

## Rapid Update Cycle Activities at Hungarian Met Service (HMS) (Present and the Future)

### **Mate Mile**



# In this talk...

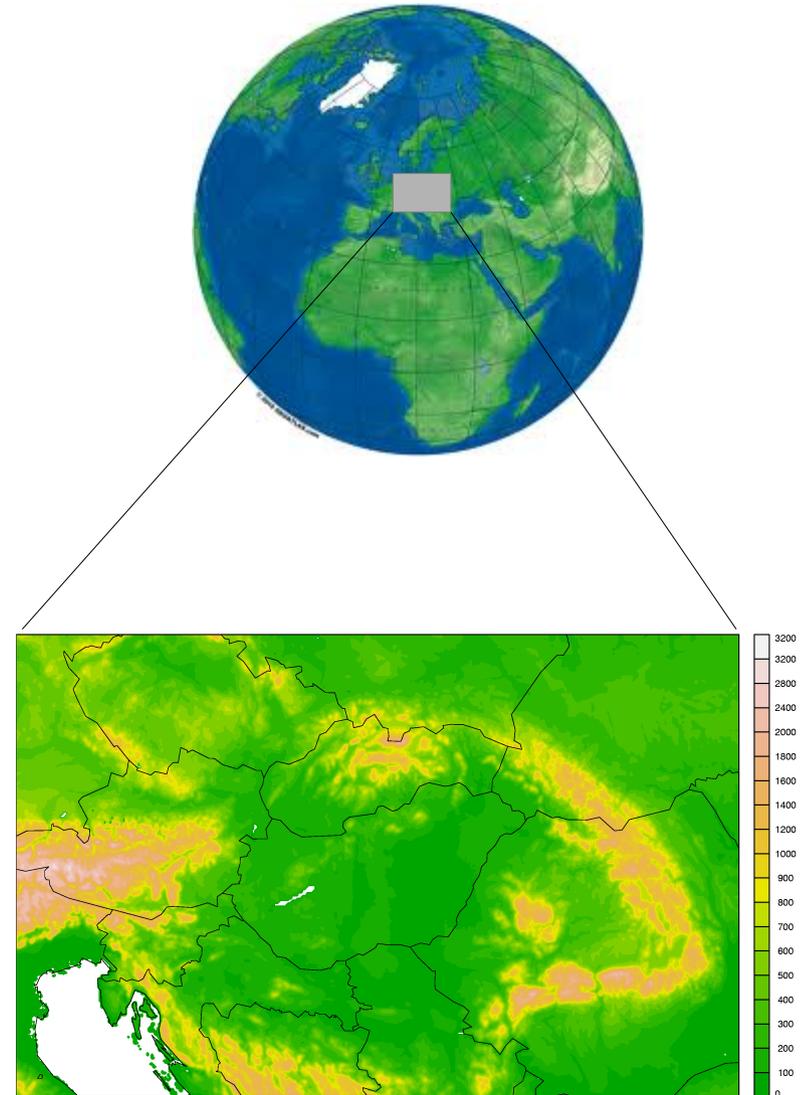
- 3h RUC versus 6h assimilation cycle
  - Observation cut-off
  - Control noise accumulation
  - Background error statistics
  - Forecast skills
- Outlook towards hourly RUC, questions



# AROME DA at Hungary

- 3h Rapid Update Cycle  
(8 3DVAR analyses per a day)
- No surface assimilation  
SURFEX LFI: ALADIN anal &  
AROME surface guess
- Background error statistics:  
AROME-EDA
- LBCs from IFS global model with  
Hourly coupling frequency
- Recently only conventional obs.  
are used

SYNOP	Z	T2	H2	U
TEMP	Z	T	Q	U
AIREP		T		U



# AROME 3h RUC

## *Observation cut-off*

- Number of used conventional observation (3h RUC vs. 6h):

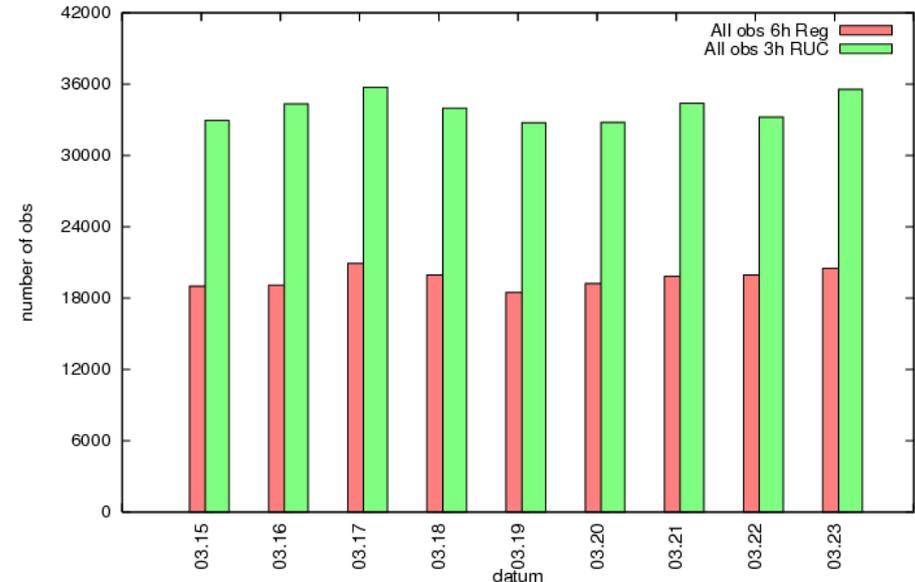
Mainly SYNOP and AMDAR observations are gained with 3h RUC →

No significant increase of radiosonde reports (expect a few at 03UTC)

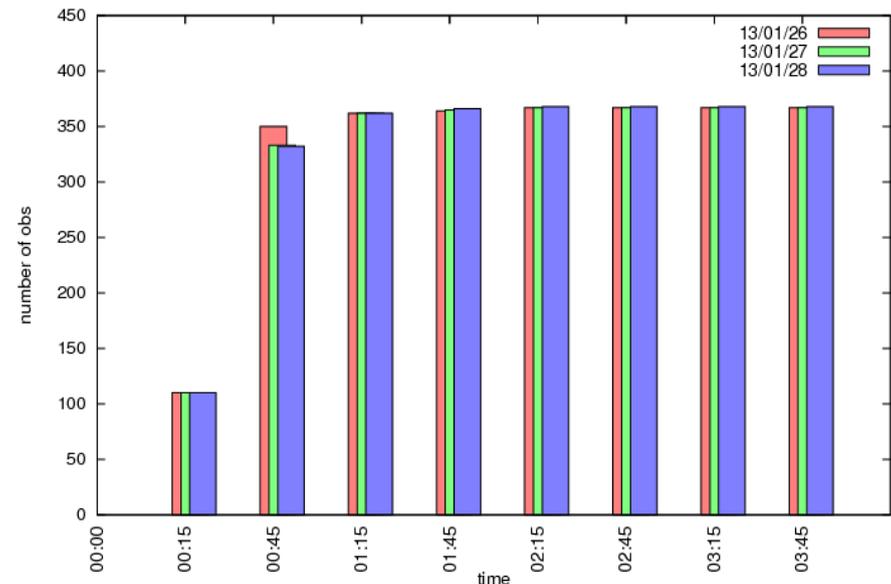
- Estimation of the optimal short cut-off time:

- incoming time of conventional observations into AROME integration domain
- At 00UTC 26th(red columns), 27th(green columns) and 28th(blue columns) of January 2013.

Obs number in AROME 6h DA vs AROME 3h RUC  
Time: 15th to 23th of March  
conv



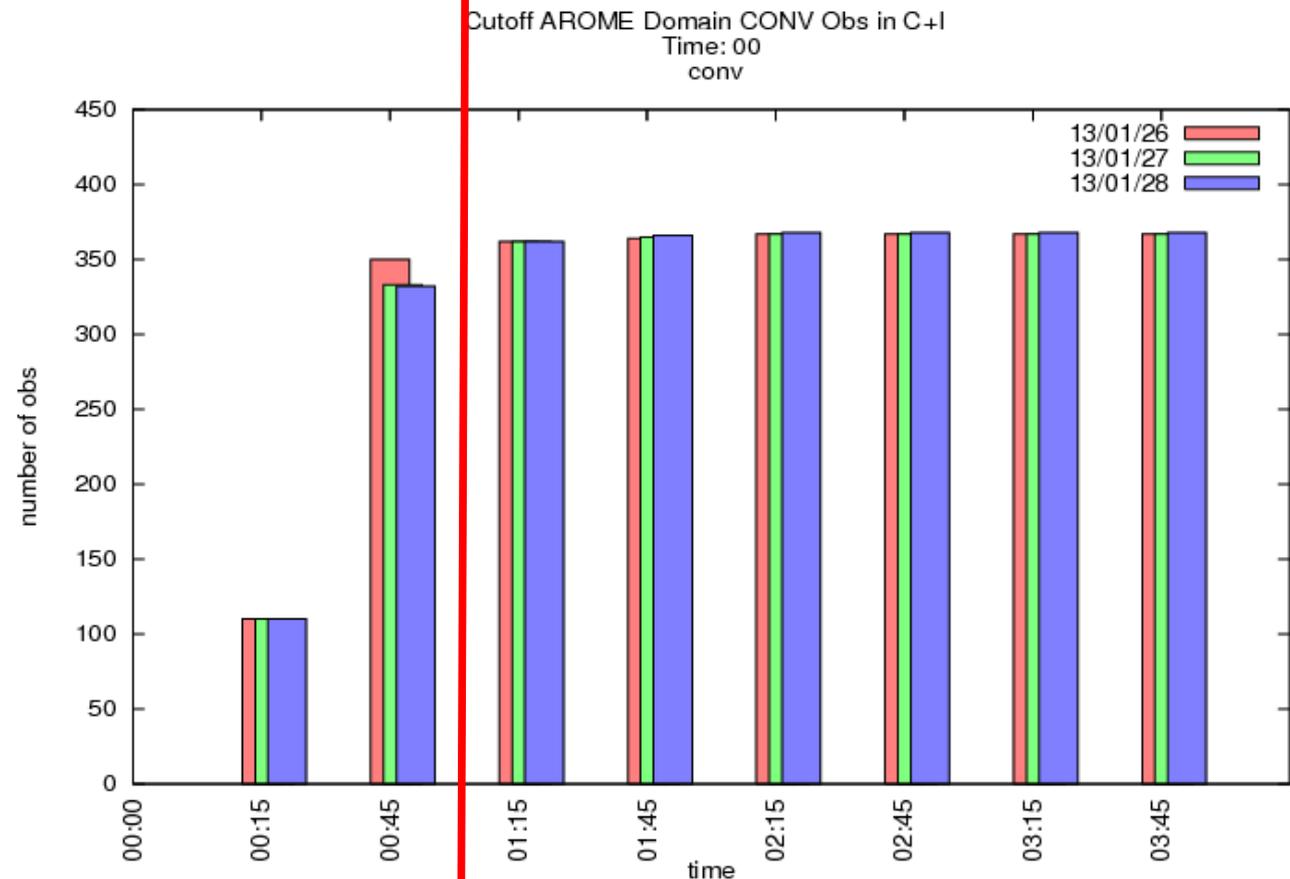
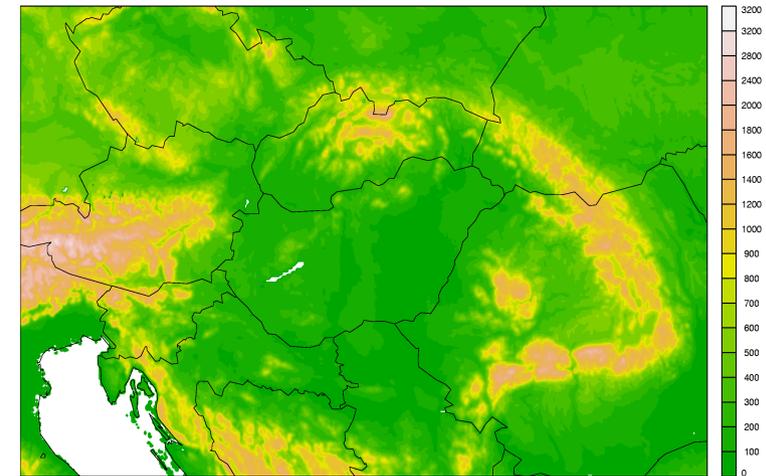
Cutoff AROME Domain CONV Obs in C+I  
Time: 00  
conv



# AROME 3h RUC

## *Observation cut-off*

- Regarding Conventional Observations from **OPLACE system** and Hungarian AROME domain, roughly **1 hour** is needed to collect observations
- This is currently the limit of AROME operational 3h RUC cut-off in Hungary
- In an hourly updated assimilation system it is a challenge to use sufficient amount of observations.

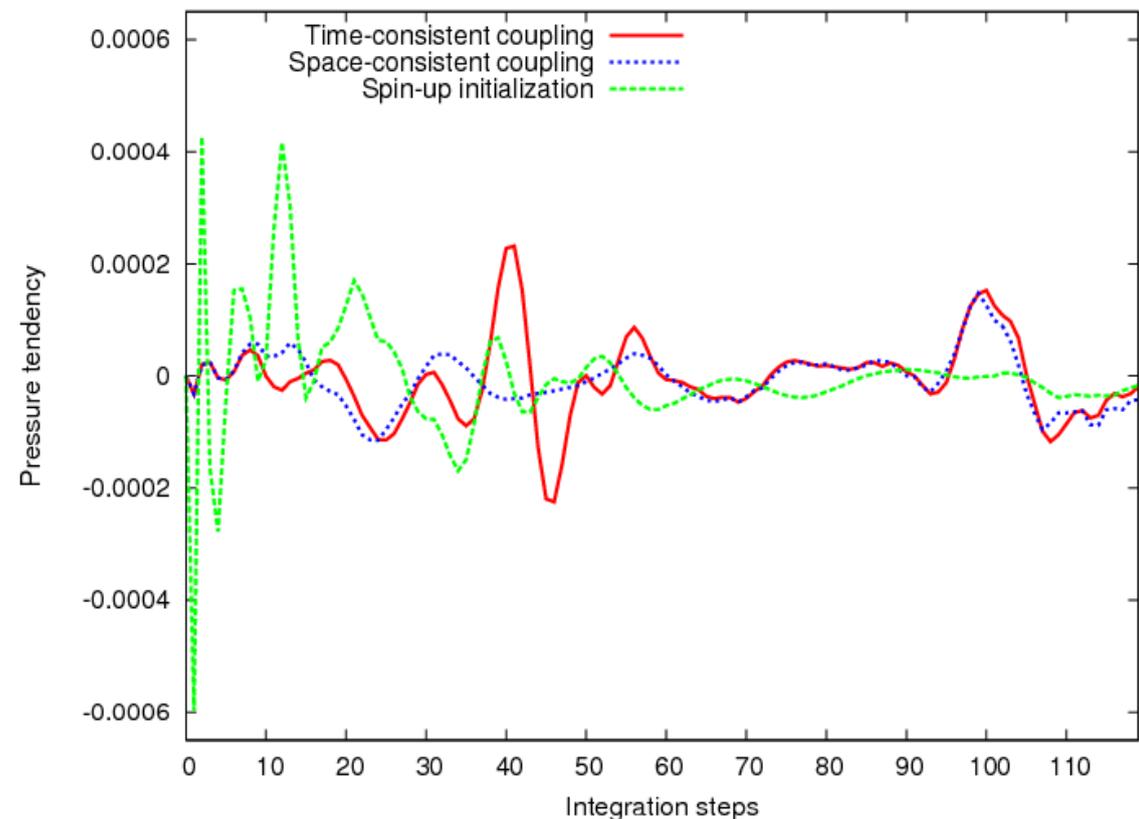
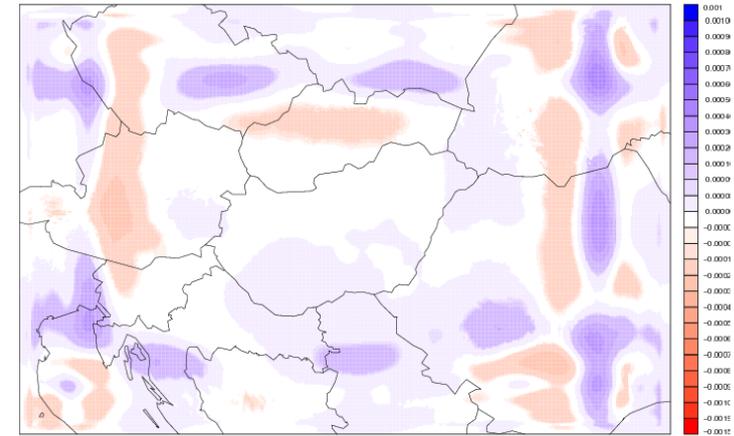


# AROME 3h RUC

## *Control noise accum.*

- Initialization is disabled in AROME to not distort small scales
- Therefore in such system the accumulation of noises has to be taken into account
- For 3h RUC space-consistent coupling has been found sufficient to avoid noise accumulation.
- For 1h RUC the coupling strategy and initialization have to be reassessed.

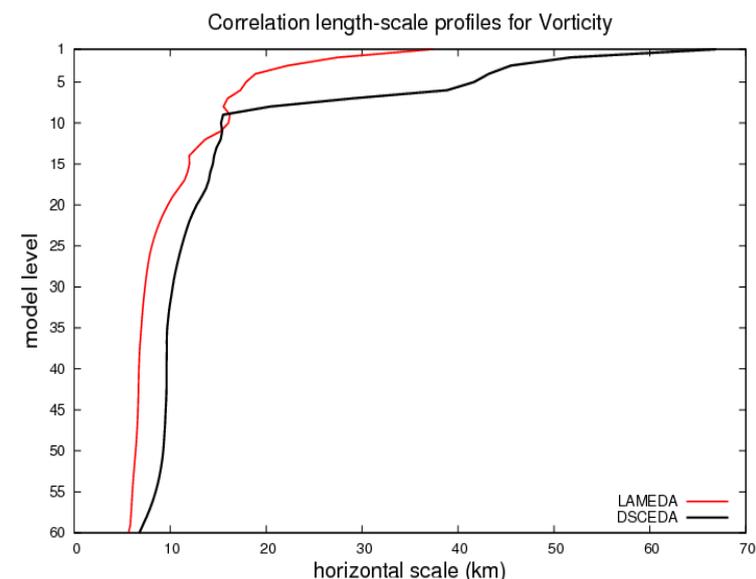
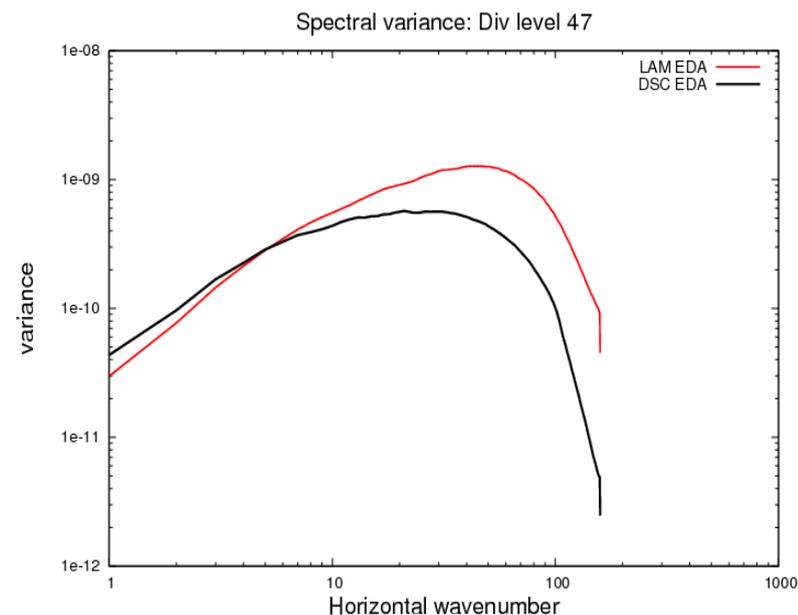
SURFPRESSION  
2012/8/1 20:0 initialized



# AROME 3h RUC

## *Background errors*

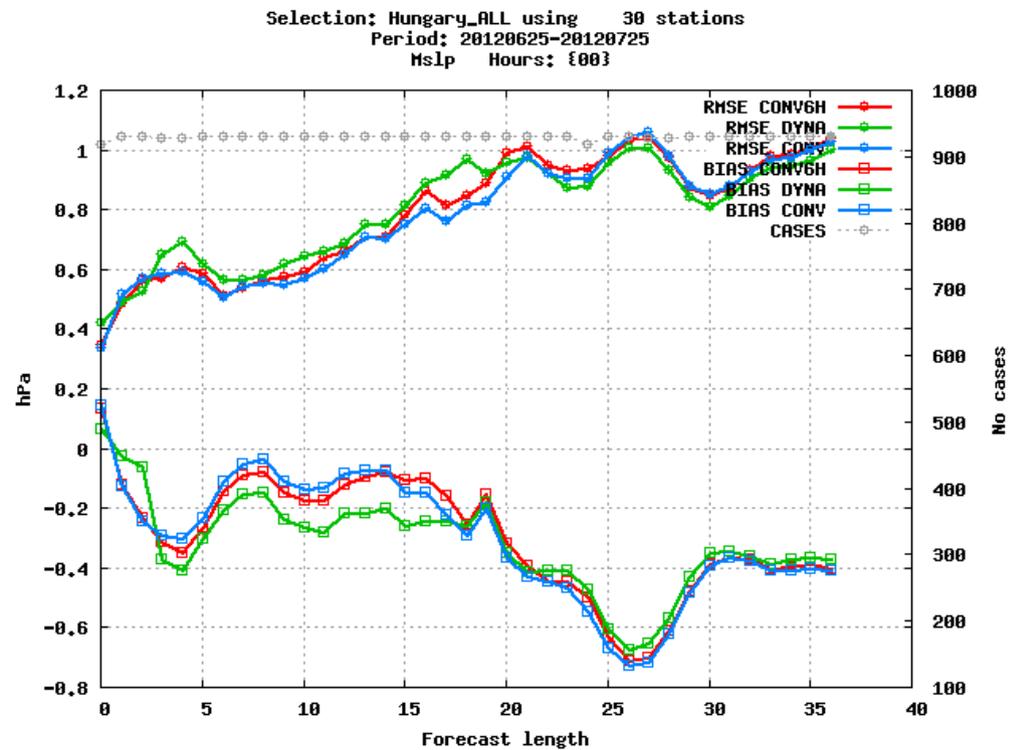
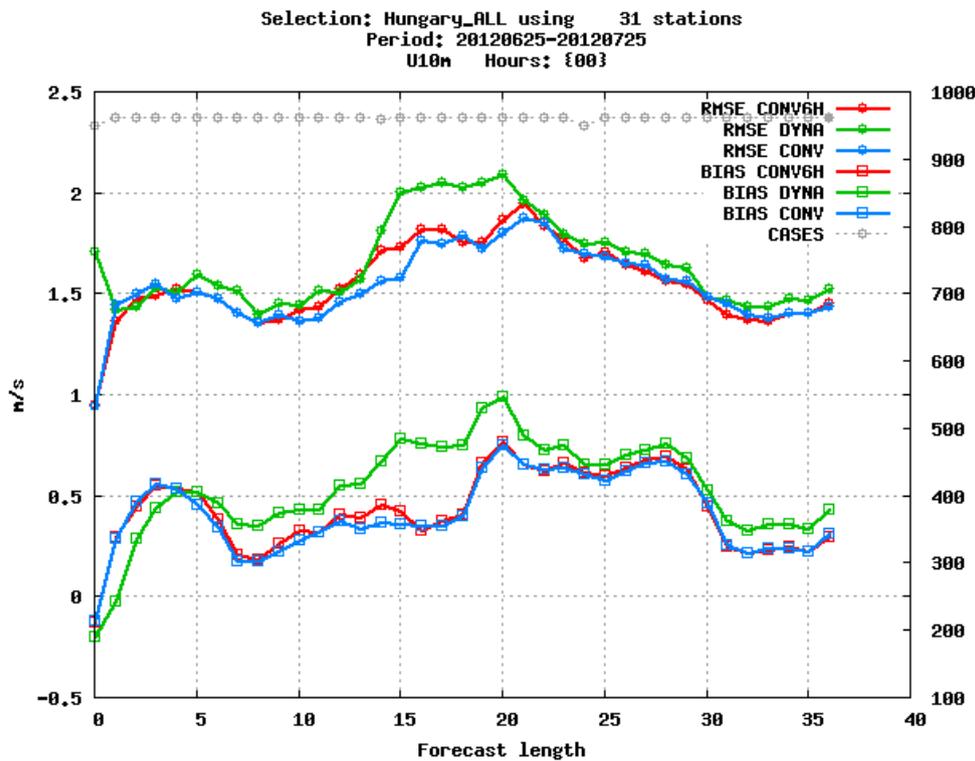
- The best estimate of background error statistics is crucial
- AROME EDA 3h forecast differences were used to derive climatological B
- In Hungary AROME EDA based B matrix was calculated which corrects more the smaller scales and has more localized length-scales compared to downscaled EDA B matrix
- AROME short-range forecasts are significantly improved using better structure functions i.e. AROME EDA B (Downscaled EDA Bmatrix vs. **AROME EDA Bmatrix**)



# Forecast skills

AROME DA 6h - Red  
AROME DYNA - Green  
AROME 3h RUC - Blue

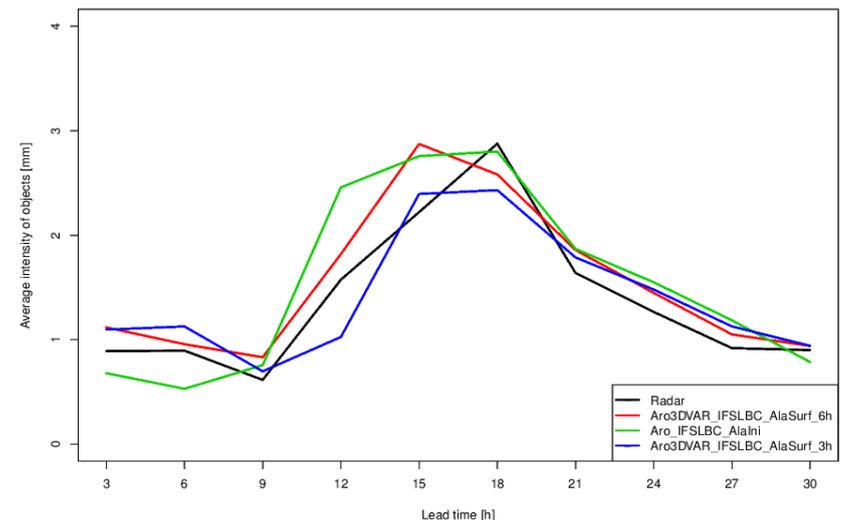
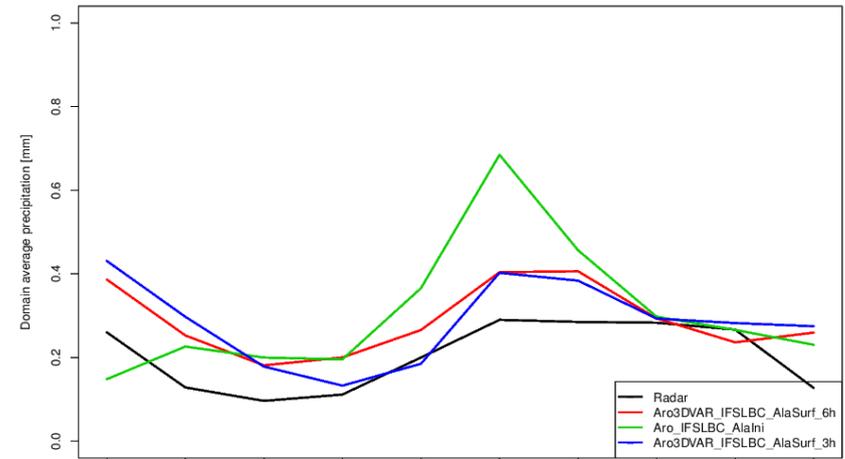
- The impact of the use of more conventional observations
- 3h RUC vs. 6h (also vs. dynamical adaptation)
- Slightly better RMSE, BIAS scores, mainly for wind speed and MSLP (neutral for temperature and humidity).



# Forecast skills

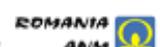
AROME DA 6h - Red  
AROME DYNA - Green  
AROME 3h RUC - Blue

- In verification against RADAR precipitation objects the 3h RUC has better performance than 6h
- Domain average precipitation is a bit closer to RADAR obs at daytime hours (upper figure → )
- Average intensity of objects are also better represented (lower figure → )



# Outlook – Hourly RUC

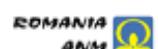
- Aim:
  - to improve AROME analysis and forecast
  - to provide warning forecasts from AROME sub-synoptic analyses and forecasts
  - to provide post-processed AROME forecasts for special end-users who are interested
  
- But there are several challenges...



# Questions

## *Observations*

- Do we have enough observation to ensure sufficient observation constraint in 3DVAR at every network time?
- What is the observation loss with hourly updated analysis cycle?
- How long cut-off should be used for hourly RUC?
- Is it possible to speed-up observation pre-processing to get more observations in short cut-off? Is it possible to do this with OPLACE or with COPE?
- What kind of observations should we consider in an hourly RUC?
  - Conventional SYNOP, AMDAR, TEMP
  - RADAR reflectivity and radial wind
  - GNSS ZTD
  - Mode-S MRAR and EHS
  - Meteosat products, SEVIRI, AMVs (Geowind, HRW)
  - Polar satellite radiances in long cut-off analyses
  - Else?



# Questions

## *Observations - RADAR*

- What is the best approach to assimilate RADAR reflectivity? 1D+3DVAR, Nudging, else?
- Is it possible to assimilate successfully reflectivity with the current incremental variational approach and its control variables? (non-linear relationship and tangent-linear approximation of H) Was it studied by someone?



# Questions

## *Initialization*

- Do we need initialization for 1h RUC?
- If initialization is needed which technique provides the best solution for that?
- What is the optimal strategy for initial LBC coupling? How this should harmonize with initialization?
- Should we treat hydrometeors differently in 1h RUC than 3h or 6h assim cycling?

# Questions

## *Background errors*

- The impact of using 3h or 6h forecast ranges for B matrix is weak. Is it true for comparing 1h and 3h as well?
- In other words can we use the climatological structure functions sampled from 3h forecast differences or not for 1h 3DVAR RUC?
- Can we get mature energy and variance spectra from 1h forecast differences?
- Can 3DVAR RUC be successful with climatological B or not? If not, what kind of opportunities we have to use flow-dependency in background error statistics and how much work is needed for the realization?

# Questions

## *LBC coupling*

- What is the optimal LBC coupling frequency in an hourly updated assimilation cycle? One hour frequency or higher?
- Can we use “old” LBC from global model updated only 4 times in a day? Is there a need for more frequently updated LBCs?



# Long-term

- The variational data assimilation approach will ensure the future way of research in ALADIN
- Flow-dependency is very important:
  - Hybrid 3DVAR
  - Grid-point sigmaB maps
- Nudging method for RADAR assimilation
- Cloud and Hydrometeor analysis, DFI with reflectivity assimilation?
- Observation error covariance matrix
- Take into account large-scale information: blending, Jk method
- More observations:
  - GPS slant, refractivity
  - AMDAR humidity
  - MTG radiances
  - Cloudy radiances

