Recent data assimilation activities at the Hungarian Meteorological Service

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Content

- Local surface assimilation (CANARI OI)
- Experiments with ETKF (Ensemble Transform Kalman Filter)
- Exploit more data in 3D-VAR: FGAT and 3-hour cycling
- OPLACE: Observation Preprocessing for LACE
- Improved 2m observation operator (László Kullmann's talk)

Local surface assimilation

New operational setting (October 2008):

- CANARI OI analysis for the surface
    1. 2m T and RH increments from 2m obs (OI)
    2. project 2m increments to the surface and soil
- Fully local assimilation: OI (surf) + 3DVAR (atm)
- SST analysis still from the global model

New LBC settings:

- More freedom with fully local initial conditions
- ECMWF LBCs in assimilation and production (use ARPEGE as backup)
- LBCs from ECMWF are used with a 6 hour time-lag (i.e. at 00 UTC use LBCs from the 18UTC run, etc.)

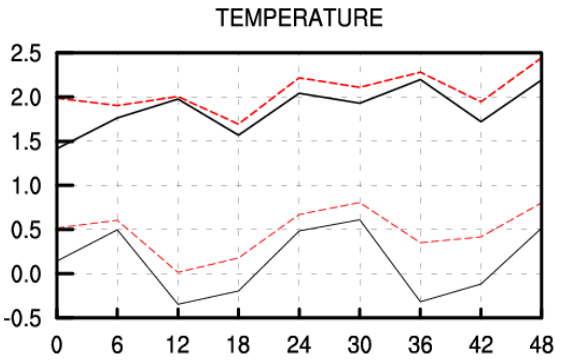
Local surface assimilation

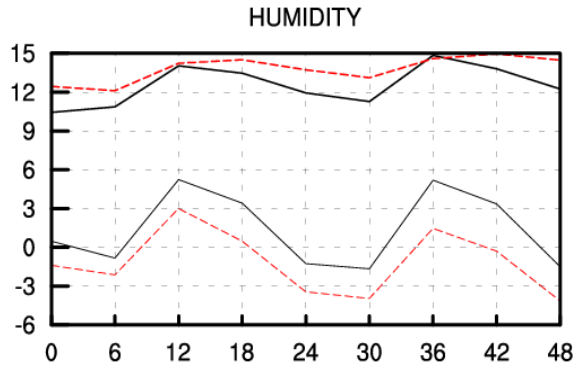
Local surface assimilation and new LBCs

Red: reference

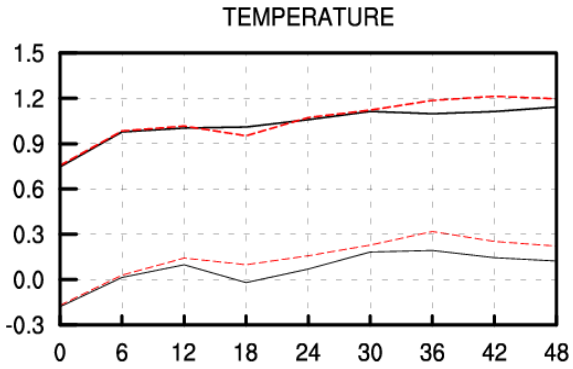
Black: new setup

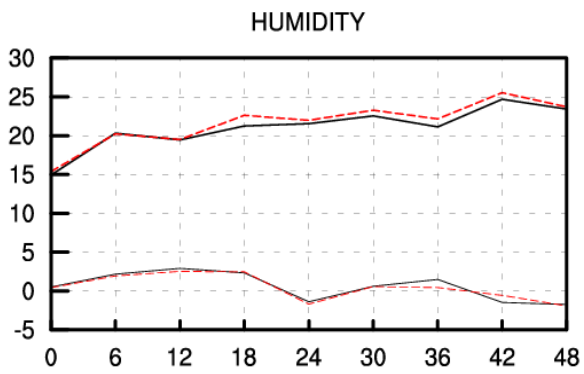
2m





700 hPa





Experiments with ETKF

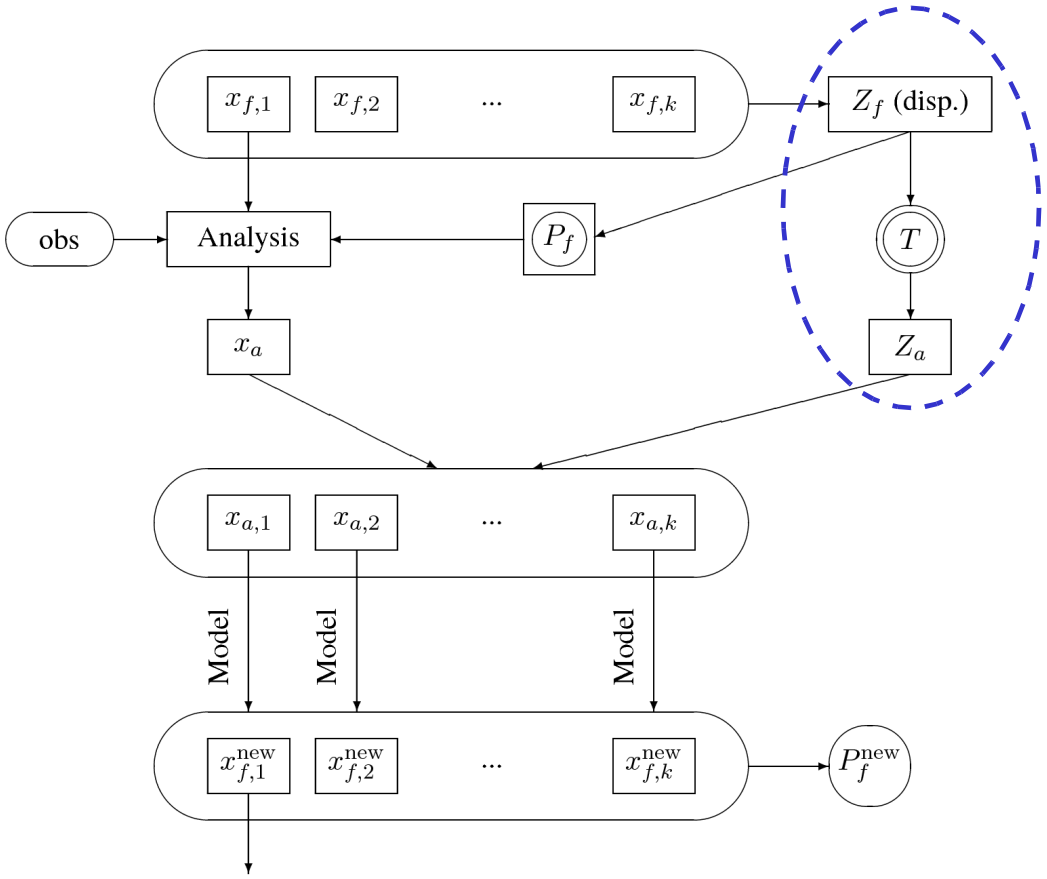
Reminder ETKF:

$$Z_a = Z_f T$$

$$T = C\left(\Gamma + I\right)^{-1/2} C^T$$

Where C and Γ comes from the diagonal decomposition below:

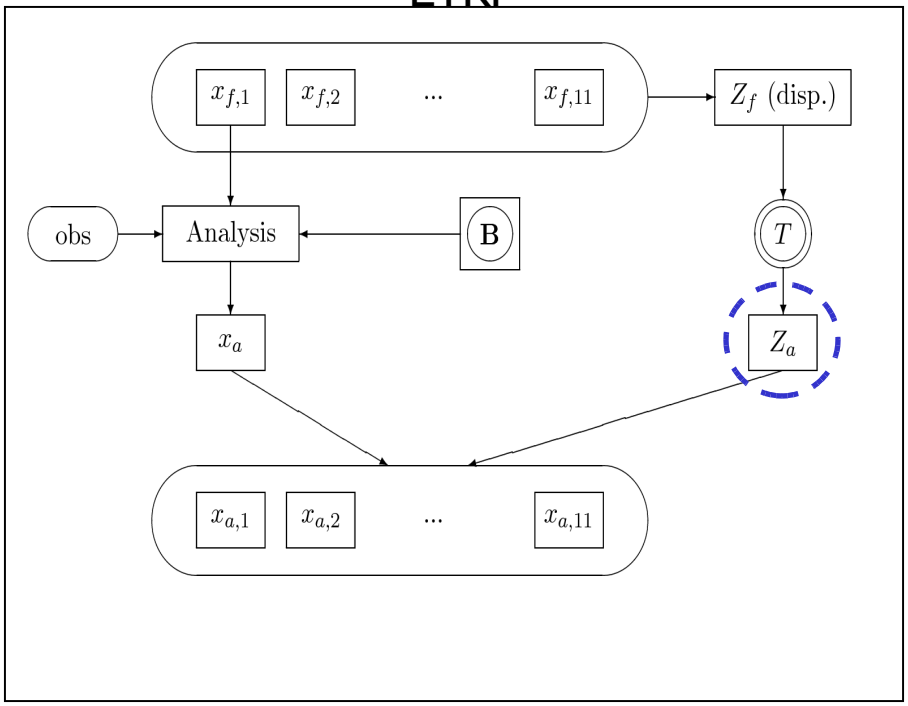
$$Z_f^T H^T P_o^{-1} H Z_f = C\ \Gamma\ C^T$$



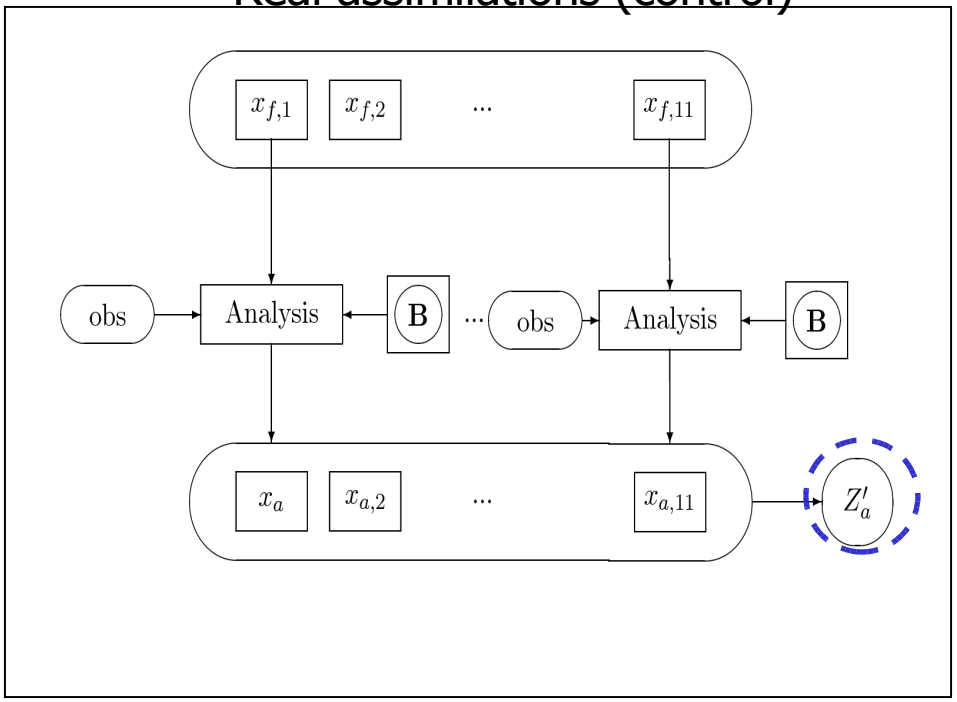
Experiments with ETKF

Basic test of the Transform matrix

ETKF



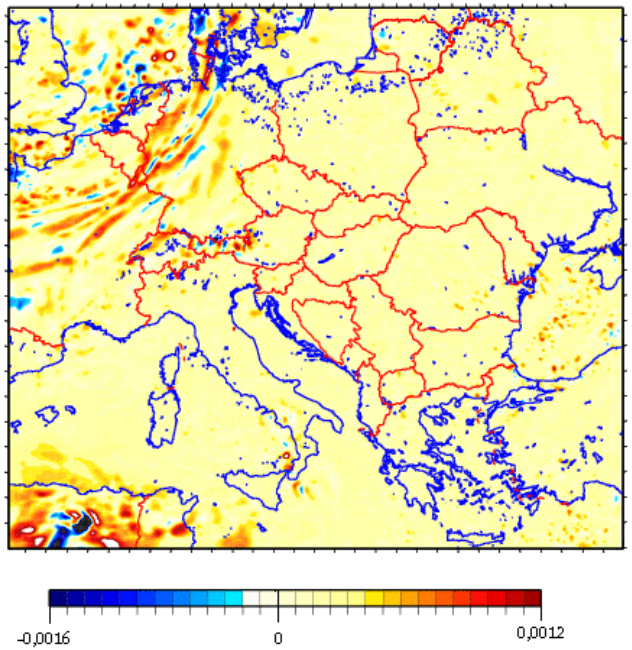
Real assimilations (control)



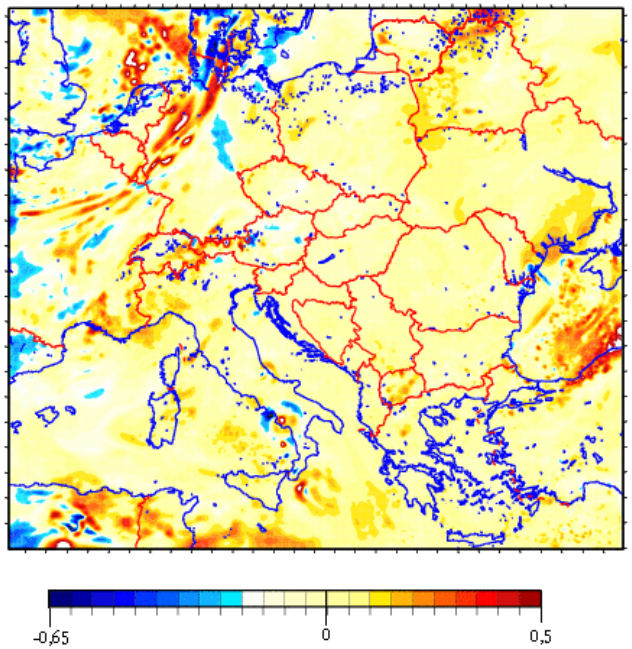
Experiments with ETKF

Basic test of the Transform matrix

ETKF



Real assimilations (control)

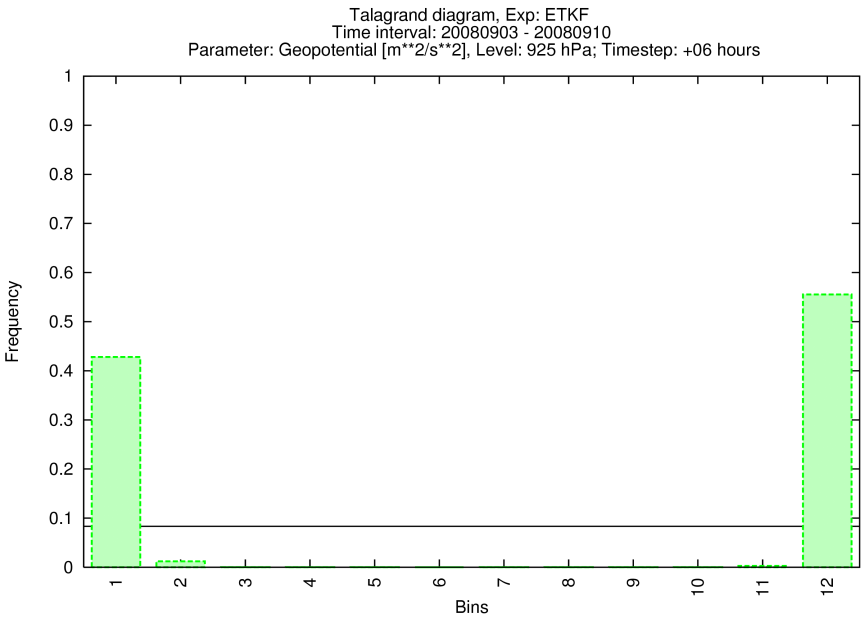


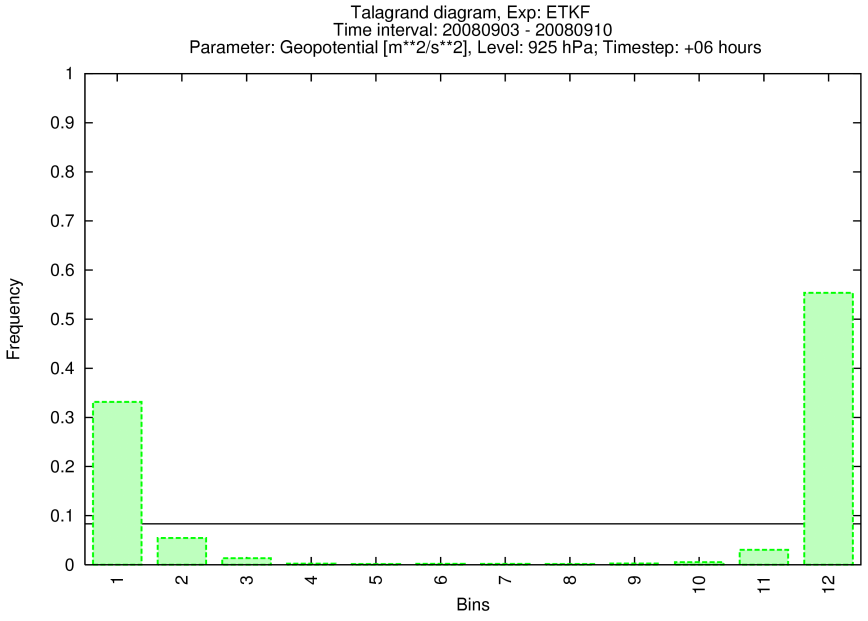
- Similar structures but small amplitudes with ETKF ➔ „Inflation”

Experiments with ETKF

The inflation method (*Désroziers et al, 2005, Wang and Bishop, 2003*)

$$Z_a = Z_f \Pi$$

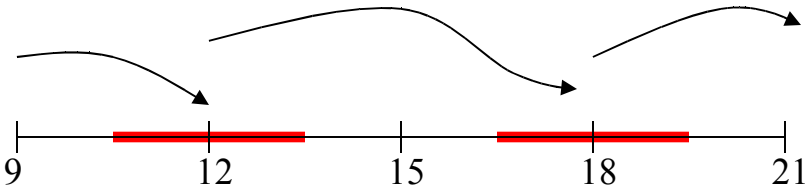




FGAT and 3-hour cycling

Motivation: exploit the available high-frequency data in the assimilation cycle

Example: use of AMDARs in the 3D-VAR at HM



„sm
win

Short term strategy:

- 3-hour cycling: more data even with „small" ob
- FGAT: reduce the innovation error ➔ „large" o

Long term strategy: 4D-VAR (hourly data f

Expectation for improving the data usage

	6h (oper)	3h	+ FGAT
SYNOP	15%	30%	
TEMP	100%	100%	
AMDAR	50%	100%	✓
Wind Prof	15%	30%	
AMSU (NOAA)	100%	100%	✓
GEOWIND (MSG2)	15%	30%	
SEVIRI (MSG2)	15%	30%	

FGAT and 3-hour cycling

Experiments:

- 2 weeks period, Jan 2009
- Oper: 6-hour cycle
- Exp1: 3-hour cycle
- Exp2: 6-hour cycle + FGAT
- Exp3: 3-h cycle + FGAT

Goals:

- Confirm earlier results based on a summer period (Exp1 and Exp2)
- Pragmatic choice for a „best" configuration based on objective scores (verif against obs, ARPEGE and ECMWF analyses)

FGAT and 3-hour cycling

Impact of FGAT

Impact of 3-h cycling

Impact of both

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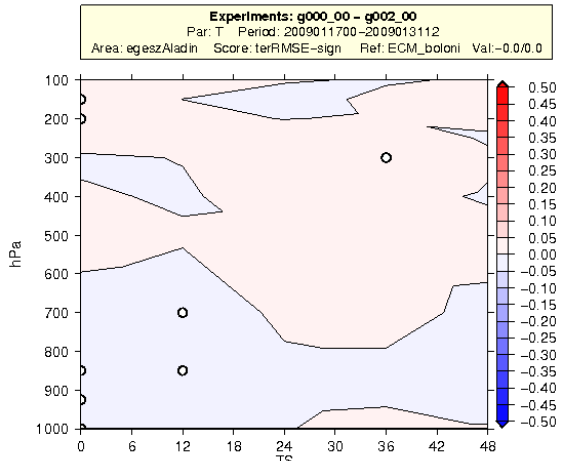
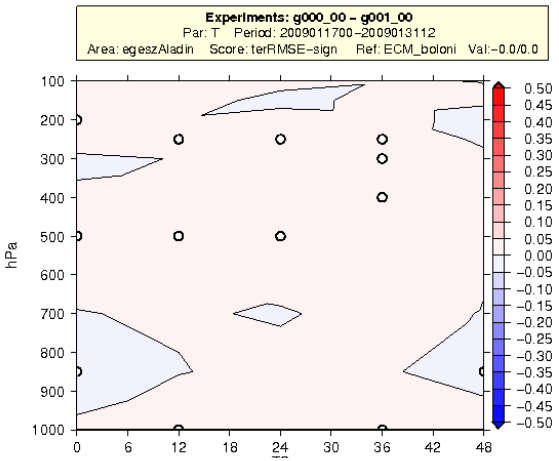
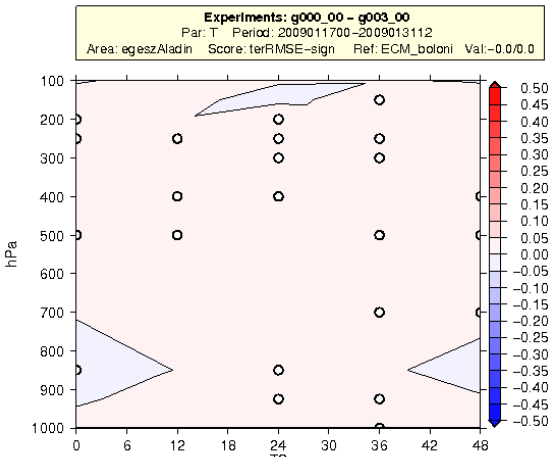
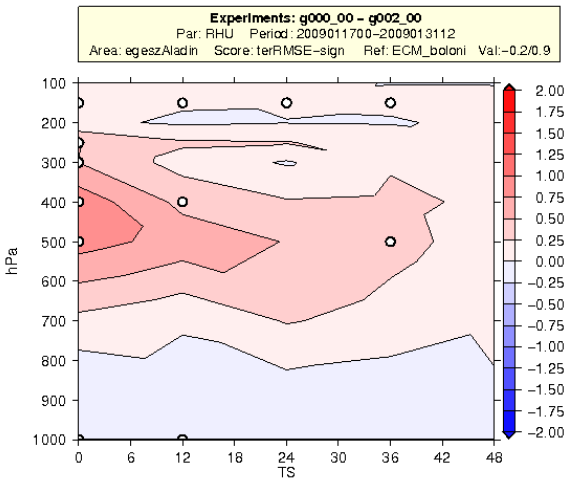
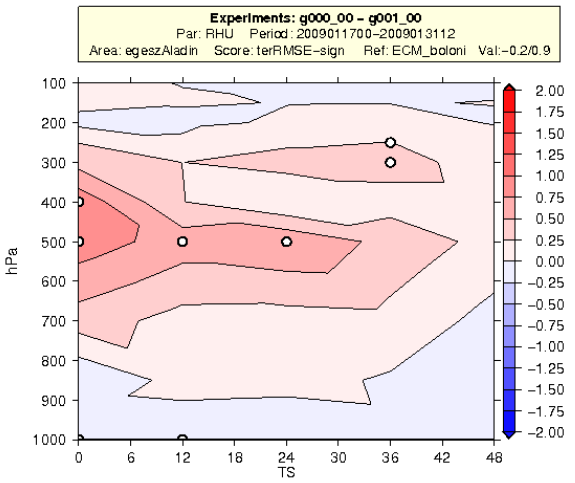


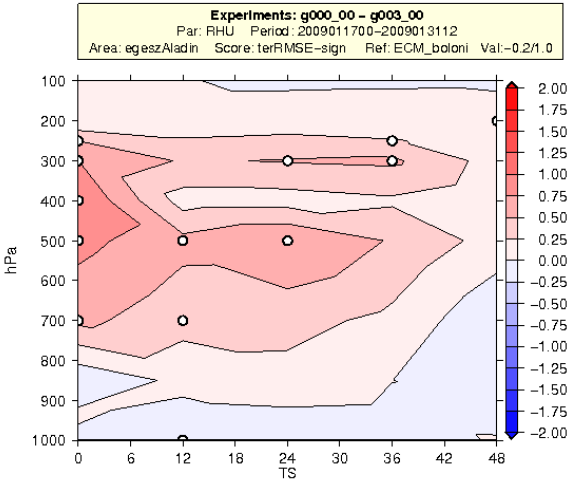




RH







FGAT and 3-hour cycling

Impact of FGAT | Impact of 3-h cycling | Impact of both

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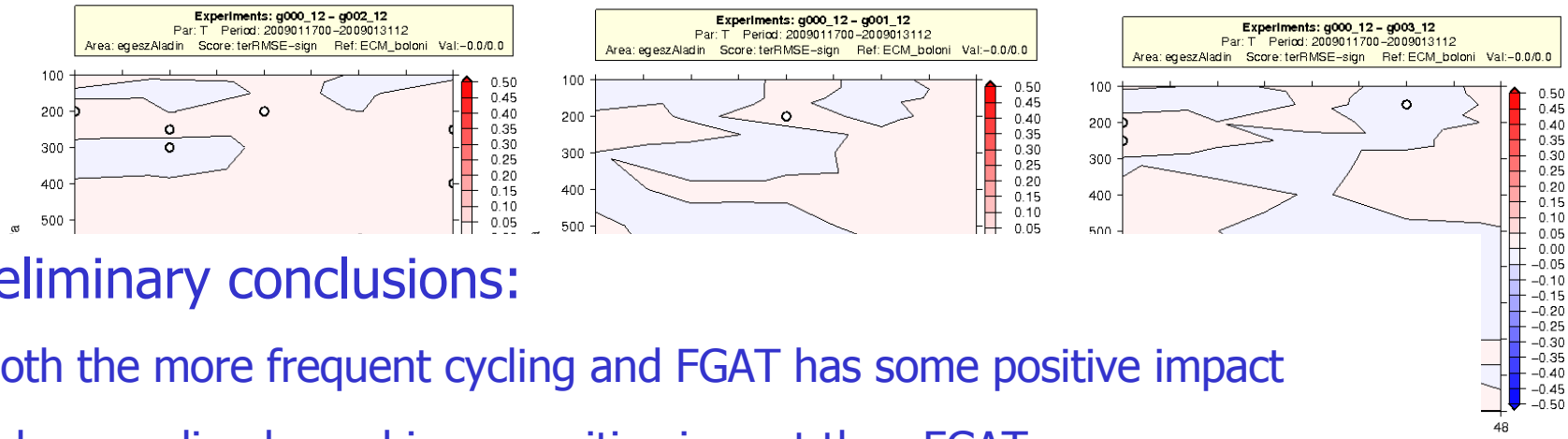
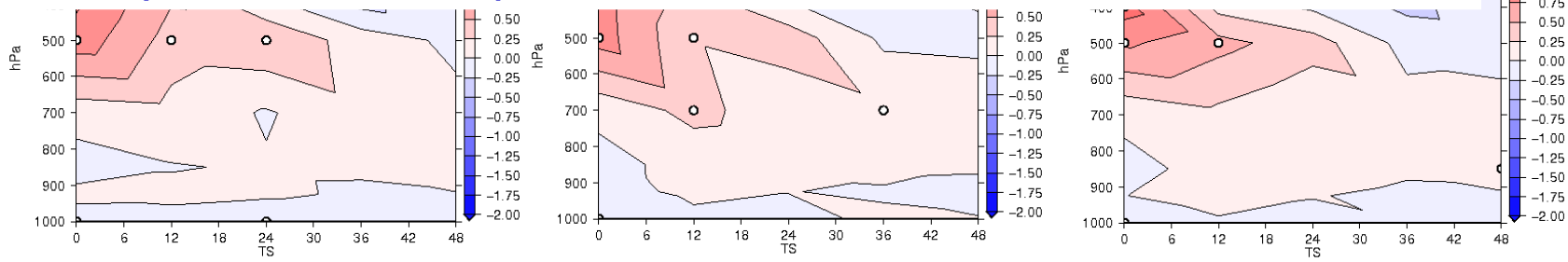


Preliminary conclusions:

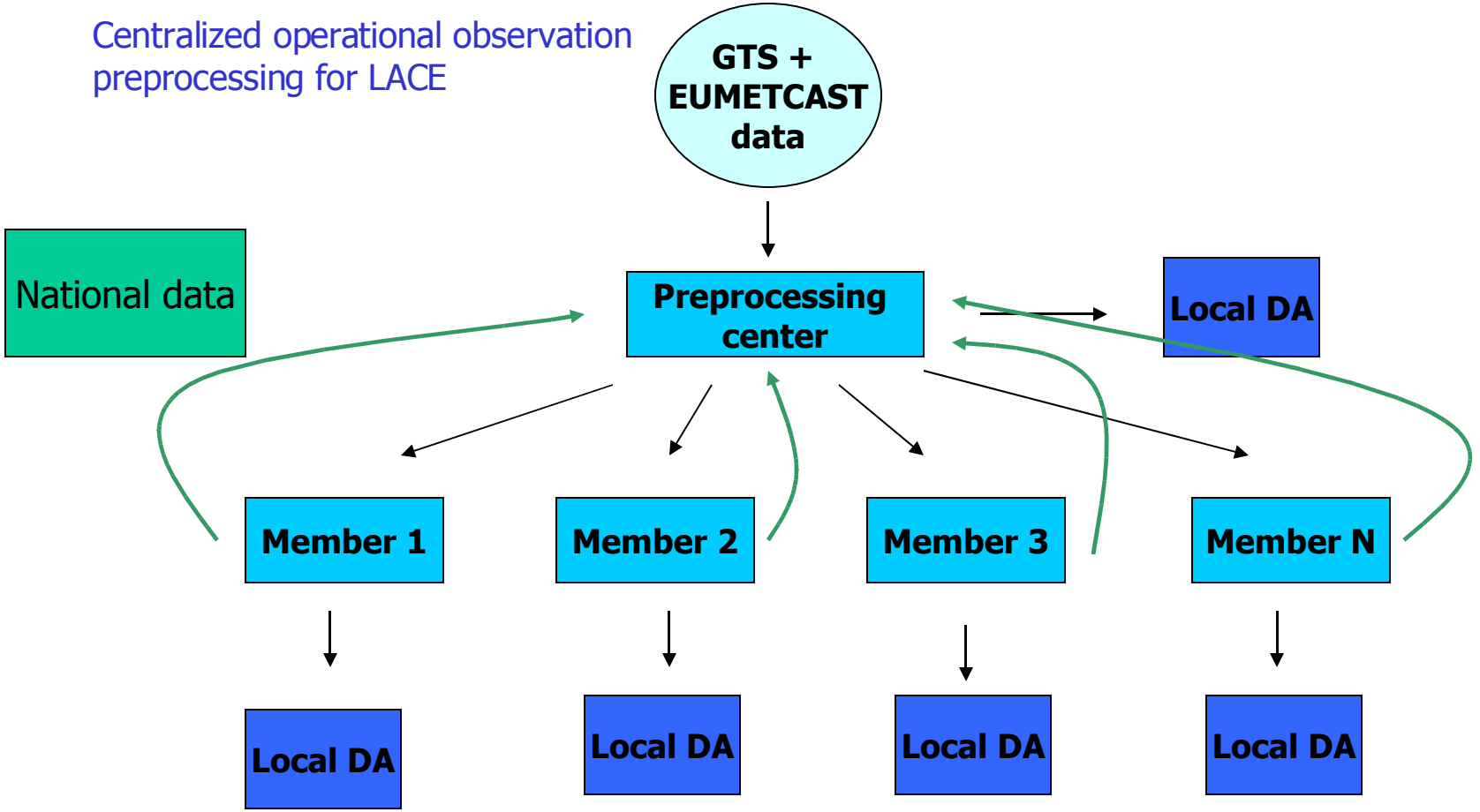
- both the more frequent cycling and FGAT has some positive impact
- 3-hour cycling has a bigger positive impact than FGAT
- FGAT on the top of 3-hour cycling can have a positive impact (for 00 UTC)
- Generally there is more impact at 00 UTC than at 12 UTC

RH



OPLACE

Centralized operational observation preprocessing for LACE



OPLACE

- Preprocessing center is the Hungarian Meteorological Service
- Dissemination started in Jan 2009
- GTS and EUMETCAST data are treated
- Later include national data from all members (from 2010 on?)
- ASCII and GRIB (later BUFR instead of ASCII)
- 1 file / timeslot / obstype (for FGAT, 4DVAR, OSEs)
- Download via Ftp from HMS
- Data updated every 30 min

OPLACE

First experiences

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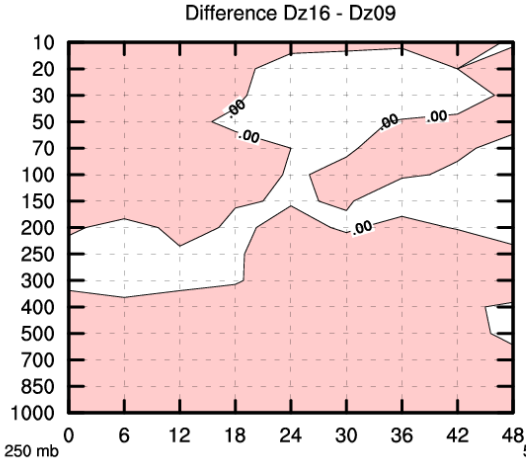
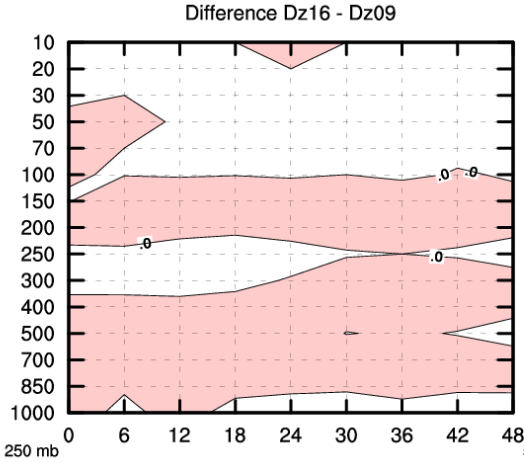
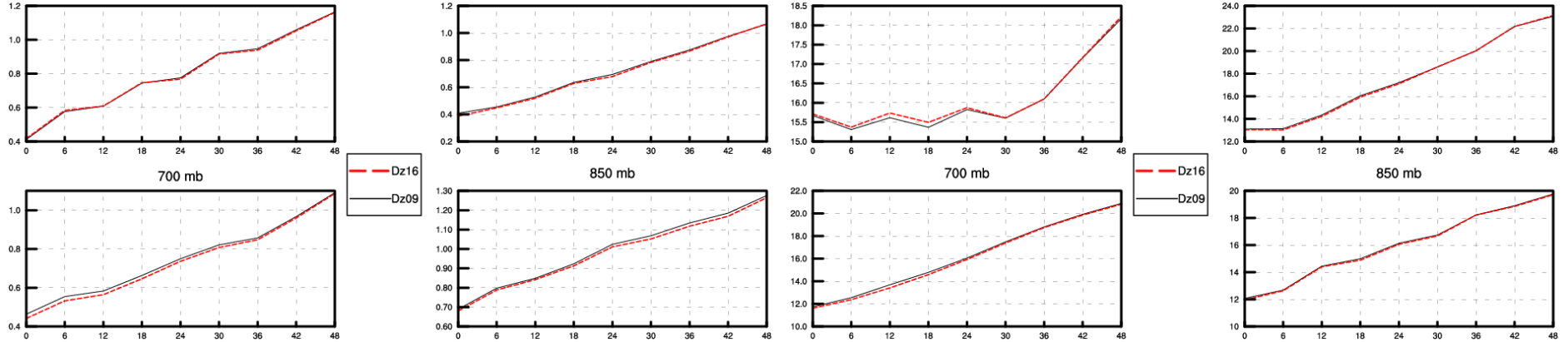


RH



Red: OPLACE

Black: CZ data



Thank you for your attention

References:

Wang X., C.H. Bishop, 2003: A comparison of Breeding and Ensemble Transform Kalman Filter Ensemble Forecast Schemes. *JAS 60*, 1140-1158

Désroziers G., l. Berre, B. Chapnik and P. Poli, 2005: Diagnosis of observation, background and analysis error statistics in observation space *QJRMS 131*, 3385-3396

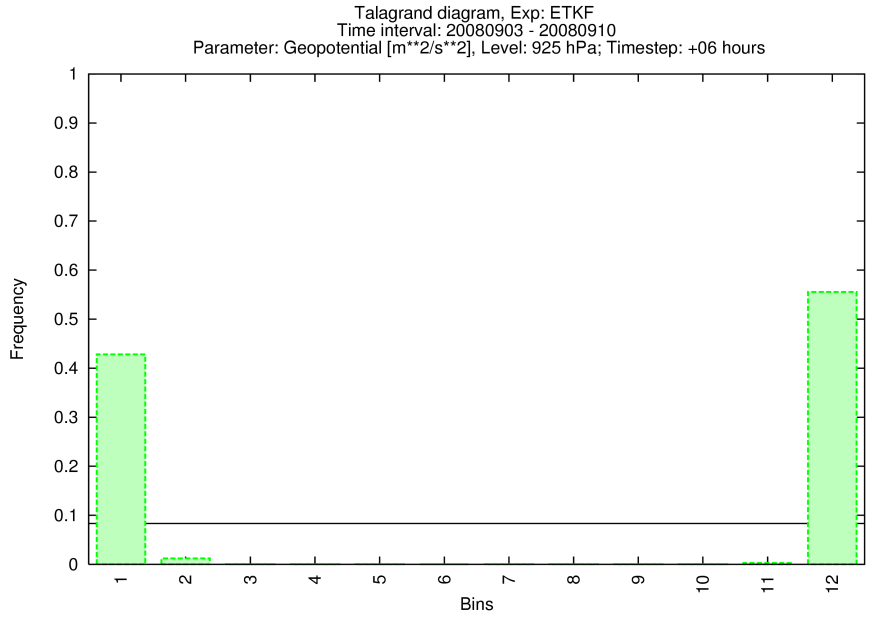
Experiments with ETKF

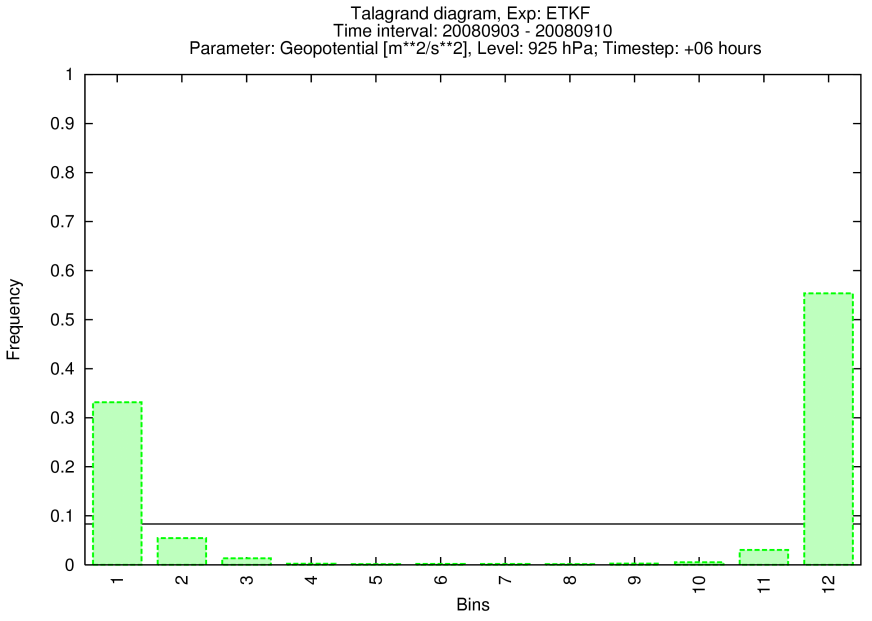
The inflation method (*Wang and Bishop, 2003*)

$$Z_a = Z_f T \Pi$$

Time dependent inflation factor:

$$\Pi_i = \sqrt{\frac{\tilde{d}_i^T \tilde{d}_i - p}{\sum_{k-1} \lambda_j}}$$





FGAT and 3-hour cycling

Expectations for an improved data usage (used / available)

	6h (oper)	6h + FGAT	3h	3h + FGAT
SYNOP	15%	15%	30%	30%
TEMP	100%	100%	100%	100%
AMDAR	50%	100%	100%	100%
Wind Prof	15%	15%	30%	30%
AMSU (NOAA)	100%	100%	100%	100%
GEOWIND (MSG2)	15%	15%	30%	30%
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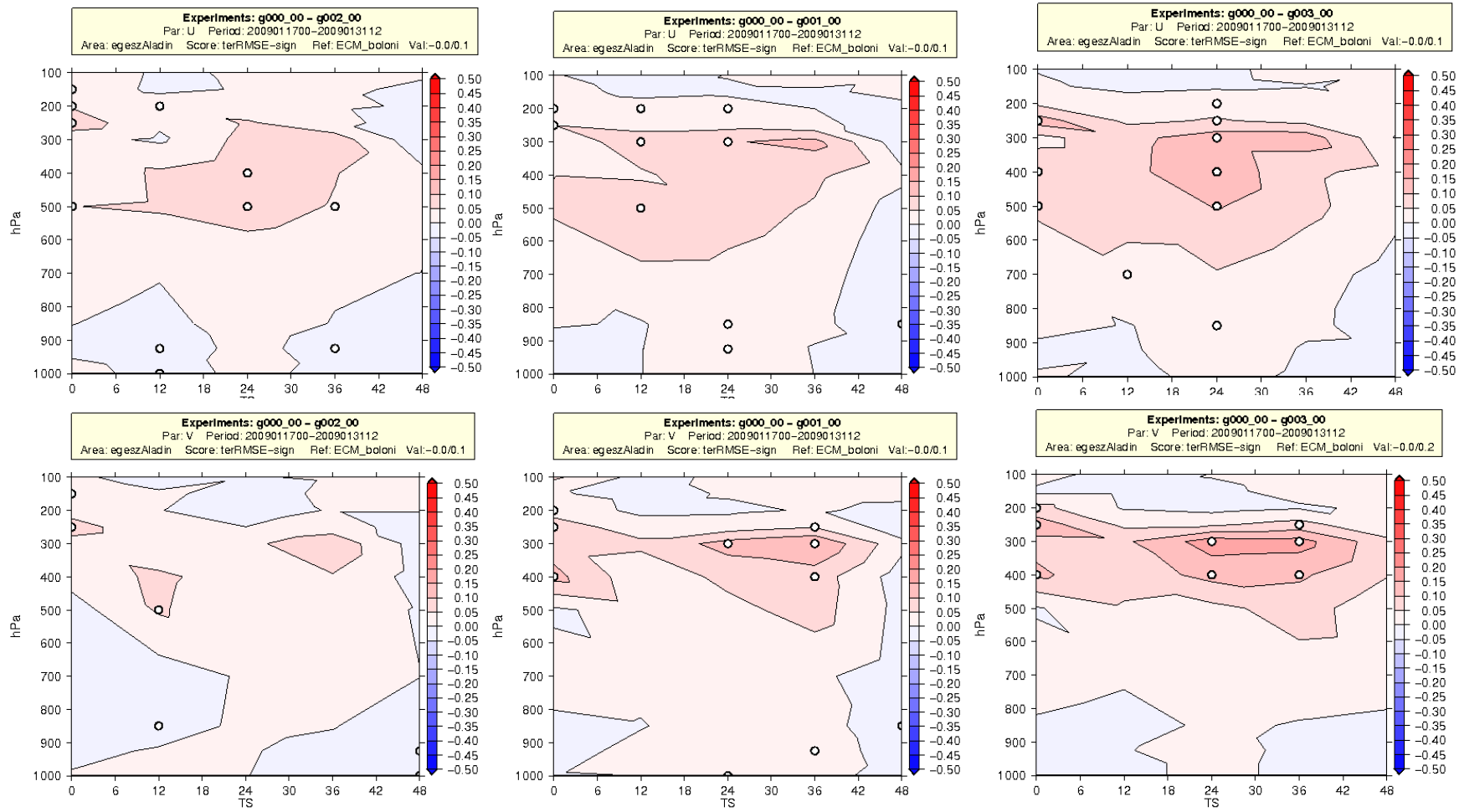
FGAT and 3-hour cycling

Verification results:



FGAT and 3-hour cycling

Verification results: