Impact of a Hybrid Ensemble-Variational Data Assimilation System on the Performance of an ETKF-based EPS System

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Marriage

Data Assimilation ↔ Ensemble System
Time Period

17 JAN – 5 MAR 2008
Time Period

17 JAN – 5 MAR 2008

25 JAN – 6 FEB 2008
Forecast Lead Time

Time

00  06  12  18

00   06  12   18   00   06  12   18   00   06  12

Forecast Lead Time
Horizontal Domain

GLAMEPS_V1

486 X 378 points  0.115 X 0.115  NLEV=40  DT=6 min
Vertical Domain

40 Levels
Boundary Conditions

EuroTEPS
Boundary Conditions

EuroTEPS

Zone at the Horizontal Boundaries

Layer at the top of the Model
Ensemble Characteristics

Size: 12 Members

Inconsistent with the BC from EuroTEPS which are Paired
Ensemble Characteristics

Size: 12 Members

Centering: Spherical Simplex
Ensemble Characteristics

Size: 12 Members

Centering: Spherical Simplex

Inconsistent with the BC from EuroTEPS which are Paired
EXPERIMENT COMPARISON - 1

ETKF vs EuroTEPS
MODEL

HIRLAM Trunk APR 2010
Boundary Conditions

EuroTEPS

ETKF  20% EuroTEPS  80% ETKF

EuroTEPS  100% EuroTEPS
DATA and DA

ONLY Conventional Data

3D-VAR
Error growth
\[ \vec{d}_{bi}^{o} = \vec{d}_{ai}^{o} + \vec{d}_{bi}^{a} \]
Vertical structure

and

Amount of Observations
Total amount of assimilated observations

Large variations with cycle

August 2007
ETKF DIVERGENCE TF=06 hr

MSEC
MSEP
SPRE

00 UTC
06 UTC
12 UTC
18 UTC

Pressure [hPa]

Mean Square Error * 10**9

-0.5 0 0.5 1 1.5 2 2.5 3
Spectra
Spectra

EuroTEPS
Spectra

ETKF
EXPERIMENT COMPARISON - 2

ETKF vs ETKF Hybrid
MODEL

HIRLAM Trunk NOV 2010
Boundary Conditions

EuroTEPS

ETKF  20% EuroTEPS  80% ETKF

ETKF Hybrid  20 % EuroTEPS  80% ETKF
DATA and DA

Conventional Data + ATOVS

3D-VAR ± HYBRID
CAVEAT

Localization scale of implicit Schur product

200 km $\rightarrow$ 500 km

Localization Function

Compact support $\rightarrow$ Exponential Decay
Error growth
From EXP 1
Mean Square Error * 10^9

Forecast Lead Time [hr]

MSEC
MSEP

ETKF
Vertical structure
and
Amount of Observations
Conclusions

- The Hybrid System improves some aspects of the ETKF performance
Conclusions

- The Hybrid System improves some aspects of the ETKF performance
- ATOVS data has a beneficial impact on the ETKF performance
CAVEAT

• Only 2 weeks diagnosed
CAVEAT

- Only 2 weeks diagnosed
- Only 12 members
CAVEAT

- Only 2 weeks diagnosed
- Only 12 members
- Climatological SST and Sea Ice
CAVEAT

- Only 2 weeks diagnosed
- Only 12 members
- Climatological SST and Sea Ice
- Only 1 ATOVS Channel
CAVEAT

- Only 2 weeks diagnosed
- Only 12 members
- Climatological SST and Sea Ice
- Only 1 ATOVS Channel
- Too strong localization