WEATHER CLIMATE WATER
TEMPS CLIMAT EAU

The Global Atmosphere Watch Programme

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World Meteorological Organization
Organisation météorologique mondiale

Global Atmosphere Watch Programme

Provides international leadership in research and capacity development 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,*
- *delivering integrated products and services related to atmospheric composition of relevance to society.*

GAW builds on partnerships involving contributors from **100** countries (*including many contributions from research community*)

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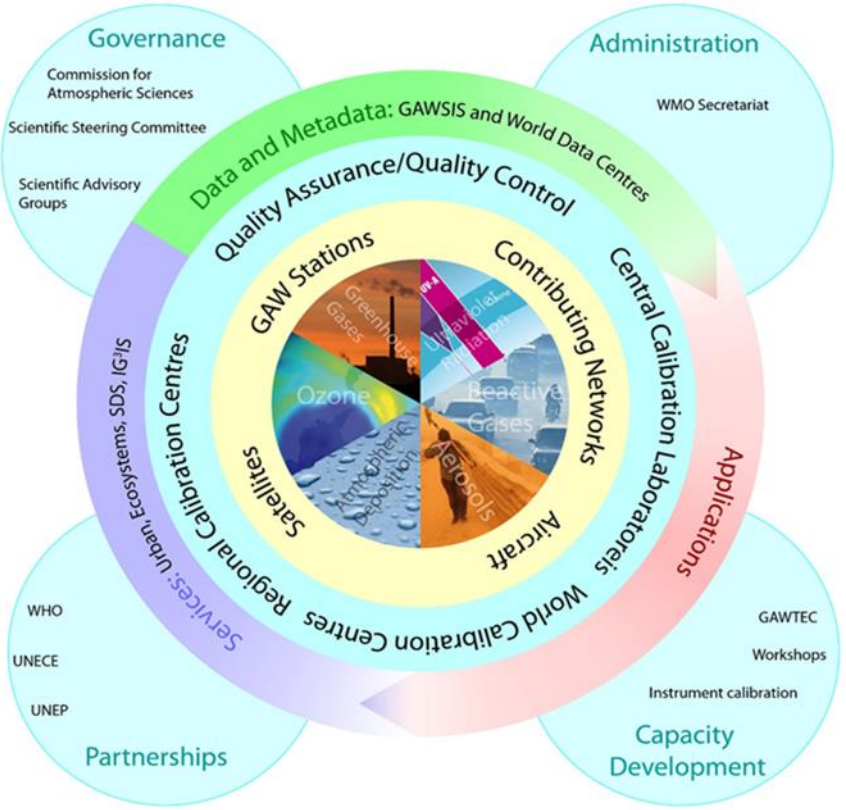
Elements integrated in GAW

- Observations
- Quality assurance
- Data management
- Modeling and analysis
- Joint research
- Capacity building
- Outreach and communications



Promote a "value chain" from observations to services

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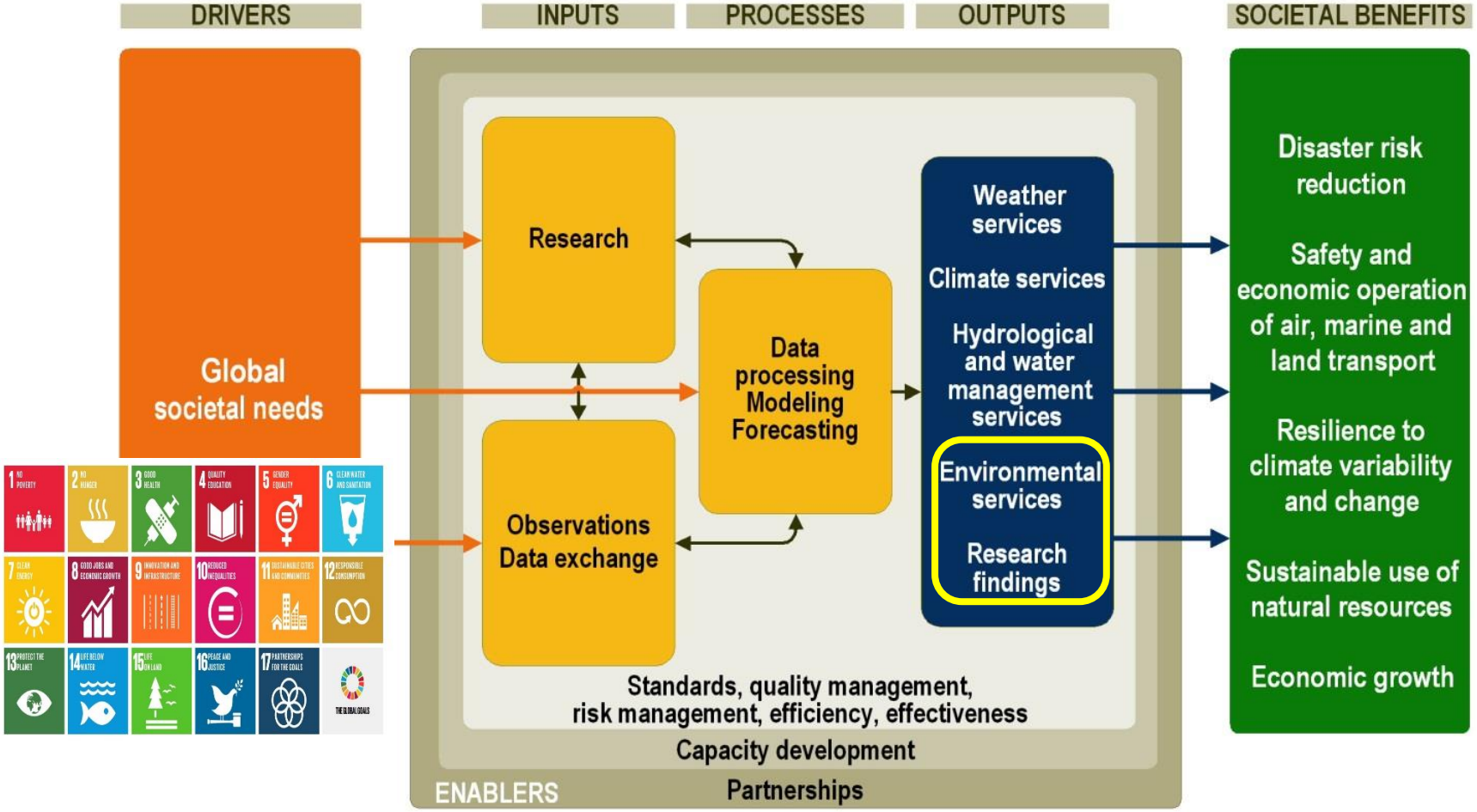
Overarching Objective - Improve Prediction Capabilities via Incorporating/Integrating Composition, Weather and Climate



Seamless Prediction *Across all Relevant Temporal and Spatial Scales (**GDPFS**)*

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Applications in GAW to supports Members

Observations and reanalysis: direct support of conventions (LRTAP, Montreal Protocol)

Specific service oriented applications:

- *Support of climate negotiations*: IG^{3}IS
- *Ecosystem services*: Analysis of total deposition, nitrogen cycle, deposition to the oceans/marine geoengineering
- *Health:* Regional (GAQF) and Urban air quality (GURME)
- *Sand and Dust Storm* Warning Advisory and Assessment System (SDS-WAS)
- *Vegetation Fire and Smoke Pollution* Warning and Advisory System (VFSP-WAS)
- *Food security:* Atmospheric composition and agriculture
- *Transport security*: Volcanic ash forecasting
- *Weather forecasting*: aerosol effects on NWP, high impact weather

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GAW – enhancing modeling

Expand GAW's role in enhancing predictive capabilities (atmospheric composition and its uses)

☑ urban air quality forecasting capabilities through GURME,

☑ new Modelling Applications SAG ("Apps") – usefulness exchanging chemical observational data in NRT

☑ expanding collaborations with WWRP/WCRP/WGNE and others

GAW SAG-APPs Work Streams

(1) Assessments (Dentener, Hegglin)

- Health, Climate Change, Ecosystems

(2) Improving emissions (Sofiev, Zhou)

- Up-to-Date, Weather-dependent, Inverse

Co-chairs: F. Dentener (JRC) & V.-H. Peuch (C

(3) Further developments of NRT systems (Hort, Peuch)

- Ensembles, enable set-up applications worldwide

(4) Data aspects (Da Silva, Tanaka)

- Identify gaps (limb sounding…), common skill scores, Use of WIS

(5) Developing scientific activities (Makar, Grell)

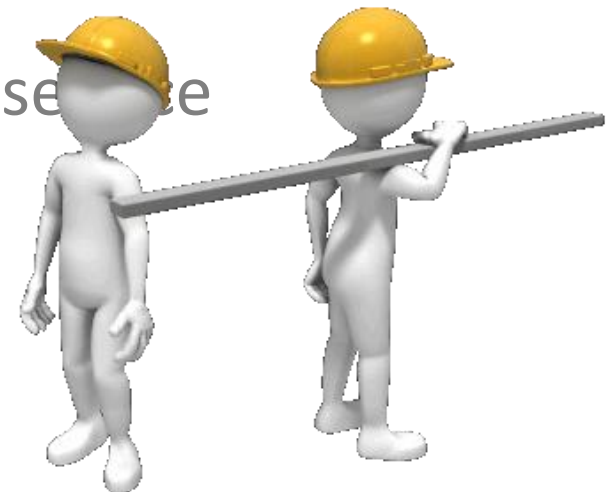
- interactive chemistry/radiation for improving NWP forecasts (up to seasonal), identify gaps in knowledge

(6) Outreach

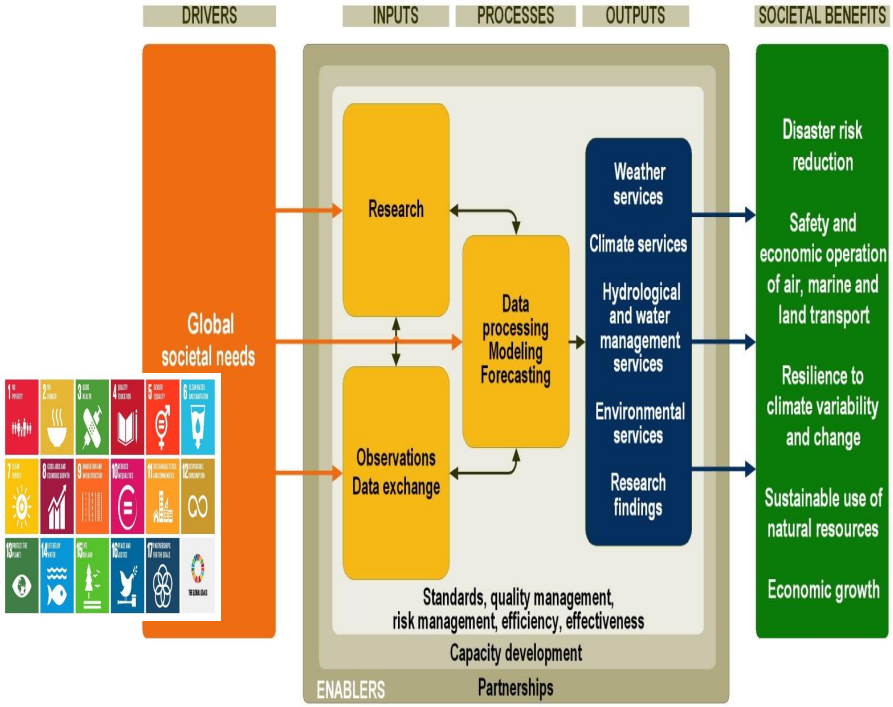
- Summer schools, webinars, “Year of Air Quality” initiative?

Cross-cutting thematic projects to develop new services :

- Integrated Global Greenhouse Gas Information System - IG^{3}IS (support of climate services)
- Measurement-model fusion for total deposition (support of the ecosystem assessment and food security)
- Global Air Quality Forecasting (GAQF) Project (support of the health sector)
- Contribution to the integrated urban se ce



Overarching Objective - Improve Prediction Capabilities via Incorporating/Integrating Composition, Weather and Climate



WMO Initiative – Seamless Prediction
*Across all Relevant Temporal and Spatial Scales (**GDPFS**)*

Opportunities for enhanced collaborations

- Improved earth system models
- Data assimilation
- Downscaling
- Improved parameterizations
- Emissions inversion
- Transport
- Improved pbl representation
- Aerosols – removal, direct/indirect effects
- New data science applications
- Metrics and evaluation
- Chemical reanalysis
- Extending forecasts

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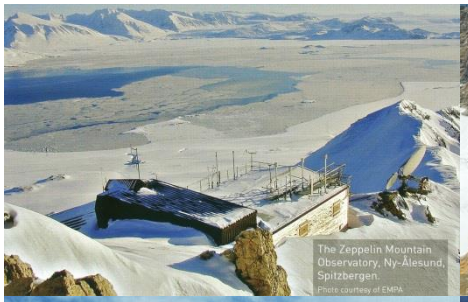
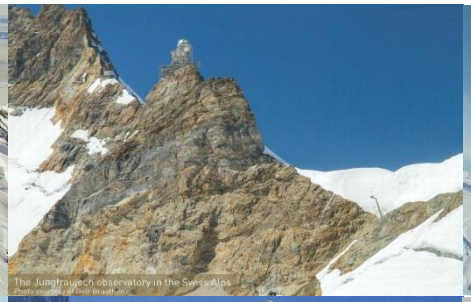
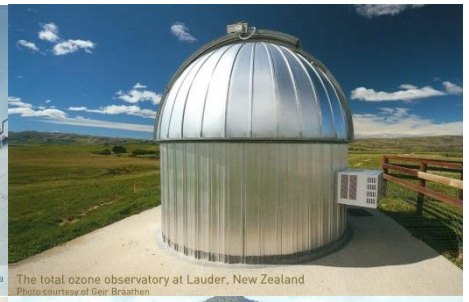
GAW


The Zeppelin Mountain Observatory, Ny-Ålesund, Spitzbergen.
Photo courtesy of EMPA


The Jungfraujoch observatory in the Swiss Alps

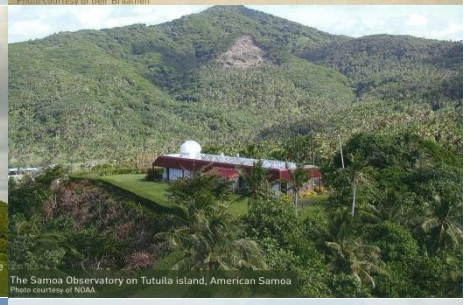

The 6th station at Halley, Antarctica
Photo courtesy of Jonathan Shanklin


The total ozone observatory at Lauder, New Zealand
Photo courtesy of Geir Braathen


The Neumayer Station III in Antarctica was inaugurated in February 2009
Photo courtesy of the Alfred Wegener Institute


Photo courtesy of CNR


The Puy de Dôme observatory became a Global GAW station in May 2015
Photo courtesy of Geir Braathen


The Samoa Observatory on Tutuila island, American Samoa
Photo courtesy of NOAA


The Izaña Observatory celebrates its 100th anniversary on 8 April
Photo courtesy of AEMET


Launching an ozonesonde from Ushuaia
Photo courtesy of SMN


Launching an ozonesonde at the Amundsen-Scott base at the South Pole


The Mt. Waliguan observatory is located 3810 metres above sea level
Photo courtesy of CAMS

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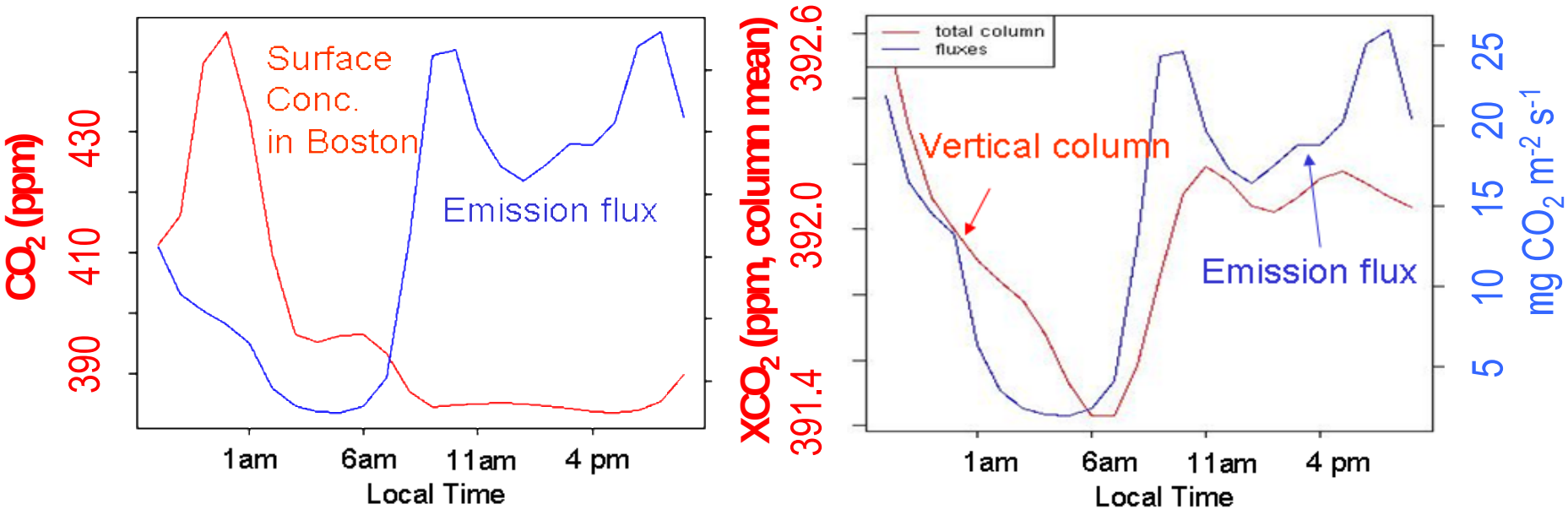
The potential of Atmospheric Composition (AC) for NWP

AC species	Impact on NWP	Mechanism
O_3, Aerosols, GHG	Dynamics , thermodynamics	Radiation scheme
Aerosols	Precipitation and clouds	Indirect effects
O_3, CO, Aerosols	Winds	4D-Var tracer mechanism
O_3, CO_2 [, N_2O], Aer	Radiance assimilation (Temp,WV)	Observation operator
CH_4	Water Vapour	Oxidation
CO_2	Surface heat fluxes	Land/sea- atmosphere interface exchange

WMO Role in GHG Information: Atmospheric Transport



The patterns in observed surface concentrations are distinctly opposite to the daily variations of emissions fluxes from human activity.

Surface concentrations of CO_2 maximize at nighttime when the nocturnal PBL is shallow, but PBL height and rush hour emissions are increasing in the morning.

Must understand atmospheric transport and dynamics to quantify emissions fluxes from atmospheric concentration measurements

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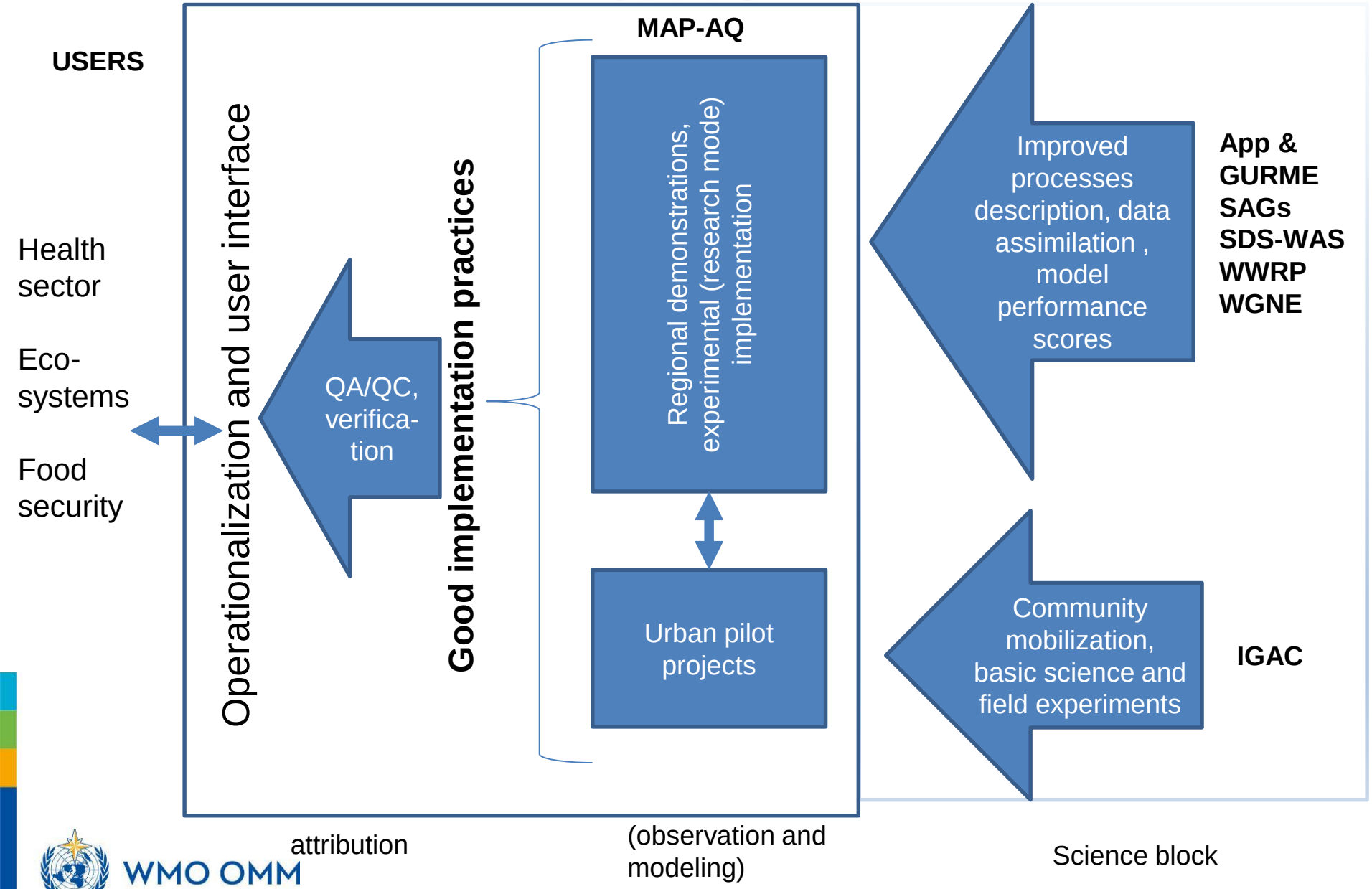
Global Air Quality Forecasting Services potentially part of GDPFS



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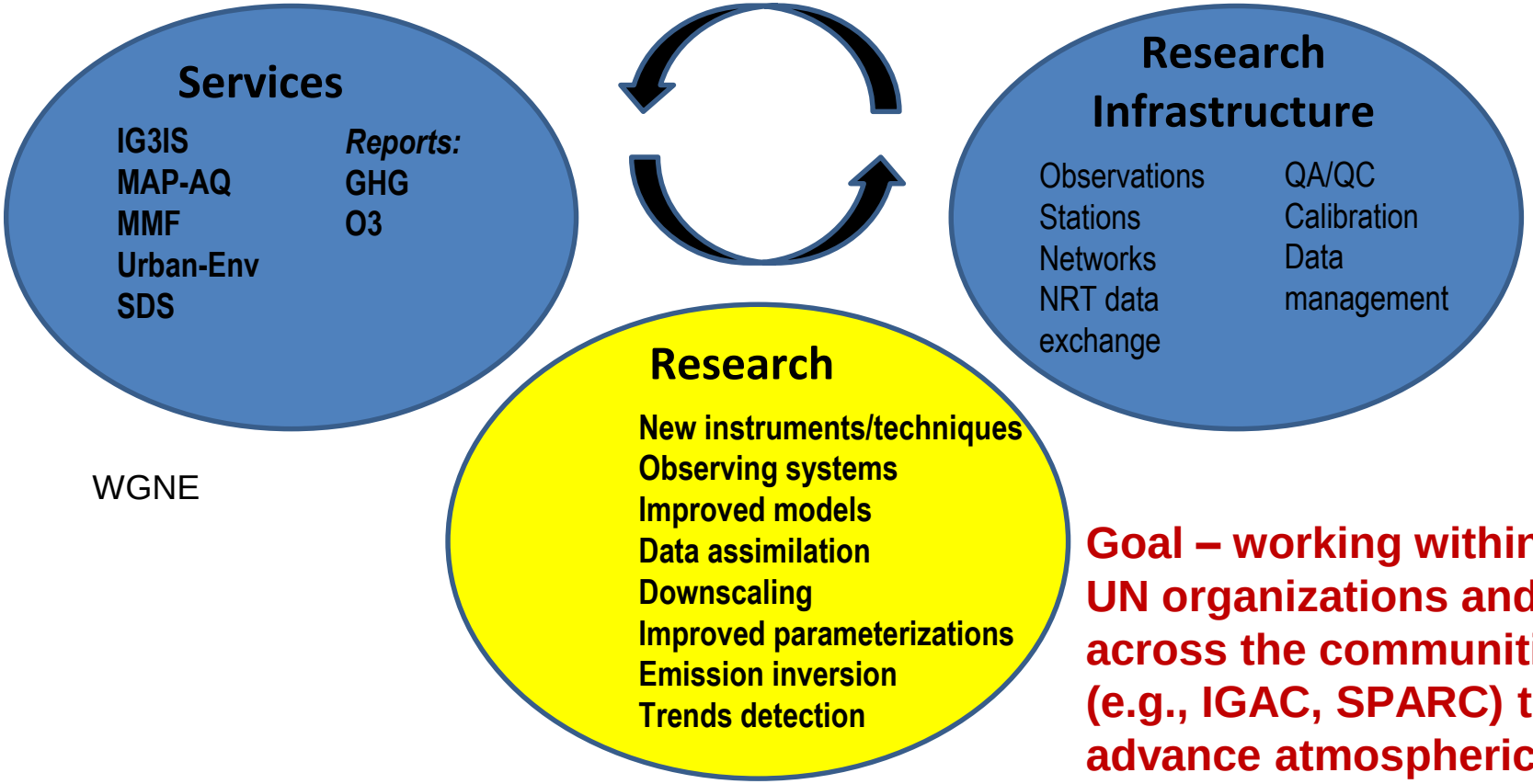
- Actions Coordinate the experiment between WGNE, S2S and APP SAG as a joint study Finish the draft protocol up to July ◦ Define a time-line for regional and S2S experiments Include a regional domain for Asia Improve the introduction text of the protocol to clarify goals Share the protocol with partners to receive their feedback Launch the protocol with WGNE, S2S, APP and Aerosol SAGs Centers

GAW Program Elements: Exploring Ways to Align with New WMO Structure



WGNE

Goal – working within the UN organizations and across the communities (e.g., IGAC, SPARC) to advance atmospheric chemistry research and its impacts on society.

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Ideas for Increased Collaboration

- guiding design and implementation of local/regional atmospheric chemistry operational forecasting systems;
- performing global/regional model reanalysis in order to build up a multi-model database resources for model applications;
- carrying on global/regional assessments via observation-modeling integration;
- developing common reference on skill standards for chemical composition models and products for evaluation purposes.

Suggestion to establish and maintain cooperation related to matters of common interest, in particular:

- *for the global and regional atmospheric composition (aerosol) observation and modelling, and*

- *for using observation data for model evaluation and data assimilation for aerosol forecasting and their applications.*

- *Forms of collaboration: informal, joint meetings, MoU, … ??*

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- Improved models
- Data assimilation
- Downscaling
- Improved parameterizations
- Emission inversion
- Transport
- Pbl
- Aerosols – remove, direct/indirect effetcs

Examples of applications and service development in GAW

- *Support of international environmental conventions since 1970*
- *Support of the services for ecosystem*
- *Support of health services*
- *Support of transport security*: volcanic ash forecasting
- *Food security:* atmospheric composition and agriculture

Development of the new services is driven by the CLEAR USER community

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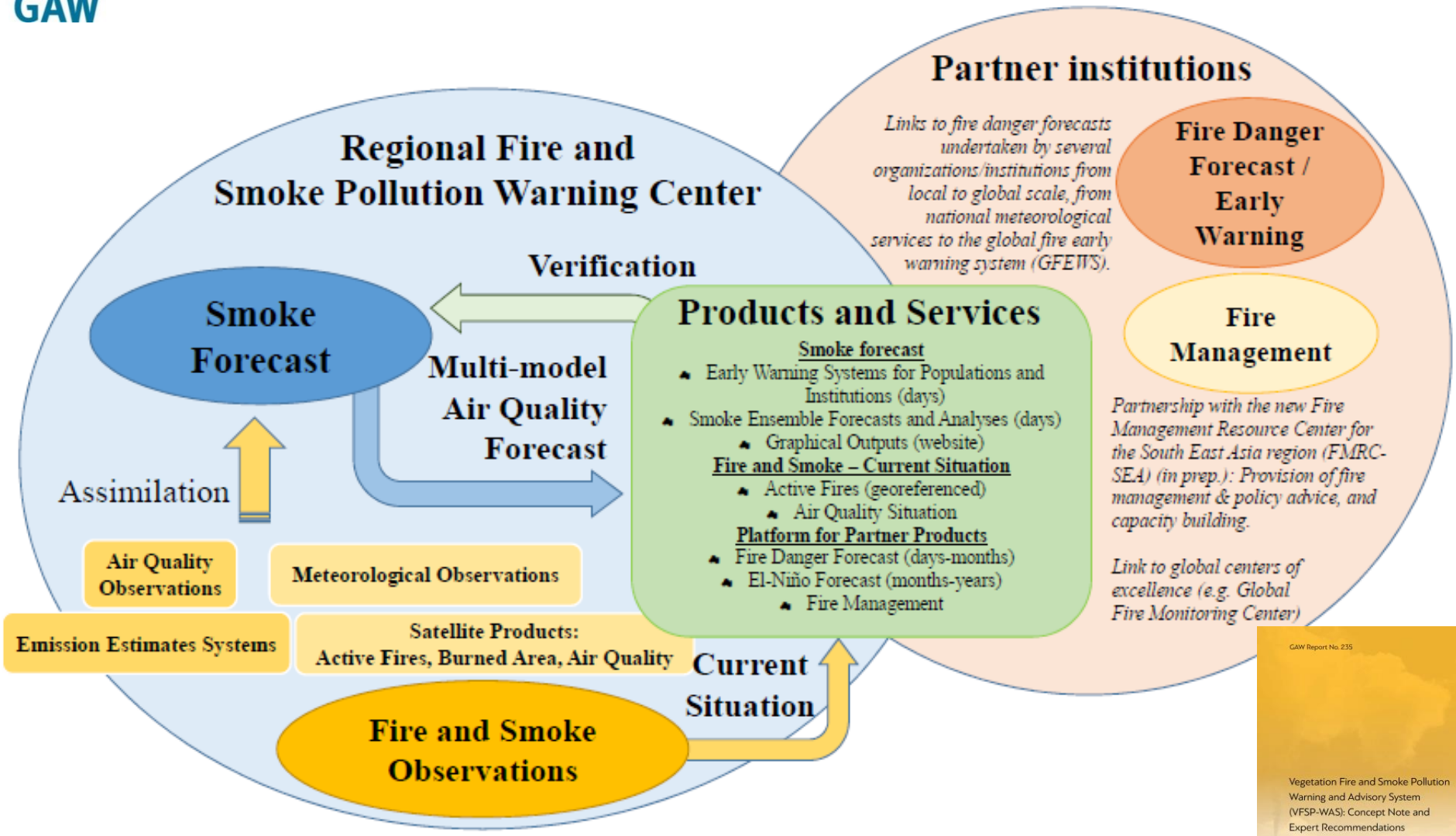
Collaboration Spaces

- Enhancing observing systems (ECV,)
  - GHG fluxes (**Integrated Global Greenhouse Gas Information System (IG^{3}IS)**
  - SLCPs (aerosols, ozone, ..)
- Enhancing modelling capabilities (seamless/integrated) (including assimilation, verification, aerosol/radiation/microphysics, S2S, reanalysis, etc.) (Africa projects….)
- Strengthening applications of modern data science
- Capacity building (including young scientists)
- ***Next steps ….. Continue active engagement***

Regional Vegetation Fire and Smoke Pollution Warning and Advisory System (VFSP-WAS)



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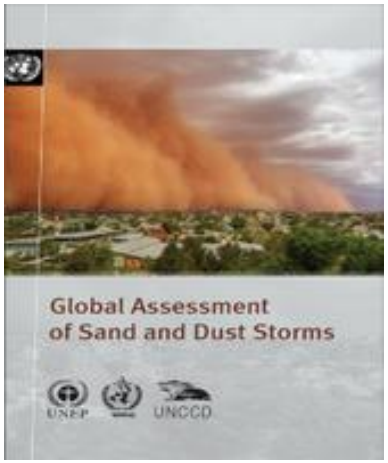
Interested countries are welcome !

Possible topics for cooperation with ICAP:

- GAW observations for evaluation and assimilation for ICAP modelling community;
- ICAP global ensemble (and members) for 193 WMO Member countries and territories: research and operational applications within the Global Air Quality Forecasting (GAQS) system;
- Contribution for SDS-WAS, VFSP-WAS, VASAG and GAW APP with global dust and other atmospheric aerosols forecasts;
- Hosting a global center and/or training facility for GAQS, SDS-WAS and other relevant applications;
- Other GAW application areas for 193 Member countries and in support of Conventions;
- Promoting scientific collaboration between the research groups supporting the ICAP and WMO/GAW and facilitate exchange of data and other relevant information between ICAP and WMO/GAW communities;
- Organizing joint events and undertaking capacity building activities for global aerosol observation and forecasting and their potential applications.

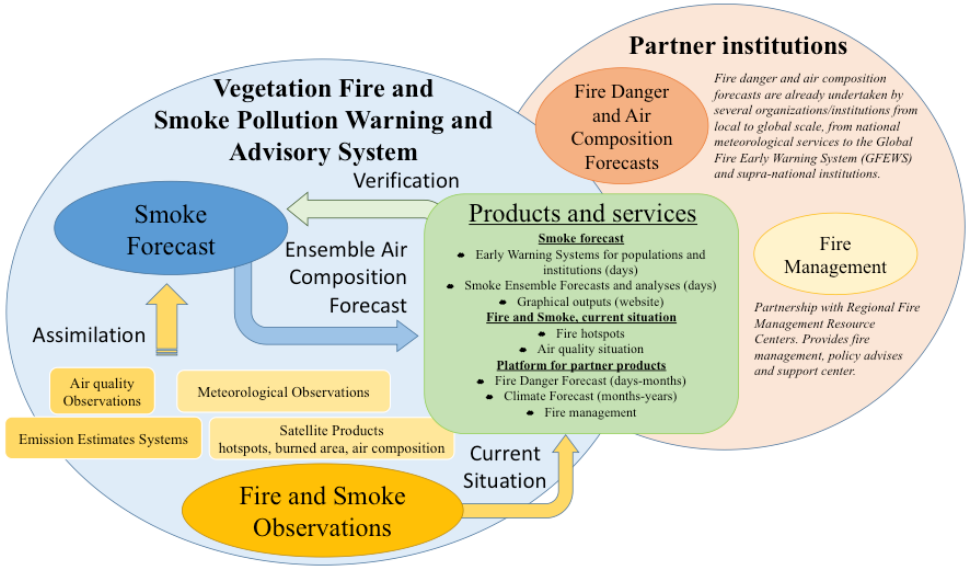
Example of the applications in GAW
Support of assessment of aerosol impacts

- Global Assessment of Sand and Dust Storms, a report jointly written by the United Nations Environment Programme (UNEP), WMO and the United Nations Convention to Combat Desertification (UNCCD) – WMO SDS-WAS supported the assessment



- Joint work with WHO on development of the Global Platform

- Forecasting Emissions from Vegetation Fires and their Impacts on Human Health and Security in South East Asia, Jakarta, Indonesia, 29 August – 1 September 2016



Overview of a potential Vegetation Fire and Smoke Pollution Warning and Advisory System

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Towards Integrated Air Quality Forecast Systems in Africa

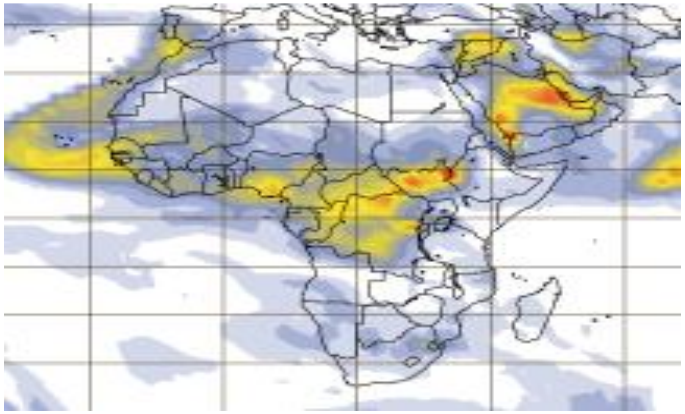
World Meteorological Organisation (WMO)

Global Atmosphere Watch (GAW)

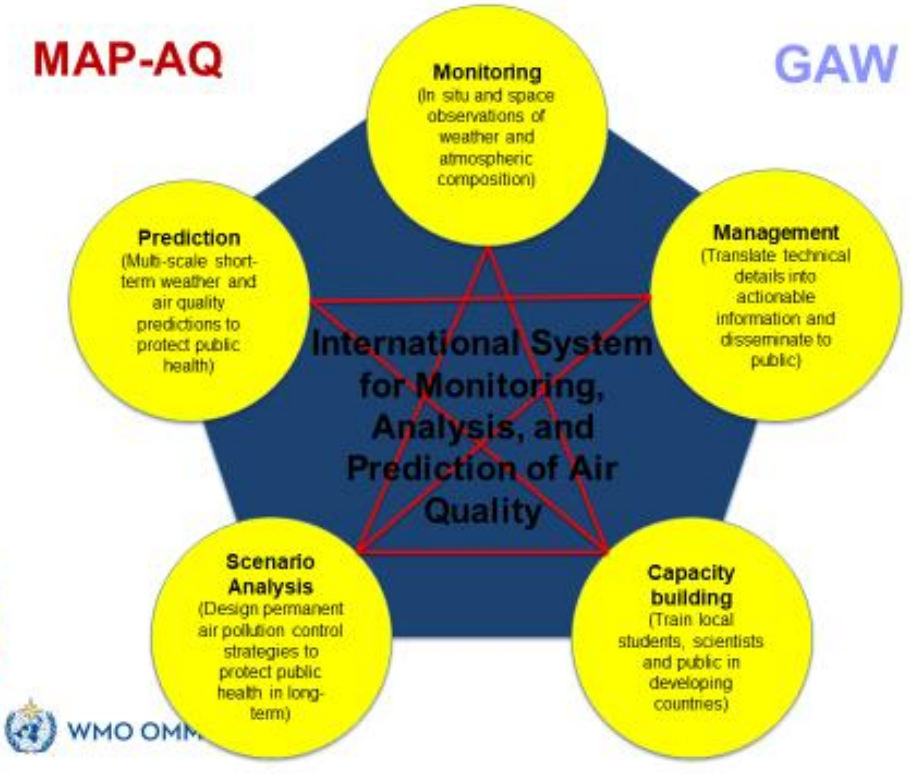
WMO Report on

International Workshop

"Seamless Prediction of Air Pollution for Africa: from Regional to Urban"



March 2018



A potential pilot project for future Global Data Processing and Forecasting System (GDPFS)

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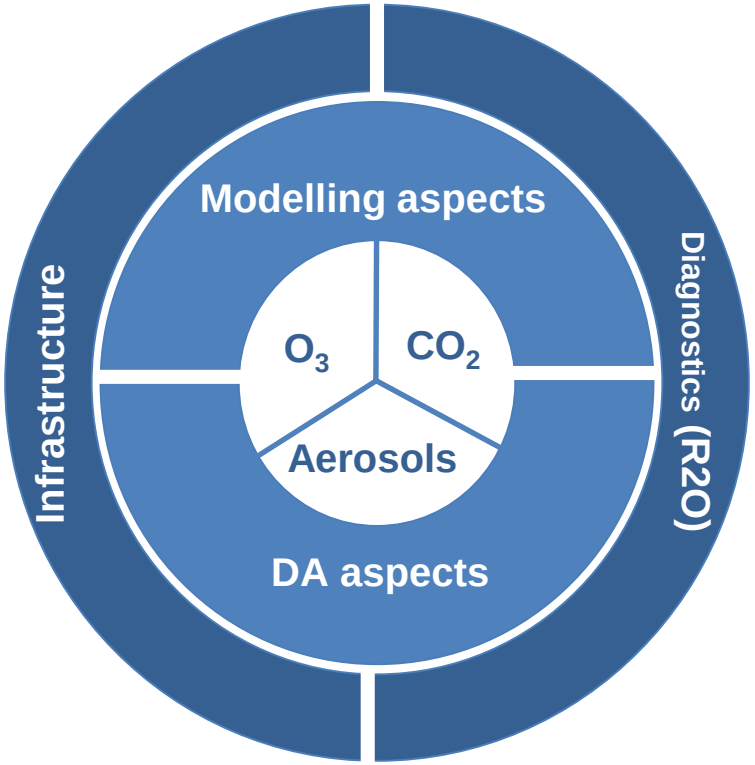
WGNE and others ORACLES

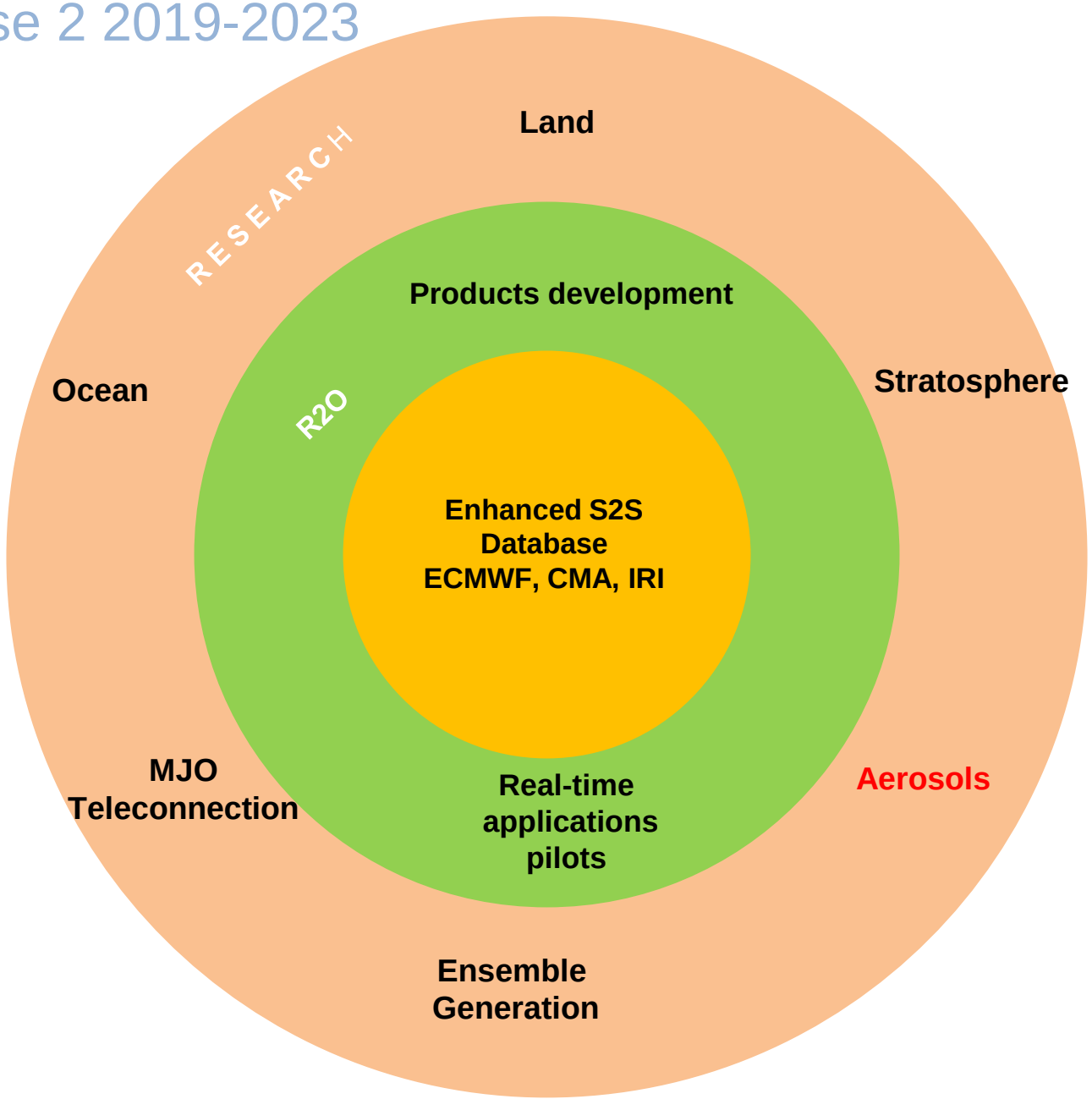
A roadmap for the future



- Recommendations on **AC priority developments useful for NWP forecasting** (**up to seasonal** time scales) to be assessed in the 2019-2022 period, and possibly implemented by 2022 **(Dragani et al, ECMWF Tech Memo 833, 2018)**.

- The aim is to **understand** through thorough and coordinated testing **what** level of **complexity and/or coupling** these **AC species** need to have **in order to impact** the **NWP** forecasts.

S2S Phase 2 2019-2023



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RESEARCH PRIORITIES: 10-YEAR FUTURE VIEW

- High Impact Weather and its socio-economic effects in the context of global change
- Water: Modelling and predicting the water cycle for improved DRR and resource management
- Integrated GHG Information System: Serving society and supporting policy
- **Aerosols: Impacts on air quality, weather and climate**
- Urbanization: Research and services for megacities and large urban complexes
- Evolving T[illegible]: impact on science and its use

WMO/OMM GAW WWRP WORLD WEATHER RESEARCH PROGRAMME

- Dear Greg,
-
- thank you very much for the draft. I think that the presentation should be more specific. WGNE is not an external community to WMO so they know well the challenges and the value chain. I think we need to talk to them on where the cooperation should be improved from the chemistry side:
- 1) there will be a presentation on aerosols, and this area of work should be enhanced in particular in two directions: radiative forcing and aerosols processes and predictability. ICAP pieces can work there
- 2) we had a conversation about improved atmospheric transport many times but it never moved anywhere (poor atmospheric transport prevents atmospheric inversions from convergence, I attached the slide here)
- 3) PBL: poor PBL description does not allow conversion of concentrations into the surface fluxes and we have some issues with the air quality forecasting in the cities where PBL is eve more complex. This is of particular relevance to urban services. You may want to mention those.
- 4) for MMF we need to understand assimilation and data fusion differences.
- 4) you may want to speak about downscaling using the example of PREFIA.
-
- We need to make it clear that GAW is involved in modelling and process studies itself and does not serve for observational data provision to the modelling community.
- Slides for RSMC are unclear to me in the context of this presentation.

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

GAW – what's next?

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

☑ through further developing urban air quality forecasting capabilities through (GURME) ,

☑ establishing a new SAG ("Apps" – usefulness exchanging chemical observational data in NRT))

☑ expanding collaborations with WWRP/WCRP/WGNE and others