Catalyzing Innovation in Weather Science: the World Weather Research Programme

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WEATHER CLIMATE WATER
TEMPS CLIMAT EAU

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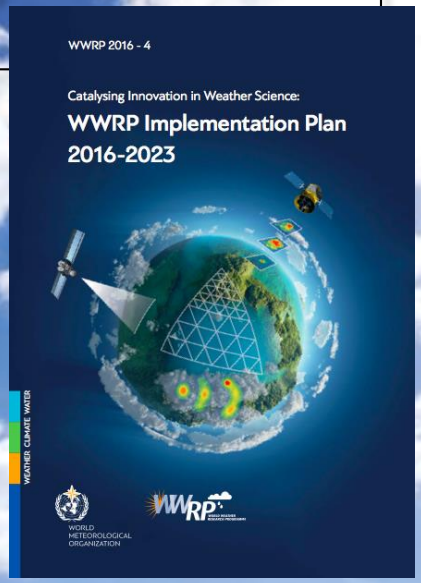
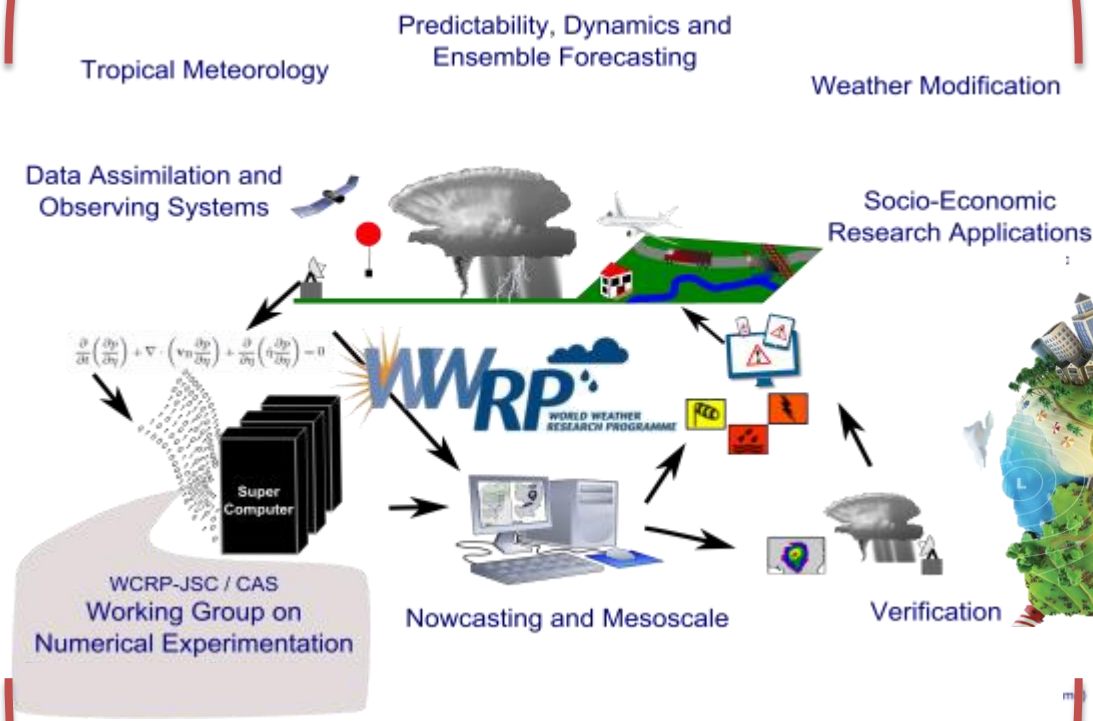


WWRP Structure

WWRP Working Groups



WWRP Core Projects

WCRP World Climate Research Programme

Subseasonal-to-Seasonal S2S Prediction Project

WWRP Regional Portfolio

Research Development & Forecast Demonstration Projects

- Convective Systems, Tropical Cyclones, Aviation, Olympic Games, Nowcasting Systems, Sand & Dust Prediction etc
- China, Argentina, US, Lake Victoria, Mediterranean, Hong Kong, South Africa, Canada, Australia, South Korea ….

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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.

High-impact Weather: Toward impact-based forecasts in a variable and changing climate

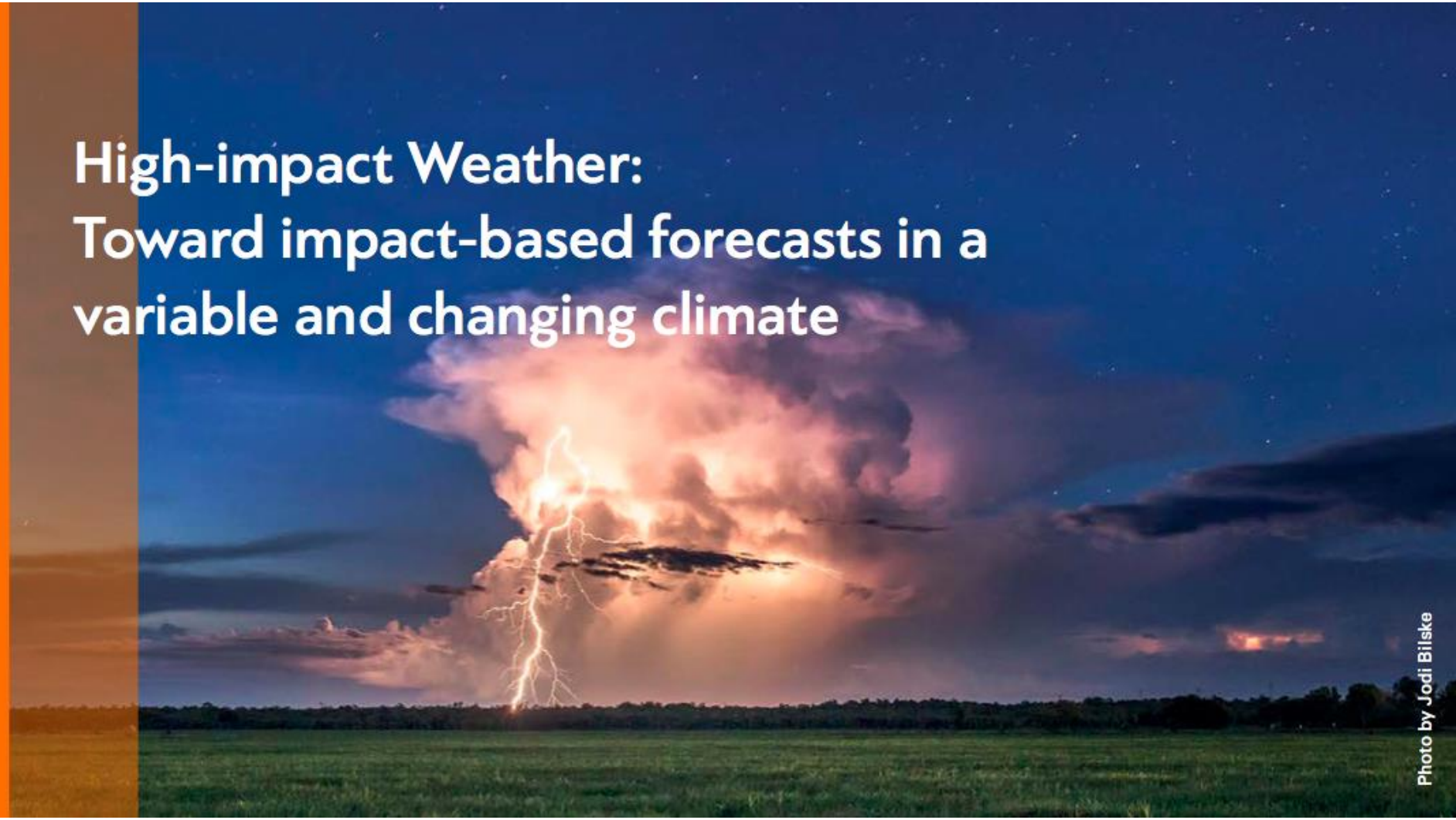

Photo by Jodi Bilske

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Action Areas 2: Uncertainty

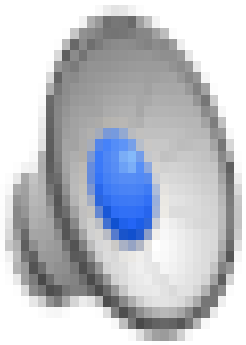
Identify, characterize and quantify analysis and forecast uncertainty using advanced probabilistic methods, and develop corresponding data channels and communication mechanisms which support decision-making under uncertainty

- Quantitative descriptions of the uncertainty of the initial state, its evolution forward in time.
- Improve the resolution and reliability of ensemble-based meteorological predictions
- Co-design communication mechanisms of uncertainty with users
- Improved diagnostics and verification tools from high-resolution ensembles that assist operational forecasters

Action Areas 2: Uncertainty

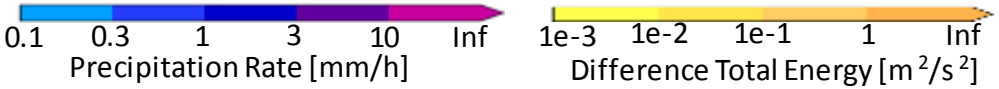
Example: *Upscale error growth in high-resolution experiment*

Selz and Craig 2015 Mon. Wea. Rev.



Perturbation error growth: Shown as difference between control and perturbed experiment

Perturbations spread out from the convective regions at a speed consistent with that of a deep (troposphere filling) gravity wave to synoptic scale disturbances.



500 hPa geopotential
line spacing 250 m 2/s 2

500 hPa geopotential difference on large scales
(>1000 km). Red positive, blue negative, line spacing 5 m 2/s 2

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

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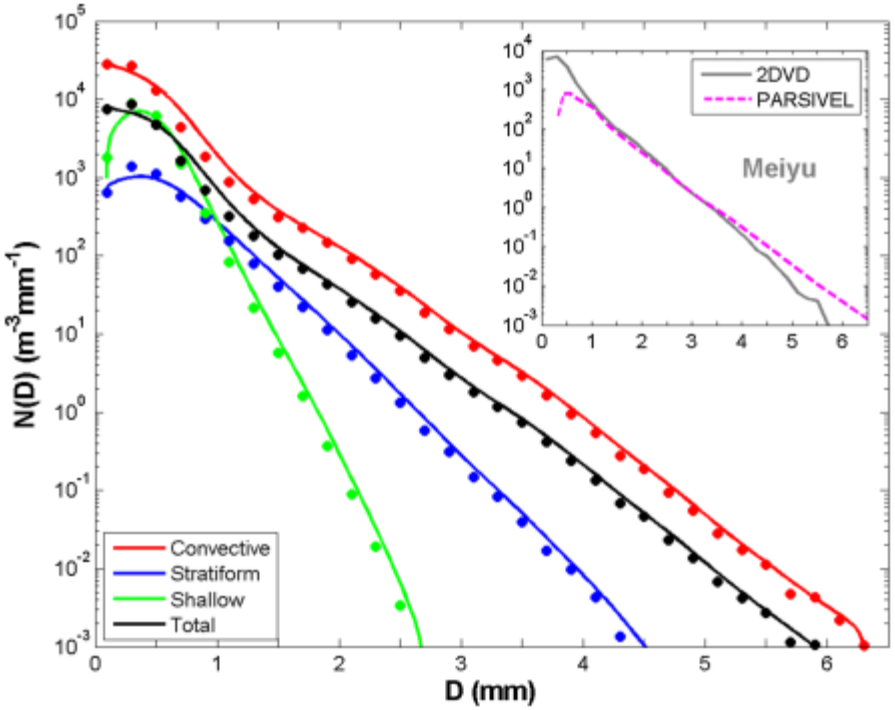
Action Areas 9: Precipitation Processes

Improve understanding, observation and modelling of aerosol, cloud and water vapour aspects of precipitation processes, with a view to improved estimation and predictions of precipitation

- Develop new/better convective parameterizations for non-convection-permitting models (which remain relevant).
- In collaboration with GAW improve the understanding of aerosol activation in the atmosphere and how this affects radiative forcing of weather and climate & cloud processes
- Make improvements to model physics and related data assimilation for improving rainfall processes

Action Areas 9: Precipitation Processes

Example: *Statistical characteristics of raindrop size distributions observed in Asian summer monsoon*



Wen et al. 2016 J. Geophys. Res.

Convective spectrum has the highest concentrations at all size ranges, resulting in a higher number concentration, a higher rain rate, and more rain water content

The stratiform spectrum is narrower, and that of shallow rain is the narrowest and has much higher concentrations below 1.1 mm, resulting in higher rain water contents

Composite raindrop spectrum curves (fitted to the observations) for the convective, the stratiform, and the shallow rain types, as well as for the total categorized data set.


Evolving Technologies:
Their impact on science and their use

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Action Areas 15: Support Facilities

Enhance access to services (observations, model output, data collection and pre-processing and global models) that require exceptional HPC and data handling

- Continue to support TIGGE, S2S, and similar data collection efforts, to enable and accelerate research worldwide
- In light of increasing data volumes, develop policies and methods for distributed data archival/ retrieval
- Develop and share (open source) tools and lessons-learned for handling and pre-processing such datasets and developing applications
- Make available to the international community model datasets in formats suitable for post-processing and verification

Action Areas 15: Big-Data

30x more data sent to customers per day in critical path

Data acquisition

100 Mb observational data per day

Forecast run

Product generation

Dissemination

RMDCN

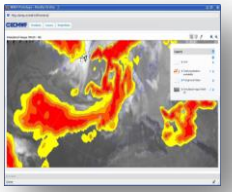
Internet

Web services

Internet

2 million grid-column calculations per time step

25x more forecast product data per day in critical path



Archive

Data Handling System

70 Tb data archived per day

By courtesy of P Bauer ECMWF. See also P Bauer et al, Nature 2015

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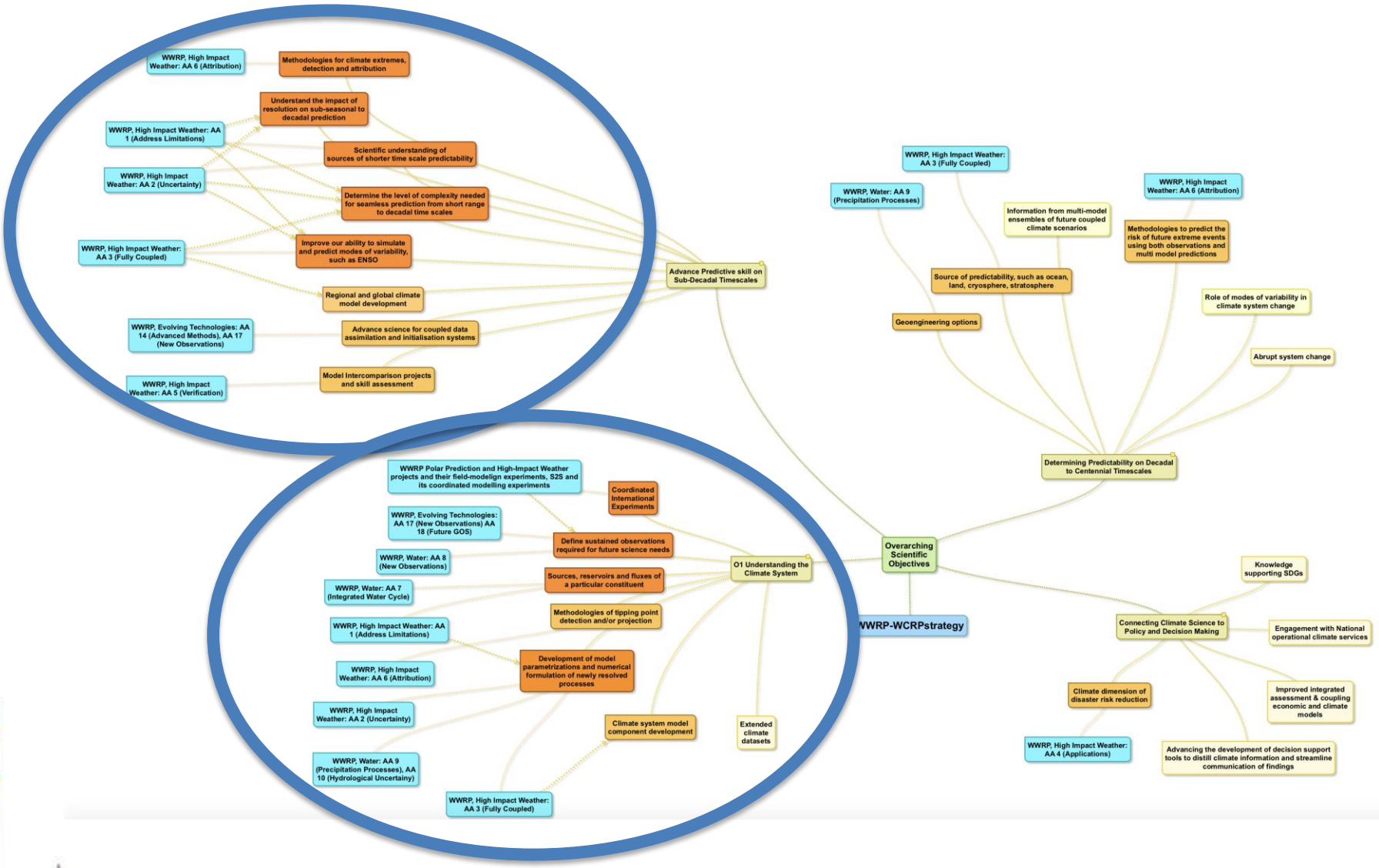
WWRP IP & WCRP Strategy



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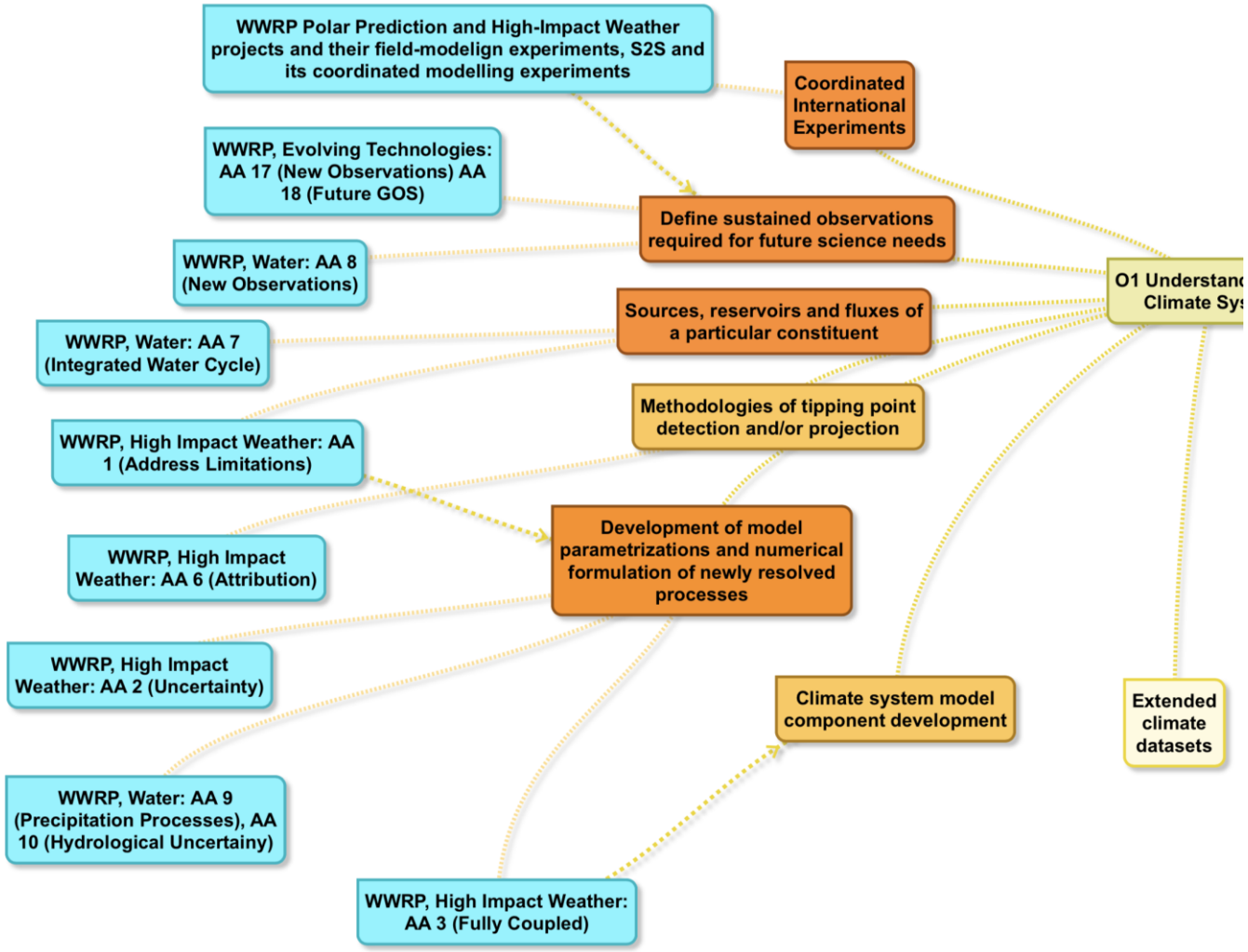
WWRP IP & WCRP Strategy

O1 - Understanding the climate system



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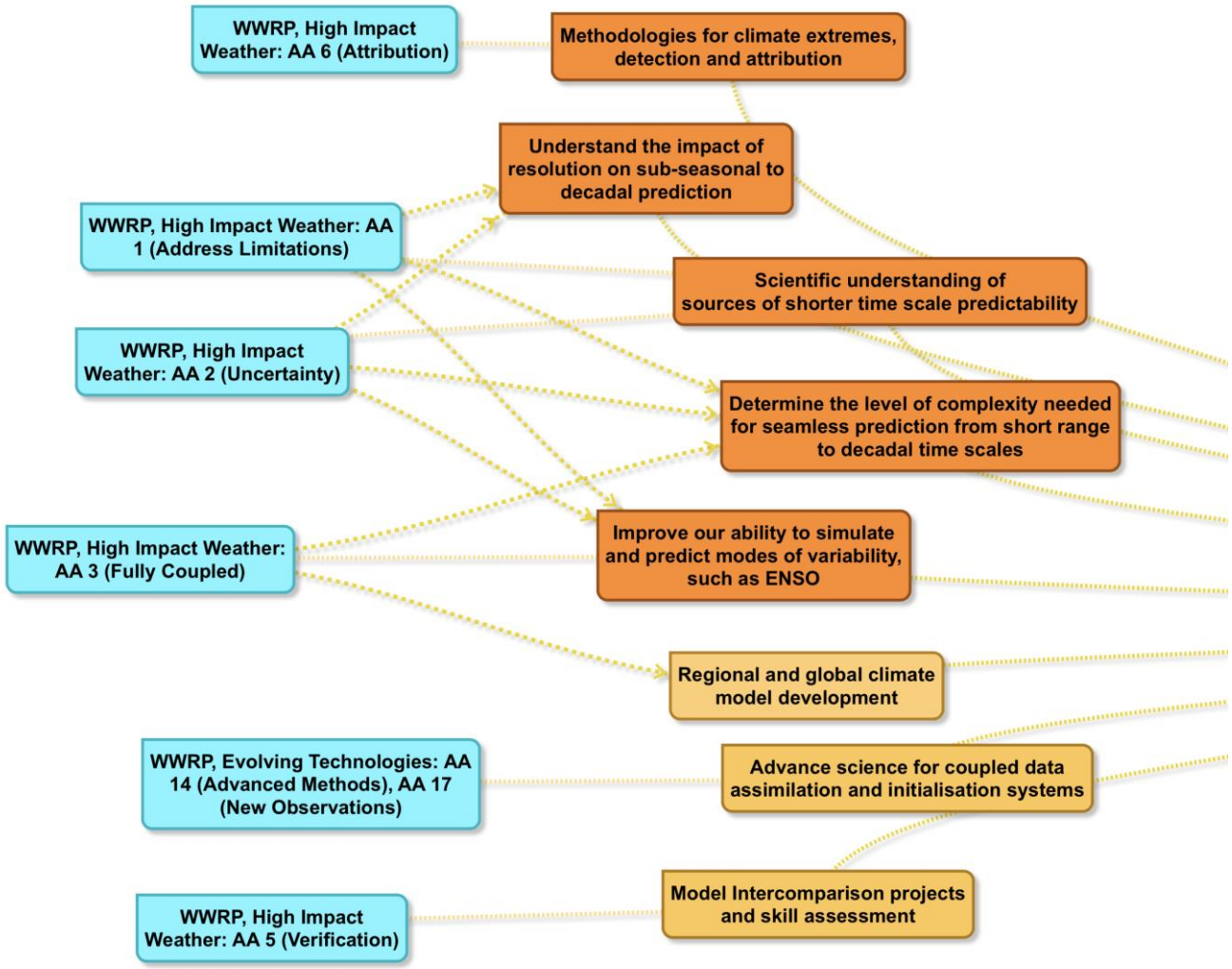
WWRP IP & WCRP Strategy

O2 - Advance predictive skill on sub-decadal timescales



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Topics for further interaction

- Advancing modeling and observations
  - Research to define future observing systems must consider needs for weather, climate, and the environment
  - Process oriented activities - How to translate process understanding into predictive skill?
- Supporting development of joint research infrastructure and networks
  - Enhance access to observations and model output
  - Share data exploration tools
  - Ensure engagement of Early Career Scientists
- Strengthening regional activities
  - Sustained development requires working in partnership to enhance regional capacity
  - Societal impacts depend crucially on regional characteristics

Catalyzing Innovation in Weather Science: the World Weather Research Programme

There is a need for co-design of science activities to make needed advances in our science and its service for society, and a need to coordinate WCRP and WWRP activities to make the most efficient use of available resources. Such coordination and co-design avoids unnecessary duplication of effort and brings to bear the diverse talents of our respective communities to tackle some of humanity's most vexing environmental challenges.

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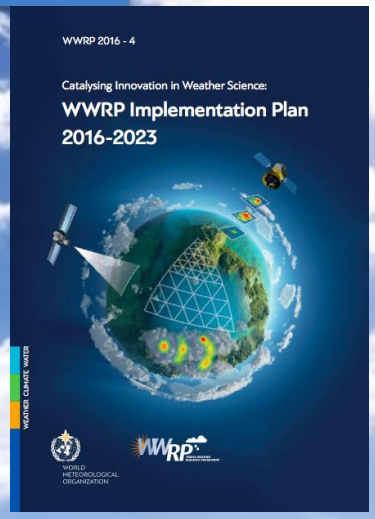
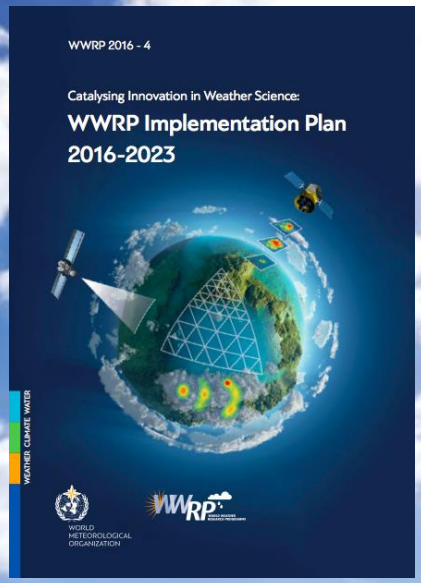


Catalyzing Innovation in Weather Science: the World Weather Research Programme

Thank you

Merci



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