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WMO Integrated Global Observing System
WIGOS NEWSLETTER

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1. Assessment of low-cost air pollution sensors

Low-cost air pollution sensors are a promising technology for research in atmospheric composition, monitoring local air quality and tracking human exposure to air pollution (when used as a personal tracking device). An upcoming publication by an international group of experts, collected on request of the WMO Commission for Atmospheric Sciences, provides a broad assessment of the state of the art of sensor approaches for air pollutants and greenhouse gas measurements. It follows up on the initial recommendations (https://www.wmo.int/pages/prog/arep/gaw/documents/GAW_Sensors_advice.pdf) made by the Global Atmosphere Watch (GAW) Scientific Advisory Group on reactive gases that is limited to the gases under auspice of this group. The ongoing broader assessment reviews different sensor technologies and application-specific requirements for data quality and calibration. As this is a fast changing field continuous reevaluation including new developments and changes in performance may be required. In the upcoming statement recommendations will be provided to what extent sensors can be employed for different applications. These recommendations cover areas from sensor use for purely indicative measurements of air quality to their utilization as measurement instrument for improved understanding of atmospheric chemical transformations, temporal and spatial variability or long-term trends of different gases and aerosols.

The emergence of such low cost devices offers the potential to substantially increase the density of observations and provide unprecedented fine spatial resolution of air constituents distribution while reducing the initial cost of observations per unit. Also, a wider range of users which is no longer limited to trained experts may in the future take measurements. However, these smaller, less sophisticated measuring devices may be less chemically-specific, less sensitive and less precise than reference analyzers. A growing body of literature shows that sensors can be prone to cross-interferences from other atmospheric pollutants, are very sensitive to meteorological variables, such as air temperature and humidity, and have untested medium and long-term stability. To avoid misleading conclusions data quality of air pollution measurements must be considered and calibration of the employed sensors for a given application is required. Regular field recalibration to account for local environmental conditions may be challenging though, for example, when a very large numbers of sensors that are widespread (e.g. across a city) need calibration.

Since the question “when a low-cost sensor could be used” is not straightforward to answer and this field is developing fast with constant emergence of new devices, their technical performance has to be evaluated for specific tasks on a case-by-case basis.

A statement including the evaluation of current sensor approaches compared to reference instruments and recommendations on their appropriate application will be open for public review in March 2018 for one month, and it will be accessible from the GAW web page.

Low-cost sensors

2. Global Cryosphere Watch: building partnerships between operational and research communities

"Observation, monitoring, and research must enable better understanding of the climate regimes and potential impacts of climate change on the tropical mountains and their ecosystems", said the Tanzania Regional Commissioner for Arusha, the Honorable Mrisho Gambo during the opening of the Global Cryosphere Watch (GCW), Tropical Cryosphere Workshop organized by the WMO and hosted by the Tanzania Meteorological Agency (TMA) in Arusha, Tanzania, from 04th to 6th July 2017. The Regional Commissioner, together with the Permanent Representative (PR) of Tanzania with WMO and Director General of TMA, Dr. Agnes Kijazi, welcomed the focus of GCW on the cryosphere in the tropical regions. The workshop was a great opportunity for addressing the role of snow and glacier in the high mountains areas of the tropical regions and, specifically, the snow caped highest peaks in Africa, Mount Kilimanjaro and Mount Kenya.

As one of the four observing components of WIGOS, GCW is best positioned to broker the development of partnerships between research and operational communities, in particular as the cryosphere observations and science have been, traditionally, the domain of engagement of research and academia.

Participants at the 1st GCW Tropical Cryosphere Workshop, Arusha Tanzania, 4-6 July 2017

The workshop was a first of its kind and brought together experts from countries in tropical regions from three continents, where snow and ice are present and have significant role in the environment, economy, and social life. The workshop was chaired by Dr. Árni Snorrason, Director General of the Icelandic Meteorological Office, the Chair of the Steering Group of GCW. Well-known GCW experts and scientists from national universities and from meteorological and hydrological services of the countries in the tropical regions, had three days of productive discussions. They focused on the current glacier monitoring activities in Peru, Ecuador, Bolivia, Colombia, and Indonesia, the snow monitoring programs in Morocco, the permafrost monitoring in Peru, and the challenges related to observations of glaciers and snow in Tanzania, Kenya, and Democratic Republic of Congo.

The participants agreed on several key actions. Among those (1) expressing full support for GCW's lead role in facilitating the cooperation between NMHSs and national and international organizations active in cryosphere observations and research (2) reiterating the need for the publication of best practices for the configuration, operation, maintenance of sustainable observations, and data availability for stations at high elevation, in very remote locations with difficult access, operating in harsh environments (3) requesting that GCW continues the development of the GCW Data Portal, for facilitating the access to existing cryosphere data, including data from previous research projects (e.g. on Mount Kilimanjaro and Mount Kenya, conducted by Universities from Austria and USA); (4) their commitment to contributing to GCW, for enhancing the access to information and the collaboration, to answer critical questions regarding mountain climates.

The workshop presentations and report are available online (http://globalcryospherewatch.org/meetings/arusha2017/). The workshop had quick and notable benefits. After well over a decade of research activities on Mount Kilimanjaro, and as a result of the Arusha workshop, Prof Douglas Hardy and his team of scientists from University of Massachusetts, met for the first time with Dr Ladislaus Chang'a, the Director of Research and Applied Meteorology at TMA. They agreed on a new data and information sharing collaboration between the two organizations, within the framework of GCW. As part of this engagement, in October 2017, Dr Chang's and Dr Hardy's team climbed together Mount Kilimanjaro (picture below – more info at the Kilimanjaro Climate & Glaciers blog, http://kiboice.blogspot.ch/). The second notable outcome is the joint University of Massachusetts-TMA submission of the Mount Kilimanjaro glacier research station, as a CryoNet station, for inclusion in the GCW observing network. Once approved by the 70th session of the WMO Executive Council, EC-70, this will be the first GCW station in Africa.

The workshop received broad attention in Tanzania, and several news outlets present at the opening ceremony published articles related to the topics discussed.

Dr Spencer Hardy (University of Massachusetts) and Dr Ladislaus Chang'a at Barafu Camp (4,670 m), the 5th night of the ascent on Mount Kilimanjaro, October 2017

3. Key decisions of JCOMM-5 with regard to implementation of global ocean observing systems

The fifth Session of the Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM) was held in Geneva, Switzerland, from 25 to 29 October 2017, after relocation from Bali, Indonesia, due to the high risk of eruption of the Agung volcano. The Indonesian Government contributed substantially to the organization and success of the Session.
In its deliberations the Session addressed a number of topics that either related to or had implications for WIGOS.

In particular, the Session endorsed the JCOMM Observations Programme Area (OPA) Vision for the next five years as well as its Work Plan and organizational structure. The vision for OPA is to contribute towards a fit-for-purpose, integrated, and coherent ocean observing system that supports 1) a rapidly expanding set of weather, climate, marine and ocean services targeting stakeholders across the globe; 2) a vibrant international research community (e.g. the World Climate Research Programme (WCRP), the World Weather Research Programme (WWRP), and the International Ocean Carbon Coordination Project (IOCCP) developing knowledge and solutions for the next decade.

As part of the Vision, the OceanObs19 conference will revisit the performance of the observing system, and opportunities to better meet current and emerging requirements (e.g. through potential new technologies and regional pilot projects like the Tropical Pacific Observing System (TPOS) 2020 Project, initial recommendations resulting from the WMO-WWRP Polar Prediction Project including coordinated special observing efforts as part of the Year of Polar Prediction (YOPP) 2017-2019 and the EU-H2020 AtlantOS project on Optimizing and Enhancing the Integrated Atlantic Ocean Observing Systems). The JCOMM OPA will also continue to contribute to the WIGOS Implementation Phase through improving the timely delivery of marine and ocean data to the Global Telecommunication System (GTS), of metadata (through JCOMMOPS) to the Observing System Capability Analysis and Review tool for surface based observations (OSCAR/Surface), promoting and leading instrument inter-comparisons, the development of guidance materials (standards and best practices) and the establishment of Regional Marine Instrument Centres (RMICs).

Some changes were also proposed with regard to the way the JCOMM Observations Coordination Group (OCG) is operating: The IOC-WMO-UNEP-ICSU Global Ocean Observing System (GOOS) was accepted as a co-Sponsor of OCG, and new Observing Networks were included in OCG membership (e.g. ocean gliders, HF Radars).

The Commission endorsed the work of the ocean observing networks, partner networks, projects and emerging networks in developing implementation goals and targets to address the requirements developed under the WMO-IOC-UNEP-ICSU Global Climate Observing System (GCOS), the GOOS, WIGOS, and other relevant bodies. It supported implementation of the global ocean observing system to address these goals and targets.

The Session decided on the Commission's contribution to the WMO Rolling Review of Requirements and urged Members/Member States of WMO/IOC to contribute to the implementation of marine meteorological and oceanographic observing systems for achieving the implementation targets of ocean observing networks, as proposed by JCOMM, while paying particular attention to some critical variables (sea surface height anomaly, sea level, waves, surface pressure and visibility) which are not adequately measured for addressing the requirements of ocean applications, and to take steps to address the gaps using appropriate observing technology.

Other JCOMM-5 Decisions of relevance to WIGOS included:

- Undertaking of an Open Access Global Telecommunication System (GTS) Pilot Project;
- Support to the Tropical Pacific Observing System (TPOS) 2020 Project and establishment of a TPOS 2020/JCOMM cross-cutting Transition and Implementation Task Team, to serve as advisory group within the TPOS 2020 Project to the Steering Committee and Resources Forum and to JCOMM;
- Decision on WIGOS Station Identifiers (WSI) for Marine Observing Platforms, whereby the JCOMM in situ Observations Programme Support Centre (JCOMMOPS) is tasked to assist and will have delegated authority (if agreeable to the Permanent Representative) to issue WSIs for ocean observation platforms for Members;
- The Commission decided to endorse JCOMMOPS as the authoritative source through which WIGOS metadata are submitted to OSCAR/Surface for all oceanographic and marine meteorological platforms and encouraged Members to ensure all platform WIGOS metadata are registered with JCOMMOPS, to allow reformatting and transfer of metadata into OSCAR/Surface in collaboration with the WMO Secretariat. Members were invited to consider providing support to JCOMMOPS to facilitate implementation of this Decision;
- Invitation to Members to consider offering additional RMIC facilities or specific RMIC functions in other regions, especially within Regional Association III (South America), Regional Association V (Southwest Pacific), and Regional Association VI (Europe), and to collaborate with the existing RMICs;
- Endorsement of the draft Strategy to Reduce Damage to Ocean Data Buoys from Vandalism;
- Recommendation on long term ship Observing Stations;
- Approval of JCOMM Capacity Development Vision together with a New Capacity Development Structure and Work Plan;
- Contribution of JCOMM to WIGOS Regulatory and Guidance Material.

4. Advances in weather radar data exchange

While weather radar systems have been an important tool for localized, short-term severe weather monitoring and prediction for several decades, the international exchange of weather radar data for use in regional and global applications is currently under active development. WMO is now coordinating efforts to advance this and other aspects of the operation of weather radar systems and networks under the WMO Global Integrated Observing System (WIGOS).

The WMO Commission for Instruments and Methods of Observations (CIMO) Inter-Programme Expert Team on Operational Weather Radar (IPET-OWR), which is managed jointly by CIMO and the Commission for Basic Systems (CBS), has collected and focused a range of international weather radar activities, previously underway in separate teams within both Technical Commissions. In undertaking this role as the steward of weather radar systems, IPET-OWR is looking to address current and future requirements leading to an increased demand for international weather radar data as an emerging global resource. This demand is being driven in particular by the forecasting application areas of numerical weather prediction and regional severe weather monitoring and prediction. For this reason, one of the priority activities of the IPET-OWR work plan is to conclude ongoing work on the development and proposal of an international standard for weather radar data representation and exchange.

In the past, data exchange and production were distinctly different domains that made different demands on data representation. Cartesian products have been and are still exchanged with little subsequent processing. Over the last ten years, however, exchange of radar data in original radial coordinates (defined by azimuth and elevation) has increased significantly, which means that new representations are required to ensure that exchanged payloads contain required and sufficient metadata to enable advanced processing by data users. In a global context, two such dominant representations have emerged and are used operationally: The first is a representation used for operational exchange and processing by the European Meteorological Services Network (EUMETNET) Operational Programme for the Exchange of Weather Radar Information (OPERA) and BALTRAD networks in Europe and also by the Bureau of Meteorology in Australia, known as ODIM_H5, which is based on the Hierarchical Data Format, version 5 (HDF5); The second, used mainly by research organizations internationally, is an extension of the Climate and Forecasting (CF) Conventions that is based on NetCDF, known as CfRadial.

IPET-OWR has produced an information model that specifies what radar information needs to be represented, and a data model that specifies how the information should be represented.

These are both independent of file format. Through their application, IPET-OWR has succeeded in converging ODIM_H5 and CfRadial within a specification that meets the known requirements of both user domains. With the introduction of version 2 of CF Conventions and version 4 of NetCDF, the hierarchical organization used by ODIM_H5 can now be replicated in CfRadial version 2 with efficient built-in compression applied to the data. The former characteristic is vital in ensuring that data can be represented together with metadata and spatial quality metrics that are generated during data processing.

The final deliverable related to data representation that has been developed by the expert team is a document that addresses WMO Member use of CfRadial 2, as a means of ensuring the consistency and conformity of internationally-exchanged weather-radar data.

In an Ad-Hoc Workshop on Weather Radar Metadata, held over 19-21 June 2017 in Locarno, Switzerland, these weather radar data exchange were reviewed and updated to ensure harmonization and consistency with the WIGOS Metadata Standard, with OSCAR/Surface, with the WMO Weather Radar Database, and with OPERA.

To complete this development process and to be able to finalize the outputs for operational use as a standard for international exchange of weather radar data, IPET-OWR will now engage with the CBS Open Programme Area Group on Information Systems and Services (OPAG-ISS) to ensure and verify that the proposed single global standard meets WMO requirements for use and maintainability.

New S-band weather radar being installed at Radisson, Saskatchewan, Canada, alongside the C-band radar that the new radar replaces
(Picture courtesy of Environment and Climate Change Canada)

5. GCOS Surface Reference Network - Outcomes of AOPC Task Team, 1-3 November 2017, Maynooth, Ireland

While not perfect, the *in-situ* component of the global climate observing system has been broadly successful in contributing to the detection, attribution, and monitoring of climate change. Measurements of surface meteorological parameters have been made for more than a century in many parts of the world and, together with satellites and other *in-situ* systems, have provided the evidence for the Intergovernmental Panel on Climate Change to conclude in its last two assessment reports that the evidence for a warming world is unequivocal (IPCC, 2013).

However, the demands on the climate observing systems are ever increasing and a more rigorous assessment of future climate change and variability is needed. This can most plausibly be delivered by a coordinated metrological reference-measurement approach to such monitoring at a sufficient subset of global sites. The principles for such a reference network are traceability, comparability, representativeness, long-term operational viability, full data and metadata retention and open data provision. Reference networks currently exist that have proven value, like the US Climate Reference Network (USCRN), the Global Climate Observing System (GCOS) Reference Upper Air Network (GRUAN), and Cryonet stations from WMO's Global Cryosphere Watch.

At the request of GCOS Atmospheric Observation Panel for Climate (AOPC) and the WMO Commission for Climatology, a paper outlining the steps toward establishing a GCOS Surface Reference Network (GSRN) was developed and has now been accepted for publication in the International Journal of Climatology. In 2017, the AOPC agreed to the creation of a 2 year task team whose main objective is to assess the feasibility of a global surface reference network by identifying the major stakeholders, the benefits, the practicality of doing this, and the costs. The task team, chaired by Howard Diamond (US National Oceanic and Atmospheric Administration/Oceanic and Atmospheric Research NOAA/OAR, Air Resources Laboratory) includes experts from the metrology community, WMO's CIMO, Numerical Weather Prediction, the climate community, other GCOS networks, and met for the first time from 1 to 3 November 2017 at Maynooth University, Ireland.

The meeting agreed that the primary benefits of a GCOS Surface Reference Network would be:
• A key step in improving the long-term accuracy, stability and comparability of the observations and result in an improved confidence in detecting the global increase in temperature, as well as the link to historical records.
• Rigorously characterized time series from these sites will lead to the development of a better understanding of important climate related processes, including extreme events, and key to assessing mitigation effectiveness.
• Observations from a GSRN can be used to improve measurements made at other, non-reference site, and co-located reference quality measurements will provide a valuable data set for the calibration and validation of satellite data.
• New techniques and equipment can be tested at the reference sites which will also provide good locations to base future field campaigns.

In addition to WMO Members contributing measurement sites, a key catalyst for the success of the GSRN would be the establishment of a global lead center structure to help ensure the adequate coordination of all GSRN activities.

The task team will produce a concept note that will be used to get feedback from the Members on whether there is interest from their country in participating, and it will include a proposed list of steps to follow in the GSRN implementation.

USCRN station Moose (Wyoming, USA)

6. Outcomes of the Joint GCOS-WIGOS Workshop for the Pacific Islands, 9-12 October 2017, Nadi, Fiji

The Joint GCOS-WIGOS Workshop for the Pacific Small Island Developing States (SIDS) was held in Nadi, Fiji on 9-12 October. The event was organized jointly by the GCOS Secretariat and the WIGOS Project Office, it was hosted by the Fiji Meteorological Office and the Secretariat of the Pacific Region Environment Programme (SPREP) who provided logistical and technical support. The primary aim was to analyze the gaps in the Pacific region surface-based observing systems supporting climate and weather applications and to discuss strategies for mitigating them.

The meeting was attended by representatives from 14 RA V Members and territories, as well as representatives from GCOS, WIGOS, the United Nations Framework Convention on Climate Change (UNFCCC) Secretariat and the Chair of the Subsidiary Body for Scientific and Technological Advice (SBSTA) to the Conference of the Parties (COP) behind the UNFCCC.

The overall structure and main regional goals of GCOS and WIGOS were presented, followed by a series of presentations on the national observing capabilities in the region. During the subsequent discussion, the Workshop developed a set of key messages that are reproduced below.

These messages were presented at the Conference of the Parties in Bonn in October 2017 by Fiji as President of COP-23, where they were very well received. The next steps will be the development of an Implementation Plan aimed at closing the observational data gap in the Pacific and the exploration of potential mechanisms for financing the implementation.

Key messages from the Joint GCOS-WIGOS Workshop on Pacific SIDS, Fiji, October 9-12 2017:

• Systematic observation of the Earth's climate is a global common good that supports the implementation of the Paris Agreement, in the context of sustainable development and efforts to eradicate poverty;

• Many meteorological observations, made at high spatial and temporal density, support local forecasting and warning applications. These observations are a national responsibility contributing to national and regional needs with some additional global value;

• However, systematic upper air observations, made routinely by radiosondes under the WMO World Weather Watch (WWW) Programme, including the GCOS Upper Air Network (GUAN), support numerical weather prediction (NWP) leading to global benefits. These observations are used primarily for forecasting and climate applications at the international level, including climate reanalyses which form the basis of much of our understanding of climate and climate change; and

• Systematic upper air observations in the Pacific region, tend to have the highest measured impact, of all ground-based measurements, on the quality and accuracy of weather and climate analysis and prediction not only locally, but globally. The resulting products underpin weather and climate aspects of early warning systems as well as other climate-related services;

• Both the spatial density and observing frequency of the upper air network over the South Pacific region currently fall short of GCOS and WMO requirements. Due to the unique geography of the region – vast swathes of ocean surface with relative little land mass distributed over some 20 small island states with modest-size populations and correspondingly modest GDPs – systematic observation is particularly challenging in this region;

• The upper air network over the South Pacific therefore needs sustained international support;

• The workshop developed an outline for a *Pacific region observing network plan in support of the GCOS Implementation Plan and the Implementation Plan for the Evolution of Global Observing Systems (EGOS IP)* to:

- Strengthen regional and national meteorological networks to support adaptation actions and avert loss and damage,
- Identify capacity building needs to ensure the sustainability of the networks,
- Be used to support requests for finance from the operating entities of the financial mechanism under the Convention, the GCOS Cooperation Mechanism and other relevant funding sources;

• Support of the observing network in the region should be based on transparent processes and a commitment to free and open data sharing in accordance with WMO Resolutions 40 and 60 and the GCOS Monitoring Principles. The network should be designed to be, efficient, sustainable, it should meet agreed international standards as well as national requirements. Ensuring sustainability is of paramount importance, and the network plan must therefore also include the necessary elements of capacity development.

• The draft plan will be developed by GCOS and WMO in collaboration with Secretariat of the Pacific Regional Environmental Programme (SPREP), the Pacific Islands Communication and Infrastructure Panel (PICI), and Pacific Meteorological Council, and submitted to COP 24.

Participants at the Joint GCOS-WIGOS Workshop for the Pacific Islands, 9–12 October 2017, Nadi, Fiji

Radiosonde launch at Nadi, Fiji

7. WIGOS Related Events/Meetings

7.1 Recent Events/Meetings

- Juelich Ozonesonde Intercomparison Experiment – Southern Hemisphere Additional Ozonesondes campaign, 9 October – 3 November 2017, Juelich, Germany,
- Second Session of the ICG-WIGOS Editorial Board (WEdB-2), 31 October-3 November 2017, Geneva, Switzerland
- Eighth Meeting of the RA I Dissemination Expert Group (RAIDEG-8), 1-2 November 2017, Geneva, Switzerland
- AOPC GCOS Surface Reference Network Task Team, 1-3 November 2017, Maynooth, Ireland
- RA V Working Group on Infrastructure (WG-INFR-1), 7-9 November 2017, Singapore
- 33rd Session of JCOMM Data Buoy Cooperation Panel (DBCP-32), 13-17 November, Brest France
- Dobson Spectrophotometer and UV Radiation Sensor Comparison, Buenos Aires, Argentina,13 November-1 December 2017
- Joint Meeting of the Expert Team on WMO Information System Centres, Expert Team on Telecommunications Infrastructure and Task Team on Global Information System Centres (ET-WISC, ET-CTS, TT-GISC), 13-17 November 2017, Geneva, Switzerland
- First Session of the CIMO Task Team on Radiation References, 15-17 November 2017, Teddington, UK
- Meeting of the Expert Team on the Evolution of WIS (TT-eWIS), 21-23 November 2017, Geneva, Switzerland
- Sixth Session of the ICG-WIGOS Task Team on WIGOS Metadata (TT-WMD-6), 27-29 November 2017, Zurich, Switzerland
- Second Session of the CIMO Expert Team on Operational Metrology, 27-30 November 2017, Tokyo, Japan
- First Session of the Task Team on GCOS Upper Air Network (TT-GUAN-1), 5-7 December 2017, Lindenberg, Germany
- Regional Workshop on AMDAR for Eastern Europe, 7-8 December, Budapest, Hungary
- Seventh Session of the Polar Space Task Group (PSTG-7), 11-13 December 2017, Innsbruck, Austria
- Second Session of the ICG-WIGOS Task Team on WIGOS Data Quality Monitoring System (TT-WDQMS-2), 12-14 December 2017, Reading, UK
- Fifth Session of the Global Cryosphere Watch (GCW) Steering Group, 8-12 January 2018, Oslo, Norway
- Seventh Session of the Inter-Commission Coordination Group on WIGOS (ICG-WIGOS-7), 15-17 January 2017, Geneva, Switzerland

7.2 Coming Events/Meetings

- Third Session of the CBS Inter-Programme Expert Team on the Observing System Design and Evolution (IPET-OSDE-3), 29 January – 1 February 2018, Geneva, Switzerland
- Session of the PSTG-GCW Snow Radar Science Meeting, 30-31 January 2018, Geneva, Switzerland
- CIMO Editorial Board, First Session, 30 January - 1 February 2018, Offenbach am Main, Germany
- First meeting of the GCOS/CCl Task Team on Lightning Observations for Climate Applications 5-7 February 2018, College Park, Maryland, United States
- Tenth Session of the Implementation-Coordination Team on Integrated Observing System (ICT-IOS-10), 5-8 February 2018, Geneva, Switzerland
- RA VI Regional Conference, 5-6 February 2018 and Regional Association VI (Europe) Seventeenth Session, 7 to 9 February 2018, Geneva, Switzerland
- Meeting of the drafting team of the Statement on Low Cost Sensors 7-9 February 2018, Dübendorf, Switzerland
- Meeting of the Steering Group on Radio Frequency Coordination (SG-RFC) 12-15 February 2018, Honolulu, Hawaii, USA
- Fourth Session of the Inter-Programme Expert Team on Satellite Utilization and Products (IPET-SUP-4), 26 February – 1 March 2018, Geneva, Switzerland
- 23rd Session of the Atmospheric Observation Panel for Climate (AOPC-23), 6-9 March 2018, Darmstadt, Germany
- 21st Session of the GCOS/GOOS/WCRP Ocean Observations Panel for Climate (OOPC-21) 13-18 March 2018,Mar Del Plata, Argentina
- Session of the GCOS Terrestrial Observations Panel for Climate (TOPC) 19-21 March 2018,Geneva Switzerland
- Regional Association II (Asia) WIGOS Workshop, 19-23 March 2018, Tokyo, Japan
- Eighth Session of the Executive Council Panel of Experts on Polar and High-mountain Observations, Research and Services (EC-PHORS) 21-23 March 2018, Kittila, Finland
- Commission for Basic Systems Technical Conference 2018, and expanded CBS Management Group meeting, 26-29 March 2018, Geneva, Switzerland
- CIMO Management Group meeting, 26-29 March 2018, Geneva, Switzerland
- 7th session of the WCRP Data Advisory Council, 26-27 March 2018, Geneva, Switzerland
- 9th session of the CEOS-CGMS Working Group Climate, 27-29 March 2018, Geneva, Switzerland
- European Geophysical Union (EGU) General Assembly – Planned session EOS14 "Vision for Earth Observations in 2040", 8-13 April 2018, Vienna, Austria

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