

PRELIMINARY STUDY OF A TEMPERATURE INVERSION CASE OVER EASTERN ROMANIA: MODELLING ERRORS

A. Iriza-Burcă (NMA)

M. Pietriși (ROMATSA)

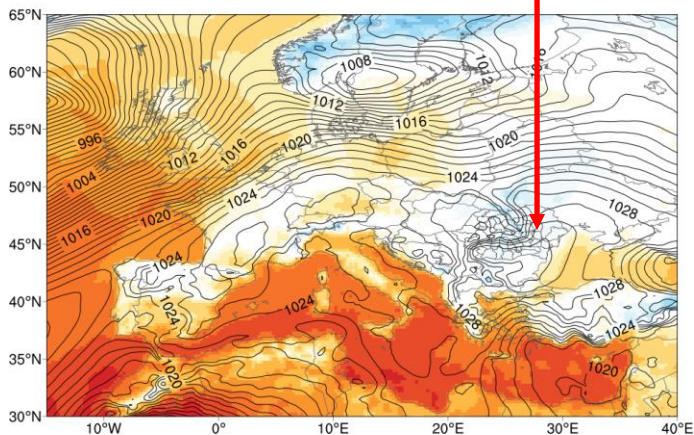
Ș. Dinicilă (NMA)

I. Ș. Gabrian (NMA)

R. C. Dumitrache (NMA)

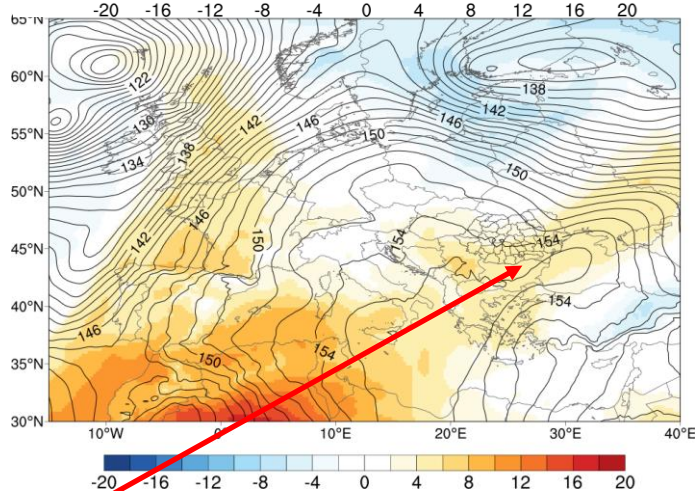
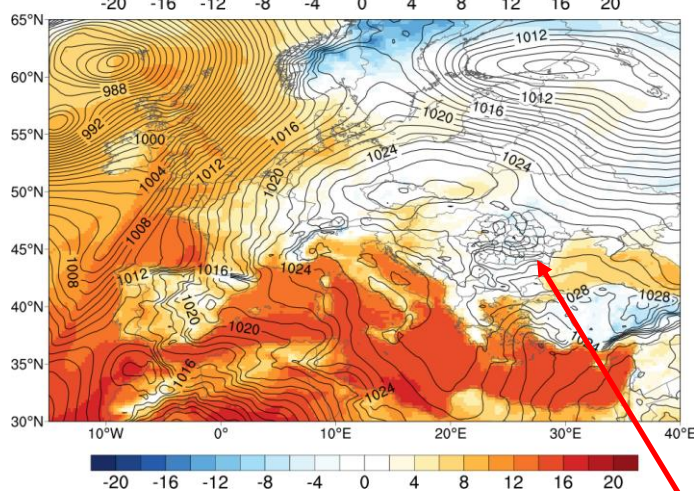
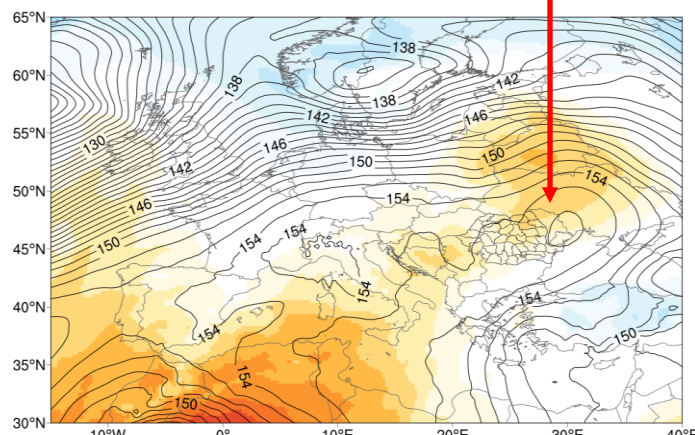
01.03.2026, 06 UTC

T2M + MSLP



Temperature + geopotential at 850hPa

01.03.2026, 06 UTC



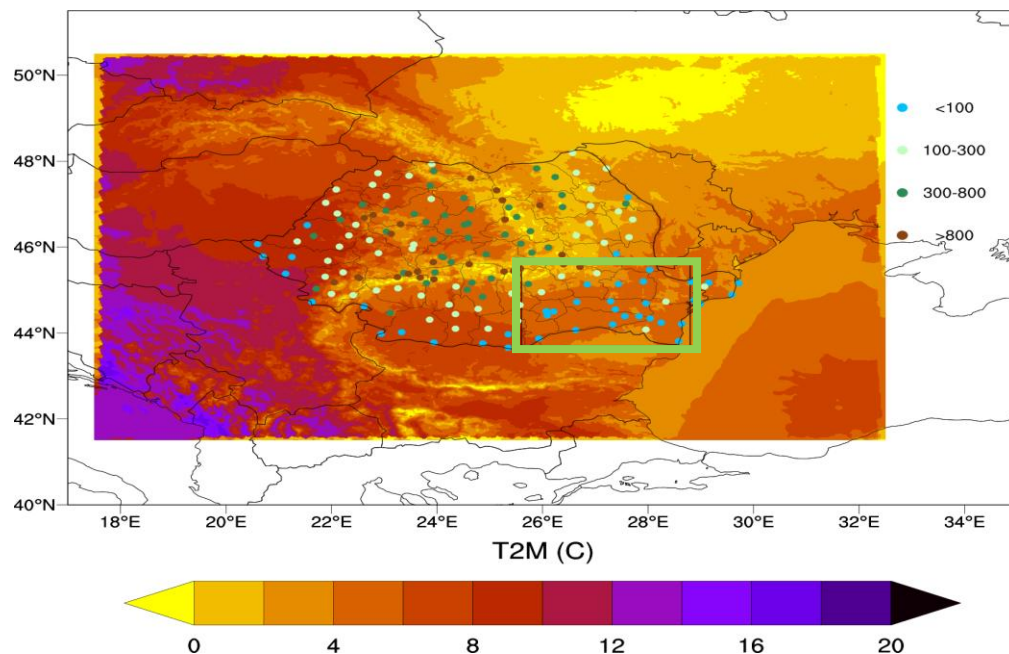
- persistent low-pressure systems (W & NW) and anticyclonic belt formed by the ridges of the Azores High and the Eastern European High
- Romania - under the influence of this belt (pressure values > 1030 hPa)
- generating downward air movement (subsidence) that led to temperature inversions, particularly in regions outside the Carpathian arc.

- areas outside the Carpathians & low-lying basins: displacement of the denser, heavier cold air mass was a slow process => persistently stable atmospheric stratification within the PBL
- lack of pressure gradients and vertical air mixing => weak atmospheric circulation, favoring the settling of the cold air mass & formation of fog

Main Problem

Most numerical weather prediction models (not only ICON!) struggled to accurately simulate the low temperatures during this period, particularly in areas outside the Carpathian mountains, where values were strongly overestimated.

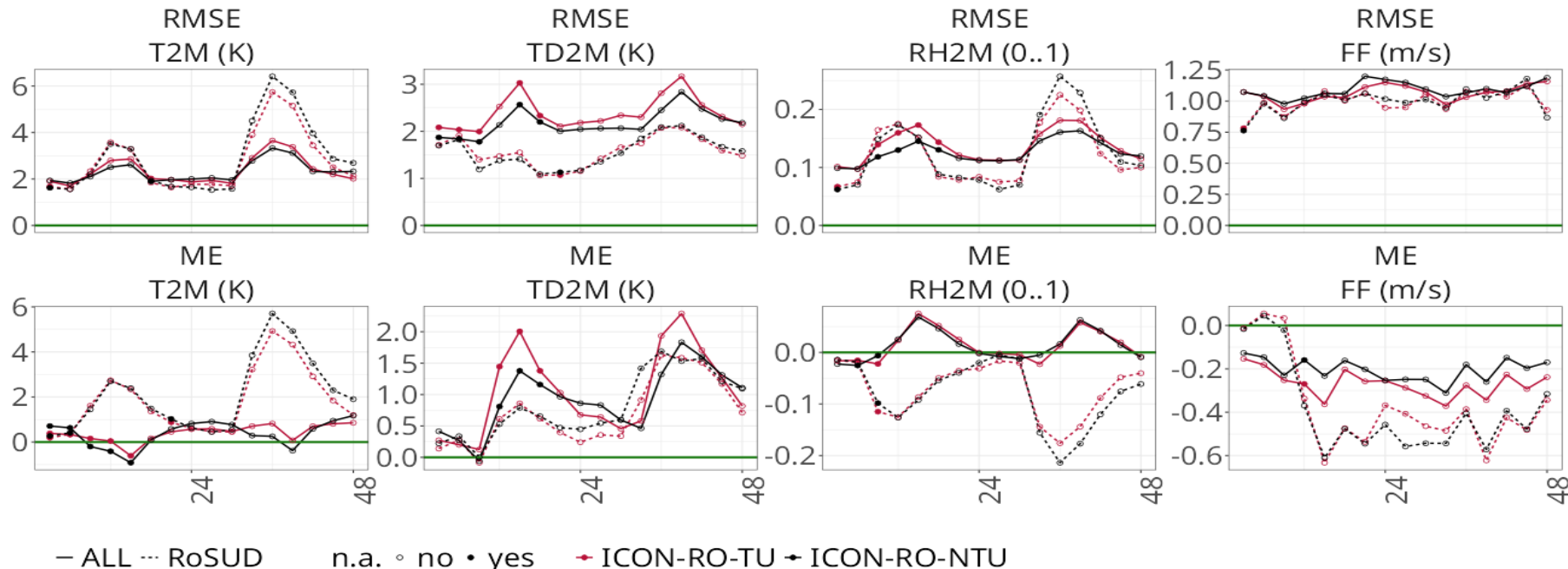
Area of Study



29 SYNOP stations (domain covering 43.70-45.65 lat & 25.60-28.80 lon)

- 21 - altitudes below 100 m,
- 5 - altitudes between 100-300 m,
- 1 – altitudes between 300-800 m
- 2 – altitudes above 800 m.

- **Lowest:** Constanta Dig (0 m)
- **Highest:** Vf. Penteleu (1772 m)
- Bucharest Baneasa (BB, **peri-urban**)
- Bucharest Filaret (BF, **urban**)
- **TEMP/PILOT:** BB

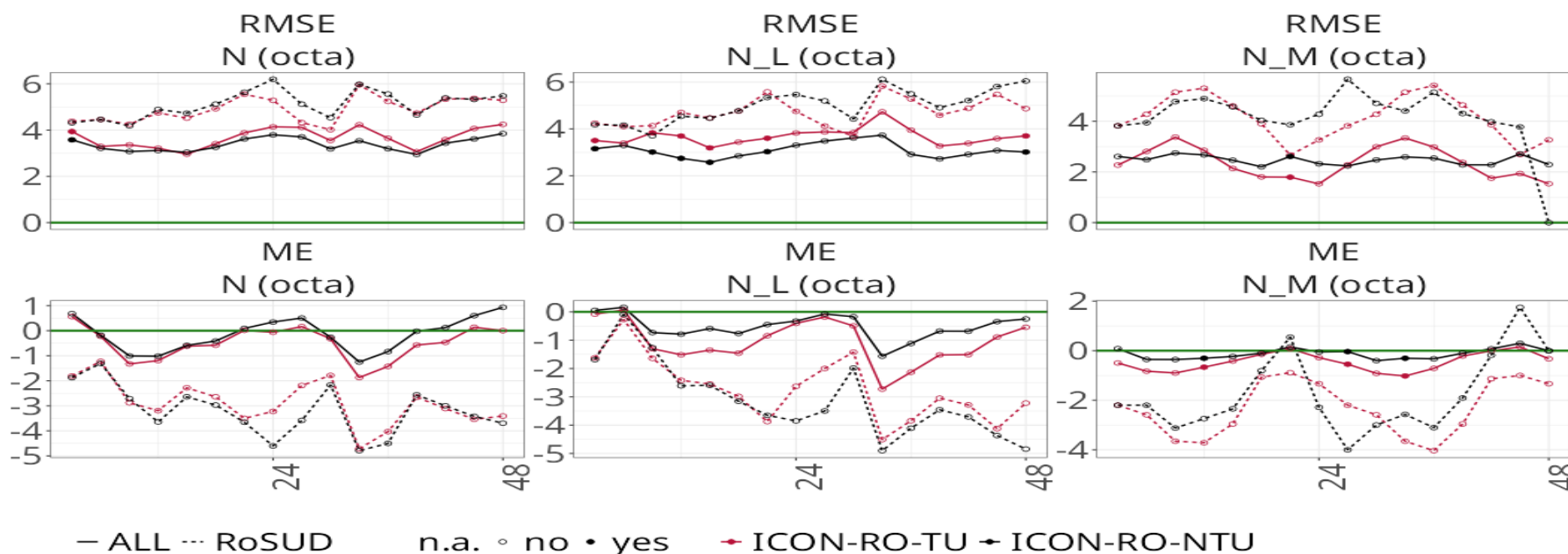


Lower performance of the model for the **area of interest** compared to the entire country for T2M, RH2M and N

Analyzed area (scores dotted)

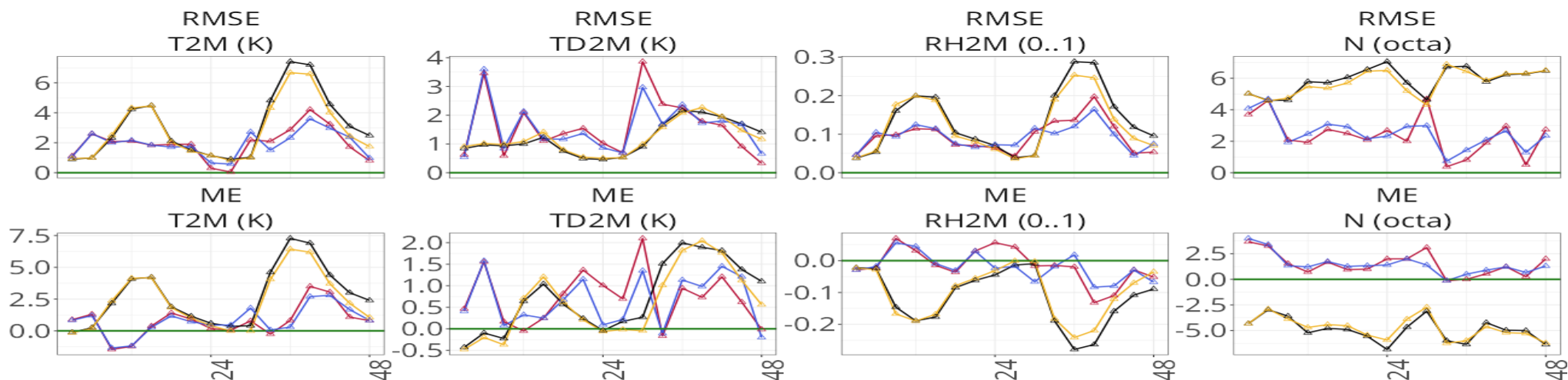
- **strong overestimation** T2M and TD2M during daytime (12 UTC)
- FF and RH2M generally underestimated
- large errors accompanied by large amplitude of errors => errors are systematic
- For T2M, RH2M and FF **urban setting had a small positive impact**

- strong overestimation bias in T2M and TD2M indicative of excessive warming during the day
- coupled with underestimations of RH2M values = > suppressing cloud formation.

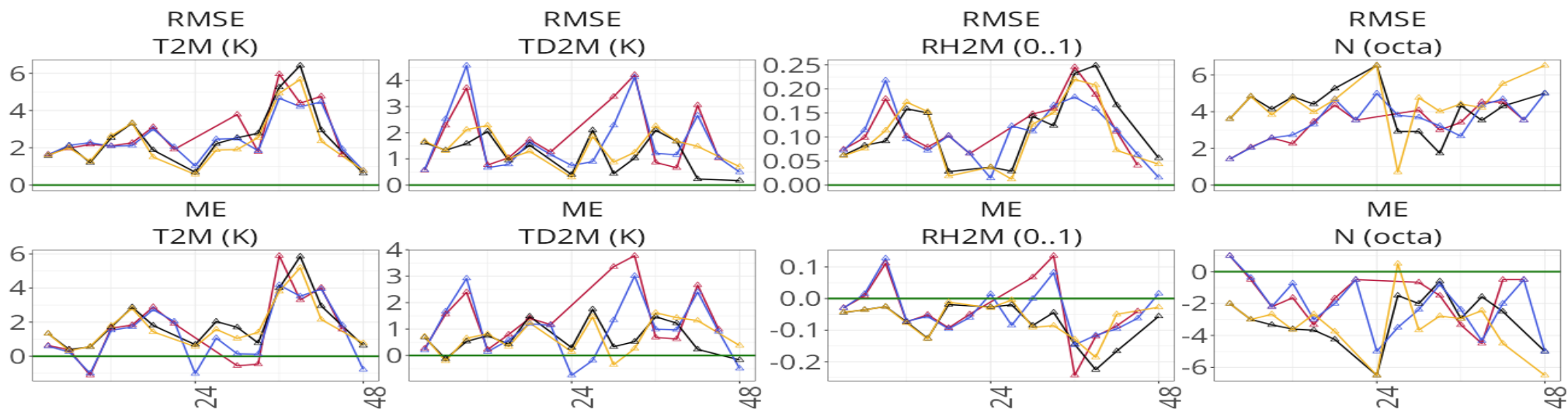


- overall tendency of the model to underestimate cloud cover
- amplitude of errors is higher for N and N_L, respectively
- **urban setting had a small positive impact for N and N_L**

conditioned by N (observed)
c1 $N \leq 2$ octa, c2 $3 \leq N \leq 5$ octa, c3 $6 \leq N \leq 7$ octa, c4 $N = 8$ octa



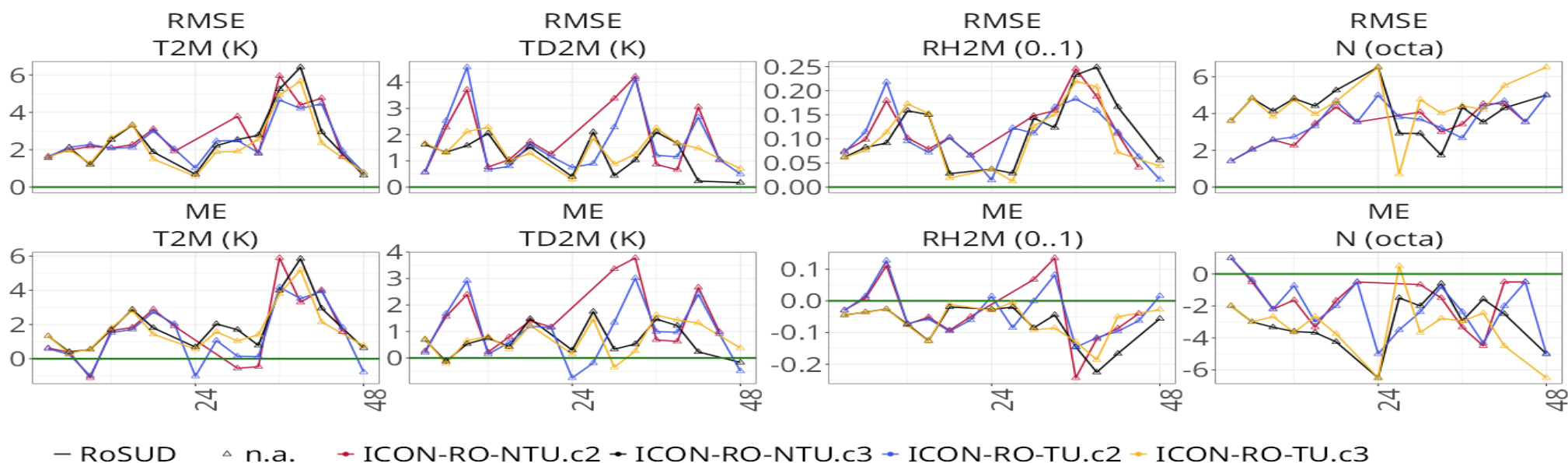
— RoSUD ▲ n.a. — ICON-RO-NTU.c1 — ICON-RO-NTU.c4 — ICON-RO-TU.c1 — ICON-RO-TU.c4



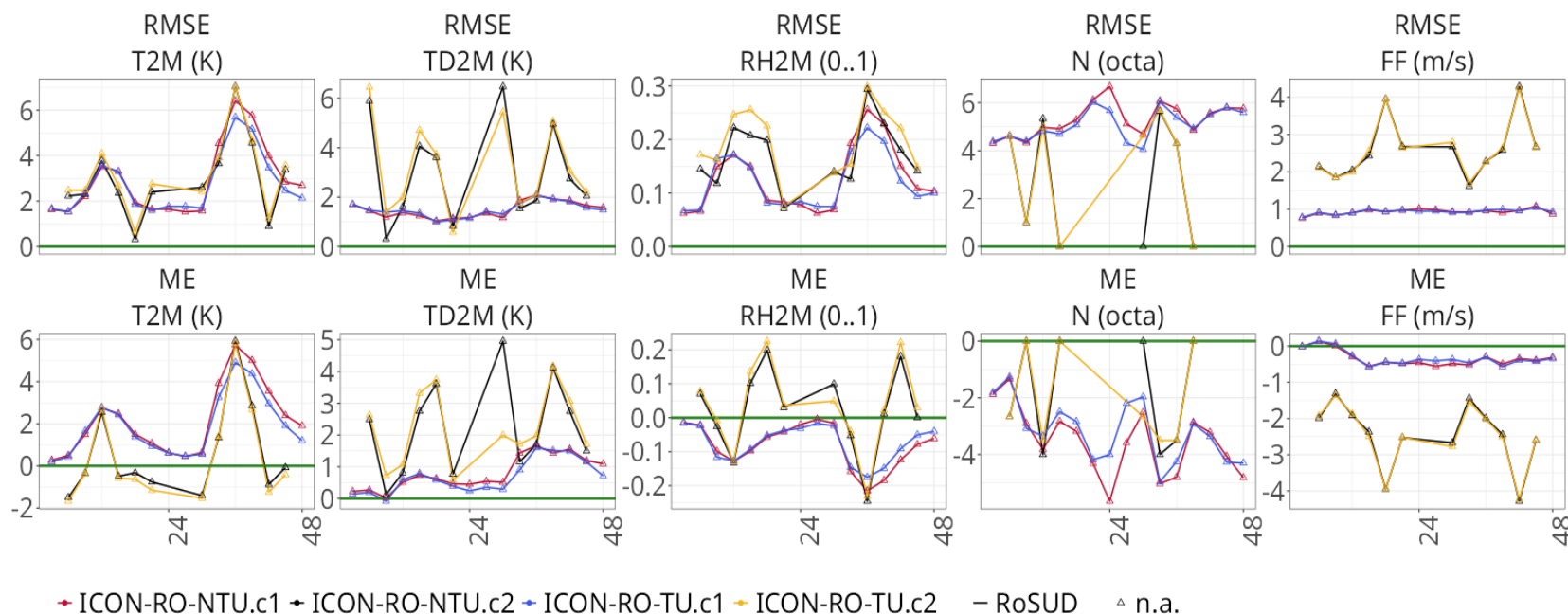
— RoSUD ▲ n.a. — ICON-RO-NTU.c2 — ICON-RO-NTU.c3 — ICON-RO-TU.c2 — ICON-RO-TU.c3

conditioned by N (observed)
c1 $N \leq 2$ octa, c2 $3 \leq N \leq 5$ octa, c3 $6 \leq N \leq 7$ octa, c4 $N = 8$ octa

- overestimation for T2M and TD2m + a dry atmosphere also **significant for $N > 2$ octa**
- **lower values of N** - smaller bias in T2M + good accuracy in RH2M
- **strong diurnal cycle of T2M**, similar for all cloud cover classes
- *thermodynamic error in coupling between the surface and PBL*
- largest biases in temperature and moisture do not correspond to largest errors in N
- **In general, urban setting had a small positive impact**

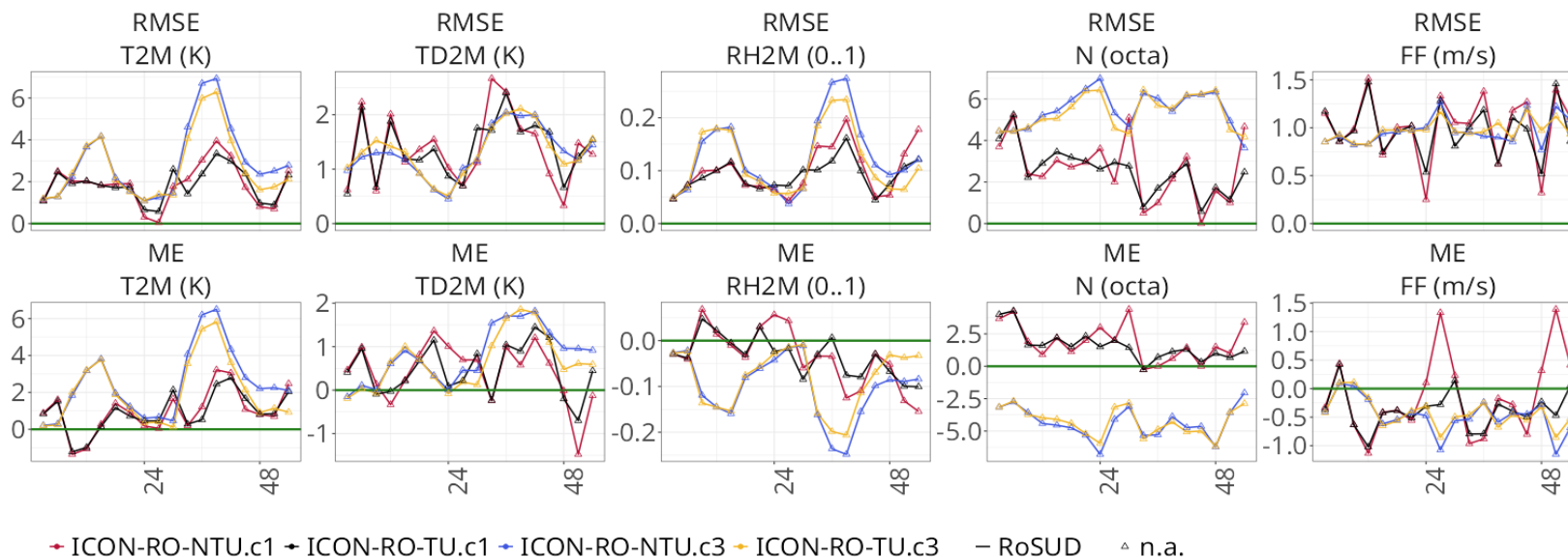


conditioned by FF (observed)
c1 FF ≤ 4m/s, c2 FF > 4m/s



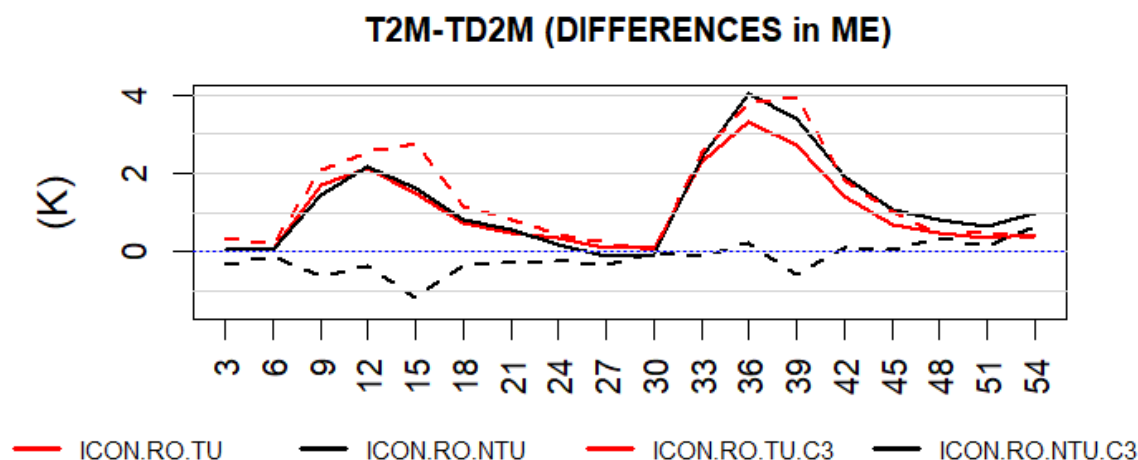
- warm bias in T2M is enhanced under weak wind
- sample cases for FF > 4m/s are very small
- ***Some positive impact from the urban setting, mostly visible in RMSE***

Combined conditioned by N & FF (observed) c1 N≤2 octa, c3 N>3=octa; FF≤4m/s (small sample FF > 4m/s)



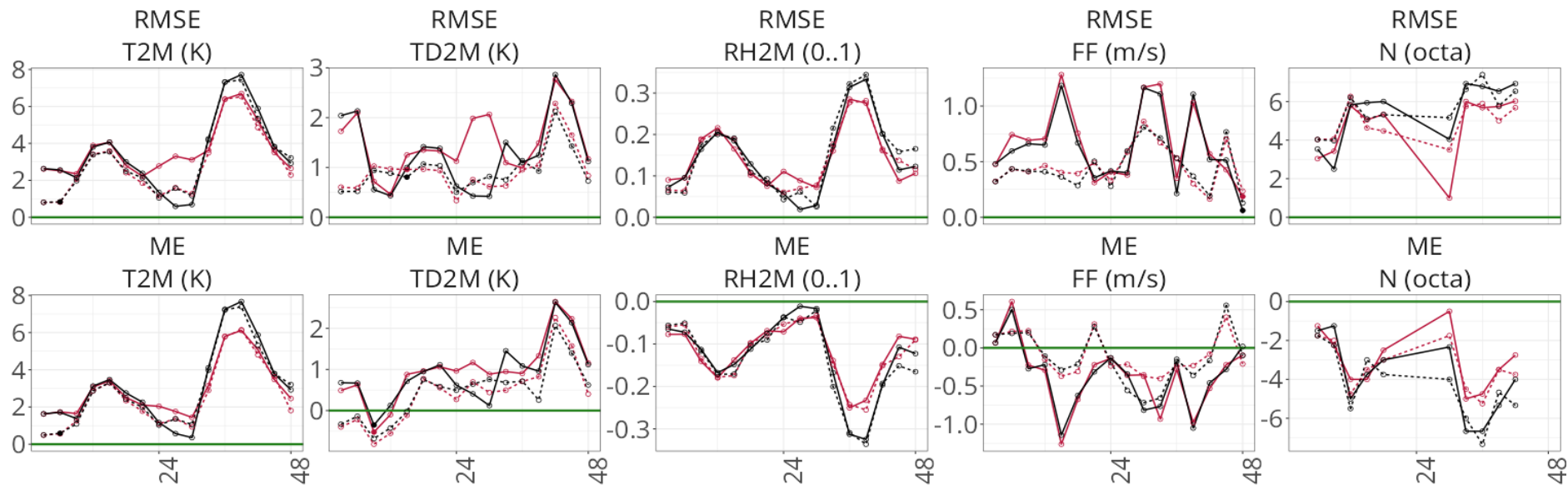
- **diurnal cycle visible** across most conditions (some combinations show a less distinct cycle)
- forecast errors **generally smaller** under clear-sky & weak-wind
- characteristic diurnal evolution remains
- atmosphere was predominantly weakly ventilated
- Strongest/most persistent T2M error in the dominant weak-wind/high-cloud regime (12–13 UTC) => reproducible temporal structure of the error
- the 12 UTC humidity error much more systematic under higher N
- under clearer conditions, errors less consistently biased in one direction

Differences in ME between T2M & TD2M Overall (line) and under combined c3, $N \geq 3$ octa, $FF \leq 4 \text{ m/s}$ (dotted)



- Overall differences are always positive
- largest differences consistent with the placement of the largest T2M errors (12UTC)
- highest errors in temperature are timed to the maximum errors in near-surface saturation. overly warm/dry state for the near-surface atmosphere.
- For the overall scores, **urban setting had a small positive impact**

T2M, TD2M, RH2M, FF and N for BB (line) and BF (dotted)

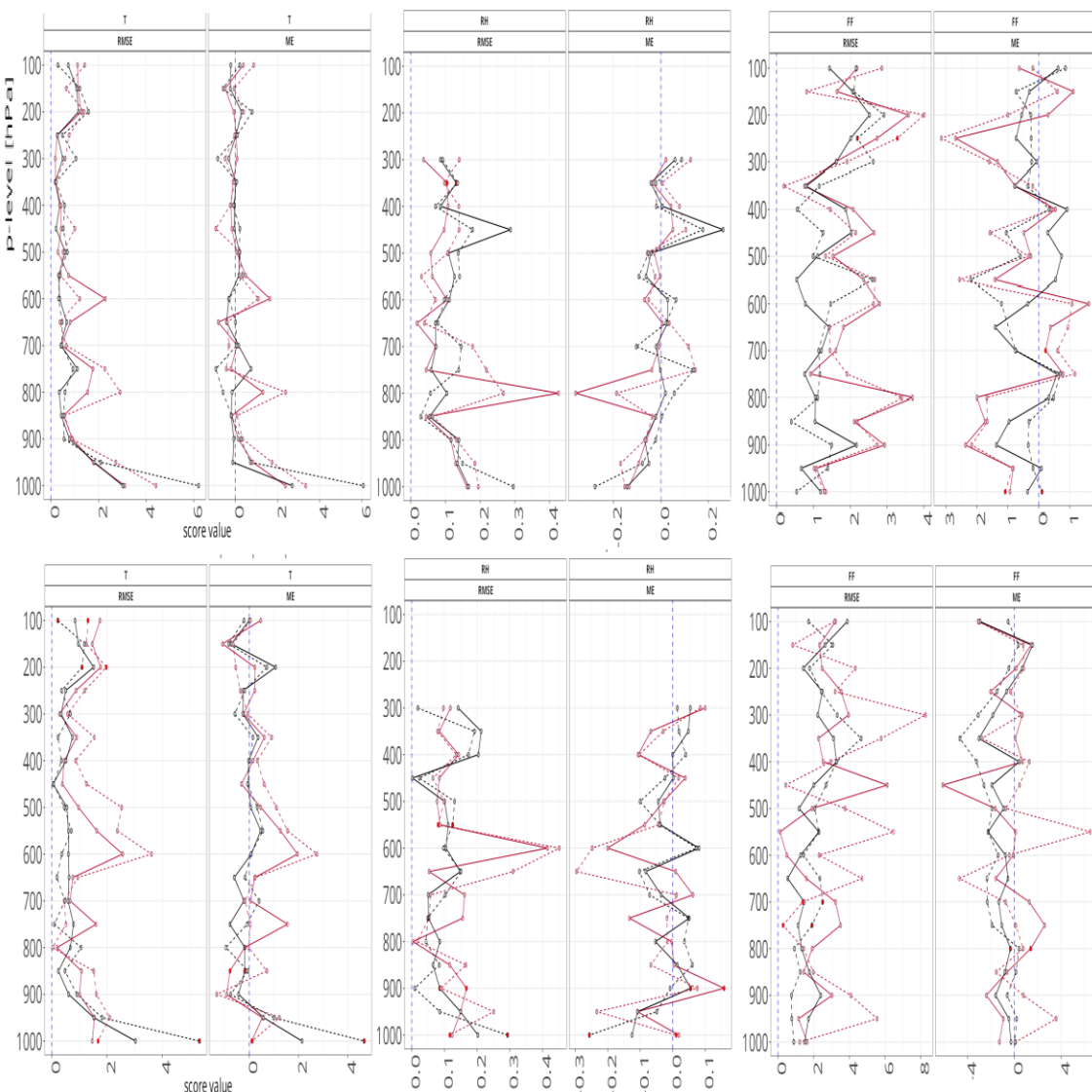


n.a. ° no • yes — ICON-RO-TU • ICON-RO-NTU — ROBB • ROBF

- Difficult to have a good estimate, as N observations are missing during the night
- All FF values $\leq 4\text{m/s}$
- **urban setting generally had a small positive impact during the day**
- *slight worsening during the night*
- Not known at the moment: if/how strong UHI

Upper air T, RH and FF for BB (line) Top: +12 hours (line), +36 hours (dotted) Bottom: +24 hours (line), +48 hours (dotted)

- 12 UTC: largest T errors at 1000 hPa (positive bias)
- errors at intermediate levels include negative biases around the 850-hPa layer (where inversion is evident in reanalysis data)
- 00 UTC: the 1000-hPa T error relatively small, largest bias occurs near 600 hPa
- vertical error structure closely related to diurnal phase
- T and RH errors peak at different levels.
- thermodynamic error is not vertically uniform
- *urban setting visible positive impact in the lower atmosphere*



Planned Further analysis

- Analyze data from **ceilometers** available in the area of interest
- Identify the **fog** observations
- Verification of **radiation** forecast

Thank you for your attention!