Developments in data assimilation for LACE

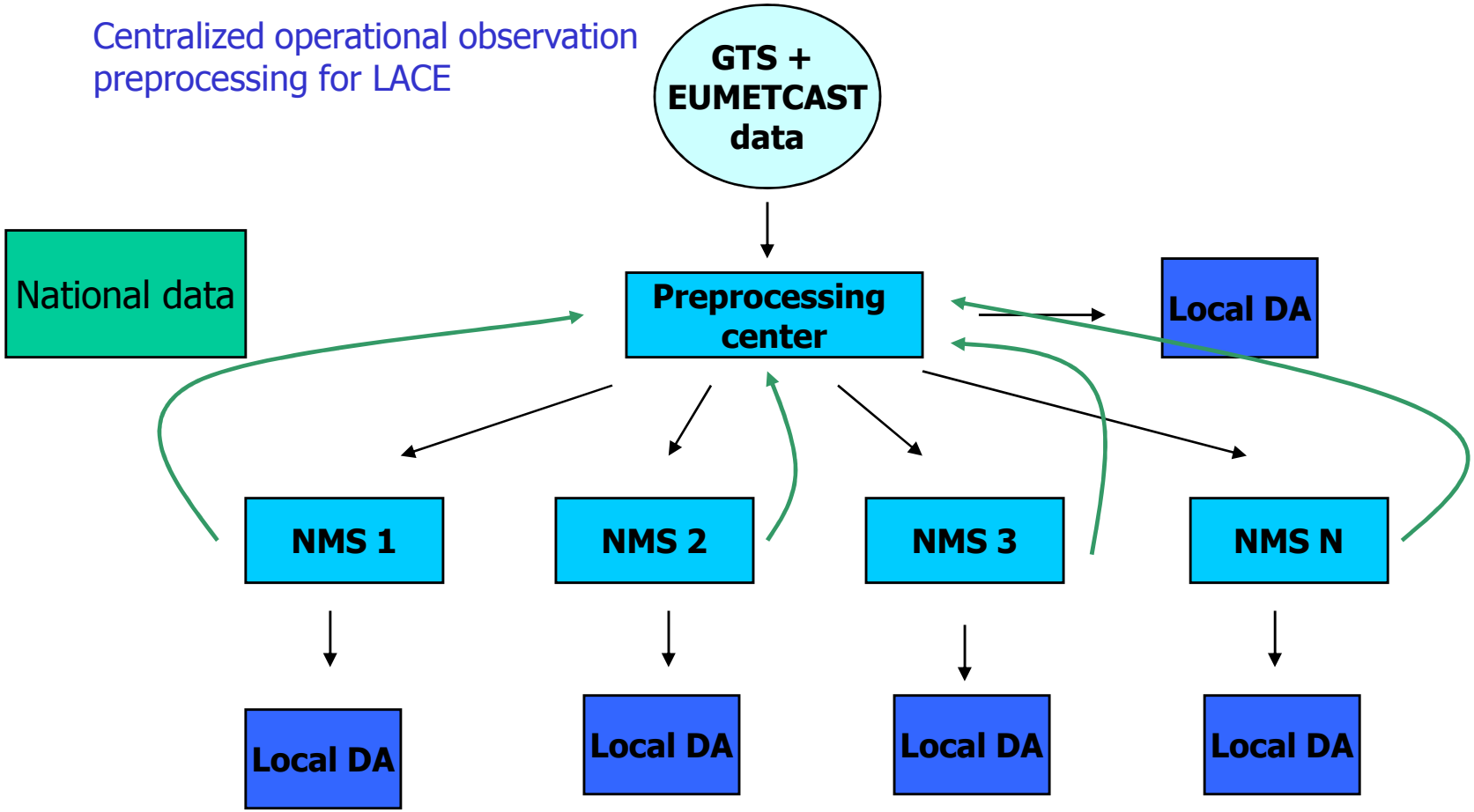
Gergely Bölöni, Edit Adamcsek, László Szabó, Alena Trojáková, Xin Yan, Florian Meier, Tomislav Kovacic, Antonio Stanesic, Jure Cedilnik, Benedikt Strajnar

Content

1. OPLACE: Observation Preprocessing for LACE
2. Progress in DA implementations
3. Benefit more from available obs: 3-hour cycling and FGAT
4. Experiments with ETKF (Ensemble Transform Kalman Filter)

OPLACE

Centralized operational observation preprocessing for LACE



OPLACE

What's inside?

- GTS and EUMETCAST data
- Later include national data fr
- ASCII and GRIB (later BUFR i
- 1 file / timeslot / obstype (for
- Download via Ftp from HMS
- Data updated every 30 min

SYNOP & SHIP	P_s, T, RH, u, v
AMDAR	u, v, T
TEMP	u, v, T, q
Wind Profiler	u, v
MSG2/SATOB	u, v
AMSU-A (NOAA15-18)	Tb
AMSU-B (NOAA17)	Tb
MHS (NOAA18)	Tb
HIRS (NOAA15-18)	Tb
MSG2/SEVIRI	Tb

OPLACE

How it's used?

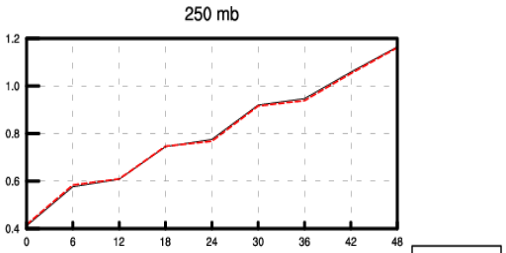
- Preprocessing center is the Hungarian Meteorological Service
- Dissemination started in Jan 2009
- tested in almost all LACE countries (bugs found and corrected)
- detailed tests at Czech Rep (3 weeks BlendVar run comparing locally processed and OPLACE data ➔ comparable results)
- OPLACE used operationally in Hungary (July 2009)

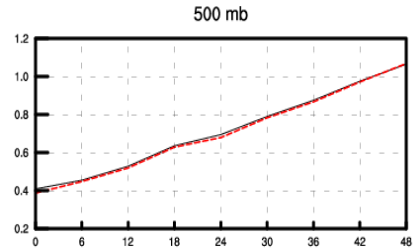
OPLACE

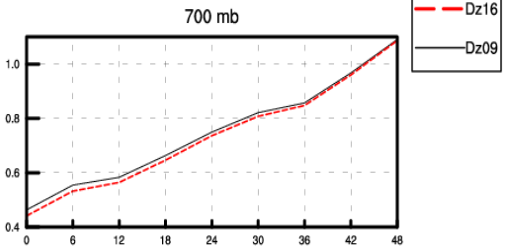
Red: OPLACE

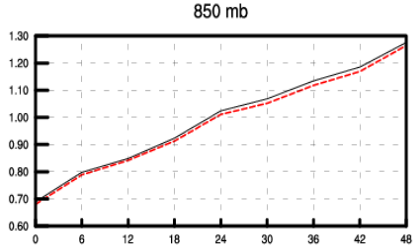
Black: CZ data

Temperature

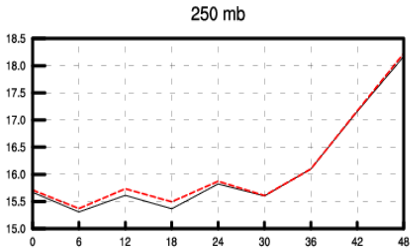


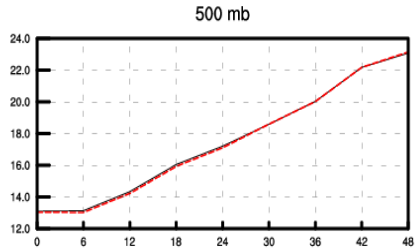


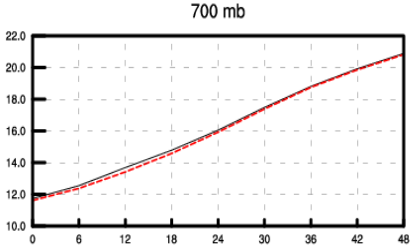


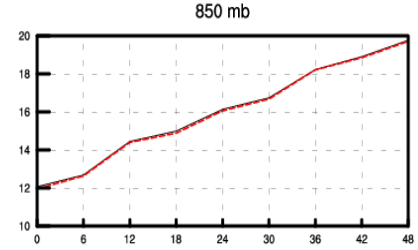


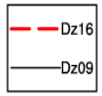
Relative humidity











Progress in DA implementations

- Regular DA runs in 5 countries: Austria, Croatia, Czech Rep., Hungary, Slovenia

- Observations: OPLACE + local high-resolution SYNOP data

- Atm. 3DVAR + surf. OI (but wide range of cycling setups: IDFI, Blending of large scales)

- Improvement at 2m but not always above 850 hPa

→tuning needed: B variances, local sat bias corrections

- LACE forum is a good tool to share knowledge

Progress in DA implementations

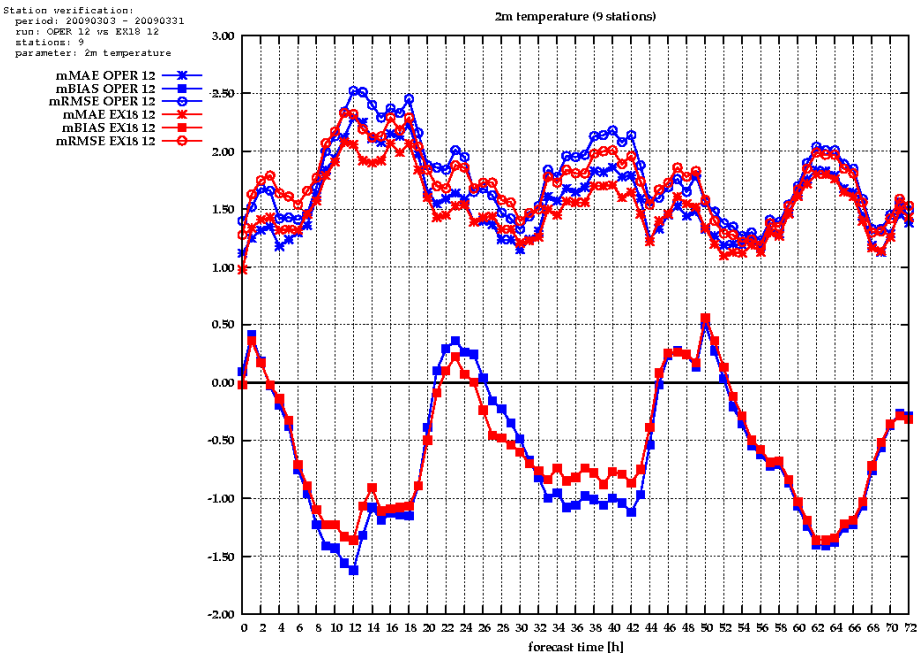
Austria: 3DVAR suite with OPLACE data (March 2009)

Blue: no DA

Red: 3DVAR

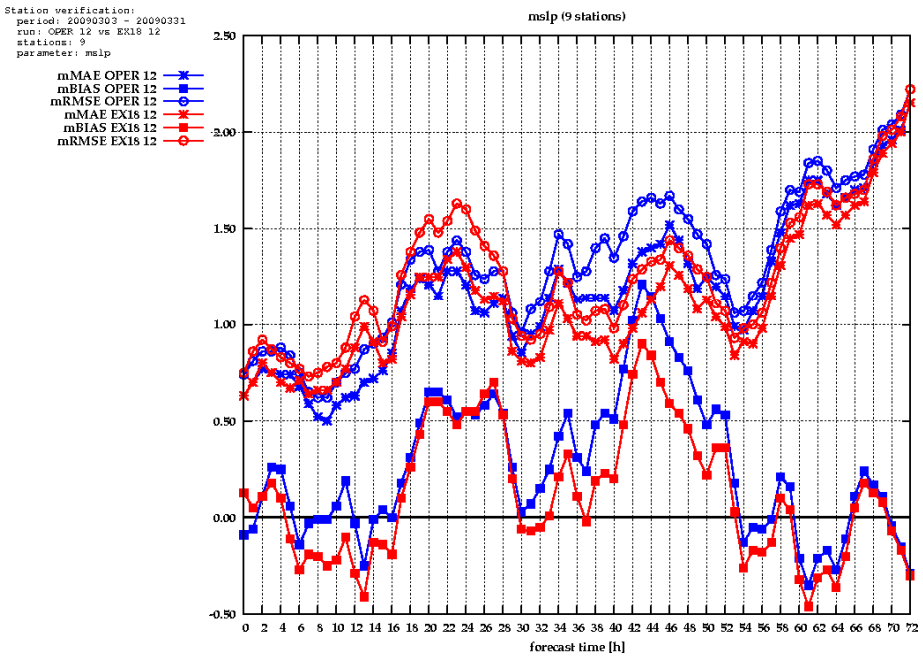
(a)

T2m



(b)

mslp



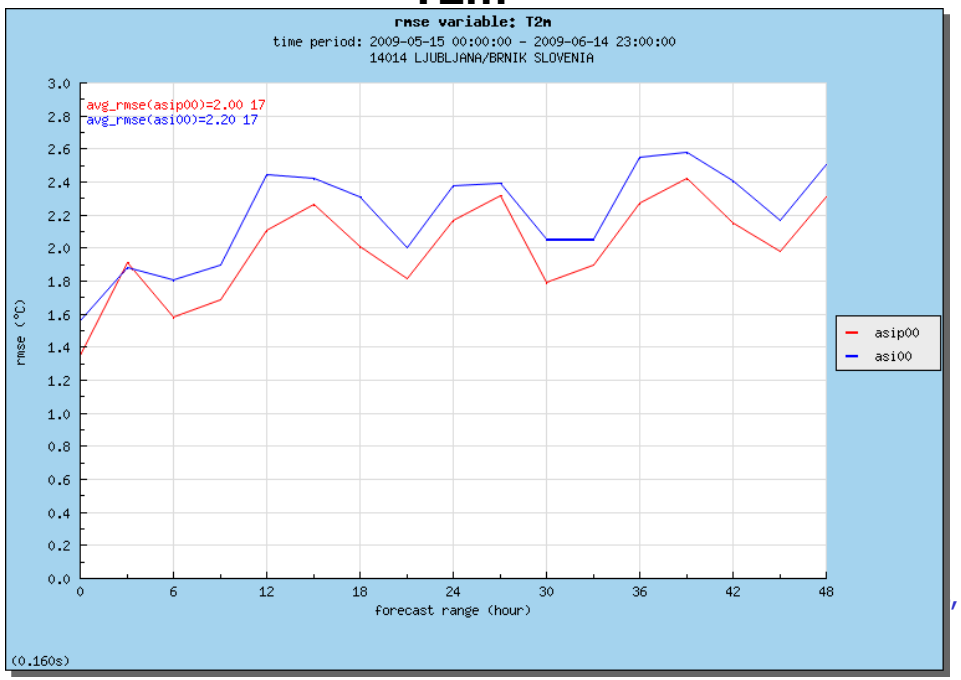
Progress in DA implementations

Slovenia: 3DVAR + CANARI suite with OPLACE data (May-June 2009)

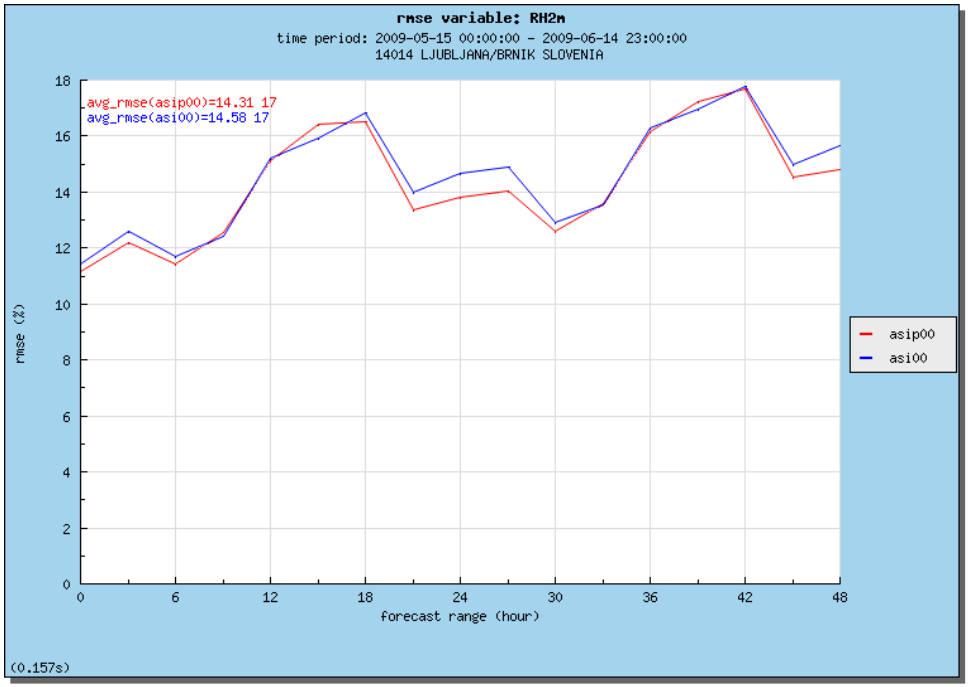
Blue: no DA (9km)

Red: 3DVAR (4km)

T2m



RH2m



Progress in DA implementations

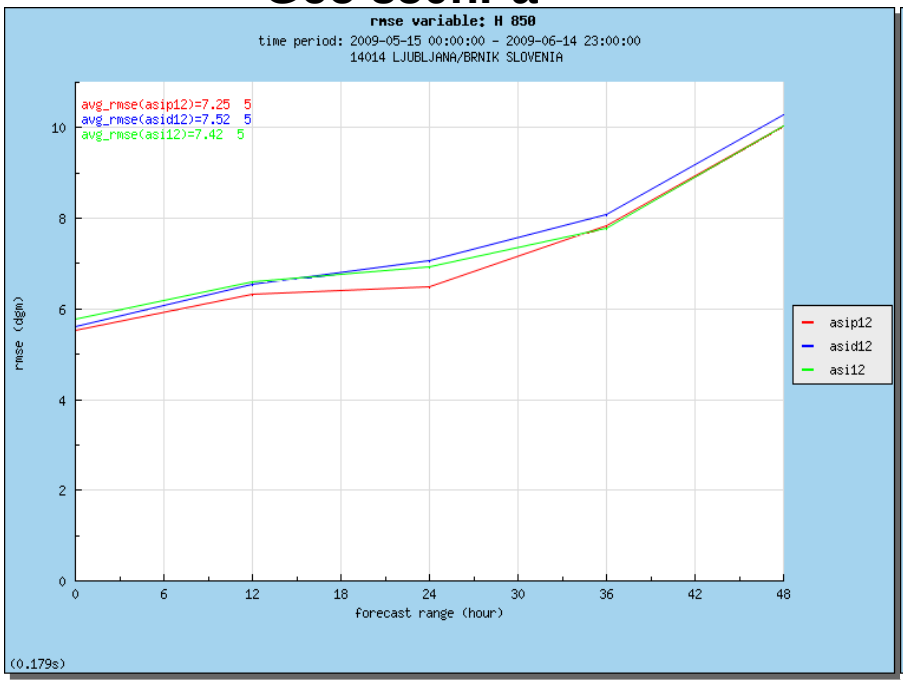
Slovenia: 3DVAR + CANARI suite with OPLACE data (May-June 2009)

Green: no DA (9km)

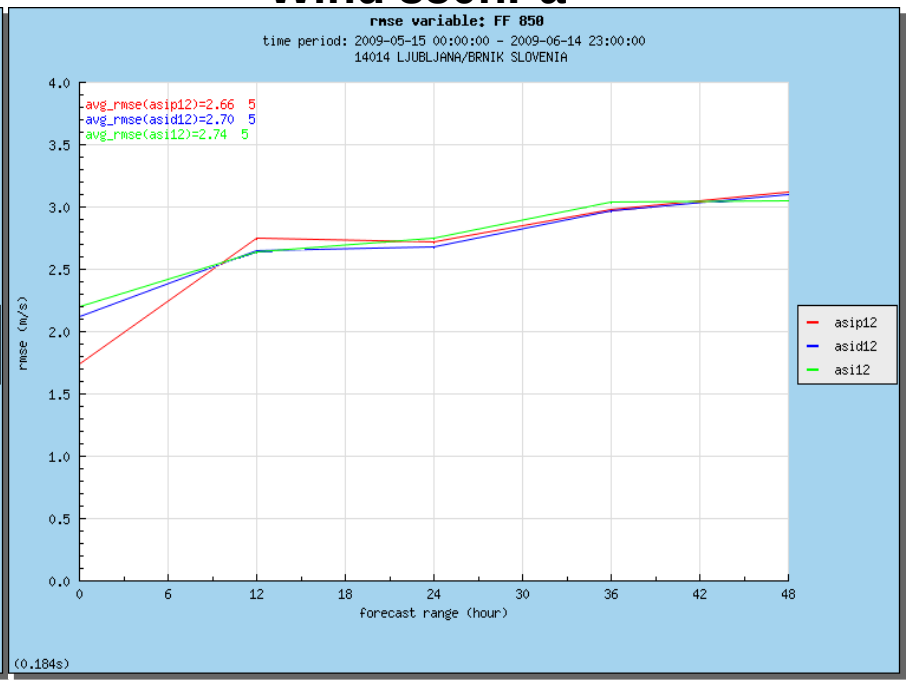
Blue: no DA (4km)

Red: 3DVAR (4km)

Geo 850hPa



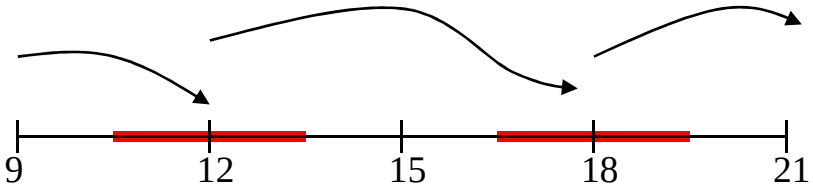
Wind 850hPa



3-h cycling and FGAT

Motivation: make more use of the available high-frequency data in the assimilation cycle

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



„sma
wind

Short term strategy:

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

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

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%	

3-h cycling and FGAT

Experiments:

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

Goals:

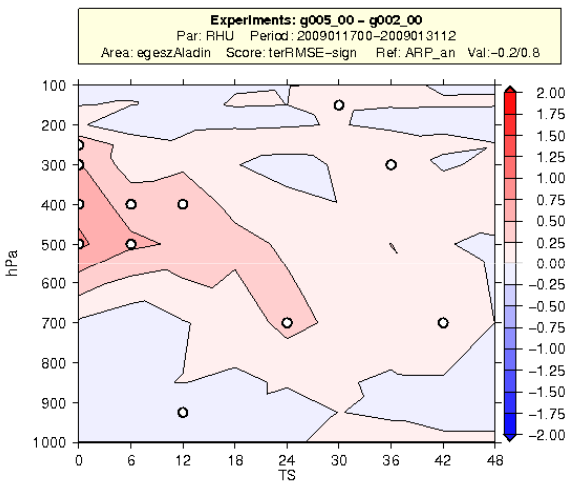
- Confirm earlier results based on a summer period (Exp1 and Exp2)
- Pragmatic choice for a „best" configuration based on objective scores (verif against obs, ARPEGE and ECMWF analyses)

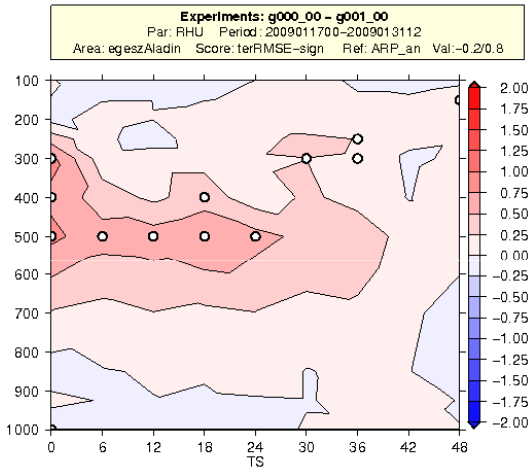
3-h cycling and FGAT

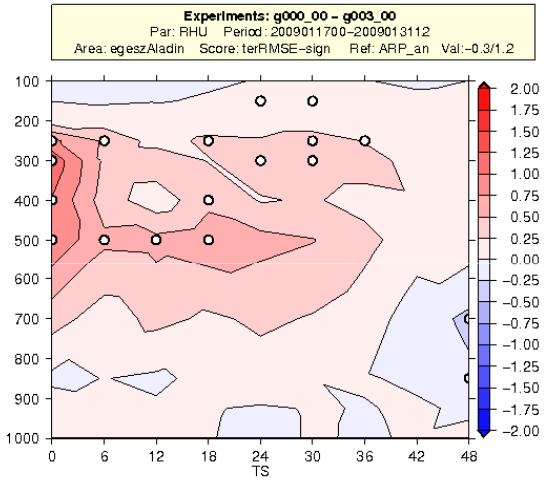
RH

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

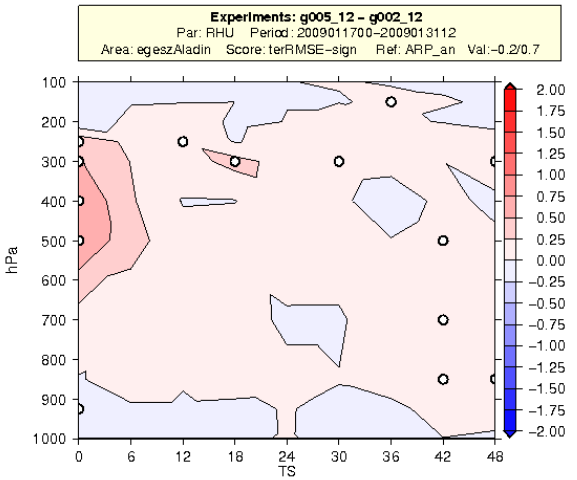
00 UTC

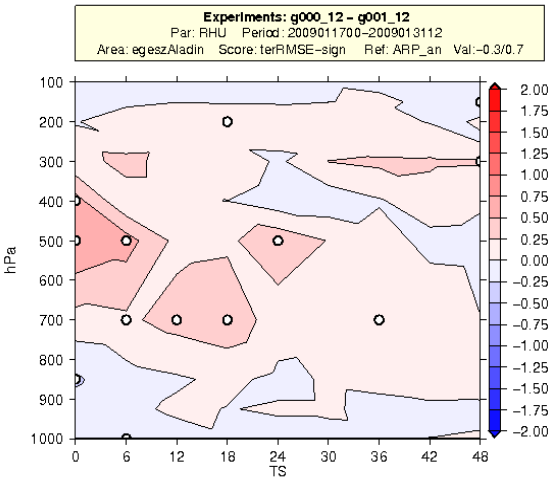


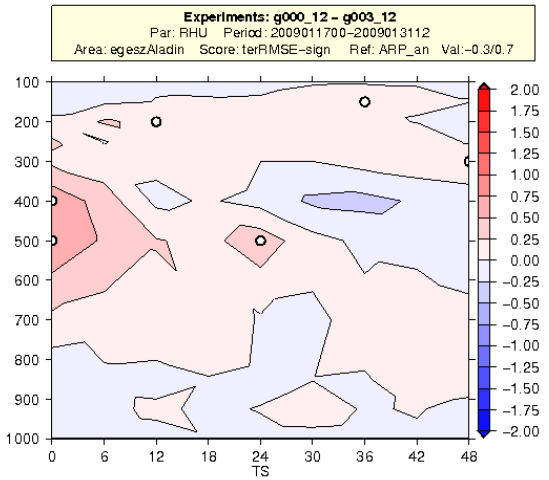




12 UTC







3-h cycling and FGAT

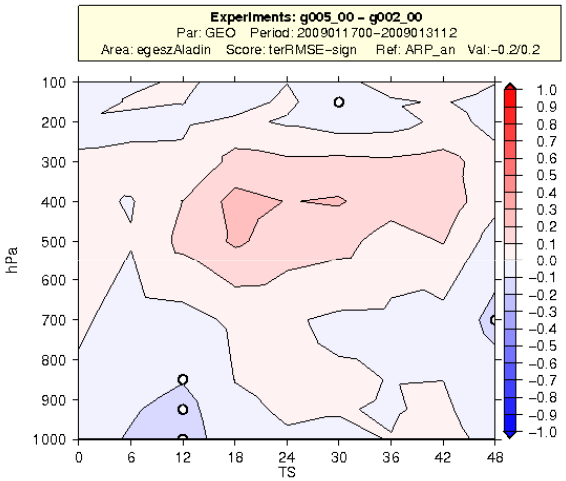
GEO

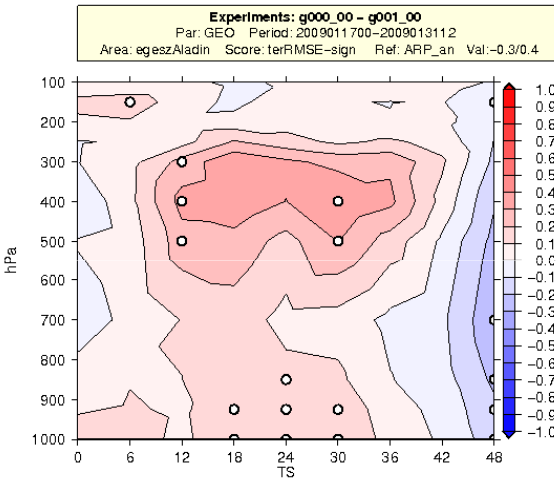
Impact of FGAT

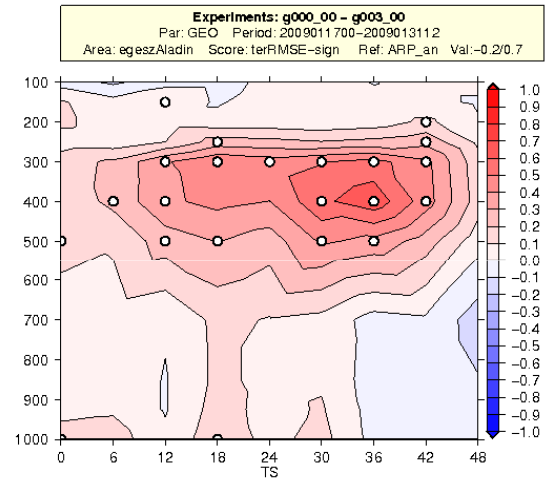
Impact of 3-h cycling

Impact of both

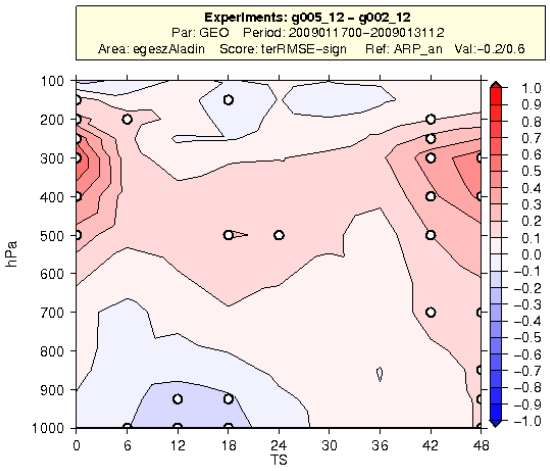
00 UTC

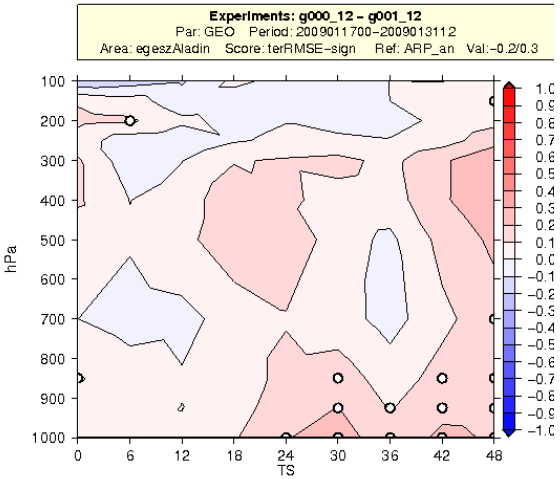


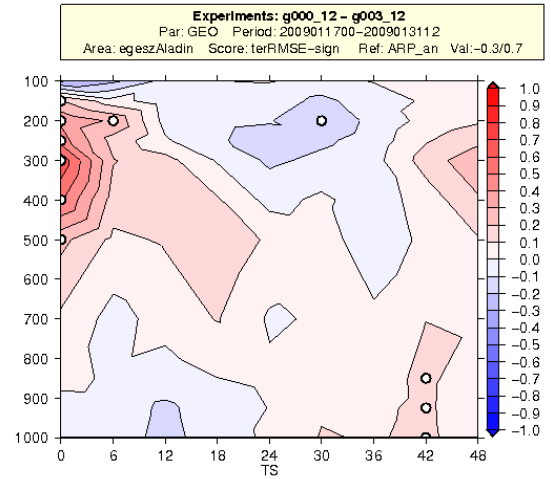




12 UTC







3-h cycling and FGAT

Conclusions & open questions:

- 3-hour cycling is a minimum step forward (significant positive impact)
- FGAT on the top of 3-hour cycling has further positive impact (mostly for 00 UTC)
- Operational implementation to be done in 2010
- Generally there is more impact at 00 UTC than at 12 UTC
- Background errors for 3h forecasts needed (?)
- Spinup of 3h forecasts to be studied

Experiments with ETKF

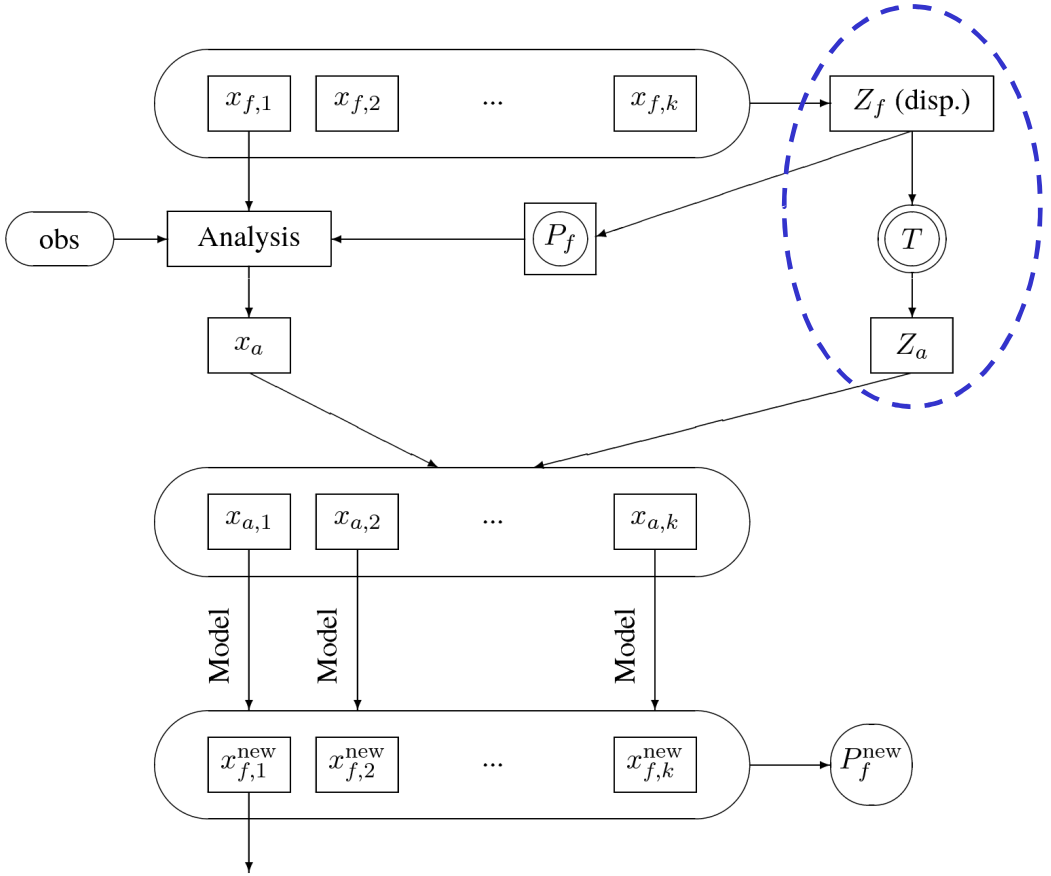
Reminder ETKF:

$$Z_a = Z_f T$$

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

Where C and Γ comes from the diagonal decomposition below:

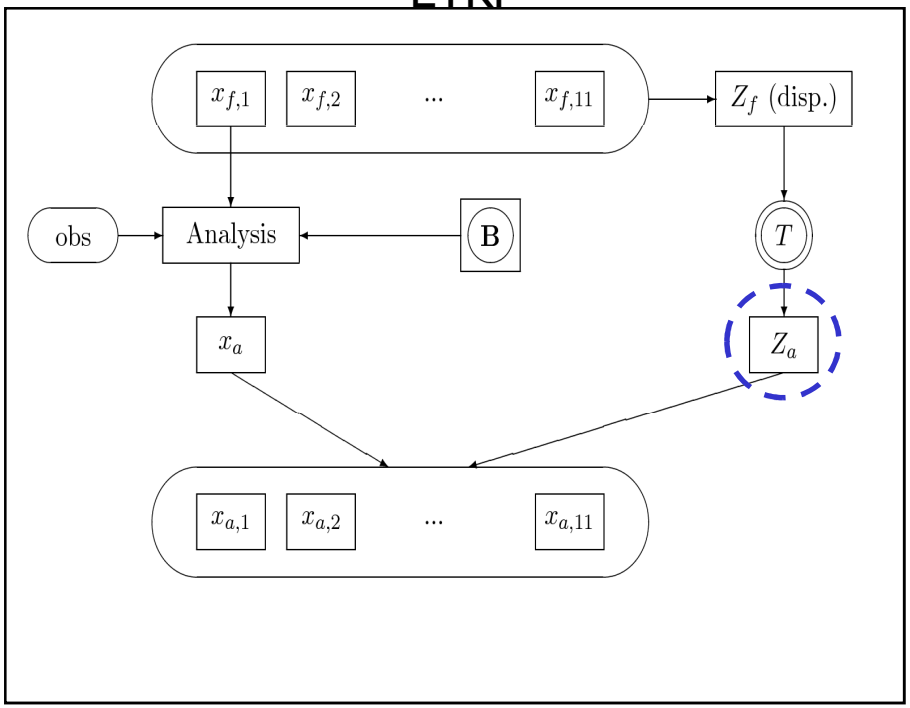
$$Z_f^T H^T P_o^{-1} H Z_f = C\ \Gamma\ C^T$$



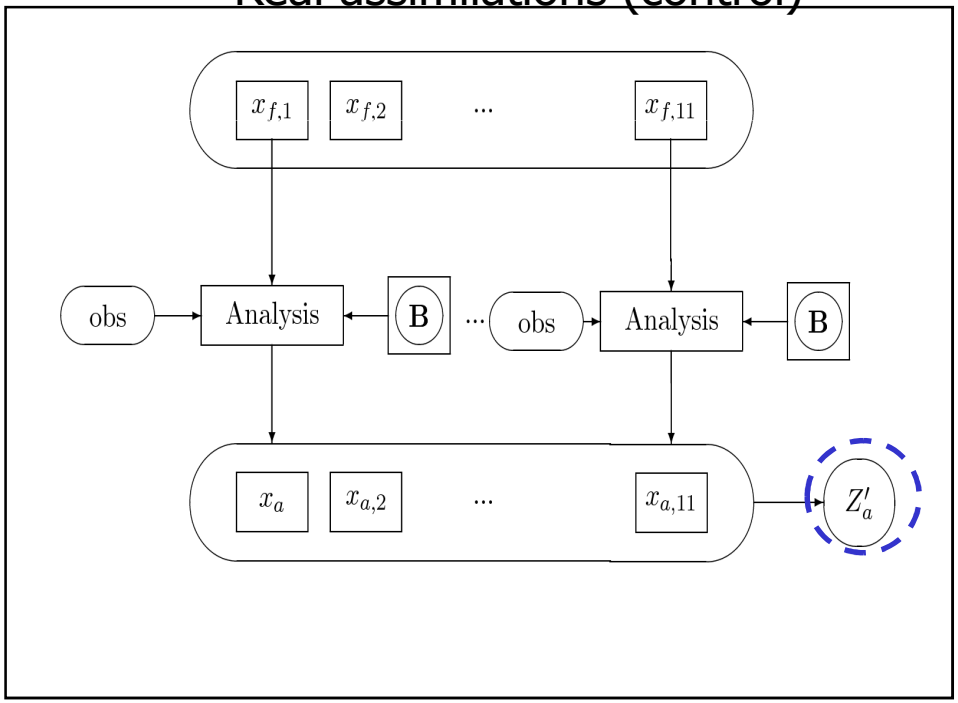
Experiments with ETKF

Basic test of the Transform matrix

ETKF



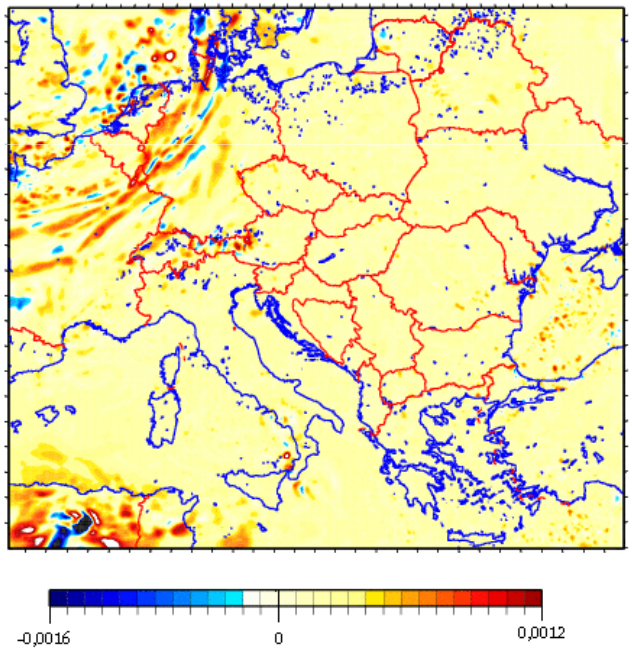
Real assimilations (control)



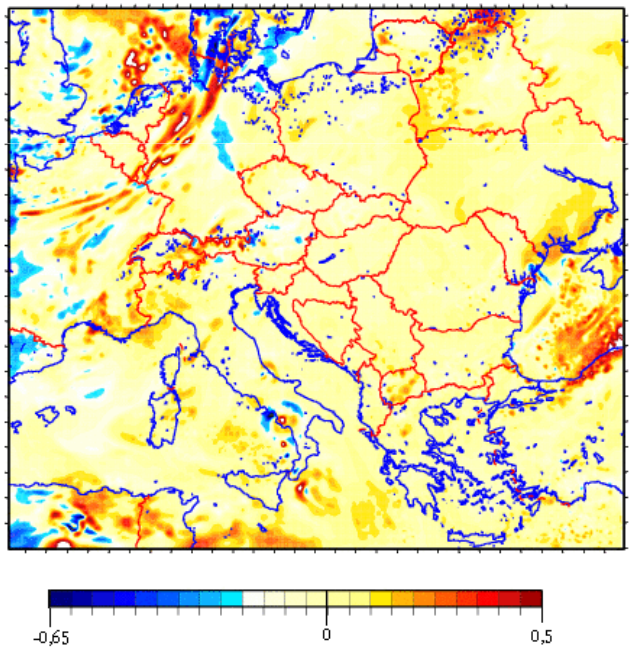
Experiments with ETKF

Basic test of the Transform matrix

ETKF



Real assimilations (control)

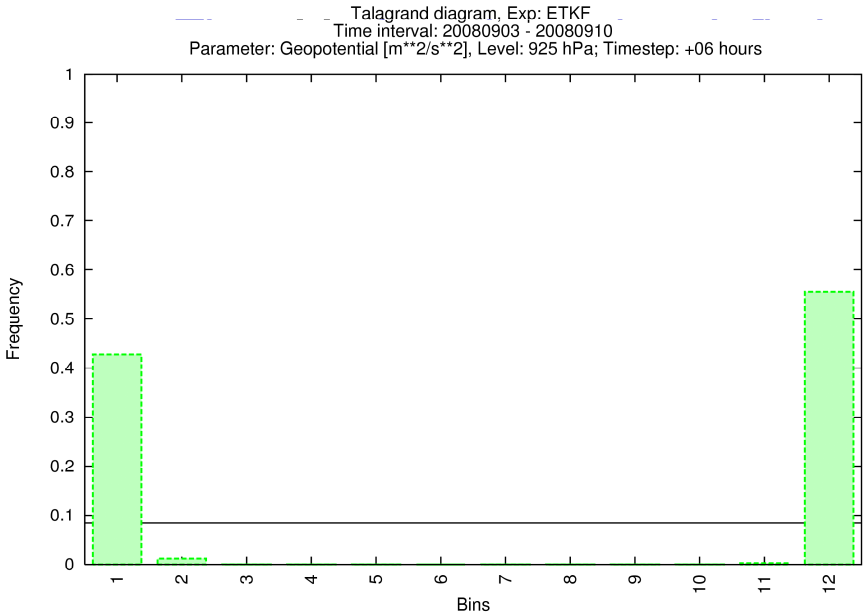


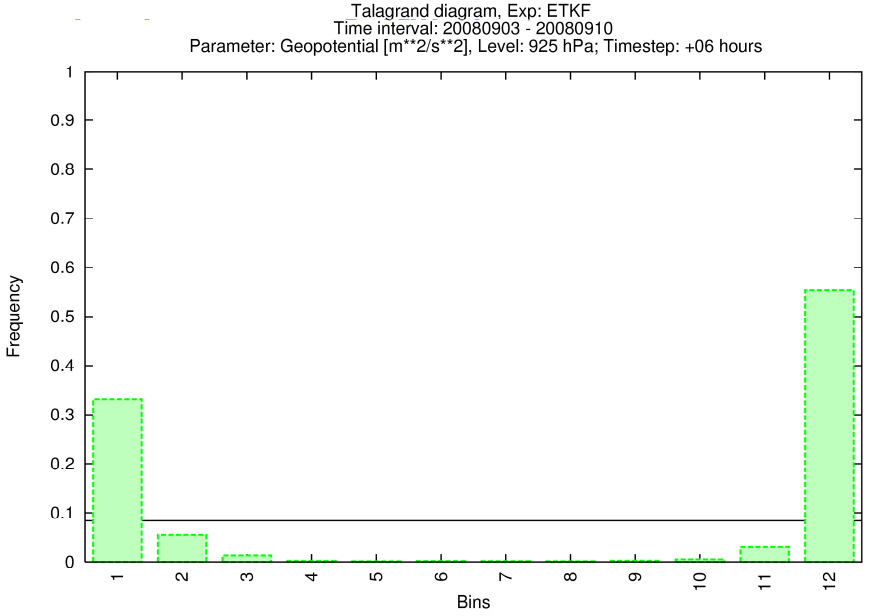
- Similar structures but small amplitudes with ETKF ➔ „Inflation"

Experiments with ETKF

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

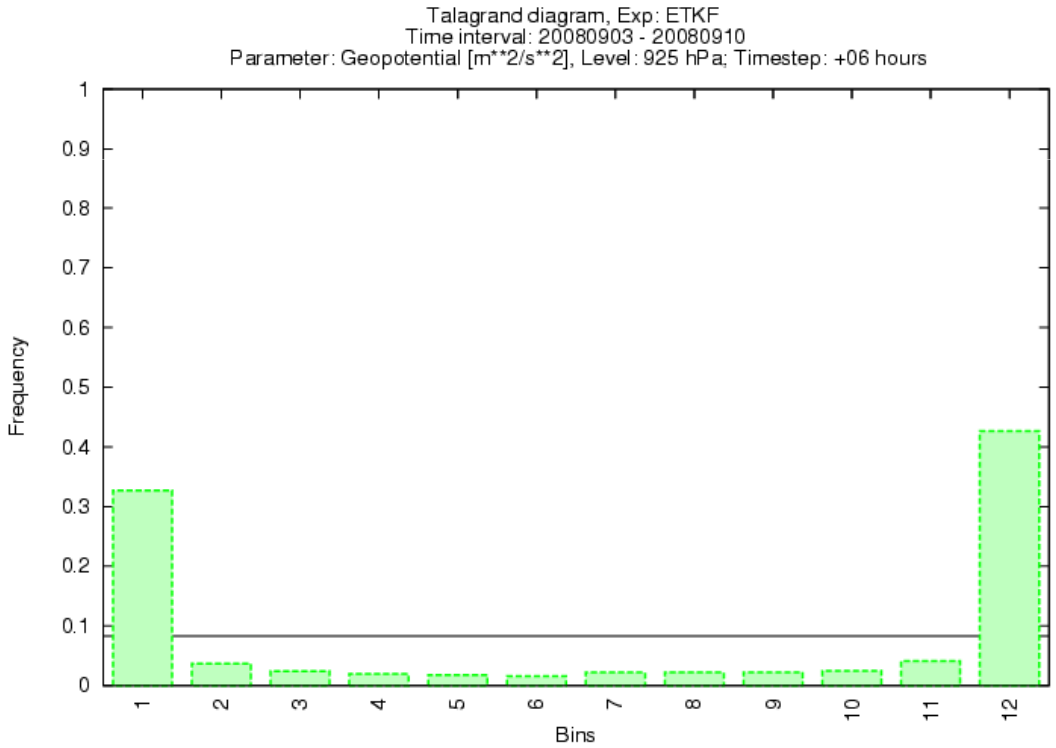
$$Z_a = Z_f T\Pi$$





Experiments with ETKF

LBC perturbation



Thank you for your attention

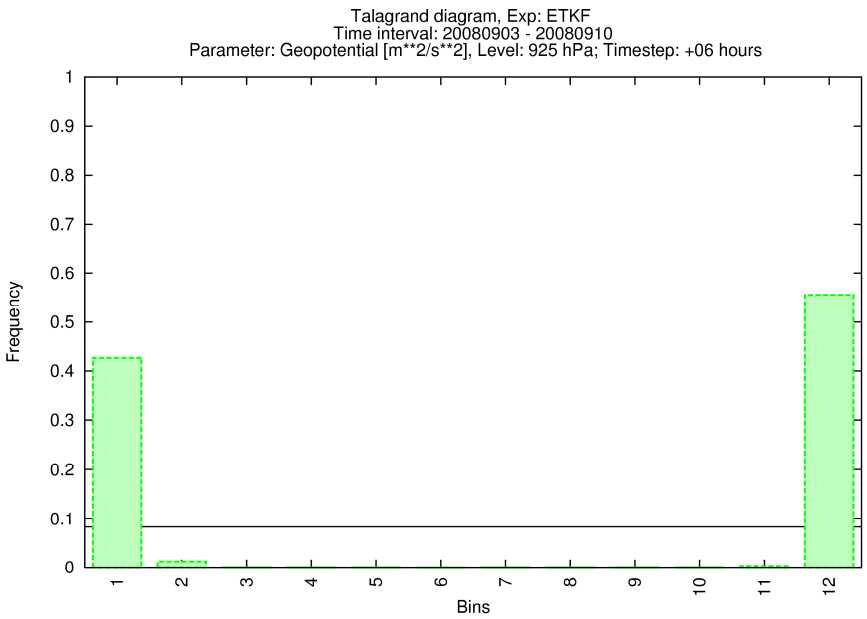
Experiments with ETKF

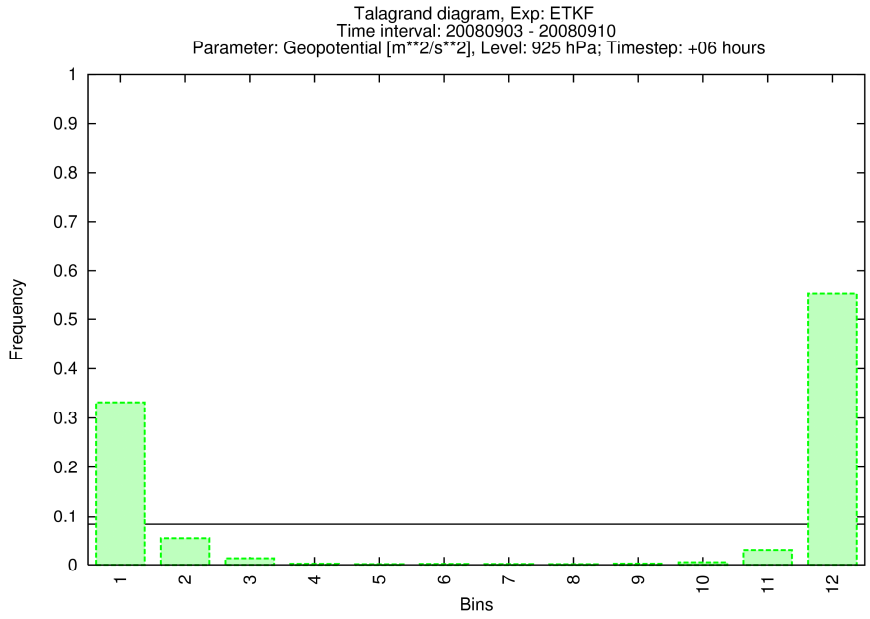
The inflation method (*Wang and Bishop, 2003*)

$$Z_a = Z_f T \Pi$$

Time dependent inflation factor:

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





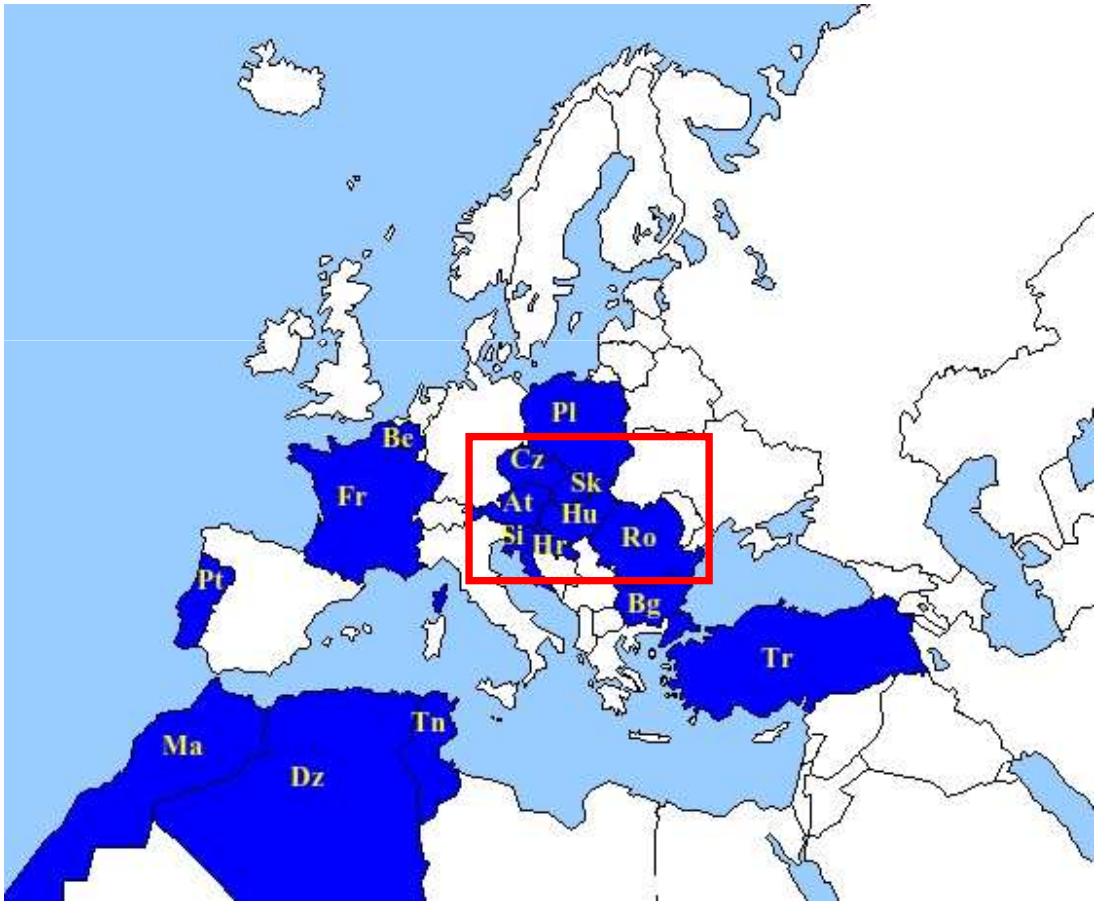
FGAT and 3-hour cycling

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%
SEVIRI (MSG2)	15%	15%	30%	30%

LACE

- Austria
- Croatia
- Czech Republic
- Hungary
- Romania
- Slovakia
- Slovenia



Progress in DA implementations

	BATOR (ODB)	CANARI (conf 701)	SCREENING (conf 002)	3DVAR (conf 131)
AU	OK	OK	OK	OK
CR	OK	OK	OK	OK
CZ	OK	OK	OK	OK
HU	OK	OK	OK	OK
RO	-	-	-	-
SK	-	-	-	-
SI	OK	OK	OK	OK

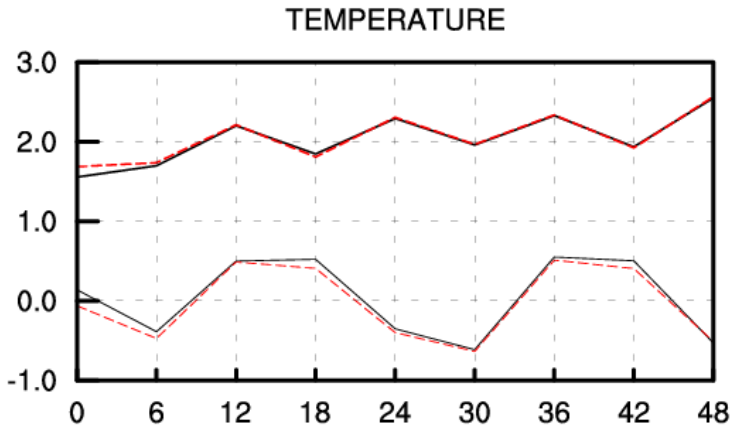
Preparation of operational assimilation suites (Hungary)

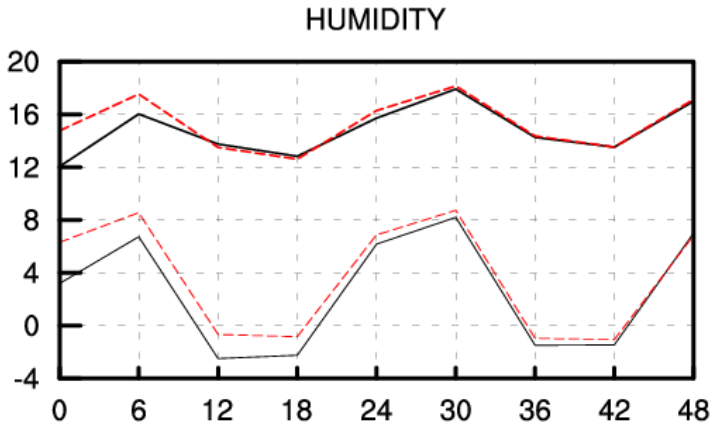
Test: CY33T1 with SEVIRI and SYNOP T,RH

2m scores:

Red: old OPER

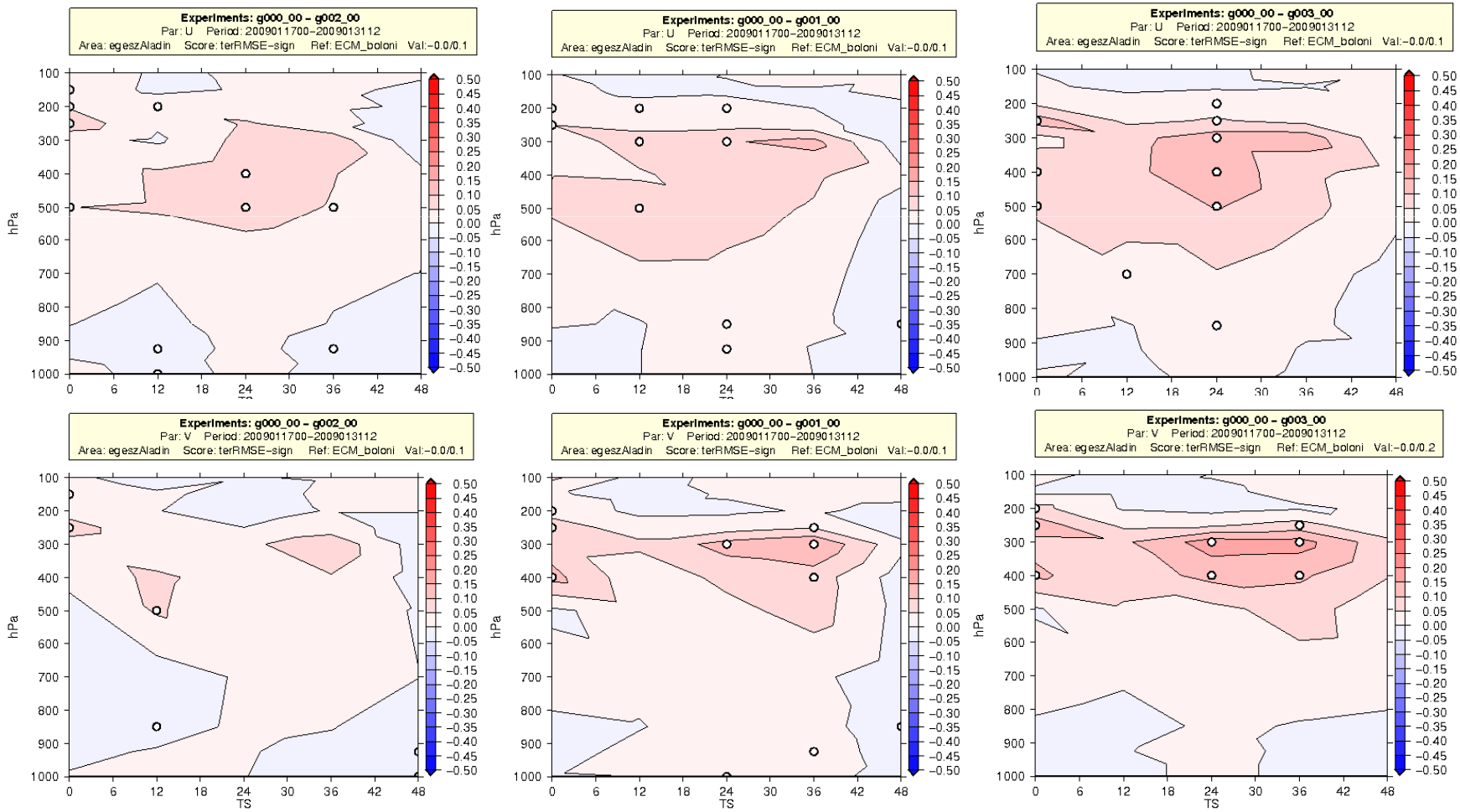
Black: new OPER





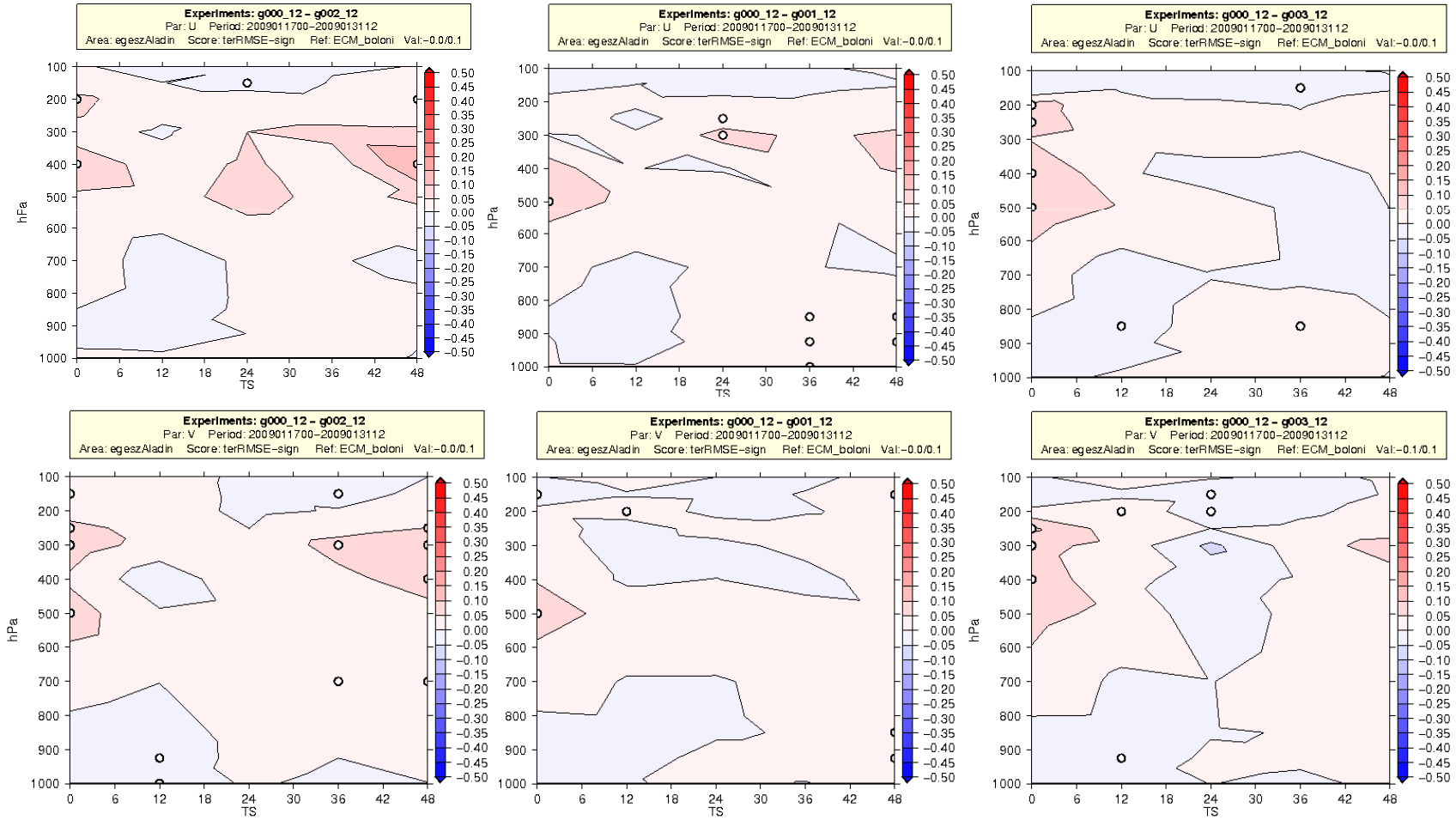
FGAT and 3-hour cycling

Verification results:



FGAT and 3-hour cycling

Verification results:



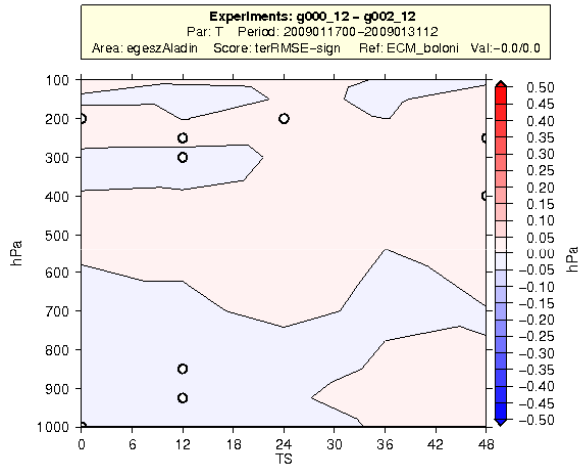
3-h cycling and FGAT

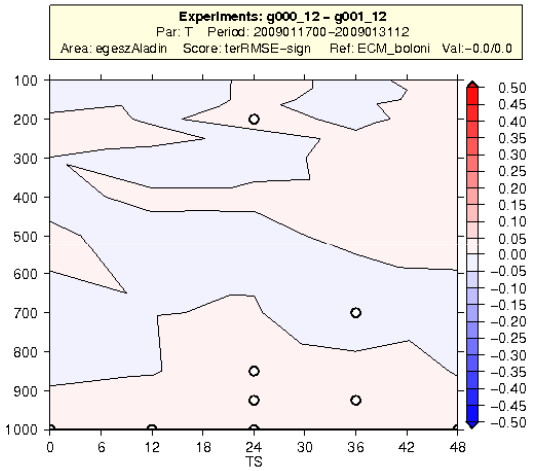
Impact of FGAT

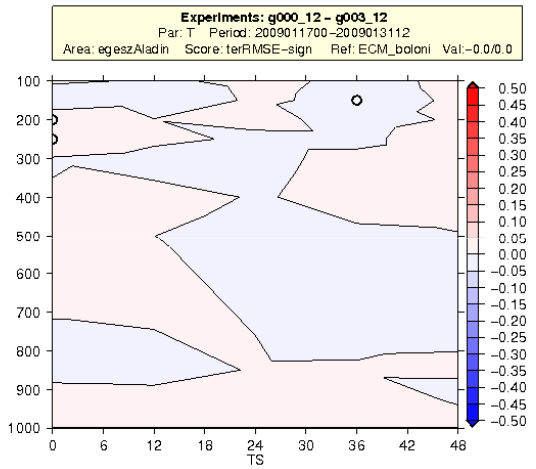
Impact of 3-h cycling

Impact of both

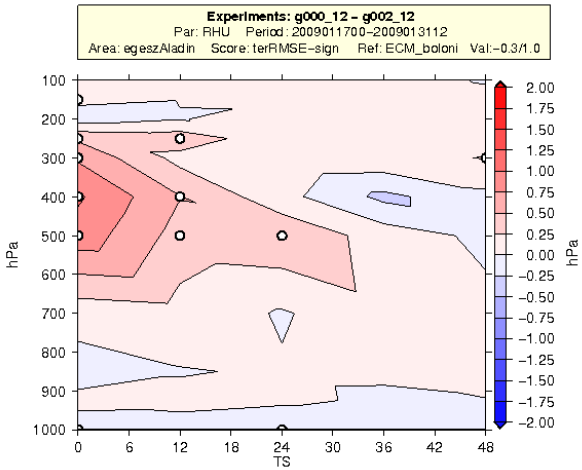
T

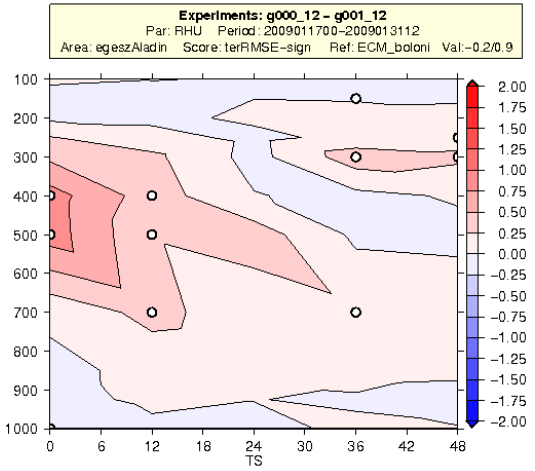


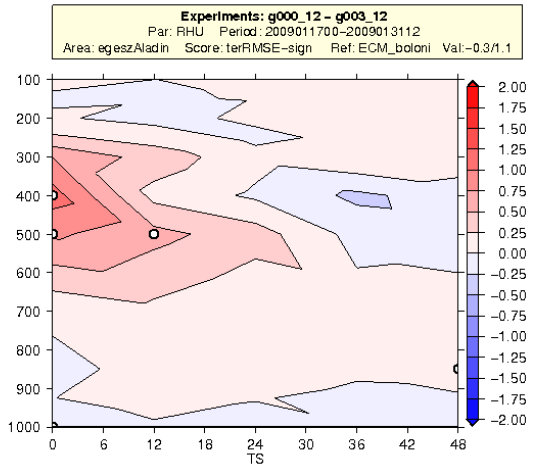




RH







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