World Meteorological Organization

Weather • Climate • Water

## Technical Commission for Atmospheric Science

# World Weather Research Programme


## Sarah Jones, Chair WWRP SSC

## Paolo Ruti, Chief WWRD,WMO


Christof Stache/AFP/Getty Images; Marina Shemesh /publicdomainpictures.net; Alexandros Vlachos/EPA; NOAA NWS; NOAA NWS

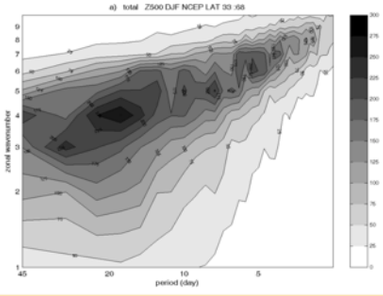
# Societal challenges: a 10y vision

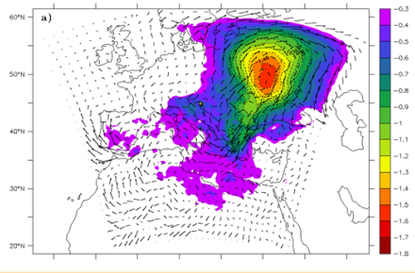
- High Impact Weather and its socio-economic effects in the context of global change
- Water: Modelling and predicting the water cycle for improved Disaster Risk Reduction and resource management
- Urbanization: Research and services for megacities and large urban complexes
- Evolving Technologies: Their impact on science and its use

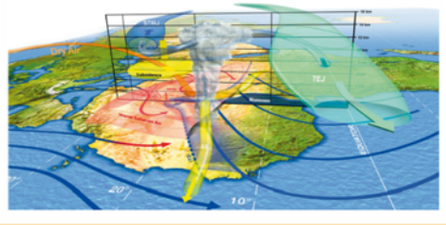
Technical Commission for Atmospheric Science

# WWRP Mission

- WWRP advances society's resilience to high impact weather through research focused on improving the accuracy, lead time and utilization of weather prediction, and through engaging users & stakeholders to define research priorities and facilitate transition to applications
- WWRP promotes cooperative international & interdisciplinary research in the operational and academic communities and supports the development of early career scientists
- WWRP aims at Seamless Prediction of the Earth System from minutes to months, from global to local, using coupled systems – thus applying expertise in weather science to promote convergence between weather, climate and environmental communities



# WWRP overarching goals

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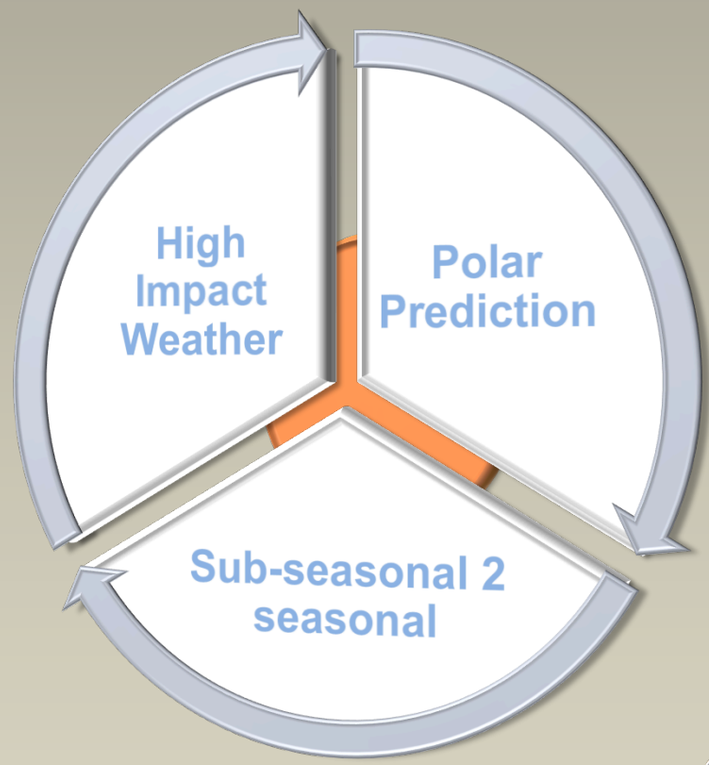
- Towards Environmental Prediction, integrating modeling components (hydrology, sea-ice, ocean, atmospheric composition, etc.) to better understand coupled processes and to improve forecasting methods.
- Towards a seamless predictive capability, developing a unified approach to advance environmental prediction from minutes to months, from global to local, for different users in different parts of the world.
- 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.

WWRP a seamless programme

WWRP WORLD WEATHER RESEARCH PROGRAMME

- High Impact Weather
- Predicting Water Cycle
- Urbanization
- Emerging Technologies




- Numerical Experimentation
- Nowcasting and Mesoscale
- Tropical Meteorology
- Predictability Dynamics and Ensemble Forecasting
- Data Assimilation and Observing Systems
- Verification
- Societal & economic
- Weather Modification

**Challenges** Key Projects Working Groups

WWRP a seamless programme

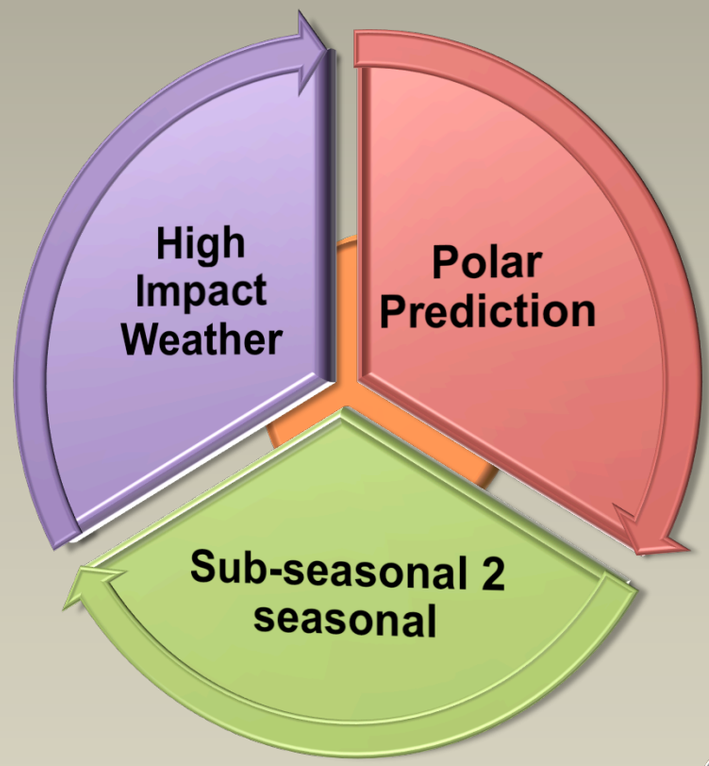
WWRP WORLD WEATHER RESEARCH PROGRAMME

High Impact Weather

Predicting Water Cycle

Urbanization

Emerging Technologies

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WORLD WEATHER RESEARCH PROGRAMME

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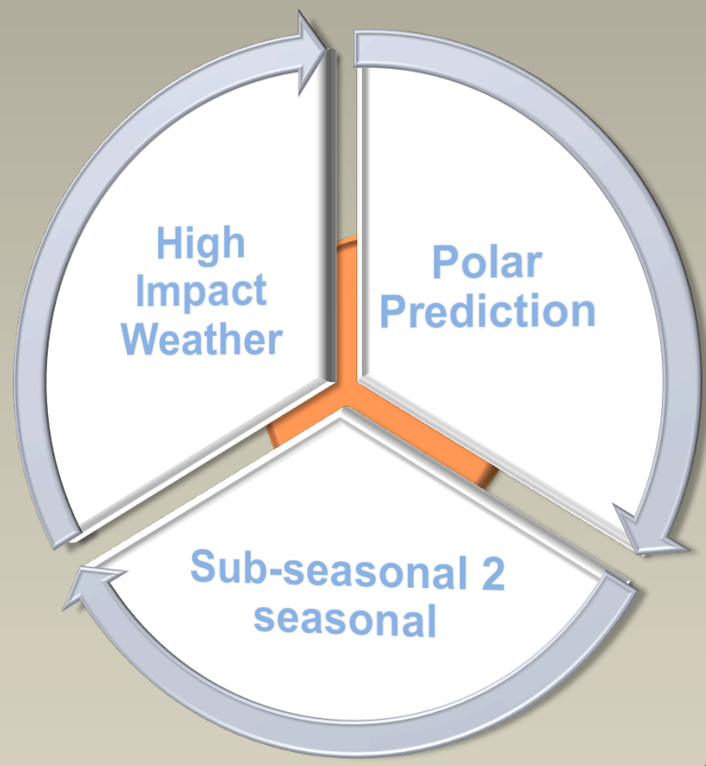


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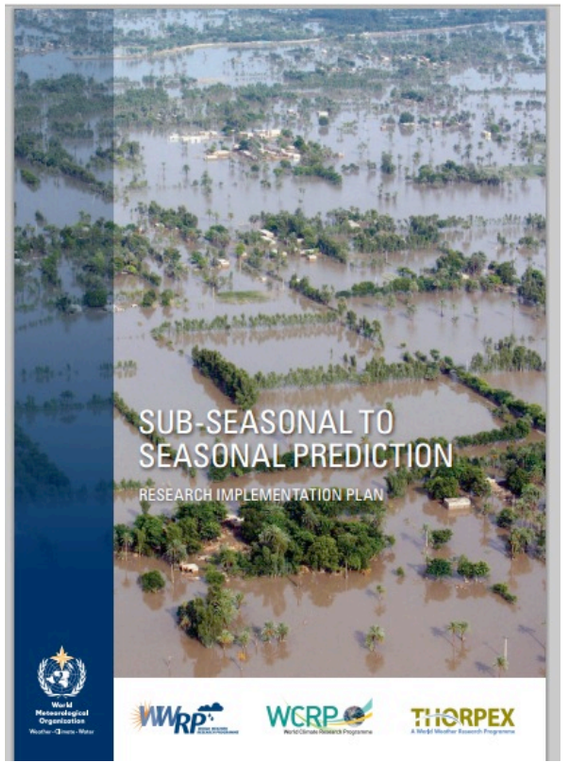
Challenges Key Projects **Working Groups**

# Sub-seasonal to seasonal

## "Bridging the gap between weather and climate'




**Co-chairs: Frédéric Vitart (ECMWF), Andrew Robertson (IRI)**

Evaluate potential predictability of sub-seasonal events through a multi-model approach.

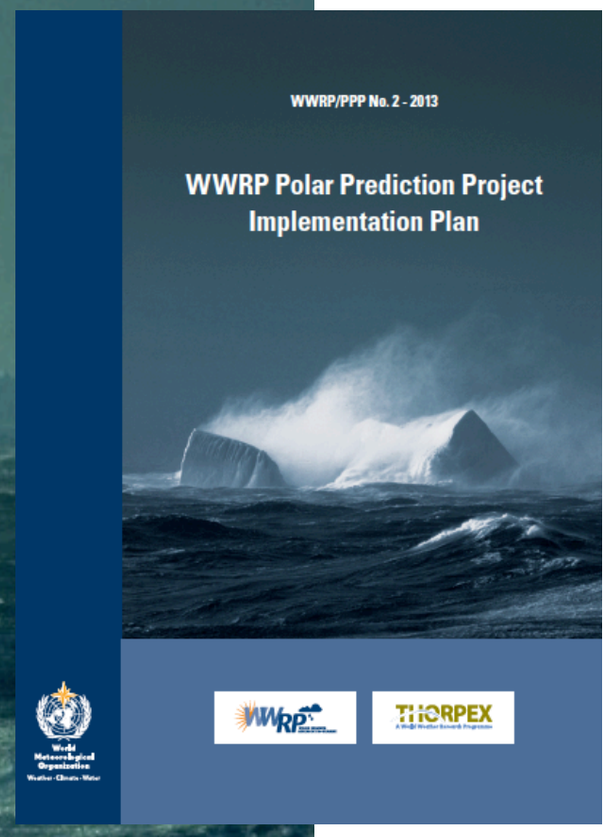
Understand systematic errors and biases in the sub-seasonal to seasonal forecast range

Focus on specific extreme event case studies increasing resilience and improving adapting capacity.

**Project Office: KMA/NIMR**

# The Polar Prediction Project

**Promote cooperative international research enabling development of improved weather and environmental prediction services for the polar regions, on time scales from hourly to seasonal**




**Chair: Thomas Jung, AWI**

**Project Office: Alfred Wegener Institute, Germany**

# The Year of Polar Prediction

| Preparation Phase 2013 to mid-2017 | YOPP mid-2017 to mid-2019 | Consolidation Phase mid-2019 to 2022 |
|---|---|---|
| Community engagement | Intensive observing periods & satellite snapshot | Data denial experiments |
| Alignment with other planned activities | Dedicated model experiments | Model developments |
| Development of Implementation Plan | Coupled data assimilation | Dedicated reanalyses |
| Preparatory research | Research into use & value of forecasts | Operational implementation |
| Summer school Workshops | Intensive verification effort | YOPP publications |
| Fundraising & Resource mobilization | Summer school | YOPP conference |

# High Impact Weather Project

- Increasing resilience to Urban Flood, Wildfire, Urban Heat and Air Pollution in Megacities, Localised extreme wind, Disruptive winter weather through improving forecasts for timescales of minutes to two weeks and enhancing their communication and utility in social, economic and environmental applications
- Links to WCRP through quantifying vulnerability and risk assessment, and for response to High Impact Weather in a changing climate.

**Co-Chairs: Brian Golding (MetOffice, UK)**

**David Johnston (Massey University, NZ)**

Christof Stache/AFP/Getty Images; Marina Shemesh /publicdomainpictures.net; Alexandros Vlachos/EPA; NOAA NWS; NOAA NWS

# HIWeather scope defined by a set of weather-related hazards

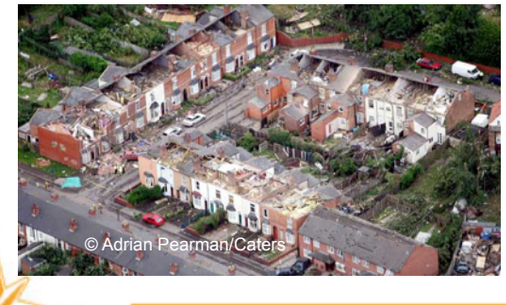

**Urban Flood**: Reducing mortality, morbidity, damage and disruption from flood inundation by intense rain.

**Disruptive Winter Weather**: Reducing mortality, morbidity, damage and disruption from snow, ice and fog to transport, power & communications infrastructure.



**Wildfire**: Reducing mortality, morbidity, damage and disruption from wildfires & their smoke.

**Urban Heat Waves & Air Pollution**: Reducing mortality, morbidity and disruption from extreme heat & pollution in the megacities of the developing and newly developed world.


**Extreme Local Wind**: Reducing mortality, morbidity, damage and disruption from wind & wind blown debris in tropical & extra-tropical cyclones, downslope windstorms & convective storms, including tornadoes.

# HIWeather Research themes

**Predictability & Processes**

**Develop knowledge and understanding of processes relevant for initiation and evolution of weather systems related to hazard and the factors that determine their predictability**

**Multi-Scale Forecasting**

**Enhance multi-scale prediction of variables needed to forecast weather impacts in coupled modelling systems**

**Vulnerability & Risk**

**Produce more relevant forecasts and warnings through prediction of the impact of hazards on individuals, communities and businesses, their vulnerability and hence their risk**

**User-oriented Evaluation**

**Evaluate benefit and build trust in forecasts and warnings through assessment of accuracy, value and response.**

**Communication**

**Achieve more effective responses to forecasts through better communication of forecasts and warnings of hazards and their impacts**

# WWRP Implementation Plan 2016-2023: Science and Implementation Challenges

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

***Science challenges***

- Seamless approach to water: time, space, nonlinear interactions across different components of the earth system, high spatial heterogeneity
- Understanding and modelling moist processes, including precipitation-generating processes (including chemistry/aerosols).
- Understanding socio-economic benefits, and decision processes, in relation to the integrated water cycle (probabilistic information and ensemble approaches for the water cycle & impacts, probabilistic communication of risks and opportunities).

***Implementation challenges****:* National / international availability of water-related data, including weather radar; Working across disciplines; Development, application and optimal use of advanced remote sensing technologies; international coordination of model development.

# WWRP Implementation Plan 2016-2023: Selected Action Areas

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

- Improve understanding, observation, assimilation and modelling of the components of the integrated water cycle, and its global, regional and local interactions (AA7)
- Assess and exploit new in-situ and remotely sensed hydro-meteorological observations (AA8)
- 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 (AA9)
- Characterise how QPE and QPF uncertainty translates to hydrological uncertainty (and vice versa) (AA10)

# WWRP Implementation Plan 2016-2023: Selected Action Areas

## High-impact Weather and its socio-economic effect in the context of global change

- Increase knowledge of the factors limiting the capability to predict, communicate and mitigate the impacts of high-impact weather events; identify how these limitations can be overcome; demonstrate the resulting improvements for specific high-impact weather events from minutes to months, from global to local, for different users in different parts of the world (AA1)
- Work with different science communities to ensure that modelling systems fully integrate all relevant components of the earth system; link to and utilise socio-economic models and data to assess impacts (AA3)
- Connect knowledge and abilities to simulate high-impact weather events at high spatial and temporal resolution to more confidently attribute linkages to longer term climate variability and change (AA6)

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# Coupled Hydrology-Atmospheric Modelling and Prediction

**Paolo Ruti,**
**World Weather Research Programme,WMO**

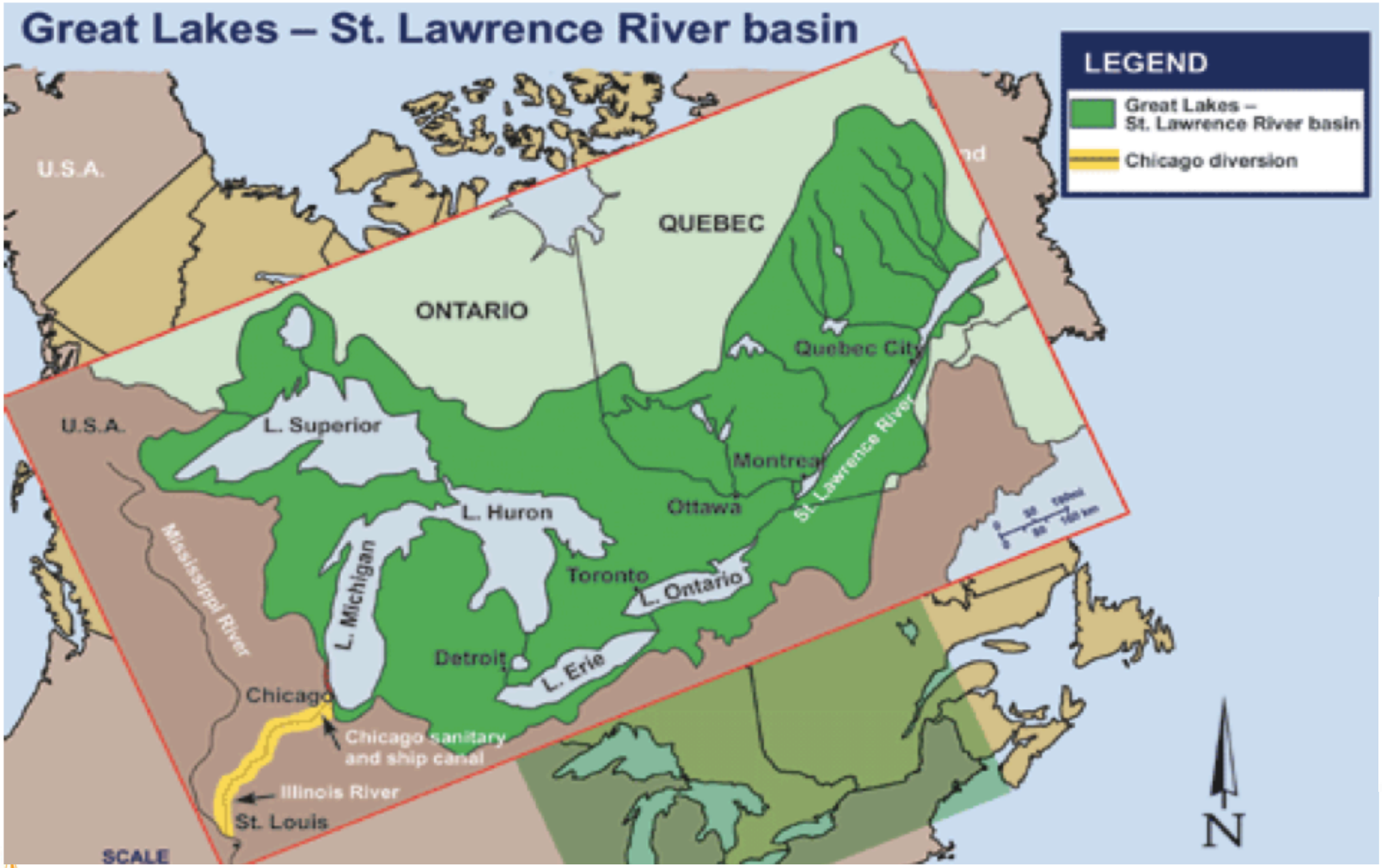
* Thanks to Vincent Fortin, EC

# Analogies …

**Regional Hydroclimate Projects are generally large, regionally-focused multidisciplinary projects that aim to improve the understanding and prediction of that region's weather, climate, and hydrology.**

**Coupled Hydrology-Atmospheric Modelling and Prediction (CHAMP) is a WMO initiative established by Congress-17. This initiative will be implemented on a regional basis where the coupling of hydrological and atmospheric predictive systems is crucial to delivery of new advanced services and/ or enhance predictive capabilities.**

# A first regional research project

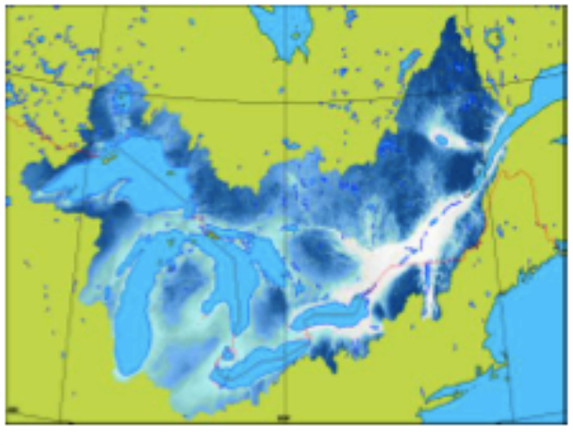


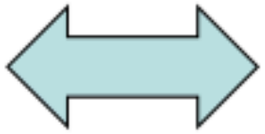

GLERL
Great Lakes Environmental Research Laboratory

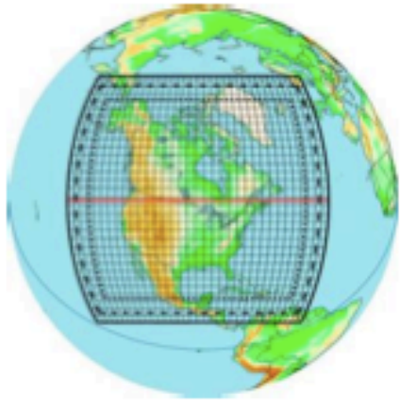
Environnement Canada
Environment Canada

NOAA
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE

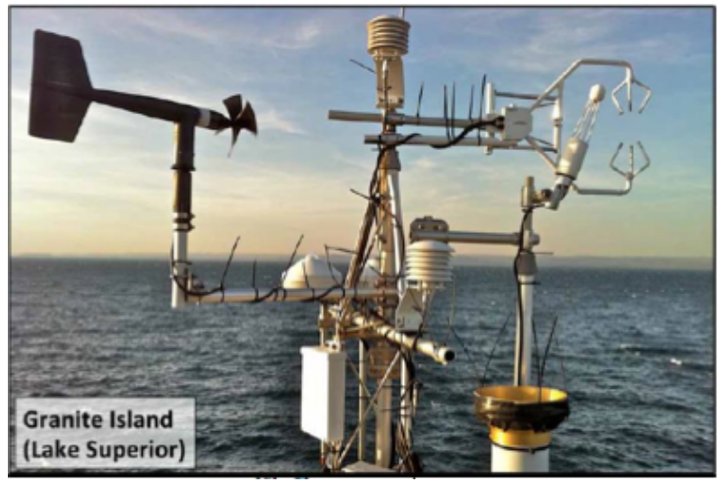
# Monitoring, modelling and services



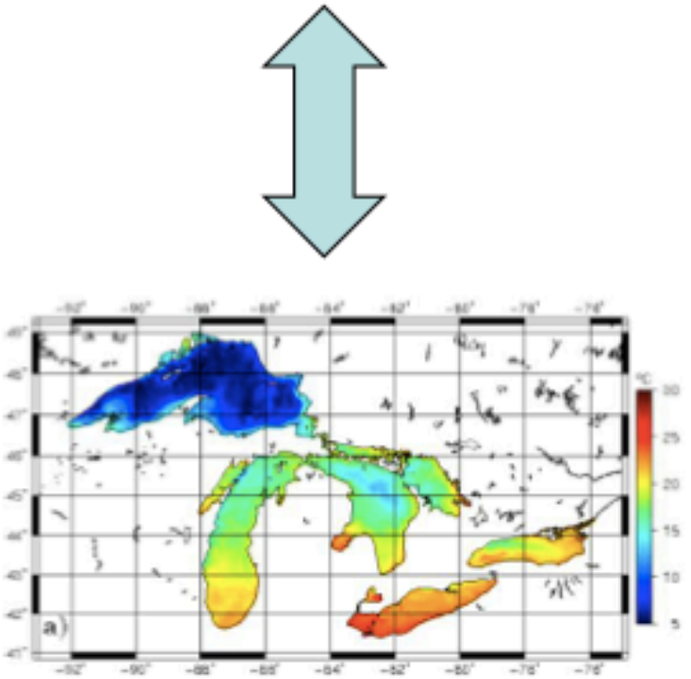




Atmospheric model




Surface, hillslope, and river routing model



Lake model +wave and ice

Ecological forecasting model

# Based on societal challenges

**... but are not always up to the task for emerging issues, which require more spatial and temporal resolutions, more physical processes and more lead time:**

**Recreational use of the water, search and rescue operations**

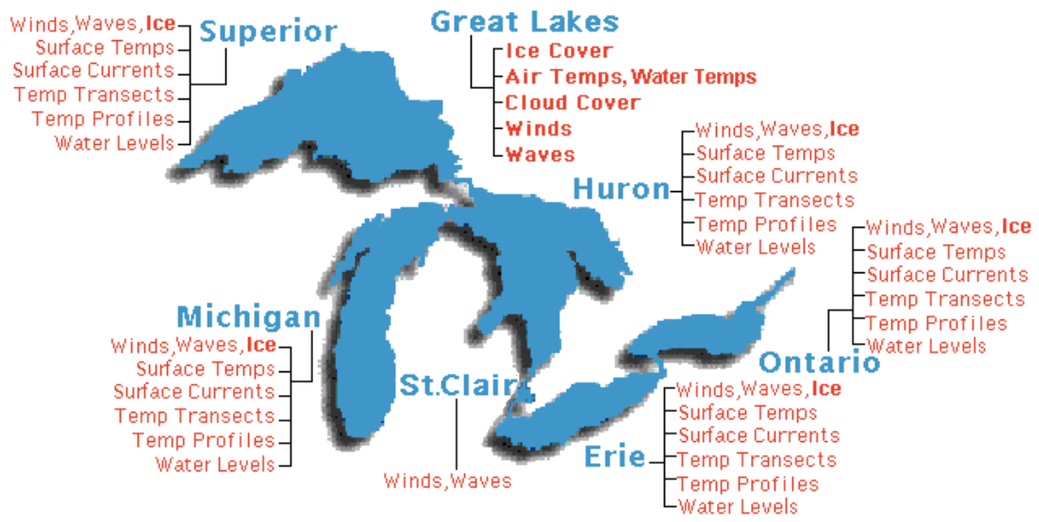
**Maintaining biodiversity and fighting invasive species**

**Water quality, eutrophication and algae blooms**

**Climate change impact and adaptation studies**

**Flood warning and preparedness**

**Urbanization**



# Outline of the project

**Phase I: 2014-2016**

Project initiation

Identification of key science questions

Inventory of existing datasets (weather, hydrometric, vegetation, soil texture)

**Phase II: 2016-2017**

Drafting of the science and implementation plans

Identification of co-leads and investigators

**Phase III: 2017-2022**

Implementation phase, including possible enhanced observation periods in the cold season

# The Seamless Book

http://library.wmo.int/pmb_ged/wmo_1156_en.pdf

# Thanks

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