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DRAFT 1

3. PROGRAMME ACTIVITIES, CLOSE PARTNERS AND GUIDANCE

3.2 GLOBAL ATMOSPHERIC WATCH (GAW) PROGRAMME HIGHLIGHTS

1. General

The Strategic Plan of the Global Atmosphere Watch Programme for the period 2008-2015 came to an end in 2015. The new Implementation Plan (IP) has been developed and it is presented to the CAS Management Group for approval prior to delivery to Executive Council. The new GAW IP covers the period 2016-2023 (two WMO planning periods) and it is aligned with the priorities of WMO for the next financial period. The IP is built around the theme "atmospheric composition matters" and the concept of research-enabled services. The short outline of the plan is provided in Annex 1 and the full version is available at www.wmo.int/gaw.

The Third Meeting of the Environmental Pollution and Atmospheric Chemistry Scientific Steering Committee (EPAC SSC) was held at the World Meteorological Organization (WMO) in Geneva, Switzerland, from 15 to 17 March 2016.

The SSC took several decisions related to the observational network, Scientific Advisory Groups membership and a federated approach to data management. It further worked on the finalization of the GAW IP. The SSC decided that actions are required to develop a strategy related to nitrogen, and to improve coordination of activities related to air quality between WMO, UNEP and WHO. Among important needs, the SSC highlighted the development of concepts/business models for resource mobilization and a refinement of the collaboration with GCOS. Development of joint activities with WWRP and WCRP on an integrated strategy for aerosols was considered as a high priority. These action items are partly reflected in the new GAW IP as well as summarized in the SSC report to be published by the end of 2016.

2. Observations and data management

Within the last year, several stations joined the GAW's observational network (one in the UK and four in Italy), while a new station in Malaysia is undergoing the review process. Although development of the observational network is progressing, there are still major gaps that require further efforts in order to be filled, especially in climate sensitive regions. Implementation of service-orientated observations requires that stations have more complex measurement programmes. Further to the new requirements for stations, outlined in the new GAW IP, only stations that measure more than one parameter are accepted. Such an approach is more beneficial for the Members as it allows the establishment of high quality stations that can be used as reference stations for the national air quality networks, to be used to estimate regional fluxes and in turn inform impacts studies. This approach is well in line with the network design principles of WIGOS, which requires multi-functionality of the observing network.

The requirements of the GAW observational network were further refined through the Rolling Review of Requirements process, which is also an important element of WIGOS. The second session of the CAS Task Team on Observational Requirements and Satellite observations (the team that leads this process), met from 12 to 13 August 2015 to further review the list of variables required to support three GAW related application areas. The updated set of network requirements was produced with the assistance of the SAGs on Greenhouse Gases and on Reactive Gases and communicated to the Inter Programme Expert Team on Observing System Design and Evolution (IPET-OSDE) at its second session, held in WMO, from 11 to 14 April 2016. Needs for satellite observations of atmospheric composition were communicated through the Inter-Programme Expert Team on Satellite Utilization and Products, whose second session took place in WMO, from 23 to 26 February 2016, and will be further highlighted at the 44th session of the Coordination Group for Meteorological Satellites that will take place from 5 to 10 June 2016.

The GAW Station Information System (GAWSIS) was also updated and a new version was launched by MeteoSwiss (https://gawsis.meteoswiss.ch) in May 2016, as a ground-based observational capacity database for OSCAR. This new version automatically checks for data submission on a monthly basis, and changes the operational status of the station in the system depending on data availability. The system automatically generates an e-mail informing the stations focal points of the change in the station's operational status. The Members of the CAS Management Group are invited to take note of this advanced GAWSIS functionality, and ensure timely data submission either to GAW data centres or to the data centers of contributing networks that have signed an agreement with GAW.

The GAW data management strategy was reviewed at a dedicated workshop in August 2015 to which representatives of the WMO Data Centres as well as other atmospheric data archiving centres were invited (BADC, CDIAC, US EPA, HTAP, Aeronet, NDACC, EMEP, EANET, MACC, GEIA, Aerocom, IAGOS). To ensure that the burden on the data providers is reduced and to avoid multiple submission of the same data, a recommendation to adopt a federated data management approach was made, where GAW contributing networks collect and disseminate data from their stations through their data centre, while ensuring the proper exchange of metadata with GAWSIS. In this way, GASWIS will serve as a hub for discovery of GAW relevant data.

3. Quality Assurance

Quality Assurance continues to play an important role in GAW, ensuring that the data can be used in support of intended applications. GAW Central Facilities support the GAW Quality Assurance system. The report of the GAW Central Facilities was compiled prior to the SSC meeting and is available online at http://www.wmo.int/pages/prog/arep/gaw/documents/ReportofGAWCentralFacilities2014-2015.pdf.

In 2016, two new GAW Central Facilities were established. One is the World Data Centre for Reactive Gases run by NILU, that assumed the archiving of reactive gases from the GAW network, and that is currently working with the World Data Centre for Greenhouse Gases in JMA on the transfer of historic reactive gases data. The second new Central Facility is the Central Calibration Laboratory for NO in the National Physical Laboratory, UK, that provides primary NO standards to GAW stations and other Central Facilities.

Several activities were completed in order to assess the quality of the GAW observational network. An assessment of the GHG network compatibility was accomplished through the Sixth WMO Round Robin Comparison campaign which finished in September 2015. Also an intercomparison and calibration campaign for Dobson instruments in Asia took place in Tsukuba, Japan, in March 2016, and was organized by the Regional Dobson Calibration Centre for Asia (hosted by JMA). Instruments from China, Japan, Pakistan and Thailand took part in the exercise.

4. GAW focal areas

GAW continued its activities in support of the six focal areas: greenhouse gases, reactive gases, aerosols, ozone, total atmospheric deposition and UV Radiation.

The strategy on the global carbon observations was refined at the BiPM Carbon meeting that took place in June 2015 in Paris. The outcome of the meeting was published as a recommendations report which is available as a draft at http://www.bipm.org/utils/common/pdf/carbon-workshop-report-20151120.pdf.

The Greenhouse Gas observational community met for the 18th WMO/IAEA Meeting on Carbon Dioxide, Other Greenhouse Gases, and Related Measurement Techniques (GGMT-2015) at the Scripps Institute of Oceanography, La Jolla, USA, from 13 to 17 September 2015. This was the 40th anniversary of the first GGMT meeting (then called "CO_2 Experts Meeting") which was also held at Scripps in 1974, and follows a series of regular meetings held every two years. The scope of the meeting was extended over the years. In recognition of the important role of the marine and urban environments for carbon cycle research, special sessions were included in the programme of GGMT-2015 to facilitate collaboration with the respective communities. This meeting reviewed the requirements for network compatibility and recommendations for QA/QC procedures.

The SAG GHG meeting was held back-to-back with the GGMT-2015 meeting. One of the items discussed by the SAG was the establishment of the connection between the GHG observational community and a broader group supporting the Integrated Global Greenhouse Gas Information System (IG^3IS).

After Cg-17 approval, the IG^3IS Planning Team was nominated and formed. The team held two face-to-face planning meetings and three planning meetings via teleconference. The IG^3IS concept was presented at the IPIECA Oil and Gas Industry Methane Monitoring Workshop (October 2015, in Paris), the WIGOS Space 2040 (November 2015, in Geneva), the GEO Plenary (November 2015, in Mexico City), at USA, UN, Nordic and EU side-events during COP21 (December 2015, in Paris), and at the American Geophysical Union 2015 Fall Meeting (December 2015, in San Francisco). The concept was further presented at the side event of the 44th SBSTA Session in Bonn, on 18 May 2016, and at the side event during the United Nations Environmental Assembly in Nairobi, on 24 May 2016. The first draft of the IG^3IS Concept Paper was completed in January 2016. The outline of the IG^3IS concept paper is provided in Annex 2. The paper will be presented for approval by EC-68.

The SAG on Aerosols had a face-to-face meeting from 22 to 25 April 2015 in Toronto, Canada. It also organized several teleconferences to follow up on aerosol data submission and to discuss collaboration with other aerosol observation networks toward the implementation of a surface-based international network of networks. The next face-to-face meeting will take

place from 1 to 3 June 2016 in Seoul, South Korea. There is a substantial interest in improving collaboration between Aerosol SAG, SDS activities and modelling of aerosol (such as in NWP in collaboration with WWRP). There was a strong call for revitalization of GALION activities at the VAAC best practices workshop that was held in Buenos Aires, Argentina, from 25 to 27 April 2016. There is a strong need to improve collaboration with CIMO related to calibration of lidar aerosol observations. SAG Aerosol also continued to offer calibration/intercomparison workshops in order to ensure that observations from other networks meet GAW standards. Training workshops supported by SAG Aerosol were held in Bolivia and India. An updated version of aerosol measurement guidelines has also been completed and will be released later in 2016. An Aerosol Bulletin on Black Carbon will also be published in 2016.

On 15 April 2016, the Gas Analysis Working Group (GAWG) of the Consultative Committee on Metrology in Chemistry and Biology (CCQM), organized a particulate workshop at the BIPM, jointly with WMO, with the aim to clarify the requirements for aerosol measurements from the various stakeholders, to outline the present and future role of national metrology institutes in supporting the accuracy of such measurements, and to define priorities and activities for the next few years. The follow up activities concentrate on the development of the reference material for Black Carbon/ Elemental Carbon, the establishment of the traceability of aerosol particle size measurements, and the organization of inter-comparisons of the most mature particle number measurements on a global scale.

The major achievement within ozone focal areas is the finalization by the committee "ACSO" ("Absorption Cross Sections of Ozone") of a review of the absorption cross sections in the ultraviolet part of the spectrum, with the final recommendations published as GAW Report no. 218. The Ozone SAG met in Zurich, from 5 to 6 May 2016. One of the specific issues discussed by the SAG was the evolution of the ozone observational network.

The SAG on Total Atmospheric Deposition met during the International Acid Rain Conference that took place in Rochester, USA, from 18 to 23 October 2015. A new activity of the SAG-TAD is to explore the measurement-model fusion approaches to develop total deposition maps for various regions, and is planning a workshop in 2017 to engage data providers and users within and outside GAW (such as HTAP, GESAMP) in this cross-cutting activity.

A major achievement of the SAG on Reactive Gases is the publication of the overview paper “The Global Atmosphere Watch reactive gases measurement network” in the peer-reviewed journal Elementa in 2015, and the support of a special issue in this journal for papers from the GAW Reactive Gases community. The GAW Reactive Gas community is closely involved in the Tropospheric Ozone Assessment Report initiative, which plans to produce a comprehensive report by the end of 2016. The GAW workshop on Nitrogen Oxides (NOx) took place from 12 to 13 April 2016, in York, UK. The workshop reviewed the status of the GAW Network for NOx measurements, data quality objectives, progress with the measurement techniques and standards, and development of the measurement guidance. It had a special session related to the evaluation of low cost sensors, and came to the conclusion that these sensors need a lot of verifications and must be supplemented by high quality calibration facilities to add value to the observational network. Workshop recommendations and NOx Measurement Guidelines will be produced by the end of 2016.

GAW continues to support the work of GESAMP by sponsoring the participation of experts in GESAMP meetings as well as the activities of WG 38 on The Atmospheric Input of Chemicals to the Ocean. WG 38 is currently planning two workshops to be held simultaneously in 2017 in order to initiate two recently approved activities: 1) an investigation of the changing atmospheric acidity and the oceanic solubility of nutrients, and 2) an investigation of the impact of ocean acidification on fluxes of non-CO_2 climate-active species. GAW is also supporting the work of a new WG tasked to assess the impact of marine geoengineering on marine ecosystems by sponsoring an atmospheric expert to participate in this activity.

5. Cross-cutting activities

The GAW Urban Research Meteorology and Environment (GURME) SAG contributed to the WMO Cross-cutting Urban Focus and the concept of the integrated weather/climate/hydrological/environmental urban services. It also considered several new Pilot Projects for megacities in China, Chile, India and Mexico; initiated a joint study with the World Urban Database and Access Portal Tools (WUDAPT) initiative; and participated in a joint CCAC/WHO Urban Health Initiative and the World Bank Pollution Management and Environmental Health (PMEH) programme.

A reconstituted GAW SAG on Modelling Applications (SAG-Applications) was established to enhance exchanges between the GAW community and different end-user communities of atmospheric composition data. The initial activities of the group in support of diverse application areas of the programme will be discussed at the first meeting to be held in Reading, UK, from 8 to 10 June 2016. In order to foster the inclusion of atmospheric composition data to further model development, GAW was represented at the meeting of the Working Group on Numerical Experimentation that met in South Africa in May 2016.

A joint CAgM/CAS workshop was organized in Pune, India, in November 2015, to review the connection between atmospheric composition and agriculture. It highlighted the strong impacts from atmospheric composition on agriculture and vice versa, it stressed that field-scale studies are needed to develop mitigation measures for agriculture, while the atmospheric composition community was requested to develop downstream services for farmers based on air quality forecast systems. It also recommended the development of a regional pilot project to increase the monitoring of tropospheric ozone in agricultural areas with a possible focus on agricultural areas of India.

An international workshop on the Nitrogen Cycle took place from 13 to 14 April 2016, in York, UK. The community identified ammonia as a gap to be addressed by GAW on a global scale and recommended that organic nitrogen compounds in the gas phase, aerosol phase and total deposition, be identified as an important area for research and measurement activities.

The Sand and Dust Storm Warning and Assessment System (SDS-WAS) is a cross-cutting interdisciplinary project between WWRP and GAW. The SDS-WAS Science and Implementation plan 2015-2020 was published in 2015, and several meetings and workshops were organized in collaboration with WHO, UNEP and UNCCD. WMO contributes to a Rapid Global Assessment of Sand and Dust Storms coordinated by UNEP.

6. Capacity development

Within the last year, two two-week GAWTEC sessions were organized covering aerosol, reactive gases and UV radiation measurements. Twenty-one station operators were trained at these courses.

The World Calibration Centre for SF6 organized the second Training and Education Course on SF6 measurements in Jeju, Republic of Korea, in October 2015. The Indian Institute of Technology, Madras, hosted a winter school on aerosols in January 2016. The Latin America Aerosol Measurements School: "From measurements technologies to applications" was organized in La Paz, Bolivia, from 22 to 27 June 2015, and addressed aerosol measurement techniques. In order to better involve the young scientist community in GAW activities, early career scientists from the GAW community were sponsored to participate in the YESS (Young Earth System Scientists) Early Career Researchers Workshop 2015 organized in Offenbach, Germany, from 28 to 30 October 2015.

7. Outreach

GAW continues to produce regular Bulletins (GHG Bulletin, Antarctic and Arctic ozone Bulletins). The Aerosol Bulletin (#2) on Black Carbon is in the production stage. GAW implemented a new communication tool called eZine, which is a newsletter featuring news from the programme produced every three months.

ANNEX 1

GAW IP EXECUTIVE SUMMARY

1. GAW IP builds around the concept "Research Enabling Services". It establishes the main implementation principles, describes major programme activities and key elements required to implement the concept.

2. The plan relies on the earlier achievements GAW has made during the twenty-five years of its existence. It refers to international leadership GAW played in research and capacity building in atmospheric composition observations and analysis through maintaining and applying long-term systematic observations of the chemical composition and related physical characteristics of the atmosphere, emphasizing quality assurance and quality control. The plan establishes further objectives of GAW in provision of products and possible service required by different user communities including NMHSs, environmental conventions, research institutes and many others.

3. Thus, the current Implementation Plan (IP) builds upon the growing importance of atmospheric composition observations and predictions, and focuses on research that enables a wide variety of products and services related to atmospheric composition (based on high-quality observation, analysis and modelling – all at various spatial and temporal scales). Applications addressed by the plan are summarized in the three large groups: Monitoring (Observation and Analysis) of Atmospheric Composition and Quantification of their Changes; Forecasting Atmospheric Composition changes on various scales, and Providing Atmospheric Composition information to support services in urban and populated areas. The plan provides details of more specific application in these three broad areas and describes the collaboration which has to be established in support of specific applications.

4. The IP supports the WMO priority areas identified in the WMO strategic plan and priority areas by the Commission for Atmospheric Sciences (CAS) for the period 2016-2020 through observations, analysis and modelling activities that allow for development of services to WMO Members. Particular contributions of GAW include improvement of forecasting capability for air quality in support of disaster risk reduction, sustained long-term global observations of the major climate change drivers, and development of the Integrated Global Greenhouse Gas Information system. GAW coordinated observations also contribute to implementation of the WMO Integrated Global Observing system. GAW supports enhancement of aviation meteorological services through research of atmospheric aerosols dispersion and research related to polar and high mountain regions trough analysis of atmospheric composition impact on air quality and snow albedo in related areas. Capacity development remains one of the key GAW activities and it is implemented through GAW dedicated training events, support of summer schools, expertise exchange and other means.

5. GAW IP describes specific objectives and activities related to observational network development, implementation of the Quality Assurance and data management, provides a framework for development of modelling tools, gives details of capacity building approach and outreach strategy and provides terms of reference of programme bodies and involved partners.

ANNEX 2

IG^{3}IS CONCEPT PAPER ANNOTATED OUTLINE

1. Motivation

In order to provide GHG information that will support post COP21 action, there is need for an Integrated Global GHG Information System (IG^{3}IS) working at the "policy-relevant" local, regional, and national scales, as well as global scales. An IG^{3}IS combines atmospheric composition with bottom-up inventory data to better inform policy and decisions. The motivations section further describes the background for IG^{3}IS.

2. Goals of IG^{3}IS

This section describes more specific goals of the system. It calls for the establishment of the partnerships and highlights the need for the involvement of user communities in design of specific IG^{3}IS building blocks. The section also reflects on the potential of combining atmospheric composition and socioeconomic activity data to quantify progress of emission reduction agreements (e.g., NDCs), to reduce uncertainty of emission inventory reports, and to inform additional mitigation actions.

3. IG^{3}IS Principles

Implementation of IG^{3}IS requires that all elements of the system are built in a harmonized way. This section lays out the principles by which IG^{3}IS will achieve such harmonization such as:

- IG^{3}IS will serve as an international coordinating mechanism and establish and propagate consistent methods and standards.
- IG^{3}IS will provide a common framework for development of the best practices utilizing diverse measurement and analysis approaches.
- Stakeholders are entrained in planning and implementation from the beginning to ensure that information products meet user priorities.
- The system must be practical and focused.
- Success-criteria are that the information guides additional and valuable emission-reduction actions.
- IG^{3}IS must mature in concert with evolution of user-needs, policy and technical skill.

4. Potential applications

This section describes potential applications of the system. The applications can be considered in tiered approach coming from the quantification of the progress of global agreements to sub-national efforts and new mitigations. It highlights how combination of atmospheric composition and socioeconomic data can ensure more frequent and low-latency trend assessment of NDCs in support of Global Stocktaking in the context of the Paris Agreement. IG^{3}IS can further guide Members in complementary emission reporting to UNFCCC based on inverse modelling techniques (e.g., UK example). The section reflects on the possible additional sub-national reduction efforts through addressing large urban source-regions (megacities) or specific emissions from a given sector (e.g. detection and attribution of CH_4 emissions from oil and gas sector).

5. Improved Tools

Last section reflects the need for the new tools, like enhancements to aircraft observations of greenhouse gases and isotopic measurements for source attribution.