LACE data assimilation: recent activities

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LACE
nwp central europe

OMSZ

Outline

1. Progress in DA implementations

2. Case studies

3. CANARI surface assimilation developments for mountains

4. Developments related to background error simulation

5. Plans

Progress in DA implementations

- All LACE members are running regular/test data assimilation suites (surface or upper air)

- Austria implemented operational surface assimilation (CANARI) in the high resolution ALARO 5km runs

- Slovenia implemented operational surface + upper air assimilation (CANARI + 3DVAR) in the high resolution ALARO 4.4km runs → positive feedback from forecasters

Progress in DA implementations

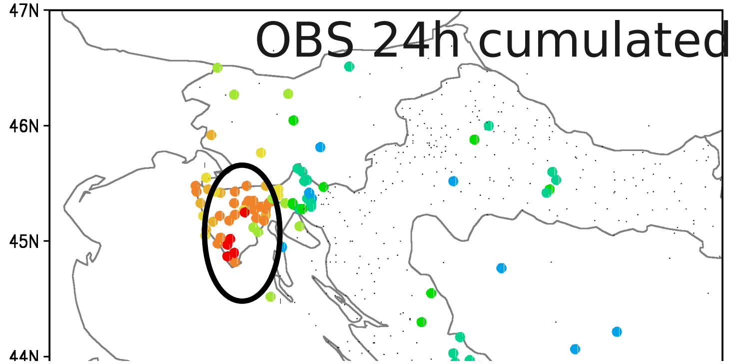
- Croatia showed improvements by data assimilation in terms of classical scores. Also case studies are found with improvements by assimilation. Although no operational implementation yet mainly because Tmin and Tmax at 2m are degraded by assimilation in summer.

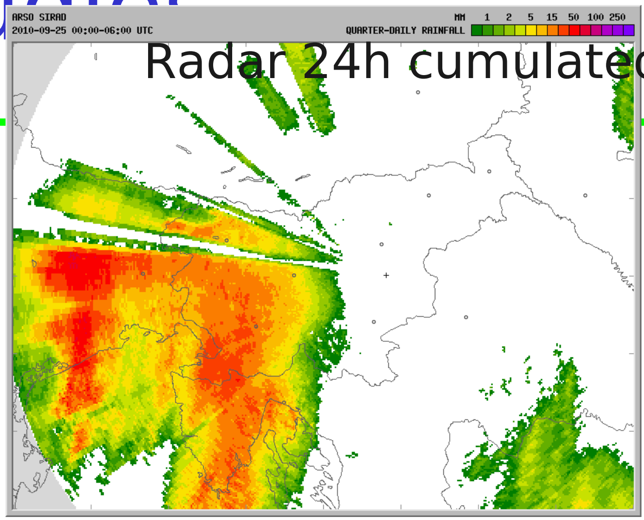
- Collection and redistribution of national (non-GTS) surface data is on the table (starts soon with CZ data)

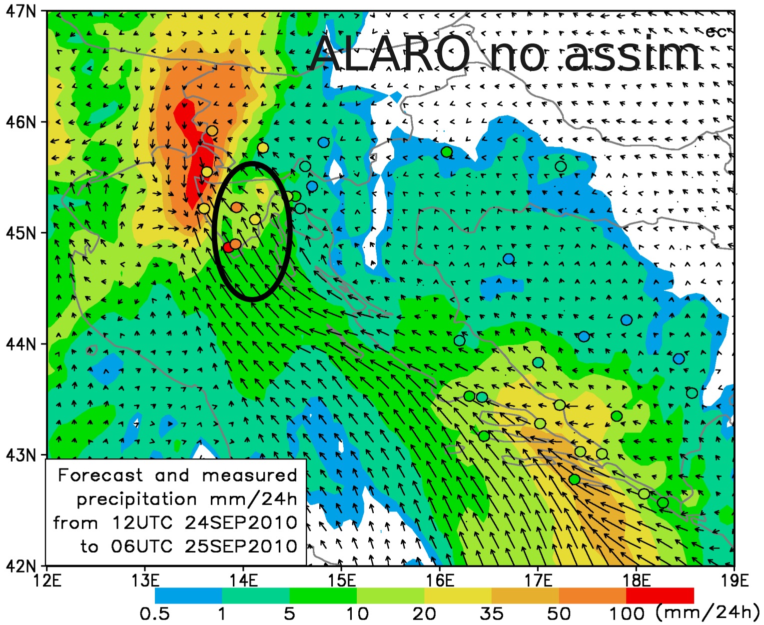
- OPLACE extended to METOP/IASI data

Istria flood 25 September 2010 (Croatia)

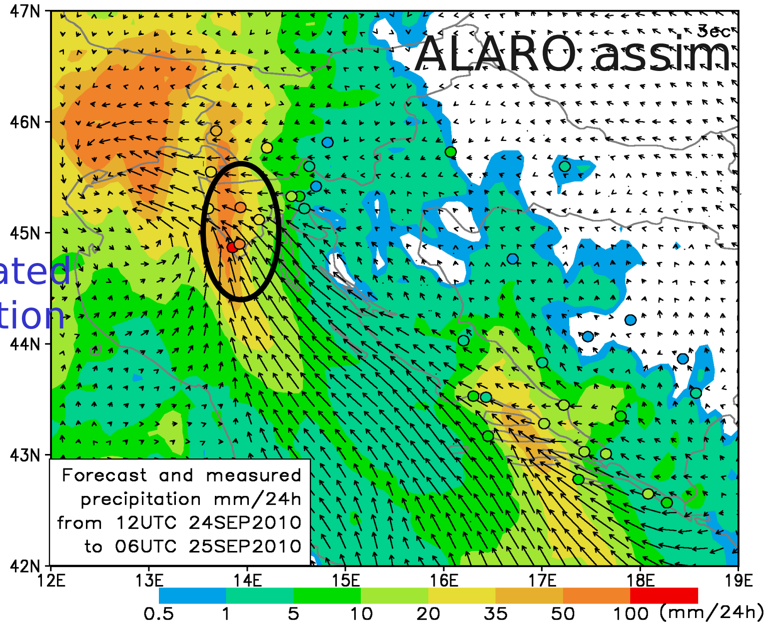
Case studies





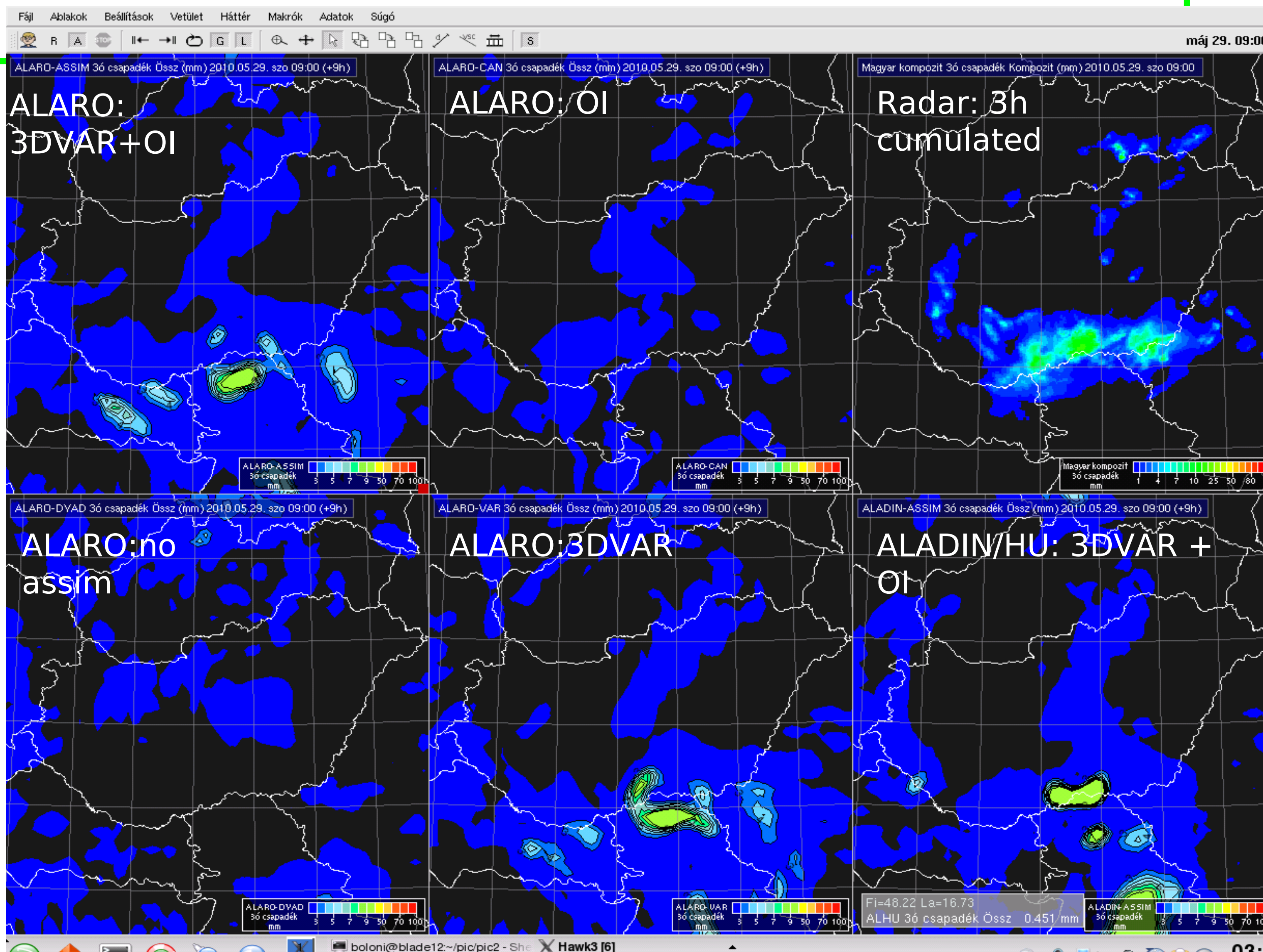


24 hours accumulated precipitation



Convective case 29.05.2010 (Hungary)

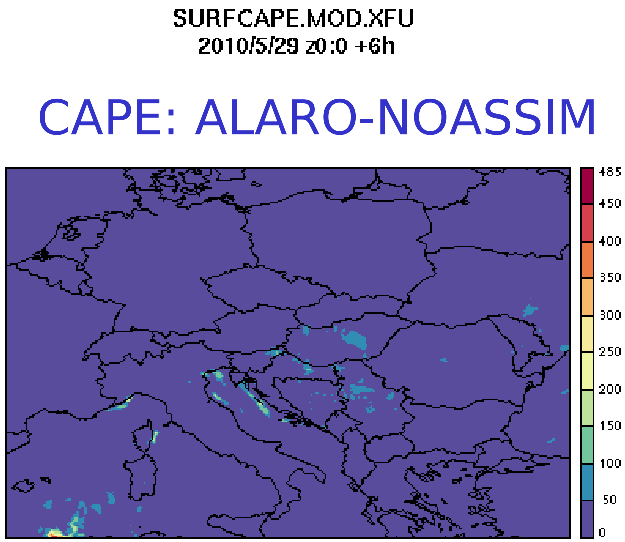
Case studies



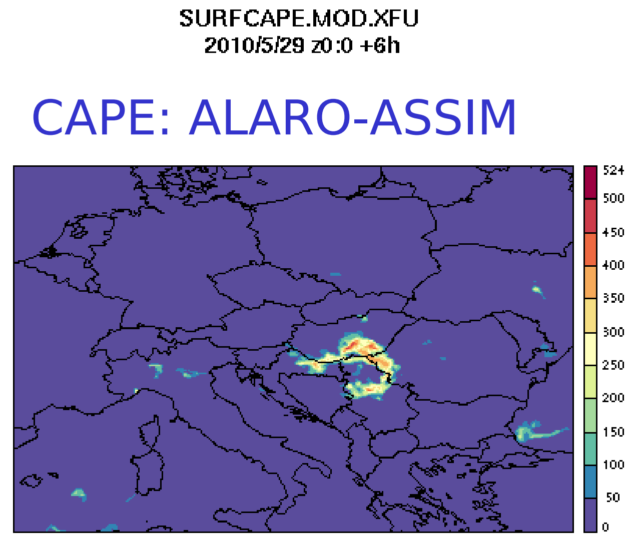
Accumulated precipitation: (+9h) – (+6h)

Case studies

CAPE: ALARO-NOASSIM



CAPE: ALARO-ASSIM



+6h

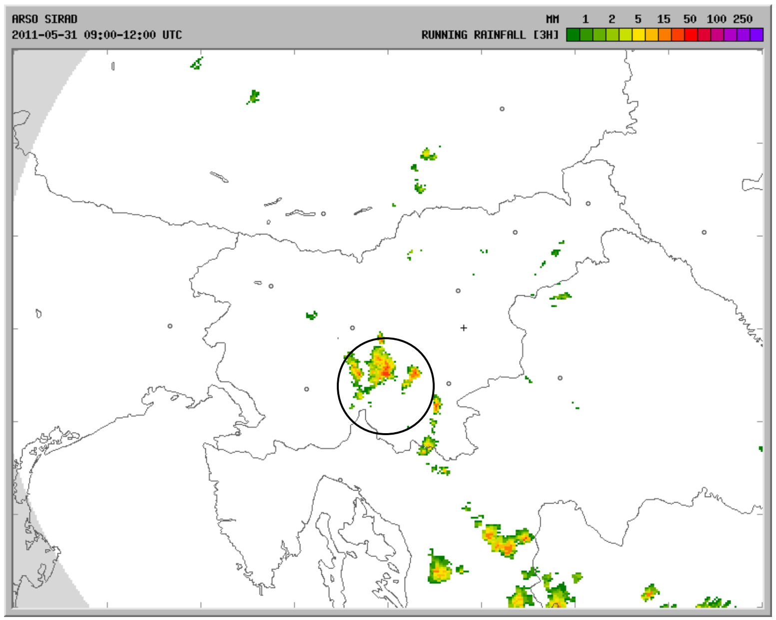
Some conclusions:

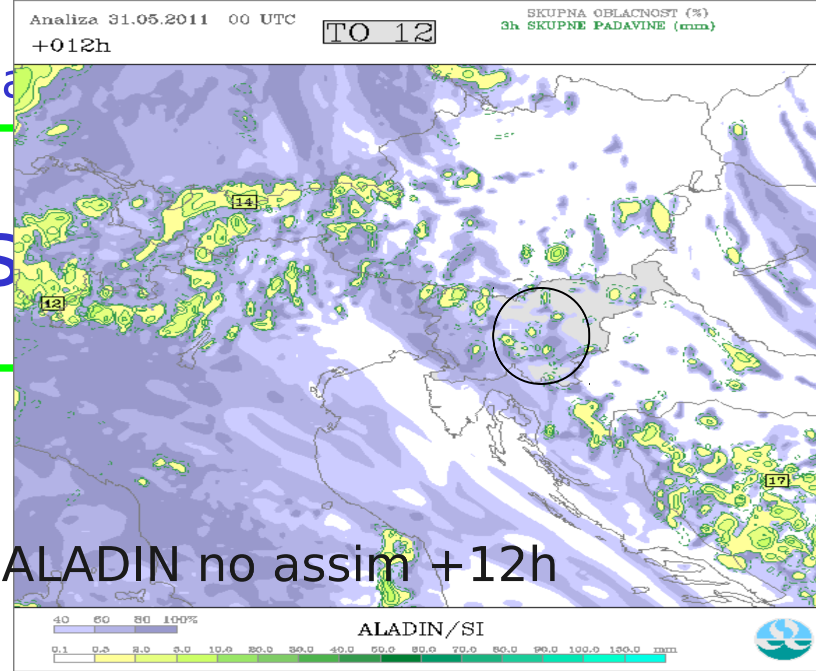
- Assimilation (mostly 3DVAR) has increased the low level humidity → improved CAPE
- The impact mostly came from SYNOP RH
- ALARO physics propagates the system more realistically (compared to old ALADIN/HU physics)

Convective case 31.05.2011 (Slovenia

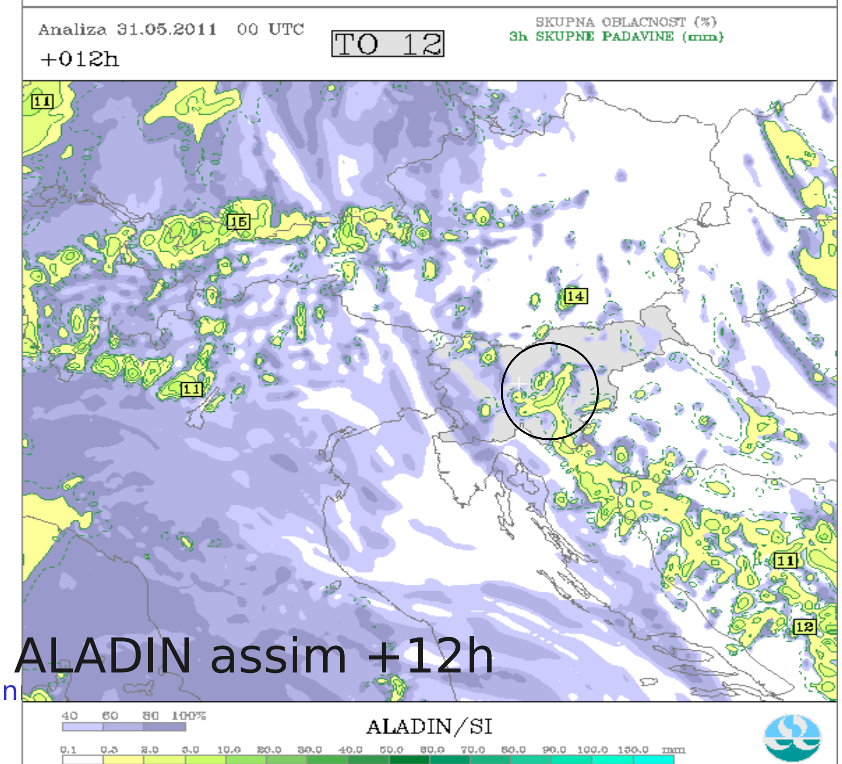
Case s

Improved location and time of the first thunderstorm



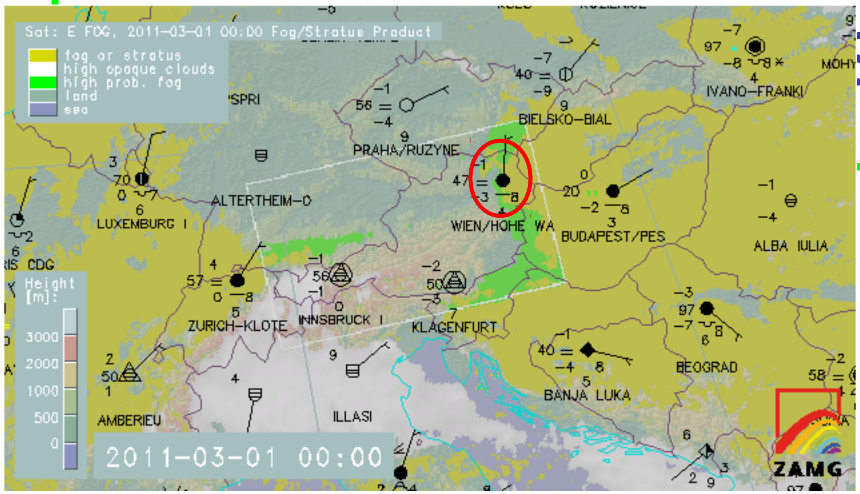


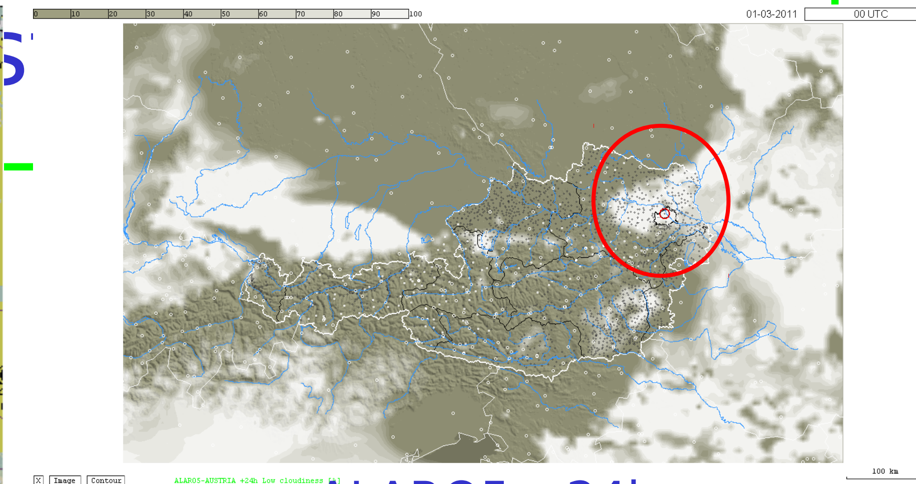
ALADIN no assim +12h



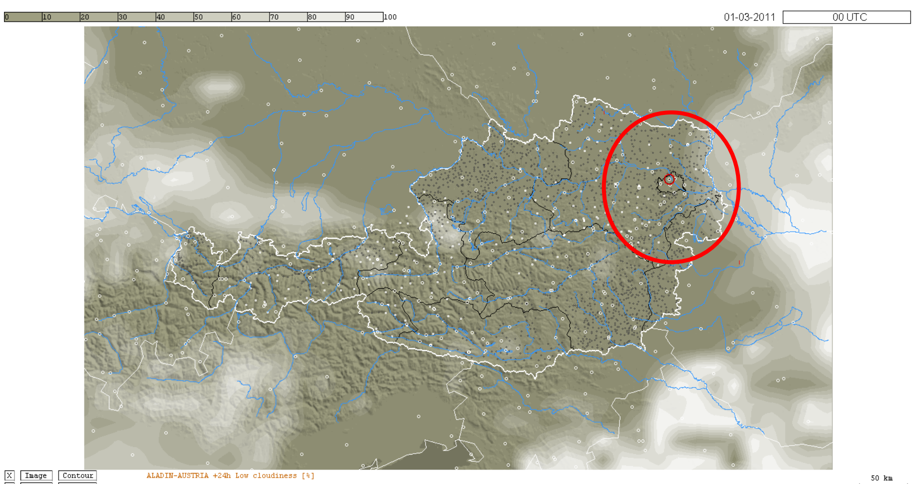
ALADIN assim +12h

Low stratus case 01.03.2011 (Austria)

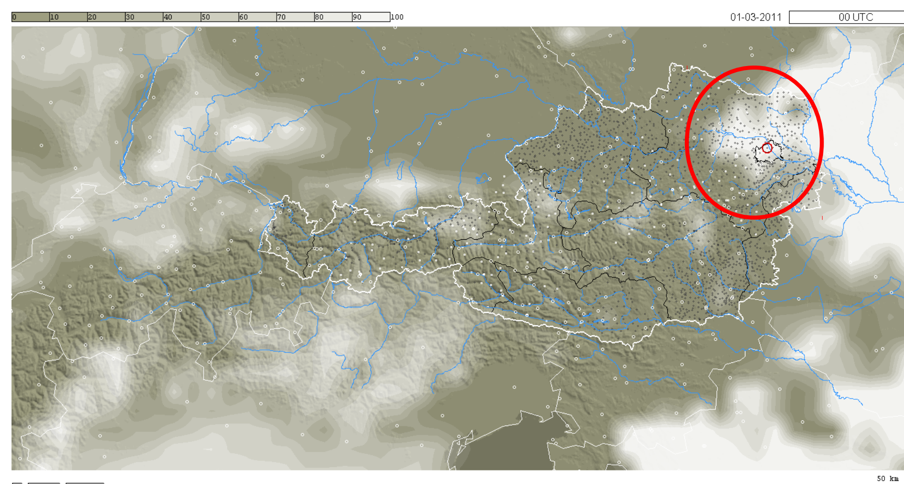




ALARO5 +24h



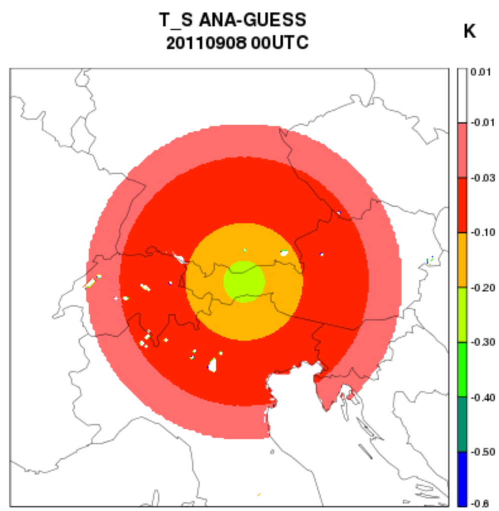
ALADIN-Austria +24h



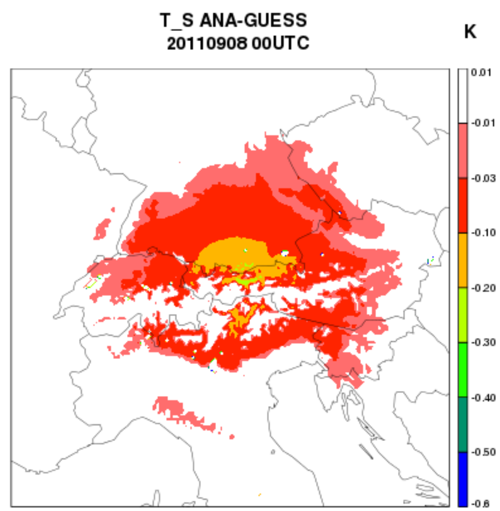
ALADIN assim +24h

CANARI developments for mountains (Austria)

CANARI increments are quite smooth especially in Alpine areas and even in ALARO5 -> reduction of background horizontal correlation length and introduction of vertical correlation function as already existing for snow analysis also for T2m, RH2m in „catrma“ and „cacova“ (LCORRF=.TRUE.)



Ts standard CANARI



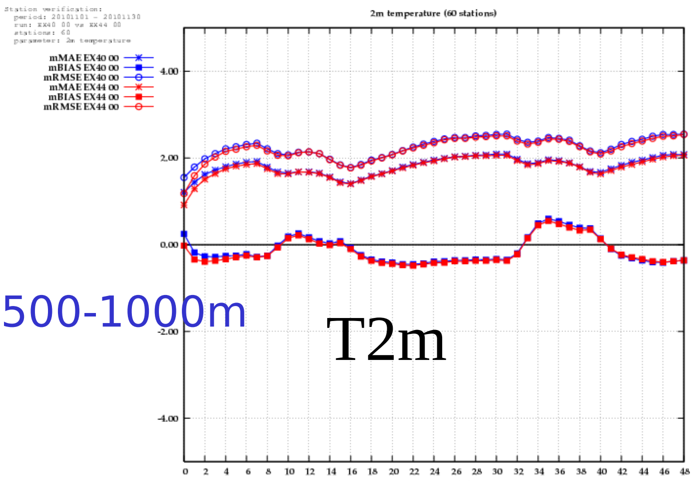
Ts CANARI +vert. corr.

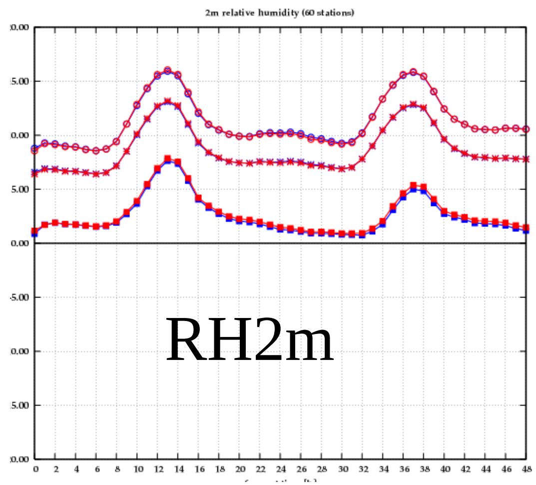
$$\mu(r,p)=e^{\left(-0.5*\sqrt{\frac{r_{ij}^2}{d^2}}\right)}*e^{\left(-0.5*\ln\left(\frac{p_i}{p_j}\right)*\frac{1}{P_c}\right)}$$

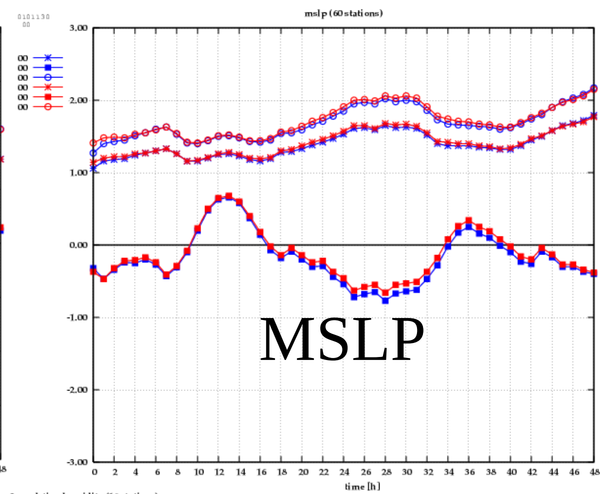
One month verification (Nov 2010): positive effect on T2m for very short range, especially for stations between 1000-1500m, otherwise rather neutral impact

CANARI developments for mountains (Austria)

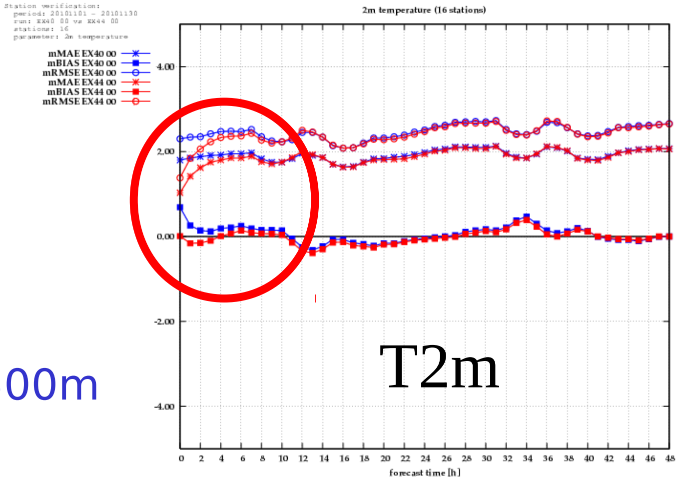
500-1000m

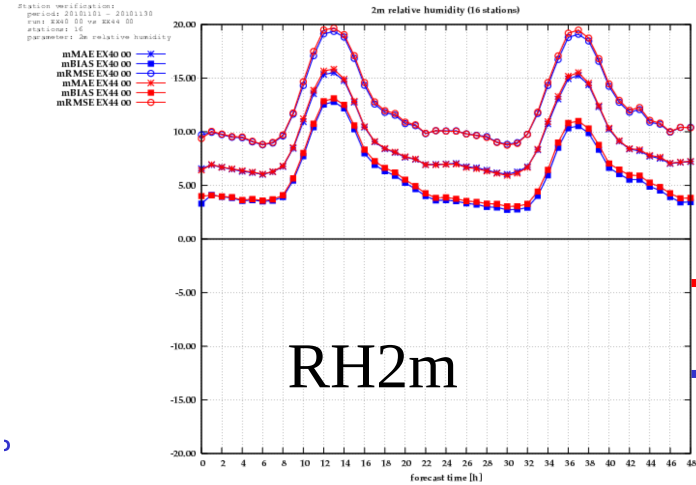






1000-1500m

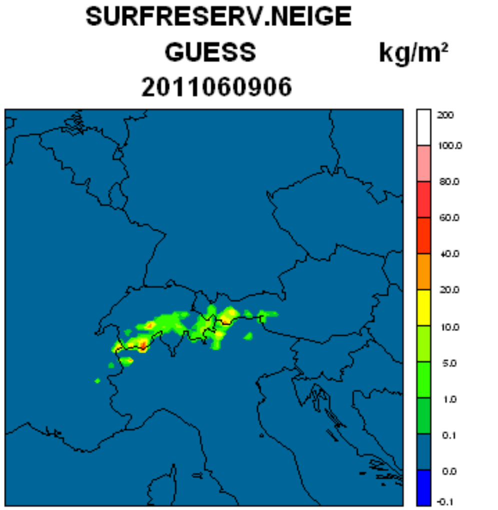




vert. corr.

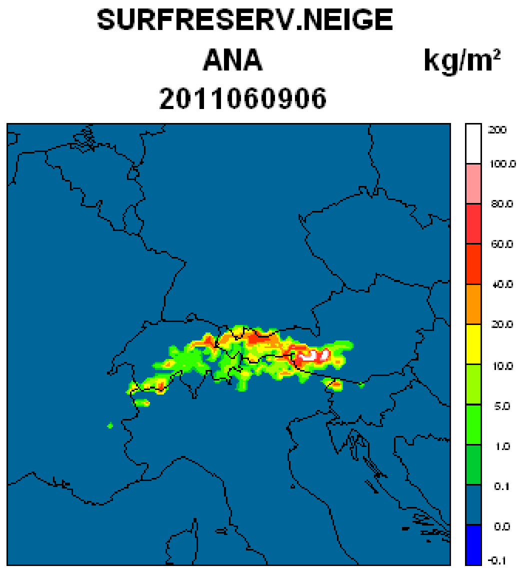
reference

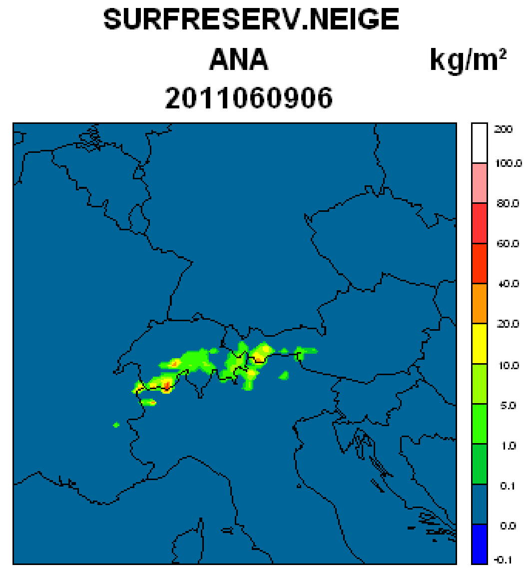
Snow analysis in CANARI



RI developments for mountains (Austria)

Problem: too strict O-G rejection for snow → almost no snow observation accepted in the Alps





RCSNSY=200.

RCSNSY=2.5 (default)

LAM background error simulation

Aim: simulation of background errors (ε_b) in order to generate a statistical sample for the computation of the background error covariance matrix (B) in the variational analysis:

$$B = E\left(\varepsilon_b \varepsilon_b^T\right) \qquad J_b\left(x\right) = \frac{1}{2}\left(x - x_b\right)^T B^{-1}\left(x - x_b\right)$$

$$\varepsilon_b \approx M\varepsilon_a$$

Model uncertainty

LBC uncertainty

Analysis uncertainty

- What is the relative importance of the different uncertainties?
- How to represent these different uncertainties?

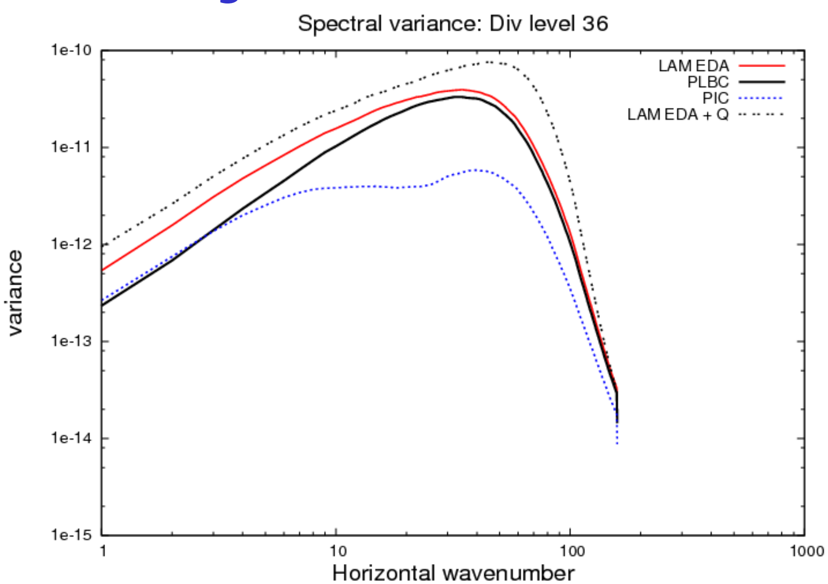
LAM background error simulation

PIC: „Perfect Initial Condition framework” – same initial condition (oper DA) for all members but different LBCs used from an IFS EDA run (Isaksen et al., 07/2007, 4DVAR T255/L91) →**accounting for LBC uncertainty**

PLBC: „Perfect LBC framework” – same LBCs used for all members but perturbed analyses used as Ics (normalized random perturbation of observations) →**accounting for IC uncertainty**

LAM EDA: both IC and LBC perturbations applied as explained above →**accounting for IC + LBC uncertainty**

LAM EDA +Q: additional physics perturbations added (ALARO vs operational ALADIN/HU physics) →**accounting for IC + LBC + model uncertainty**



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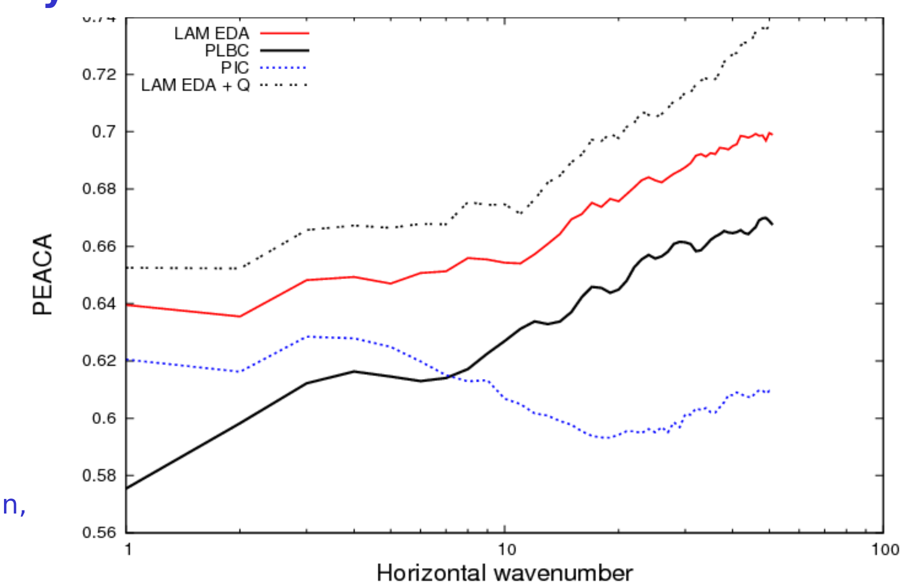


LAM background error simulation

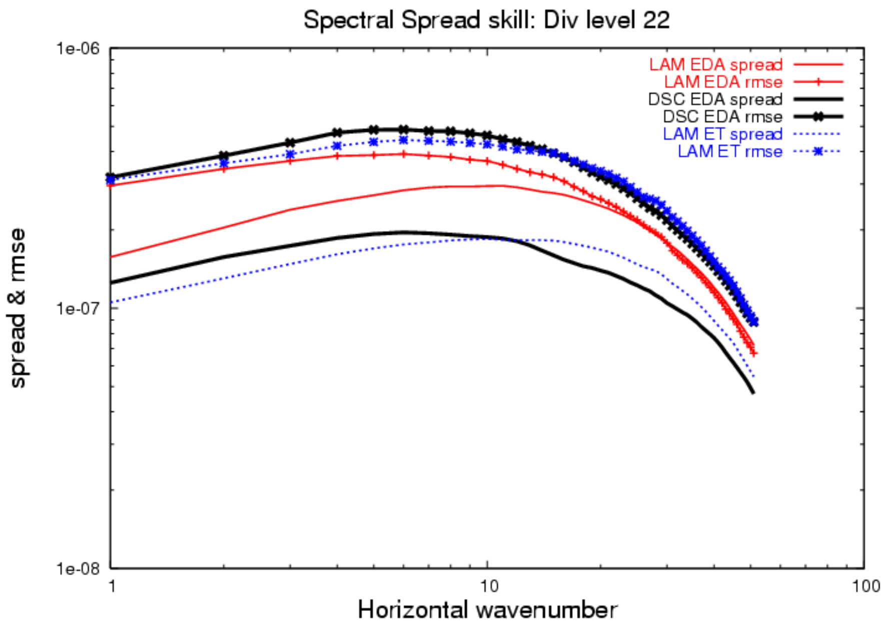
What representation of analysis uncertainty to use?

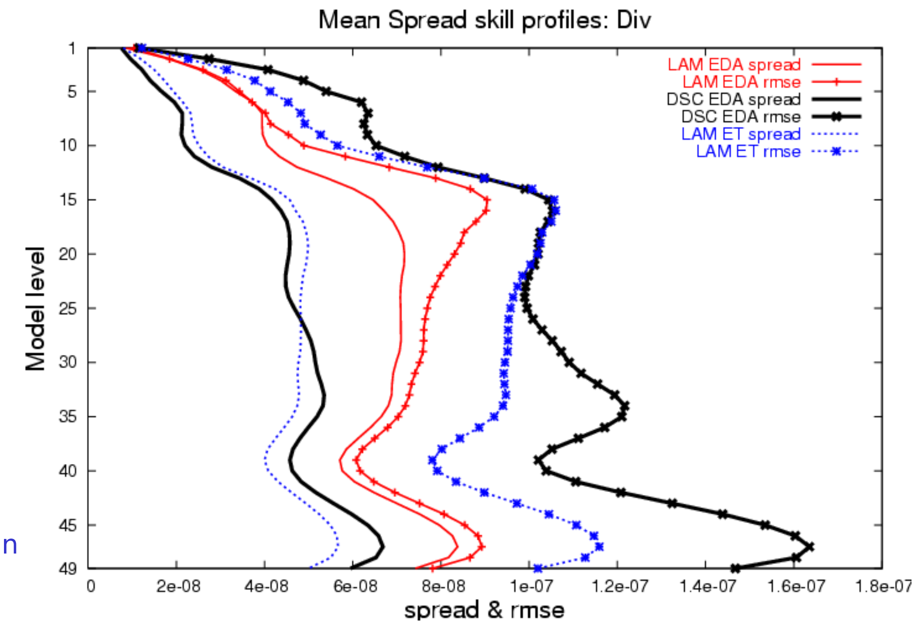
DSC EDA: downscaling of the IFS EDA initial perturbations (no local assimilation involved)

LAM EDA: local EDA (normalized random perturbation of observations)

LAM ET: local perturbations by the Ensemble Transform

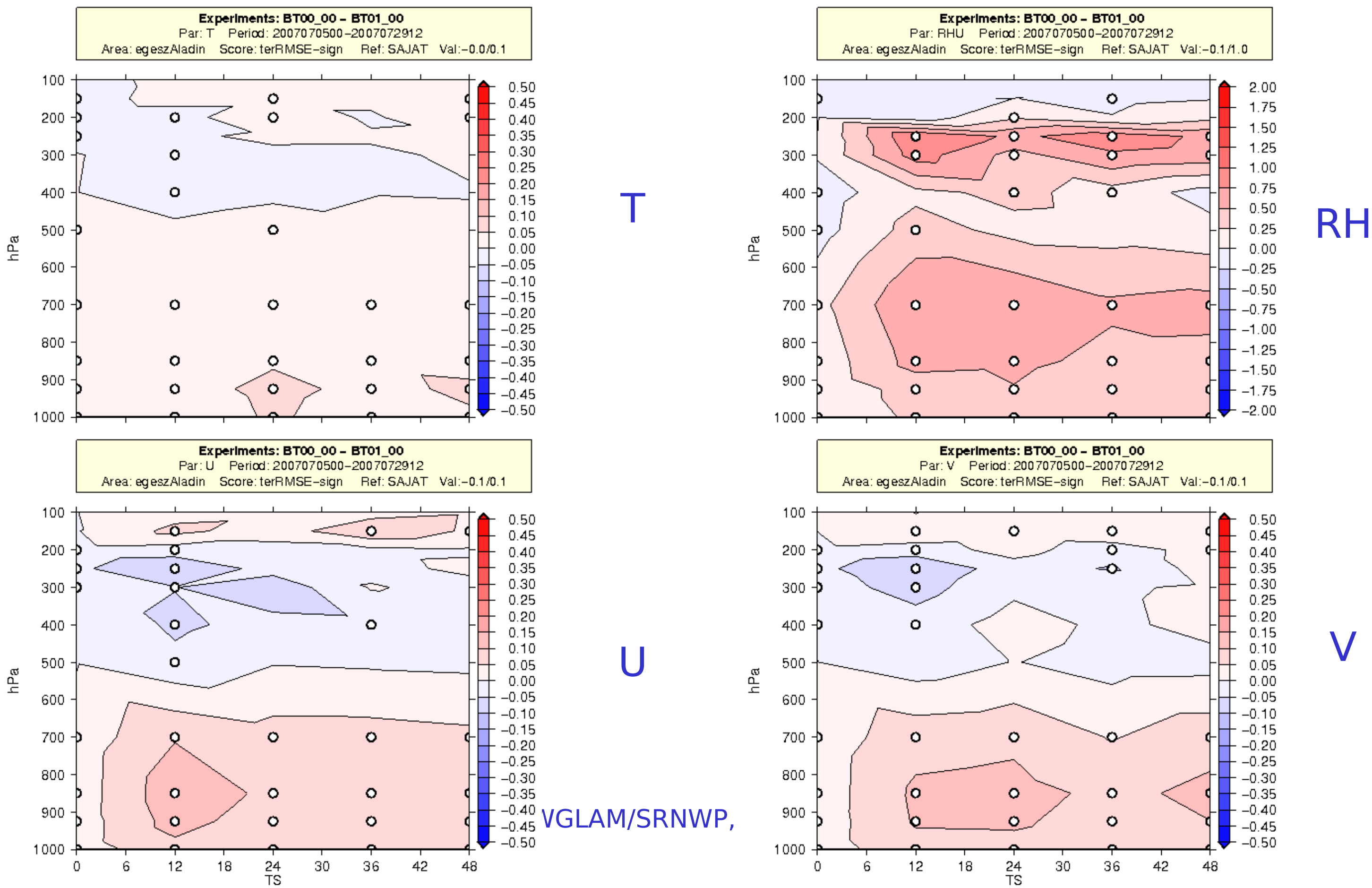
(LBCs are perturbed in all the simulations above)





LAM background error simulation

RMSE against analysis (each experiment against its „own”



VGLAM/SRNWP,

Plans

Finalize operational 3DVAR and CANARI implementations

Maintain OPLACE

- National SYNOPs
- E-GVAP
- LandSAF albedo

High resolution (AROME and ALARO) assimilations to set up with

- Rapide update frequencies (3-1 hours)
- Include radar data
- Include IASI data
- Include GPS data (ZTD and RO)

Improve surface assimilation with

- External EKF for LandSAF albedo (snow)
- CANARI + OI_main

Plans

Ensemble Data Assimilations for:

- Estimation of background errors (climatological and flow-dependent)
- Contribution to LAMEPS IC perturbations (LAEF, HUNEPS)

Thank you for your attention!

?

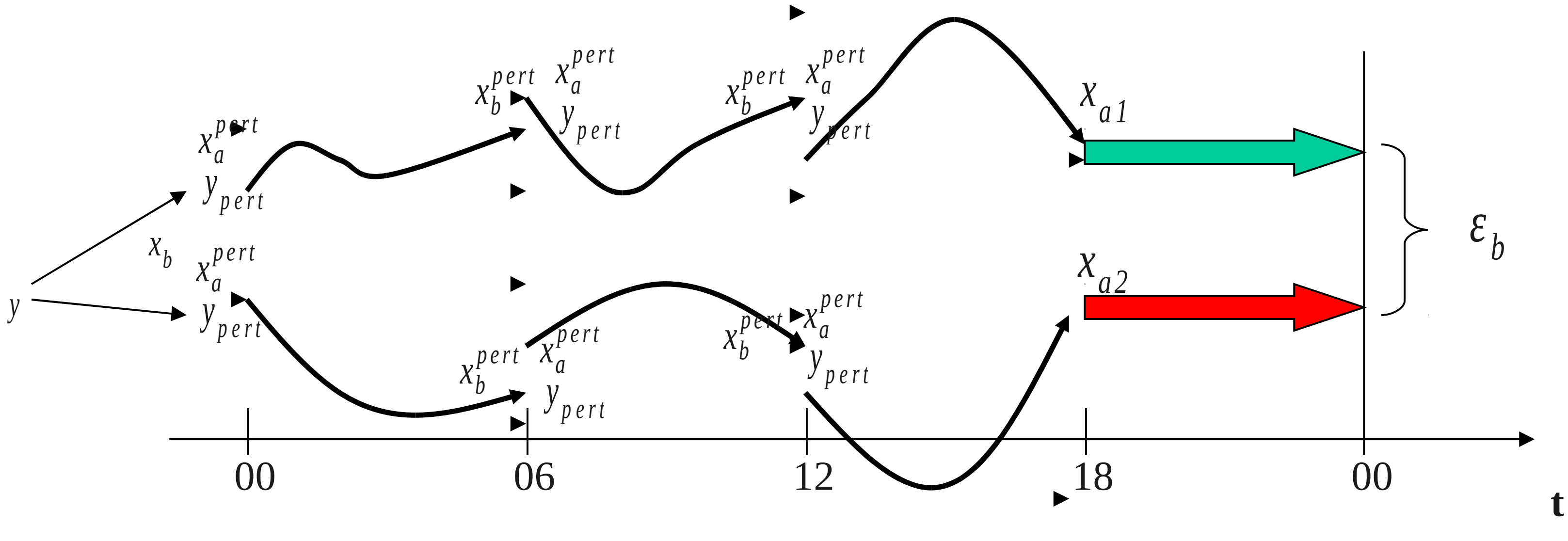
The simulation techniques in play

Background error simulation with EDA

$$x_{b1} = Mx_{a1}$$
$$x_{b2} = Mx_{a2}$$

$$\varepsilon_b \approx x_{b1} - x_{b2}$$

(EDA: Ensemble Data Assimilation)



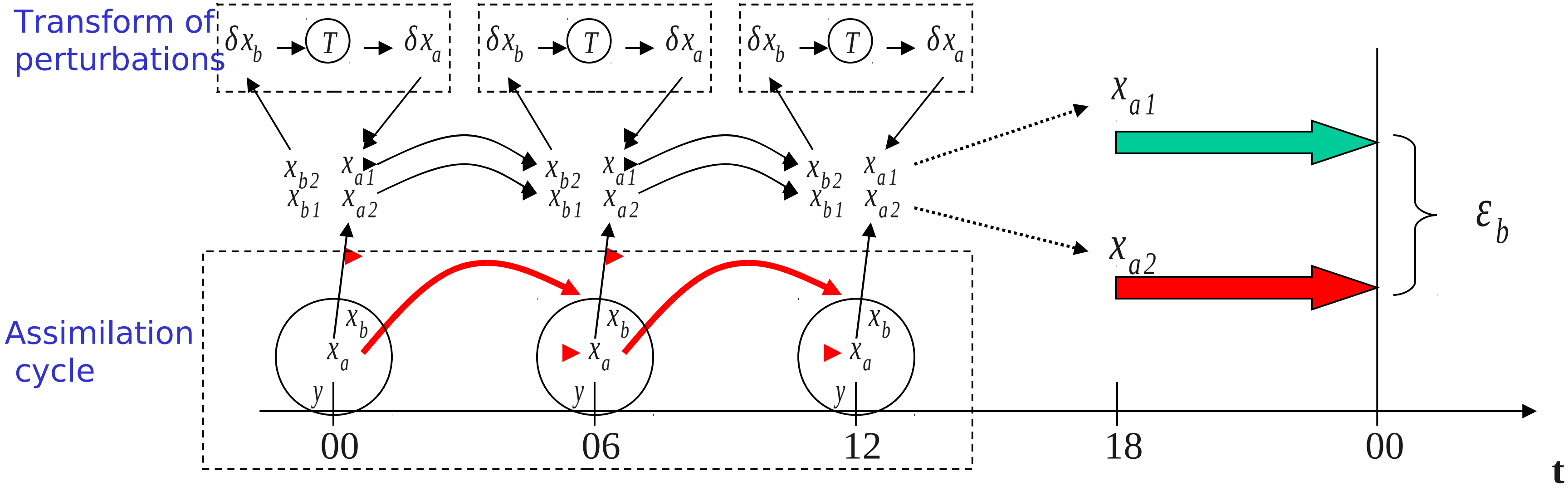
The simulation techniques in play

Background error simulation with ET

$$x_{b1} = Mx_{a1}$$
$$x_{b2} = Mx_{a2}$$

$$\varepsilon_b \approx x_{b1} - x_{b2}$$

(ET: Ensemble Transform)



Diagnostics

PEACA (Perturbation vs. Error Amplitude Correlation Analysis):

$$Corr\left(|\varepsilon_b|,|\varepsilon_b^{ref}|\right)=\frac{Cov\left(|\varepsilon_b|,|\varepsilon_b^{ref}|\right)}{\sigma\left(\varepsilon_b\right)\sigma\left(\varepsilon_b^{ref}\right)}=\frac{\sqrt{\frac{1}{N}\sum_{i=1}^{N}\left(|x_b^j-\overline{x_b}|\right)\left(|x_a^{verif}-\overline{x}_b|\right)}}{\sqrt{\frac{1}{N}\sum_{i=1}^{N}\left(x_b^j-\overline{x_b}\right)^2}\sqrt{\frac{1}{N}\sum_{i=1}^{N}\left(x_a^{verif}-\overline{x}_b\right)^2}}$$

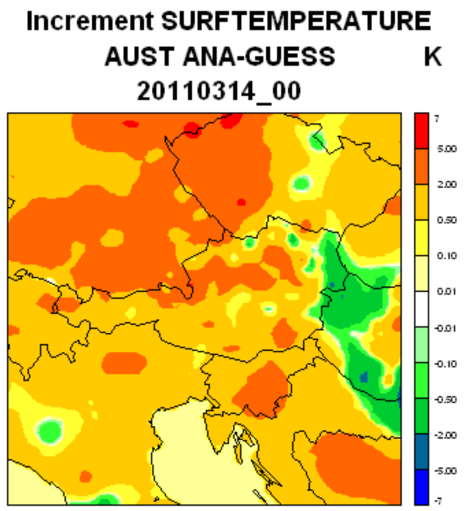
$\varepsilon_b=\overline{x_b}-x_b^j$ simulated background error

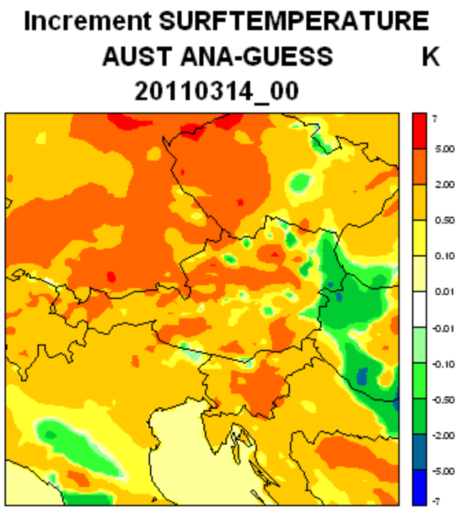
$\varepsilon_b^{ref}=x_a^{verif}-\overline{x_b}$ „real” background error (x_a^{verif} ¿ x_t)

N= member size + time realizations

CANARI developments for mountains (Austria)

- CANARI increments are quite smooth especially in Alpine areas and even in ALARO5 -> reduction of background horizontal correlation length and introduction of vertical correlation function as already existing for snow analysis also for T2m, RH2m in „catrma“ und „cacova“ (LCORRF=.TRUE.)





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