Regional Cooperation for Limited Area Modeling in Central Europe

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Data assimilation work in Hungary

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Outline

- ▶ Status of operational DA systems
- ▶ B-matrix recalculation for 90 levels
- ▶ HRW AMV experiments
- ▶ SEKF experiments (see Helga's talk)
- ▶ Experiments with AROME at 1.3 km resolution
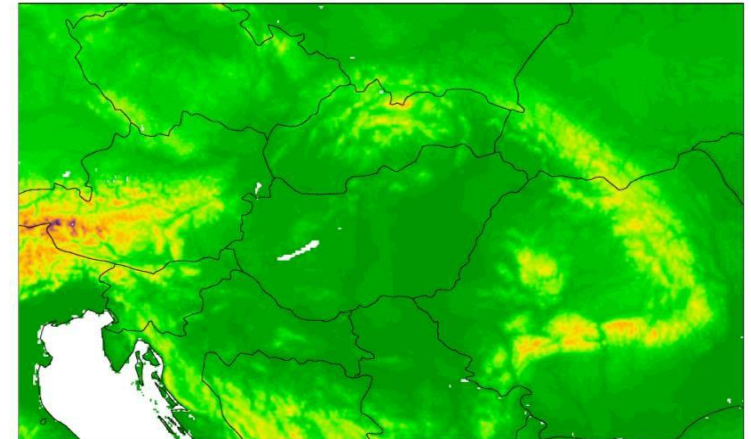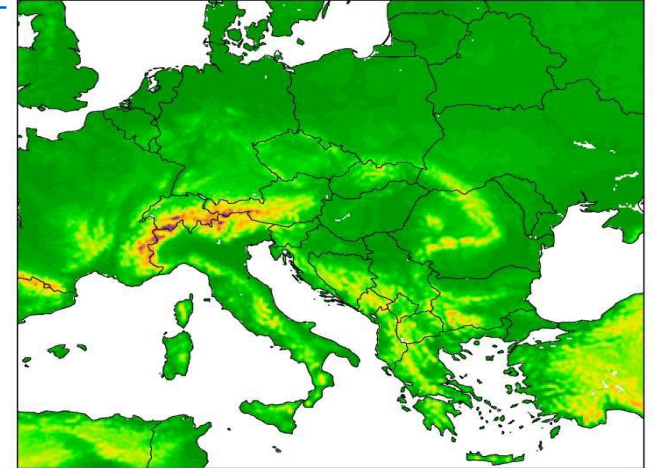- ▶ AROME-RUC experiments
- ▶ Future plans

Operational NWP and DA systems

- **ALARO**
  - 8 km horizontal resolution/49 vertical levels
  - 300 s timestep
  - cy40t1_bf05
  - SMS environment
  - 4 runs/day up to 60/48/60/36 hours
  - Coupled to ECMWF HRES
    - 3-hourly frequency
    - Time-lagged coupling for forecast
    - Direct coupling for DA cycle

- **AROME**
  - 2.5 km horizontal resolution/60 vertical levels
  - 60 s timestep
  - **cy43t2_bf11**
  - SMS environment
  - 8 runs/day up to 48/36 hours
  - Coupled to ECMWF HRES
    - 1-hourly frequency
    - Time-lagged coupling for forecast
    - Mixed coupling in DA cycle
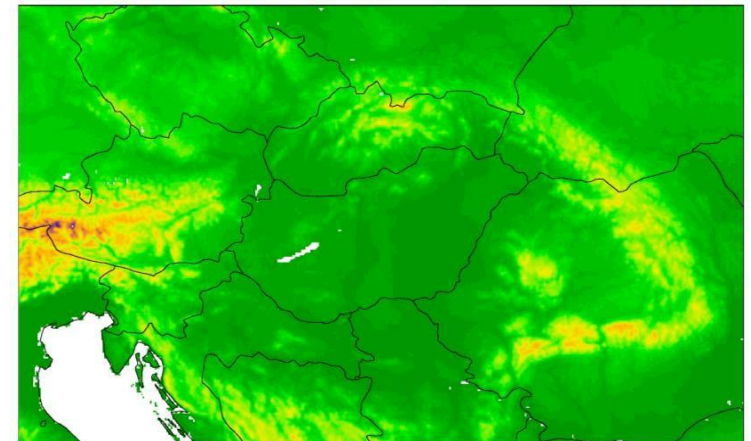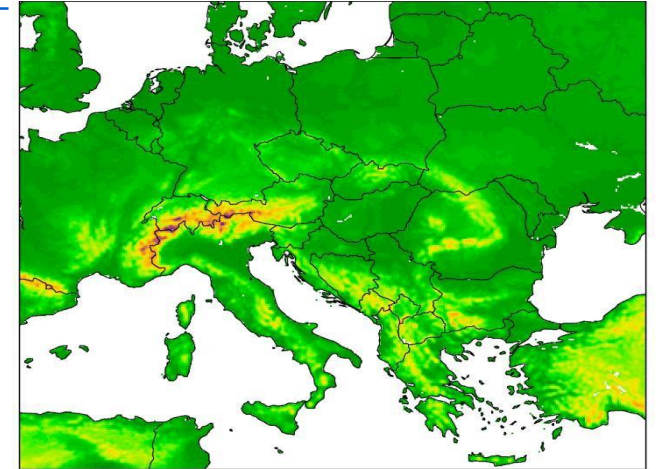
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Operational NWP and DA systems

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- **ALARO**
  - With digital filter initialization
  - 3DVAR + CANARI
  - 6-hour DA cycle
  - Observations: SYNOP, AMDAR, TEMP, SEVIRI, Geowind AMV, NOAA-18 AMSU-A, MHS
 - ALADIN EDA B-matrix
- **AROME**
  - Without digital filter initialization
  - 3DVAR + OI_MAIN
  - 3-hour DA cycle
  - Observations: SYNOP, AMDAR, TEMP, GNSS-ZTD, Slovenian and **Czech** Mode-S MRAR
  - AROME EDA B-matrix

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Operational NWP and DA systems

‣ **AROME-EPS (from February 2020)**

  ‣ 11 members

  ‣ 2.5 km horizontal resolution

  ‣ 60 vertical levels

  ‣ **cy43t2_bf11**

  ‣ SMS environment

  ‣ 1 run/day up to 48 hours

  ‣ Coupled to ECMWF ENS (first 10 members + control member)

    ‣ **1-hourly frequency**

  ‣ No data assimilation

  ‣ Initial conditions:

    ‣ ECM-ENS + AROME-det. surface
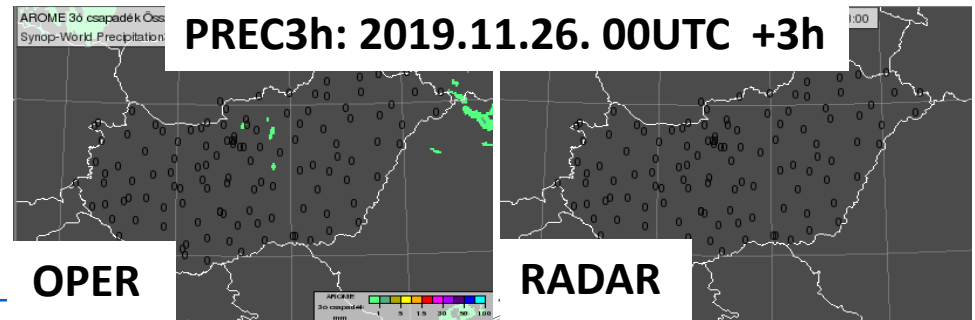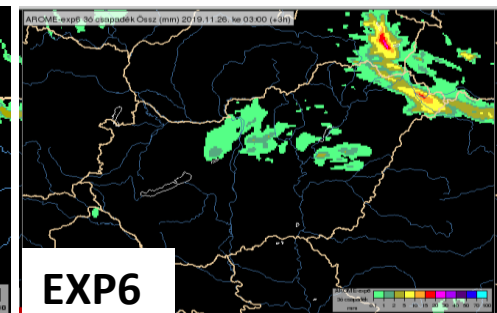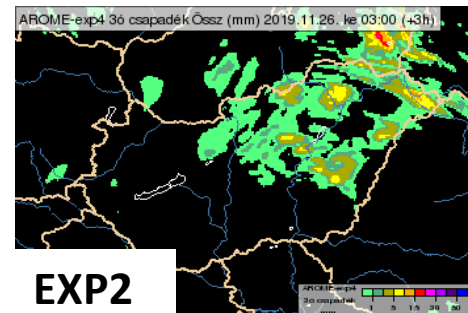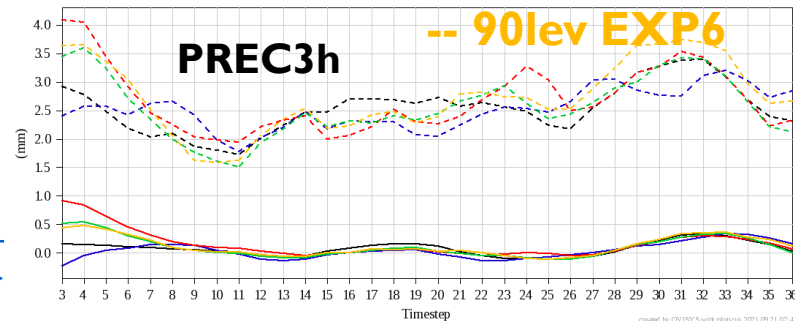
B-matrix recalculation for 90 levels

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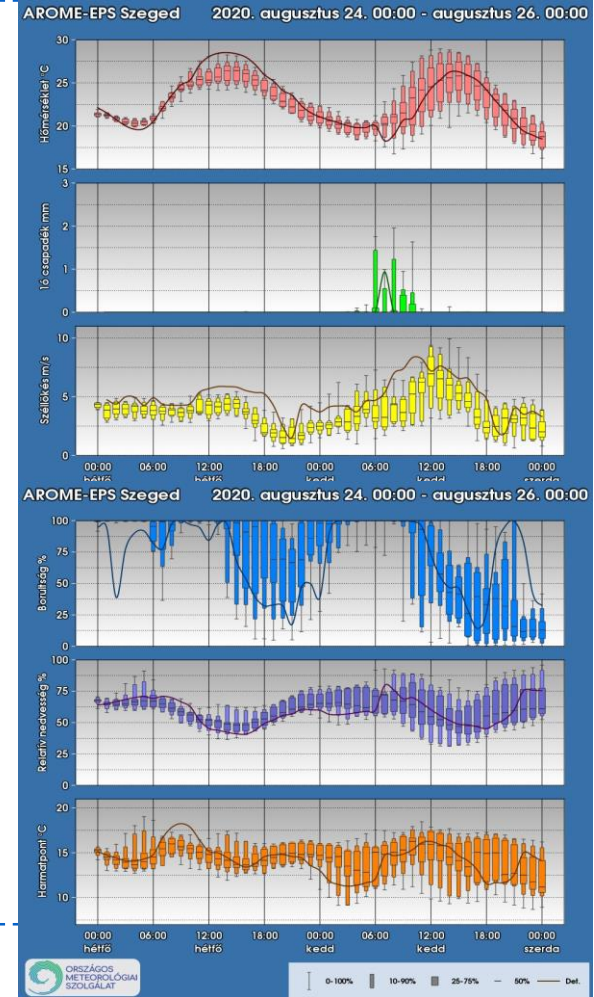
- ▸ Tuning of **B** and **R**

- ▸ Desroziers et al. (2005) ~ EXP1→ deterioration

- ▸ EXP6 settings gives the best results, but overestimation of 3h-precipitation is still problematic in the beginning of the forecast

	CANOPY	NLEVBAL0/ NLEVBAL1	SIGMAO_COEF	REDNMC	REDNMC_Q
REF 60 lev	yes	11/17	0.9	1.2	-
EXP1 90 lev	no	0/0	0.71	1.26	-
EXP2 90 lev	no	0/0	0.9	1.2	1.67
EXP6 90 lev	no	22/30	0.9	1.2	1.67

-- **60 lev OPER**   -- **90lev EXP1**

-- **90lev DYNA**   -- **90lev EXP2**

-- **90lev EXP6**

PREC3h

EXP2   EXP6

PREC3h: 2019.11.26. 00UTC +3h

OPER   RADAR

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HRW AMV experiments

- Winter experiment in AROME showed mostly neutral impact

- Revision of blacklisting settings
  - O-B statistics didn't show any concerns regarding data between 350 and 800 hPa

- Winter experiment with new blacklisting –adding data between 350 and 800 hPa
  - Mainly neutral impact for surface parameters
  - For higher vertical levels neutral or small positive effect

- Plans:
 - Summer experiment with new blacklisting settings
  - cy40t1 →cy43

DA: ALD/3DVAR   Exp: AMD8
Period: 2019.12.01–2019.12.18   HH: all UTC
Obs: SATOB   Var: U (m/s)
Obs–Guess (mean & std)   Obs–An (mean & std)
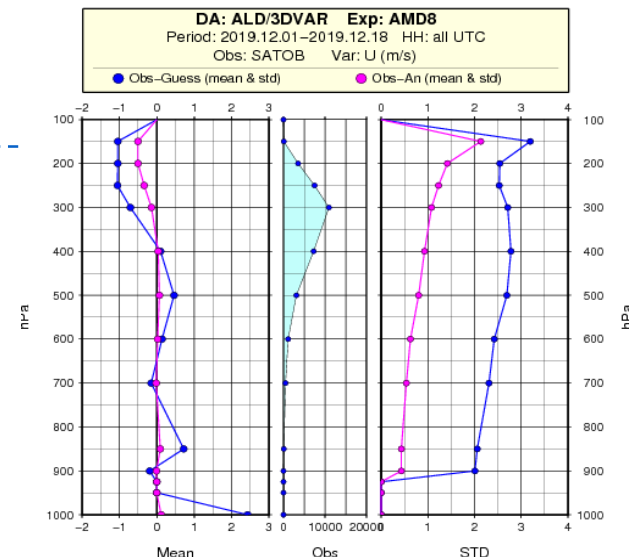
| Period: | 12/01/2019 - 12/18/2019 |
Area:	AROME_max_400m_2021
Variable:	Wind speed (500 hPa)
Runhour:	12

Wind speed (500 hPa)

Legend (Model/Score)
AROME_cy40_AMV8_test2019dec/RMSE   AROME_cy40_AMV_ref2019dec/BIAS
AROME_cy40_AMV8_test2019dec/BIAS
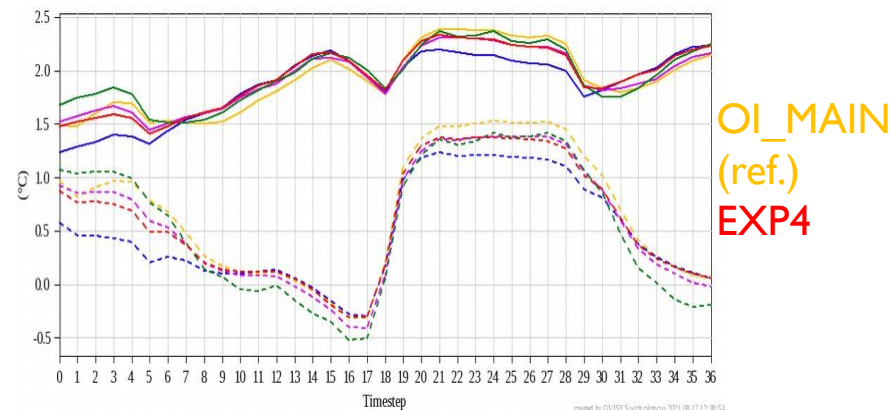AROME_cy40_AMV_test2019dec/RMSE
AROME_cy40_AMV_test2019dec/BIAS
AROME_cy40_AMV_ref2019dec/RMSE

RMSE

BIAS

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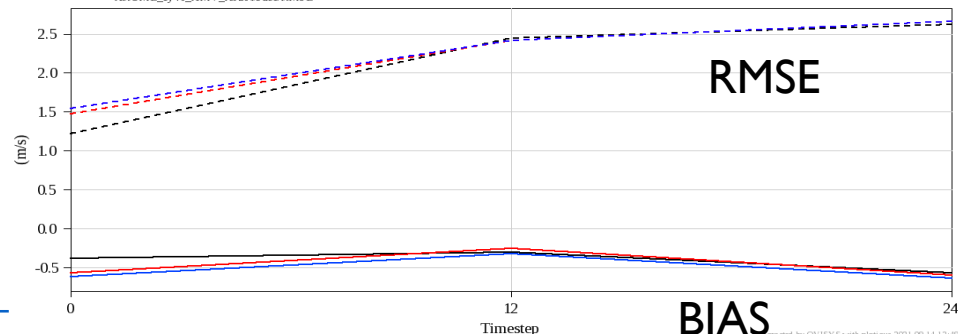
- ## Spurious TG2 values in the Alps in winter
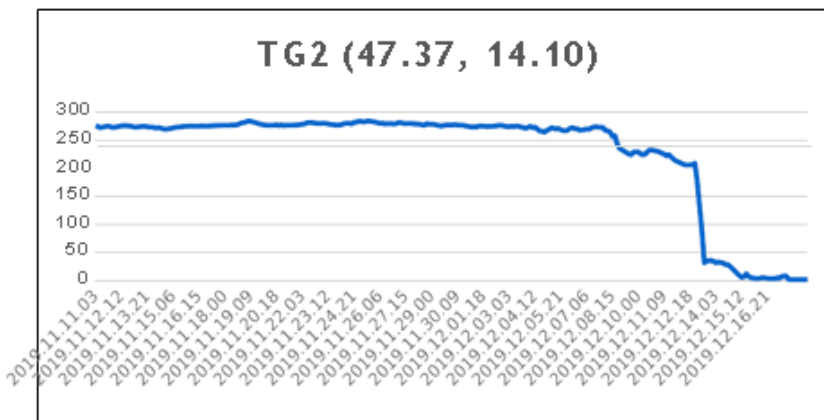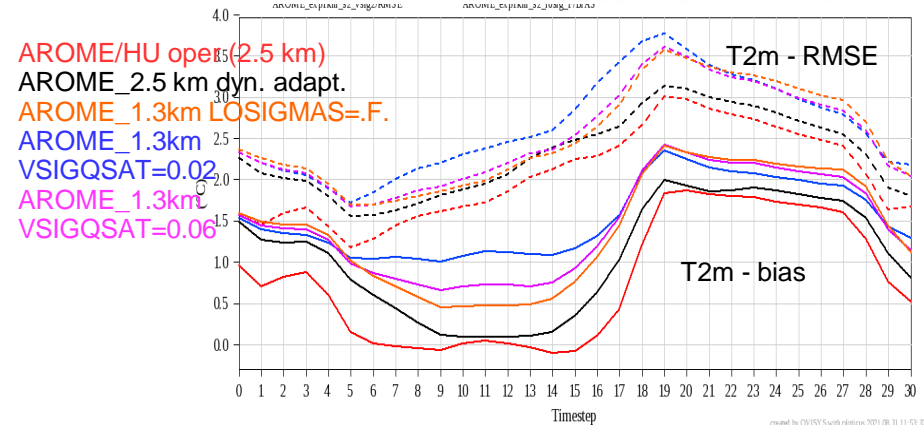

- The error related to the assimilation settings (observ. error, backgr. error, perturb. size)

- Many test with different settings (possible candidates)

- Bugfix in the SEKF code

- Summer run with the possible settings
- Bias (--) and RMSE (—) of 2m temperature over Hungary with different SEKF assim. settings

OI_MAIN (ref.)
EXP4

- Plans:
  - SEKF e-suite with EXP4 settings this autumn -> decision on operational introduction

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Experiments with AROME at 1.3 km resolution

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- ▸ Setup:
 - ▸ Domain size similar to AROME/HU oper
  - ▸ Dynamics/physics settings same as for AROME-France
- ▸ In these experiments dynamical adaptation was used (ECMWF/IFS in upper-air, surface is cycled without DA)
- ▸ Main difference between AROME-1.3km and AROME/HU oper is in microphysics (LOSIGMAS=.T. in 1.3 km)
- ▸ VSIGQSAT (for cloudiness computation) parameter was tested, value of 0.06 seems best choice (MF: 0.02)
- ▸ Small deterioration in T2m and ws10m in summer, other parameters show improvement as compared to 2.5 km model

AROME/HU oper (2.5 km)
AROME_2.5 km dyn. adapt.
AROME_1.3km LOSIGMAS=.F.
AROME_1.3km VSIGQSAT=0.02
AROME_1.3km VSIGQSAT=0.06

T2m - RMSE

T2m - bias

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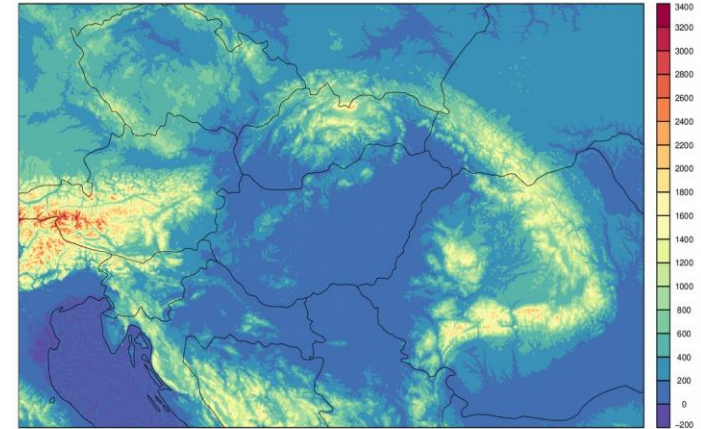
AROME-RUC experiments

- Previous experiment on winter period showed better results with mixed settings (1 hourly 3D-Var and 3 hourly surface RUC)
- New experiment:
  - Summer period (2020.07.01-22)
  - 1 hourly surface RUC vs. 3 hourly surface RUC (OI_MAIN)
  - 1 hourly 3D-Var in the upper atmosphere
- Conclusions:
  - The 1 hourly setup yields better results in many cases
  - Noticable improvement with some surface variables and larger precipitation events

24-hour precipitation

1 hourly   **3 hourly**   **radar**
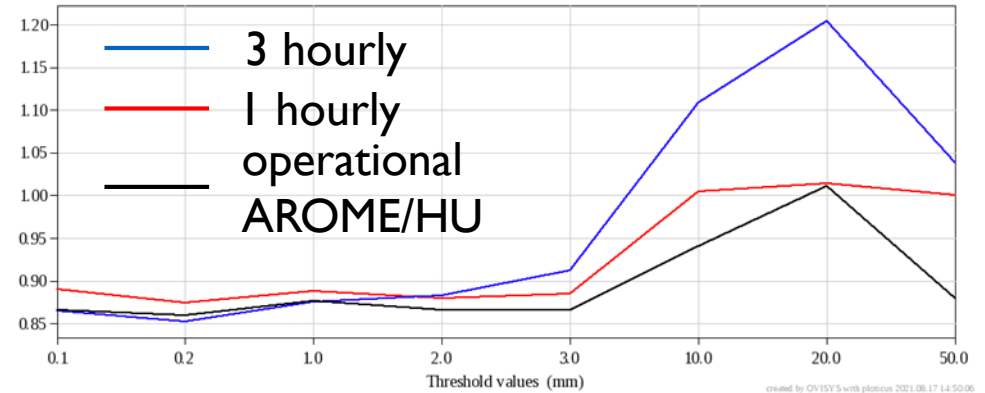
3-hour precipitation

AROME-RUC experiments
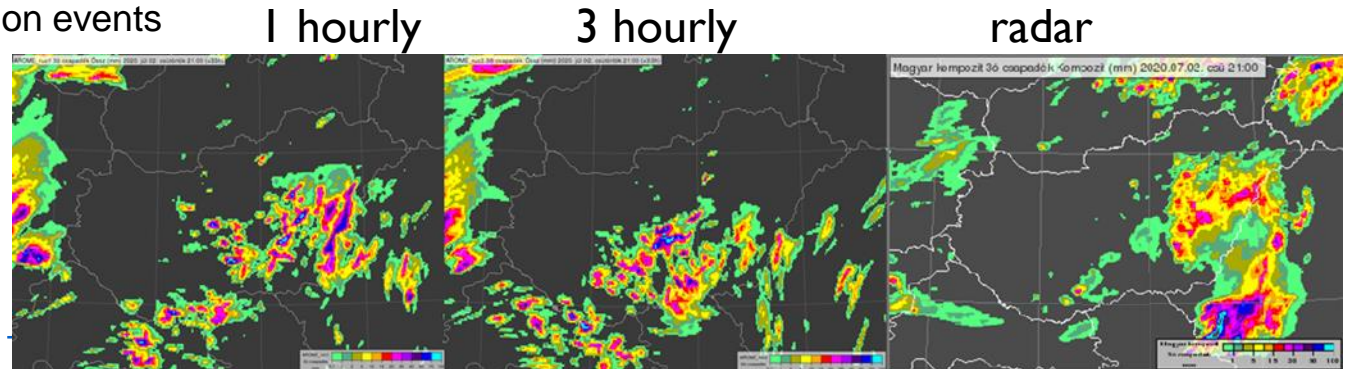
▶ Plans for further investigation:

  ▶ Closer examination of the differences between the two setups to determine the exact cause of the differences

  ▶ Experiments with the hourly setup using real-time observations

  ▶ Experiments with the hourly setup with the 1.3 km resolution

▶ Open questions:

  ▶ Assimilation window: -30/+30 or -45/+15?

  ▶ How to use GNSS data properly (1 hour delay in operational setup not suitable for hourly RUC setup)

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- **Improvements to the operational AROME/HU setup (2.5 km resolution)**
  - Implementation of AMV data after further experiments
  - Implementation of Hungarian Mode-S data
  - Implementation of SEKF after further experiments
  - Experiments with daily updated LAI in AROME/HU using SURFEX-ISBA-Ags
- **Experiments with AROME at 1.3 km resolution**
  - Experiments with RUC using different settings
  - Start work on radar data assimilation
  - Experiments with SEKF
- **OPLACE maintenance**

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Thank you for your attention.