

Supplementary Materials:

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Figures S1 and S2 present, respectively, the time-series for both downward longwave incoming radiation (GLW) and downward shortwave incoming radiation (SWDOWN) for the 2014 and 2015 study periods, with observed [Ref S1] and modeled data to support the answer.

Both GLW and SWDOWN (Figures S1a and S1b) produced by the model were compared to observations during the 2014 study period. In short, the predicted SWDOWN overestimated the observations, which indicates an underestimation of cloud cover, allowing more shortwave radiation to reach the surface in comparison to the observations. Almost all PBL schemes overestimated the observed GLW during the period from September 30 at 08 LT, as well as between October 1 at 01 LT and October 2 at 08 LT. This indicates a relationship with the underestimation of the predicted cloud cover. In addition, the prediction of spurious (non-observed) rainfall on September 30 by some PBL schemes (in particular local PBL schemes), as well as on October 1, certainly contributed to the differences between predicted and observed 2 m air temperatures, as well as the heat fluxes. In particular, this relation between predicted colder temperatures, and spurious rainfall was already discussed in Section 3.1.1 of the manuscript.

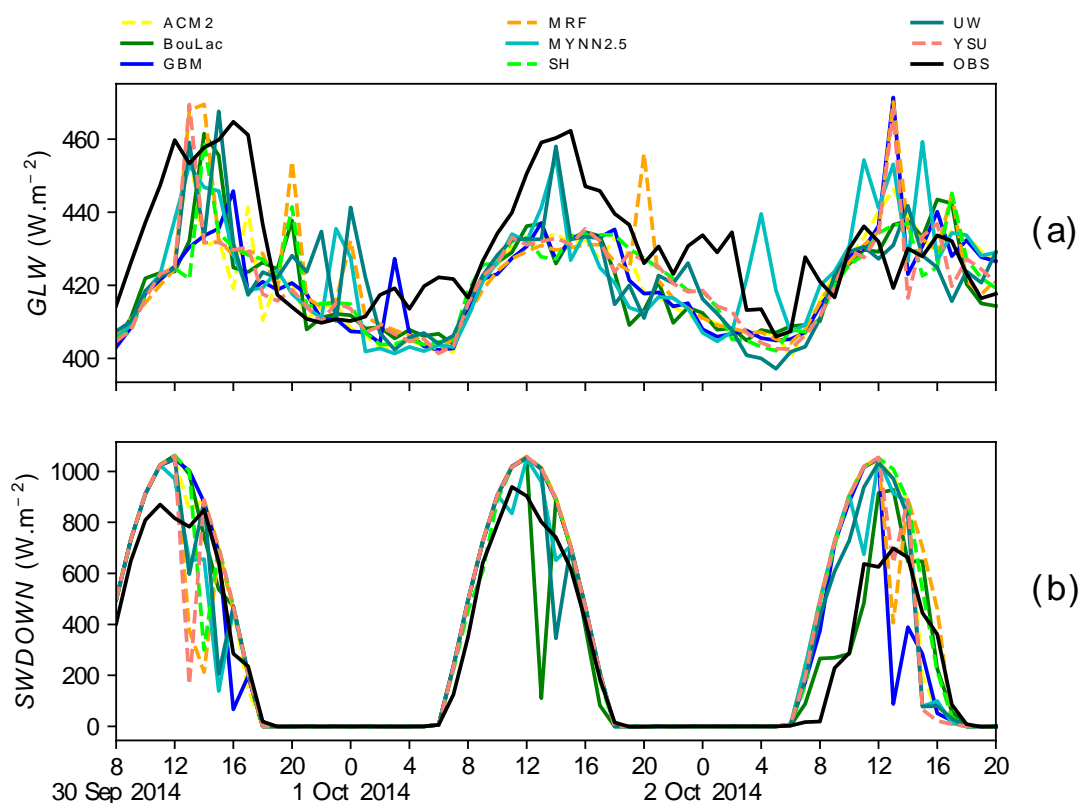


Figure S1. (a) Comparison of models predicted (eight PBL schemes) and SEBS observations [66] for downward longwave incoming radiation ($\text{W}\cdot\text{m}^{-2}$) and (b) downward shortwave incoming radiation ($\text{W}\cdot\text{m}^{-2}$) from September 30 to October 2, 2014, starting at 08 LT (x-axis is date and local time). Results from local (nonlocal) PBL schemes are plotted with filled (dashed) lines.

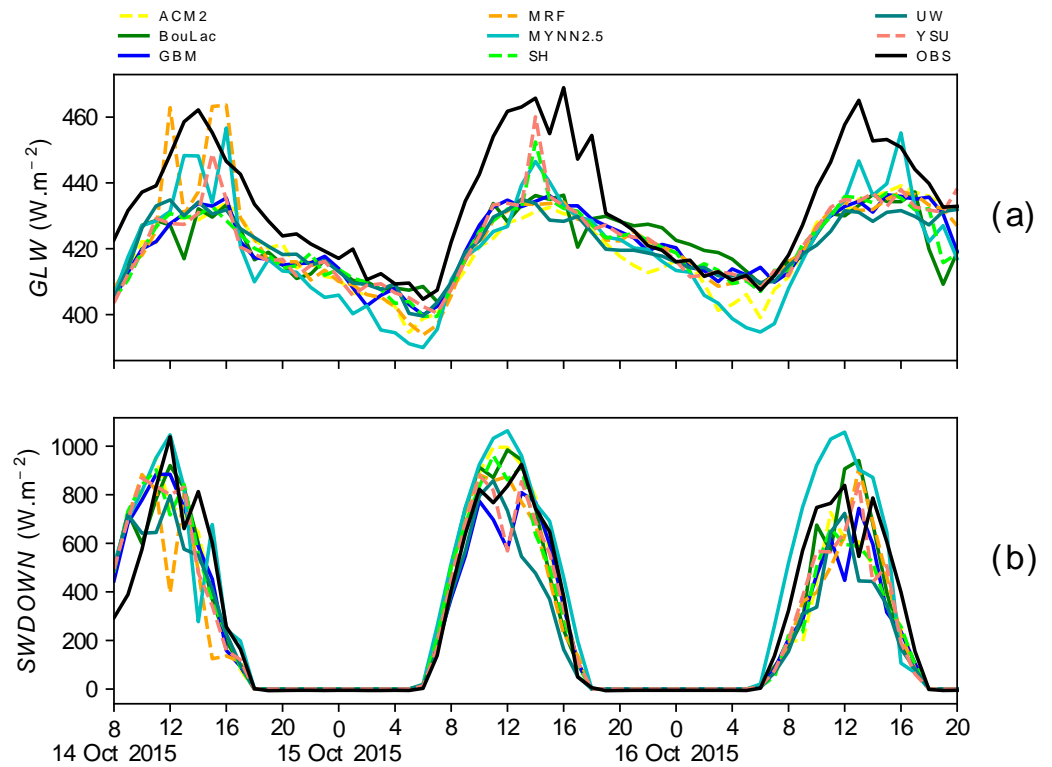


Figure S2. Same as for **Figure S1**, but for the period from October 14 to 16, 2015.

During the 2015 study period, the simulated GLW, given by all PBL schemes, was about 20 W.m^{-2} smaller than the observed value (Figure S2a). On October 14 at 09 LT, there was observed, at the site, a very small rainfall ($< 0.5 \text{ mm/h}$, Figure 3 in the manuscript), which was not reproduced in the simulations, which is related to the overestimation of SWDOWN (Figure S2b) by all PBL schemes. This is also reflected in the temperature, which was overestimated by the simulations at the beginning until 12 LT, when the predicted SWDOWN were smaller than the observed one, indicating that the model simulations increased the cloud cover over the site. Analyzing the following days of simulation, it seems that the formation of clouds by the model simulations occurs later in relation to the observations. However, the behavior of incoming radiation (short and longwave) on the ground alone does not explain the underestimation of 2 m air temperatures (Figure 3a in the manuscript) after October 15 at 11 LT until the end of the simulation. This cold bias is correlated with an overestimation of the latent heat flux (Figure 5b in the manuscript).

The reference of incoming radiation data from Surface Energy Balance System [66] needs to be included in the Supplementary Material as follows.