Environnement Canada Environment Canada

Canada

Overview of Canadian Regional Ensemble System Development

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National Workshop on Mesoscale Probabilistic Prediction

Boulder, NCAR, 23 - 24 September 2009

Talk Outline

- Brief historical review
  - The different development stages since 2004
- Applications until now
  - Research tool during Olympic events (Beijing 2008, Vancouver 2010)
  - Tests in winter and summer 2009
- Some objective verifications and comparisons
  - Surface fields
  - Precipitation

Development stages since 2004

- Summer 2004: Start work on downscaling of the operational global EPS (150 km resolution)
  - GEM-LAM at 15 km on North East of North America
  - Serious problems related to the global EPS initialization method
  - The approach is temporarily abandoned
- 2004-2006: Targeted singular vector approach and physical stochastic perturbations with Markov chains
  - Li, X., M. Charron, L. Spacek, and G. Candille (2008): A regional ensemble prediction system based on moist targeted singular vectors and stochastic parameter perturbations, *Mon. Wea. Rev.*, **136**, 443-462.
- 2006-2009: Following improvements to the global EPS, the downscaling (of the global EPS) approach is re-tested (paper to be submitted soon)

Applications until now

- Tests over China for the Beijing 2008 Olympics in summer 2006, 2007, and 2008. System at 15 km resolution for 36h forecasts. Comparison with 5 other systems (2xChina, USA, Japon, France-Austria).
- January and July 2006 over North America. System at 33 km for 48h forecasts.
- February 2008 and winter 2009 over North America. System at 33 km for 48h forecasts. Run for Vancouver 2010 pre-tests.
- Summer 2009

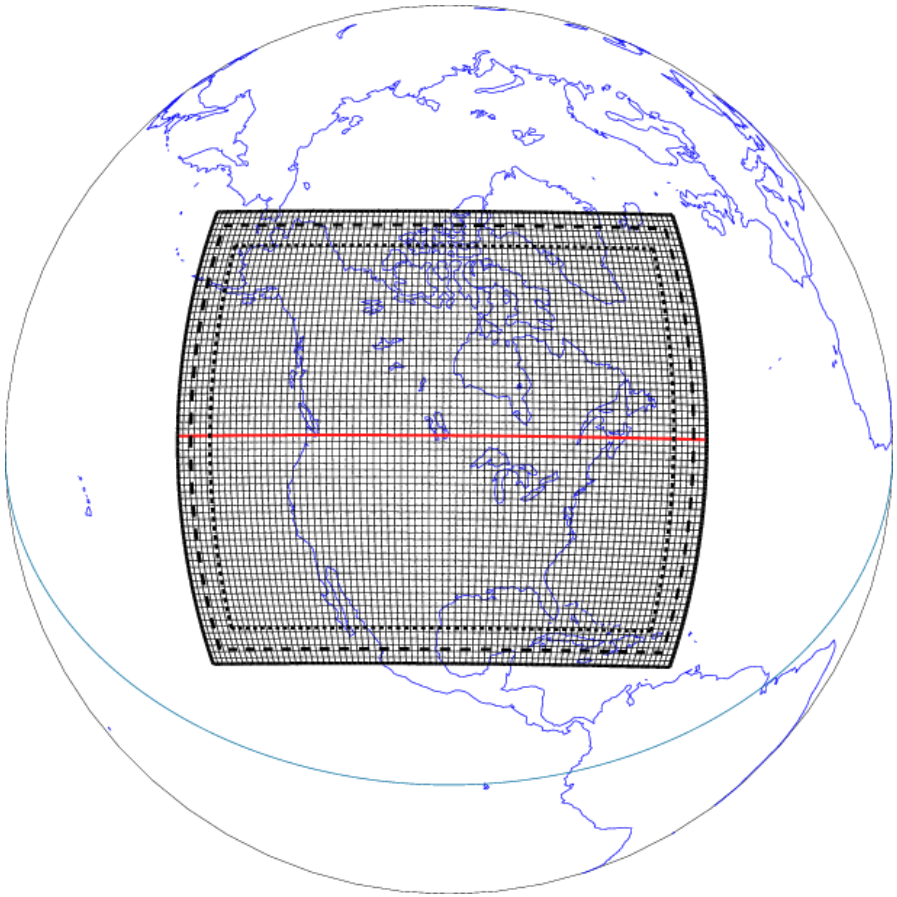
Downscaling the Canadian global EPS

- The pilot integrations:
  - Initial conditions for the operational Canadian Global EPS are provided by an Ensemble Kalman filter with 96 members
  - 20 members are used for medium-range weather forecasts
  - Multi-parameter, multi-parameterization approach with a single dynamical core (the GEM model)
  - Stochastic physics: physical tendency perturbations (à la ECMWF) and kinetic energy backscatter scheme (à la Shutts, 2005)
- The LAM integrations:
  - 20 GEM-LAM integrations at 33 km resolution
  - Stochastic perturbations of physical tendencies and surface parameters
  - Boundary condition updating frequency: once per three hours
  - Same sub-grid scale parameterizations and resolution as deterministic global model

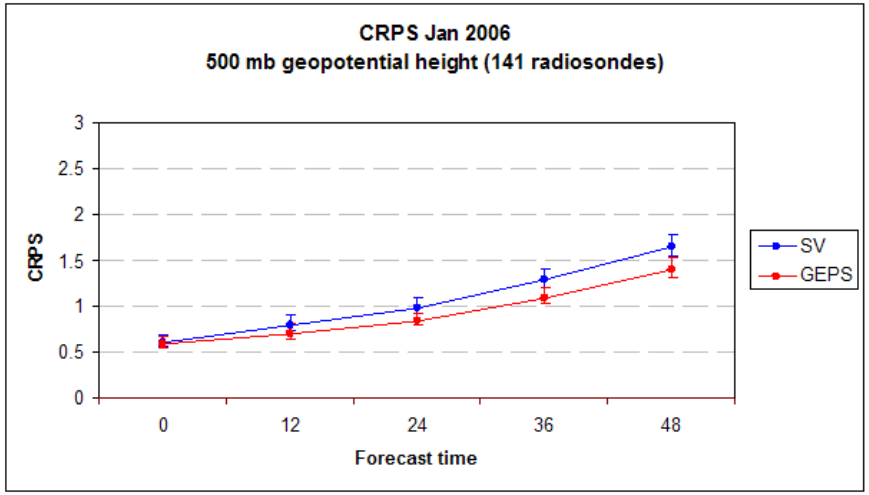
Main differences with global EPS physics

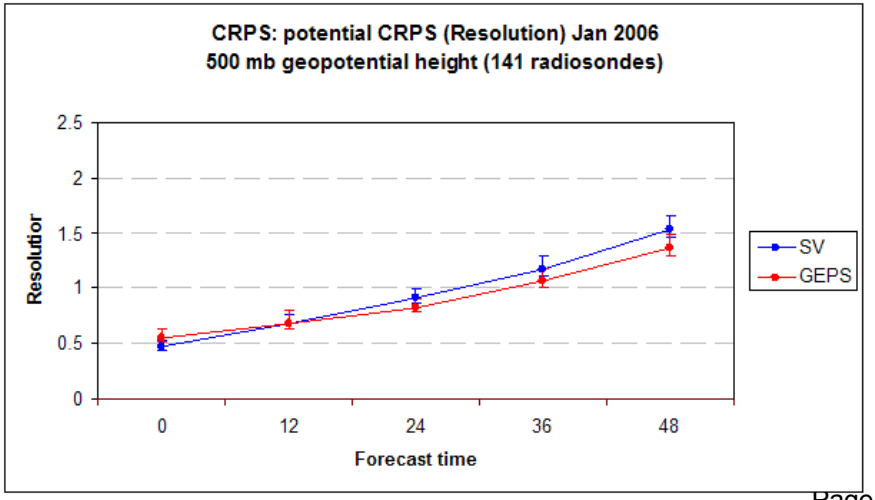
- Global EPS: Two surface scheme (Force-restore and ISBA)
- Regional EPS: Only ISBA
- Global EPS: Four deep convection schemes (Kain-Fritsch, Relaxed Arakawa-Schubert, 2 flavors of Kuo)
- Regional EPS: Only Kain-Fritsch
- Global EPS: Different parameter values for GWD and ABL schemes
- Regional EPS: All members have same parameter values
- Global EPS: Use SKEB
- Regional EPS: no SKEB
- Global EPS: Fouquart/Bonnel+Garand radiation scheme
- Regional EPS: Li and Barker (correlated-k)

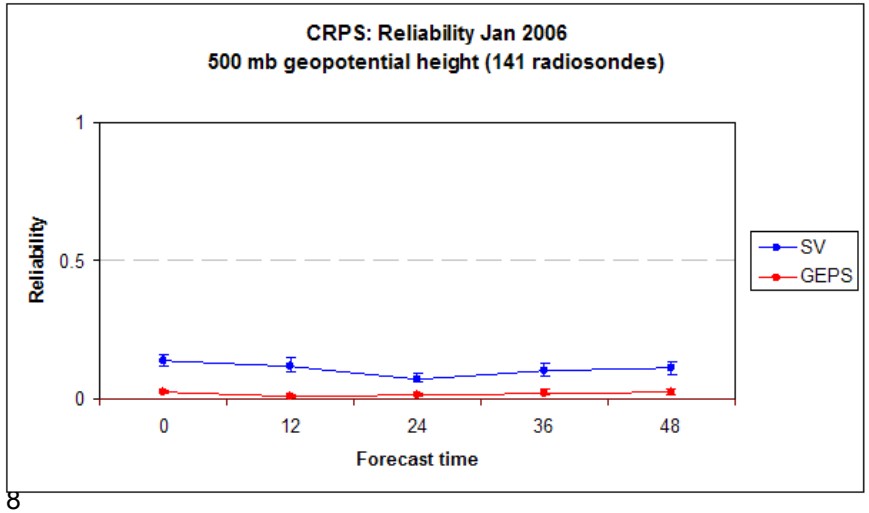
Domain of the REPS



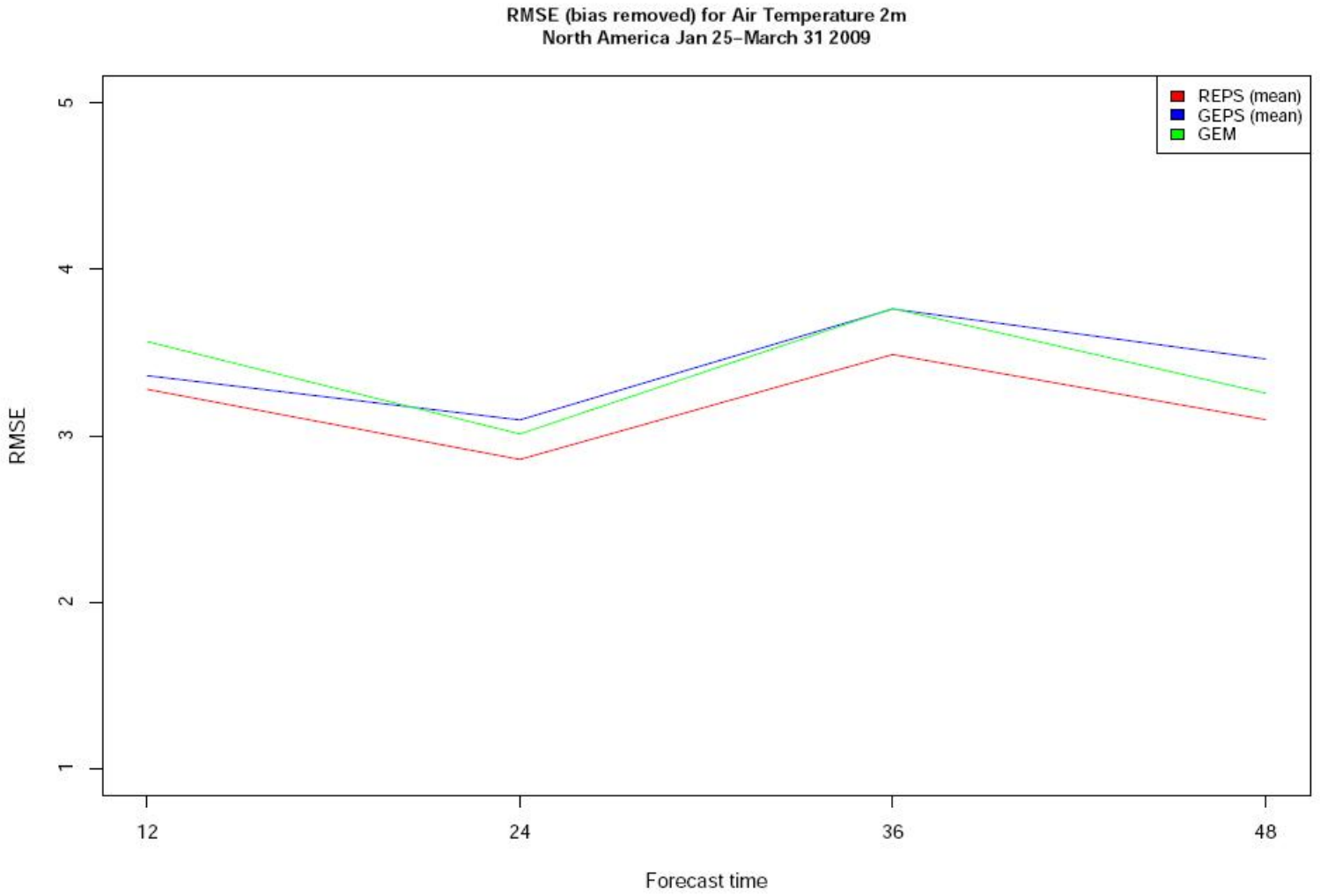
SV versus downscaling approach (GZ500)



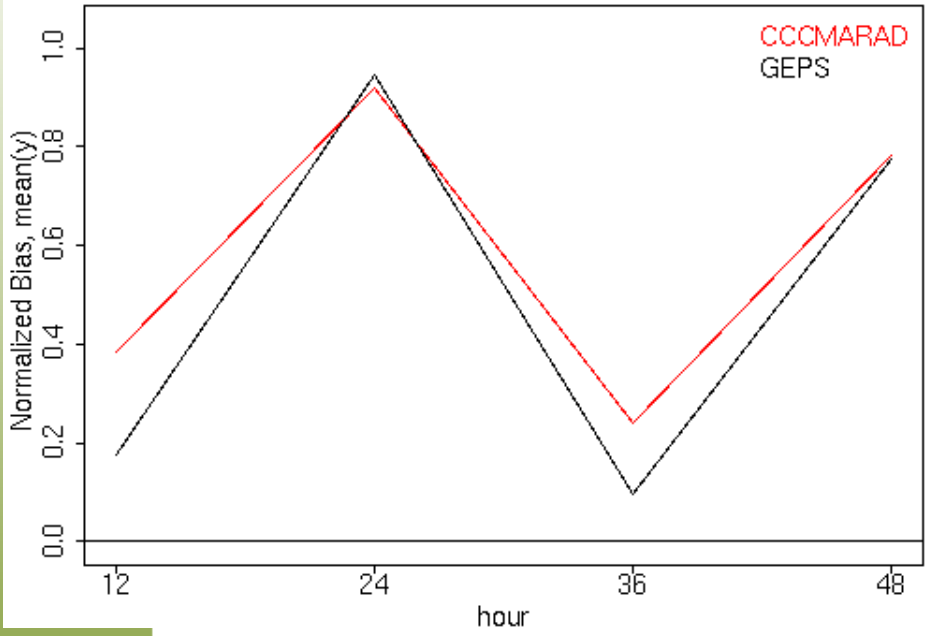


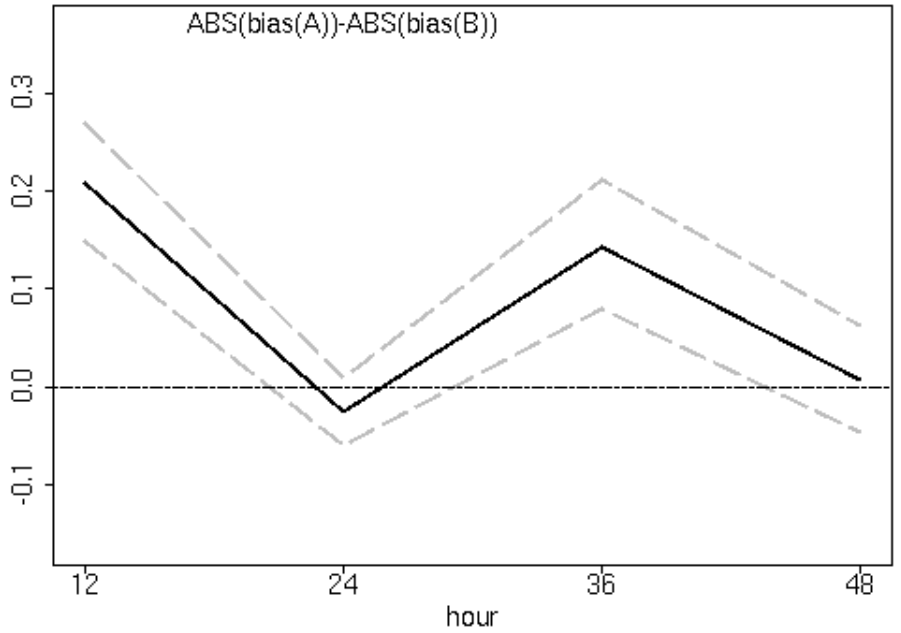


Regional EPS versus Global EPS
RMSED, Temperature at 2m, winter 2009

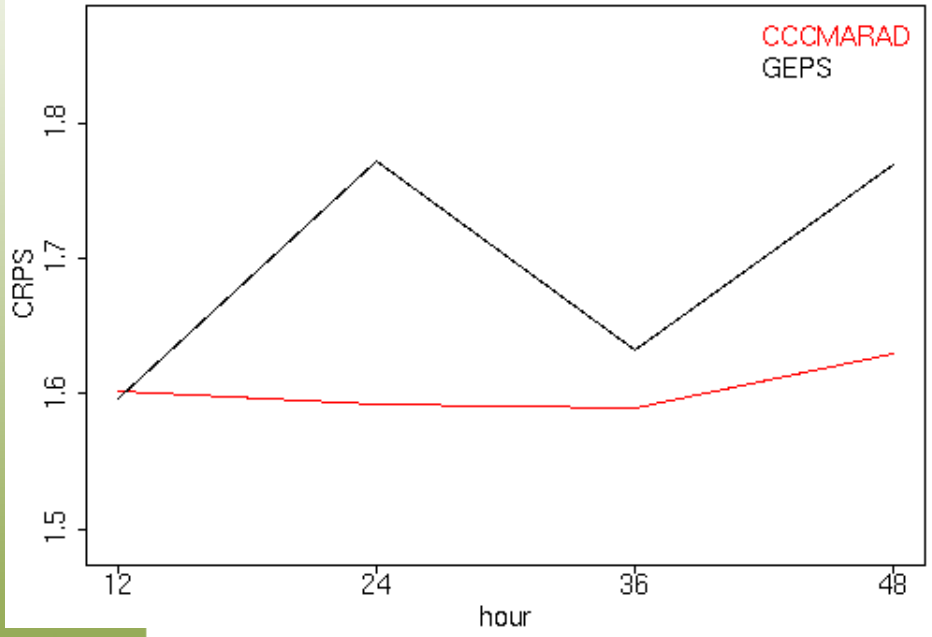


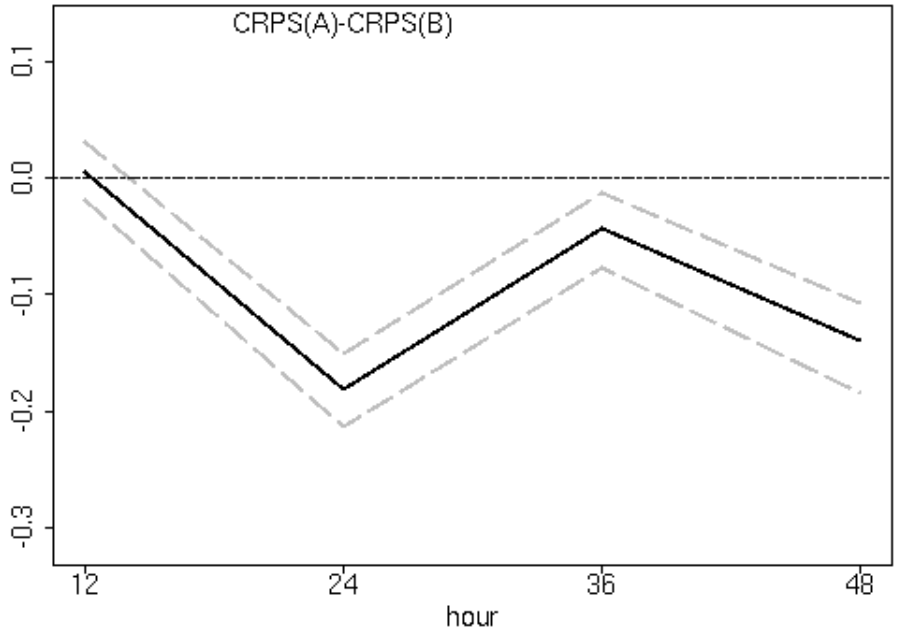
Regional EPS versus Global EPS
Bias, Temperature at 2m, winter 2009



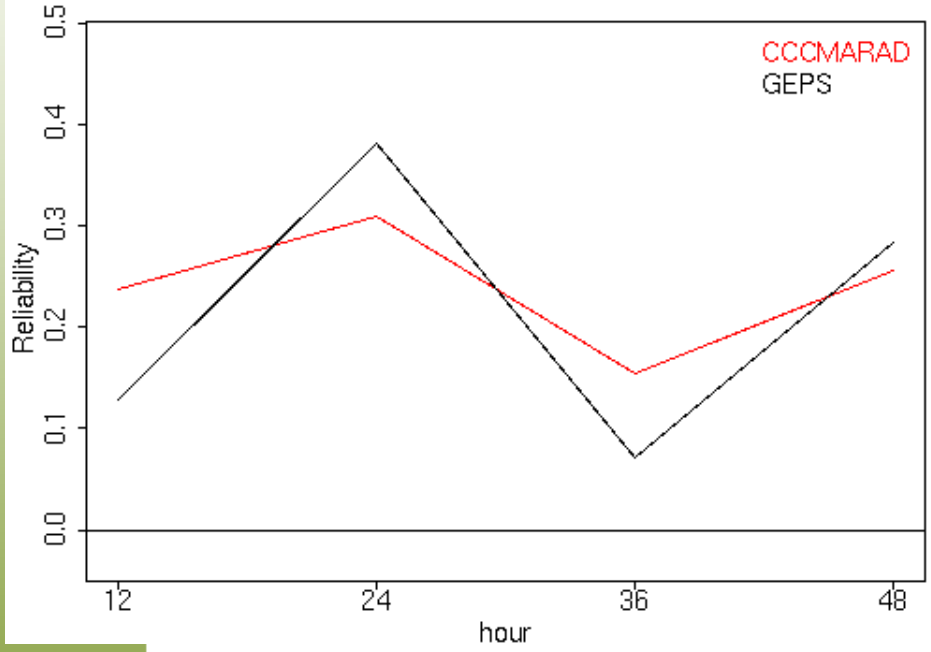


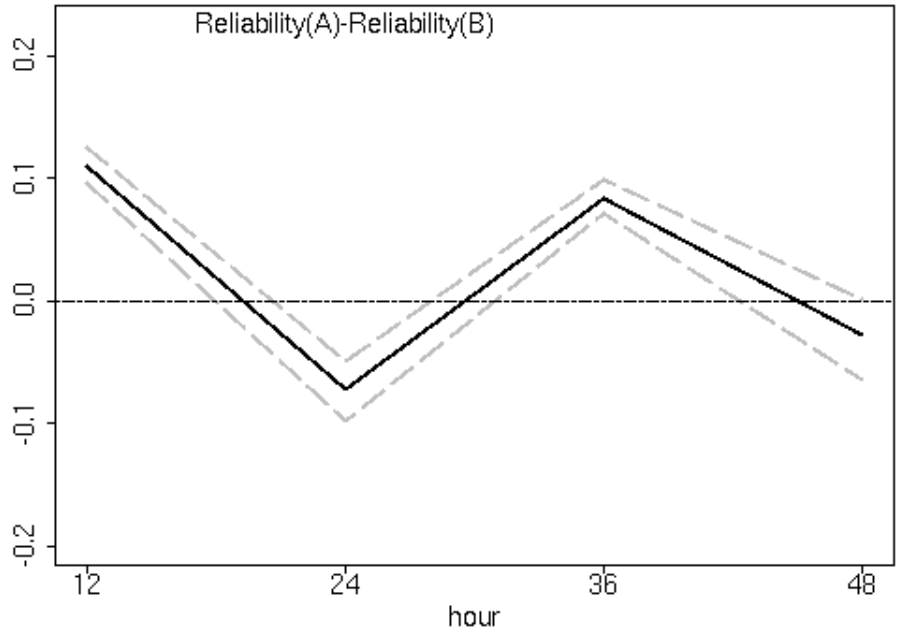
Regional EPS versus Global EPS
CRPS, Temperature at 2m, winter 2009



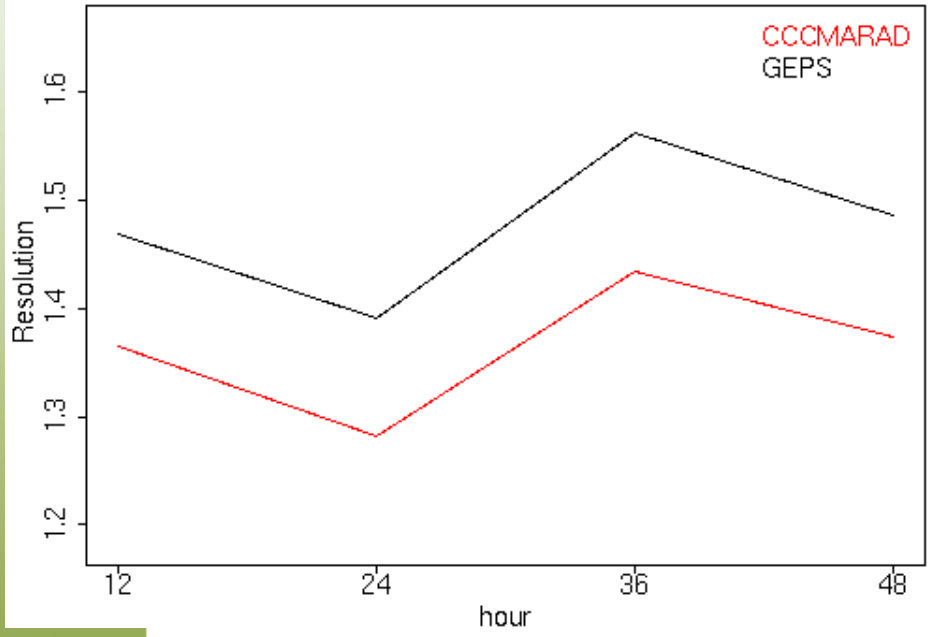


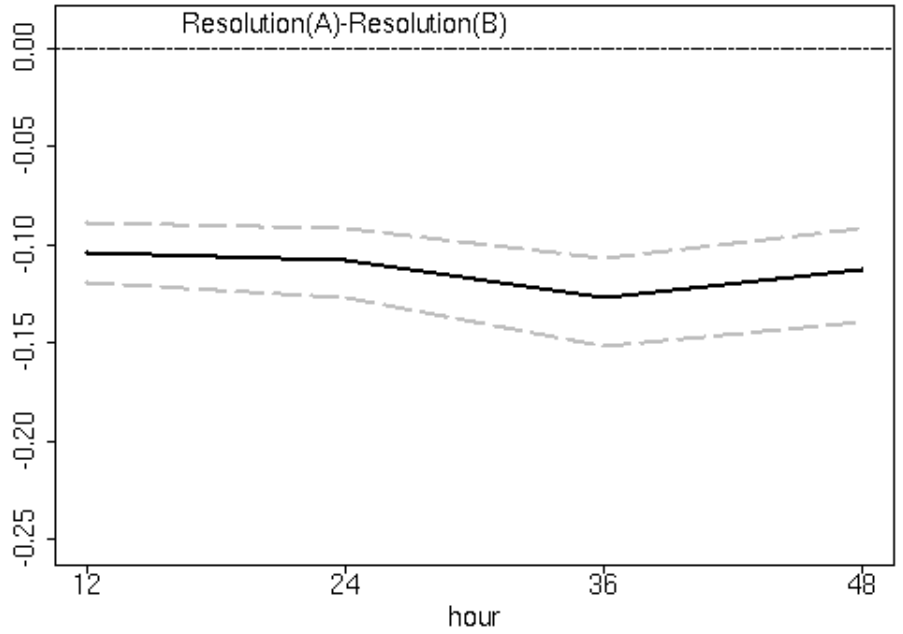
Regional EPS versus Global EPS Reliability, Temperature at 2m, winter 2009



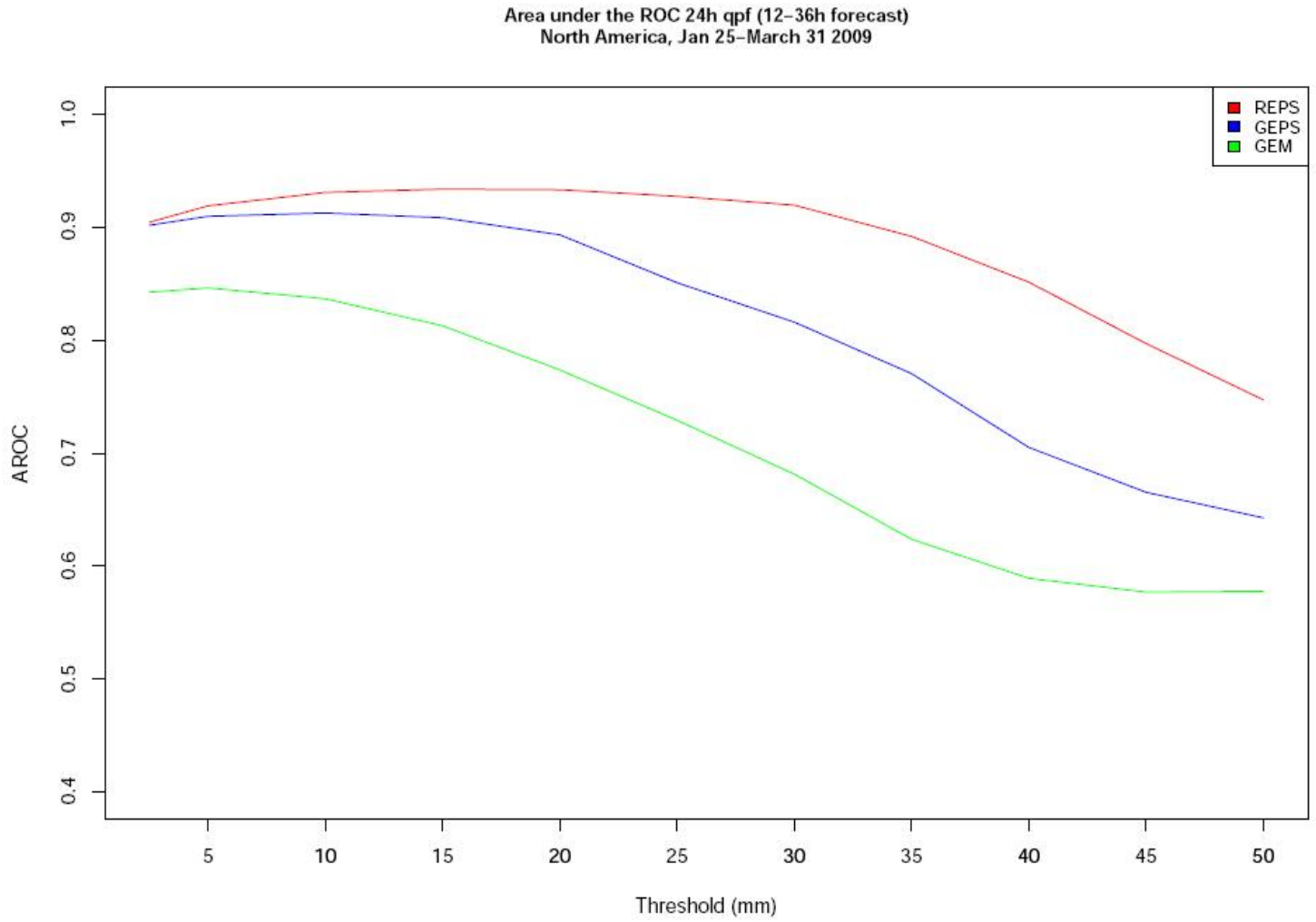


Regional EPS versus Global EPS Resolution, Temperature at 2m, winter 2009

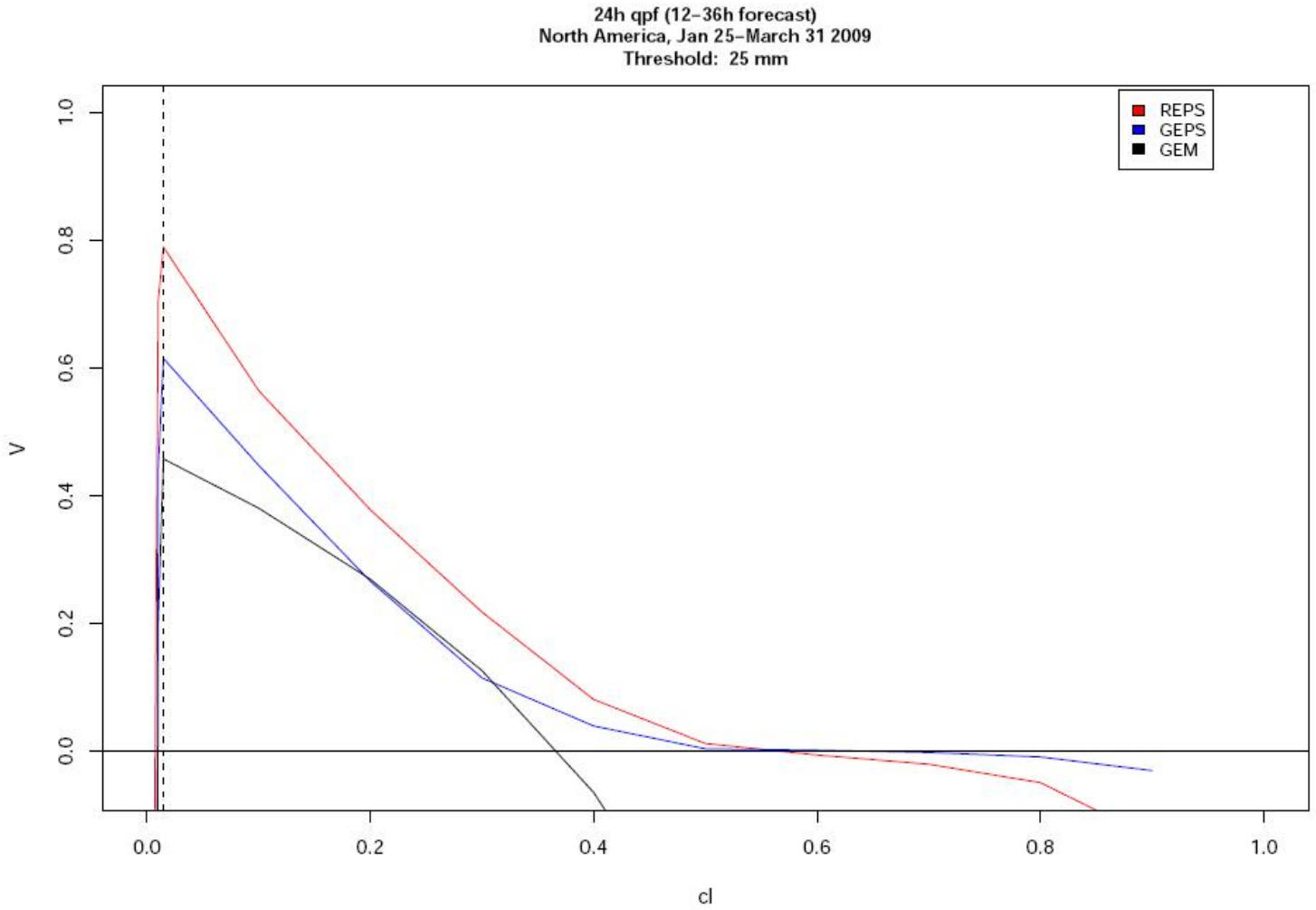




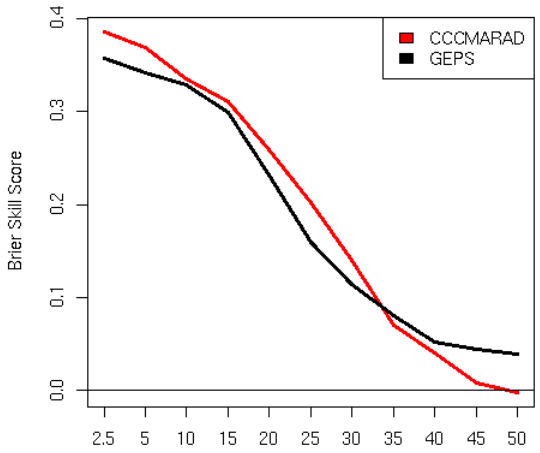
Regional EPS versus Global EPS
Area under ROC, 24h precip. accum. 12-36 h

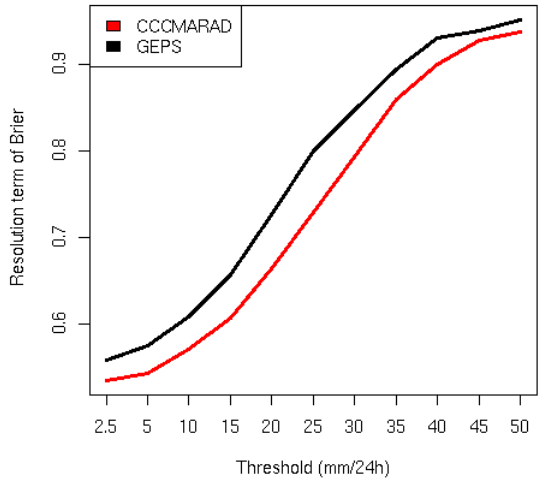


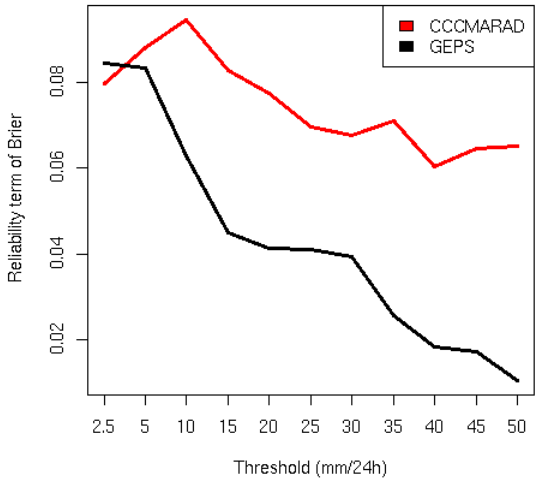
Regional EPS versus Global EPS
Economic value, precip. accum. > 25 mm



Regional EPS versus Global EPS
Brier Skill Score, 24h precip. accum. 12-36 h







Winter 2009

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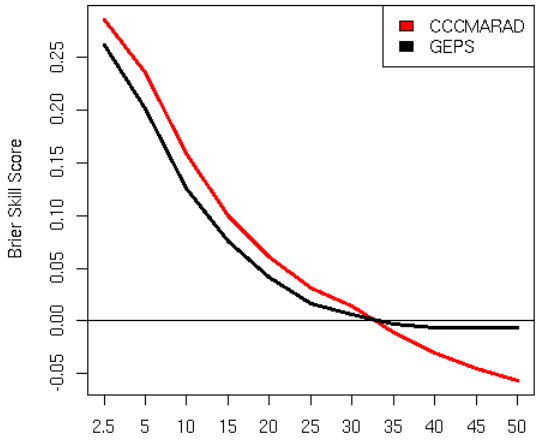
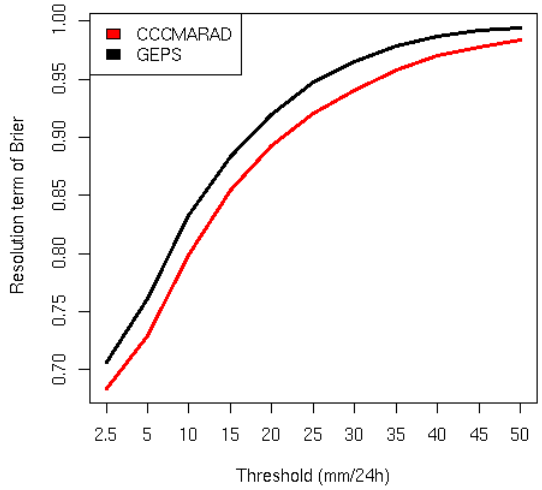
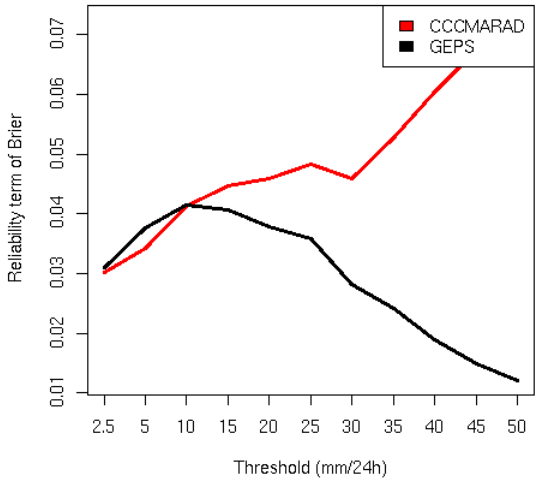
Regional EPS versus Global EPS
Brier Skill Score, 24h precip. accum. 12-36 h







Summer 2009

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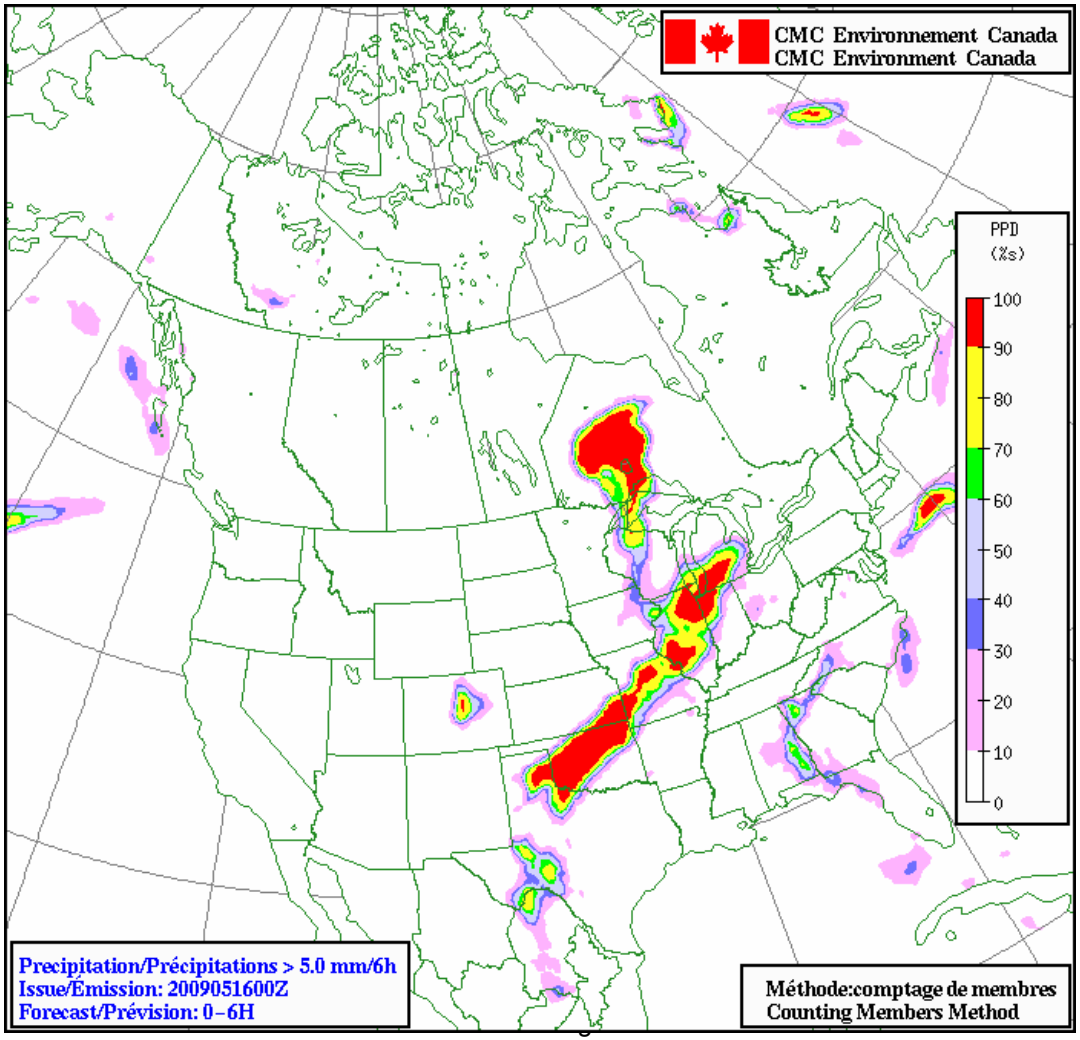
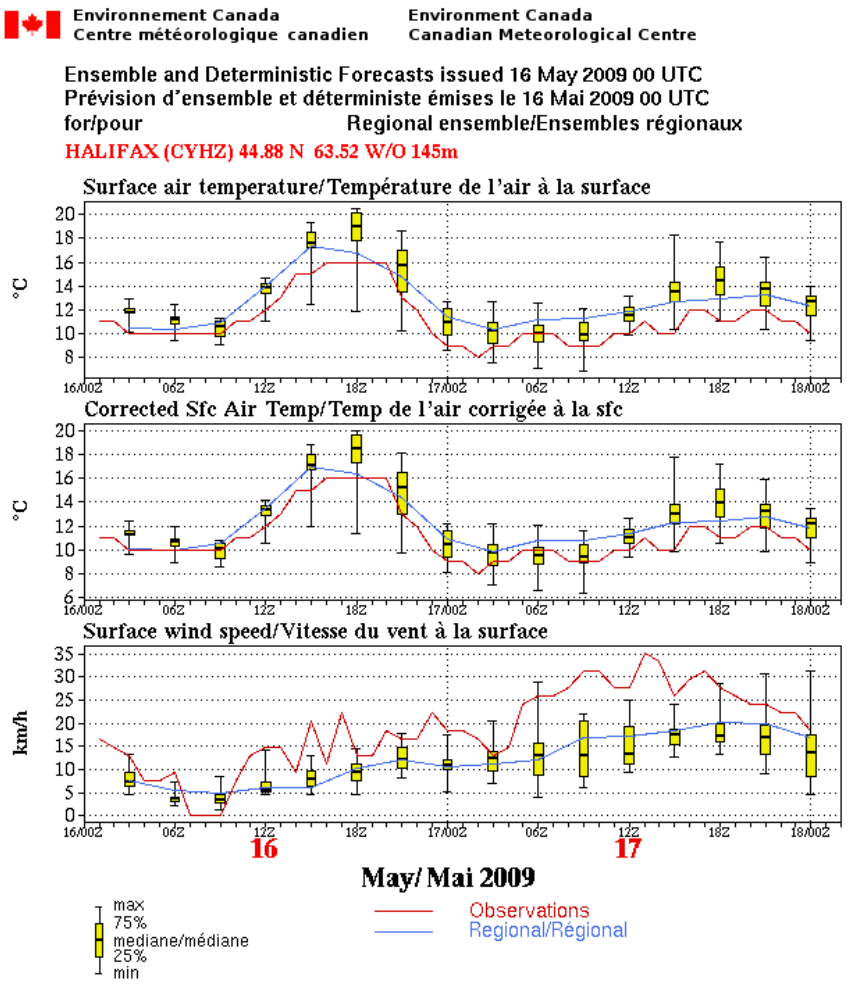
Examples of products



Examples of products



Some remarks

- Piloting the LAM integrations with the Canadian global EPS provides better results than using targeted singular vectors
- Our aim is an experimental (operational?) status of the REPS in 2010
- Still need to continue to demonstrate the added value of the REPS to the Canadian global EPS
- We put the emphasis on having a good resolution
- Still need to improve reliability
- In the future, we will focus on
  - improving the representation of model error at the surface
  - assimilate surface observations
  - Develop a regional ensemble Kalman filter

Interesting applications

- Short-range weather forecating
  - Probability of high-imppact weather
- Hydrological modelling
  - POP estimated from the REPS
- Wind energy forecasting?

Regional EPS versus Global EPS
CRPS, Temperature at 2m, summer 2006