ICON

Recent activities and developments at DWD

WGNE Meeting, Exeter, Oct. 9-12, 2017

Günther Zängl

Model improvements since summer 2016

- Improved tuning of SSO scheme, revision of SSO-turbulence coupling
- (Partial) transition to a more recent ozone climatology
- Climatology-based daily update of SST
- Improved formulation for bare soil, plant and snow evaporation, and interception storage, in land-surface model TERRA
- Prognostic sea-ice albedo
- Revised tuning of turbulent vertical diffusion in the stratosphere
- Revision of cloud cover scheme (ongoing)
- Improved assimilation of screen-level observations (RH and wind)
- Activation of physics parameter perturbations in ensemble (assimilation cycle and forecasts)

Monthly analysis verification, Arctic 5 hPa

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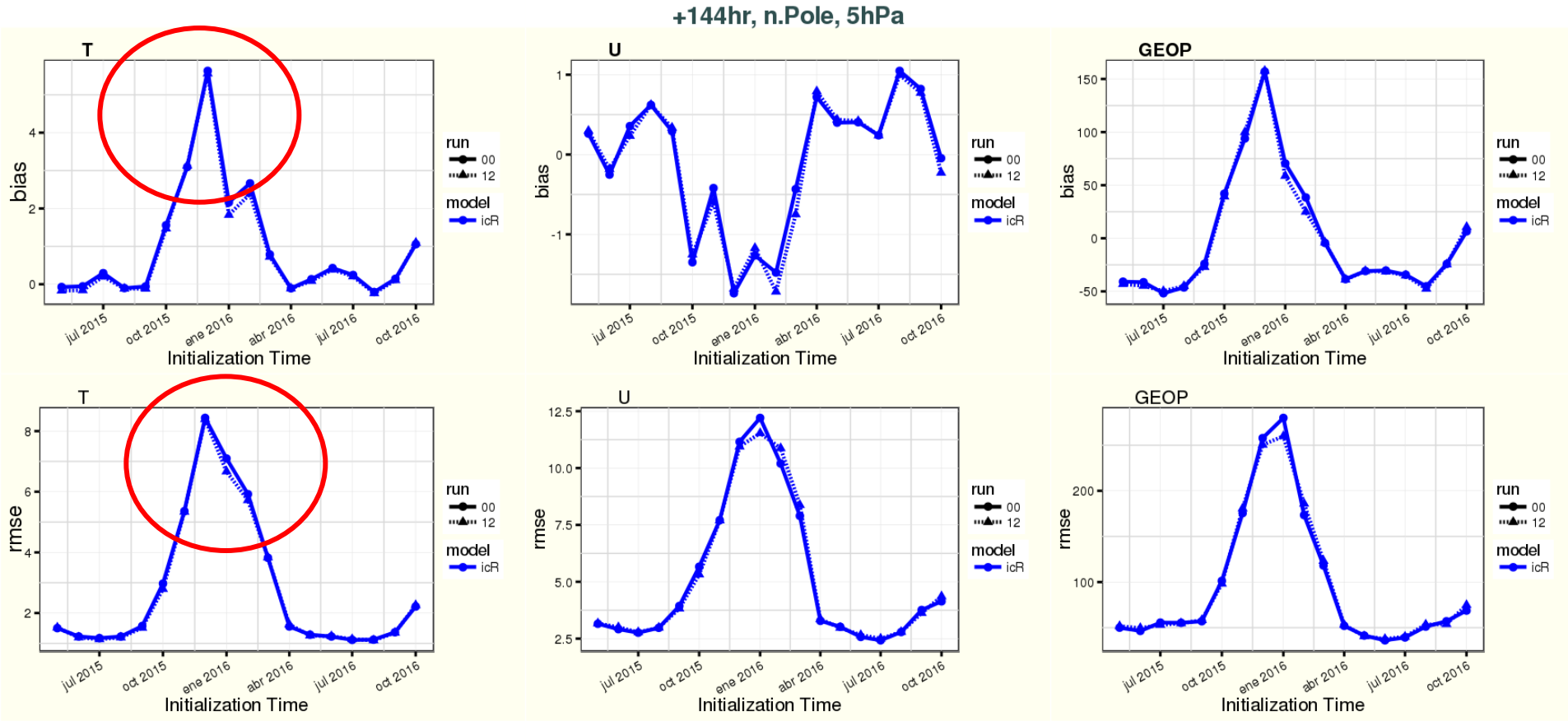
Huge forecast errors in the winter months!



What goes wrong?

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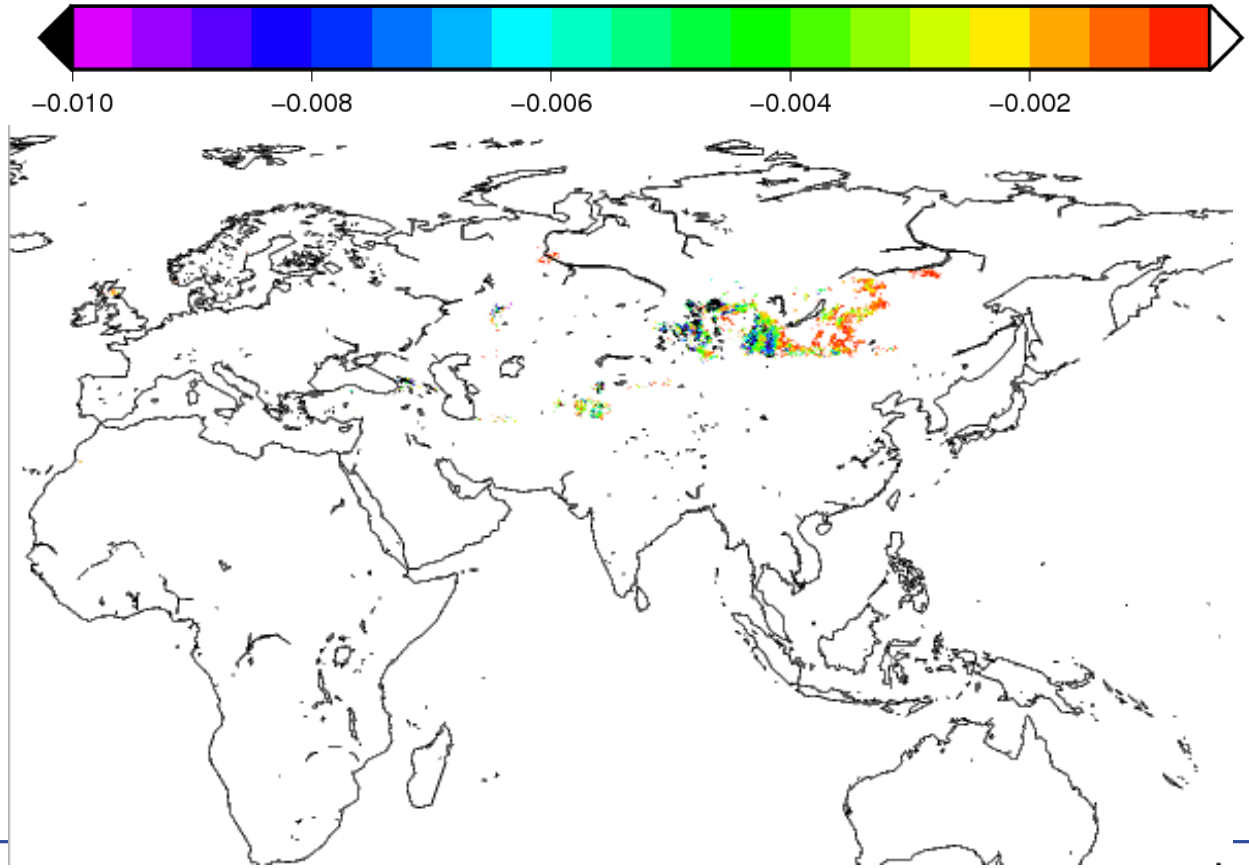
The SSO scheme sporadically produces nonsensically large wind tendencies in the stratopause / lower mesosphere region

Example: SSO tendency für u wind component (m/s²), level 10 (ca. 53 km), 26.11.16 12 UTC



Provisional solution

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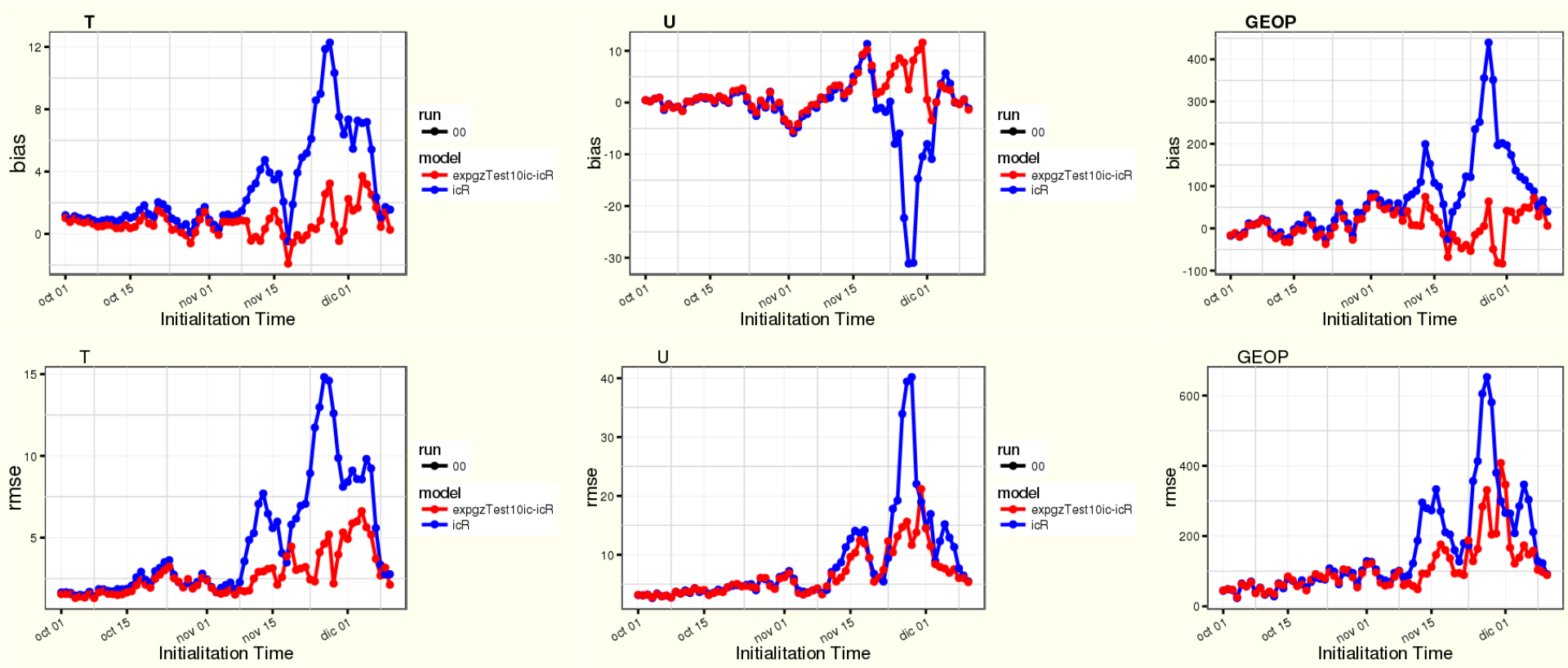
Limitation of SSO tendencies above the middle stratosphere

blue: Operational forecasts for 1.10.-10.12.16

red: Experiment with artificially limited SSO tendencies in stratopause region and mesosphere

+144hr : n.Pole 5hPa



Retuning of critical Froude number in SSO scheme

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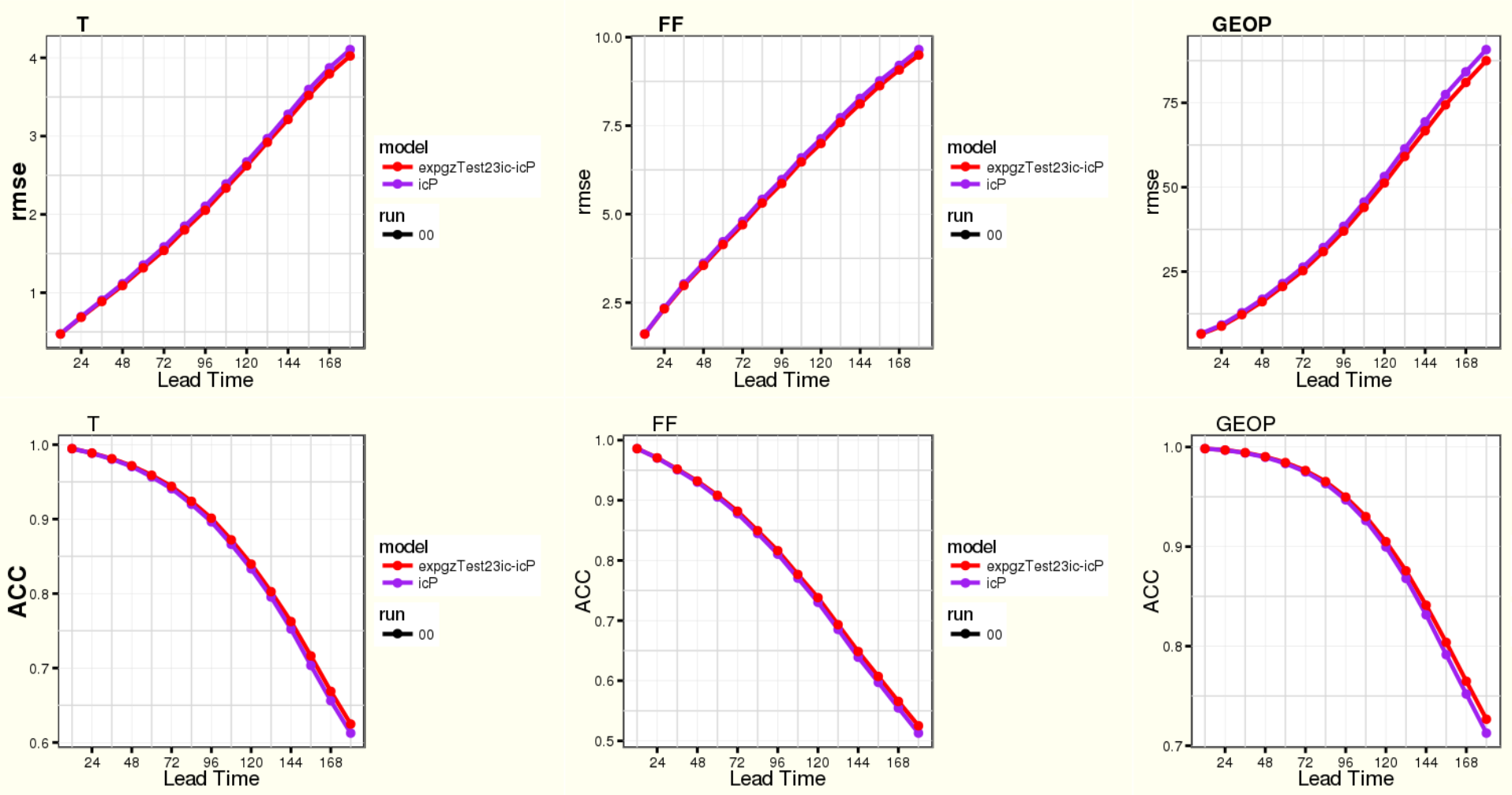
Analysis verification NH 500 hPa, Dec 16 / Jan 17



Monthly analysis verification Antarctica, 50 hPa,
Too strong ‚ozone hole' in Antarctic spring?
Need more recent ozone climatology?

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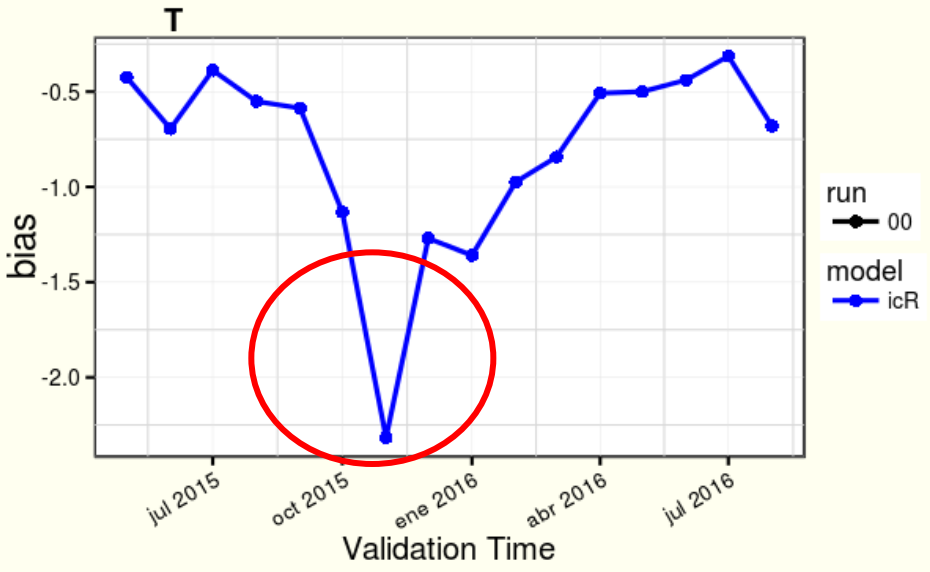
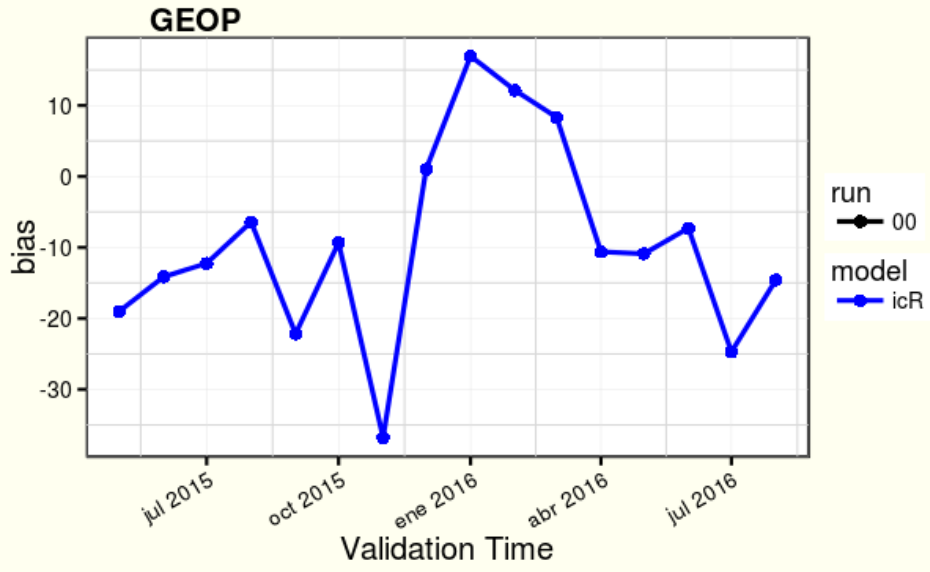
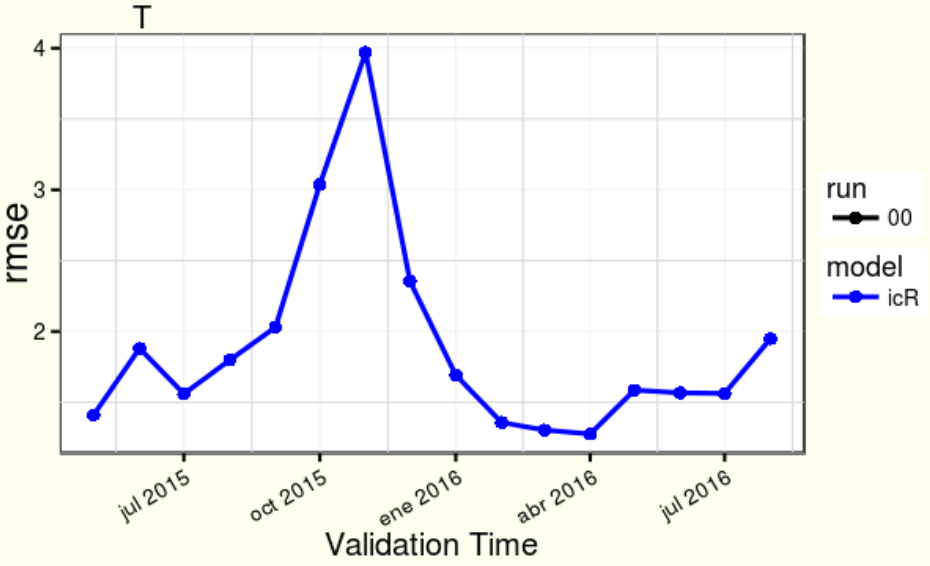
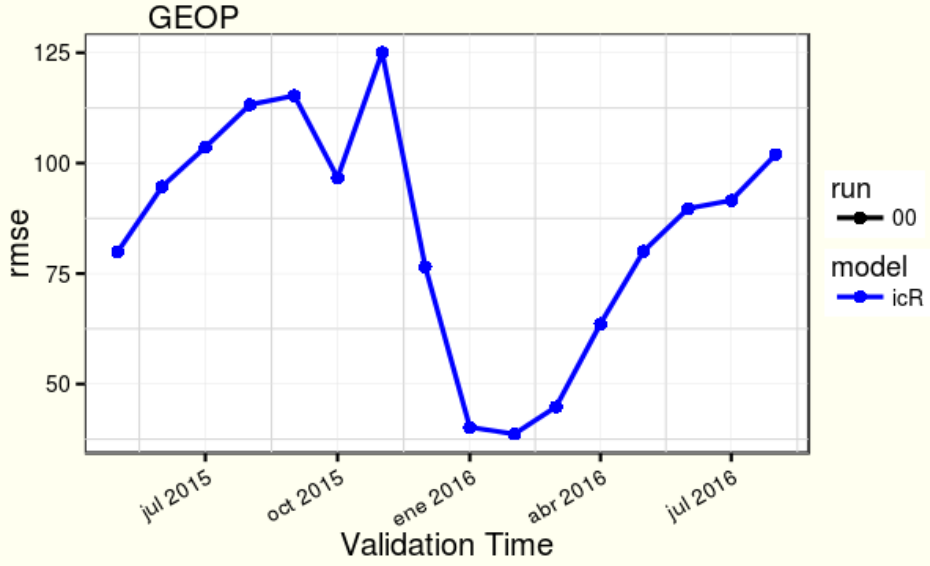
+144hr, s.Pole, 50hPa









Antarctica, 50 hPa, Okt/Nov 2016

red: MACC climatology, blue: GEMS climatology

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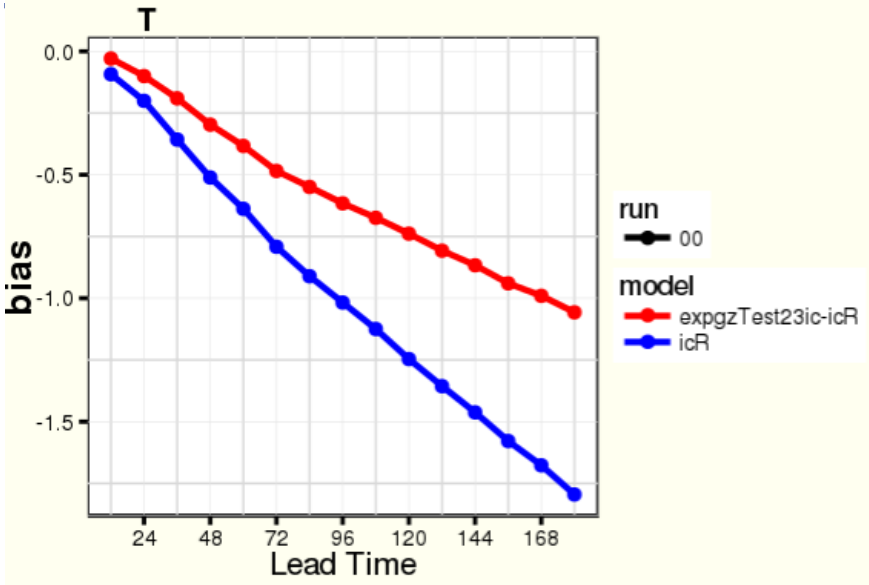

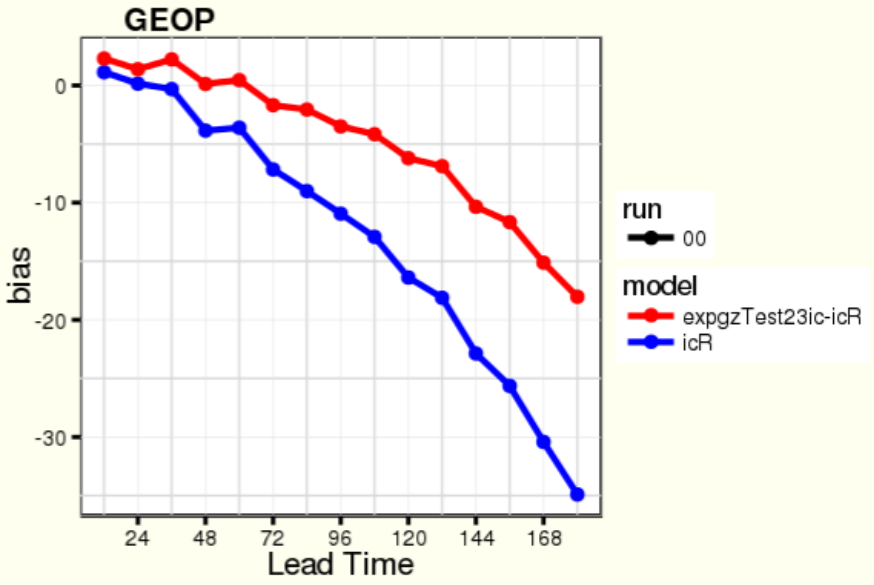

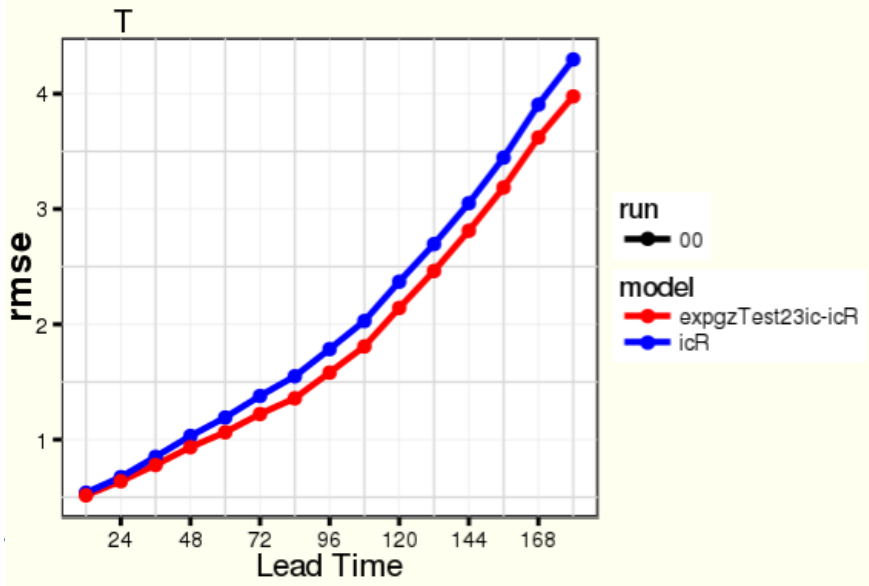

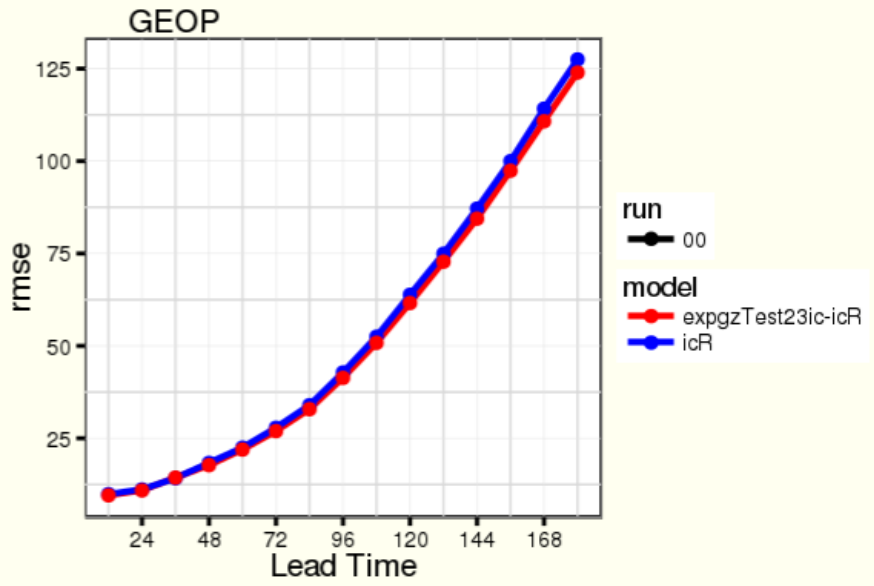

Climatology-based daily SST update: experiment for April/May 2016, N-Atlantic

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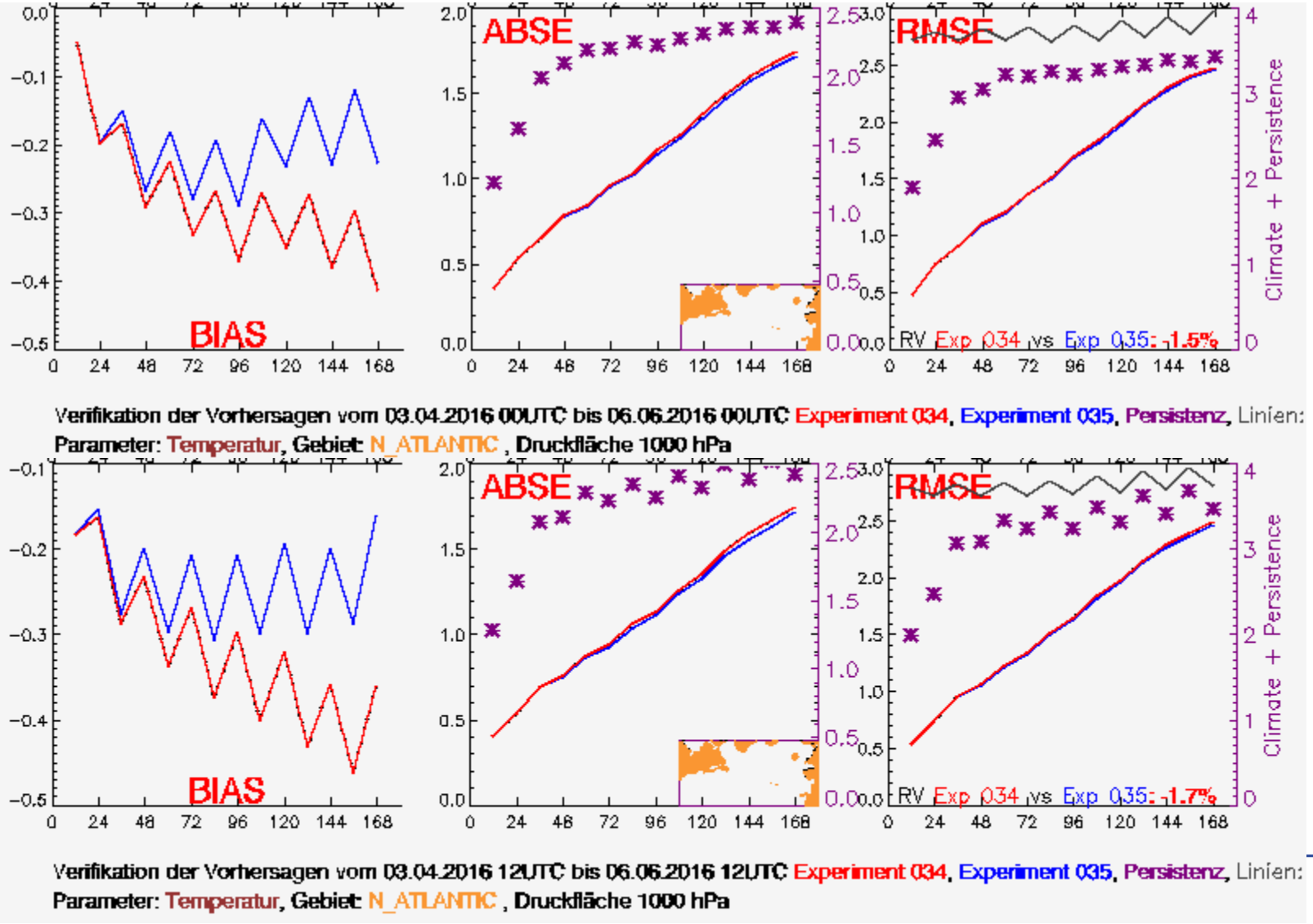
blue: with SST update, red: reference (fixed SST)



Impact of new bare soil evaporation scheme: RH and T @ 2m, Europe, July 2016

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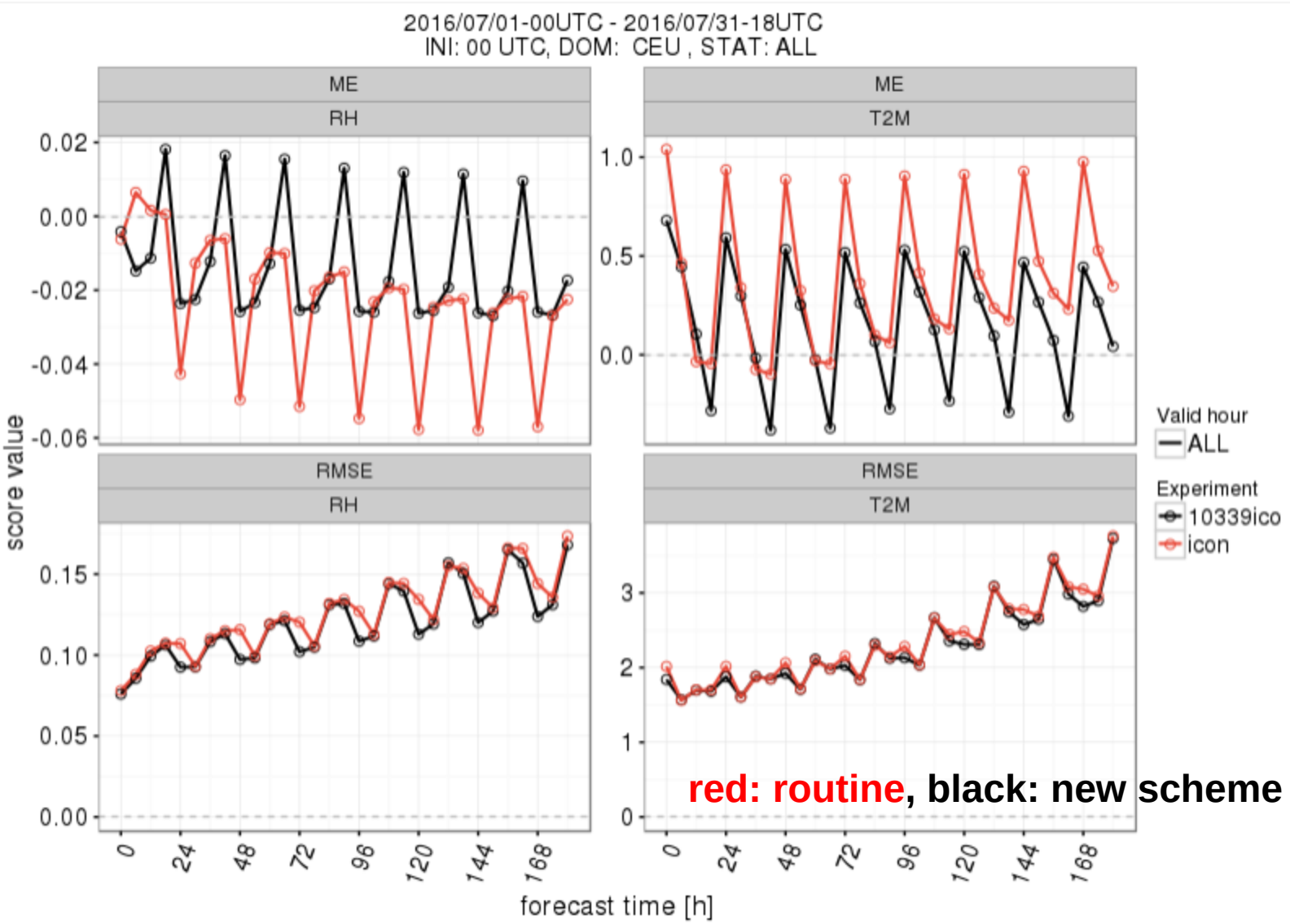
bias

RMSE



Impact of new bare soil evaporation scheme: RH and T @ 2m, Europe, September 2016

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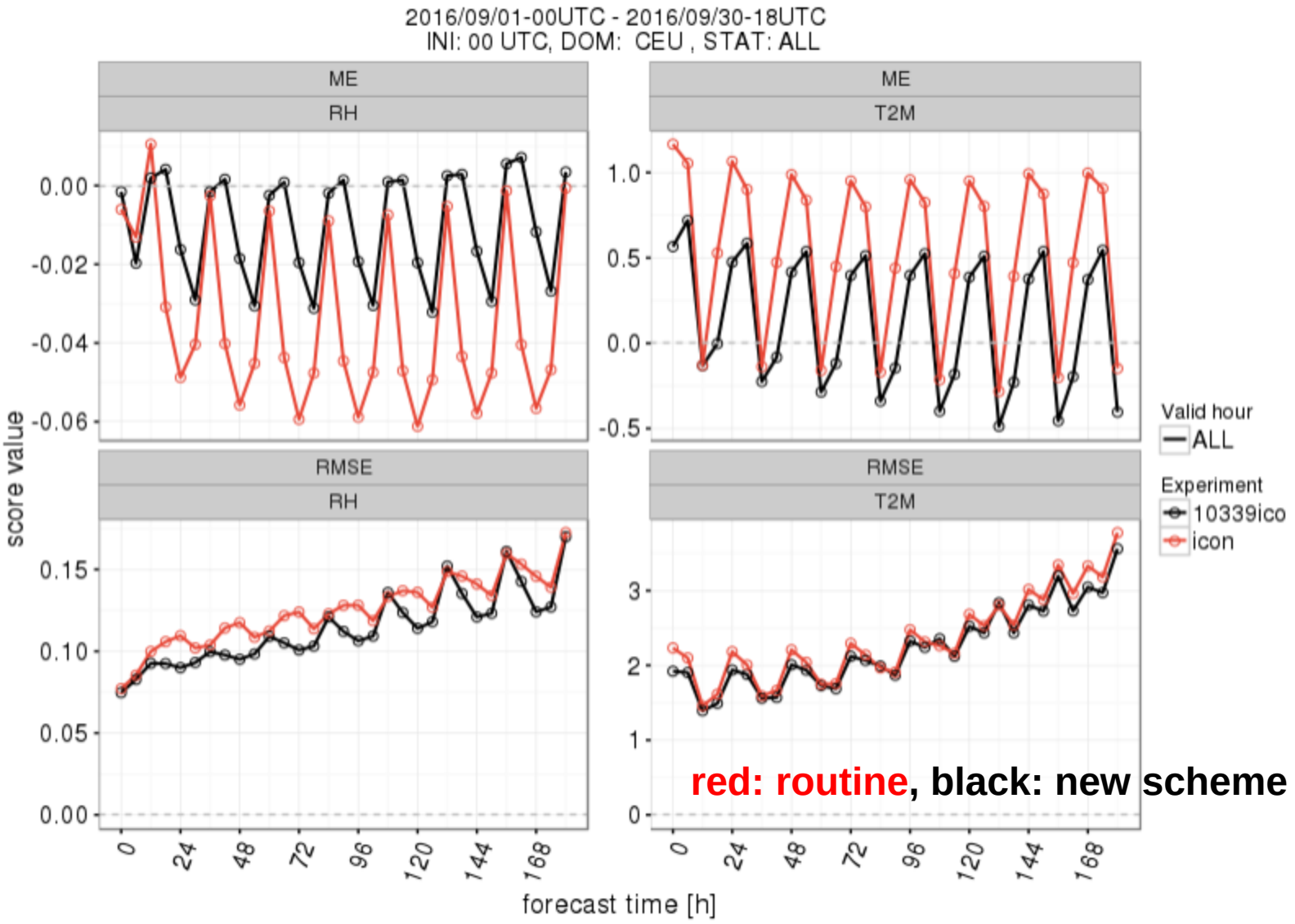

Impact of new bare soil evaporation scheme: RH and T @ 2m, SW-Siberia, September 2016

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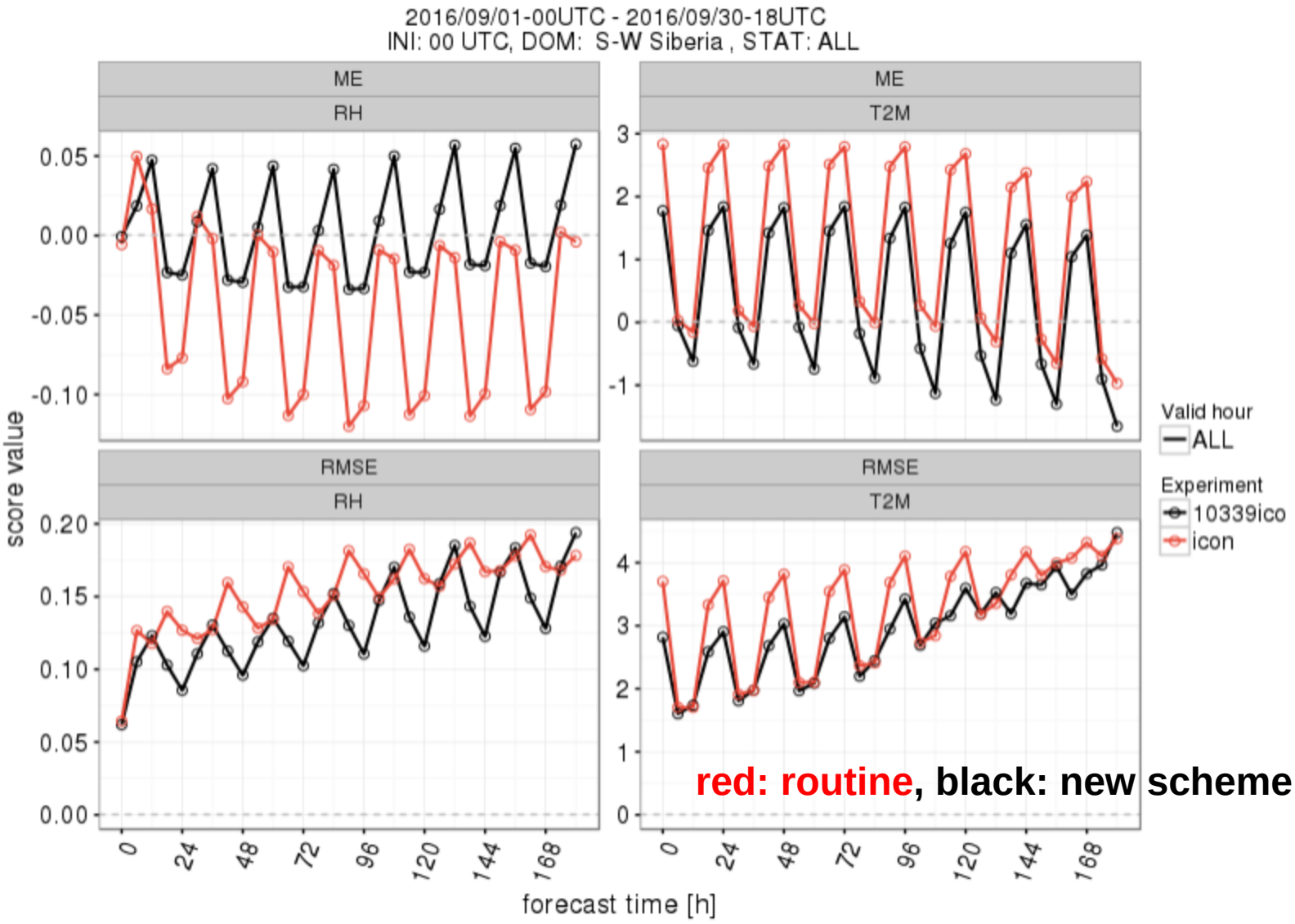
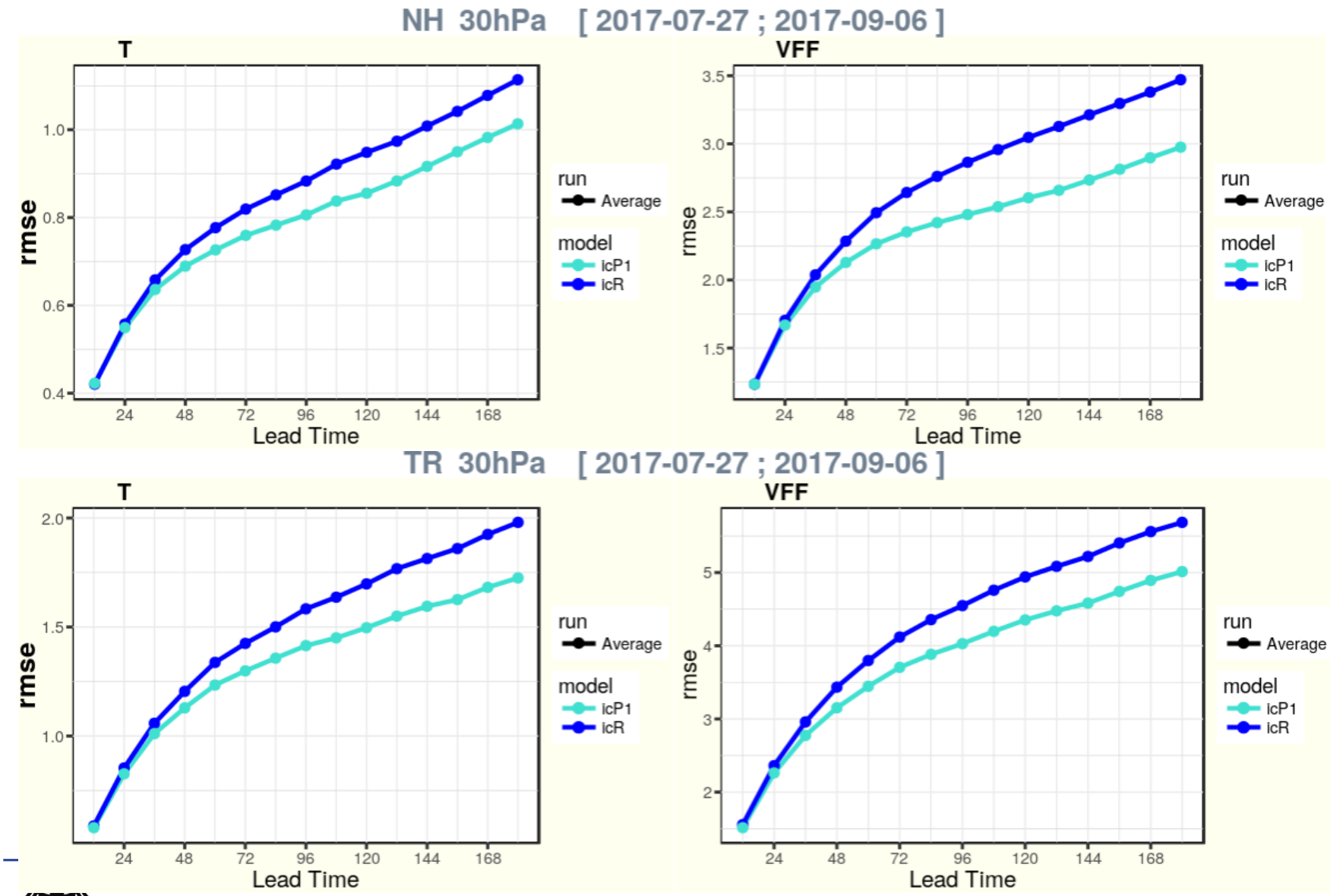


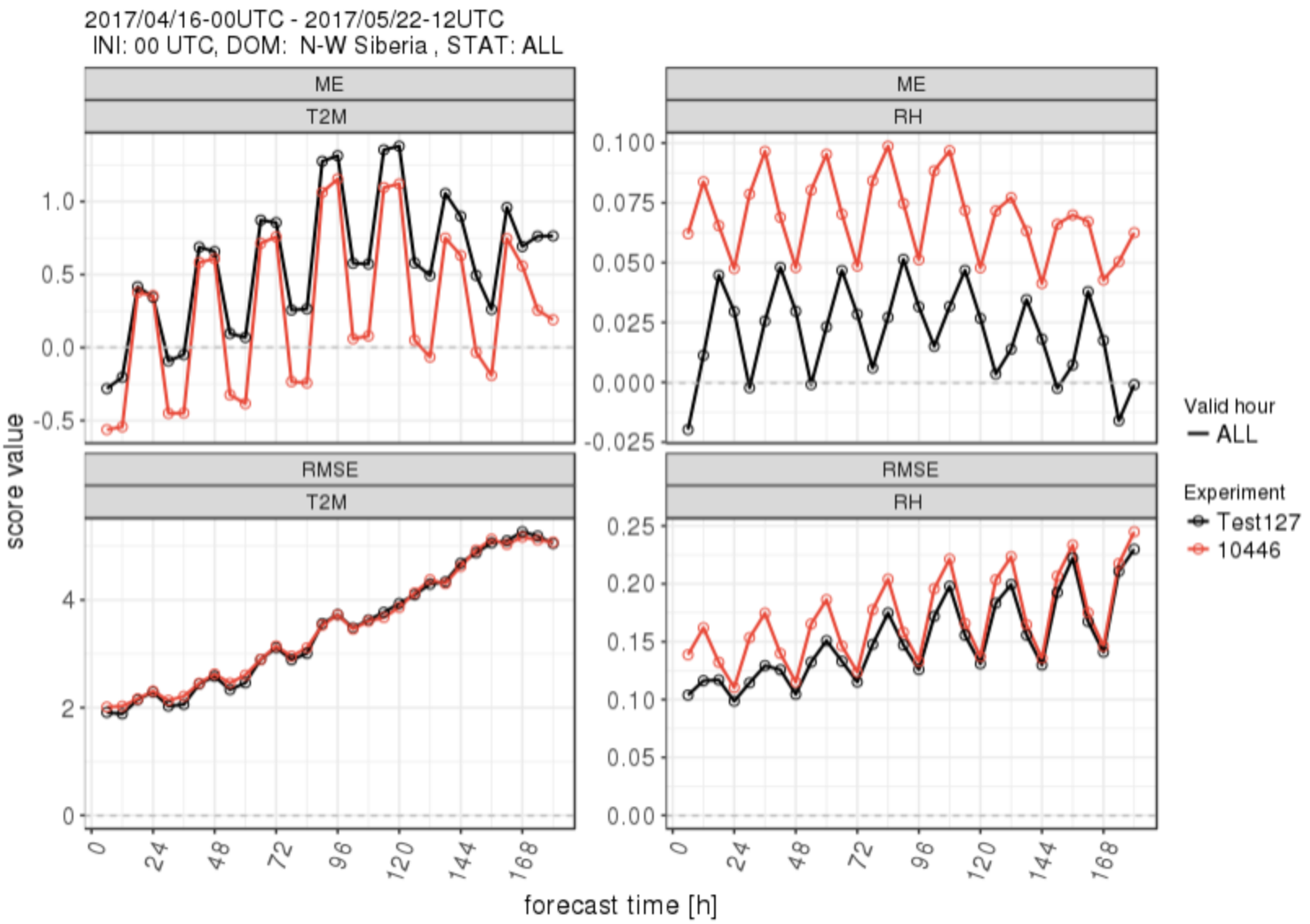
Retuning of stratospheric diffusion: Analysis verification of T and vector wind, NH and TR, 30 hPa



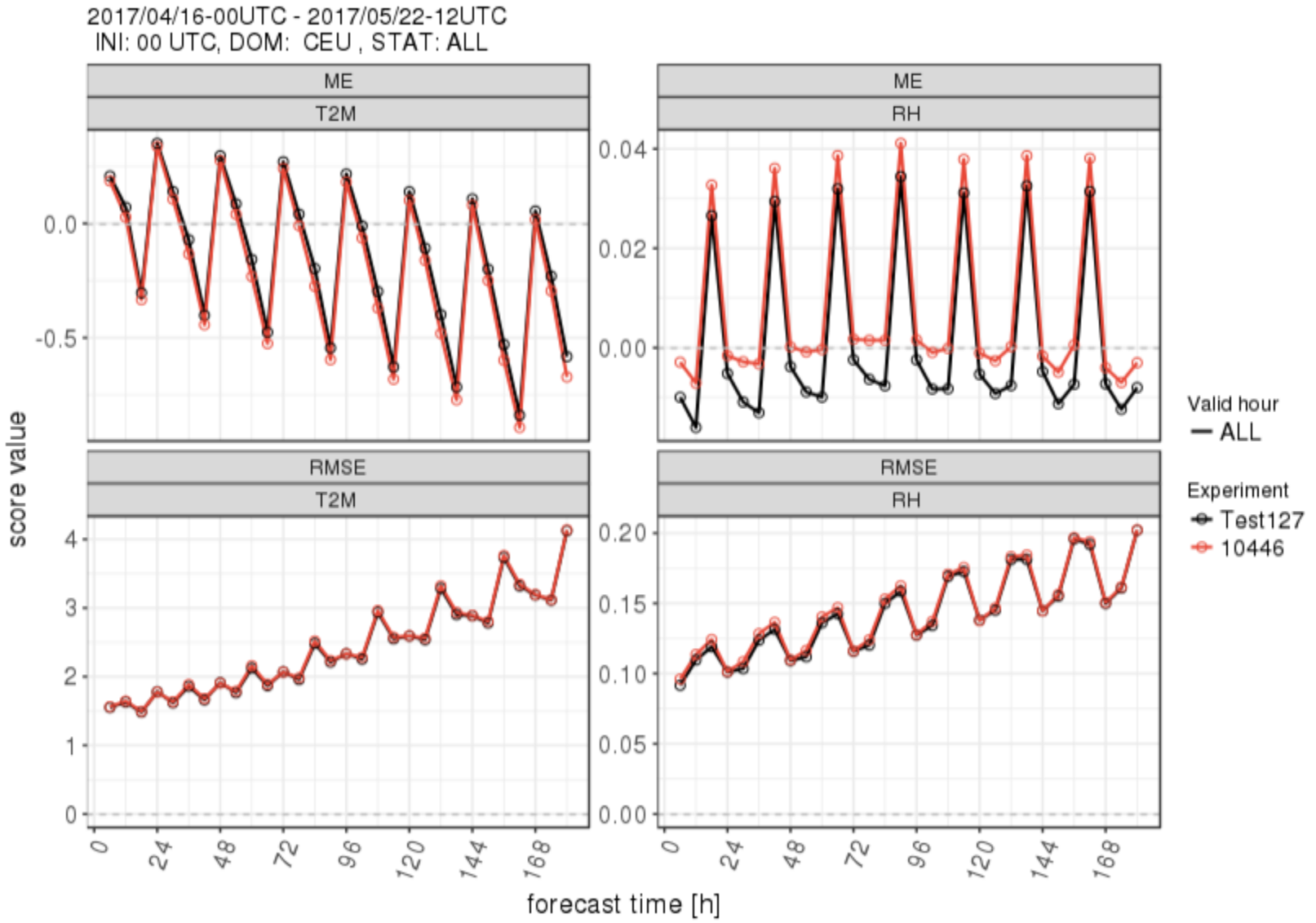
Evaporation from snow-covered areas

- **Problem:** Due to the lack of a canopy layer scheme, ICON uses a ‚darkened' snow albedo in the presence of higher vegetation; correspondingly, the snow temperature model variable represents a mixture of snow and vegetation elements rather than the snow itself
- On the other hand, we assume potential evaporation over a fully snow-covered surface
- Too much evaporation during daytime
- **Idea:** parameterize the temperature difference between the snow proper and the model variable T_SNOW depending on differential radiative heating and saturation deficit

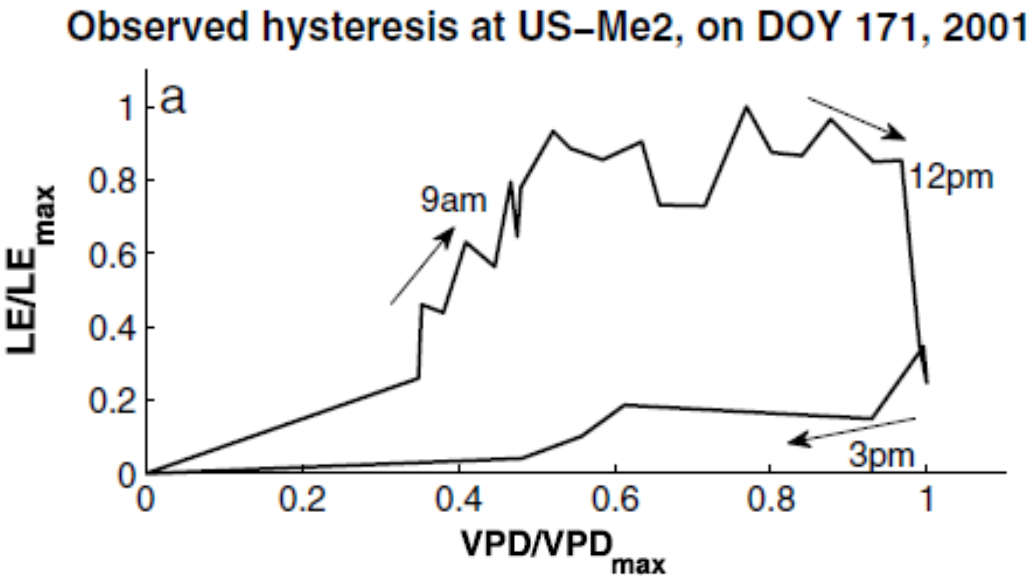
T2M + RH2M, April/May 2017, NW-Siberia



T2M + RH2M, April/May 2017, Europe



Observed diurnal cycle of plant evaporation (station in USA, early summer)



Matheny et al. (2014)

Plant evaporation

- **Detailed vegetation models include a prognostic variable for water storage in the stem**
- **Parameterization approach in TERRA: Introduce a prognostic variable for integrated plant evaporation since sunrise (with some offset) and vary minimum stomata resistance depending on this variable**

Preliminary results: June 2017, central Europe

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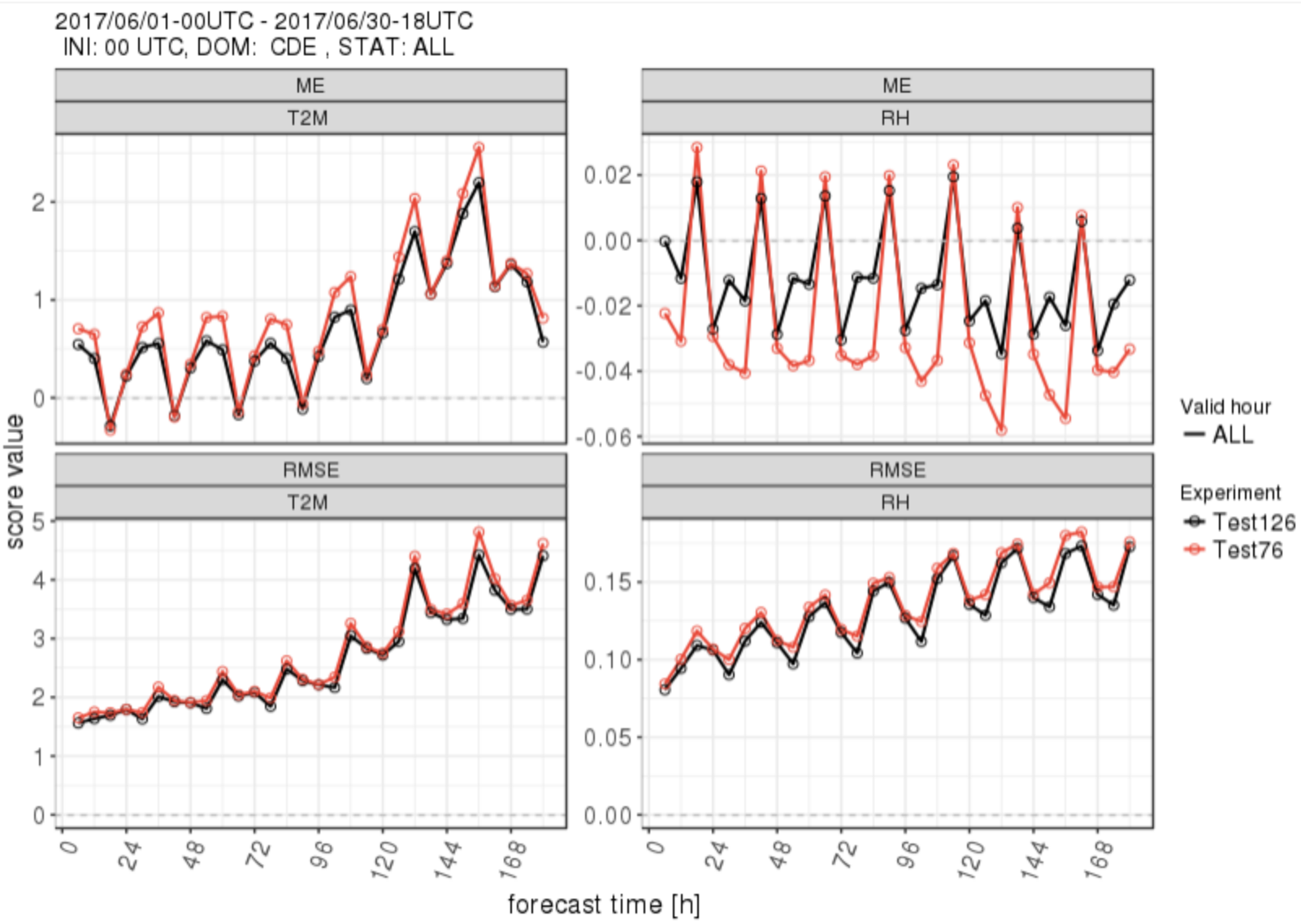

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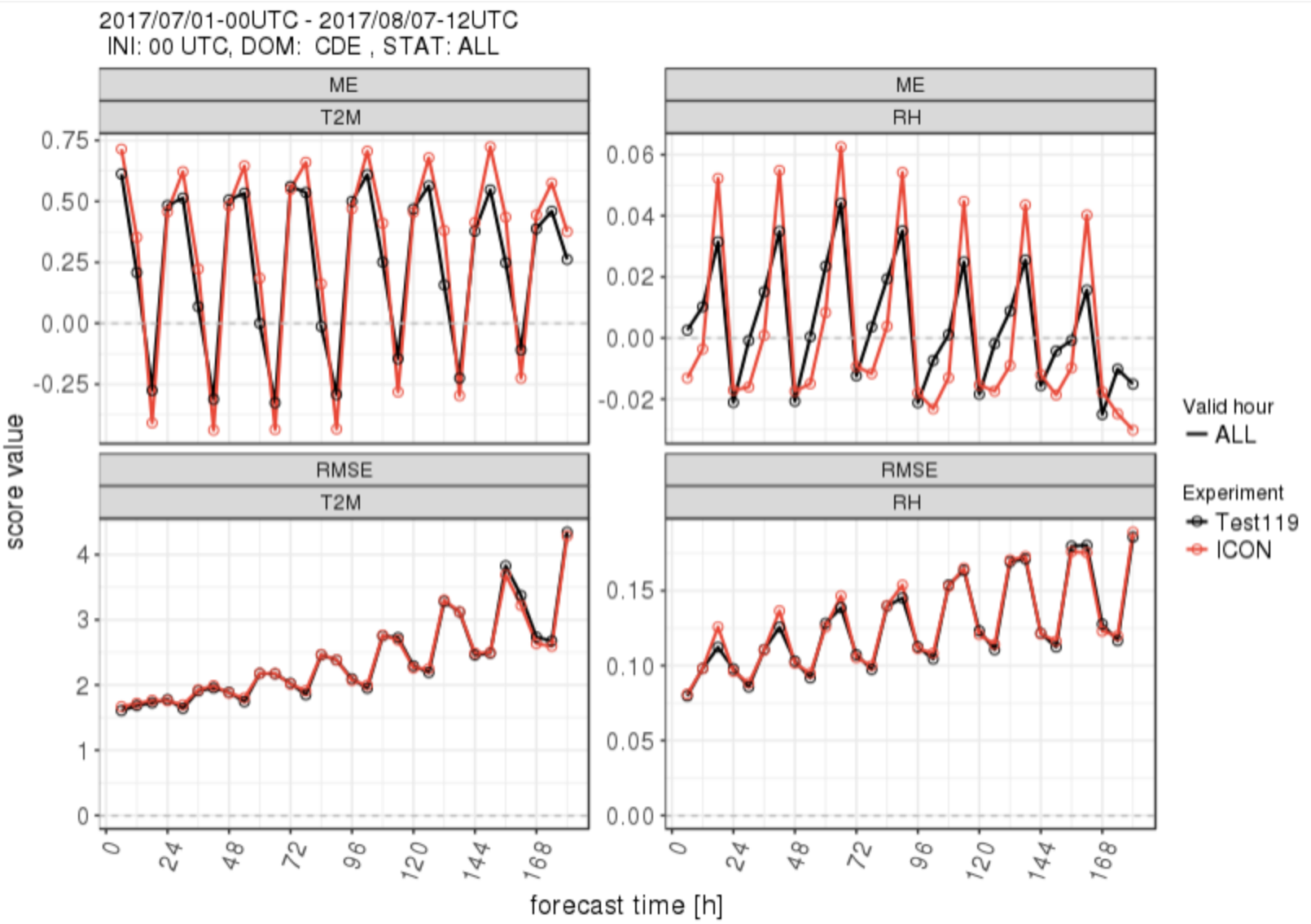

Evolution of forecast quality since 1968: Tendency correlation of sea-level pressure, Northern Atlantic and Europe

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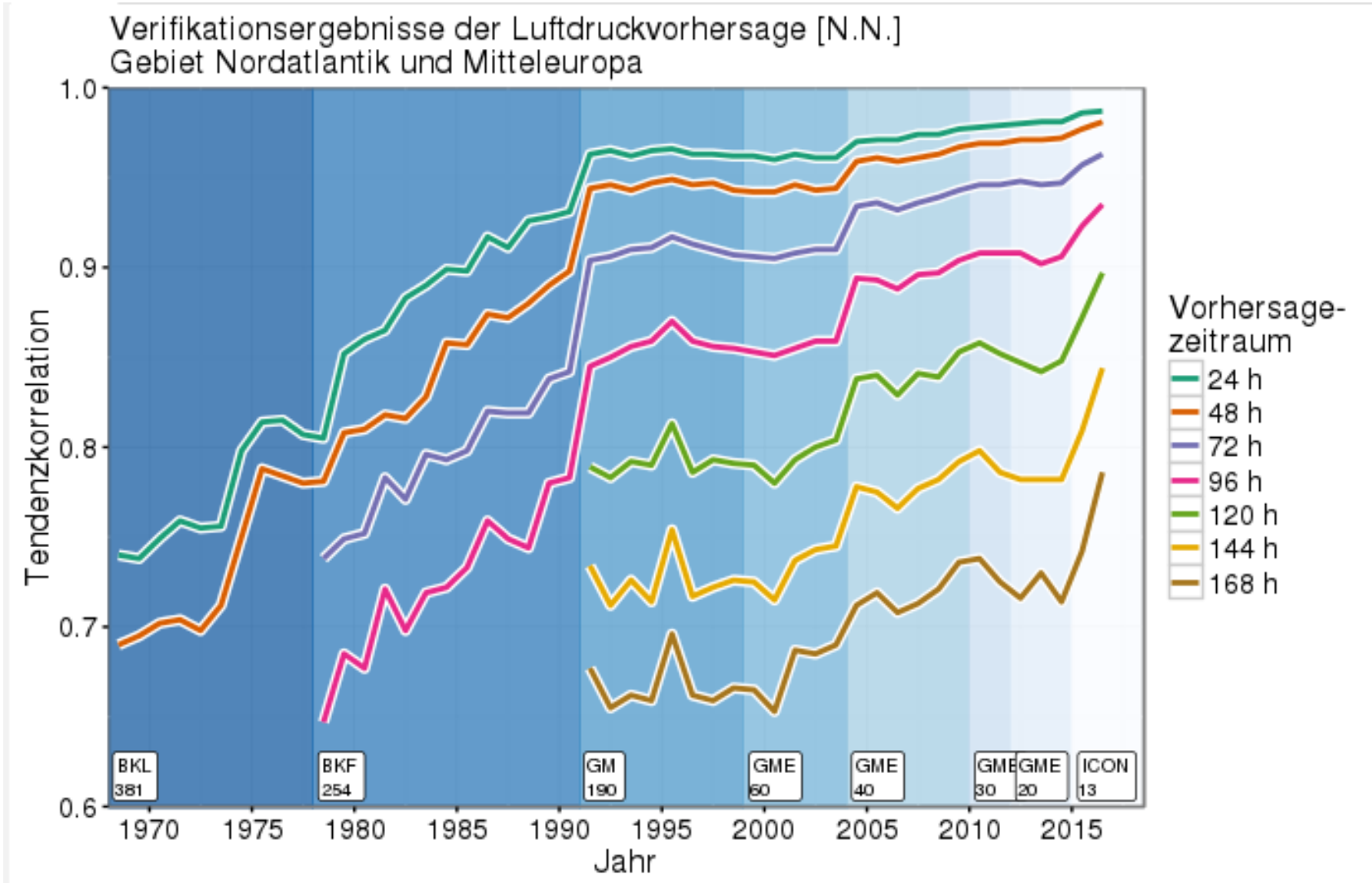
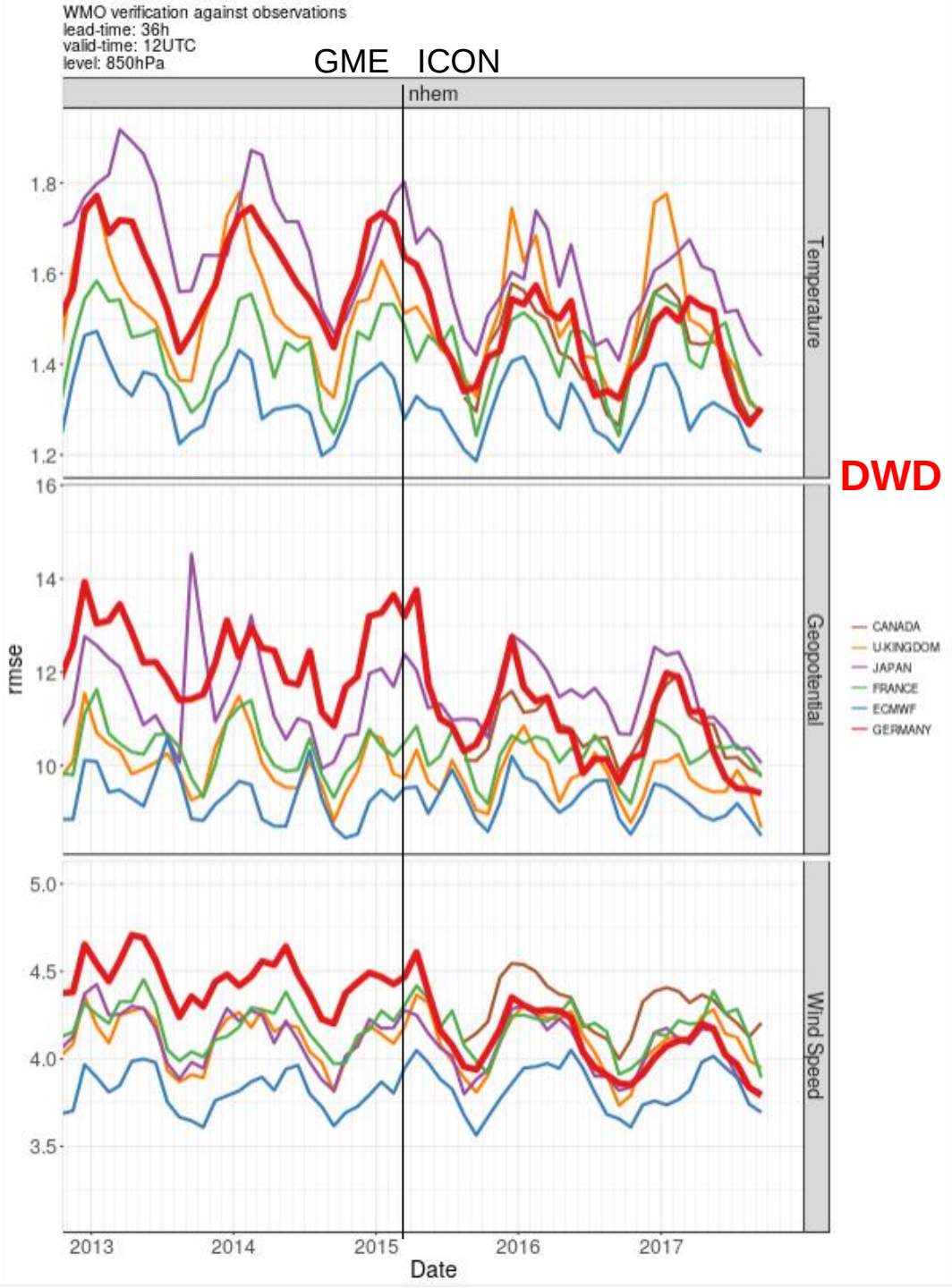


WMO verification against radiosondes

Comparison between DWD and other global NWP centers

RMS errors of temperature, geopotential and wind speed at 850 hPa, lead time 36 h, northern hemisphere

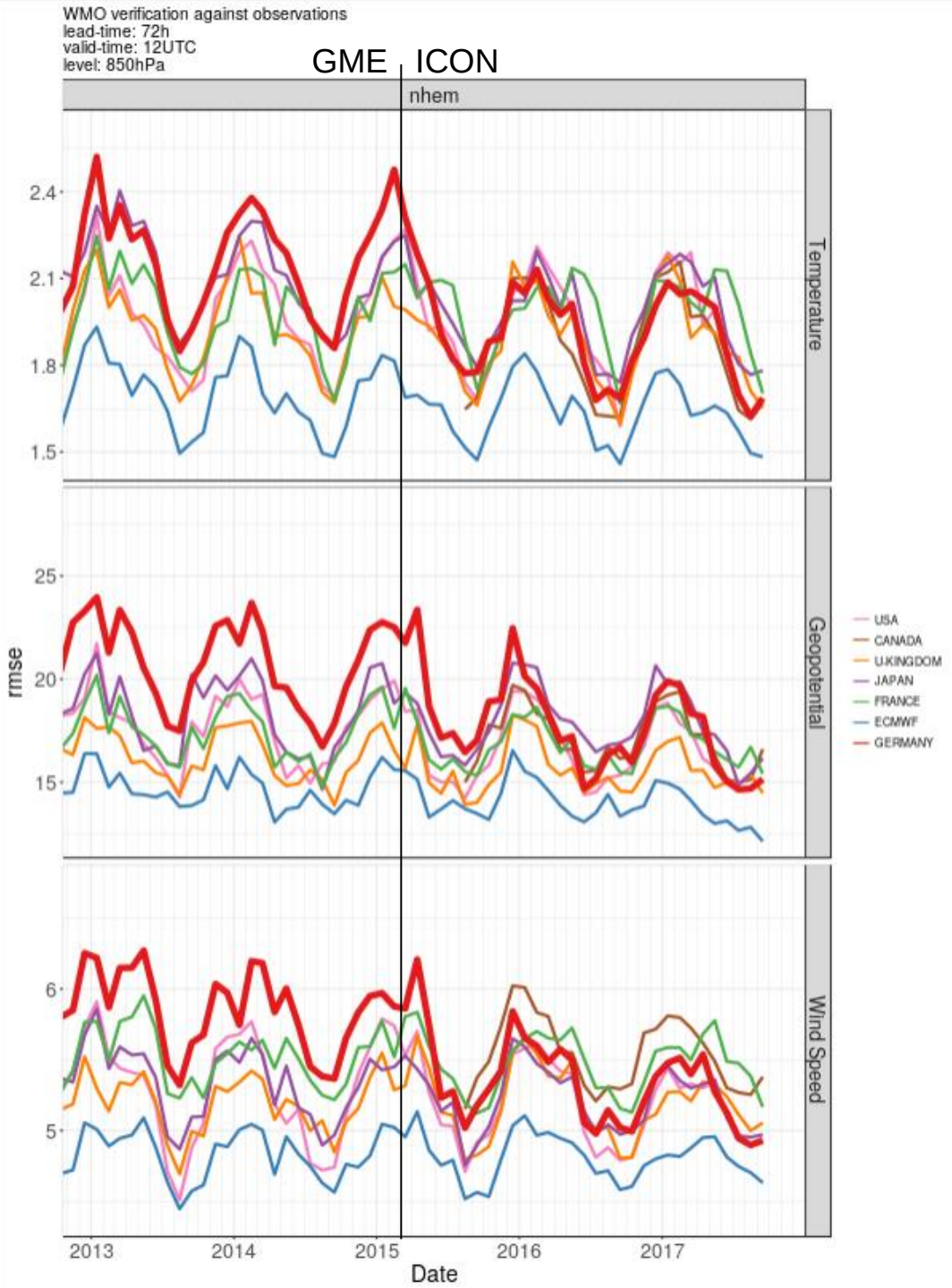


DWD

WMO verification against radiosondes

Comparison between DWD and other global NWP centers

RMS errors of temperature, geopotential and wind speed at 850 hPa, lead time 72 h, northern hemisphere



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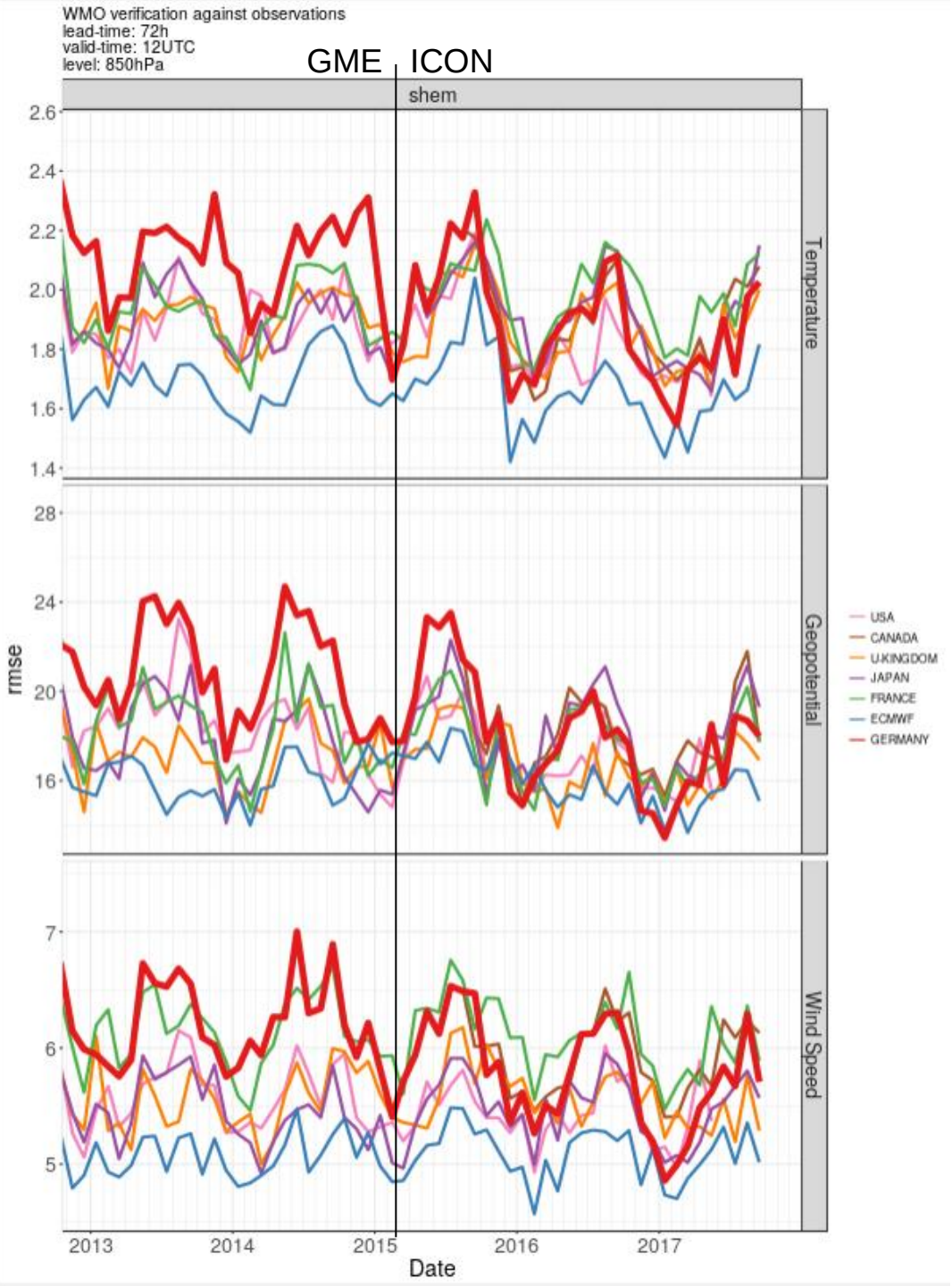

To summarize…

Substantial improvements in forecast quality with the change from GME to ICON, and progress is ongoing!