



Environment
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Environnement
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Numerical Weather Prediction System Dedicated to Urban Comfort and Safety During the 2015 Pan American Games in Toronto (Canada)



Photo : Toronto, credit: Sylvie Leroyer

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Anna-Belle filion, and
David Theriault***

Environment Canada

22 July 2015, ICUC-9 Conference in Toulouse, France



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Context

NWP moving towards sub-km scales with urban processes included

***NWP science showcase during Toronto 2015
Pan-American games (EC project)***

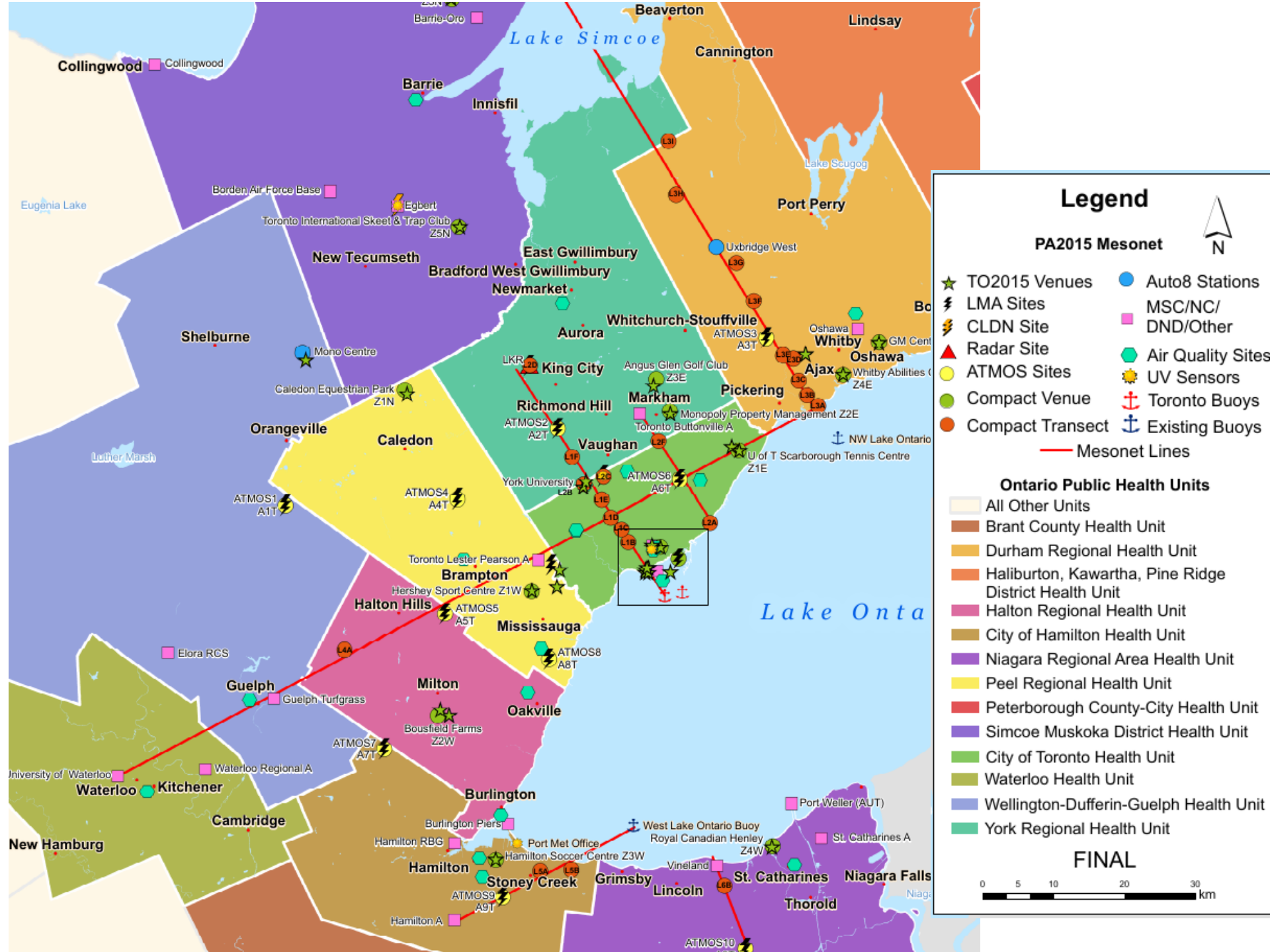
***Summertime extreme weather in the Greater
Toronto Area***



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Environmental Prediction Systems

NWP (GEM), 2.5km, 1km, and 0.25km

Air quality model (GEM MACH), 2.5km

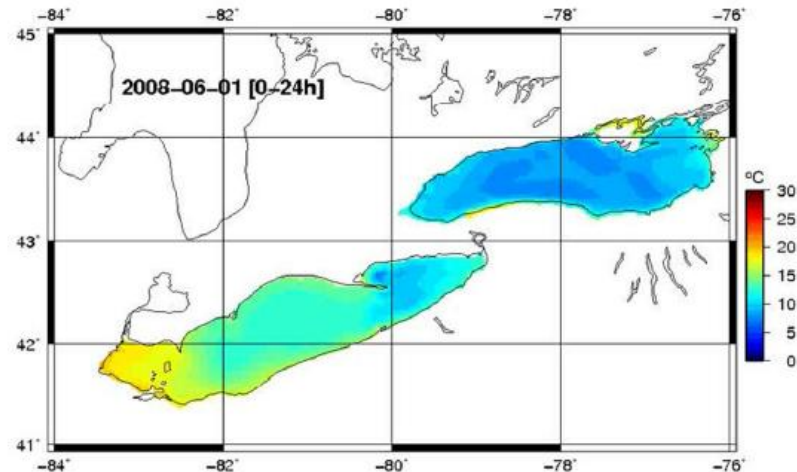
3D Lake model (NEMO), 2km

Particle tracing

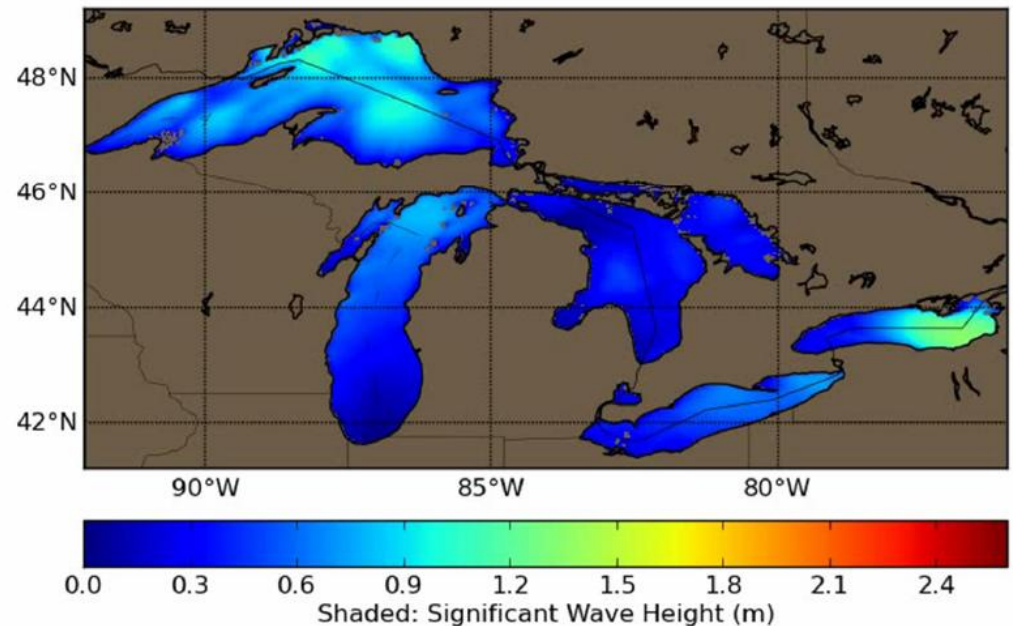
Water level forecasting

Wave forecasts (WW3), 1km deterministic, 2.5km ens.

Precipitation analysis and streamflow prediction



Water temperature [C]



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NWP km- and subkm-scale systems

*Upper air initial conditions
from regional 10-km system*

*Land surface initial conditions
from CaLDAS*

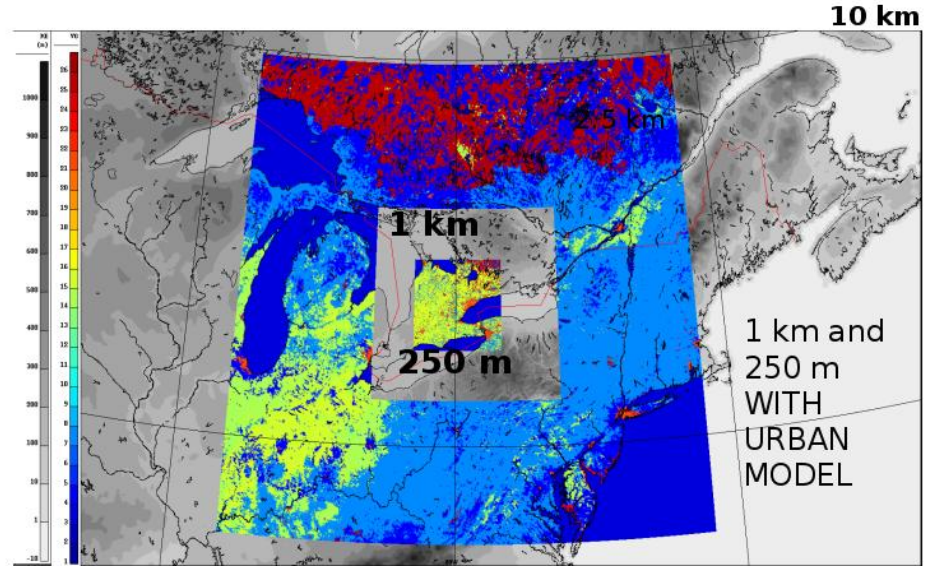
*Lake water temperatures from
NEMO*

One run per day, at 0600 UTC

Includes the TEB urban model and appropriate microphysics

Diagnostics for PBL height, comfort indices, extreme weather

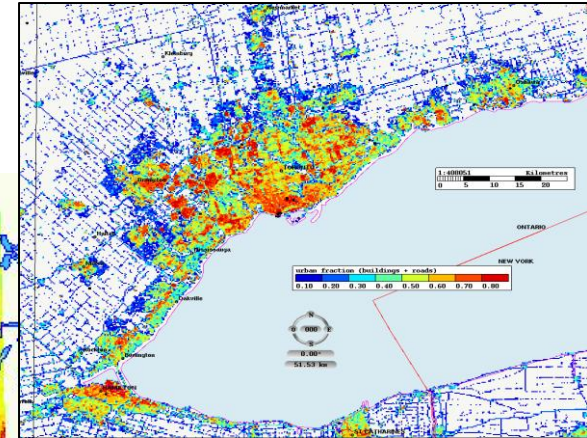
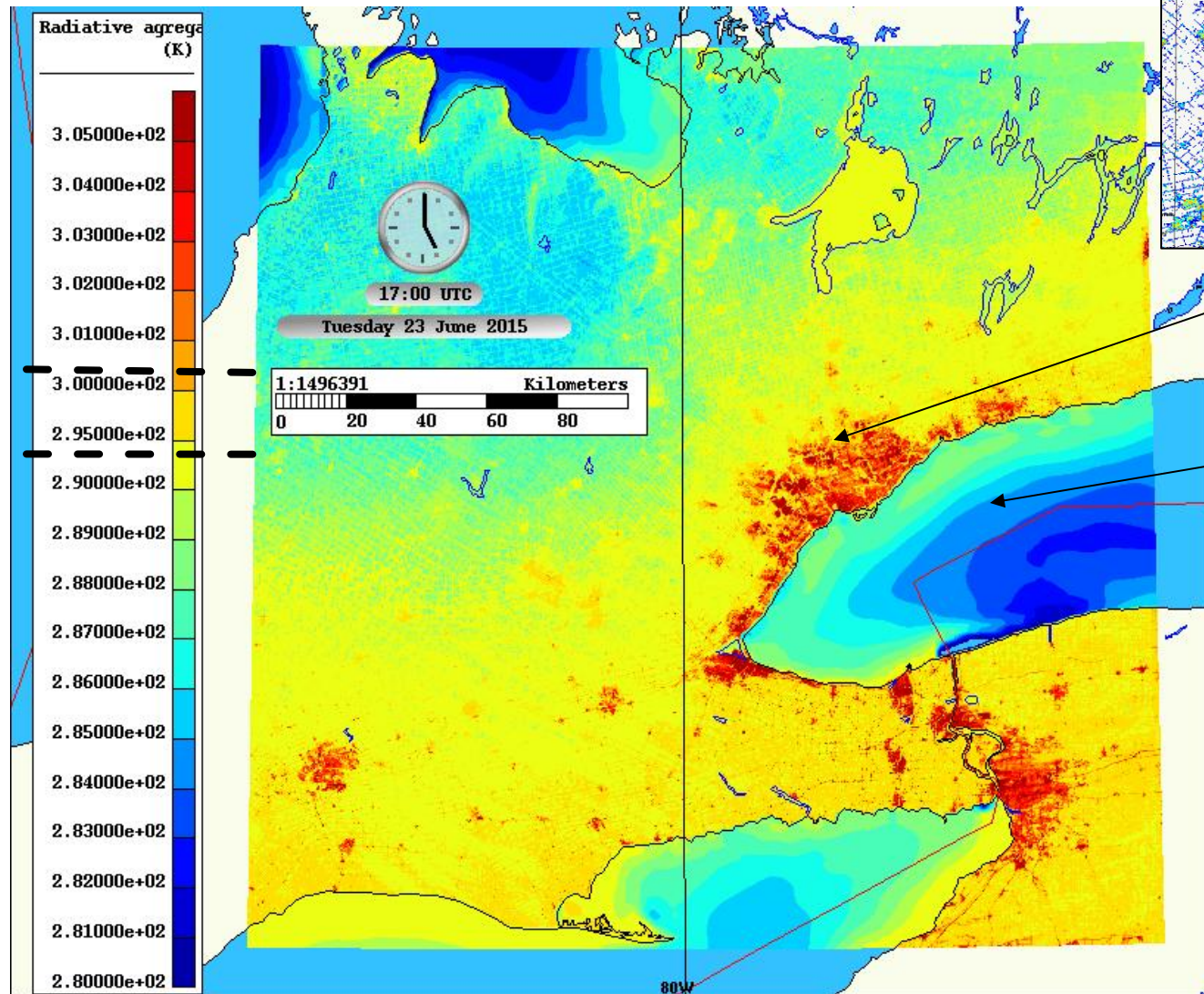
Available real-time through GRIB2 and web mapping service



Radiative Surface Temperature

250-m GRID SPACING, *Urban fraction (%)*

i Not linear



TEB

NEMO

Heat stress indices

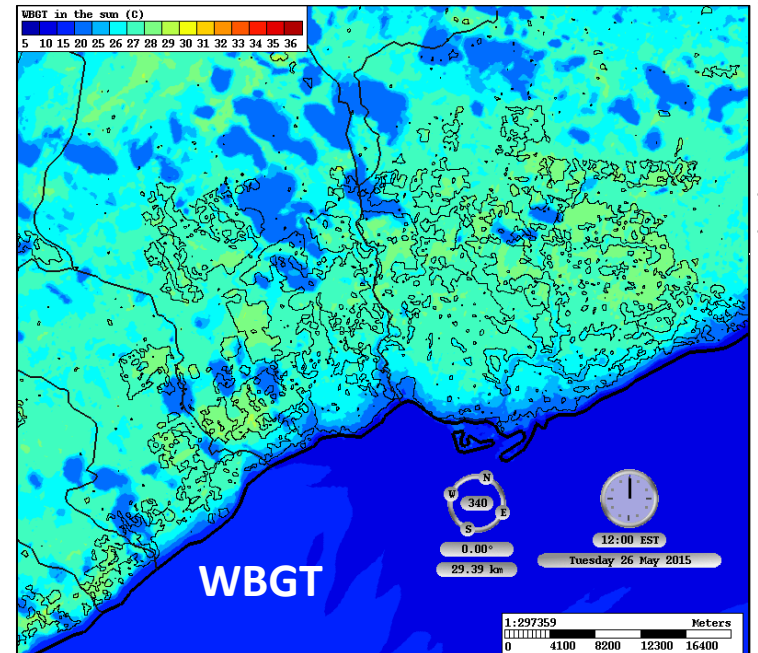
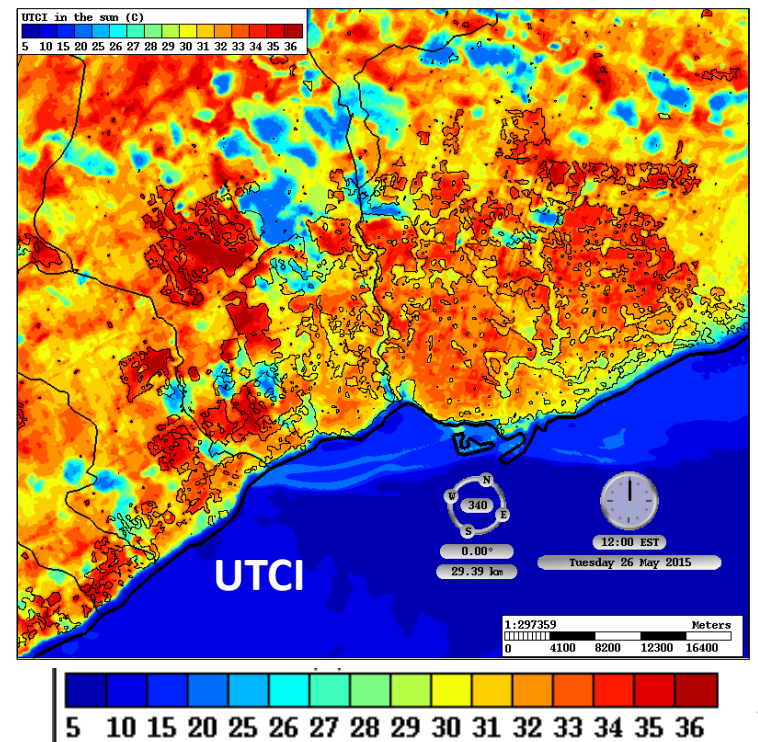
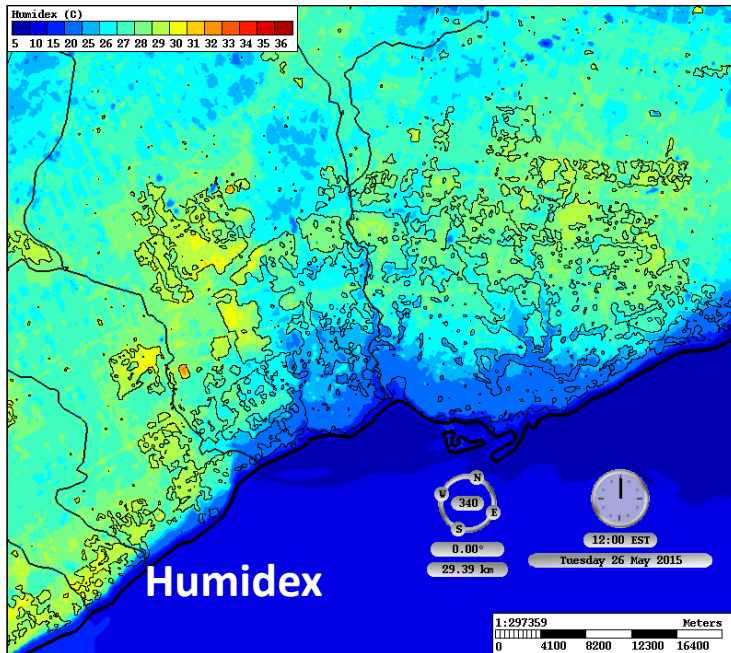
Humidex (equivalent dry air temperature)

UTCI (Universal Thermal and Climate Index)

WBGT (Wet-Bulb Globe Temperature)

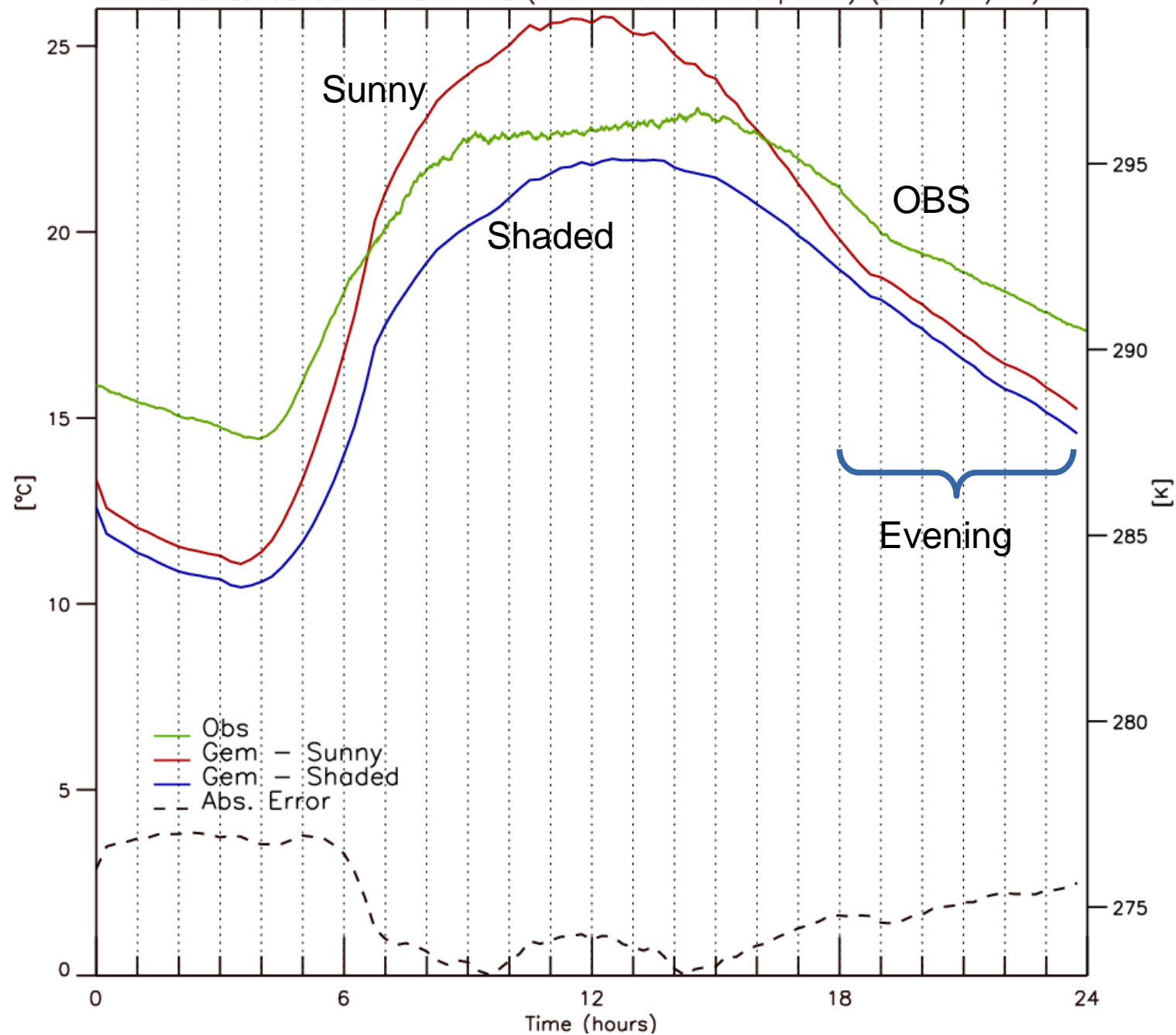


to evaluate UTCI and WBGT : PanAm
Obs. of the globe temperature



Black contour: 50 % urban

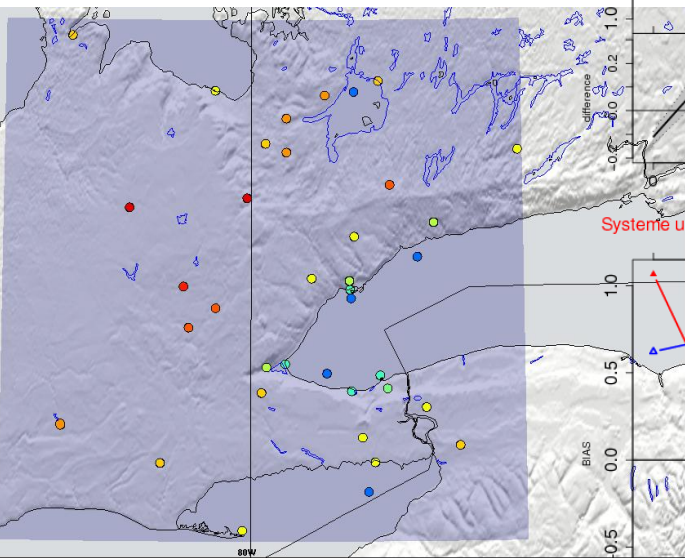
WET BULB GLOBE TEMPERATURE (Obs vs. all Stations points) (2015/07/11)



Objective evaluation

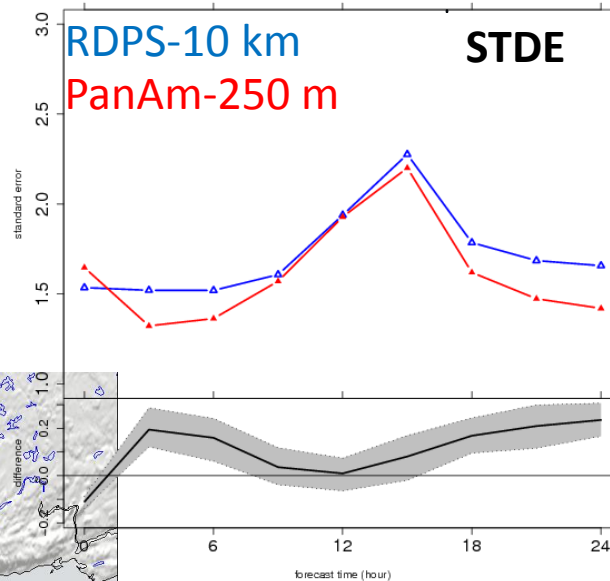
Summertime, period **from 2014-07-07 to 2014-08-31**

**Near-Surface
Wind Speed,
(m/s)**

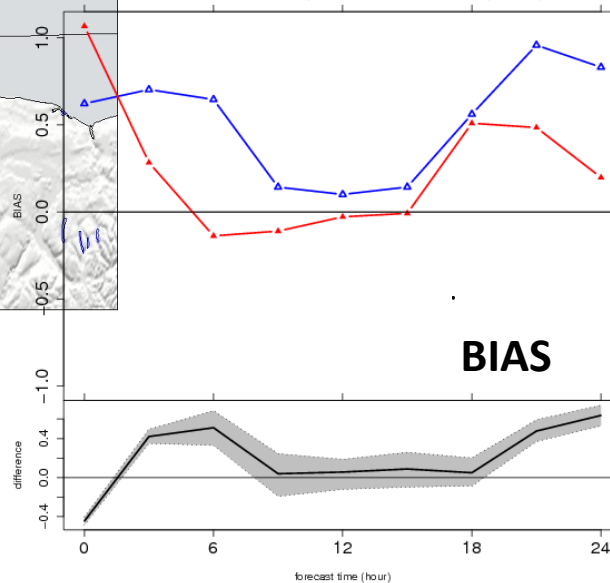


37 stations EC

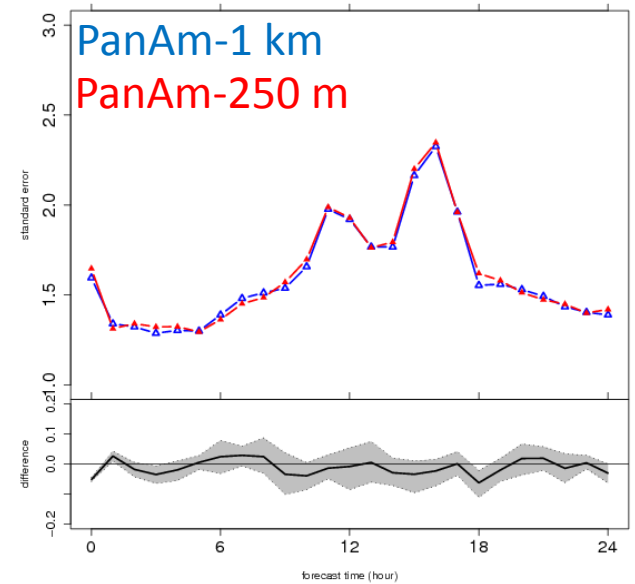
Système urbain a haute resolution de prevision deterministe (SHRPD) a 250 m
Système regional de prevision deterministe (SRPD)



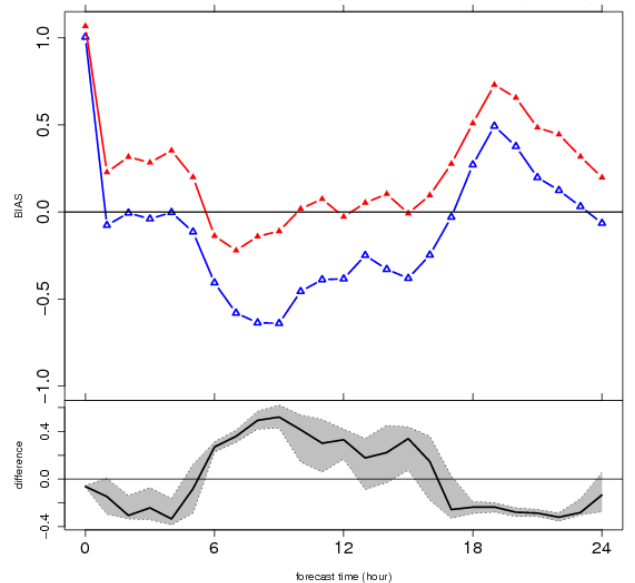
Système urbain a haute resolution de prevision deterministe (SHRPD) a 250 m
Système regional de prevision deterministe (SRPD)



Système urbain a haute resolution de prevision deterministe (SHRPD) a 250 m
Système urbain a haute resolution de prevision deterministe (SHRPD) a 1 km



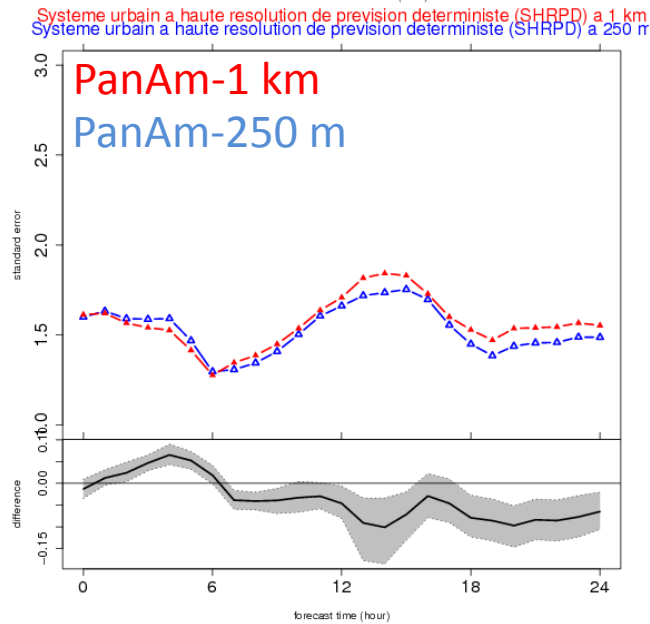
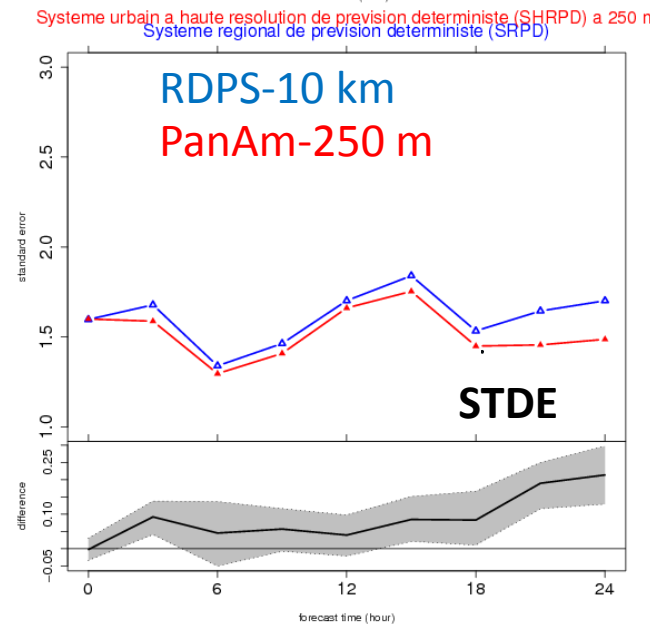
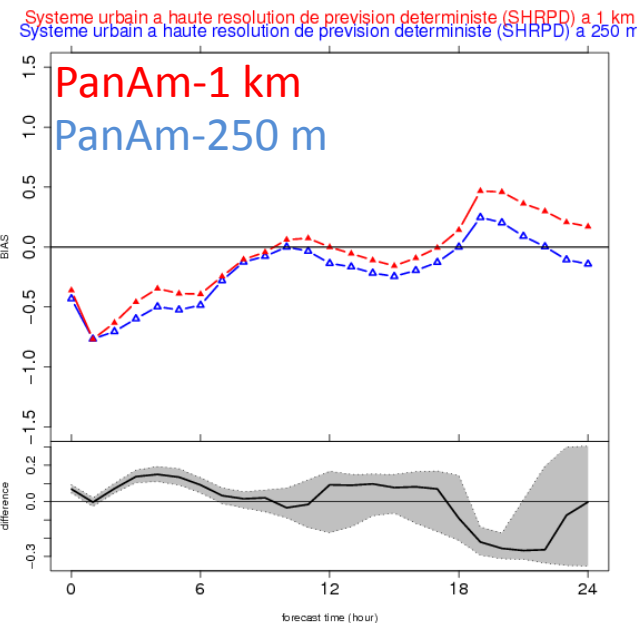
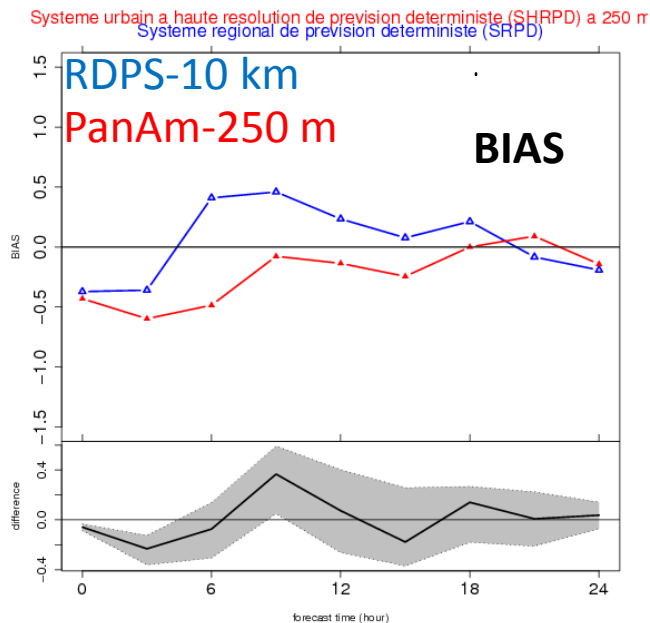
Système urbain a haute resolution de prevision deterministe (SHRPD) a 250 m
Système urbain a haute resolution de prevision deterministe (SHRPD) a 1 km



Objective evaluation

Summertime, period from 2014-07-07 to 2014-08-31

Near-Surface
Air Temperature,
(oC)



37 stations EC

Interacting land breezes

18 July 2014

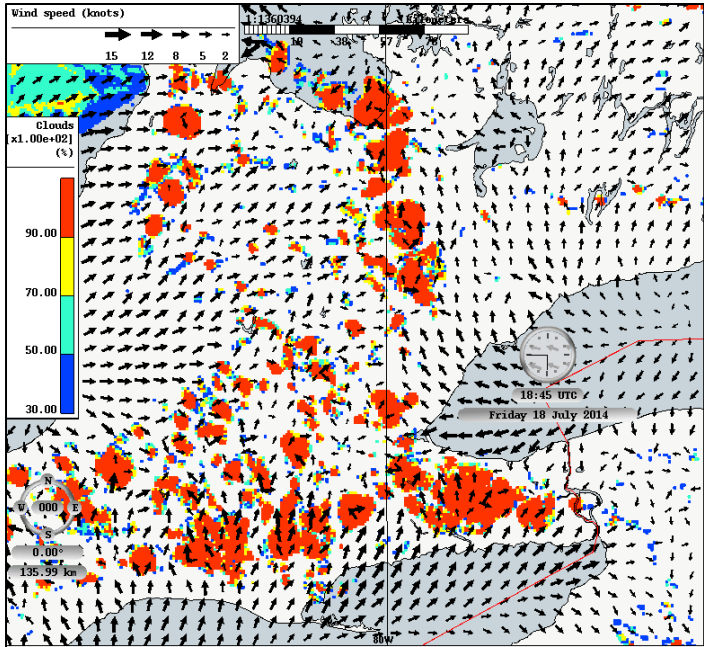
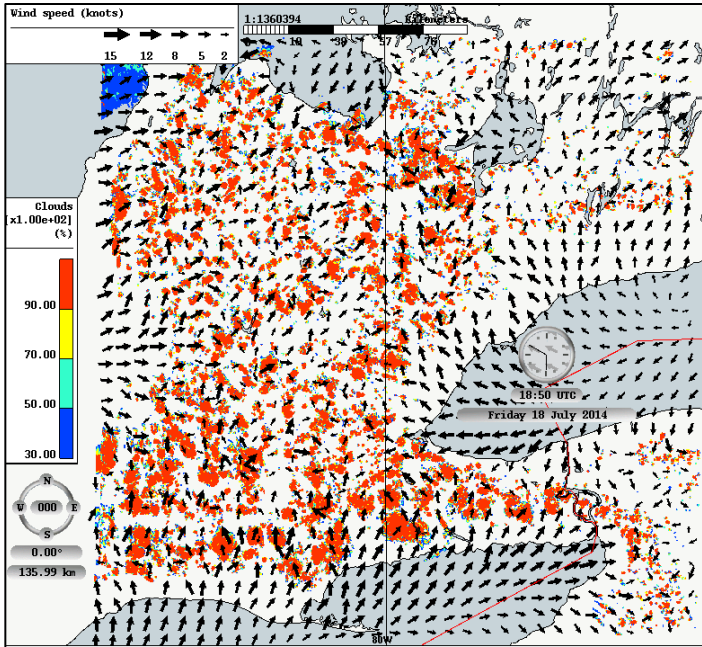


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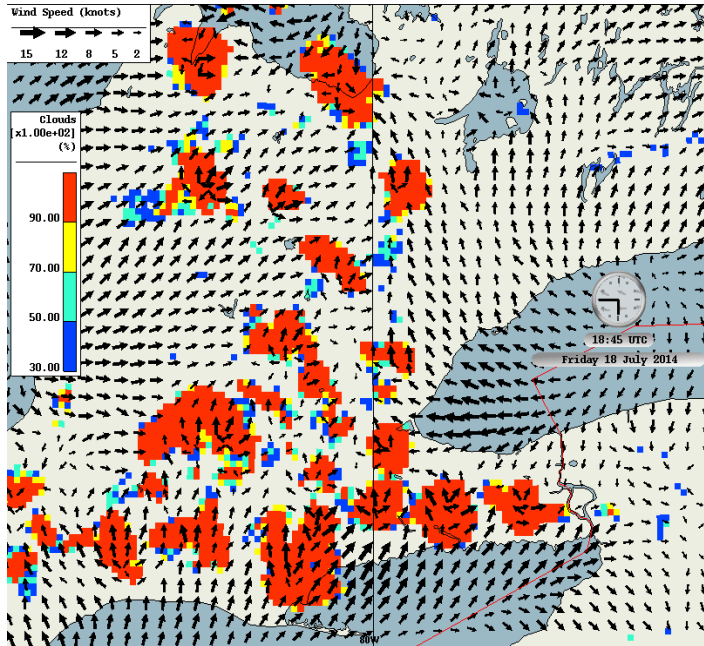
Cloud cover structure (18:50)

250 m



1 km

MODIS
Aqua
250 m



2.5 km

Last few words...

Will serve as the basis for upcoming experimental systems at Environment Canada (Vancouver, Toronto, Montreal, some airports)

Current and future tests over other cities / airports (international, e.g., Tokyo – TOMACS, presentation yesterday)

Pan Am will provide an interesting database for development and evaluation of sub-km urban NWP systems.