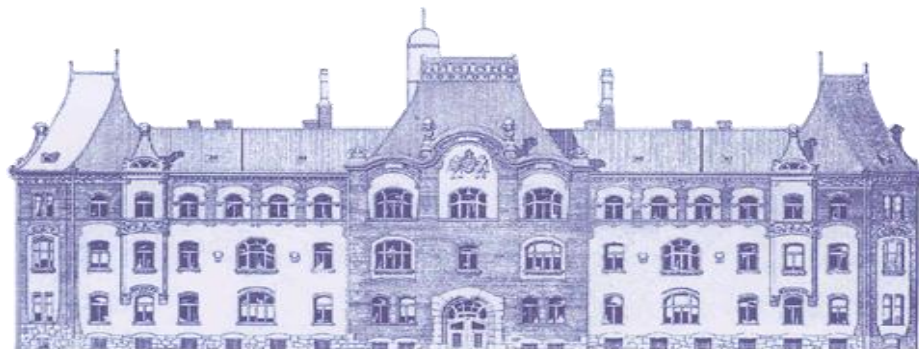


Assimilation of GNSS ZTD data in the NWP system of the Hungarian Meteorological Service

Work presented: Hungarian Meteorological Service (OMSZ)
Unit of Modelling



Alapítva: 1870



Content

- Short-range limited area modelling
 - Operational system
 - Future plans
- GNSS ZTD
 - Observation network
 - Impact on forecast quality



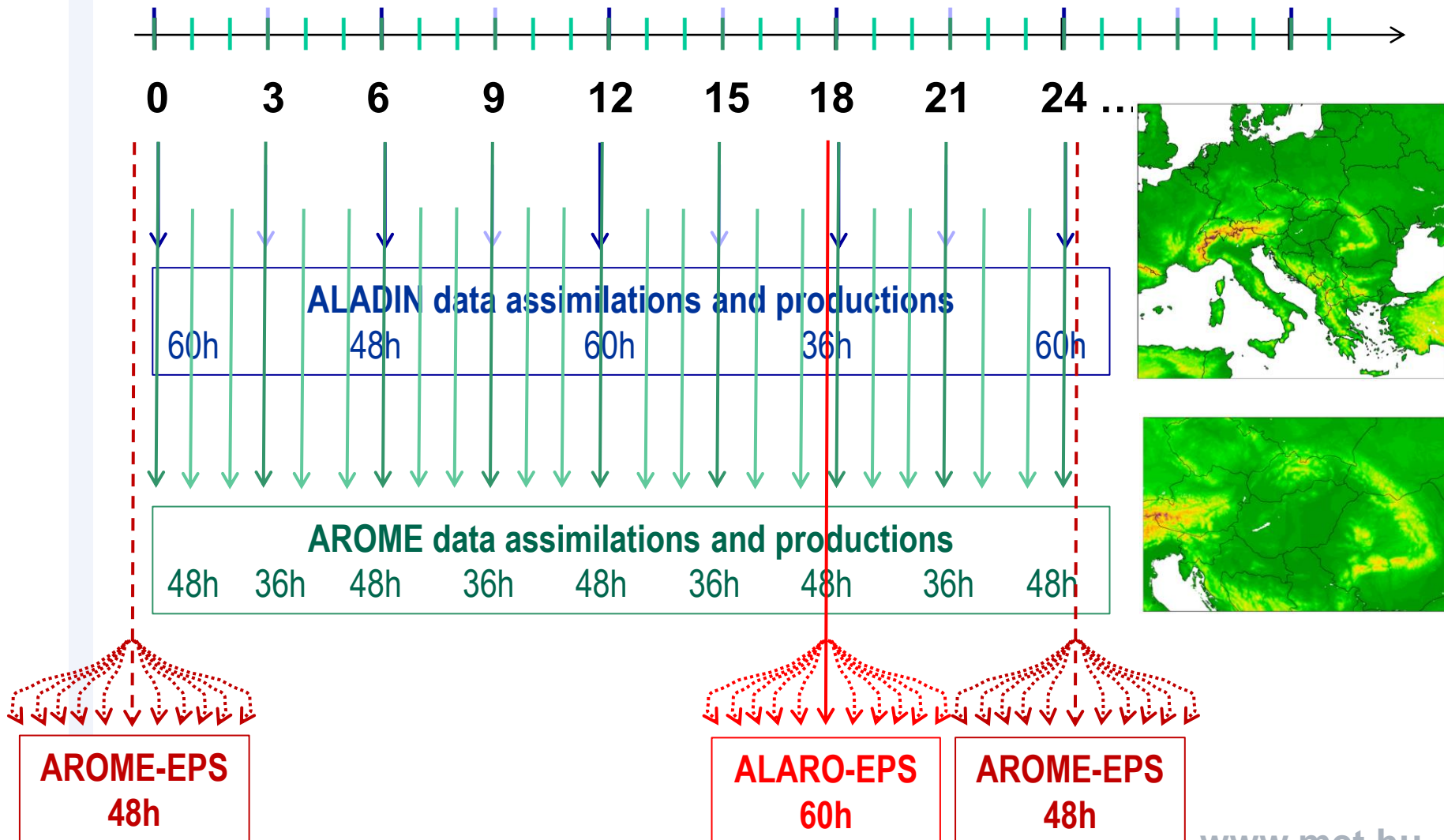
Limited area modelling at OMSZ

- Based on ALADIN/ALARO and AROME models using ECMWF/IFS lateral boundary conditions
- Migration to new HPC in spring 2019 → new cycle (cy40t1)
- Model runs in SMS system:
 - ALADIN/ALARO: 4 times a day, 8 km, 49 levels
 - AROME: 8 times a day, convection-permitting, 2.5 km, 60 levels
 - ALARO EPS at 18 UTC, 11 members, 8 km
 - Quasi-operational: AROME EPS at 0 UTC, 11 members, 2.5 km
- Continuous monitoring system



Operational LAM runs

ECMWF forecasts → (lagged) lateral boundary conditions for LAMs





Data assimilation

	ALADIN	AROME
Data assimilation method and frequency	6 hourly 3D-Var + surface data assimilation (optimal interpolation)	3 hourly 3D-Var + surface data assimilation (OI) Hourly 3D-Var (RUC)
Assimilated observations	<ul style="list-style-type: none">• SYNOP (u, v, T, RH, z)• SYNOP-SHIP (u, v, T, RH, z)• TEMP (u, v, T, q)• AMDAR (u, v, T)• ATOVS (AMSU, MHS radiances)• MSG/GEOWIND (AMV)• MSG (SEVIRI radiances)	<ul style="list-style-type: none">• SYNOP (u, v, T, RH, z)• TEMP (u, v, T, q)• AMDAR (u, v, T, humidity)• Slovenian Mode-S MRAR• GNSS ZTD• Radar data• Further Mode-S data• MSG/GEOWIND (AMV)
Background error	EDA B-matrix	EDA B-matrix (6 hourly) 90-level 3 hourly B-matrix

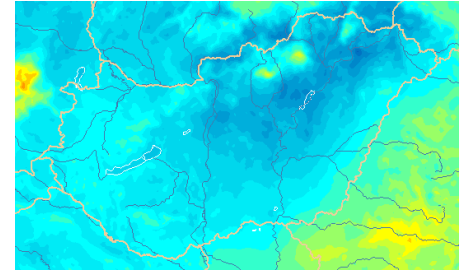


Ongoing developments

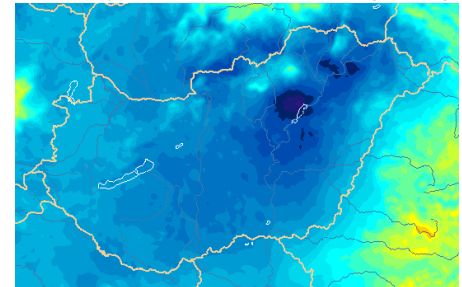
- AROME-RUC (rapid update cycle)
 - Crucial to increase the number of assimilated observations – hourly data assimilation → hourly forecasts
 - Improves the forecast on 0-12 h time range
- AROME-EPS
 - Estimation of uncertainty on convective scale – operational suite
 - Local perturbations:
 - SPPT (uncertainty in physics)
 - EDA (uncertainty in data assimilation)

**2-metre temperature [°C]
29 January 2017 12 UTC**

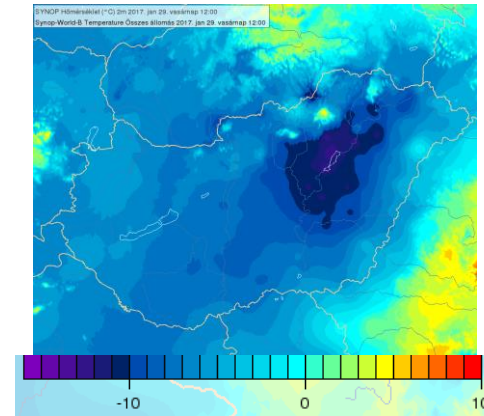
3 hourly data assimilation (oper)



Hourly data assimilation (RUC)



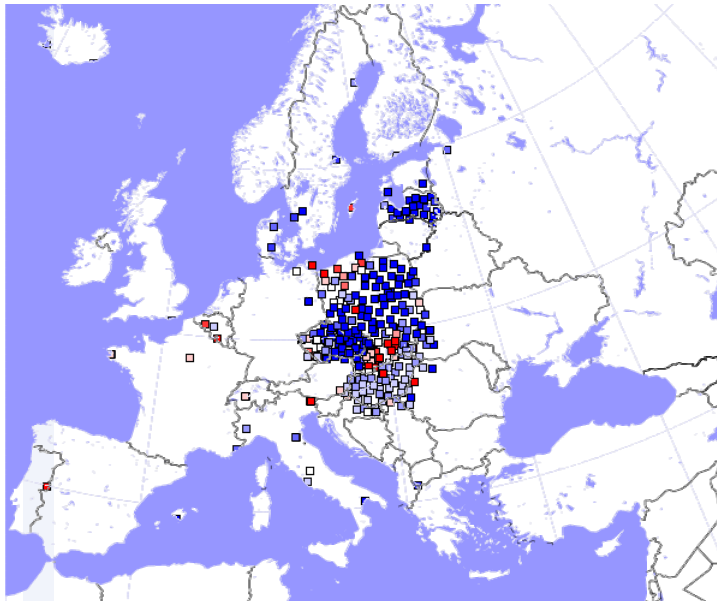
Observation



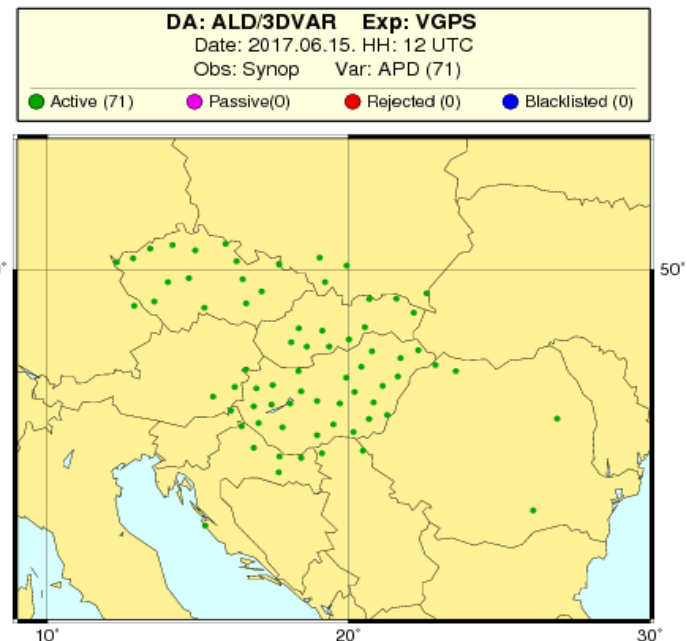
GNSS ZTD in data assimilation

- Operational usage since 2018
- Using data from Hungarian, Czech and Polish networks (via E-GVAP) after pre-processing

Available networks



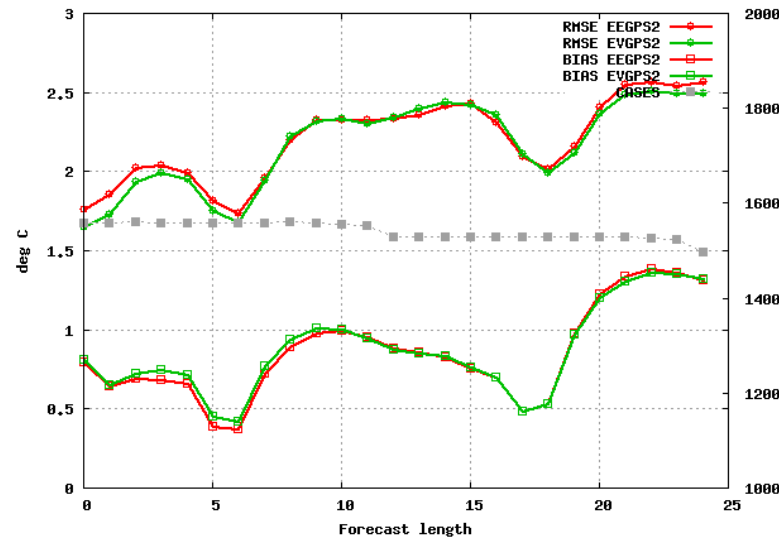
Observations used in assimilation



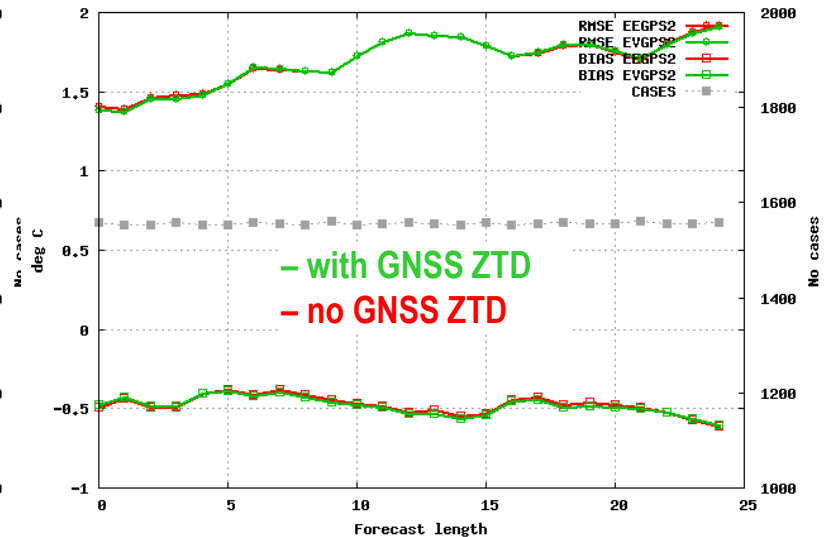
Impact on forecast quality

- Positive impact in summer in the first 12 hours
- Neutral in winter

2-metre temperature RMSE and bias [$^{\circ}\text{C}$] over Hungary
June 2017



December 2017



- To use GNSS ZTD data in **operational RUC** a better availability is needed in time