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Data Assimilation Activities at MeteoSwiss

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WG Meeting on Data Assimilation, 7.3.2024, DWD Offenbach



Content

- KENDA-CH1, transition to ICON
- Revisiting T2m/RH2m assimilation



KENDA-CH1

- The journey of operational implementation of ICON at MCH is soon coming to its end
- KENDA-CH1 quality superior to operational KENDA-1 except
 - T2m/RH2m bias
 - 10m wind speed bias
- Major challenges with new HPC system delayed the «go-opr»
- Current plan: Q2 2024
- Recent implementation progress
 - Introduced snow analysis in KENDA-CH1 cycle
 - Switched to HDF5 format for producing the LHN obs input files
- Assimilation of Raman Lidar obs (ICCARUS talk of Bas)



Tackling the T2m bias

- Look at model physics
 - Topographic shading effects
 - Turbulence max. diffusion length
- Improve DA
 - Introduce snow analysis to KENDA-CH1
 - Revisit/diagnose T2m/RH2m assimilation



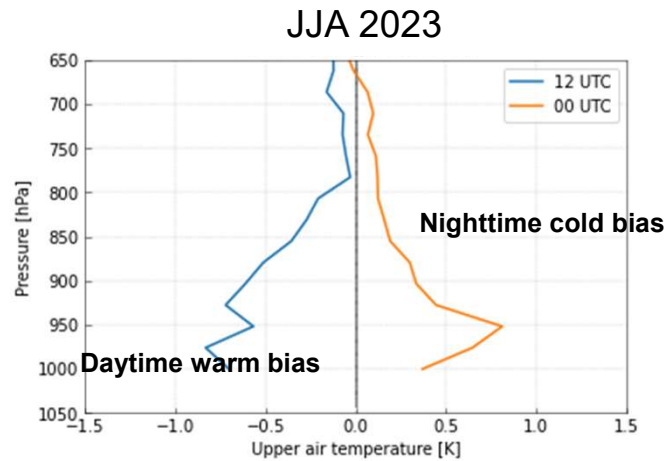
Revisiting T2m / RH2m Assimilation

- T2m/RH2m assimilation has proven to significantly improve the thermodynamical state of the PBL of operational KENDA-1 (with COSMO)
- Particular benefit in fog and low stratus cases
- Recent verification against radiosondes has revealed a large near-surface temperature bias
- Does T2m/RH2m assimilation produce non-optimal increments in the free near-surface atmosphere?

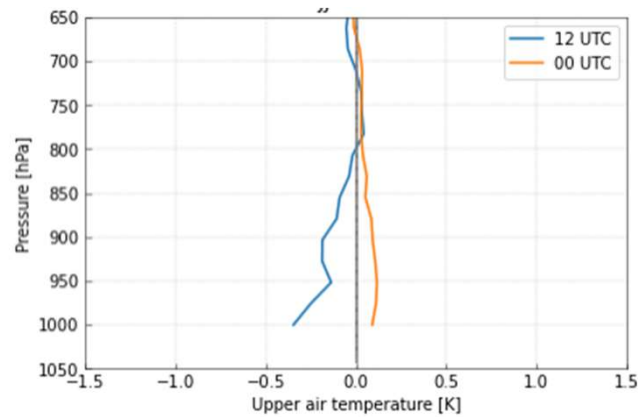


Temperature in Radiosonde Space

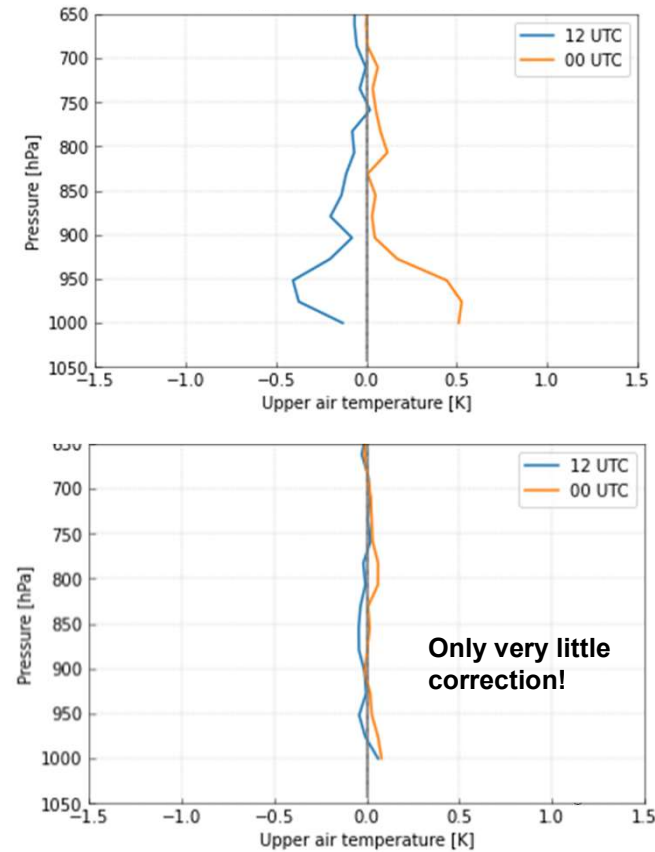
O-B



A-B



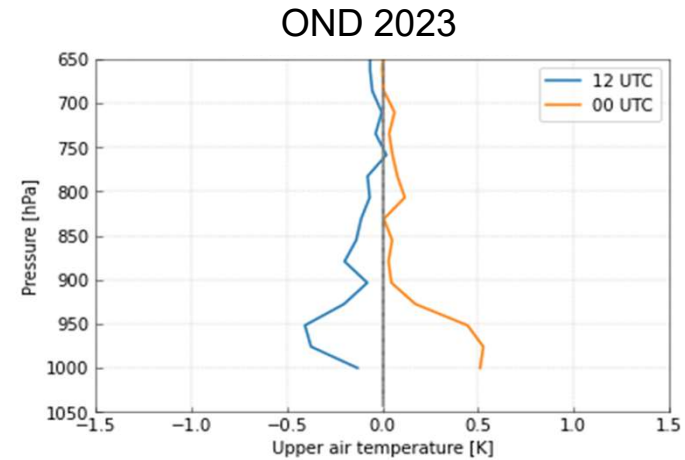
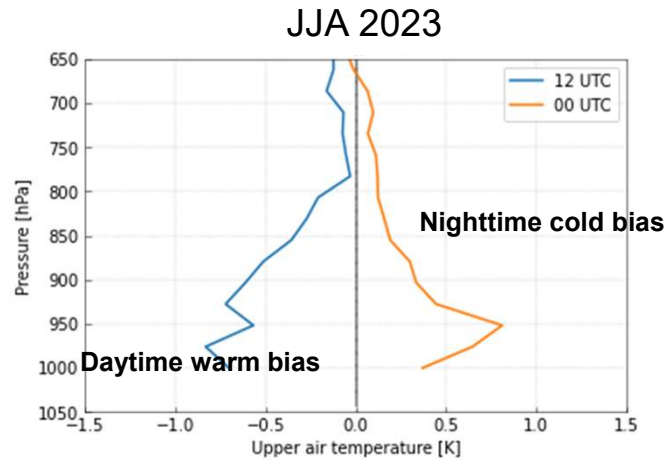
OND 2023



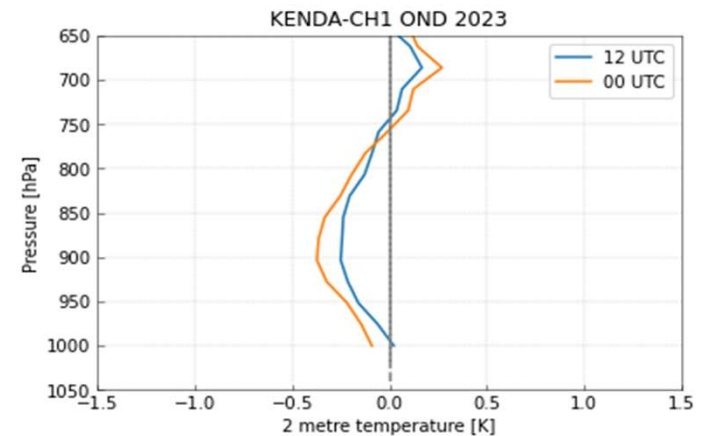
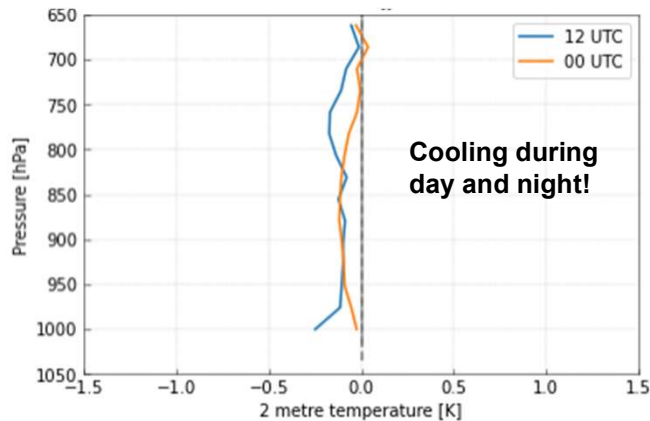


Influence of SYNOP T2m Assimilation

O-B
TEMP

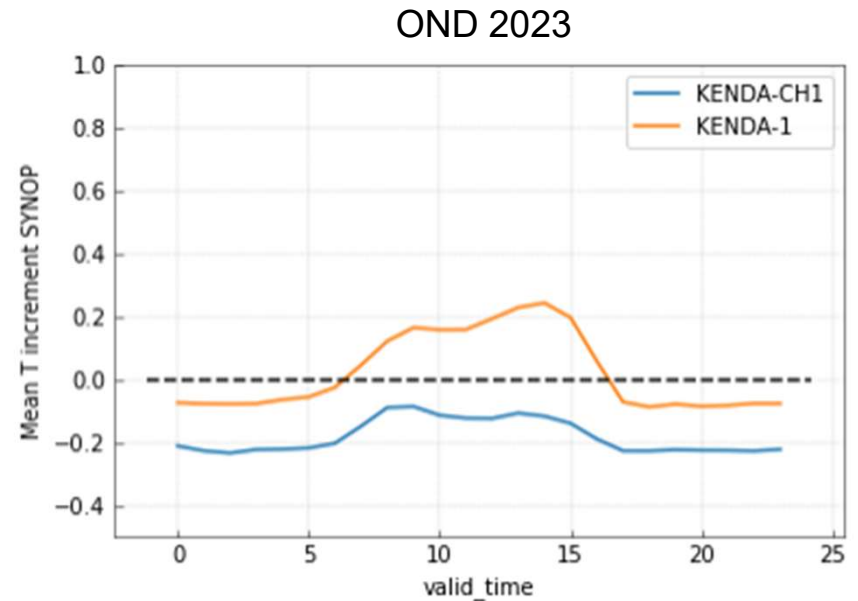
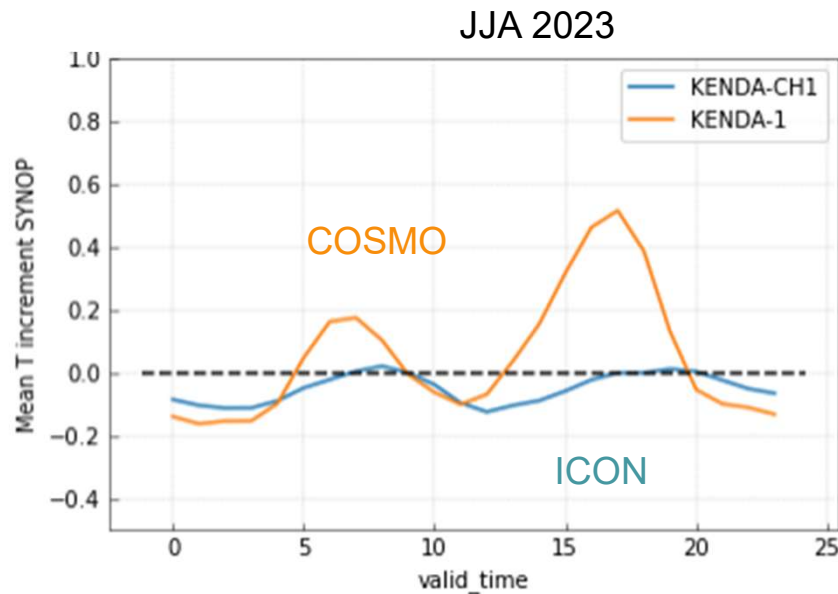


A-B
SYNOP





Daily Cycle of T2m Increments



Cooling increments from SYNOP consistent with T2m warm bias



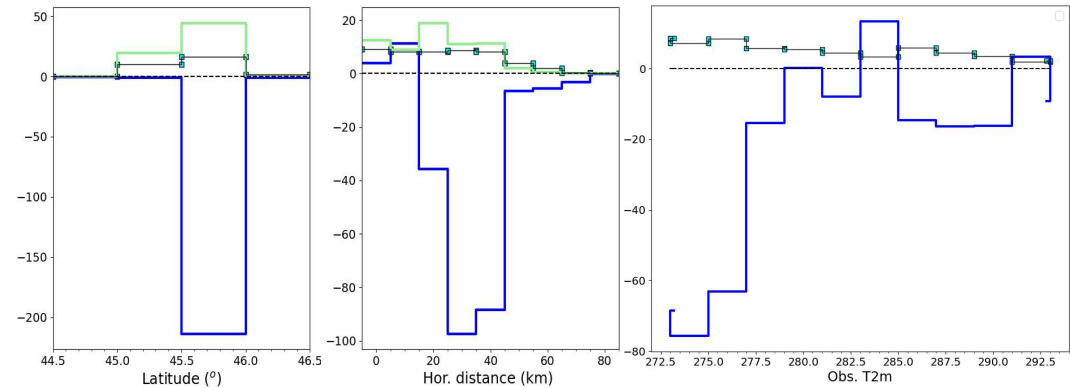
Interim Remarks

- Day-time warm bias and night-time cold bias in TEMP verification
- Only very little increments to counteract this bias (combined increments from all observation systems!)
- SYNOP T2m increments cooling at every height range and during day and night -> enhances night-time cold bias and reduces day-time warm bias
- Suspicion: SYNOP assimilation supports the TEMP assimilation during day, but counteracts it during night
- Focus on region south of the Alps (Milano Radiosounding)
 - Effect very similar to overall effect just presented
- Use cross-validation tool to investigate effect of SYNOP T2m assimilation on radiosonde

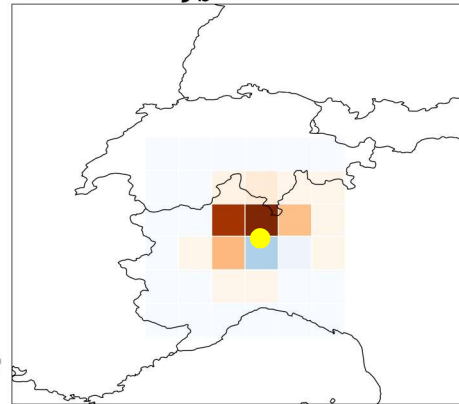


The Cross Validation Tool (Stiller 2021)

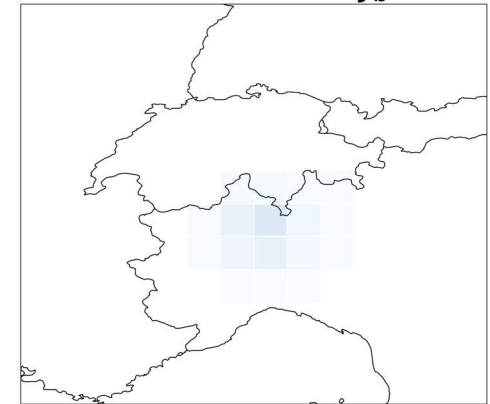
- Validating the T2m observations over the Po valley specifically 950-1050hPa is validated against the Sonde in Milano
- The negative impact is significant
- To gain more confidence in the diagnosed impact, ideal assimilation tests which mimics the single observation diagnostic were carried out.
- Also looked at the timeseries of various quantities during this period.



J_b term



Estimated noise in J_b term

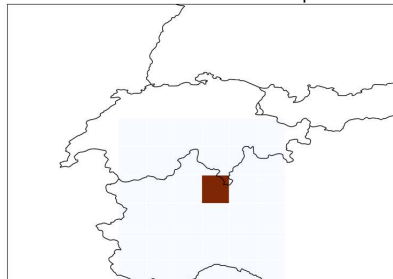


MeteoSchweiz

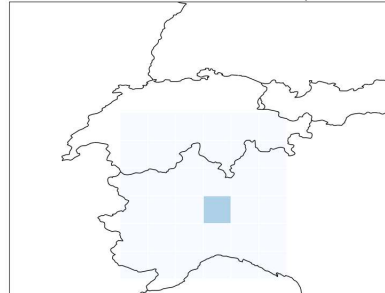


T2m Bias

Region 1

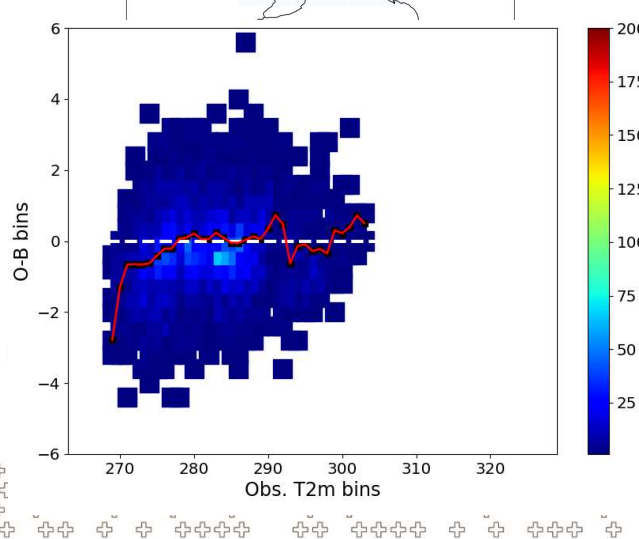
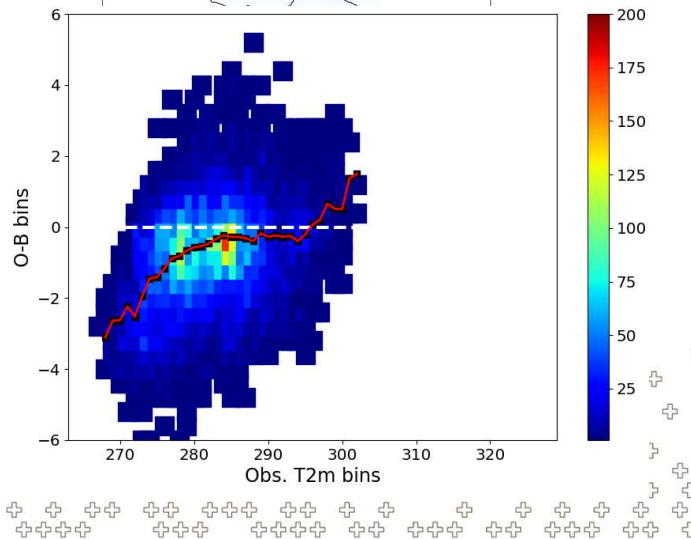


Region 2



Statistics from
OND2023

- Systematic bias at colder surface temperatures.
- More biased pixels over the region 1 compared to region 2



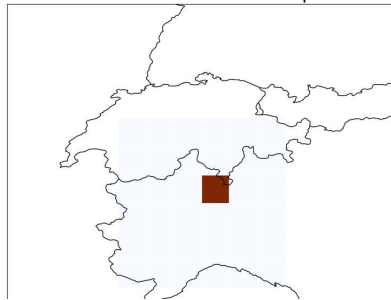
Daniel Leuenberger

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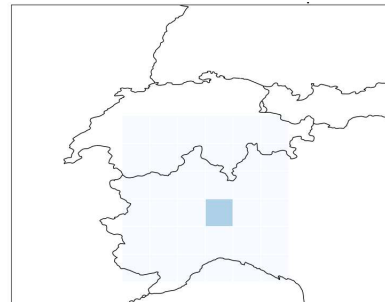
Spread/Skill Ratio

Region 1

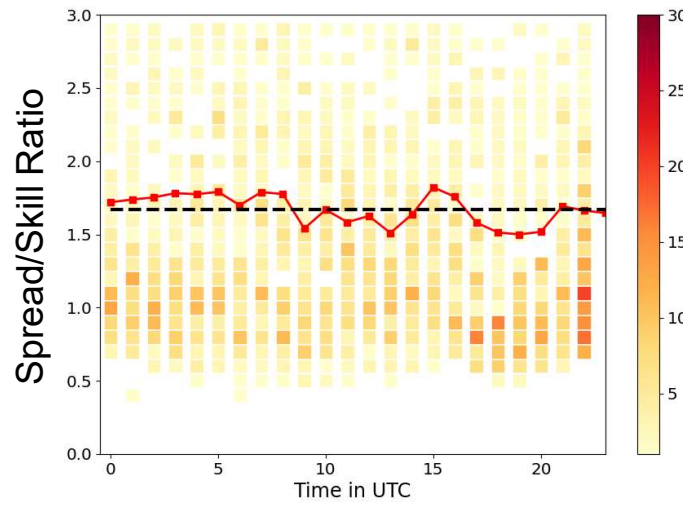
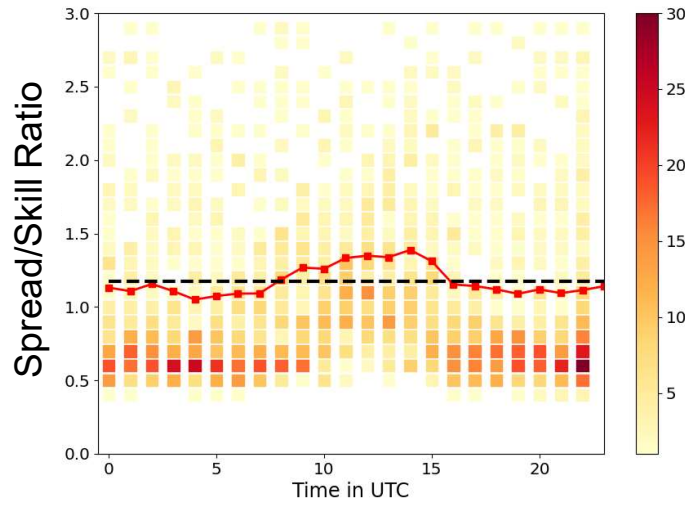


Statistics from
OND2023

Region 2



- Underdispersive during night in region 1
- Suggests systematic model error in night and region 1





Concluding Remarks

- KENDA-CH1 superior to KENDA-1 in most variables and scores
- Biases in T2m/RH2m and 10m wind still larger than with COSMO
- Cross-validation tool has proven to be helpful in identifying negative impact of T2m assimilation
 - Missing surface pressure observation leads to wrong height assignment of increments in LETKF
 - Issues in redundancy check of T2m observations?
- Negative impact due to
 - O and B mismatch (biases) or
 - too large localization radius (both vertical and horizontal)?



Outlook

- Introduce KENDA-CH1 to operations (Daniel)
- Raman Lidar assimilation (opr in KENDA-CH1, Bas)
- Continue work on KENDA-CH1 diagnostics (Krishna)
- Combined effort to reduce T2m/RH2m bias (all, together with physics team)
 - Test fix of height assignment in case of missing surface pressure obs
 - Test adaptive parameter tuning
 - Test parameter perturbations in KENDA-CH1
- Continue work on radar volume assimilation (Claire and Alina)



Discussion Topics

- Implementation of Raman Lidar Forward Operation in MEC (currently in MEC light)