How to shape future met- services: a seamless perspective

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WEATHER CLIMATE WATER
TEMPS CLIMAT EAU

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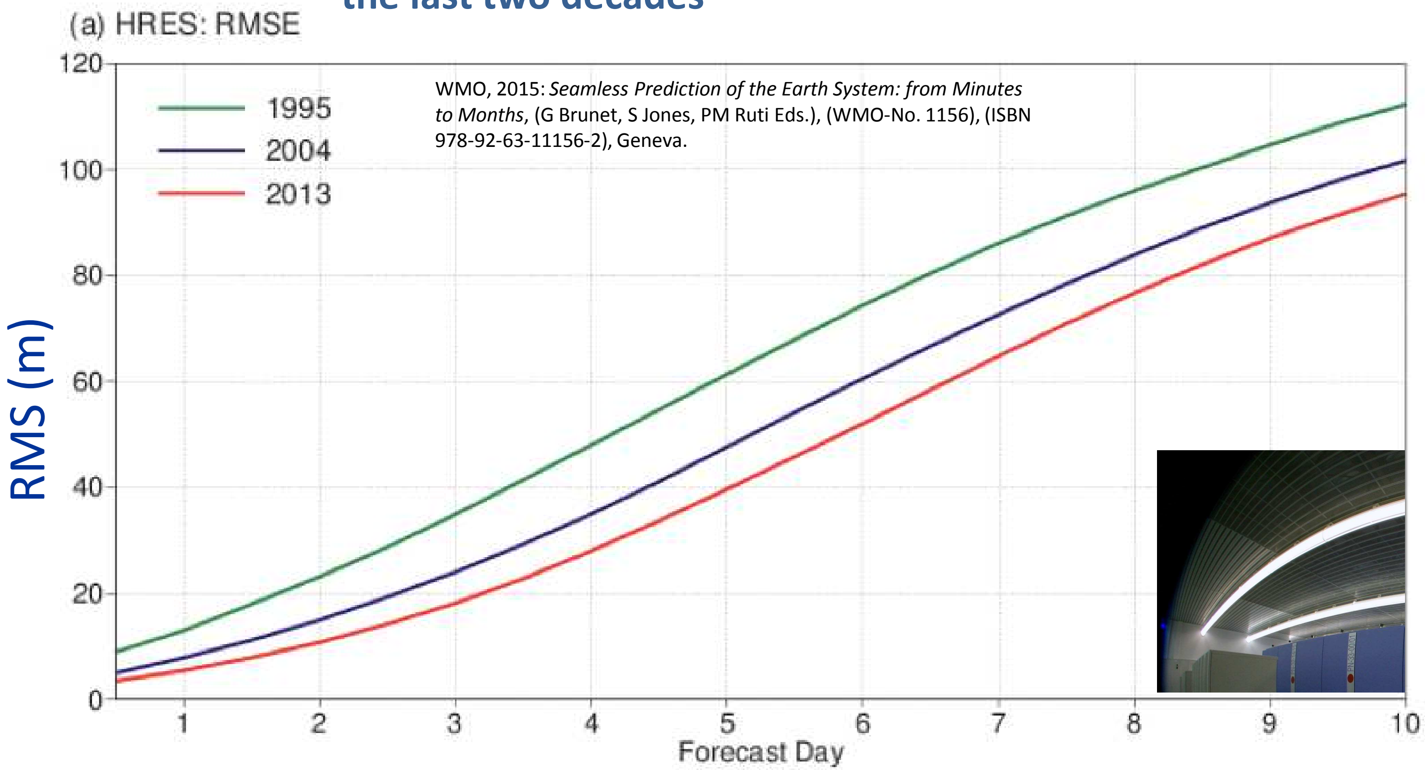
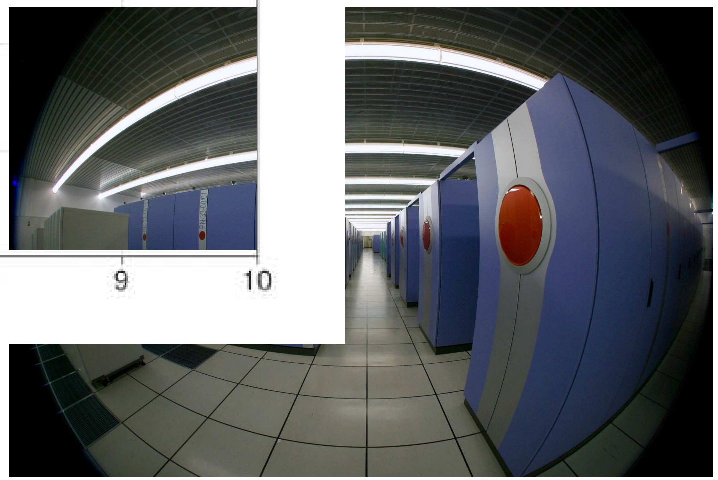
Improving the skill – big resources

ECMWF's forecast Z500hPa extra-tropical error growth over the last two decades



ECMWF



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WMO in three words

UN mandate on Weather, Climate and Water

- Weather Disaster Risk
- Research
- Climate & Water
- Observation

World Climate Research Programme (WCRP)

World Weather Research Programme (WWRP)

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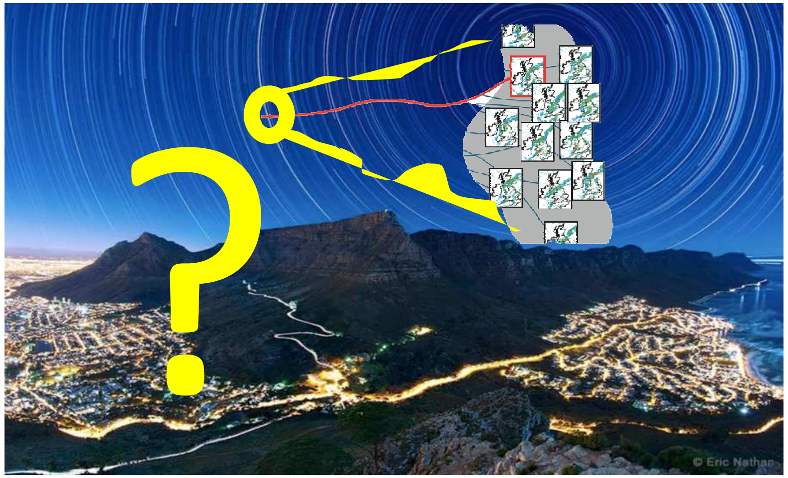
How to shape the met-climate future services?



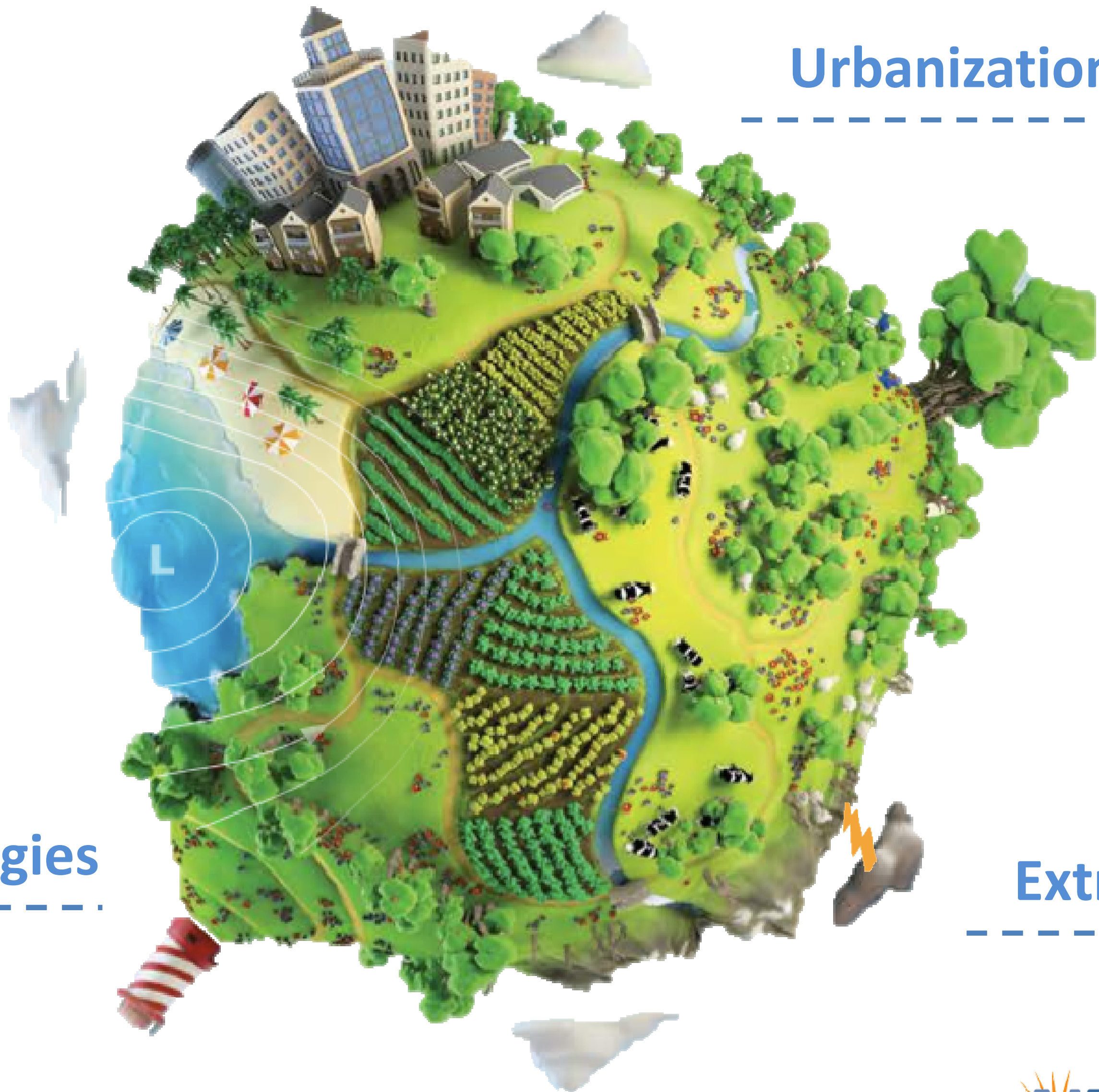
Overarching goals

- Towards Environmental Prediction, integrating modeling components (hydrology, sea-ice, ocean, atmospheric composition) to improve forecasting systems
  → Ex. Polar Prediction Project
- Towards a seamless predictive capability, developing a unified approach to advance environmental prediction from minutes to months and seasons, from global to local, for different users
  → Ex. Sub-seasonal to Seasonal Prediction Project
- Towards impacts forecasting, building community resilience in the face of increasing vulnerability to extreme weather events, through a better understanding of communication and decision-making processes
  → Ex. High-Impact Weather Project

Around 4 societal challenges

Urbanization

Water



New Technologies

Extremes

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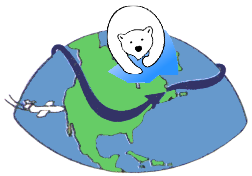
WWRP WORLD WEATHER RESEARCH PROGRAMME

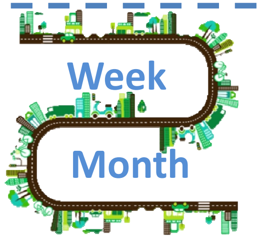
WWRP assets

Projects

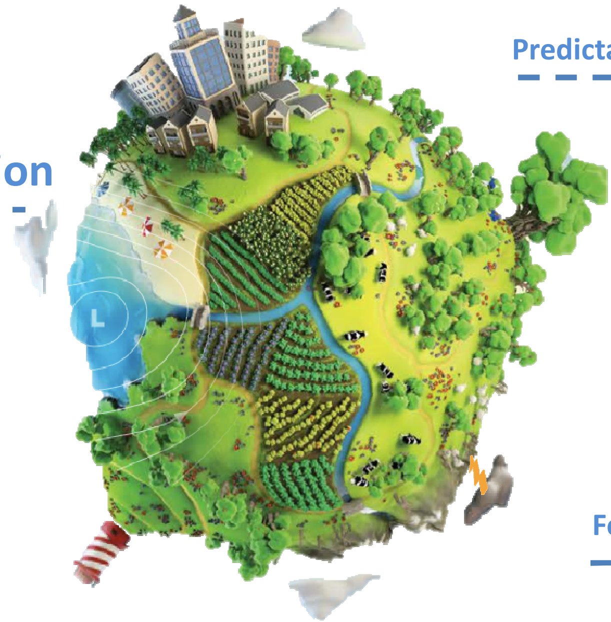
Polar Prediction Project



Sub-seasonal to Seasonal Prediction



High Impact Weather



Working Groups

- Numerical Experimentation
- Nowcasting and Mesoscale Weather Forecasting
- Predictability, Dynamics and Ensemble Forecasting
- Tropical Meteorology
- Social and Economic Research Applications
- Data Assimilation & Observing Systems
- Forecast Verification Research
- Weather Modification

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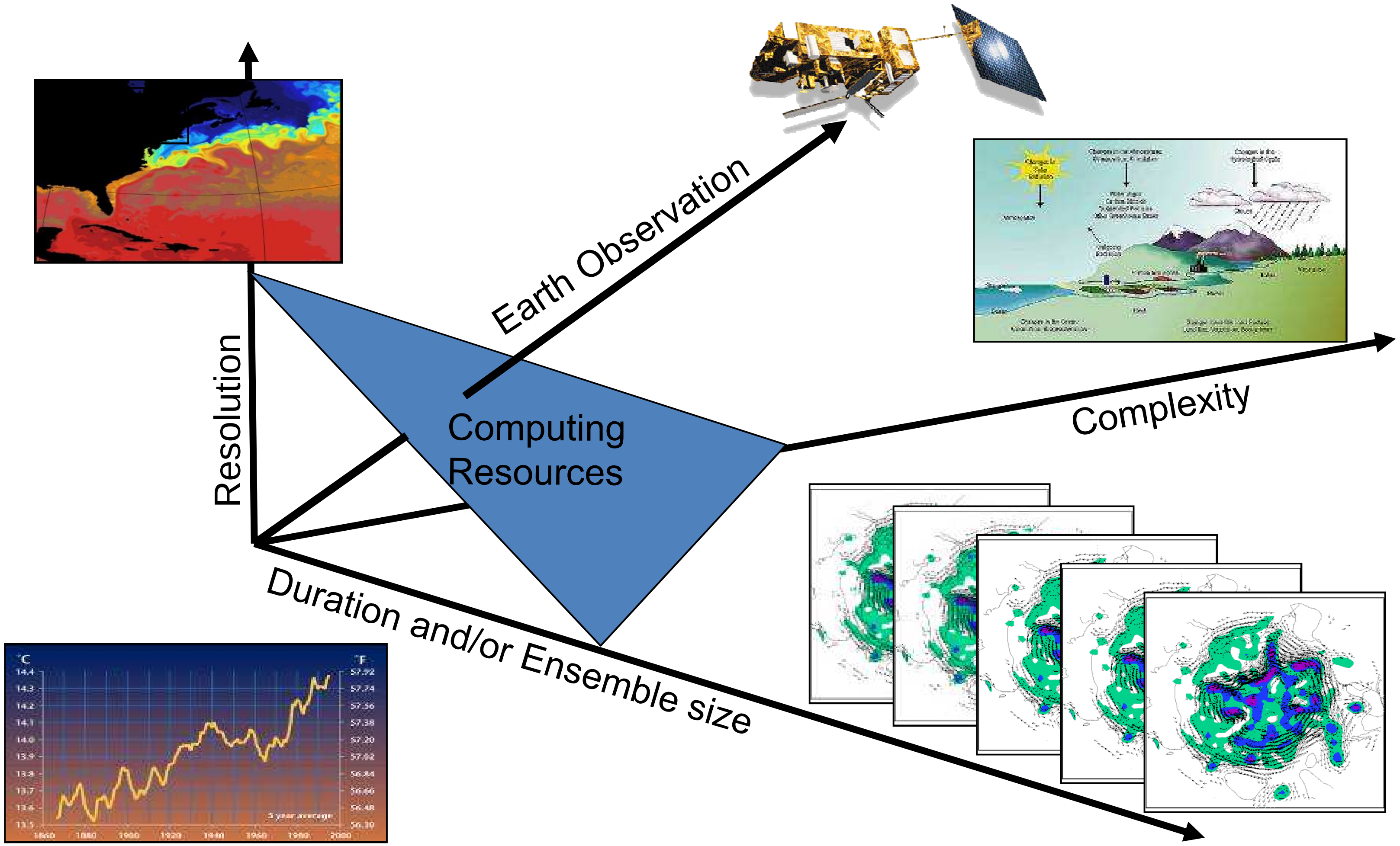
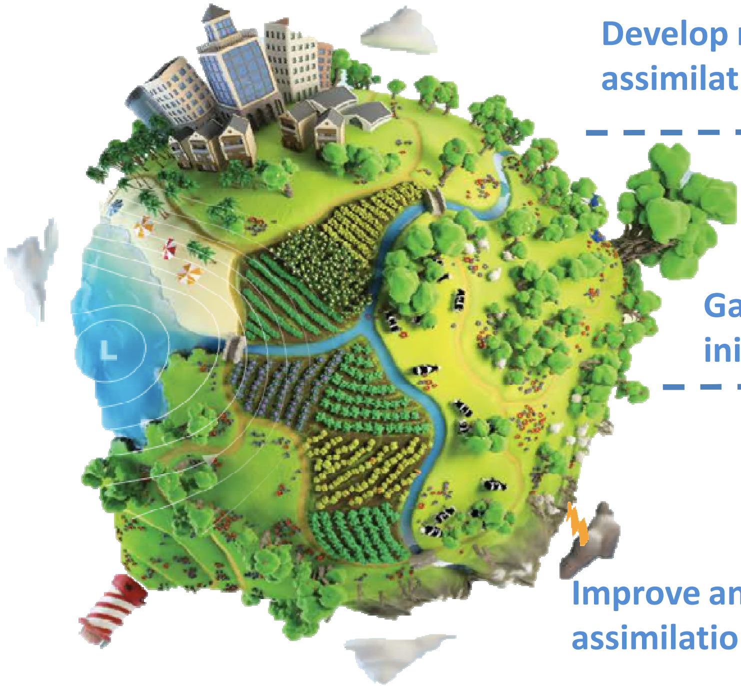
WWRP WORLD WEATHER RESEARCH PROGRAMME

Improving predictive skill



Weather & Technologies



Develop rapid-update convection-permitting Numerical Weather Prediction assimilating a variety of conventional and non-conventional observations

Gain a better understanding of ensemble strategies – mixed physics, initial conditions, number of members needed

Improve and implement efficient strategies for strongly and weakly coupled data assimilation to enhance the accuracy of predictions on long and short time scales

A) List view B) Map view C) Chart view

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Evolving technologies: their impacts on science and their use

ACTION AREAS

ADVANCED METHODS

Invest in methodological research (numerical methods, coupling strategies, assimilation methods, observational and model data information exploitation, including post-processing) to ensure that scientific enhancements can be implemented in future forecasting systems, and that systems can provide timely services

SUPPORT FACILITIES

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

TOOLS

Share specialist methods and tools enabling complex modelling systems to be run by a wider community

NEW OBSERVATIONS

Prepare for exploitation of information from new, advanced observing systems, as well as commodity-technology-based data

International Coordination

WMO, through WWRP, will need to coordinate with, amongst others,

WMO technical commissions for Basic Systems and for Instruments and Methods of Observations about unconventional observations;

and Regional Associations. This might include data sharing policies to be in place.

Other international research initiatives (Horizon2020, ICSU, UNISDR …)

Stakeholders and donors (European Commission, National Science Foundation…) who may benefit from technical advances;

Private sector …

Advanced Methods

Focus new development on models and coupling strategies that take advantage of more scalable computer architectures and GPUs

Improve and implement efficient strategies for strongly and weakly coupled data assimilation to enhance the accuracy of predictions on long and short time scales

Gain a better understanding of ensemble strategies – mixed physics, initial conditions, number of members needed

Improve and implement efficient strategies for regional ensemble forecasting systems to be used by smaller NMHSs

Develop rapid-update convection-permitting NWP assimilating a variety of conventional and non-conventional observations, to underpin improved short-range forecasts and warnings for high impact weather ("warn on forecast")

Develop and apply improved post-processing methodologies to value-add to numerical predictions to improve accuracy and generate products.

Provide improved tools for visualization of forecasts and their impacts

New Observations

Improve understanding and quantification of the positive impact of existing and new observation data streams on the accuracy of numerical prediction, especially in the mesoscale where there is currently a poorer idea of how best to assimilate observations

Better understand the potential global and regional benefit of additional observing systems deployed to remote regions (oceans, polar regions)

Design a prototype more comprehensive global observing system that takes greater advantage of non-conventional data sources (crowd-sourced, cell phone, etc.)

Design a prototype adaptable observing system that (in a statistical sense) minimizes analysis and forecast uncertainty

Develop quality control methodologies and data formats for new kinds of observations

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Urbanization and interesting case study

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

OBSERVATIONS & PROCESSES
Improve observations and understanding of the unique urban physical processes, including dynamical, chemical and hydrologic. Increasingly use third party networks, data from air quality monitoring sites, and crowd-sourced and other non-conventional data to help fill the gaps in the measurement networks in urban areas

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Global Data-processing and Forecasting System

In other words, if we project ourselves in the year 2031, that is, 15 years from now

At that time, the overall accuracy of state of the art global prediction models will have improved enough to add 1.5 days of overall predictability.

Global NWP models will have resolutions below 5km , and mesoscale models significantly below 1km, down to a few tens of meters in urban areas for example.

We will have achieved skill at the sub seasonal time scales, ensembles will routinely have hundreds of members, shared between many global centers,

and forecast products will provide accurate and detailed information on such things as closed water budgets over most watersheds, wind, temperature and air quality information in urban street canyons and outwards to the surrounding country side, ….

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What challenges from now to 2031 …

In fact, recent technology changes open up the possibility of Numerical Weather Prediction future development strategies relying on distributed computing and data storage capacities, thus making relatively obsolete the need for purely national facilities.

The development and provision of tools giving access to pooled resources, so that NMHS's, especially the ones need the most, can obtain the information they need bypassing the need to implement modeling capacities at home

The need to devise a system that would be flexible and easily adaptable to the many technical and expanding service needs and requirements emerging in the user and producer communities

The need to expand collaborations with many other partners, not necessarily in the traditional family of NMHS's

The need for a win-win business model with the private sector ….

A seamless community

There is a need to bring the impact, weather and climate communities closer together, to "talk the same language".

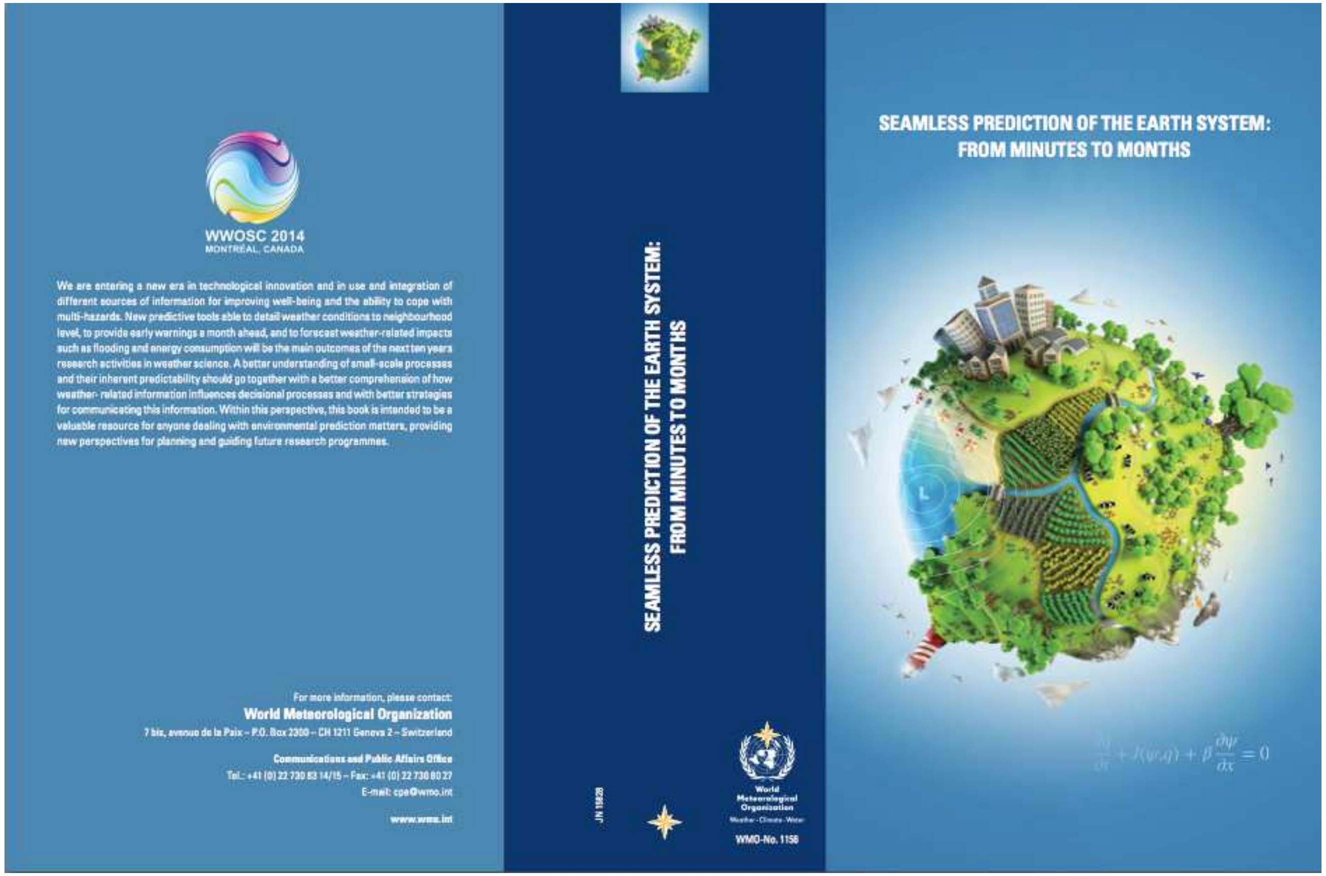
Weather and climate scales do naturally come together in the Subseasonal to Seasonal project, and in WWRP's Polar Prediction Project working with WCRP's Polar Climate Predictability Initiative.

But there is a need to promote coordination and collaboration among partners in areas of cross-cutting interest, such as quantifying vulnerability and risk, and analyses/reanalyses of earth system components (and their coupling) for research, applications, and services.

In relation to Attribution there is a challenge in using WWRP expertise to assist WCRP; attribution requires understanding of climate drivers on larger space scales and longer time scales, but then the actual high-impact weather is on much smaller weather scale processes. Critical adaptation decisions affecting countries and regions depend on knowledge of weather events that occur on spatial and temporal scales that are either poorly or not represented in current climate models, but are within the scope of WWRP weather research and modelling.

What successful people read before bed?

Google: seamless prediction WMO
https://www.wmo.int/media/content/seamless-prediction-minutes-months



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Thank you
Merci

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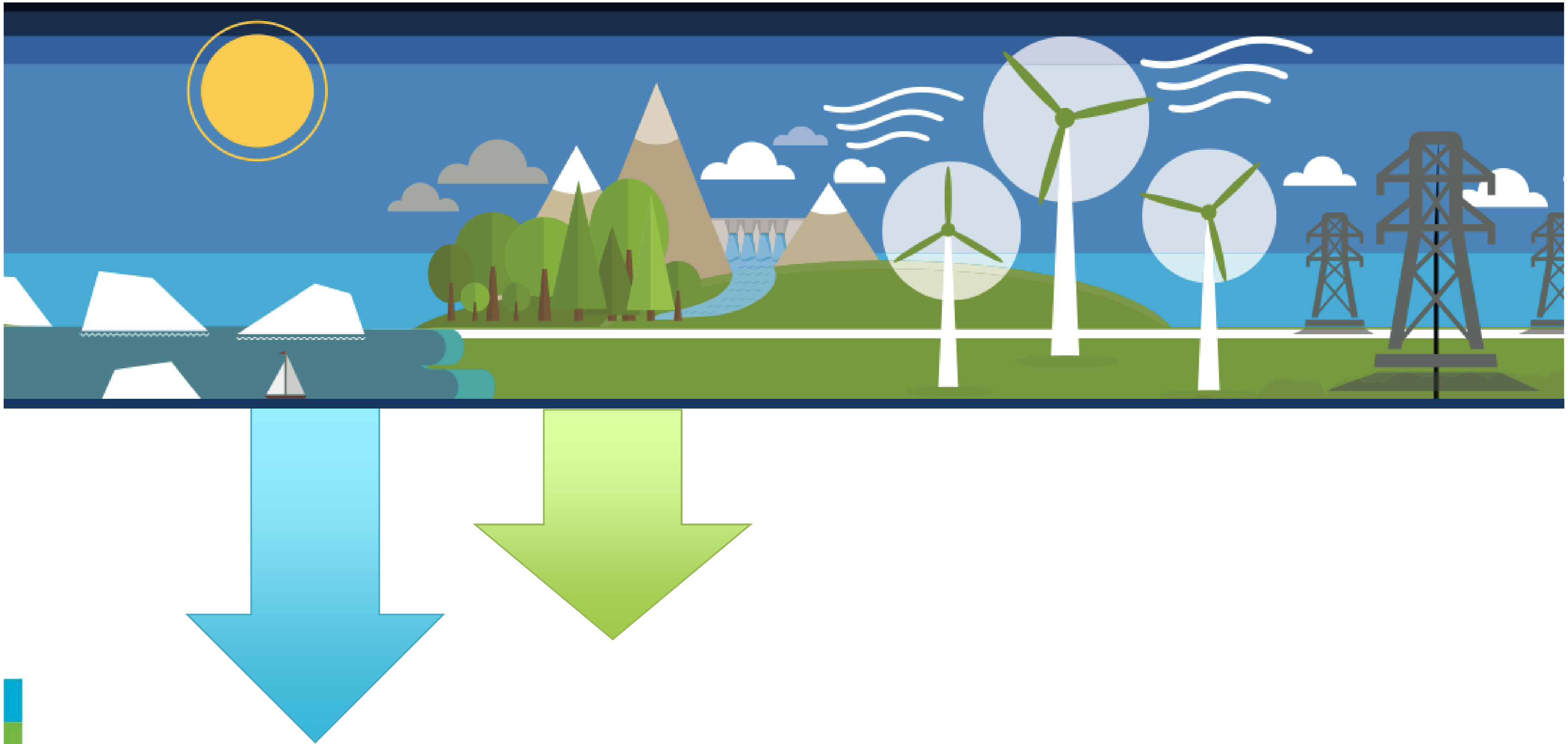

Historical background