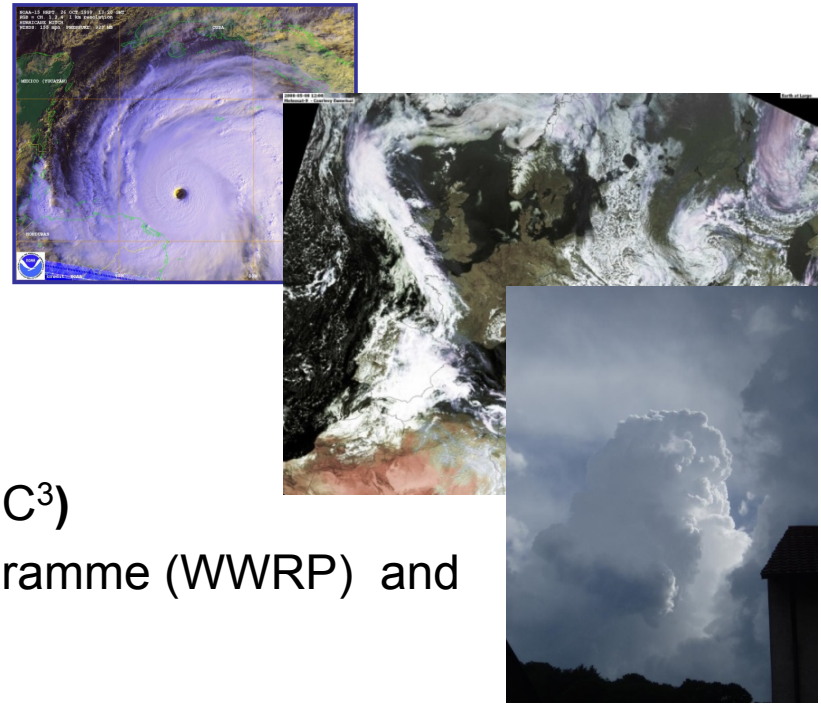
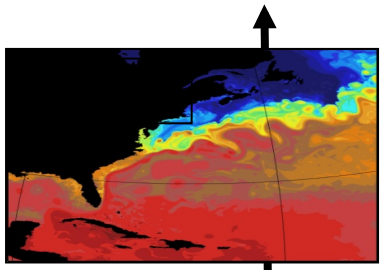
Toward more joint weather-climate research activities

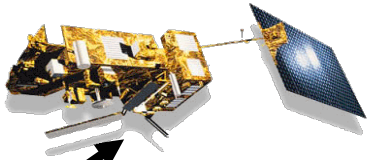


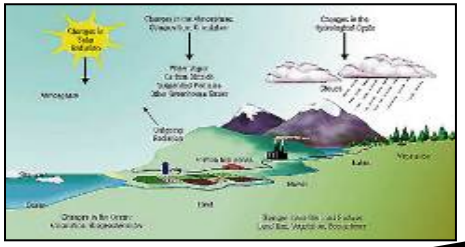
Gilbert Brunet

- Director
  Meteorological Research Division
  Environment and Climate Change Canada (EC^3)
- Member of the World Weather Research Programme (WWRP) and former chair (2007-14)

Seamless forecasting in time, space and complexity: the weather and climate challenges







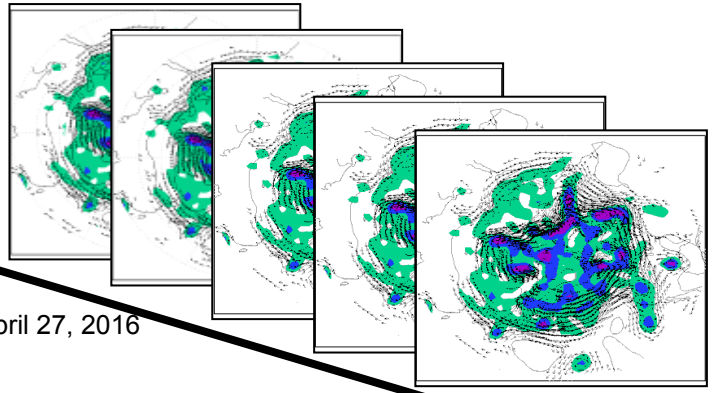
Earth Observation

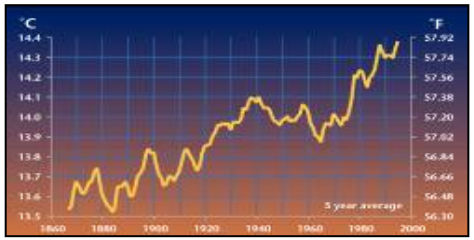
Resolution

Computing Resources

Complexity

Duration and/or Ensemble size





Numerical Weather and Environmental Prediction Systems for the 2015 Pan Am Games: from urban to regional scales.

Environment Canada Environnement Canada

Canada

(Photograph: Sylvie Leroyer)

Numerical Modeling for Pan Am: Objectives

Improve forecasts related to:

Extreme heat

Intense precipitation

Strong winds

Lake breezes

Air quality events

Lake conditions

The City of Toronto

Numerical Modeling for Pan Am: Resolution

Improve forecasts related to:

Extreme heat

Intense precipitation

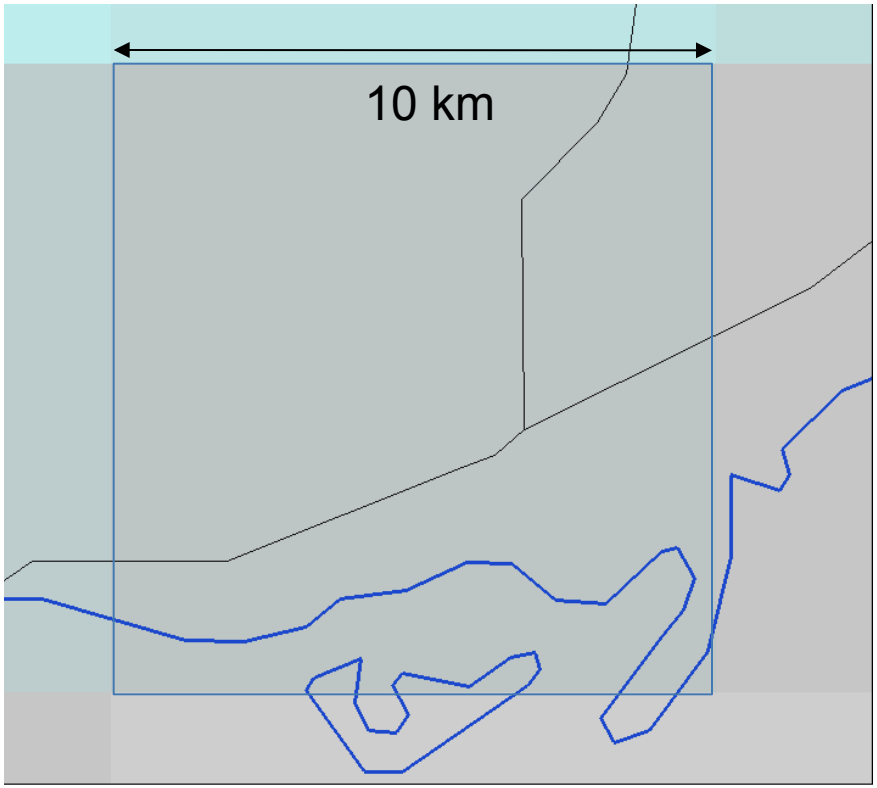
Strong winds

Lake breezes

Air quality events

Lake conditions

The City of Toronto



Current Operational EC^3 *Model – 10-km pixel*

Numerical Modeling for Pan Am: Resolution

Improve forecasts related to:

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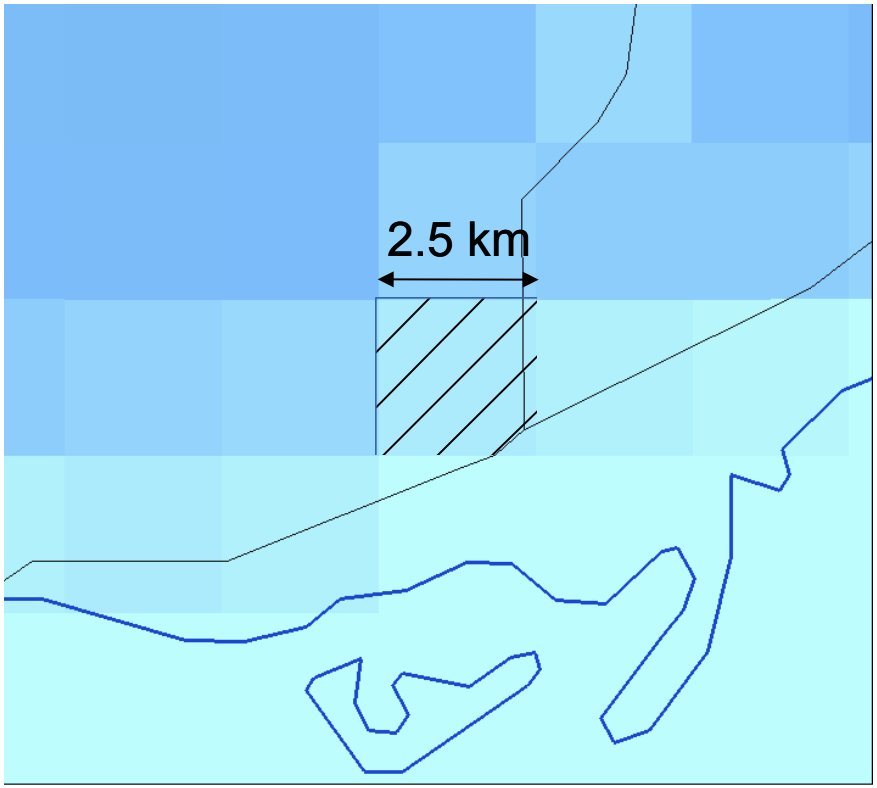
The City of Toronto



EC^3 *'s Experimental Model – 2.5-km pixel*

Numerical Modeling for Pan Am: Resolution

Improve forecasts related to:

Extreme heat

Intense precipitation

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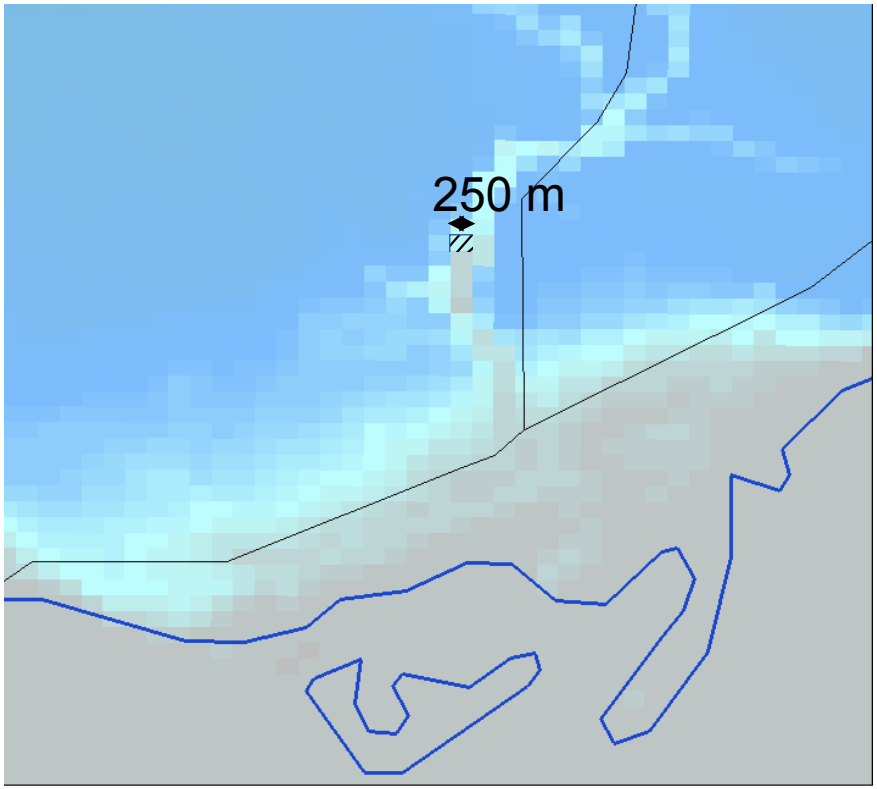
Air quality events

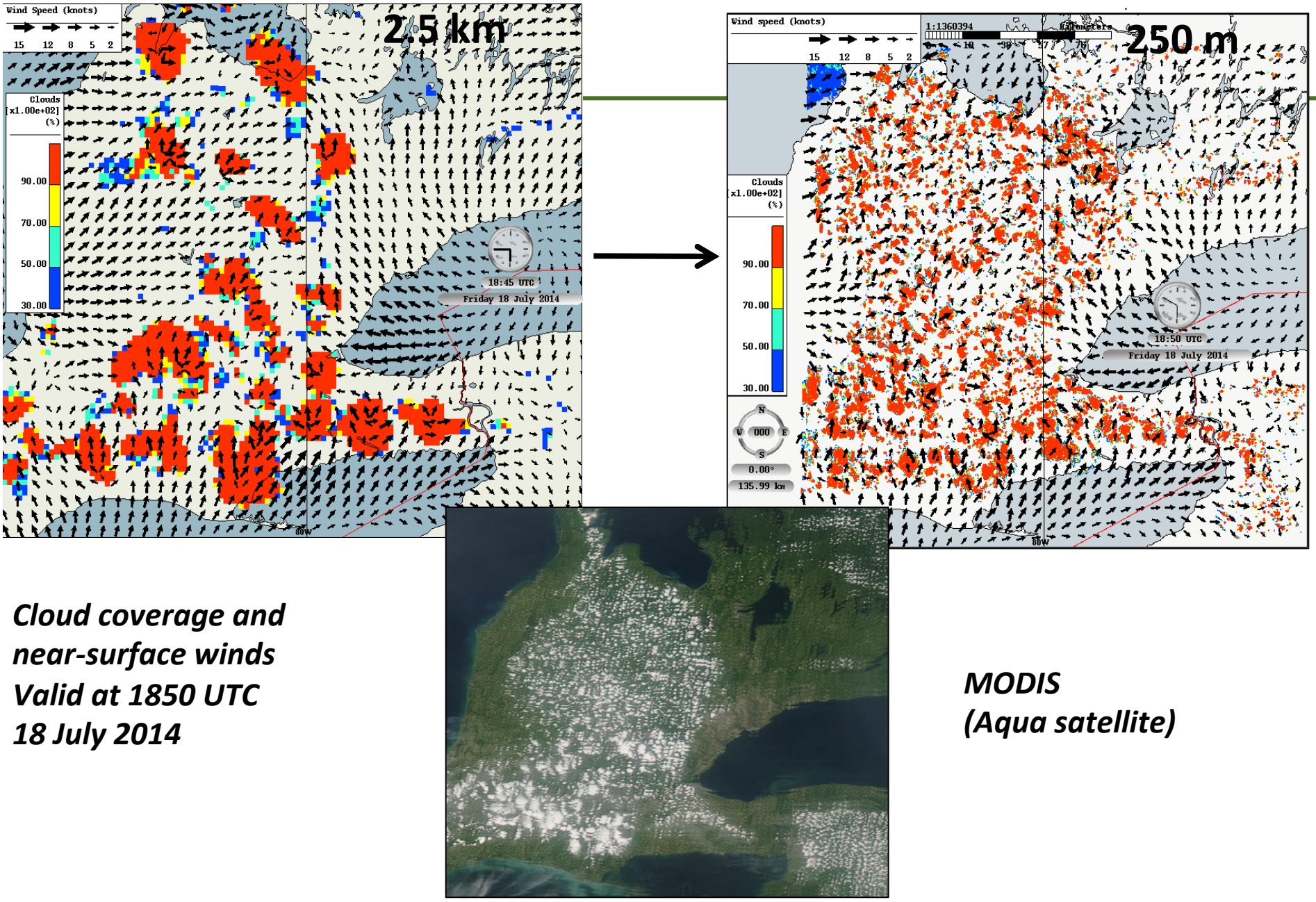
Lake conditions

The City of Toronto



EC[3]*'s Pan Am Experimental Model – 0.25 km pixel*

Example of Daytime Convective Activity



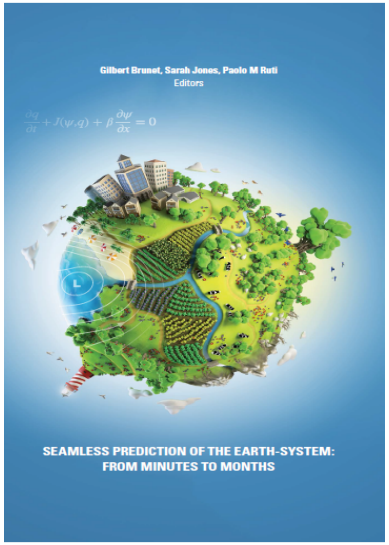
Cloud coverage and near-surface winds
Valid at 1850 UTC
18 July 2014

MODIS
(Aqua satellite)


Collingwood
Barrie
Lake Simcoe
Oshawa
Toronto
Guelph
Lake Ontario
Hamilton
Niagara Falls
London
Buffalo
Lake Erie

World Weather Open Science Conference (Montreal, 2014)

- *Seamless Prediction of the Earth System: from minutes to months*
  Editors: Brunet, Jones and Ruti
  - Provide a reference of current state and future challenges of NWP Science in 25 chapters.
  - It is freely available on the WMO website.



- *The quiet revolution of numerical weather prediction*
  Bauer, Thorpe and Brunet
  (Nature, September 3, 2015)

Toward more joint weather-climate research activities

The Way Forward

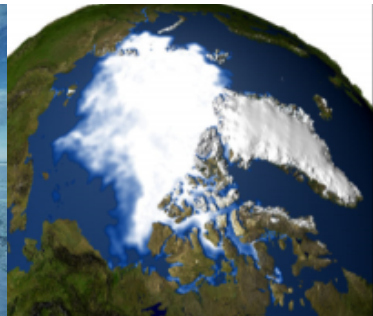
Challenges of Numerical Weather and Environmental Prediction Research

World Weather Research Programme (WWRP) projects to advance the science of seamless prediction:

- The Sub-seasonal TO Seasonal (S2S) project (jointly with WCRP);
- Polar Prediction Project (PPP) with joint WCRP activities (reanalyses, predictability and model error);
- HIgh-impact Weather (HIWeather) project.







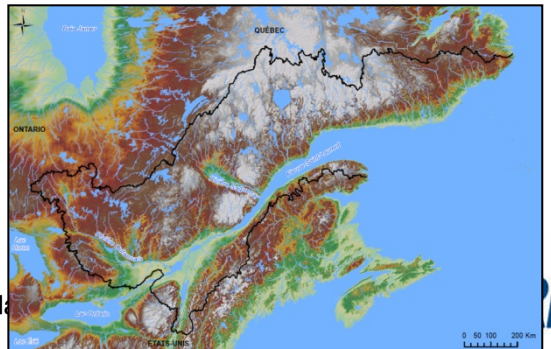
Coupled Hydrology-Atmospheric Modelling and Prediction (CHAMP)

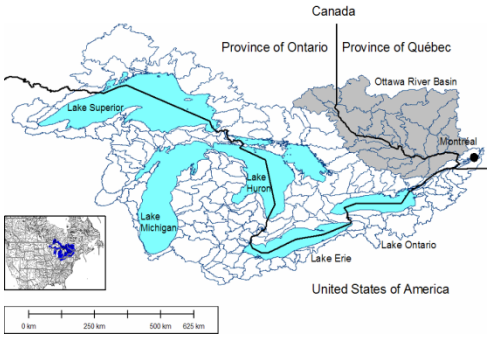
CHAMP project is proposed as a **WMO CAS-CHy-CBS** inter-commission research and forecasting demonstration project to:

- demonstrate the capacity for improvement to weather and hydrological forecasts of a coupled atmospheric-lake-ice-waves-hydrological numerical prediction system **(e.g. Do we close the water and energy budget?)**;

- demonstrate that such environmental prediction systems have direct applications to the forecast and management of water levels and discharges in **the Great-Lakes–St Lawrence system and ecosystem management**; and

- develop and evaluate specialized forecasting products to assist decision-making on time-scales ranging from real-time nowcasting **to monthly and up to annual** (for the surface water system).





Environment and Climate Change Canada

WORLD WEATHER RESEARCH PROGRAMME

Regional Integrator: GEWEX related matters

- Follow on of last GEWEX steering group meeting discussion with WWRP:
  - i) How to extend atmospheric activities (http://www.gewex.org/panels/global-atmospheric-system-studies-panel/gass-projects/) by increasing the link with WWRP and proposing new champions.
  - ii) How to increase the link between our regional activities (HIWeather, RDP, FDP, CHAMP) and Regional Hydroclimate Projects (http://www.gewex.org/panels/gewex-hydroclimatology-panel/regional-hydroclimate-projects-rhps/).
  - Jan Polcher has been invited to attend the HIWeather kickoff meeting. We can think to have a GEWEX representative attending the next WWRP SSC.

Other joint initiatives

- WCRP Extreme Grand Challenge (lead: GEWEX/CLIVAR)
  - Brian Golding attended the meeting last year in Oslo.
  - Extreme Grand Challenge is focusing on extremes catalogue specifically working on rainfall time series at high-time resolution (3-6 hourly).
  - Links to **WWRP** Predictability, Dynamics and Ensemble Forecasting (**PDEF**) and High Impact Weather (**HIWeather**) need to be nurtured.

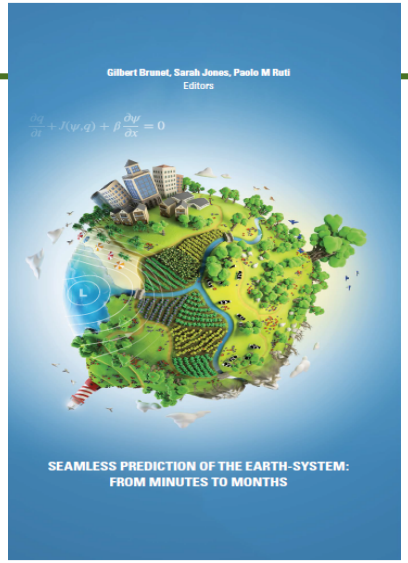
- WCRP Reanalysis Working Group
  - WWRP DAOS is promoting coupled data assimilation activities and workshops.

- Scalability and large dataset (new dynamical cores …)
  - EUROPE, USA, South Korea (KIAPS), Canada (EC^3) and others are working on new dynamical cores to be more efficient in new technological horizons;
  - Most of these projects will satisfy the requirements of the weather, climate and atmospheric composition communities. WGNE should play an important role.

Young Earth System Scientists (YESS)

- YESS submitted the white paper that summarizes the discussions from the first workshop (supported by WWRP) to BAMS;
- YESS had the first elections and further concretized its structure:
  - YESS Council: All people who are involved in organizing and promoting YESS activities (~25 people);
  - YESS Executive Committee: The "backbone" of YESS, keeping everything together and active (7 people);
  - Regional Representatives: Responsible for coordinating YESS activities and promotion in their Region (Africa, Asia/Middle East, South America, North America, South West Pacific, Europe).
- YESS is in touch with PR of Argentina, regarding the support/ establishment of a YESS Office in Argentina.

Toward the second World Weather Open Science Conference.



- WWRP next strategy (2020-24)?
- We welcome WCRP involvement in some seamless sessions.
- Joint SSC - JSC in 2018?
  - It would be nice to have at a certain point the two JSC SSC close together with one day discussing together.

Questions and Answers

Merci beaucoup!

Thank you very much!

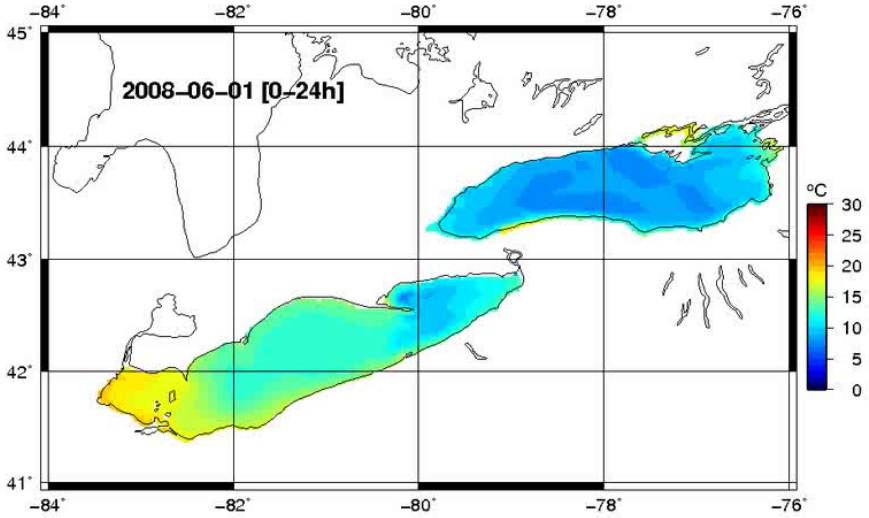
Great Lakes prediction system

Coupled models

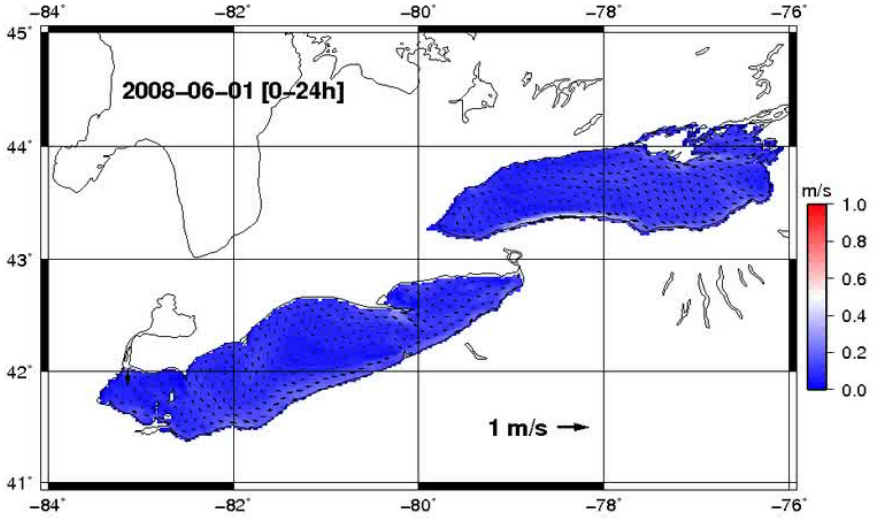
- GEM atmospheric model
- NEMO ocean model
- WW3 wave model
- WATROUTE river routing model

Applications

- Weather forecasting
- Search and rescue
- Particle tracking (drifting boat, oil spill)
- Storm surge and coastal inundations
- Optimization of hydropower production



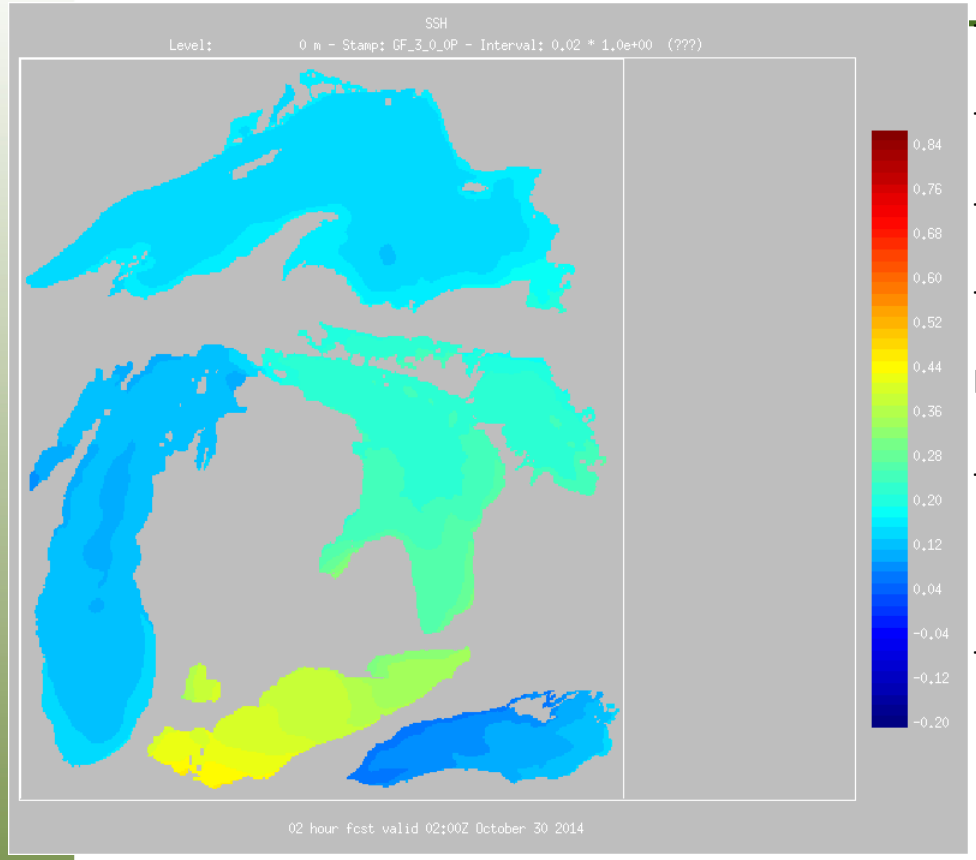
Water temperature [C]



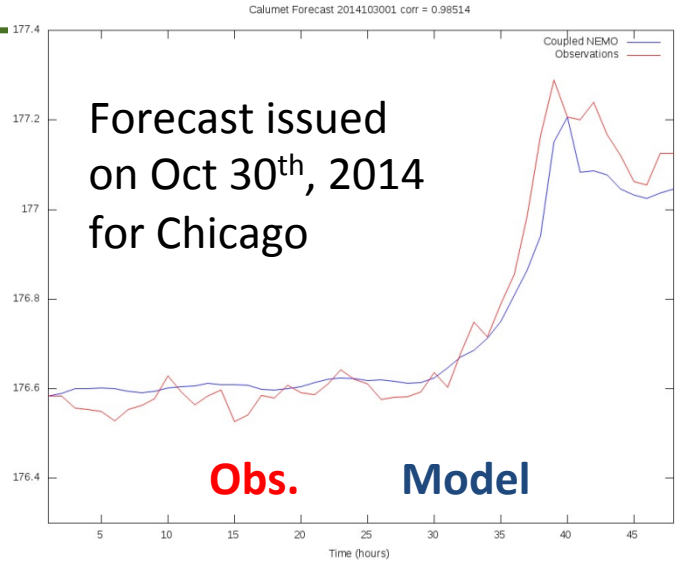
Surface currents [m/s]

Summer of 2008 (system running daily since the fall of 2014)

Water level forecast



+80 cm
+60 cm
+40 cm
+20 cm
Init H.
-20 cm

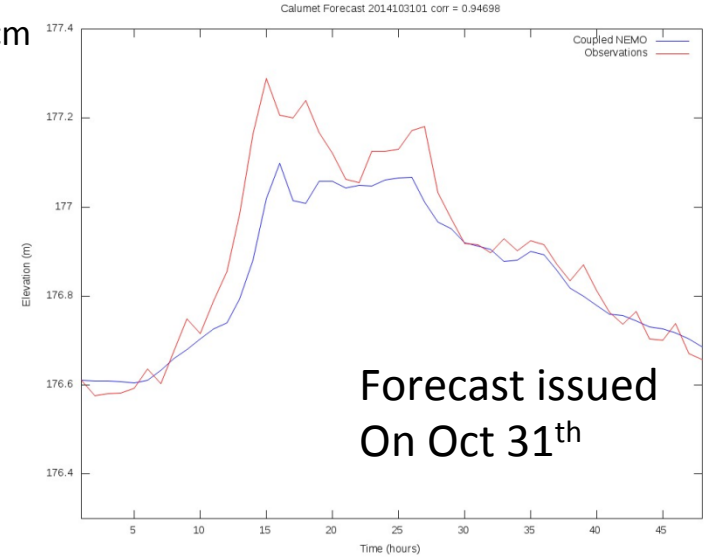


Forecast issued
on Oct 30th, 2014
for Chicago

Obs. Model

0h 24h 48h

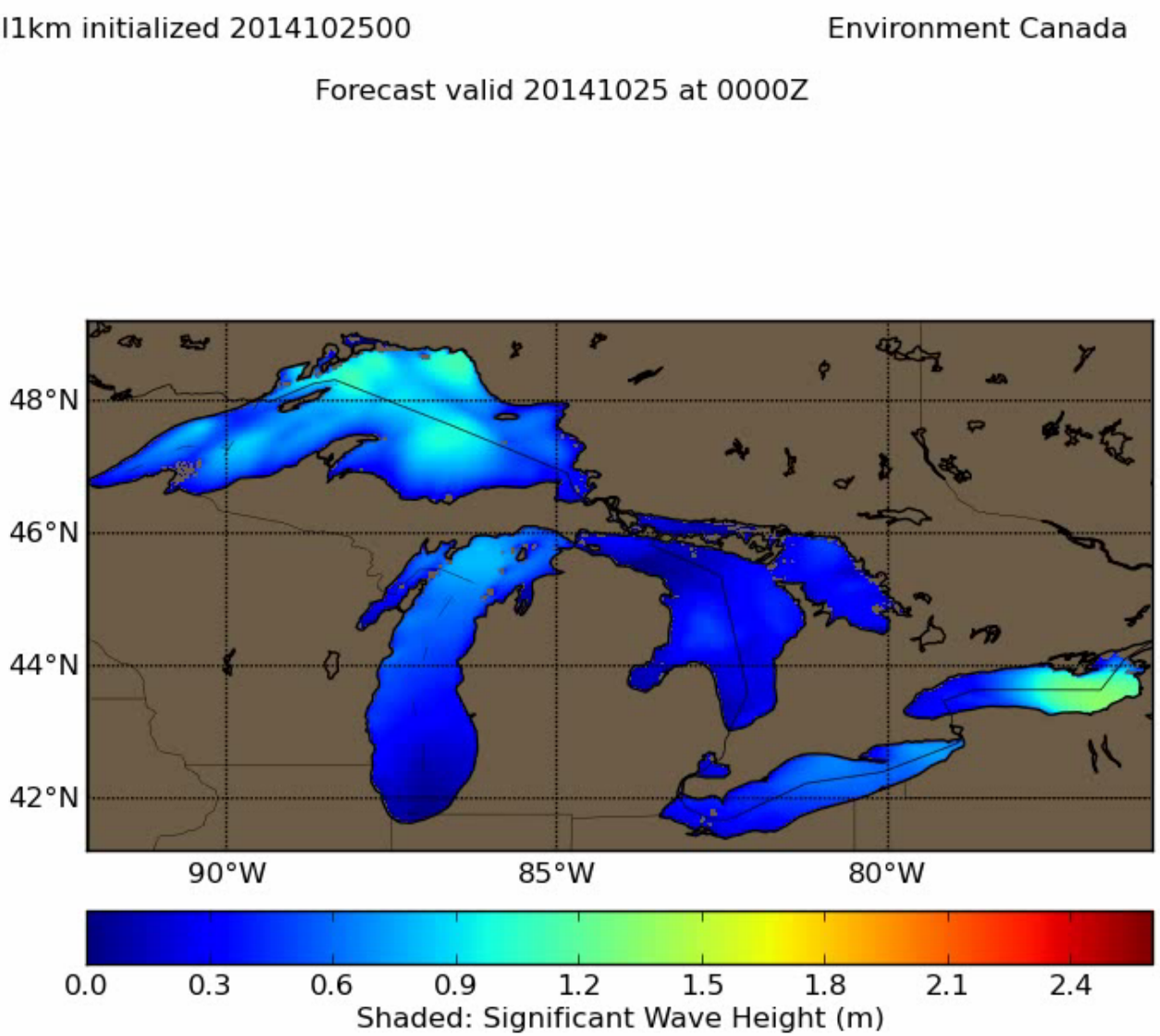
+80 cm



Forecast issued
On Oct 31th

Climate Change Canada Changement climatique Canada

Wave forecast



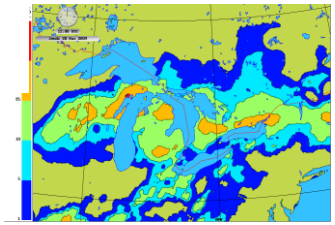
1-km deterministic forecasts with possible 250-m nest in the Toronto Area.

2.5-km wave ensemble for probabilistic forecasts

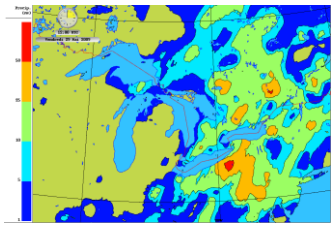
Precipitation analysis (CaPA) and streamflow prediction

CaPA analysis

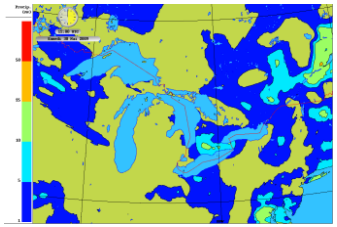
May 27th



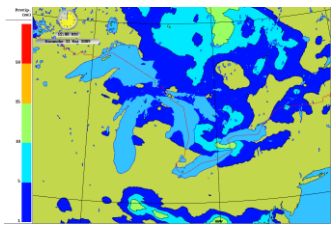
May 28th



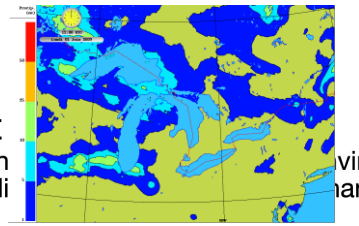
May 29th



May 30th



May 31st



Simulated Lake Ontario tributary flow
28-31 May 2009