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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Insights into the diurnal cycle of global Earth outgoing radiation using a numerical weather prediction model" *by* Jake J. Gristey et al.

Anonymous Referee #1

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Manuscript summary:

This study describes the results of an analysis of the diurnal cycle of the Earth outgoing radiation (EOR). A weather prediction model is used as the main tool, but comparisons are also done using satellite data. The diurnal cycle of the EOR and its individual components is analyze using empirical orthogonal functions and principle component analysis. Further the authors tried to correlate the diurnal cycles of EOR with other possibly relevant physical parameters like cloud parameters. The manuscript gives well-described insights into the diurnal cycle of EOR on a global scale.

Review Summary:

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Discussion paper

The manuscript is well written and presents relevant research on the Earth Outgoing Radiation, that is important for analyzing and understanding the Earth's energy balance. Different data sources are used and the results are well described and discussed. The analysis is only based on 1 month of data, so that the results may partly not represent a climatological behaviour of the diurnal cycle. For example the influence of cloud diurnal cycles may vary from month to month even when globally averaged. This fact is also mentioned in the manuscript, and leads partly to results that should be mainly seen qualitatively, which are still of relevance and interest. In general it should be mentioned even more clearly, that the results may strongly depend on the model used, even though the used Met Office model seems to deliver a reasonable behaviour of the diurnal cycle, which is remarkable as especially the diurnal cycle of clouds is a known weakness in climate and weather models. Overall the manuscript needs only minor revisions.

Review details: (L=line, f=following)

L.39: "lies at the heart of" – please use another formulation!

L.41: "the incoming solar radiation" – better say "the TOA incoming solar radiation", to be more precise

L.46: "discrepancies highlight a lack of understanding" – I think it is not only a lack of understanding that is responsible for the discrepancies between observations and models, it is also a lack of computer power resources to run convective permitting models.

L.46: "yet it is essential we can correctly represent" – sounds wrong –> better say "yet it is essential to correctly represent"

L.71: I would not say "undoubtedly" here. I have seen models that totally missed the observed diurnal cycle of clouds, which meant that no understanding at the process level was possible using this model.

L.132: When mentioning the CLAAS-2 data record, please cite also: - Finkensieper, Stephan; Meirink, Jan-Fokke; van Zadelhoff, Gerd-Jan; Hanschmann, Timo; Benas, Nikolaos; Stengel, Martin; Fuchs, Petra; Hollmann, Rainer; Werscheck, Martin (2016): CLAAS-2: CM SAF CLoud property dAtAset using SEVIRI - Edition 2, Satellite Application Facility on Climate Monitoring, DOI:10.5676/EUM_SAF_CM/CLAAS/V002, https://doi.org/10.5676/EUM_SAF_CM/CLAAS/V002.

L.240 to L.243: According to Fig 1d, does this mean that the diurnal cycle of clouds over land dominates over the diurnal cycle of clouds over ocean ?

L.258: "for a select few regions" sounds wrong.

L.287f: "As a result, the first EOF (Fig 3a) exhibits positive weights in many different predominantly cloud-free regions, such as the global deserts"; Either I did not get the point or something is wrong here. According to Fig 3a, the cloud-free regions, like the Sahara desert, exhibit only very small positive weights, if positive at all.

L.317: "which appears to be captured by the model." – this is a process that is relatively well represented in weather and climate models, which is in line with findings of Pfeifroth et. al, 2012, whom you might cite at this point (https://dx.doi.org/10.1127/0941-2948/2012/0423).

L.372: "is consistent with the lifecycle of a convective system"; Please be aware that this may be a too simplified description. Different types of convective systems exist in the troposphere. Some are locally initiated; and these are the ones that are referred to in this study. However, there are for example also mesoscale convective systems (MCS), which my have a totally different life cycle, and may live for multiple days.

L.421: "because the first two PCs are reversed when compared". How does this come? This is a bit confusing, and if it is only for a technical reason, this fact might be left out completely.

L.472: "understanding of Earth." – something seems to missing here.

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