



Status of Numerical weather prediction at NIMH

B. Tsenova, M. Tsankov, K. Mladenov, M. Dinev, M. Parvanov, Hajar Naji

Department of Forecast and Information Services, Section Numerical modeling,
National Institute of Meteorology and Hydrology, Sofia, Bulgaria

1. Operational NWP suites in NIMH

	ALADIN-BG	AROME-105	AROME-IFS	AROME-DA
Horizontal resolution	5 km (256x200)	2.5 km (320x240)	2.5 km (320x240)	2.5 km (320x240)
Vertical levels	105	105	90	105
LBCs, frequency	ARPEGE, 3h	ARPEGE, 1h	IFS, 1h	ARPEGE, 1h
Forecast range	96h/72h/48h	72h/48h	72h/48h	72h/48h
Data assimilation	No	No	No	Surface data assimilation

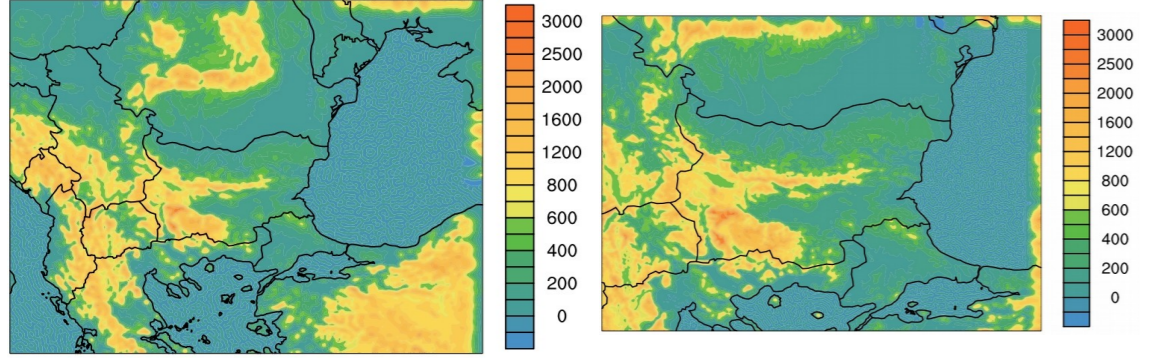


Fig.1. ALADIN-BG (left) and AROME (right) domains of integration with corresponding model orography

2. Surface Data Assimilation

	00 UTC run	06 UTC run	12 UTC run	18 UTC run
LBC	ARPEGE 18 UTC run	ARPEGE 00 UTC run	ARPEGE 06 UTC run	ARPEGE 12 UTC run
Assimilated Surface data	BG synop data at 21 UTC	BG synop data at 03 UTC	BG synop data at 09 UTC	BG synop data at 15 UTC
First guess	DA 18 UTC run for 21 UTC	DA 00 UTC run for 03 UTC	DA 06 UTC run for 09 UTC	DA 12 UTC run for 15 UTC
Forecast range	51h (starting from 21 UTC)	75h (starting from 03 UTC)	51h (starting from 09 UTC)	75h (starting from 15 UTC)

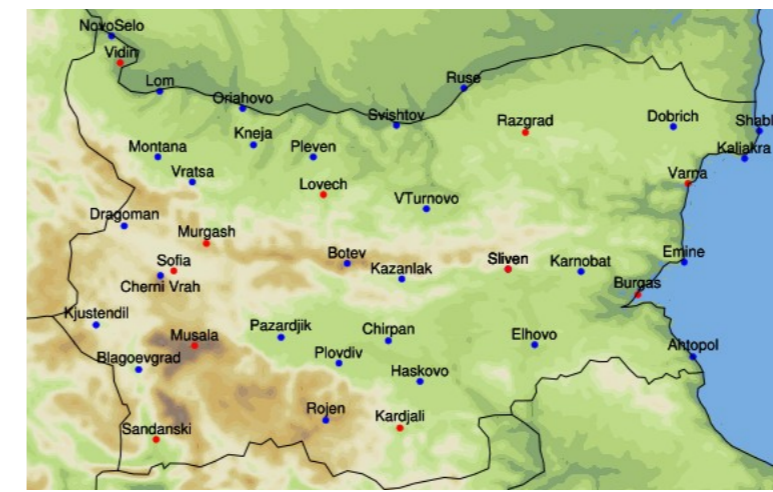


Fig.2. Synoptic stations in Bulgaria (in red are given the stations transmitted in WMO international exchange) over AROME-BG model orography

3. Some forecast verification results and specific forecast postprocessing

The performance of the four models in forecasting 3-hourly temperature at 2 m and wind speed at 10 m and 24-hourly precipitation was evaluated and compared. For this purpose, the root mean square errors (RMSE) for each synoptic station of each model were investigated for 2025 as a function of forecast lead time.

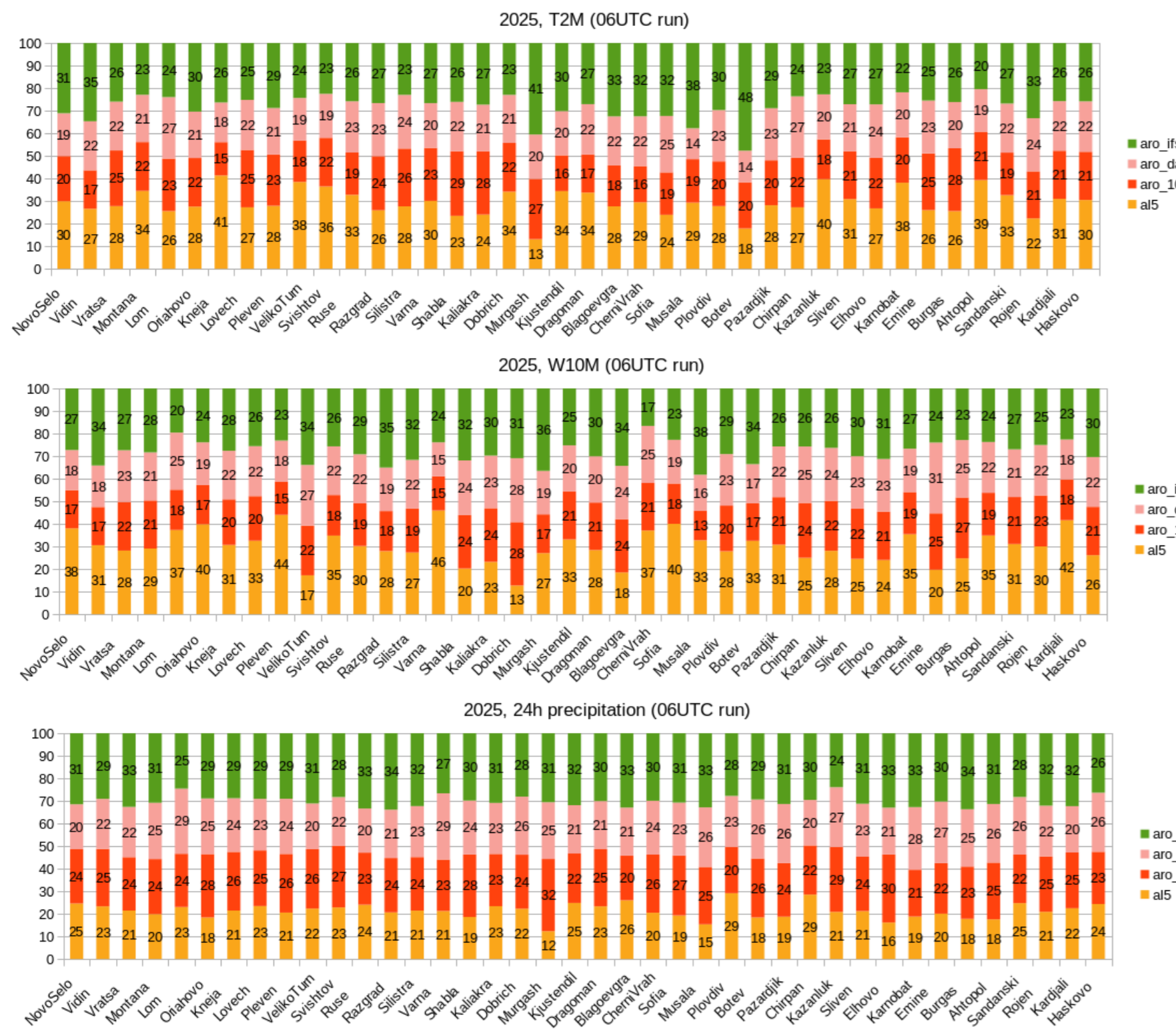


Fig.3. Percent of cases with best performance for 2025 for each synoptic station for temperature at 2m (top panel), wind speed at 10m (middle panel) and 24 hour precipitation (bottom panel) for AROME-IFS (in green), AROME-DA (in pink), AROME-105 (in red) and ALADIN-BG (in orange)

Since November 2025 forecast range of ALADIN-BG (06 UTC run) has been increased from 72h to 96h ahead.

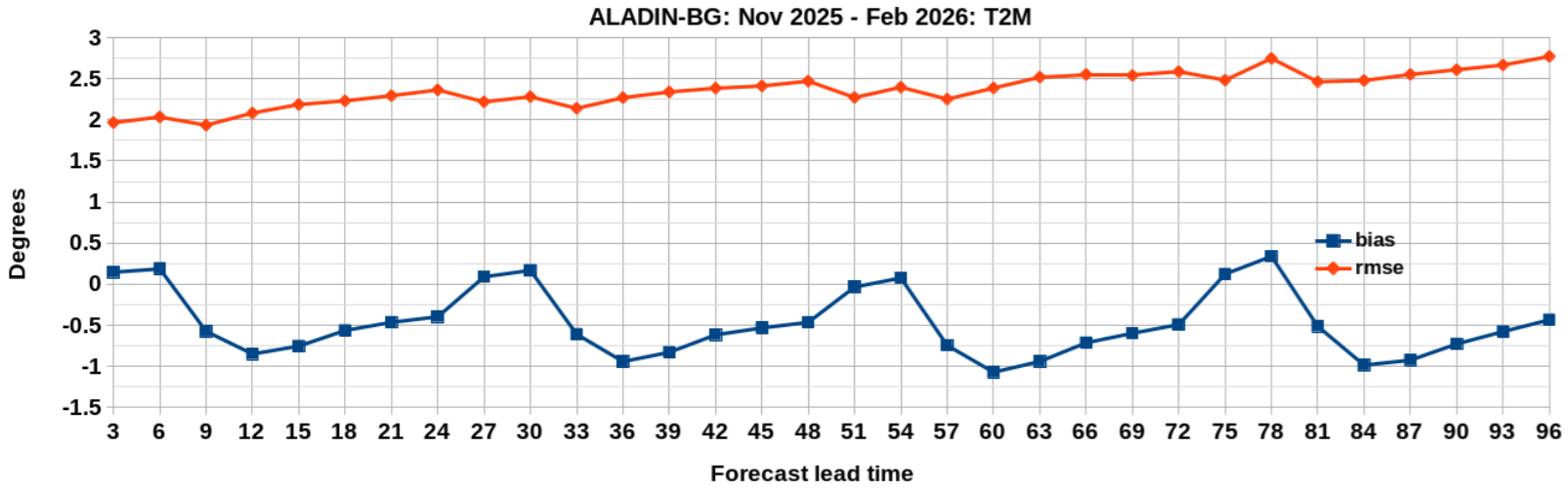


Fig.4. ALADIN-BG average Mean Monthly BIAS and RMSE for the period November 2025 - February 2026 for all 40 synoptic stations for 2m temperature as a function of forecast lead time.

Lightning probability based on AROME-105 microphysics (graupel mixing ratio in altitude)

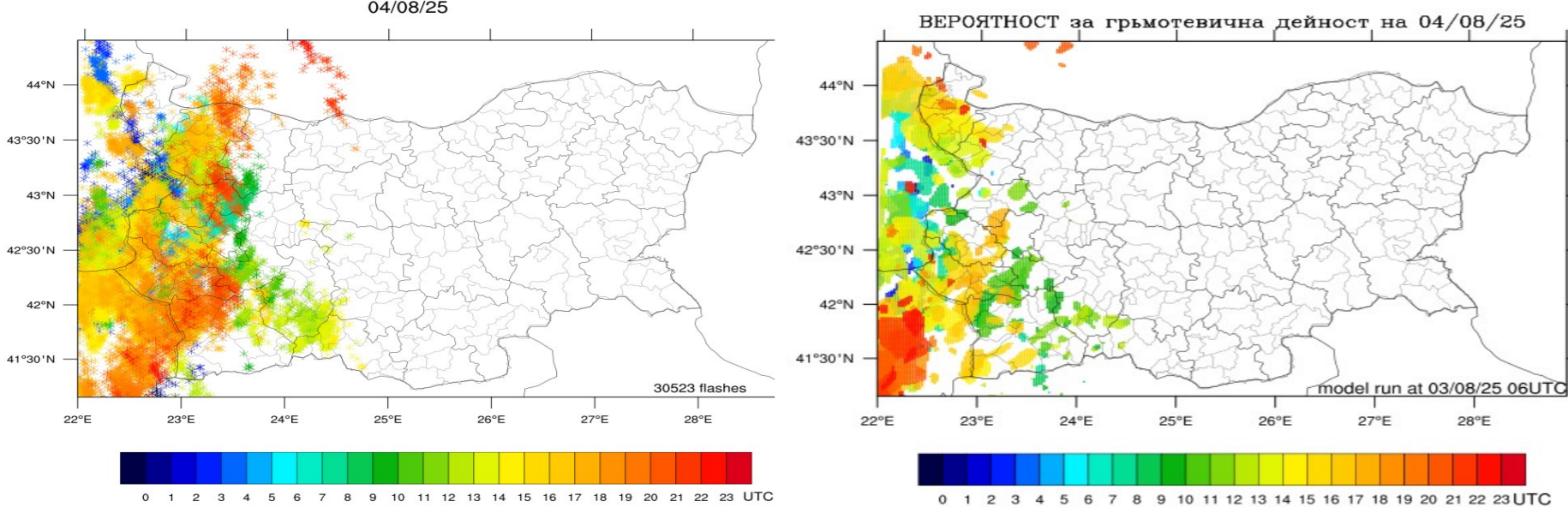


Fig.5. Spatial and temporal distribution of detected by LEELA flashes over the region of Bulgaria during 04 June 2025 (left panel) and spatial and temporal distribution of lightning probability forecast based on AROME-105 24h before.

Atmospheric instability based on AROME-105 thermodynamics in altitude

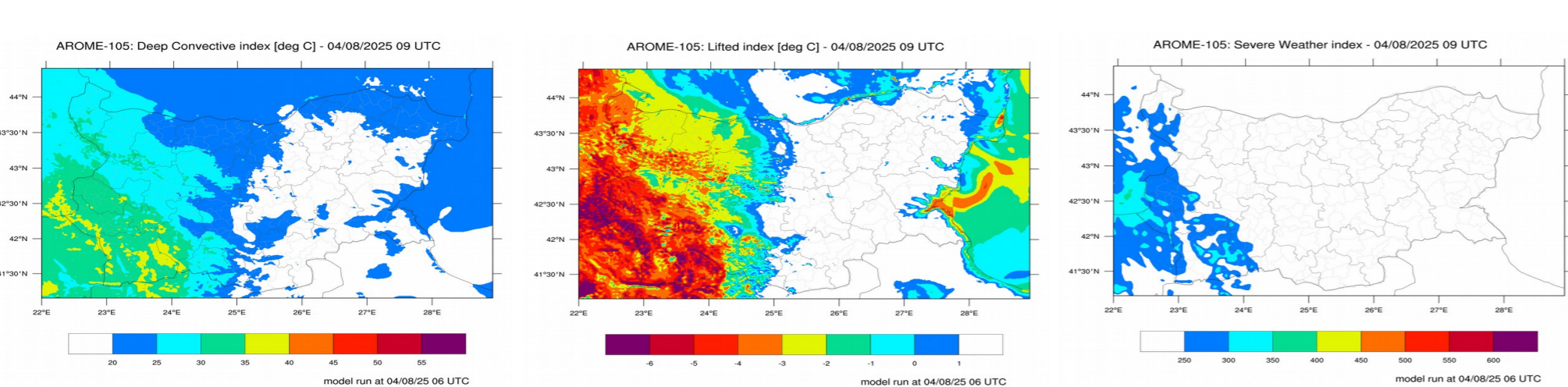


Fig.6. Deep Convection Index, Severe Weather Index and Lifted Index based on AROME-105 forecast fields for 04 June 2025 at 09 UTC.

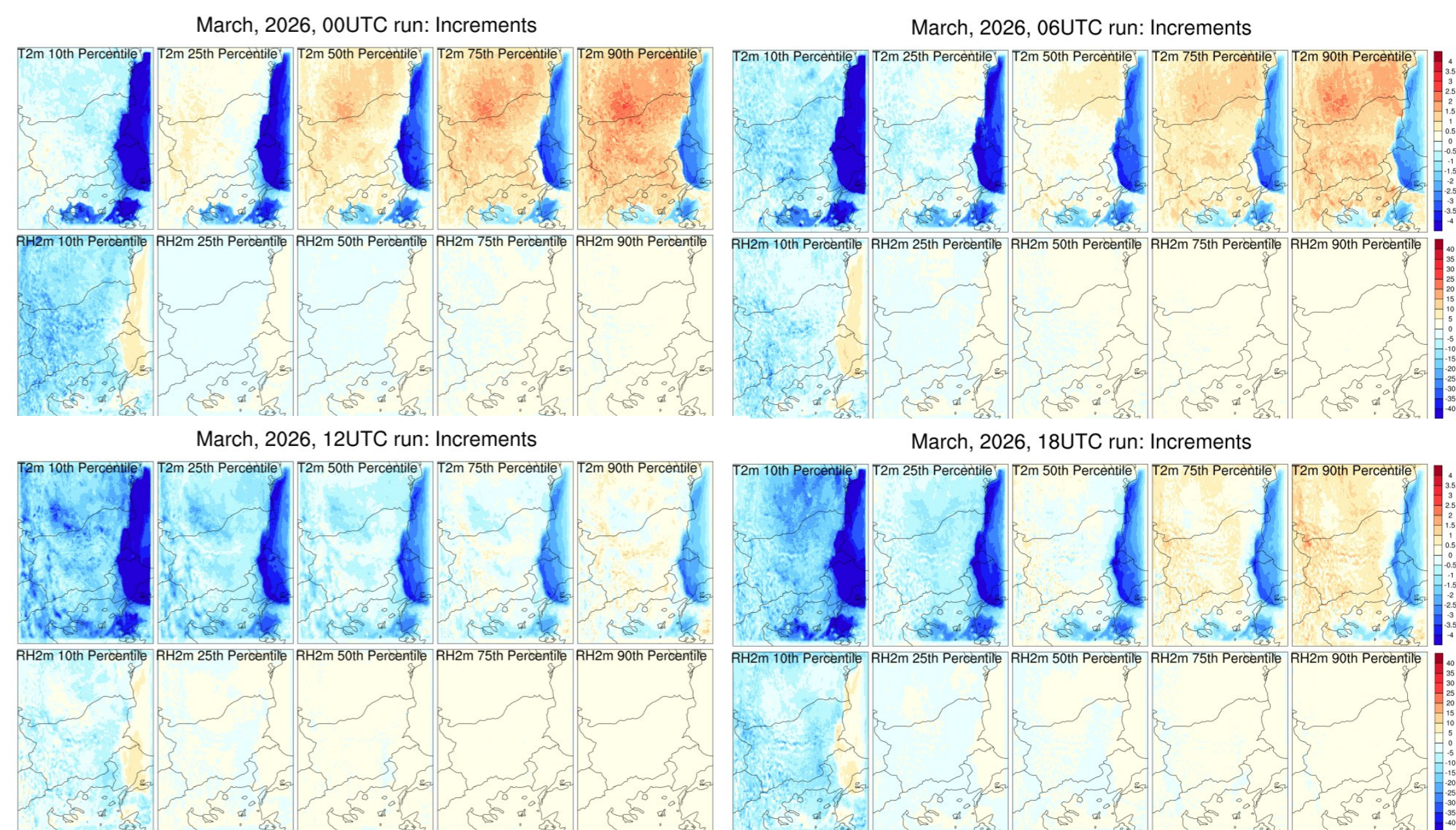


Fig.7. 10th, 25th, 50th (median), 75th and 90th percentiles of T2m and RH2m increments (analysis-1st guess) for the 4 model runs in March 2026.

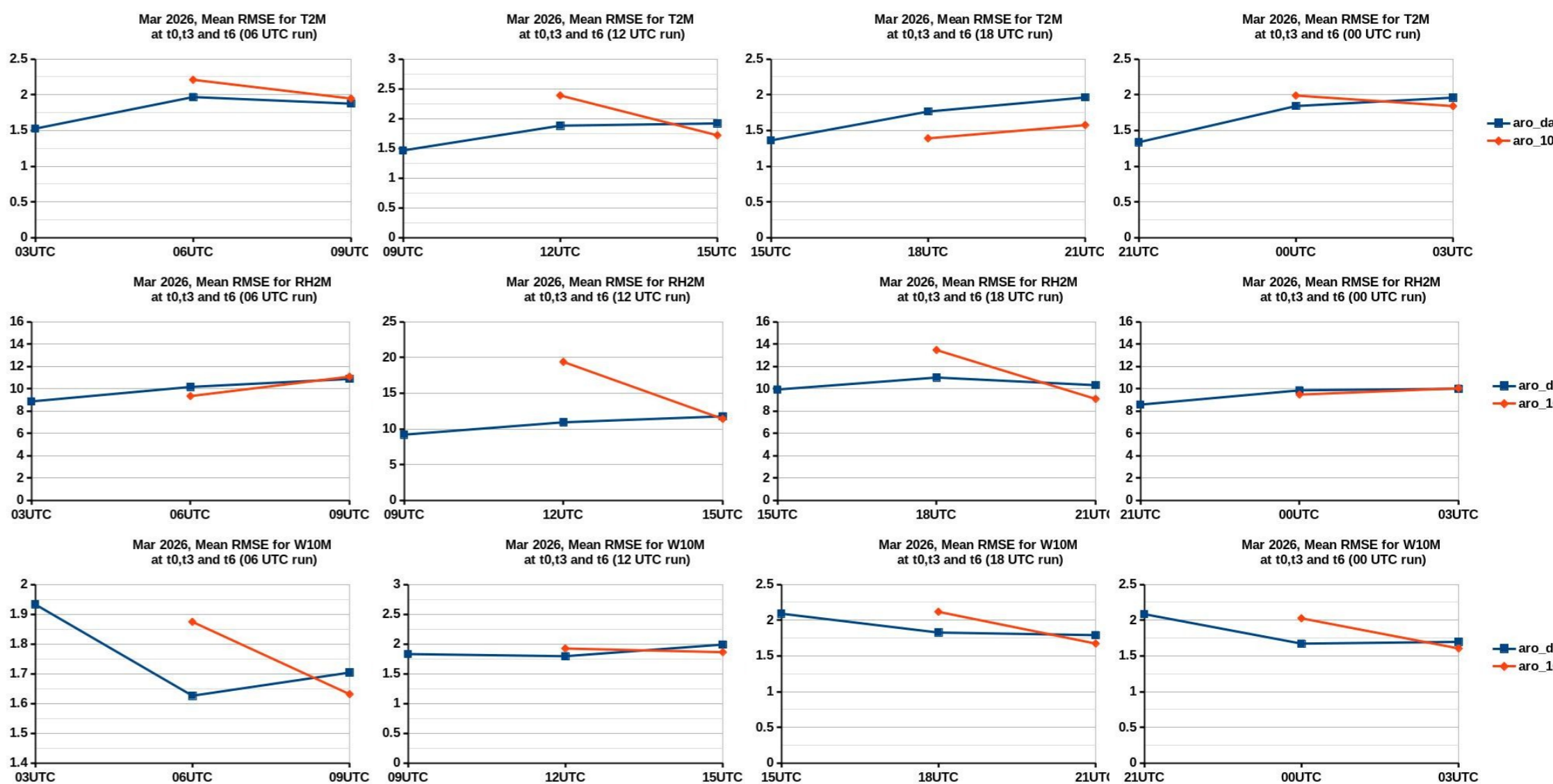


Fig.8. March 2026: Mean Monthly RMSE for 2m temperature (in K, first row), 2m relative humidity (in %, second row), 10m wind (in m/s, third row) for the first integration hours for the 4 daily AROME-DA runs and comparison with corresponding deterministic AROME-105 runs

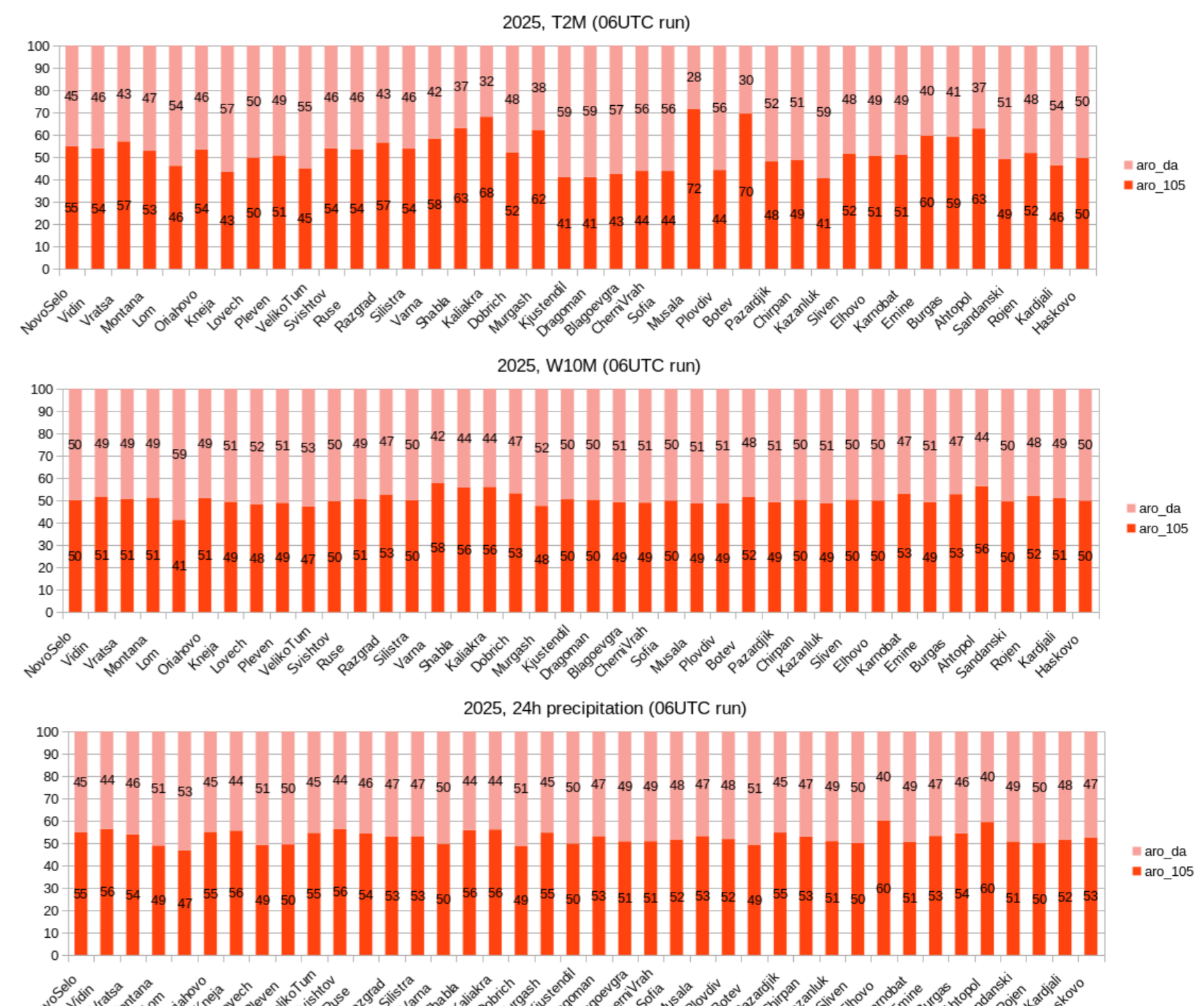


Fig.8. Percent of cases with better performance for 2025 for each synoptic station for temperature at 2m (top panel), wind speed at 10m (middle panel) and 24 hour precipitation (bottom panel) for AROME-DA (in pink) and AROME-105 (in red)