GAW URBAN RESEARCH METEOROLOGY & ENVIRONMENT PROJECT (GURME)

Day 1

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Agenda

Theme 1: Advancing GURME objectives through facilitation of research

- General updates for research activities
  - A. Baklanov – 10min: GAW IP, H-III & New UN Urban Agenda, Res 68 Cg-17, WMO-IAUC MoU, WUDAPT workshop, UMHEWS and Integrated urban sercices
  - V. Bouchet – 10 min: IWAQFR recommendations, WWRP IP
  - M. Hortt – 10 min: APP-SAG

- Modelling
  - Proposal for linking urban initiatives
    - Proposal: V. Bouchet 5 min
    - Discussion & tasking : S. Grimmond, H. Schluenzen, J. Tan – 25 min
  - Surface characteristics: update & discussion S. Grimmond/ V.Bouchet – 15 min
  - APP-SAG: Outline and collaborations : V. Bouchet/M. Hortt – 30min

- **11:00 Break – 15 min**

General updates

IWAQFR 8 – January 10-12, 2017

- International Workshop on Air Quality Forecasting Research
  - Operational forecasting / Emissions / Data Assimilation & Evaluation / Post-processing / Interaction Meteorology & AQ / Urban and High Resolution AQ Modelling
  - https://cpaess.ucar.edu/iwaqfr-2017-presentations-en

- Release of the Pan Am 2015 Database
  - Presentations
  - Access to data : http://open.canada.ca/en/open-data Keyword TO2015

- Panel Discussion on Urban Environmental Modelling

High spatial and temporal resolution dataset was assembled on the Greater Toronto Area urban environment. It included new automated land- and marine-based weather stations, additional experimental monitoring platforms, six AWOS stations at higher frequency, four ground-based radiometers (ultraviolet radiation instruments), air quality stations for O3, PM2.5 and NO2, multiple mobile observations of weather parameters and air quality, in addition to the on-going ECCC stations. ECCC designed the network to monitor weather at the venues, while providing close tracking of southern Ontario lake breezes, which can be associated with severe weather initiation, extreme heat and high air pollutant concentrations.

IWAQFR Panel Highlights

- **What are the current knowledge gaps in developing coupled urban environmental models?**

- **What initiatives, current or new, might help address some of these knowledge gaps?**

- **Where do you see the "state of the science" in urban environmental modelling in 10-years?**

Panel members: Greg Carmichael, Guy Brasseur, Matthew Hort, Stephane Belair, Veronique Bouchet

IWAQFR Panel Highlights

Gaps

- Linkages between scales (urban ↔ global)
- Physical processes & resolution, PBL & vertical representation
- Ancillary information (surface characteristics, emissions) now time sensitive
- Chemistry in proximity of sources
- Data assimilation & use of obs at km scale
- Predictability at km scale
- Uncertainties – break down of deterministic approach
- Verification metrics
- Joint work between the Met & AQ communities

Initiatives

- More observations, not just at urban scale
- Understanding potential information in new obs technology (low-cost sensors)
- **Common and coordinated studies**, building on existing activities given costs
- Facilitating **joint work & linking communities**, network of urban initiatives
- Exploit wind tunnel studies
- **More effort on linking with user/health community**
- **Acute health impact**
- **Temp/sentinel/GEMS: exchange notes**

Future 10 years from now

- ✓ Km-sale Environmental modelling & services i.e. meteorology, land surface, hydrological, AQ 2 way coupled.
- ✓ With DA - surface and remote - & routinely adjusting emissions - probabilistic
- ✓ we will have figured out how to make 'good enough' low-cost sensors and make use of variable quality data in DA

World Weather Research Programme - IP

- WWRP: sister programme to GAW

- WWRP: Research activities focusing on high-impact weather – from basic research in the academic community to operational contributions
  - international mechanism to promote cooperative research for improved weather and environmental prediction services over various time scales.
  - ensures the implementation of a research strategy towards the seamless prediction of the Earth system from minutes to months.

WWRP a seamless programme

Extremes

Predicting Water Cycle

Urbanization

Emerging Technologies

High Impact Weather

Polar Prediction

Sub seasonal 2 seasonal

Numerical Experimentation

Nowcasting and Mesoscale

Tropical Meteorology

Predictability Dynamics and Ensemble Forecasting

Data Assimilation and Observing Systems

Verification

Social & economics

Weather Modification

Challenges   Core Projects   **Working Groups**

World Weather Research Programme

Weather · Climate · Water

WWRP - IP

IP addresses 4 societal challenges

- Extreme: High-Impact Weather and its socio-economic effect in the context of global change
- Water: Modelling and predicting the water cycle for improved disaster risk reduction and resource management
- **Urbanization: Research and services for megacities and large urban complexes**
- Evolving Technologies: Their impact on science and their use

Urbanization: Research and services for megacities and large urban complexes
AA11 Understand Needs *Improve understanding and knowledge of the relationship between the urban physical and built environment, the social, behavioural and economic needs of its population, and the requirements for integrated weather-related environmental services*
AA12 Observations & Processes *Improve observations and understanding of the unique urban physical processes, including dynamical, chemical and hydrologic*
AA13 Urban Prediction *Develop, validate and demonstrate urban prediction capabilities, toward building urban environment integrated information systems to support decision making for different applications in different parts of the world*

WWRP– P: Expectations for GURME

- TBC

APP-SAG

Modelling

Proposal for linking urban initiatives

- From the IWAQFR panel discussion, suggestion arose for common and coordinated studies, to help advance the modelling/prediction for the urban environments.

- Presentations on number of campaigns where the city environment is instrumented more heavily :
  - Toronto (PanAm)
  - S.Korea (WISE)
  - Japan (TOMACS)
  - London (2012 Olympics)

- The panel recognized the usefulness of such intensive periods and the difficulties to encourage more of such campaigns because of cost.

- What if there was a set of recommendations as to the kind of measurements that could be systematically targeted and encourage a network to be established where groups share the data ?

- The idea would be to allow studies to be done across geographical differences in addition to just locally.

Outcome of discussion on linking urban initiatives

- Decision & tasking

Outcome of discussion on Surface Characteristics

APP-SAG : collaborations

- Running statistics for AQ models, verification metrics

- BC methodology for cascading

- Acute health impacts

- Joint work on GDPFS inclusion of atmospheric composition

Agenda

Administrative matters

- Membership & chairs – 10 min

- Website – 15 min

- Next meeting: ITM, May 2018, Ottawa – 15 min

- Opportunities to advertise GURME (outreach strategy, conferences, training, and other upcoming opportunities)

- **12:00 Lunch – 1h15min**

Administrative Matters

Membership & Chairs

- Membership regulations following CAS 16th:
  - No more than 10 members per SAG
  - Mandates are 4 year long
  - Mandates are renewable once in given position

Year	2009/10	2014	2016
Number of SAG members	**2**	3	4

- Chair
  - Introduction of a co-chair for GURME

Chair	Co-Chair
WMO commissions/ structures/secretariat(s) NMHS & government bodies Research centres in government Service delivery	Engagement with user and partner communities (Habitat, CCAC) Pilots & capacity building (including training) Engagement of academia (with SAG members)

Next Face-to-Face

- **In conjunction with ITM 2018 - May 14-18 2018, Ottawa, Canada**

- ITM key topics:
  1. Local and urban scale modelling (including the effects of building wakes, street canyons, urban canopy, urban energy balance)
  2. Regional and intercontinental modelling (including observational and modelling of current and future scenarios, and impacts on meeting and maintaining air quality standards)
  3. Data assimilation and air quality forecasting (including new research on focusing ground- and satellite- based observations into model outputs in creating high-resolution spatial maps of air quality, network design)
  4. Model assessment and verification (including performance evaluation, diagnostic evaluation, dynamical evaluation, and probabilistic evaluation as part of comparison of model outputs with observations)
  5. Aerosols in the atmosphere (aerosol dynamics, aerosol formation, interaction with multiphase chemistry)
  6. Interactions between air quality and climate change (observational analysis and modelling analysis of the effects of air pollution on climate and the impact of changing climate on future air quality)
  7. Air quality effects on human health, ecosystems and economy (including air quality trend assessments, cost benefit analysis of regulatory programs and their effects on air quality, human exposure and ecosystem burden, integrated modelling approaches).

- Heinke proposed for science committee (1 or 4)
- Pablo proposed for session organiser (2,3 or 4)

- Questions: participation / funding of SAG/ students or young scientists / invited speakers / joint sessions / logistic of f2f

Agenda

Theme 1: Advancing GURME objectives through facilitation of research

- Observations & assimilation
  - Satellite-remote sensing
    - Update – J. Kim/P. Saide – 10 min
    - Discussion & tasking: J. Kim,P. Saide – 20 min
  - Low-cost sensors in urban environment
    - Highlights of Pune/Mumbai experience – G. Beig – 10 min
    - Discussion in preparation for GAW Symposium – 20min
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- Health impacts: discussion & proposal
  - Update – P. Saldiva – 10 min
  - Discussion & tasking: P. Saldiva, L. Molina, A.Baklanov – 20 min
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- Finances – 30min
  - Funding situation and strategy
  - Trust fund
-
- **3:15 Break – 15 min**

Outcome of discussion on Observations & remote sensing

Outcome of discussion on health impacts

Administrative Matters - Finances

Agenda

Theme 3: Research to operations

- Methodology for UAQ information and forecasting systems and Urban multi-hazard early warning systems, contribution to Urban Integrated Services (Guidelines for UAQIFS/UMHEWS)
    - Concept of Urban Integrated Services – S. Grimmond (15min)
    - Presentation for UAQIFS/UMHEWS – A. Baklanov (15min)
    - Discussion and tasking – 30 min

- The WMO operational framework and Research initiative
    - CBS framework: GDPFS (V. Bouchet – 15min)
    - MAP-AQ initiative (Veronique Bouchet for Guy Brasseur – 15 min)
    - Discussion and tasking – 30 min

Theme 3 – Research to Operations

Outcome of discussion on UAQIFS/ UMHEWS

- Actions & tasking

Future Global Data-processing and Forecasting System (GDPFS)

WEATHER CLIMATE WATER
TEMPS CLIMAT EAU

WMO OMM

World Meteorological Organization
Organisation météorologique mondiale

Michel Jean
President of CBS

Global Data-processing and Forecasting System (GDPFS)

- Central activity/delivery mechanism of the Commission for Basic System
  - CBS: Operational arm of WMO
  - WIS and WIGOS are part of the infrastructure that support the GDPFS

- Main objective: Enabling worldwide use of timely, reliable and accurate Numerical Weather Prediction (NWP) products and services in all time-scales for applications related to weather, climate, water and environment.
  - The GDPFS is the world-wide network of operational centres operated by WMO Members

What is the purpose of the GDPFS?

- Some parts of WMO WWW …e.g. WIS, WIGOS…are about sharing all our data so that we can all provide services
  - Virtually all WMO Members provide data into the system which allows *relatively few* to run advanced prediction systems, global or regional (NWP, seasonal, ocean models, …)

- GDPFS goes the other way:-
  - Give back outputs from those prediction systems to WMO Members to support their provision of services in their countries

The GDPFS today…

GDPFS Centres

★ World Meteorological Centre

■ RSMC - Geographic

☆ Atmospheric Transport Modelling

⬠ Regional Climate Centre

▲ Global Producing Centre for Long-Range Forecasts

⬠ RSMC -TC

◆ RSMC - Medium Range Forecast

◆ RSMC - Sand/Dust

● RSMC - UV
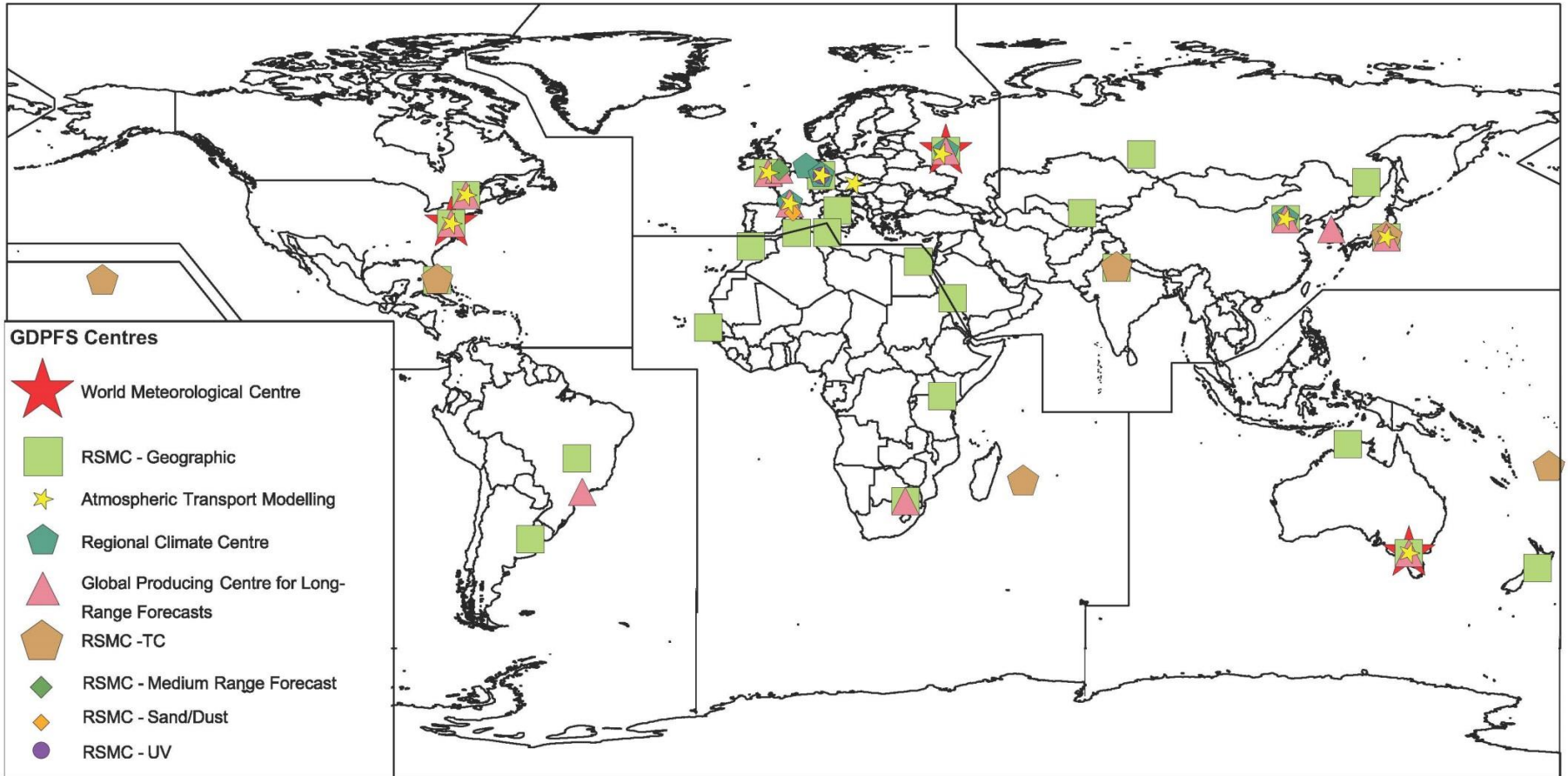
The Manual on the GDPFS

- A single source of technical regulations for all operational data-processing and forecasting systems operated by WMO Members

- It includes the criteria for designation of operational centres, including those coordinated by CBS, jointly with other technical commission(s) and/or WMO Programme(s), as well as with other international organizations
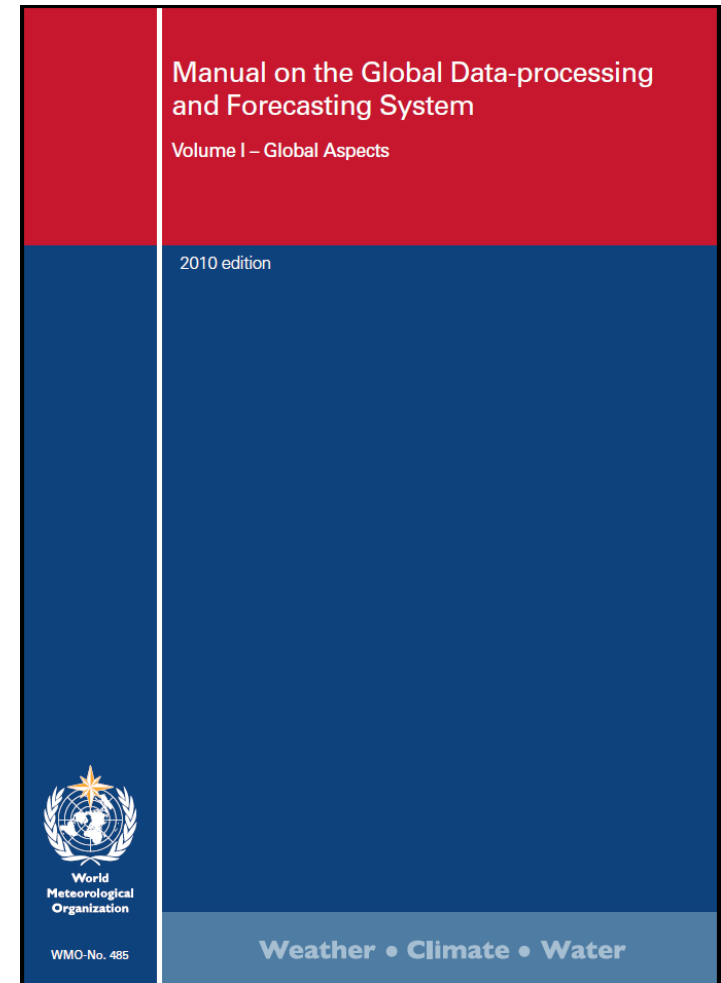
Manual on the Global Data-processing and Forecasting System
Volume I – Global Aspects

2010 edition

World Meteorological Organization

WMO-No. 485

Weather • Climate • Water

Global infrastructure

GPCLRFs

RCCs

- GPCLRF & RCC inventory of GFCS-relevant climate data and products (ECVs) 165+ pp.
- Not discoverable or organized in systematic form
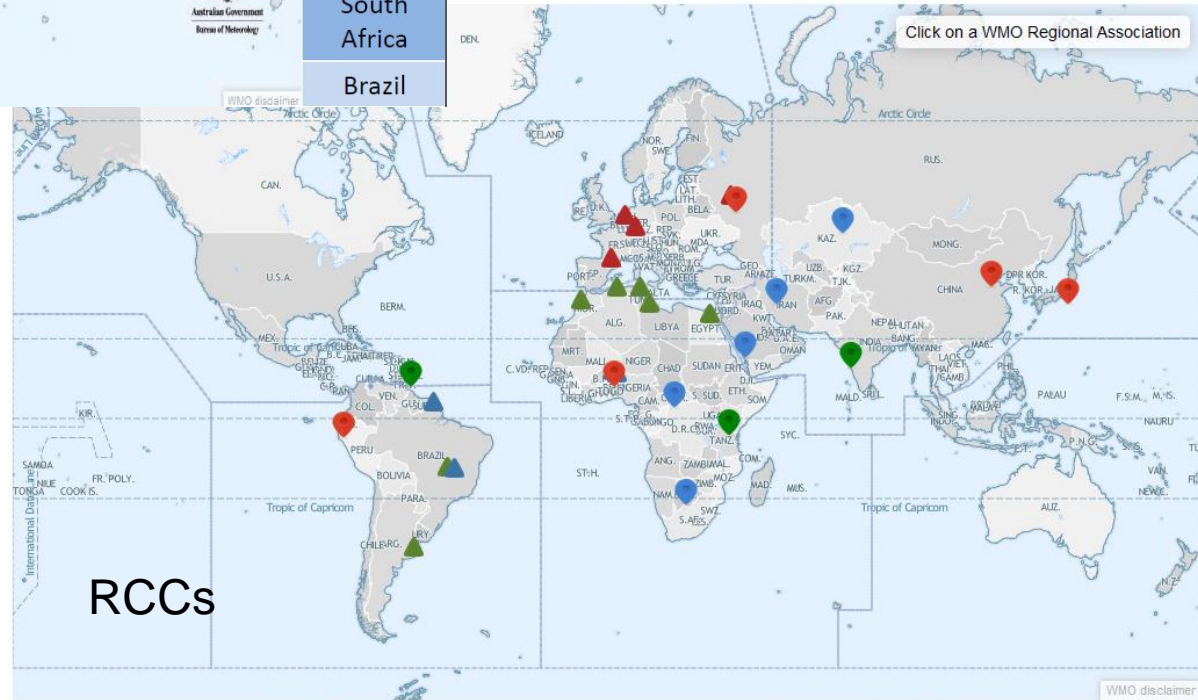
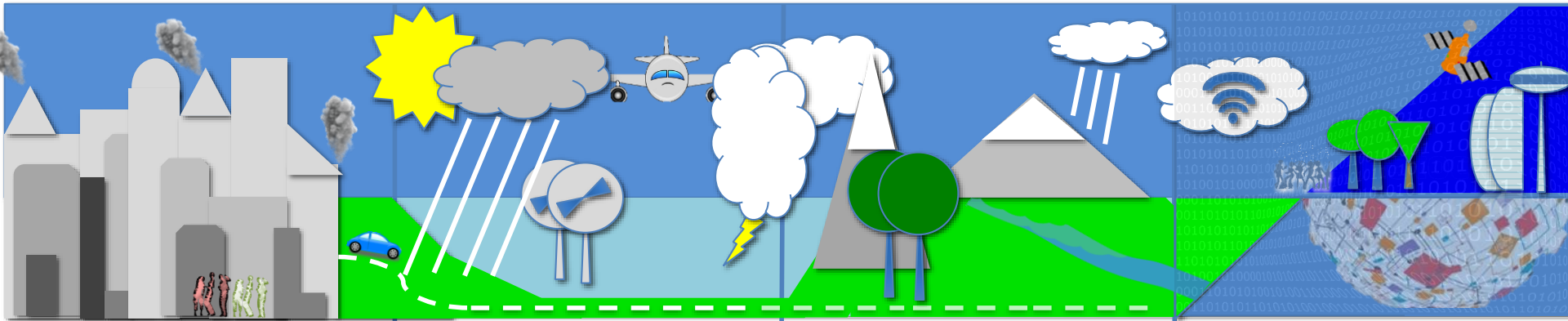**Legend**

- 🔴 designated RCC
- 🟢 RCC in demonstration phase
- 🔵 RCC proposed
- 🔺 designated RCC-Network
- 🔺 RCC-Network in demonstation phase
- 🔺 RCC-Network proposed

How GDPFS relates to Research
CAS Societal Challenges

URBANIZATION

HIGH IMPACT WEATHER

WATER & AEROSOLS

NEW TECHNOLOGIES & GHG Information System

Seamless prediction in the CAS context considers all compartments of the Earth system as well as disciplines of the weather enterprise value chain (monitoring and observation, models, forecasting, dissemination and communication, perception and interpretation, decision- making, end-user products) to deliver tailor made weather information from minutes to months and from global to local.

The future GDPFS will…

- Be an effective and adaptable monitoring and prediction system enabling Members and partners to make better-informed decisions

- Facilitate the provision of impact-based forecasts and risk-based warnings through partnership and collaboration

- 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

GDPFS working group workplan

- CBS 16th approved workplan:

- Collaborate with CAS to develop capabilities for Air Quality forecasting and its future transition to operations. Consideration should be given to the establishment of a Task team on Operational Air Quality to assist with the work.

- OPAG- DPFS co-chairs: Yuki Honda (Japan) and Paul Davies (UK)

Monitoring, Analysis and Prediction of Air Quality: MAP-AQ initiative (G. Brasseur)

The overarching goal of MAP-AQ :

- to constitute and develop a consortium of expert groups to coordinate and enhance research and services that will help mitigate air pollution, specifically in regions of the world where high concentrations of pollutants are observed.

- *to develop and implement a global air pollution monitoring, analysis and prediction system (MAP-AQ) with downscaling capability in regions of the world that are affected by high levels of atmospheric pollutants, in particular in low and middle-income countries. We will combine an ensemble of state-of-the-art multi-scale chemical transport models, high-resolution emission inventories, space observations and surface measurements to provide near-real-time forecasts and analyses of air pollution and its effect at the global to regional and local scales.*

- support the development of simple devices for air quality monitoring. We will co-design and co-develop with users and other stakeholders relevant products and services, and transfer air quality related information to the public.

- create collaborative efforts for the application of the system to urban planning. Educational activities will provide the basis for sustained capacity building.

Air Quality Forecasts in Different Regions of the World

Image from NASA - U.S. Geological Survey
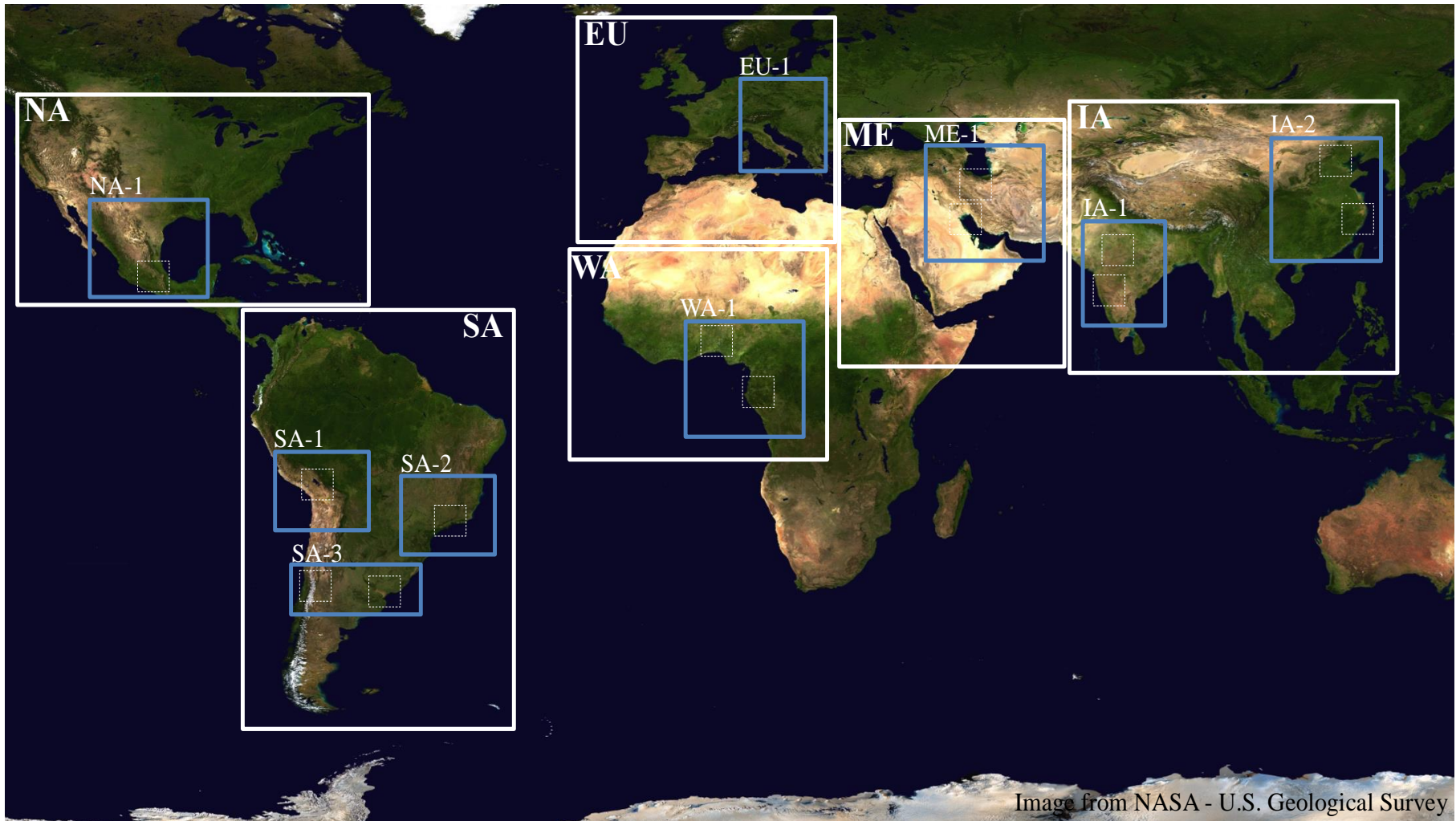
MAP-AQ : outline of prediction system

The prediction system will include several main components:

- (a) a multi-model, multi-scale state-of-the-art **air quality forecast system** (hemispheric, regional, urban and local)
  - Multi-model ensemble with different level of coupling between dynamical, physical and chemical processes
- (b) a state-of-the-art **data assimilation system** capable of providing the best estimate of the atmospheric chemical composition via integration of a wide range of Earth observations within chemistry transport models
  - a range of data assimilation schemes such as three dimensional variational (3DVAR), four dimensional variational (4DVAR), ensemble-based methods (LETKF) and hybrid data assimilation systems
- (c) a state-of-the-art **evaluation system** that will quantify uncertainties and estimate errors in air quality predictions (e.g., Delle Monache et al., 2006).

This state-of-the-science modeling system will be used

- To provide daily deterministic and probabilistic air quality forecasts for Asia, Africa and Latin America and the Caribbean with spatial resolutions that will be increased in densely populated areas (grid nesting).
- To provide spatial analysis and forecasts of atmospheric composition in support of experimental field campaigns and monitoring activities.
- To study the expected changes in future air quality in response of various forcings and feedbacks such as changes in the primary pollutant and precursor emissions, urbanization, industrialization land-use, environmental and climate change.
- To support the design of air pollution mitigation strategies.
- To support the design of air quality monitoring networks.
- To support educational activities related to air pollution and climate change.
- To train students and scientists from the targeting areas.

Outlook

- MAP-AQ is not a project. It is an **umbrella** under which several projects could develop in different parts of the world.

- MAQ-AQ is currently establishing a rather broad Implementation Group with representatives from all continents and different disciplines (research and service) to guide the development of the Programme

- MAQ-AQ will also constitute a small Executive Board

- In addition to the existing White Paper, a paper presenting the objectives of MAP-AQ will soon be submitted to an international journal (Nature)

- MAP-AQ is an open structure. Everyone is invited to contribute.

- MAQ-AQ is looking for ways to consolidate the initiative

MAP-AQ is an IGAC Emerging Activity and is encouraged by WMO as a support of the Global Atmospheric Watch (GAW)

Expectations for GURME SAG

- Actions & tasking