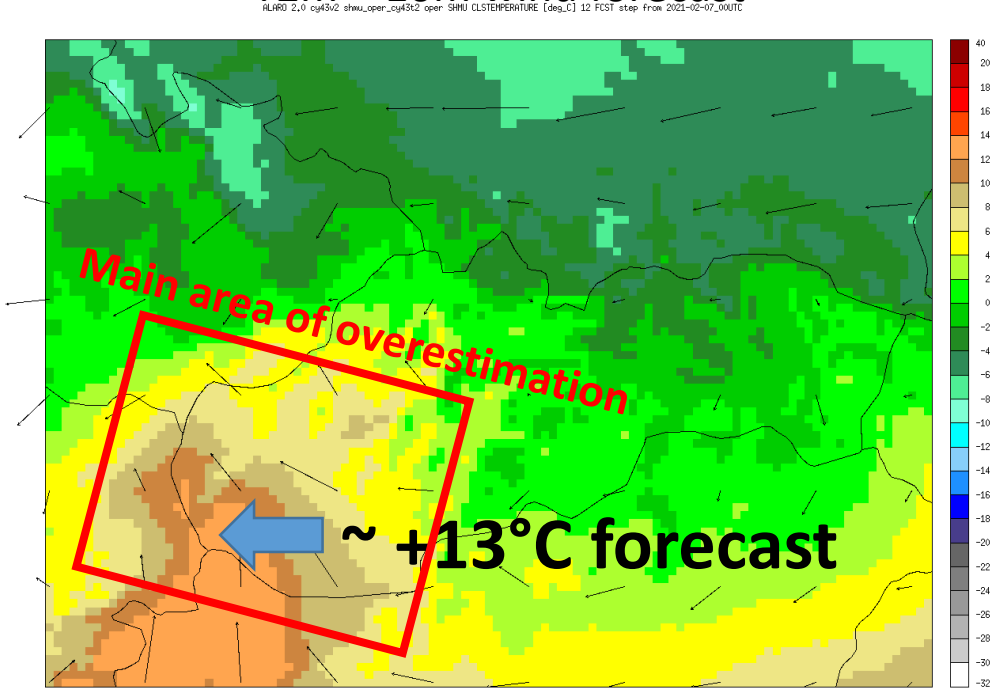
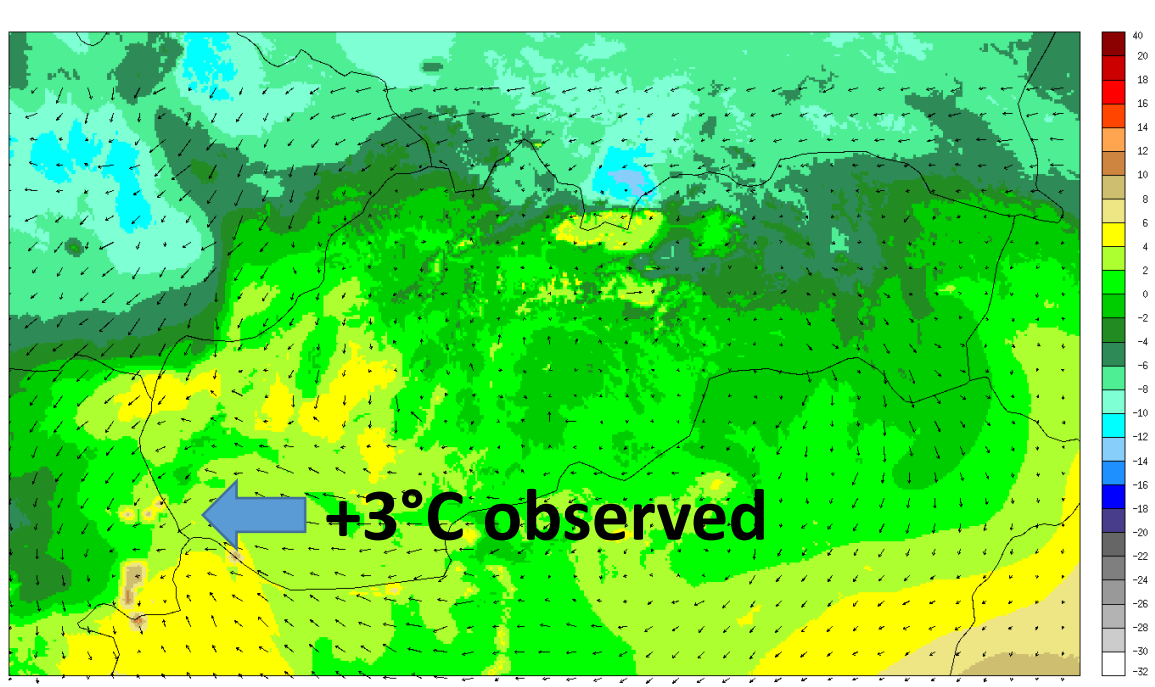
False model advection of warm air over Bratislava on 07 February 2021

- Base forecasts: 07 February 2021 00 UTC (and earlier runs as well)
- Forecast length: 12h
- Place: western Hungary and southwest Slovakia (+ A,SK,CZ border region)
- T2m overestimated by ~10 deg. C (mainly SW Slovakia and SK/H border region)

ALARO SHMÚ cy43t2 op. model +12h
T2m + 10m wind forecast

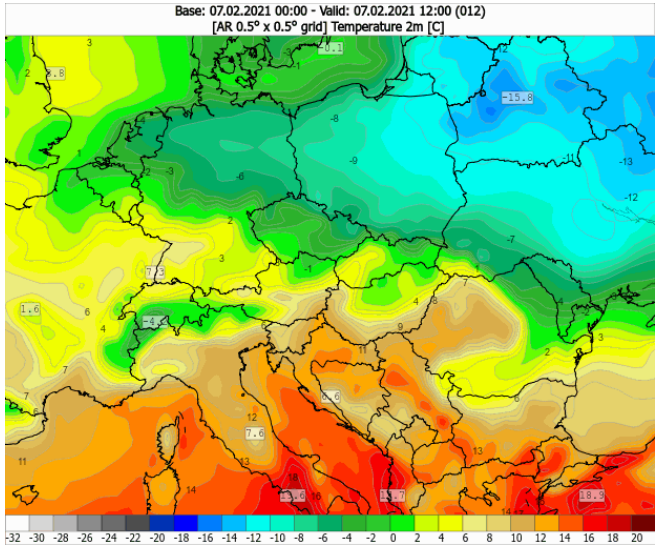


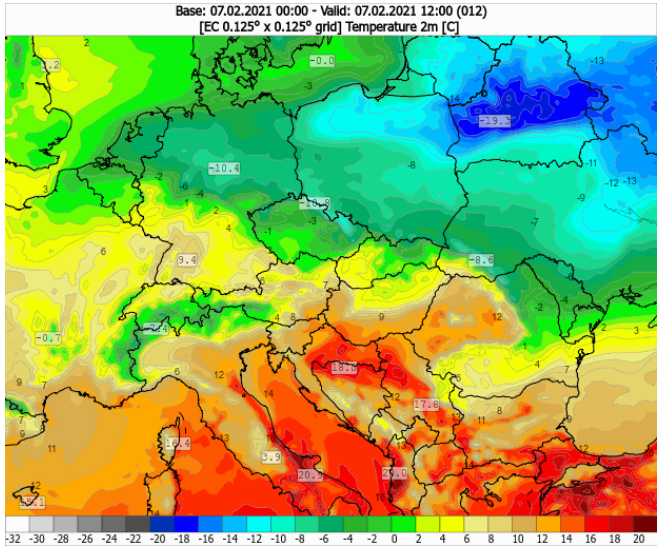
INCA T2m + 10m wind analysis

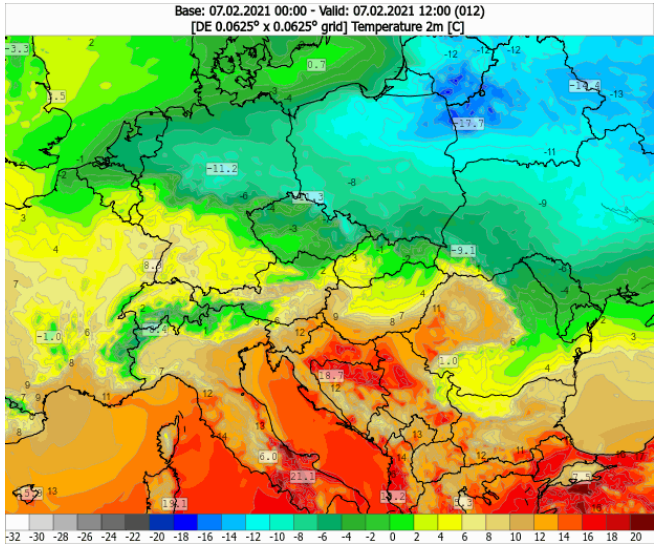


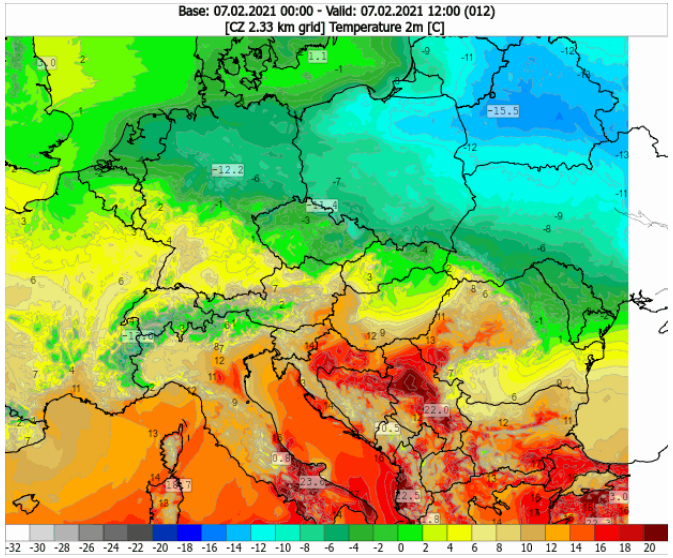
Forecasts of other global/LAM models (rclace.eu)

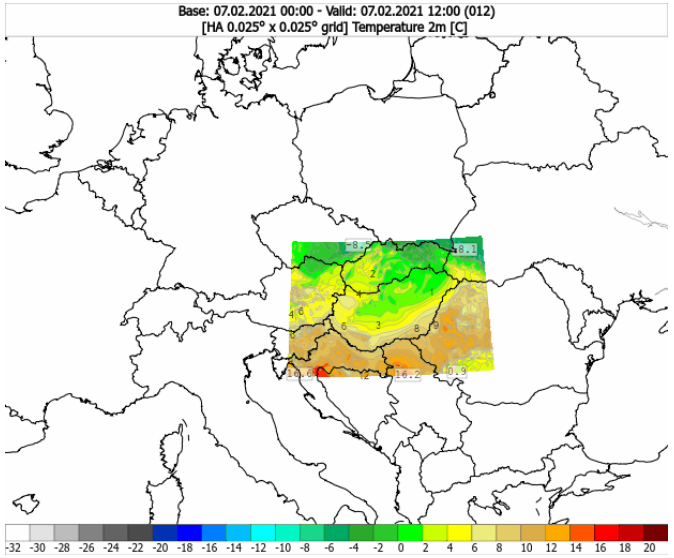
- Most of the models forecast a “tongue” of warmer air spreading toward North, with different extension. AROME models (H, A, PL) were exceptions – probably even too cold over Hungary.

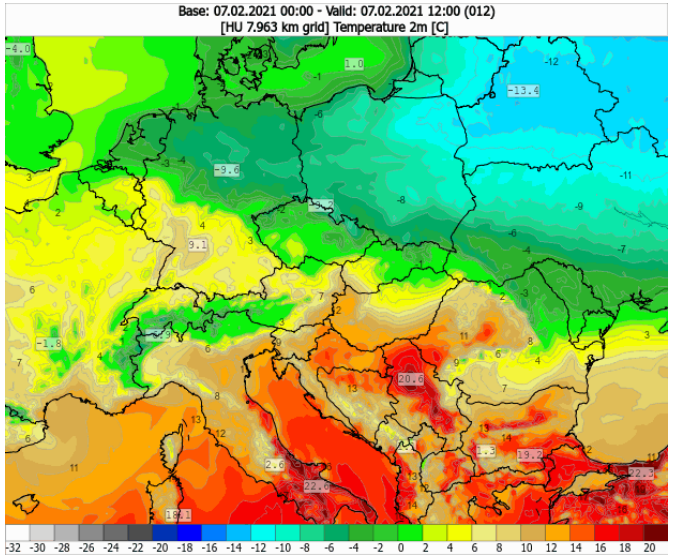




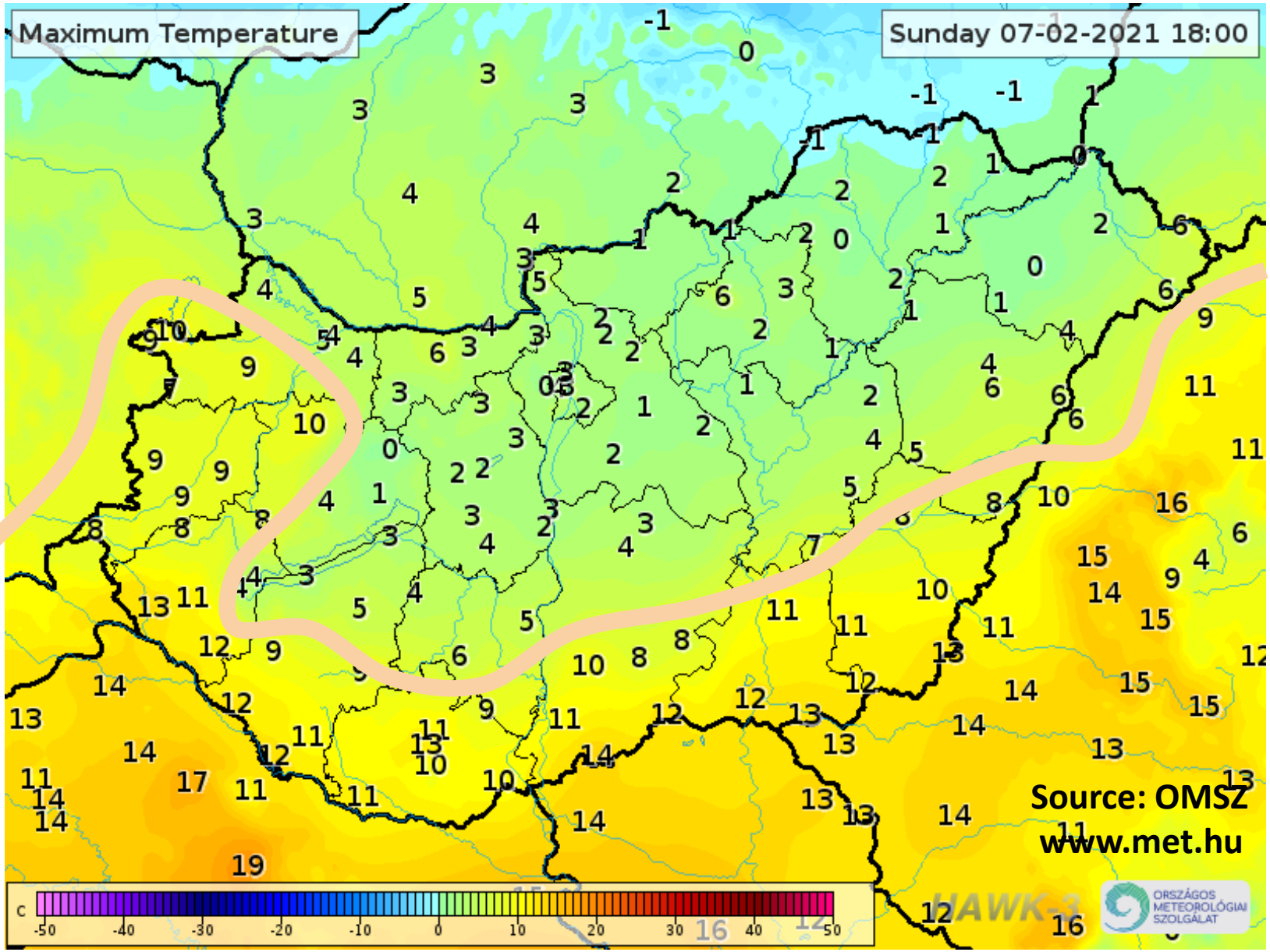






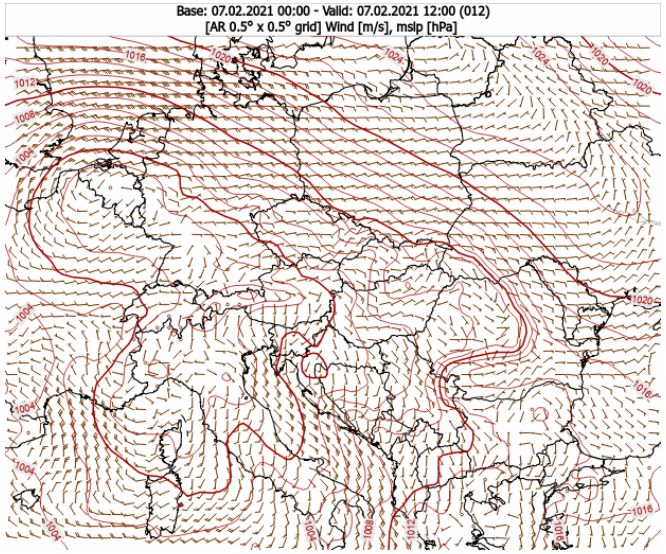


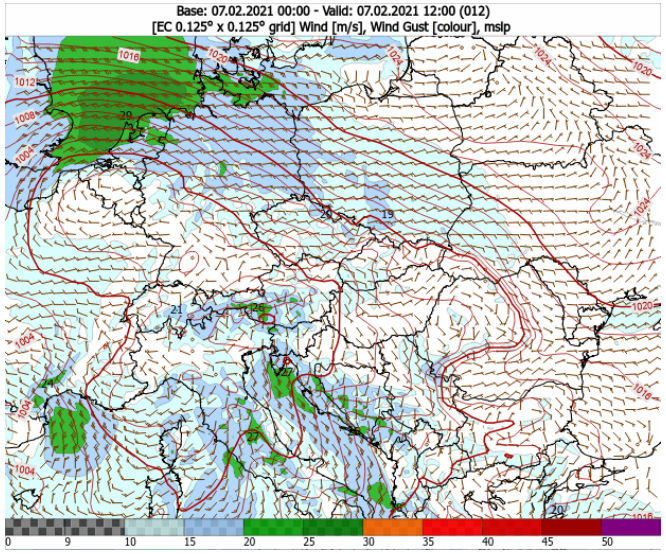
Daily temperature maxima at Hungary and extension of the warm air tongue

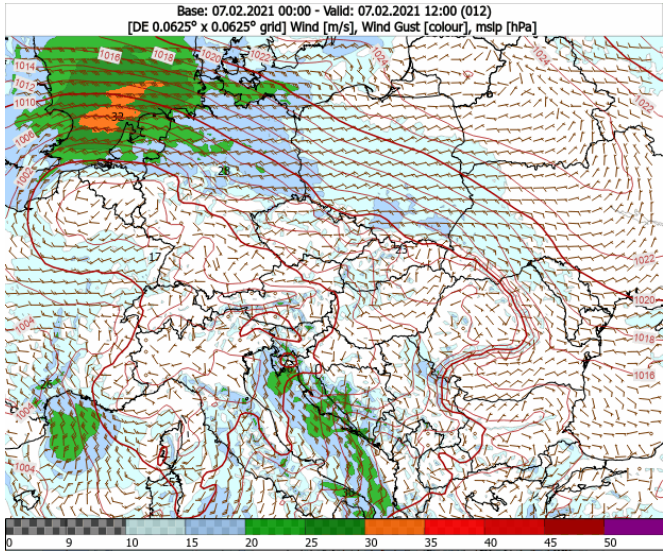


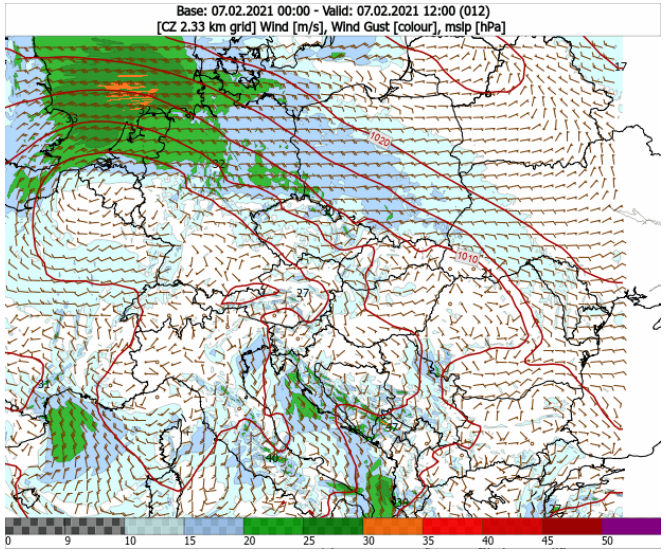
Forecasts of MSLP and 10m wind

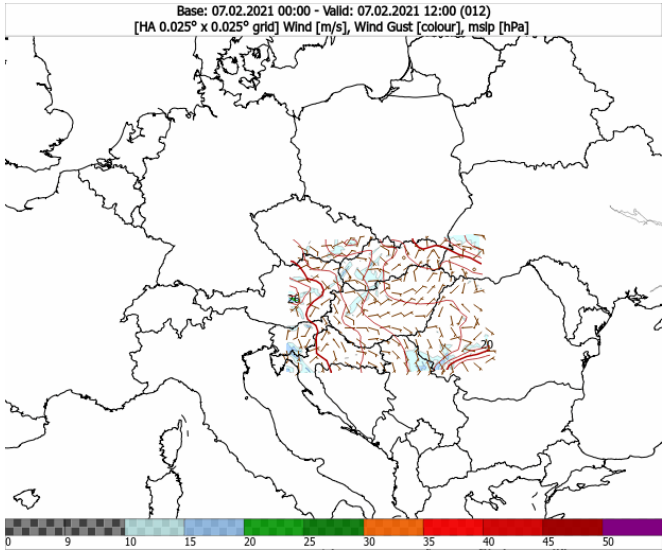
- There were rather local differences in the MSLP field but stronger pressure gradients developed in the “warm” forecasts and the wind direction was more southerly there (stronger temperature advection)

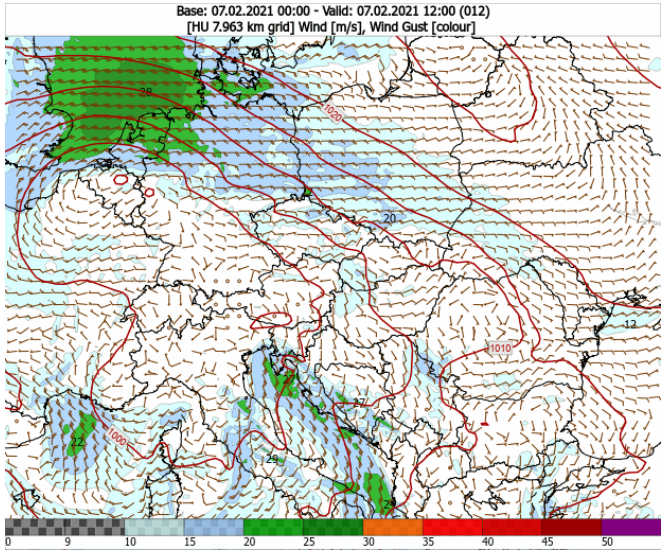










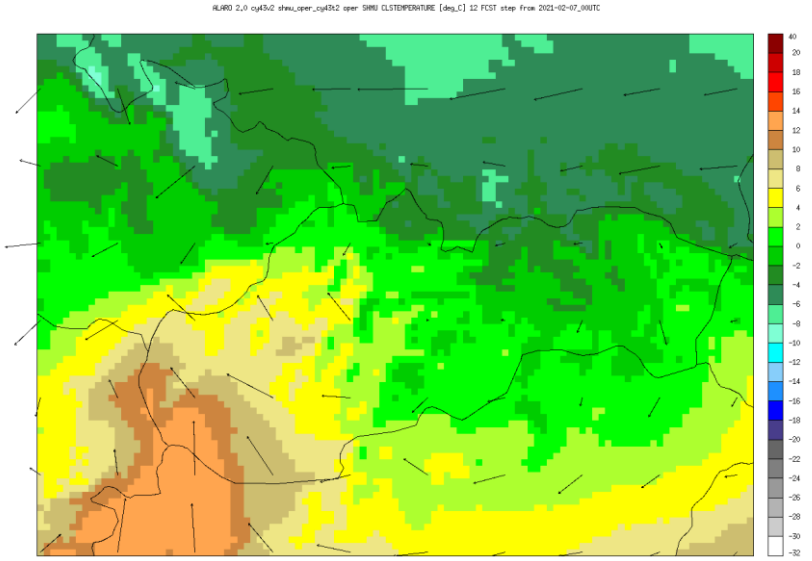


Local model runs at SHMÚ

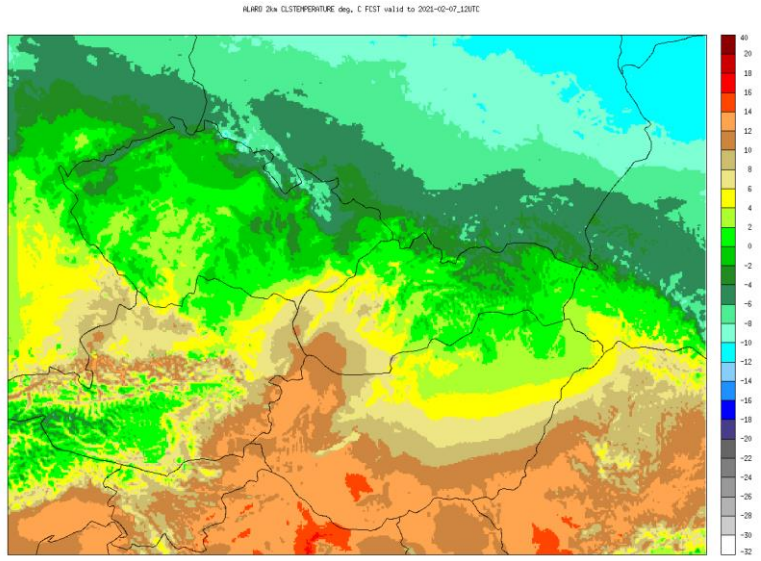
ALARO 4.5 km : from the operational suite (ARPEGE LBC 3h coupling, 63 vert. levels), CANARI, cycling
ALARO 2.0 km : regular runs, ARPEGE LBC 1h coupling, 87 vert. levels, dynamic adaptation, DFI
AROME 2.0 km: experimental, cy40, ARPEGE LBC 1h coupling, 73 vert. levels, dynamic adaptation, SURFEX (this run had a little positive impact on both wind and temperature)

Not shown, run only for this case (showed rather little impact):
AROME 2.0 km: experimental, cy40, ECMWF (ffei files) 3h coupling – little effect compared to previous AROME
ALARO 2.0 km: exp., 73 levels, cy43, z0 from AROME SURFEX, smoothed, 1h ARPEGE coupling (used as reference later on)
ALARO 2.0 km: as before, but with various ALMAV (75,300) and other turbulence/precip./microphysics setup

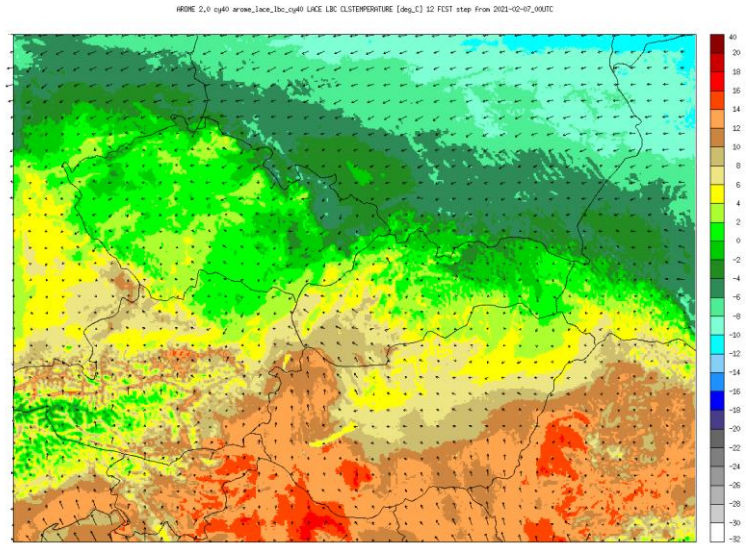
ALARO 4.5 km op cy43



ALARO 2.0 km cy43

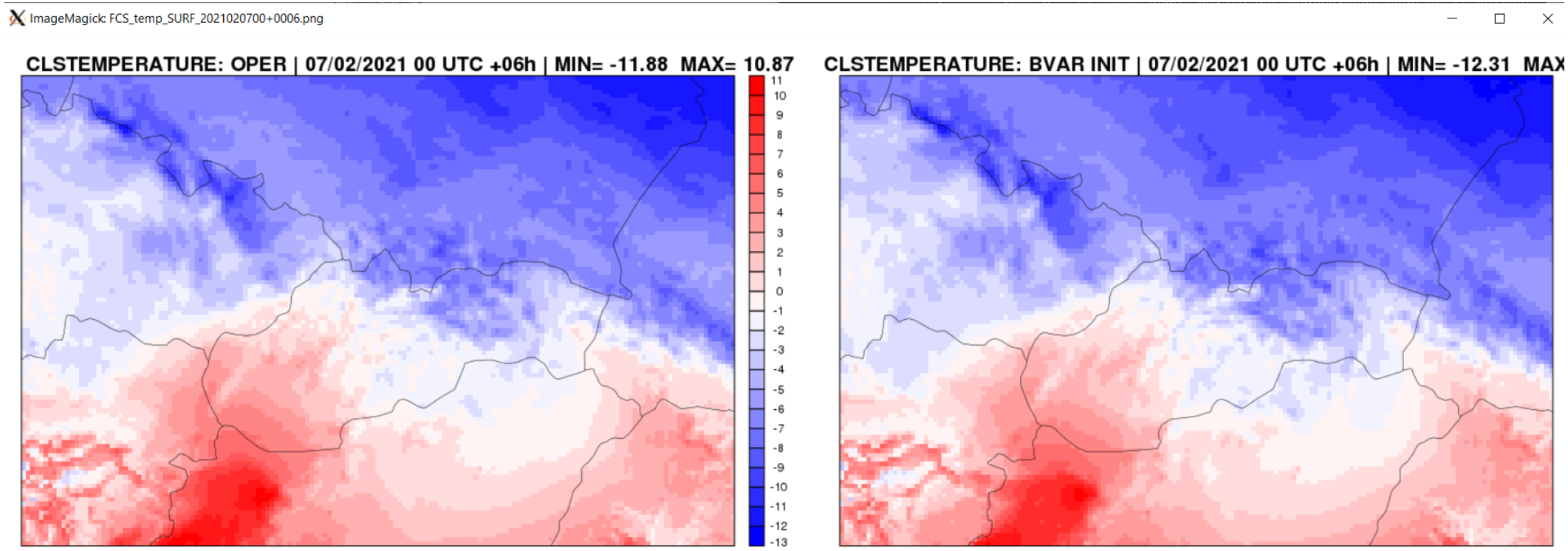


AROME (exp) 2.0 km cy40



Blendvar experiments (M. Derková)

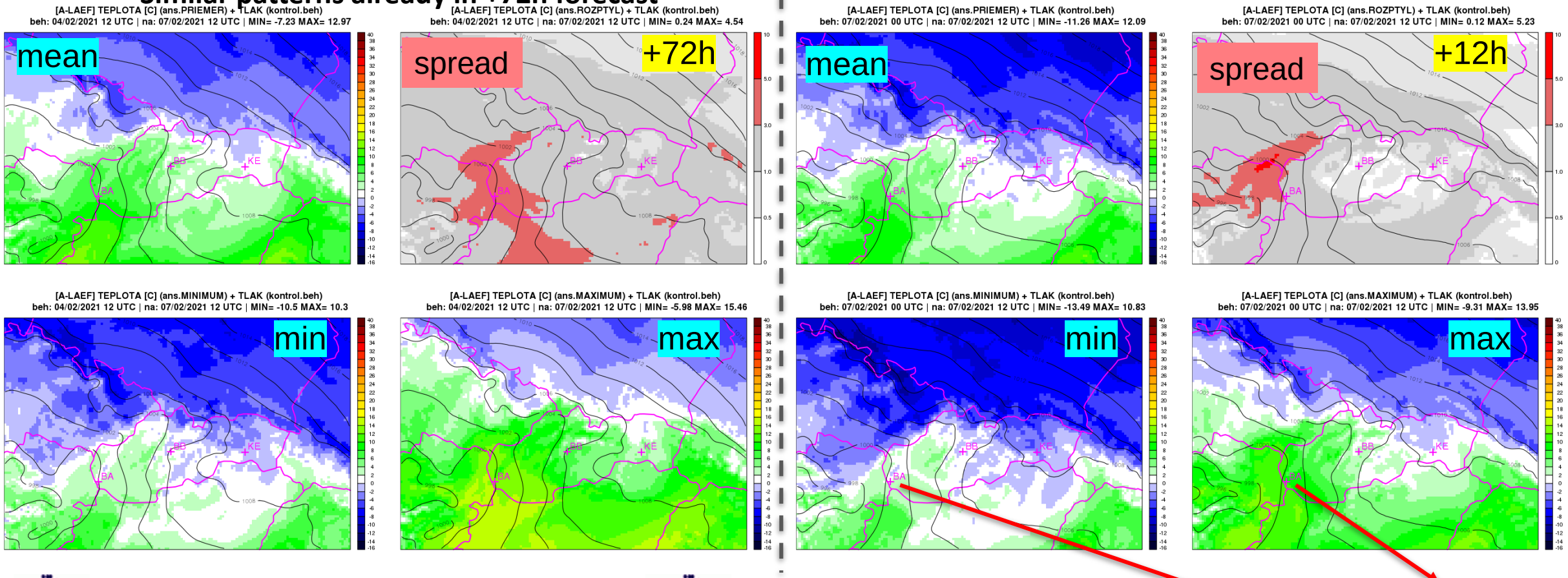
- 6h forecast from BLENDVAR (assimilation) INIT (produced by M. Imrišek) – little better

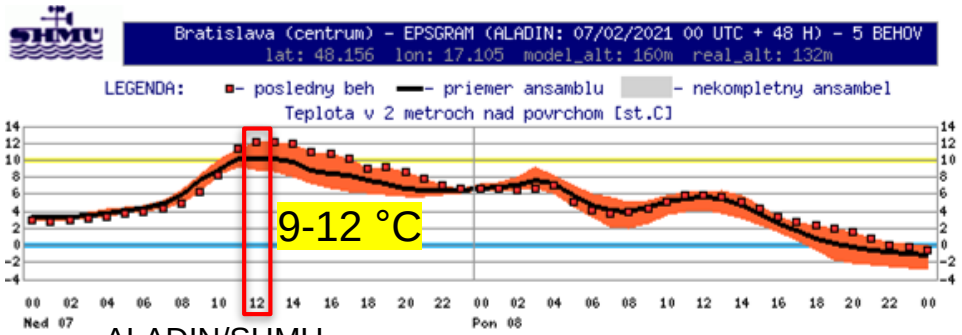


M. Belluš

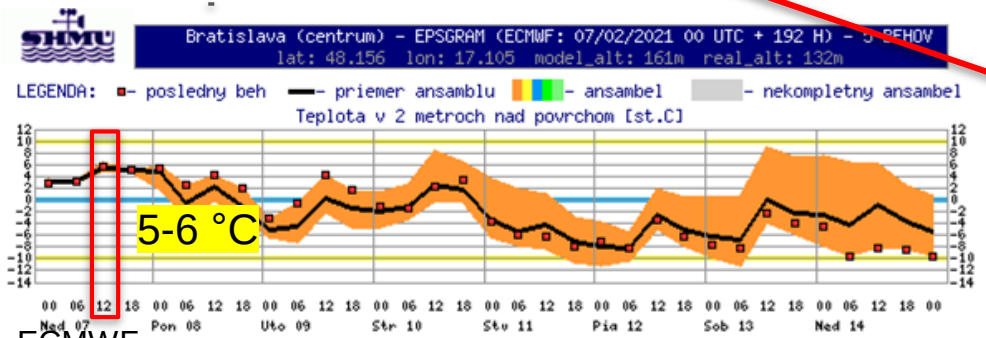
A-LAEF: 2m temperature predictability (valid for 07-02-2021 12 UTC)

Similar patterns already in +72h forecast





ALADIN/SHMU



ECMWF

2-4 ~ 10-12 °C

A-LAEF

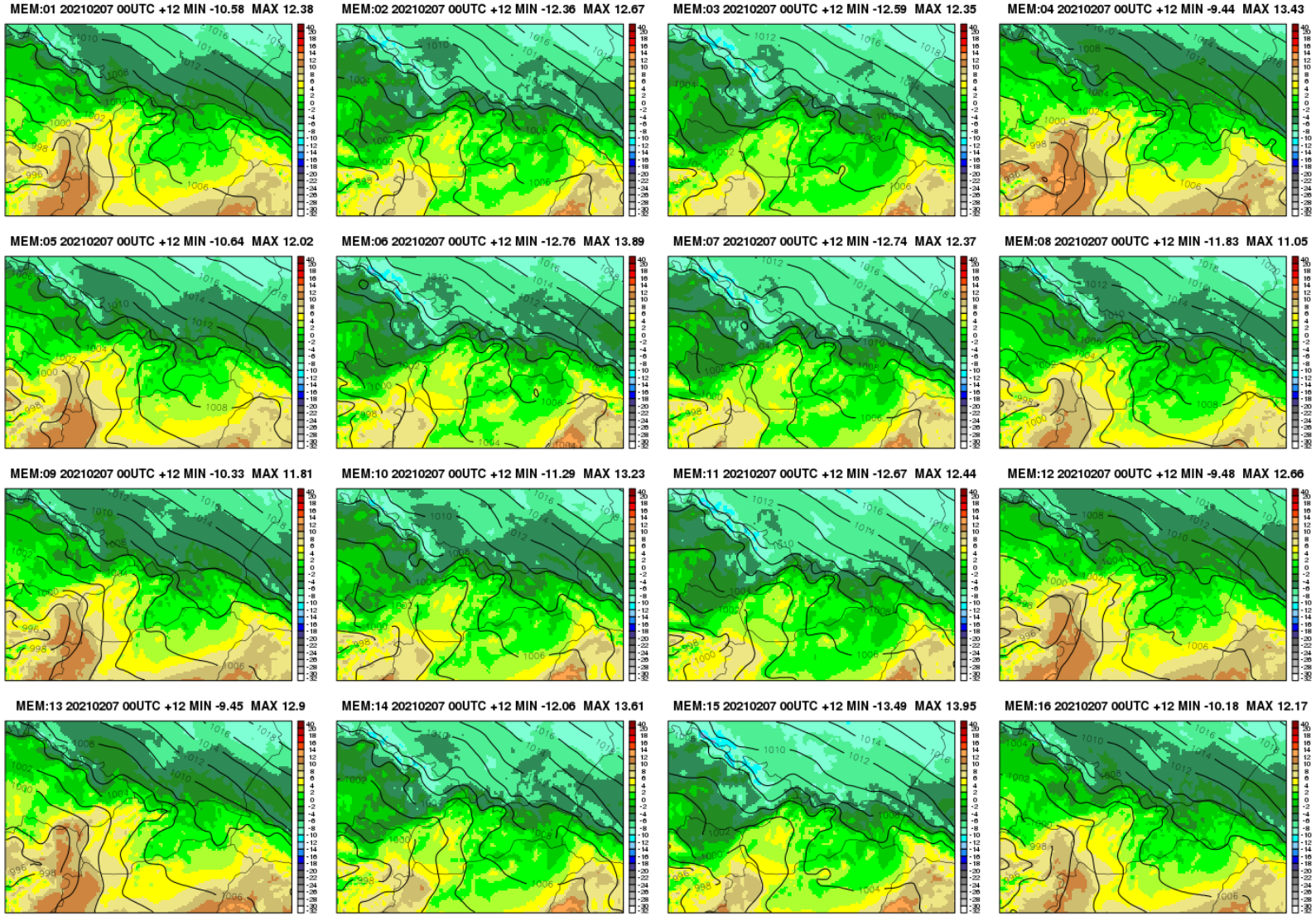
2.8 °C

OBS

A-LAEF (LBC from ECMWF, stochastic physics, ESDA, various LBC)

- Clusters 2, 3 (both using QNSE turbulence parameterization with „stable“ Geleyn-Cedilnik mixing length) show significant, systematic improvement compared to cluster1 or control cluster (same setting as OP)

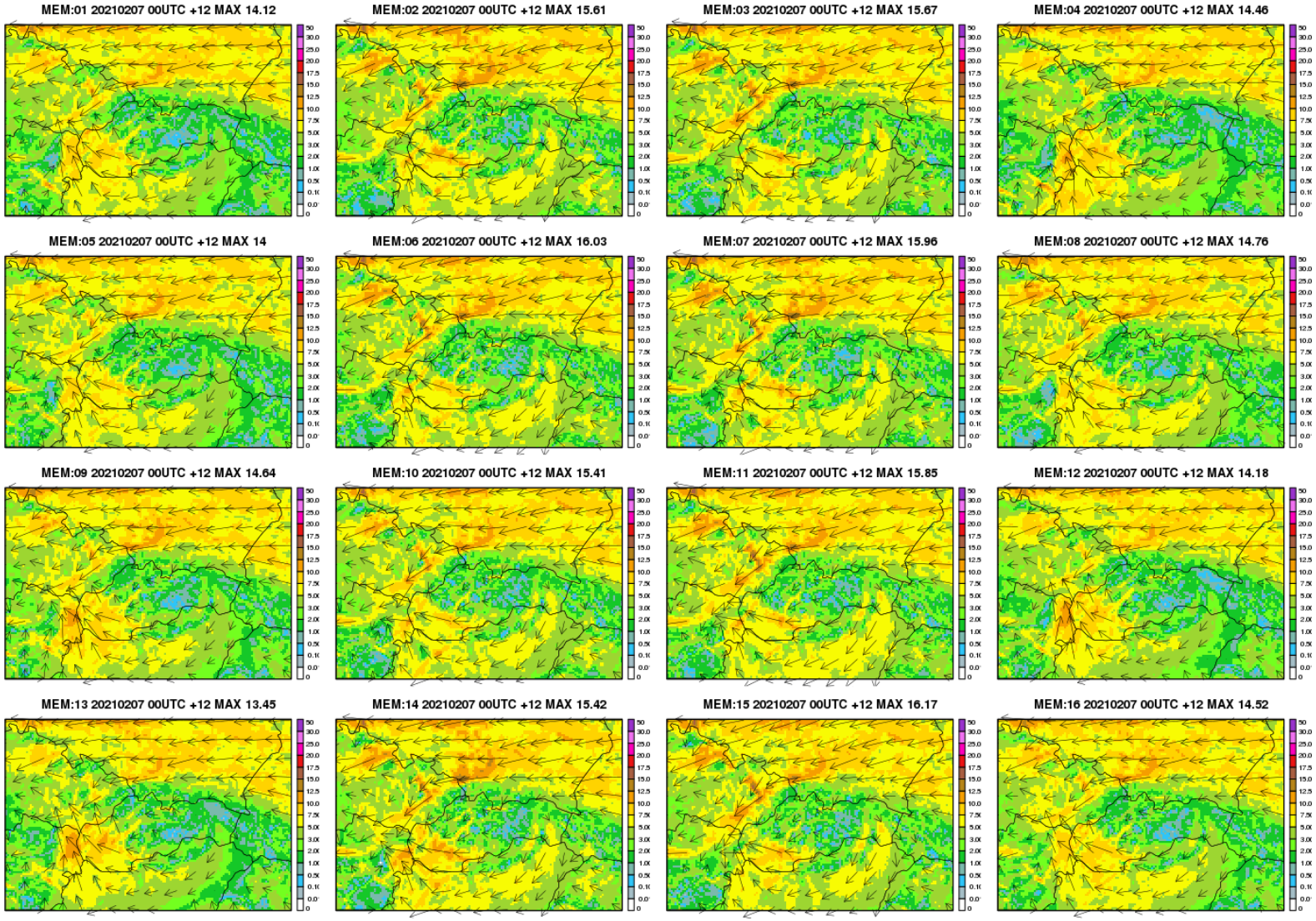
cluster 1 cluster 2 (QNSE, EL3) cluster 3 (QNSE, EL3) cluster 4 (control)



2m temperature

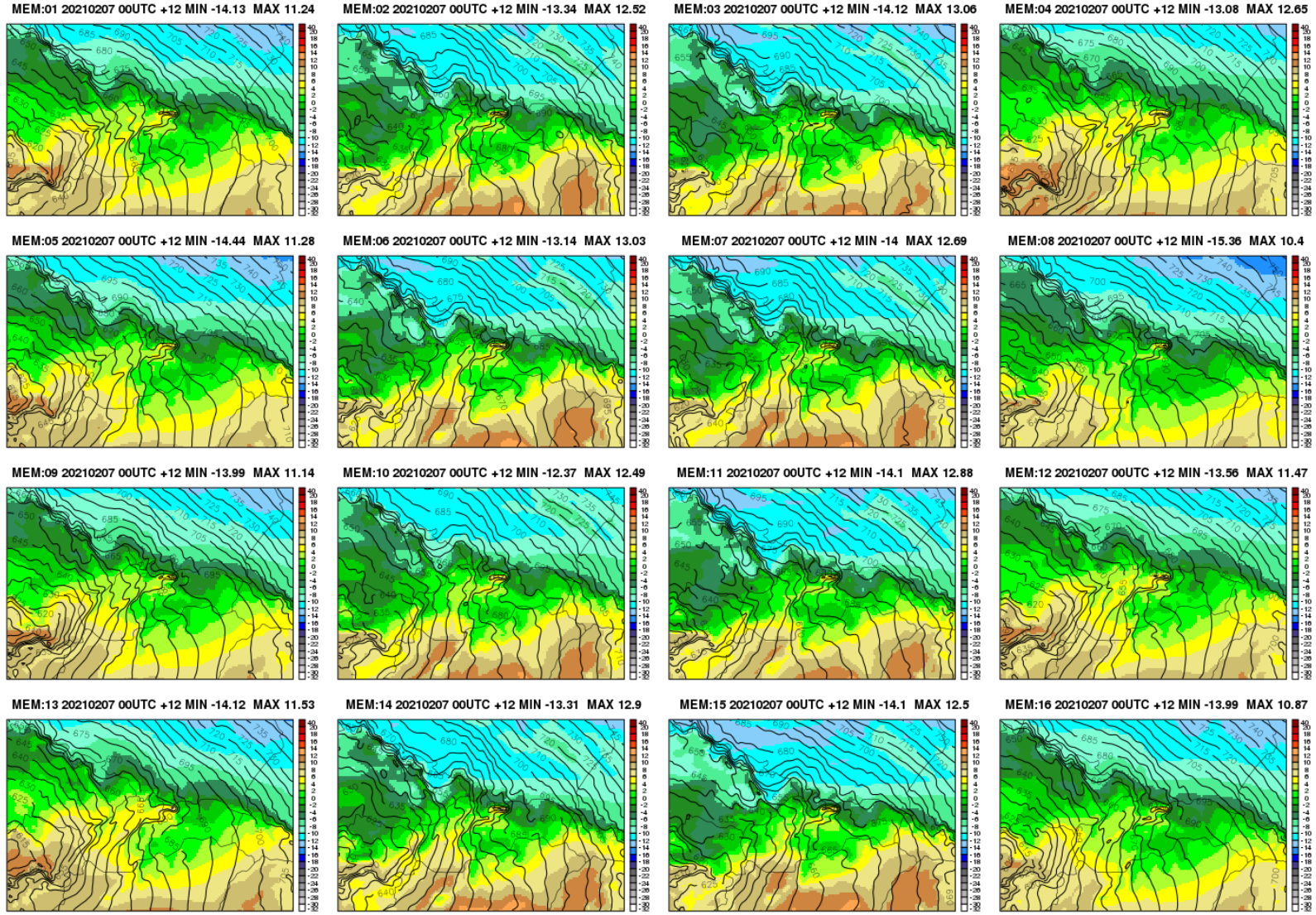
A-LAEF – 10m wind and wind speed

- The impact on 10m wind speed is less systematic but southerly wind is less dominant at the AT,H,SK borders in the 2,3 clusters compared to the control (4) cluster



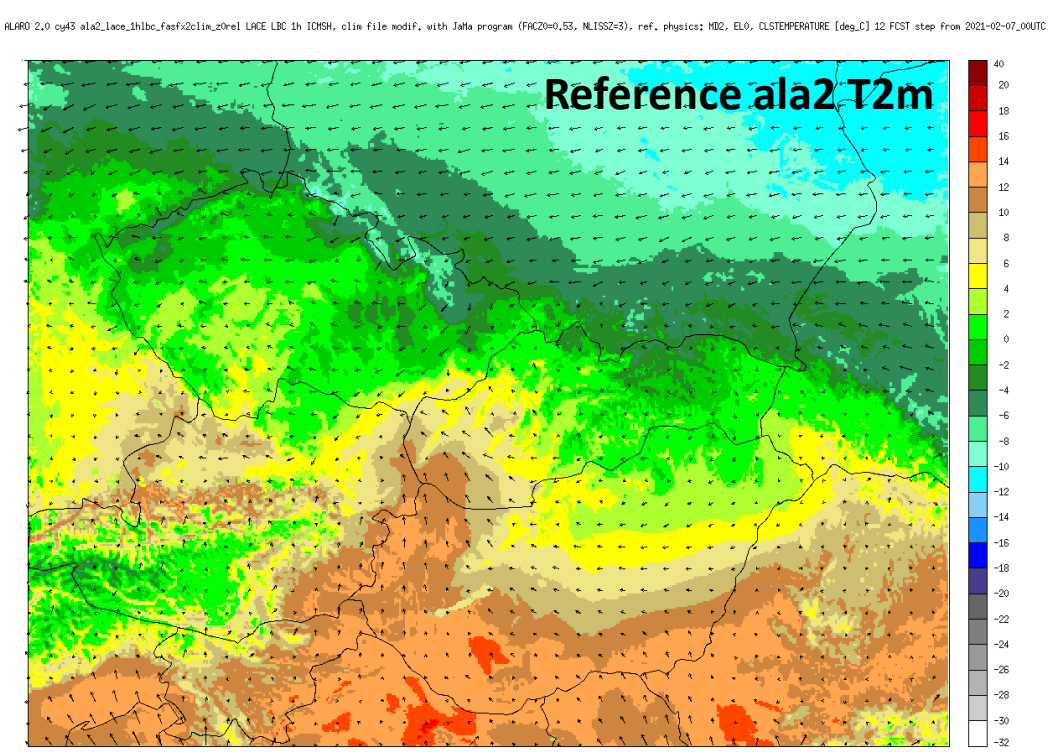
A-LAEF 925 hPa temperature

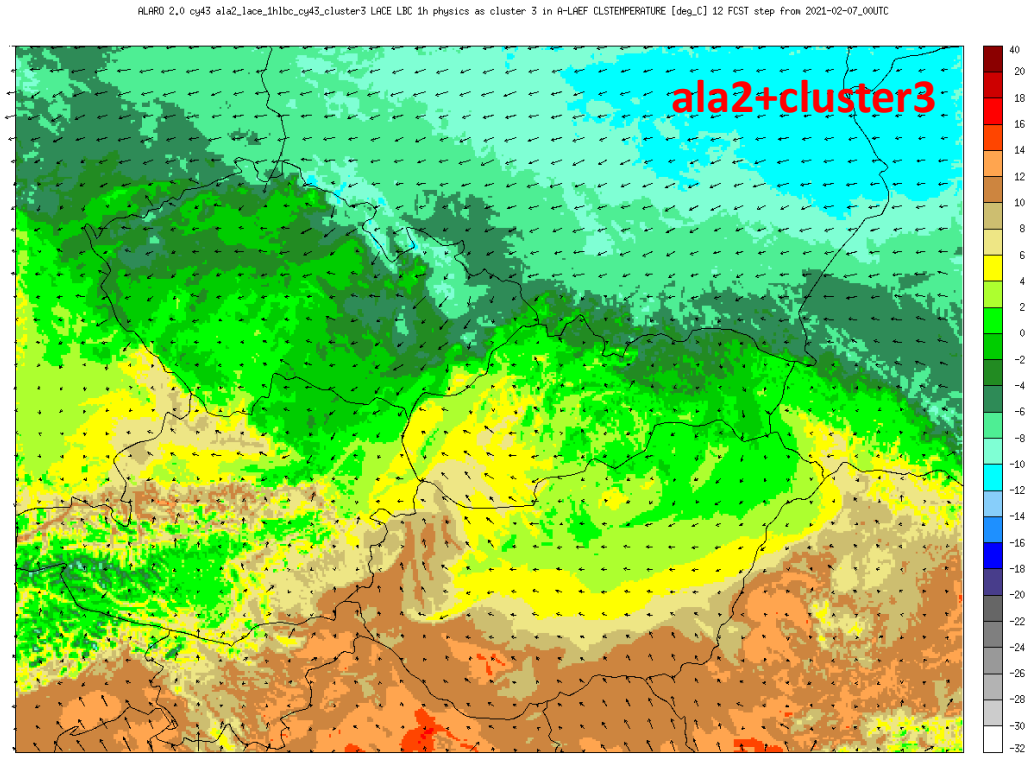
- There was probably an inversion with a top around 925 hPa. Here the differences between the clusters are less systematic. There are areas in cluster 3, which are warmer than in cluster 4, etc.



ALARO 2km, 73L, Cy43 with A-LAEF cluster 3 setup

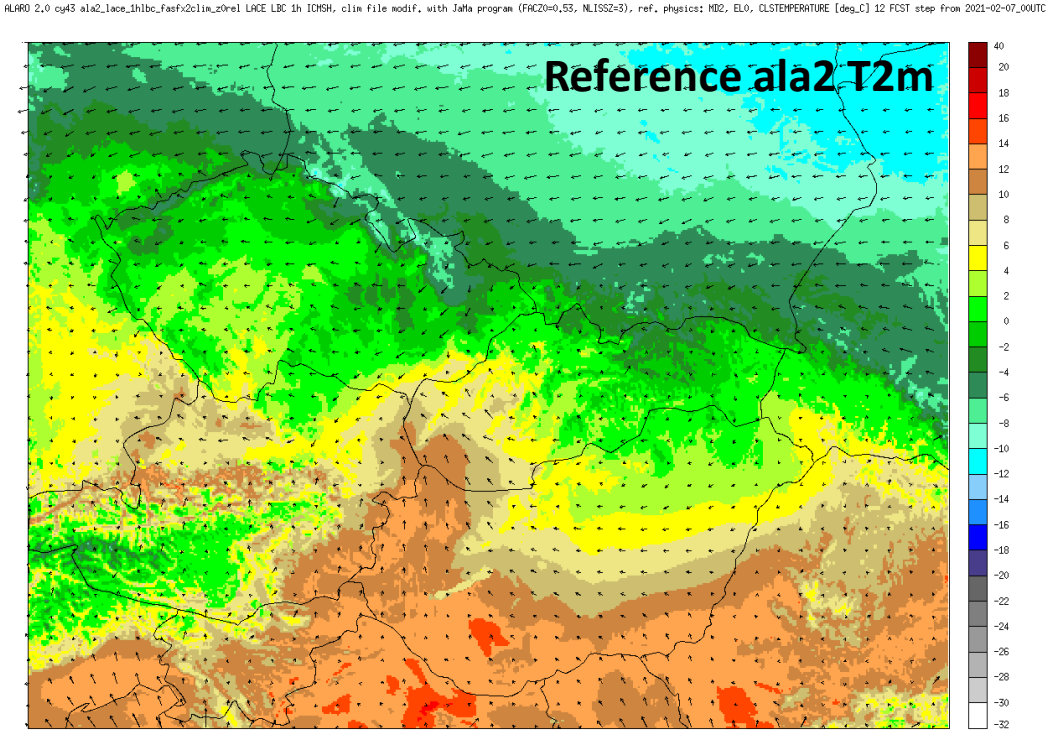
- Experiment using ALARO 2 km model with modified z0 (SURFEX, ECOCLIMAP II), 1h coupling frequency from ARPEGE (8km LACE files), CGMIXLEN='EL0', CGTURS='MD2', C3TKEFREE=1.183, C_EPSILON=0.871, ETKE_OLAM=0.29, NUPTKE=0.5265 (reference with warm T2)
- Physics modifications: CGMIXLEN='EL3', CGTURS='QNSE', LCVGQD & LCVGQM & LENTCH =.F., LPRGML=.F., LSCMF=.F., LSMGCDEV=.T., LXRCDEV=.F., C3TKEFREE=1.39, C_EPSILON=0.798, ETKE_OLAM=0.324, NUPTKE=0.504, **significant impact, largely similar to A-LAEF members in cluster 3 !**

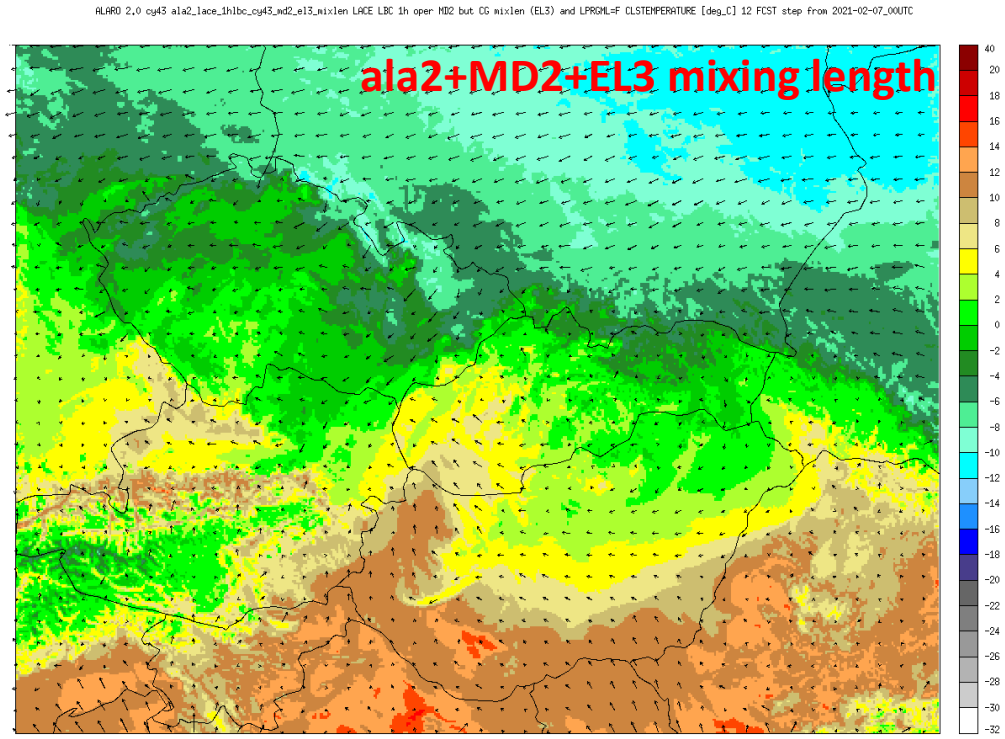




ALARO 2km, 73L, Cy43 with „stable“ GC mixing length

- Further experiments (not shown): cluster2: only turbulence changes (a bit warmer than cluster3), qnse: QNSE with EL0 mixing length brings the reference too warm forecast back!., qnse+EL0+lprgml=F also does not improve the inversion forecast. Thus, use of EL3 was a significant factor. EL3 means that L =min (LN , Lmax) if Ri > 0, else L=L_{GC} (as in EL0)
- We provided an experiment with the original MD2 parameterization of turbulence and only setting CGMIXLEN='EL3‘ & LPRGML=.F., which forecasts lower temperature (but note that **not only** on the place of interest!), L_N=sqrt(2TKE/N**2)

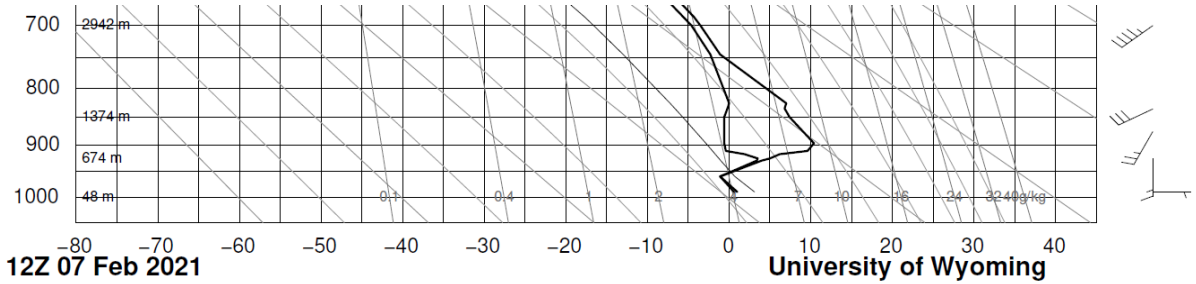


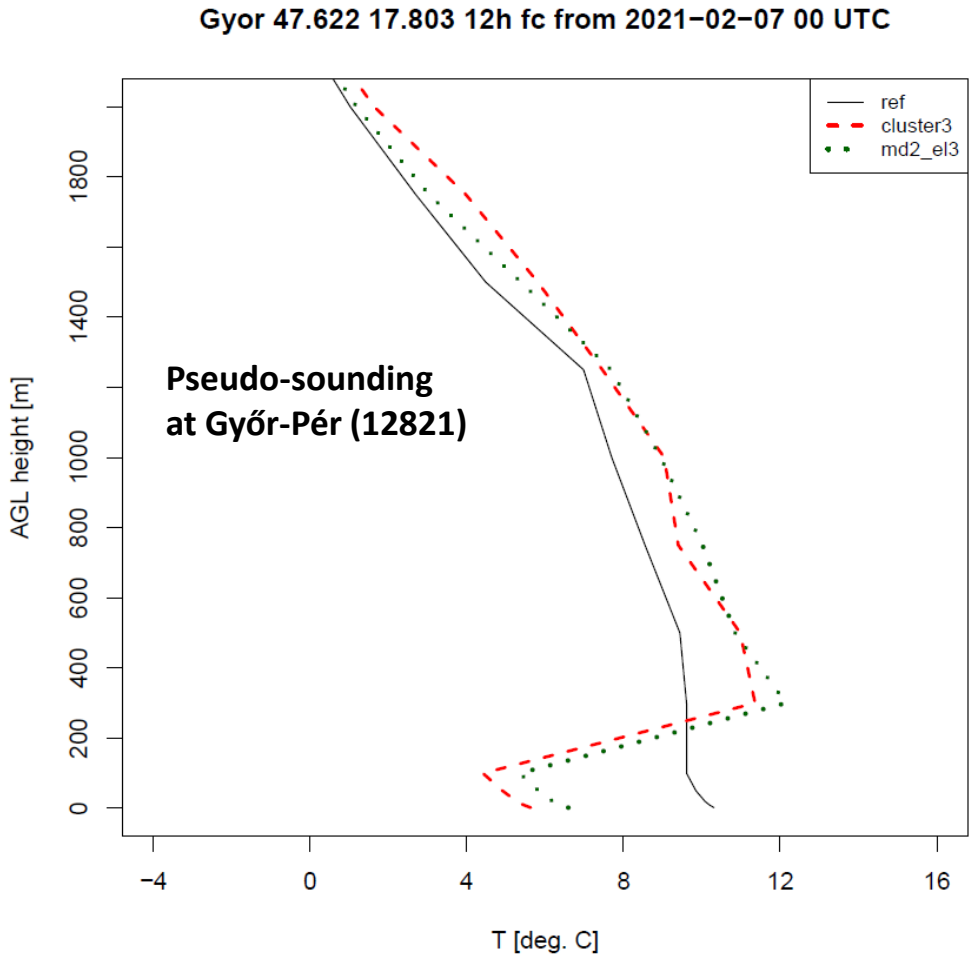


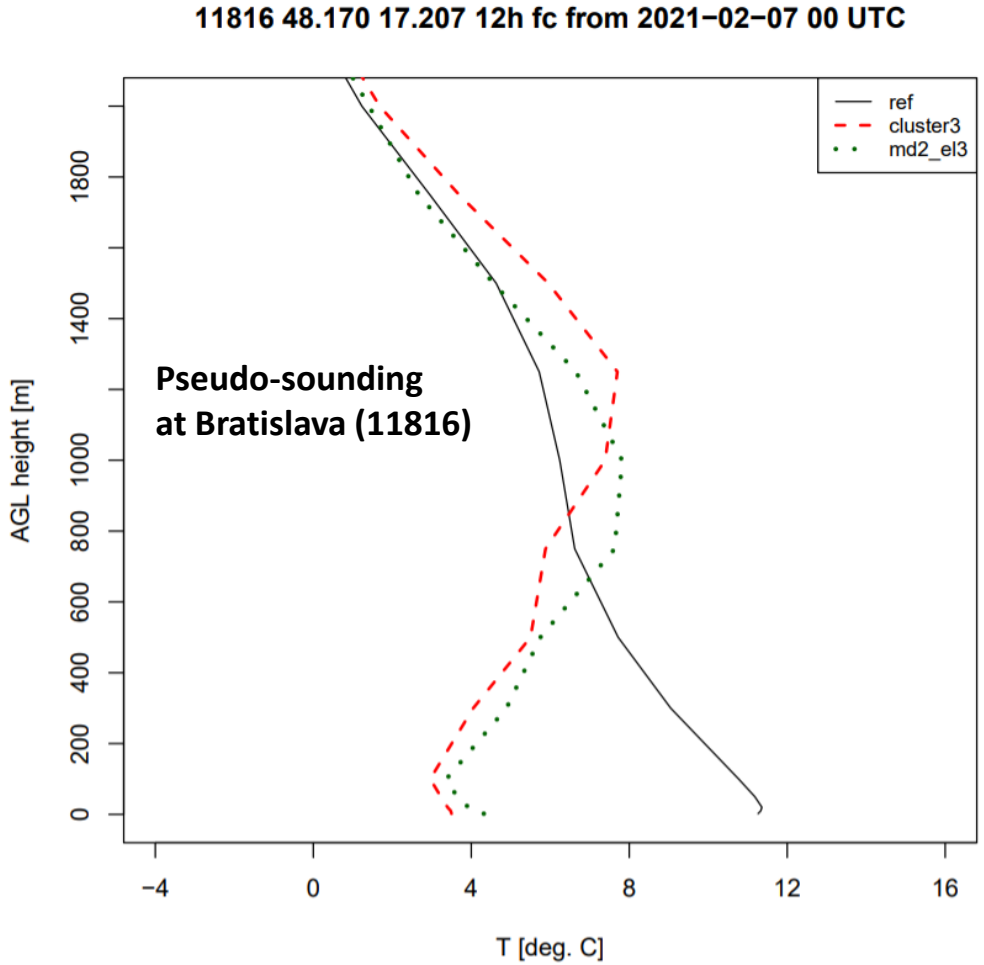
Vertical temperature profiles, alaro 2 km

- Experiments: **Reference**/A-LAEF cluster 3 physics/ reference+EL3 mixing length

12843 Budapest sounding 7 February 2021 12 UTC







Summary

- On 7 February 2021 there was a strong southerly advection of warm air, however, a temperature inversion developed over the border area of SK, CZ, H, A countries indicated by soundings and several forecasts. High differences in 2m temperature forecasts were related to different spread of the mixed PBL region in various models (somewhere extended by several tens of km-s northward compared to reality).
- The A-LAEF outputs indicate that the uncertainty in the 2m temperature forecast was already present in early short-range (e.g. +72h) runs, nearly in similar areas. However, the „warm“ and „cold“ versions show some correlation with respect to particular clusters using different setups of physics.
- Experiments with similar setups of physical parameterisation show that the forecast of the temperature inversion could have been sensitive on the choice of the mixing length profile. The use of „EL3“ or „EL5“ (not shown), where the mixing length is limited in case of stable stratification, improve the temperature profile, thus the T2m forecast as well (by at least 5-6 °C).
- Data assimilation, LBC choice or other physical parameterisation features could also have an impact but the rate of their influence is less certain
- The A-LAEF cluster3 setup performed better forecasts in other cases as well, but it would be too preliminary to generalize, whether different turbulence scheme (QNSE) or mixing length profile would be systematically better in other types of weather situations (e.g. summer convection). In some cases (e.g. very low temperatures over snow) it had rather neutral impact.