

The Canadian High Resolution Ensemble Kalman Filter (HRENKF) : Examination of Forecast Errors at Convective Scale

Kao-Shen Chung¹, Weiguang Chang²,

Luc Fillion¹ and Monique Tanquay¹



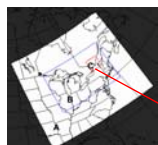
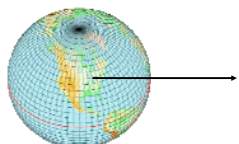
¹ Meteorological Research Division, Environment Canada, Dorval, Québec, Canada

² Department of Atmospheric and Oceanic Sciences, McGill University, Montréal, Québec, Canada

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Introduction

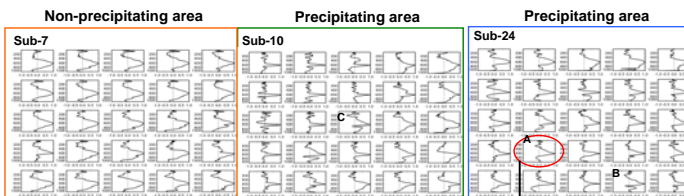
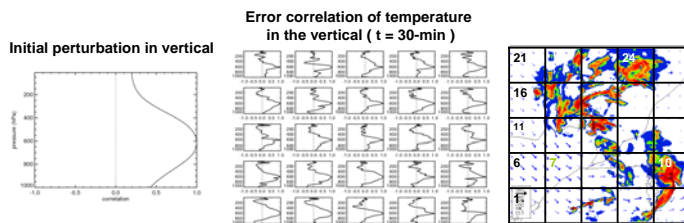
- Based on the global EnKF system (Houtekamer and Mitchell 2005; Houtekamer et al. 2009) operational at the Canadian Meteorological Center (CMC), a High Resolution Ensemble Kalman Filter (HRENKF) system has been developed for the limited area model (GEM_LAM)
- The goals are to have a cloud-resolving scale data assimilation system and assimilate radar data



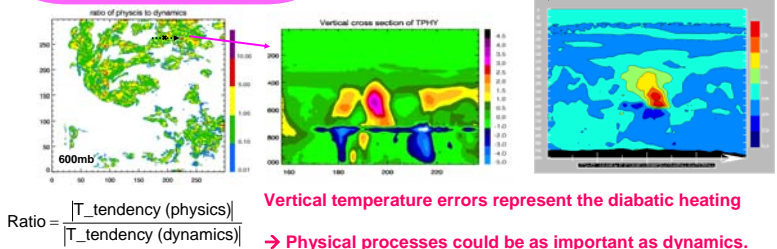
Extent of limited-area model domains for the nested system

A: LAM-15 km
B: LAM-2.5 Km
C: LAM-1 km 300x300 (Montréal region)
Domain of HRENKF

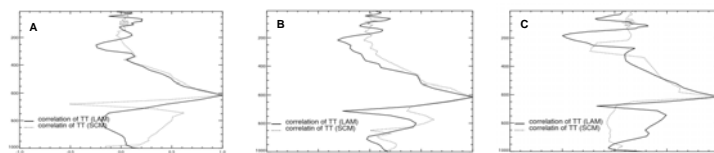
Vertical error structures



Physics versus Dynamics



Single Column Model (1D, dashed line)
v.s.
Ensemble Forecasts (3D, solid line)



Single column model (SCM)
→ Well represent the error structure at the mid levels

Summary

- The HRENKF system has been implemented for the purpose of limited area radar data assimilation.
- The forecast errors are very different between precipitating and non-precipitating areas.
- The results from ensemble forecast errors showed strong situation-dependency and revealed the importance of physical processes over precipitating areas

References

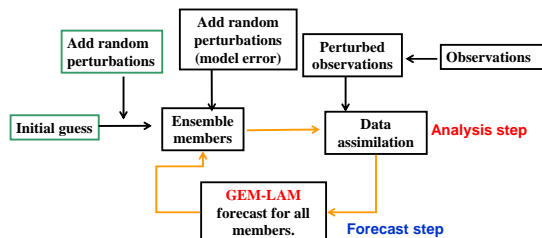
Houtekamer, P. L. and H. L. Mitchell, 2005: Ensemble Kalman filtering. *Quarterly Journal of the Royal Meteorological Society*, **131**, 3269-3289.

Houtekamer, P. L., H. L. Mitchell, and X. Deng, 2009: Model Error Representation in an Operational Ensemble Kalman Filter. *Monthly Weather Review*, **137**, 2126-2143.

Acknowledgements

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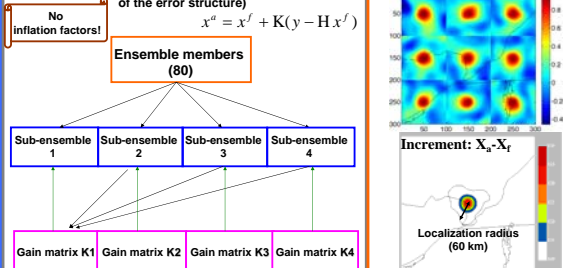
Methodology and Features



Batching procedure of observations (sequential data assimilation)

Partitioning the ensemble (to deal with the underestimation of the error structure)

Localization (to deal with sampling errors)



Forecast errors at convective scale

- The forecast error structures are not fully known at the cloud-resolving scale.
- The synoptic scale climatologic error statistics present improper structures at convective scales.
- HRENKF → Ensemble forecasts → investigate the forecast errors at convective scales

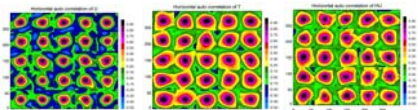
Model configurations

- 1-km resolution in horizontal; 58 vertical levels; time step = 30sec
- Initial perturbations: U, V, T, HU, TG and PO
- Do not consider the model errors
- Cycling hydrometeor variables
- No radar data

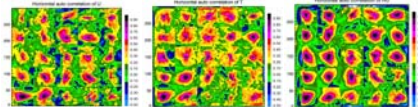
Horizontal error structures

Prescribed error structure: homogeneous & isotropic, correlation length is fixed at 10km for all variables (ϕ , χ , T, HU)

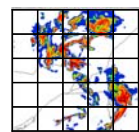
00-min Forecast Error Correlations (800mb)



30-min Forecast Error Correlations (800mb)



Summer case study (July / 22 / 2010)



- The forecast errors rapidly evolve to situation dependent structures (within 30-min)
- Different error structures between precipitating and non-precipitating areas