

Ensemble predictions at CMC

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Overview

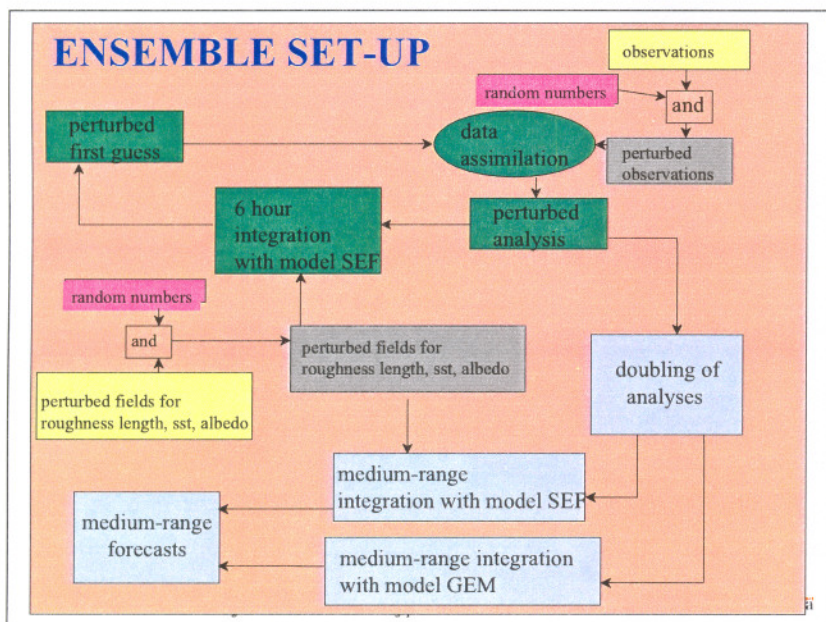
- Current Status
- Upcoming changes
- Applications
- International collaboration

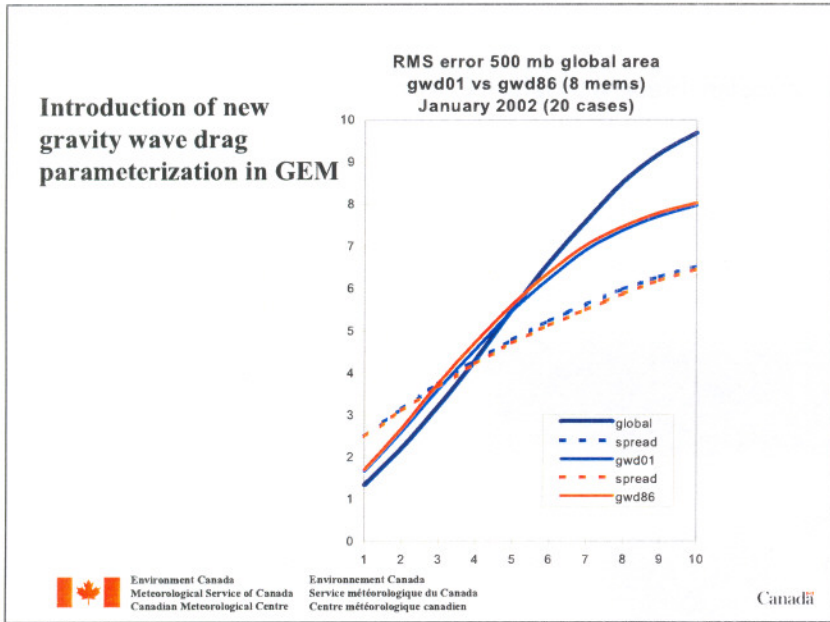
History of the ensemble forecasting system

- 8 SEF models semi-operational March 1996
- OI-SEF officially in February 1998
- 8 GEM models added in August 1999
- External Web page in October 1999
- Increased resolution in June 2001
- Improved GEM model in March 2002
- Thinned SATWINDS in March 2002

Current System

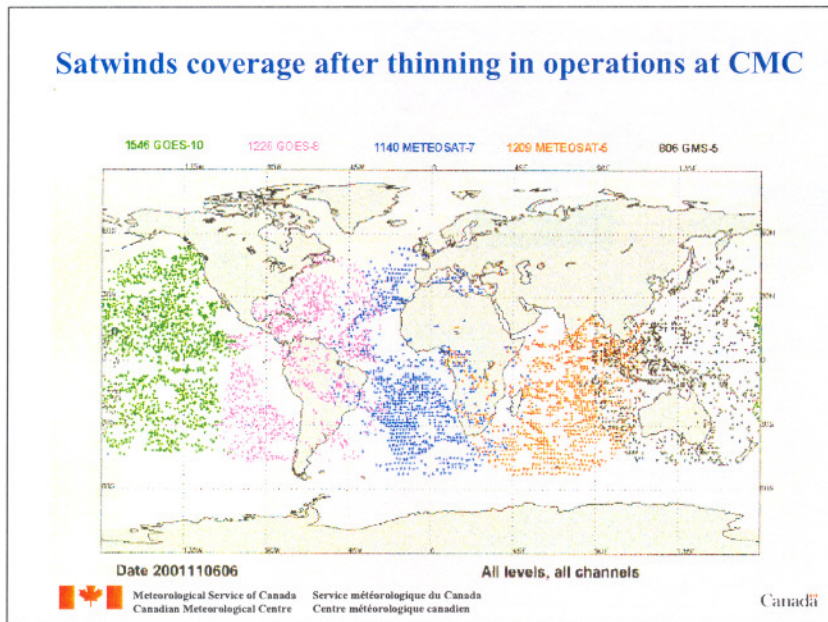
- Runs to 10 days, at 00Z
- 16 members:
 - 8 GEM 1.2° -8 SEF T149
- Perturbed analyses-Perturbed observations-Perturbed OI assimilation cycles
- Varying physical parameterizations



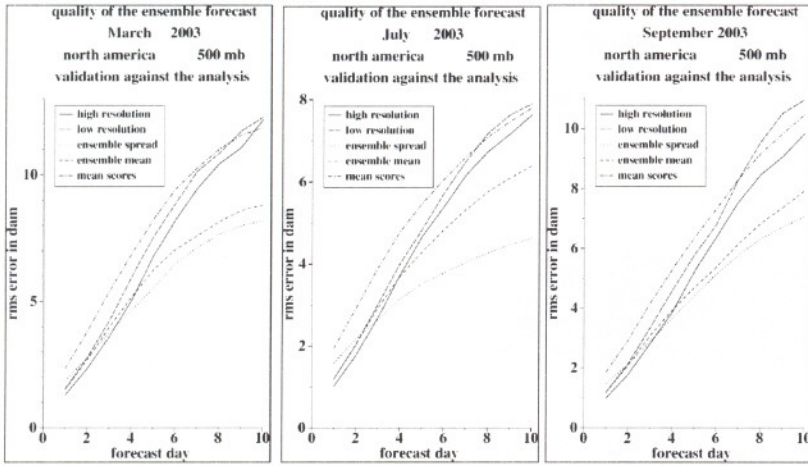


Inclusion of SATWINDS in the ensemble forecasting system

- application of thinner 1.5°x 1.5°
- observation closest to analysis time
- quality control including blacklisting
- GOES-8&10, METEOSAT 5&7, GMS-5
- mostly improves high troposphere
- Implemented March 2002



Verification



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 Meteorological Service of Canada
 Canadian Meteorological Centre

Environnement Canada
 Service météorologique du Canada
 Centre météorologique canadien

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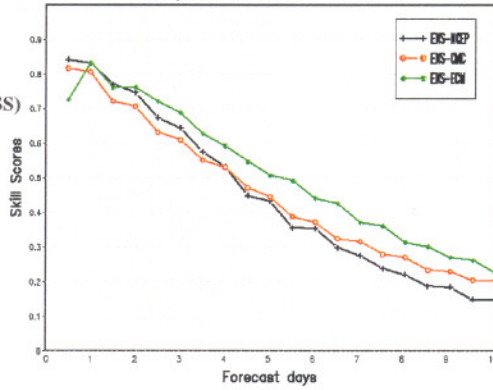
The area under the relative operating characteristic curve (ROCA) measures the ability of a system to discriminate between hits and false alarms.

The ROCA skill score (ROCASS) is defined as:

$$\text{ROCASS} = 2 * \text{ROCA} - 1$$

(ROCASS tends to 1 for a skilful system)

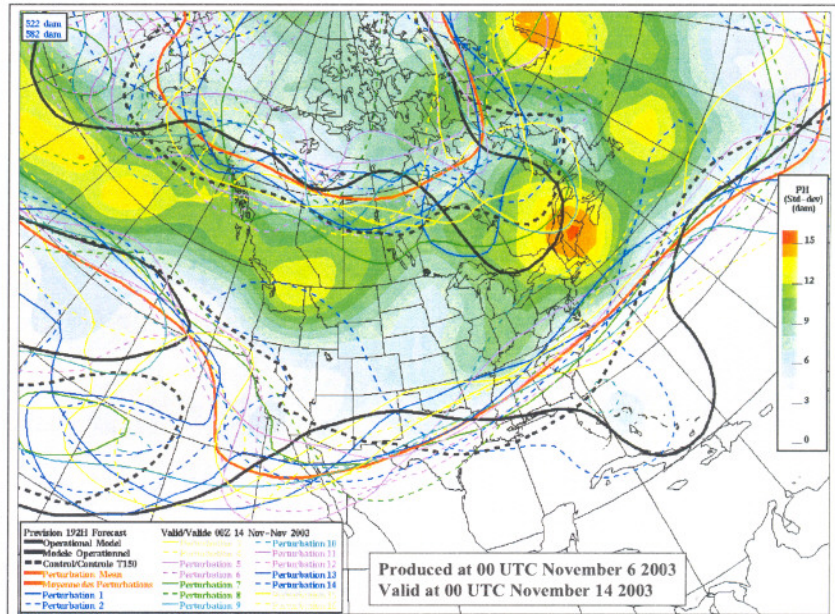
Northern Hemisphere 500 mb Height
Average For 20020501 - 20020731



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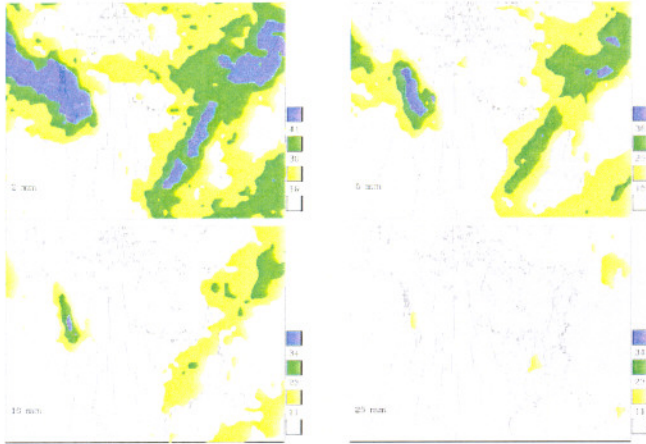
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Produced at 00 UTC November 6 2003
Valid at 00 UTC November 14 2003

Calibrated probability of precipitation



Produced at 00 UTC November 6 2003
Valid at 00 UTC November 14 2003

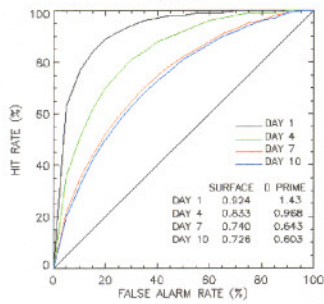


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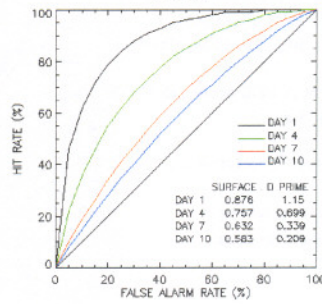
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5 MM PRECIPITATION (DECEMBER 2002 - FEBRUARY 2003)
STATISTICS (HIT RATE vs FAR)
ALL-STNS



5 MM PRECIPITATION (JUNE - AUGUST 2003)
STATISTICS (HIT RATE vs FAR)
ALL-STNS



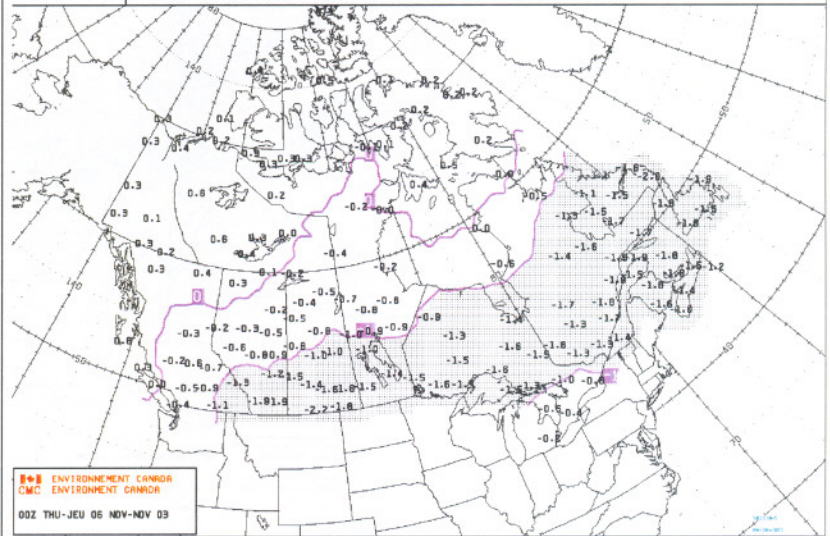
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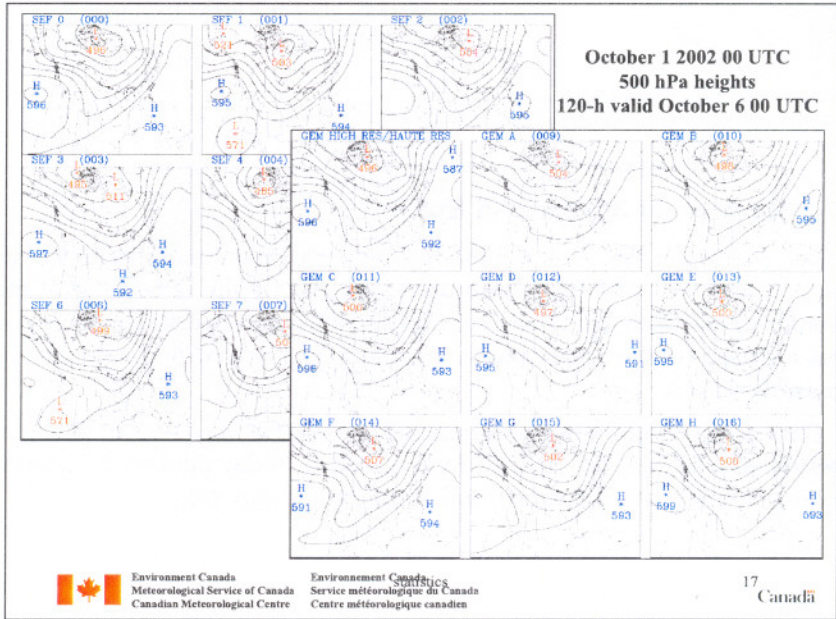
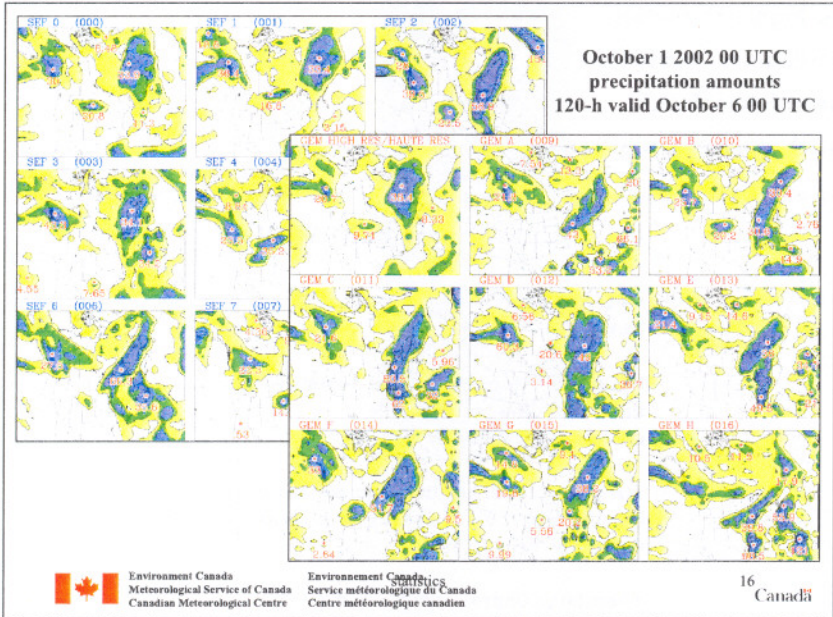
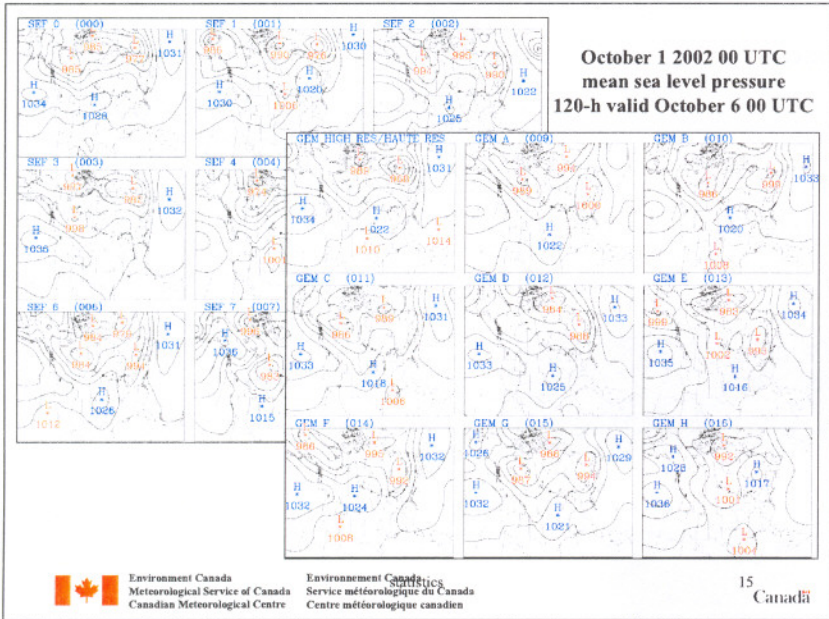
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ENSEMBLE
8 SEF 8 GEM

10 DAY MEAN - MOYENNE SUR 10 JOURS
NORMALISED TEMPERATURE ANOMALY
ANOMALIE DE TEMPERATURE NORMALISEE





Upcoming changes

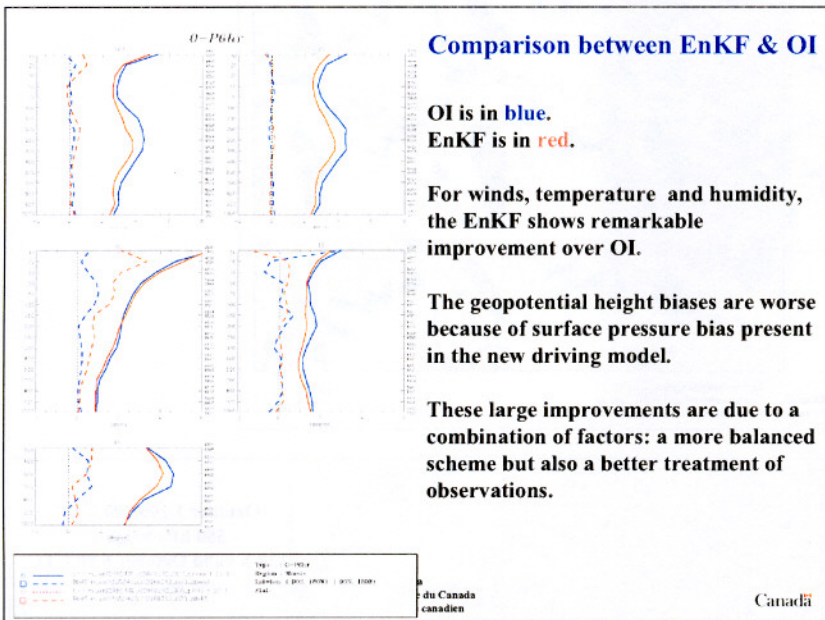
- March 2003: Ministerial Announcement
- Major restructuring of MSC
- A few areas with new funding
- Ensembles is one of these

Announcement on Ensembles

- Development of 7 day forecasts
- Development of week 2 forecasts
- Probabilistic forecasts for specialized users
- High impact weather forecasts
- 400K US\$ per year

Upcoming changes

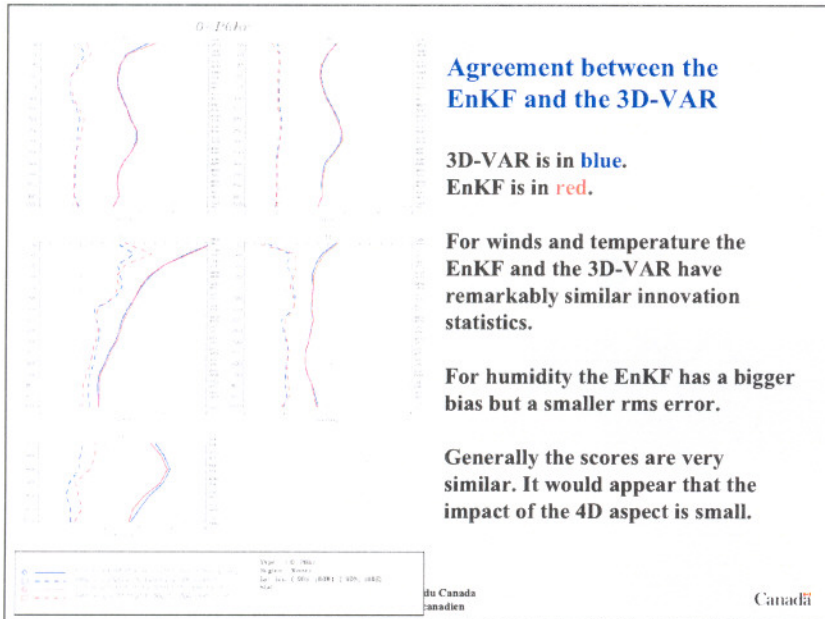
- Runs as 00Z and 12Z
- Up to 15 days
- More members, higher resolution
- New data assimilation scheme:
 - Ensemble Kalman Filter (EnKF)
- Single model with stochastic physics?



Comparison of 3D-Var and EnKF

A comparison of 3D-Var and EnKF has been performed (manuscript by Houtekamer et al. submitted to MWR). The 3D-Var and the EnKF have been used with exactly the same forecast model (resolution, physical parameterizations, etc) and with exactly the same observational network. The same data are assimilated. The same error statistics are used for the observations. The same quality control procedure (background check and variational quality control) is used.

Data assimilation cycles were started on 00 UTC May 19 2002. The innovation statistics are compared for the period 00 UTC May 24 -12 UTC June 2 2002 (a 10 day period). Innovation statistics were computed with respect to an extremely reliable subset of the radiosonde network.

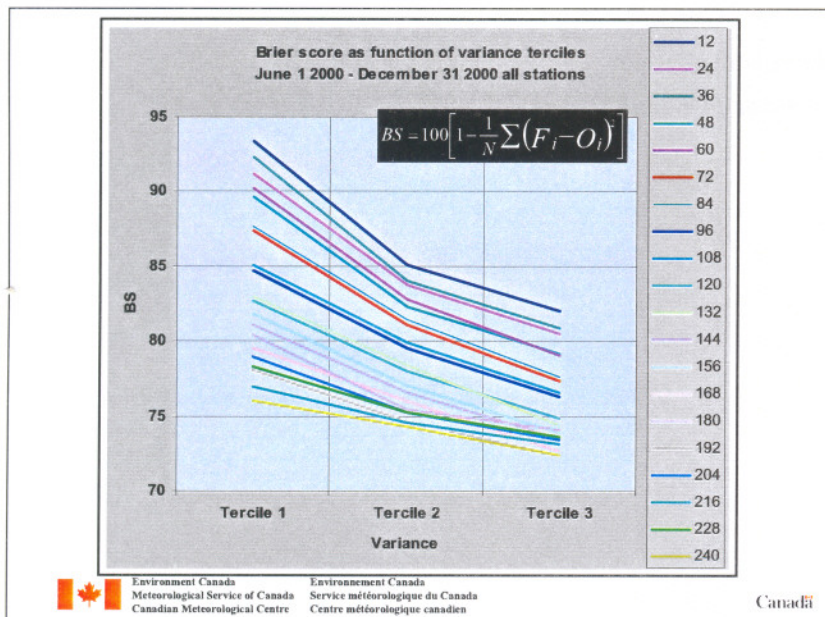


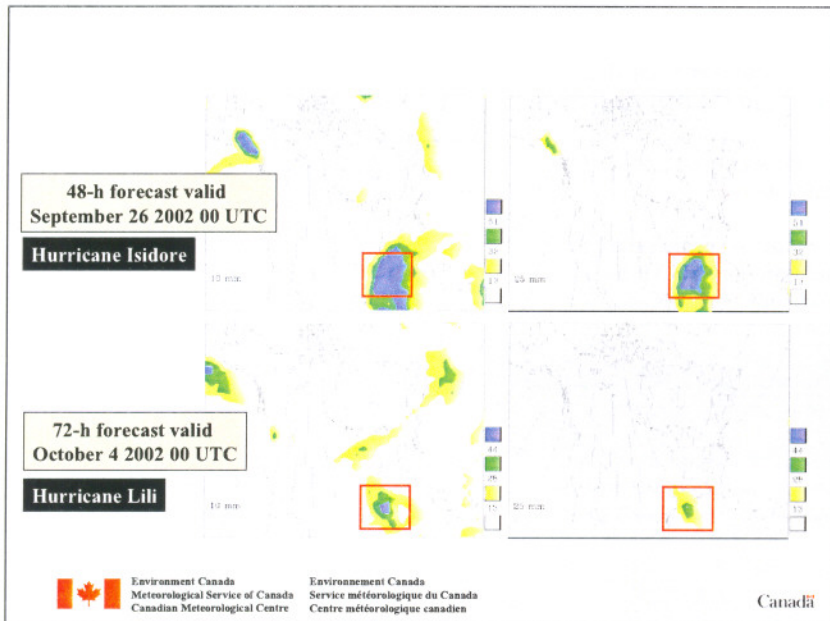
Applications

- Goal: use of probabilistic and scenario based forecasts in decision making
- Automated products, up to 2 weeks
- Targeting major economic sectors:
 - energy, transport, forestry, energy, agriculture, water resources...
- Targeting high impact weather events

Extending forecasts up to 7 days

- Mean of ensemble already better than deterministic model
- Use of spread-skill relationship to provide information on skill within the forecast
- Automated plain language forecasts





International collaboration

Agreement with NCEP to develop joint approach

- Data exchange: standardized outputs
- Debiasing of each model-joint methodology
- Moving to similar looking products
- Products based on combined ensembles
- Eventually, joint products
- Hoping that experience between Canada and US can eventually be extended to other ensemble producers
- Hoping that more ensemble products can be made widely accessible to all countries, possibly as part of EOS strategy

Conclusion

- CMC is strengthening its ensemble forecasting system
- Emphasis on high impact events and major economic sectors
- Applications will diversify rapidly
- Key challenge: Representativeness
- International collaboration essential