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Federal Office of Meteorology and Climatology MeteoSwiss
Swiss GAW/GCOS Office

Joint National GAW/GCOS coordination meeting minutes

Date, Time:	23 March 2023, 09:30-16:30
Location:	EPA, Bern and virtual
Participants:	Carolina Adler (MRI), Alistair Bell (University of Bern), Antonio Bombelli (WMO), Jana Brenn (MeteoSwiss), Simone Brunamonti (Empa), Dominik Brunner (Empa), Brigitte Buchmann (Empa), Bertrand Calpini (MeteoSwiss), Greg Carmichael (University of Iowa), Martine Collaud Coen (MeteoSwiss), Lukas Emmenegger (Empa), Adrianos Filinis (University of Bern), Julian Gröbner (PMOD/WRC), Martin Gysel-Beer (PSI), Alexander Haefele (MeteoSwiss), Martin Hirschi (ETH Zurich), Martin Hoelzle (University of Fribourg), Matthias Huss (ETH Zurich), Stelios Kazadzis (PMOD/WRC), Jörg Klausen (MeteoSwiss), Thomas Konzelmann (MeteoSwiss), Jelle Lever (WSL), Emmanuel Mahieu (University of Liège), Renaud Matthey (University of Bern), Claudia Mohr (PSI), Jeannette Nötzli (WSL/SLF), Samuel Nussbaumer (WGMS), Cécile Pellet (University of Fribourg), Yann Poltera (ETH Zurich), Maurizio Pozzoni (Supsi), Renzo Ramelli (IRSOL), Christian Rohr (University of Bern), Mario Rohrer (Meteodat GmbH), Stefan Rösner (DWD), Andrea Rossa (MeteoSwiss), Yves-Alain Roulet (MeteoSwiss), Nadine Salzmann (SLF), Christoph Schär (ETH Zurich), Michael Schibig (BAFU), Petra Schmocker-Fackel (BAFU), Jonas Schwaab (ETH Zurich), Stavros Stagakis (University of Basel), Michelle Stalder (MeteoSwiss), Martin Steinbacher (Empa), Gunter Stober (University of Bern), Thomas Stocker (University of Bern), Markus Stoffel (University of Geneva), André Streilein (swisstopo), Oksana Tarasova (WMO), Béla Tuzson (Empa), Yann Vitasse (WSL), Sebastian Vivero (University of Fribourg), Daniel Vonder Mühll (ETH Zurich), Isabelle Werner (MeteoSwiss), Heini Wernli (ETH Zurich), Frank G. Wienhold (ETH Zurich), Stefan Wunderle (University of Bern), Michael Zemp (University of Zurich)

1 Welcome: Bertrand Calpini, Deputy Director MeteoSwiss and Thomas Stocker, Chair Scientific Steering Committee

2 Secretariat news

a) GCOS - Antonio Bombelli, GCOS Secretariat

A. Bombelli presented the main achievements obtained by the GCOS community in 2022. Among them:

- Publication of the 2022 GCOS Implementation Plan (GCOS-244)
- Publication of the 2022 GCOS ECVs Requirements (GCOS-245)
- GCOS IP welcomed by UNFCCC COP27. “The need to address existing gaps in the global climate observing system” emphasized by the Sharm el-Sheikh Implementation Plan.
- GCOS 2nd Climate Observation Conference held in Darmstadt, Germany, 17-19 October 2022, with around 150 in-presence participants and more than 100 talks.
- The GCOS governance and structure was reviewed by the Joint Study Group on GCOS that proposed an updated MoU that should be approved by sponsors.

The important contribution from GCOS Switzerland was underlined. GCOS recognizes the importance of: the inventory of long-term climatological time series and atmospheric monitoring maintained by Switzerland; the Swiss participation in GRUAN; the Swiss leadership in cryosphere monitoring (Glaciers, Permafrost, Snow, etc.) and its related Global Terrestrial Networks, e.g. GTN-G, GTN-P.

GCOS appreciates in particular the recent call for proposals of projects contributing to the implementation of the GCOS IP and GCOS Switzerland Strategy 2017-2026. The funded projects address topics absolutely relevant to GCOS (i.e. glaciers monitoring, phenology, urban vegetation, water vapour). It would be important to keep the GCOS Secretariat informed about the developments of these projects. The implementation of the GCOS-IP actions by Swiss research and observation centers is another occasion for collaboration. In general, a further and closer coordination between GCOS Switzerland and the GCOS Secretariat is welcomed.

b) GAW/GCOS CH - Michelle Stalder, MeteoSwiss

M. Stalder presented general news from the Swiss GAW/GCOS office including an overview of the activities in the framework of the two national programmes. M. Stalder also informed about the upcoming update of the GCOS-CH inventory report "National Climate Observing System" in the course of 2023/24. The update will consist of a general review of all chapters as well as an update in regards to new potential ECVs following the new GCOS implementation plan. Lastly, M. Stalder mentioned the various outreach channels (website newsletter, twitter, ProClim Flash, MeteoSwiss Blog and Twitter/LinkedIn account), and also referred to an upcoming update of the GAW and GCOS Switzerland websites which will be merged to one joint website.

3 COP27 UNFCCC - Isabelle Werner, MeteoSwiss

I. Werner gave a short overview over the most important outcomes of the last Conference of the Parties (COP27) in the framework of the United Nations Framework Convention on Climate Change UNFCCC. Three documents[1] were adopted referring to systematic observations. Amongst other, important text refers to welcoming the GCOS IP-2022 and the ECV requirements report, the WMO Greenhouse Gas Bulletin, the need to close observation gaps especially in the cryosphere and mountain areas, the importance of open data-sharing, data collection, data management and the Greenhouse Gas Monitoring Infrastructure Initiative. This year, Switzerland again made an important contribution to the adoption of pertinent text for the systematic observing community.

4 Greenhouse Gas Monitoring Infrastructure (GGMI) - Oksana Tarasova, WMO

The presentation reflected on the development of the Global Greenhouse Gas Monitoring Infrastructure (GGMI) by WMO. Reaching the goals of the Paris Agreement requires understanding of both the anthropogenic and the natural sources and sinks of greenhouses gases. While the reporting has been largely focused in the anthropogenic sources which humans can control, the natural component and the negative emissions are poorly understood, ineffectively regulated and are subject to climate change themselves. WMO has a long term experience with globally consistent, high quality long term observations of greenhouse gases through the Global Atmosphere Watch Programme, though the outputs are difficult to place directly in the context of policy making and there are large geographical gaps in the observing system. The WMO's Integrated Global Greenhouse Gas Information System (IG3IS) demonstrated that atmospheric observations combined with modelling and analysis tools ("top-down" approach) can improve knowledge of emissions and uptakes on policy relevant scales, but this application has been limited to the countries and subnational entities what have resources for the implementation. In the ideal world the "top-down" flux estimate should be available to all WMO Members that that is the ultimate objective of the GGMI. Such infrastructure would consist of the comprehensive observing system using surface and satellite based systems, international data exchange, prio emission estimates, high resolution Earth System models and data assimilation system. The initial output would bimonthly net fluxes of CO2, CH4 and possible N2O with 1x1 degree horizontal resolution delivered with a maximum of one month delay. Potentially concentration fields for these gases will be also produces. There are three modelling centers (in US, Japan and Copernicus in Europe) that are ready to produce these products and have comprehensive comparisons and QAQC of outputs. The most challenging part at this point is to massively scale up the observing capabilities on the ground to achieve substantial reduction of the net fluxes uncertainty. Research will continue playing an important role in development of GGMI through evaluation of observing and modelling system and development of applications. This is reflected in the new GAW

[1] *1) COP27 decision 'Implementation of the Global Climate Observing System', 2) COP27 Cover Decision 'Early warning and systematic observation', 3) SBSTA57 Conclusion 'Research and systematic observation'*

implementation plan (objective SO-C1) and GCOS Implementation plan (action F5). GGMI was recommended by the WMO Executive Council for the presentation to the 19th World Meteorological Congress in May 2023.

5 Joint Call for Proposals: Presentations of the four new projects

a) Tapping the potential of one decade of annual repeat altimetry to study glacial and periglacial processes (TapRep) - Matthias Huss, ETH Zurich

Glacier retreat and the newly exposed area in front of the receding ice terminus are among the most visible signs of climate change. They represent an extremely fast shift in the high-alpine environment resulting in a complete reorganization of the landscape. TapRep is an interdisciplinary project centered around an exceptional dataset of annual aerial images and digital elevation models (2012-2023) at very high resolution acquired by swisstopo and supported by the Federal Office for the Environment. This data allows a suite of new insights into the rapid and accelerating processes of ice melt and changes in the proglacial system, including sediment transfer. In addition, a high potential for public outreach related to data visualization is identified. With contributions from four universities with different expertise (ETH Zürich, University of Lausanne and Zurich, EAWAG) the project will tackle a variety aspects of research related to several ECVs:

- Glacier elevation change and mass balance at the regional scale,
- Glacier collapse features and potential flood hazards,
- Proglacial sediment dynamics,
- Alpine sediment dynamics, including the study of proglacial lakes,
- Visualization of climate change.

b) Feedbacks between vegetation, carbon, energy, and water cycles in the urban environment (UrbaNature) - Stavros Stagakis, University of Basel

The new project UrbaNature targets to improve the current knowledge and methodologies on monitoring and simulating the role of vegetation in carbon, energy, and water cycles in the highly challenging and heterogeneous urban environment. In summary the main objectives of the project are to:

- Identify plant photosynthetic responses and hydraulic strategies in the urban environment
- Develop remote sensing methods of key urban abiotic and biotic parameter monitoring in appropriate resolution
- Develop a high-resolution process-based ecophysiology model for urban environments
- Develop a mesoscale urban climate model integrating building-vegetation interactions

c) The Swiss H2O Hub: High-quality water vapor measurements from ground to space - Gunter Stober, University of Bern

Water vapor is an essential climate variable and also of high relevance for the radiatve budget on Earth. The pressence of water vapor is essential for the cloud formation at all altitudes from the troposphere to the stratosphere and mesosphere (noctilucent clouds). In this project, we provide high-quality measurement of water vapor from the ground to the edge of space using two balloon borne sensors and two remote sensing insturments:

- compiling of water vapor profiles from ground to space during several summer campaigns flying the ALBATROSS Laser spectrometer and the PCFH radiosonde in Switzerland
- validation campaign for the PCFH instrument, which are supposed to replace the current water vapor instruments for weather services
- performing almost continuous monitoring observations with RALMO and MIAWARA to monitor the water vapor content in the troposphere and straosphere and mesosphere
- development of new radiometer MIAWARA-C-Cryo to enhance the altitude coverage of the radiometer

d) SwissPhenocam: country-scale automated phenology tracking from imagery - Jelle Lever, WSL

The objective of the SwissPhenoCam project is to develop a Swiss-wide automated plant-phenology monitoring network that reasons across in-situ (manual) observations, ground-level (webcam) images, and satellite images using modern deep learning methods. By using the existing network of Roundshot webcam imagery from MeteoSwiss (25 sites) and third party cameras (likely up to 100 out of 338 sites) we aim at tracking phenological states of target species using machine learning. We plan to link webcam and satellite observations, and aim to disentangle the change signal from disturbances in these data to provide near real time updates of plant phenology using deep neural networks.

To improve our understanding of phenology as an integrated part of the climate system, we will set up webcams at four new sites that facilitate linkage with in-person observations of phenology and climate observations, and will study climate-phenology interactions by calibrating existing models of phenology using data from the Swiss Phenology Network, i.e. a traditional, manually operated observation network of 155 stations founded in 1951, and a wide variety of other data sources. In addition to this, we propose to analyse entire time series of, e.g., daily changes in greenness to identify (shifts in) species and ecosystem types, and to develop indicators of stress and resilience based on these time series.

In summary, we want to 1) get automated evaluation of species-level phenology from webcam imagery and link this to satellite data and 2) use that information to put phenology in the context of global environmental change, ecosystem functioning and stability, while 3) comparing and validating our results with manual observations of phenology.

6 QC/QA: How it all began - Brigitte Buchmann, Empa

Reliable time series are key to atmospheric research and the basis for environmental and climate researchers to understand and quantify changes in the atmosphere. However, this requires that the data are globally comparable and of very high quality. Furthermore, it is important to provide policy makers with sound information in order to negotiate global reduction measures and globally binding protocols. This awareness led the World Meteorological Organisation (WMO) to introduce a quality assurance system for the newly established Global Atmosphere Watch (GAW) programme in the early 1990s.
Subsequently, the World Calibration Centre (WCC-Empa) for surface ozone (O3) was established in 1996. WCC-Empa's original jurisdiction for surface ozone was expanded to include carbon monoxide (CO) in 1998, methane (CH4) in 2001 and carbon dioxide (CO2) in 2009. In 2000, the Quality Assurance/Science Activity Centre (QA/SAC Switzerland) was established to provide technical and scientific support in general for the parameters mentioned above.
Within the framework of this quality assurance system, developed for the WMO GAW programme, more than 100 audits have been carried out at 30 different GAW stations since 1996. Today, all results of system and performance audits at GAW stations are publicly available on the WMO website (WMO Audit Reports) and on the WCC-Empa website.
In addition, the GAW quality assurance concept serves as a model for other environmental research infrastructure programmes and improves the global comparability of atmospheric observations.
The activities of WCC-Empa and QA/SAC Switzerland are part of the Swiss contribution to the WMO/GAW programme and are co-financed by the Federal Office of Meteorology and Climatology (MeteoSwiss) and Empa.

7 GAW Scientific Implementation Plan 2024-2027 - Greg Carmichael, Chair Environmental Pollution and Atmospheric Chemistry Scientific Steering

G. Carmichael, Chair of the GAW Scientific Steering Committee, presented the GAW Strategic Implementation Plan (GAW SIP2024) and emphasised the increasing importance of atmospheric composition for issues such as air quality, environment, weather and climate. The GAW mission remains unchanged in the GAW SIP2024. It aims to reduce or minimise the risks to society and the environment associated with atmospheric composition. This is achieved by making long-term, high-quality and trustworthy information available. The theme is aligned with the

current IP 2017-2023 since research should enable services through science, infrastructure and dialogue with stakeholders.

The structure of the GAW SIP2024 is aligned with the Earth System Framework and its strategic objectives are closely aligned with four of the five strategic objectives of the WMO Strategic Plan.

8 GCOS Implementation Plan 2022 - Michael Zemp, GCOS Steering Committee

M. Zemp presented a summary of the process and the content of the GCOS Implementation Plan 2022, together with implementation examples from the World Glacier Monitoring Service. He encouraged the Swiss GCOS community to actively make use of the latest GCOS IP as guideline for their actions as implementing organizations.

9 Synthesis Table discussions regarding the new GCOS and GAW Implementation Plans

The table discussions allowed for a dialogue between the community members and aimed at engaging with the new implementation plans. The participants discussed at six tables six different topics: Observations, data analysis, data management, modelling, policy/services and capacity building. For each topic, the discussions at the tables were guided by respective experts. The six experts presented a short synthesis of the discussion in plenary.

a) Observations - Jeanette Nötzli, WSL/SLF

J. Nötzli first noted the wide range of subjects within the observation topic and its high relevance for most participants. The following common points of different monitoring and research fields were highlighted during the table discussions:

- Sustainability of observations was mentioned as a key aspect in most fields. Challenges may include long-term funding, changing environment (e.g. glacier retreat) or stability at the institutional level (e.g. retirement of principal investigators).
- Specific variables were mentioned regarding data and observation gaps in Switzerland (e.g. water cycle, water infiltration, high mountain areas).
- Automatisation of observations, modelling of remote sensing data and the use of proxies were mentioned as a possibility to increase the number of measurements as well as to enhance temporal and spatial resolution. These approaches are still developing but need to be continued.
- The data quality of observations was mentioned as an important aspect amongst others for data analysis. The definition of best practices is considered to improve data quality.

b) Data analysis - Martin Gysel-Beer, PSI

M. Gysel-Beer first noted that many participants mentioned that there is plenty but useful data around. Examples where exploration has been initiated are Phenocams or Rega's ceilometer network.
The following aspects were further highlighted:

- Artificial intelligence is a potentially useful tool for data analysis, e.g. on instrument level, for large data sets or networks of basic sensors. .
- Urban area in the focus of several different activities. One major challenge addressed by different groups is simulating transport on urban scale.
  Getting the 4D picture is important. For this it is necessary to combine modelling, assimilation of observations, re-analysis as well as user requirements. This can only be achieved with coordinated data management.

c) Data management – Michael Zemp, WGMS/UZH

M. Zemp first mentioned the main question that was discussed at the tables: "Do you share your data and if yes, what makes you do so?" The following aspects were further highlighted:

- The discussions showed that not all the data obtained are shared via an acknowledged international data center.

- In general participants noted that national databases are working well, whereas there are difficulties in regards to international data centers (e.g. for permafrost).
- International data centers would profit from a central governance (e.g. at WMO) to be able to deal with the different types of data.
- Participants mentioned reasons to share data are regulations, data citations or ideology/history and being passionate about the subject.

d) Modelling - Dominik Brunner, Empa

D. Brunner first noted the importance of modelling not only for GAW but also for GCOS and the recognition to further engage with the modelling community. The following aspects were further highlighted:

- Switzerland has excellent modelling capacities, for example in inverse modelling.
- Coupled air quality and meteorology modelling was mentioned as being something to be further improved in Switzerland.
- Models are useful and their importance for spatial and temporal interpolation and for process understanding was highlighted.
- Furthermore, the need to make sure that the quality is good and that process are correctly represented in models was highlighted, e.g. through model benchmarking and model evaluation.

e) Policy/Services - Brigitte Buchmann, Empa

B. Buchmann first noted the need for for high quality, globally comparable data for policy decisions and services. The following aspects were further highlighted:

- Services must be available in an easy way with comparable and quality assured data. It was highlighted that this is not an easy task but is considered key for good services.
- Services are needed on a Swiss as well as on a global level and knowledge should also be made available to other countries.
- Providing services for policy services is not trivial since the interpretation of them can be a challenge. It was thus mentioned that translation from services to policy is an important factor.
- A policy gap was mentioned relating to the fact that although there are good data and results available, feeding them into policy processes should further be increased.

f) Capacity Building - Martin Steinbacher, Empa

M. Steinbacher first mentioned how know-how transfer and training was addressed by many participants to support capacity building in order to close capacity gaps world-wide. The following aspects were further highlighted:

- The participants discussed the different roles that may exist between different institutions, e.g. between governmental and educational institutions, especially with regards to their long-term mission and funding availabilities.
- The importance of training people across all levels (e.g. from operators to directors) and of teach-the-teacher programmes to reach out to larger audiences were mentioned as key elements.
- The role of universities could be strengthened with regards to their engagement in e.g. exchange programmes, which were considered as potential low hanging fruits to optimize capacity building.
- Participants mentioned repeated trainings, patience and long-term funding to be key for sustainable success of capacity building efforts.

10 Closing of the meeting