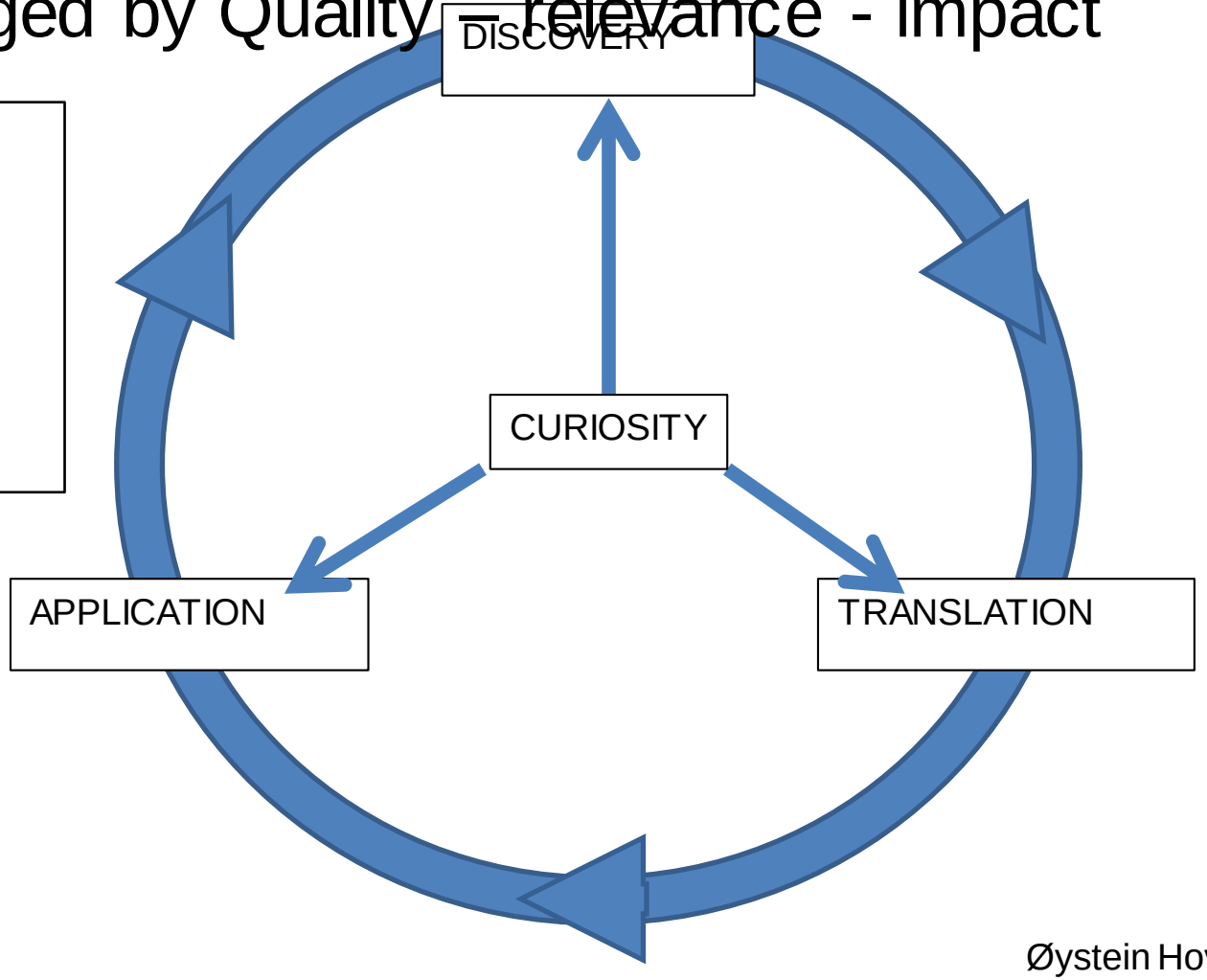
Science <u>for</u> service in thematic research: A value cycle, or continuum discovery-translation-application. Judged by Quality – relevance - impact

Enabling technologies and enabling cultures are required



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Øystein Hov

Co-design of projects WCRP-CAS?

Example: Global Data Processing and Forecast System

(Backbone of WMO: GOS+GTS+DPFS = WWW is moving from NWP to seamless Earth System Forecasting)

The proposed vision for the Future GDPFS (co-chaired by CBS and CAS) is:

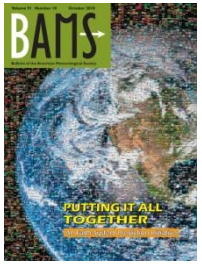
The GDPFS will be an effective and adaptable monitoring and prediction system enabling Members and partners to make better-informed decisions;

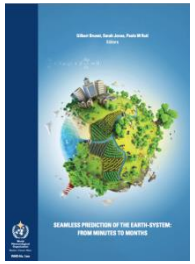
The GDPFS will facilitate the provision of impact-based forecasts and risk-based warnings through partnership and collaboration;

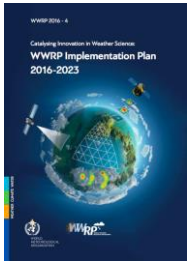
The GDPFS will do so through the sharing of weather, water, climate and related environmental data, products and services in a cost effective, timely and agile way, with the effect of benefitting all WMO Members, while also reducing the gaps between developed and developing Members.

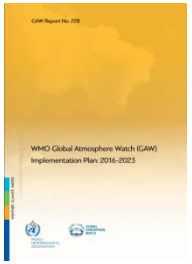
A Seamless Road Map for Seamless Earth System Forecasting

- Putting it all together (BAMS, 2010)
- World Weather Open Science Conference (2014)
- Seamless prediction of the Earth System: from minutes to months (WMO, 2015)
- Resolution 11 Cg-17 - Move to seamless, integrated Data Processing and Forecasting System
- Catalysing Innovation in Weather Science: WWRP Implementation plan (2016-2023)
- GAW Implementation Plan (2016-2023)
- Making it work seamlessly: Global Data Processing and Forecasting System Implementation Plan (2018-)









Co-design WCRP-CAS of GDPFS Potential Pilot Projects?

Requirements for WIS

Requirements for WIGOS

Requirements across timescales
Use Flagship e.g. Polar Prediction Project

Regional Focus
e.g. Nowcasting RSMC
- Co-develop products
- Co-design with partners
- Cooperation with neighbours

Seamless weather – climate
Implement Interactive model
Enhance data availability
Assess usage

Science for Services
Integrated Air Quality Prediction and Forecast Systems in Africa

Public Private Partnership
e.g. on big data and analytics

Accessibility
COPERNICUS Climate Data Store and GDPFS
Test Uptake, usage, parameters, licensing, …..

Partnership
combine Ocean – Ice forecasts from different organisations

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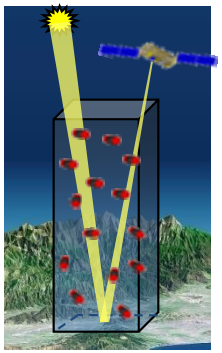
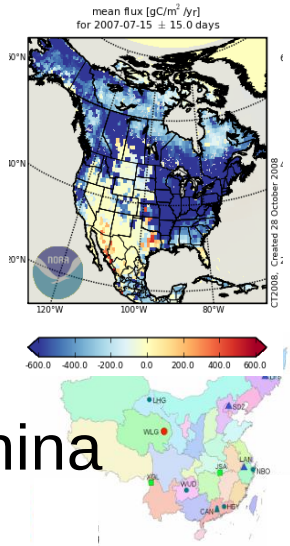
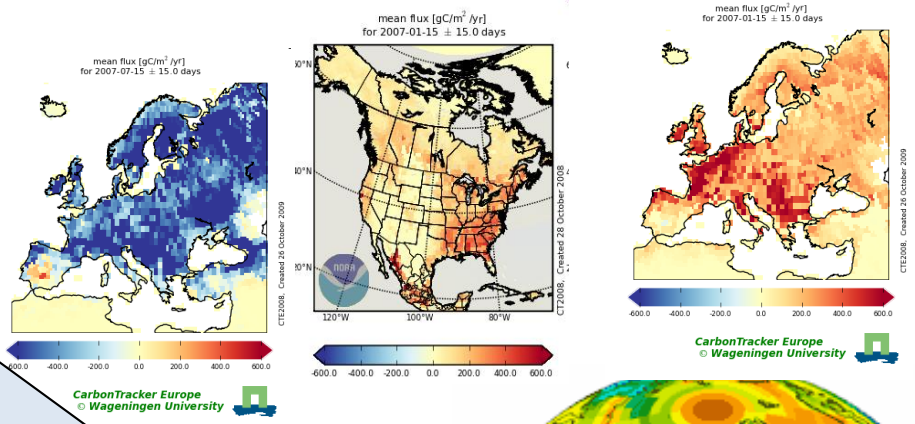
Codesign SPARC-IGAC-CAS: Example - Integrated, Global Greenhouse Gas Information System (IG³IS)?

Satellites

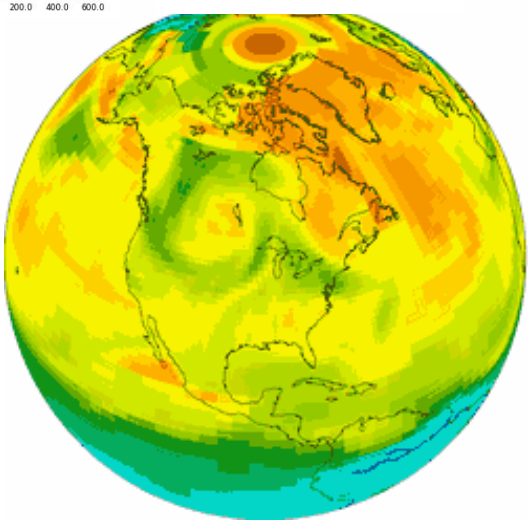




China



"Carbon Weather"

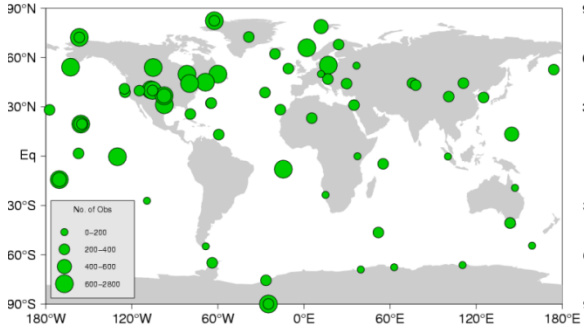


Manage GHG Budgets

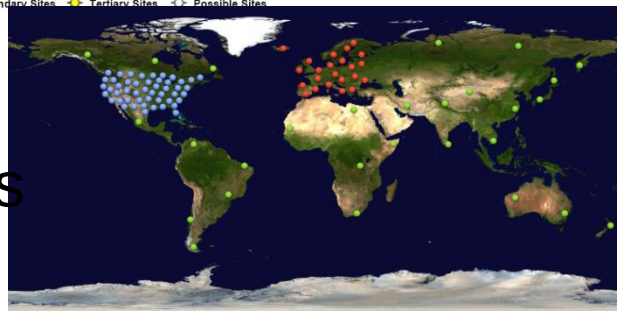
TCCON

SE Asia

Current Network



Earth Networks



Brazil

WEATHER CLIMATE WATER
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The Global Atmosphere Watch Programme

Greg Carmichael & Oksana Tarasova*
*WMO Research Department

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Global Atmosphere Watch Programme

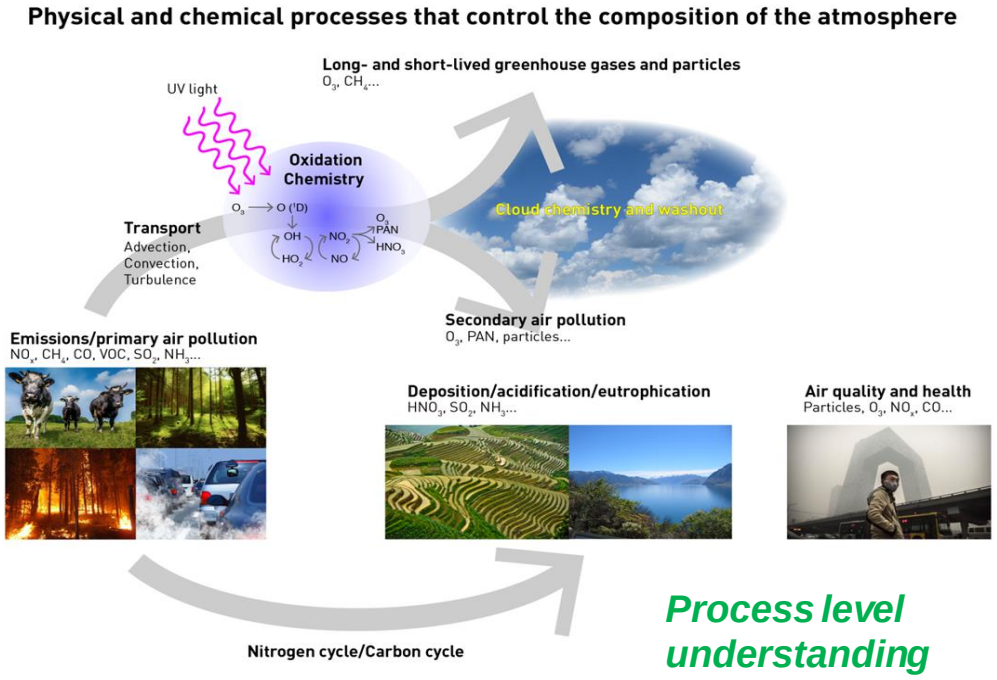
Provides international leadership in research and capacity development in atmospheric composition observations and analysis through:

- *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*)

GAW Implementation Plan (2016-2023)

*IP builds upon the premise that **atmospheric composition matters** - to climate, weather forecasting, human health, terrestrial and aquatic ecosystems, agricultural productivity, aeronautical operations, renewable energy production, and more.*



The vision for the next decade of GAW is to grow the international network of high-quality atmospheric observations across local to global scales to drive high quality and impact science while co-producing a new generation of research enabled products and services. **(S4S)**

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https://library.wmo.int/opac/doc_num.php?explnum_id=3395

“Health” of the observational network

GAW Station Information System (GAWSIS)

GAW observational network comprises:

- Global stations (31)
- Regional stations
- Local stations
- Mobile platform
- Contributing networks (10)

5 contributing networks joined GAW: MPLNET, AD-NET, LALINET, CASTNET, and aircraft-based network (IAGOS) during inter-sessional period.

Expanding the connections and capabilities in satellite based atmospheric composition observations (RRR process, WIGOS)

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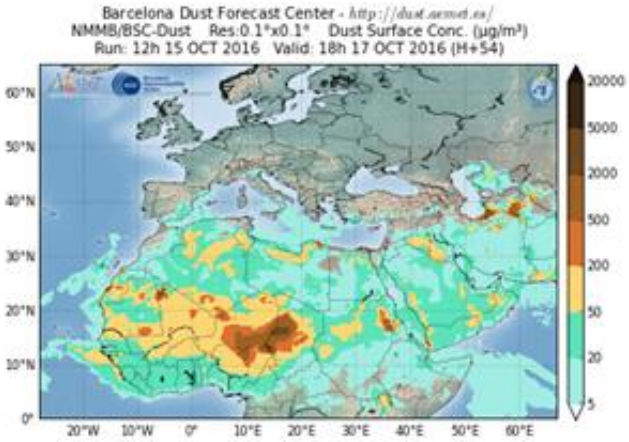
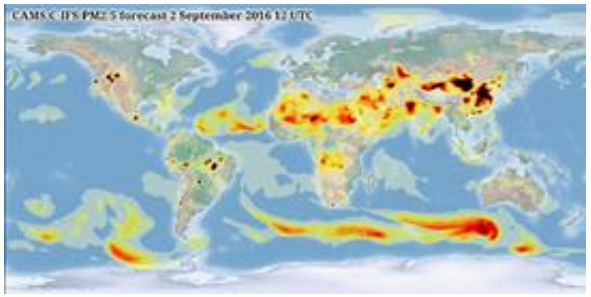
GAW – Enhancing Modeling

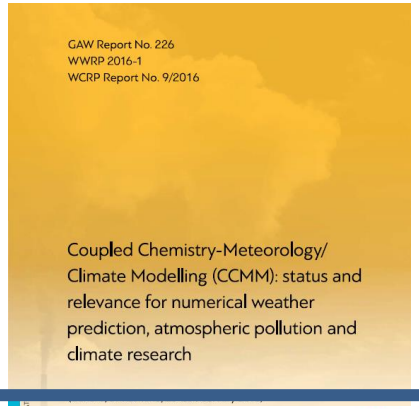
Expanding GAW's role in enhancing predictive capabilities (of atmospheric composition and its uses)

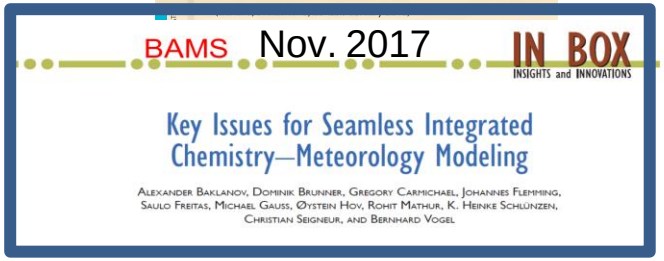
- ☑ Through further developing urban air quality forecasting capabilities through (GURME),
- ☑ Establishment of a new SAG ("Apps") – to enhance forecasting and monitoring functions at scales from regional to global)
- ☑ **Expanding collaborations with WWRP/WCRP/WGNE and others**
- ☑ Contributing to the Data-processing and Forecasting System (GDPFS) and Global Framework for Climate Services (GFCS).

Recommendations on the model development were formulated at the Symposium on Coupled Chemistry-Meteorology/Climate Modelling and GAW Symposium









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WCRP/GAW Collaboration Space

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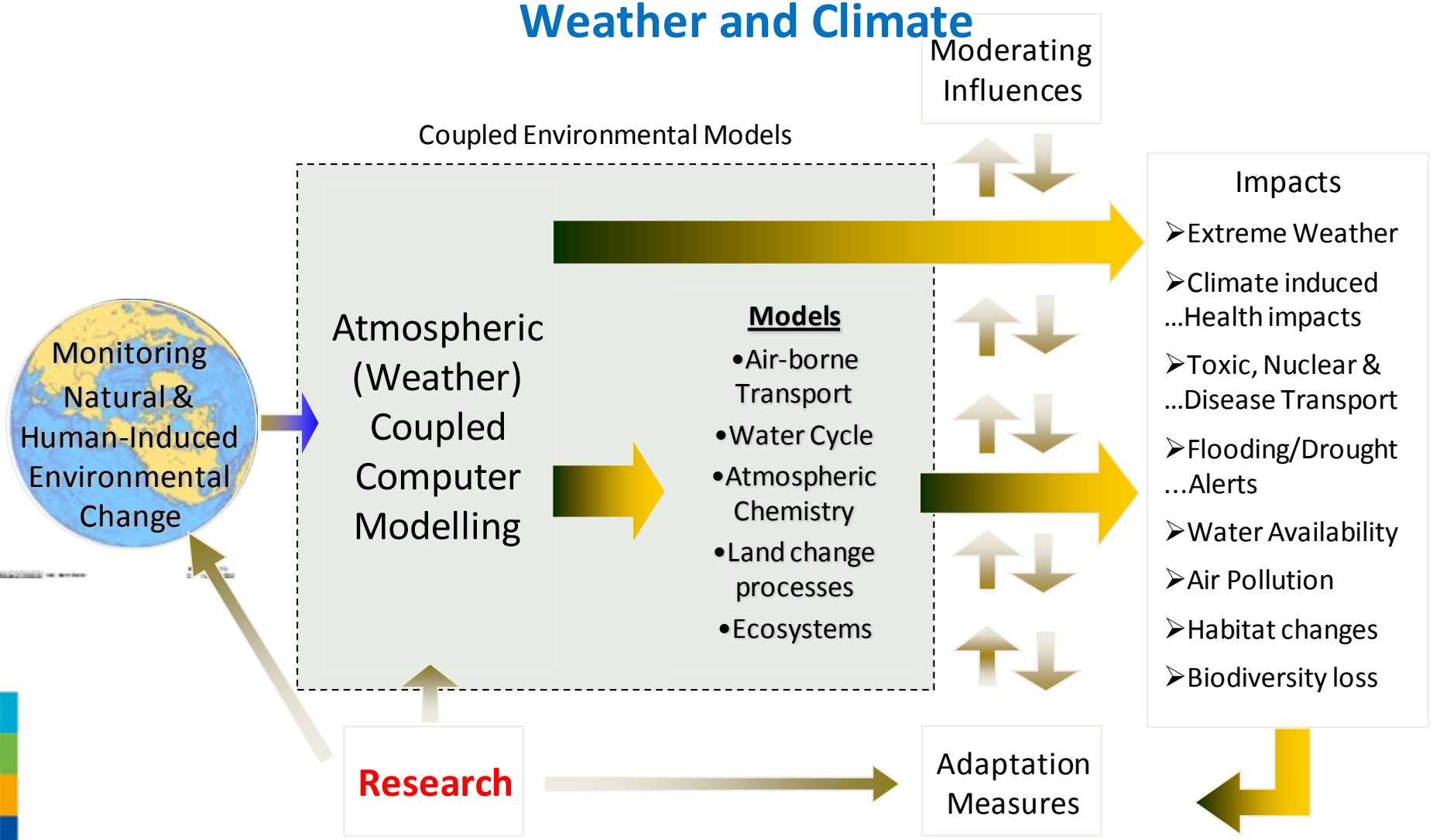
WCRP/WWRP/GAW Share Common Research Objective: Improve Prediction Capabilities via Incorporating/Integrating Composition, Weather and Climate



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Across Relevant Temporal and Spatial Scales

WCRP/GAW Collaboration Space

O1. Understanding the Climate System

Identify and constrain key processes that critically determine the reservoirs and flows of energy and water – and carbon, aerosols, salt, and other constituents – within and between the components of the Earth System.

O2. Determining Predictability on Seasonal to Decadal Timescales

Quantify the uncertainties and predictabilities inherent in seasonal to decadal time scales of the climate system.

O3. Determining Projectability on Decadal to Centennial Timescales

Quantity the sensitivities and emerging constraints inherent in the changing climate system.

O4. Connecting Climate Science to Policy and Decision Making

Improve the generation and use of decision relevant climate information and knowledge about the evolving Earth system, across space and time scales, to natural variability and climate change.

WCRP/GAW Collaboration Space

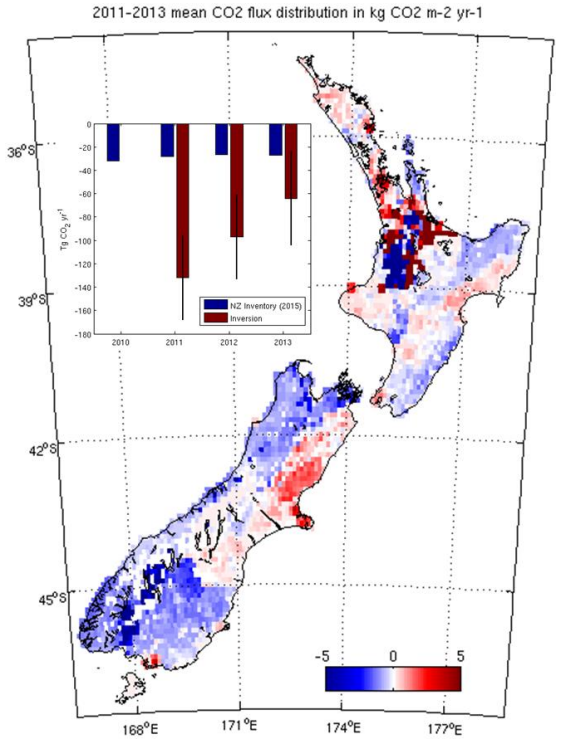
- GHG fluxes (**Integrated Global Greenhouse Gas Information System (IG^{3}IS)**
- Enhancing the observing system
- SLCPs (including ozone)
- Urban environments
- Enhancing modelling capabilities (seamless/integrated) (including assimilation, verification, aerosol/radiation/microphysics)
- Training (including young scientists)

Example of the applications in GAW
Support of climate negotiations

Near-term Objectives the Integrated Global Greenhouse Gas Information System (IG^{3}IS): through combination of measurements and inverse modelling techniques and utilizing complementary information to :

1. Reduce uncertainty of national emission inventory reporting to UNFCCC;
2. Locate and quantify previously unknown emission reduction opportunities such as fugitive methane emissions from industrial sources; and,
3. Provide subnational entities such as large urban source regions (megacities) with timely and quantified information on the amounts, trends and attribution by sector of their GHG emissions to evaluate and guide progress towards emission reduction goals.
4. Support of globalstock taking

Cross-cutting activity on development of inverse modelling techniques



Results for LULC emissions (by B.Gordon, NIWA)

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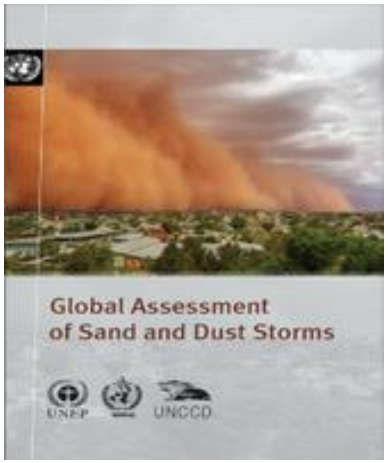
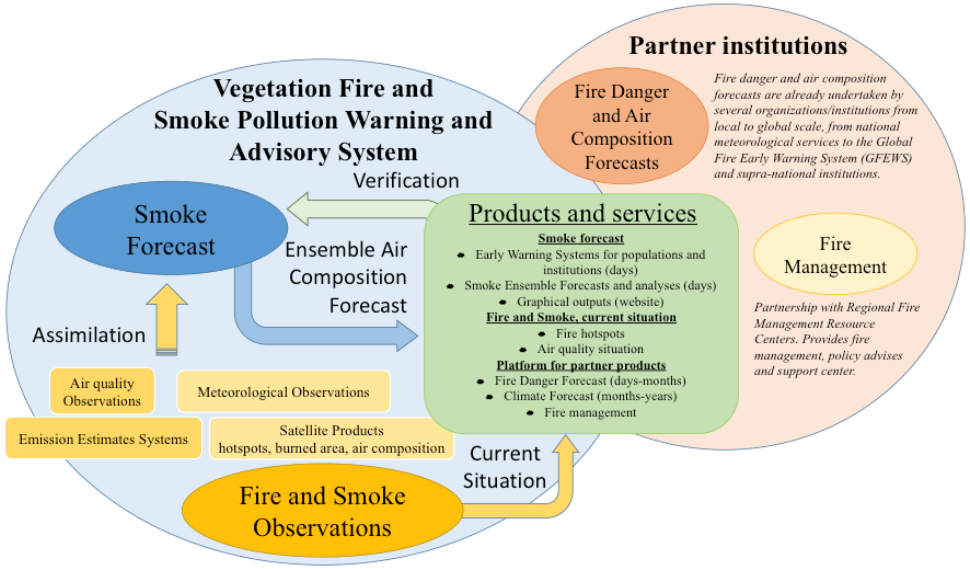
Example of the applications in GAW
Support of assessment of aerosol impacts

- 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

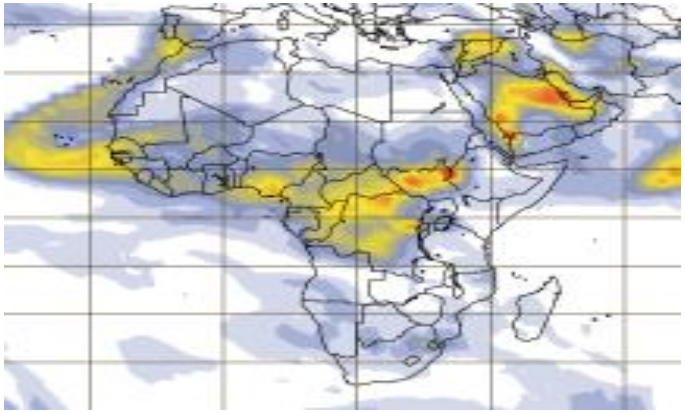
World Meteorological Organisation (WMO)

Global Atmosphere Watch (GAW)

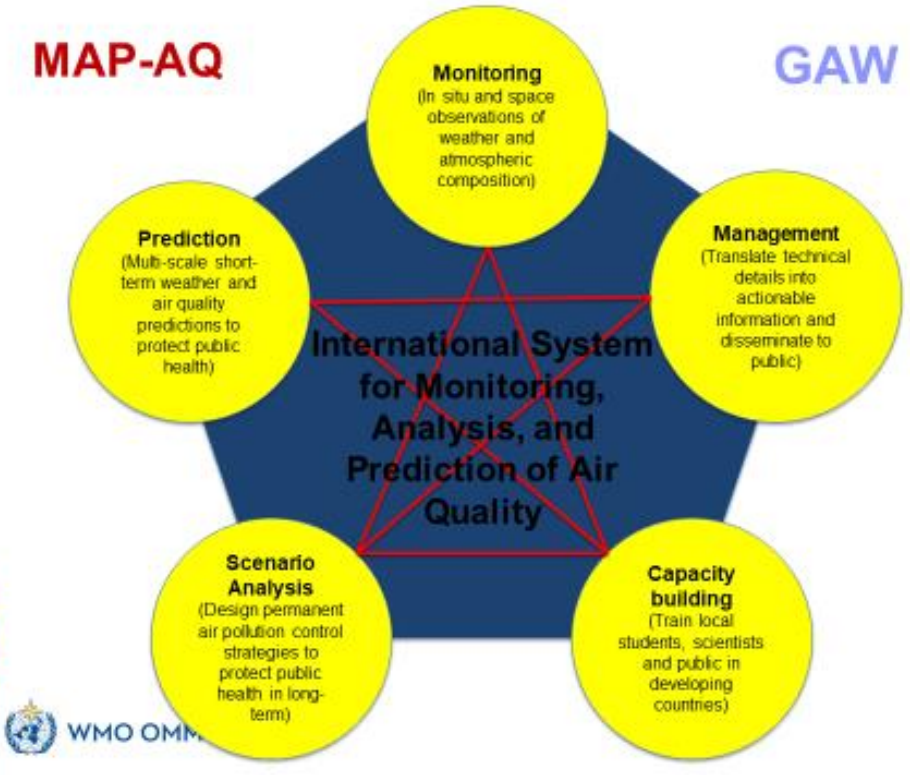
WMO Report on

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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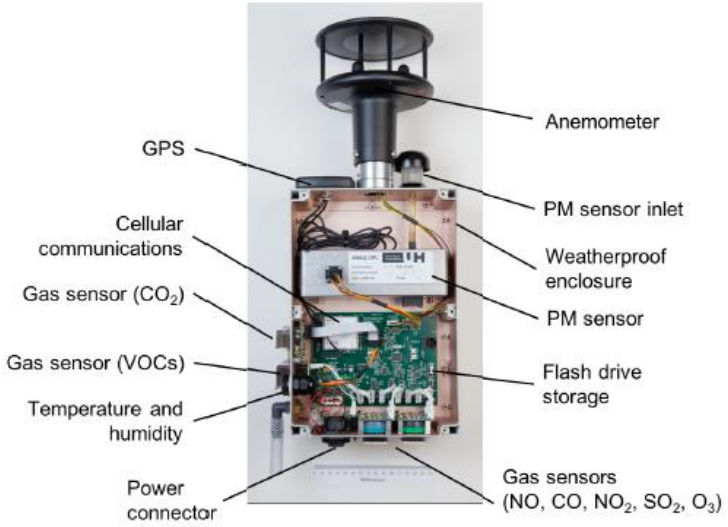
WGNE and others ORACLES

WORLD METEOROLOGICAL ORGANIZATION

Low-cost sensors for the measurement of atmospheric composition: overview of topic and future applications

Editors: Alastair C Lewis, Erika von Schneidemesser and Richard Peltier

http://www.wmo.int/pages/prog/arep/gaw/documents/Draft_low_cost_sensors.pdf



This assessment was initiated by request of the WMO Commission for Atmospheric Sciences (CAS) and supported by broader stakeholder atmospheric community including the International Global Atmospheric Chemistry (IGAC) project, Task Force on Measurement and Modelling of LRTAP Convention, UN Environment, World Health Organization, Network of Air Quality Reference Laboratories of the European Environment Agency.

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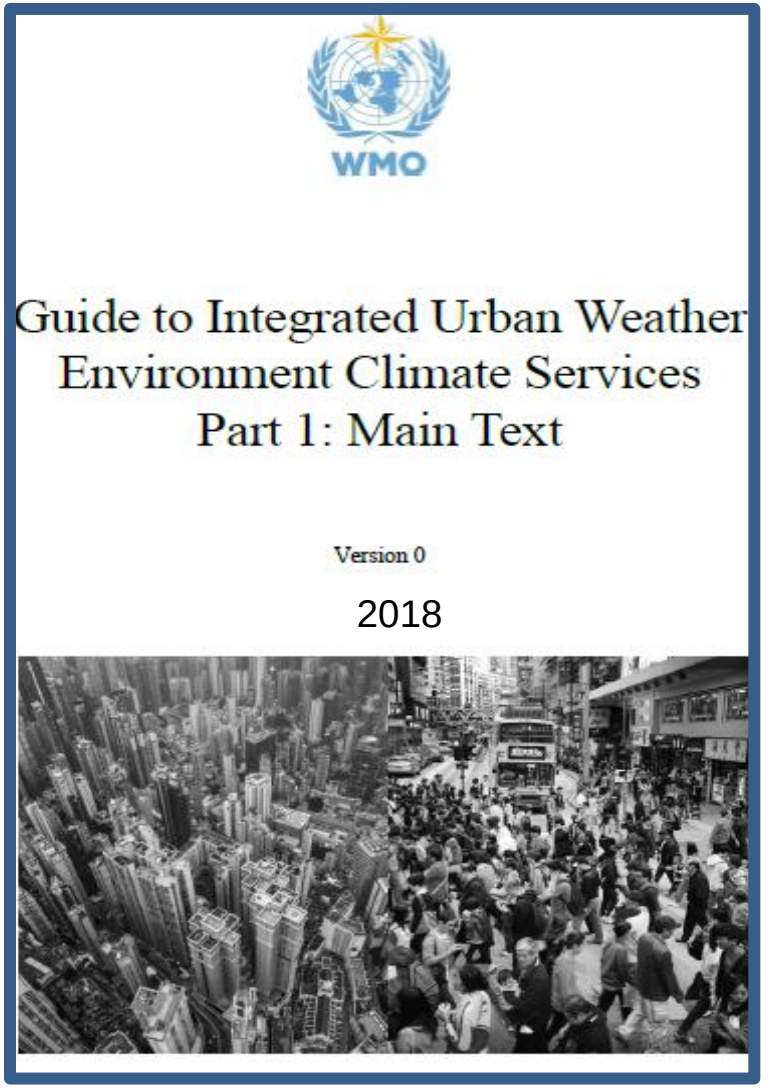
WMO Priority: Urbanization - Research and services for megacities and large urban complexes

Goal: Integrated Urban Weather, Water, Environment and Climate **Services** to address Urban Hazards and Risks.

- Focus on impact-based forecast and risk-based warnings
- Addressing key scientific issues: requirements for observations; near-real-time data assimilation; coupling of air quality, meteorological, surface, hydrological processes; seamless approach for scales interaction; high-resolution modelling: 'grey zone'

Recent GURME pilot projects: the Shanghai Multi Hazard Early Warning System (MHEWS), the System of Air Quality and Weather Forecasting and Research (SAFAR), the Mexico City project and a project for Chilean cities



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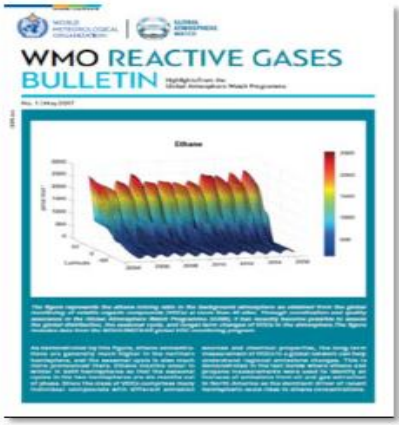
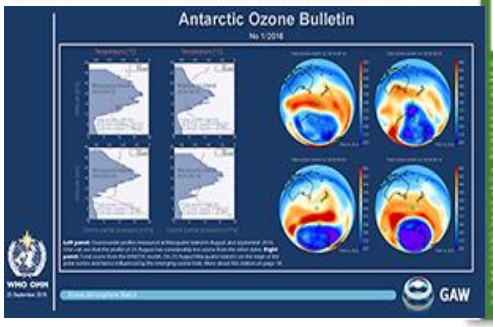
Outreach

GAW developed an outreach strategy to communicate the value of science and long-term high-quality observations

- WMO Bulletins (ozone and greenhouse gases)
- Scientific Assessments
- GAW thematic reports
- Electronic Newsletter (eZine)





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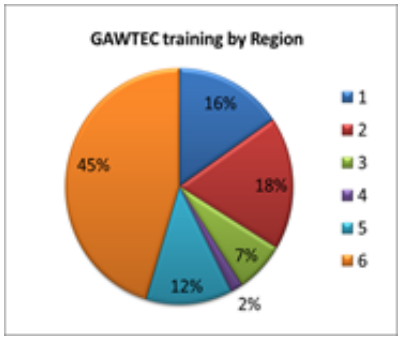
Capacity building tools in GAW

- formal training programs at the GAW Training and Education Centre (GAWTEC) supported by Germany;
- specialized training schools and workshops;
- training of the station personnel and knowledge exchange during station audit and comparison campaigns;
- twinning programmes and personnel exchange where new and established stations or labs are paired to fast-track the development of the new station to full operational status.



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WCRP/GAW Collaboration Space

- GHG fluxes (**Integrated Global Greenhouse Gas Information System (IG^{3}IS)**
- Enhancing the observing system
- SLCPs (including ozone)
- Urban environments
- Enhancing modelling capabilities (seamless/integrated) (including assimilation, verification, aerosol/radiation/microphysics)
- Training (including young scientists)
- ***"Alone we can do so little, together we can do so much." --Helen Keller***

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Thank you
Merci

WEATHER CLIMATE WATER
TEMPS CLIMAT EAU

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World Meteorological Organization
Organisation météorologique mondiale

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WCRP/GAW Collaboration Space

Q2: Advance Predictive Skills to Sub/Seasonal Time Scales

Methodologies for climate extremes detection and attribution	Something about convection	Model intercomparison projects that incorporate skill assessment
Advancing the science required to develop coupled data assimilation and initialization systems, using a broader range of climatic data sources		
Improve our ability to simulate and predict modes of variability, such as ENSO	Scientific understanding of sources of shorter time scale predictability, including further development of skill metrics and authoritative diagnostics	
Regional and global climate model development using advanced software engineering protocols - maybe this is an imperative?		
Determine the level of complexity needed for seamless prediction from short range to decadal time scales.		Understand the impact of resolution on sub-seasonal to decadal prediction.

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WCRP/GAW Collaboration Space

Q4: Connecting Climate Science with Policy and Services

Articulating the climate dimensions of disaster risk reduction	Advancing the development of decision support tools to distill climate information and streamline communication of findings
Supporting the development of understanding of trade-offs and synergies inherent in the sustainable development goals	Engagement with international, regional and national climate services and infrastructure
Engage with other research communities to improve understanding of needs for and methods of couple climate system and socio-economic models in support of improved climate resilience and integrated assessment	
Advance capacities for co-production with decision makers to identify decision relevant thresholds for climate services	