

Report on UK activities related to the International Union of Geodesy and Geophysics (IUGG) during 2021

Overview

Kate Heal, University of Edinburgh, Chair UK Committee for IUGG

UK scientists hold positions of responsibility centrally in the IUGG and within most of its Associations. Senior positions for 2019-2023 include:

- IUGG President: Kathryn Whaler (University of Edinburgh);
- IUGG Liaison Officers: UNESCO Intergovernmental Oceanographic Commission - Denise Smythe-Wright (National Oceanography, NOC), ISC Scientific Committee on Antarctic Research - John Turner (British Antarctic Survey, BAS), Group on Earth Observations - Kathryn Whaler;
- IACS Secretary General: Richard Essery (University of Edinburgh);
- IAPSO Early Career Scientist Working Group Chair; Alejandra Sanchez-Franks (NOC).

Additionally, 10 IUGG Fellows are from the UK. Senior positions within the individual Associations of IUGG that are currently held by UK scientists include: IAGA and IASPEI Executive Committees; IAMAS & IAPSO Past-Presidents, President/President-Elect of four of IAHS' 10 Commissions, IAHS Treasurer; ; Chair of International Permafrost Association Nominations & Awards Committee.

The IUGG Bureau (led by Kathryn Whaler) is reviewing IUGG activities and how IUGG operates to ensure that IUGG continues to best support Earth sciences research, innovation, impact and networking internationally, especially for early career scientists and in developing countries, during and after the COVID-19 pandemic.

The IUGG grants program has continued. Key priority areas for grants include creation of new knowledge in Earth and space sciences; dissemination of knowledge, data and information; and Geoscience for sustainable development, policy, education and outreach. Proposals that link with the 2022 International Year of Basic Science for Sustainable Development are particularly welcomed.

The UK hosts/leads IUGG and IUGG Association services to the international science community

- Permanent Service for Mean Sea Level (PSMSL) of IAG responsible for the collection, publication, analysis and interpretation of sea level data from the global network of tide gauges. Based at NOC, Liverpool, under the current directorship of Lesley Rickards.
- International Seismological Centre (ISC) an international non-governmental body with strong links with IASPEI, under the current directorship of Dmitry Storchak. In 2019 the ISC Seismological Dataset Repository was launched, which allows individual researchers or groups to submit seismological data to be openly available to the scientific community.
- The IAPSO Standard Seawater Service is the only internationally recognised standard for the calibration of salinity measurement devices, ensuring the quality and comparability of salinity data worldwide. The service has been hosted since 1989 by an SME in Hampshire, Ocean Scientific International Limited (OSIL). The demand for IAPSO standard seawater remains strong and the service is currently contributing to groups globally involved with the S.I. traceability relating to density.
- International GNSS Service working group on Satellite Vehicle Orbital Dynamics chaired by Marek Ziebart (UCL).
- Peter Clarke (University of Newcastle) is a member of the IGS (International GNSS Service) Reference Frame Working Group.
- The IAHS office (employing 4 staff) is based at the UK Centre for Ecology & Hydrology (Wallingford).

Activities of the UK Committee for IUGG

In 2021, in line with the maximum eight-year term for UK National Representatives, Bryn Hubbard (University of Aberystwyth) came to the end of term as the UK National Representative for the International Association of Cryospheric Sciences (IACS) and was replaced by Isabel Nias (University of Liverpool). Sally Gibson (University of Cambridge) stood down as the UK National Representative for the International Association for Volcanology and Chemistry of the Earth's Interior (IAVCEI) and was replaced by Tamsin Mather (University of Oxford). Michael Meredith stood down as the UK National Representative for the International Association for the Physical Sciences of the Oceans (IAPSO) and was replaced by Katy Sheen (University of Exeter). Richard Walters (University of Durham) stood down as the UK National Representative for the International Association of Geodesy (IAG) and a replacement is being sought. The contributions of outgoing UK Committee members is gratefully acknowledged and new Committee members are welcomed.

Although the COVID-19 pandemic meant that most in person IUGG and Association meetings, summer schools, etc. in 2021 were moved online, postponed or cancelled, UK scientists have been active in contributing to the re-formatting of these meetings and in participating. For example, Richard Essery organised the IAMAS-IACS-IAPSO online international seminar series in July 2021.

The annual meeting of the UK Committee for IUGG was held online in May 2021, including special invitees of UK scientists with positions of responsibility centrally in the IUGG. The meeting theme was increasing interactions between IUGG Associations and UK Learned Societies, who were also represented at the meeting. It was reported that not all Associations engage with National Correspondents, which is being followed up with IUGG and with individual Associations.

The Chair of the UK Committee for IUGG input to the Global Environment Research Committee (GERC) of the Royal Society (as an Ex-Officio member) at their 2021 meeting focused on "Synthetic Chemicals in the Environment".

Kate Heal liaised with the IUGG Secretariat to submit the annual application for the UK membership dues to IUGG to the International Organisation Membership Fees Grant scheme administered by the Royal Society. Funding has been awarded for 2022, and the application for 2023 membership dues was submitted in September 2021.

UK Annual Reports

In the following pages are presented the annual reports for 2021 from the UK national representatives to the IUGG Associations.

2021 REPORT FOR UK IUGG COMMITTEE ON THE INTERNATIONAL ASSOCIATION OF CRYOSPHERIC SCIENCES (IACS)

Isabel Nias, University of Liverpool, UK National Representative to IACS

The current Secretary General of IACS, to serve until 2023, is Richard Essery of the University of Edinburgh. Richard chaired IACS' virtual Annual Meeting in November 2021.

In January 2021, the Joint IACS-IAPSO Commission on Ice-Ocean Interactions (JCIOI) was formally established by IACS and IAPSO. Isabel Nias (University of Liverpool) is serving as co-chair (along with Felicity McCormack, Monash University, Australia), and Donald Slater (University of Edinburgh) is a member.

Noel Gourmelen (University of Edinburgh) is a member of the working group for Regional Assessments of Glacier Mass Change (RAGMAC), contributing to WP2 on glacier mass changes based on altimetry and gravimetry. UK scientists contributed to a Research Topic led by the WG and published in *Frontiers* entitled "Observational Assessments of Glacier Mass Changes at Regional and Global Level".

The Randolph Glacier Inventory Working Group was renewed in 2020, until 2023, and steering committee members include Tobias Bolch (University of St Andrews) and James Lea (University of Liverpool), with contributions from other UK scientists.

UK scientists are involved in the Working Group on Debris Covered Glaciers and have contributed to a Research Topic in *Frontiers* entitled "Debris-Covered Glaciers: Formation, Governing Processes, Present Status and Future Directions", editors of which included Duncan Quincey (University of Leeds).

IACS continues to operate and liaise closely with several professional bodies, including the International Permafrost Association (IPA), the International Arctic Scientific Committee (IASC), the Scientific Committee for Antarctic Research (SCAR), Climate of the Cryosphere (CliC), and the International Glaciological Society (IGS).

2021 REPORT FOR UK IUGG COMMITTEE ON THE INTERNATIONAL ASSOCIATION OF GEODESY (IAG)

UK National Representative to IAG post is currently vacant, a replacement is being sought

2021 REPORT FOR UK IUGG COMMITTEE ON THE INTERNATIONAL ASSOCIATION OF GEOPHYSICS AND AERONOMY (IAGA)

Mark Clilverd, British Antarctic Survey, UK National Representative to IAGA

The main event of 2021 for IAGA was the IAGA-IASPEI Joint Scientific Assembly in August. It should have been held in Hyderabad, India, but had to be turned into full virtual format due to the ongoing COVID-19 pandemic. The joint Scientific Assembly 2021 involved two Associations of the International Union of Geodesy and Geophysics: IAGA and IASPEI (the International Association of Seismology and Physics of the Earth's Interior). The meeting attracted 828 participants, over 500 from IAGA, with 56 countries represented. The UK provided 8 convenors for the 36 IAGA and joint sessions, an executive committee member, and several IAGA working group chairs. In total there were 35 UK co-authors on papers presented across the IAGA sessions. IAGA also undertook its 5th Summer school virtually, with 36 young scientists participating remotely. The UK provided 1 of the 7 senior scientists to lecture in geomagnetism.

2021 REPORT FOR UK IUGG COMMITTEE ON THE INTERNATIONAL ASSOCIATION OF HYDROLOGICAL SCIENCES (IAHS)

Adie Collins, Rothamsted Research, UK National Representative to IAHS

UK-based scientists continue to play prominent roles in various International Association of Hydrological Sciences (IAHS) scientific commissions: Adrian Collins (Rothamsted Research) is the ICCE (International Commission on Continental Erosion) Past President, Chris White (University of Strathclyde) is Secretary of ICCLAS (International Commission on Coupled Land-Atmosphere Systems), Melody Sandells (CORES) is President of ICSIH (International Commission on Snow and Ice Hydrology) President, Wouter Buytaert (Imperial College, London) is Past President of ICWQ (International Commission on Water Quality) and Stefan Krause (University of Birmingham) Vice-President, and in the ICSW (International Commission on Surface Water) David Hannah (University of Birmingham) is President and Honeyah Irvani (UCL) is the early career representative. In addition, Kate Heal (University of Edinburgh) is IAHS Treasurer and Chair of IAHS Ltd and Helen Houghton-Carr (UK Centre for Ecology & Hydrology) is IAHS Ltd Secretary.

Adrian Collins (Rothamsted Research) continued to be on the international scientific organisation committee for the ICCE stand-alone conference on “River sediment quality and quantity – environmental, geochemical and ecological perspectives” to be held in Bydgoszcz, Poland. This meeting was originally planned for 1-5 June 2020 but given the COVID-19 pandemic, has now been postponed to September 2022. The UK Centre for Ecology & Hydrology prepared and advertised the Hydro-Jules winter school (10-14 January 2022). Des Walling was on the international scientific organising committee for the International Conference on the Status and Future of the World’s Large Rivers (3-6 August 2021), originally planned to take place in Moscow, but held online due to the ongoing pandemic.

The 12th Annual Catchment Science Summer School (29 August – 3 September 2021) was delivered online and involved a number of UK scientists including David Hannah (University of Birmingham) and Chris Soulsby (Aberdeen University). Ian Foster (University of Northampton) was guest editor for a special issue in the international journal *Catena* organised on behalf of ICCE following an ICCE-led session at the 2019 IUGG General Assembly in Montreal. This special issue entitled - Using fingerprinting, monitoring and modelling to explore erosion, connectivity and transfers in catchment sediment systems – has now been published in full.

2021 REPORT FOR UK IUGG COMMITTEE ON THE INTERNATIONAL ASSOCIATION OF METEOROLOGY AND ATMOSPHERIC SCIENCES (IAMAS)

Tom Lachlan-Cope, British Antarctic Survey, UK National Representative to IAMAS

The COVID-19 pandemic has had a large impact on many of the activities of IAMAS and its commissions. The physical BACO-21 Joint Assembly planned for South Korea in conjunction with IACS and IAPSO was replaced by a joint virtual series of invited lectures. This Virtual Atmosphere-Cryosphere-Ocean (VACO-21) meeting took place during 19-23 July 2021. There was no cost to this meeting and it was organised by Richard Essery (University of Edinburgh).

A number of our large commission meetings have had to be postponed, including the International Radiation Commission quadrennial meeting originally scheduled for 2020, will now be held in Thessaloniki, Greece during 4-8 July 2022. A list of delayed/virtual meetings is below.

The immediate past president of IAMAS (John Turner, British Antarctic Survey) has been working hard developing the IAMAS Strategic Plan that was first agreed at the 2019 IUGG General Assembly in Montreal. He has also been involved with the development of the IAMAS web site.

Tracy Moffat-Griffin (British Antarctic Survey) has taken over as secretary of the International Commission on Polar Meteorology.

Delayed/virtual meetings

- The IAMAS-sponsored International Conference on Clouds and Precipitation was held as a hybrid/virtual meeting in Pune, India, 2-6 August 2021.
- The International Global Atmospheric Chemistry Conference planned to be held in Manchester, UK, 14-18 September 2020 has been postponed to 2022 to be held at the same place.
- The IAMAS-sponsored International Ozone Commission Quadrennial Ozone Symposium QOS2020 planned to be held in Seoul, Rep. of Korea, 4-10 October 2020 was postponed to 3-9 October 2021 as an online meeting.
- The IAMAS-sponsored Quadrennial International Radiation Symposium planned to be held in Thessaloniki, Greece, 6-10 July 2020 has been postponed to 4-8 July 2022 to be held at the same location.

2021 REPORT FOR UK IUGG COMMITTEE ON THE INTERNATIONAL ASSOCIATION FOR THE PHYSICAL SCIENCES OF THE OCEANS (IAPSO)

Michael Meredith, British Antarctic Survey, UK National Representative to IAPSO

Virtual Atmosphere-Cryosphere-Ocean seminar series (VACO-21), 19-23 July 2021

VACO-21 replaced the postponed joint assembly between IAPSO, IAMAS and IACS in Busan (South Korea). Instead of a general call for abstracts, VACO-21 consisted of a reduced number of invited speakers. The programme was organised over 5 days from Monday 19 July to Friday 23 July 2021. Over the week, 187 individuals joined the audience. Recordings of the excellent presentations are available here: <https://www.youtube.com/channel/UCP3bCxu-NIglNmeoHgGxEQ/videos>
The UK was especially well represented in VACO-21, with invited contributions delivered by Laura Stevens (University of Oxford), Markus Frey (British Antarctic Survey), Jenny Mecking (National Oceanography Centre), Doug Smith (MetOffice) and Byongjun Hwang (University of Huddersfield).

IAPSO Early Career Scientist Working Group

The IAPSO Early Career Scientist (ECS) Working Group was established in 2018, chaired by Alejandra Sanchez-Franks (United Kingdom) and co-chaired by Malin Ödalen (Sweden). This IAPSO ECS group has now produced a website <https://www.iapsoecs.org> and a twitter account https://twitter.com/iapso_ecs?s=20 for this working group, where the newsletters, job and research cruise opportunities and ECS-related events get routinely updated. The IAPSO ECS Working Group organised and submitted a review of the Second Order Draft of the Working Group I (WG1) contribution to the sixth IPCC Assessment Report.

IAPSO Best Practice Study Groups

IAPSO has begun funding Best Practice Study Groups, expecting to fund two of these every two years year. Each Best Practice Study Group will receive up to US\$12,000 towards the costs of a meeting. In January 2020 we chose the first two such IAPSO Best Practice Study Groups (out of nine quality applications), one concerned with the use of data from moored oceanographic instruments, and the other with the measurement accuracy and interpretation of pH measurements. The next round was advertised in September with closing date 15 November 2021 for submitting new proposals (http://iapso.iugg.org/%20http://iapso.iugg.org/index.php?option=com_acymailing&ctrl=archive&task=view&mailid=110).

New IAPSO/IACS joint Commission on Ice-Ocean Interactions

A new joint commission between IAPSO and IACS is being established on the interactions between ice (both sea ice and ice shelves) and the ocean. We have identified two co-chairs, one of whom is Isabel Nias (University of Liverpool), and are now populating the joint commission with members. It is anticipated that this group will have notable relevance to (and representation from) the UK community, given the strong UK heritage in oceanographic, cryospheric and cross-disciplinary science.

CoP26

Considerable activity was undertaken to support and engage with activities of the United Nations Framework on Climate Change (UNFCCC) Conference of Parties 26. This involved numerous IAPSO members convening outreach events and sessions at CoP in Glasgow, UK, in addition to many online and media engagements.

2021 REPORT FOR UK IUGG COMMITTEE ON THE INTERNATIONAL ASSOCIATION OF SEISMOLOGY AND PHYSICS OF THE EARTH'S INTERIOR (IASPEI)

James Hammond, Birkbeck, University of London, UK National Representative to IASPEI

Like 2020, activities this year were largely impacted by the COVID-19 pandemic. Despite this, several activities did manage to go ahead, largely online. The main highlight was the 3rd IAGA-IASPEI joint scientific assembly (21-27 August). This was organized out of Hyderabad, India. The meeting was attended by 823 participants from 53 countries, with ~300 having a primary affiliation to IASPEI. UK involvement was evident across many abstracts and almost 18% of symposia involving UK convenors. The next joint IAGA-IASPEI meeting will take place in Lisbon, Portugal in 2025. Another meeting that took place this year as a virtual conference was the European Seismological Commission (hosted by the Ionian University and National Observatory of Athens), with 596 scientists attending, with 86% from Europe. However, attendance from the UK was limited. The annual EGU (online) and AGU (jointly in person and online) meetings also took place in Vienna, Austria, and New Orleans, USA, respectively. These meetings are the main focal point for the UK IASPEI community and were well attended (e.g., the UK has the second highest number of participants at EGU after Germany). In the UK, the annual British Geophysical Association (BGA) Postgraduate Research in Progress (PGRIP) meeting took place online and was well attended, with 41 presentations taking place over 3 days, many with an IASPEI related topic. Upcoming UK meetings include BGA PGRIP 2022 (Cambridge, Summer 2022) and of relevance to the UK IASPEI Community, the British Seismology Meeting (Downing College, Cambridge, 12-14 September 2022).

Other items of note include Dr Sheila Peacock Blacknest (AWE) being awarded the Distinguished Service Award, Prof. Chris Jackson the Coke Medal and Dr. Finnigan Illsley-Kemp a President's Award from the Geological Society of London. The BGA produced a report on community representation and diversity within UK geophysics, which while wider in scope, is of relevance to the IASPEI community. This preliminary effort is to collate (incomplete) data to understand the past and current levels of community representation, diversity and inclusion within UK geophysics.

Finally, the UK (The University of Oxford, The Royal Society) continues to host the International Seismological Centre (ISC) that acts under the supervision of IASPEI/IUGG. During the past year, by collaboration with ~150 institutions in ~100 countries, the ISC continued with production and update of the following products that are widely used by UK and international scientific community and referenced in several hundred research publications:

- ISC Bulletin (1964-2021)
- ISC-EHB Dataset (1964-2018)
- ISC-GEM catalogue (1904-2017)
- IASPEI Reference Event List (Ground Truth list) (1964-2019)
- ISC Event Bibliography (1904-2021)
- International Seismological Contacts (started in 2005 following the Great Sumatera Earthquake, with support and encouragement from IUGG).
- ISC Seismological Dataset Repository - allows individual researchers or groups to submit seismological datasets that they wish to be openly available to scientific community for a long period of time, especially to assist free access to data used in scientific publications.
- ISC Electronic archive of printed station/network bulletins (1904 - circa 1970)

2021 REPORT FOR UK IUGG COMMITTEE ON THE INTERNATIONAL ASSOCIATION OF IAVCEI

Sally A. Gibson, University of Cambridge. UK National Representative to IAVCEI

The Volcanic and Magmatic Studies Group (VMSG), chaired by Sally Gibson, is a joint special interest group of the Mineralogical Society of Great Britain and Ireland, and the Geological Society of London, and is the official UK representative for IAVCEI.

UK-based scientists continue to play prominent roles in numerous International Association of Volcanology and Chemistry of the Earth's Interior (IAVCEI) scientific commissions: Kathy Whaler (University of Edinburgh) is the IUGG President and co-leader of the IASPEI/IAVCEI Joint Commission on Physics and Chemistry of Earth Materials; Dr Claire Horwell (University of Durham) is co-leader of the International Volcanic Health Hazard Network (IVHHN); Dr Mike Widdowson (University of Hull) is co-leader of the Commission on Large Igneous Provinces; Prof Jurgen Neuberg (University of Leeds) is co-leader of the IASPEI/IAVCEI Commission on Volcano Seismology and Acoustics; Carina Fearnley (UCL) is Secretary of the Cities and Volcanoes Commission of IAVCEI, and co-founded and leads the World Organisation of Volcanoes (WOVO) Volcano Alert Level Working Group; Janine Kavanagh (University of Liverpool) is Chair of the Commission on Volcano and Igneous Plumbing Systems. Jamie Farquharson (Lancaster University) and Ailsa Naismith (Bristol University) have been serving on the committee of the IAVCEI ECRNet and helped to organise some recent ECR webinars.

Four UK volcanologists (Prof. Kathy Cashman, University of Bristol; Dr Mike James, University of Lancaster; Dr John Smellie, University of Lancaster; Dr Richard Brown, University of Durham) serve on the editorial board of IAVCEI's journal, the *Bulletin of Volcanology*.

UK volcanologists have also be involved in organising several virtual IAVCEI events. For example, Prof. Juliet Biggs (University of Bristol) and Dr Susana Ebmeier (University of Leeds) were lead convenors of the "Workshop on volcano monitoring infrastructure on the ground and in space" held virtually in February 2021.

Due to the COVID-19 pandemic, the Cities on Volcanoes Commission of IAVCEI postponed its meeting in Greece until June 2022. The Scientific Organising Committee for this meeting contains several VMSG members (Profs. Tamsin Mather & David Pyle, University of Oxford & Dr Claire Horwell, University of Durham).