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Atmospheric Composition: Update of Observation Requirements

(Submitted by Richard Eckman, NASA)

Summary and Purpose of Document

This document reports on recent activities of the WMO Global Atmosphere Watch (GAW) Task Team on Observational Requirements and Satellite Measurements as regards Atmospheric Composition and Related Physical Parameters.

ACTION PROPOSED

The eighth session is invited to take note of the WMO GAW Task Team activities relating to the status of atmospheric composition space capabilities and comment accordingly.

Appendices: A. Terms of Reference of the WMO Global Atmosphere Watch (GAW) Task Team on Observational Requirements and Satellite Measurements as regards Atmospheric Composition and Related Physical Parameters

DISCUSSION

Introduction

Various forums have addressed observational requirements and looming gaps in space-based observations relating to the composition of the atmosphere. The Integrated Global Atmospheric Chemistry Observation System (IGACO) Report “The Changing Atmosphere – An Integrated Global Atmospheric Chemistry Observation Theme for the IGOS Partnership”, which was published in September 2004 jointly by WMO and the European Space Agency (GAW Report 159), presented a strategy for deploying integrated observation system by combining ground-based, aircraft, and satellite observations with suitable data archives and global models.

Given the long period of time since the publication of the IGACO report, WMO’s sixteenth Congress in 2011 recommended that “GAW set up an ad-hoc Task Team to review the needs for GAW regarding satellite measurements and the IGACO recommendations on these that date back to 2004.”

Task Team Meeting Outcomes

A WMO GAW Task Team on Observational Requirements and Satellite Measurements as regards Atmospheric Composition and Related Physical Parameters was formed in 2014 and met in Geneva during the week of 10 November 2014. The international team assembled spent considerable time discussing the important variables relevant to atmospheric composition to be measured and mapping them to the WMO Observing Systems Capability Analysis and Review Tool (OSCAR) data base.

The team noted that the Rolling Review of Requirements (RRR) process defined by the Manual on the Global Observing System created an Application Area called “Atmospheric Chemistry”. However, the team agreed that atmospheric chemistry is more a scientific discipline than a WMO Integrated Global Observing System (WIGOS) Application Area and that this wording was chosen as a kind of placeholder. Therefore, following deliberations, the team recommended three Applications Areas that encompasses major elements of GAW research consistent with the theme, “GAW – research enabling services”:

- **Forecasting Atmospheric Composition (F)** – Covers applications from global to regional scales (with horizontal resolutions similar to global NWP (~ 10 km and coarser) with stringent timeliness requirements (NRT) to support operations such as sand and dust storm and chemical weather forecasts.
- **Monitoring Atmospheric Composition (M)** - Covers applications related to evaluating and analyzing changes (temporally and spatially) in atmospheric composition regionally and globally to support treaty monitoring, climatologies and re-analyses, assessing trends in composition and emissions/fluxes, and to better understand processes, using data of controlled quality (and with less stringent time requirements (not needed in NRT)), and used in products such as Ozone and Greenhouse Gas Bulletins, and State/Health of the Atmosphere reports.
- **Providing Atmospheric Composition information to support services in urban and populated areas (U)** - Covers applications that target limited areas (with horizontal resolution of a few km or smaller and stringent timeliness requirements to support services related to weather/climate/pollution, such as air quality forecasting. (The GURME SAG will review all related entries).

In addition, the team identified key parameters needed for each of these applications and suggested required spatial and temporal coverage requirements for each. The team also developed a strategy to begin the Rolling Review Process (RRR) process and to populate the OSCAR data base for the applications defined above. The process will engage the WMO Scientific Advisory Groups (SAGs) and the Environmental Pollution and Atmospheric Chemistry Scientific Steering Committee (SSC).

Among the next steps envisaged by the team are that the SAGs should work with other application areas that use atmospheric composition data to develop a plan to discuss atmospheric chemistry requirements. Key contacts and actions will be identified through the Secretariat.

Appendix A: Terms of Reference of the WMO Global Atmosphere Watch (GAW) Task Team on Observational Requirements and Satellite Measurements as regards Atmospheric Composition and Related Physical Parameters

Background

The Global Atmosphere Watch (GAW) Programme in its Addendum for the Period 2012 – 2015 to the WMO Global Atmosphere Watch (GAW) Strategic Plan 2008 – 2015 tasked each of its Science Advisory Groups (SAGs) to establish the Rolling Review of Requirement (RRR) process in each focal area (Ozone, Greenhouse gasses, reactive gasses, atmospheric wet deposition, UV radiation and Aerosols) as well as consider the requirements within GURME.

The comparison of user requirements with observing system capabilities for a given application area is called a Critical Review. The output of this is reviewed by experts in the relevant application area and used to prepare a Statement of Guidance (SOG), the main aim of which is to draw attention to the most important gaps between user requirements and observing system capabilities, in the context of the application. The SOG serves as a guiding document for the Members to develop an observational network which is appropriate for the applications.

The SOG for Atmospheric Chemistry was prepared in 2004 and approved by ET-EGOS in December 2005. It was, to a large extent, based on the IGACO Report “The Changing Atmosphere – An Integrated Global Atmospheric Chemistry Observation Theme for the IGOS Partnership”, which was published in September 2004 jointly by WMO and the European Space Agency (GAW Report no. 159). The SOG and the IGACO Report have served as guidance for setting up observational requirements and observational network development in the GAW Programme. Neither observational requirements, nor the observational capacity has been critically evaluated since then. Hence, there is an urgent need to update the recommendations, the overview of measurement capabilities and the identification of gaps in the observational network. The application area “Atmospheric Chemistry” also serves rather as a place holder than a real application area. In addition, satellite agencies require user based information on what is needed for future missions as regards observations of atmospheric composition and related physical parameters, because the observational capacity is delivered by a composite observing system (including ground and satellite based platforms).

According to decisions of WMO Congress, all component observing systems under the WMO Integrated Global Observing System (WIGOS) framework will use RRR process to vet and document observations data requirements, assess observational capabilities and provide guidance regarding future evolution of observing systems. This process is relatively mature for certain components (notably the Global Observing System), but is now increasingly being adopted also by other WIGOS components (e.g. GAW).

This led WMO’s sixteenth Congress in 2011 to make the following recommendation¹:

Regarding satellite measurements of atmospheric chemical constituents and related physical parameters, Congress recommended for GAW to set up an ad-hoc Task Team to review the needs for GAW regarding satellite measurements and the IGACO recommendations on these that date back to 2004. Congress further recommended for this work to be done in coordination with the CBS Expert Team on Satellite Systems (ET-SAT) and the Expert Team on Evolution of the Global Observing Systems (ET-EGOS), the Committee on Earth Observation Satellites (CEOS) Atmospheric Composition Constellation group and the Coordination Group for Meteorological

¹ Sixteenth World Meteorological Congress, Geneva 16 May – 3 June 2011. WMO-No. 1077. Chapter 3.2.3, p. 39.

Satellites (CGMS) and also taking into consideration GCOS requirements and the vision for the GOS in 2025. Congress highlighted that the required coverage, precision, spatial and temporal resolution called for geostationary and low earth orbit observation capabilities to be implemented and sustained. Congress requested Members operating satellites to include atmospheric sensors of proven capability aboard future spacecraft, and to maintain continuous atmospheric composition measurements for as long as possible, making a selection of data available to all interested users. Congress recognized that such remote sensing observations are meaningful when they are combined with the in-situ observations to produce global three dimensional high resolution and high quality products. The importance of the in-situ observations by Members is not at all reduced by the presence of satellite and aircraft observations.

Purpose

The Task Team (TT) will help to define application areas for GAW in cooperation with Scientific Steering Committee for Environmental Pollution and Atmospheric Chemistry (EPAC SSC) under CAS. Further, the TT will assess the needs within GAW and other WMO Programs for measurements in the general area of atmospheric composition (within identified application area) in cooperation with the EPAC SSC. The TT will review how atmospheric composition measurements relate to the current application areas within RRR process (<http://www.wmo.int/pages/prog/www/OSY/GOS-RRR.html>). The TT should refer to the above-mentioned Statement of Guidance in atmospheric chemistry application area. The communities that will require this information are those working with atmospheric chemistry and climate, air pollution and human and ecosystem health, air quality forecasting, and inclusion of atmospheric composition data in meteorological models. The information provided by the TT will be incorporated in the Observing Systems Capabilities, and Review (OSCAR) database supporting the RRR process for all WIGOS components and all WMO application areas. Furthermore, the task team will assist the EPAC SSC to establish the RRR process as integrated part of GAW within the WIGOS framework.

Membership, meetings and reporting

The TT should consist of about 10-15 members including representatives from the GAW and other communities with and interest in atmospheric composition, and the entities mentioned in para 3.2.3 Cg-XVI, and representatives of relevant WMO Programmes, with a chairperson leading the work. The TT is to meet in person with subsequent work being conducted mainly by email and teleconferencing. The TT will report to the WMO EPAC SSC and will provide input to the work of WIGOS and the WMO Space Programme. The work may proceed in stages, however, major output is expected in time for documentation to the WMO 17th Congress, to be held 25 May to 12 June 2015.

Terms of Reference (ToRs)

1. To take note the current WIGOS overall application area of atmospheric chemistry and consider a revision resulting in a number of application areas covered by its activities to be done in close cooperation with EPAC SSC. Suggest an update of the inventory of application areas within the field of atmospheric chemistry to be supported under the RRR and used in the GAW Implementation plan for the period 2016-2023.
2. For identified application areas to review user requirements for observations of atmospheric composition and related physical parameters, focusing on GAW variables, in a broad technology-free manner. Review user requirements for observations of atmospheric composition and related physical parameters for other than atmospheric chemistry applications areas already identified in WIGOS
3. To review the current observational capabilities in support of identified applications areas
4. To review current use of available satellite information in this field and how to enhance its use
5. To consider timelines for the need of delivery of satellite products
6. To consider needs for collocation of instruments for vertical distribution and surface measurements as relates to satellite observations, for inclusion in models and for satellite validation, especially for high resolution data,

7. To identify current and future gaps in observational capability, given the needs for observations and the observational capability.
 8. To provide an input to the respective GAW bodies necessary for the update of the Tables and Figures in the SOG (and the IGACO Report) that give an overview of key atmospheric constituents to be targeted, an overview of existing and planned platforms and instruments addressing these key constituents and tables with observational requirements for inclusion into the OSCAR database,
 9. To study the ongoing work on the WMO Rolling Review of Requirements (RRR) described at: <http://www.wmo.int/pages/prog/www/OSY/GOS-RRR.html> and the Observing Systems Capabilities Analysis and Review tool (OSCAR), a component of the RRR for recording observational requirements and observing capabilities (both space-based and surface-based), and conducting critical reviews, please see: <http://www.wmo.int/pages/prog/www/OSY/RRR-DB.html>
 10. Assist the EPAC SSC with drafting the procedures to establish the RRR process as an integrated part of GAW within the WIGOS framework.
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