World Weather Research Program and GEWEX

Michael C. Morgan

WWRP Science Steering Committee Representative

The World Weather Research Programme

WWRP promotes international and interdisciplinary research for more accurate and reliable forecasts from minutes to seasons, expanding the frontiers of weather science to enhance society's resilience to high-impact weather and the value of weather information for users.

WWRP aims at Seamless Prediction by increasing convergence between weather, climate and environmental approaches. WWRP strengthens academic – operational partnerships and interdisciplinary collaborations, and enhances the role of Early Career Scientists.

WEATHER CLIMATE WATER
TEMPS CLIMAT EAU

Sarah Jones,
Chair WWRP Scientific Steering Committee

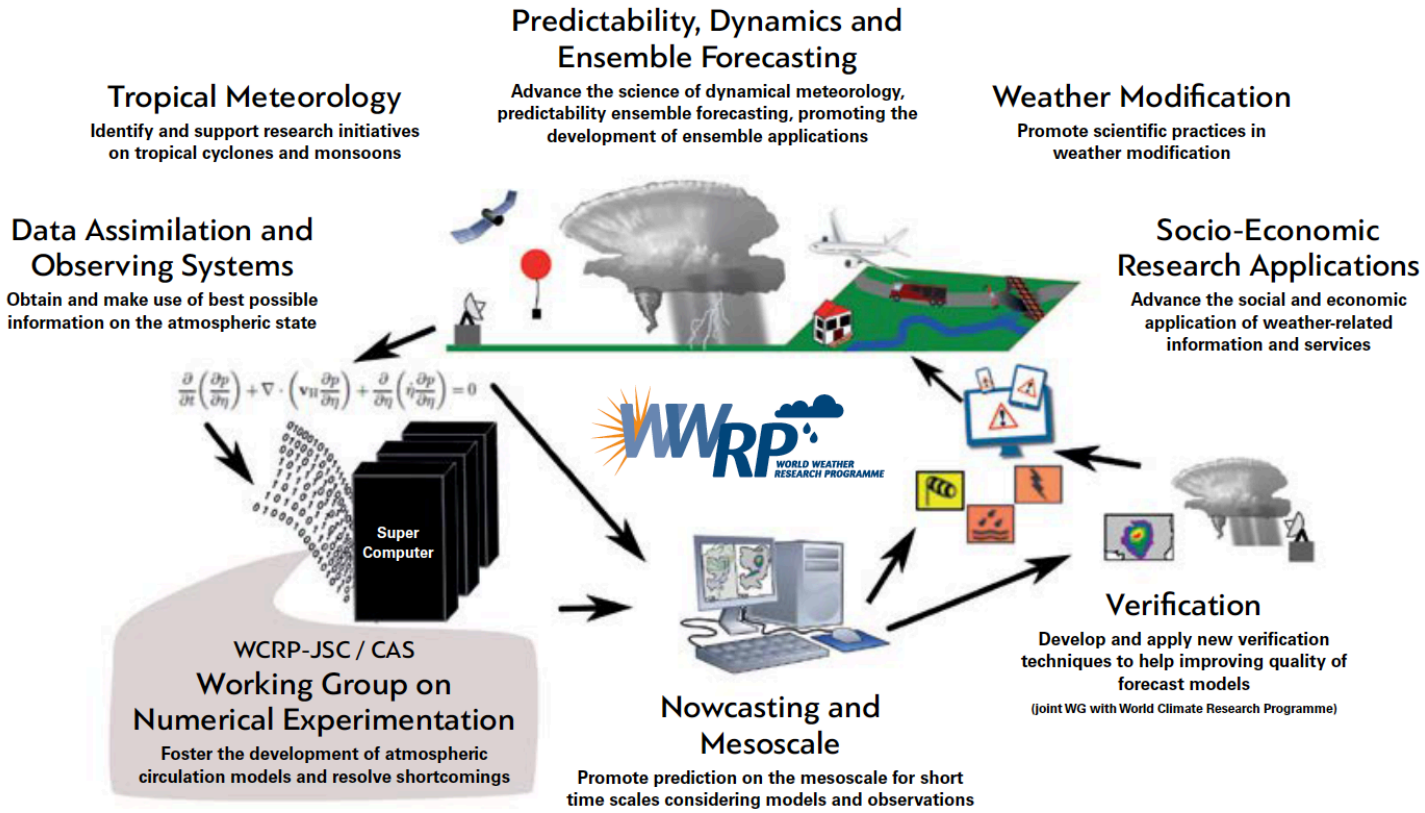
Paolo Ruti, Chief World Weather Research Division

WMO OMM
World Meteorological Organization
Organisation météorologique mondiale

WWRP

- WWRP advances society's ability to cope with high impact weather through research focused on improving the accuracy, lead time, and utilization of weather prediction.
- WWRP is composed of Projects, Working Groups, and an Expert Team.

WWRP Structure



High-Impact Weather Project (HIWeather)
Improvement of high impact weather forecasts, their communication and utility on timescales from minutes to two weeks

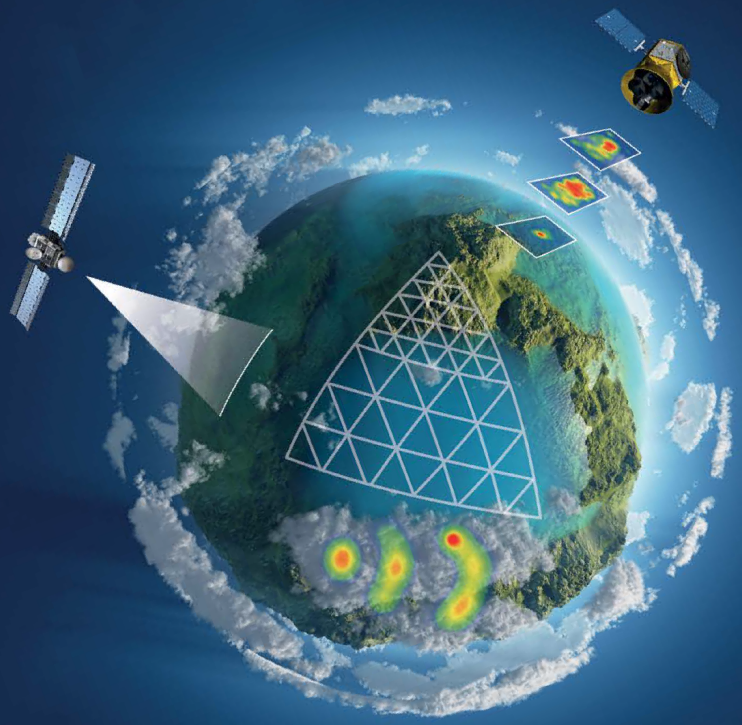
Subseasonal to Seasonal Project (S2S)
Improve forecast skill and understanding of predictability on the subseasonal to seasonal timescales and promote uptake and exploitation by community

Polar Prediction Project (PPP)
Enable development of improved weather and environmental prediction services for polar regions on time scales from hours to seasons

WWRP 2016 - 4

Catalysing Innovation in Weather Science:

WWRP Implementation Plan 2016-2023



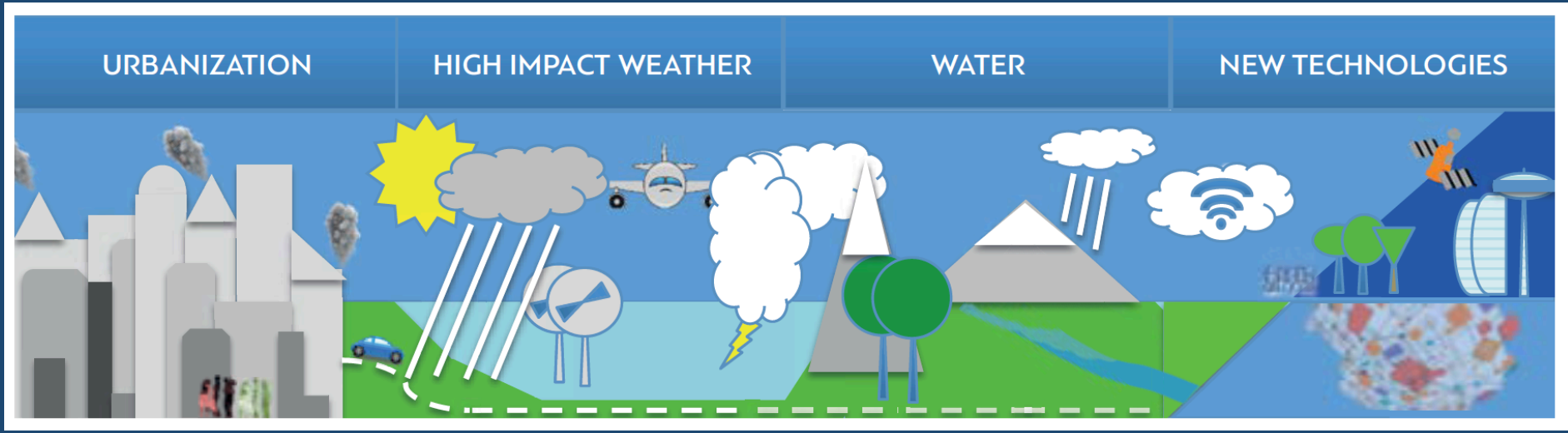
WEATHER CLIMATE WATER

WORLD METEOROLOGICAL ORGANIZATION

WWRP WORLD WEATHER RESEARCH PROGRAMME

WWRP Research Strategy

The implementation plan facilitates the realization of a research strategy developed to tackle four scientific and societal challenges culminating ultimately in seamless prediction of the Earth system from minutes to months.



WWRP Action Areas

Societal Challenges

HIGH IMPACT WEATHER	WATER	URBANIZATION	NEW TECHNOLOGIES

Action Areas

Address Limitations Uncertainty Fully Coupled Applications Verification Attribution	Integrated Water Cycle New Observations Precipitation Processes Hydrological Uncertainty	Understand Needs Observations & Processes Urban Prediction	Advanced Methods Support Facilities Tools New Observations Future GOS

Objectives and Concrete Activities

Each Action Area comes along with a set of objectives.
Concrete Activities have been defined that will ensure to achieve the objectives and make progress in the action areas.

WWRP Action Areas

Societal Challenges

HIGH IMPACT WEATHER	WATER	URBANIZATION	NEW TECHNOLOGIES

Action Areas

Address Limitations Uncertainty Fully Coupled Applications Verification Attribution	Integrated Water Cycle New Observations Precipitation Processes Hydrological Uncertainty	Understand Needs Observations & Processes Urban Prediction	Advanced Methods Support Facilities Tools New Observations Future GOS

Objectives and Concrete Activities

Each Action Area comes along with a set of objectives.
Concrete Activities have been defined that will ensure to achieve the objectives and make progress in the action areas.

Water:
Modelling and predicting the water cycle for improved disaster risk reduction and resource management

Water Action Areas

AA7: Integrated Water Cycle: Improve understanding, observation, and modeling of aerosol, cloud and water vapor aspects of precipitation processes with a view improved estimation and predictions of precipitation

AA8: New Observations: Assess and exploit new *in situ* and remotely sensed hydro-meteorological observations

AA9 Precipitation Processes: Improve understanding, observation and modeling of aerosol, cloud and water vapour aspects of precipitation processes, with a view …

AA10: Hydrological Uncertainty: Characterize and communicate how QPE and QPF uncertainty translates to hydrological uncertainty (and *vice versa*)

WMO Strategic Plan 2020-2023

[WMO] Vision: all resilient by 2030

.

1 Services — Better serve societal needs: delivering, authoritative, accessible, user-oriented information and services

2 Systems — Enhance **Earth system** observations and predictions: Strengtheni technical foundation for the future

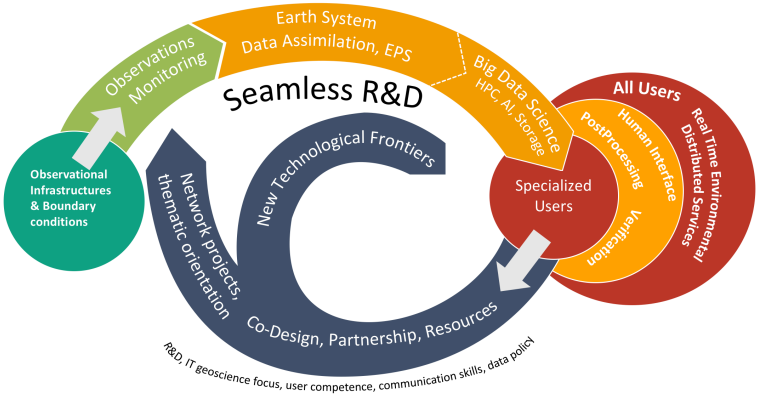
3 Science — Leveraging leadership in science to improve understanding of the **Earth system** for better services

4 Support to Members — Enhancing service delivery capacity of developing countries to ensure availability of essential information and services

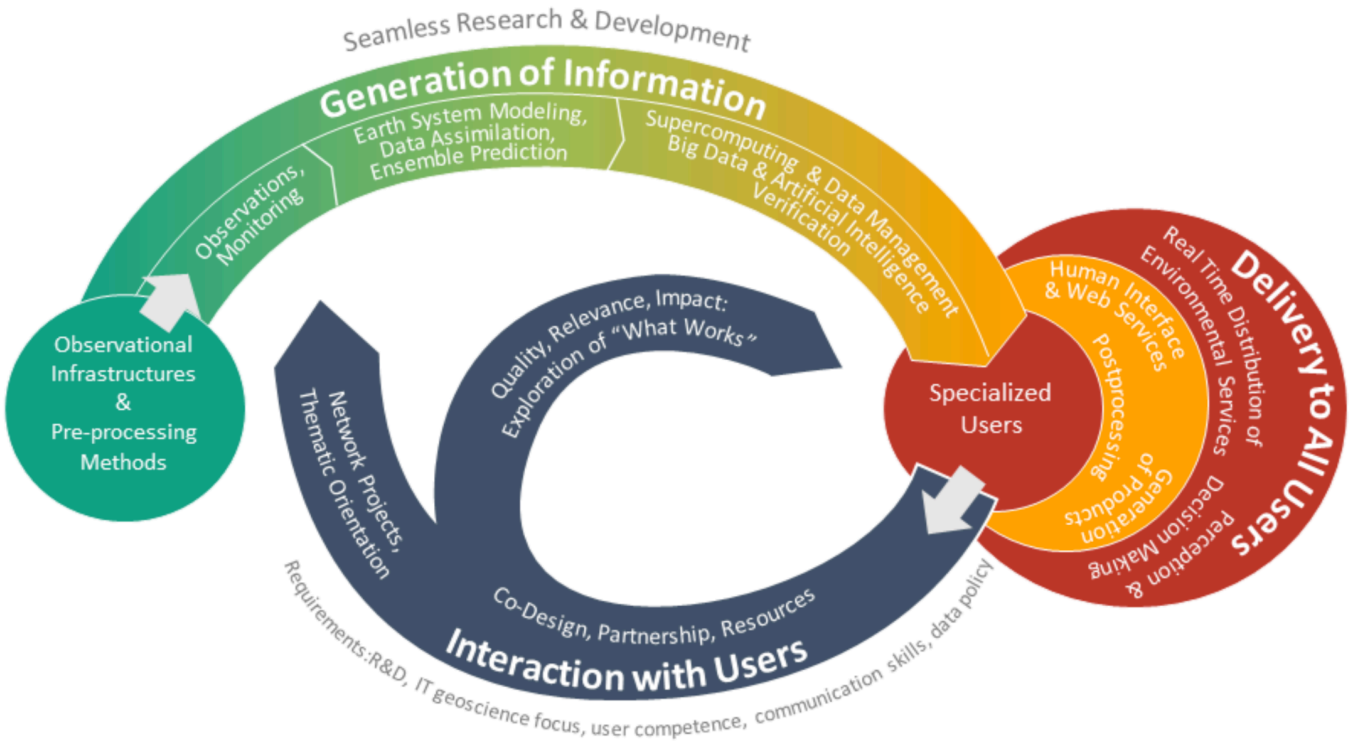
5 Smart Organization — Strategic realignment of WMO structure for effective policy- and decision-making and implementation

RB primary responsibility: to deliver the Long Term Goal of the WMO Strategy "Advance Targeted Research"

- Advance Scientific Knowledge of the **Earth System**
- Enhance the **science-for-service** value chain ensuring scientific and technological advances improve predictive capabilities
- Advance **policy-relevant science**

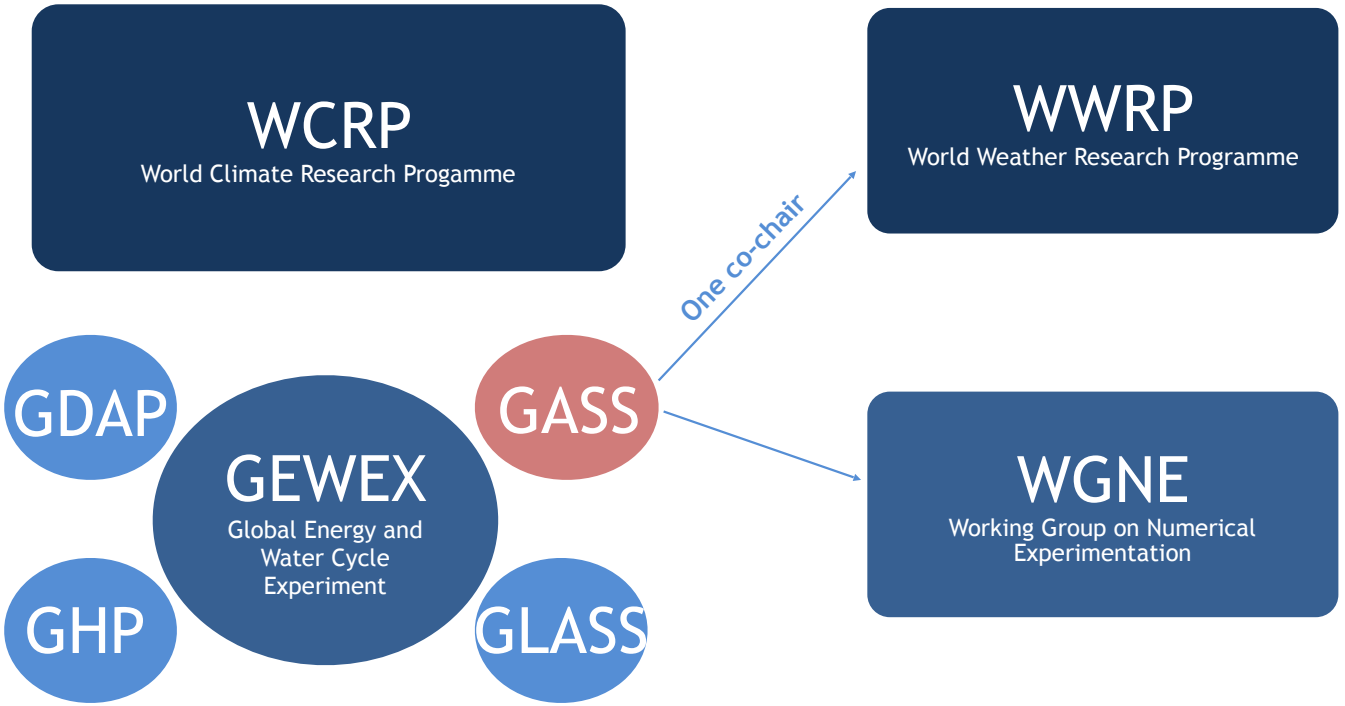


The Earth System Science you need to make your life safer and better



Technical developments on seamless Earth system science need to go hand in hand with informed advancement of observations, monitoring capabilities and advanced assimilation and Earth system modelling and other prediction methods, which are the backbone of existing meteorological services.

Ruti et al., BAMS 2019. DOI 10.1175/BAMS-D-17-0302.1



Goal of GASS: to understand the physical processes and their coupling to atmospheric dynamics

Mission of GASS:

- to develop and improve the representation of the atmosphere in weather and climate models.
- to contribute to the development of atmospheric models.

What are the opportunities for collaboration?

- WWRP supports the organization of GASS around process-oriented science challenges and views this approach as it builds the focus of scientific community in areas or mutual important to both GEWEX and WWRP.
- GEWEX Phase III (2013-2022) and WWRP IP (2016-2023): an opportunity to mutually reprioritize research foci and identify emerging areas
- While recognizing and respecting that the programs have different objectives, there is an opportunity to identify where there are overlaps that would foster organic collaboration
- Identification of WWRP (GEWEX) research activities that project onto the GEWEX activities (WWRP AA's) would be insightful.

Collaborative prospects

- The importance of AA1 (Address limitations), AA3 (Fully coupled), AA7 (Integrated water cycle), and AA9 (Precipitation processes) remain areas for which collaboration and sharing of expertise should prove to be mutually fruitful.
- Examples: Convective-permitting climate modeling; exa-scale computing and data science methodologies
- An intended outcome of collaboration would be the advancement of an Earth System Science framework in support of seamless prediction with benefits across timescales ranging from weather to S2S to climate (including the future water cycle in future climate)
- S2S from perspective of water management and land-atmosphere interactions

Key Topics at weather-climate intersection

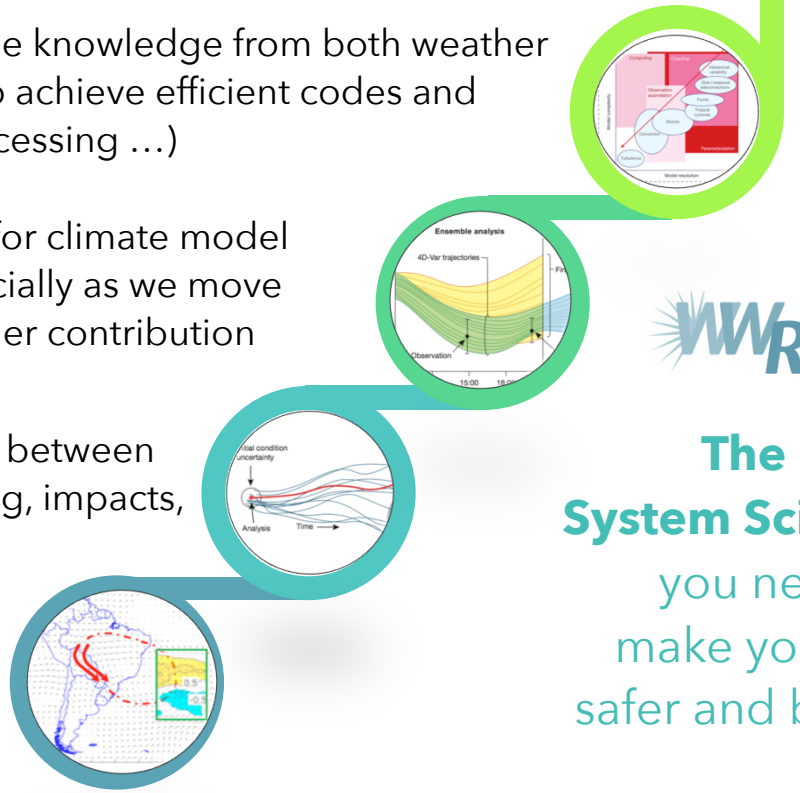
Collaborative nodes

Exascale computing and machine learning, where the knowledge from both weather and climate communities is going to be important to achieve efficient codes and new advanced methods (parametrizations, post-processing …)

Data assimilation, becoming increasingly important for climate model development as a means of identifying biases, especially as we move to develop higher-resolution climate models – weather contribution

Sub-Seasonal to Seasonal Prediction – a joint project between WCRP and WWRP – synergies: predictability, coupling, impacts, decision making processes

Science and technology underpinning coupled processes where climate community developed advanced methods



WWRP WORLD WEATHER RESEARCH PROGRAMME

The Earth System Science you need to make your life safer and better