



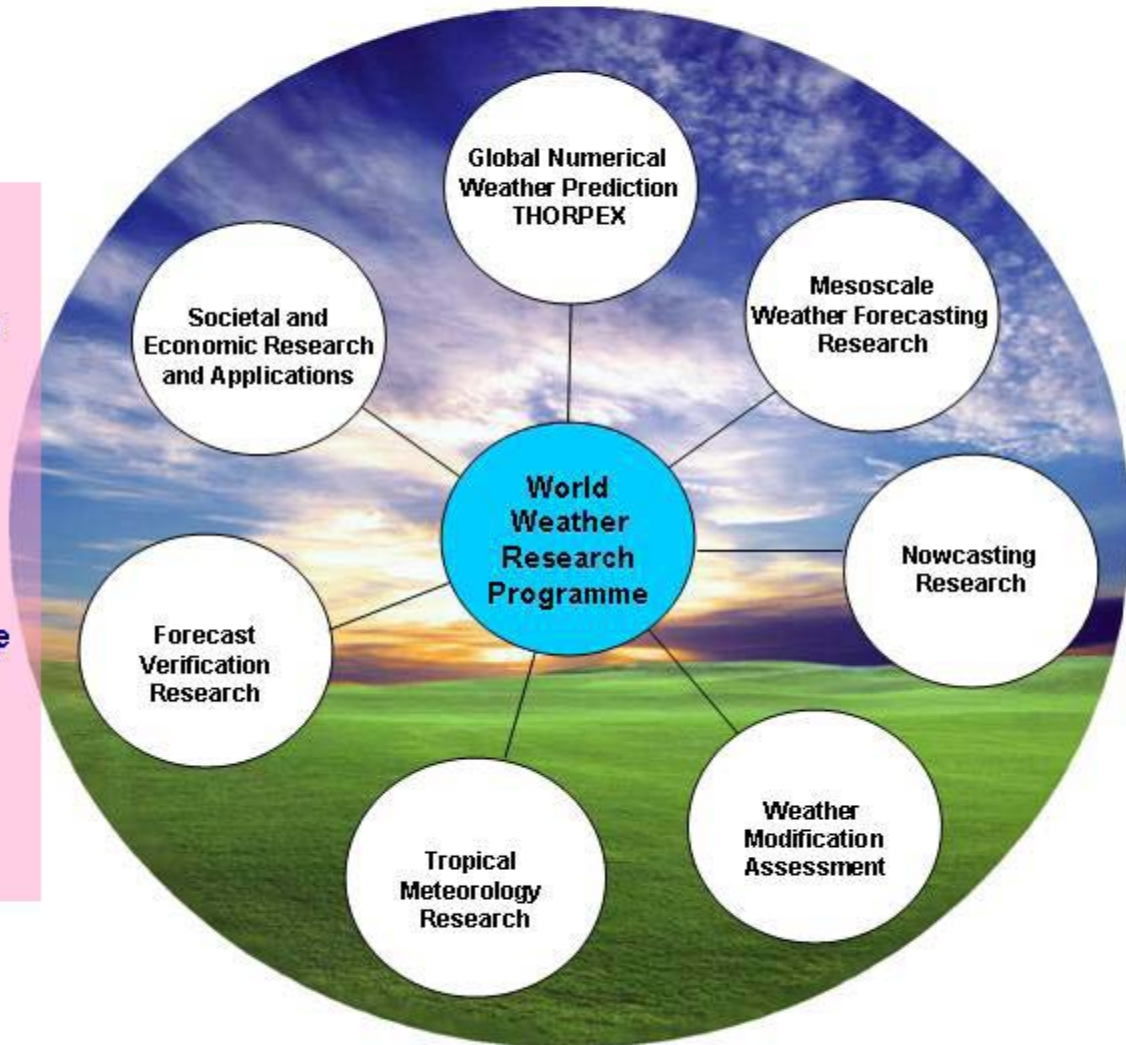
***Report from CAS XVI Session, Antalya, Turkey, 20-26 November 2013***

A ten-year future view: emerging challenges and opportunities

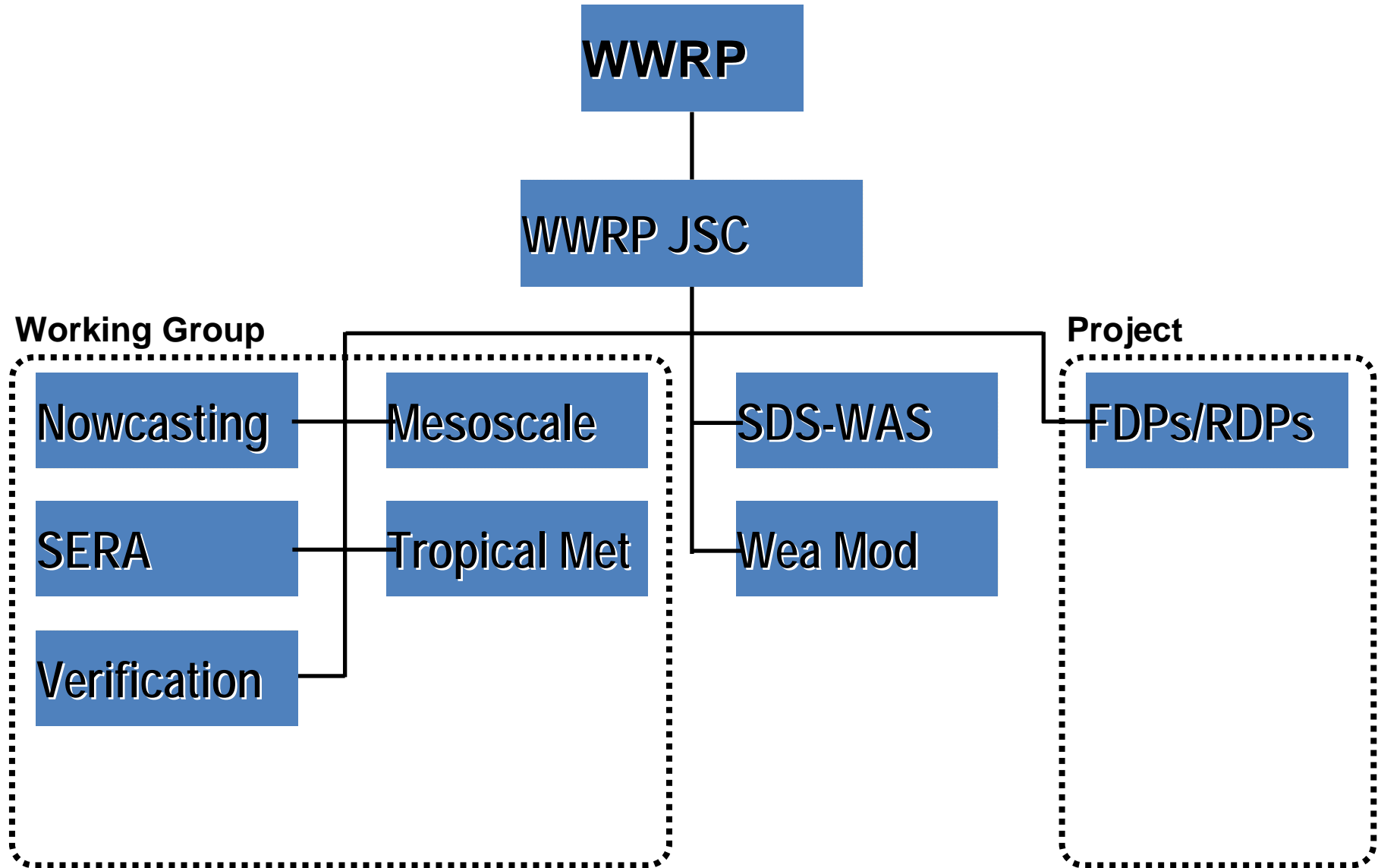
Gilbert Brunet  
WWRP/SSC Chair  
WGNE, Melbourne  
March 10, 2014

### Major Partners

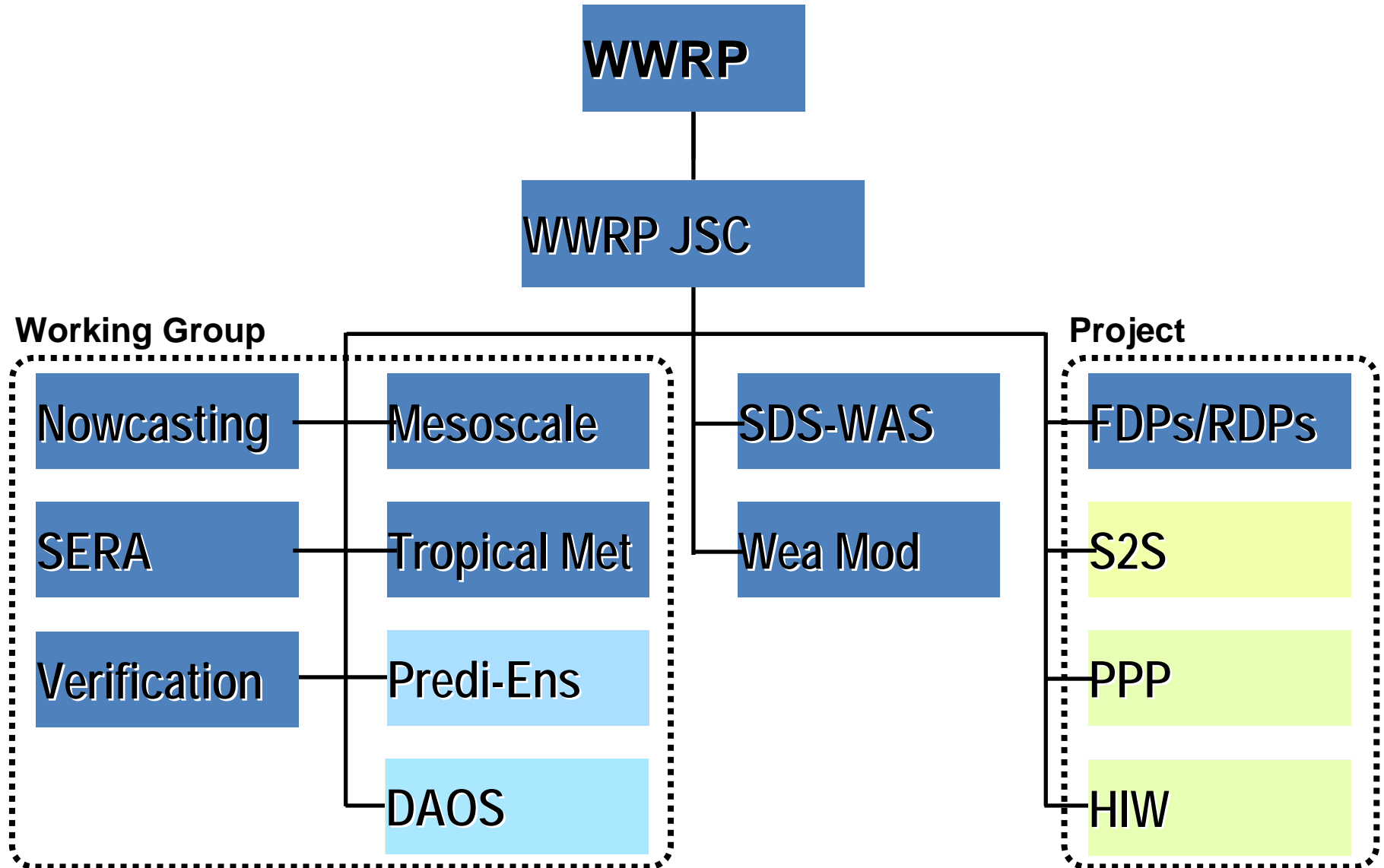
- Joint Working Group on Numerical Experimentation (WGNE)
- World Climate Research Programme (WCRP)
- WMO Weather and Disaster Risk Reduction Services
- Global Atmosphere Watch (GAW)
- WMO Integrated Global Observing System (WIGOS) and Information System (WIS)
- The International Council for Science (ICSU): Integrated Research on Disaster Risk (IRDR)
- Hydrological Research Community
- Ocean Observations and Modelling Research Community



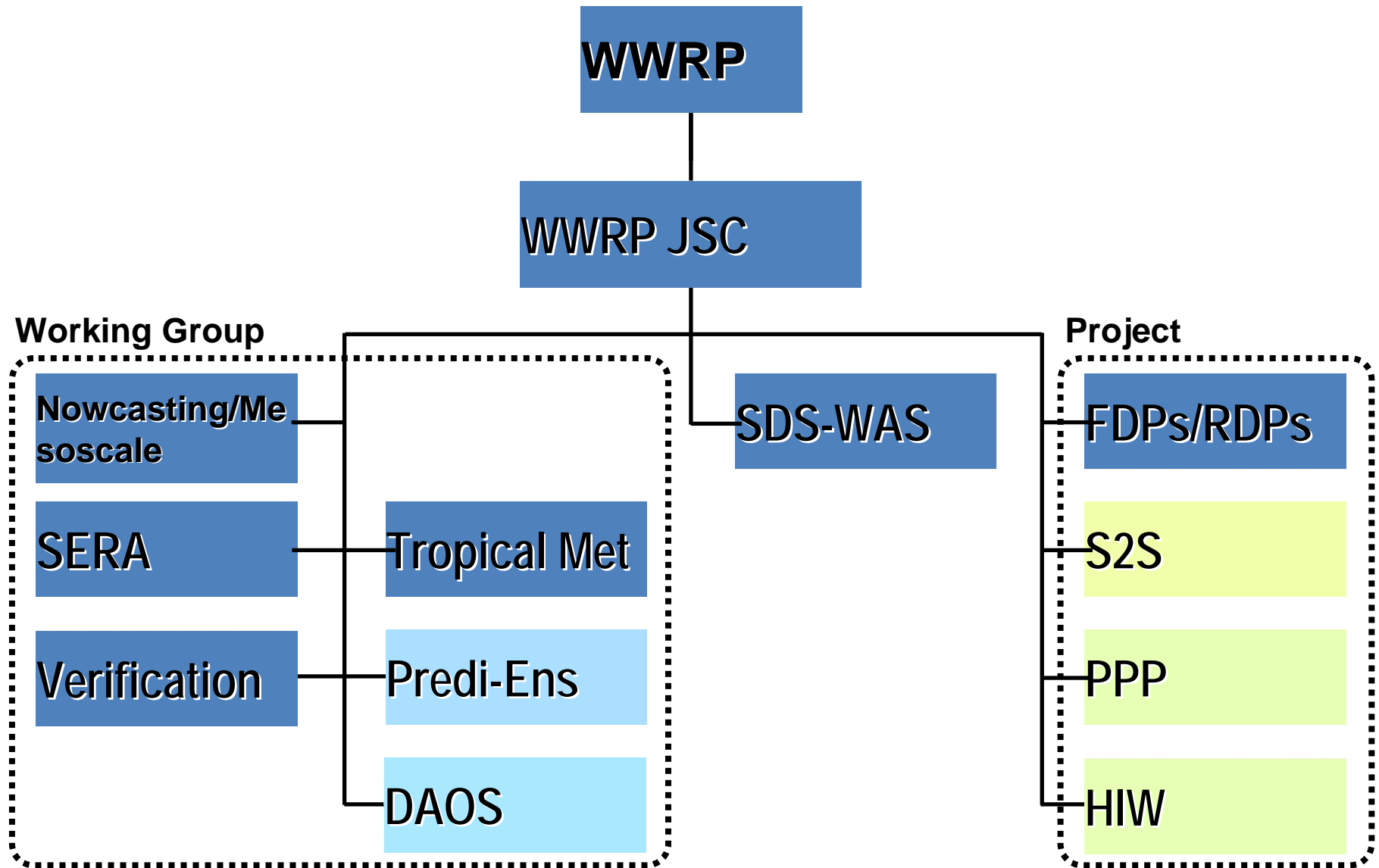
# Current Structure



# New Structure



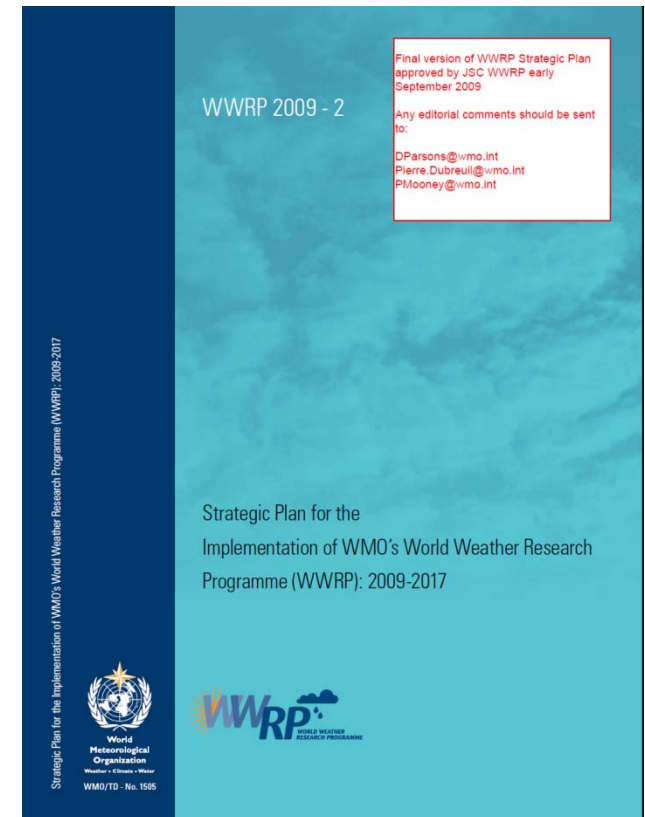
# Planned Future Structure





# WWRP Strategic Plan

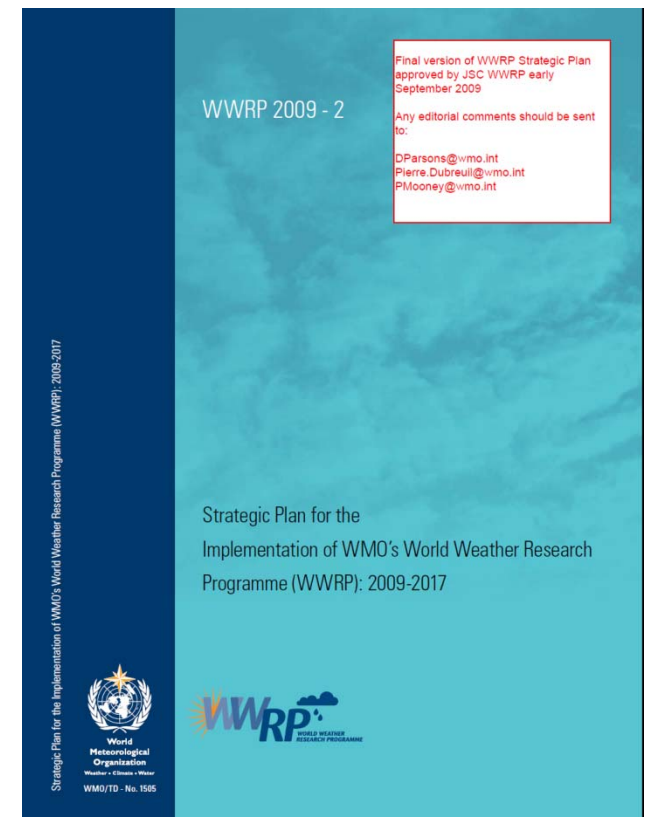
- The first Strategic Plan for the Implementation of WMO's World Weather Research Programme (WWRP): 2009 – 2017 (WMO/TD-No. 1505).
- The WWRP strategic plan integrates WMO Member activities in THORPEX, tropical meteorology, mesoscale weather forecasting, nowcasting, verification and societal and economic applications.
- The plan maintains and reinforces the traditional strong links with GAW, the World Climate Research Programme (WCRP) and other WMO activities.





# WWRP Strategic Plan

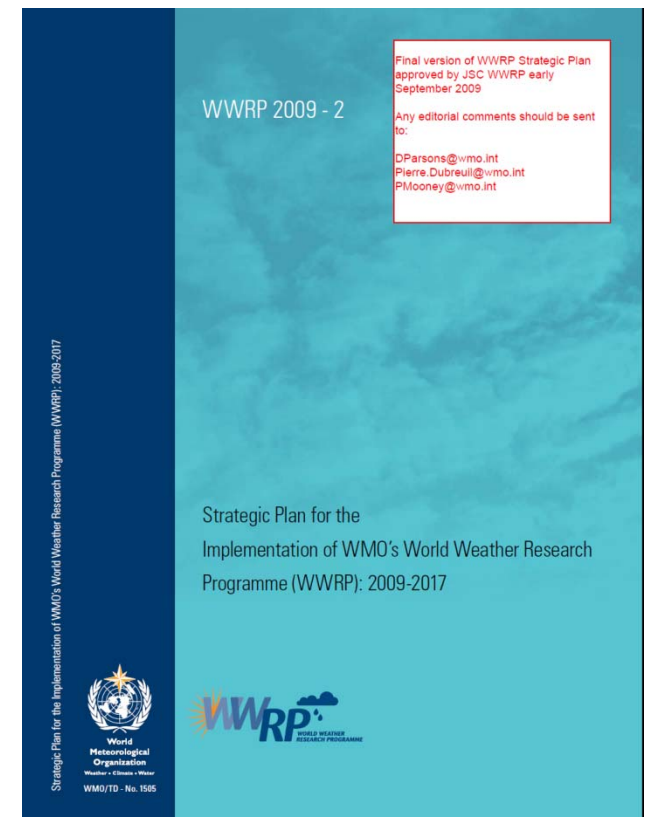
- Implementation activities outlined in the first Strategic Plan address cross cutting activities at the interface of:
  - nowcasting-mesoscale;
  - mesoscale-global;
  - weather-climate prediction research.
- research-operations that are related to the delivery of a weather and climate services:
  - ensemble weather prediction systems;
  - tropical convection;
  - sub-seasonal to seasonal prediction;
  - polar prediction.





# WWRP Strategic Plan: on good track!

- Implementation activities outlined in the first Strategic Plan address cross cutting activities at the interface of:
  - nowcasting-mesoscale (**HIW, PPP**);
  - mesoscale-global (**HIW, PPP**);
  - weather-climate prediction research (**PPP, S2S**).
- research-operations that are related to the delivery of a weather and climate services:
  - ensemble weather prediction systems (**HIW, PPP, S2S**);
  - tropical convection (**HIW, S2S**);
  - sub-seasonal to seasonal prediction (**S2S**);
  - polar prediction (**PPP**).



Including the participation of **WGNE** and **WWRP WGs** in many of these activities!

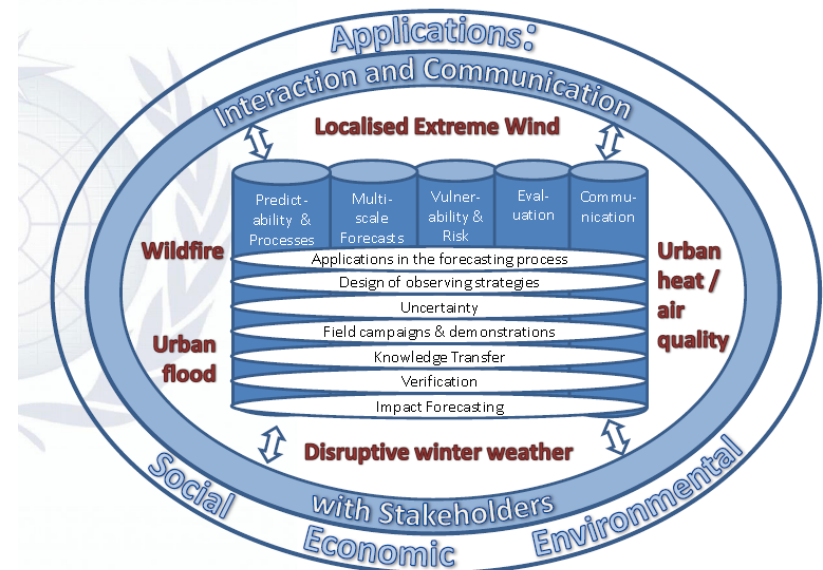


# The *High Impact Weather* Project



- New capabilities in short range forecasting (new observations, convective-scale probabilistic NWP)
- Advances in coupling prediction models
- Better understanding of the challenges to achieving effective responses to warnings
- Focus on predictive time scales of minutes to two-weeks:

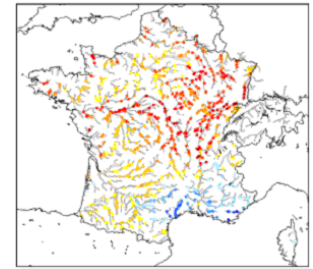
“Promote cooperative international research to achieve a dramatic increase in resilience to high impact weather, worldwide, through improving forecasts for timescales of minutes to two weeks and enhancing their communication and utility in social, economic and environmental applications”



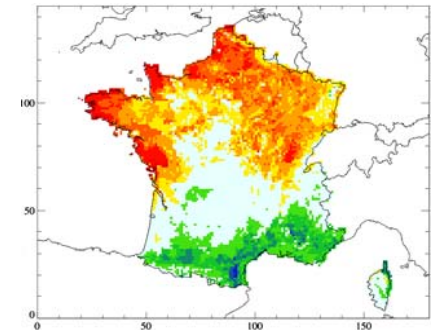


## Water: modelling and predicting the water cycle for improved DRR and resource management

- Growing improvements in the quality of coupled weather hydrological prediction systems;
- **CAUTION:** but none can claim to be in operation and to close the water cycle budget with sufficient accuracy for reliable automation, but next five years are promising;
- **Seamless:** developing the climate tool of the future
- Increasing requirement for the employment (e.g. population growth) of nowcast to sub-seasonal to seasonal predictions for a wide range of hydrological applications which include:
  - **River-flow** for flood prediction and hydroelectric power generation;
  - **Warnings** of the likelihood of severe hydrological impact weather (droughts, flooding, etc.) to help protect life and property;
  - **Water management** (e.g. agriculture)
  - **Hydrological climate information** at the regional (e.g. reservoir) level for long term planning and regulatory framework;
  - **Urban flood**, including flooding from the sea, rivers and directly from rainfall, with particular emphasis on flood impacts in the growing megacities.



Q  
(River Flow)



SWI  
(Soil Wetness Index)





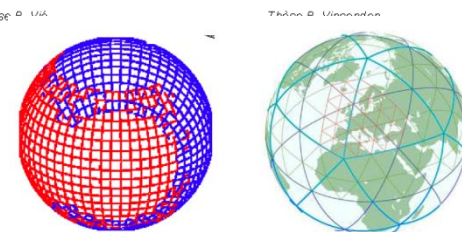
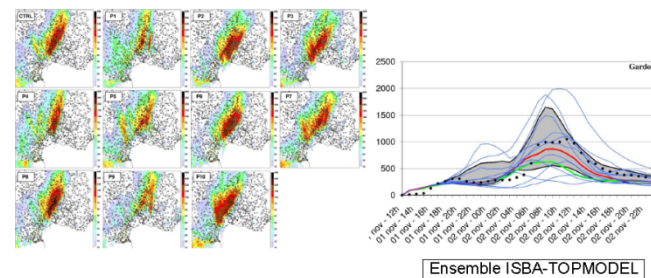
## Current research issues: a challenge for WWRP and WGNE

- Improve the accuracy of short-range forecasts for security of people and properties, health, transport, defense and the energy market;
- Develop climate services, i.e. improve seasonal prediction and assess decadal prediction.

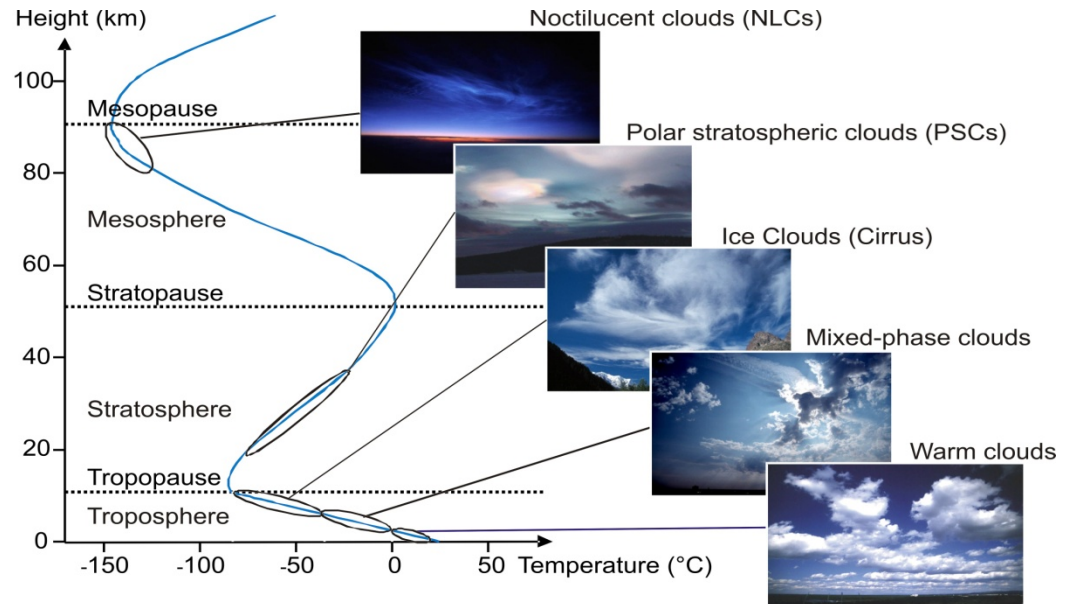
# Trends for NWP systems

- Integrated NWP systems (for efficiency)
- Seamless forecasts
- Continued trend in increased resolution
- Generalization of ensembles to impact models
  - Towards the end of the « deterministic forecasts »?
- Revisiting the basic equations for non-hydrostatic dynamics
- More scalable dynamical cores, optimizing the data flux between processor (e.g. ECMWF scalability workshop)
- Towards unstructured grids to better represent steep orography (like in ocean models)
- Toward coupled NWP with ocean, sea-ice, waves, chemistry and hydrology

Hydrological model ensemble for fast flood risk



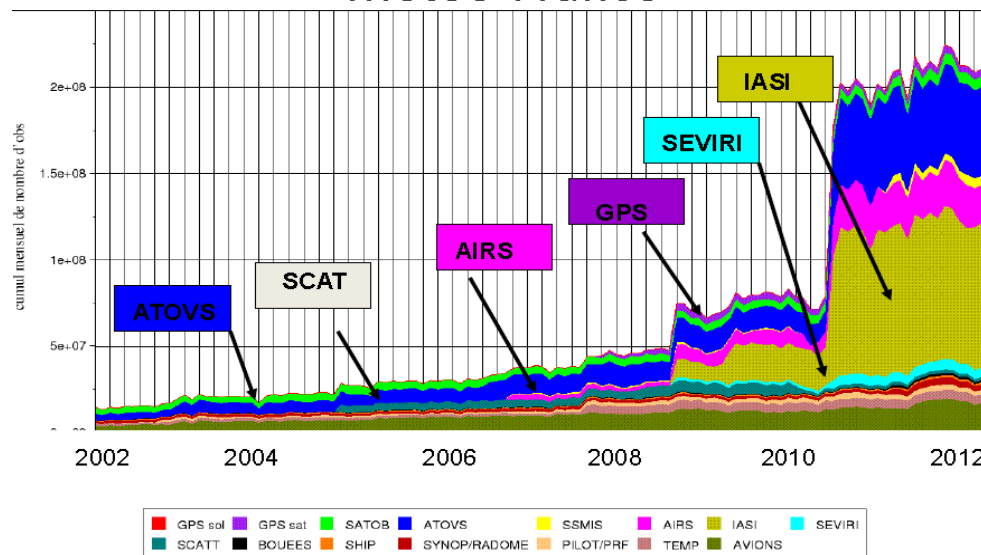
# Model physics



- Towards more conservative variables (e.g. chemistry)
- More advanced microphysics
- Accounting for horizontal exchanges by turbulence and radiation for grid cells  $< 1\text{km}$  (e.g. urban NWP)
- Parametrization of convection remains a difficult problem for grid cells  $> 5\text{km}$
- More « grey zone » problems as the integrated forecasts systems will be used at various resolutions

# Ensemble and Data assimilation techniques

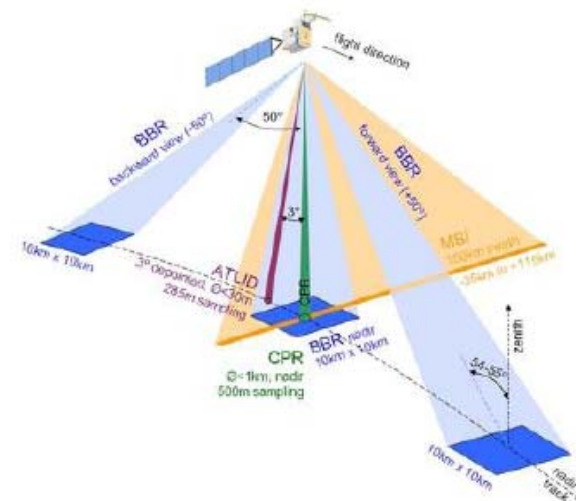
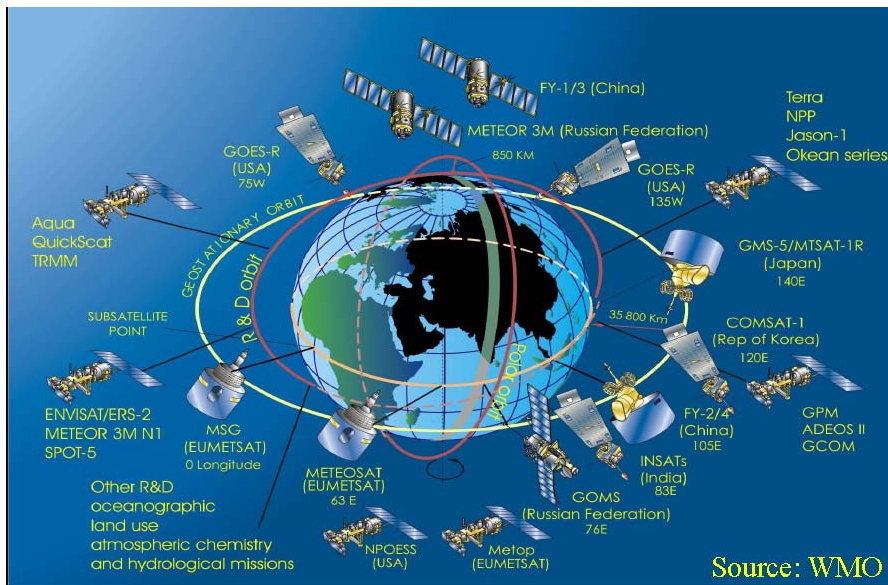
Number of observations assimilated at Météo-France



- Evolution driven by both progress in science and constraints from massively parallel machine architectures
- Increasingly hybrid methods (ensembles-variational)
- Work on improving description of model uncertainty
- Develop suitable verification techniques (deterministic, probabilistic, ensemble and high-resolution)

# New observations

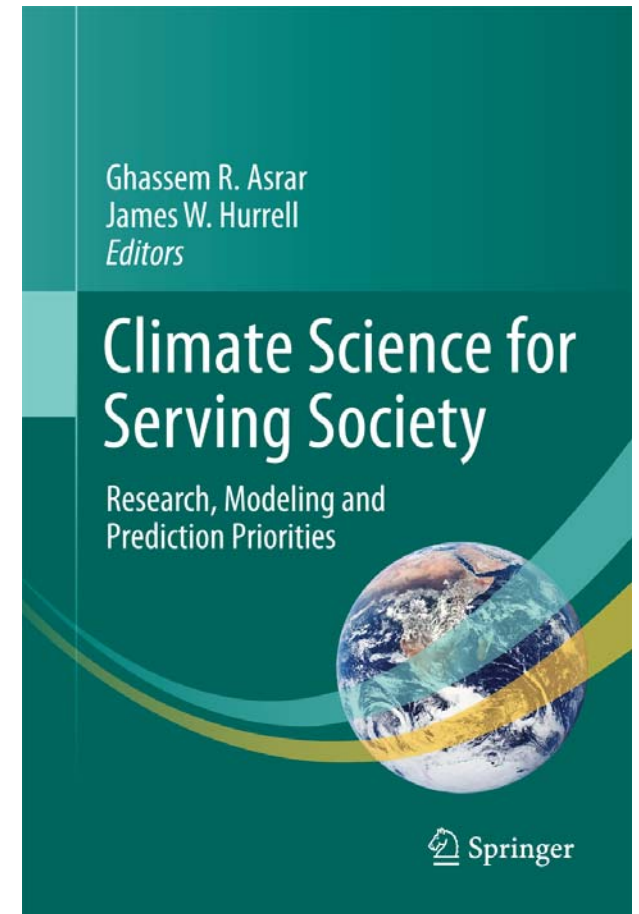
- High spectral resolution IR sounders on geostationary satellites (MTG in 2020)
- Space wind lidars (Aeolus in 2015)
- Advanced usage of met radars
- New types of observations (e.g EarthCare)





## WCRP Grand Challenges

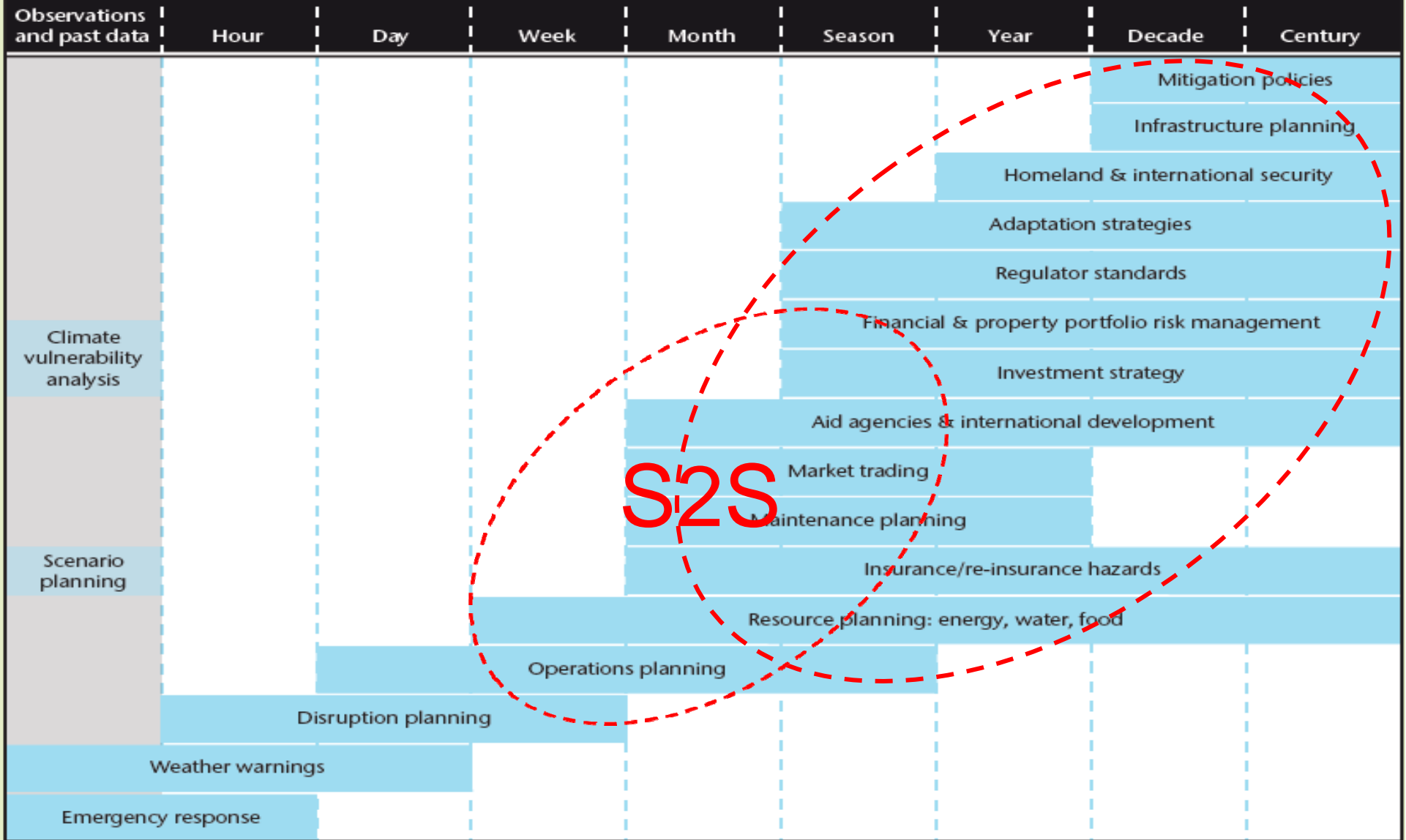
- **Regional Climate Information**
- **Regional Sea-Level Rise**
- **Cryosphere in a Changing Climate**  
(link with PPP)
- **Clouds, Circulation, and Climate Sensitivity**
- **Changes in Water Availability**  
(link with WWRP?)
- **Science Underpinning the Prediction and Attribution of Extreme Events** ( link with S2S)





# Seamless forecasting services

## Forecast lead-time



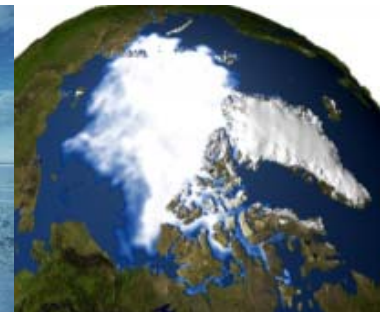
S2S

Courtesy of UK MetOffice



## Accelerating international cross-cutting collaboration

- International opportunities to advance the science of seamless prediction
  - High-Impact Weather (HIWea) project;
  - the Sub-seasonal TO Seasonal (S2S) project (jointly with WCRP);
  - Polar Prediction Project (PPP) with joint WCRP activities (reanalyses, predictability, model error).





# WMO/WWRP/THORPEX World Weather Open Science Conference

**Saturday 16 – Thursday 21 August 2014, Montréal, Canada**

## **Scientific Programme**

The overarching theme of the OSC is ***Seamless Prediction of the Earth System: from minutes to months***. The science presented at the conference will range from basic research that extends our knowledge of processes and methods to the applied research required to put the prediction system together and assess the impacts of weather and climate events.



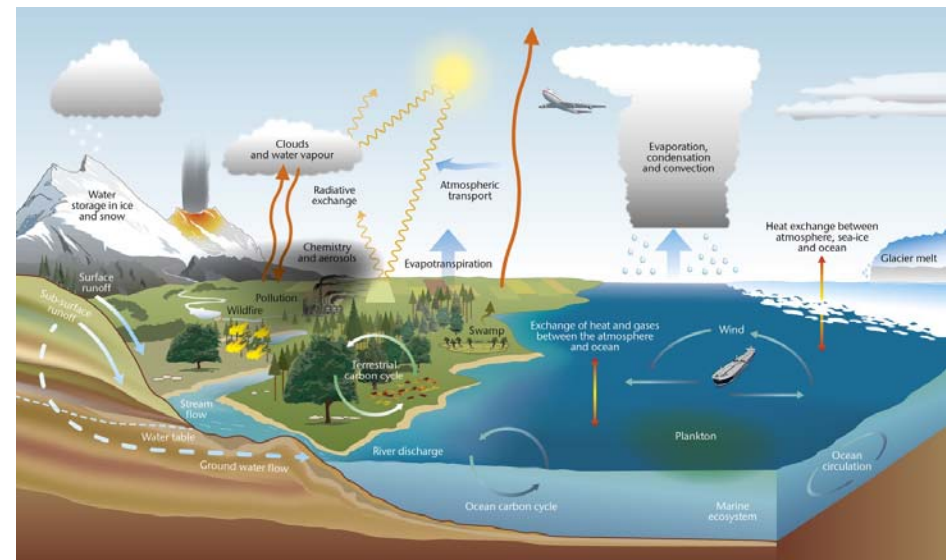
The scientific program will be organized around five science themes:

- Data Assimilation and Observations;
- Predictability and Dynamical/Physical/Chemical Processes;
- Interactions between sub-systems;
- Prediction of the Earth system: putting it all together;
- Impacts of weather and climate events.

A particular focus will be given also to major cross cutting themes, such as ensemble prediction.

Status (confirmed):

- Over 1000 submitted abstracts.
- Over 130 co-conveners
- Over 120 keynote speakers
- Gender balance: over 23%
- Academia: over 30%





Thank you!  
Merci!