# AROME Data Assimilation Activities at Hungary

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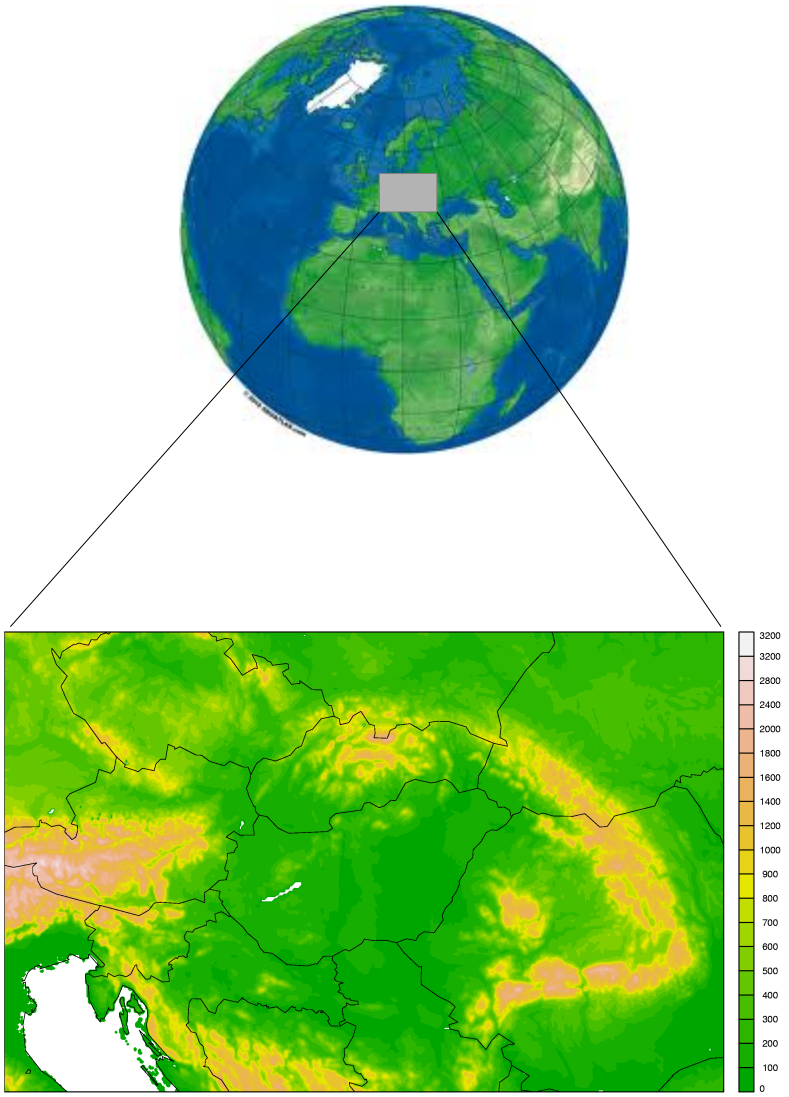
# Outline

- AROME forecasts at HMS
- AROME DA system and development
  - Activities 1: Design of RUC
  - Activities 2: Observations
  - Activities 3: Forecast Initialization
  - Activities 4: Surface Assimilation
  - (*Activities 5: RADAR assimilation – Roger's talk*)
- AROME DA future plans

# AROME at Hungary

- Model version: **CY36T1**
- **2.5 km** horizontal resolution (500*320 points)
- **60** vertical model levels
- Four production runs a day: 00 UTC (48h); 06 UTC (36h); 12 UTC (48h); 18 UTC (36h
- Initial conditions: from **AROME/DA** and **ALADIN/DA** at the surface
- Lateral Boundary conditions from **ECMWF/IFS** with 1h coupling freq.
- To calculate the screen level fields we use the SBL scheme over nature and sea



# AROME DA system

(design and settings)

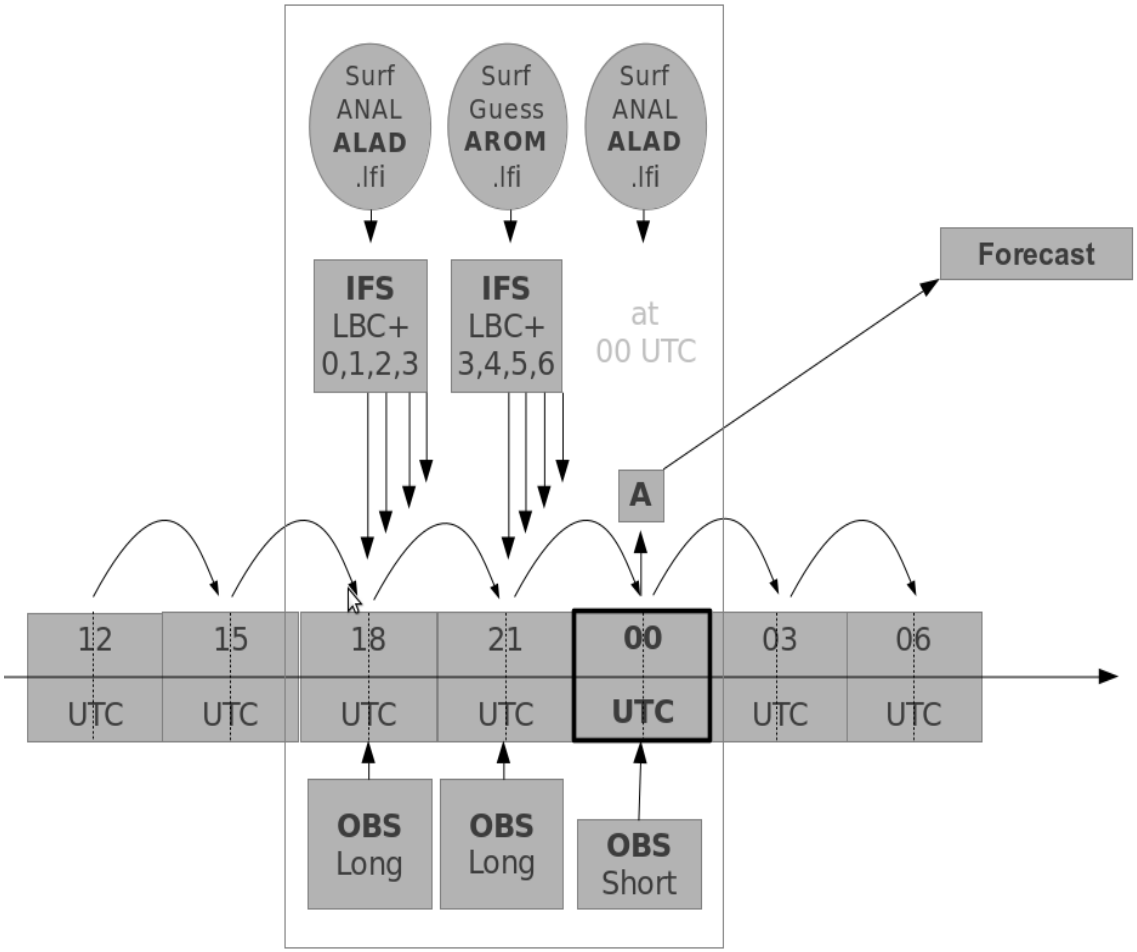
- Operational since March 2013 (brand new)

- 3h Rapid Update Cycle (8 3DVAR analyses per a day)

- No surface assimilation => SURFEX LFI: ALADIN anal & AROME surface guess

- Background error statistics: Downscaled ALADIN-EDA

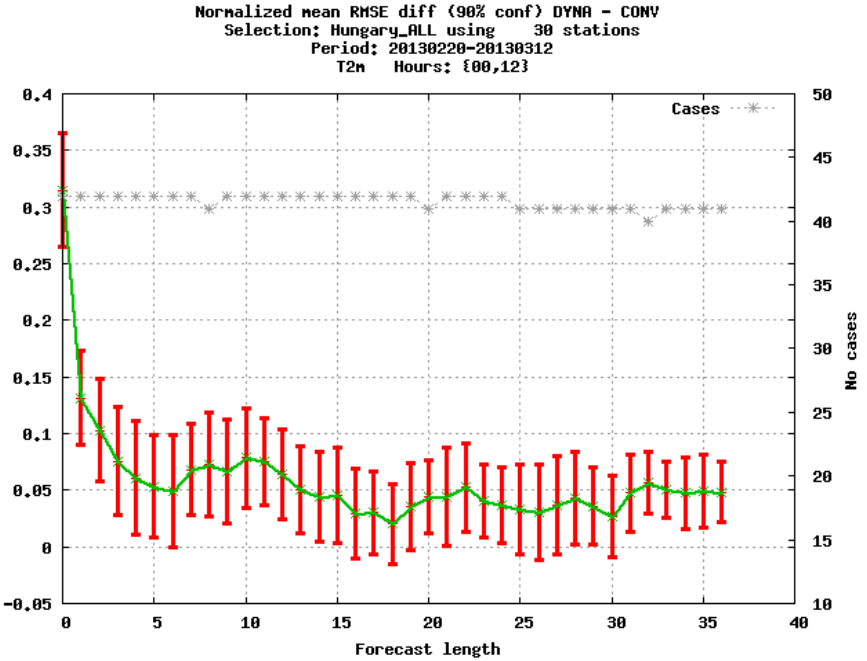
- Recently Conventional obs. are used (SYNOP,TEMP,AMDAR)

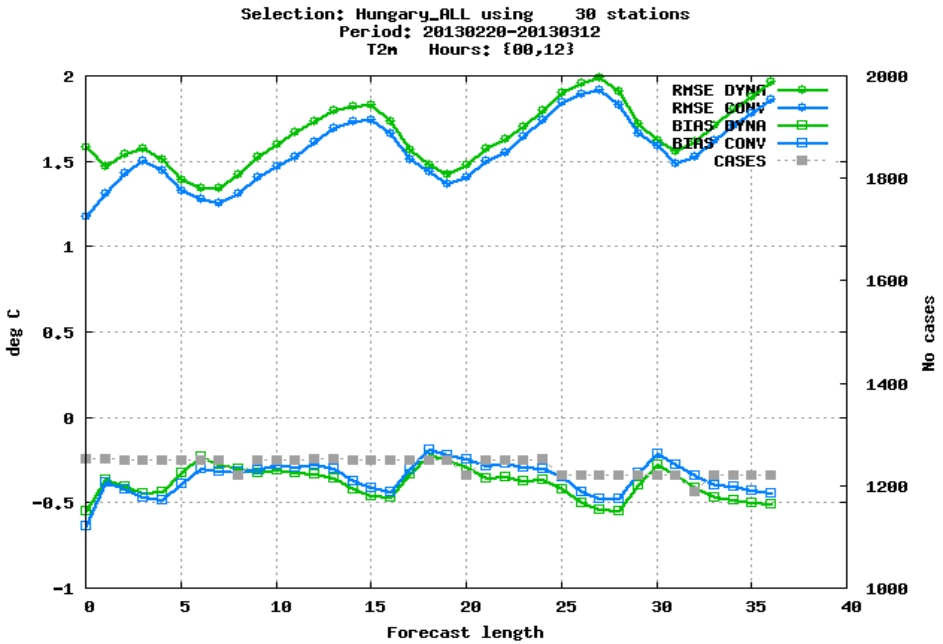


# AROME/DA vs AROME/DYNA (1)

- In order to estimate the skill of the AROME DA several verification studies were made (summer,spring and winter period)

- Better performance was obtained mainly for short-ranges, biggest improvement in the temperature, humidity and wind



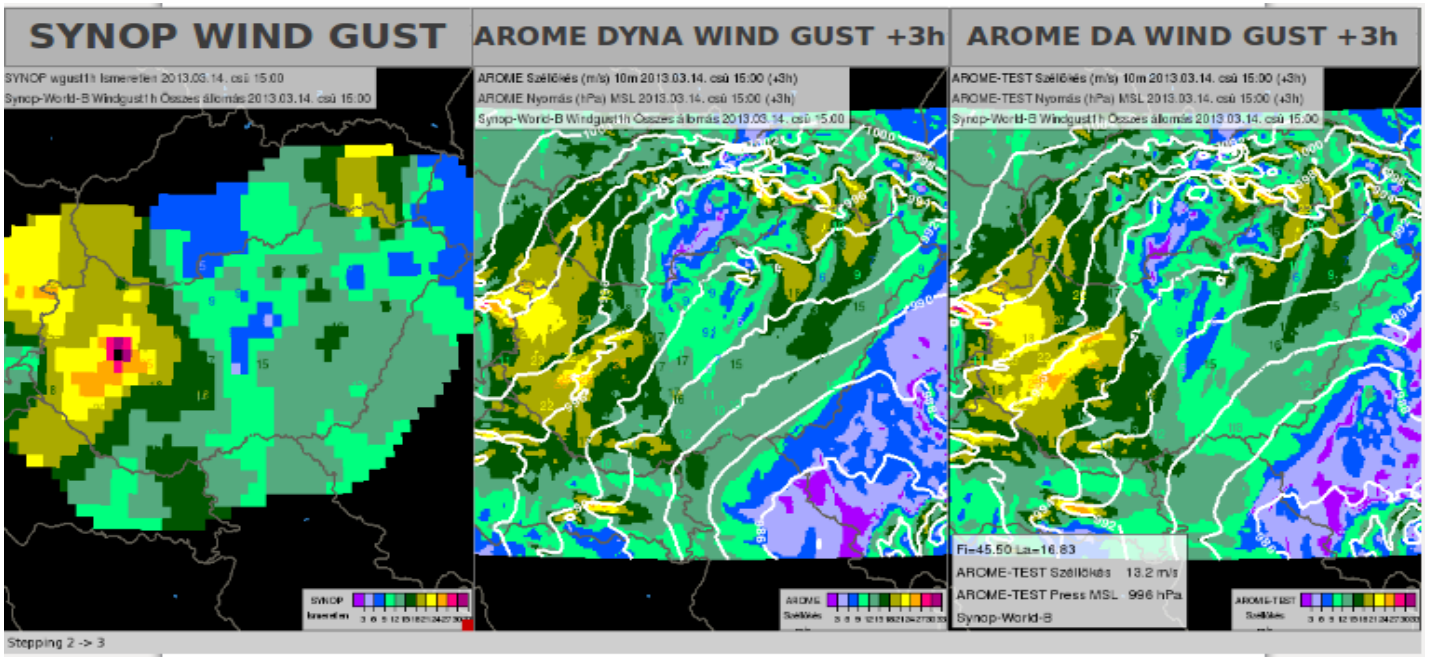

AROME DYNA – Green
AROME DA - Blue

# AROME/DA vs AROME/DYNA (2)

Hungarian forecasters said:
(AROME DA Parallel Suite)

*"...in the first 6 hours the precipitation and temperature field were better represented than the operational AROME"*

*"...the low level absolute humidity was overestimated in the operational. The AROME DA could improve it."*



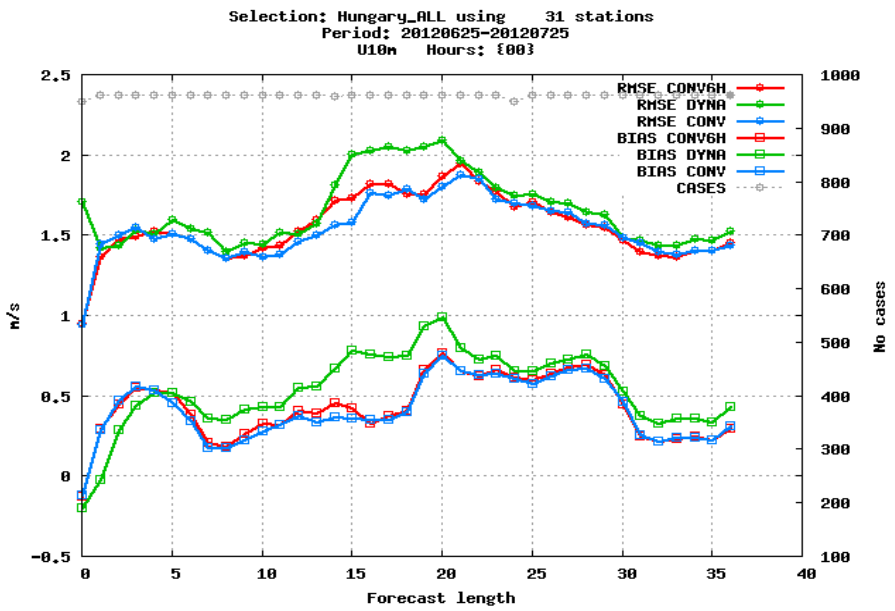
# *Act1.1* **RUC why?**

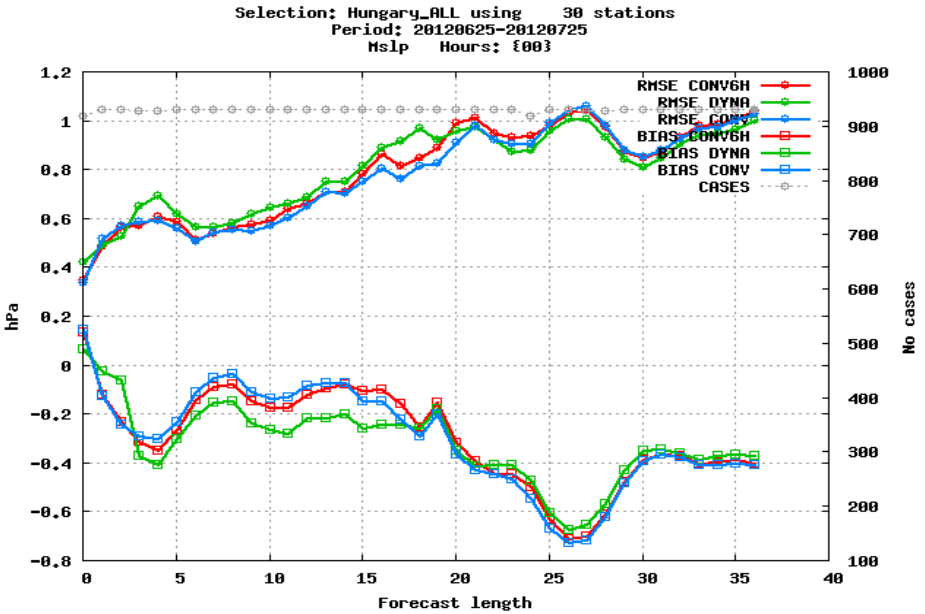
- To use more available observations

- For future development to implement non-conventional observations with high temporal and spatial coverage in the system (e.g. Radar assimilation purposes)

- Slightly better RMSE, BIAS scores, mainly for wind speed and MSLP (neutral for temperature and humidity).

AROME DA 6h - Red
AROME DYNA – Green
AROME DA - Blue



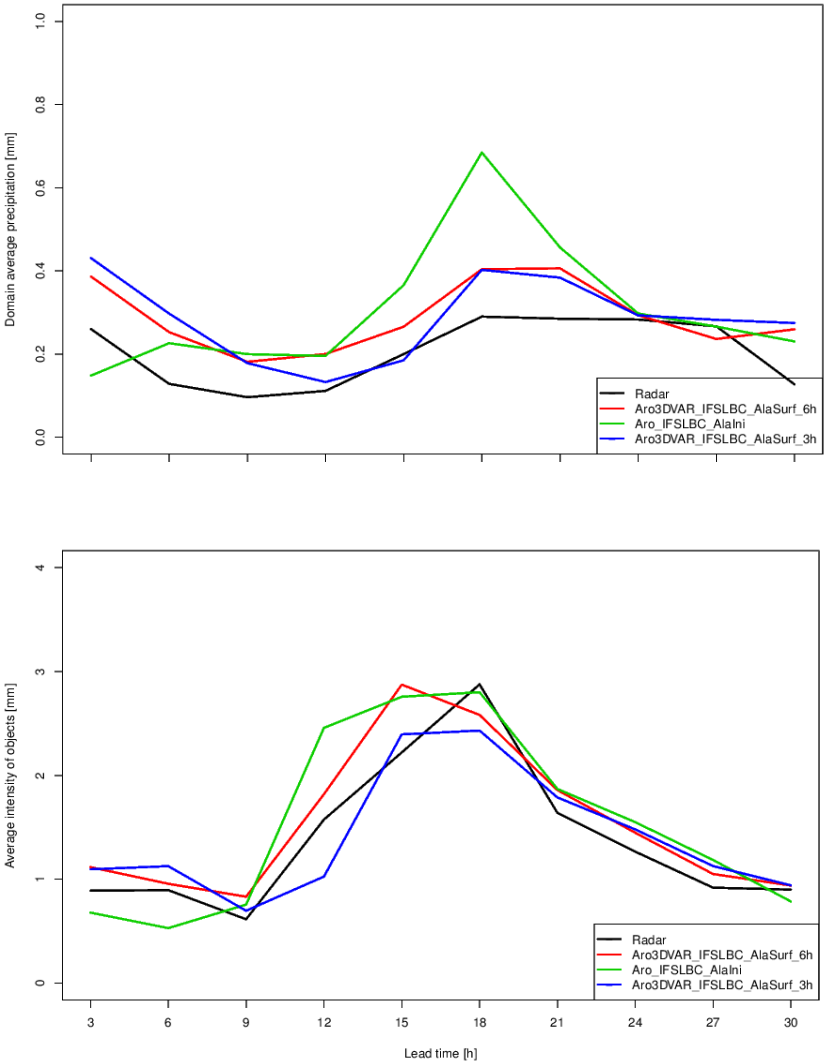
# *Act1.2* **RUC why?**

AROME DA 6h - Red
AROME DYNA – Green
AROME DA - 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 → )



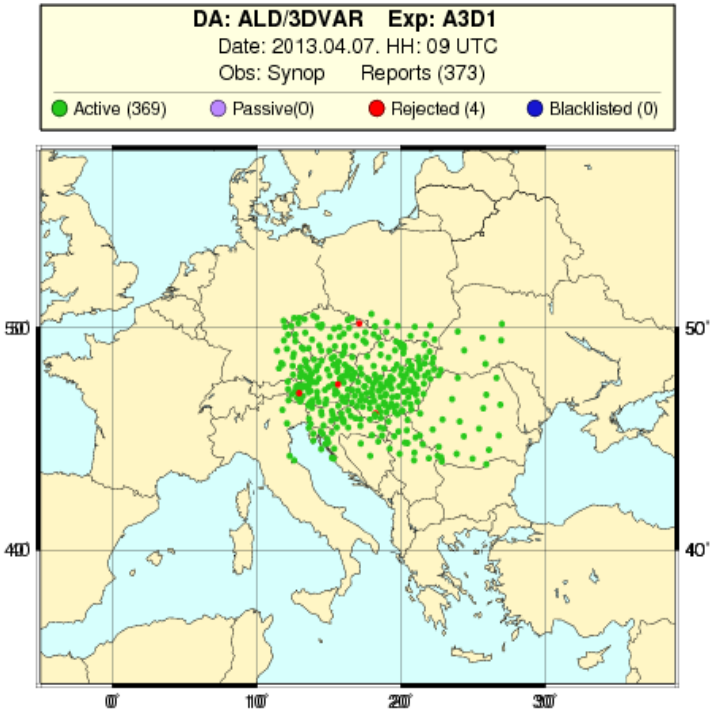
# *Act2.1*
# Observations

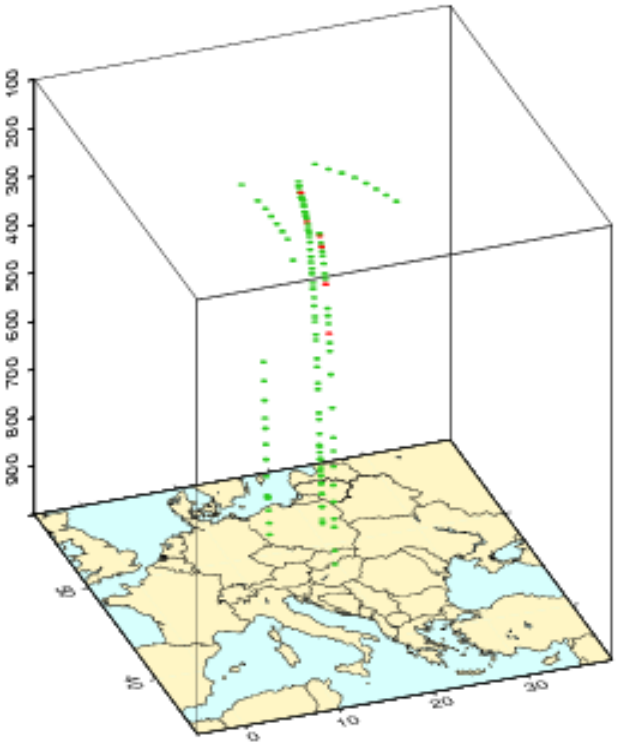
- Recently conventional observations are assimilated in AROME DA.

- AMDAR thinning: 10km

- using 10m wind obs above land (LSLRW10=.FALSE.)

- OPLACE system observations




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

# *Act2.2*
# **Observations**

- To evaluate the impact of obs on analysis, DFS was computed (2013041012, 2013041200UTC)

- Absolute DFS is the biggest for wind obs → Important to use LSLRW10!

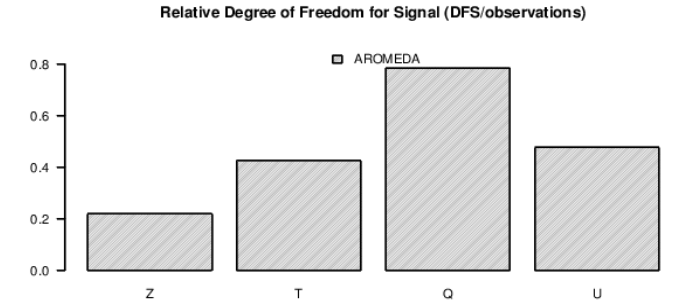
- Relative importance of humidity obs

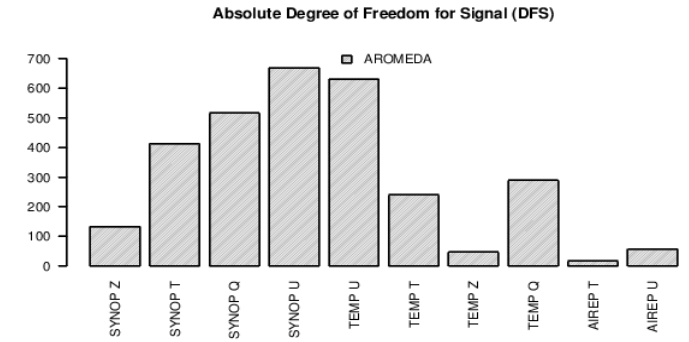
DFS computation:

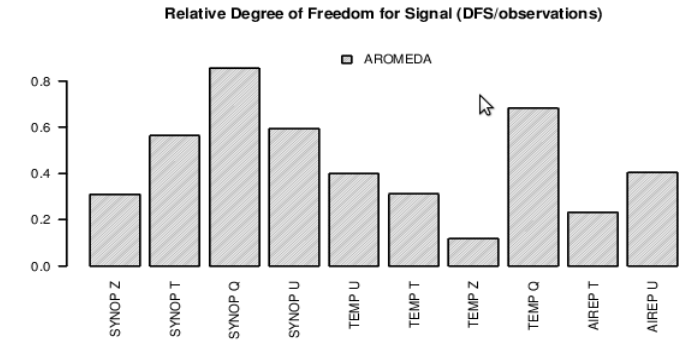
*(Chapnik et al., 2006) Girard's method*

$$DFS = Trace(\boldsymbol{HK})$$

$$Trace(\boldsymbol{HK}) \approx (y' - y)^T R^{-1} (Hx'_a - Hx_a)$$

# *Act3.1*
# ***Question of Initialization***

- No Digital Filter Initialization in AROME Hungary

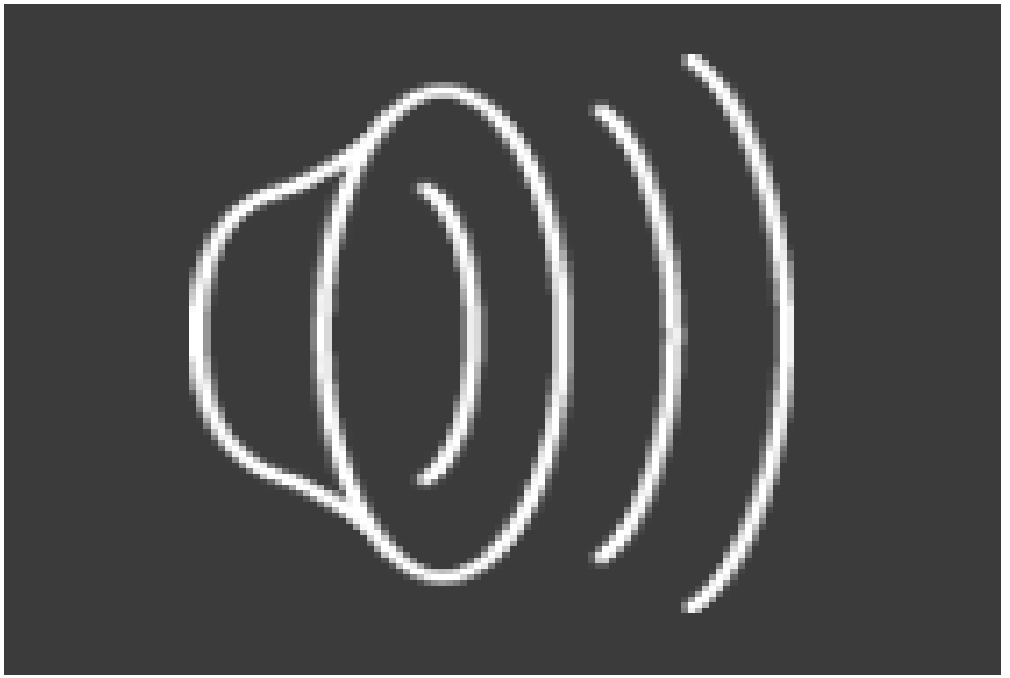
- Spurious noises were observed at the very beginning of the integration

- Using AROME analysis as LBC at initial time → **Space Consistency Coupling** helps to reduce noises and equilibrates more quickly

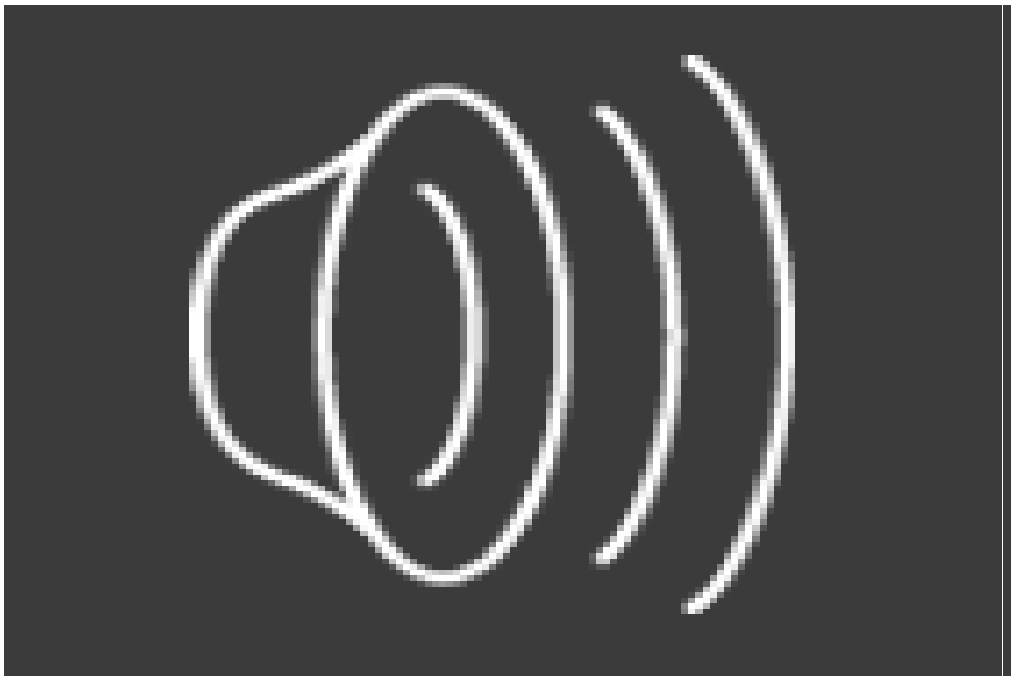
- To verify the phenomena surface pressure differences were plotted step by step

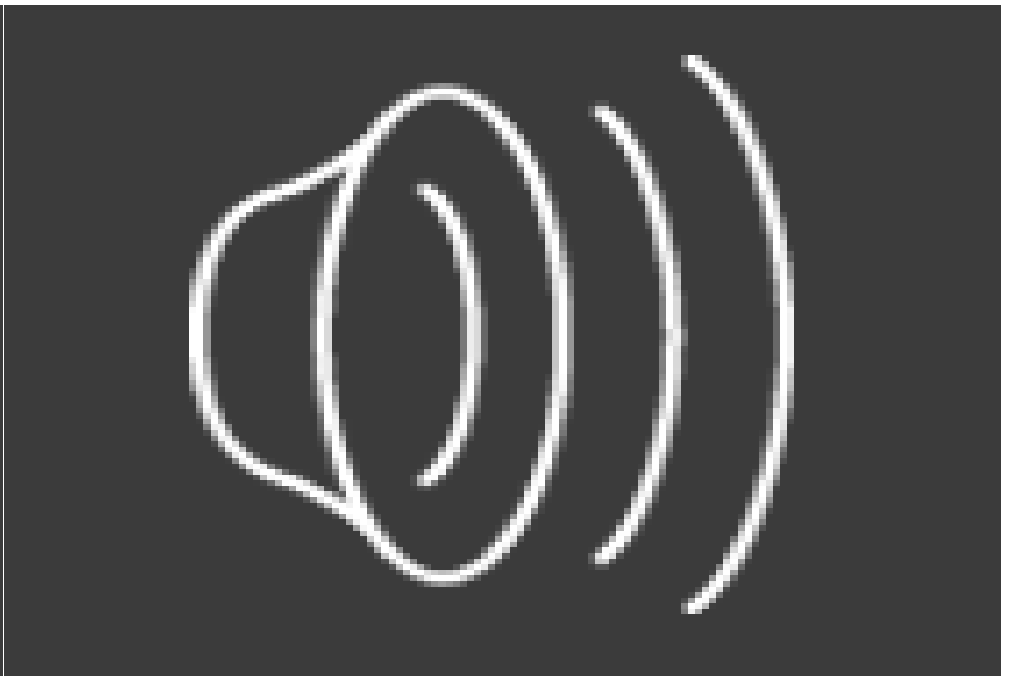
# Act3.2
## Question of Initialization

*Dynamical Adaptation*



*Time Consistency Coup.*
*Init: AROME analysis*
*LBC0: Downscaled IFS*





*Space Consistency Coup.*

# *Act4.* ***Surface Assimilation***

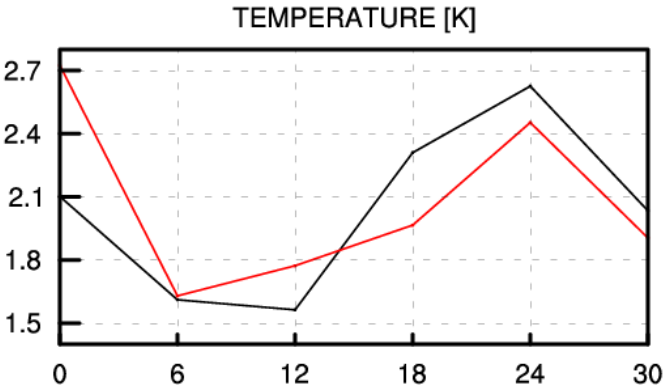
AROME OI_main – Black
AROME DYNA - Red

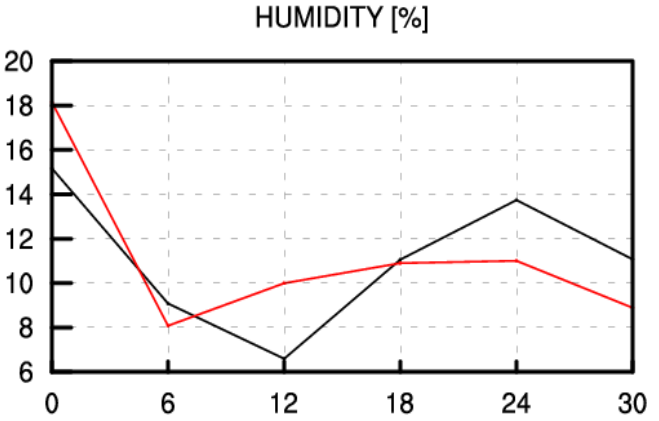
- AROME OI_main (alone) was tested for winter and summer period

- In dry regimes OI_main could improve wet and cold bias present in AROME dynamical adaptation at first 12 hours

- In wet regimes OI_main alone is not able to beat DYNA

- RMSE scores for 2m temperature and humidity in figures →




A part of this study was conducted
in the framework of a French-Hungarian
bilateral project; Project numbers
TET_11-2-2012-0003 (Hungary) and 27855UD (France)

# Conclusion & Plans

## (What's next in AROME DA?)

- AROME Rapid Update Cycle has added value and efficient to use more obs

- The 10m wind observations are an important part of AROME DA Hungary

- Space Consistency Coupling can avoid spurious noises at initial time

- RADAR data assimilation

– Test and implement other non-conventional observations
(satellite observations)

– Find reasonable solution for surface assimilation OI_main
(move towards the EKF in the future)

- Make better representation of background error statistics(AROME EDA)

# Thank you for your attention!
# Questions?

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*(AROME EPS; ALARO; AROME PBL)*

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