

*Regional Cooperation for
Limited Area Modeling in Central Europe*



Data assimilation work in Hungary

Kristóf Szanyi, Gabriella Tóth, Helga Tóth, Zsófia Kocsis, **Viktória Homonnai**



ARSO METEO
Slovenia



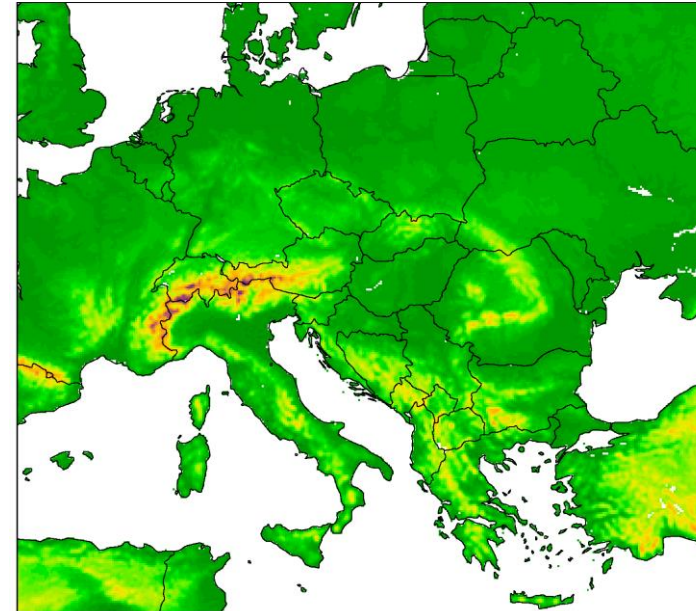
Outline

- ▶ Status of operational DA systems
- ▶ Implementation of cy43t2_bf10
- ▶ AROME RUC experiments
- ▶ Maintenance of the observation monitoring system
- ▶ B-matrix recalculation for 90 levels
- ▶ New observations:
 - ▶ Mode-S MRAR data – Czech and Hungarian data (see Kristóf's talk)
 - ▶ HRW AMV
- ▶ Surface assimilation:
 - ▶ SEKF studies (see Helga's talk)

Operational NWP and DA systems

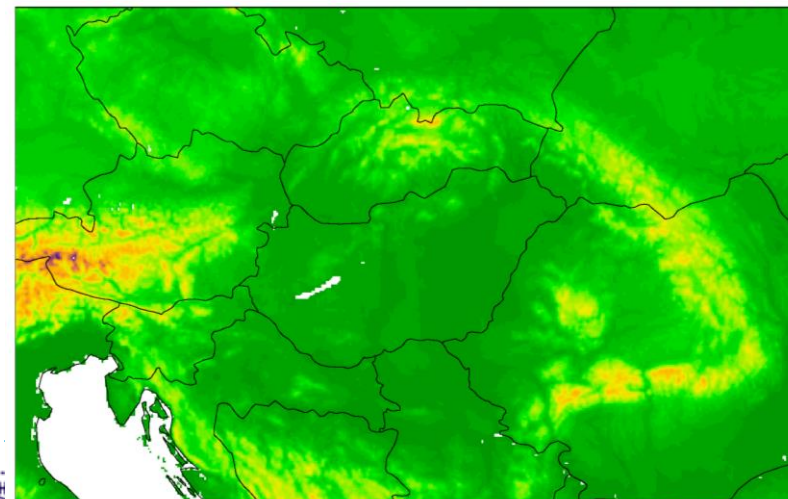
▶ **ALARO**

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



▶ **AROME**

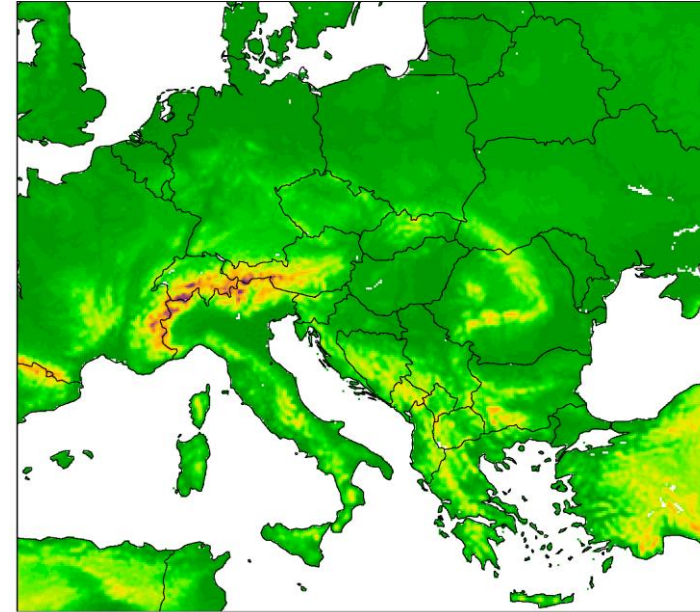
- ▶ 2.5km horizontal resolution/60 vertical levels
- ▶ 60s timestep
- ▶ cy40t1_bf05
- ▶ SMS environment
- ▶ 8 runs/day up to 48/36 hours
- ▶ Coupled to IFS global
 - ▶ 1-hourly frequency
 - ▶ Time-lagged coupling for forecast
 - ▶ Mixed coupling in DA cycle



Operational NWP and DA systems

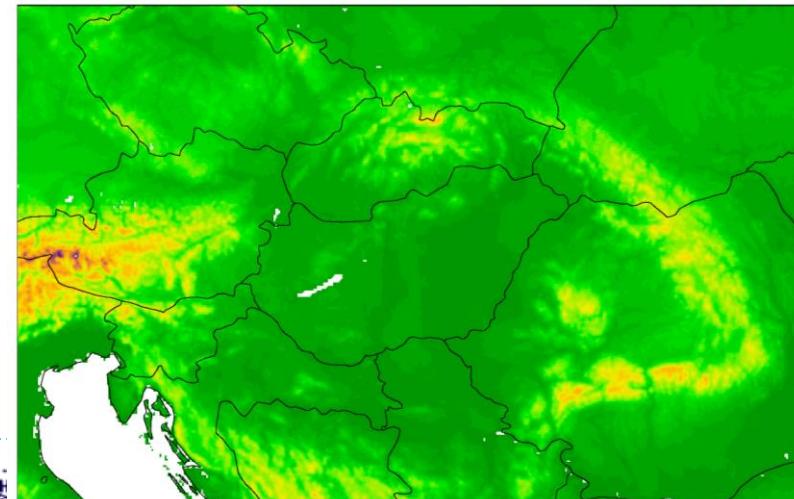
▶ **ALARO**

- ▶ 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 Mode-S MRAR
- ▶ AROME EDA B-matrix

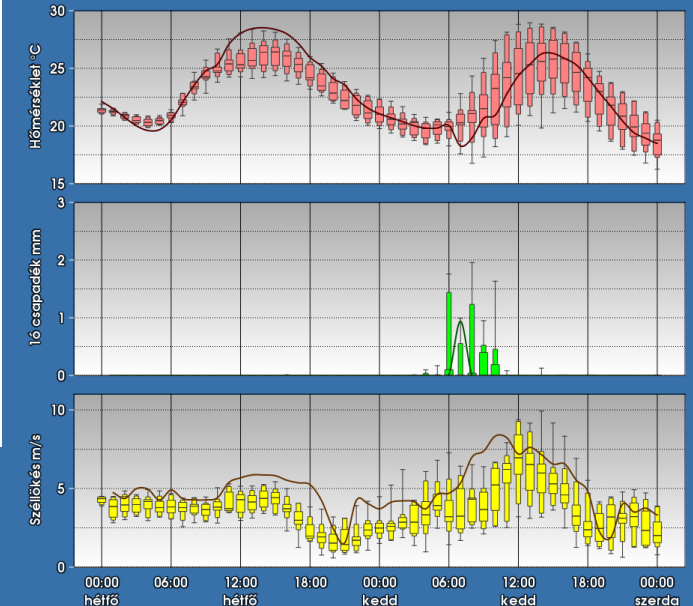


Operational NWP and DA systems

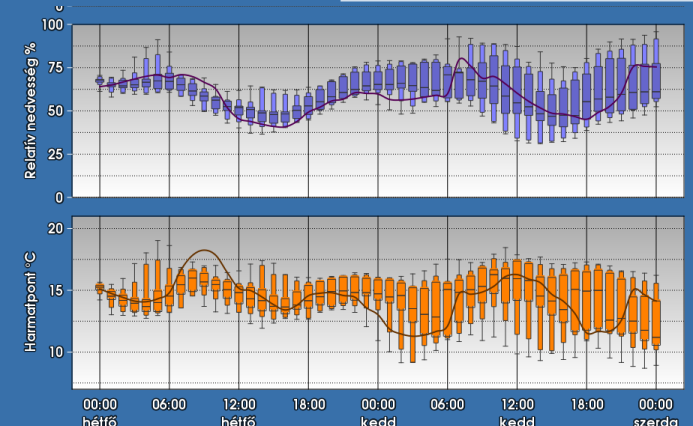
▶ AROME-EPS (from February 2020)

- ▶ 11 members
- ▶ 2.5km horizontal resolution
- ▶ 60 vertical levels
- ▶ cy40t1_bf05
- ▶ SMS environment
- ▶ 1 runs/day up to 48 hours
- ▶ Coupled to IFS global
 - ▶ 3-hourly frequency
- ▶ No data assimilation
- ▶ Initial conditions:
 - ▶ ECM-ENS +AROME-det. surface

AROME-EPS Szeged 2020. augusztus 24. 00:00 - augusztus 26. 00:00



0-100% 10-90% 25-75% 50% Det.



0-100% 10-90% 25-75% 50% Det.

Implementation of cy43t2_bf10

- ▶ cy40: $N_{\text{active}} + N_{\text{rejected}} = N_{\text{total}} ; N_{\text{rejected}} > N_{\text{blacklisted}}$
- ▶ cy43: ? N_{rejected} smaller ; $N_{\text{active}} + N_{\text{rejected}} + N_{\text{blacklisted}} \neq N_{\text{total}}$

4702 *** SCREENING STATISTICS
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4704 *** FOR WHOLE OBSERVATION ARRAY
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4707 STATUS SUMMARY OF REPORTS:
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OB. TYP	REPORTS	ACTIVE	PASSIVE	REJECTED	BLACKLISTED
1	517	513	0	4	0
2	4	4	0	0	0
3	0	0	0	0	0
4	0	0	0	0	0
5	13	13	0	0	0
6	0	0	0	0	0
7	0	0	0	0	0
8	0	0	0	0	0
9	0	0	0	0	0
10	0	0	0	0	0
11	0	0	0	0	0
12	0	0	0	0	0
13	0	0	0	0	0
14	0	0	0	0	0
15	0	0	0	0	0
16	0	0	0	0	0
17	0	0	0	0	0
18	0	0	0	0	0
TOT	534	530	0	4	0

4731 STATUS SUMMARY OF DATA:
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OB. TYP	REPORTS	ACTIVE	PASSIVE	REJECTED	BLACKLISTED
1	2328	2071	134	257	116
2	12	12	0	0	0
3	0	0	0	0	0
4	0	0	0	0	0
5	4271	3187	0	1084	1062
6	0	0	0	0	0
7	0	0	0	0	0
8	0	0	0	0	0
9	0	0	0	0	0
10	0	0	0	0	0
11	0	0	0	0	0
12	0	0	0	0	0
13	0	0	0	0	0
14	0	0	0	0	0
15	0	0	0	0	0
16	0	0	0	0	0
17	0	0	0	0	0
18	0	0	0	0	0
TOT	6611	5270	134	1341	1178

4753 EVENT SUMMARY OF REPORTS:
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OB. TYP:	1	2	3	4	5	6	7	8	9
16	17	18							

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4883 *** SCREENING STATISTICS
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4885 *** FOR WHOLE OBSERVATION ARRAY
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4888 STATUS SUMMARY OF REPORTS:
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OB. TYP	REPORTS	ACTIVE	PASSIVE	REJECTED	BLACKLISTED
1	517	516	1	1	0
2	4	4	0	0	0
3	0	0	0	0	0
4	0	0	0	0	0
5	13	13	0	0	0
6	0	0	0	0	0
7	0	0	0	0	0
8	0	0	0	0	0
9	0	0	0	0	0
10	0	0	0	0	0
11	0	0	0	0	0
12	0	0	0	0	0
13	0	0	0	0	0
14	0	0	0	0	0
15	0	0	0	0	0
16	0	0	0	0	0
17	0	0	0	0	0
18	0	0	0	0	0
TOT	534	533	1	1	0

4911 STATUS SUMMARY OF DATA:
4912

OB. TYP	REPORTS	ACTIVE	PASSIVE	REJECTED	BLACKLISTED
1	2328	2070	135	138	120
2	12	12	0	0	0
3	0	0	0	0	0
4	0	0	0	0	0
5	4271	3192	0	29	1062
6	0	0	0	0	0
7	0	0	0	0	0
8	0	0	0	0	0
9	0	0	0	0	0
10	0	0	0	0	0
11	0	0	0	0	0
12	0	0	0	0	0
13	0	0	0	0	0
14	0	0	0	0	0
15	0	0	0	0	0
16	0	0	0	0	0
17	0	0	0	0	0
18	0	0	0	0	0
TOT	6611	5274	135	167	1182

4936 EVENT SUMMARY OF REPORTS:
4937
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4939

OB. TYP:	1	2	3	4	5	6	7	8	9
16	17	18							

AROME RUC experiments

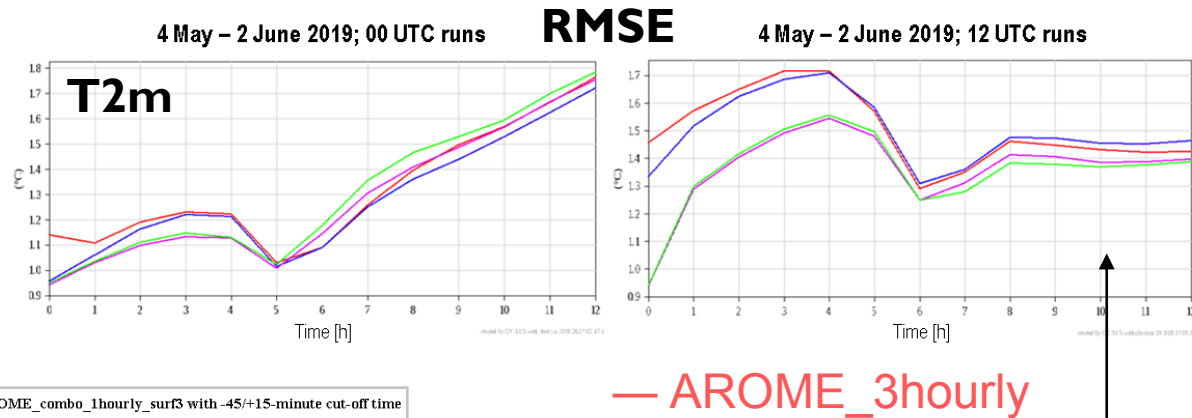
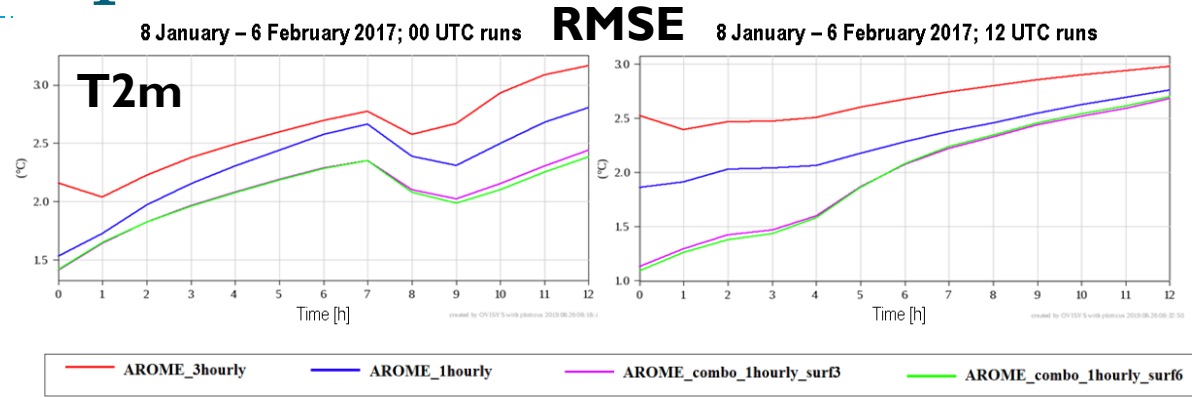
Conclusions:

- ▶ one-hour upper DA cycle + three-hour surface DA cycle
- ▶ cut-off time: -45/+15 min

AROME_1hourly_surf3

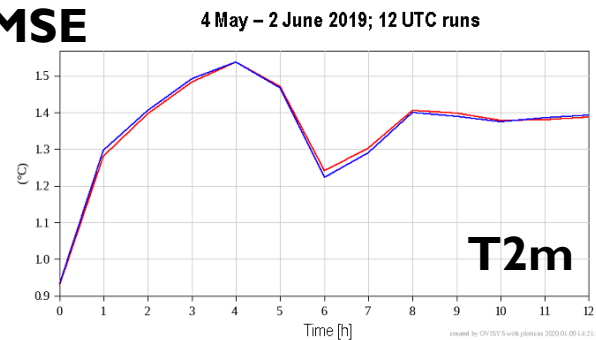
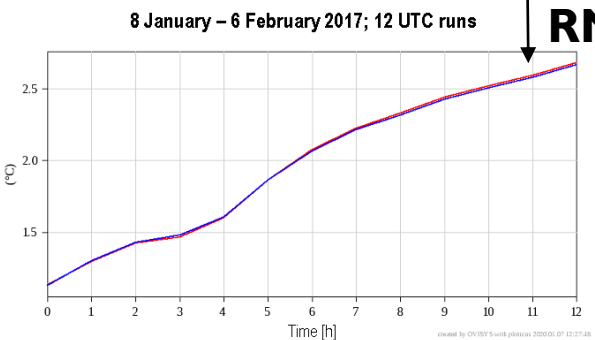
— -30/+30 min cut-off time

— -45/+15 min cut-off time



— AROME_combo_1hourly_surf3 with -30/+30-minute cut-off time

— AROME_combo_1hourly_surf3 with -45/+15-minute cut-off time



— AROME_3hourly

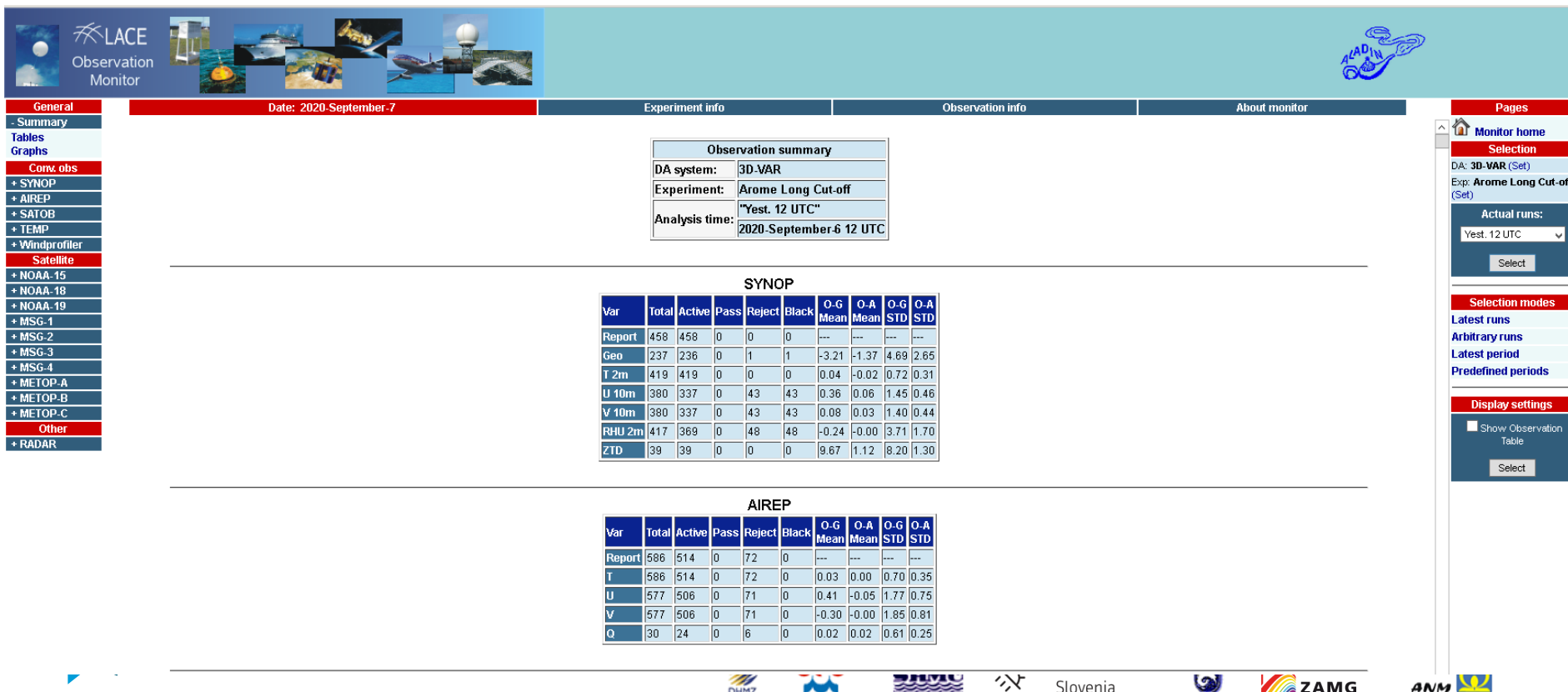
— AROME_1hourly

— AROME_1hourly_surf3

— AROME_1hourly_surf6

Maintenance of the observation monitoring system

- ▶ It is working since 2005, mainly for ALADIN → outdated
- ▶ Implementation of new observations which used only in AROME → batch mode and web interface as well



The screenshot shows the LACE Observation Monitor web interface. The top navigation bar includes 'General', 'Date: 2020-September-7', 'Experiment info', 'Observation info', and 'About monitor'. The left sidebar contains a menu with categories like 'General', 'Summary', 'Tables', 'Graphs', 'Conv. obs', 'Satellite', and 'Other'. The main content area displays an 'Observation summary' box and two data tables: 'SYNOP' and 'AIREP'. The right sidebar shows 'Pages', 'Monitor home', 'Selection', 'Actual runs', 'Selection modes', 'Predefined periods', and 'Display settings'.

Observation summary

DA system: 3D-VAR

Experiment: Arome Long Cut-off

Analysis time: "Yest. 12 UTC"

2020-September-6 12 UTC

SYNOP

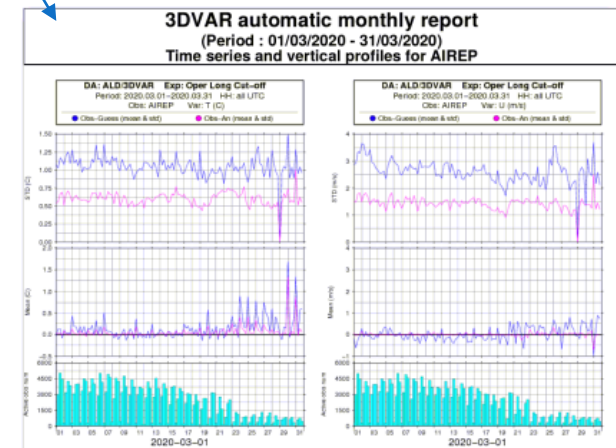
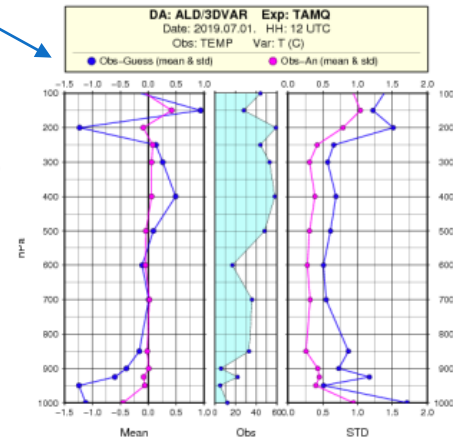
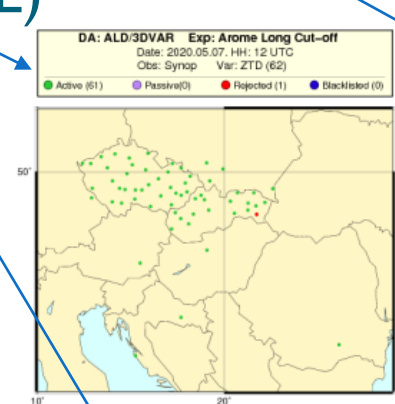
Var	Total	Active	Pass	Reject	Black	O-G Mean	O-A Mean	O-G STD	O-A STD
Report	458	458	0	0	0	---	---	---	---
Geo	237	236	0	1	1	-3.21	-1.37	4.69	2.65
T 2m	419	419	0	0	0	0.04	-0.02	0.72	0.31
U 10m	380	337	0	43	43	0.36	0.06	1.45	0.46
V 10m	380	337	0	43	43	0.08	0.03	1.40	0.44
RHU 2m	417	369	0	48	48	-0.24	-0.00	3.71	1.70
ZTD	39	39	0	0	0	9.67	1.12	8.20	1.30

AIREP

Var	Total	Active	Pass	Reject	Black	O-G Mean	O-A Mean	O-G STD	O-A STD
Report	586	514	0	72	0	---	---	---	---
T	586	514	0	72	0	0.03	0.00	0.70	0.35
U	577	506	0	71	0	0.41	-0.05	1.77	0.75
V	577	506	0	71	0	-0.30	-0.00	1.85	0.81
Q	30	24	0	6	0	0.02	0.02	0.61	0.25

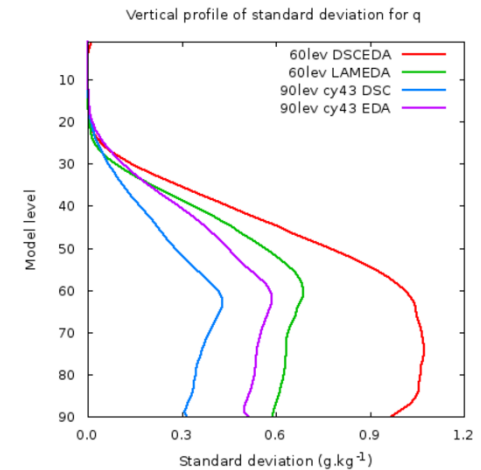
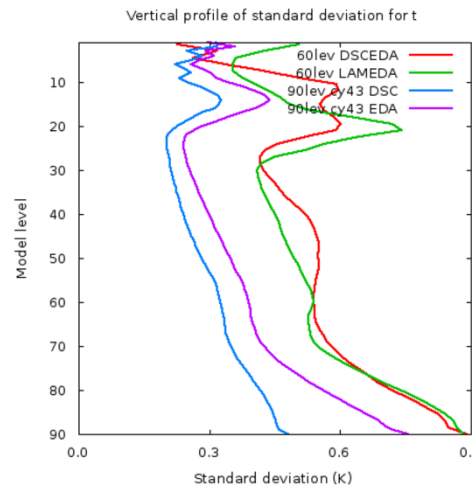
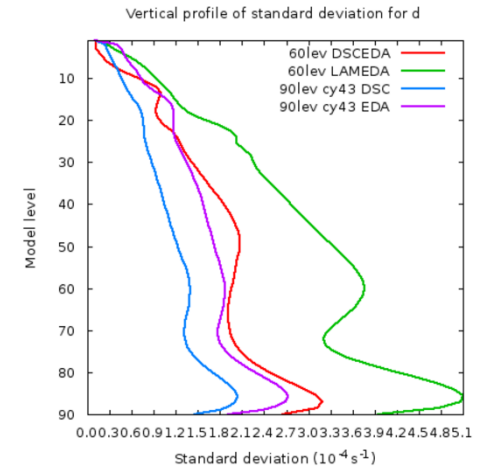
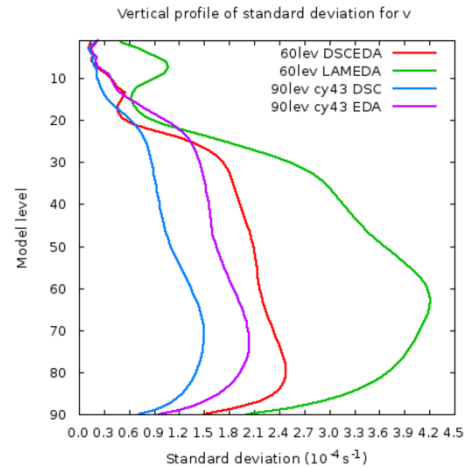
Maintenance of the observation monitoring system

- ▶ Implementation of new observations:
 - ▶ AMDAR humidity (used only in AROME)
 - ▶ GNSS ZTD (used only in AROME)
- ▶ monthly report for AROME
- ▶ additional effects:
 - ▶ missing TEMP from Austria (data arrives only in BUFR)
 - ▶ monitor of AMDAR due to COVID-19
 - ▶ wrong blacklist settings for AMV



B-matrix recalculation for 90 levels

- ▶ There were instabilities with 60-levels AROME → we would like to change to 90-levels with different model top.
- ▶ downscaled EDA → spinup B-matrix → full EDA → EDA B-matrix
- ▶ experiments on a longer period
- ▶ tuning of **B** and **R** is needed
- ▶ Desroziers et al. (2005) → REDNMC = 1.26
SIGMA_COEF = 0.71 → deterioration



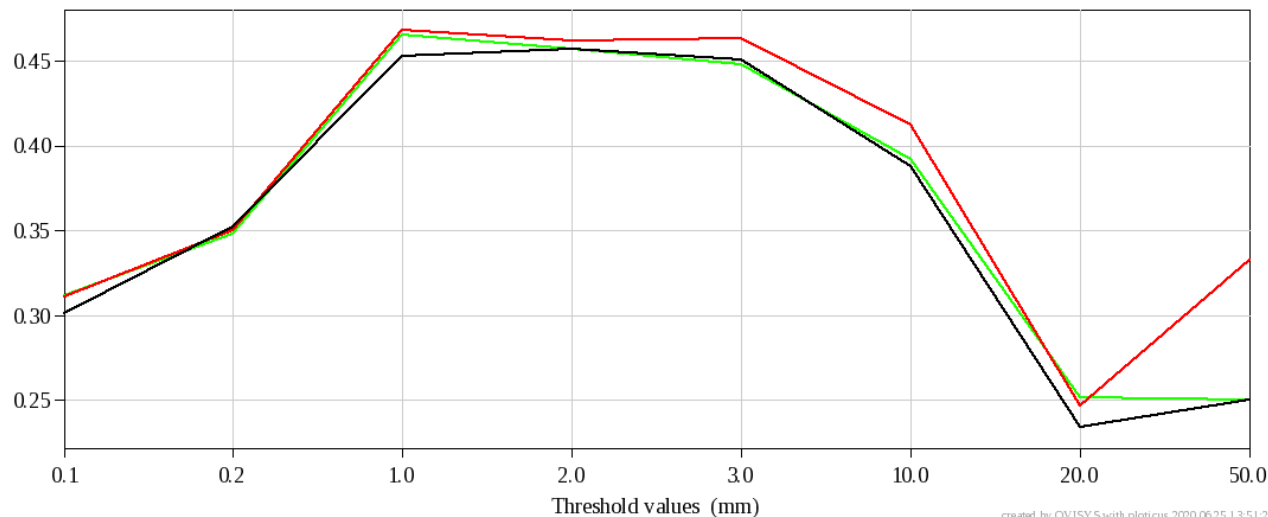
New observations: Czech and Hungarian Mode-S MRAR data

- ▶ Czech data with whitelist see **Kristóf's talk**
- ▶ Hungarian data without whitelist in the first experiment

Period: 12/01/2019 - 12/19/2019
Area: AROME_max_400m
Variable: Precipitation (24 hour sum)
Timestep: 024
Score: ETS
Runhour: 12

— AROME_20191201
— AROME_mode-s_cz
— AROME_MODE_S_mrnr

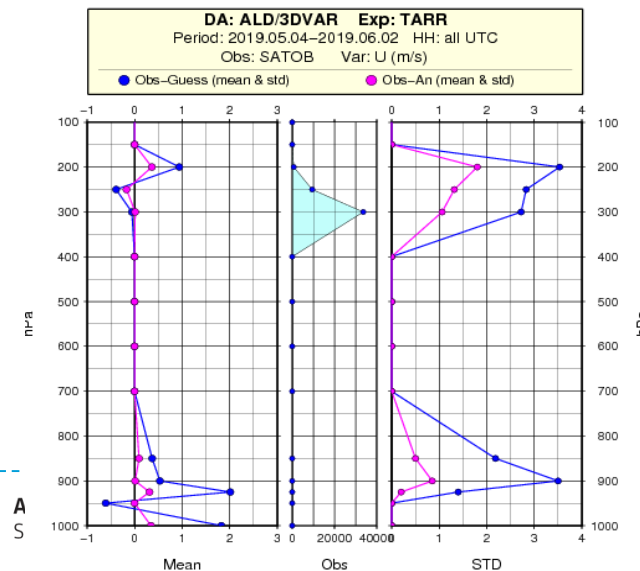
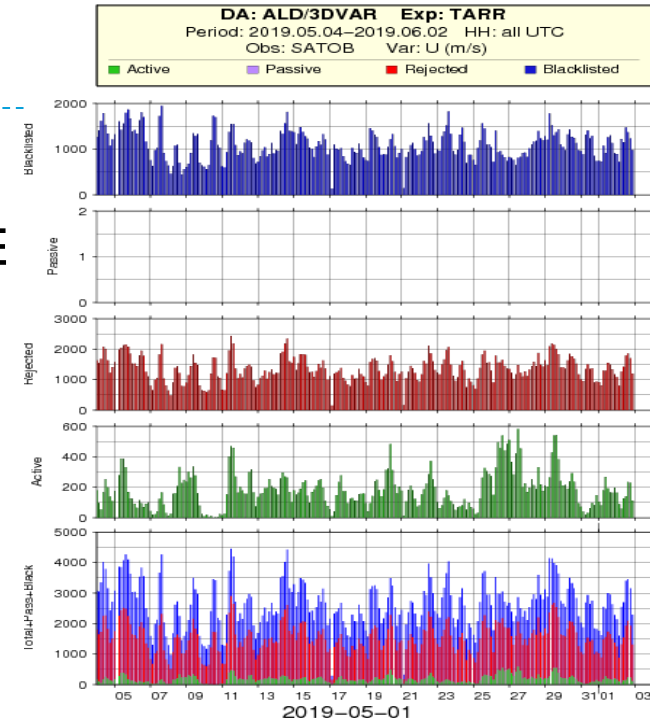
— REF
— CZ MRAR
— HUN MRAR



created by OVISYS with ploticus 2020.05.25 13:51:28

New observations: HRW AMV

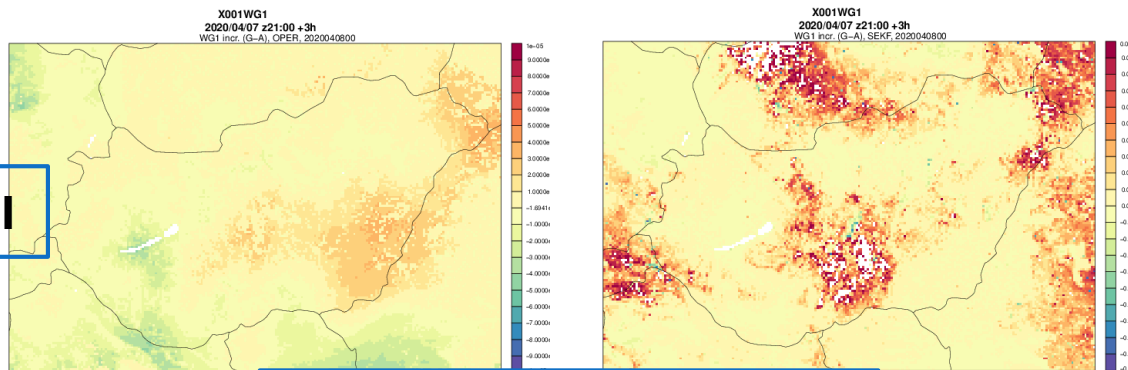
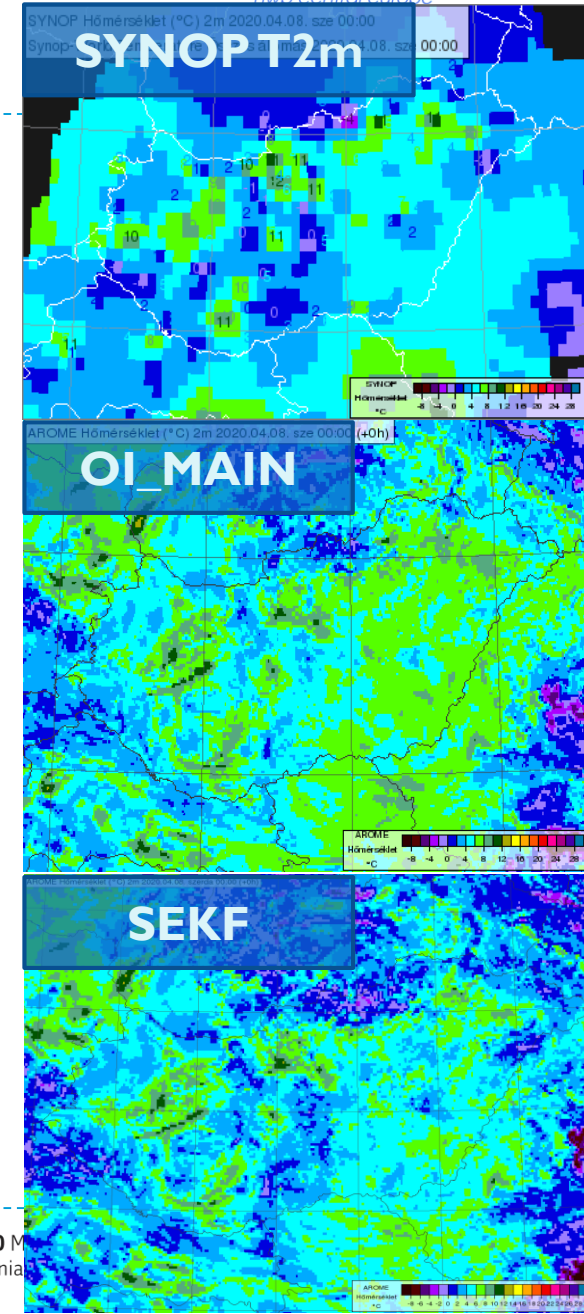
- ▶ geowind is operational in ALADIN
- ▶ experiments with geowind and hrwind in AROME
- ▶ Two different periods:
 - ▶ spring period with large-scale precipitation
 - ▶ summer period with deep convection
- ▶ mainly neutral impact during both periods
- ▶ most of the measurements are blacklisted
- ▶ Future plan:
 - ▶ winter period
 - ▶ revise the blacklisting setup



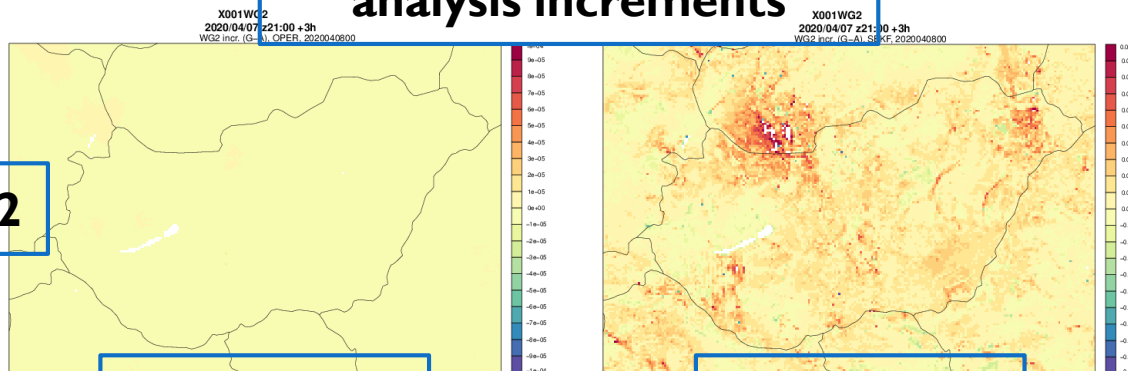
Surface assimilation: SEKF studies

see Helga's talk

- ▶ 8th April 2020 00UTC – dry and warm case →
- ▶ minimum temperature is usually overestimated
- ▶ Soil moisture increments are usually bigger with SEKF than with OI_main (operational)



analysis increments



OI_MAIN

SEKF

RSO M
ovenia

Plans for 2021

- ▶ Large project: AROME Nowcasting system with 1-hour RUC on 1.3 km horizontal resolution and 90 vertical levels → new supercomputer
- ▶ cy40t1 → cy43t2 in the operational AROME runs (ALADIN will not be updated any more)
fullpos on lat-lon grid → new climate files are necessary
- ▶ Start to work on radar assimilation
- ▶ B-matrix calculation
- ▶ HRW AMV and Hungarian Mode-S MRAR → operational
- ▶ Further experiments with SEKF