World Meteorological Organization

Weather • Climate • Water

Global Atmosphere Watch – Opportunities for Fostering Enhanced Collaborations with WWRP/WCRP/WGNE…

GAW Motivation: *Research conducted on atmospheric composition accounting for the human impact on the atmosphere enables better services*

The GAW Mission

- *Systematic* ***Global Monitoring*** of the Chemical Composition of the Atmosphere.
- Analysis and Assessment in Support of ***International Conventions***.
- Development of Air Pollution and Climate ***Predictive Capability.***

GAW – What's Next?

GAW Strategic Implementation Plan (2016-2023)
- within the context of WMO SP & CAS priorities

WMO Strategic Plan, which can be summarized as «Science for service» and includes:

- Disaster risk reduction
- Global integrated polar prediction system (GIPPS)
- Megacities
- Global Framework for Climate Services (GFCS)
- WMO Integrated Global Observing System (WIGOS) and WMO Information System (WIS)

GAW – What's Next?

CAS-16, which identified six emerging areas:

1. High Impact Weather and its socio-economic effects in the context of global change;
2. Water modelling and predicting the water cycle for improved DRR and resource management;
3. Integrated GHG Information System (IG^3IS) - serving society and supporting policy;
4. Aerosols and their impacts on air quality, weather and climate;
5. Urbanization - research and services for megacities and large urban complexes; and
6. Evolving Technologies (including geo-engineering) and their impact on science and its use.

GAW – What's Next?

New Strategic Implementation Plan (2016 – 2023)
Research Enabling Services

Focuses on the theme ***- Atmospheric Composition Matters*** **-** to climate, weather forecasting, human health, terrestrial and aquatic ecosystems, agricultural productivity, aeronautical operations, renewable energy production, and more.

GAW has a central role to play in helping WMO members and society develop and deliver improved products and services involving atmospheric composition.

GAW - Thematic research application areas (1) – used to help focus activities

- **Forecasting Atmospheric Composition (F)** – Covers applications from global to regional scales, with horizontal resolutions similar to global NWP (~ 10 km and coarser), and with stringent timeliness requirements (NRT). These applications, for example, include support for operations such as sand and dust storm warnings and chemical weather forecasts.

GAW - Thematic research application areas (2)

- **Analysis and Monitoring of Atmospheric Composition (M)** - Covers applications related to evaluating distributions of and analyzing changes in atmospheric composition on regional to global scales.
- In contrast to forecasting applications, this theme requires data of assured quality but with less stringent time requirements.
- These applications include assessments of trends in composition, deposition, and emissions; development of climatologies and re-analyses; evaluation of regional and global chemical transport models and their representation of processes; evaluation of satellite-derived retrievals of atmospheric composition variables; and support of treaty monitoring, etc.

GAW - Thematic research application areas (3)

- **Providing Atmospheric Composition information to support services in urban areas (U)** - Covers applications that target limited areas (with horizontal resolution of a few km or smaller) and, in some cases, with stringent timeliness requirements.
- A distinguishing feature of this category of applications is their emphasis on research in support of operational services, such as air quality forecasting, which use approaches such as pilot projects and feasibility demonstrations.

GAW - Targeted Services/Cross-Cutting Topics

- climate change;
- high-impact weather and events;
- urban meteorology, air quality and health;
- ecosystems; and
- conventions and treaties.

PLUS Cross cutting issues…

- aerosols
- GHG tracking
- Health

GAW – What's Next?

Continue to improve observational systems and data using ***RRR and WIGOS/WIS*** **(**WMO Integrated Global Observing System and WMO Information System) ***to evolve the observing system for atmospheric composition to support the growing services to:***

+ allow near real-time provision of GAW data,
+ support integration of surface, vertical profile and column datasets from different platforms to provide a unified understanding of aerosol and gas distributions,
+ minimize gaps in the measurement networks in data-poor regions,
+ support the expanding service needs related to cities, high impact weather, and climate

Priority – Expanding GAW's role in enhancing predictive capabilities (wrt atmospheric composition and its uses)

- The focus of the new SIP on services provides a framework via the priority application areas to evolve observations and to enhance modeling elements;
- GAW has played an active role in further developing urban air quality forecasting capabilities through (GURME) - these efforts will continue and expand;
- Establishing a new SAG ("GAW-Aps") focused on the objective "To demonstrate usefulness of exchanging chemical observational data in NRT in support of monitoring and forecasting applications" targeting applications that use NRT data delivery on scales larger than urban; and
- Expand collaborations with WWRP/WCRP/WGNE and others…

Explore collaborations around applications involving atmospheric composition

- Chemical weather / air quality forecasting and reanalyzes
- NWP for precipitation, visibility, thunderstorms, etc.
- Sand and Dust Storm Modelling and Warning Systems
- Wild fire atmospheric pollution and effects
- Volcano ash forecasting, warning and effects
- High Impact Weather and Disaster Risk
- Data assimilation for air quality and NWP
- Weather modification and geo-engineering
- Effects of Short-Lived Climate Forcers
- Earth System Modelling and Projections

Ideas moving forward for collaborations

- Target activities related to:
  - 1) atmospheric composition forecasting with a focus on urban areas;
  - 2) role of atmospheric composition (e.g., aerosols) in NWP and climate prediction (CCMI);
  - 3) role of on-line seamless models (as discussed in recent CCMM meeting - Coupled chemistry–meteorology modelling: status and relevance for numerical weather prediction, air quality and climate communities);
  - 4) assimilation of atmospheric composition data in NWP with the purpose to improve the forecasting skills;
- Explore activities with WGNE on topics such as aerosol (WWOSC) and assimilation of atmospheric composition data to NWP models; and
- Establish joint vision and subsequent projects, working groups, etc. with GAW;
- Others….

Background Slides

Urban activities

- CAS-16 Priority “Urbanization: research and services for megacities and large urban complexes”
- Population growth and urbanization are amongst the main drivers for the demand for increased and more accurate environmental assessments and predictions
- GURME has a great long-term experience need to expand throughout GAW
- Climate Service department has a long-term experience in urban climate and meteorology
- WWRP is focusing on many issues relevant for urban areas: HIW project, Meso&Nowcasting WG, disaster risk reduction, …
- WWRP White Papers on ‘Urbanization’ + ‘Seamless MetChem’ – good scientific background for SIP
- TOMACS groups - future collaborations perhaps associated with Tokyo 2020 Olympic project.
- Growing interest of WHO, CCAC Urban Health Initiative (UHI),
- Link of different departments and activities within WMO and UN

Goals of the Exercise

- This project aims to improve our understanding about the following questions:
- How important are aerosols for predicting the physical system (NWP, seasonal, climate) as distinct from predicting the aerosols themselves?
- How important is atmospheric model quality for air quality forecasting?
- What are the current capabilities of NWP models to simulate aerosol impacts on weather prediction?

WMO WGNE-GURME - EuMetChem COST ES1004 collaboration

- Joint analysis of on aerosol feedbacks on NWP (case studies of WGNEE (3), EuMetChem (3), AQMEII (2010))
- Discussions on EGU Session 'Integrated physical and chemical weather modelling with two-way interactions' (Apr 2014) and on WWOSC Integrated Modelling Session (Aug 2014)
- Participation in Aveiro Summer School, 6-11 June 2014
- Joint EuMetChem/MACC/GURME/WGNEE/WCRP Coupled Chemistry-Meteorology Modelling Symposium at WMO, Geneva, 23-25 Feb 2015.
- Joint Web-site and WMO report.
- ACP/GMD special issue jointly with WMO WGNE and EGU/WWOSC/AQC Integrated modelling sessions.
- Joint vision of further priorities after COST ES1004
- White paper on Coupled Chemistry-Meteorology Modelling for WWOSC White Papers Book

Online coupling for (i) NWP and MetM, (ii) AQ and CWF, (iii) Climate and Earth System modelling

- Relative importance of online integration and of the priorities, requirements and level of details necessary for representing different processes and feedbacks can greatly vary for these related communities.
- **NWP** might not depend on detailed chemical processes but considering the cloud and radiative effects of aerosols can be important for fog, visibility and precipitation forecasting.
- For **climate modelling**, feedbacks from GHGs and aerosols become extremely important. However in some cases (e.g., for long-lived GHGs on global scale), fully online integration of full-scale chemistry is not critically needed. Still too expensive, so models need to be optimized and simplified.
- For **chemical weather forecasting** and prediction of atmospheric composition in a changing climate, the online integration definitely improves AQ and chemical atmospheric composition projections.
- Different targets with respect to temporal as well as spatial scales, but also to processes under focus.
- For **AQ forecasting**, the key issue is usually the ground-level concentration of pollutants, whereas for weather and climate studies model skill is typically based on screen level temperature, wind speed and precipitation.
- For **pollen forecast**: Improve pollen emission simulation and correspondingly concentrations. Feedbacks are not important. Chemistry is not considered, but interaction with allergens would be interesting to study (not done yet).
- **Main gaps**: Understanding of several processes: aerosol-cloud interactions are poorly represented; data assimilation in online models still to be developed to avoid over-specification and antagonistic effects.; model evaluation for online models needs more (process) data and long-term measurements – and a test-bed.

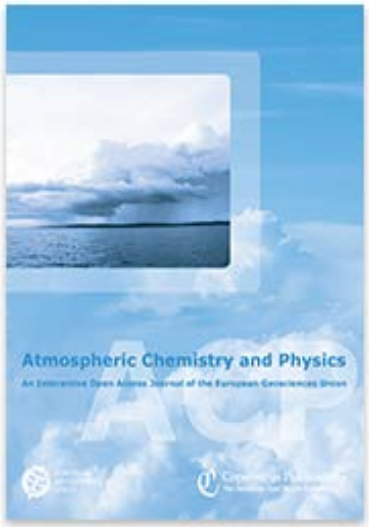
What are the advantages of integrating meteorological and chemical/aerosol processes in coupled models for NWP?

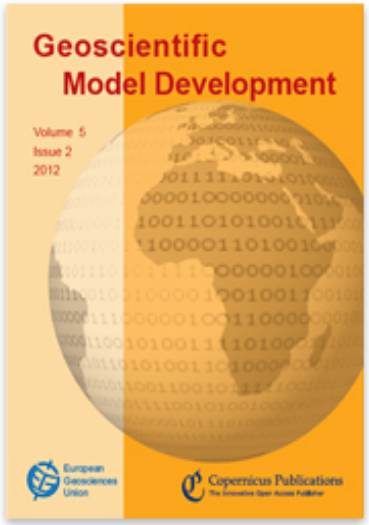
- Advantages for episodes in relation to
  - health effects
  - aviation forecasts (icing, volcanic ash)
  - Radiation & surface temperature
  - Plume rise
- Cloud properties - probably
- Precipitation - not yet clear.
- Benefits under ‘normal’ conditions not clear
- Improving satellite retrieval of CO2 concentrations (and others?)

How important are the two-way feedbacks and chains of feedbacks for NWP? (1)

- strong evidence for the importance of some of the model chains – e.g increased AOD -> lower surface T -> shallower PBL-> increasing primary pollutant concentrations
- Importance varies strongly with location (indirect effect more important in tropics?) and time (episodes) and with the model used
- For weather prediction the 3D real-time aerosol would most probably be important in specific cases of high aerosol concentrations.

CCMM Special Issue of ACP & GDM Journals





Special Issue jointly organized between Atmospheric Chemistry and Physics and Geoscientific Model Development journals :

Coupled chemistry–meteorology modelling: status and relevance for numerical weather prediction, air quality and climate communities.

Open for submissions until August 2015 (can be prolonged)

See: http://www.atmos-chem-phys-discuss.net/special_issue241.html

All participants of the CCMM Symposium and all interested are invited to submit papers!!

WMO

World Meteorological Organization

A United Nations Specialized Agency

Working together in Weather, Climate and Water

Thank you for participation!

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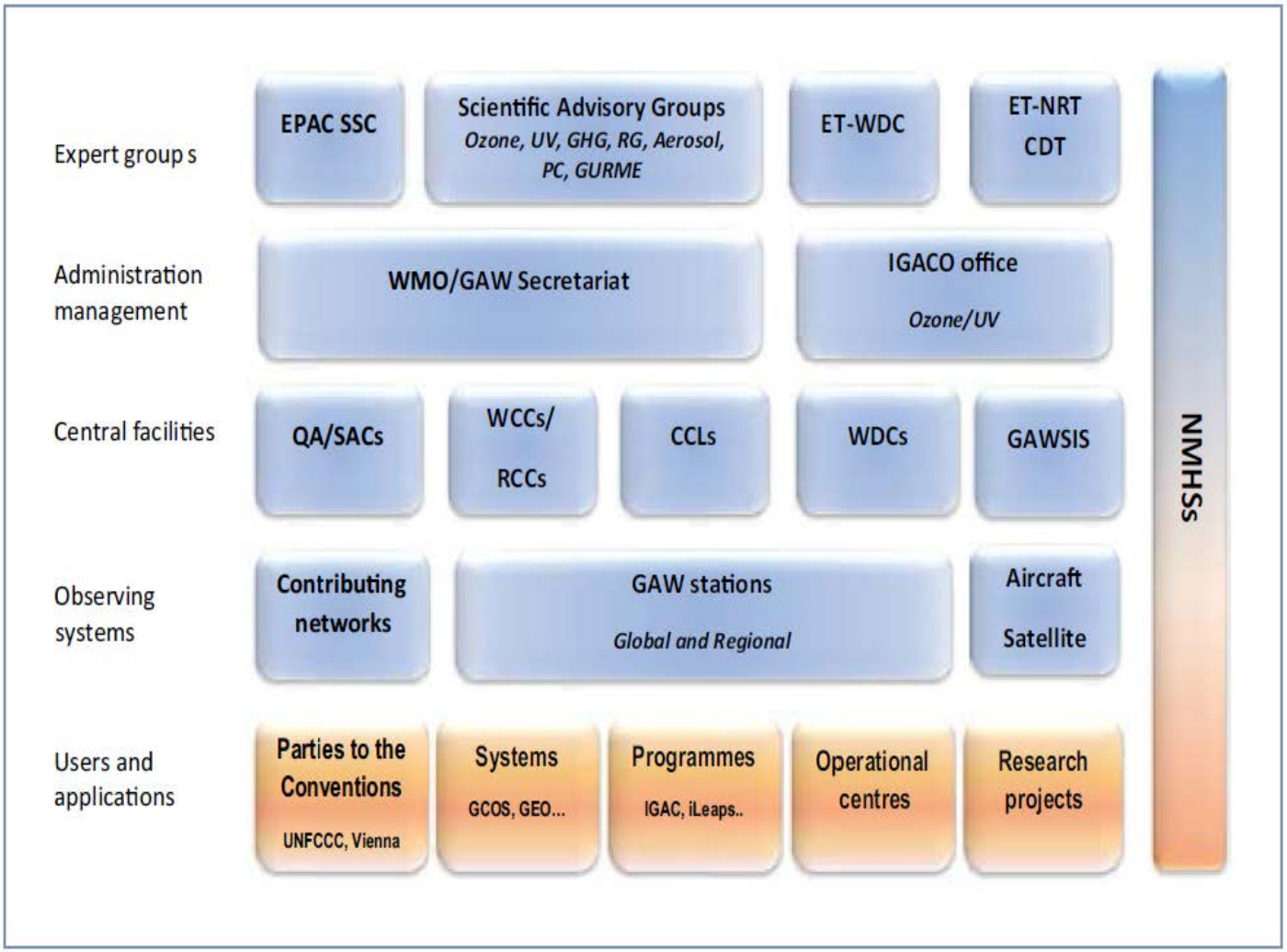
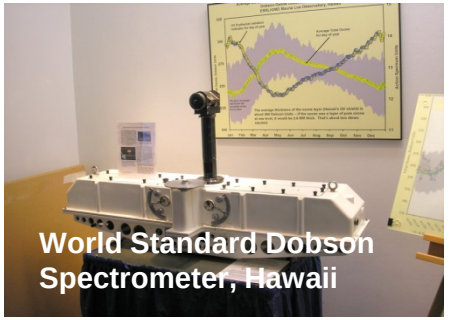
EUROPEAN COOPERATION IN SCIENCE AND TECHNOLOGY

The GAW Programme Elements




World Standard Dobson Spectrometer, Hawaii

Application Areas – Background (1)

WIGOS Applications:

- Global numerical weather prediction (GNWP);
- High-resolution numerical weather prediction (HRNWP);
- Nowcasting and very short range forecasting (NVSRF);
- Seasonal and inter-annual forecasting (SIAF);
- Aeronautical meteorology;
- Atmospheric chemistry;
- Ocean applications;
- Agricultural meteorology;
- Hydrology;
- Climate monitoring (as undertaken through the Global Climate Observing System, GCOS);
- Climate applications; and
- Space weather.
- In addition, the observational requirements for WMO polar activities and the Global Framework for Climate Services (GFCS) are also to be considered under WIGOS.

- SSC agreed with the view of Paolo Ruti that potential collaboration areas between GAW and WWRP can include:
- 1) atmospheric composition forecasting with a focus on urban areas;
- 2) assimilation of atmospheric composition data in NWP with the purpose to improve the forecasting skills;
- SSC noted that collaboration with S2S project lays a bit out of the major scope of GAW activities.
- Another potential body where GAW can profit of collaboration is the Working Group on Numerical Experimentation (WGNE). WGNE is developing numerical models and has a group on aerosols and a group on assimilation of atmospheric composition data to NWP models. GAW will benefit from collaboration with these groups. Greg Carmichael accepted an invitation to participate in WGNE meeting in March 2015 and he will follow up on the potential collaboration activities between WGNE and GAW.
- SSC noted that the ways of collaboration with the World Climate Research Programme (WCRP) should be further investigated.
- Alexander Baklanov noted that potential collaboration ways between

Possible Next Steps

- Must be enhanced in GURME («Urban meteorology» projects) -> potentially should be involved in high impact weather activities.
- SDS-WAS provides regional forecasting of one of the GAW variables, but it is detached from GAW. There is no communication between SDS steering groups and GAW Scientific Advisory Group on Aerosols.
- Several potential joint initiatives are suggested, including:
- Sand and dust storms are but the one of the problems related to aerosol transport, others include aerosol transport from biomass burning or volcanic plumes propagation. Those transport related alterations of atmospheric composition should be considered systematically as similar scientific issues.
- GAW is supporting the Interdisciplinary Biomass Burning Initiative, but the formal involvement of the GAW or WWRP communities in this initiative is rather limited. Links should be established with WMO activities (S2S project)
- WWRP and GAW can work together on the development of assimilation schemes of the GAW observations in NWP models (e.g. through WGNE)

During discussions the following action items were recorded:

- The SSC suggested to involve WGNE to develop research activities for meteorology-chemistry modeling and forecast.