

Impact of increased satellite data density in areas most sensitive to forecast error growth

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in lovely Reading, Berkshire, UK

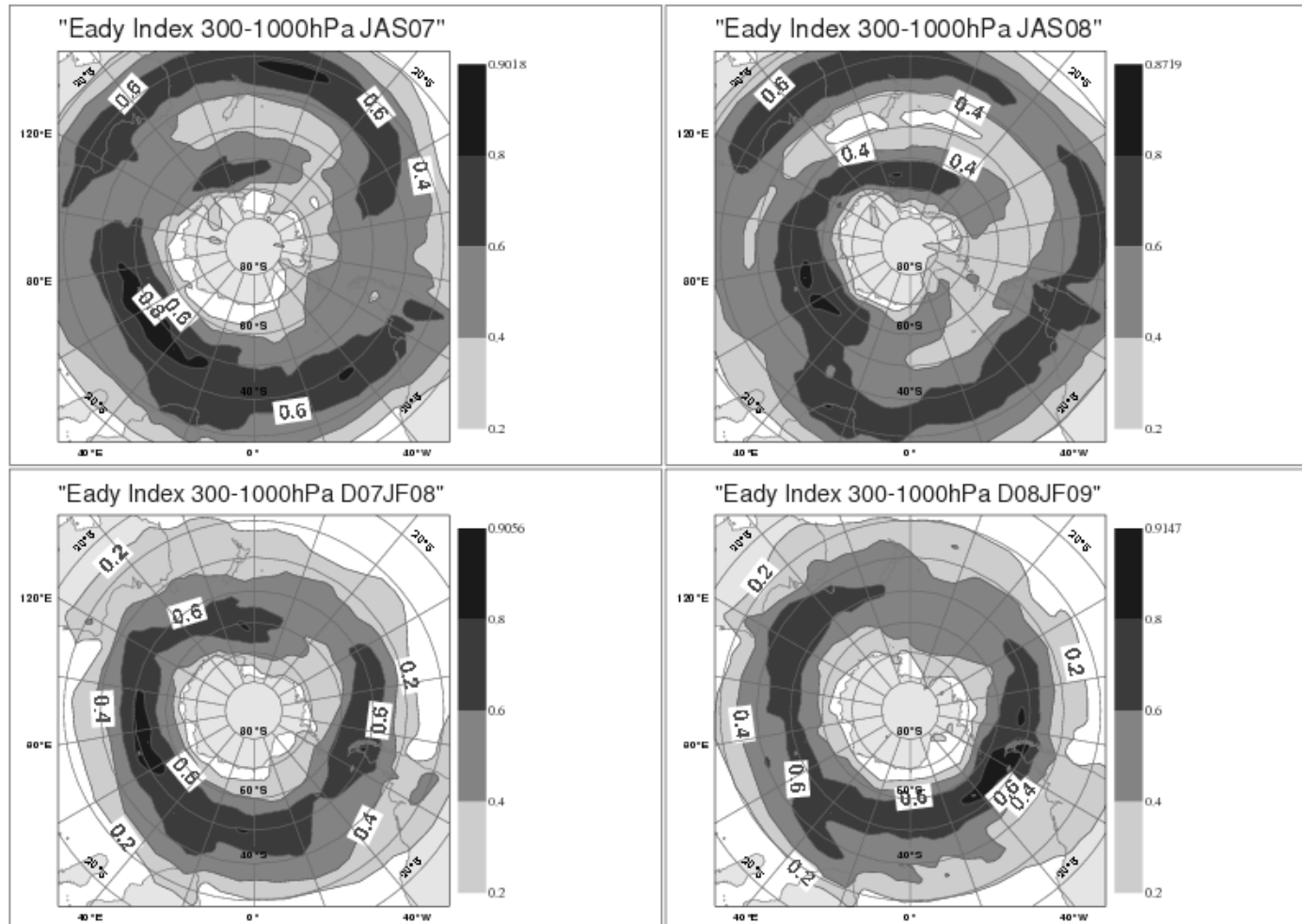
Study contents

Background

- Thinning of data is applied to:
 - reduce data volume,
 - avoid the introduction of spatial observation error correlation that is currently not accounted for in data assimilation algorithms.
- Thinning is performed statically on a fixed latitude/longitude grid.

Eady index

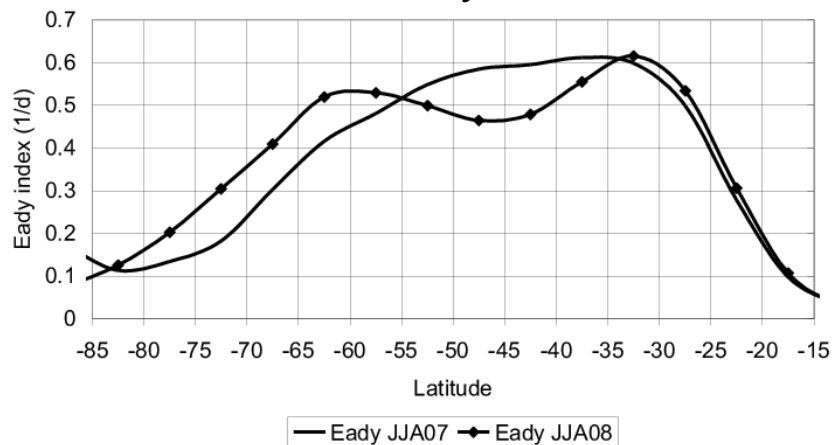
Eady-index as a proxy for baroclinic instability in the atmosphere



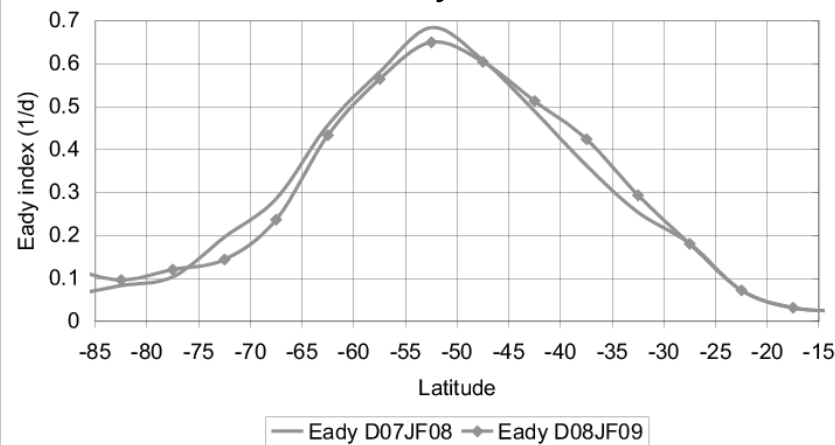
- ⇒ difference between seasons is rather strong;
- ⇒ year-to-year variability has significant seasonal dependence as well.

Eady index → target areas

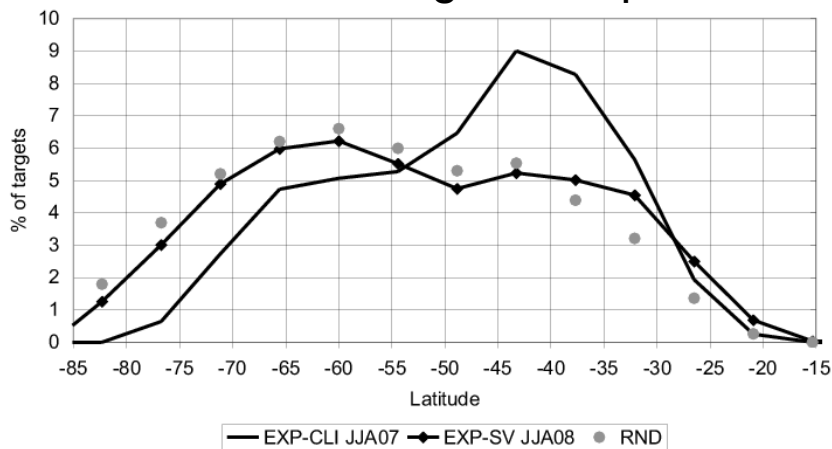
JAS – Eady index



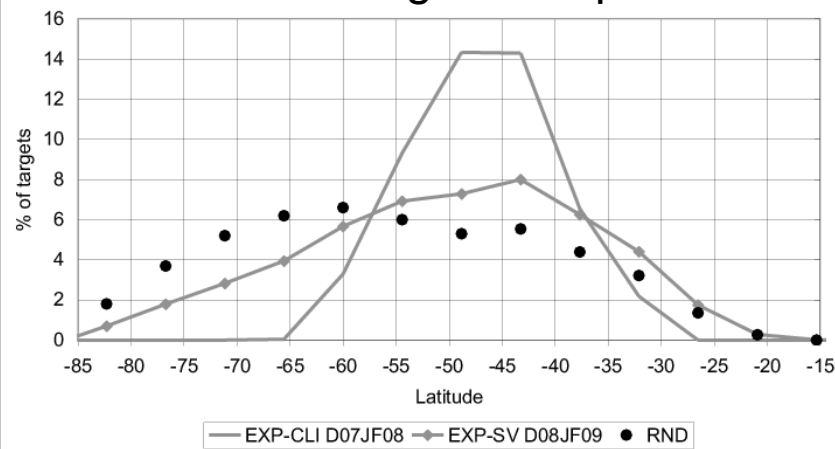
DJF – Eady index



JAS – target area pdf



DJF – target area pdf



Experiments

Selective data thinning

- EXP : data is globally thinned to $1/1.25^\circ$ (i.e. operational thinning)
- EXP-HI : data is globally thinned to $1/0.625^\circ$
- EXP-SV : data is globally thinned to $1/1.25^\circ$ and $1/0.625^\circ$ in SV areas.
- EXP-CLI : data is globally thinned to $1/1.25^\circ$ and $1/0.625^\circ$ in *climatological* SV areas.
- EXP-RND : data is globally thinned to $1/1.25^\circ$ and $1/0.625^\circ$ in *randomly* distributed areas.

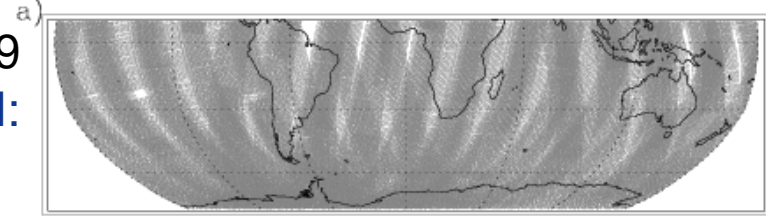
Additional information

- All experiments were run at T511L91 (12-hour 4D-Var).
- All experiments were verified with EXP-HI model analyses (without first 7 days (spin-up) i.e. 83 cases).
- All SV/RND/CLI areas occupy same fraction (15%) of the Southern hemisphere.
- The SV-based climatology was derived from the mean 2007 SV-areas.

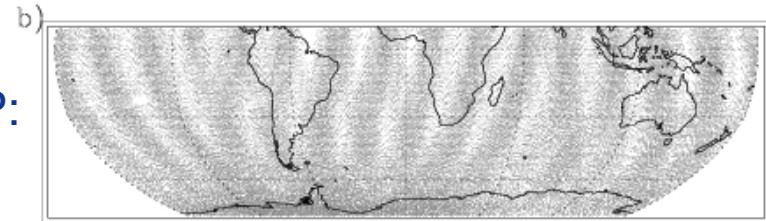
Data coverage

14/12/2008 00 UTC data density AMSU-A channel 9

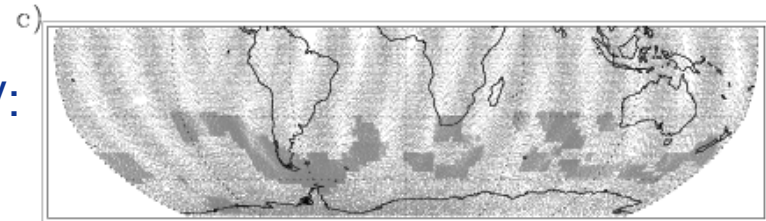
EXP-HI:



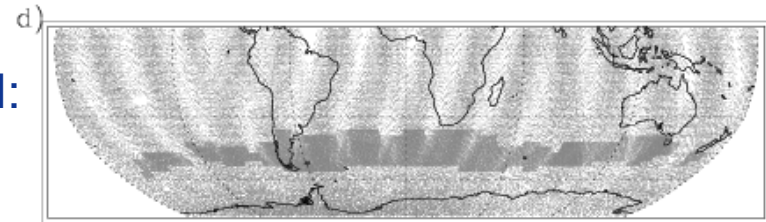
EXP:



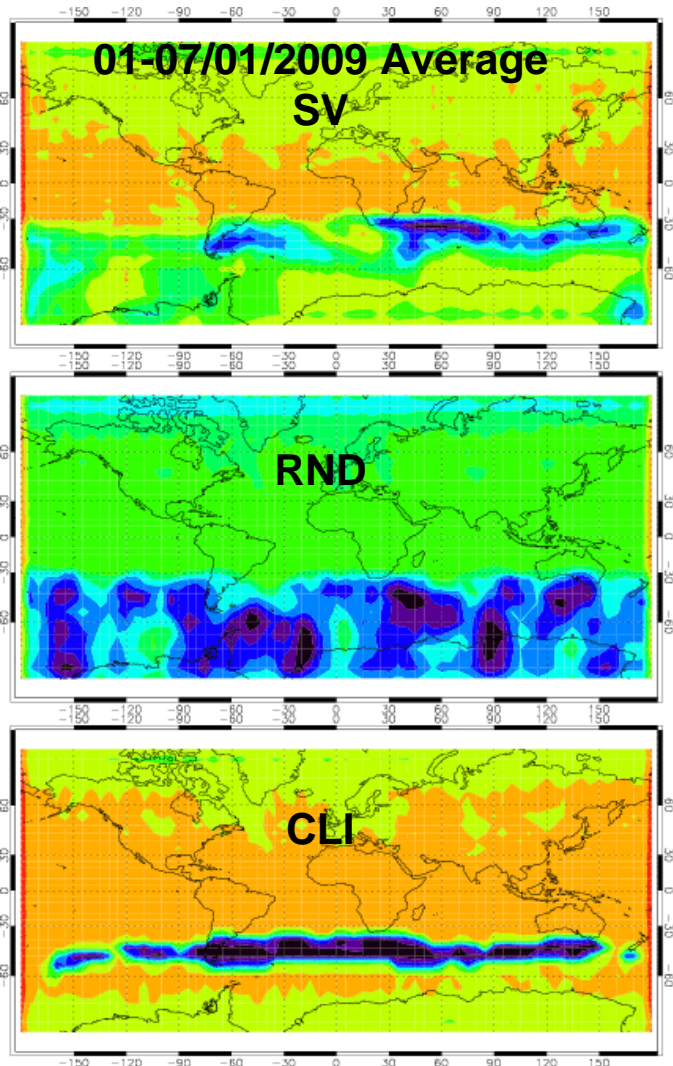
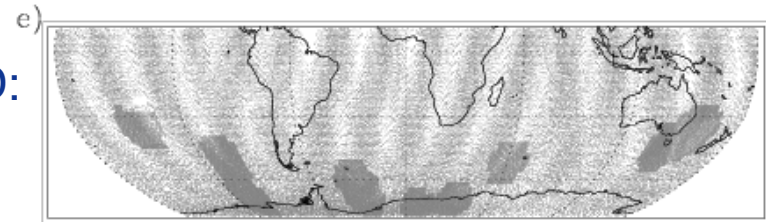
EXP-SV:



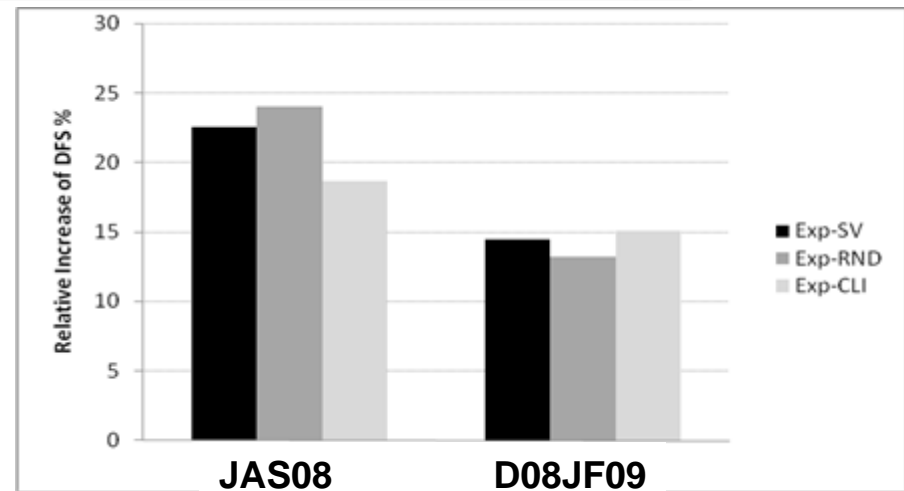
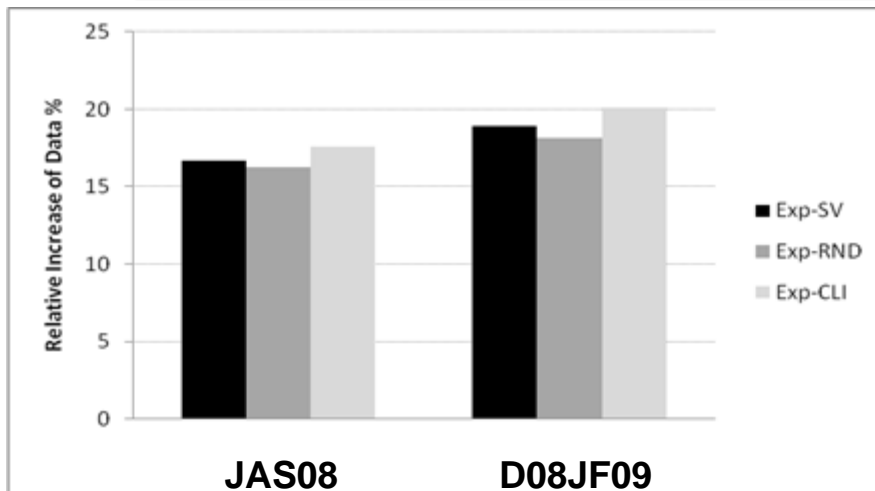
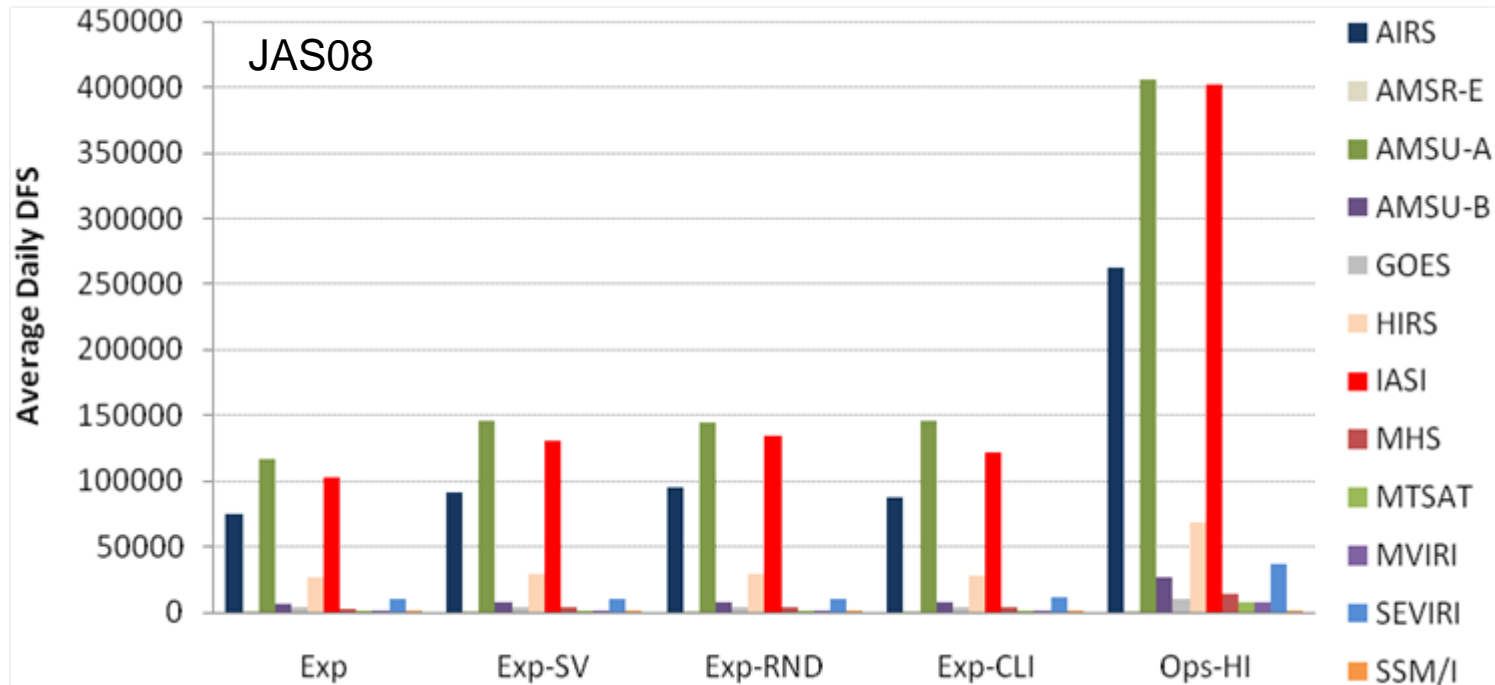
EXP-CLI:



EXP-RND:

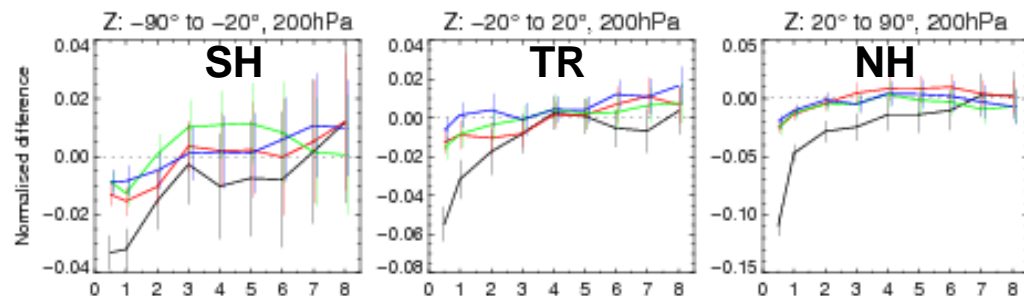


Analysis impact: Information content

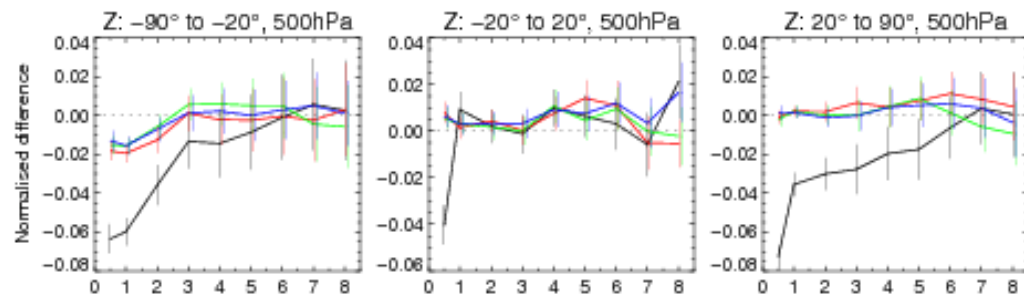


Forecast impact: z – JAS08

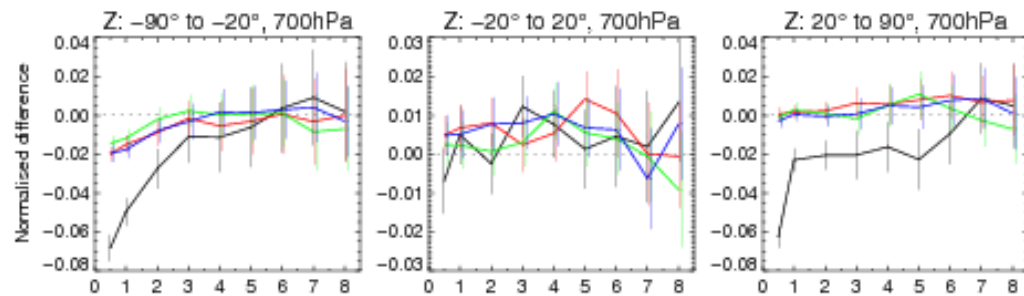
200 hPa:



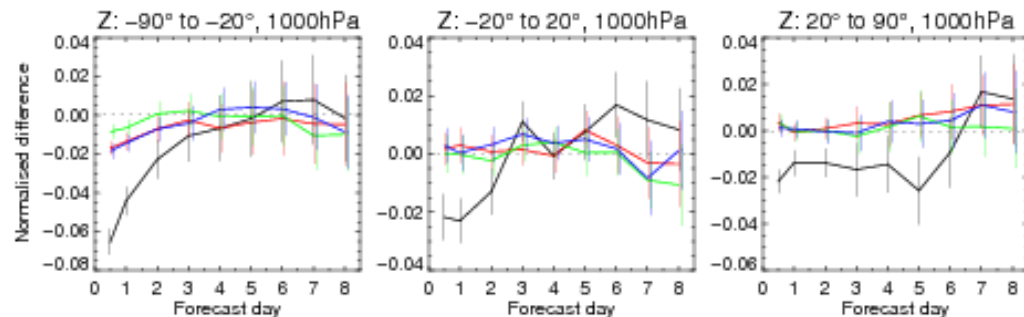
500 hPa:



700 hPa:



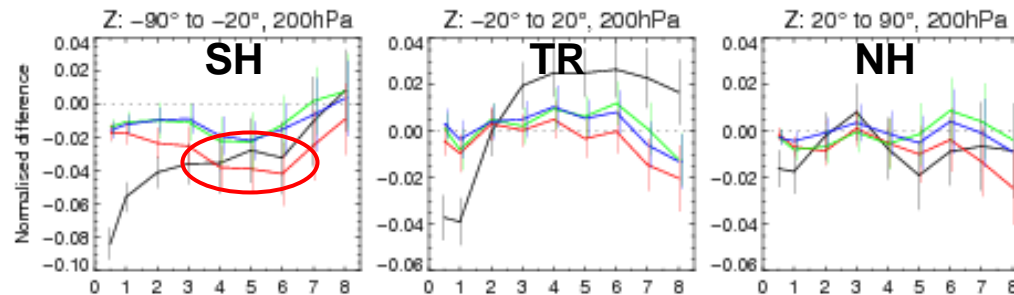
1000 hPa:



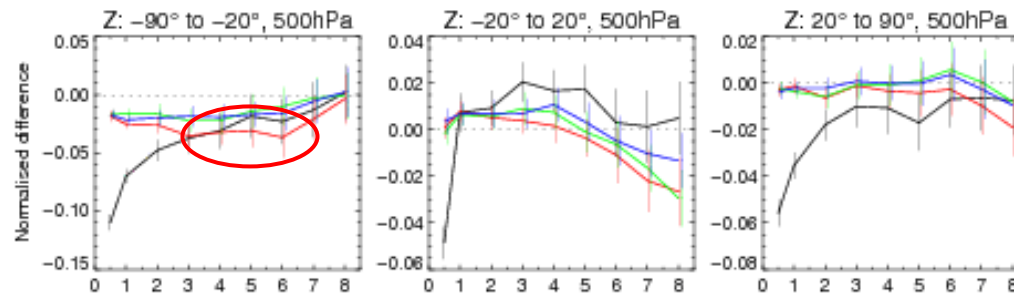
EXP-HI – EXP
EXP-SV – EXP
EXP-CLI – EXP
EXP-RND – EXP

Forecast impact: z – D08JF09

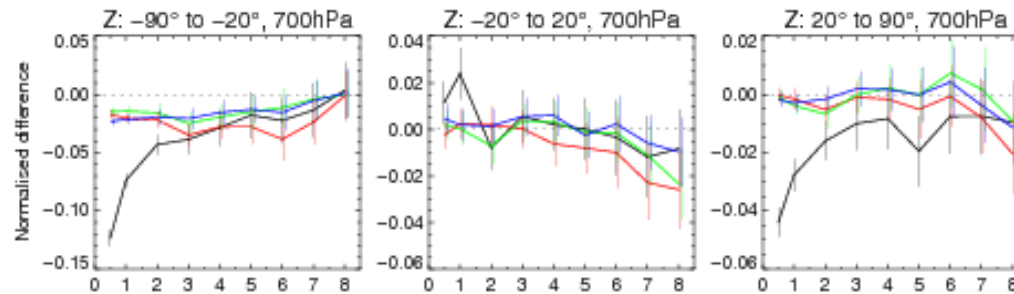
200 hPa:



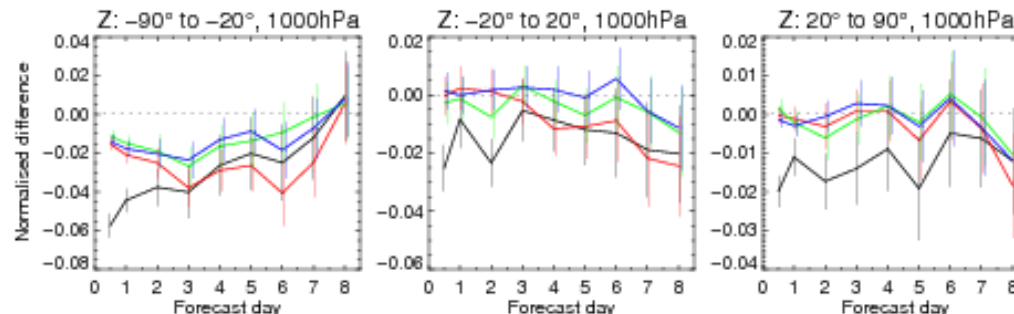
500 hPa:



700 hPa:



1000 hPa:

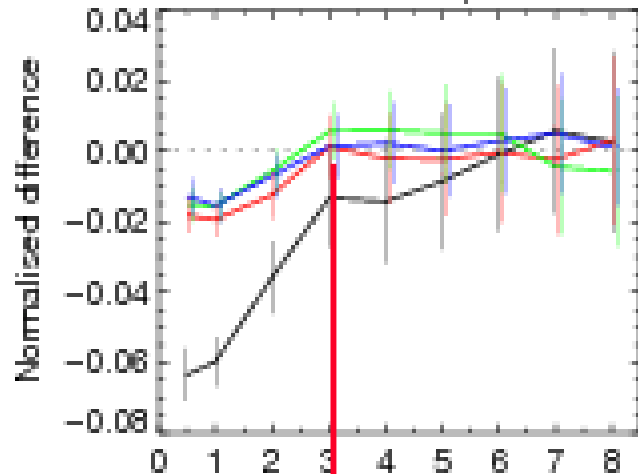


EXP-HI – EXP
 EXP-SV – EXP
 EXP-CLI – EXP
 EXP-RND – EXP

Forecast impact: z500 – D08JF09

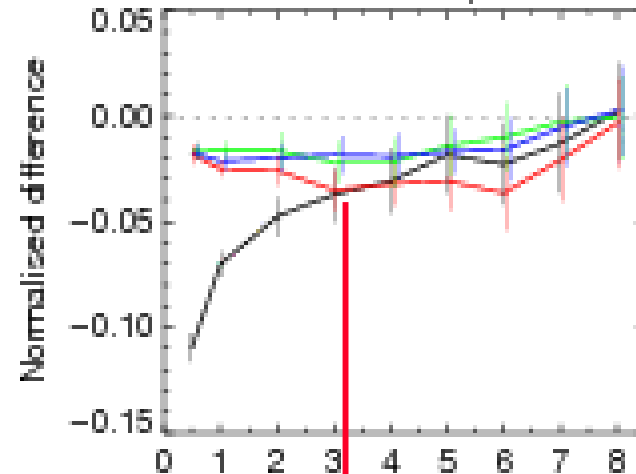
JAS08

Z: -90° to -20° , 500hPa

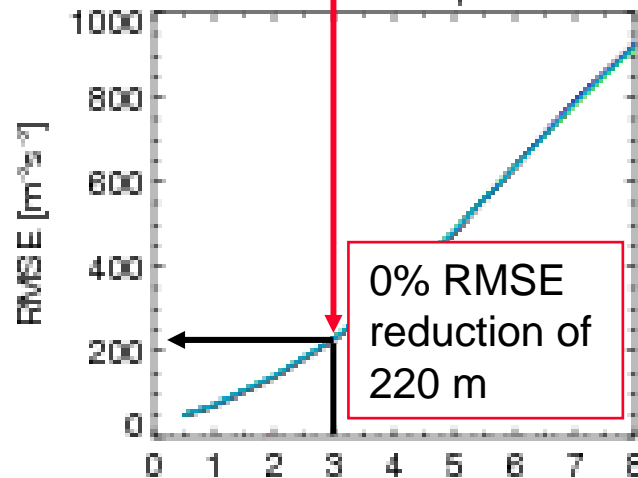


D08JF09

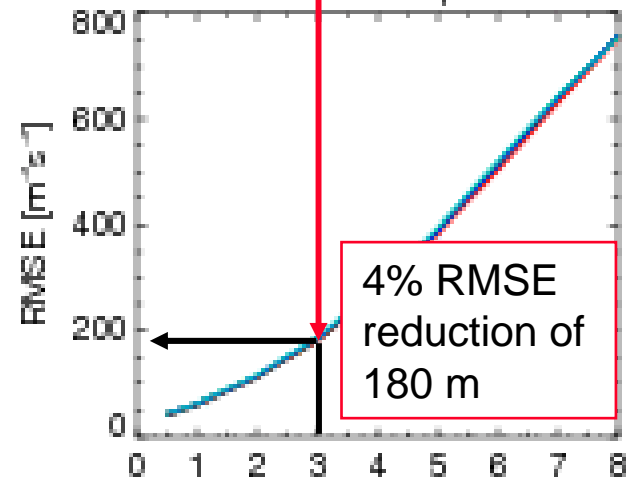
Z: -90° to -20° , 500hPa



Z: -90° to -20° , 500hPa



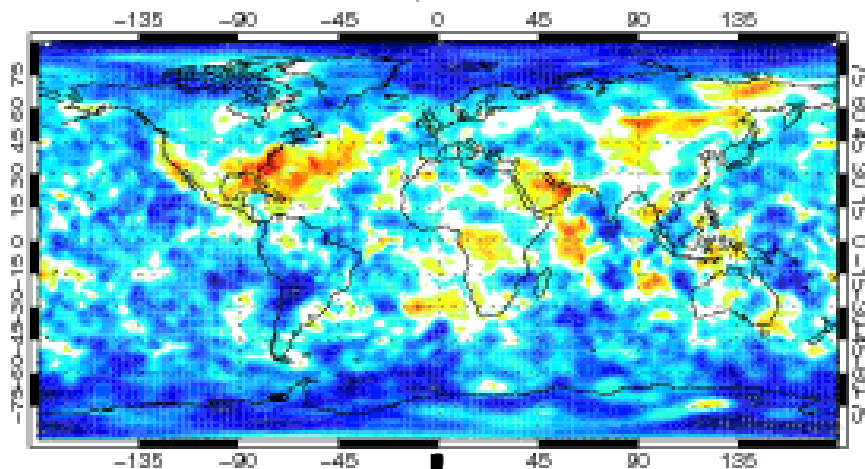
Z: -90° to -20° , 500hPa



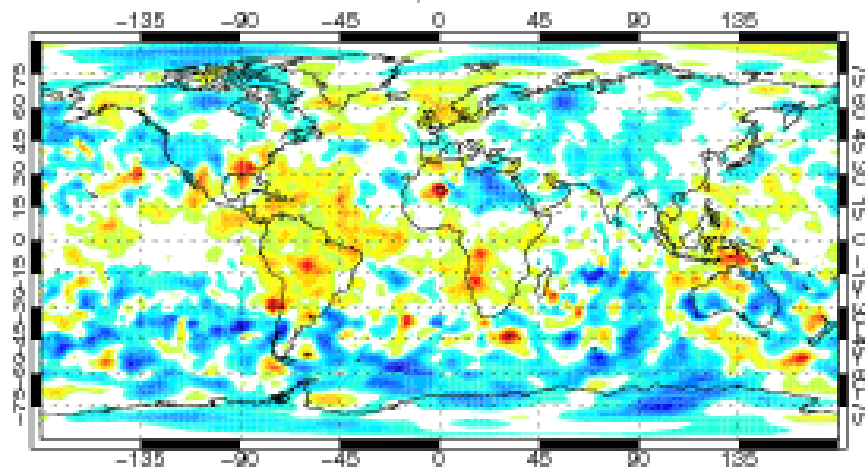
Forecast impact: z – D08JF09

EXP-HI – EXP

T+12; 500hPa

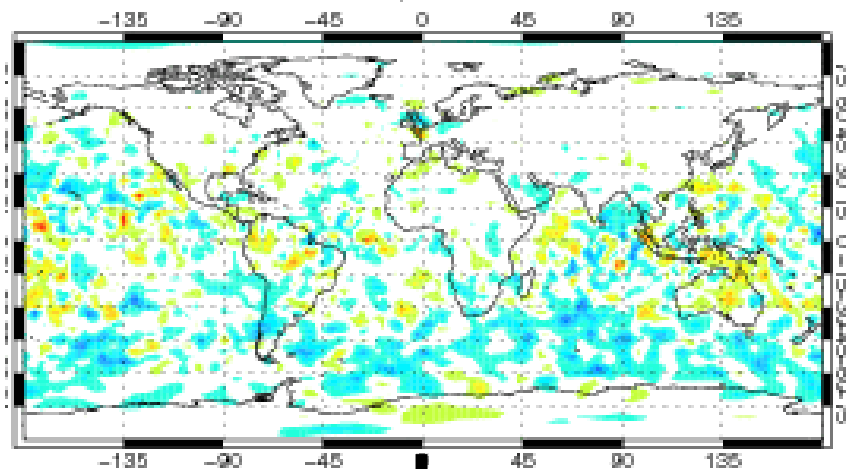


T+72; 500hPa

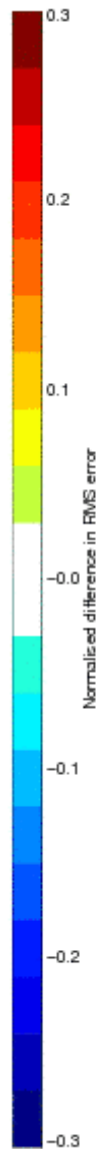
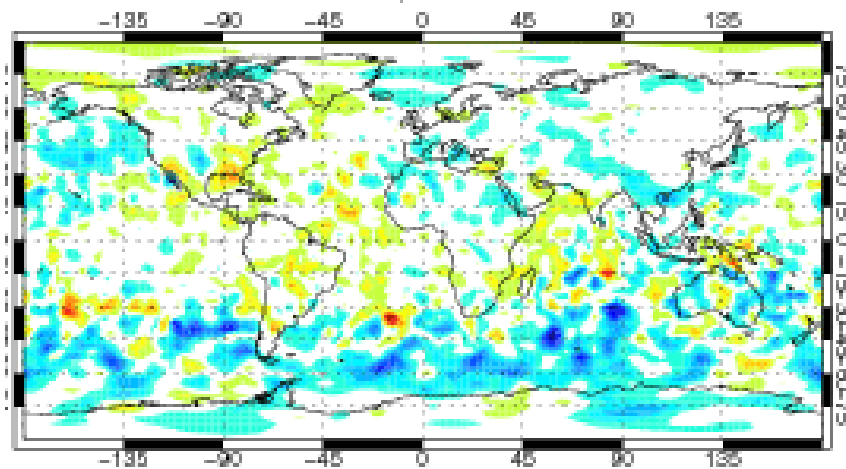


EXP-SV – EXP

T+12; 500hPa



T+72; 500hPa



Conclusions

Global data thinning (not shown):

- Current operational setting (1.25°) is too conservative and satellite data density could be increased.
- 0.625° thinning will be considered for operational implementation (note Niels Bormann's study on error correlation).

Selective data thinning:

- Previous-year climatology more representative of average conditions in DJF than JAS \Rightarrow climatology-type thinning bears risks
- DFS demonstrates observation contribution to analysis through combination of observation number, observation errors, model background errors and model contributions \Rightarrow less data in SH winter produces higher DFS
- In D08JF09, all experiments (EXP-SV/CLI/RND) perform better than in JAS08.
- In D08JF09, forecast scores are best for EXP-SV and similar to EXP-HI after 72h; JAS08 is more neutral \Rightarrow 15% more data in sensitive areas can match impact of 100% more data (season dependent!)

International TOVS Study Conference, 17th, ITSC-17, Monterey, CA, 14-20 April 2010.
Madison, WI, University of Wisconsin-Madison, Space Science and Engineering Center,
Cooperative Institute for Meteorological Satellite Studies, 2011.