Système de Prévision Éolienne (SPÉO)

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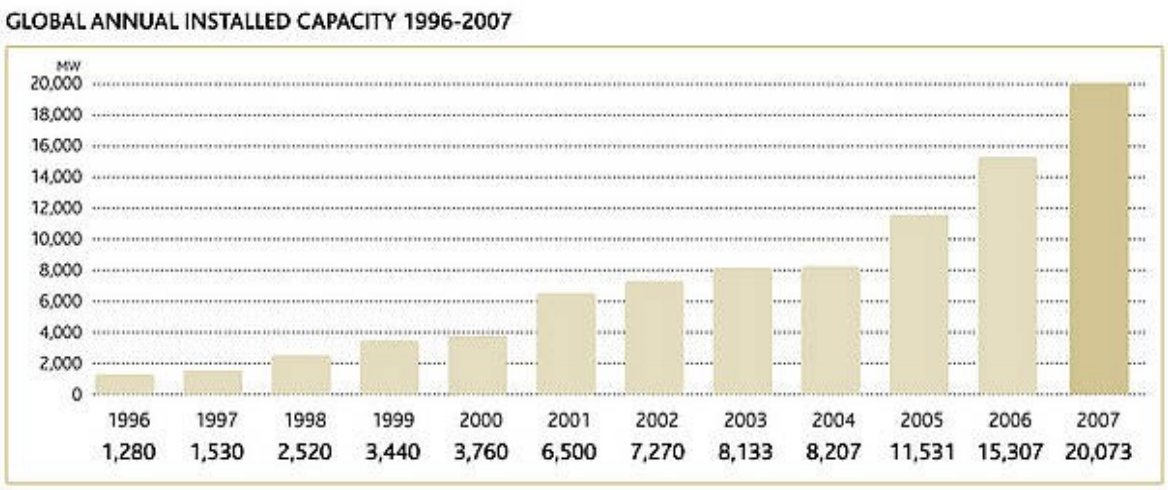
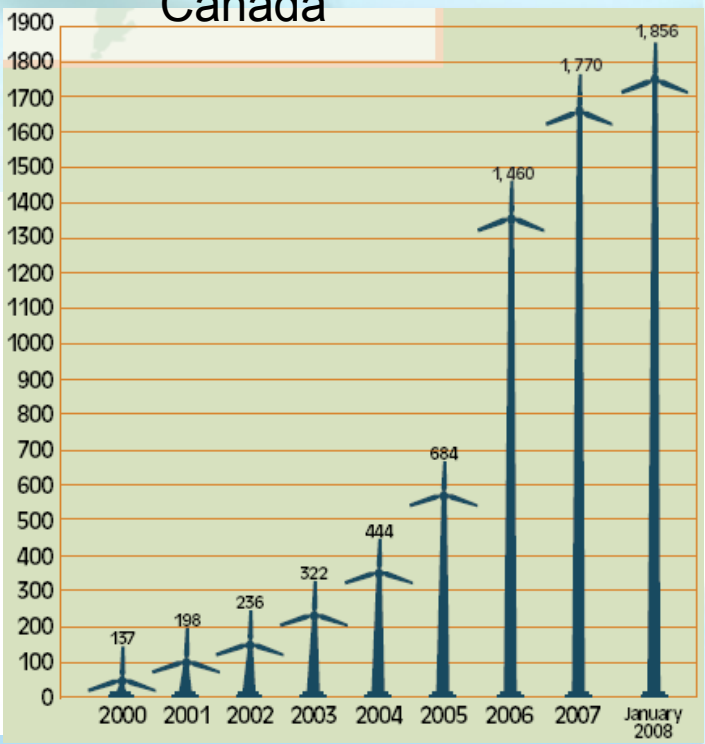
Outline

- Introduction
- Wind Energy Forecasting System (or Système de Prévision ÉOlienne: SPÉO)
- Calibration results with historical events
- Preliminary results from real-time test
- Summary and future plan

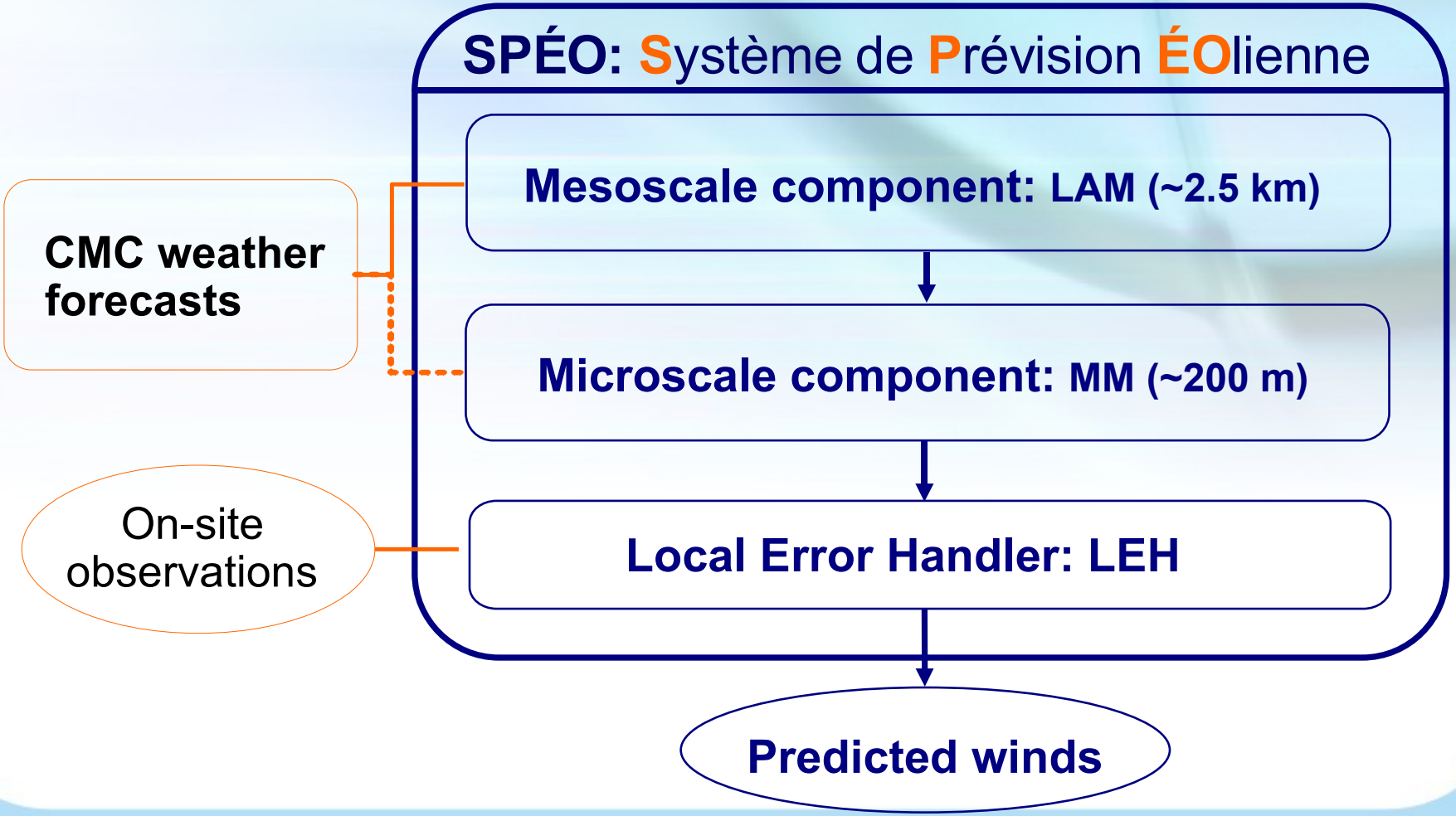
Introduction

- Wind energy industry: the fastest growing sector
- Need for wind forecasting for grid integration
- Explore the potential application of a NWP model for high resolution wind forecasting
- Collaboration between EC and Hydro-Quebec (HQ)
  - Oct 2006: EC-HQ signed a collaboration agreement
  - Oct 2006 – May 2007: Calibration of the system
  - May 2007 – Aug 2008: Real-time test of the system
  - Sep 2008: Evaluation and improvement



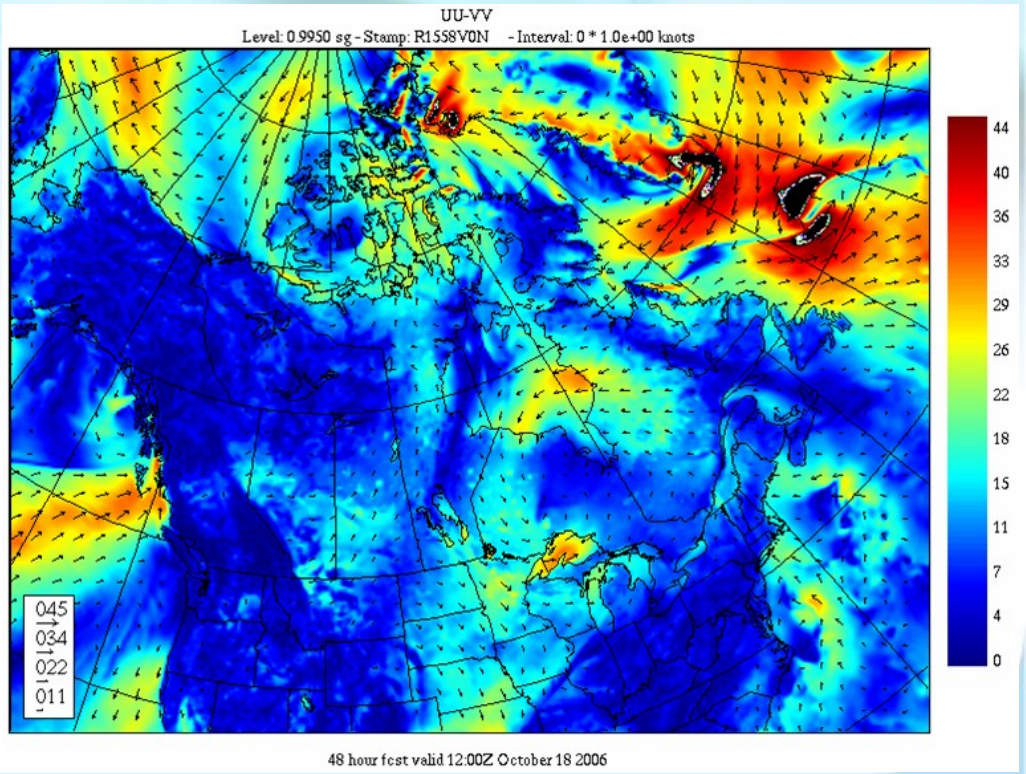


Wind Energy Forecasting System



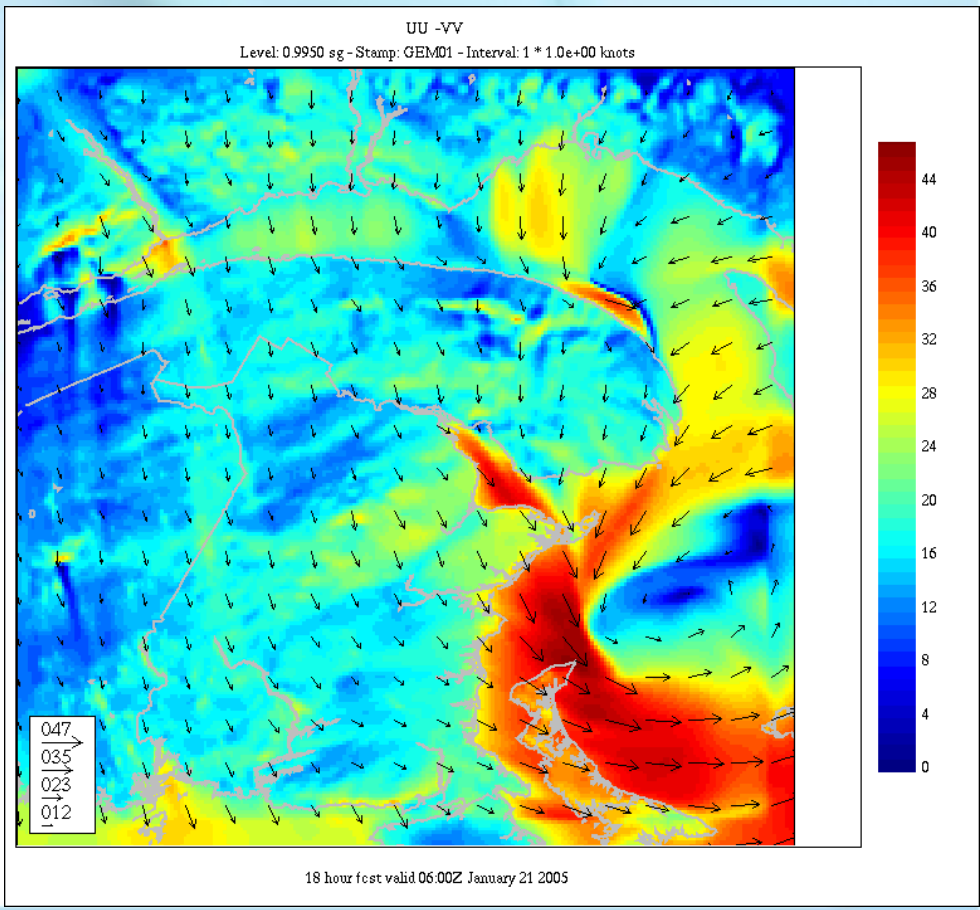
Input to the SPÉO

- GEM-regional (15 km resolution)
- Hourly forecast for the next 2 days
- Twice a day
- Four times a day soon



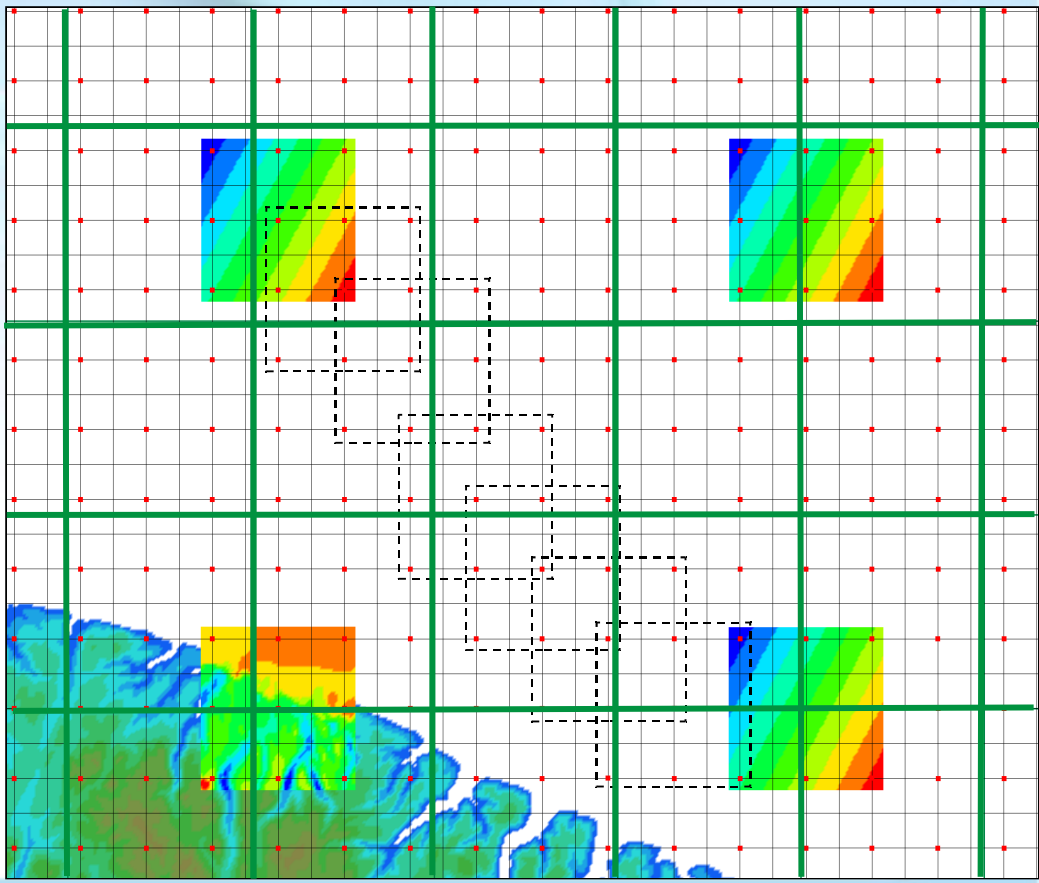
SPÉO: Mesoscale component (GEM-LAM)

- The same model as the operational one
- PC-cluster
- Horizontal resolution: 2.5 km
- Roughness length only depends on vegetation types (or local roughness)
- Vegetation cover based on SAFORAH
- Terrain elevation based on high resolution database (SRTM)



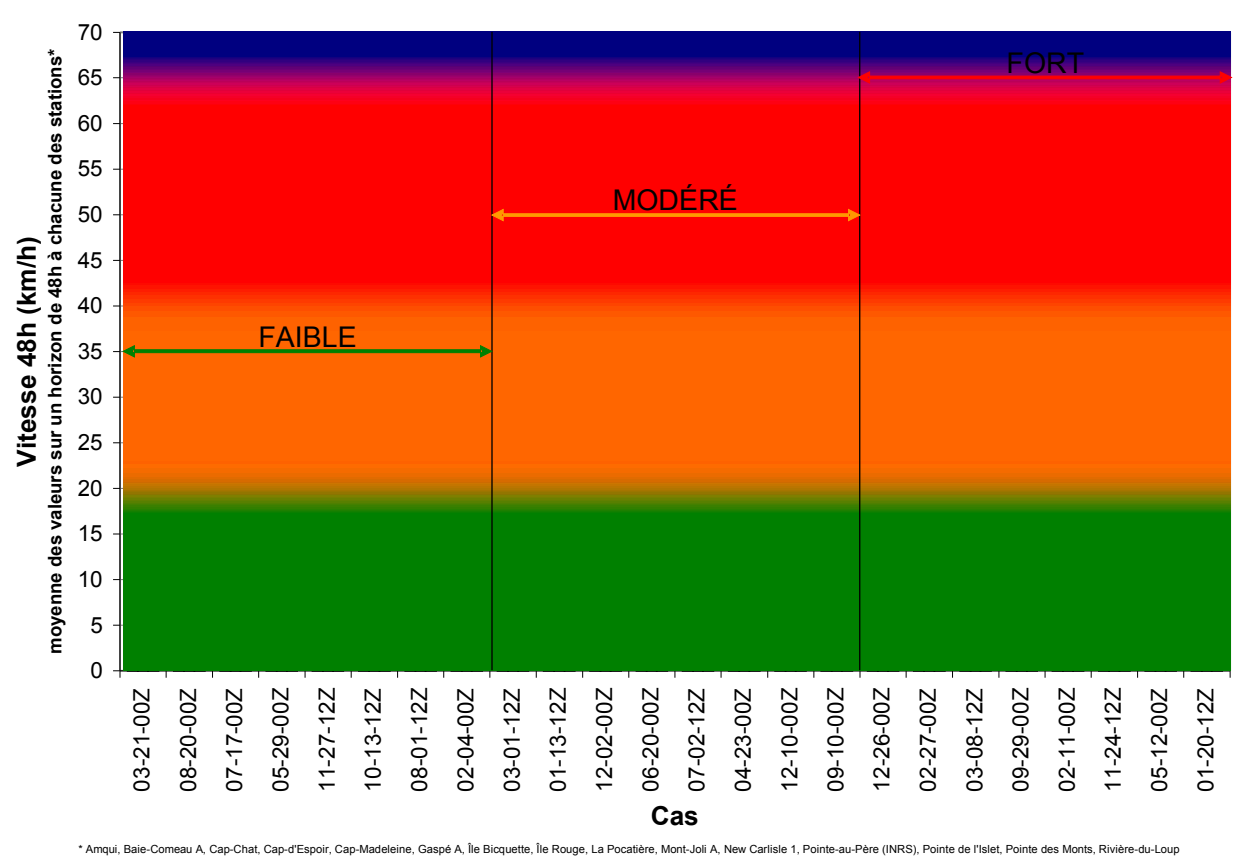
SPÉO: Microscale component (MsMicro)

- Model: MsMicro (Walmsley, Salmon and Taylor, 1982)
  - Linear model
  - Steady solution
- Spot approach
  - One microscale model domain for one site
- Mosaic approach
  - Overlapped tiles (60%)
  - 200m resolution
  - Red dots: center of tiles
- Merging the tiles
  - Thousands of tiles
  - Spatial weighting



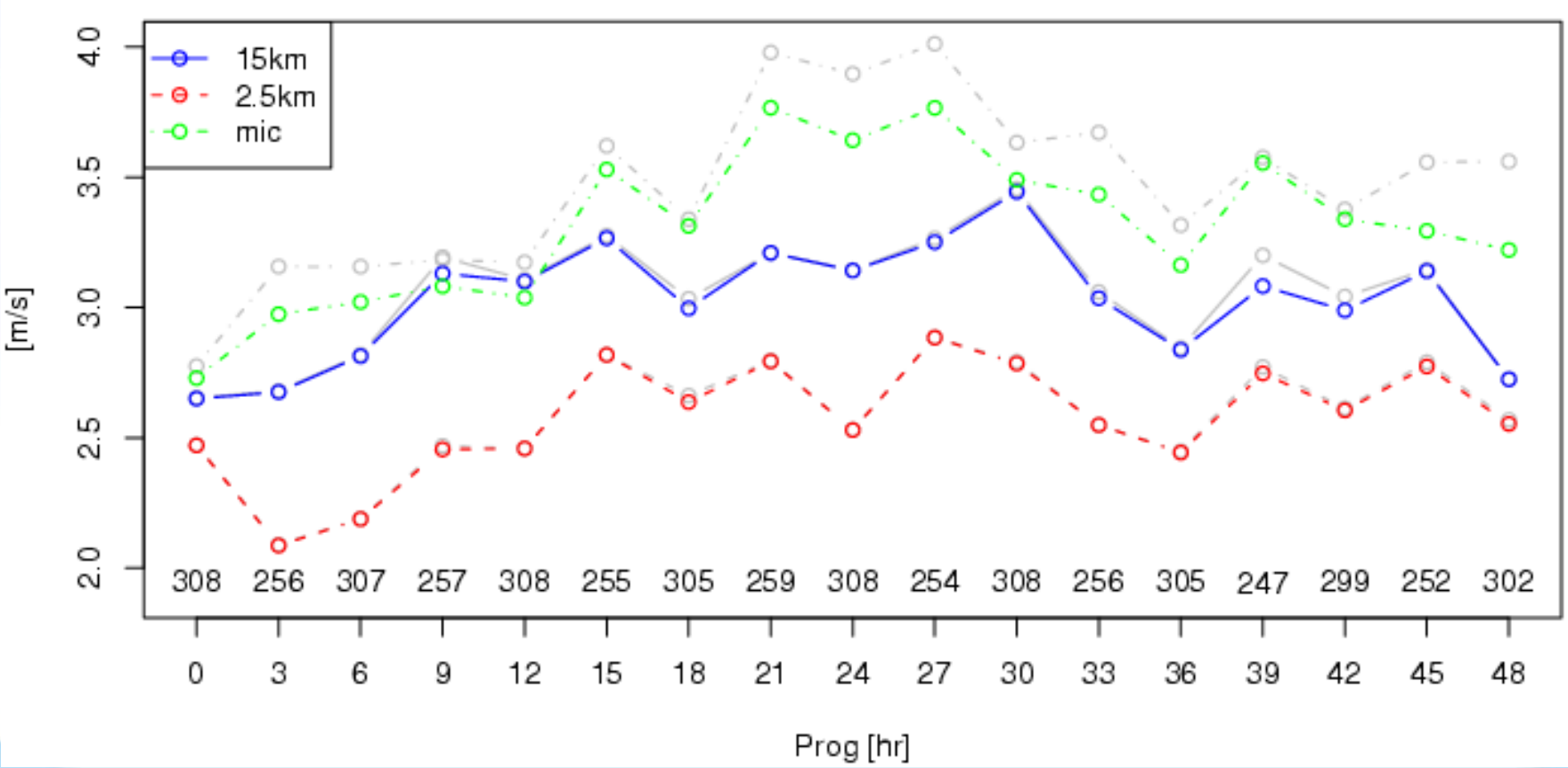
Calibration: 24 events in 2005

- 24 events of 48-hours sequence starting at 00 and 12 Z
- 3 wind speed classes: light, moderate, and strong winds



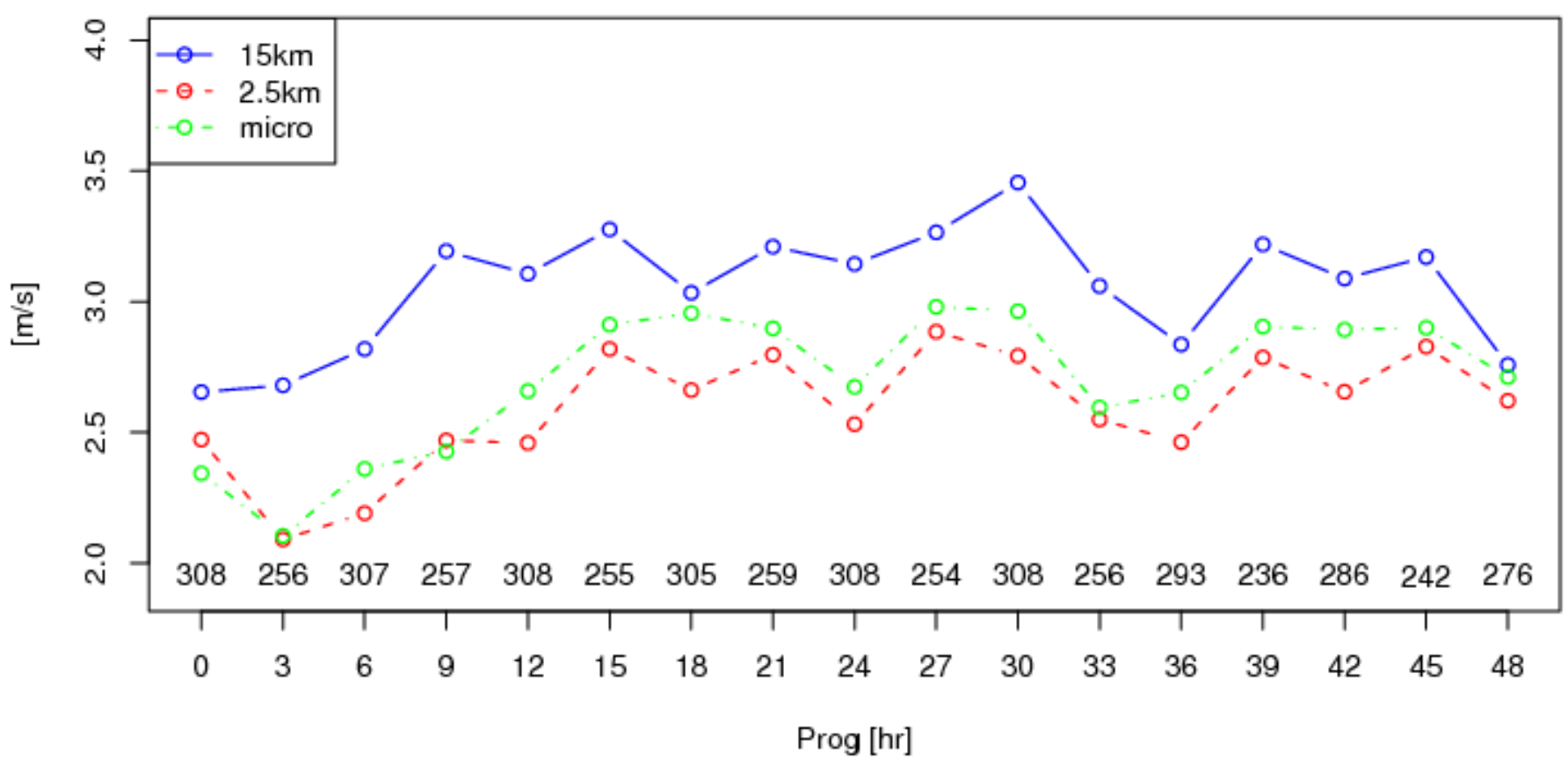
Calibration: Unbiased Root Mean Square Error

- Based on EC's meteorological station observations (10m AGL)



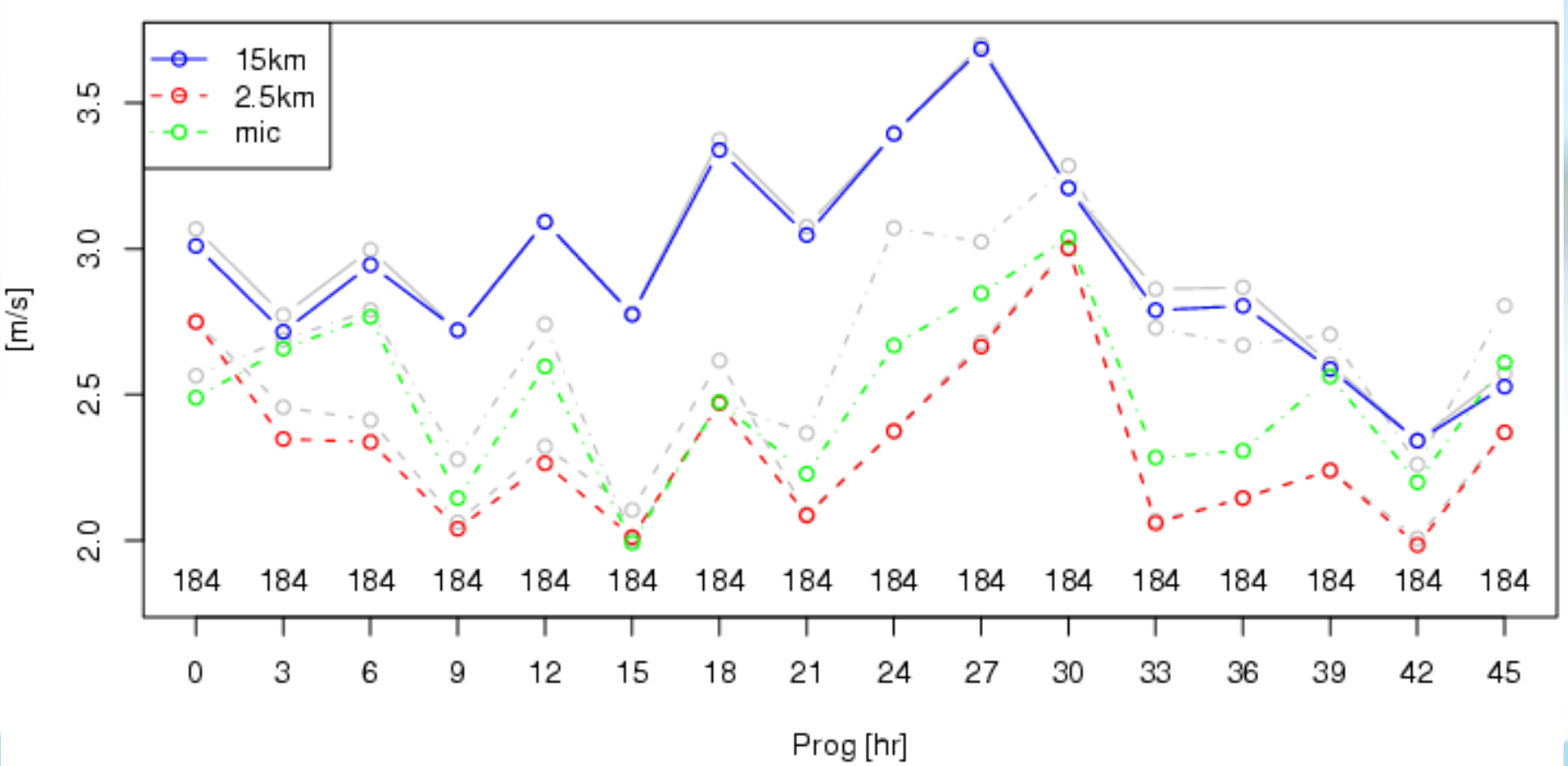
Calibration: Unbiased Root Mean Square Error

- Based on EC's meteorological station observations (10m AGL)
- With improved coupling strategy to MsMicro



Calibration: Unbiased Root Mean Square Error

- Based on wind power plants masts' observations (40m AGL)

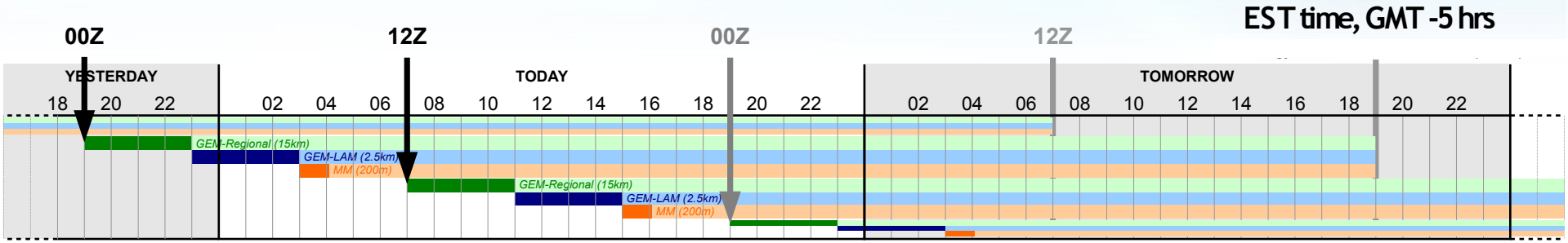


Real-time test: model chain and chronology

Two runs per day at 00 GMT and at 12 GMT

(Global Environmental Multiscale = GEM)

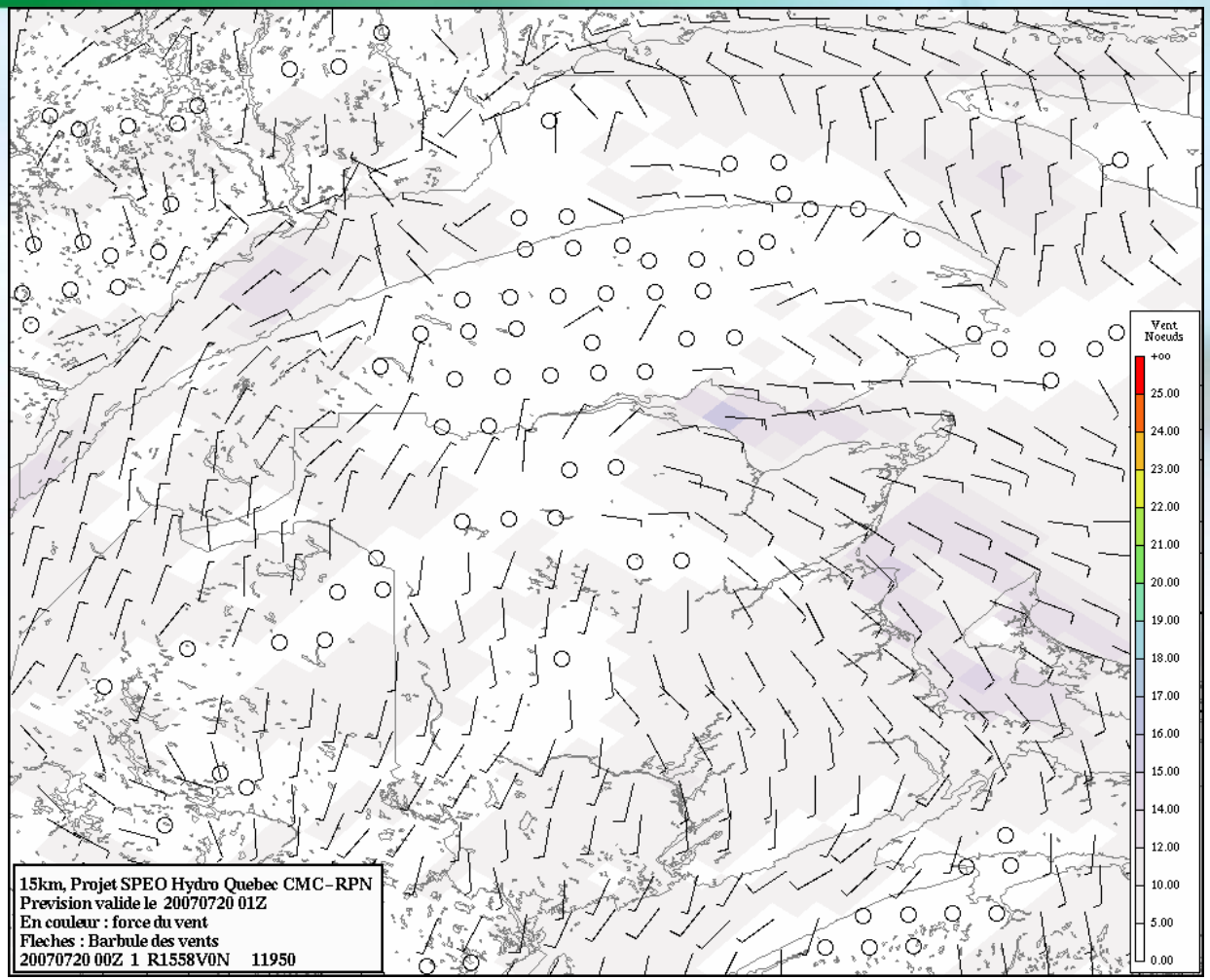
GEM-REG 15 km	
GEM-LAM 2.5 km	
MSMicro 200 m	



Real-time test: example of GEM-15km forecast

20 July
2007
00 GM T

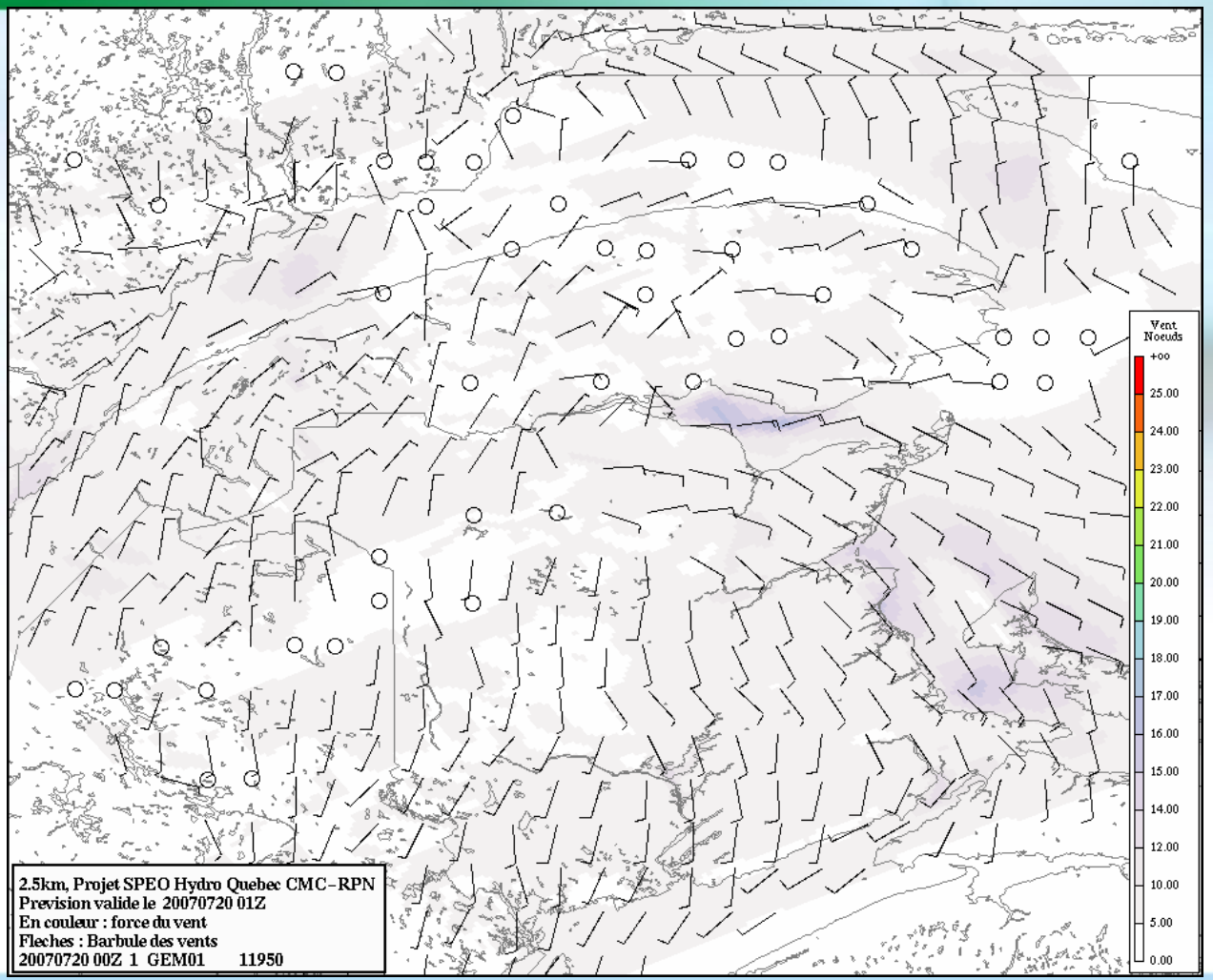
GEM 15 km
48-h animation
40 m AGL
Zoom over
SPÉO area



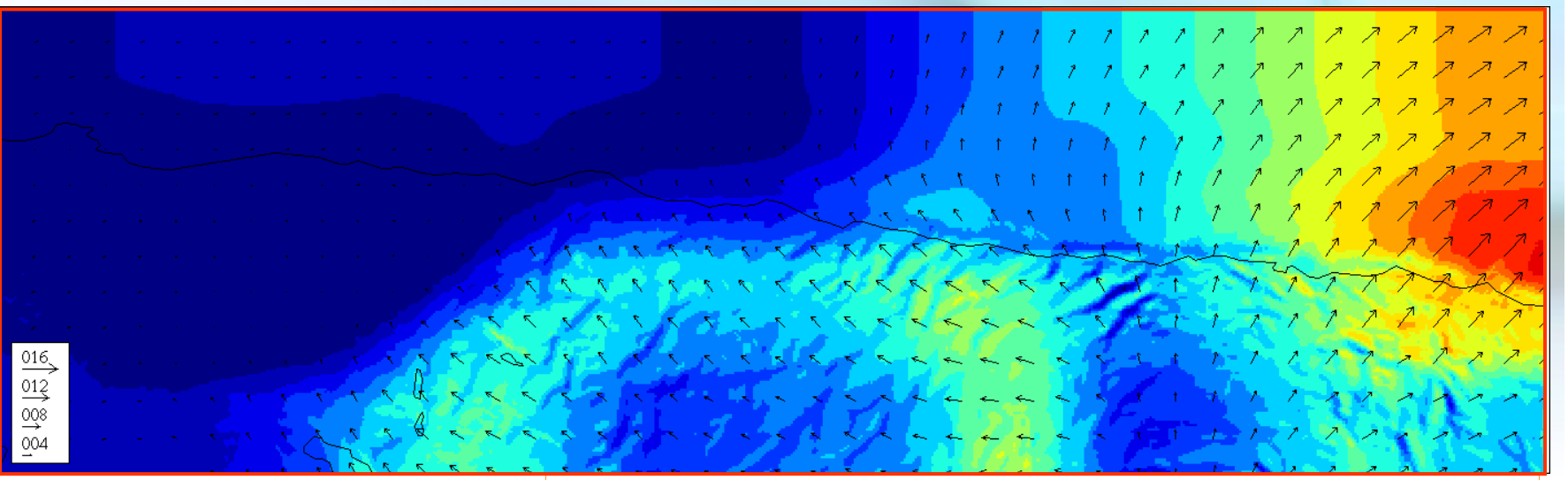
Real-time test: example of GEM-2.5km forecast

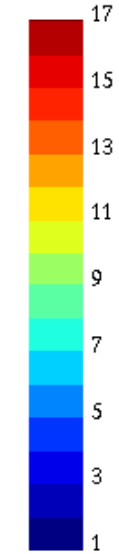
20 July
2007
00 GM T

GEM 2.5 km
48-h animation
40 m AGL
Full SPÉO area



Real-time test: example of MsMicro 200m forecast

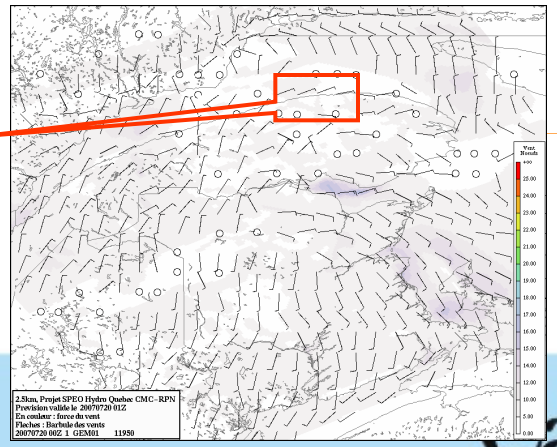




knots

20 July 2007 00 GMT

Baie-des-Sables



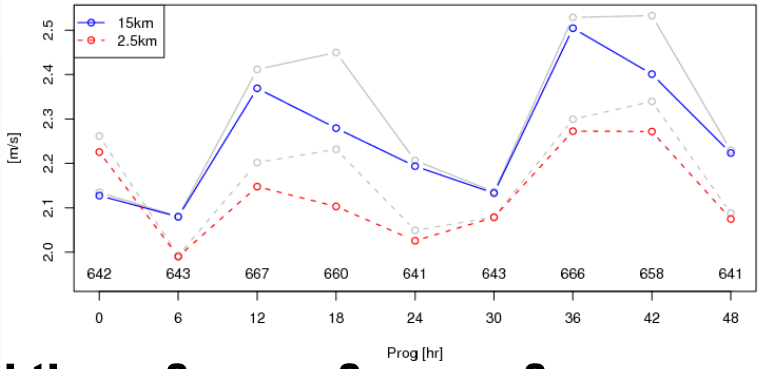
Microscale model
200 m grid
48-h animation
80 m AGL

Environment Canada Environnement Canada

Canada

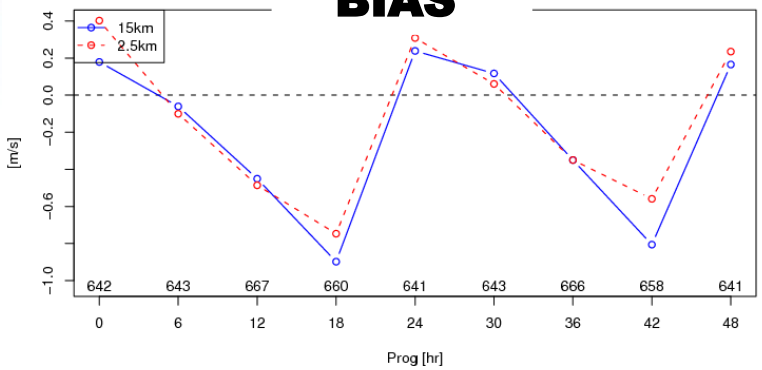
Validation with synoptic stations (April 10 - May 9)

URMS for 00Z forecasts



Local times: 2am 2pm 2am 2pm

BIAS



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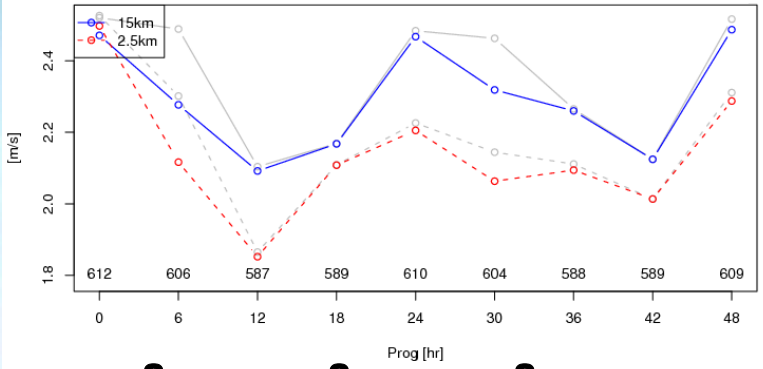
URMS for 12Z forecasts



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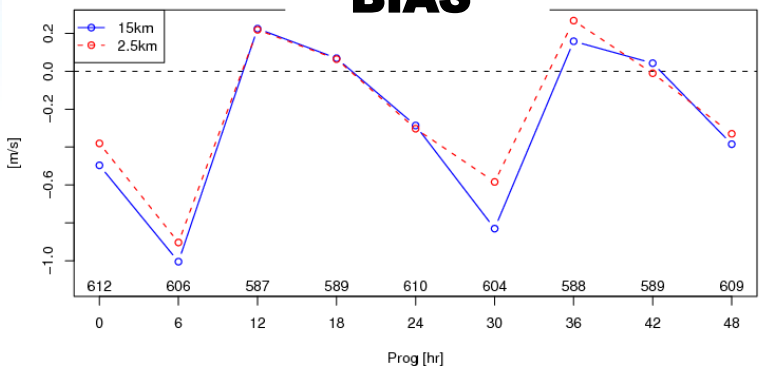

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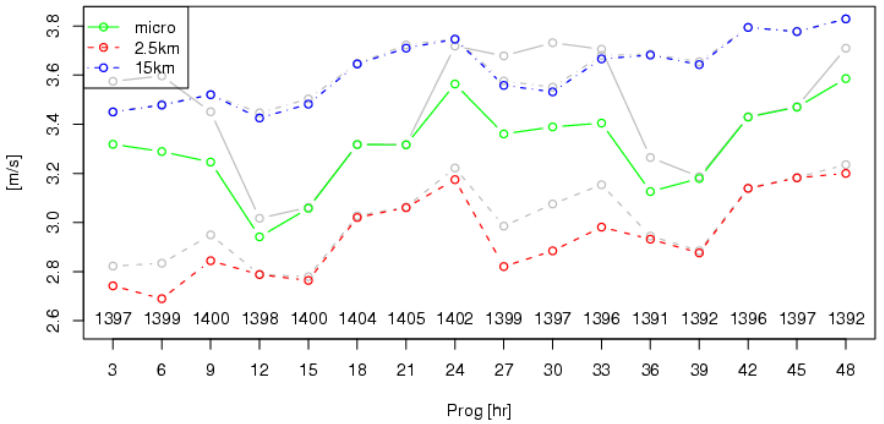
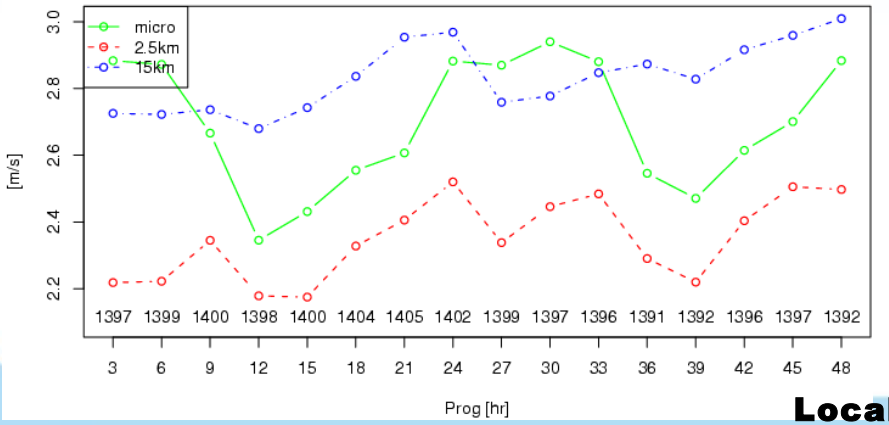
Validation for forecasts initiated at 00Z

Wind speed validation with available observations at wind plant **masts at 40m** above ground level (15 July 2007 – 31 January 2008)

URMS



Mean absolute error



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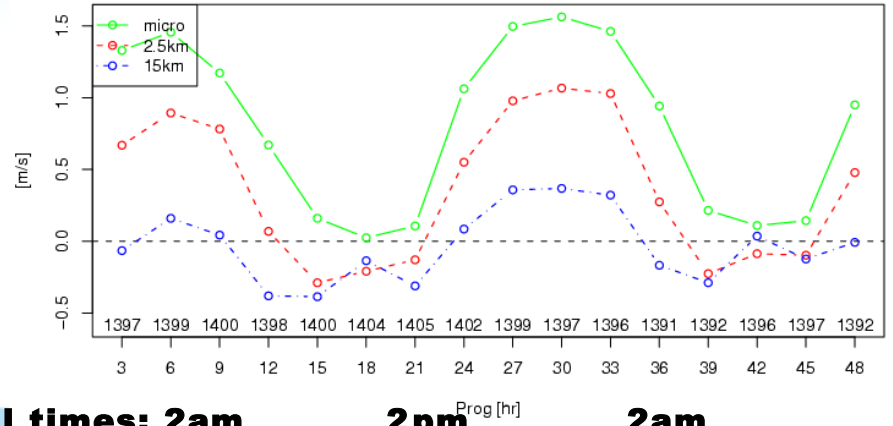
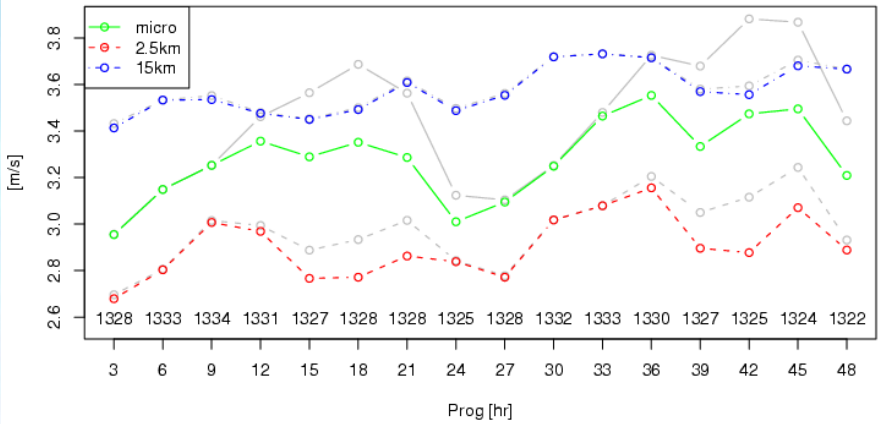


Local times: 2am 2pm 2am 2pm

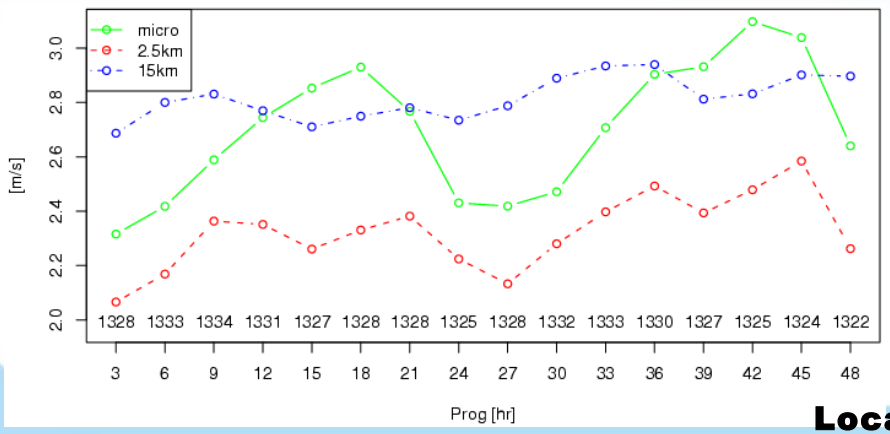
Validation for forecasts initiated at 12Z

Wind speed validation with available observations at wind plant **masts at 40 m** above ground level (15 July 2007 – 31 January 2008)

URMS



Mean absolute error



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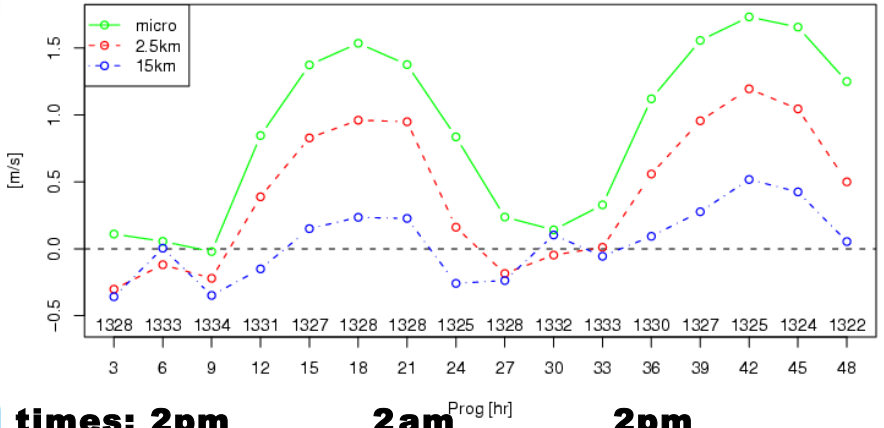


Local times: 2pm 2am 2pm 2am

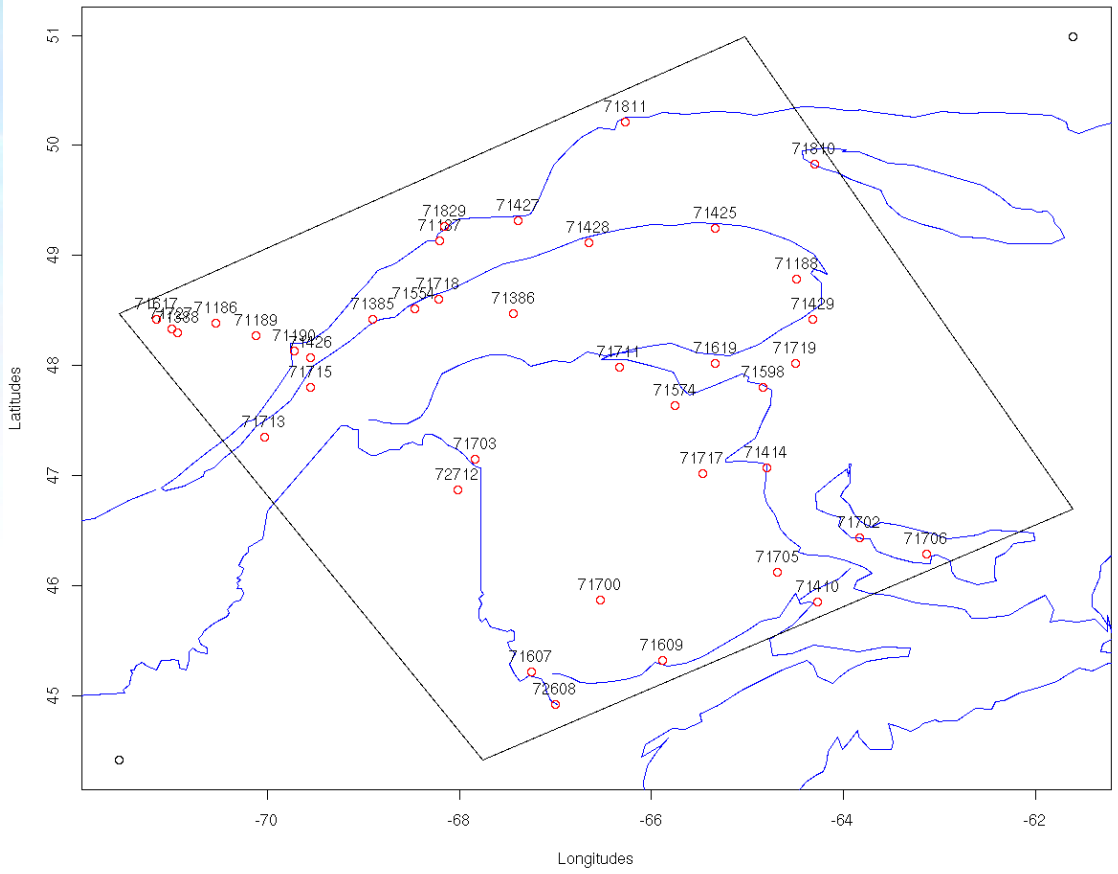
Summary and future plan

- Results from calibration and real-time test
  - GEMLAM performs better than GEM-regional
  - Diurnal cycle not well simulated
  - MsMicro needs a recalibration (work in progress)
- Future plan
  - Identify the source of error related to the diurnal cycle
  - Re-visit the statistic module for model error correction
  - Dynamical downscaling of winds for the surface model
  - Nowcasting of winds (increase the refresh rate)
  - Collaboration with WESNet (Wind Energy Strategic Network) on the development of a "transfer function" from wind speed to power production
  - Extend the collaboration with Hydro-Quebec to other electricity utilities (e.g. PEI, NB, ON, AB, MB, etc.) for field trials and demonstrations

Thank you!

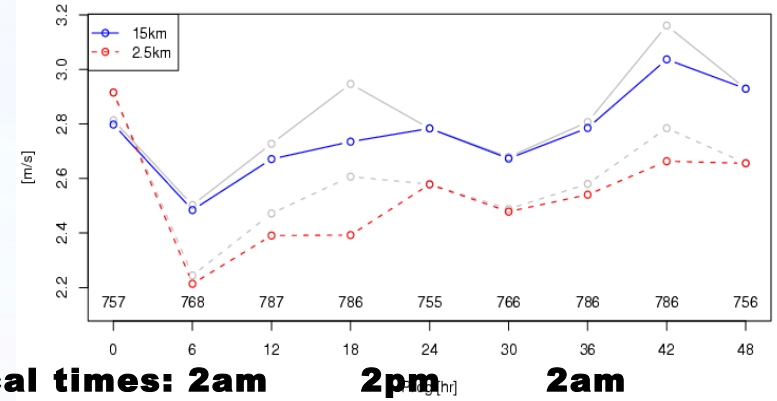
Validation with 39 synoptic stations

- "CAP ROUGE, QUE (AUT) " ["71186"]=
- ["71187"]= "BAIE COMEAU A QUE (AUT) "
- ["71188"]= "GASPE A QUE "
- ["71189"]= "POINTE CLAVEAU, QUE (AUT) "
- ["71190"]= "POINTE DE L'ISLET (AUT) QUE "
- ["71385"]= "ILE BIQUETTE, QUE (AUT) "
- ["71386"]= "AMQUI, QUE (AUT) "
- ["71388"]= "LA BAIE, QUE (AUT) "
- ["71410"]= "AMHERST (AUT) N.S. "
- ["71414"]= "POINT ESCUMINAC (AUT) NB "
- ["71425"]= "CAP MADELEINE QUE (AUT) "
- ["71426"]= "ILE ROUGE (AUT) QUE "
- ["71427"]= "POINT DES MONTS QUE (AUT) "
- ["71428"]= "CAP CHAT (AUT) QUE "
- ["71429"]= "CAP D'ESPOIR (AUT) QUE "
- ["71554"]= "POINTE-AU-PERE (INRS) QUE "
- ["71574"]= "BATHURST A, N.B. "
- ["71598"]= "BAS CARAQUET, NB (AUT) "
- ["71607"]= "ST.STEPHEN (AUT) N.B. "
- ["71609"]= "SAINT JOHN A N.B. "
- ["71617"]= "JONQUIERE, QUE (AUT) "
- ["71619"]= "NEW CARLISLE, QUE (AUT) "
- ["71700"]= "FREDERICTON A N.B. "
- ["71702"]= "SUMMERSIDE, PEI (AUT) "
- ["71703"]= "ST LEONARD, NB "



Validation with synoptic stations (march 10 - April 9)

URMS for 00Z forecasts



Local times: 2am 2pm 2am 2pm

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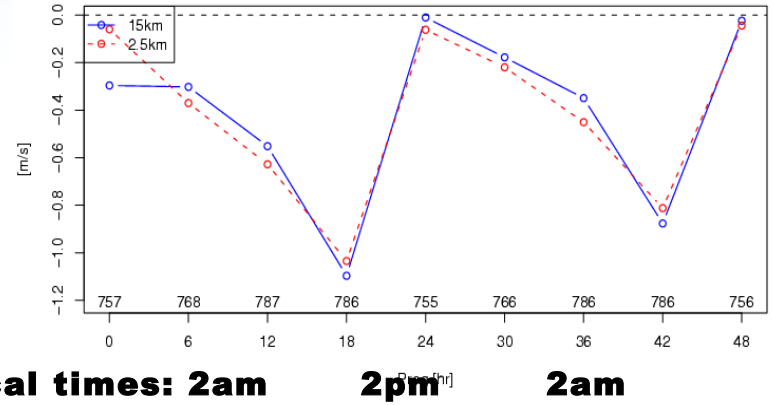

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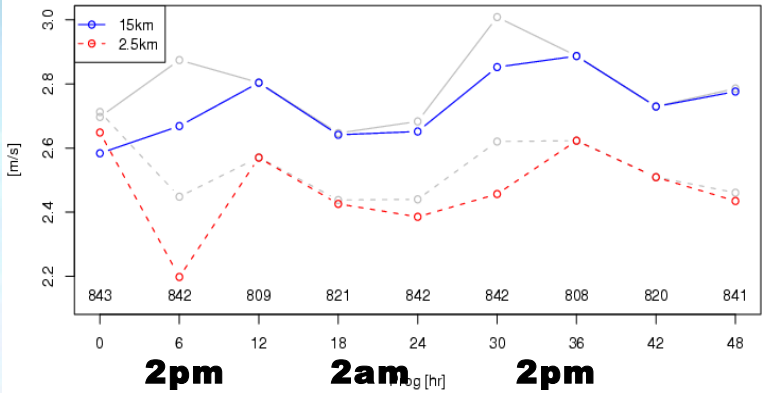
URMS for 12Z forecasts



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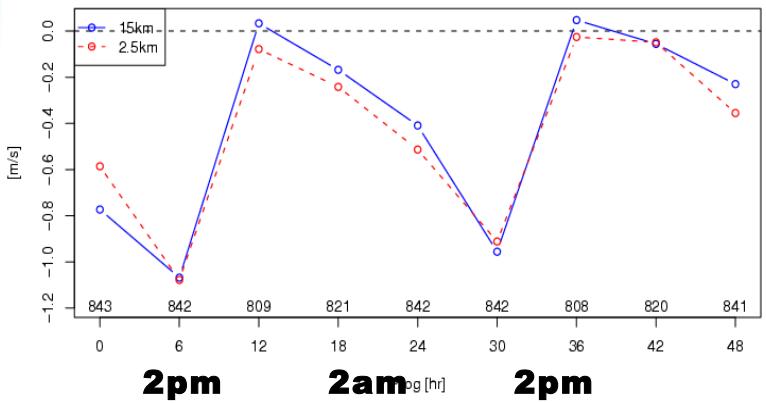

2pm 2am 2pm 2am

Validation with 14 masts in Gaspé peninsula

Observations at 40 m above ground level