Review of "Evaluating solar radiation forecast uncertainty" by Tuononen et al.

6 Dec 2018

General comments

The manuscript prepared by Tuononen et al. evaluates the surface downwelling solar irradiance from the IFS model by comparing 4 years of observations from one location in Helsinki, Finland, with model output at the nearest grid point. Overall, the model bias in the surface solar irradiance is positive. This positive bias results from a combination of negative biases in less-frequent clear-sky conditions and positive biases in more-frequent overcast conditions. As part of the analysis, a new algorithm is also presented for improved detection of cloud base, precipitation and fog from ceilometer observations, which can be applied at other sites.

The paper is very nicely written, with clear motivation and aims, well thought out methods, and concise results. The paper is almost ready and I recommend publication after addressing the minor comments outlined below.

Specific comments

P6, L21: "obtained from the closest land grid point to the measurement site". How close is this exactly? And how much does this distance change when the resolution of the model increased from 16 to 9 km? I think numbers should be mentioned here.

P7, L25–26: "one hour averaging corresponds to advection speeds of 4.5 m s^{-1} or 2.5 m s^{-1}". I generally like the idea to use temporal averaging of the observations to better match the spatial scale of the model, but I think this could have been handled better. Specifically, I think the analysis would have been more consistent if observed (or even modelled) wind speeds were used to define the appropriate averaging time of the observations on a case-by-case basis. I do not suggest the authors change their analysis, but they should provide a sentence or two to support their decision. For example, are the corresponding advection speeds of 4.5 m s^{-1} and 2.5 m s^{-1} at least close to climatological wind speeds at this site?

P8, L2–3: "Additionally, a cloud base may not be detected in strong precipitation due to the attenuation of the lidar signal". I found this statement a bit contradictory to the earlier results presented in Fig. 2. Perhaps it could be rephrased or, if this is now an infrequent issue, it could be left out to avoid confusion.

P8, L16–17: "which may result in a slight overestimate". Seems a bit vague. Could a reference be provided here?

P8, L18: "5.2". For the comparison of surface shortwave irradiance between model and observation, I think one important difference has been overlooked. The observations see the entire hemisphere above the given location and are therefore inherently 3D. In contrast, the model output is likely a result of 1D radiative transfer, using only the atmospheric properties of the vertical column at the given location. Under homogeneous conditions (eg. clear-sky or overcast), this may not be important. But Fig. 4 shows the prevalence of broken

cloud in summer for which 3D effects can be large. I think the authors need to acknowledge that they are aware of this difference (3D vs. 1D), even if they are not able to account for it.

P9, L19: "Thus, the amount of solar radiation at the top of the atmosphere is much higher during summer". Not just because the length of the day is longer in summer, but also because the sun reaches higher in the sky (will scale as the cosine of the solar zenith angle).

P9, L22: "clouds and the atmosphere". Better to mention aerosols explicitly here. Perhaps "clouds, aerosols and atmospheric gases".

Technical corrections

P3, L16: "cloud contain" -> "cloud contains"

P3, L25: "(Kotthaus et al., 2016)" -> "Kotthaus et al. (2016)"

P6, L20: "corresponding" -> "correspond"

P6, L26: "(LCC; Table 1) … (MCC)". Seems inconsistent, should probably cite Table 1 in both brackets, or not at all.

P8, L27-28: "therefore penalizing larger errors more than small but more common differences". This doesn't make sense to me, consider re-phrasing.

P10, L6: "forecasts" -> "forecast"

P11, L24: "cloud radiative properties" -> "cloud radiative effect"

P13, L29: "to remove the observed bias" -> "to remove the bias"