Impact of the High Resolution Winds On the ALADIN/Hungary Limited Area Model

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Outline of the talk

- ➔ Motivations and acknowledgements
- ➔ Observations pre- and processing, with focus on HRW
- ➔ The ALADIN Hungary assimilation and forecast system
  (please refer to our poster for more details)
- ➔ The impact of the AMV data (HRW and the EUMETCast winds):
  - → on the analysis system
  - → on the forecast system
  - → some case studies
- ➔ Concluding remarks

Motivations and Acknowledgements

➔NWCSAF has developed a retrieval tool for computation, among other parameters, of atmospheric motion vectors (AMV), which was successfully implemented at OMSZ;

➔The output of the retrieval package is actually in use for different purposes at OMSZ;

➔Since the operational limited area model (ALADIN) assimilates similar observations (received through the EUMETCast), it is of interest to test the data produced with local environments.
– *The objective of this study is to evaluate the impact of the locally processed high resolution winds (HRW) in the operational ALADIN model analyses and forecasts with respect to that of the EUMETCast data;*

➔This work was supported by NWCSAF, and realised in cooperation with the AEMet expert team: especially ***Javier Garcia Pereda.***

Data pre-processing and collection

➔The HRW data was produced with special settings in full agreement with the NWCSAF, in particular with the AEMet experts;

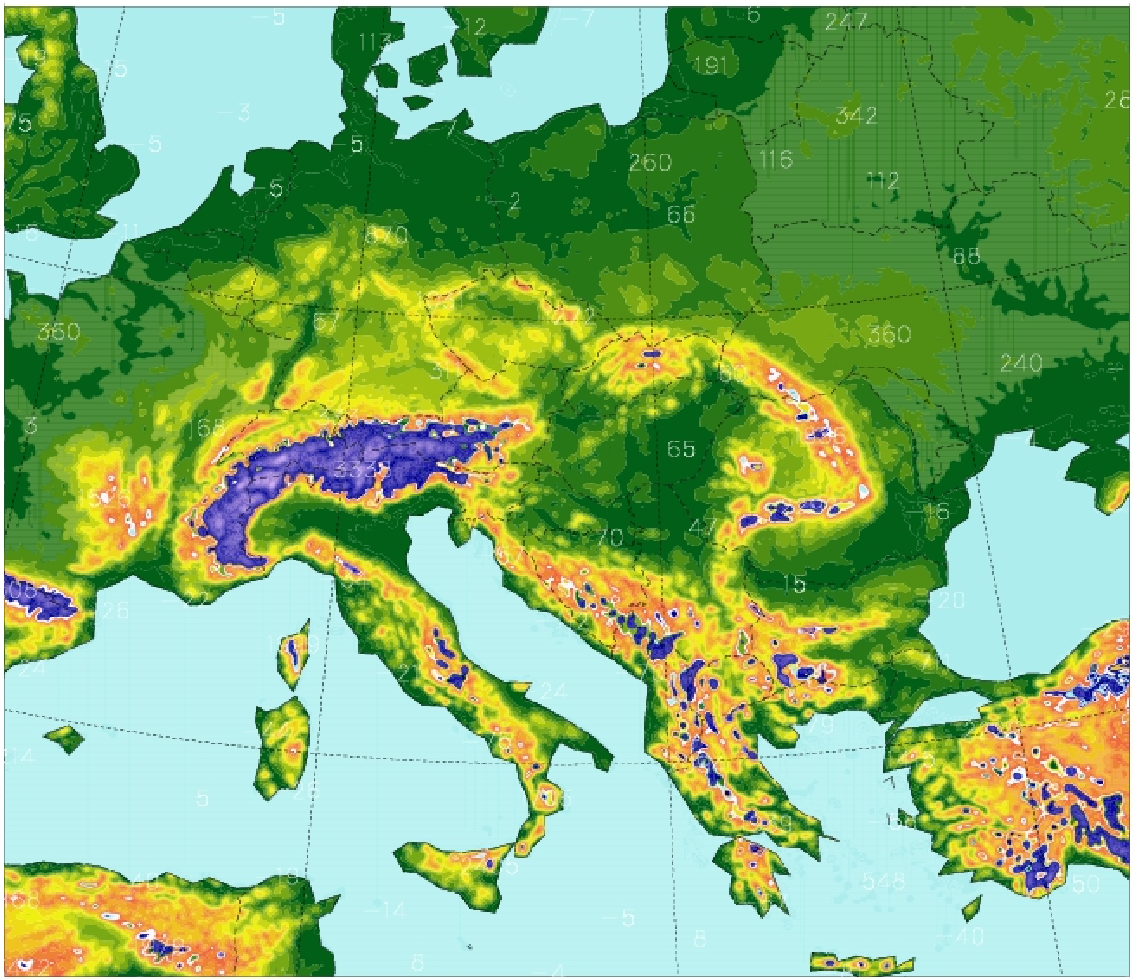
➔Since in ALADIN the AMV data are used in BUFR format, in this study as well the BUFR formatted data were processed;

➔We faced some technical problems related to the fact that HRW BUFR data were created with different BUFR tables than those used in operational (from EUMETSAT).

➔The extraction of the HRW data was done with instruction given by the NWCSAF expert – Javier ;

➔For the purpose of this study the HRW wind data were archived for several months in 2011.

ALADIN Hungary assimilation and forecast system (1)
(ALADIN - Air Limitee Adaptation Dynamique development InterNational)



Model domain:

Domain: Lambert projection
Dx=dy= 8 km, 49 vertical levels up to 5 hPa

ALADIN assimilation and forecast system (2)

Upper-air analysis

→ Three-dimentional variational (3DVAR) assimilation system

- Use of conventional and satellite data

6 hour cycling → run 4 times a day

Surface analysis

→ Optimum interpolation

- Univariate analysis of 2m T and 2m Hu
- Diagnosis parameters are skin T and water content

Forecast system

→ Hydrostatic (IFS/ARPEGE/ALADIN/HARMONIE) CY36T1

→ Initialisation technique: Digital filter

→ Lateral boundary files: ECMWF analyses and forecasts

Peculiarities of the experiments

➔The decision:
- To choose a summer period: 15.07.2011 – 20.08.2011;
- where the period between 15 and 19 was used as warming period for the assimilation system;
- The reason for choosing this period was that during this period we observed both relatively "dry" and "wet" periods, while the summer was enough warm and reach regarding convective events;
- Due to limitation in computational resources, we decided to perform longer (up to 48 hour) forecast only for 00 and 12 UTC assimilation and lead times. For 06 and 18 UTC, 6-hour forecast guaranteed for creating the next first-guess for following assimilation.

➔The following four experiments were performed:
AMV1- run with the HRW data
AMVE- run with EUMETCast AMV data
AMVA- run with both the AMV winds
AMVN- run without AMV winds

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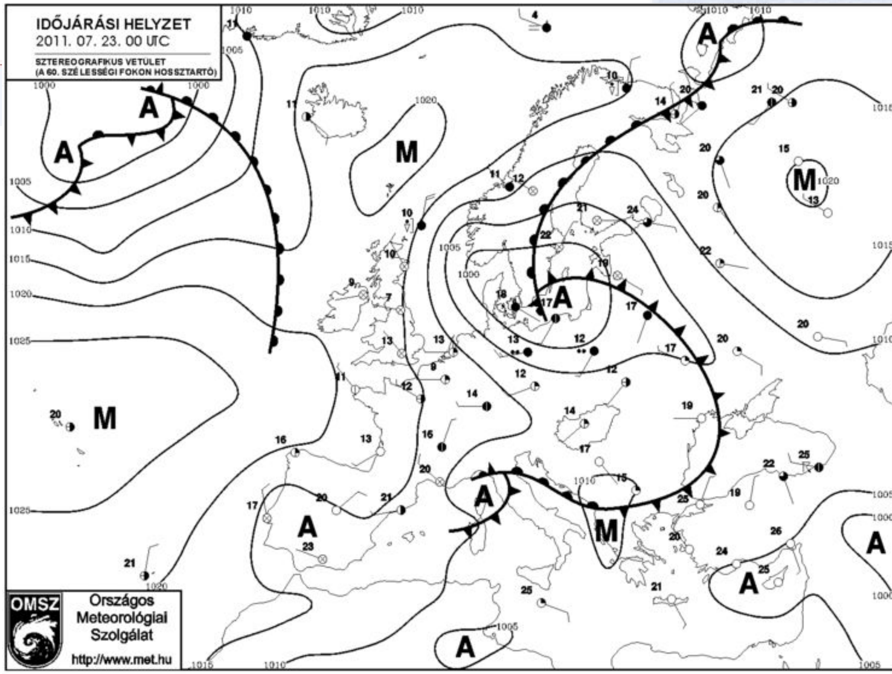
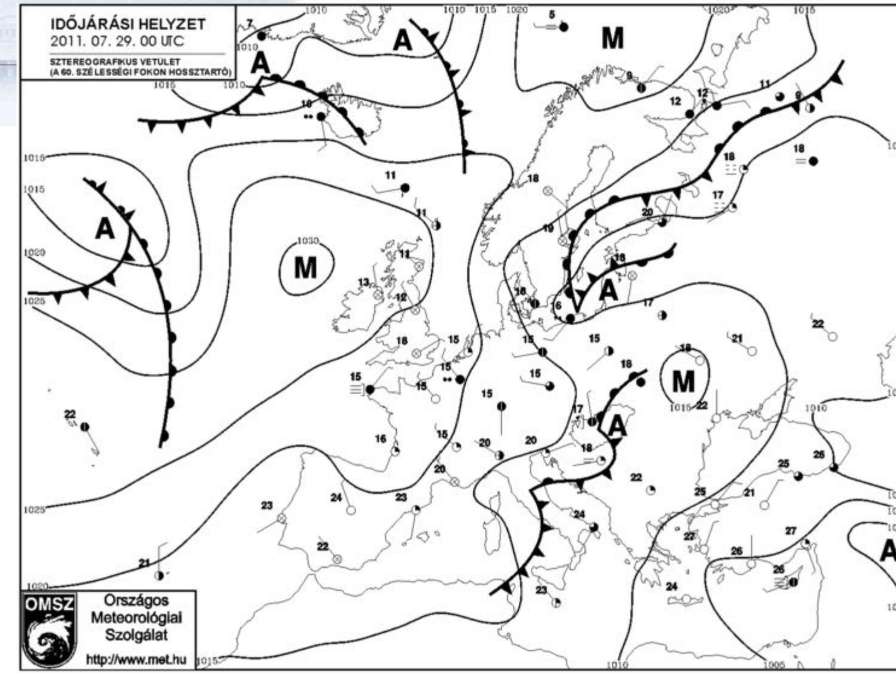
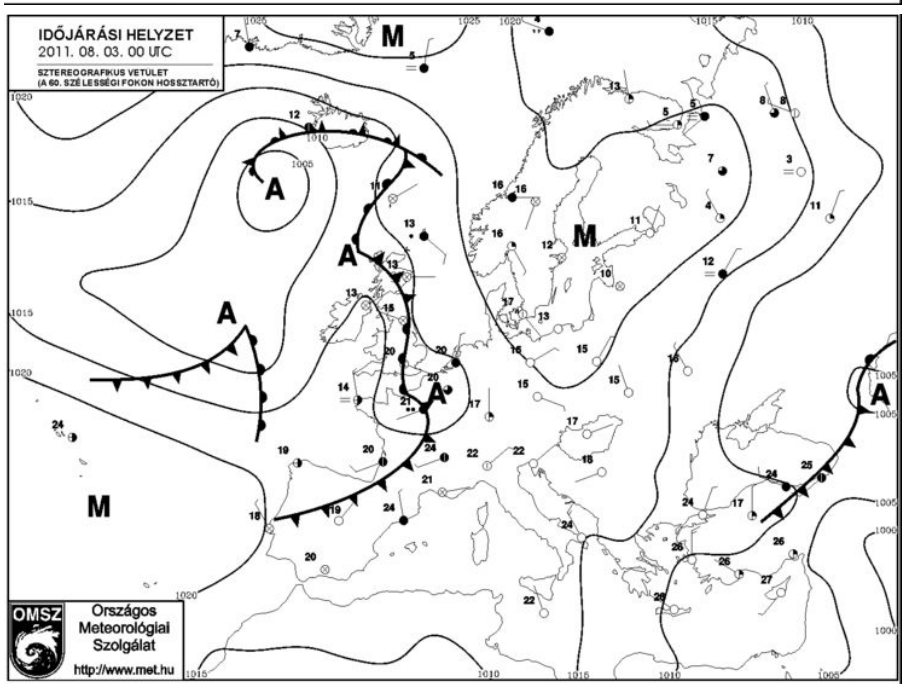
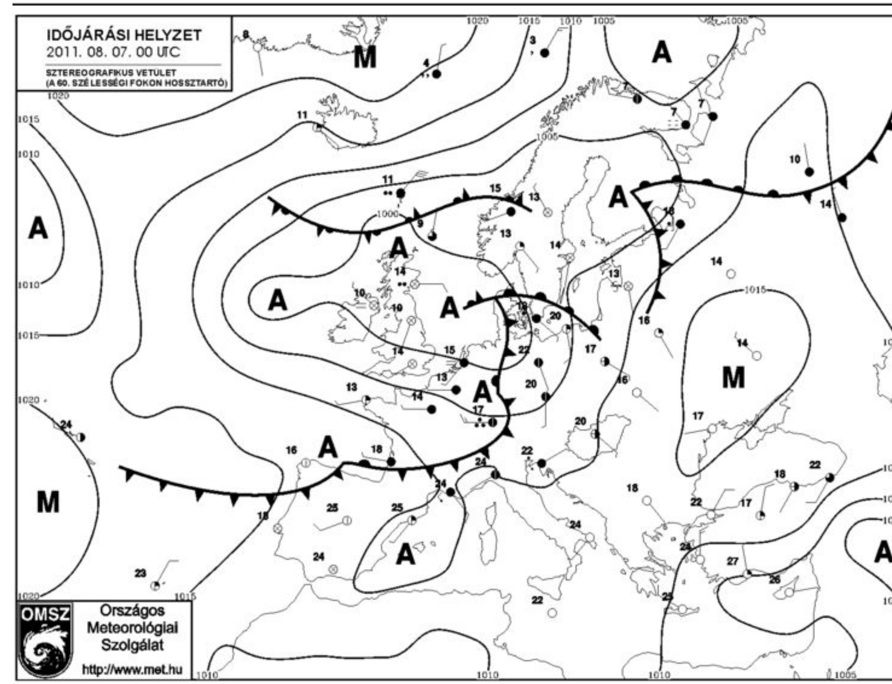
Typical weather charts during the chosen period









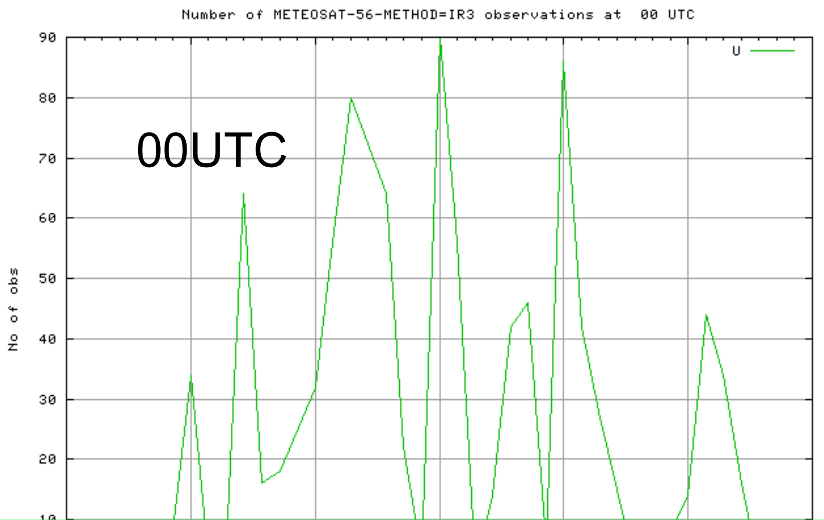
The impact study – the availability of the AMV data and the used observations

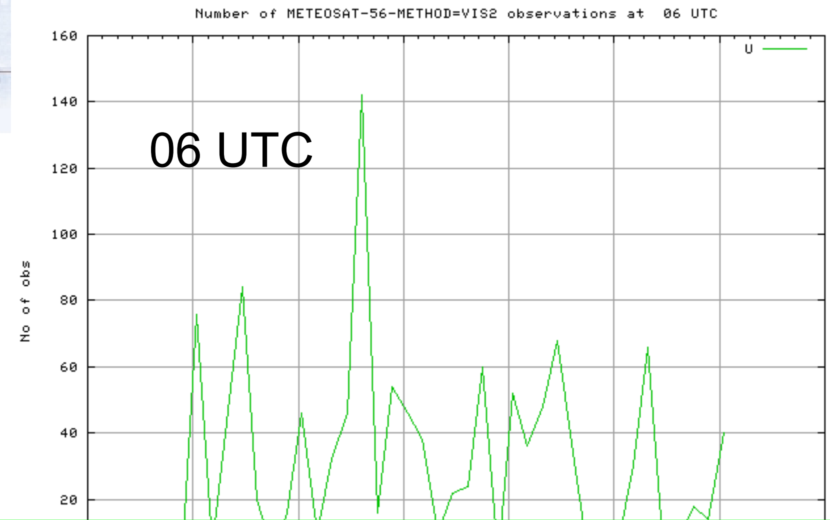
Assimilation time	Oper AMV (EUMETCast AMV)	HRW data
00 UTC	IR3, WVCL1, WVCL2	IR3
06 UTC	IR3, VIS2, VIS3, WVCL1, WVCL2	VIS2
12 UTC	IR3, VIS2, VIS3, WVCL1, WVCL2	VIS2
18 UTC	IR3, VIS3, WVCL1, WVCL2	VIS2

➔The following observations were used in the assimilation system:

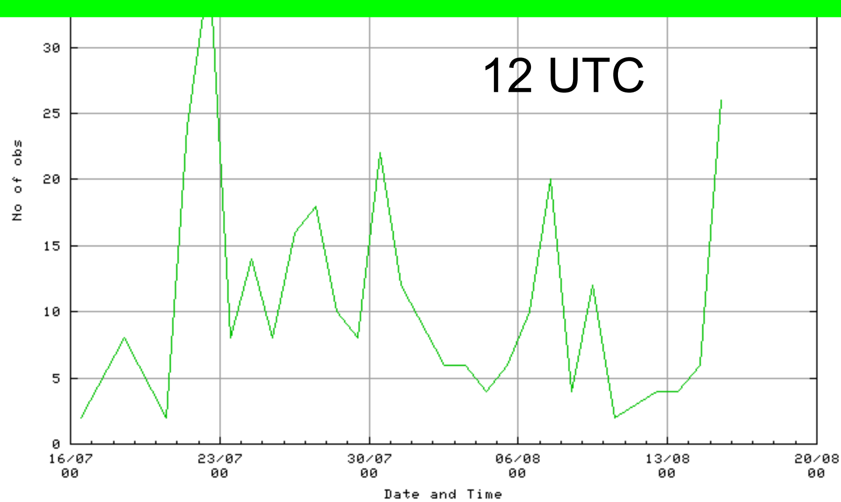
Type	Parameter (Channel)	Bias correction	Thinning
TEMP	U, V, T, Q, Z	Only T using ECMWF tables	No
SYNOP	Z	No	Temporal and spatial
PILOT (Europrof.)	U, V	No	Redundancy check against TEMP
DRIBU	Z	No	Temporal and spatial
AIREP	U, V, T	No	25 km horizontal
AMV	U, V	No-Use of quality flags	25 km horizontal
MSG/SEVIRI	2 wv channels	Variational	70 km horizontal
AMSU-A	5 to 10	Variational	80 km horizontal
AMSU-B, MHS	3, 4, 5	Variational	80 km horizontal

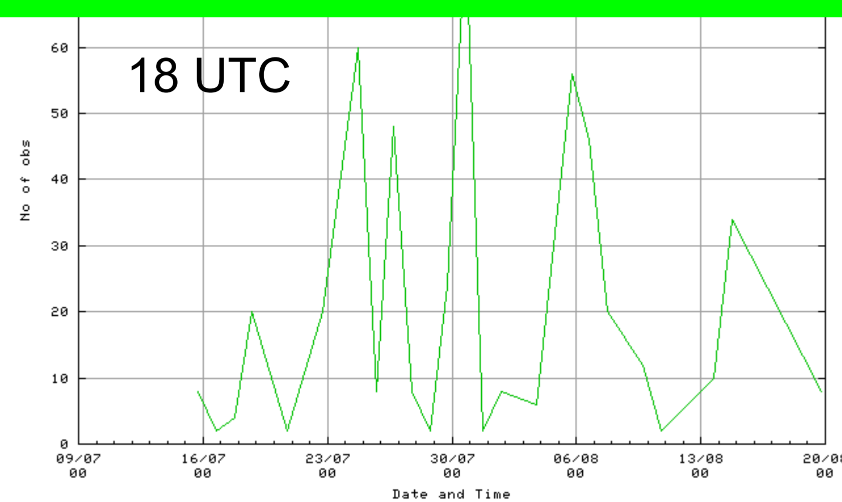
The impact study – number of the active HRW data during the study period





➔Similar amount of active EUMETCast AMV data was observed for each available inversion technique, thus more active observations are in use in case of EUMETCast data

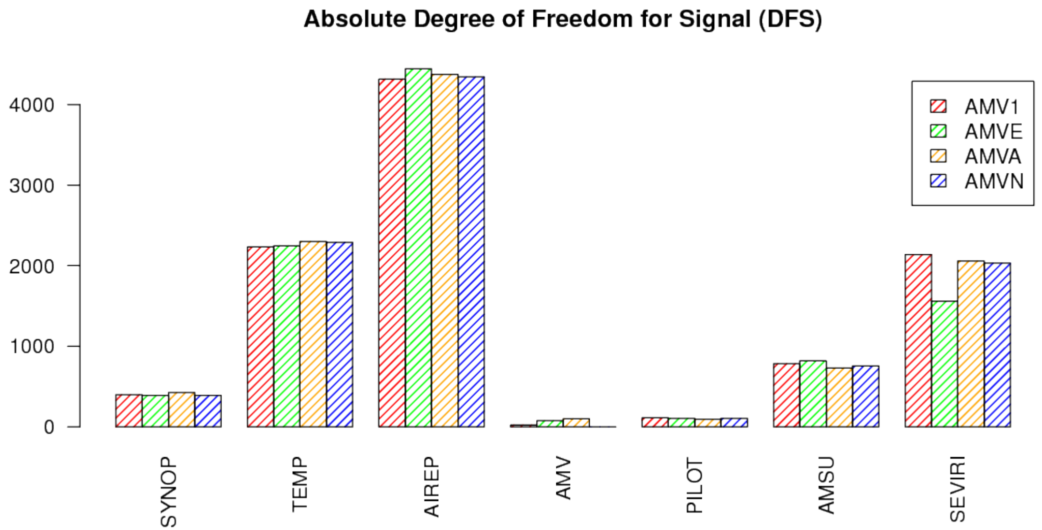


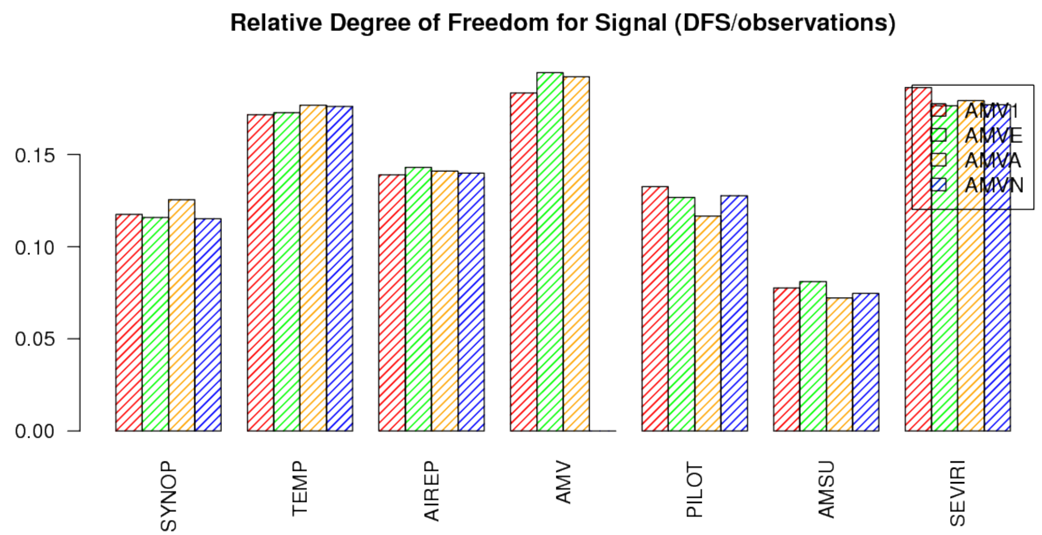


The impact of the AMV data on the analyses and forecasts

Impact of HRW data on the analyses – Degrees of Freedom for Signals (DFS)

for more details see: Randriamampianina R, Iversen T, Storto A. 2011. Exploring the assimilation of IASI radiances in forecasting polar lows. Q. J. R. Meteorol. Soc. 137: 1700–1715. DOI:10.1002/qj.838





– Due to relatively small amount of active AMV data, the absolute DFS values are small, but the relative impact is indeed considerable.

– Note that when choosing the “representative” analysis times, the availability of the AMV data was considered, which makes this comparison a bit unfair. The following distant to each other assimilation times were used for the computation of the DFS: 25.07.2011 (00UTC), 30.07.2011 (06 UTC), 08.08.2011 (12UTC), and 16.08.2011 (18UTC).

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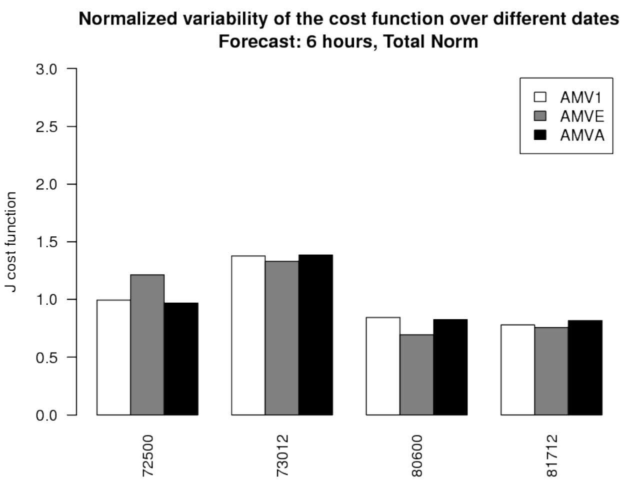
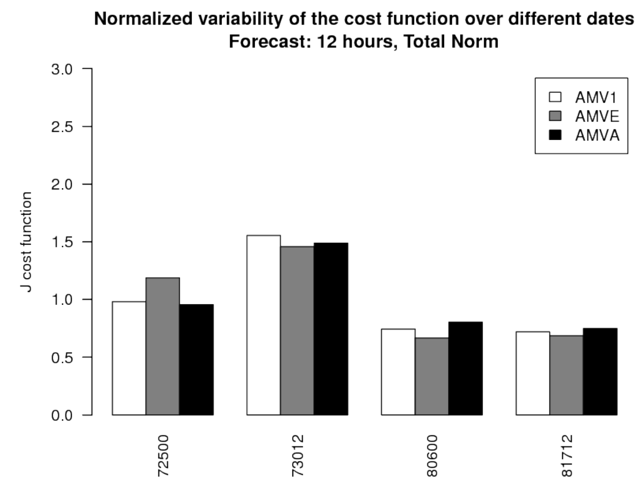
Impact of the HRW data on the forecasts – Moist total energy norm

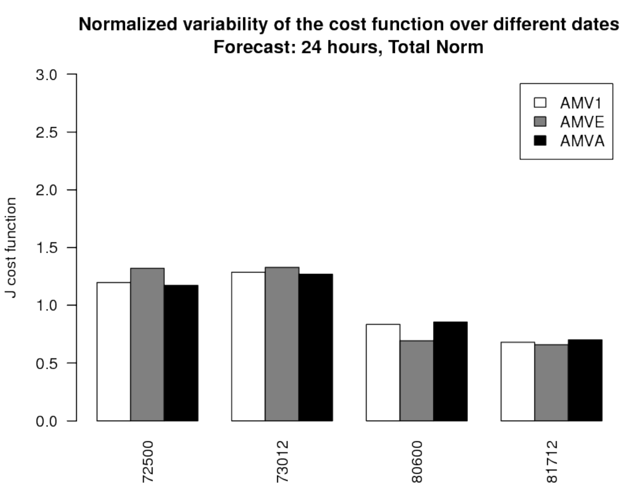
for more details see: Storto, A., and Randriamampianina, R. 2010. The relative impact of meteorological observations in the Norwegian regional model as determined using an energy norm-based approach. *Atmos. Sci. Let.*, **11:**51–58.

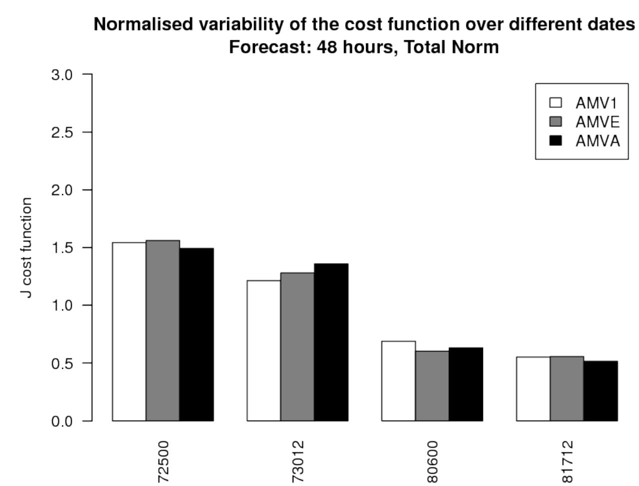




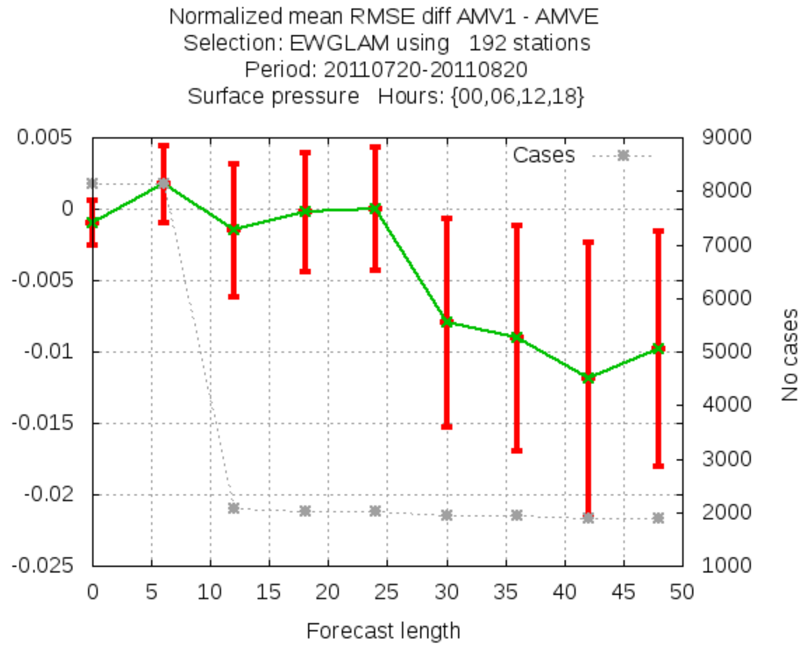
The runs used for the computation were:

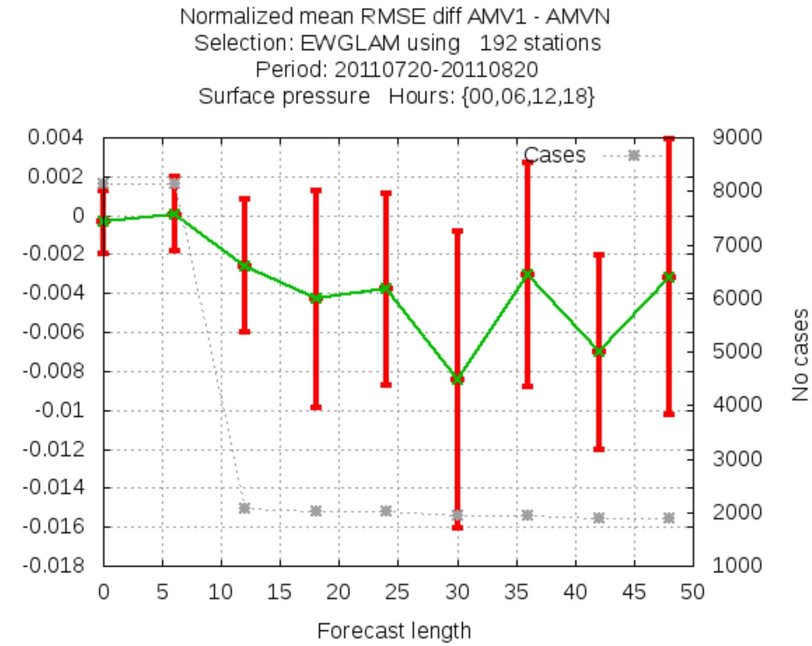
25.07.2011 (00UTC) (72500);
30.07.2011 (12UTC) (73012);
06.08.2011 (00UTC) (80600);
17.08.2011 (12UTC) (81712)



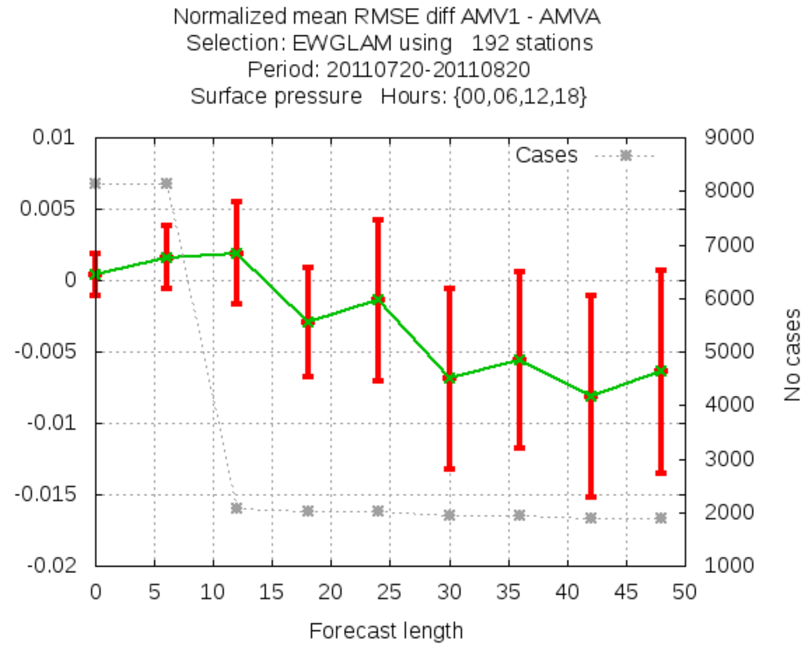


Impact of the HRW data on the forecasts – The verification scores (1)

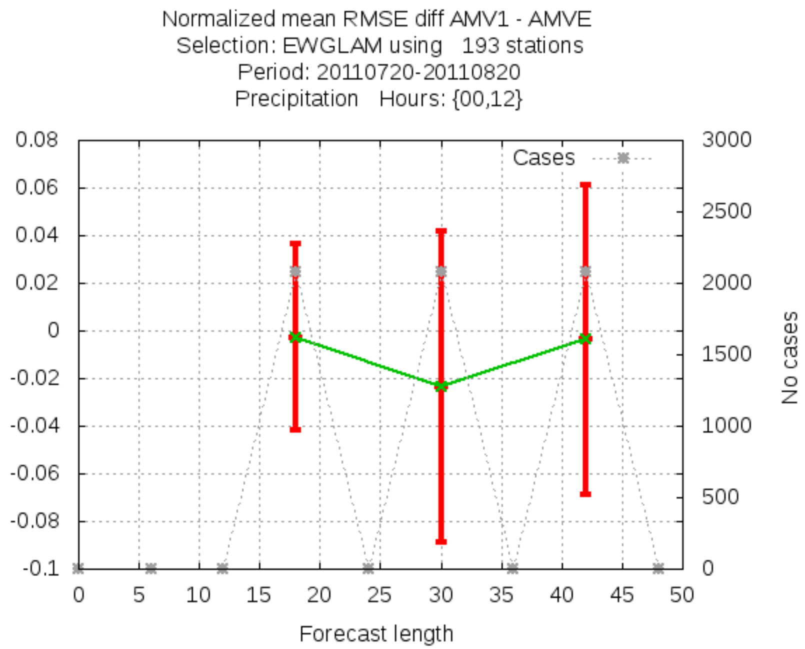


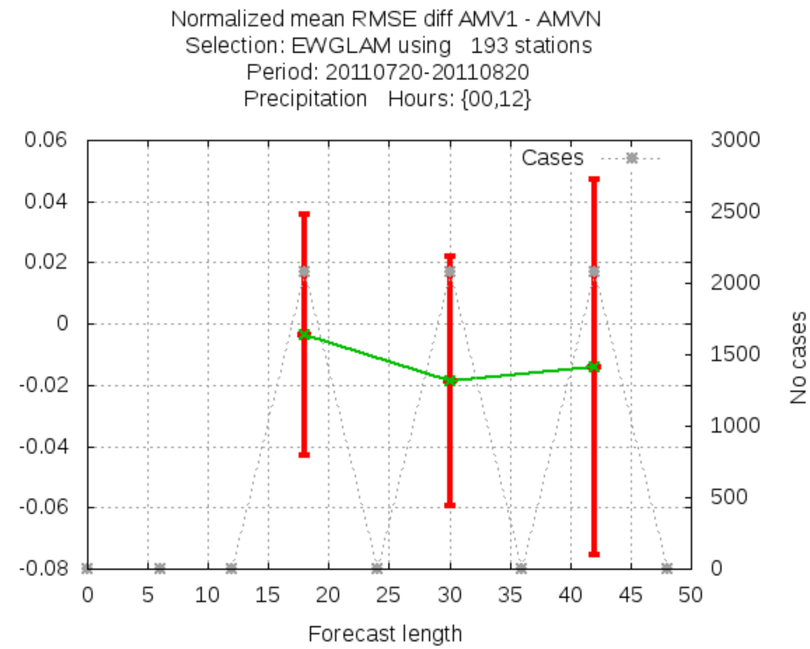


→ In all cases negative means less error for the run with HRW, which is good!
→ The significance interval is 90% two-sided confidence.
→ significant when the error bar does not cross the “zero line”.

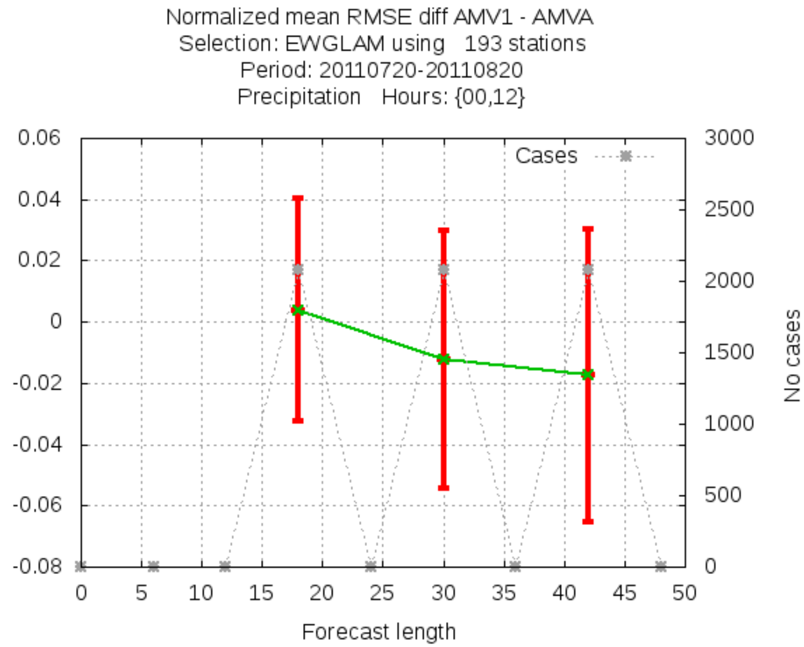


Impact of the HRW data on the forecasts – The verification scores (3)

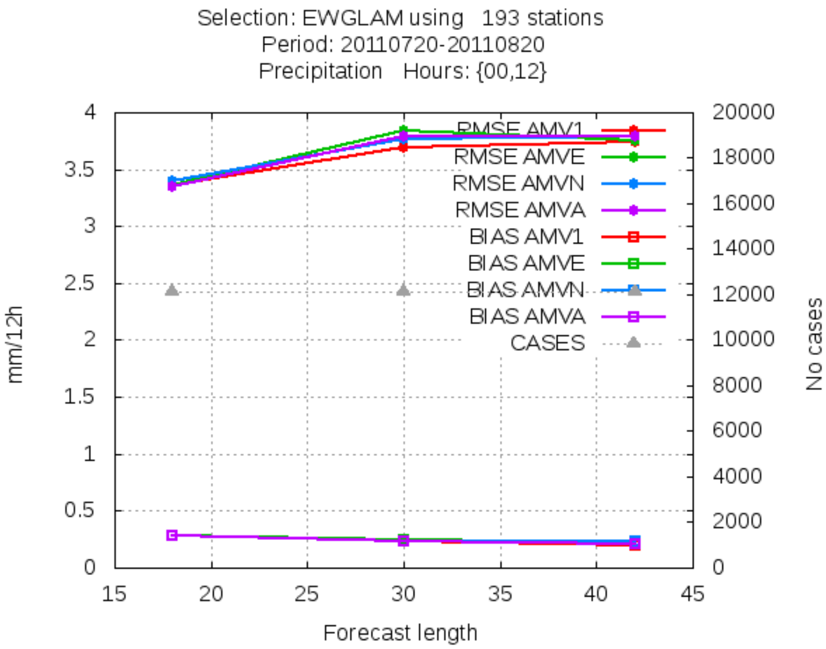


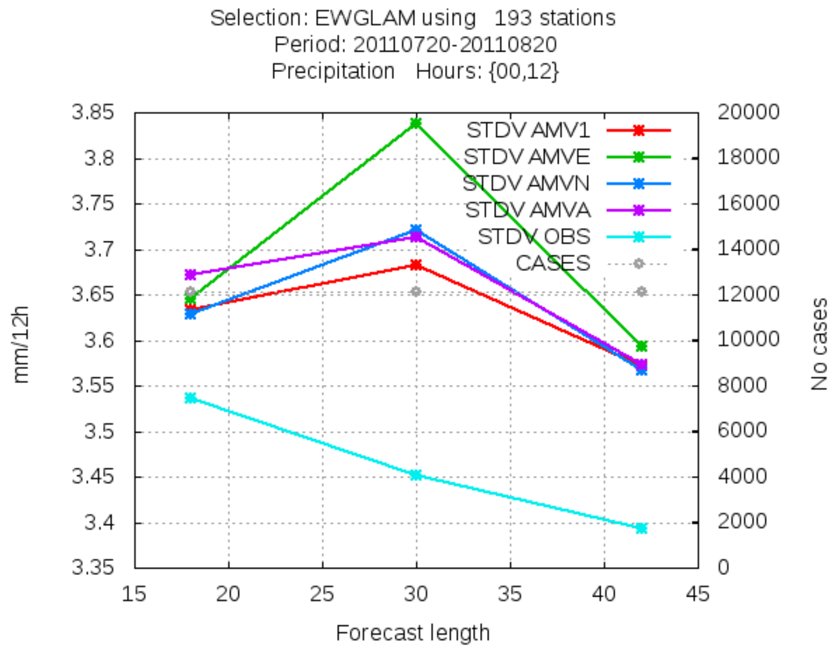


→ Scores for 12-hour cumulated precipitation

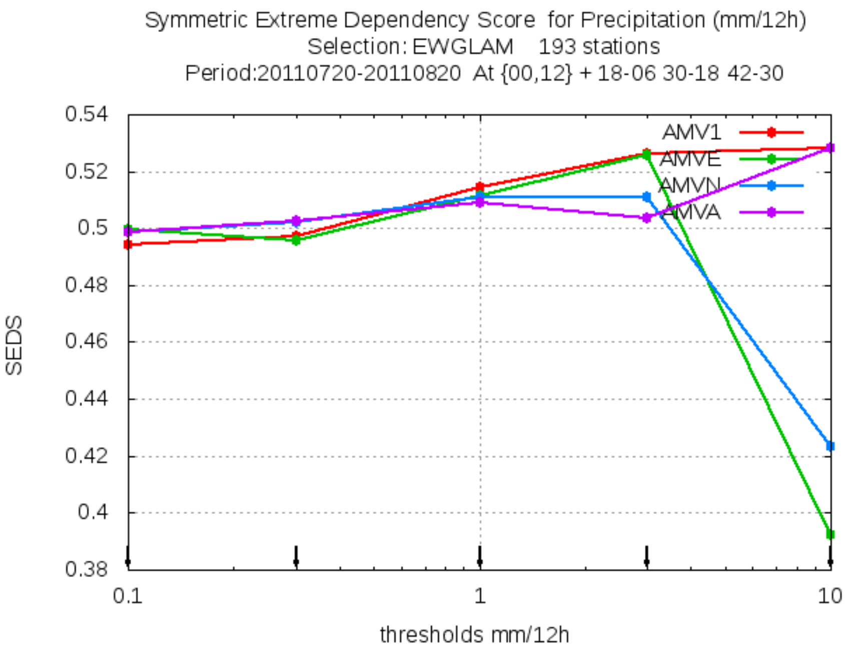


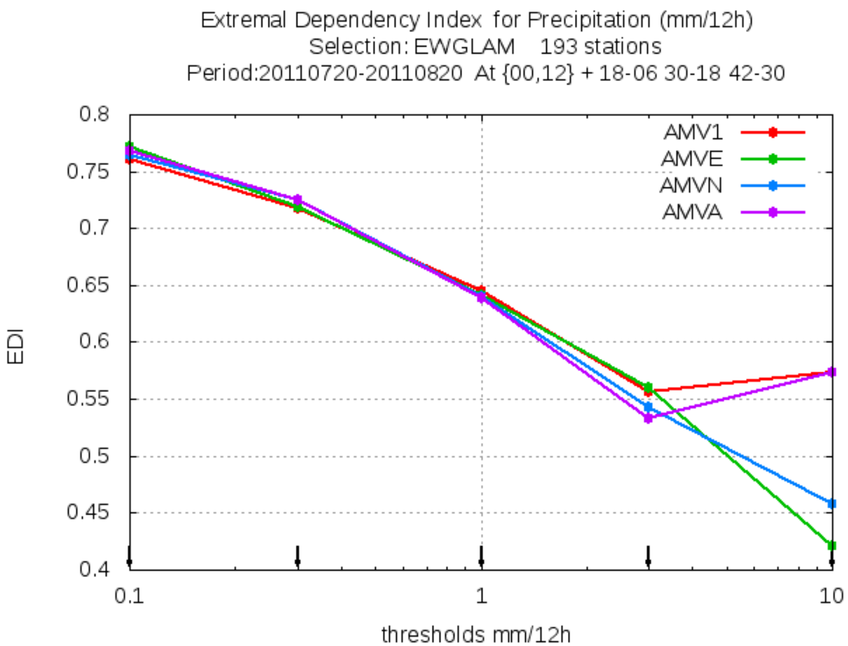
Impact of the HRW data on the forecasts – The verification scores (4)

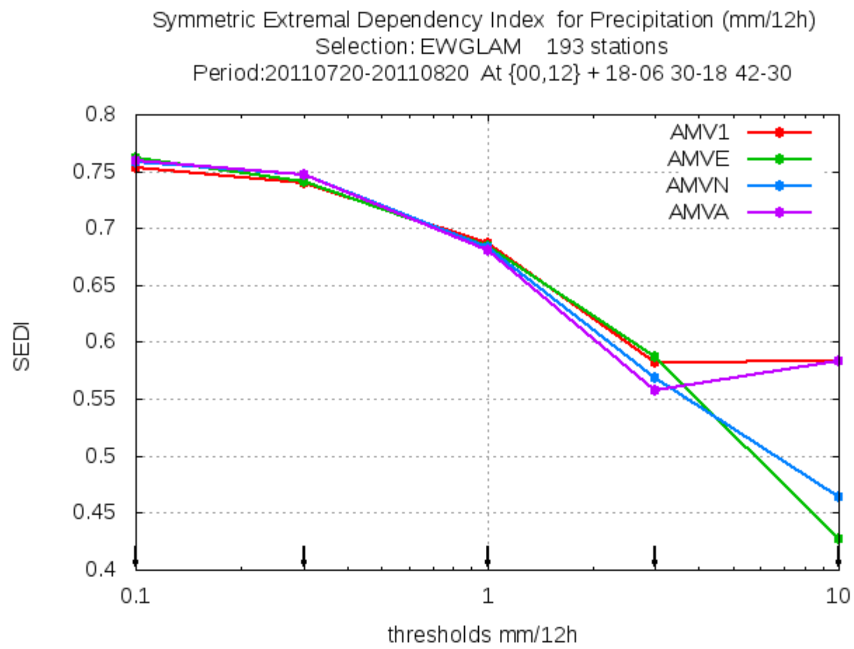




Impact of the HRW data on the forecasts – The verification scores (5)





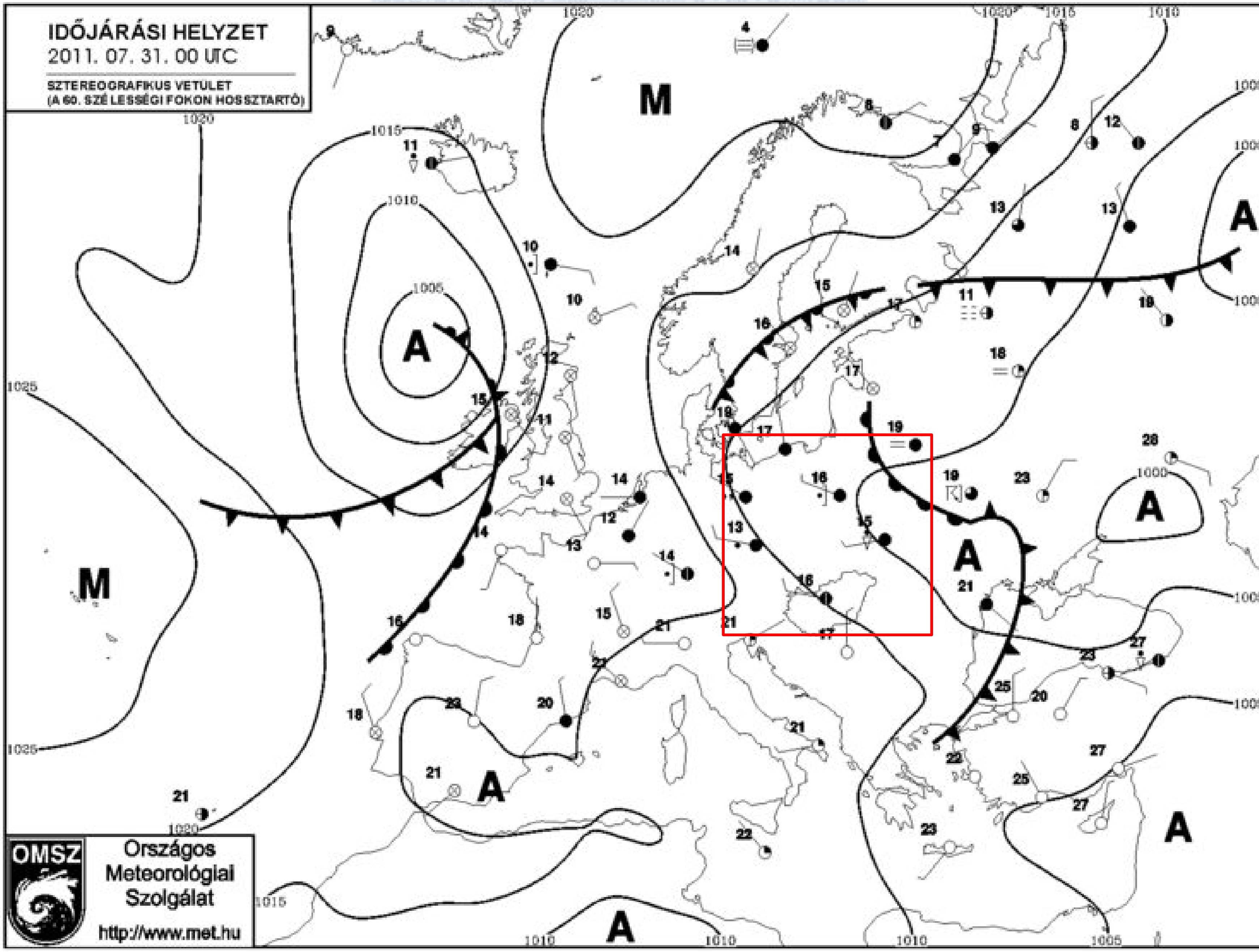


The case studies

Impact of the HRW data on the forecasts –

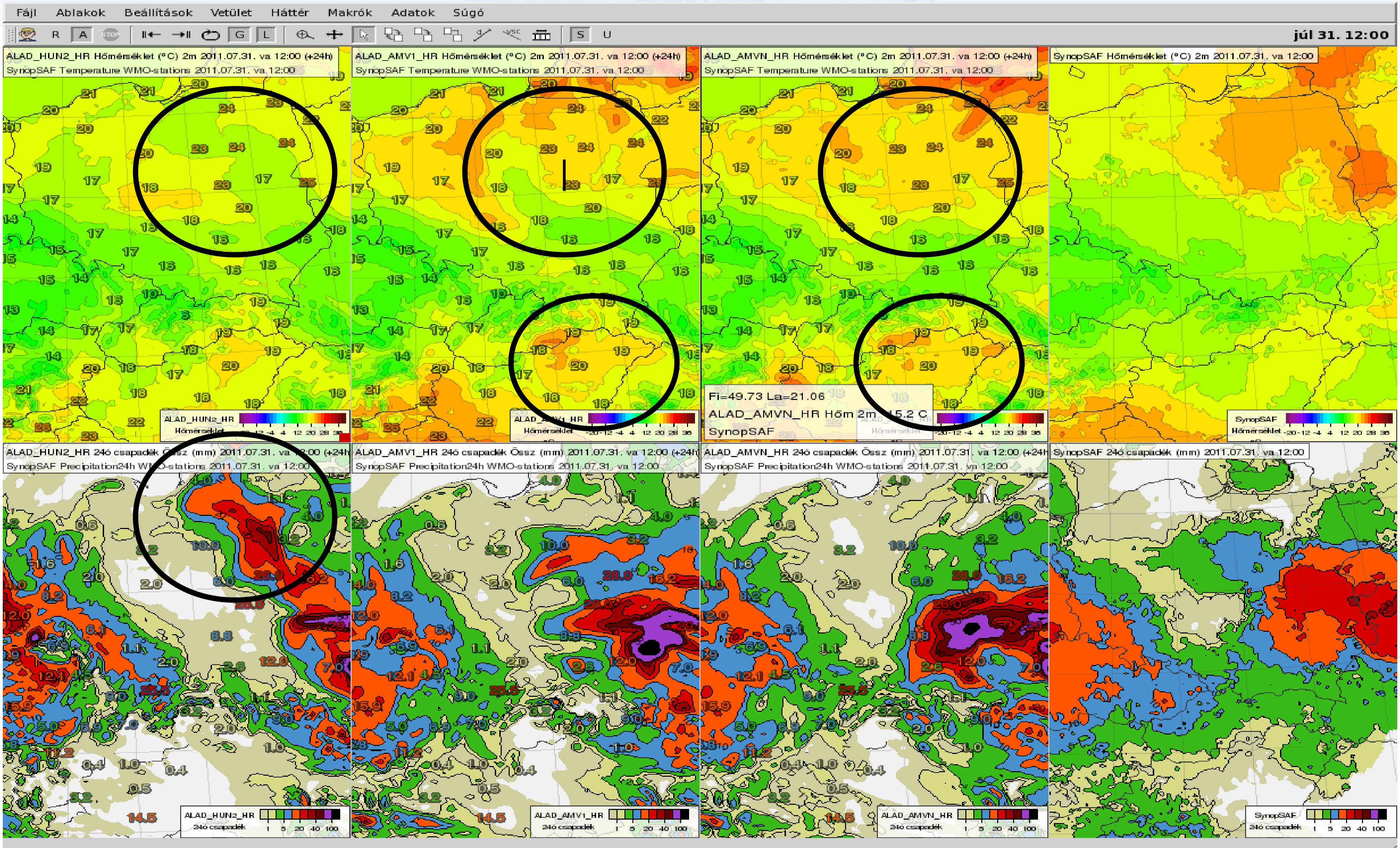
Case studies (1) – case of 24-hour forecast

The weather chart for 31.07.2011 00UTC , verifying time is 12 UTC



Impact of the HRW data on the forecasts – Case studies (1) – 24-h forecast (for 31.07.2011 12UTC) (t2m and precipitation mm/24h)

AMVE | AMV1 | AMVN | interpolated obs



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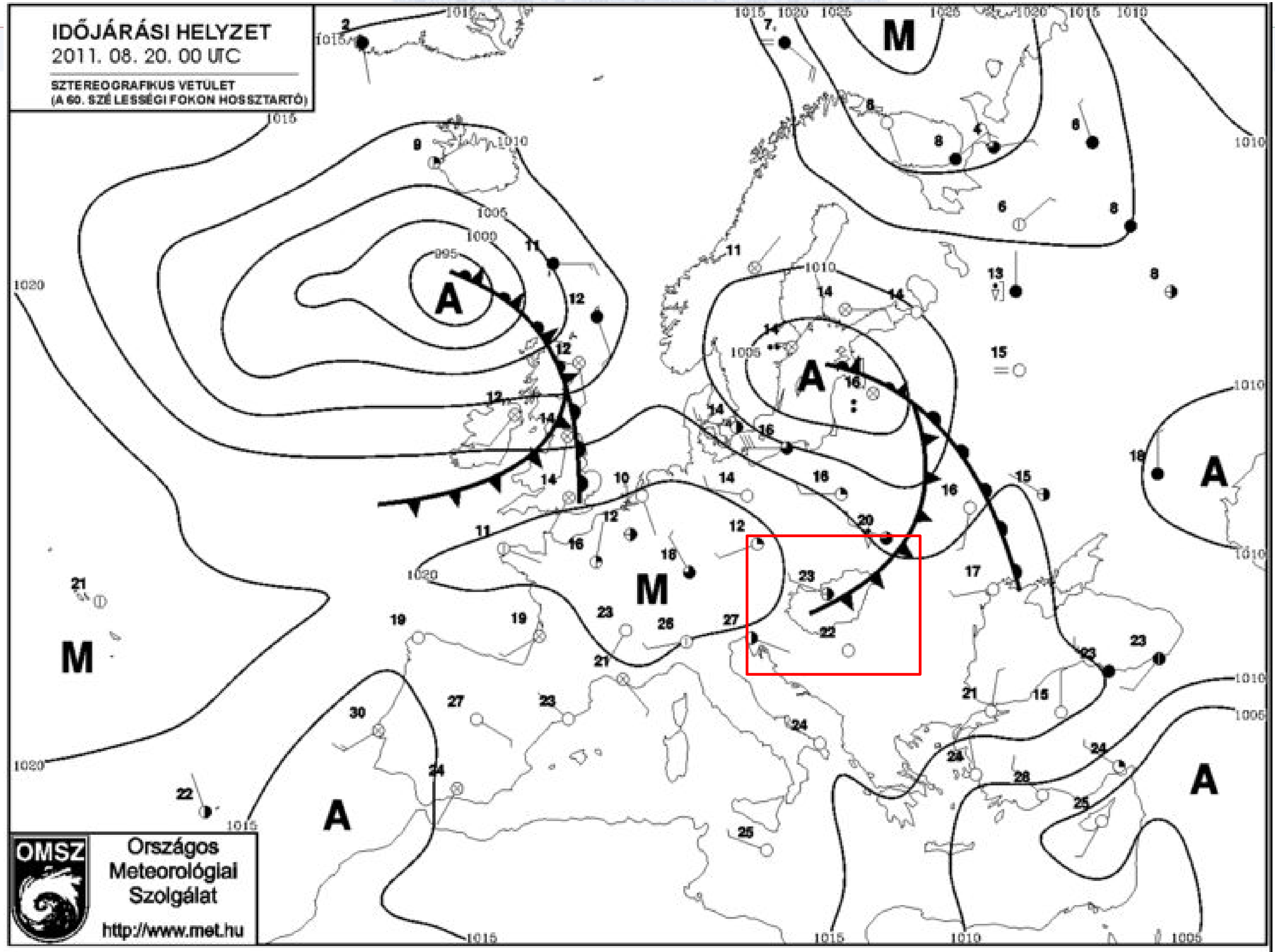
Impact of the HRW data on the forecasts –

Case studies (3) – forecast of the same event

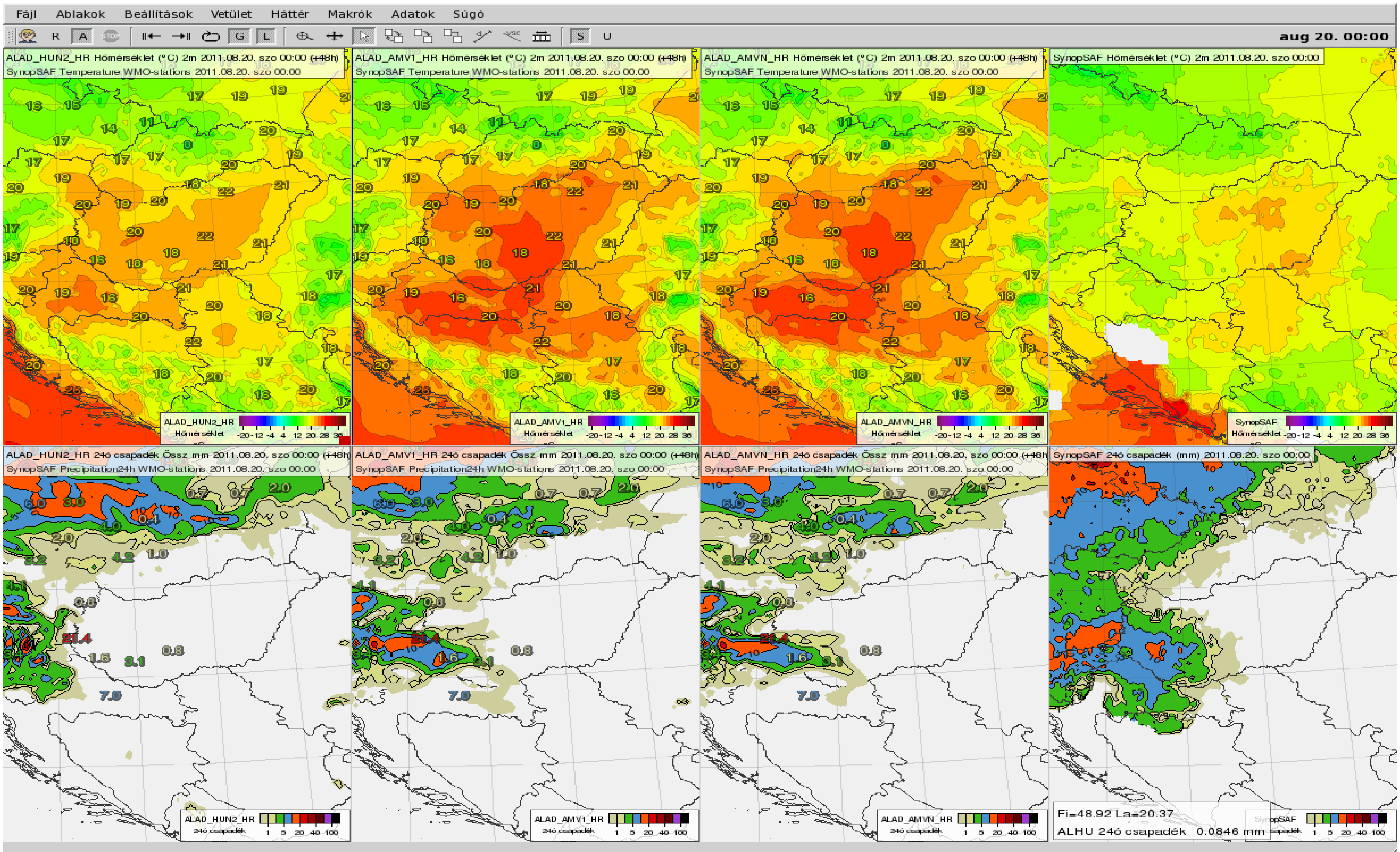
The weather chart for the verifying time (20.08.2011 00UTC)



Impact of the HRW data on the forecasts –

Case studies (3) – forecast of the same event (20.08.2011 00UTC) – 48h before

emplacement: the same as before



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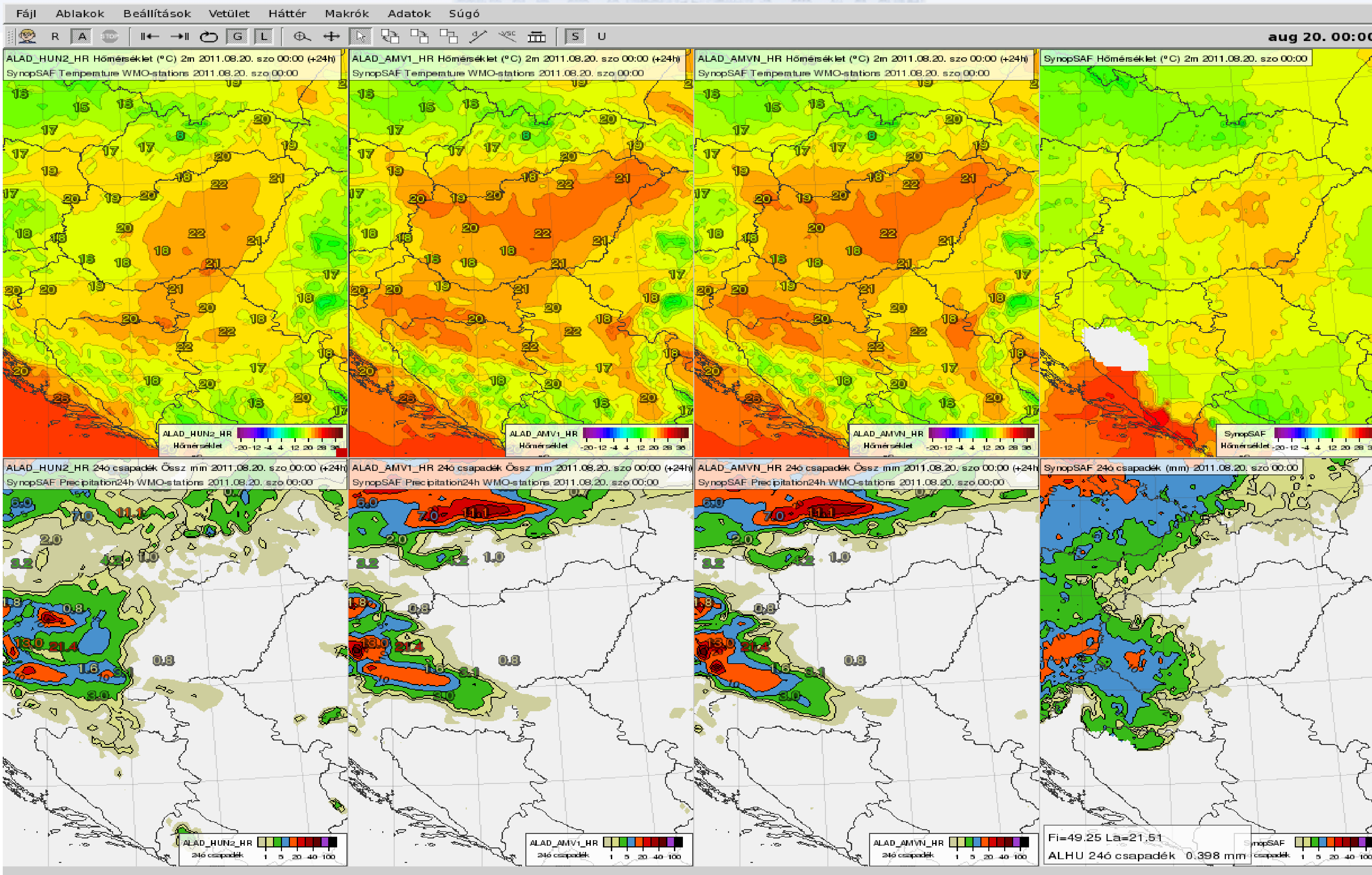
Impact of the HRW data on the forecasts –

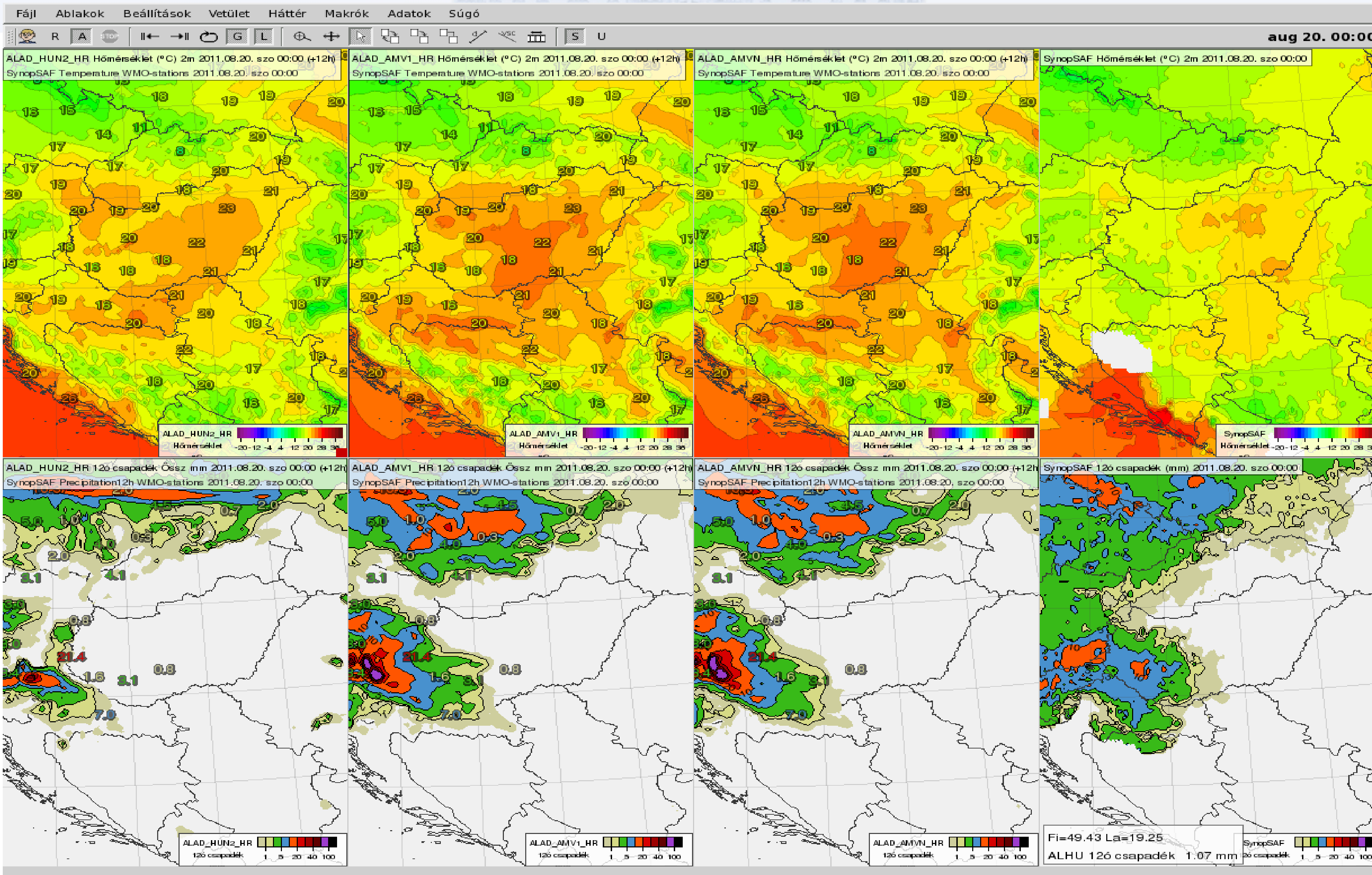
Case studies (3) – forecast of the same event (20.08.2011 00UTC) – 24h before emplacement: the same as before



Impact of the HRW data on the forecasts –

Case studies (3) – forecast of the same event (20.08.2011 00UTC) – 12h before

emplacement: the same as before



The availability of the AMV data

Assimilation time	Oper AMV (EUMETCast AMV)	HRW data
00 UTC	IR3, WVCL1, WVCL2	IR3
06 UTC	IR3, VIS2, VIS3, WVCL1, WVCL2	VIS2
12 UTC	IR3, VIS2, VIS3, WVCL1, WVCL2	VIS2
18 UTC	IR3, VIS3, WVCL1, WVCL2	VIS2

Concluding remarks and recommendations (1)

➔ Due to a strong data quality check, only few AMV data were kept in the analysis system. Also, NWCSAF products comprise 2 inversion techniques versus 5 available in EUMETCast data.

➔ Computation of the DFS to assess the impact of the AMVs on the analysis system approved that the AMV data have considerable relative contribution in the analysis system. It was also shown that the assimilation of the HRW data improved the use of other implemented observations during the analysis;

The computation of the moist total energy norm showed that the sensitivity of the Aladin/Hungary forecasts to the AMV data was relatively small, but it could be considerable depending on the weather condition over the investigated domain;

Concluding remarks and recommendations (2)

➔The verification skill scores showed also relatively small impact over the whole Aladin/hu domain. Our earlier study showed that the impact can be considerable over „sensitive" (unstable/convective) region;

➔The impact of both the AMVs together was not obviously better than what one of them could separately show. This indicates that some of the inversion techniques used to produce the data through EUMETCast are not consecutively efficient in the analysis, and thus, in producing reliable forecast.

→ **Recommendation:** *Additional experiments are needed to clarify which of the inversion techniques is less efficient.*

The case study was helpful in clarifying the possible differences between the impact of the HRW and the EUMETCast data. Furthermore, the few investigated cases supported the idea on the need of additional experiments to define the best data component for permanently reliable analyses and forecasts of the operational Aladin/hu model.

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Thank you for your attention