

Evaluation of the global radiation simulated by the operational ICON model over Germany

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COSMO WG3b / CLM SOILVEG Working Group Meeting

ICCARUS and Working Group Meetings, 26 Feb. - 2 Mar. 2018, Offenbach

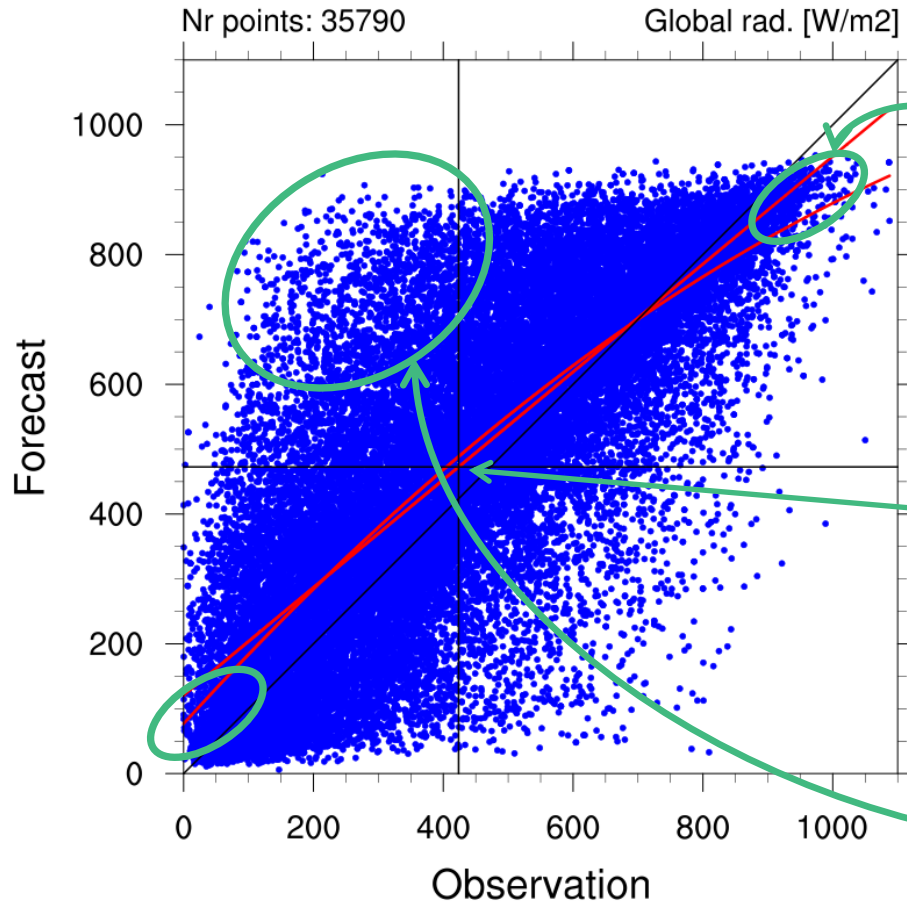


201707, 07-17h, Globalstrahlung

Andrea Steiner, DWD

opera, 2017070100 - 2017073100, vv=07-17 h

→ Tagsüber



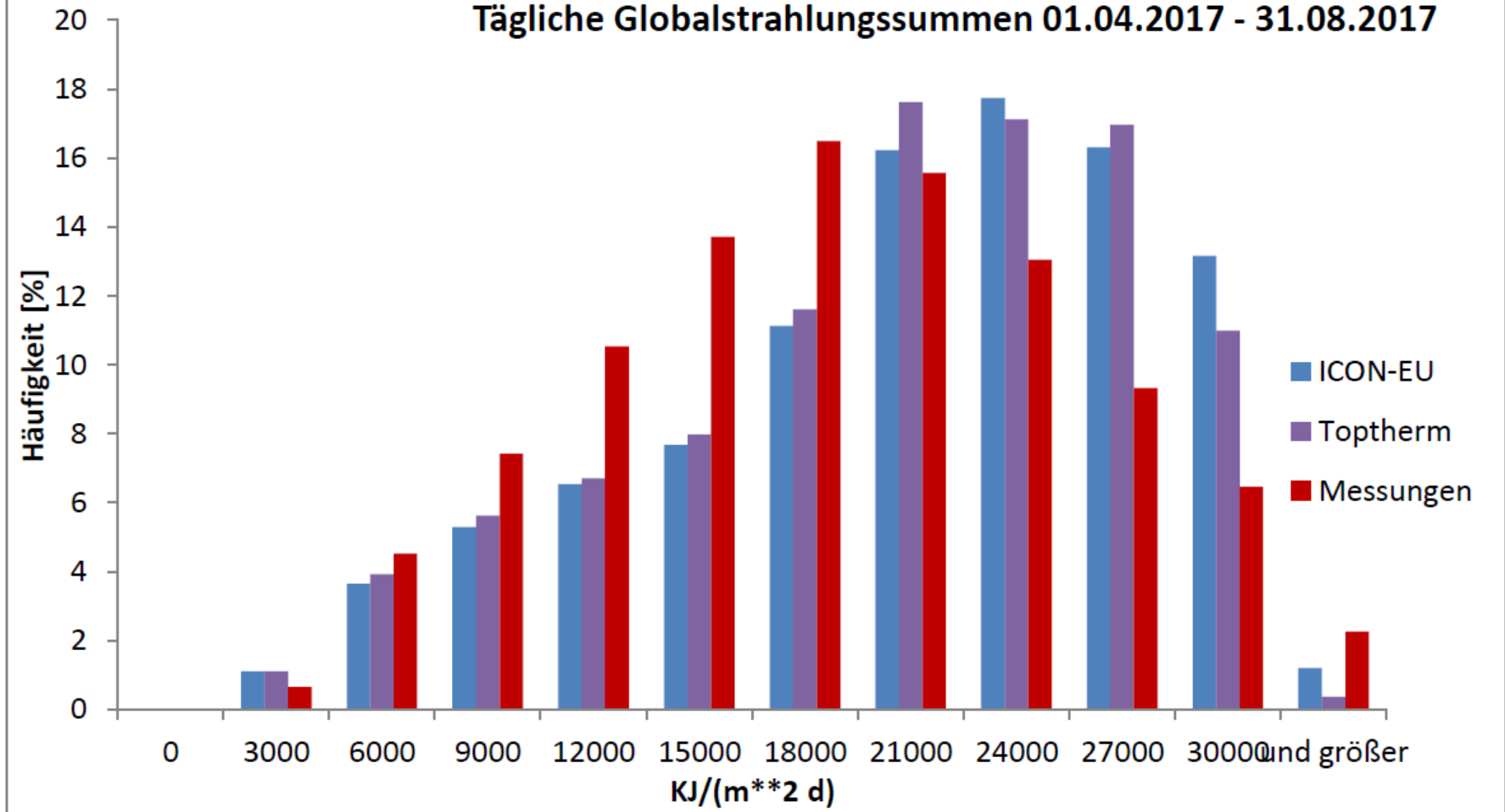
Hohe Einstrahlungswerte werden unterschätzt (optisch zu dicke Aerosole/Zirren/Atmosphäre?);
Geringe Einstrahlungswerte überschätzt (fehlende Wolken?)

Mittlerer Bias von knapp 50 W/m² im Juli; (Auswertung nur für Lindenberglage aber über 1 Jahr ergab: 20 W/m²)

Überschätzung der Einstrahlung;
Optisch zu dünne Wolken?
Oder zu wenig Wolken?

All: rmse: 167.95, bias: 49.01, mae: 122.25, stdv: 160.64, min: -776.65, max: 725.51

Tägliche Globalstrahlungssummen 01.04.2017 - 31.08.2017



Ralf Thehos, DWD: „Der Vergleich mit den Messungen von ca. 100 DWD-Synopstationen für das Sommerhalbjahr 2017 ergibt eine im Mittel 12.85% höhere tägliche Globalstrahlungssumme des ICON-EU-Modells gegenüber den Messungen. Tage mit Globalstrahlung unterhalb des Mittel- oder Medianwertes sind gegenüber den Messungen unterrepräsentiert, Tage mit Globalstrahlung darüber sind überrepräsentiert.“

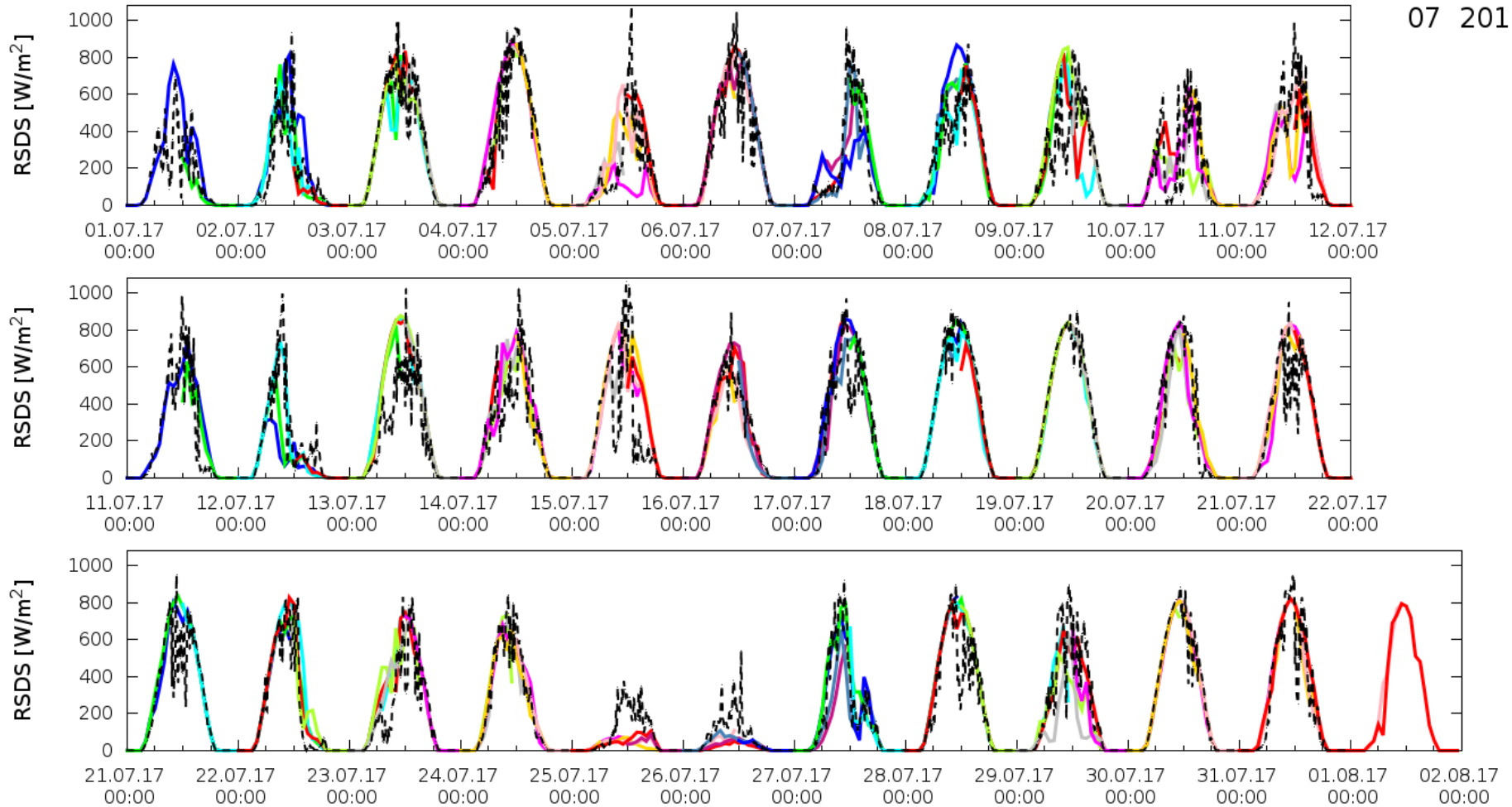


ICON GLOBAL

downward_shortwave_flux_in_air

stations_id=5810 Falkenberg

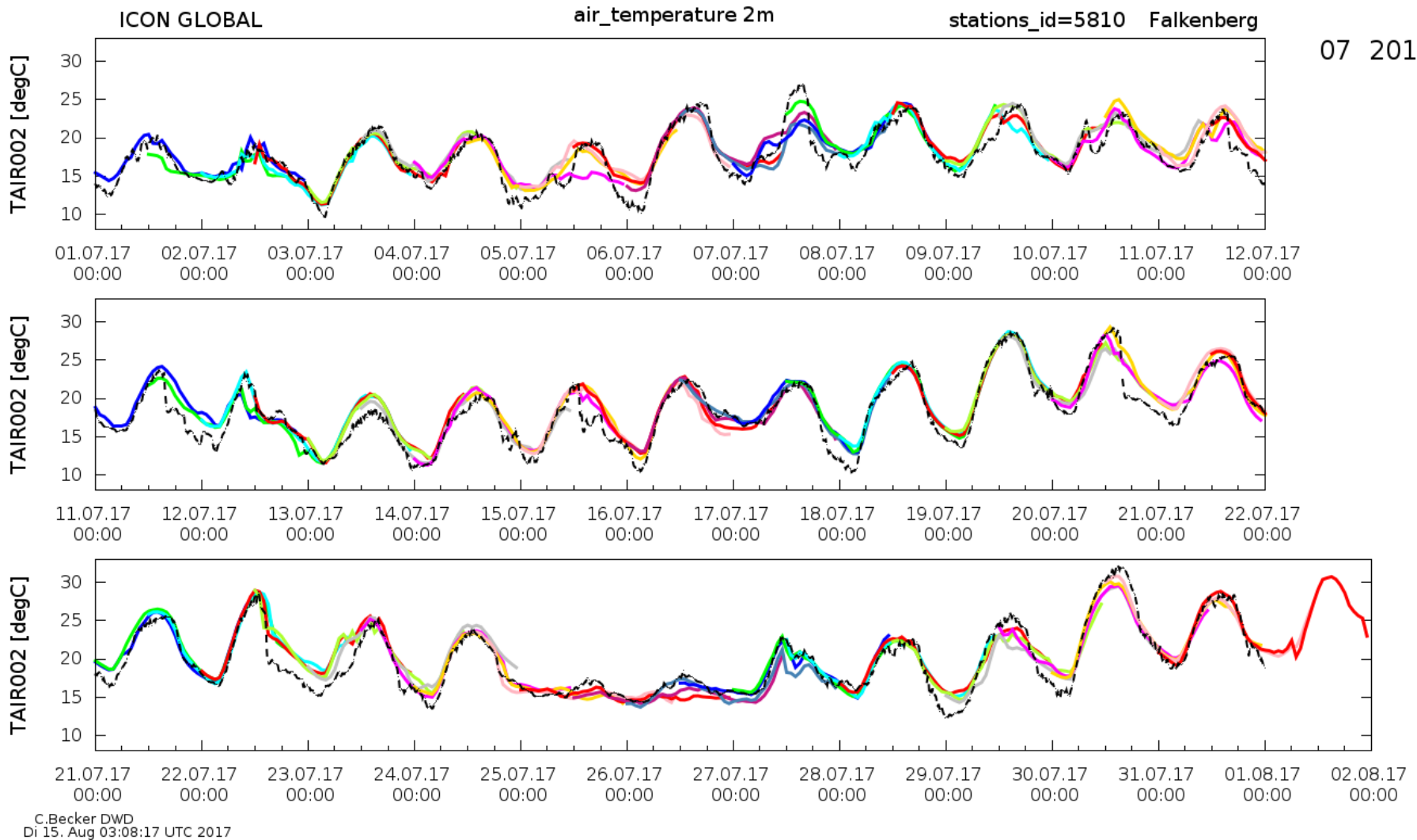
07 2017



C.Becker DWD
Di 15. Aug 03:08:26 UTC 2017

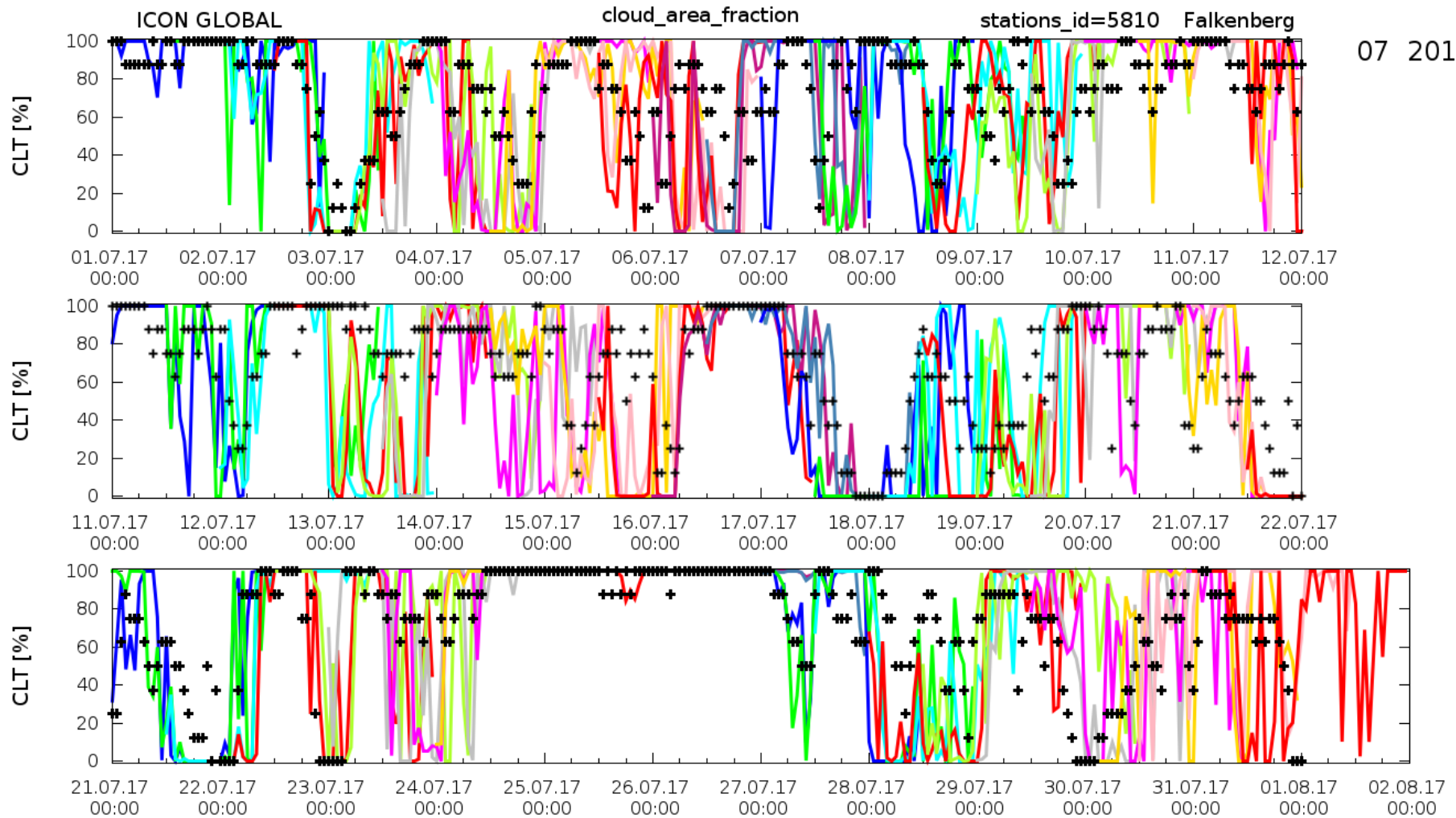
Downward shortwave radiation at surface: For clear sky (19 & 30 Jul.) good (or slightly underestimated), for partly cloudy conditions (13 & 14 Jul.) overestimated.





2-m temperature: For clear sky (19 & 30 Jul.) diurnal amplitude underestimated, for partly cloudy conditions (13 & 14 Jul.) diurnal amplitude (often) overestimated.

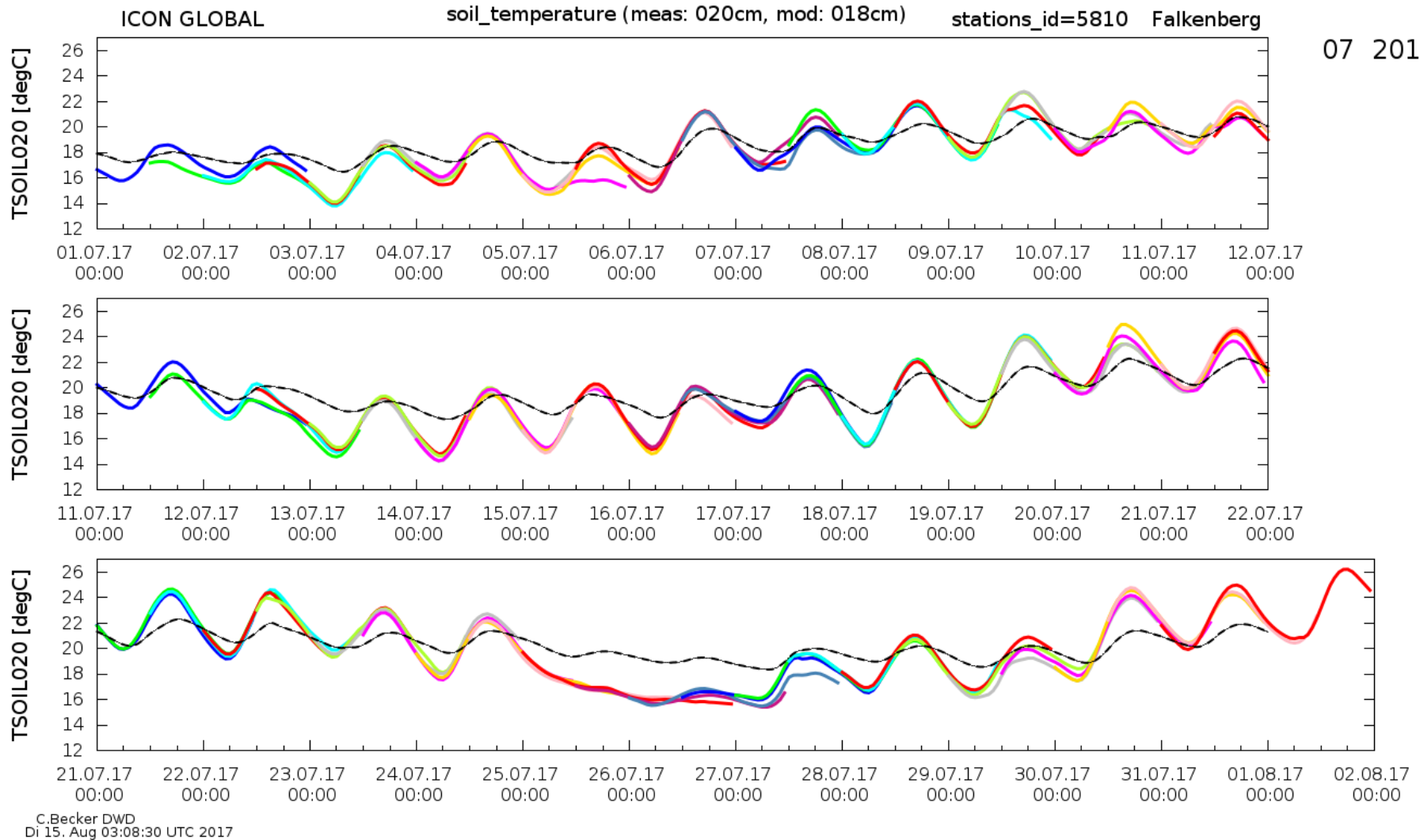




07 2017

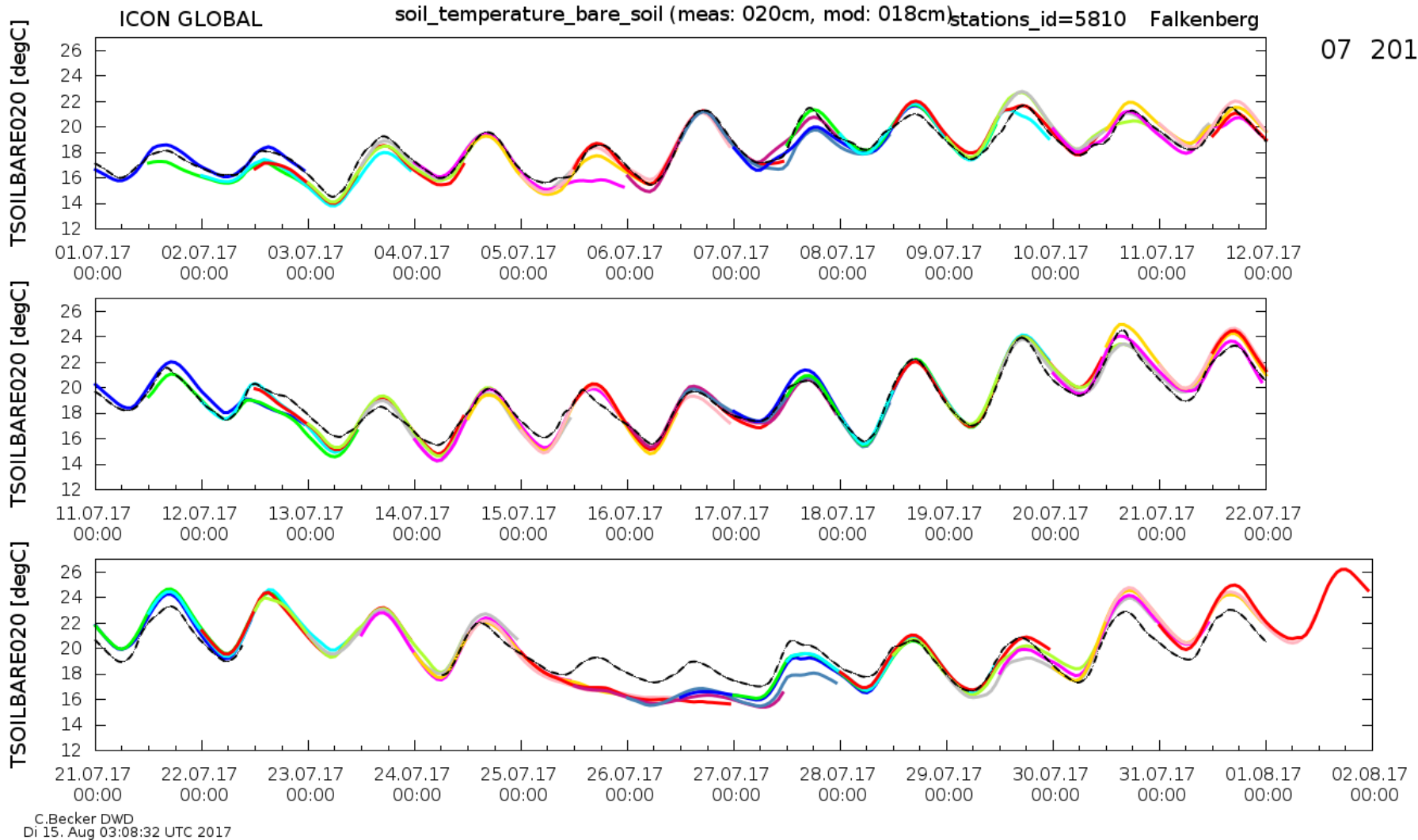
C.Becker DWD
Di 15. Aug 03:08:28 UTC 2017





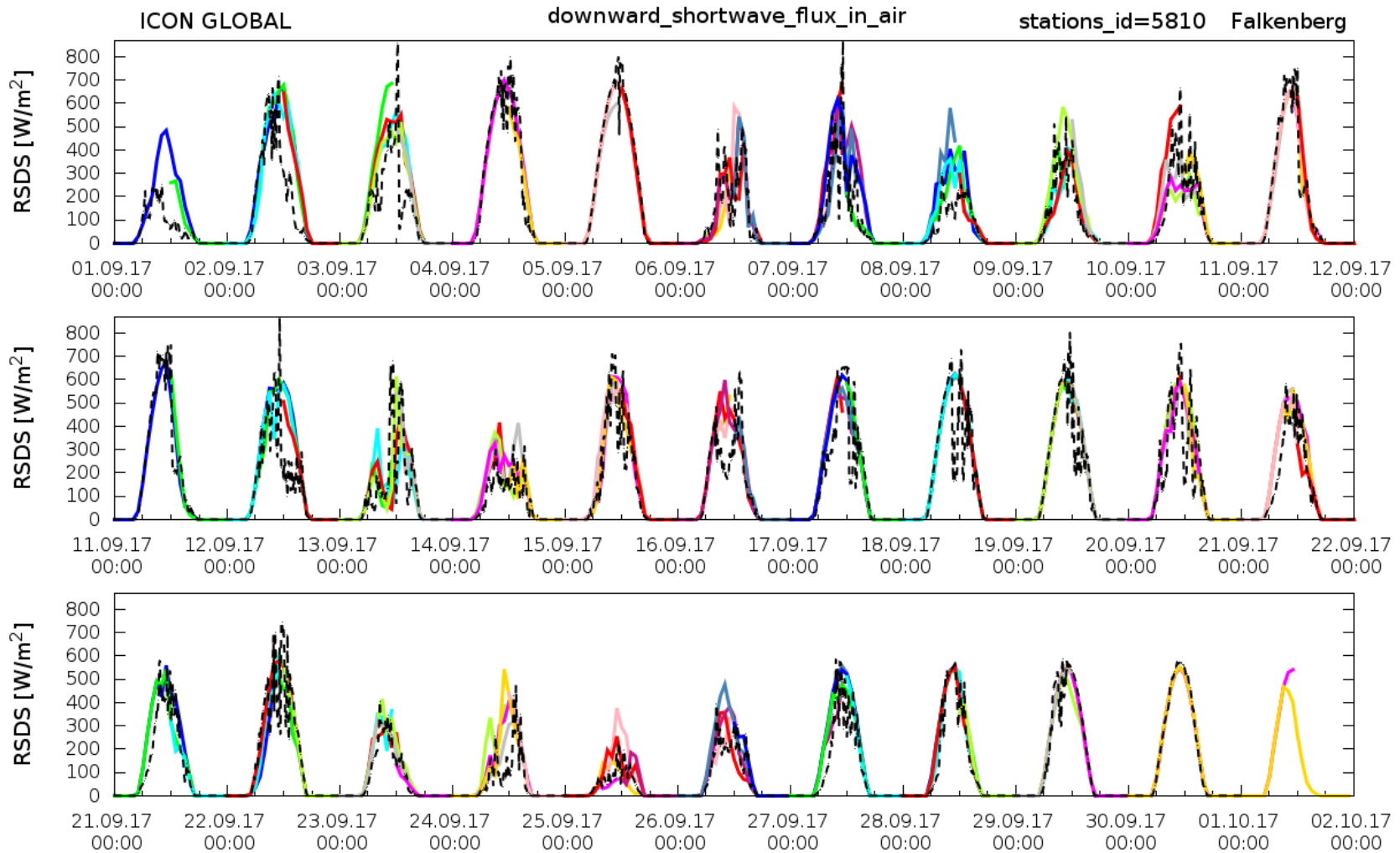
Amplitudes of the diurnal cycles of the simulated soil temperatures under grass are systematically overestimated.





Amplitudes of the diurnal cycles of the soil temperatures under bare soil are simulated very well.



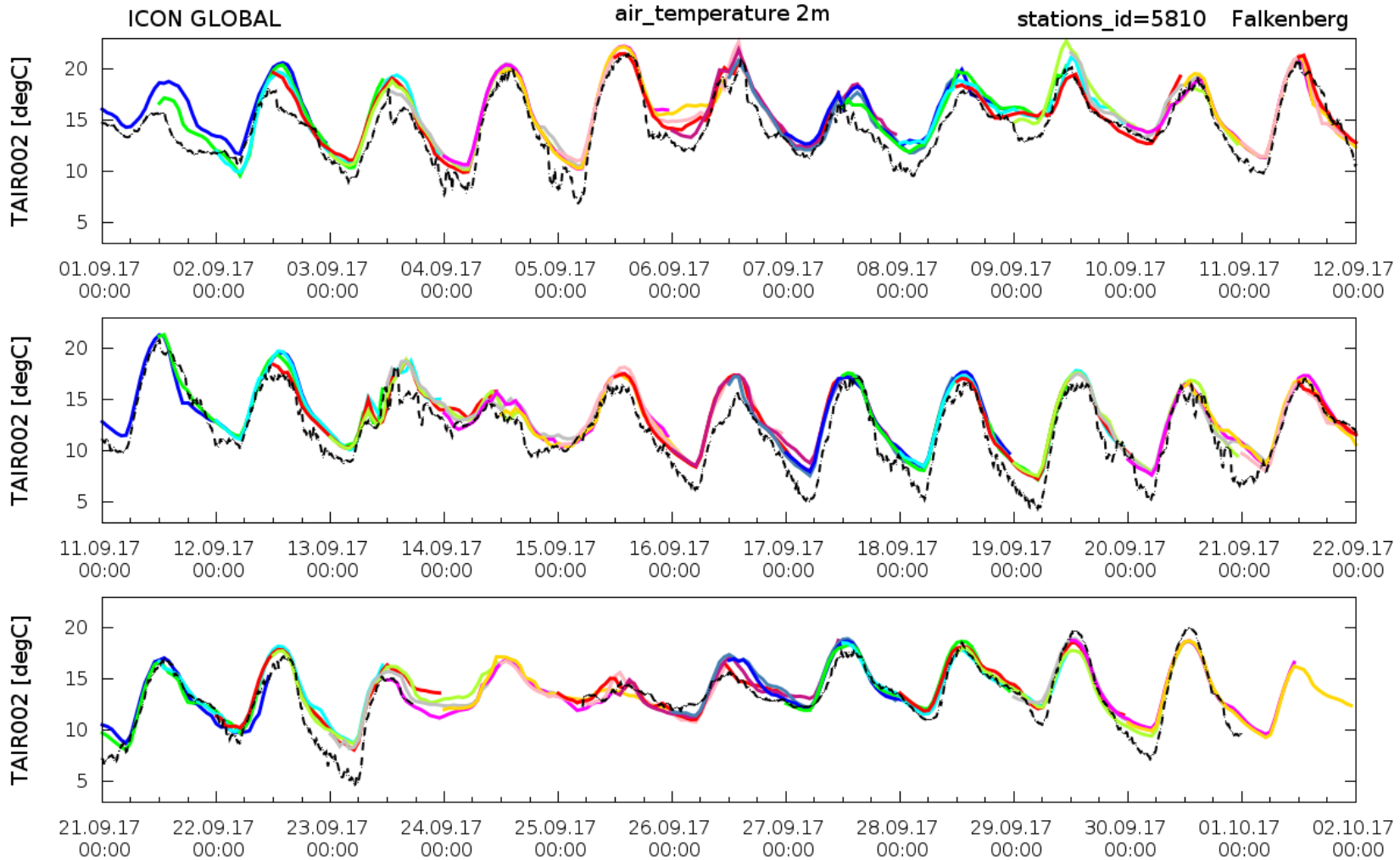


09 2017

C.Becker DWD
So 15. Okt 06:27:15 UTC 2017

Downward shortwave radiation at surface: For clear sky (30 Sep.) good (or slightly underestimated), for partly cloudy conditions (1 & 2 Sep.) overestimated.

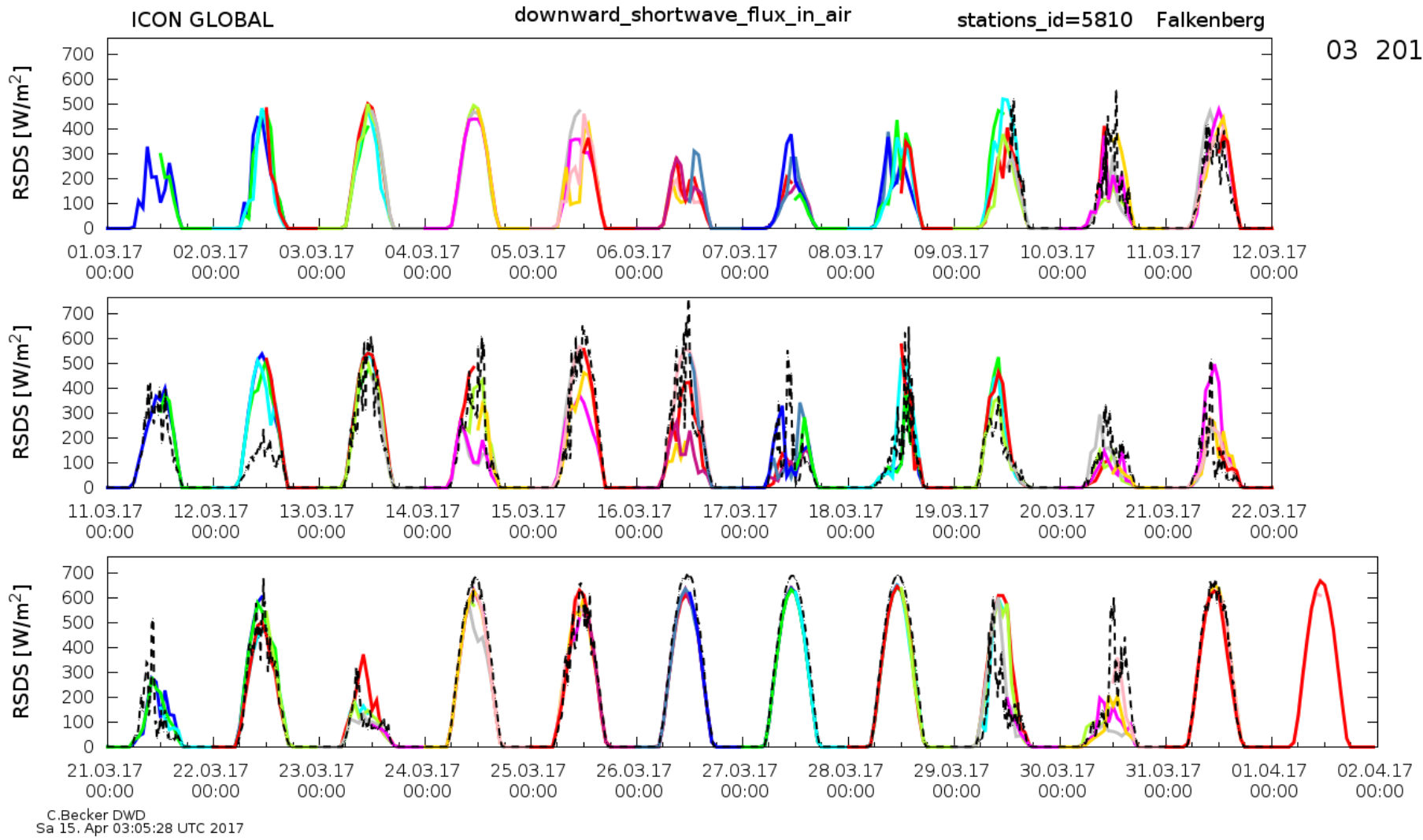




C.Becker DWD
So 15. Okt 06:27:05 UTC 2017

2-m temperature: For clear sky (30 Sep.) diurnal amplitude underestimated, for partly cloudy conditions (1 & 2 Sep.) diurnal amplitude (often) overestimated.

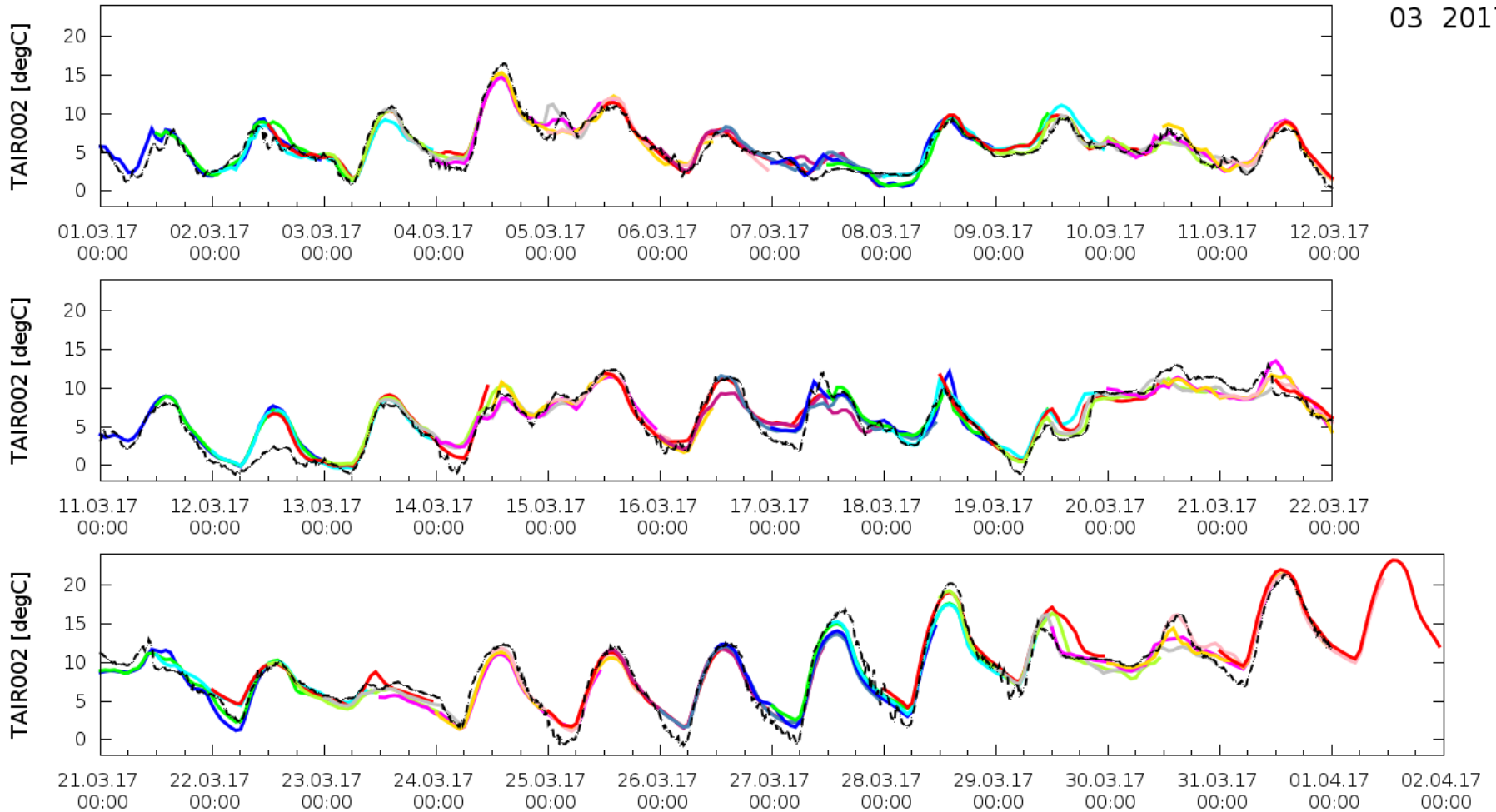




03 2017

Downward shortwave radiation at surface: For clear sky (31 Mar.) good (or slightly underestimated), for partly cloudy conditions (12 Mar.) overestimated.





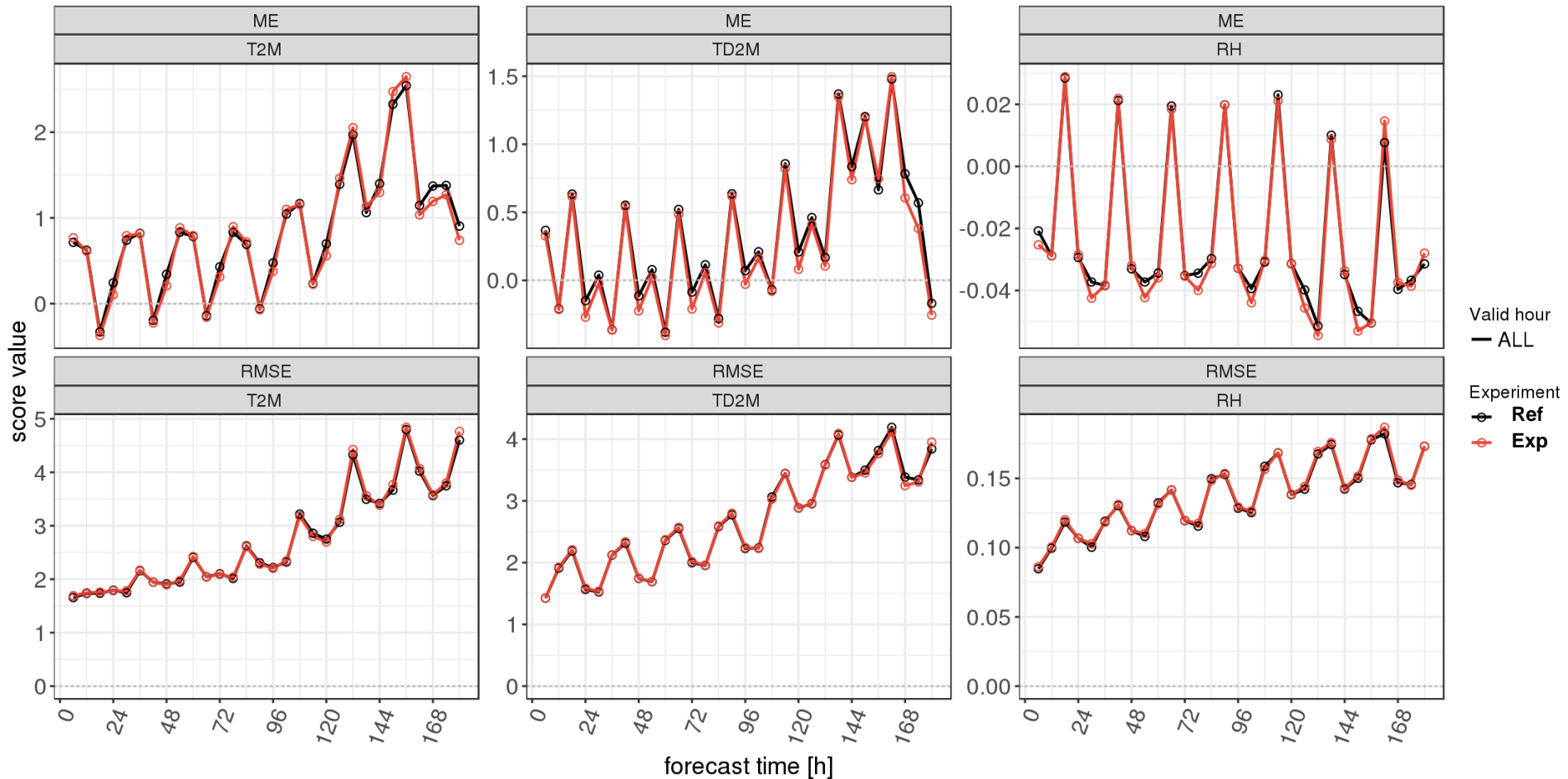
C.Becker DWD
 Sa 15. Apr 03:05:14 UTC 2017

2-m temperature: For clear sky (31 Mar.) diurnal amplitude underestimated, for partly cloudy conditions (12 Mar.) diurnal amplitude (often) overestimated.



ICON: Central Europe, June 2017, 00 UTC

2017/06/01-00UTC - 2017/06/30-18UTC
INI: 00 UTC, DOM: CDE, STAT: ALL



ICON shows warm bias at noon, and strange cold and moist bias at 18 UTC.
Problem in transpiration?



Surface temperature in TERRA

(Doms et al. 2011)

$$C_s \frac{\partial T_s}{\partial t} = R_{SW} + R_{LW} + LE + H + G$$

T_s : surface temperature

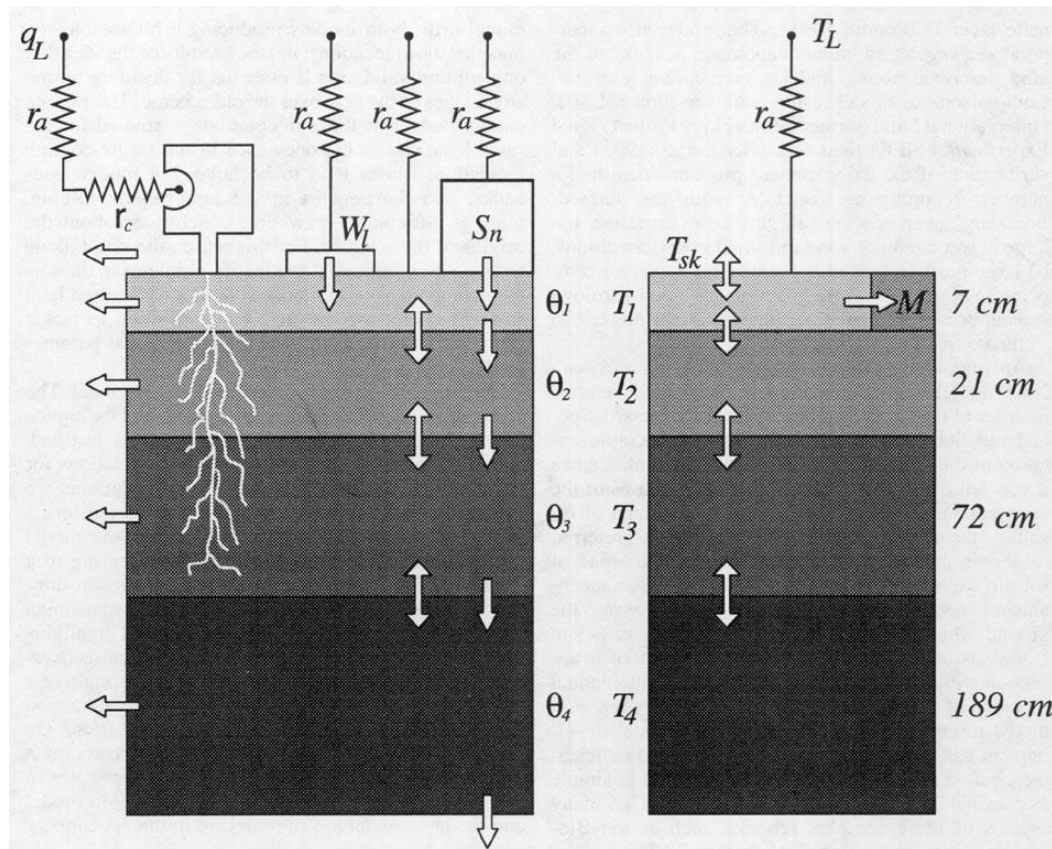
C_s, t : heat capacity per unit area, time

R_{SW}, R_{LW} : net shortwave radiation flux, net longwave radiation flux

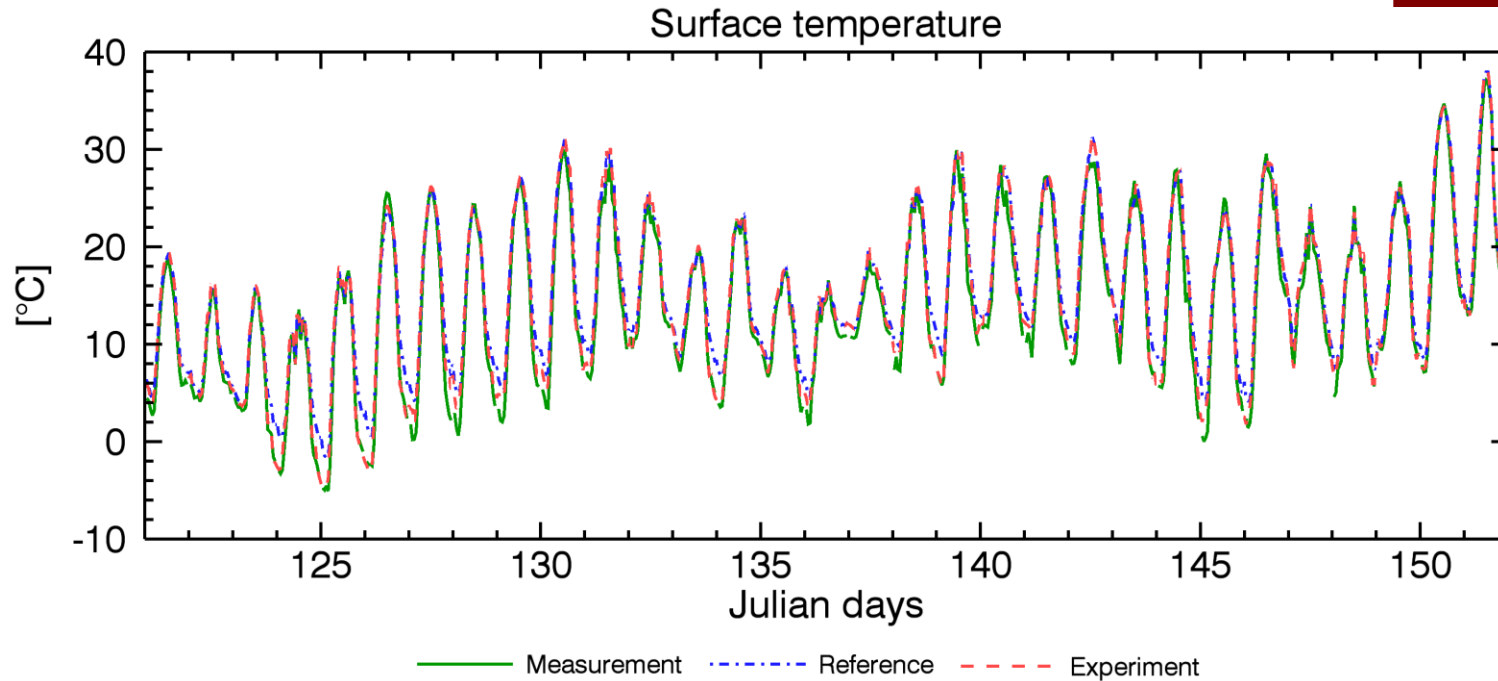
LE, H, G : latent heat flux, sensible heat flux, ground heat flux

Skin temperature in IFS

(Viterbo and Beljaars 1995)

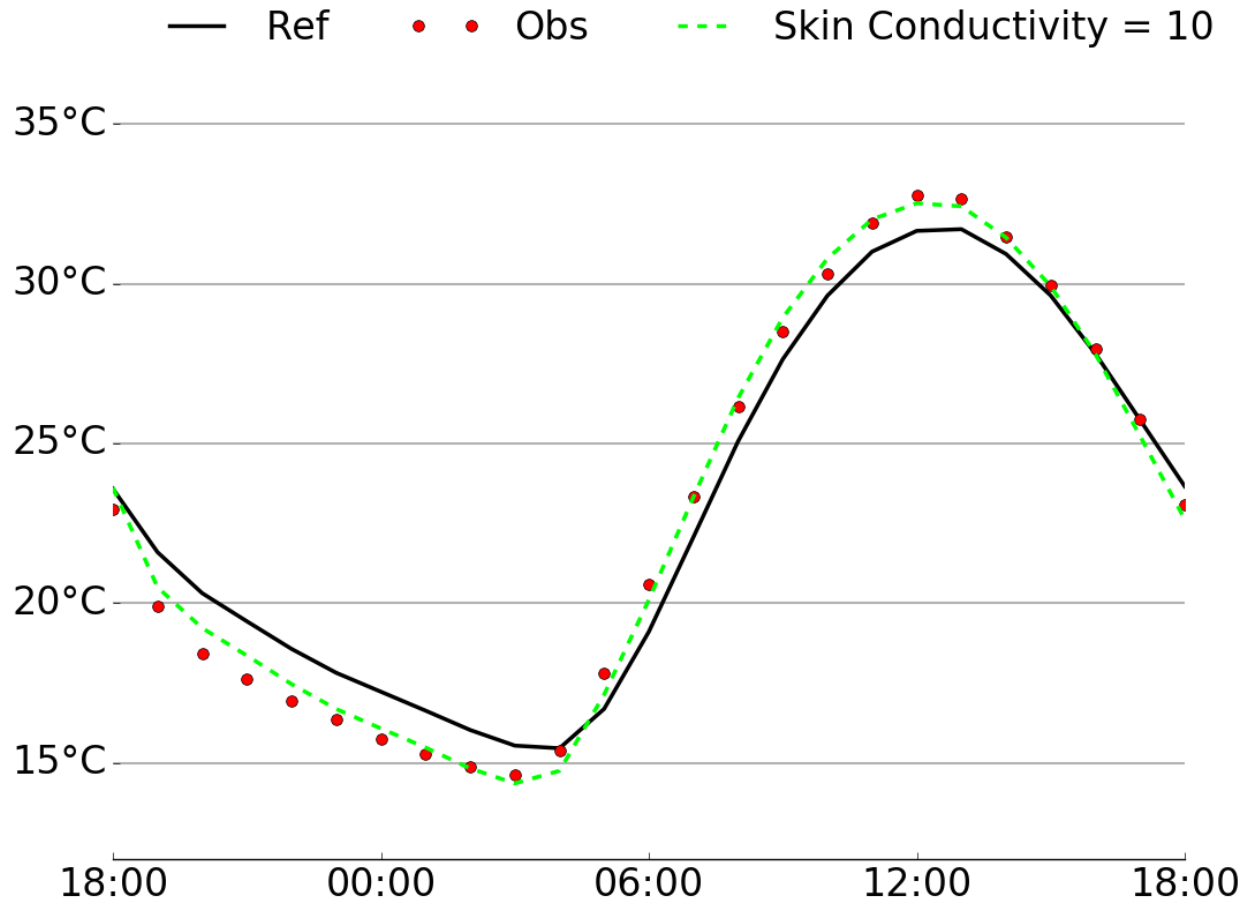


May 2011



Amplitude of the diurnal cycle of the surface temperature in TERRA is systematically underestimated (clear nocturnal warm bias), with the skin temperature formulation it is substantially increased and much closer to the measurements

COSMO-DE: 1 - 2 July 2015

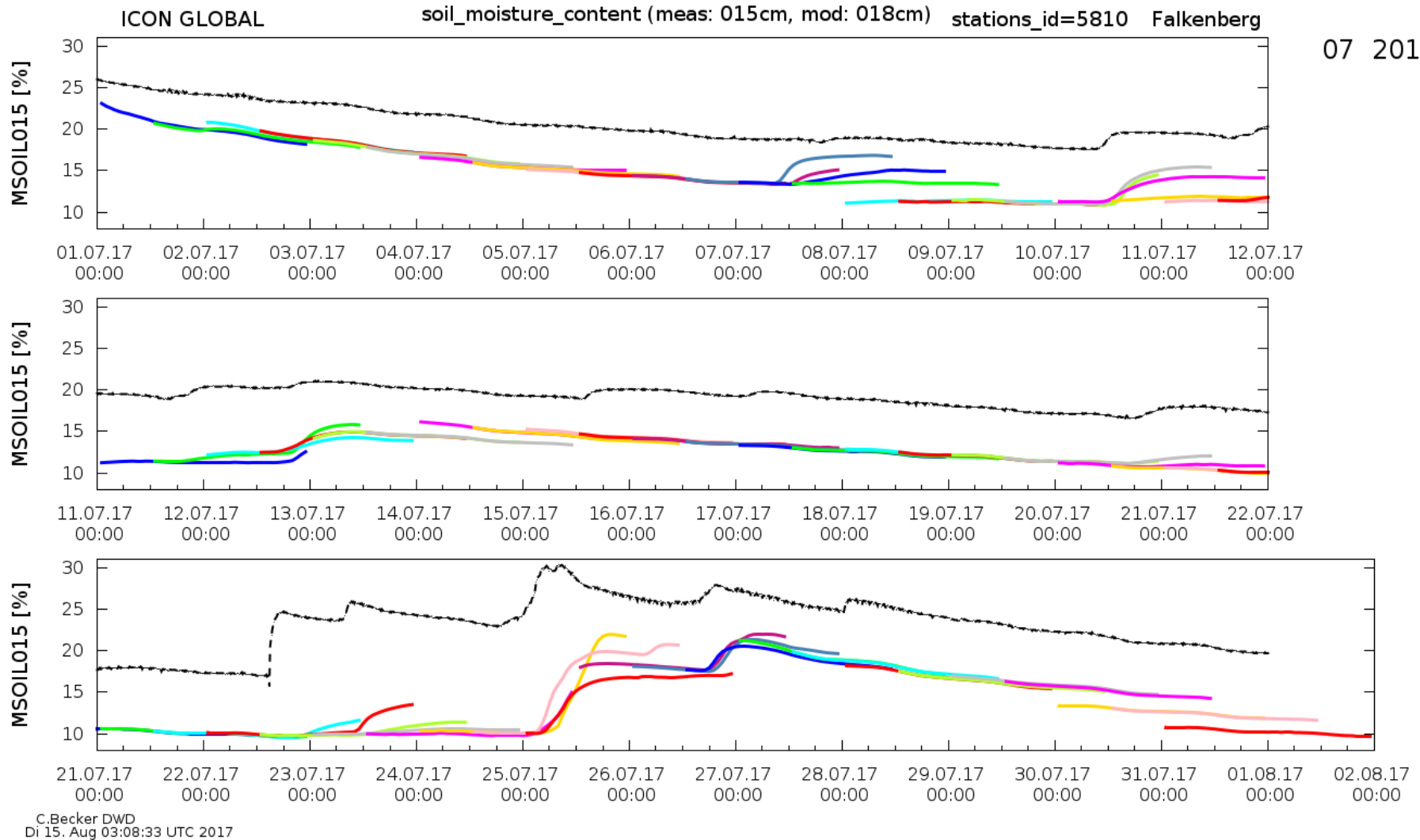


- **Obs:** Meteosat, cloud free pixels in satellite and model
- **Black line:** TERRA surface temperature (COSMO-DE)
- **Green line:** IFS skin temperature

Christine Sgoff, HErZ Frankfurt

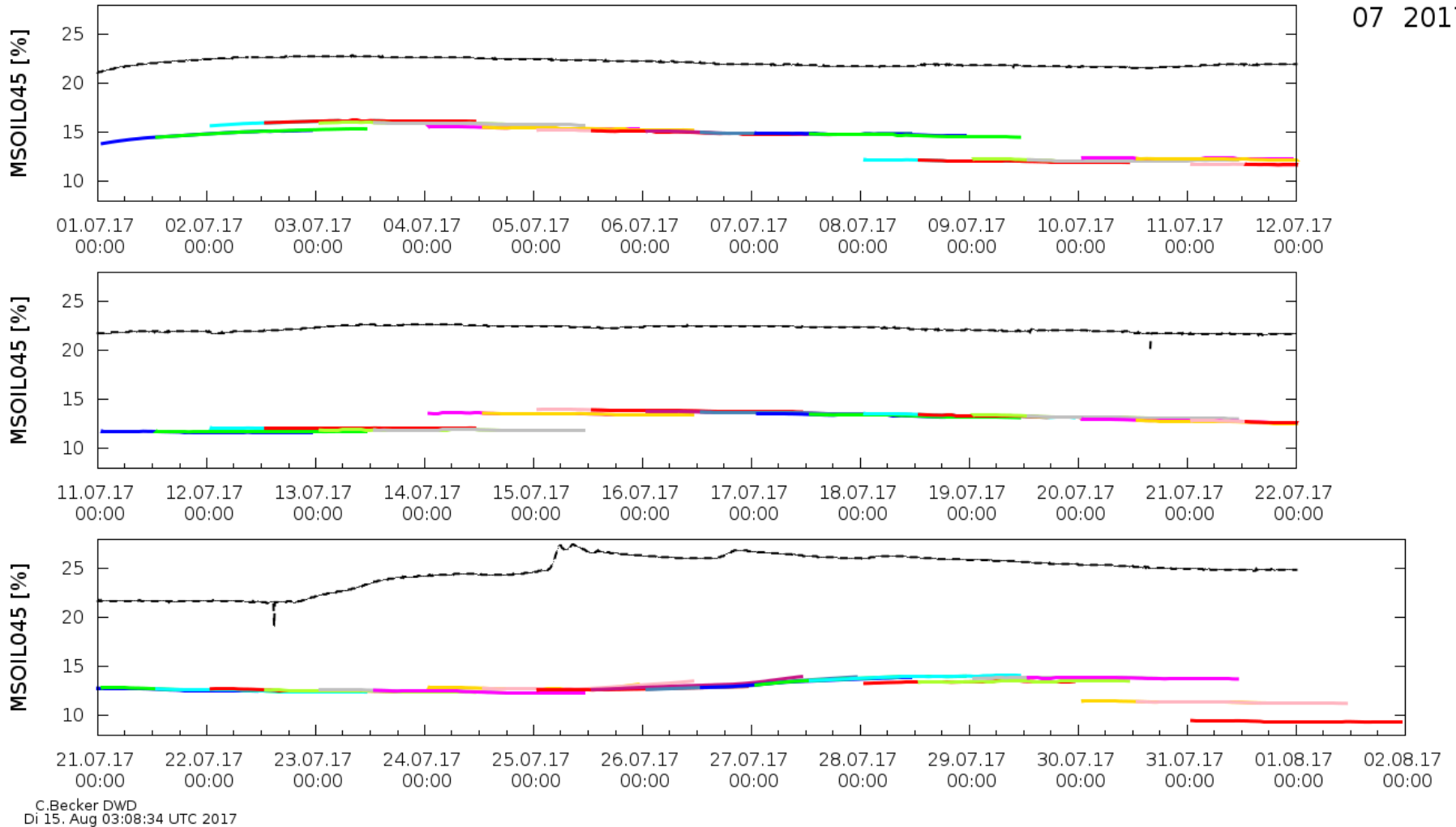
Amplitude of the diurnal cycle of the surface temperature in TERRA is systematically underestimated, with the skin temperature formulation it is substantially increased and much closer to the measurements





The soil water content is substantially underestimated. Unphysical increments due to the soil moisture analysis are visible.





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Conclusions

- The **global radiation** in ICON is systematically **overestimated** over Germany (on average).
- When the **global radiation** is **realistically** simulated, e.g. in some clear-sky cases, then the amplitude of the diurnal cycle of the simulated **2-m temperature** is systematically **underestimated**, in particular the nights are too warm.
=> Canopy or skin temperature formulation is needed.
- When the **global radiation** is **overestimated**, e.g. in many cases of partial cloud cover, also the amplitude of the diurnal cycle of the simulated **2-m temperature** is systematically **overestimated**, in particular the days are warm.
=> Positive radiation bias causes positive temperature bias.