SEKF Surface Assimilation activities in Hungary

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ORSZÁGOS METEOROLÓGIAI SZOLGÁLAT

3rd ACCORD All Staff Workshop, Tallinn, 27-31. March, 2023

Outline

- SEKF settings in 2.5 km resolution and 60 levels
  - AROME deterministic
  - AROME EDA EPS
- SEKF settings in 1.3 km resolution and 90 levels
- Future Plans

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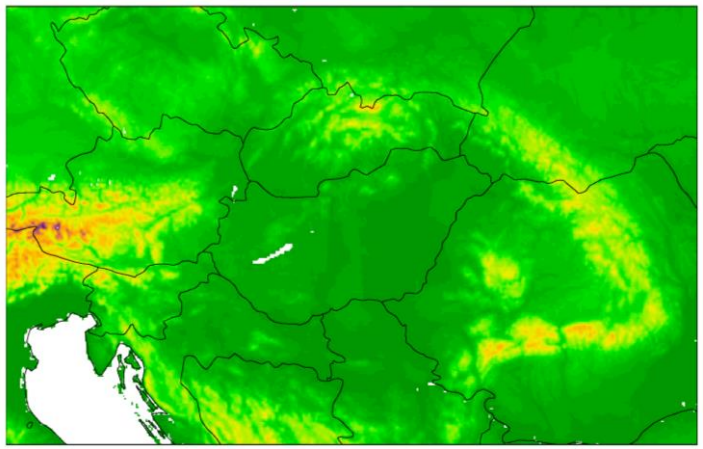
AROME cy43t2 bf11 + SURFEX 8.0

- 2.5 km horizontal resolution
- 60 vertical levels
- 3D-VAR + SEKF (operational from 29th June, 2022, former oper. OI-MAIN)
- 3L-ISBA
- 1 patch, 4 tiles
- SODA and SURFEX complied from the pack, and works only 1 proc.

- Observations: T2M and HU2M (CANARI)
- Control variables: TG1, TG2, WG1 and WG2



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Tests with different assimilation settings

	EXP1	EXP2	EXP3	DEF	ECM	ECM_B	EXP4
XERROBS (T2M, HU2M)	0.5, 0.2	0.5, 0.2	1.0, 0.4	1.0, 0.1	1.0, 0.04	1.0, 0.04	1.0, 0.07
XSIGMA (WG2, WG1, TG2, TG1)	0.15, 0.1, 2, 2	0.15, 0.1, 2, 2	0.15, 0.1, 2, 2	0.15, 0.1, 2, 2	0.15, 0.1, 2, 2	0.01, 0.01, 1, 1	0.15, 0.1, 2, 2
XTPRT (WG2, WG1, TG2, TG1)	10^{-4}, 10^{-4}, 10^{-5}, 10^{-5}	10^{-3}, 10^{-3}, 10^{-4}, 10^{-4}	10^{-4}, 10^{-4}, 10^{-5}, 10^{-5}	10^{-4}, 10^{-4}, 10^{-5}, 10^{-5}	10^{-4}, 10^{-4}, 10^{-5}, 10^{-5}	10^{-4}, 10^{-4}, 10^{-5}, 10^{-5}	10^{-4}, 10^{-4}, 10^{-5}, 10^{-5}
TG2 acceptable?	NO	NO	YES	YES	NO	YES	YES

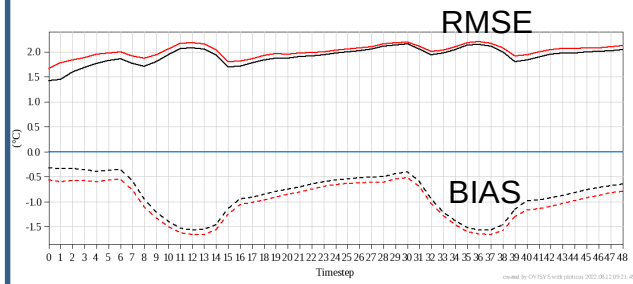
Parallel tests:

- Winter: 19/11/2021 – 18/12/2021
- Spring: 04/05/2022 – 01/06/2022

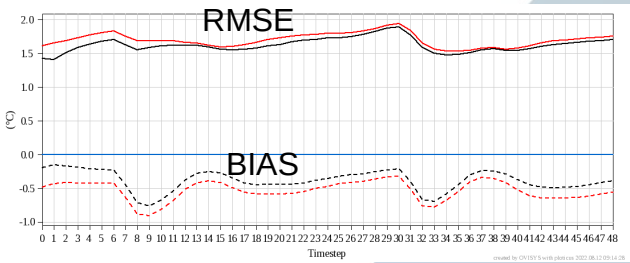
Winter

---- **AR-OPER**
---- **AR-SEKF**

T2M



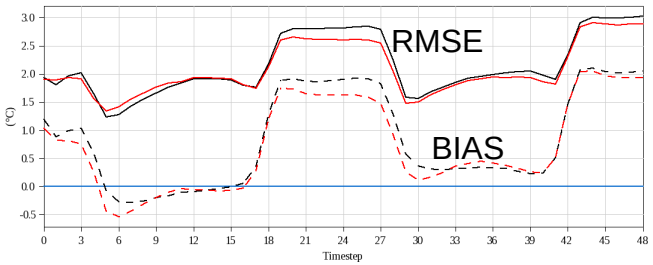
TD2M



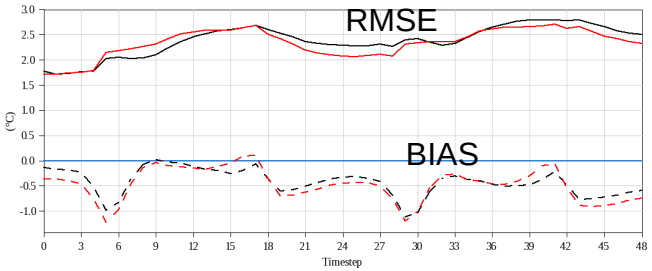
Spring

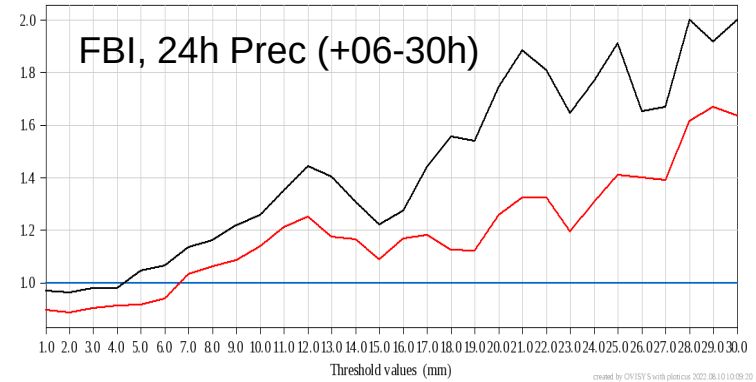
---- **AR-OPER**
---- **AR-SEKF**

T2M



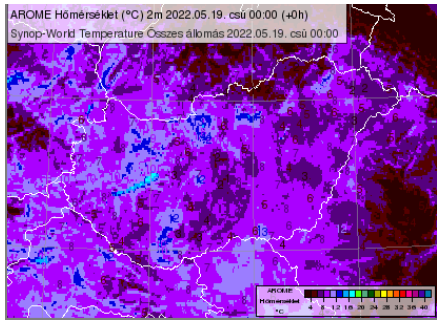
TD2M



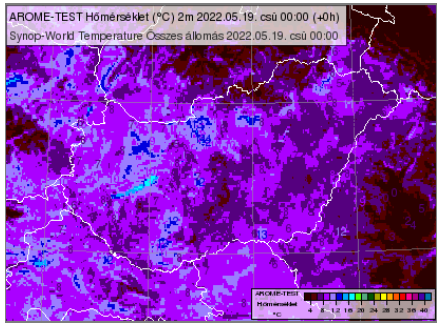


- Lower Tmin, higher Tmax by SEKF => wider diurnal cycle of 2 m temperature
- High prec. events predicted better by SEKF

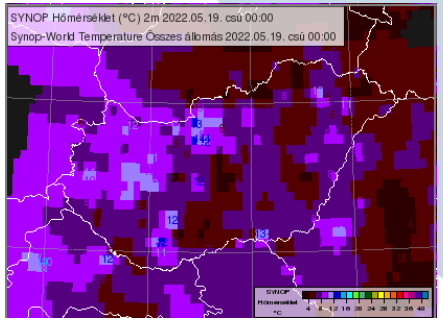
T2M AR-OPER



T2M AR-SEKF



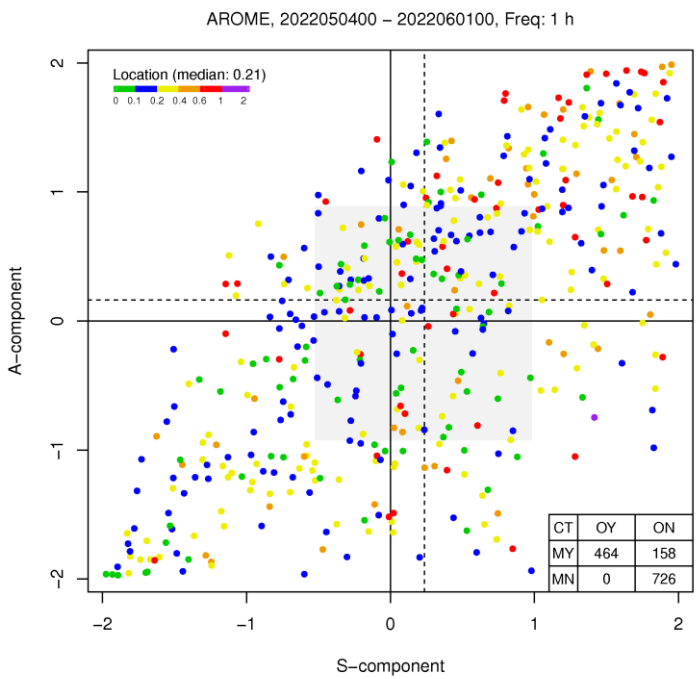
T2M SYNOP



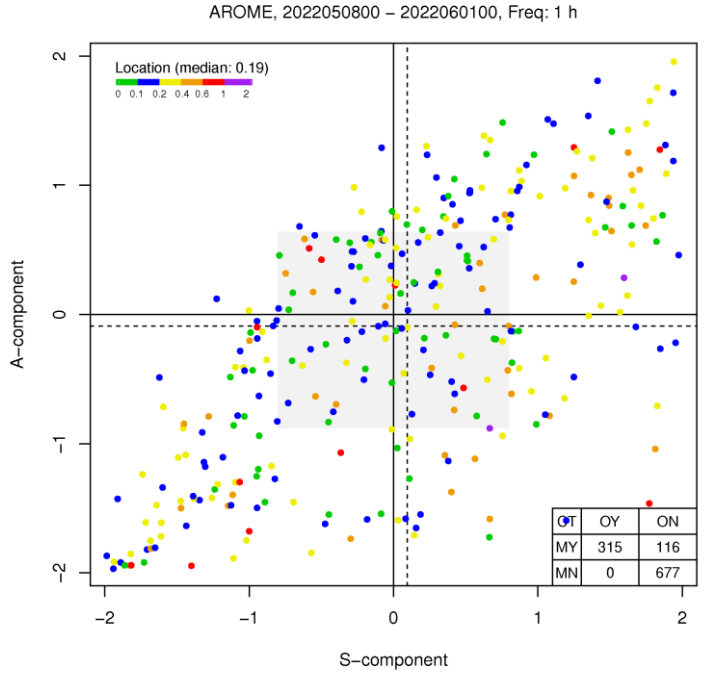
=> SEKF operational from 29/06/2022

SAL verification for the spring case

AR-OPER



AR-SEKF



S: The predicted precipitation objects are too large compared to the radar (S>0) ← Improvement by SEKF
A: AR-OPER overestimates the total precipitation amount (A>0) ← Improvement by SEKF

	5%		10%		20%		50%	
	OPER	SEKF	OPER	SEKF	OPER	SEKF	OPER	SEKF
00 UTC	0.44	0.36	0.56	0.49	0.74	0.68	1.32	1.20
06 UTC	0.44	0.39	0.60	0.54	0.82	0.71	1.45	1.29
12 UTC	0.44	0.38	0.57	0.52	0.81	0.74	1.32	1.36

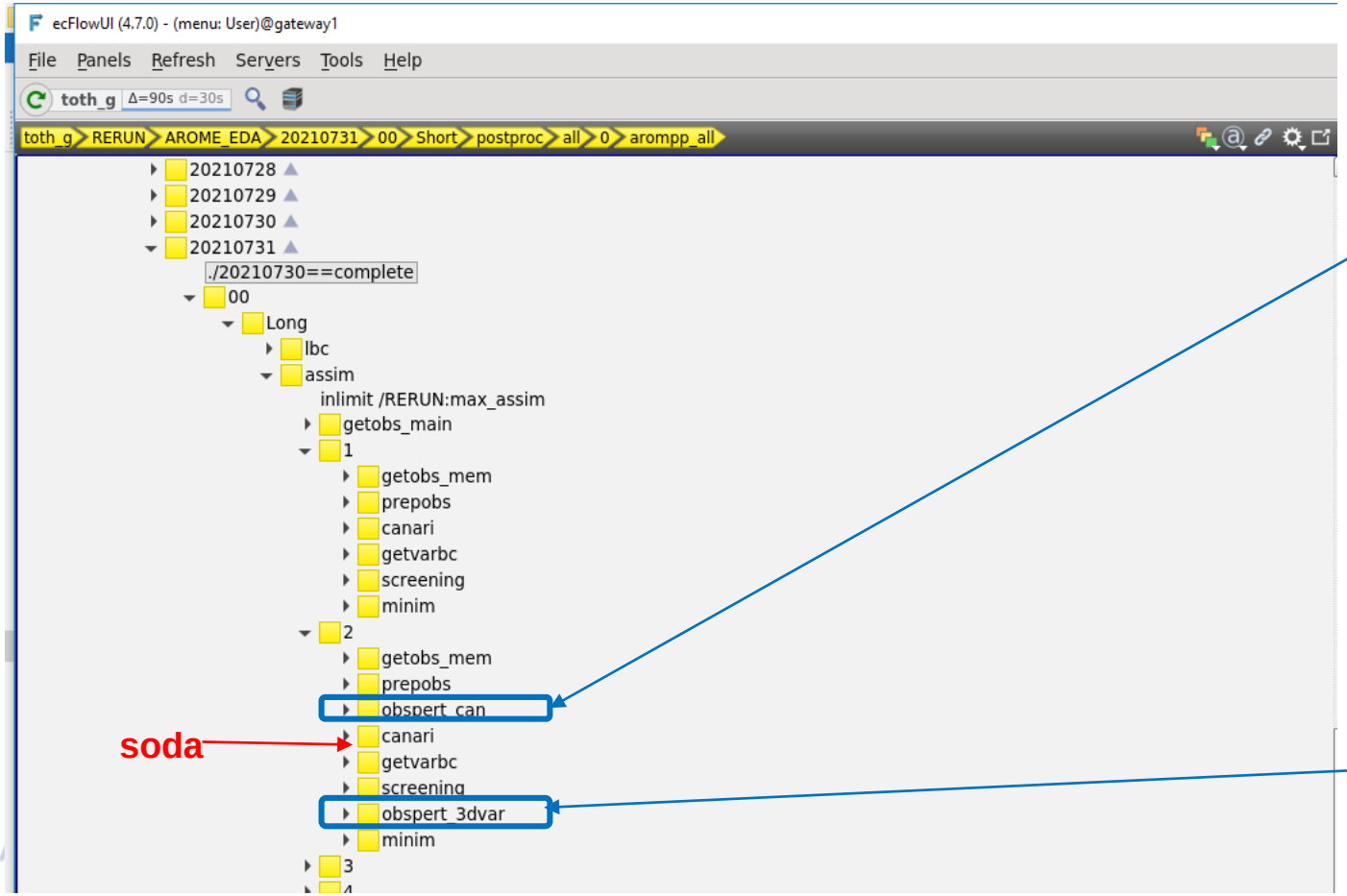
Ensemble Data Assimilation in AROME-EPS with SEKF

Former Operational setup (Downscaled AROME EPS):

- 11 members
- cy43t2_bf11
- 1 hourly coupled lbc from ECMWF-ENS
- Forecast: at 00 and 12 UTC, lead-time: 48h
- Res., physics as in AROME det.

New Operational setup (EDA AROME EPS):

- 11 members
- cy43t2_bf11
- 1 hourly coupled lbc from ECMWF-ENS
- **3 hourly assimilation cycle:**
  3DVAR + OI-MAIN
  3DVAR + SEKF
- Forecast: at 00 and 12 UTC, lead-time: 48h
- Res., physics as in AROME det.



Perturbation of surface measurements (SYNOP T2M, Rh2M)

Perturbation of upper air measurements (TEMP: u, v, T, q SYNOP: T2M, Rh2M, Z, u10, v10 GNSS ZTD, AMDAR: T, Q, V, MRAR: u, v, T, AMV, HRWIND)

EDA+SEKF is operational from 20/03/2023

Ensemble Data Assimilation in AROME-EPS (Test case)

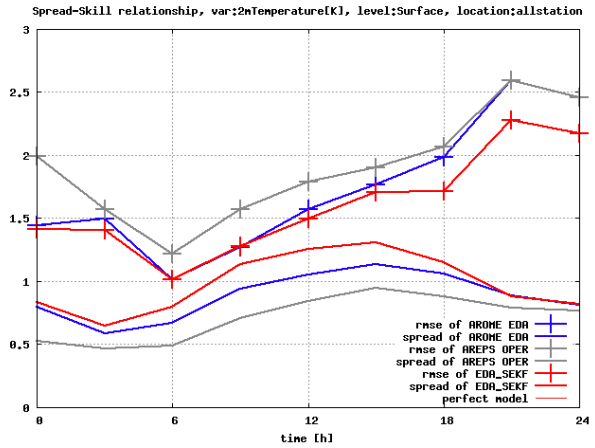
OI-MAIN EDA EPS
SEKF EDA EPS
Downscaled EPS

Summer experiment, for 1-31 July 2021

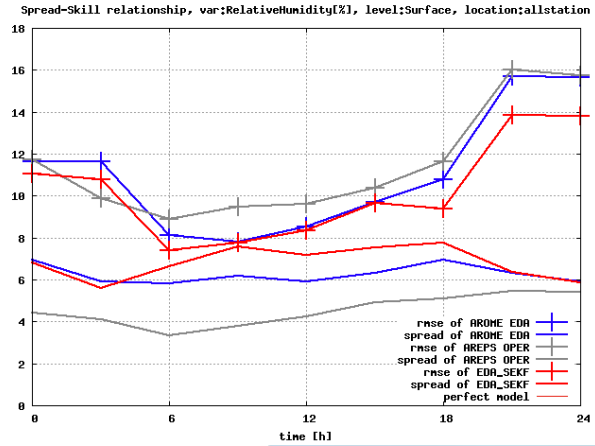
- **Setup**: 11 members
  cy43t2_bf11
  1 hourly coupled lbc from ECMWF-ENS
  3 hourly **3DVAR + OI-MAIN**
  3DVAR + SEKF
  Forecast: at 00 UTC, lead-time: 24h

- **Improvement** in surface variables (T2M, RH2M,10m WindSpeed and gust, prec3h)
  - RMSE is decreasing, while reliability, spread is increasing, reducing the under- and overestimation
- **Disimprovement**: mean sea level pressure and total cloudiness

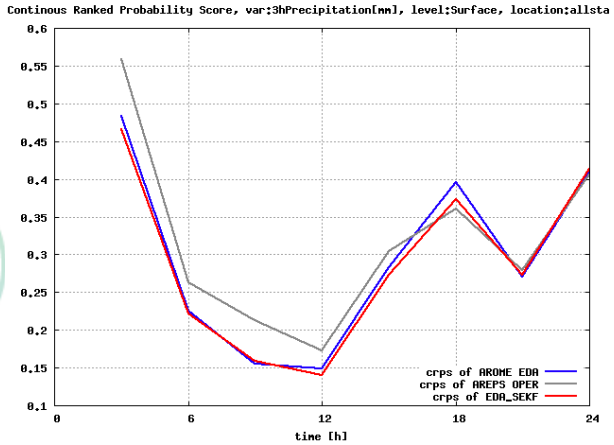
RMSE and Spread for T2M



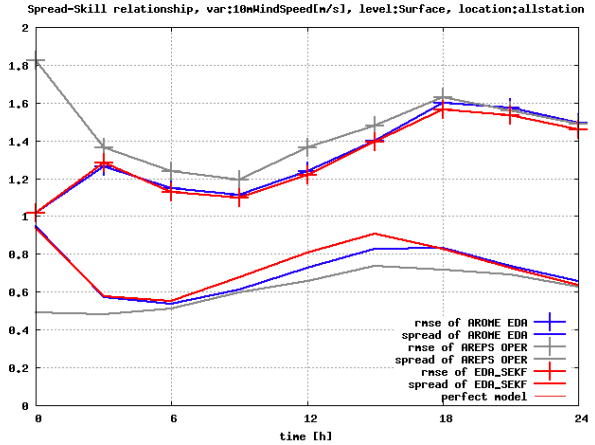
RMSE and Spread for Rh2M



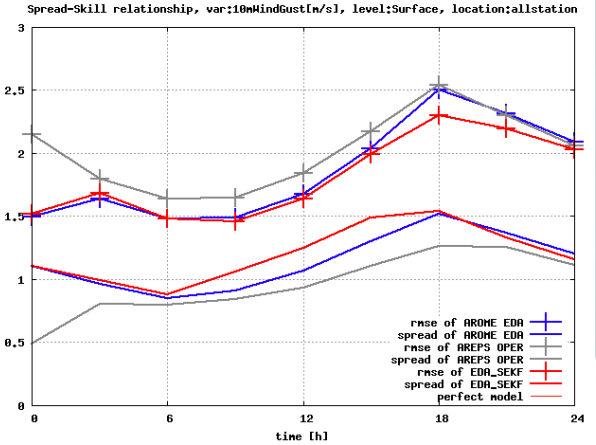
CRPS for Prec3h

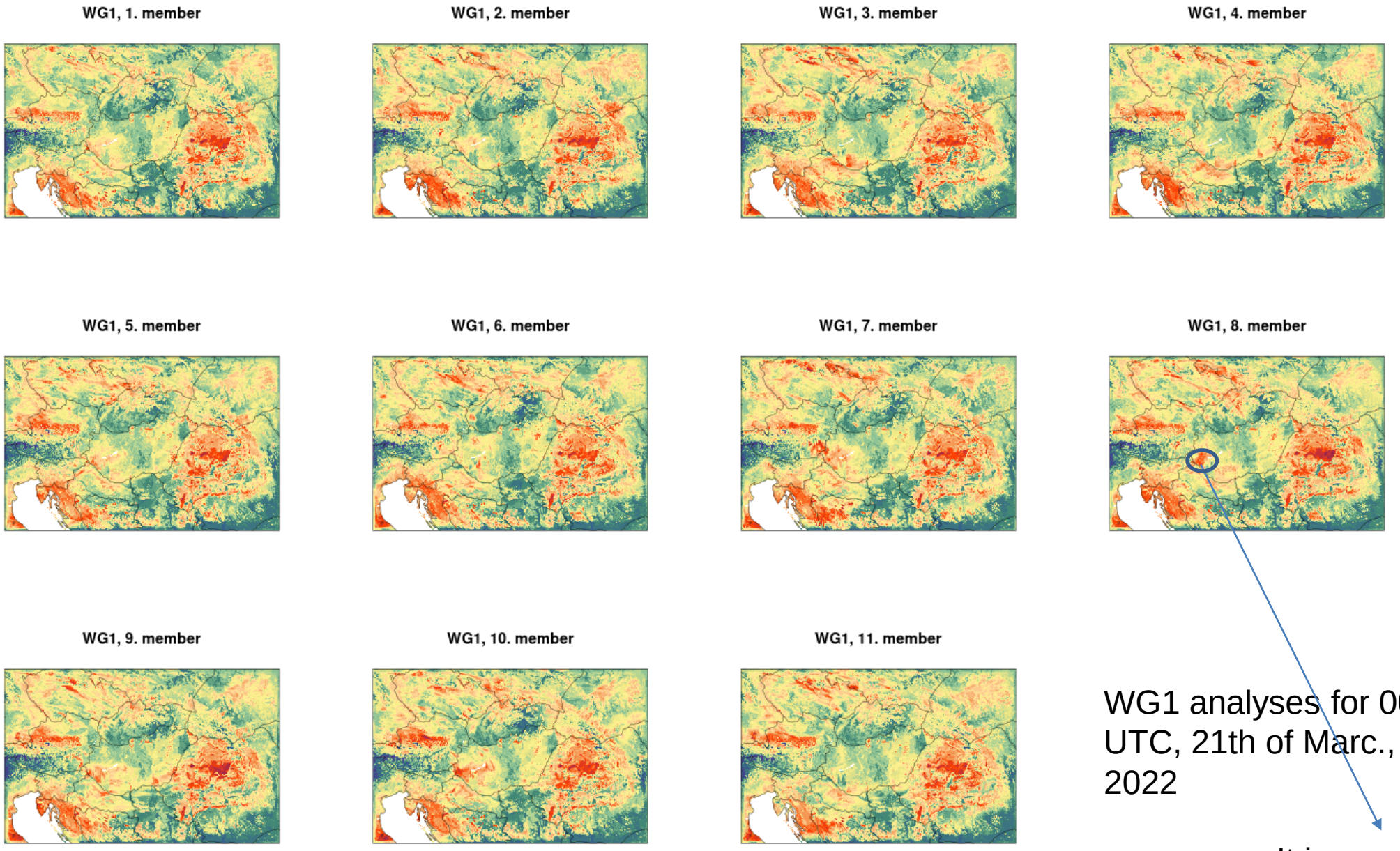


RMSE and Spread for Wsp10M



RMSE and Spread for Gust10M



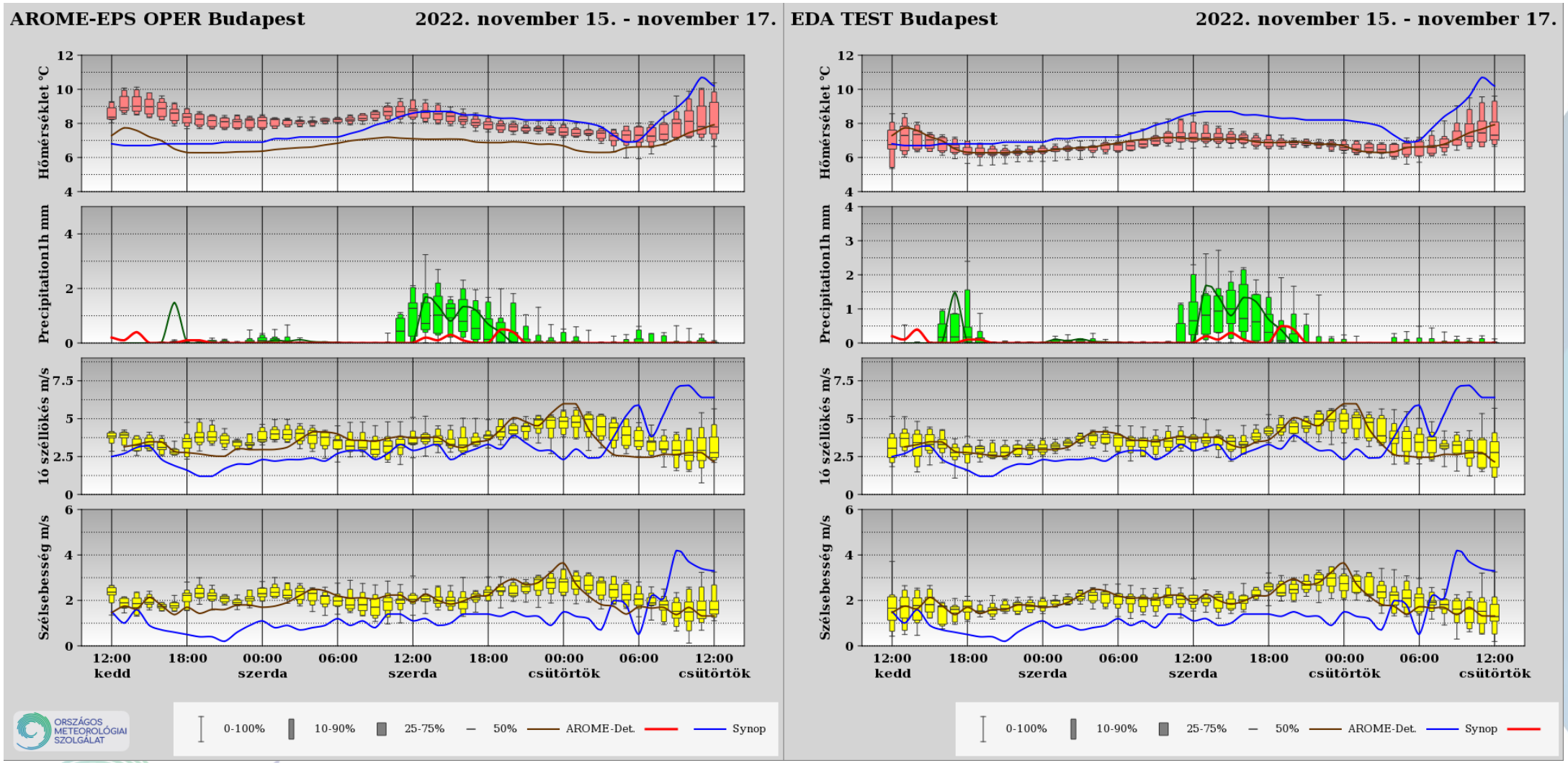


WG1 analyses for 00 UTC, 21th of Marc., 2022

It is varying between 0.15-0.31 at this point

=> After 6 months of cycling the soil moisture and temperature fields become different for the individual members

2022. 11. 15. 12 UTC



=> For EDA the spreads are larger and the analysis and the forecast is more correct

Fine resolution test

- 1.3 km horizontal resolution
- 90 vertical levels
- 3D-VAR + SEKF and 3D-VAR + OI-MAIN with REDNMC=0.7
- No GNSS ZTD in 3D-VAR
- 3L-ISBA
- 1 patch, 4 tiles
- With Canopy
- Modified settings (from MF):
  - Predictor-corrector
  - Radiation (cloud eff. radius)
  - SLHD and Spectral diffusion
  - Cloudiness: LOSIGMAS=T with VSIGQSAT=0.06
  - SURFEX: XFRACZ0=5
- First layer at 5 m

- SODA and SURFEX complied from the pack with MPI:
  - with using -DSFX_MPI switch in gmkfile/MPIFORT.DIANA file and
  - without -lmpidummy in ics_surfex and ics_soda)

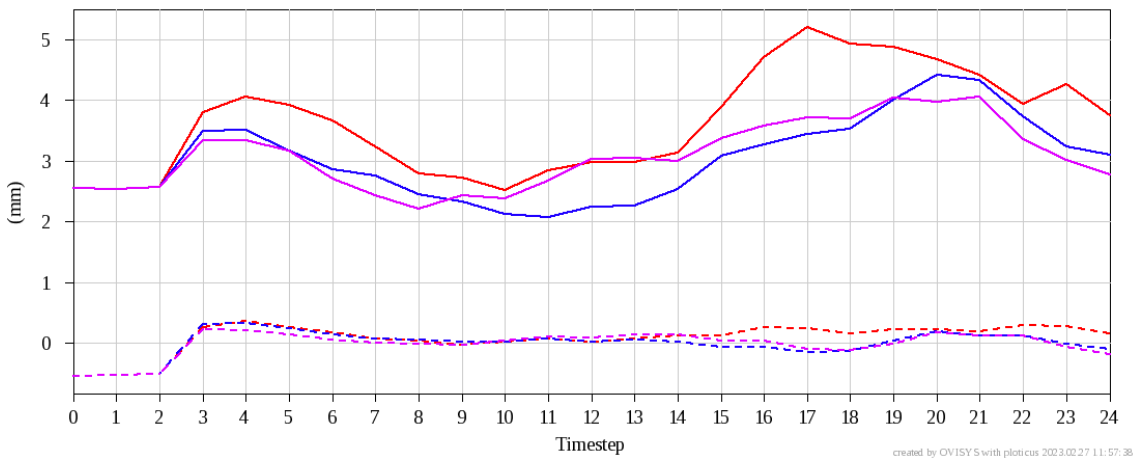
- Observations: T2M and HU2M (CANARI)
- Control variables: TG1, TG2, WG1 and WG2
- Settings (same as for 2.5km):
  - XERROBS= 1.0, 0.07
  - XSIGMA= 2.0, 2.0, 0.1, 0.15

- Experiment: 8-21 July, 2021 (spin-up: 1-8 July)

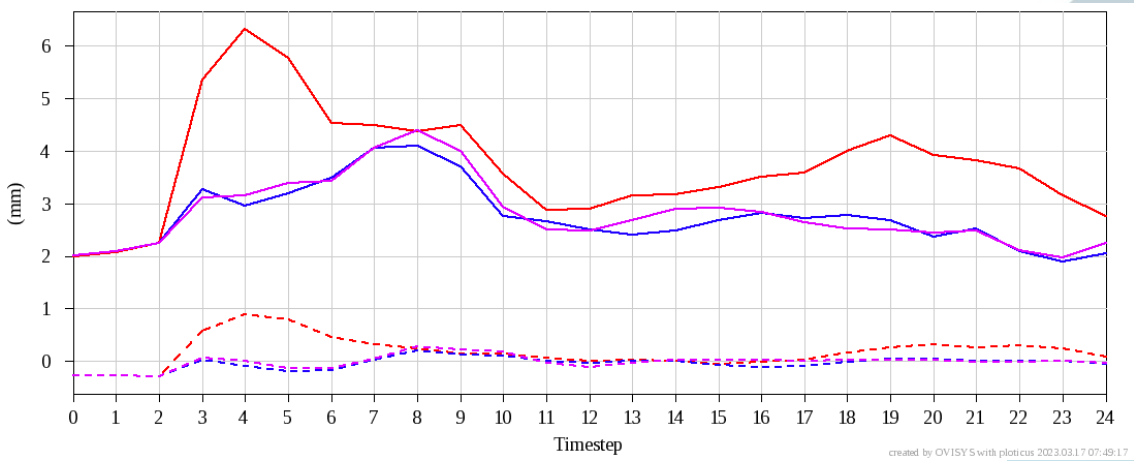
Verification of Precip3h

---- 2.5 OI-MAIN
---- 1.3 OI-MAIN
---- 1.3 SEKF

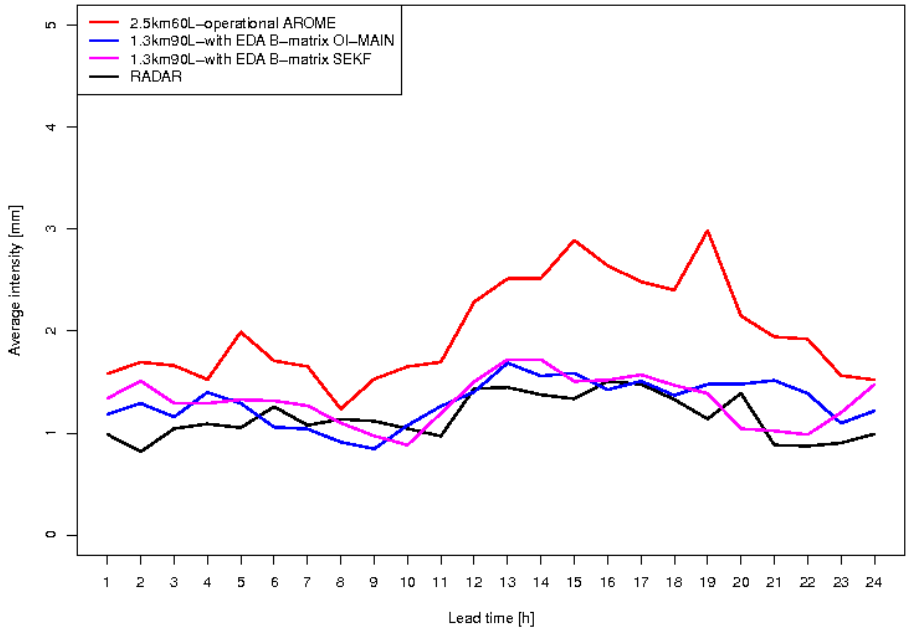
00 UTC run

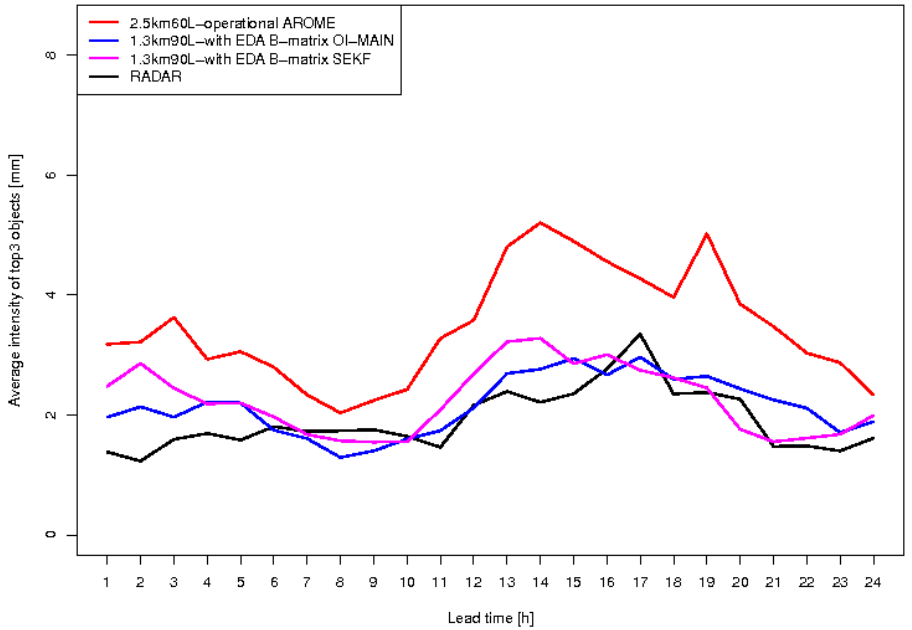


12 UTC run



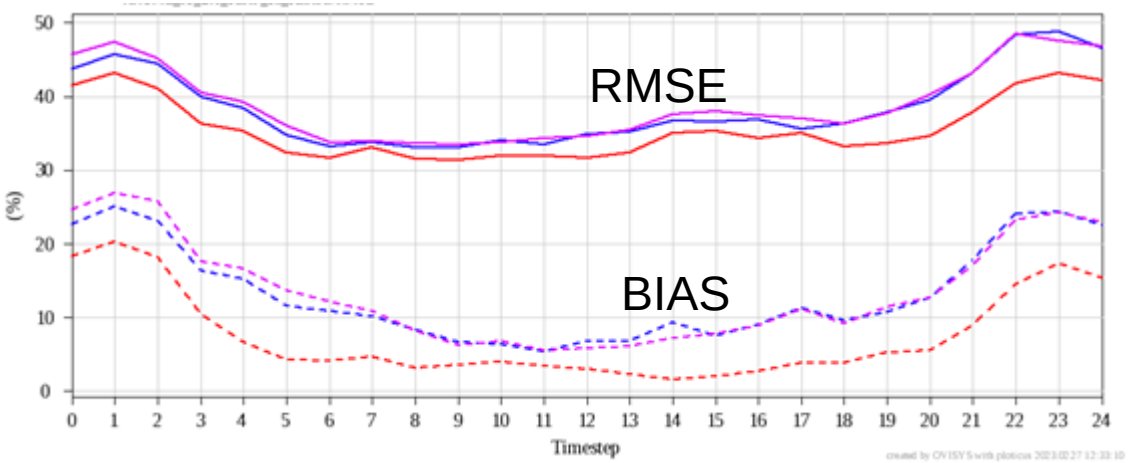
SAL verification



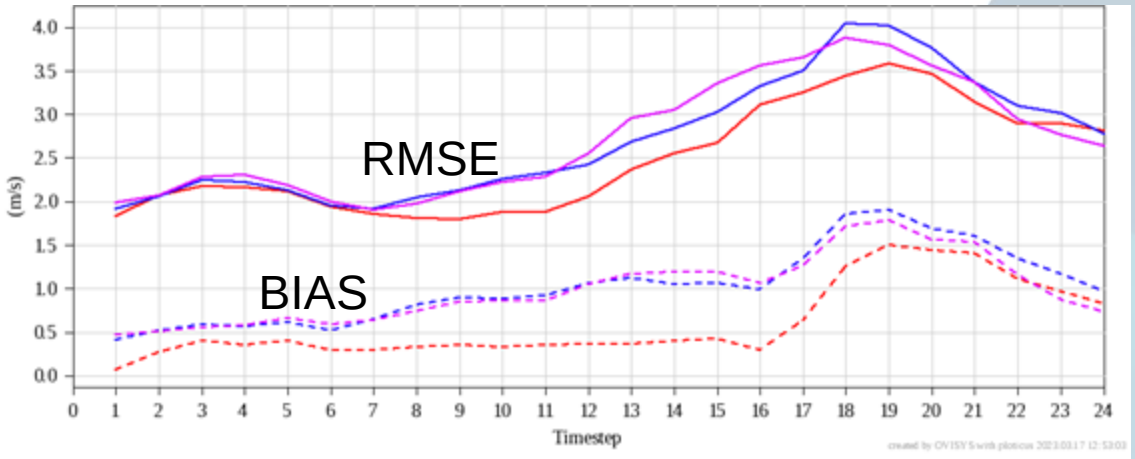


---- 2.5 OI-MAIN
---- 1.3 OI-MAIN
---- 1.3 SEKF

Cloudiness



Wind gust



=> Overestimation by the fine res. Models. Parameter tuning is required!

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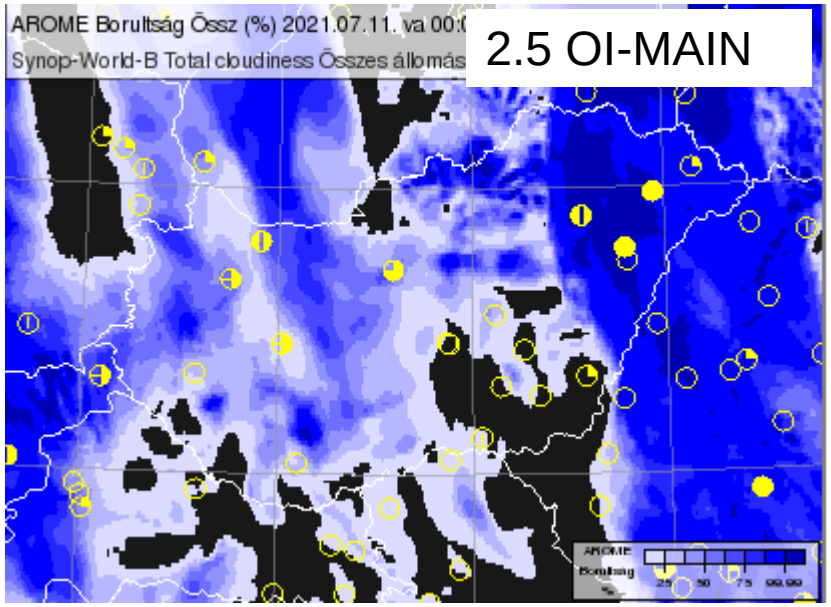
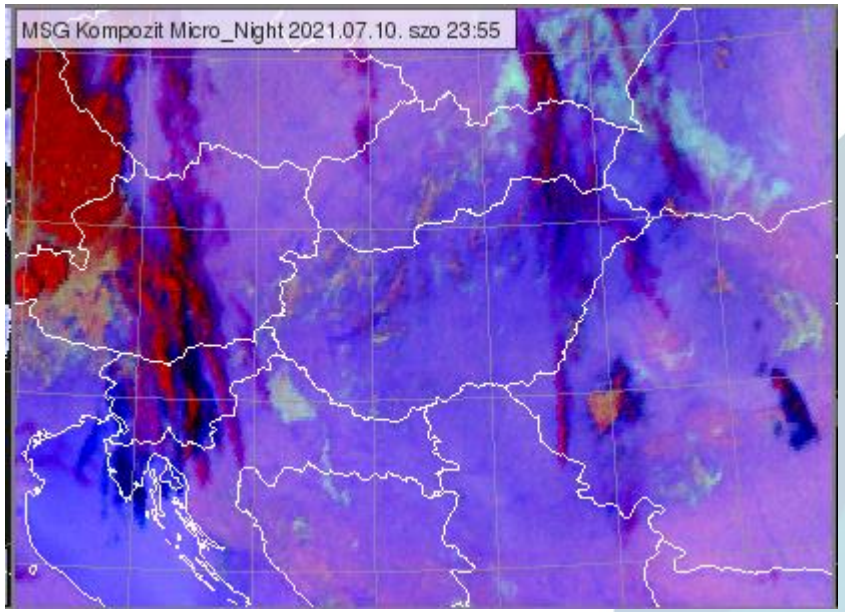
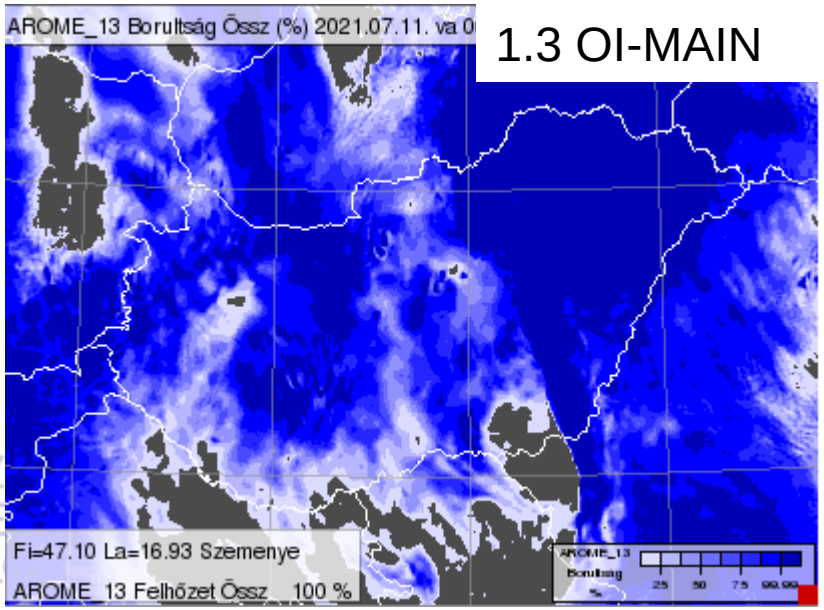
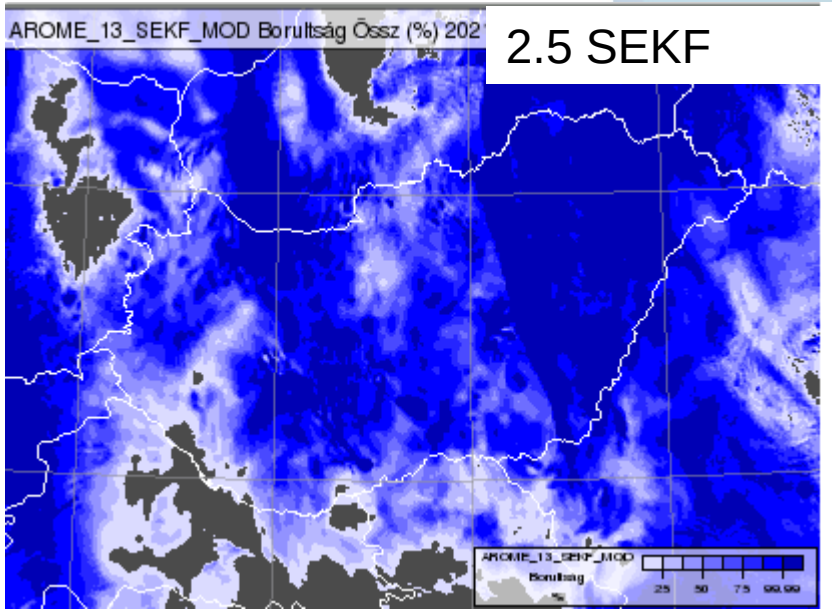
Cloudiness analyses at 11/07/2021 00 UTC





Overestimated by the fine res. runs =>





Future Plans

2.5 km resolution AROME

- Assimilation of H-SAF ASCAT Soil Moisture near-real time data (H28 – 1km sampling, or H122 – 6.25km sampling) with SEKF
- Snow assimilation (synop snowdepth) with SEKF

1.3 km resolution AROME

- AROME-RUC – 1h cycle in upper air and testing of surface assimilation cycle (1h?, or rarely?)

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Tänan tähelepanu eest!

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