. “This is a significant milestone for global geodesy. It sends a very clear message to member states, and other global geodetic entities, that the focus on enhancement of geodetic reference frames should be a long term strategic priority for governments,” says Gary Johnston, co-chair of the UN-GGIM Working Group on the GGRF. The suggestion to elevate the Working Group’s mandate through the establishment of a UN-GGIM Sub-Committee on Geodesy was put forward by New Zealand at the UN-GGIM sixth session. The proposal was supported by the Member States. The UN-GGIM Working Group on the GGRF consists today of 32 Member States and two organizations; the World Health Organization and the International Association of Geodesy (IAG) of IUGG. IAG welcomes and unreservedly appreciates the establishment of a United Nations Sub-Committee on Geodesy. This advancement will augment the impacts of geodesy on the political level as well as its visibility in society. IAG and its Global Geodetic Observing System (GGOS) as promoting geodetic science and coordinating the international geodetic services will strongly support the new Sub-Committee whenever necessary and wherever possible.

At the UN-GGIM session, the member states endorsed also the Roadmap for the GGRF as a principle based briefing document for national governments. The Roadmap aims to enhance the GGRF and make it more sustainable. The GGRF was among the highlights at the UN-GGIM session where 260 delegates from 86 Member States participated.

The UN has decided to establish a permanent sub-committee on geodesy to provide stability and longer-term planning for the GGRF (photo: Anne Jørgensen)

The Fijian Minister for Land and Mineral Resources Mereseini Vuniwaqa was a keynote speaker at a UN-GGIM Side Event on the GGRF. Fiji led the adoption on the UN resolution on GGRF at the General Assembly, 26 February 2015. "This resolution calls for more cooperation, and we are pleased to see that the Working Group has come up with the Roadmap on GGRF so quickly. The implementation of the Roadmap has top priority", said the Minister. The engagement from the Fijian Minister was welcomed by co-chair Gary Johnston: "The development of the implementation plan will require close cooperation between National Mapping Agencies, Space Agencies, IAG, the International Federation of Surveyors (FIG), and other interested research institutions. Collectively we have an opportunity to utilize the momentum that has been created within UN-GGIM to establish a better future for the global geodetic community, and for our society which relies on our products and services," said Johnston (reported by Harald Schuh, IAG President).

Future of the Seas and Oceans: IUGG response to the G7 Science Ministers proposal

A special report for policymakers on the ocean and its seas has been submitted to the G7 Science and Technology Ministers ahead of their meeting in Tsukuba City, Japan, 15-17 May 2016. The report was prepared by a non-governmental international expert group coordinated by IUGG via the International Association of Physical Sciences of the Oceans (IAPSO) and the Scientific Committee on Oceanic Research (SCOR) of the International Council for Science (ICSU), and focuses on seven critical marine research issues including (i) plastic pollution of the marine environment, (ii) deep-sea mining, (iii) ocean acidification, (iv) ocean warming, (v) de-oxygenation, (vi) biodiversity loss, and (vii) marine ecosystem degradation.

The report came in response to concern expressed by the G7 Science Ministers on these issues at their meeting in Berlin, Germany, last year. There was a direct call to the international scientific community "to understand the ocean as a whole through international scientific cooperation". Although the report was not tabled formally at the Ministerial Meeting because of some procedural requirements, the Communique highlights the importance of global observations and research on oceans and seas to support taking actions, which agrees with the recommendations proposed by the international expert group.

The Ministers reaffirmed the importance of further scientific work to "better understand the extent and impacts of marine litter, which contributes to the implementation of the priority measures identified by the G7 Toyama Environment Ministers' Meeting". Also the Ministers recognized "the importance of strengthening the resilience of societies to hazards and disasters", and acknowledged that "Open Science can change the way research and development (R&D) is undertaken, with emerging findings leading to far greater global collaboration and encouraging a much broader range of participants and stakeholders."

Mapping IUGG to Sustainable Development Goals

Adopted by the UN General Assembly in 2015, the 2030 Agenda for Sustainable Development represents a new way of thinking about how to better link issues such as climate change, natural disasters and education. It intertwines social, economic, and environmental targets in 17 Sustainable Development Goals (SDGs; UN, 2015). Each of the SDGs is divided into several sub-goals. The interrelation between SDGs is not obvious, and one SDG can limit options or even clash with another SDG. The International Council for Science (ICSU) analyzed the complexity of interactions between different SDGs, and published a working paper that presents a tool to analyze and understand interactions between different goals. "While the scientific community has emphasized the need for a systems approach to sustainable development, scientists, like policy-makers, are now facing the challenge of turning the goals into reality" (Nilsson et al., 2016).

Considering this issue important, IUGG and the Union Associations have been mapped to the SDGs, to clarify how IUGG could contribute to the achievement of the goals. All the SDGs and sub-goals were divided into two groups: (i) those goals where IUGG can contribute, and (ii) goals where a potential contribution of the Union would be insignificant. Table 1 lists the 31 sub-goals to which IUGG could contribute. The sub-goals can be combined into several groups:

- air pollution (sub-goal 3.9),
- climate and environmental issues (1.5, 2.5, 3.9, 11.6, and 13.3),
- hazard and disaster risk (1.5, 2.5, 11.5, 11b, 13.1, and 15.3),
- education and capacity building (4.7, and 4b),
- energy (7a),
- gender (5.5),
- oceans and seas (14.1-14.3, 14a, and 14c),
- research and innovation (9.5, and 9b), and
- water issues (3.9, 6.3-6.7, 15.1, and 15.3).

From this mapping, it becomes clear that all Union Associations, the Union Commissions on Geophysical Risk and Sustainability (GeoRisk), Climatic and Environmental Change (CCEC), and Data and Information (UCDI) as well as the IUGG Committee on Capacity Building and Education could

contribute to the sub-goals related to climatic change, natural hazards and risk, gender issues, education and capacity building, research and innovation. Particularly, the IAMAS Commission on *Atmospheric Chemistry and Global Pollution* and the IAHS International Commission on Water Quality could contribute to sub-goal 3.9 "to reduce the number of deaths and illnesses from … air, water … pollution and contamination". The IASPEI-IAVCEI-IAPSO's International Heat Flow Commission could advance knowledge on geothermal energy. IAPSO and IAHS could contribute to the issues of oceans, seas and water. The next step is to analyze how IUGG and its Associations should work towards the implementation of the SDGs.

References

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Table 1. *Mapping IUGG and Union Associations to the UN Sustainable Development Goals*

Goal	IUGG	IACS	IAG	IAGA	IAHS	IAMAS	IAPSO	IASPEI	IAVCEI
1.5	CCEC, GRC	✔	✔	✔	✔	✔	✔	✔	✔
2.4	CCEC, GRC	✔	✔		✔	✔	✔	✔	✔
3.9					✔	✔			
4.7	✔	✔	✔	✔	✔	✔	✔	✔	✔
4.b	CBEC	✔	✔	✔	✔	✔	✔	✔	✔
5.5.	✔	✔	✔	✔	✔	✔	✔	✔	✔
6.3, 6.7		✔				✔			
7.a					✔	✔	✔	✔	✔
9.5, 9.b	✔	✔	✔	✔	✔	✔	✔	✔	✔
9.6	✔	✔	✔	✔	✔	✔	✔	✔	✔
11.5	GRC	✔	✔	✔	✔	✔	✔	✔	✔
11.6	CCEC					✔			
11.b	GRC	✔	✔	✔	✔	✔	✔	✔	✔
13.1	CCEC, GRC	✔	✔	✔	✔	✔	✔	✔	✔
13.3	CCEC	✔			✔	✔	✔		
14.1-14.3							✔		
14.a, 14.c							✔		
15.1		✔			✔	✔		✔	
15.3	GRC				✔	✔			
16.6, 16.7	✔	✔	✔	✔	✔	✔	✔	✔	✔
17.6	✔	✔	✔	✔	✔	✔	✔	✔	✔
17.16	✔								
17.18	UCDI		✔	✔			✔		

The relevant SDGs are listed in Appendix B to this Annual Report (written by Alik Ismail-Zadeh, IUGG Secretary General).

GEOSCIENCE EDUCATION

IUGG grants to support geoscience education events in 2016

IUGG awarded six grants (US$ 15,000 in total) to support workshops and training schools organized by the Abdus Salam International Centre for Theoretical Physics (ICTP) in 2016 as recommended by the IUGG Committee on Capacity Building and Education and in accordance with the Memorandum of Understanding between IUGG and ICTP signed in 2015. The list of the events co-sponsored by IUGG is as follows:

- 15 - 19 February (Sao Paulo, Brazil), Advanced School on Regional Climate Modeling over South America

- 23 May - 3 June (Trieste, Italy), Eighth ICTP Workshop on the Theory and Use of Regional Climate Models
- 27 June - 1 July (Trieste, Italy), Earth System Physics: Summer School on Aerosol-Cloud Interactions
- 18 - 29 July (Pune, India), Earth System Modelling School
- 24 - 28 October (Trieste, Italy), School on Recent Advances in Analysis of Multivariate Ecological Data: Theory and Practice
- 7 - 11 November (San Jose, Costa Rica), Second Workshop on Climate Change, Variability and Modeling over Central America and Mexico

Founded in 1964 by the late Nobel Laureate Abdus Salam and co-sponsored by UNESCO, IAEA, and the Italian government, the Abdus Salam International Centre for Theoretical Physics - ICTP seeks to accomplish its mandate by providing scientists from developing countries with the continuing education and skills that they need to enjoy long and productive careers. ICTP has been a major force in stemming the scientific brain drain from the developing world. The impact of ICTP extends well beyond the Centre's facilities to virtually every corner of the Earth. The Earth System Physics (ESP) Section of ICTP studies a wide spectrum of the Earth system, from its fluid components (oceans and the atmosphere) to the planet's interior.

Report on the ICTP education events in 2015 co-sponsored by IUGG

IUGG and the Abdus Salam International Centre for Theoretical Physics (ICTP) continue cooperation in geosciences education. In 2015, IUGG co-sponsored seven workshops and schools organized by ICTP and held in Iran, Italy, and Turkey.

Workshop on Ionospheric Effects on SBAS and GBAS Applications at Low Latitudes

The workshop was held from 2 to 13 March 2015 in Trieste (ICTP), Italy. 70 scientists attended the activity: 22 Lecturers and instructors from 8 countries and 50 participants from 18 countries. Participants were exposed to both theoretical lectures and hands-on work about a series of themes regarding Global Navigation Satellite Systems (GNSS) operations in general, the particular systems that use augmentation techniques, such as satellite-based augmentation system (SBAS) and ground-based augmentation system (GBAS), and the ionospheric effects that influence their operations. The theoretical topics included the fundamentals of GNSS, basics of aviation systems using GNSS, the ionosphere and ionospheric measurements using GNSS, SBAS and GBAS technologies, and some complementary topics including measurements techniques. An important aspect of the activity was the laboratory hands-on work carried out by the workshop's participants; the hands-on work included GNSS receiver demonstration laboratory, GNSS total electron content calibration, and exercises with a SBAS simulation platform. The participants divided in working groups were requested to solve problems related to SBAS and GBAS operations, particularly in low latitude regions where ionospheric effects are stronger. The working groups reported their results at the end of the workshop. In the opinion of lecturers and participants, the aim of the workshop of contributing to the promotion of ionospheric research in low latitude countries to support the needs of navigation satellite augmentation systems, has been fulfilled.

Third Workshop on Water Resources in Developing Countries

The workshop was held from 27 April to 8 May 2015 in Trieste (ICTP), Italy. The workshop addressed the major challenges facing the water resources planning community: assessment of the impact of climate change and variability on the different component of the water cycle. The most influential component of the water cycle for resource management is precipitation, especially its extremes causing floods and droughts. The reliability of projection of precipitation (average, distribution,

frequency, intensity) is still less than adequate and limits its usefulness to decision management of the water systems. Aside from the issue of reliability of precipitation projections, which are usually obtained from global or regional climate models (GCM/RCM), there is also the need for estimates at resolutions sufficiently fine for simulating the water cycle at watershed and useful hydrological scales. Therefore, there continues to be a need to bridge the resolution gap between the global or regional and the river basin scale. Moreover, the hydrological model outputs are very sensitive to the GCM/RCM biases therefore often bias correction techniques have to be applied before the GCM/RCM output can be used to input the hydrological models. The workshop was composed of one week of lectures and laboratory training followed by a second week of laboratory sessions.

International Conference and School on Structure, Tectonics and Earthquakes in the Alborz-Zagros-Makran Region

The International Conference and School were held from 22 to 31 May 2015 in Tehran, Iran. The purpose of the 3-day conference and the following 6-day school was to present the latest developments in the field of earthquake hazards and to motivate and train participants with particular attention to the following topics: (i) continental tectonics: kinematics (fault patterns) and dynamics (driving forces) of continental deformation, and their relation to understanding earthquake-related hazards; (ii) monitoring and observational foundations of earthquake hazards: the essential modern toolkit, including earthquake seismology, satellite-based radar interferometry (InSAR), GPS, field- and space-based geomorphology and Quaternary geology, paleo-seismology; (iii) associated earthquake hazards: understanding tsunamis and landslides; and (iv) modelling continental deformation and the earthquake cycle: using models to link geophysical, geological and geomorphological data to hazard evaluation. The program was specifically designed to benefit scientists in countries that are vulnerable to earthquake hazards, but who currently lack the local infrastructure, expertise, national capability or critical mass of researchers to be effective. More than 20 experts from France, Germany, India, Iran, Italy, Switzerland, and the UK, who have done extensive work in the region, were invited to deliver lectures at the Conference and to contribute to the School. The Conference had more than 120 registered participants from India, Iran, Kazakhstan, Pakistan, Syria, and the UK. However, the conference was open to unregistered experts as well. The 6-day School was a mixture of theoretical and practical courses and thus limited to registered participants only (see photos taken during the school below). About 45 scientist and students from Iran and other countries participated in the School. Many students presented their research at poster sessions of the conference and school.

Workshop on Modelling of Wildfires and their Environmental Impacts

The workshop was held from 22 to 26 June 2015 in Trieste (ICTP), Italy. 16 lecturers from six countries, workshop organizers, and 41 students from 25 different countries took part in the workshop. The workshop was very well balanced, both from a scientific and geographical perspective, and the expertise of the organizers and faculty were all elements that made it very successful. The first part of

the week was mainly dedicated to presentations about the physics of wildfires and high resolution studies, while the second part was principally devoted to impacts. This allowed the participants to get a very synthetic overview of the different implications of wild fire activity including ecosystem dynamics, civil security, climate and air pollution. The afternoons were dedicated to hands-on computer sessions using state of the art wild fire models. The practical sessions were perhaps the greatest success of the workshop, with a lot of interactions between participants and instructors sometime running until late evening. The participants were very motivated and managed to get the know-how and data necessary to run a model and to pursue research on wildfires modeling back at their home institutions.

Workshop on Uncertainty Quantification in Climate Modeling and Projection

The workshop was held in Trieste (ICTP), Italy from 13 to 17 July 2015. The prediction of future climate change is one of the most complex problems undertaken by the scientific community. Although scientists have been striving to better understand the physical basis of the climate system behavior and to improve climate models, the overall uncertainty in projecting future climate has not been reduced (e.g., from the IPCC 2007 to 2013). With the rapid increase of complexity in Earth system models, reducing uncertainties and increasing reliability of climate projections becomes an extremely challenging task. Since uncertainties always exist in climate models, interpreting model simulations and quantifying uncertainty is a key to understanding and modeling atmospheric, land, ocean, and socio-economic phenomena and processes. Meanwhile, climate change adaption and impact on communities rely on climate models to provide climate change information. Such information, if not accurate, should be provided with well-quantified uncertainty. Uncertainty Quantification (UQ) is a fundamental challenge in numerical simulations of Earth's weather and climate. It entails much more than attaching defensible error bars to predictions. In recent years, formal methods of verification, validation, and UQ employed in other simulation problems have been applied to climate simulations. The topics discussed in this workshop included many aspects of UQ in climate modeling, such as identifying sources of uncertainty, describing uncertainty associated with input parameters, evaluating model uncertainty through validation against observations, model comparison between numerical and/or analytical solutions, and upscaling/downscaling, as well as quantifying uncertainty through both forward modeling (sensitivity analyses) and inverse modeling (optimization/calibration) in all components of climate and integrated Earth system models at various spatial and temporal scales. The workshop aimed at providing both theoretical lectures and hands-on sessions on the theory and application of the various UQ methods and approaches, such as sensitivity analysis, construction of

surrogate models and response surfaces, input parameter calibration studies, forward propagation of uncertainties, and assessment of model discrepancies and structural uncertainties. Supervised by the directors and lecturers, participants were encouraged to design, complete and report on short research projects during the event.

Summer School on Ocean Climate Modelling: Physical and biogeochemical dynamics of semi-enclosed seas

The Summer School took place from 28 September to 1 October 2015 in Ankara, Turkey. The School attracted some of the best ocean modelers from Germany, Italy, Turkey, and the USA, and 27 selected students and early career scientists. Attendants came from Croatia, Greece, Iran, the Netherlands, Russia, Turkey, and Ukraine. The school focused on the dynamics of coastal and semi-enclosed seas and its relevance to global scale circulation. Given that a large fraction of the students were from the Turkish community and neighboring countries, the school emphasized topics that are relevant for the Mediterranean, Black, and Caspian Seas. Lectures introduced students to regional and coastal modeling with emphasis on upwelling, nesting capabilities, adaptive grid solutions and applications to biogeochemical dynamics and their representation in physical models. Particular attention was given to physical-biogeochemical interactions in upwelling regions. Dynamics of straits and overflows were also treated in terms of their local effects and numerical representation, as well as their global impact in terms of circulation variability and stability. The themes of the activity covered (i) process understanding (dynamics of straits, overflows, mixing and upwelling) and (ii) modeling solutions (fine-resolution, nested, and adaptive grids). Modeling semi-enclosed seas and coastal regions implies impacts on biogeochemistry, fisheries, ocean forecasting and relevance to general circulation models. The last part of the school thus covered the main aspects of coastal forecasting and operational oceanography. The summer school was followed by a mini workshop largely devoted to the CLIVAR (Climate and Ocean – Variability, Predictability and Change) Research Focus on upwelling. The goal was to expand a couple of the foci of the summer school, namely upwelling and biogeochemisty, from a regional context to a broader, but still limited context, i.e., focusing on eastern boundary upwelling regions, including biogeochemistry. The Mediterranean, Black and Caspian Seas, in the middle of three large continents of contrasting climates, regulated with vital multi-scale interactions by complex topographies and interconnecting straits, exemplify all the complexity and climatic controls relevant for the world ocean. Some of the processes of common interest for semi-enclosed basins as well as the world ocean are persistent upwelling, coherent structures, coastal and mid-sea jets and currents, shelf and open sea convection, thermohaline circulation cells, inter-basin exchange flows and hydraulic controls.

International School on Geothermal Development

The International School was held in Trieste (ICTP), Italy from 7 to 12 December 2015. Geothermal energy offers unique possibilities to support the sustainable progress of the economy of developing and least developed countries through the extensive utilization of a renewable energy source. Its peculiar characteristics make it particularly appealing as a renewable, stable, reliable, cost-effective and environmentally benign solution for the energy challenge of the third millennium. Exploration focuses on the initial phase of any geothermal project, namely the identification and assessment of resources by means of integrated geological, remote sensing, geochemical and geophysical methods. The School provided advanced knowledge of geothermal exploration methods with specific reference to the following topics: (i) geothermal energy resources distribution with specific reference to geologic and tectonic framework; (ii) geological surveying methods through lectures, tutorials and case studies/histories; (iii) remote sensing, (iv) geochemical and (v) geophysical methods in geothermal exploration through lectures, case studies and laboratory sessions; and (vi) reservoir engineering and numerical modeling with laboratory sessions on geothermal power plants.

(photos: ICTP)

IUGG IN THE INTERNATIONAL COUNCIL FOR SCIENCE (ICSU)

ICSU Scientific Unions meeting

The triennial meeting of the International Council for Science's Union Members took place at the Fondation Simone et Cino del Duca in Paris, France on 12-13 April 2016. At the meeting, representatives from the Union Members heard updates about its activities since the General Assembly in Auckland in 2014, shared their own reports on major activities, and discussed the way forward for the Council and the Unions in the next 18 months until the General Assembly in Taipei in October 2017. A particular focus of the discussion was the ongoing process to develop a new strategic plan for the organization. The discussion covered many topics including two central questions: What are the new or emerging global challenges that the international scientific community should be helping to solve? And what kind of actions could the Council take to address those challenges? The meeting also provided the opportunity for participants to network informally with members of the Council's Executive Board and the Directors of several of its interdisciplinary bodies.

GeoUnions

The GeoUnions (GUs) is a network of representatives of the international scientific unions of the International Council for Sciences (ICSU) dealing with Earth and space sciences. The GUs established a Steering Committee in 2004 (in Paris, France) to promote the sciences worldwide, to communicate and to coordinates scientific activities of individual unions, and to speak on behalf of GUs members to ICSU Executive Board, ICSU Members and its interdisciplinary bodies and at international level, especially to the United Nations organizations and other global stakeholders. The current Members of the GUs are:

- the International Astronomical Union (IAU),
- the International Cartographical Association (ICA),
- the International Geographical Union (IGU),
- the International Union for Quaternary Research (INQUA),
- the International Society for Photogrammetry and Remote Sensing (ISPRS),
- the International Union of Geodesy and Geophysics (IUGG),
- the International Union of Geological Sciences (IUGS),
- the International Union of Soil Sciences (IUSS), and
- the International Union of Radio Science (URSI).

More information on GeoUnions can be found at: http://www.icsu-geounions.org

GeoUnions met in Paris

The GeoUnions (GUs) Steering Committee met in Paris, France on 11 April 2016 on the occasion of the ICSU Scientific Unions meeting. The meeting was hosted by the Société Géologique de France at Maison de la Géologie. Representatives of nine Unions participated in the meeting. Alik Ismail-Zadeh (IUGG Secretary General) chaired the Steering Committee meeting. The IUGG President Michael Sideris represented IUGG. The representatives of GUs discussed the important topics related to the Agenda of the Scientific Unions Meeting (held on 12-13 April). The major topics were: (i) the challenges and opportunities for ICSU and scientific Unions within a shifting global scientific landscape; (ii) the place of ICSU and its Unions in the world scientific community; (iii) the role of Unions in the activities of ICSU interdisciplinary bodies; (iv) the benefits of Unions being under the ICSU umbrella and the benefits of ICSU having Unions as Members; (v) “Open Data Campaign”, a new initiative of the Science International (a coalition of ICSU with other international science organizations); (vi) the future of the relationship between ICSU and the International Social Sciences Council (ISSC); (vii) the cooperation

with Future Earth and other ICSU interdisciplinary bodies. David Black, ICSU Secretary General, attended the meeting and took part in the discussions related to the ICSU Executive Board's proposal about the changes in the procedure of voting for the Executive Board membership.

ACTIVITIES OF THE UNION ASSOCIATIONS

The following reports, prepared by the Secretaries General of the eight Associations of IUGG:

International Association of Cryospheric Sciences (IACS)
International Association of Geodesy (IAG)
International Association of Geomagnetism & Agronomy (IAGA)
International Association of Hydrological Sciences (IAHS)
International Association of Meteorology & Atmospheric Sciences (IAMAS)
International Association for the Physical Sciences of the Oceans (IAPSO)
International Association of Seismology and Physics of the Earth's Interior (IASPEI)
International Association of Volcanology and Chemistry of the Earth's Interior (IAVCEI)

illustrate the impressive range of activities within each Association as well as their dedication to supporting science within developing countries.

International Association of Cryospheric Sciences (IACS)

IACS website: www.cryosphericsciences.org

This report covers the period from January 2016 to February 2017.

INTRODUCTION

The International Association for Cryospheric Sciences (IACS) is the Association of the International Union of Geodesy and Geophysics (IUGG) that is concerned with snow and ice science and which provides expert advice on cryospheric issues to governmental and non-governmental organizations. The objectives of IACS are to:

- Promote studies of cryospheric subsystems of the Earth and solar system.
- Encourage research in the above subjects by members of the cryospheric community, national and international institutions and program, and individual countries through collaboration and international co-ordination.
- Provide an opportunity on an international basis for discussion and publication of the results of the above research.
- Promote education and public awareness on the cryosphere, and facilitate the standardization of measurement or collection of data on cryospheric systems and of the analysis, archiving and publication of such data.

ADMINISTRATION

A Bureau of 11 elected officers manages the business of IACS. The current IACS Bureau was elected at the IACS Plenary Administrative Meeting during the 26th IUGG General Assembly in Prague, Czech Republic. It consists of *Charles Fierz* (IACS President until February 2017, Immediate Past President thereafter), *Regine Hock* (President Elect until February 2017, President thereafter), *Andrew Mackintosh* (Secretary General), *Olga Solomina* (Vice President), *Cunde Xiao* (Vice President), *Ian Allison* (Vice President), *Hiroyuki Enomoto* (Head, Sea Ice, Lake and River Ice), *Christine Schott Hvidberg* (Head, Planetary and other ices of the solar system), *Liss Andreassen* (Head, Glaciers and Ice Sheets), Ethan Greene (Head, Snow and Avalanches), *Valérie Masson Delmotte* (Head, Cryosphere, Atmosphere and Climate), *Anaïs Orsi* (Deputy Head, Cryosphere, Atmosphere and Climate). Note that in October 2015, Valérie Masson Delmotte was elected as co-chair of Working Group 1 of the Intergovernmental Panel on Climate Change (IPCC), and thus Anaïs Orsi was appointed to deputize on her behalf. Anaïs as a relatively early career researcher (PhD in 2013) also brings fresh experience to our bureau.

To run the 'daily' business, the IACS Executive Committee (EC) consisting of President, Secretary General and Immediate Past President or President Elect holds regularly teleconferences, in which all

Bureau members are welcome to join. IACS also held its 2016 Bureau meeting by teleconference. Two-hours sessions were organized on three consecutive days in June 2016. Teleconferencing required more preparation for all participants but the discussions were productive and conclusive.

2017 IACS Bureau Meeting meeting in Christchurch, New Zealand. From left to right Xiao Cunde, Liss Andreassen, Ian Allison, Charles Fierz, Anaïs Orsi, Andrew Mackintosh, Regine Hock, Hiroyuki Enomoto

ACTIVITIES

IACS facilitates the transfer of research methods and explores new avenues in cryospheric science through Standing Groups and Working Groups devoted to a theme or subject and composed of experts in the particular field of study. The currently active Working Groups (WG) of IACS are the *Randolph Glacier Inventory and infrastructure for glacier monitoring* (2014 – 2018), *Glacier ice thickness estimation* (2014-2018), and *MicroSnow* (2012-2016). All three of these working groups are very active.

The MicroSnow Working Group started 2012 and will close in 2017. This active group held workshops in 2013, 2014, and 2015, culminating in the Intercomparison of Snow Grain Size Measurement Workshop held in March 2014 in Davos, Switzerland. The final outcome of this Working Group will be a special issue of the journal *The Cryosphere* with the title 'Intercomparison of methods to characterize snow microstructure'.

Both the *Randolph Glacier Inventory and infrastructure for glacier monitoring* and the *Glacier thickness estimation* working groups were very active since they started to operate. The Randolf group was the first to provide a globally comprehensive glacier inventory; it is now preparing the release of version 6.0 of their database. The inclusion of Randolf Inventory data into the GLIMS (Global Land Ice Measurements from Space) database is now completed, and the working group collaborates closely with the World Glacier Monitoring Service (WGMS; an IACS Service). The Glacier Thickness Working Group and the World Glacier Monitoring Service collaborate to provide glacier thickness data to the community. The IACS Working Group on Glacier Thickness Estimation completed its first experiment and a paper was submitted to *The Cryosphere*. The working group is now preparing for its second phase. More information can be found here.

The current Standing Groups (SG) are the *Joint Commission on Volcano-Ice Interactions* (with the International Association of Volcanology and Chemistry of the Earth's Interior - IAVCEI), *Glacier and*

Permafrost Hazards in Mountains (GAPHAZ, a joint SG with the International Permafrost Association IPA), and the *Steering Committee of the Global Terrestrial Network for Glaciers* (GTN-G). The latter was recently strengthened through the addition of Ben Marzeion (University of Bremen) and Stephen Briggs (European Space Agency). GAPHAZ also links IACS to the Union Commission on GeoRisk (M. Krautblatter is our representative).

Meetings and symposia

International Symposium on the Cryosphere in a Changing Climate: Wellington, 2017

IACS held its 2017 scientific assembly from 12-17 February 2017 in Wellington, New Zealand. This meeting brought together three of the leading international associations focusing on the cryosphere; the International Association of Cryospheric Sciences (IACS), the International Glaciological Society (IGS) and the World Climate Research Programme Climate and Cryosphere Project (WCRP CliC). This conference was held at Victoria University of Wellington, Andrew Mackintosh's home institution. Andrew chaired the Local Organizing Committee while Ian Allison chaired the Scientific Steering Committee. Around 250 delegates from more than 25 countries attended this conference. IACS provided travel grants to allow more than 15 early career scientists and scientists from developing countries to attend this meeting. Chris Rizos, IUGG Bureau Member, welcomed participants on behalf of IUGG President Michael Sideris. Attendees included senior and chief editors of the journals *Nature* and *Nature Climate Change* respectively. About 30 delegates also attended the pre- and post-conference field trips to Tongariro and Aoraki/Mt Cook National Parks. All indicators suggest that this conference was a major success. Further information about the conference is still available on the conference website.

Delegates enjoying dinner on the Mid-Conference Field Trip to the Waiarapa. International Symposium on the Cryosphere in a Changing Climate, Wellington 2017

In addition to our scientific assemblies, IACS also supports events that are of interest to the cryospheric community. Our contributions are either to cover part of the travel costs of attendees (early career scientists and scientists from developing countries) or towards IACS awards for scientists in these categories. Recent sponsorships are listed below:

- IACS co-sponsored the second *Snow Science Winter School*, 14-20 February 2016, Preda-Davos, Switzerland. The feed-back from the 26 participants from 11 countries was enthusiastic and they provided a special feed-back to IACS and other sponsors. The event also benefited from an IUGG grant.
- IACS co-sponsored a *Training Course on Mass Balance Measurements and Analysis 2016* organized by WGMS 10-16 July in La Paz, Bolivia.

IACS early career scientist award

- In 2016 IACS offered its second *IACS Early Career Scientist Prize* for the best paper published within the field of the Cryosphere in the last 24 months. In 2016 the Committee awarded two prices jointly to Rachel Tilling (University College London) and Thorben Dunse (University of Oslo). The IACS Bureau decided to award two prizes bi-annually from now onwards. These prizes will be presented at bi-annual scientific assemblies (IACS, and IUGG General Assemblies). More information about the 2016 awardees can be found here.

FUTURE ACTIVITIES

Transfer of Presidency

On 22 February 2017, the IACS Presidency was transferred from Charles Fierz to Regine Hock. The IACS bureau and community thank Charles for his many years of outstanding service, which he will continue as Immediate Past President. Regine Hock, the new IACS President, is Professor of Geophysics at the University of Alaska, Fairbanks, USA. Regine has previously served as a Vice President of the International Glaciological Society, and as Secretary of the International Commission on Snow and Ice Hydrology (2005-2015), an IAHS commission. She is also the Chief Editor of Frontiers in Earth Science - Cryospheric Sciences. Regine's background is in glacier modelling, and projecting the contribution of glacier melt to sea level rise. We look forward to the continuing success of IACS under Regine's presidency.

Three IACS Presidents enjoying the scenery at Mueller Glacier lake and Mt Sefton (3151 m) in Aoraki/Mt Cook National Park, New Zealand on the Wellington 2017 Post-Conference Field Trip. From left to right: President Regine Hock (2017-2021), Immediate Past President Charles Fierz (2013-2017) and current Vice President Ian Allison (President from 2009-2013)

IACS Individual Membership

IACS has just established free individual membership, and we will be promoting this very shortly. We already have about 50 members who have signed up despite a very limited amount of publicity to date. We hope that offering individual membership will help to create a stronger community around IACS, promoting its activities and its relationship with IUGG and its other seven constituent associations. Specifically, IACS members will receive regular information about IACS activities and opportunities, and will be eligible to engage in IACS activities and bodies. This includes the possibility of receiving IACS sponsorship and financial support for workshops, summer schools, and other IACS-sponsored activities, and for the IACS early-career scientist prize (if members qualify). More information about IACS membership can be found here. Everybody is welcome to join, including members of other IUGG associations.

New Working Groups

IACS is currently seeking new Working Groups. We have currently received two preliminary enquiries; the first is from the *Microsnow Working Group*, who are putting together a new proposal to explore the feasibility of a Community Snow Model that would be as physically based as possible, covering snow from its deposition on the surface down to the transition of firn into ice. The model could then serve as a benchmark for evaluating less complex models. The second enquiry is from a multi-organizational group that proposes to investigate ocean and ice-sheet model ensembles, a highly topical area of research of direct relevance to the Intergovernmental Panel for Climate Change.

IACS sponsorship of forthcoming meetings

IACS will co-sponsor the 2017 *Glacial Seismology Training School* between 11-17 June 2017, in Fort Collins, CO, USA. The program will include lectures and practical exercises aimed at current and emergent seismological study of glaciers. Students will have the opportunity to spend one-on-one time with leading researchers in the emerging glaciological seismology community. More information is available here.

Andrew Mackintosh, IACS Secretary General

International Association of Geodesy (IAG)

IAG website: www.iag-aig.org

INTRODUCTION

Geodesy is the discipline that deals with the measurement and time-dependent representation of the geometry and physics of the Earth, i.e. the shape of the Earth's surface and its deformation, the Earth's orientation and rotation in space, the Earth's gravity field and dynamic behavior, and parameters of the atmosphere and hydrosphere and their variations. The mission of IAG is the advancement of geodesy by furthering geodetic theory through research and teaching, collecting, analyzing, modelling and interpreting observational data, stimulating technological development, and providing consistent, time-dependent parameters of the Earth's geometry and gravity field for global change research.

The structure of IAG includes four Commissions, the Inter-Commission Committee on Theory (ICCT), thirteen International Scientific Services, the Global Geodetic Observing System (GGOS), and the Communication and Outreach Branch (COB). The Commissions are divided into Sub-commissions, Study Groups and Working Groups. The ICCT investigates scientific geodetic problems in close cooperation with the Commissions. The Services generate scientific products by means of Operations, Data and Analysis Centers. One of the roles of GGOS is the coordination of the different IAG components, relating in particular to the maintenance of global reference frames for measuring and consistently interpreting key global change processes, and to promote its use to the scientific community, policy makers and the public. The COB provides communication, public information and outreach links, in particular via the IAG website and the monthly newsletters.

IAG's administration is supervised by the Council and conducted by the Executive Committee, the Bureau and the Office. The Council is composed by the delegates appointed by the national adhering bodies; the Bureau comprises the IAG President, Vice-President and Secretary General; the Executive Committee consists of the Bureau and other members elected by the Council; and the Office assists the Secretary General. The detailed program of IAG is published in the quadrennial Geodesist's Handbook, and reports are published in the bi-annual IAG Reports (Travaux de l'AIG).

ADMINISTRATION

IAG Council

The IAG Council meets regularly at the IUGG General Assemblies. In between it is informed by the Secretary General on current activities. Main topics in 2016 were related to the preparation of the joint IAG-IASPEI Scientific Assembly to be held in Kobe, Japan, in July-August 2017.

IAG Executive Committee (EC)

The EC met in Potsdam, Germany, from 25 to 27 April 2016. Most important was a one-day retreat for discussing the strategic planning for the future which shall result in a document to be adopted by the IAG Council at the next IUGG General Assembly in 2019. Another important issue was the adoption of a position paper describing IAG's view on the Global Geodetic Reference Frame (GGRF) adopted by a resolution of the United Nations on 26 February 2015. The EC has nominated IAG members in the corresponding UN-GGIM GGRF Working Group. Other topics were the reports of the IAG structure components. The meeting summary is published on the IAG website.

Participants of the IAG Executive Committee Retreat, Potsdam, Germany, April 25-27, 2016

IAG Bureau

The IAG Bureau discussed the day-to-day decisions by email exchange. It decided on 37 travel award applications of young scientists and granted 26 with a total amount of USD 15,700.

IAG Office

Main activities of the IAG Office were the publication of the IAG Handbook 2016 as a special issue of the Journal of Geodesy with the complete description of the IAG scientific program 2015-2019 (300 pages), the preparation of the IAG-IASPEI Scientific Assembly 2017, the handling of the IAG budget, and the organization of the EC meeting. Minutes were written for internal use and meetings summaries for the IAG website and the IAG newsletter (published in the Journal of Geodesy). The individual IAG membership (220 full and student members by the end of 2016) was managed.

ACTIVITIES

Commissions, Inter-Commission Committee, and Services

The four IAG Commissions (Reference Frames, Gravity Field, Earth Rotation and Geodynamics, Positioning and Applications), the Inter-Commission Committee on Theory (ICCT), and the thirteen Services maintain their individual websites (all accessible via the IAG website). Several Services and sub-components (Sub-Commissions, Working and Study Groups) held administrative meetings (Coordinating, Directing or Governing Board), and organized symposia and workshops (see below).

Global Geodetic Observing System (GGOS)

The new structure of GGOS was implemented at the beginning of 2016. The GGOS Consortium (made up by representatives of the IAG Components) and the Coordinating Board (the elected decision making body) met at the annual GGOS Days and regularly by tele-conferences. The GGOS Chair, appointed for the period 2015-2019, resigned from his office due to his overloading with other professional duties. The new appointment procedure was initiated at the end of 2016.

Communication and Outreach Branch (COB)

Main activities of the COB were the publication of the monthly newsletters (online and in the Journal of Geodesy), and the maintenance of the IAG website. The IAG newsletter is sent to the IAG officers and individual members, to the Presidents and Secretaries General of the IUGG and its Associations, and to the members of the Joint Board of Geospatial Information Societies (JBGIS).

Important Meetings of IAG Components and IAG Sponsored Meetings in 2016

- IGS Workshop, Sydney, Australia, 15-19 February 2016;
- 9th IVS General Meeting, Ekudeni (Johannesburg), South Africa, 13-17 March 2016;
- 3rd Joint Symposium on Deformation Monitoring, Vienna, Austria, 30 March – 1 April 2016;
- 4th IAG Symposium “Terrestrial gravimetry: Static and mobile measurements”, Saint Petersburg, Russia, 12-15 April 2016;
- European Reference Frame Symposium (EUREF 2016), San Sebastian, Spain, 25-27 May 2016;
- 18th Geodynamics and Earth Tide Symposium 2016, Trieste, Italy, 5-9 June 2016;
- Joint IAU/IAG/IERS Symposium “Geodesy, Astronomy and Geophysics in Earth Rotation (GAGER2016)”, Wuhan, Hubei, China, 18-23 July 2016;
- International Symposium on Geodesy and Geodynamics (ISGG2016), Tianjin, China, 22-26 July 2016;
- 1st International Conference on GNSS+ (ICG+2016)**,** Shanghai, China, 27-30 July 2016;
- IAG Commission 4 “Positioning and Applications” Symposium, Wroclaw, Poland, 4-7 September 2016;
- 18th General Assembly of WEGENER “Understanding earth deformation at plate boundaries”, Ponta Delgada, Azores, Portugal, 12-15 September 2016;
- 1st Joint Commission 2 and IGFS Meeting, International Symposium on Gravity, Geoid and Height Systems 2016 (GGHS2016), Thessaloniki, Greece, 19-23 September 2016;
- First International Workshop on VLBI Observations of Near-field Targets, Bonn, Germany, 5-6 October 2016;
- 20th International Workshop on Laser Ranging, Potsdam, Germany, 9-14 October 2016;
- GGOS Days, Cambridge, MA, USA, 24-28 October 2016;
- IDS Workshop, La Rochelle, France, 31 October – 1 November 2016;

- Reference Frame for South and Central America Symposium (SIRGAS2016), Quito, Ecuador, 16-18 November 2016;

Schools organized by the IAG

- 2nd IVS Training School on VLBI for Geodesy and Astrometry, Hartebeesthoek, South Africa, 9-12 March 2016;
- ISG Geoid School, Ulaanbaatar, Mongolia, 6-10 June 2016;
- SIRGAS School on Vertical Reference Systems, Quito, Ecuador, 21-25 November 2016;

Cooperation with other Organizations

IAG maintains close cooperation with several organizations outside IUGG such as: Advisory Board on the Law of the Sea (ABLOS, presently with IAG presidency), Group on Earth Observation (GEO), ICSU Commission on Space Research (COSPAR, Sub-commission B2 and PSD), International Astronomic Union (IAU, Commission A2), International Standards Organization (ISO, TC211 Geographic Information / Geomatics), Joint Board of Geospatial Information Societies (JBGIS), United Nations Initiative on Global Information Management (UN-GGIM), United Nations Offices for Outer Space Affairs (UNOOSA, with Space-based Information for Disaster Management and Emergency Response, UN-SPIDER, and International Committee on Global Navigation Satellite Systems, ICG).

Scholars of the SIRGAS School on Vertical Reference Systems, Quito, Ecuador, November 21 – 25, 2016

Publications

The main publications in 2016 were the monthly issues of the Journal of Geodesy, the IAG Symposia Series (Vols. 143 “IAG 150 Years” and 144 “International Gravity Field Service”) and the Geodesist’s Handbook 2016 as a special issue of the Journal of Geodesy.

Awards, Anniversaries, Obituaries

Travel awards were granted to 26 young scientists for presenting research results at 5 IAG Symposia. Three obituaries were written for former IAG officers and associates.

FUTURE ACTIVITIES

The main activities in 2017 will be related to the joint IAG-IASPEI Scientific Assembly 2017 in Kobe, Japan. The IAG strategy document will be drafted and discussed, and the assessment of the IAG Services will be continued, in particular focusing on some restructured services. GGOS will fully implement its new structure, in particular the new Coordinating Office, and improve the Internet representation (website and e-mail exploder).

Hermann Drewes, IAG Secretary General

International Association of Geomagnetism and Aeronomy (IAGA)

IAGA website: www.iaga-aiga.org

INTRODUCTION

IAGA, the International Association of Geomagnetism and Aeronomy (AIGA - Association Internationale de Géomagnétisme et d'Aéronomie) is one of the eight Associations of the International Union of Geodesy and Geophysics (IUGG). It is a non-governmental body funded through the subscriptions paid to IUGG by its Member Countries. IAGA has a long history and can trace its origins to the Commission for Terrestrial Magnetism and Atmospheric Electricity, part of the International Meteorological Organization, which was established in 1873.

IAGA is the premier international scientific association promoting the study of terrestrial and planetary magnetism, and space physics. IAGA is concerned with the understanding and knowledge that result from studies of the magnetic and electrical properties of:

- the Earth's core, mantle and crust
- the middle and upper atmosphere
- the ionosphere and the magnetosphere
- the Sun, the solar wind, the planets and interplanetary bodies.

ADMINISTRATION

Since 2015, IAGA is organized in six Divisions and four Inter-divisional Commissions, each led by a Chair and a Co-Chair. Each Division may form Working Groups in given specialized topics and elects officers to run the business of the Working Groups. During the XXVI IUGG General Assembly in Prague (2015), IAGA renewed its officers.

IAGA is administered by an Executive Committee on behalf of IUGG Member Countries in accordance with the Association's Statutes and By-Laws. The current Executive Committee members are:

President: Eduard Petrovsky (Czech Republic)
Vice-President: Monika Korte (Germany)
Secretary General: Mioara Mandea (France)

Members: Inez Batista (Brazil), Archana Bhattacharyya (India), Brian J.Fraser (Australia), Pieter Kotze (South Africa), Renata Lukianova (Russia), Alan Thomson (UK), and Andrew Yau (Canada).

IAGA communicates with Member Countries through National Correspondents nominated by appropriate national bodies. Member Countries are represented at IAGA Assemblies by accredited Chief Delegates who may vote on matters, according to the voting rules set out in the Statutes and By-Laws, at meetings of the Conference of Delegates. Information on the EC members and National Correspondents can be found online.

ACTIVITIES

One of the important achievements of 2016 is the new design of the IAGA website, and the new domain www.iaga-aiga.org.

Sponsored Topical Meetings

IAGA sponsored several topical meeting during 2016. The main achievements are published in the last IAGA newsletters.

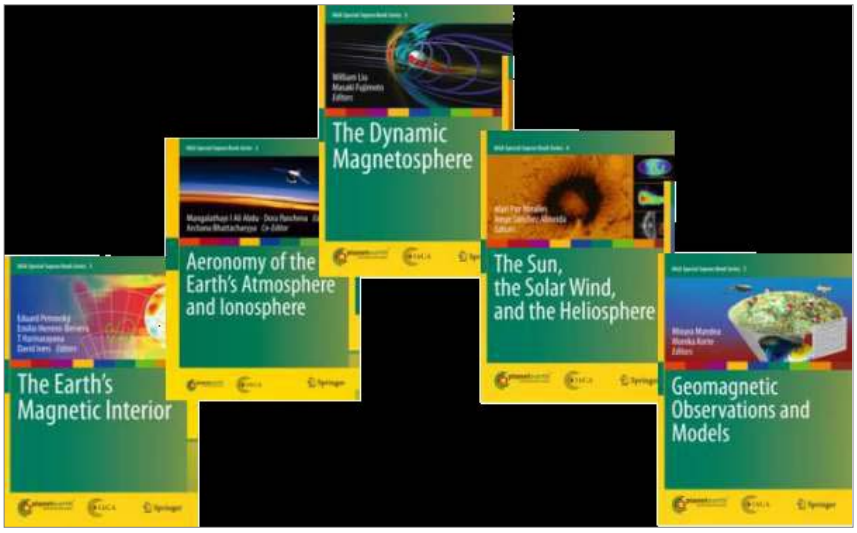
20-24 Mar	IAGA-4: Heliospheric Physics during a deep solar minimum	Hurghada, Egypt	A Hady
16-18 May	3rd Magnetotelluric 3D Inversion workshop	Bari, Italy	A Siniscalchi
18-21 Jul	Data intensive System Analysis	Sochi, Russia	A Gvisiani
25-29 Jul	6th IAGA/ICMA/SCOSTEP Workshop on Vertical Coupling in the Atmosphere-Ionosphere System	Taiwan	P Koucká Knížová
14-20 Aug	23rd Electromagnetic Induction	Chiang Mai, Thailand	U Weckmann
21-27 Aug	15th Castle meeting - Paleo, Rock and Environmental	Dinant, Belgium	S Spassov
4-10 Sep	XVIIth IAGA Workshop on Geomagnetic Observatory	Dourbes, Belgium	J Rasson
19-23 Sep	7th workshop of the URSI/IAGA Joint Working Group on ELF/VLF Remote Sensing of Ionospheres and Magnetospheres (VERSIM)	Hermanus, South Africa	J Bortnik

The XVIIth IAGA Workshop on Geomagnetic Observatory Instruments, Data Acquisition and Processing was held in Dourbes, Belgium

The 15th edition of the Castle meeting was held in the Castel de Pont-a-Lesse, Belgium

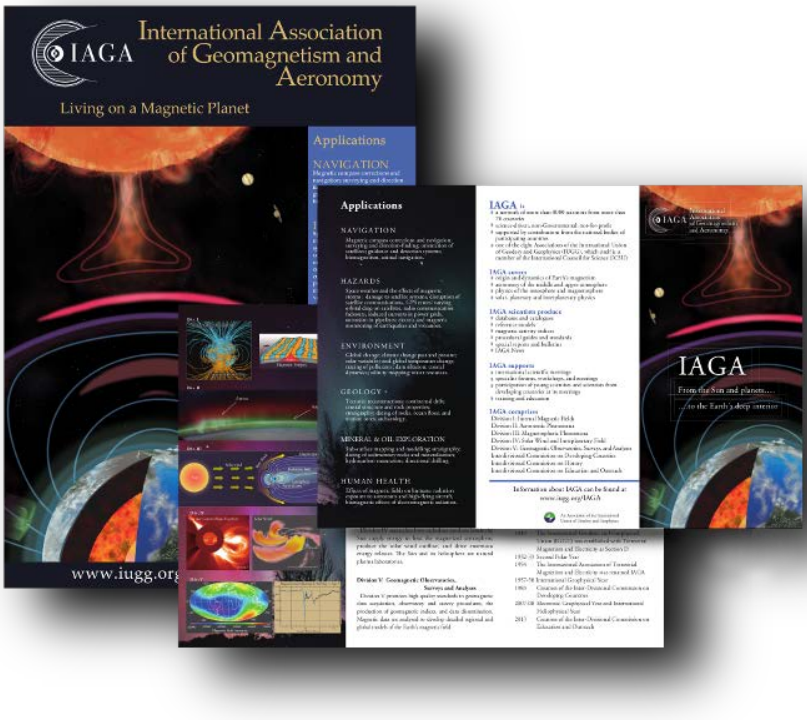
Publications

IAGA books. One of the most important achievements of IAGA was to publish, with Springer, a series of five books, summarizing the state of the science of the IAGA five divisions. As well as providing useful reference texts, the income to IAGA from Springer for this venture was used to support scientists attending the last Scientific Assembly in Sopron, Hungary.



IAGA Newsletters. 53; the last issue of IAGA Newsletters was distributed at the end of December 2016. It can be downloaded from the IAGA website.

New Flyer and Poster. The new version of the IAGA flyer is also available online.



FUTURE ACTIVITIES

Preparations for IAGA 2017

For the 2017 joint IAPSO-IAMAS-IAGA Scientific Assembly the route is to South Africa!

South Africa is the host to many National Research Facilities including the Hermanus Magnetic Observatory (where IAGA plans to organize the 3rd Summer School). The meeting will bring many occasions for scientists to discuss a wide range of topics, over breaks, poster sessions, and the IAGA special dinner party.

The 2017 Joint IAPSO-IAMAS-IAGA Scientific Assembly will be organized in Cape Town, South Africa. The Joint Assembly, endorsed by the University of Cape Town and the South African Department of Science and Technology, will take place from 27 August to 1 September 2017 at the Cape Town International Convention Centre (CTICC).

Detailed information on the program, abstract submission, registration, accommodation, and the venue are provided online.

Mioara Mandea, IAGA Secretary General

International Association of Hydrological Sciences (IAHS)

IAHS website: http://iahs.info

INTRODUCTION

IAHS promotes the study of all aspects of hydrology through discussion, comparison, and publication of research results and through the initiation of research that requires international cooperation. IAHS Press publishes the Hydrological Sciences Journal, the Proceedings of IAHS (PIAHS, successor of the Red Book Series), the Benchmark Paper series, and other specialized publications. IAHS maintains strong connections with the International Hydrological Programme of UNESCO and with the Hydrology and Water Resources Programme of the World Meteorological Organization (WMO), and is partner of the UN Water mechanism.

ADMINISTRATION

The following International Commissions, Working Groups and Initiative of IAHS conduct conferences, symposia, workshops, courses, and research programs:

- International Commission on Continental Erosion (ICCE)
- International Commission on the Coupled Land-Atmosphere System (ICCLAS)
- International Commission on Groundwater (ICGW)
- International Commission on Remote Sensing (ICRS)
- International Commission on Snow and Ice Hydrology (ICSIH)
- International Commission on Statistical Hydrology (ICSH)
- International Commission on Surface Water (ICSW)
- International Commission on Tracers (ICT)
- International Commission on Water Quality (ICWQ)
- International Commission on Water Resources Systems (ICWRS)
- Working Group MOXXI on Measuring and Observing in the XXIst century
- Working Group on Education
- Decadal Initiative Panta Rhei 2013-2022

ACTIVITIES

Highlights are the following standalone conferences:

- 7th International Water Resources Management Conference of ICWRS, Bochum, Germany, 18-20 May 2016;
- 12th UNESCO-IAHS Kovacs Colloquium on “Water-related SDGs implementation: Knowledge, data, indicators, tools & innovations”, UNESCO, Paris, France, 15 June 2016;
- Summer school on PUB, Vienna, Austria, 4-7 July 2016;
- 2016 ICCE Symposium, Exeter, UK, 11-15 July 2016;
- 9th IAHS Groundwater Quality Conference GQ16, Shenzhen, China, 24-28 July 2016;
- STAHY 2016 International workshop on Statistical Hydrology, Québec, Canada, 26-27 September 2016;
- International workshop on hydrological knowledge, innovation and practices in developing countries – Panta Rhei, Shenzhen & Wuhan, China, 13-17 November 2016;
- MOXXI first topical conference at ESA, Frascati, Italy, 21 November 2016;

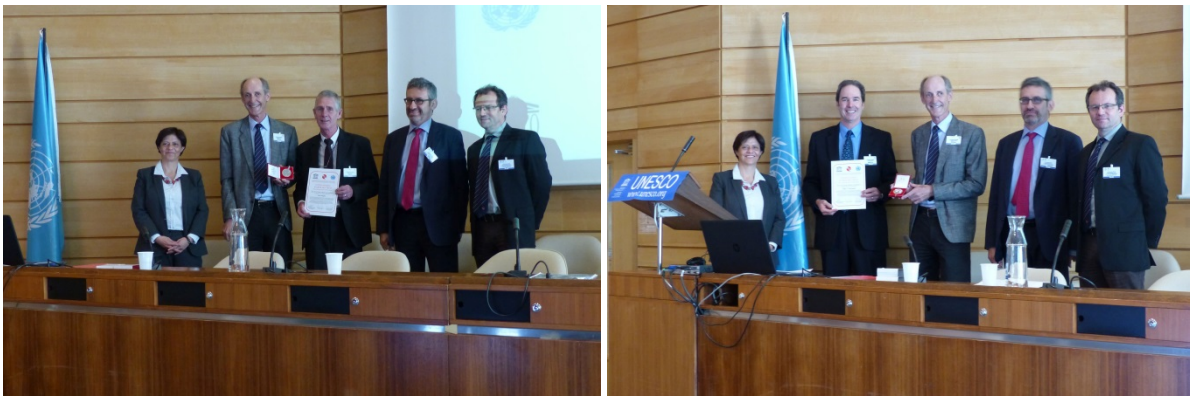
Participants of the International workshop on hydrological knowledge, innovation and practices in developing countries, Shenzhen, China, 13-15 November 2016

and the following co-organized/sponsored conferences and sessions at other events:

- Panta Rhei and thematic sessions at the EGU Assembly, Vienna, Austria, 17-22 April 2016;
- 4th IAHR Europe Congress on “Sustainable Hydraulics in the era of global change”, Liège, Belgium, 27-29 July 2016;
- HIC 2016 12th International IAHR-IWA-IAHS Conference of hydroinformatics, Incheon, Korea, 21-26 August 2016;
- 17th Waternet Symposium, Gaborone, Botswana, 26-28 October 2016;
- International UNESCO-Friend conference on African large river basins hydrology;
- WMO-IAHR-IAHS International hydrometry workshop, Queenstown, New Zealand, 28 November 2016;
- Panta Rhei session at AGU Assembly, San Francisco, USA, 12-16 December 2016.
- *Participants of the International workshop on hydrological knowledge, innovation and practices in developing countries, Shenzhen, China, 13-15 November 2016*

Participants of the 17th Waternet Symposium, Gaborone, Botswana, 26-28 October 2016

The pivotal event of this inter-assembly year has been the Kovacs Colloquium held at UNESCO on 15 June 2016. The annual prize ceremony was held on this occasion, and the IAHS bureau meeting on the day after. Denis Hughes (South Africa) and Jeff McDonnell (Canada) were awarded the IAHS-UNESCO-WMO International Hydrology Prize, respectively the Volker and Dooge medals. Guillaume Thirel, Jean-Nicolas Audouy, Lionel Berthet, Carina Furusho, Anna Kuentz, Julien Lerat, Thibault Mathevet, Denis Ruelland (France) received the Tison Award for early-carreer scientists.



Denis Hughes (South Africa; left picture) and Jeff McDonnel (Canada; right picture) were awarded the IAHS-UNESCO-WMO International Hydrology Prize, Paris, France, 15 June 2016

Charles Onstad (USA) retired from the position of the IAHS Treasurer and Cate Gardner (UK) became the new Treasurer as anticipated at the Prague IUGG 2015 Assembly. All the financial issues were transferred from the USA to UK. Ross Woods (New Zealand, UK) was nominated co-editor of Hydrological Sciences Journal.

In 2016, IAHS Press published Hydrological Sciences Journal (HSJ) in cooperation with Taylor and Francis (T&F). The size of the journal has increased from 12 to 16 issues per year. The performance indicators have strongly improved. Promotion by "features articles" continues, with details disseminated in press releases and via IAHS social media. Featured articles and Tison Award papers are made open access. All papers become open access two years after they get published. Any other paper can be openly accessed from the online display, on Author's paying principle.

Two special issues were included in *HSJ* vol. 61:

- *Hydrology and Peace in the Middle East* (invited; K. Aggestam and R. Berndtsson), and
- *Facets of Uncertainty* (Kos October 2013; A. Carsteanu, E. Eris, S. Weijs and E. Volpi).

A joint editorial has been published in seven major hydrological journals including *HSJ*, with a focus on innovation and impacts of scientific publications:

- Koutsoyiannis D. *et al.* 2016. Joint editorial – Fostering innovation and improving impact assessment for journal publications in hydrology. *HSJ* 61 (7) 1170-1173.

The continuation of the Panta Rhei initiative is well under way, with a coordinating team for the 2015-2017 biennium, standalone and joint events, and a publication plan in Hydrological Sciences Journal and in other journals. As the first biennium of the IAHS "Panta Rhei" initiative was reached in 2015, several papers on this topic have been submitted to *HSJ*. The papers are being made clearly identifiable by the Panta Rhei logo, both in print and at TFO. It is planned to group them within a Virtual Special Issue at the *HSJ* website, to be promoted by T&F, and to make the papers free to view for a time if they are not yet open access.

Three such papers were published in vol. 61:

- McMillan *et al*., 2016. Panta Rhei 2013–2015: global perspectives on hydrology, society and change. *HSJ* 61 (7), 1174–1191;
- Mount e*t al.,* 2016. Data-driven modelling approaches for socio-hydrology: opportunities and challenges within the Panta Rhei Science Plan. *HSJ* 61(7), 1192–1208;
- Ceola *et al.*, 2016. Adaptation of water resources systems to changing society and environment: a statement by the International Association of Hydrological Sciences. *HSJ* 61 (16), 2803–2817.

In addition, a special series of *HSJ* Opinion Papers directly linked to Panta Rhei was launched in 2016, coordinated by associate editor Heidi Kreibich. The aim is to publish these through IAHS and other media to invite formal discussion in the form of comments and replies that will also be submitted to *HSJ*. Again, it is planned to group these articles within a Virtual Special Issue. The following papers have already been published online in this Panta Rhei series, and have been assigned to vol. 62 (3):

- Kreibich, H. *et al*., Editorial – Scientific debate of Panta Rhei research – how to advance our knowledge of changes in hydrology and society? Published online 7 December 2016, 1–3;
- Blume, T. *et al*., The role of experimental work in hydrological science – insights from a community survey. Published online 26 October 2016, 1–4;
- Srinivasan, V. *et al*., Prediction in a socio-hydrological world. Published online 12 December 2016, 1–8.

The two papers tackling the second research question in this series, Liu, J. *et al*. and Di Baldassarre, G. *et al*., are under review and likely to be published in 2017.

The transition from Red books towards the new PIAHS open-access e-book series, in cooperation with Copernicus, was finalized, volumes being either proceedings of IAHS conferences or publications from other events. Two volumes have been produced in 2016:

- Volume 373 *The spatial dimensions of water management – Redistribution of benefits and risks* out of the ICWRS conference in Bochum and

- Volume 374 *Resources Assessment and Seasonal Prediction* out of an external meeting in Koblenz organized by the German Federal Institute for Hydrology.

The close cooperation of IAHS with UNESCO, WMO, the UN-Task Force on Water and Climate and the UN-Water Group has been continued. We have contributed to the WDRR2016 (Water and jobs) and 2017 (water quality), attended the UNESCO IHP Bureau meeting in April and the intergovernmental council meeting in June as well as the WMO CHy commission meeting in December.

FUTURE ACTIVITIES

Important preparations have been made for the IAHS scientific assembly in Port Elizabeth, South Africa to be held from 10 to 14 July 2017, locally organized by SANCIAHS, the South African Committee for IAHS and Rhodes University, Grahamstown.

Christophe Cudennec, IAHS Secretary General

International Association of Meteorology and Atmospheric Sciences (IAMAS)

IUGG

IAMAS

International Association of Meteorology and Atmospheric Sciences

IAMAS website: www.iamas.org

INTRODUCTION

IAMAS is the specialized Association of the International Union of Geodesy and Geophysics (IUGG) that deals with all aspects of the gaseous envelope around the Earth and other planets. The main research work is carried out, coordinated and communicated through IAMAS's 10 International Commissions (IC), which are in alphabetical order the:

- International Commission on Atmospheric Chemistry and Global Pollution (ICACGP)
- International Commission on Atmospheric Electricity (ICAE)
- International Commission on Climate (ICCL)
- International Commission on Clouds and Precipitation (ICCP) including the Committee on Nucleation and Atmospheric Aerosols (CNAA)
- International Commission on Dynamical Meteorology (ICDM)
- International Commission on the Middle Atmosphere (ICMA)
- International Commission on Planetary Atmospheres and their Evolution (ICPAE
- International Commission on Polar Meteorology (ICPM)
- International Ozone Commission (IOC)
- International Radiation Commission (IRC)

All the ICs, and IAMAS as a whole, play a leading role in global coordination, communication and discussion of the latest research through organization of and participation in a wide range of scientific meetings that are open to all scientists.

ADMINISTRATION

The Bureau did not change during 2016. In this period its members communicated regularly by monthly teleconference and email. The 2016 Bureau meeting was held over 13-14 April, 2016 in Kyoto, Japan. The Bureau reviewed the IAMAS financial status and activities, and discussed important items related to the IAMAS management, the plan for future activities, such as IAMAS program arrangement for the IAPSO-IAMAS-IAGA Assembly 2017, the host proposals for the IAMAS Assembly 2021, and award nominations. Elections were conducted by some commissions and new commission officers were elected as follows:

ICCP:	President	Andrea Flossmann (Second term)
	Vice-President	Greg McFarquhar
	Secretary	Darrel Baumgardner (Second term)
IO3C:	President	Sophie Godin-Beekman
	Vice-President	Paul A. Newman
	Secretary	Irina Petropavlovskikh
IRC	President	B.J. Sohn
	Vice-President	Peter Pilewskie
	Secretary	Marcia Yamasoe

ACTIVITIES

Website and Newsletter

The new official website of IAMAS was launched in January 2016. Also, the Newsletter "IAMAS Info-Email" was redesigned and made more readable and attractive, enhancing the interaction and the sharing of information with the commissions.

Publications

According to the MOU between IAMAS and Advances in Atmospheric Sciences (AAS), AAS has published four meeting reports, which are all open access online.

- ICPM: "The 10th Antarctic meteorological observation, modeling, and forecasting workshop"
- ICPM: "3rd ANtarctic Gravity Wave Instrument Network (ANGWIN) science workshop"
- IO3C: "The Quadrennial Ozone Symposium 2016"
- IRC: "The International Radiation Symposium 2016"

AAS also organized two special issues (to be published in 2017), with some IAMAS scientists as guest editors.

- "Special Issue: Impact of a Rapidly Changing Arctic on Eurasian Climate and Weather" (Guest Editor Andrew Orr from ICPM)
- "Special Issue: Aerosols, Clouds, Radiation, Precipitation, and Their Interactions" (Guest Editors Teruyuki Nakajima and Byung-Ju Sohn from IRC)

Awards

- The 2016 Alfred Wegener Medal and Honorary Membership of the European Geosciences Union (EGU) was bestowed on Prof. John P. Burrows, Chair of the IAMAS Commission on Atmospheric Chemistry and Global Pollution (iCACGP)
- The IRC Gold Medal was awarded to Prof. Teruyuki Nakajima, Secretary General of IAMAS
- Honorary Fellow of the Geological Society of India (GSI) was bestowed on Prof. Sir Brian Hoskins, Past President of the IAMAS

Highlights from the IAMAS International Commissions

ICACGP

The International Global Atmospheric Chemistry (IGAC) 2016 Science Conference was held in September in the USA with many presentations and posters. Earlier in the year, ICACGP members joined an international effort to argue strongly in favor of the climate change program at CSIRO to evolve positively to meet the need for evidence and improved prediction and not be cut back. ICACGP commission members participated in the Mario J. Molina Symposium held as part of the American Meteorological Society meeting in January 2016. ICACGP recommended the Atmospheric Composition and the Asian Monsoon (ACAM) meeting granted by IAMAS and IUGG.

ICAE

ICAE has published two issues of newsletters. The ICAE newsletters are well received by ICAE colleagues and can be accessed through the ICAE website. The ICAE website and mailing list have been updated. The next International Conference on Atmospheric Electricity 2018 (ICAE 2018) will be held in NARA, and is currently under preparation.

ICCL

The 13th General Circulation Model Simulations of the East Asian Climate (EAC) workshop took place at the Beijing Normal University in Beijing, China from 24-25 March 2016 with about 100 participants, among which 13 were from Japan, South Korea and USA, and about 50 were students and early-career researchers. The workshop was organized by Beijing Normal University, National Natural Science Foundation of China (NSFC), Ministry of Science and Technology (MOST), State Key Laboratory of Numerical Modeling for Atmospheric Sciences and Geophysical Fluid Dynamics (LASG), Institute of Atmospheric Physics (IAP), Chinese Academy of Sciences, The International Commission on Climate (ICCL) and IUGG Union Commission on Climatic and Environmental Change (CCEC). The workshop included four sessions (1. Detection and Attribution, 2. Climate Variability, 3. High-Impact Weather and Extremes, 4. Predictability, Prediction and Projection) with 33 oral presentations and 34 posters.

ICCP

ICCP held its 17th quadrennial International Conference in Manchester, UK from 25-29 July, which was attended by over 450 scientists from 26 countries. Two related workshops were held prior: the 9th International Cloud Modeling Workshop in Exeter, UK from 18-22 July 2016, and the 3rd ICCP Workshop on Cloud Microphysics Data Processing Analysis and Presentation Software in Manchester, UK from 23-24 July 2016.

ICDM

The commission co-sponsored and commission members helped planning the Workshop on Atmospheric Blocking held at the University of Reading, UK from 6-8 April 2016. The commission sponsored or co-sponsored proposals for three joint and eight IAMAS symposia to be held at the IAGA-IAMAS-IAPSO Joint Assembly in Cape Town, South Africa in 2017.

ICMA

ICMA has been actively participating in the organization of the IAPSO-IAMAS-IAGA General Assembly "Good Hope for Earth Sciences", 27 August - 1 September 2017, Cape Town, South Africa. In Cape Town, ICMA will hold the IAMAS M12 Middle Atmosphere Symposium and co-lead the joint IAGA and IAMAS JA4 solar-related Variability of the Atmosphere Symposium. We expect both symposia will contribute to bring together our vibrant community working on the dynamics, radiation and chemistry of the middle atmosphere. IAMAS/ICMA has been awarded by the IUGG Grants Program a 5,000 USD grant for a "Training school on stratosphere-troposphere interactions on the occasion of IAPSO-IAMAS-IAGA 2017 in Cape Town, South Africa". The organization of the school, in collaboration with World Climate Research Programme / Stratosphere-troposphere Processes and their Role in Climate (WCRP/SPARC) is ongoing. The announcement of the training school can be found online.

IOC

The 2016 Quadrennial Ozone Symposium (QOS-2016) was held from 4-9 September 2016 in Edinburgh, UK. The Symposium had more than 300 participants from 39 different countries, and featured six keynote talks, 75 oral presentations and 270 poster presentations. New Officers (President: Dr. Sophie Godin-Beekman, Vice-President: Dr. Paul A. Newman, Secretary: Dr. Irina Petropavlovskikh) were elected.

ICPAE

ICPAE is looking forward to the IAPSO-IAMAS-IAGA assembly in Cape Town, South Africa, where it will hold the IAMAS Session M13 - Comparative Planetary Atmospheres within and beyond the Solar System and the IAGA-IAMAS Joint Session JA 1 - Space weather throughout the solar system: bringing data and models together. Abstract submissions on planetary atmospheres in the solar system and around other planetary systems are welcome. Contributions pertaining to recent progress in the effective incorporation of data into planetary space weather modeling and prediction at any point along the chain from sun to planets are strongly encouraged. The Joint Session welcomes approaches that are less traditional in the space weather community but possess potential for significant progress in forecasting and understanding space weather in the Solar System.

ICPM

ICPM endorsed and, with funding from IAMAS, supported the 12th Antarctic Meteorological Observations, Modeling, and Forecasting Workshop (AMOMFW) in Columbus, OH, USA. A summary of the workshop, held from 5-9 June 2016, is in preparation. In conjunction with this meeting, the ICPM sanctioned Polar Boundary Layer Symposium was held along with the International Workshop on Coupled Modeling of Polar Environments. The 3rd Antarctic Gravity Wave Instrument Network (ANGWIN) Science Workshop held in Cambridge, UK, from 12-14 April 2016, was also an ICPM endorsed event, sponsored by IAMAS. The ICPM has been planning for the Cape Town IAPSO-IAMAS-IAGA Joint Assembly in Cape Town, South Africa. Two sessions are planned: a session on polar oceanography and meteorology and a session on vertical atmospheric coupling in the polar atmosphere. Additionally, ICPM is also planning for the Workshop on Antarctic Meteorology and Climate (AMC), along with the Year of Polar Prediction-Southern Hemisphere and Southern Ocean Regional Panel, meetings the week of 26-30 June 2017. The 2017 AMC conference (the new name for the AMOMFW event) is supported by IAMAS with travel support for students and young scientists.

IRC

The IRC International Radiation Symposium 2016 (IRS 2016) was held at the University of Auckland, Auckland, New Zealand, from 16 - 22 April 2016. The 268 scientists from 28 countries presented recent research results covering all aspects of the atmospheric radiation. The IRC Gold Medal Award was given to Teruyuki Nakajima and the Young Scientist Award to Zhibo Zhang. New IRC officers (President: B. J. Sohn, Vice President: Peter Pilewskie, Secretary: Marcia Yamasoe) were also elected there for the 2017-2020 term.

FUTURE ACTIVITIES

All commissions are engaged in the planning of the IAPSO-IAMAS-IAGA Assembly to be held from 27 August to 1 September 2017 in Cape Town, South Africa. IAMAS leads four joint sessions:

- JM1/Observing our Planet from Space (IAMAS, IAGA, IAPSO), Convenor – B. J. Sohn;
- JM2/Climate Variability and Change on all Scales (IAMAS, IAPSO), Convenor – Fei Fei Jin;
- JM3/Thunderstorm Coupling to the Upper Atmosphere (IAMAS, IAGA), Convenor - Colin Price;
- JM4/Future Climate for the African Continent (IAMAS, IAPSO), Convenor – Charles Williams.

22 sessions will be held as IAMAS-only Symposium. We are planning to hold the IAMAS EC meetings on 27 and 31 August 2017. The host of the 2021 IAMAS Science Assembly will be elected at this meeting.

Teruyuki Nakajima, IAMAS Secretary General

International Association for the Physical Sciences of the Oceans (IAPSO)

IAPSO website: http://iapso.iugg.org

INTRODUCTION

IAPSO has the prime goal of 'promoting the study of scientific problems relating to the oceans and the interactions taking places at the sea floor, coastal, and atmospheric boundaries insofar as such research is conducted by the use of mathematics, physics, and chemistry'. IAPSO works mainly through 1) biennial scientific assemblies; 2) working groups; 3) commissions; 4) services; and 5) website information. Of special importance to IAPSO is the involvement of scientists and students from developing countries in oceanographic activities.

IAPSO maintains formal liaison with other scientific commissions and committees. These include the ICSU's Scientific Committee on Oceanic Research (SCOR), and UNESCO's Intergovernmental Oceanographic Commission (IOC). More information can be found here.

ADMINISTRATION

The 2015-2019 Bureau of IAPSO comprises:

President:	Denise Smythe-Wright, (UK)
Past President:	Eugene Morozov, (Russia)
Secretary General:	Stefania Sparnocchia (Italy)
Treasurer:	Ken Ridgway (Australia)

The Executive Committee comprises the Bureau members and

Vice-Presidents:	Isabelle Ansorge (South Africa)
	Trevor McDougall (Australia)
Members:	Agatha de Boer (Sweden)
	Hans van Haren (The Netherlands)
	Toshiyuki Hibiya (Japan)
	Christa von Hildebrandt-Andrade (USA and Puerto Rico)
	Chris Meinen (USA)
	Satheesh Chandra Shenoi (India)

The IAPSO office is located at the Institute of Marine Science of the National Research Council of Italy, Trieste, and day-to-day business is managed by Secretary General (SG), Stefania Sparnocchia. The SG is responsible for the IAPSO website and in July 2015 a new IAPSO Facebook page was created, with the aim of facilitating the spreading of information in the community. Together with the President, the SG also prepares and distributes a bi-annual newsletter to IAPSO delegates and interested parties.

Financial management is presently split between Australia and Sweden. The previous Secretary General, Johan Rodhe, was co-opted by the IAPSO executive to assist the Treasurer, Ken Ridgway, with day to day banking and facilitate a smooth transfer of funds from the IAPSO bank account in Sweden to a new account in Australia. IAPSO finances will be consolidated there in the near future.

There were no formal IAPSO Executive business meetings organized in 2016; business was done by email and video conference where appropriate.

ACTIVITIES

2017 Assembly

The principal activity during 2016 was the preparation of the Joint IAPSO-IAMAS-IAGA Assembly to be held in Cape Town, South Africa, from 27 August - 1 September 2017. The President and the Secretary General have been active in the planning process and participated in several video conferences and a site visit from 16-18 May 2016. During this visit, the Presidents and SGs of the three associations were introduced to the conference organizers and shown around the venue and attractions. A preliminary list of sessions was drawn up and finalized during two video conferences. Details of the assembly can be found online.

SCOR Administration

IAPSO has maintained its formal relations with SCOR during the year. It has been involved in the evaluation of the 2016 Working Group proposal to be funded by SCOR in the next years. President, Denise Smythe-Wright participated in the SCOR Annual Meeting in Sopot, Poland, 5-7 September 2016. One important issue during the meeting was the decision about which working groups to fund.

G7 initiative

In November 2015, the Secretary General of IUGG, Alik Ismail-Zadeh, requested the President of IAPSO, Denise Smythe-Wright to instigate an initiative in response to the marine science issues raised by the G7 Science Ministers in the communiqué arising from their meeting in October 2015. The G7 countries have outstanding oceanographic capabilities and are well-placed not only to continue to provide world leadership in marine environmental research, but also to use the research outcomes for their wider socio-economic benefit. Realizing that this was not just an IAPSO initiative, she approached Peter Burkill, President of SCOR at the time and together they mustered 14 international experts to address the following issues:

- Marine Litter
- Ocean Acidification
- Biodiversity Loss
- Deoxygenation
- Ocean Warming
- Ecosystem degradation
- Deep-sea mining

The resulting report - *Future of the Ocean and its Seas: a non-governmental scientific perspective on seven marine research issues of G7 interest,* was completed in April 2016 and submitted to the Science Ministers prior to their meeting in Japan, in May 2016. A copy of the report can be found here.

At their meeting in Tsukuba, Japan, the Science Ministers proposed a way forward and the lead for this was taken by the UK Department of Business Innovation and Skills (UK BIS) working with the UK National Oceanography Centre and a working group with representatives of all G7 countries was set up. A follow up meeting of this Working Group was held at the National Oceanography Centre in November 2016. The focus of the work is on observations and while IAPSO-SCOR are not formally part of this initiative the President of IAPSO is keeping a close eye on events to ensure that IAPSO-SCOR input continues, if appropriate.

The G7 communiqué can be found here.

IUGG/IAPSO support to scientific meetings

IAPSO endorsed three scientific meetings that were supported by IUGG in 2016:

- The workshop "Arctic Subarctic Ocean Flux Study" (ASOF) was held on 30-31 March 2016 in Lerici, Italy, and was dedicated to the challenges associated with observing, modeling, understanding, and predicting heat exchanges between the Subarctic and the Arctic, in both the atmosphere and the ocean. The workshop addressed the questions: Where are we?, What do we know?, and What needs to be done? In addition, the workshop featured other contributions relevant to ocean fluxes between the Arctic and Subarctic seas. Three early-career scientists benefited from IUGG funds to attend the workshop that gathered 26 participants and 21 presentations.
- The 48th International Liège Colloquium on Ocean Dynamics took place from 23 to 27 May 2016, in the Academic Room of the University of Liège (ULg), Liège, Belgium. Every year the Colloquium addresses a cutting-edge topic in Ocean Science with the goal to foster discussions and collaborations amongst scientists from all around the world. The 48th edition was devoted to "Submesoscale Processes: Mechanisms, Implications and new Frontiers" and was a success with 200 participants from over 40 countries, 72 oral presentations, 8 keynote talks and 143 posters. IUGG funds helped the participation of an early-career researcher from Chile.

Participants of the 48th International Liège Colloquium on Ocean Dynamics, Liège, Belgium, 23-27 May 2016

- The Conference "A connected ocean" – the challenge of observation data integration, held in Brest, France, on 11-12 October 2016. The Conference has been the first opportunity to gather two scientific communities: the "Ocean Engineering Society" OES of IEEE, and the IAPSO of IUGG. The sessions covered four themes: 1) Interoperability standards for the marine environment, 2) Multimodal synergies in ocean studies, 3) Big Data infrastructure and analytics in ocean science, 4) Biological rates, upwelling: new autonomous approaches and integrated observations. It

gathered 182 participants. IUGG funds were used for a partial support of the participation of one invited Ivorian speaker working in Brazil.

IAPSO sponsored activities:

- Commission on Mean Sea Level and Tides (CMSLT). President: Gary T. Mitchum. Vice-President: Simon Holgate. Website.
- Permanent Service for Mean Sea Level, hosted by Proudman Oceanographic Laboratory, UK. Director: Lesley Rickards. IAPSO Liaison: Philip L. Woodworth. Website.
- IAPSO Standard Seawater Service, hosted by OSIL, Havant, Hampshire, UK. Director: Richard Williams. Website.
- Joint Committee on the Properties of Seawater, JCS (with SCOR and IAPWS). Chair: Rich Pawlowicz. Vice-Chairs: Trevor McDougall, Rainer Feistel. Website.
- IAPSO/IASPEI/IAVCEI Joint Tsunami Commission. Chair: Vasily V. Titov. IAPSO Representative: Efim Pelinovsky. Website.
- The working groups, commissions and services report to IAPSO. These reports are published on the IAPSO website.

IAPSO Liaison Officers and IUGG Commission Correspondents:

The Liaison Officers and Correspondents to Commissions and Committees for 2015-2019 are as follows:

- UNESCO Intergovernmental Oceanographic Commission (IOC): Stefania Sparnocchia (Italy) and Eugene Morozov (Russia)
- ICSU Scientific Committee on Oceanic Research (SCOR): Denise Smythe-Wright (UK)
- ICSU Regional Office for Africa (ROA): Isabelle Ansorge (South Africa)
- Climatic and Environmental Changes (CCEC): Harry Bryden (UK)
- Mathematical Geophysics (CMG): Adam Monaham (Canada)
- Geophysical Risk and Sustainability (GRC): Christa von Hillebrandt-Andrade (USA)
- Data and Information (UCDI): Ira Didenkulova (Estonia)
- Working Group on History (WGH): John Gould (UK)

Obituary

James J. O'Brien (1935-2016)

IUGG Fellow James J. O'Brien, Professor Emeritus of Meteorology/Physical Oceanography in the Department of Earth, Ocean and Atmospheric Science at Florida State University (FSU), died peacefully on 20 September 2016 at Tallahassee Memorial Hospital from complications following open heart surgery. Prof. O'Brien, the Robert O. Lawton Distinguished Professor of Meteorology and Oceanography, founded the Center for Ocean-Atmospheric Prediction Studies at FSU. He served as a weather officer in the U.S. Air Force from 1958 to 1960, promoted to the rank of Captain. He took advantage of the Air Force's financial assistance and training to earn both his Masters (1964) and Ph.D. (1966) degrees in Meteorology at Texas A&M University. He is internationally known for mentoring young scientists, and under his guidance, 44 students completed their Ph. D. degree and over 80 students completed their M.S. degree. He was particularly proud of his success in dramatically increasing the number of women scientists in oceanography and meteorology. Once nicknamed "Dr. El Niño", he was a pioneer in using early supercomputers to model atmospheric and oceanic interactions which led to new breakthroughs in understanding and prediction of coastal upwelling, El Niño, La Niña, and hurricane effects on the ocean. Prof. O'Brien served as the President of the

International Association for Physical Sciences of the Oceans (IAPSO), from 1987 to 1991, and retired in December 2006 after 38 years at Florida State. He will be sadly missed by the oceanographic community.

FUTURE ACTIVITIES

The main activity involving IAPSO in 2017 is the IAPSO-IAMAS-IAGA Joint Assembly "Good Hope for Earth Sciences", Cape Town, South Africa, 27 August-1 September. With the help of 45 IAPSO-related scientists, 15 symposia have been organized, covering a wide range of IAPSO's topics, eight of them jointly with IAMAS and IAGA. We are planning to hold the IAPSO EC meetings on 28 and 29 August and on 1 September. The IAPSO General Business Meeting will be held on August 31. During the third EC meeting, the Eugene LaFond Medal Committee will report on the selection of the ocean scientist from a developing country awarded in 2017. On 31 August, Distinguished Professor Lynne Talley, from the Scripps Institution of Oceanography, University of California San Diego, La Jolla, CA, USA, will be awarded with the Prince Albert I Medal 2017, and will deliver her Albert I Memorial Lecture.

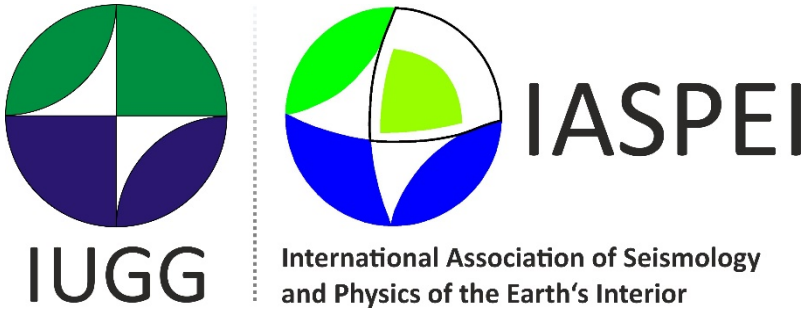
The Joint Assembly program details and other relevant information can be found on the website.

Further activities in 2017 are the following IUGG/IAPSO sponsored meeting, selected for support in 2016:

- IndOOS Review Workshop, Perth, Australia, 30 January-1 February 2017, which goal is to review the sustained Indian Ocean Observing System, conceived 10 years ago. In particular the workshop aims to review its design, to consider its failures and successes, and to propose a way forward in the context of new scientific frontiers and observing technologies.
- Past Antarctic Ice Sheet (PAIS) conference, Trieste, Italy, 10-16 September 2017, a programmatic conference of the PAIS Geoscience SCAR Research Programme. The aim is to offer the opportunity for cross disciplinary exchange of information among specialists with different fields of expertise, about their recent scientific results and about knowledge gaps.
- THEMES 2017 workshop, Venice, Italy, 29 November-1 December 2017. This will be the third edition of the workshop, aiming to discuss, within the broad community including oceanography, meteorology, climatology, marine ecology, and, more generally, marine environmental sciences, actual topic related to the comprehension of marine (eco)systems.

Stefania Sparnocchia, IAPSO Secretary General

International Association of Seismology and Physics of the Earth's Interior (IASPEI)



IASPEI website: http://iaspei.org

INTRODUCTION

The International Association of Seismology and Physics of the Earth's Interior is the leading international association promoting studies in seismology, earthquake processes, and structure and ongoing geodynamical processes within the Earth's interior. IASPEI achieves its goals primarily through scientific conferences organized by IASPEI and its Commissions, but also sponsors other international initiatives, fosters international cooperation, both in monitoring of seismic sources and research and education activities, especially in countries that are working towards full scientific development.

Most of the IASPEI efforts during 2016 were directed towards the General Assemblies of IASPEI's four Regional Commissions.

However, several important additional scientific meetings have been supported or sponsored by IASPEI and IUGG and several ongoing projects continued.

ADMINISTRATION

EC & Bureau meetings

The IASPEI Bureau met for a phone conference in September 2016. Several emails regarding important questions on financial support or business to be solved immediately have been exchanged with the members of the Bureau and EC throughout the year.

Other matters

Statutes. No changes. Due to moving the IASPEI bank accounts to Norway, it became necessary to register IASPEI as an Norwegian organization (Norwegian Org. Number 916 047 495).

Newsletters. IASPEI Newsletters have been regularly sent as pdf-file attachments to more than 2,000 email addresses. The Newsletters are also available for downloading from the website. Four issues were distributed in 2016.

ACTIVITIES

General Assemblies of IASPEI's Regional Commissions and IASPEI-Sponsored Meeting in 2016

- The 1st General Assembly of the African Seismological Commission (AfSC) was held during a Nile cruise in Egypt, 2-5 April 2016. The assembly had 92 participants and was followed by the "2nd African Workshop on Seismic Hazard" (6-9 April 2016).

Group picture from the 1st General Assembly of the African Seismological Commission (AfSC) in Egypt in April 2016

- The 2nd General Assembly of the Latin America and Caribbean Seismological Commission (LACSC) was held in San José, Costa Rica, 20-22 June 2016. The assembly had 207 participants. A one-week course on "Seismic Moment Inversion" was given before the assembly.
- The 35th General Assembly of the European Seismological Commission (ESC) was held in Trieste, Italy, 4-9 September 2016. The assembly had 536 participants. A one-week "School on Seismology beyond Textbooks" was organized before the assembly (29 August-3 September 2016).
- The 11th General Assembly of the Asian Seismological Commission (ASC) was held in Melbourne, Australia, 25-27 November 2016. The assembly had 45 participants. A workshop on "Seismological Contributions to Earthquake Risk Reduction" was organized before the assembly.
- IASPEI supported the Xth International Workshop on "Physics and Forecasting of Rock Destruction", which was held in Apatity, Murmansk region, Russia, 13-17 June 2016.

Other activities

Some 2,000 hard copies of the first printed edition of the IASPEI New Manual of Seismological Observatory Practice (**NMSOP 2002**) are currently in use in more than 100 countries at seismological observatories, data and analysis centers, in teaching, research, and field applications, used as basic material in national and international seismology training courses, or by private enterprises and

individual scientists. In 2014, a rigorously updated and amended electronic second edition, **NMSOP-2**, was completed and put online, thanks to the efforts of the late Peter Bormann. This version, as well as future ones, are professionally maintained, further developed and edited by the GFZ German Research Centre for Geosciences under a long-term commitment and the auspices of IASPEI and its Commission on Seismological Observation and Interpretation (CoSOI).

All versions are freely available and downloadable from the website of the GFZ Library.

The **IDEA** (International Digital Earthquake Archives) project of the Committee for Preservation of WWSSN and Historical Seismograms (also called ***Seismoarchives****: Seismogram Archives of Significant Earthquakes of the World*), continued its mission. IRIS is archiving the scanned seismograms. During the IUGG General Assembly in Prague it was decided that Graziano Ferrari (INGV) takes over the IDEA Project from W. H. K. Lee. The project for scanning old Batavia seismograms continued in 2016.

Awards, obituaries

The **IASPEI Medal** is awarded for merits in seismology: for sustaining IASPEI goals and activities and for scientific merits in the field of seismology and physics of the Earth's interior.

In 2016, the IASPEI Bureau established an **IASPEI Early Career Scientist Award** program aimed at engaging excellent young researchers in the IASPEI community. Each of the four IASPEI Regional Commissions will be asked to select one Early Career researcher (graduate student, postdoctoral research, pre-tenure faculty member) from their commission at each even-year Assembly of that Regional Commission.

No awards were presented in 2016.

Obituaries for prominent scientists were regularly published in the IASPEI Newsletters.

FUTURE ACTIVITIES

- In 2017, the main focus will be on the joint Scientific Assembly of IAG and IASPEI, which will be held in Kobe, Japan, 30 July - 4 August. Website.
- The locations of the 2018 General Assemblies of LACSC and ESC are already decided (Puerto Rico and Malta, respectively). The locations of the AfSC and ASC have to be decided in 2017.
- The 2021 Scientific Assembly of IASPEI is planned as a joint assembly together with IAGA.

Johannes Schweitzer, IASPEI Secretary General

International Association of Volcanology and Chemistry of the Earth's Interior (IAVCEI)

IUGG

IAVCEI

International Association of Volcanology and Chemistry of the Earth's Interior

IAVCEI website: http://www.iavcei.org/

INTRODUCTION

At the First General Assembly of IUGG (Rome, 1922), the *Section de Vulcanologie* became one of the constituent sections of the Union. This name was changed into *Association Internationale de Vulcanologie* at the Fourth General Assembly (Stockholm, 1930). It took its present name at the Moscow General Assembly (1971).

The IAVCEI is the primary international focus for research in volcanology and for efforts to mitigate volcanic disasters. Scientists also participate in IAVCEI research in closely related disciplines, such as igneous geochemistry and petrology, geochronology, volcanogenic mineral deposits, and the physics of the generation and ascent of magmas in the upper mantle and crust. Work is carried out in the following special Commissions:

- Chemistry of Volcanic Gases
- Cities and Volcanoes
- COSIV-Statistics in Volcanology
- Arcs Magmatism
- Collapse Calderas
- Explosive Volcanism
- Large Igneous Provinces
- Monogenetic Volcanism
- Remote Sensing
- Submarine Volcanism
- Tephra Hazard Modelling
- Volcanic Lakes
- Volcanic Hazards and Risk
- Volcanogenic Sediments
- Volcano Geoheritage and Protected Volcanic Landscapes
- Volcano Geology
- Volcano Geodesy
- International Volcanic Health Hazard Network
- Working Group on Volcano Acoustics
- World Organisation on Volcano Observatories

The members of the Executive Committee for the 2015-2019 term are:

President	Donald Bruce Dingwell	GERMANY
Secretary General	Roberto Sulpizio	ITALY
Vice-President	Patrick Allard	FRANCE
Vice-President	Shanaka Da Silva	USA
Immediate Past President	Raymond Cas	AUSTRALIA
Members	Eliza Calder	UK
	Jan Lindsay	NEW ZEALAND
	Michael Ort	USA
	Lizzette Rodriguez	PUERTO RICO

ADMINISTRATION

IAVCEI Executive Committee activities

- Revision of IAVCEI finances, funding support, and potential funding sources and strategies;
- Update of the IAVCEI Commissions and Working Groups, conducted by the two Vice-Presidents and approved by the EC, in which active commissions have been identified and several inactive commissions have been deactivated;
- Continuous updating of the website. Publication of a Facebook page;
- Update of the Editorial Board of the Bulletin of Volcanology;
- Call for the new Editor in Chief of the Bulletin of Volcanology;
- Publication of statements about freedom of science and against religious bans;
- Revision and publication of rules for IAVCEI prizes and awards;
- Appointment of two new Commissions: Volcano Geology and Volcano Geodesy.

Discussion on the current state of IAVCEI and its relationships with IUGG

- Adoption of the Principle of Freedom of Participation in Learned Societies following the submission of Proposal to Modernize IUGG and ICSU to IUGG and ICSU, focusing on adoption of self-governance of the associations;
- Agreement of the need to reintroduce compulsory individual membership fees along the lines of the AGU membership fee structure, to ensure the dramatic decline in financial reserves between end 2013 and 2014 is arrested.

ACTIVITIES

Members

In 2016, a membership fee was reintroduced for IAVCEI. This induced a lowering in the number of IAVCEI members, which was in the order of 800 people at the end of 2016. Among them, the life members are 90, around 500 regular members and around 200 student members.

Website

After the complete redrawn of website in 2015, the refurbishment of the IAVCEI website has been continued, and now it contains more info about IAVCEI activities, structure and initiatives.

Newsletters

Three issues of the newsletter "IAVCEI News" have been published through the website, in 2016.

2016 Meetings, workshops and courses

The following meetings, workshops, and courses have been (co-)organized or sponsored by one (or more) of the IAVCEI commissions in 2016:

- 3rd Workshop on Volcano Geology, Etna and Aeolian Islands, Italy, 3-10 July 2016;
- 6th International Maar Congress, Changchun, China, 30 July- 3 August 2016;
- 5th International Post-graduate Course of Volcanology, Olot, Girona, Spain, 12-25 October 2016;
- XXIII Central Andes Volcanological Field Course, Universidad Nacional de Salta, Salta, Argentina, 11-21 November 2016;
- Cities on Volcanoes 9 (COV9). Understanding volcanoes and society: the key for risk mitigation, Puerto Varas, Chile, 20-25 November 2016;
- Chapman Conference on Submarine Volcanism: New Approaches and Research Frontiers, Hobart, Tasmania, Australia, 30 January - 3 February 2017.

Group photo of the attendants at 3rd Workshop on Volcano Geology, Etna and Aeolian Islands, Italy, in July 2016

FUTURE ACTIVITIES

Foreseen activities for 2017:

- Publication of 4 IAVCEI newsletters;
- Revision of Commission activity and definition of minimum requirement for a commission to be considered active;
- Funding of workshops and meetings;
- Completion of IAVCEI website.

Meetings in 2017:

- IAVCEI Scientific Assembly. Fostering Integrative Studies of Volcanism, Portland, OR, USA, 14-18 August 2017. Website;
- 6th International Post-Graduate Course in Volcanology (in Spanish), Olot, Spain. Website, Contact: *ageyertraver@gmail.com*;
- 5th Course: Italian Association for Volcanology (AIV) 2017 International School in Volcanology: The use of geological data for hazard mapping, Trento, Italy. Website.

Roberto Sulpizio, IAVCEI Secretary General

ACTIVITIES OF THE UNION COMMISSIONS

The following reports illustrate the impressive range of activities within each Union Commission as well as their dedication to supporting science within developing countries. Each Union Commission has a website where much more information can be found.

Union Commission on Climate and Environmental Change (CCEC)

CCEC website: www.ccec-iugg.org

INTRODUCTION

The Union Commission on Climatic and Environmental Change (CCEC) was established by the Executive Committee of IUGG in June 2012 to promote scientific understanding of climatic and environmental change, to define criteria for collaborative trans-disciplinary research on climate and environmental change, to provide an all-Union perspective on climatic and environmental change, and to make available the knowledge and insights developed through scientific research to the benefit of society and planet Earth, including consideration of the science of global change, related vulnerability and impacts, and potential responses.

CCEC is distinct from the IAMAS Commission on Climate (ICCL) in that CCEC seeks to establish links across IUGG disciplines and across ICSU disciplines by collaborating with the Associations, Geo-Unions, and other scientific members of ICSU.

ADMINISTRATION

The following are current officers and members of the Commission:

Executive Committee:

Chair:	Tom Beer (Australia)
Vice Chair:	Jianping Li (China)
Secretary-Treasurer:	Keith Alverson (USA)

Members of the Commission are listed in the IUGG Yearbook.

ACTIVITIES

The second workshop of the IUGG Commission on Climatic and Environmental Change (CCEC) took place at the Université du Luxembourg in Belval, Luxembourg, from 21-22 October 2016. The workshop was conducted as a meeting of chapter authors of a forthcoming edited monograph "Global Change and Future Earth: The Geodetic and Geophysical Perspective" to be produced by the Cambridge University Press in October 2017. The monograph, which will be the third in the IUGG Series, seeks to deal with both aspects of the meaning of the term 'future earth'. In title case, Future Earth refers to the recent international scientific research program launched by the International Council for Science (ICSU), the International Social Science Council (ISSC), the Belmont Forum and a number of UN agencies. In lower case, it refers to the future of our planet, Earth.

The monograph thus seeks to expound how the geoscience community can assist Future Earth so as to improve the future of the Earth. It will comprise international and interdisciplinary contributions around the subject of climate change and its impacts on natural disasters and food security around the globe. The roles of the established scientific unions (e.g., IUGG) as well as new collaboration initiatives (e.g., Future Earth) in the advancement of multidisciplinary research will be highlighted throughout the monograph.

Sixteen authors from Austria, Australia, Canada, China, Denmark, England, Germany, India, Japan, Luxembourg, New Zealand, Turkey, and USA presented, discussed, and finalized the content and structure of their chapters and the monograph's eight key sections: 1) Future Earth and Planetary Issues, 2) Future Earth and Geodetic Issues, 3) Future Earth and the Earth's Fluid Environment, 4) Future Earth and Regions, 5) Future Earth and Urban Environments, 6) Future Earth and Food Security, 7) Future Earth, Risk, Safety and Security, 8) Future Earth, Climate Change and Global Change.

Opening Session of the second workshop of CCEC taking place at the Université du Luxembourg in Belval, Luxembourg, from 21-22 October 2016 (photo: Y. Kontar)

Fumiko Kasuga, Future Earth Global Hub Director, Japan, attended the meeting and gave an overview of Future Earth as an international global change research activity. Other contributions on the first day of the workshop included an overview of Climatic and Environmental Change by Tom Beer, CCEC Chair, as well as contributions from Alik Ismail-Zadeh, IUGG Secretary-General, and CCEC Members Eigil Friis-Christensen, Serhat Sensoy, Tonie Van Dam, Jianping Li and Harry Bryden (who presented jointly with Lawrence Mysak).

Contributions discussed during the second day of the workshop concentrated on the work of cognate scientific unions and included contributions from Prof. R. B. Singh (the International Geographical

Union); Albert McGill (the International Union of Food Science and Technology), Ibrahim Elmadfa (the International Union of Nutritional Sciences), Jane Rovins (a former Executive Director of the Integrated Research on Disaster Risk (IRDR) Scientific Programme of ICSU, ISSC and UN Office for Disaster Risk Reduction), as well as those from Yekaterina Kontar (University of Alaska, USA) and Anke Schneider (GEOMAR, Germany). The meeting invited a social scientist Catherine Wong (University of Luxembourg), to provide a social science perspective on the proposed monograph, the work program, the meeting, and the organization.

The workshop was facilitated by the local host, CCEC Member Tonie van Dam, Vice Rector of the University of Luxembourg, whose hard work and organizational capacities were greatly appreciated by all participants. Financial support to assist was provided by IUGG and IAMAS.

FUTURE ACTIVITIES

The three members of the CCEC Executive Committee comprise the editors of the forthcoming monograph. Editorial activities to finalize the production of the book are expected to be the main CCEC activities during 2017.

CCEC is co-organizing sessions at the Associations' General Assemblies:

Together with UNEP, IAMAS and the IAMAS commission on climate (ICCL), a session "Resilience: the science of adaptation to climate change" (M16) at the IAMAS/IAPSO/IAGA Assembly in Cape Town, South Africa, 29 August -3 September 2017. An edited book of the same title is in preparation under contract with Elsevier Press.

IAMAS and CCEC are co-sponsors of M18: Advances and Frontier challenges in Global Monsoon Studies, also at the Cape Town assembly.

Tom Beer, CCEC Chair

Union Commission on Mathematical Geophysics (CMG)

INTRODUCTION

The commission organized and held the 31th biennial CMG meeting at Université Pierre et Marie Curie in Paris, France, from 6-10 June 2016. A business meeting was held during the conference.

ADMINISTRATION

Membership. The CMG membership remained the same in 2016. *Chair*: Yehuda Ben Zion (USA); *Vice-Chairs*: Einat Aharonov (Israel) and Claudia Pasquero (Italy); *Secretary*: Ilya Zaliapin (USA); *Past Chair*: Dan Rothman (USA) *Business meeting.* A CMG business meeting was held during the 31st CMG conference at the Institute de Physique du Globe de Paris, Room 108, 9 June 2016, 12:30-14:00. *Attendance*: Yehuda Ben-Zion (Chair), Alexander Feigin (Russia), Alik Ismail-Zadeh (IUGG Secretary General), Sang-Moon Lee (South Korea), Claudia Pasquero (Vice-Chair), Klaus Regenauer-Lieb (Australia), Malcolm Sambridge (IASPEI), Daniel Schertzer (IAHS), Gordon Swaters (IAPSO), Manolis Veveakis (Australia), Ilya Zaliapin (Secretary).

The *agenda* included the presentation of proposals to hold the 32nd CMG meeting in 2018, and a proposal from the IUGG Secretary General Alik Ismail-Zadeh on celebrating the 100th anniversary of IUGG. The Commission received fixe excellent proposals. Considering the potential for close interaction between participants, expanding scientific collaborations, availability of sponsorship and support to young scientists, and overall readiness by the local organizing committee, the Committee and IUGG Association Representatives selected the proposal presented by Alexander Feigin, Russian Academy of Science.

ACTIVITIES

CMG biennial meeting 2016 in Paris, France

The IUGG Commission on Mathematical Geophysics (CMG) held its 31st meeting at the Université Pierre et Marie Curie in Paris, France, from 6-10 June 2016. . This year's meeting had a strong emphasis on computational and experimental science. In particular, it reached out to experimental science communities via a special session on "*Experimental Geophysics*", which focused on bridging the gap between theory and field observation. The scientific program included 16 special sessions divided into four thematic blocks: *Earth System and Planets*, *Fluids and Granular Flows*, *Seismology, tectonics and Rock Mechanics*, and *Cross Disciplinary Approached, Methods, and Data.*

The meeting featured invited plenary talks by Maria T. Zuber, Department of Earth, Atmospheric and Planetary Sciences, Massachusetts Institute of Technology, on *Advances in Planetary Gravity Mapping* and by Chris Paola, Department of Earth Sciences and St. Anthony Falls Laboratory, University of Minnesota on *Using unscaled and partially scaled experiments in geophysics*.

Each session included talks by several invited speakers, as well as contributed talks and posters. The meeting was attended by 218 researchers, postdocs, and students from 23 countries, including France (98 participants), USA (24), UK (17), Australia (11), Netherlands (11), Germany (7), Switzerland (6) and

many others. The social program included a field trip "*Geology of Paris: the birth of a capital*", organized by young geologists of IPG Paris.

CMG 2016 meeting participants

The IUGG CMG 2016 local organizing committee: Philippe Claudin (CNRS, École Supérieure de Physique et Chimie Industrielles), Alexandre Fournier (Institut de Physique du Globe, Paris), Valérie Vidal (CNRS, École normale supérieure de Lyon), and Renaud Toussaint (CNRS, Institut de Physique du Globe, Strasbourg).

Additional information and detailed meeting program is available here.

FUTURE ACTIVITIES

The Commission is preparing to the 32st CMG meeting in Russia in 2018 (see above).

Ilya Zaliapin, CMG Secretary

Union Commission on Geophysical Risk and Sustainability (GRC)

GRC website: www.iugg-georisk.org

INTRODUCTION

The IUGG Commission on Geophysical Risk and Sustainability (IUGG GeoRisk Commission) established by the IUGG Bureau in August 2000 is dedicated (i) to promoting scientific studies applied to the reduction of risk from natural hazards in an increasingly urbanized world and sustainability and (ii) to reducing death and destruction from natural and technological hazards by providing hazards data and information to emergency managers, policy-makers, scientists and the general public in the most timely and effective manner as possible. This includes the integration of knowledge concerning environmental, social and economic processes. The fundamental scope of this Commission is to facilitate communications – between scientists via meetings, workshops and publications, as well as between scientists and decision makers, between scientists and the public, and between scientists and schools.

ADMINISTRATION

Business Meeting

No business meeting was held in 2016.

Membership

Joan Marti	Chair	IAVCEI
John Labrecque	Vice-Chair	IAG
Alan Thomson	Vice-Chair	IAGA
Paula Dunbar	Secretary-Treasurer	IAPSO
Christa von Hillebrandt-Andrade	EC Member	IAPSO
Guy Brasseur	EC Member	IAMAS
Michael Krautblatter	EC Member	IACS
Mohsen Ghafory-Ashtiany	EC Member	IASPEI
Kuniyoshi Takeuchi	Past Chair	IAHS
Kosuke Heki	Member	IAG
Stephen McNutt	Member	IAVCEI
Martin Funk	Member	IACS
David Boteler	Member	IAGA
Vladimir Kossobokov	Member	IASPEI
Tom Beer Honorary	Member	IAMAS
Ramesh P. Singh	Honorary Member	IASPEI

Alik Ismail-Zadeh	Honorary Member	IASPEI
Harsh Gupta	Advisory Board Member	IASPEI
Viacheslav Gusiakov	Advisory Board Member	IAPSO
Uri Shamir	Advisory Board Member	IAHS
Gordon McBean	Advisory Board Member	ICSU
Hannah Jenkins	Webmaster	

Treasurer's Report

A separate report from the Treasurer was sent to Aksel Hansen, IUGG Treasurer.

ACTIVITIES

In 2016, the GRC activities have been mostly concentrated in endorsing and participating in initiatives organized by other institutions with interests on risk reduction. These included:

- IASPEI-IAVCEI International Worksop on Earthquakes and Volcanoes, Barcelona, Spain, 7-9 November 2016;
- International Conference "Data Intensive System Analysis for Geohazard Studies", Sochi, Russia, 18-21 July 2016; Plenary XIII of the Group on Earth Observations (GEO), St. Petersburg, Russia, 7-10 November 2016.

In addition, it is worth mentioning that Kunioshi Takeuchi (Japan), IAHS Past President, and the Immediate Past Chair of the IUGG GeoRisk Committee, was bestowed a certificate of appreciation by the Jakarta Office of the UNESCO International Hydrological Program in recognition of his long-term support and contributions to UNESCO Natural Science programs in Asia and the Pacific region, especially in the area of water management.

FUTURE ACTIVITIES

Several actions are planned to be undertaken during 2017 as a measure to reactivate the GRC and to make it more visible at the international level. These will include the full update of its website, a revision of the state of the art on the scientific aspects of risk reduction involving all IUGG Associations, and a possible joint meeting with AGU.

In addition, GRC will continue endorsing and participating in meeting and activities organized by other institutions or groups in which risk reduction is one of its main aims. By now, GRC is already endorsing the following upcoming meetings:

- GNSS Tsunami Early Warning System Workshop, Sendai, Japan, 25-27 July 2017

Joan Martí, GRC Chair

Union Commission on the Study of the Earth's Deep Interior (SEDI)

SEDI website: www.sedigroup.org

INTRODUCTION

SEDI is an international scientific organization dedicated to the **S**tudy of the **E**arth's **D**eep **I**nterior. The scope of SEDI includes the core and lower mantle, but interest may extend to the surface. The scientific questions and problems of interest to SEDI include: 1) the investigation of the origin, evolution**,** structure, geochemical and mineralogical composition of the inner core, outer core, mantle and crust, 2) the investigation of core magnetohydrodynamics at all time scales, both from a theoretical point of view and from an observational point of view, and of more general fluid rotational dynamics that can affect the core, 3) the investigation of mantle dynamics, both from a theoretical point of view and observational point of view, 4) the investigation of mechanical, electromagnetic, thermal and chemical interactions between the inner-core, core, mantle, crust and possibly outer layers on a planetary scale, particularly in view of a global understanding of the Earth as a globally interacting system, with special emphasis on investigation of interfaces, and 5) The thermodynamics of the Earth and the investigation of its long-term thermal evolution.

Since 1987, SEDI has been a Union Commission of the International Union of Geodesy and Geophysics (IUGG). As such, it cuts across the traditional discipline-oriented bounds of the Associations of the IUGG [such as the International Association of Geodesy (IAG), the International Association of Geomagnetism and Aeronomy (IAGA), the International Association of Seismology and Physics of the Earth's Interior (IASPEI), and the International Association of Volcanology and Chemistry of the Earth's Interior (IAVCEI)], which normally study the Earth from a particular point of view. The intent of SEDI is to amalgamate all sources of data and all points of view to generate the most coherent and consistent picture of the workings of the Earth's deep interior.

ADMINISTRATION

SEDI is currently chaired by Jonathan Aurnou (UCLA, USA), vice-chaired by Christine Thomas (University of Münster, Germany), with Michael Bergman (Simon's Rock College, USA) acting as Secretary General. It has a membership of about 600, as recorded on the email list used to broadcast information related to SEDI activities, upcoming meetings, funding opportunities, and academic openings.

ACTIVITIES

The 15th Symposium of SEDI was held in Nantes, France, from 24-29 July 2016. The Laboratoire de Planétologie et Géodynamique was in charge of the local organization. The symposium gathered 205 students and scientists coming from 20 countries. As is usually the case with SEDI meetings, the

meeting was organized by eight sessions led by discussion leaders. Each session had one keynote talk and two shorter more focused talks, followed by ample time for discussion of posters and key scientific issues. These eight sessions were: S1: Mantle – Observations, S2: Mantle – Modeling & Dynamics, S3: The Core-Mantle Boundary, S4: Inner Core, S5: Outer Core – Observations, S6: Outer Core – Dynamics, S7: Experiments, and S8: Other Planets.

Group picture from the 15th Symposium of SEDI in Nantes, France, in July 2016

Highlights of the meeting included the Zatman Lecture on "Force balance and wave motion in Earth's core" by Alex Fournier (IPGP) and the awarding of the Doornbos Prizes for outstanding work by early career scientists. At the meeting, the Doornbos Prizes were awarded to:

> **Chris Davies**, for linking core dynamics to paleomagnetic observations and seminal work on the geophysical implications of deep earth diffusivities;
>
> **Kumiko Hori**, for novel studies of core physics, including the development of a new tool to give us an independent source of information about the geomagnetic field;
>
> **Shigehiko Tateno**, for cutting edge experimental studies of the structure of deep Earth minerals made over the entire range of deep Earth conditions.

The proceedings of the 2016 SEDI meeting are being handled by the Journal *Physics of Earth and Planetary Interiors*. Jonathan Aurnou, Michael Bergman, Christine Thomas and Michael Le Bars (IRPHE, Marseille) joined the editorial team as Associate Editors.

The business meeting was also held on 28 July 28 2016, and was attended by most of the participants. After a rather lively discussion, it was agreed that the location of the next (16th) SEDI international symposium would be left undecided until after the November 2016 US election. Based on its results, the SEDI Executive Committee has decided to hold the 2018 SEDI meeting in Edmonton, Canada. The lead local organizers at the University of Edmonton are Matthieu Dumberry and Moritz Heimpel.

FUTURE ACTIVITIES

IAG-IASPEI Assembly 2017

The joint scientific assembly of IAG and IASPEI will be held from 30 July to 4 August 2017, in Kobe, Japan. Various SEDI-related symposia (7 IAG, 27 IASPEI and 9 joint symposia) are planned. Further information can be found here.

IAPSO-IAMAS-IAGA Assembly 2017

The IAPSO-IAMAS-IAGA Joint Assembly will be held from 27 August to 1 September 2017 in Cape Town, South Africa. It features over 60 total sessions covering a variety of SEDI-focussed topics. Further information can be found here.

Jonathan Aurnou, SEDI Chair
Christine Thomas, SEDI Vice-Chair
Michael Bergman, SEDI Secretary General

Union Commission on Planetary Sciences (UCPS)

UCPS website: http://202.127.29.4/geodesy/ucps

INTRODUCTION

The IUGG Union Commission on Planetary Sciences (UCPS) was established by the IUGG Executive Committee in June 2015 to promote and coordinate scientific (physical, chemical, and mathematical) studies of planets in the solar system and around other stars. UCPS intends to advance planetary science through advocacy of solar system and extrasolar exploration, seeking insights on the origin, formation and evolution of planets and systems, including a search for habitable worlds beyond Earth. The UCPS together with other IUGG Associations will share knowledge through scientific research and comparative studies between planetary objects and the Earth in the fields of atmosphere, surface and interior science.

Additional information about UCPS can be found online.

Objectives

- To advance and foster the study of scientific problems in the planetary sciences;
- To promote and coordinate international cooperation in planetary science, and promote planetary science activities in developing countries;
- To facilitate, on an international basis, discussion and publication of the results of the studies, research and work indicated above;
- To contribute to coordinating activities for future space missions.

ADMINISTRATION

Executive Committee

- Chair: Shuanggen Jin (IAG, China) Vice-Chair: Athena Coustenis (IAMAS, France)
- Vice-Chair: Joern Helbert (IASPEI, Germany)Secretary/Treasurer: Scot Rafkin (IAMAS, USA) Member: Christine Schott Hvidberg (IACS, Denmark)
- Member: Michael Purucker (IAGA, USA)
- Member: Fabrizio Capaccioni (IAHS, Italy)
- Member: Philippe Lognonne (IASPEI, France)
- Member: Jose Luis Macias-Vasquez (IAVCEI, Mexico)

Members

- Oliver Baur (Austria, IAG)
- Jean-Pierre Bibring (France, IAHS)
- Anil Bhardwaj (India)
- Shane Byrne (USA)
- Nader Haghighipour (USA)
- Paul Hartogh (Germany)
- Masato Iguchi (Japan)
- Wing-Huen Ip (Taiwan, China)
- Takahiro Iwata (Japan)

- Catherine Johnson (Canada, IAGA)
- Sanjay Limaye (USA)
- Jesus Martinez-Frias (Spain)
- Jürgen Oberst (Germany)
- Rosanna de Rosa (Italy)
- Binod Sreenivasan (India, IAGA)
- Darrell Strobel (USA)
- Feng Tian (China, IAMAS)
- Dmitri Titov (Germany)
- Pieter Visser (The Netherlands, IAG)

ACTIVITIES

UCPS-AOGS Special Session: Recent advances in planetary exploration and geophysics, Beijing, China, 31 July - 5 August 2016. Website

To advance planetary sciences, the UCPS in collaboration with AOGS held a joint Special Session at the 13th Asia Oceania Geophysical Sciences Society Meeting: "Recent Planetary Exploration and Geophysics". Papers on planetary atmosphere, geophysics, geodesy, magnetism, cryosphere, seismology, volcanology, the physics and chemistry of the interior of the planets in our solar system and around other stars, and future mission opportunities were presented and discussed.

Conveners: Shuanggen Jin (SHAO, China)
Jorn Helbert (DLR, Germany)
Noriyuki Namiki (NAO, Japan)
Wing-Huen Ip (NCU, Taiwan)
Paul Hartogh (MPG, Germany)

AOGS session: Terrestrial Planetary Atmospheres and Their Evolution, Beijing, China, 31 July – 5 August 2016. Website

The AOGS held a session at the 13th Asia Oceana Geophysical Sciences Society Meeting relevant to the UCPS: "Terrestrial Planetary Atmospheres and Their Evolution". Understanding the nature, variability, physical and chemical mechanisms, and the evolution of planetary atmospheres is a main component of planetary sciences. While the long-term evolution of our own planet is constrained by a wealth of geological/geochemical data, the evolutionary paths of other terrestrial planetary bodies in and outside our solar system must be reconstructed from less abundant planetary mission data and astronomical observations. The discovery of exoplanets provides additional opportunities for interdisciplinary collaborations between geoscientists, astronomers, and planetary scientists. Our understanding of the Earth and other planets can greatly benefit from comparative studies of terrestrial planetary atmospheres. This session welcomes both observational and theoretical studies relevant to current physical and chemical states of terrestrial planetary atmospheres in and outside of our solar system (including the Earth) and their evolution.

Conveners: Feng Tian (Tsinghua University, China)
Eric Chassefiere (Univ Paris-Sud, France)
Yongyun Hu (Peking University, China)

Special Session SS7 4: The Effects of Solar and Stellar Magnetic Activity on Planets, at European Week of Astronomy and Space Science, Athens, Greece, 4-8 July 2016. Website

The magnetic activity of cool stars in the form of flares, winds and coronal mass ejections have a direct impact on planets. This activity varies with the mass, age and rotation rate of the star and can be damaging for life, even in the case of a fairly inactive star like the Sun. During periods of intense solar activity, the solar wind is enhanced and geomagnetic storms produce auroras, disrupt radio transmissions, affect power grids, damage orbiting satellites, and can be hazardous to astronauts. By analogy, the magnetic activity of cool stars may be hazardous for the creation and development of life and is therefore of potential importance for habitability.

In this Special Session, we aim to bring together observers/theoreticians whose diverse research interests are linked with solar and stellar activity and its effect on orbiting planets. Questions that will be addressed are:

1) How do stellar magnetic activity influence the exoplanets orbiting main-sequence stars?
2) Which lessons learned from our own solar system can be incorporate in exoplanetary research?
3) How can stellar activity affect habitability?

Scientific organizers: Heidi Korhonen (University of Turku, Finland)
Aline Vidotto (University of Geneva, Switzerland)
Contact: heidi.h.korhonen@utu.fi

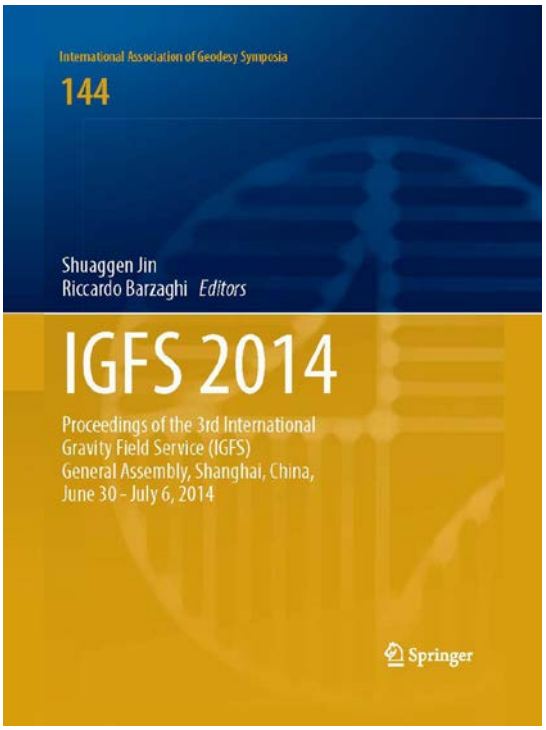
COSPAR2016 - Scientific Event B0.2: Mars Exploration and Science, Istanbul, Turkey, 30 July- –7 August 2016. Website

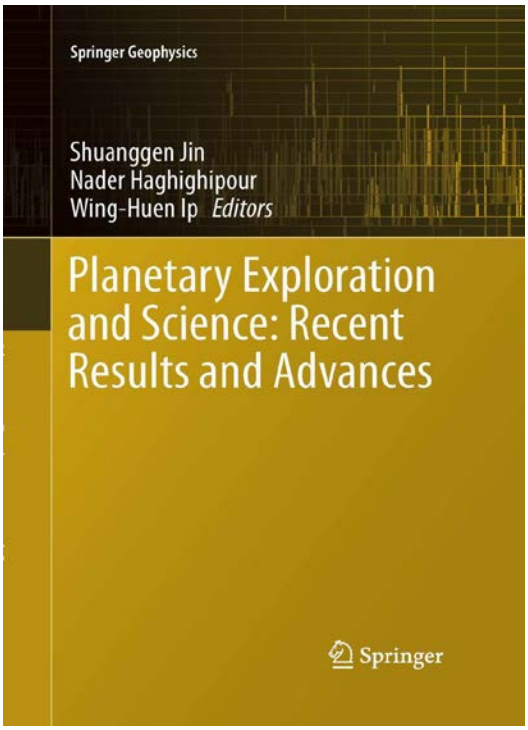
Mars has been extensively explored by spacecraft. At present, several orbiters (e.g., MRO, MAVEN, MOM, Mars Express) and the Curiosity and Opportunity rovers are exploring the Mars surface and atmosphere, history, and habitability. Additional missions to study the interior structure and the habitability of Mars are expected to fly by the time of the COSPAR 2016 Assembly (e.g., InSight, Trace Gas Orbiter and they accompanying demonstration lander). This session is to mainly address new results on Mars exploration and science, including theory, methods, measurements, and findings as well as comparative studies with the Earth in the atmosphere, surface, and interiors. Papers describing future Mars missions, in flight or planned and simulated results are also welcome.

Main Scientific Organizers (MSO): Shuanggen Jin (SHAO, China)
Oleg Korablev (IKI, Russia)

Publications

- Jin, S.G., and R. Barzaghi (Eds.) (2016), IAG Symposia Book Series: International Gravity Field Service General Assembly (IGFS2014), Shanghai, China, 30 June-6 July 2014, Springer Verlag, Heidelberg, Germany, ISBN: 978-3-319-39819-8, 224pp.
- Jin, S.G., N. Haghighipour, and W.-H. Ip (Eds.) (2015), Planetary Exploration and Science: Recent Results and Advances, Springer Verlag, Heidelberg, Germany, ISBN: 978-3-662-45051-2, 340pp.





FUTURE ACTIVITIES

1st IUGG Symposium on Planetary Sciences (IUGG-PS 2017) - Interdisciplinary observation and understanding of the Solar System, Berlin, Germany, 3-5 July 2017. Website

Planetary science is an increasingly interdisciplinary field of research propelled forward by advances in space exploration and ground based studies. Detailed characterization of planetary environments within and beyond our Solar System requires collaborative studies across the fields of geology, atmospheric science, geophysics, geodesy, seismology, aeronomy, planetary origins, chemistry and astrobiology. The 1st IUGG Symposium on Planetary Science (IUGG-PS2017): Interdisciplinary observation and understanding of the Solar System will be held from 3-5 July 2017 in Berlin, Germany. The IUGG-PS2017 aims to bring together international scientists and engineers focused on an interdisciplinary work on exploration and science of the solar system and seeking life beyond Earth. Topics include planetary geodesy, remote sensing, atmosphere, ionosphere/plasma physics, magnetic and gravity field, geomorphology, geophysics, geodynamics, geology, petrology, volcanology, geochemistry, interior physics, life & astrobiology. All objects from the terrestrial and giant planets to exoplanets, including small bodies are welcome.

The IUGG-PS2017 is sponsored by the IUGG Union Commission on Planetary Sciences (UCPS), the International Association of Planetary Sciences (IAPS), and the German Aerospace Center (DLR). The UCPS was established in June by the Executive Committee of International Union of Geodesy and Geophysics (IUGG) to advance emerging and existing interdisciplinary research on planetary sciences.

Shuanggen Jin, UCPS Chair

Working Group on History (WGH)

INTRODUCTION

At the IUGG General Assembly 2011 in Melbourne, Australia, an ad-hoc interest group for the history of IUGG was formed having in view the centenary of the Union in 2019. In November 2012, the IUGG Working Group on History (WGH) was formally established by the IUGG Executive Committee. The broad goals of the WGH are to raise the historical consciousness of IUGG Association members and to help preserve IUGG's scientific and institutional history. Historical awareness helps to broaden scientists' horizon and to enrich their lives by enabling them to relate the struggles and triumphs of predecessors to their own day-to-day challenges.

The WGH promotes historical content in Union and Association scientific sessions and sponsors stand-alone history sessions at Union General Assemblies, with emphasis placed on the centenary of IUGG's foundation coming-up in 2019. The WGH encourages publication of historical articles by Association members in relevant journals, in books, and on websites. In a secondary role, the WGH serves as a consultant to the IUGG and Association leadership on the preservation of institutional and scientific records.

ADMINISTRATION

During 2016, the representation in WGH did not change. The last business meeting was held on 27 June 2015 during the IUGG General Assembly in Prague, Czech Republic. The following individuals agreed to serve during the current quadrennium:

Chair:	Hans Volkert (Germany)	**Vice-Chair:**	Claude Boucher (France)

Association representatives:

IACS:	Marc Carey (USA)	**IAG:**	József Ádám (Hungary)
IAGA:	Edward Cliver (USA)	**IAHS:**	Maurits Ertsen (Netherlands)
IAMAS:	Hans Volkert (Germany)	**IAPSO:**	John Gould (UK)
IASPEI:	Roger Musson (UK)	**IAVCEI:**	Grant Heiken (USA)

History of science advisors:

Ronald Doel (USA)	Gregory Good (USA)

ACTIVITIES

In 2016, WGH representatives continued to search for and collect material to be used for the IUGG centennial publication. An arbitrary, though illustrative and old example is the rediscovery of a 125-year old group photograph of 34 participants of the non-governmental International Meteorological Conference in Munich, German Empire, from 26 August to 2 September 1891. Full names and compact biographical information were added for all participants, most of them directors of the then young national meteorological services as well as of geophysical observatories on three continents. The gathering of 1891 can be considered as one important root to both, the *non-governmental* IUGG (founded in July 1919) and the *inter-governmental* World Meteorological Organization (existing since 1952).

WGH members contributed to the editorial process of the broad – partly historical, partly programmatic – review by the IUGG Secretary General, who presented our union as a representative case study within the group of international unions making in their entirety "geosciences

international" within ICSU (Ismail-Zadeh, 2016). Furthermore, a brief note exemplified the long tradition of focused workshops in geophysics as an important means to further international cooperation on a voluntary basis (Volkert, 2017).

Participants at the non-governmental International Meteorological Conference in Munich, German Empire, in summer 1891; six columns with given name, SURNAME, and in brackets: age at conference, country of work, life span (photo: MetOffice library, Exeter, UK)

FUTURE ACTIVITIES

During 2017, coordination will continue and intensify between WGH representatives and Jo Ann Joselyn (IUGG Secretary General, 1999-2007) regarding the final structure of the IUGG centennial book with the tentative subtitle "from different spheres to a common globe". A face-to-face meeting of contributors may take place along-side the three association IAPSO-IAMAS-IAGA assembly in Cape Town, South Africa, at the beginning of September 2017 or later in the autumn at the American Institute of Physics (Center for History of Physics) near Washington, D.C, USA, where many old IUGG documents are preserved and the history of science advisor Gregory Good is working. The target date for the completion of the text of the book and transfer to the – still to be chosen - publisher was put to September 2018.

References:

Ismail-Zadeh, A., 2016: Geoscience international: the role of scientific unions. *Hist. Geo Space. Sci.*, 7, 103-123, doi:10.5194/hgss-7-103-2016.

Volkert, H., 2017: Putting faces to names: Snapshots of two committee meetings, 95 years apart, emphasize continuous international cooperation in the atmospheric sciences. *Adv. Atmos. Sci.*, 34 (5), doi: 10.1007/s00376-017-6329-6., in press.

Hans Volkert, WGH Chair

THE INTER-ASSOCIATION WORKING GROUP: Electro-magnetic Studies of Earthquakes and Volcanoes (EMSEV)

EMSEV website: www.emsev-iugg.org/emsev

INTRODUCTION

EMSEV Inter-Association Working Group on 'Electromagnetic Studies of Earthquakes and Volcanoes' is under the purview of the International Union of Geodesy and Geophysics (IUGG), IAGA, IAVCEI, and IASPEI. These associations support EMSEV and promote its activities. EMSEV goals are to explore and develop new research and findings in electromagnetism (EM) and to integrate data from other geophysical methods in order to broaden the understanding of dynamical processes leading to fault rupture and volcanic eruptions.

EMSEV objectives are: (1) the evaluation and the promotion of advanced studies in the electromagnetic (EM) field through international cooperation, conferences and regional workshops, as well as high levels international publications, (2) the integration of electromagnetic with other geophysical methods to study earthquakes and volcanic eruptions and their effects on ground and in space around the globe, (3) conducting international and regional workshops and sponsoring sessions at international meetings, and (4) the participation in educational programs.

ADMINISTRATION

EMSEV activities and the involvement of scientists throughout the globe have increased. More than 320 scientists are now actively working on EMSEV related activities. They have expanded methodologies and utilized ground observations, laboratory measurements and data obtained remotely from satellites to understand earthquake and volcanic processes and seismo-electromagnetic effects.

At the EMSEV business meeting held during the 2015 IUGG General Assembly in Prague, Czech Republic, new elections were held. During the last International EMSEV meeting held in Lanzhou, China, in September 2016, the community decided to slightly reorganize the EMSEV body and to upgrade the EMSEV website. This has been completed and the upgraded website can be found here.

The EMSEV body now consists of the Executive Bureau, Working Group Members (that include all scientists involved in EMSEV activities), National Representatives (selected from the Members with about two per country) and EMSEV collaborators (that includes all interested scientists from other geophysical disciplines). The Executive Bureau is elected every four years. Currently, this is as follows:

Executive Bureau. Chairperson (J. Zlotnicki), Vice-Chairperson (M.J.S. Johnston), and Secretary (T. Nagao) were again nominated. J. Zlotnicki pointed out that he will step down as Chair after the next International EMSEV meeting scheduled in Italy in 2018. M. J. S. Johnston will do likewise. T. Hashimoto from Hokkaido University was nominated as IAVCEI liaison member with Y. Sasai assisting him during the next few years. J. Y. Liu from the Institute of Space Science in China-Taipei will continue to assume the liaison with IAGA. M. Johnston will remain IASPEI liaison member. T. Harinarayana will keep the position of IAGA WG1-2 corresponding liaison member. Several scientists were again elected or introduced in the bureau for their strong expertise and involvement in EM research: Q. Huang (China), V. Lapenna (Italy), A. Meloni (Italy), V. Korepanov (Ukraine), and R. Singh (India,USA). Seiya Uyeda is Past-Chairperson (2001-2007).

Working Group Members. This includes all who also have other responsibilities, all students, young scientists, senior scientists, engineers, experts, and interested in EMSEV activities. Information is exchanged through EMSEV website, direct mailing list, and conferences.

National Representatives. At present, 32 key scientists involved in EM and promoting EMSEV activities in their countries and abroad have been selected to be EMSEV National Representatives. They represent 15 different countries: China, China-Taipei, France, Greece, India, Indonesia, Italy, Japan, Kyrgyzstan, Philippines, Poland, Romania, Russia, Ukraine, and USA. Some concern was voiced that some countries, particular in South America, are clearly under-represented.

Collaborators. EMSEV collaborators provide a very important independent contributions and insight from related fields to the EMSEV community. Currently, two scientists have been nominated to be collaborators. These include V.G Kossobokov, a seismologist from Russia, and Alain Bernard, a geochemist from Belgium.

Business meetings are regularly organized at the EMSEV meetings and International General Assemblies. Minutes of the meetings are distributed and kept on the EMSEV website Information, activities, and annual and business meetings reports are also kept on the EMSEV website mainly organized by T. Nagao (webmaster@emsev-iugg.org). Messages/activities are distributed through the EMSEV mailing list (by T. Nagao).

ACTIVITIES

In 2016, EMSEV pursued to maintain a high level of activities by the EMSEV members. EMSEV was involved in several international meetings, organizing sessions devoted to EM phenomena. EMSEV also kept a high level of activities through international cooperation as well as on Taal in the Philippines and Kyrgyzstan ridge.

It should be emphasized that some articles published in international journals clearly mention the support and the sponsorship of IUGG and EMSEV.

Meetings and workshops

Among the sessions in international conferences sponsored and/or organized by EMSEV members, some are given below:

EGU, 12-19 April 2016, Vienna, Austria

- NH4.3/SM3.1: Short-term Earthquakes Forecast and multi-parametric time-dependent assessment of seismic hazard. Conveners: P.F. Biagi, K. Hattori, J.Y. Liu, V. Kossobokov, G. Martinelli, D. Ouzounov, G. Papadopoulos, M. Parrot.

IWEP3-2016, 27-28 May 27-28 2016, Chiba, Japan

- 3rd International Workshop on Earthquake Preparation Process, Observation, Validation, Modeling, Forecasting. Meeting hosted by Pr K. Hattori, with the contribution of J.Y. Liu, D. Ouzounov, Q. Huang.

AOGS, 31 July-5 August 2016, Singapore, Singapore

- SE14: Electromagnetic Methods Applied To Studies Of Crustal And Mantle Dynamics. Convenors: Q. Huang, M. Uyeshima, L. Liu, X. Hu.

International IAPSEI-IAVCEI workshop on Earthquakes and Volcanoes, 7-9 November 2016, Barcelona, Spain

- EMSEV participation: Possible eruptive activity at Taal volcano (Philippines) inferred by Electromagnetic methods: Risk evaluation. J. Zlotnicki, M.J.S. Johnston, Y. Sasai, and G. Vargemezis and PHIVOLCS EM team.

AGU, December 12-16, 2016, San Francisco (USA)

- NH017: Pre-earthquake processes: An interdisciplinary approach to earthquake prediction studies. Convenors: D. Ouzounov, S. Pulinets, K. Hattori, P. Taylor.
- NH21A: Hydrological, Geochemical, and Geophysical Responses to Earthquakes. Conveners: Ramesh Singh, Michael Manga, Chi-Yu King.

The 2016 International EMSEV meeting: Beijing, China, 22-25 August and Lanzhou, China, 25-29 August 2016. Website

In order to promote the China Seismo-Electromagnetic Satellite mission (CSES), two complementary international workshops were organized within EMSEV in 2016. The first pre-workshop, held in Beijing, China, from 22-25 August, was organized by the Institute of Crustal Dynamics under the leadership of Shen Xuhui, Academic leader of Satellite application in Earthquake Science and Deputy Director of ICD (Institute of Crustal Dynamics, China). This workshop was also supported by the China Earthquake Administration (CEA) and the China National Space Administration (CNSA) with the participation of the Italian Space Agency. The target of this workshop segment was to focus on the China Seismo-Electromagnetic Satellite Mission.About 120 persons attended this meeting.

The second EMSEV workshop was hosted by Xuebin Du in Lanzhou (Lanzhou Institute of Seismology), China, from 25-29 August. About 120 participants attended the two meetings. The next 2017 EMSEV meeting will be held in Italy. This workshop focused on understandingearthquakes and volcanoes from lithosphere to space with key topics (e.g., Earthquake activities and precursors in Qinghai-Tibet Plateau, electromagnetic signals associated with large earthquakes and volcanic eruptions, study of earthquakes and volcanoes by electromagnetic methods and multi-disciplinary approaches, recognition of precursors [forerunners signals] to earthquakes and volcanic eruptions from lithosphere to space, mechanism, laboratory, and modeling studies, precursors of earthquakes, volcanic eruptions, and other natural hazards: reliability, EMSEV related international projects). About 140 persons participated in this meeting which included more than 88 oral presentations. 25 foreign scientists were present.

EMSEV activity on volcanoes

EMSEV formed a co-operative program with The Philippines Institute of Volcanology and Seismology (PHIVOLCS) on Taal volcano in November 2004. At present, the international cooperation involves teams from Japan, France, USA, Greece, Italy, and Belgium.

EMSEV is involved in field studies for understanding and monitoring Taal volcano, and simultaneously builds an electromagnetic team at PHIVOLCS. As far as possible, EMSEV and PHIVOLCS try to lead one field campaigns each year. Japanese team performed a new campaign lately in September 2016. The volcanic structure is now better known based on the detailed studies of magnetic, self-potential, ground temperatures profiling, resistivity and magnetotelluric soundings, degassing mapping from the land and the Crater Lake. In addition, EMSEV was involved in much effort deploying real-time multi-parameter stations on the volcano that PHIVOLCS maintains and uses for its volcano monitoring. A number of articles have been jointly published and some others are in course.

EMSEV activity related to Earthquake Processes

In 2011, EMSEV started a new research effort focused on understanding fault failure and the mechanisms of earthquakes, and developed a cooperative research program with the Bishkek Research Station in Kyrgyzstan under the Russian Academy of Sciences where some outstanding research on the relation between EM phenomena and electrical resistivity changes with earthquakes are being carried out in the last 30 years. A cooperative agreement between EMSEV and the Bishkek Research Station was signed in November, 2011 and renewed during EMSEV workshop in Athens, Greece, in April 2015. A paper title, “Seismic Electric Signals in seismic prone areas" will be published in 2017. A new effort is being planned in 2017 for developing joint field studies and data analysis. EMSEV will also participate in the 7th International Symposium on: *Problems of Geodynamics and Geoecology of Intracontinental Orogens*. Foreign teams from different countries Japan, France, Greece, and China are cooperating.

We note the Bishkek Research Station has very advanced electrical current systems that are able to inject more than 700A current into 4.2 km long electrical lines. These can be used for monitoring:

- Changes of the electrical resistivity of the ground in relation to crustal stress and regional seismicity.
- Effects of large current injection on the induced local seismicity which may provide insights into controlling earthquakes.

Submitted by Jacques Zlotnicki, EMSEV Chair

THE INTER-UNIONS COMMISSION: International Lithosphere Programme (ILP)

ILP website: http://ilpdev.gfz-potsdam.de

INTRODUCTION

The International Lithosphere Program (ILP) is a joint project of IUGG and IUGS and receives additional funding from several member states (see financial report). ILP seeks to elucidate the nature, dynamics, origin and evolution of the lithosphere through international, multidisciplinary geoscience research projects – Task Forces (TFs) and Regional Coordinating Committees (CCs) addressing major ILP themes: I. Geoscience of global change, II. Contemporary dynamics and deep processes, III. Continental lithosphere, IV. Oceanic lithosphere

All TFs and CCs are led by international teams and supported by ILP with 4,000 US $ per year over a period of 5 years. This “seed money” is used by the project leaders to raise additional funds and build strong interfaces with other projects (ICDP, TOPO-EUROPE, MEDINA, etc.).

ADMINISTRATION

ILP operates on the base of terms of reference and has an International Bureau. They meet regularly to monitor the progress and to select new projects in close consultation with the representatives of National Committees. The Bureau is chaired by the President with support from the Secretary General (SG). The ILP Secretariat is located in the German Research Centre for Geosciences in Potsdam, Germany (GFZ-Potsdam), and is headed by the Executive Secretary A. Rudloff (Germany). The current ILP Bureau membership is presented below:

President:	S. Cloetingh	The Netherlands
Secretary General	M. Scheck-Wenderoth	Germany
Representative of IUGG	H. Gupta	India
Representative of IUGS	S. Dong	China
Chair Committee National Representatives:	A. Tibaldi	Italy

The Bureau is also supported by the associate members: J.-P. Burg (Switzerland), H. Thybo (Denmark), A. Morozov (Russia), F. Roure (France), M. Zoback (USA), and P. Mc Keever (UNESCO); by the lifetime members M. von Knorring (Sweden) and H. Gupta (India) as well as by Honorary President A. Green (Switzerland) and ILP Fellow J. F. W. Negendank (Germany).

Business meeting of ILP, Vienna, Austria, 2016

The annual business meeting was held at the EGU General Assembly 2016. It was attended by most of the PIs in ILP as well as by guests from IUGG and IUGS. A short report was given by the President and

SG on new developments and all active TFs and CCs reported on their activities and future plans. IUGG SG Alik Ismail-Zadeh and IUGS President Roland Oberhänsli reported on the news from the mother unions and made constructive recommendations for the ongoing work in ILP. Philippe Yamato received the Flinn Hart Award for 2015. The minutes were distributed among the Bureau Members and are available on request. The next business meeting at the EGU General Assembly 2017 in Vienna, Austria, is scheduled for 24 April 2016.

Reports to Executive Committee (EC) meetings of IUGG and IUGS

The SG has participated at the IUGS EC Meeting in Cape Town, South Africa, August 2016, and presented a brief report on past activities.

ACTIVITIES

Scientific meetings, developments for the different TFs and CCs:

As every year, most of the ILP TFs and CCs have been visible at the large international meetings organized by EGU, AGU, ISRM, and EAGE. In addition, ILP had a strong presence at the IGC in Cape Town, South Africa. Moreover, most TFs and CCs contributed to specific conferences within their thematic fields and held dedicated smaller international workshops. The publication activity was significant for most teams and some TFs and CCs produced Special Issues in peer-reviewed journals. A joint meeting of CC 1, TF 2 and TF 6, "From Deep Earth to Surface processes and sustainability: integrating lithosphere dynamics with rift basins and margins" was held in Clermont-Ferrand, France and ILP has co-sponsored the Deep Seismix Conference in Aberdeen, UK.

TF 2: Structural and rheological constraints on magma migration, accumulation and eruption through the lithosphere (Chairs: A. Tibaldi, Italy and A. Gudmundsson, UK)

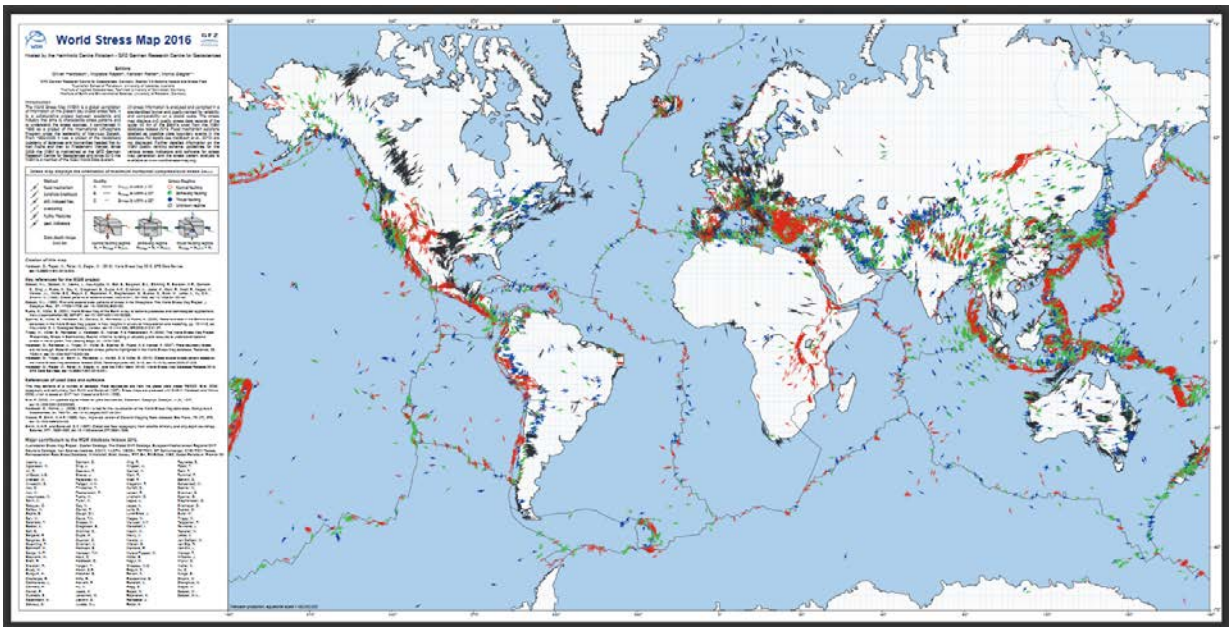
A new website informs on the project. Two projects were submitted to the EU, as well as several other minor projects were submitted to the various home country funding agencies. TF 2 also organized and conducted two Training Courses for Young Researchers: (i) Caucasus: measurement of active deformations, in Georgia, in May 2016 and (ii) Northern Rift: active tectonics and volcanism, in Iceland, in September 2016.

TF 3: The seismic cycle at continental transforms from seismological observation and forward simulation (Chairs: M. Bohnhoff, Germany and O. Heidbach, Germany)

A JGR Solid Earth Special Section on "Stress at active plate boundaries – measurement and analysis, and implication for seismic hazard" has been prepared, edited by Martha Savage, Simon Lamb, Marco Bohnhoff, and Liu, M. A new release of the World Stress Map database went online.

TF 4: Fate of the subducted continental lithosphere: insight through analytical mineralogy and microstructures (Chairs: L. Dobrzhinetskaya, U.S.A. and J. Zhang, China)

2016 International Conference on the Earth's deep interior" in Wuhan, China, in November 2016, with J. Zhang as a Chair of the Organizing Committee, L. Dobrzhinetskaya – a member of the Scientific Committee. Participation at Goldschmidt Intern. Conf. (Yokohama, Japan); Taiwan Geoscience Assembly (Taipei, Taiwan); Intern. Conf. on the Earth's deep interior (Wuhan, China).



Heidbach, O.; Rajabi, M.; Reiter, K.; Ziegler, M. (2016): World Stress Map 2016*. GFZ Data Services*

TF 6: Sedimentary Basins (Chairs: L. Matenco, Netherlands and F. H. Nader, France)

Special Volume dedicated to the 2014 activities of TF 6, in Arabian Journ. of Geosciences, Vol. 9, Issue 12, August 2016. Final stages of publication of the Tectonophysics special volume dedicated to the 2015 10th Workshop of the ILP Task Force of Sedimentary Basins, Tokyo, Japan. Organization of the session "Lithospheric crustal-scale geology and geophysics in Europe" at AAPG European Regional Conference and Exhibition, Bucharest, Romania, 2016.

TF 8: Lithosphere dynamics: interplays between models and data (Chair: T. Gerya, Switzerland).

Memorial Tectonophysics Volume to Evgenii Burov "Modeling and understanding of lithospheric processes", initiated with T. Gerya as one of the volume editors. Memorial session for Eugenii Burov at the 2016 EGU General Assembly in Vienna, Austria; Workshop on the Origin and Evolution of Plate Tectonics, Locarno, Switzerland; GeoMod2016, Montpellier, France.

TF 9: Subduction across scales (Chairs: P. Agard, France, A. Okay, Turkey, B. Hacker, USA, T. Gerya, Switzerland).

Setting up of an international conference for 2017 - 100 people expected.

Website and online registration set up too.

Strong implication in the "Subduction top to Bottom 2" publishing initiative with Geosphere as Associate and General Editors)

CC 1 TOPO-EUROPE: (Chairs: S. Cloething, Netherlands and S. Willett, Switzerland)

Start of ETN SUBITOP; preparation special volumes international journals in Global and Planetary Change and in Acta Geodaetica et Geophysica.

CC 1 MEDYNA: (Chairs: Carlos J. Garrido, Spain and J.-L. Bodinier, France)

Special volume in Tectonophysics 650; Participation in international conferences/workshops.

Participants at the Pre-Meeting field trip 'the Limagne Fault and the Chaîne des Puys', joint ILP – TOPO-EUROPE meeting, October 2016

FUTURE ACTIVITIES

- To further implement the science plan developed during the 35th ILP Anniversary Workshop and the subsequent Bureau Meeting for 2016-2020;
- To invite new Task Forces/Coordinating Committees;
- To organize several sessions with TF and CC contributions at the 2017 EGU General Assembly, Vienna, Austria;
- To organize several workshops of individual task forces;
- To hold an ILP Business meeting at the EGU General Assembly, Vienna, Austria;
- To award the first E. Burov medal and to organize a respective medal lecture at GGU 2017;
- To strengthen the links with other IUGG and IUGS programs.

Sierd Cloetingh, ILP President
Magdalena Scheck-Wenderoth, ILP Secretary General
Alexander Rudloff, ILP Executive Secretary

IUGG FINANCIAL REPORT

INTRODUCTION

This report describes in short the status of the IUGG finances for the year 2016, the first year of the IUGG quadrennium 2016-19. The report will be discussed at the 2017 Bureau/EC meeting in Montreal.

The 2016 budget was approved at the Council meeting in Prague, July 2015.

The price of 1 unit in 2016 was unchanged compared to 2015, which is $1,905.

By the end of 2016/beginning of 2017, IUGG has 69 members representing 276 units. 10 members are associate members. On page 116 one can find more details about memberships.

The membership dues paid by members are the economical basis for the activities of IUGG. The financial situation is now relatively steady in the sense that the union has a constant number of members and thereby also a constant income basis. There is a world-wide debate of value for money regarding memberships of scientific organizations like IUGG. Therefore, IUGG must continue having a focus on the membership issue in the foreseen future.

The accounts of the treasurer's office are audited by a chartered auditor, PWC.

The accounting is a cash flow system. Therefore, the 4-year accounting for the full budget period gives a more precise description of the financial status of the union than the individual accountings year by year.

A student assists me with the keeping order in my files, writing letters etc. Since 2007, I have not had an Assistant Treasurer.

Content:

SUMMARY OF THE IUGG ACCOUNTS IN US DOLLARS FOR 2016

US dollars		Accounts	Budget
RECEIPTS			
1. Membership Subscription		509.988,77	523.800,00
2. ICSU Grants		0,00	
3. Assembly Surcharge		0,00	
4. Sales of Publications		133,55	200,00
5. Miscellaneous			
a. Interest		-0,58	
b. Gain on exchange			
c. Other		0,00	
d. Associations, surcharge		0,00	
6. Total Receipts		510.121,74	524.000,00
7. Cash in hand		1.172,08	0,00
8. Bank balance on 1/1 2016		723.527,19	500.000,00
9. Check Sum		1.234.821,01	1.024.000,00
EXPENDITURES			
11. Administration			
11.1 Personnel		13.024,88	15.000,00
11.2 Equipment		1.157,18	1.000,00
11.3 Supplies		538,42	4.000,00
11.4 Communications		933,32	4.000,00
11.5 Travel, Administration only		56.640,76	65.000,00
11.6 Miscellaneous		2.728,23	1.000,00
11.6a surcharge		37.414,81	0,00
11.7 Travel, representation		3.024,43	
12. New initiatives			
12.1 Education and outreach		15.000,00	20.000,00
12.2 Science		45.000,00	20.000,00
13. General Assemblies			
13.1 Organization		0,00	
13.2 Travel		0,00	
14. Symposia		25.201,00	20.000,00
15. Annual allocations			
15.1 Annual allocations		288.704,74	257.200,00
16. Dues and Grants			
16.1 ICSU		24.139,30	30.000,00
17. ICSU grants			
17.1		0,00	0,00
18. Unioun activities			
18.1 GRC, SEDI, CMG, UCDI		24.000,00	26.000,00
18.2 Inter-Union Science (ILP)		14.768,38	15.000,00
18.3 Liaison Officers		4.334,90	10.000,00
18.4 International Scientific Programs		0,00	6.000,00
18.5 New commissions	UCPS	0,00	5.500,00
19. Contries in need			
19.1 Travel Grants, General Assemblies		0,00	
20. Fees			
20.1 Professional services		3.970,61	5.000,00
20.2 Bank fees		3.594,02	3.000,00
21. Contingencies		0,00	2.500,00
22. Loss on exchange		4.112,42	
23. Total Expenditures		568.287,40	510.200,00
24. Balance on 31/12 2016		666.533,61	513.800,00
25. Check sum		1.234.821,02	1.024.000,00
Check sum balance		0,00	

		USD/DKK	
	Exchange rates:	Line 8	6,820 =DEC 31, 2015
February 15, 2017		Line 22	7,103 =DEC 31, 2016
Aksel Walløe Hansen		Other:	6,737 annual average
		USD/EUR	
		Line 8	0,914 =DEC 31, 2015
		Line 22	0,956 =DEC 31, 2016
		Other:	0,905 annual average

GENERAL COMMENTS AND HIGHLIGHTS

The annual balance of the IUGG economy is of the same size or bigger than 1 year's turnover. In 2016, there is deficit of the order of $60K.

The summary of the IUGG accounts is shown in USD. It is the sum of three different Danske Bank accounts in USD, EUR and DKK, respectively. In addition, IUGG also has a Mastercard account which is used mostly in connection with traveling and I have a little cash in hands too.

A new account has been opened to handle the economy of the new IUGG Union Commission on Climatic and Environmental Change (CCEC). This account is not included in this report.

In 2016, the income from member payments of dues was relative low. Adding to this some delays of payments of surcharge from the IUGG General Assembly 2015 to a few of the Associations lead to the overall deficit in 2016.

It should be emphasized as stated above that we do the accounting as a cash flow system. Therefore, the summary for a full period will be a more robust sign of the economy of IUGG than the individual years.

Since 2008 the EUR account allows European members to pay dues directly in EUR and IUGG to do relevant transfers in EUR (several Associations have accounts in EUR).

Some highlights:

Receipts

Line 1, Membership Subscription
Right now (February 15, 2017) IUGG has received payments equivalent to a total of 235 units for 2016. This number also includes payments received in 2017 for 2016. The number of 235 units is a bit lower than we normally see. It emphasizes the importance of keeping an eye on the membership issue.

Line 3, Assembly Surcharge
No income

Line 4, Sales of Publications
A small amount of money is received from our agreement with Cambridge University Press.

Line 5.a, Interest
No interest was paid in 2016, the same as in previous years.

Line 5.b, Gain on exchange
This line together with the corresponding line 22 is used to balance the accounts. In 2016 there was a loss on exchange. We loose on exchange when we keep money in EURO and Danish Krone when the US Dollar goes up. It should also be noticed that I use an averaged exchange rate during the year.

Expenditures

By and large there is a good correspondence between accounting and budget although there are some specific deviations.

Line 11, Administration
During the whole quadrennium there has been a significant reduction of expenses under lines 11.1 to 11.4.
As explained above, the surcharge was not returned to all Associations in 2015 due to delays in establishing new accounts for the newly elected Secretaries Generals. Therefore, there is a large expenditure in line 11.6a in 2016.

Line 12, New Initiatives
In 2016 there were several payments of grants covering the years 2016-2017.

Line 14, Symposia
The expenditure is higher due to several early 2017 payments of line 14 grants.

Line 15.1, Annual allocations to Associations
The annual IUGG allocation to the Associations (50% of the dues paid the year before) is installed when the financial reports for the previous year are received. The distribution percentages for the period 2016-2019 and the allocations in 2016 are shown here:

	%	2016 amount according to the applied algorithm
IACS	10,46	$30,500
IAG	11,68	$34,056
IAGA	15,19	$44,291
IAHS	12,39	$36,127
IAMAS	15,81	$46,099
IAPSO	10,82	$31,549
IASPEI	13,19	$38,460
IAVCEI	10,46	$30,500
		$291,582

By definition IACS will get the same contribution as IAVCEI.
The amount shown in line 15.1 of the account summary differs from the $ 291K shown here due to the use of averaged exchange rates over a year.

Line 17, ICSU grants
No ICSU grant was received in 2016.

Line 18, Union activities
In 2016, only two travel reimbursements were paid out. Thanks to everybody for finding other sources of funding of the travel expenses.

see page 115 for more details.

Line 22, Loss on exchange
In 2016, there was a relative large loss. But as explained, the amount is a technical mean to balance the accounting.

OVERVIEW OF IUGG GRANTS AND ALLOCATIONS

IUGG is supporting science in different ways:

i) Annual allocation to Associations, line 15 (see further comments on page 113)
ii) New initiatives, line 12
iii) Smaller scientific meetings, line 14
iv) Special grants with ICSU, line 17
v) Union activities, line 18
vi) Travel grants in connection with General Assemblies, line 13.2 and line 19.1

Here follow some main figures for the amounts allocated in 2015:

i) Line 15.1 (2016 figures)		
8 Associations		**$ 291,582**
ii) Line 12 (New initiatives)		
12.1 ICTP training course activities	$ 15,000	
12.2 IUGG grants program to IUGG bodies	$ 45,000	
Total		**$ 60,000**
iii) Line 14 (Symposia grants)		
18 grants paid out	$ 25,200	
Total		**$ 25.200**
iv) Line 17 (ICSU grants)		
No ICSU grant in 2016	€ 0	
Total		**$ 0**
v) Line 18(Union activities)		
18.1 SEDI (2014-2016), CMG (2016-2017)	$ 20,000	
18.2 ILP	$ 15,000	
18.3 Liaison officers	$ 4,335	
18.5 CCEC	$ 4,000	
Total		**$ 43,335**
vi) Lines 13.2 and 19.1 (Grants in connection with General Assemblies)		
No payments in 2016		**$ 0**

MEMBERSHIP INFORMATION AND STATISTICS

As of December 31st, 2016 IUGG has 69 members representing 276 units, which is unchanged to the situation one year earlier.

10 members are in associate status. 20 paying members representing 43 units are in observer status:

In category 1, 11 members, 11 units

Bulgaria (6. year as observer in 2017)	payment in progress
Iran (6. year as observer)	payment in progress
Macedonia (5. year as observer)	
Azerbaijan (2. year as observer)	payment in progress
Colombia (2. year as observer)	
Indonesia (2. year as observer)	
Mozambique (2. year as observer)	
Costa Rica (1. year as observer)	
Vietnam (1. year as observer)	
Romania (1. year as observer)	
Nicaragua (1. year as observer)	

In category 2, 7 members, 14 units

Chile (2. year as observer)	payment in progress
Nigeria (3. year as observer)	
Thailand (3. year as observer)	
Pakistan (1. year as observer)	
Greece (1. year as observer)	
Egypt (1. year as observer)	
Saudi Arabia (1. year as observer)	

In category 3, 1 member, 3 units

Brazil (2. year as observer)

In category 7, 1 member, 15 units

France (1. year as observer)

In summary, the membership overview is

Category	No. of members	No. of units/ member	Total units
11	1	35	35
8	3	20	60
7	1	15	15
6	5	10	50
5	3	7	21
4	6	5	30
3	5	3	15
2	15	2	30
1	20	1	20
A	10	0	0
In total	69		276

ADDITIONAL UNION MATTERS

Awards and Honors

Ian Allison (Australia), IACS Vice-President, was elected to the Australian Academy of Science as a Fellow for his contributions to "understanding of the role of Antarctica and sea ice in climate variations".

Tom Beer (Australia), IUGG President (2007-2011), was awarded the 2016 International Award of the American Geophysical Union for sustained international scientific and societal impact through innovative cross-disciplinary science including climate change, natural hazards and risk.

IUGG Fellow ***John P. Burrows*** (Germany), Chair of the IAMAS Intl. Commission on Atmospheric Chemistry and Global Pollution, was elected Fellow of the Royal Society.

Donald B. Dingwell (Germany), IAVCEI President, was awarded the 2016 Arthur L. Day Medal of the Geological Society of America (GSA). "Don's research utilizes the fundamentals of physics and chemistry to provide our community with complete descriptions of silicate liquids, glasses, and magmas. His diverse contributions to petrology, mineralogy, and geology have helped bridge the gap between "equilibrium" in largely static magma chambers, to highly disequilibrium, dynamic systems, where magmas flow, fracture, erupt, and disperse. The merit of his dedicated efforts has illuminated a myriad of magmatic and volcanic phenomena, forming the basis for the new field of experimental volcanology" (citation by Yan Lavallee).

Harsh Gupta (India), IUGG Immediate Past President, was awarded the 2016 Axford Medal of the Asia Oceania Geosciences Society (AOGS) in recognition of his achievements and outstanding contributions to both AOGS and the geosciences community.

Mioara Mandea (France), IAGA Secretary General, is awarded the National Order of Merit by the decree of the French President for her outstanding scientific career and public service. She will be raised to the rank of Chevalier (Knight) at a special ceremony.

Marcia McNutt (USA), President of the U.S. National Academy of Sciences (IUGG Adhering Body), was elected Foreign Member of the Russian Academy of Sciences.

Igor Mokhov (Russia), Past Bureau Member of IAMAS, was elected Full Member of the Russian Academy of Sciences.

Anatoly Soloviev (Russia), Member of the IUGG Union Commission on Data and Information, and Chair, IAGA Interdivisional Commission on History, was elected Corresponding Member of the Russian Academy of Sciences.

Kunioshi Takeuchi (Japan), IAHS Past President, and the Immediate Past Chair of the IUGG GeoRisk Committee, was bestowed a certificate of appreciation by the Jakarta Office of the UNESCO International Hydrological Program in recognition of his long-term support and contributions to

UNESCO Natural Science programs in Asia and the Pacific region, especially in the area of water management.

Lev Vinnik (Russia), former Member of the IUGG-SEDI Advisory Committee, was awarded the 2016 Harry Fielding Reid Medal, the highest honor of the Seismological Society of America, for "his careful and meticulous data analyses and for developing some of the fundamental tools that seismologists around the globe use to study the interior of the Earth."

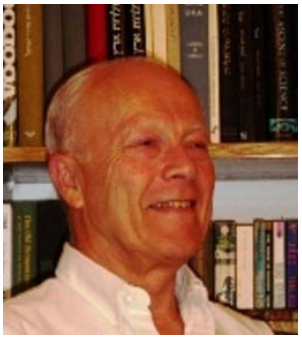
The 2016 Early Career Scientist Prize of the IACS is jointly awarded to ***Thorben Dunse*** (University of Oslo, Norway) and to ***Rachel Tilling*** (University College London, UK) for their research papers published in *The Cryosphere* and *Nature Geoscience* journals, respectively. The IACS Early Career Scientist Prize is a bi-annual cash prize of EUR 1000 awarded to each of two nominated early career scientists, who are assessed as having published the best scientific papers on a cryospheric subject during the previous two calendar year. The objective of the prize is to recognize excellence in cryospheric science by honoring and promoting early career scientist and to draw attention to the work of IACS.

The 2016 Tison Award of the IAHS was presented to ***Guillaume Thirel, Jean-Nicolas Audouy, Lionel Berthet, Carina Furusho, Anna Kuentz, Julien Lerat, Thibault Mathevet & Denis Ruelland*** for their paper published in the *Hydrological Sciences Journal*. The IAHS Tison Award, established in 1982, aims to promote excellence in research by young hydrologists. The aAward is granted for an outstanding paper published by IAHS in a period of two years previous to the deadline for nominations.

The International Hydrology Prize is awarded annually by IAHS, with UNESCO and WMO, to two people who have made an outstanding contribution to hydrological science. The 2016 International Hydrological Prize was presented to ***Jeffrey McDonnell*** (Canada), who received the Dooge Medal, and ***Denis Hughes*** (South Africa), who received the Volker Medal. The medals honor outstanding achievements by hydrological scientists but with a different focus. The Dooge Medal is aimed at fundamental contributions to the science of hydrology, whereas the Volker Medal is aimed at outstanding applications of hydrological science for the benefit of society at large.

Jubilees

Uri Shamir - 80th birthday



Uri Shamir, President of IUGG (2003-2007), and a distinguished hydrologist, who significantly contributed to water resources management and policy, celebrated his 80th anniversary on 10 July. Uri was born in Jerusalem, Israel. He graduated from the Technion - Israel Institute of Technology in 1962, and received his PhD in 1966 from the Massachusetts Institute of Technology, Cambridge, USA. Since 1979, Uri Shamir has been Professor - Emeritus since 2004 - in the Faculty of Civil and Environmental Engineering, and Founding Director (1992-2003) of the Stephen and Nancy Grand Water Research Institute, at the Technion.

In 1992, Prof. Shamir became a consultant to the Israeli Water and Sewage Authority (IWA) on matters of operation, planning and policy, and previously (1967-92) was consultant to Mekorot, the National Water Supply Company. Uri was Visiting Professor in various universities and research institutes in the USA and Canada, and has published widely on research and applications in hydrology of surface and ground water, water supply systems, planning, design and operation of water resources systems, water policy, and management of international waters.

Uri Shamir was Chairman of the Israeli Association of Hydrology (1984-1986), IAHS President (1991-1995), IUGG Vice President (1995-2003), and a Member of the Executive Board of the International Council of Science (ICSU) for the periods 2005-2011, representing the ICSU GeoUnions in the Council, Chair of the Technical Advisory Committee of the World Water Assessment Programme (WWAP-TAC), the UN water programme led by UNESCO. He is Fellow of the American Geophysical Union, the American Society of Civil Engineers, and IUGG; Foreign Member of the Spanish Academy of Science, Honorary Member of the Israel Water Resources Association, recipient of the 2000 International Hydrology Prize awarded by IAHS, UNESCO and WMO, recipient of the 2003 Julian Hinds Award for significant contributions to water resources management from the American Society of Civil Engineers, Fellow of the Environmental and Water Resources Institute of the ASCE, and recipient of the Life-Long Achievement Award of the Israeli Water Association. Congratulations to Uri Shamir!

Obituaries

David Collins (1948-2016)

David Collins, Chair of the IUGG Finance Committee since 2011, a renowned glacier scientist and a pioneer in the field of glacier hydrology, has died at the age of 68. David was a larger-than-life figure in the sometimes staid world of academia, possessing an infectious and boundless energy and enthusiasm for science and adventure that was instrumental in inspiring generations of students to fulfil their potential and attain senior positions in academia, industry and commerce.

David began his formal academic career after graduating from Emmanuel College, University of Cambridge in 1974, commencing doctoral studies at the University of Nottingham and completing his thesis, entitled 'Meltwater characteristics as indicators of the hydrology of Alpine glaciers', in 1979 under the supervision of Dr. Jean Grove. Following a brief period at the University of Liverpool in 1973, David took on the position of Lecturer at the University of Manchester in 1974, rising to the position of Reader by the early 1990s and being awarded the degree of Doctor of Science in 1997. After a brief spell at the University of Oxford as Dean of Keble College between 1996 and 1998, David returned to Manchester, taking up the position of Professor of Physical Geography at the University of Salford in 1999.

It was during his early years as an academic in the 1970s that David produced his most influential work. Focused upon the proglacial hydrology of Swiss alpine glaciers, David's work utilising proglacial meltwater discharge, solute and sediment properties as tools to interpret and understand the hidden world of glacier drainage systems was pioneering and acted as a catalyst for the development of glacier hydrology as the distinctive sub-discipline we know today. To this day, David's legacy is very much evident, as researchers continue to build upon his early, pioneering work, developing investigative and analytical methods that have clear lineage back to David. He believed passionately in field research, adventure and the collation of long-term data sets. To this end, he set up the 'Alpine Glacier Project' (AGP) while at the University of Manchester. The AGP was a long-term, monitoring project, predominantly based on proglacial hydrological monitoring, whereby students would travel to Switzerland each year to maintain instrumentation, collect data and learn field skills. Over its almost 40-year history, the AGP allowed hundreds of students to 'cut their fieldwork teeth' and, aside from the collection of some of the longest records of glacier meltwater discharge and associated sediment load in existence, provided inspiration for many to develop careers in science and to venture to more remote locations in pursuit of science. It is somewhat ironic that, during the most fruitful years of the AGP, grant funding for long-term data collection was not in vogue and yet these are the very data sets which are currently in high demand but short supply, as the long-term impacts of climate change on the cryosphere become ever more apparent.

In more recent years, David's research focus shifted to encompass the Himalaya, a region in which he first worked in the 1980s, and in particular, the relationships between long term climatic changes and meltwater runoff generation in the region, an unsurprising decision given his career-long understanding of and commitment to, long-term glaciological data collection and analysis. David's life-long dedication to fieldwork in mountain regions was formally recognised through award of the Royal Geographical Society Busk Medal in 1998, for his "outstanding contribution to the study of field processes in mountain environments in a long and productive research career based around sustained field measurements."

David had a humorously mischievous streak, which doubtless helped drive his sense of adventure and somewhat 'devil-may-care' attitude when undertaking field research in the world's more remote regions. Ranging from what became known as the 'summer of love' in 1979 on Peyto Glacier in the Canadian Rockies, to the remote and hostile environment of the Karakorum Himalaya, David conducted field research wherever and whenever he could. Peyto Glacier was revisited, along with glaciers in the South Cascades, whilst in post as visiting Associate Professor at Wilfrid Laurier University, Ontario in 1988-89, but his most adventurous fieldwork was undoubtedly that carried out in the Karakorum Himalaya in Pakistan's Northern Areas during his time at the University of Manchester. David applied his tried-and-tested field investigative techniques to large Himalayan glaciers in Pakistan, recognising the vital importance of these glaciers as suppliers of freshwater to millions. David provided invaluable data from a region that had been very much under-studied until relatively recently, as the consequences of climate change on freshwater production have become apparent and, understandably, concerns over future water resource availability have been heightened; David was indeed ahead of his time.

David also worked tirelessly for numerous learned societies, most notably his work for the International Union of Geodesy and Geophysics (IUGG) where he was Chair of the UK National Committee and Chair of the IUGG Finance Committee. He was also a leading figure within the International Glaciological Society (IGS), the International Association of Cryospheric Sciences (IACS), and the International Association of Hydrological Sciences (IAHS).

On a personal level, David was regarded with great affection and warmth by all those who worked closely with him. He was naturally an altruistic individual who cared for all those who called upon him; he offered unconditional friendship to all and was someone to turn to for support and help no matter what time of day or night. He was a fun-loving individual, as happy in a bar or nightclub as he was in his beloved mountains. David was a truly free spirit and his love of adventure, love of the mountains and love of science has left a lasting legacy in the form of his published research. But perhaps his most significant legacy is the extended international family of former students and colleagues he leaves behind, who he brought together through his infectious friendship and warmth, a common bond of a love of mountains and science and adventure and for whom he cared passionately and inspired always (authors: P. R. Porter, University of Hertfordshire, and E. M. Morris, University of Cambridge, UK)

James J. O'Brien (1935-2016)

IUGG Fellow James J. O'Brien, Professor Emeritus of Meteorology/Physical Oceanography in the Department of Earth, Ocean and Atmospheric Science at Florida State University (FSU), died peacefully on 20 September 2016 at Tallahassee Memorial Hospital from complications following open heart surgery. Prof. O'Brien, the Robert O. Lawton Distinguished Professor of Meteorology and Oceanography, founded the Center for Ocean-Atmospheric Prediction Studies at FSU. He served as a weather officer in the U.S. Air Force from 1958 to 1960, promoted to the rank of Captain. He took advantage of the Air Force's financial assistance and training to earn both his Masters (1964) and Ph.D. (1966) degrees in Meteorology at Texas A&M University. He is internationally known for mentoring young scientists, and under his guidance, 44 students completed their Ph. D. degree and over 80 students completed their M.S. degree. He was particularly proud of his success in dramatically increasing the number of women scientists in oceanography and meteorology. Once nicknamed "Dr. El Niño", he was a pioneer in using early supercomputers to model atmospheric and oceanic interactions which led to new breakthroughs in understanding and prediction of coastal upwelling, El Niño, La Niña, and hurricane effects on the ocean. Prof. O'Brien served as the President of the International Association for Physical Sciences of the Oceans (IAPSO), from 1987 to 1991, and retired in December 2006 after 38 years at Florida State. He will be sadly missed by the oceanographic community.

Denise Smythe-Wright, IAPSO President

LIST OF ACRONYMS

AAAS	American Association for the Advancement of Science
AGU	American Geophysical Union
AOGS	Asia Oceania Geosciences Society
APECS	Association of Polar Early Career Scientists
CAST	China Association for Science and Technology
CCEC	Commission on Climatic and Environmental Changes
CCTF	Consultative Committee for Time and Frequency
CEA	China Earthquake Administration
CMG	Commission on Mathematical Geophysics
CNC-IUGG	Chinese National Committee for Geodesy and Geophysics
CODATA	Committee on Data for Science and Technology
COSPAR	Committee on Space Research
CTBTO	Comprehensive Nuclear-Test-Ban Treaty Organization
DFG	German Research Foundation
EGU	European Geosciences Union
EMSEV	IAGA/IASPEI/IAVCEI Inter-Association Working Group on Electromagnetic Studies of Earthquakes and Volcanoes
GEO	Group on Earth Observation
GGOS	Global Geodetic Observing System
GOOS	Global Ocean Observing System
GRC	Commission on Geophysical Risk and Sustainability
IACS	International Association of Cryospheric Sciences
IAEA	International Atomic Energy Agency
IAG	International Association of Geodesy
IAGA	International Association of Geomagnetism and Agronomy
IAHS	International Association of Hydrological Sciences
IAMAS	International Association of Meteorology and Atmospheric Sciences
IAPSO	International Association for the Physical Sciences of the Ocean
IASPEI	International Association of Seismology and Physics of the Earth's Interior
IAU	International Astronomical Union
IAVCEI	International Association of Volcanology and Chemistry of the Earth's Interior
ICACGP	International Commission on Atmospheric Chemistry and Global Pollution
ICAE	International Commission on Atmospheric Electricity
ICAO	International Civil Aviation Organization
ICCL	International Commission on Climate
ICCP	International Commission on Clouds and Precipitation
ICDM	International Commission on Dynamical Meteorology
ICMA	International Commission on the Middle Atmosphere
ICPAE	International Commission on Planetary Atmospheres and their Evolution
ICPM	International Commission on Polar Meteorology
ICSU	International Council for Science
ICTP	Abdus Salam International Centre for Theoretical Physics
IGCP	International Geoscience Programme
IGOS-P	Integrated Global Observing Strategy Partnership
IGU	International Geographical Union
IHP	International Hydrological Programme
ILP	International Lithosphere Program

INQUA	International Union for Quaternary Research
INTERMAGNET	International Real-time Magnetic Observatory Network
IOC	UNESCO Intergovernmental Oceanographic Commission
IOC	International Ozone Commission
IRC	International Radiation Commission
IRDR	Integrated Research on Disaster Risk
ISC	International Seismological Centre
ISPRS	International Society for Photogrammetry and Remote Sensing
ISSC	International Social Sciences Council
IUGG	International Union of Geodesy and Geophysics
IUGS	International Union of Geological Sciences
IUSS	International Union of Soil Sciences
IUTAM	International Union of Theoretical and Applied Mechanics
JBGIS	Joint Board of Geospatial Information Societies
NKGG	German National Committee for Geodesy and Geophysics
OECD	Organisation for Economic Co-operation and Development
ÖNK	Austrian National Committee for IUGG
PAIGH	PanAmerican Institute of Geography and History
PHIVOLCS	The Philippines Institute of Volcanology and Seismology
ROA	ICSU Regional Office for Africa
ROAP	ICSU Regional Office for Asia & the Pacific
ROLAC	ICSU Regional Office for Latin America and the Caribbean
SCAR	Scientific Committee on Antarctic Research
SCOR	Scientific Committee on Ocean Research
SCOSTEP	Scientific Committee on Solar-Terrestrial Physics
SEDI	Study of the Deep Interior of the Earth
UCDI	Union Commission on Data and Information
UCPS	Union Commission on Planetary Sciences
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNISDR	United Nations International Strategy on Disaster Reduction
UNOOSA	United Nations Office for Outer Space Affairs
UN-SPIDER	United Nations Platform for Space-based Information for Disaster Management and Emergency Response
URSI	International Union of Radio Science
WCRP	World Climate Research Programme
WDS	ICSU World Data System
WMO	World Meteorological Organization
WPMG	Western Pacific Geophysics Meeting
WSF	World Science Forum
VAACs	Volcanic Ash Advisory Centers
VASAG	Joint WMO-IUGG Volcanic Ash Scientific Advisory Group

Appendix A. IUGG Strategic Plan 2016-2023

Preamble

The International Union of Geodesy and Geophysics (IUGG) is a non-governmental, scientific organization, established in 1919.

IUGG is dedicated to the international promotion and coordination of scientific studies of Earth (physical, chemical, and mathematical) and its environment in space. IUGG encourages the application of this knowledge to societal needs, such as mineral resources, mitigation of natural hazards and environmental preservation.

IUGG is comprised of eight semi-autonomous Associations, each responsible for a specific range of topics or themes within the overall scope of Union activities.

Responsibility for directing the Union's affairs is vested in the IUGG Council by the Statutes and By-Laws. During the General Assemblies, these policy documents that govern the Union are developed, amended, and ratified by voting members.

According to the Statute's Article 1, IUGG's *objectives* are:

a) to promote the study of all problems relating to the figure of the Earth, and the physics and chemistry of the Earth's interior, surface, fresh waters, cryosphere, oceans and atmosphere, along with relevant studies of other planets;
b) to initiate, facilitate and coordinate research into, and investigation of those problems of geodesy and geophysics which require international co-operation or which are of international interest;
c) to provide, on an international basis, for discussion and publication of the results of the research indicated in Article 1.b);
d) to promote co-ordination worldwide of scientific activities in the disciplines of interest to the Union;
e) to assist with scientific advice the study of practical problems of a geodetic or geophysical character when such problems present an international aspect or when they require international co-operation of specialists or facilities;
f) to promote and coordinate the scientific activities of several Permanent Services whose objectives are, on an international basis, to facilitate the standardization of measurements or to collect, analyze and publish geodetic or geophysical data, taking into account the results of planetary studies.

1. Mission Statement

IUGG's *mission* is to advance, strengthen and promote Earth and space sciences for the benefit of humanity, through international research cooperation and education and to communicate the knowledge to governments and policy-makers.

2. Vision Statement

IUGG envisions a future Earth that is environmentally sustainable and where societies are resilient against natural hazards.

3. Core Principles (& Aspirations)

IUGG aspires to:

- ENCOURAGE RESEARCH ACTIVITIES IN THE GEOSCIENCES
  - To foster and support researchers' discoveries in Earth and space sciences
  - To address impacts of Earth system processes on society, including those arising from climate change and natural hazards
  - To contribute to sustainable development, stewardship of natural resources, and the preservation of the environment

- UNDERTAKE RESEARCH COMMUNICATION AND EDUCATION
  - That communicates knowledge to expert community, and to wider society
  - That defends freedom of thought and expression by individual scientists
  - That promotes universal principles of ethical research, such as excellence, inclusiveness, dissemination, participation, ethics, scientific principles, non-political, and public good
  - That encourages countries to guarantee worldwide participation in, and data contribution to, the Earth and space sciences
  - That supports capacity building in developing countries

- INFORM GOVERNMENTAL & INTERNATIONAL POLICY
  - In order to play a leading role in advising policy-makers
  - To champion an open data and open publication policy in the Earth and space sciences
  - To address the issue of supporting scientists from non-IUGG member countries

- IMPROVE GLOBAL RESEARCH COORDINATION
  - To strengthen global cooperation in Earth and space sciences
  - To strengthen its Associations so that they improve their effectiveness
  - To develop and promote standards for data, models and services
  - To deliver those products and services that support the Earth and space sciences that cannot be provided by other organizations and agencies
  - To draw attention to the societal benefits from advances in the Earth and space sciences

IUGG promotes:

- Inter- and multi-disciplinary international programs and projects (see Figure 1)
- The collaboration with other multi-national or regional geodetic, geophysical or other geosciences organizations through its many partnerships and its Affiliate Membership program (see Figure 2), as well as through its Member Countries (Figure 3)

IUGG supports (Figure 4):

- Associations dedicated to the major disciplines of the Earth and space sciences, its commissions, divisions and working groups, as well as inter-association activities
- Union Commissions and Working Groups dedicated to interdisciplinary research in Earth and space sciences
- International science meetings
- An interdisciplinary international grants program
- A science education program

4. Major Goals

The Mission and Core Principles of IUGG will be addressed by focusing on several Major Goals and implementing structural and organizational changes in order to reach them:

- IUGG Visibility & Effectiveness
    - Promote IUGG and its Associations, e.g. by organizing more joint events (major IUGG-badged/themed annual event, highlight inter-association meetings, etc.), emphasizing the unique contributions of IUGG and its Associations, prepare "white papers" or summary reports on key topics, etc.
    - Promote the products and services offered by the Associations within the community and to policy-makers, e.g. through the National Correspondents and Liaison Officers, special events, etc.
    - Contribute to promoting and enhancing fundamental research in the geosciences, to understanding of the contributions the Earth and space sciences make to everyday life, and to solving crucial geo-problems in collaboration and coordination with international (e.g. the International Council for Science) or intergovernmental (e.g. U.N. organizations, the Preparatory Commission on Comprehensive Nuclear-Test-Ban Treaty Organization - CTBTO, the Group on Earth Observations - GEO) major initiatives and programs
    - Develop an IUGG Communications (Implementation) Strategy that addresses the above goals, and measures their effectiveness

- IUGG Research Collaboration & Education
    - Encourage greater collaboration with Sister/Partner Organizations, the private industry, national and space agencies
    - Encourage early-career geoscientists to participate in international science activities, e.g. through appropriate Association-level strategies, travel grants, etc.
    - Encourage countries and agencies to provide free access to data and information, and to initiate collaborative projects that have Regional and Global scope
    - Encourage the education of future generations of geoscientists, taking into account challenges and inequities such as gender inequalities, the need to offer education for individuals with diverse backgrounds, the need for greater cross-disciplinary knowledge, etc.

- Develop an IUGG Research Collaboration (Implementation) Strategy that addresses the above goals, and measures their effectiveness

- IUGG Management
  - Strengthen the role of the IUGG Council, e.g. by making decisions through electronic voting, increasing participation of its members, etc.
  - Make more effective use of Business Meetings (Bureau / Executive Committee / Council Meetings), e.g. by reducing oral reporting (focus on written reporting instead)
  - Make use of modern technology where possible to reduce the need for travel, e.g. teleconferencing
  - Strengthen the National Committees, e.g. by giving clear roles to the National Correspondents of the Associations
  - Strengthen the links to Sister/Partner Organizations through the Liaison Officers
  - Develop guidelines for Individual membership of Associations, e.g. harmonizing terminology, expectations, voting, representations, etc.
  - Develop an attractive National Membership Program to encourage countries to become a member of IUGG
  - Facilitate early-career geoscientists playing greater roles in IUGG and its Associations, e.g. by encouraging National Committees to identify such people, to mentor them, provide internship opportunities, etc.

Figure 1: Programs and Projects initiated and/or supported by IUGG

Current	Past
• **International Lithosphere Programme** (ILP, a joint IUGS-IUGG activity) • **Global Geodetic Observing System** (GGOS, an IAG program) • **World Climate Research Programme** (WCRP) • **Integrated Research on Disaster Risk** (IRDR) • **International Year of Global Understanding** (IYGU) • **Mathematics of Planet Earth** (MPE) • **World Data System** (WDS)	• **International Geosphere-Biosphere Programme** (IGBP, 1987-2015) • **International Year of Deltas** (IYD, 2013-2014) • **Extreme Natural Hazards and Societal Implications** (ENHANS, 2010-2014) • **International Year of Planet Earth** (IYPE, 2007-2010) • **Electronic Geophysical Year** (eGY, 2007-2008) • **International Polar Year** (IPY, 2007-2008) • **International Heliophysical Year** (IHY, 2007-2008) • **International Decade for Natural Disaster Reduction** (IDNDR, 1990-1999) • **Geodynamics Project** (1972-1979) • **Global Atmospheric Research Programme** (1967-1980) • **International Hydrological Decade** (1965-1974) • **Upper Mantle Project** (1964-1970) • **International Geophysical Year** (IGY, 1957-1958)

Figure 2: Partner Organizations of IUGG and Affiliate Members

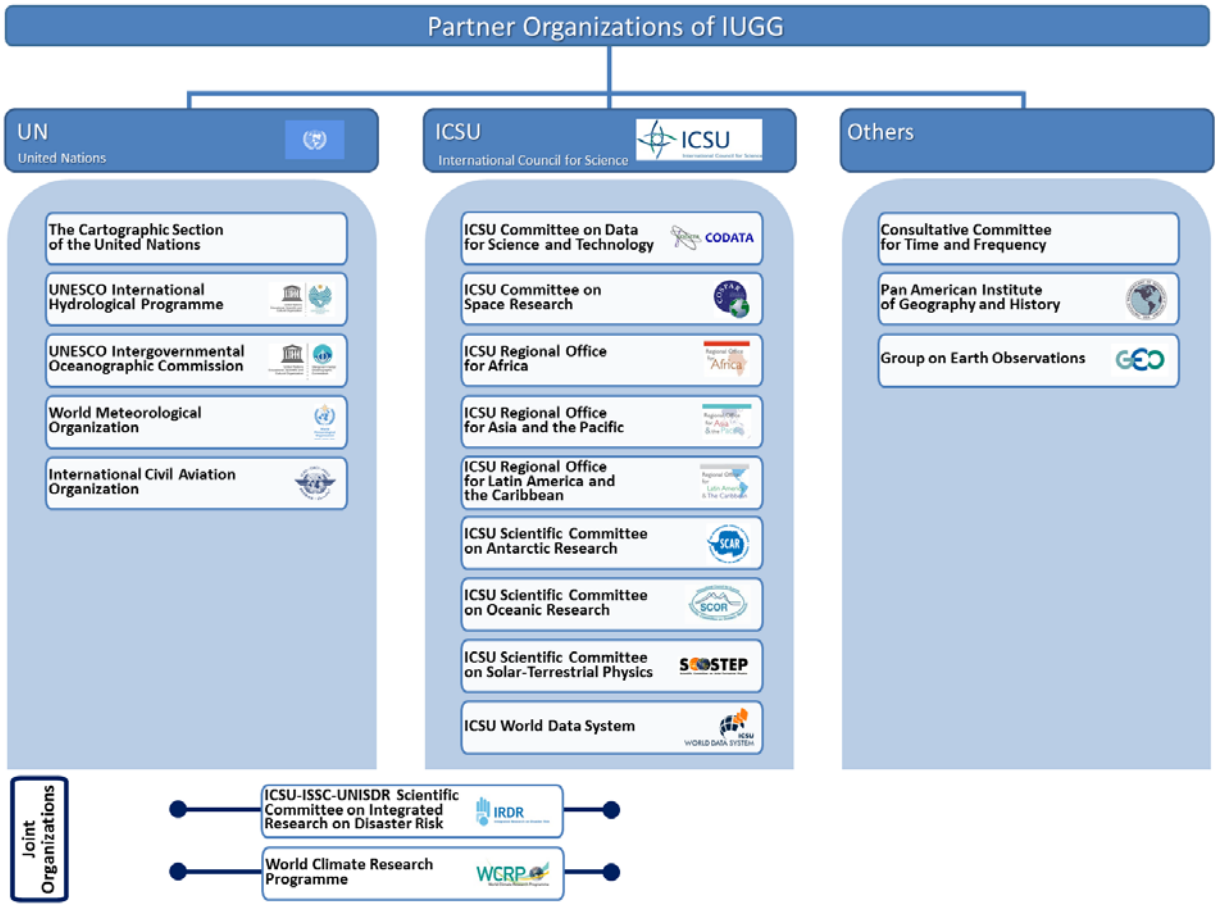


Figure 3: Regional distribution of current (dark green) and former (light green) IUGG Member Countries (as of 01.01.2016)

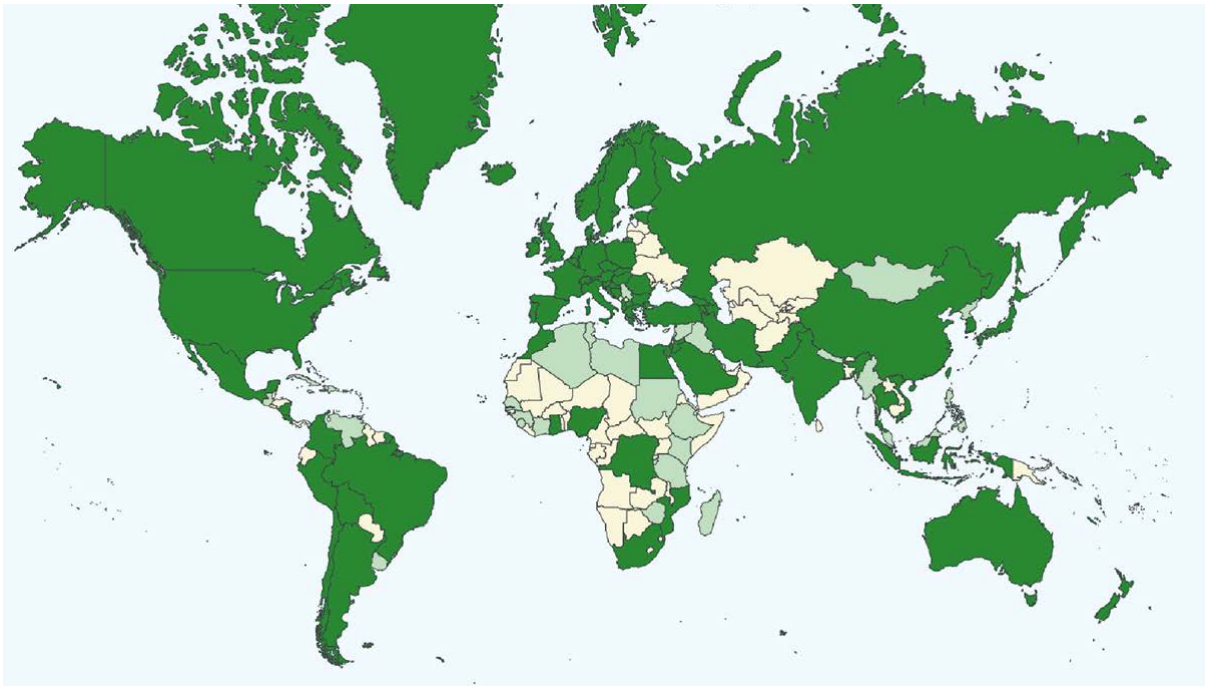
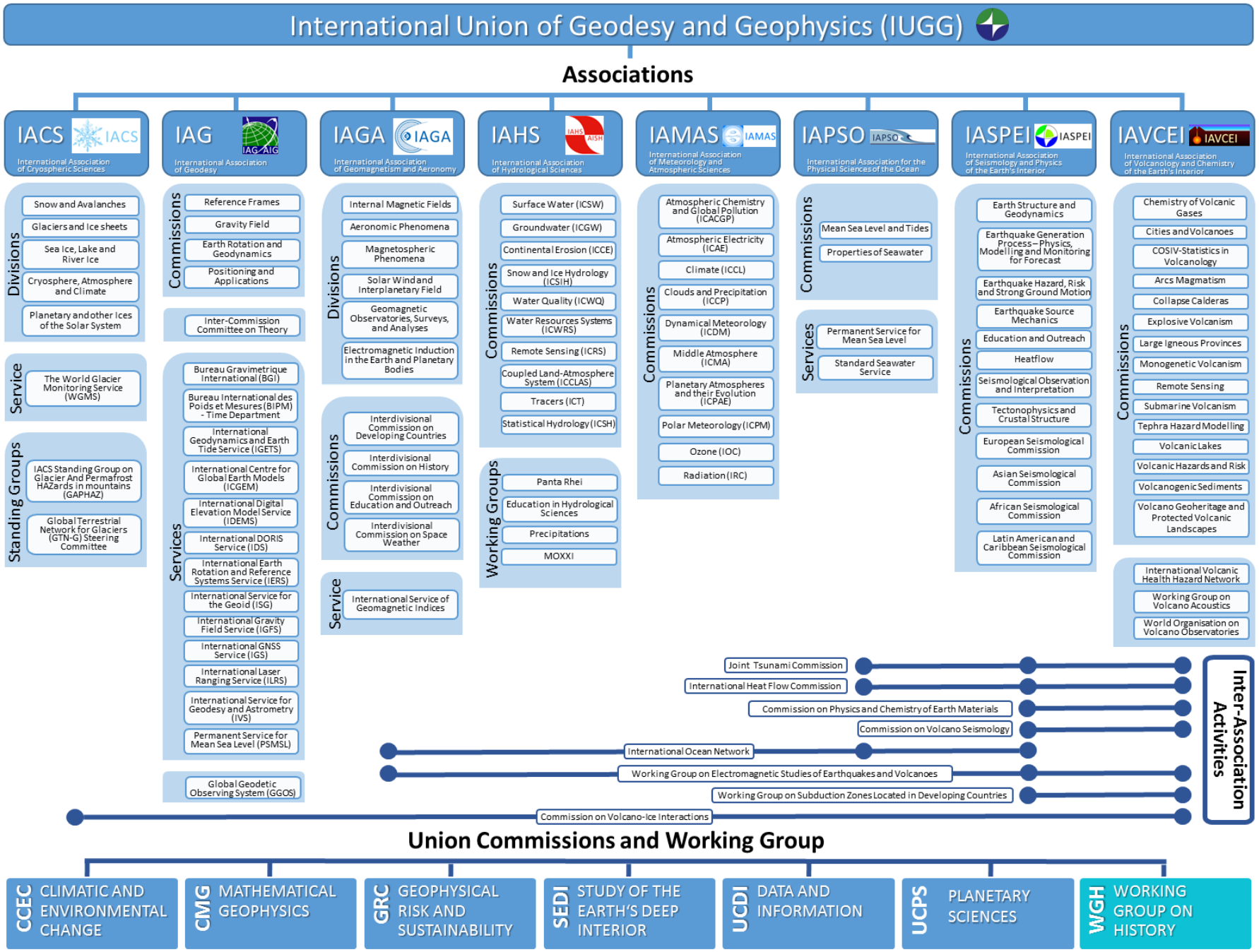


Figure 4: IUGG Structure



Appendix B. UN Sustainable Development Goals (SDGs) and sub-goals related to IUGG activities

Note: only those SDGs and sub-goals related to IUGG activities are listed below, and the *italic font* highlights the topics of interest to IUGG.

Goal 1. End poverty in all its forms everywhere

1.5 By 2030, build the resilience of the poor and those in vulnerable situations and *reduce their exposure and vulnerability to climate-related extreme events and* other economic, social and *environmental shocks and disasters.*

Goal 2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture

2.4 By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that *strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality*.

Goal 3. Ensure healthy lives and promote well-being for all at all ages

3.9 By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and *air, water and soil pollution and contamination.*

Goal 4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all

4.7 By 2030, *ensure that all learners acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development* and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship and appreciation of cultural diversity and of culture's contribution to sustainable development;

4.b By 2020, substantially *expand globally the number of scholarships available to developing countries, in particular least developed countries, small island developing States and African countries*, for enrolment in higher education, including vocational training and information and communications technology, technical, engineering and scientific programmes, in developed countries and other developing countries.

Goal 5. Achieve gender equality and empower all women and girls

5.5 *Ensure women's full and effective participation and equal opportunities for leadership at all levels of decision-making* in political, economic and public life.

Goal 6. Ensure availability and sustainable management of water and sanitation for all

6.3 By 2030, *improve water quality by reducing pollution,* eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally;

6.4 By 2030, substantially increase water-use efficiency across all sectors and *ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity;*

6.5 By 2030, *implement integrated water resources management at all levels*, including through transboundary cooperation as appropriate;

6.6 By 2020, *protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes*;

6.7 By 2030, *expand international cooperation and capacity-building support to developing countries in water- and sanitation-related activities and programmes*, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies.

Goal 7 Ensure access to affordable, reliable, sustainable and modern energy for all

7.a By 2030, *enhance international cooperation to facilitate access to clean energy research and technology*, including renewable energy, energy efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology.

Goal 9. Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation

9.5 *Enhance scientific research, upgrade the technological capabilities of industrial sectors in all countries*, in particular developing countries, including, by 2030, encouraging innovation and substantially increasing the number of research and development workers per 1 million people and public and private research and development spending;

9.b *Support* domestic technology development, *research and innovation in developing countries*, including by ensuring a conducive policy environment for, inter alia, industrial diversification and value addition to commodities.

Goal 11. Make cities and human settlements inclusive, safe, resilient and sustainable

11.5 By 2030, *significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to global gross domestic product caused by disasters, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations*;

11.6 By 2030, *reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management*;

11.b By 2020, substantially increase the number of cities and human settlements adopting and implementing integrated policies and plans towards inclusion, resource efficiency, mitigation and adaptation to climate change, resilience to disasters, and *develop and implement, in line with the*

Sendai Framework for Disaster Risk Reduction 2015-2030, holistic disaster risk management at all levels.

Goal 13. Take urgent action to combat climate change and its impacts

13.1 *Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries*;

13.3 *Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning.*

Goal 14. Conserve and sustainably use the oceans, seas and marine resources for sustainable development

14.1 By 2025, *prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution;*

14.2 By 2020, *sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts,* including by strengthening their resilience, and take action for their restoration in order to achieve healthy and productive oceans;

14.3 *Minimize and address the impacts of ocean acidification*, including through enhanced scientific cooperation at all levels;

14.a *Increase scientific knowledge, develop research capacity and transfer marine technology, taking into account the Intergovernmental Oceanographic Commission Criteria and Guidelines on the Transfer of Marine Technology, in order to improve ocean health and to enhance the contribution of marine biodiversity* to the development of developing countries, in particular small island developing States and least developed countries;

14.c *Enhance the conservation and sustainable use of oceans and their resources* by implementing international law as reflected in UNCLOS, which provides the legal framework for the conservation and sustainable use of oceans and their resources, as recalled in paragraph 158 of The Future We Want.

Goal 15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss

15.1 By 2020, *ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands*, in line with obligations under international agreements;

15.3 By 2030, *combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation-neutral world*.

Goal 16. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels

16.6 *Develop effective, accountable and transparent institutions* at all levels;

16.7 *Ensure responsive, inclusive, participatory and representative decision-making* at all levels.

Goal 17. Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development

17.6 *Enhance North-South, South-South and triangular regional and international cooperation on and access to science, technology and innovation and enhance knowledge sharing on mutually agreed terms, including through improved coordination among existing mechanisms, in particular at the United Nations level, and through a global technology facilitation mechanism;*

17.16 *Enhance the global partnership for sustainable development*, complemented by multi-stakeholder partnerships that *mobilize and share knowledge, expertise, technology and financial resources*, to support the achievement of the sustainable development goals in all countries, in particular developing countries;

17.18 By 2020, *enhance capacity-building support to developing countries*, including for least developed countries and small island developing States, *to increase significantly the availability of high-quality, timely and reliable data* disaggregated by income, gender, age, race, ethnicity, migratory status, disability, geographic location and other characteristics relevant in national contexts.

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IUGG Secretariat

Helmholtz Centre Potsdam
GFZ German Research Centre for Geosciences
Telegrafenberg, A17, D-14473 Potsdam, GERMANY

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