Great Lakes Wave Prediction Systems: Offering tailored guidance during record high lake water levels.

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Joseph Long at USGS

Environment and Climate Change Canada

Environnement et Changement climatique Canada

Canada

Photo: Toronto Star:
www.thestar.com
16 may 2017

The Problem:
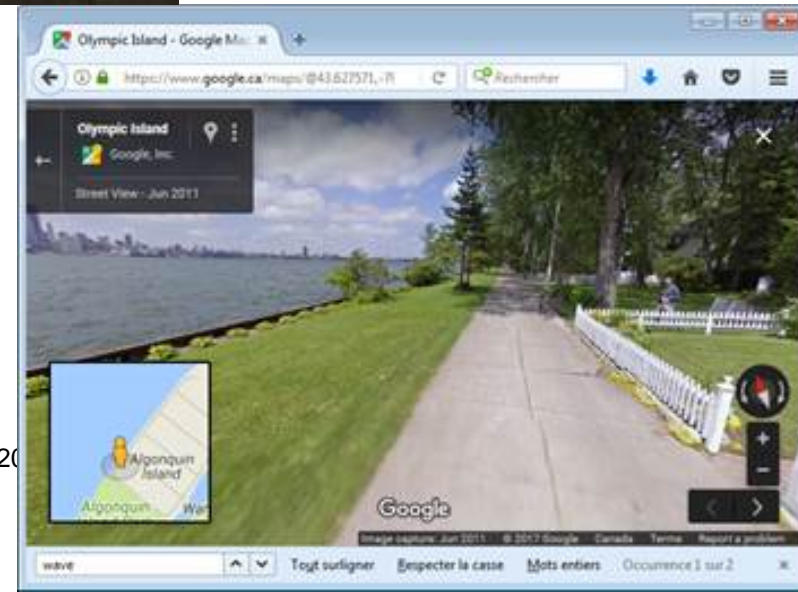
- Exceptionally high water levels

- Major concerns: continued rising levels, waves, seiching, and overtopping

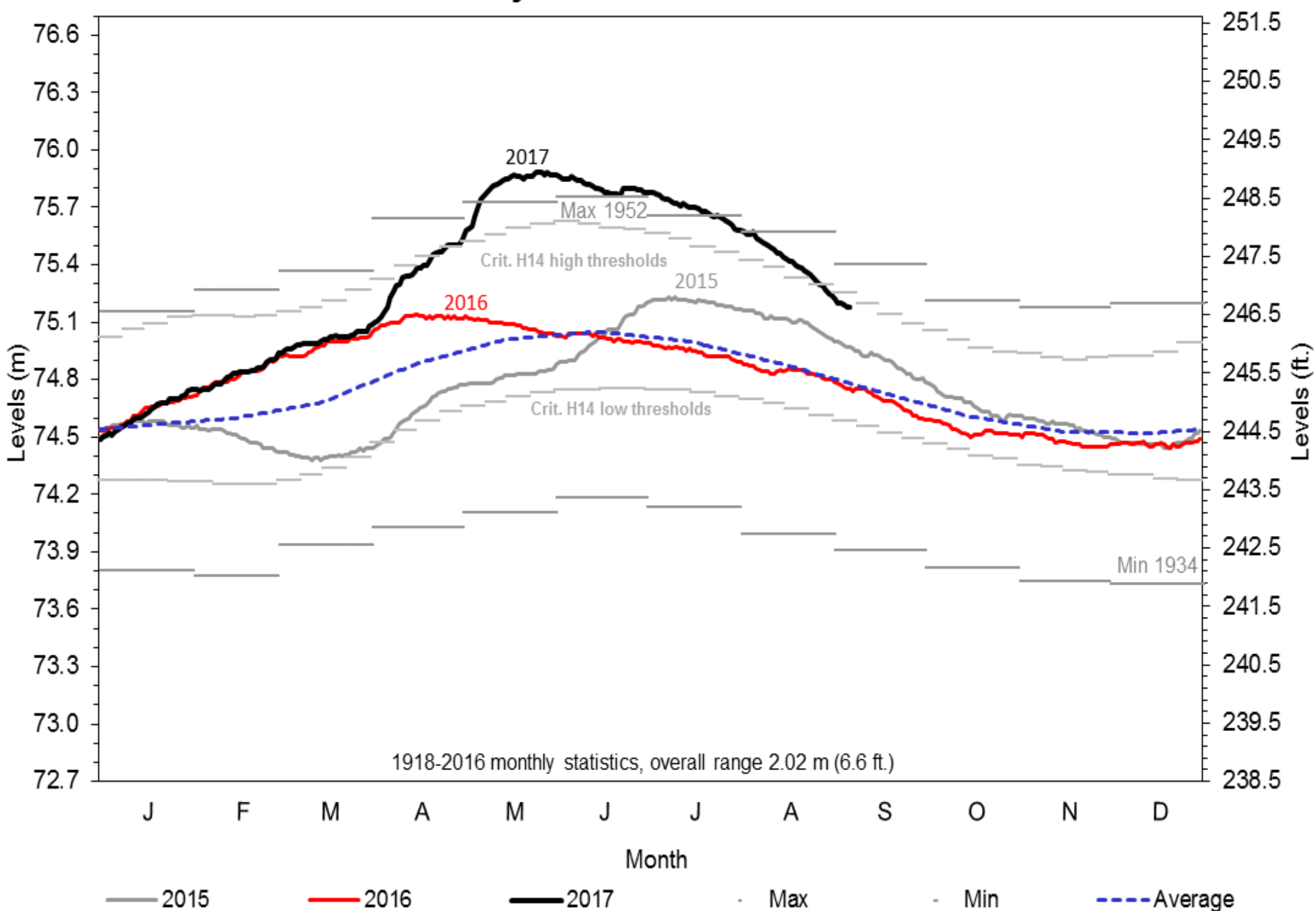Environment and Climate Change Canada

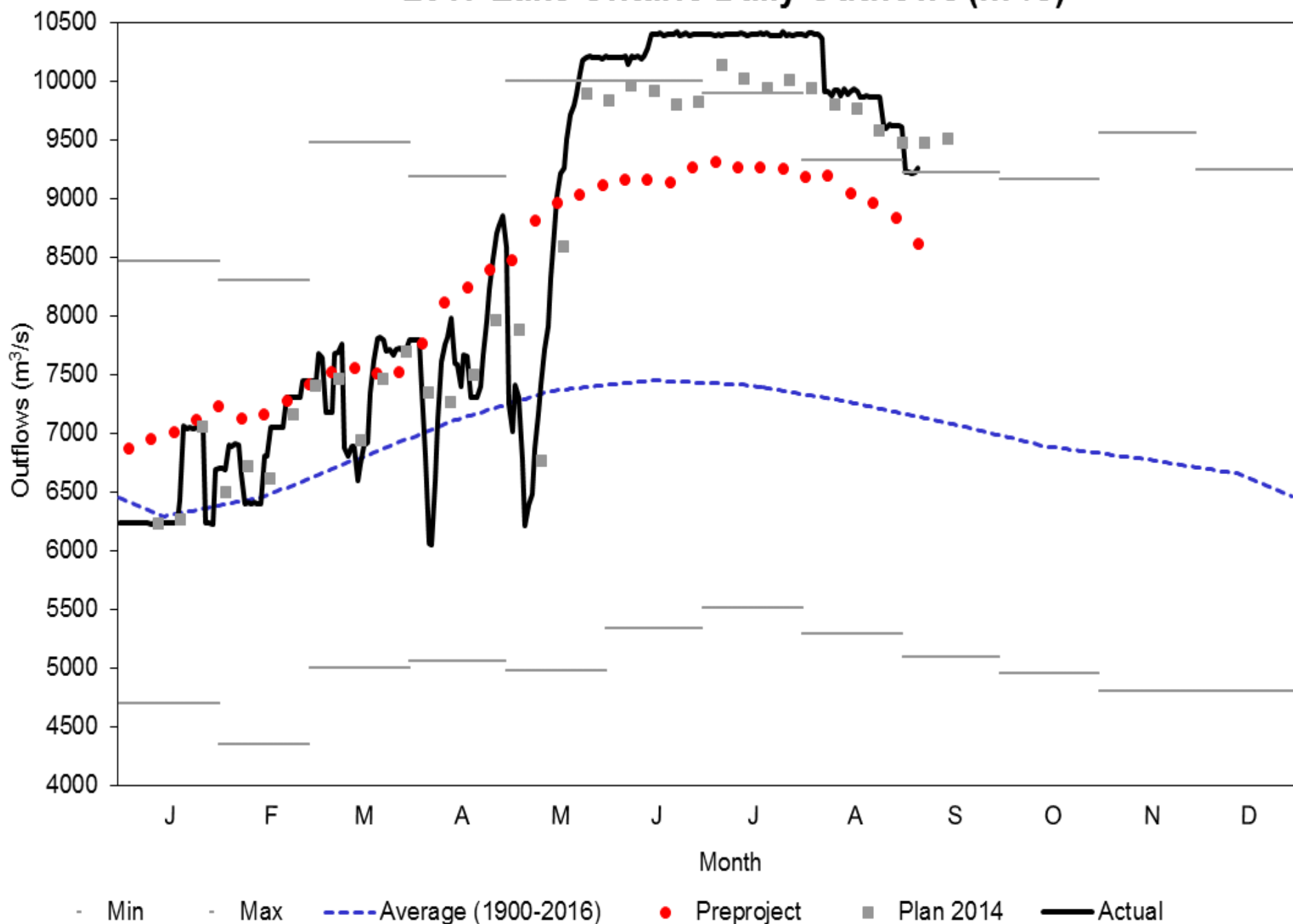Environnement et Changement climatique Canada
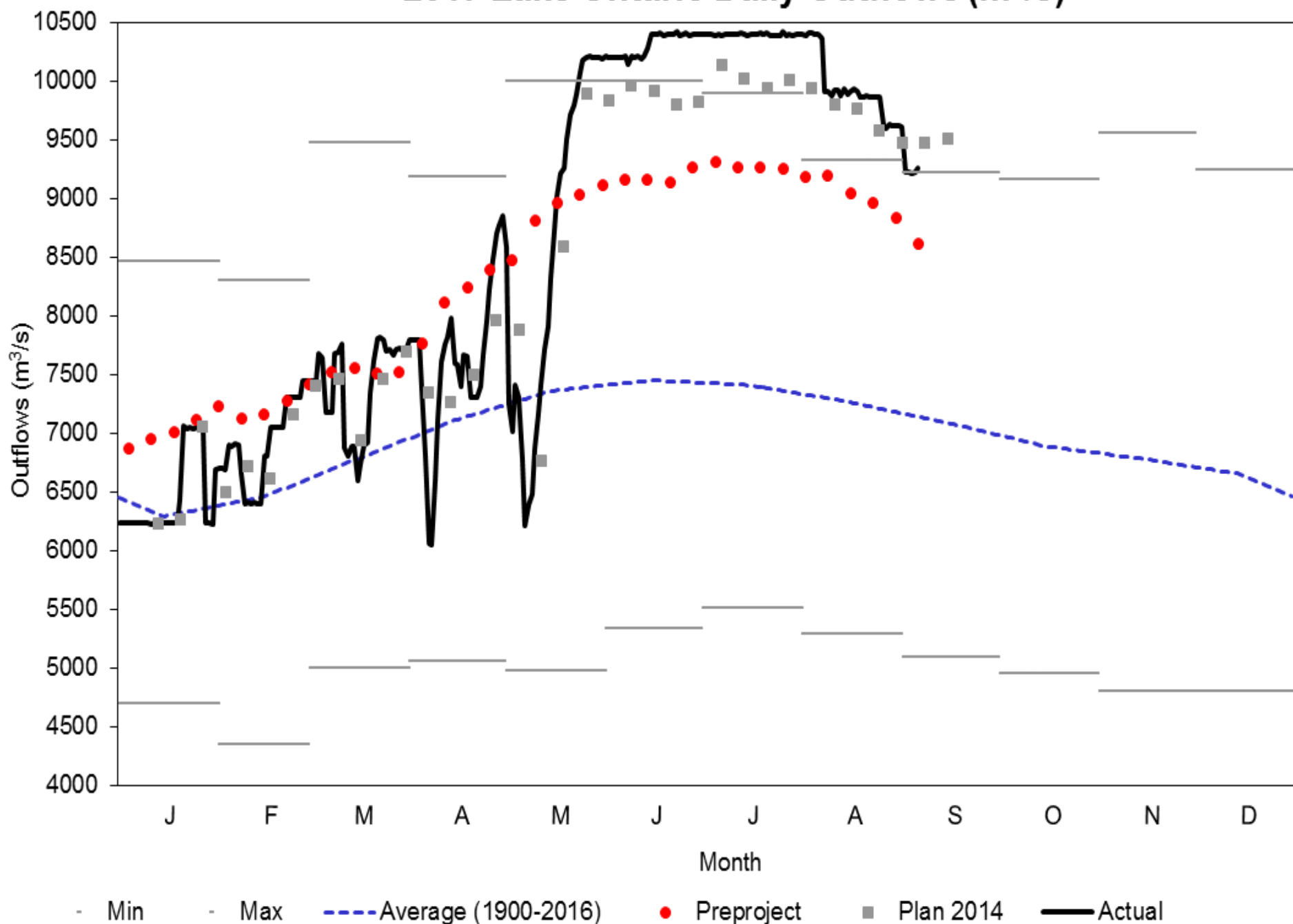
Daily Lake Ontario Levels

2017

Max 1952

Crit. H14 high thresholds

2015

2016

Crit. H14 low thresholds

Min 1934

1918-2016 monthly statistics, overall range 2.02 m (6.6 ft.)

Levels (m)

Levels (ft.)

Month

J F M A M J J A S O N D

——— 2015   ——— 2016   ——— 2017   · Max   · Min   - - - Average

2017 Lake Ontario Daily Outflows (m^3/s)

Legend: Min, Max, Average (1900-2016), Preproject, Plan 2014, Actual

Watersheds

Ottawa River
(outlet @ Carillon Dam)

Ottawa River

Lake St. Lawrence
(outlet @ Moses-Saunders &
Long Sault Dam)

Ottawa, ON

Montreal, QC

Cornwall, ON

Massena, NY

Ogdensburg, NY

Lake St Louis
(outlet @ Lasalle)

Kingston, ON

St. Lawrence River

Cobourg, ON

Toronto, ON

Lake Ontario

Port Weller, ON

Oswego, NY

Niagara River

Rochester, NY

Syracuse, NY

Buffalo, NY

Lake Erie

2017 Lake Ontario Daily Outflows (m³/s)

Min   Max   — — Average (1900-2016)   ● Preproject   ■ Plan 2014   —— Actual

The Experimental Solution: Tailored products developed for A&P

- For OPP, developing relocatable, on demand, forecast suites for enhanced numerical guidance during spill events.

- Although <u>no spill</u>, record high water level provided great test bed for tailored numerical guidance.

- Experimental wave and lake level products ready for operations were given priority on the research cluster.

- In additon, 250m atmosphere and wave systems developed for the PanAm games were re-installed, and prolongued to 48h

→ **first, tailored, water level and waves on demand marine numerical guidance produced for and used by A&P**

- Overtopping was hooked up and tested on select cases (preliminary results: products for research only).

Water Cycle Prediction System for the Great Lakes and St. Lawrence

GEM RDPS (10 km) atmospheric model
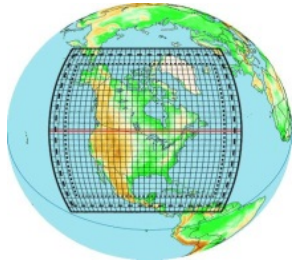
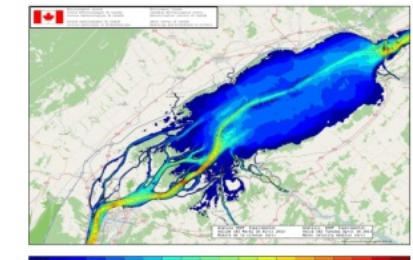**GEM LAM (10 km) atmospheric model (ISBA land-surface scheme)**

WATROUTE routing model (1km)
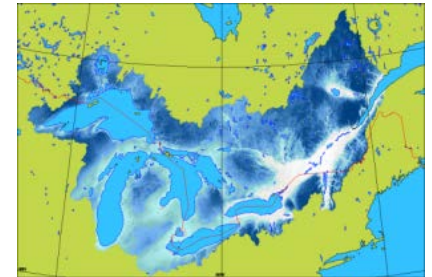
Data assimilation system (EnVAR)
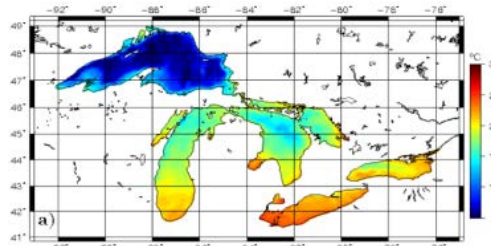
NEMO+CICE (2 km) ocean-ice model over the Great Lakes

H2D2 finite element hydrodynamic model from Montreal to the Gulf of St. Lawrence
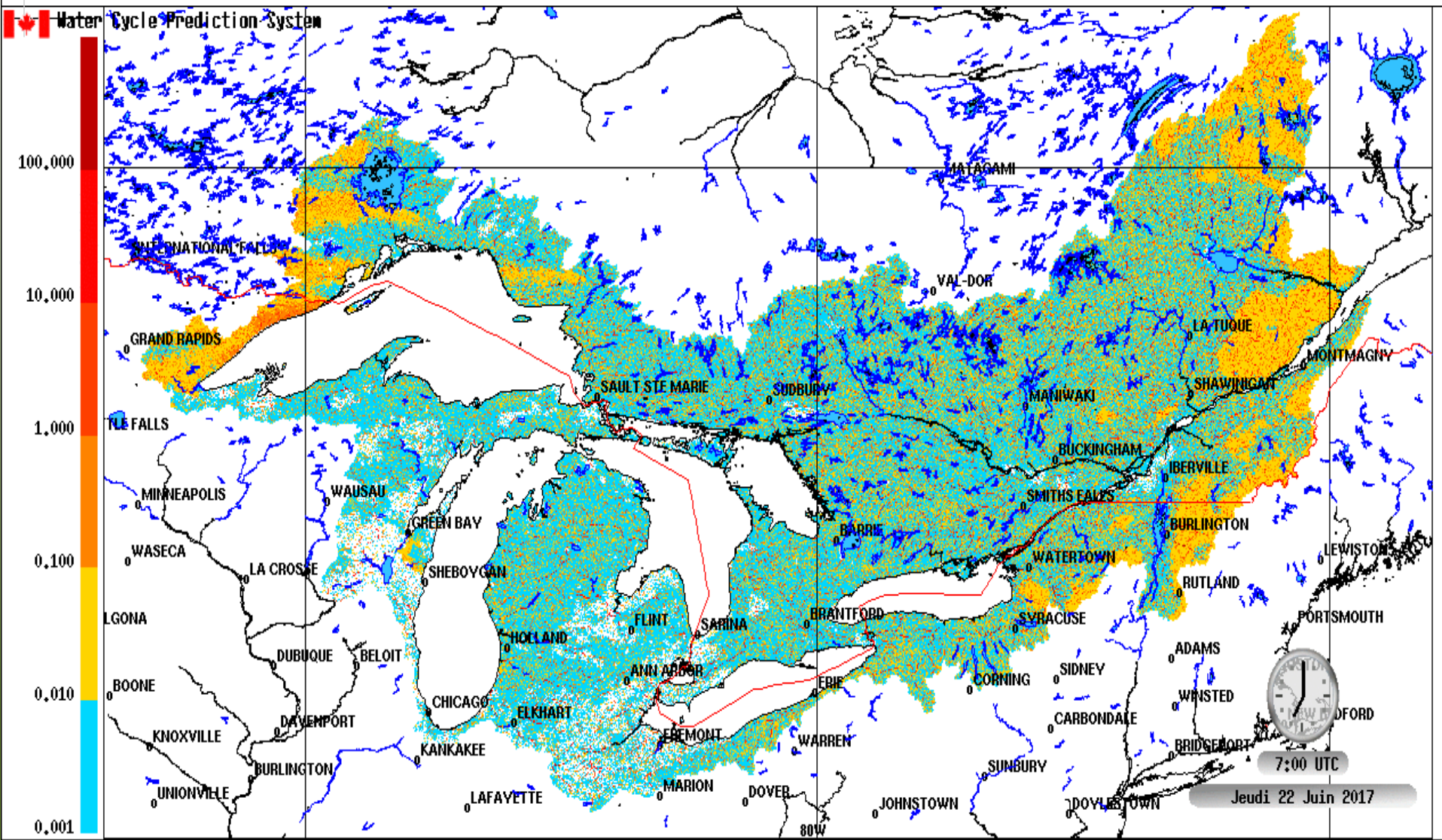
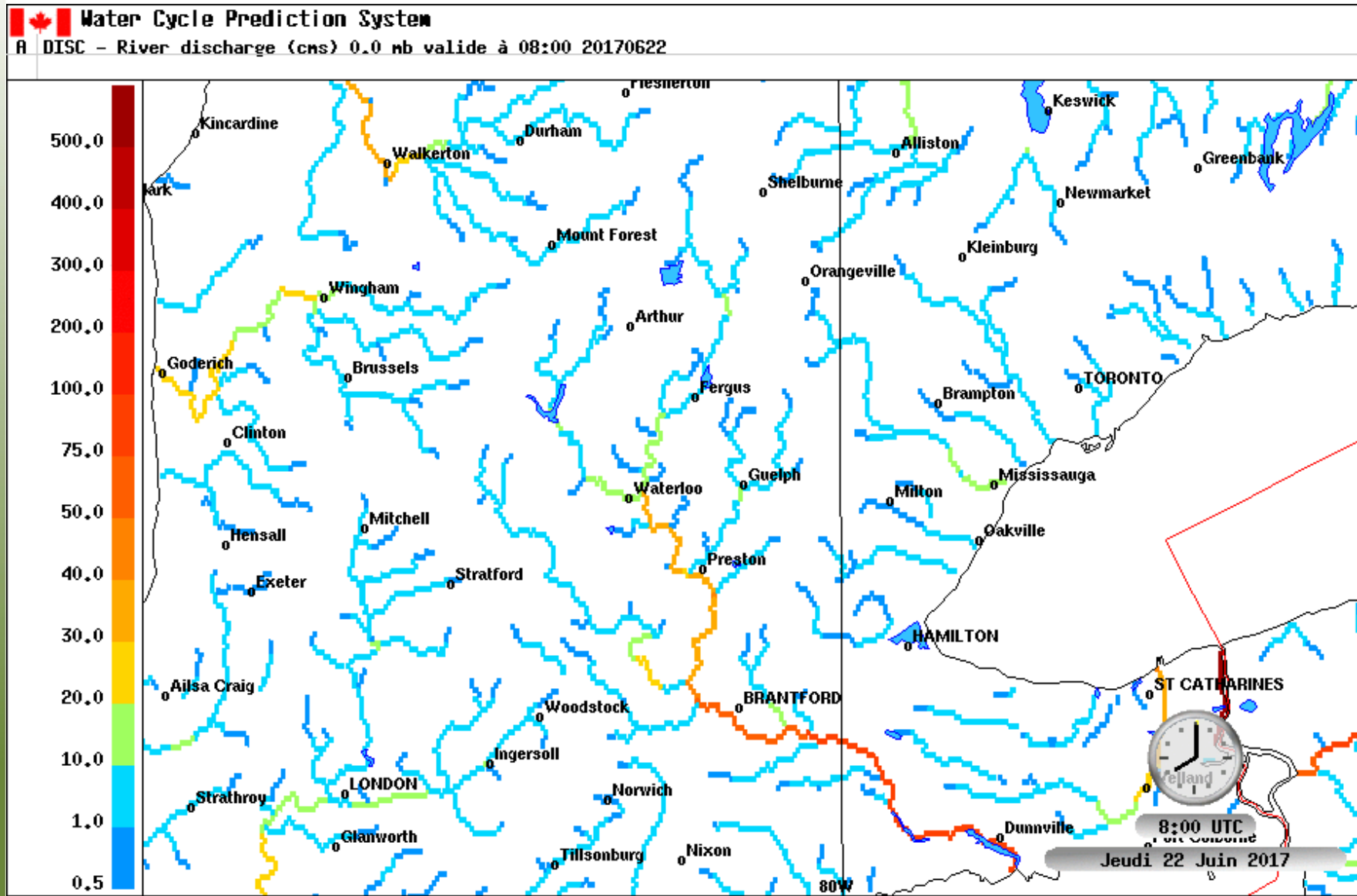Environnement et Changement climatique Canada

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Streamflow analysis cycle
2017-06-22 06Z - 2017-06-24 06Z

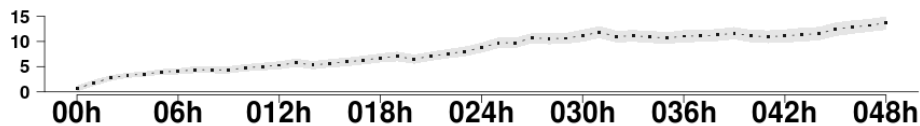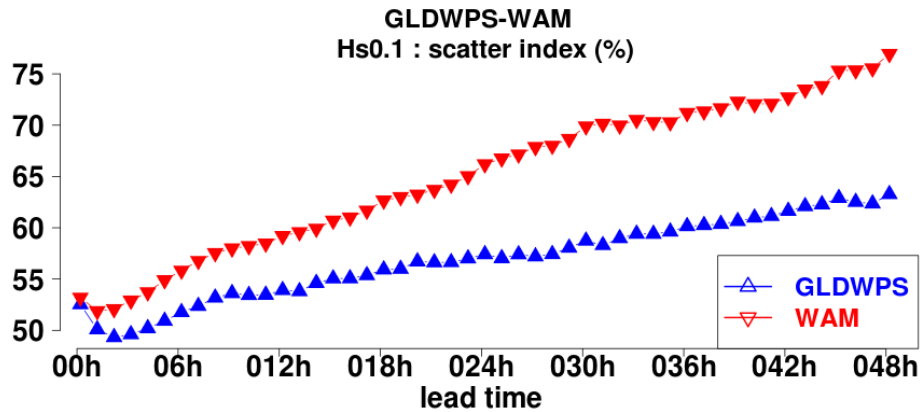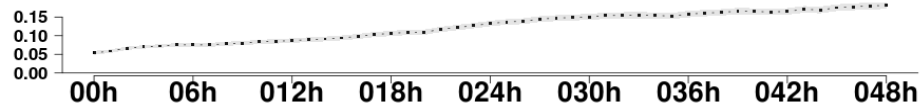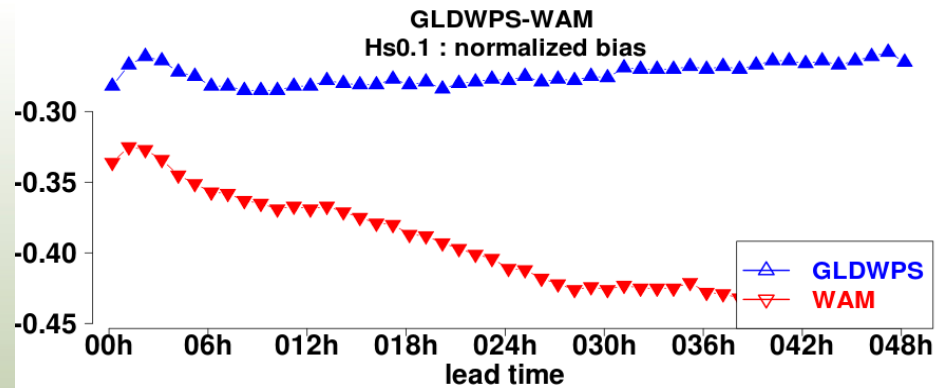# Streamflow analysis cycle
2017-06-22 06Z - 2017-06-26 06Z

Great Lakes Wave Prediction Systems (Wave model: WW3 v4.18)

RDPS

HRDPS 2.5km

1km GLDWPS

1km to 250m gem/urban

250m

REPS

2.5km GLEWPS

1 control + 20 perturbed members

GLEWPS init. 2017080412 ECCC
Ensemble Forecast for 24 hours from 2017-08-04 12:00 to 2017-08-05 12:00 UTC

Shaded: Probability of max of Significant Wave Height ≥ 2 m (%)
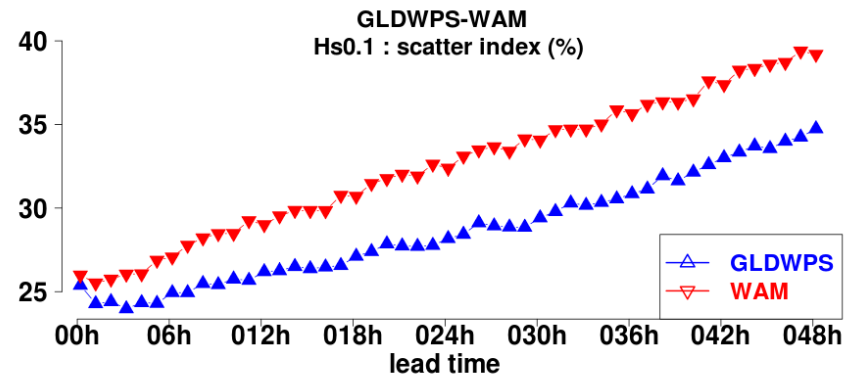
Environnement et
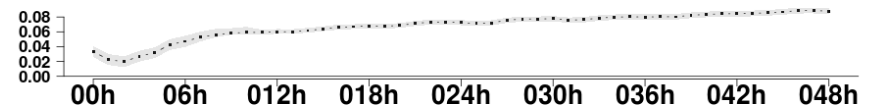Changement climatique Canada

Environment and
Climate Change Canada
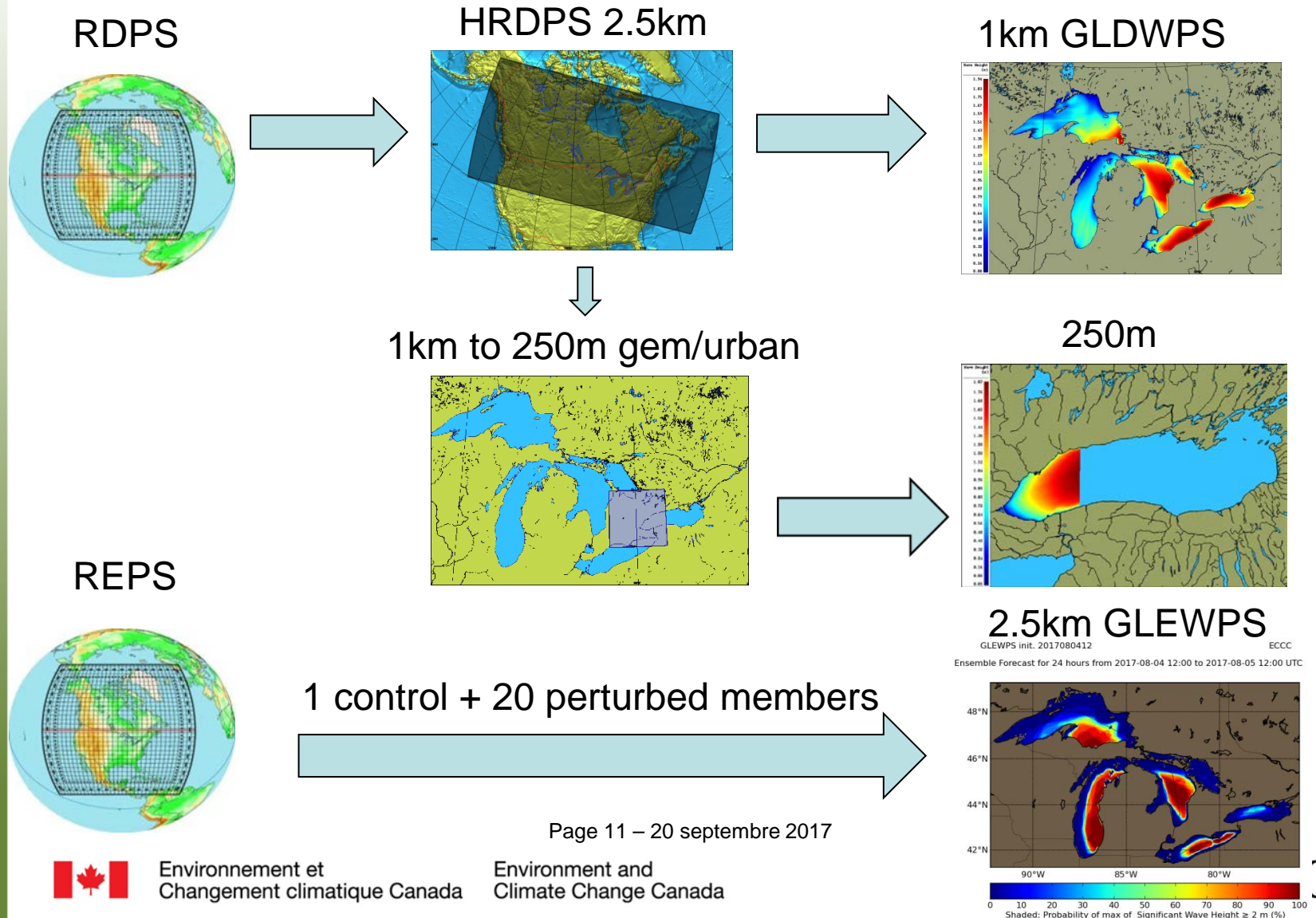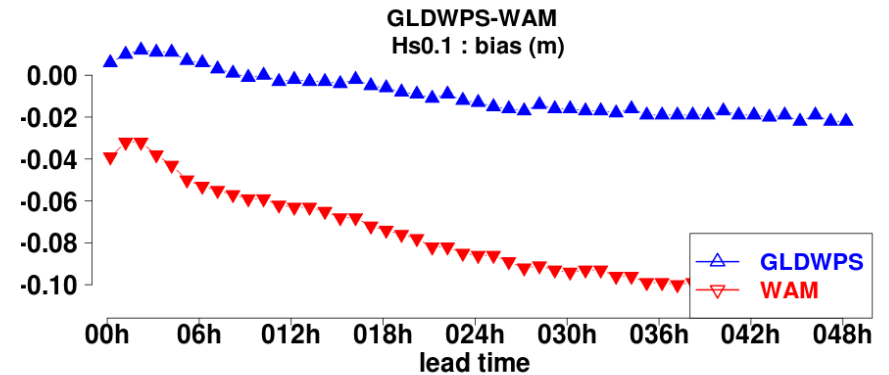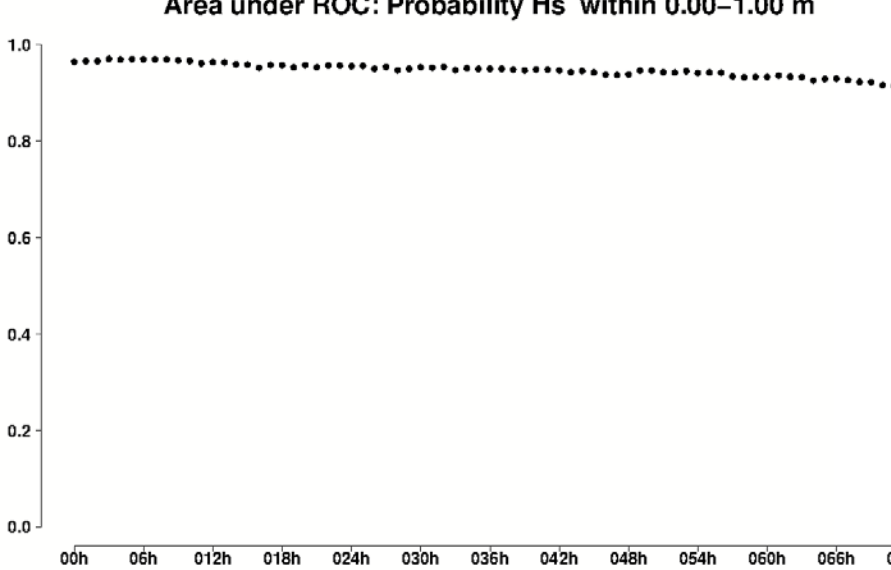
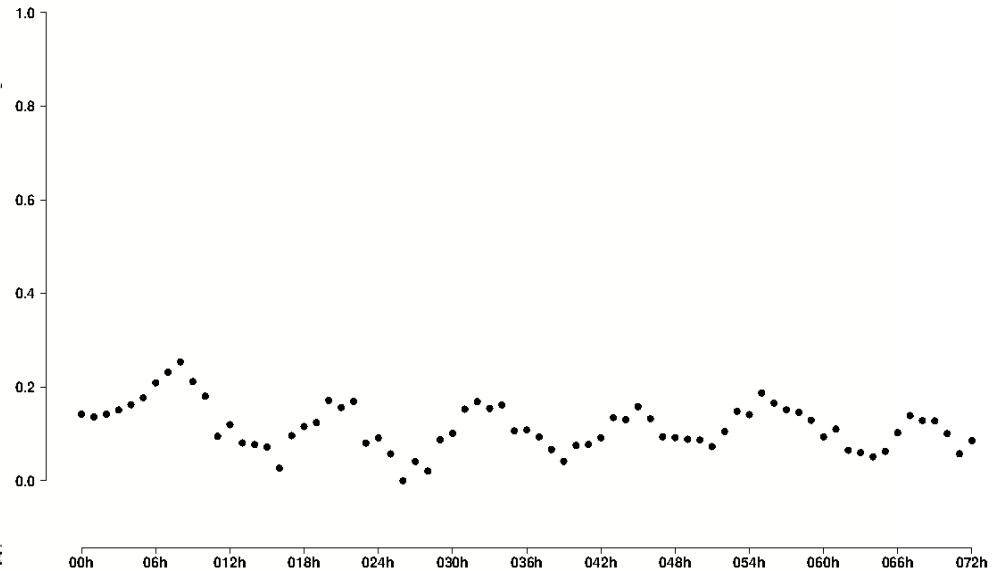June-August 2015-2016

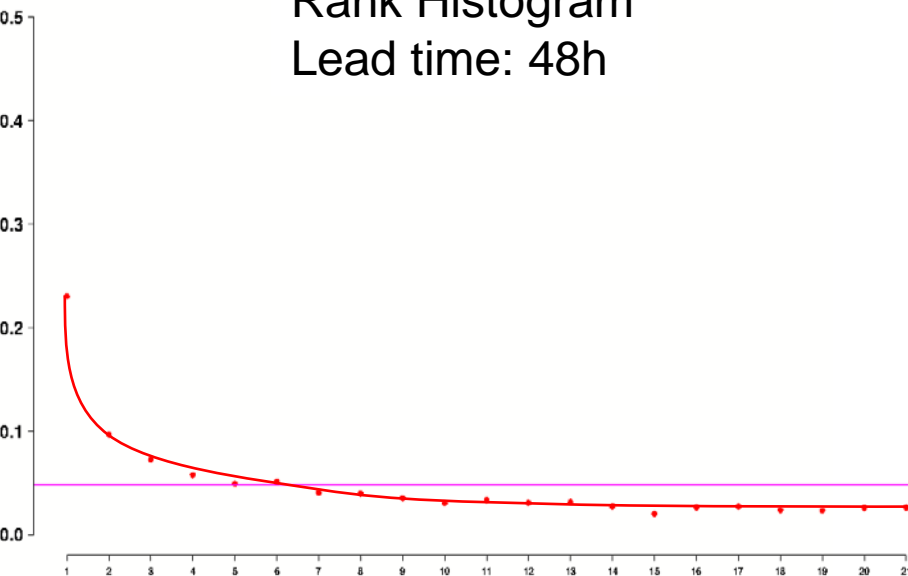September-December 2015-2016
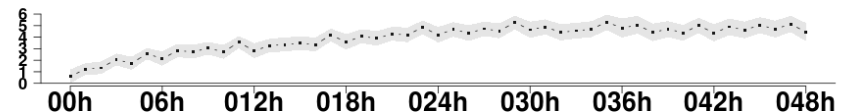
Summer Ensemble Scores (JJA 15-16)

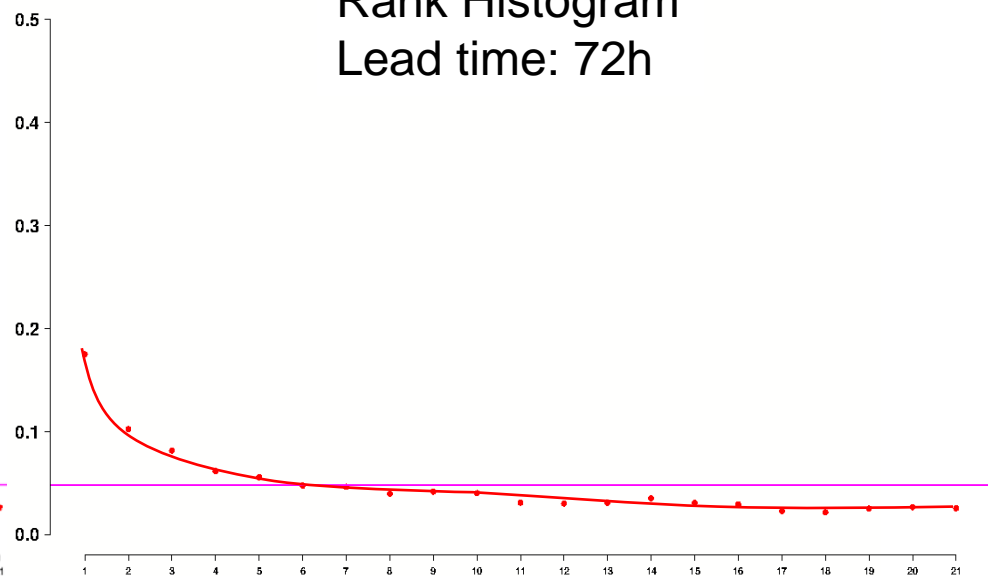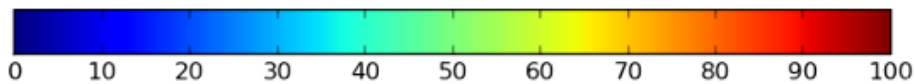Area under ROC: Probability Hs within 0.00–1.00 m
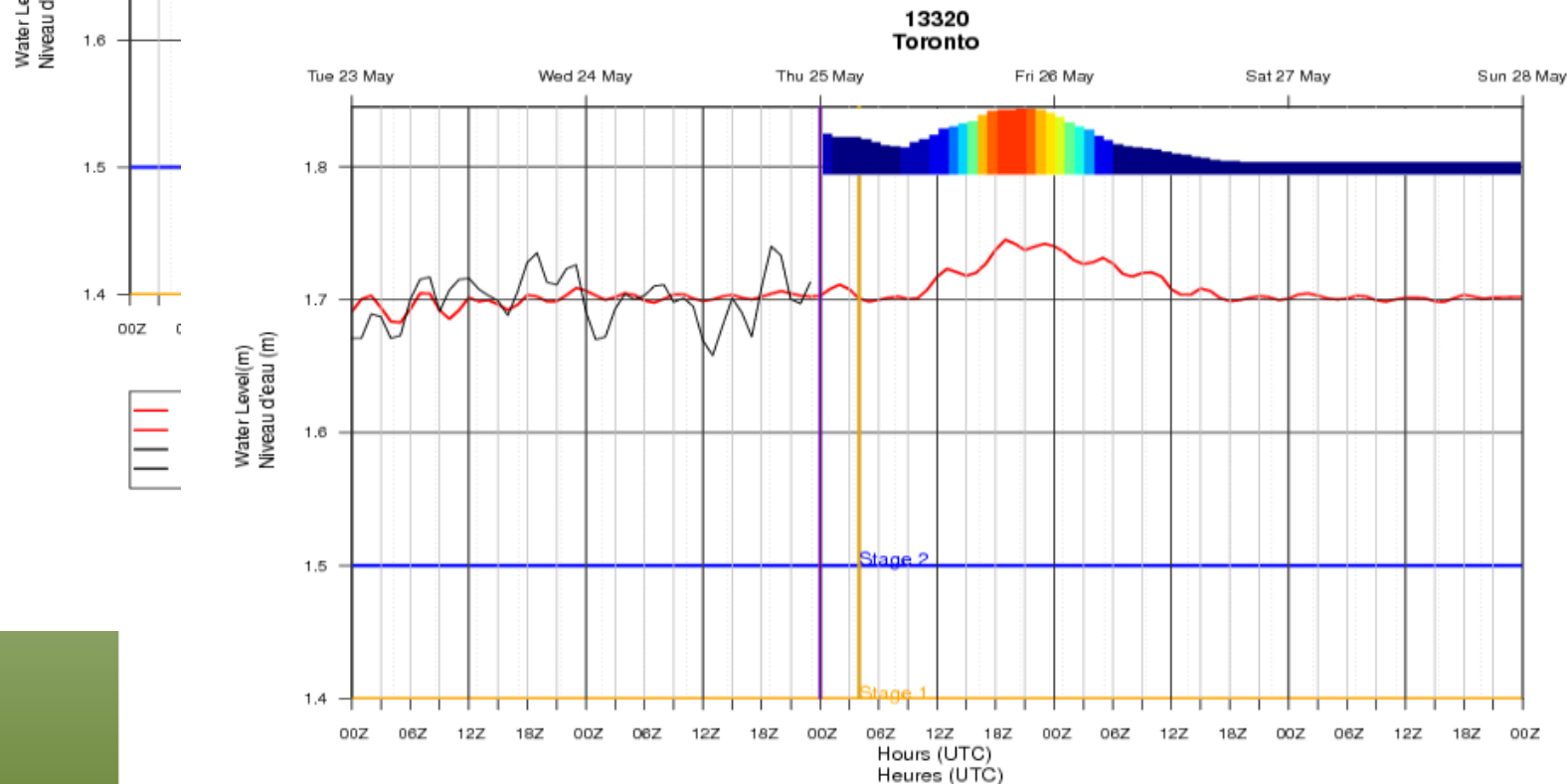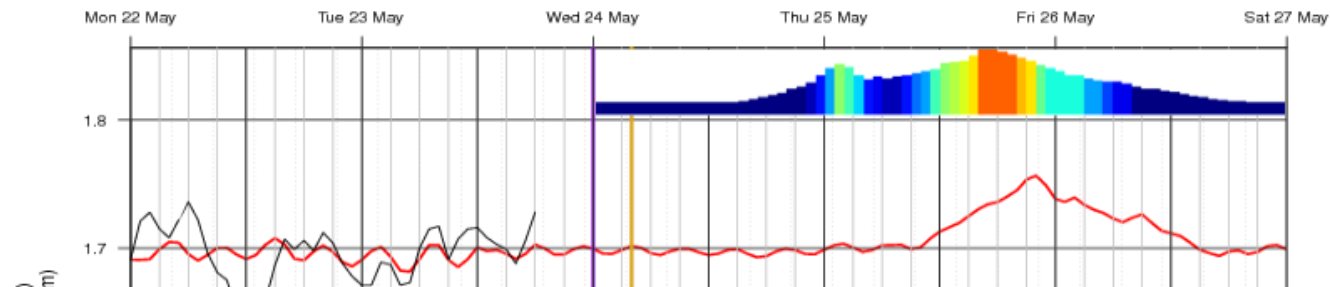
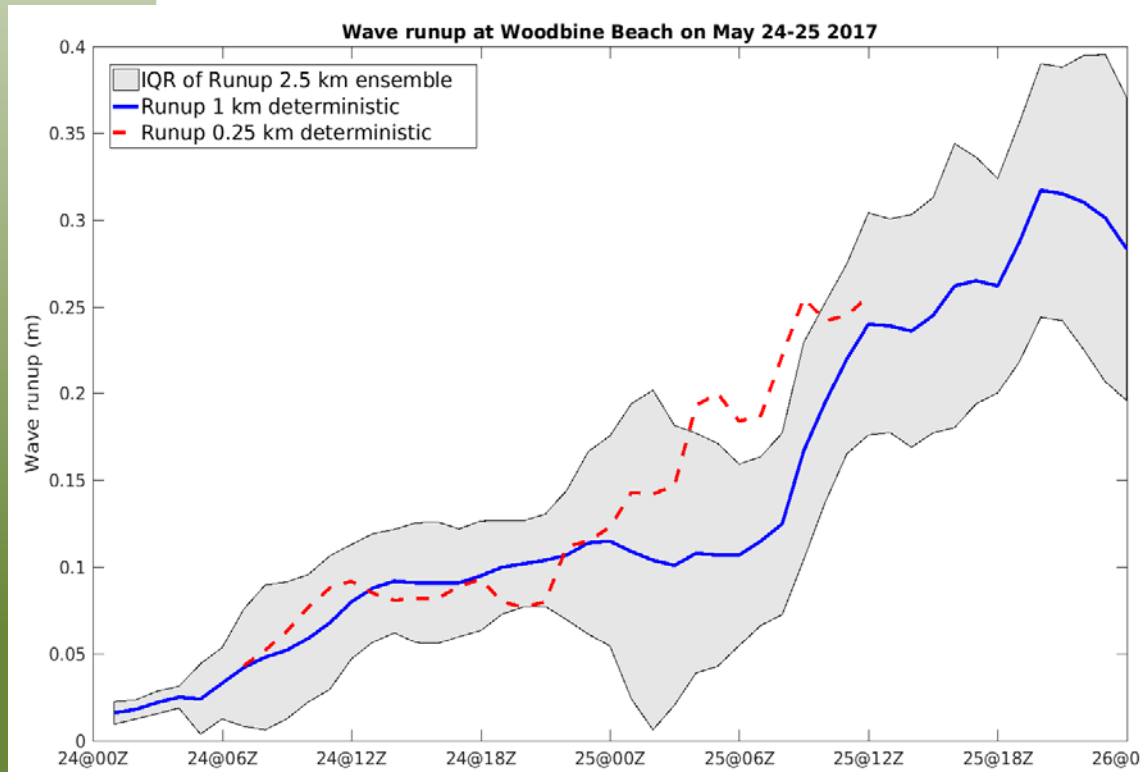Brier Skill Score: Probability Hs within 0.00–1.00 m

Rank Histogram
Lead time: 48h

Rank Histogram
Lead time: 72h

13320
Toronto
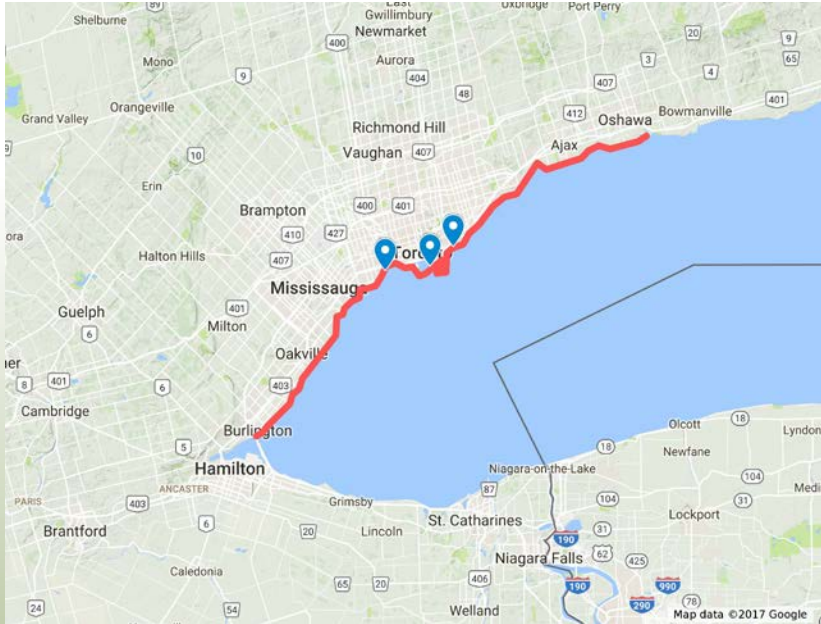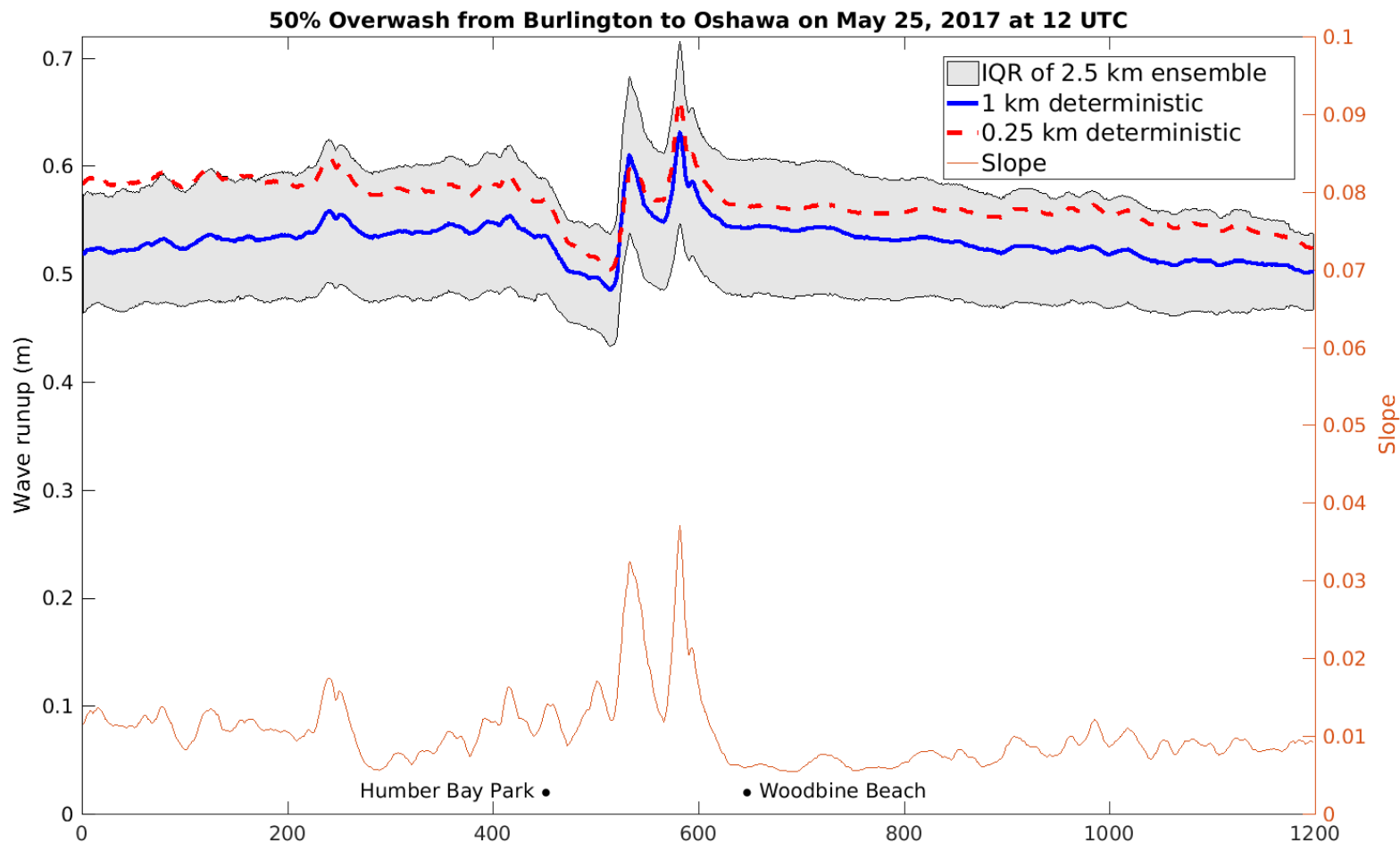
13320
Toronto

Water Level(m)
Niveau d'eau (m)

Hours (UTC)
Heures (UTC)

Deblased SSH	Current Time	Stage 1
Débiaisée SSH	Heure Actuelle	1 Etage
Observered Water Level	Last Model Run	Stage 2
Niveau d'eau Observé	Dernier Cycle du Modèle	2 Etage

Shaded: Probability of max of Significant Wave Height > 1 m (%)

0   10   20   30   40   50   60   70   80   90   100

nada

Wave runup at Woodbine Beach on May 24-25 2017

Along shore Overwash

50% Overwash from Burlington to Oshawa on May 25, 2017 at 12 UTC

Summary

- Lake Ontario wave guidance has been updated and upgraded: 2.5km ensembles and 1km deterministics (over all lakes) are scheduled for October 17 2017 operational implementation

- Prototypes of relocatable, on demand, systems were deployed to help monitor lake Ontario, a solid proof of concept for OPP

- Novel products were prepapred and are automatically generated and distributed to A&P and Govermnent of Ontario

- Very preliminary results suggest that overtopping model could be also be useful in the Great Lakes

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