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Interactive comment on "Role of atmospheric horizontal resolution in simulating tropical and subtropical South American precipitation in HadGEM3-GC31" *by* Paul-Arthur Monerie et al.

Anonymous Referee #2

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This manuscript investigates the impact of increasing horizontal resolution in the climate model HadGEM3-GC31 and how it impacts the model's representation of precipitation in South America. The manuscript evaluates the impact of increasing horizontal resolution on interannual and seasonal precipitation variability; daily precipitation variability; different precipitation intensities; as well as some aspects of remote forcing and local effects. Overall, a very thorough analysis. Moreover, South America (and the southern hemisphere in general) doesn't receive as much attention from the scientific community in comparison to the northern hemisphere. Therefore, this work is relevant to the scientific community with important societal implications for South America.

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Discussion paper

The manuscript is very well written, the figures have high quality, and I believe the authors already answered most of the concerns from the reviewers. However, I would like to propose just one more discussion, which is related to Line 78 and seasonal precipitation predictability.

Jia et al. (2015) suggests that higher atmospheric and land resolution "can" improve seasonal forecasts when combined with statistical analysis. Bombardi et al. (2019) performed a somewhat similar analysis to this manuscript, but focusing on summer precipitation predictability using the IFS (ECMWF) model. They found no significant improvement in seasonal predictability of summer precipitation due to an increase in resolution. Although there seems to be some value in increasing the resolution of the both the atmosphere and the ocean. There is some consensus in the scientific community that an increase in spatial resolution without an appropriate improvement of model physics does not lead to better forecasts, because the increase in resolution leads to an increase in noise. I don't expect the authors to perform any more analysis, I would just like to ask the authors to perhaps include a discussion on how their findings related to studies that focus on precipitation predictability (e.g. Becker et al. 2014; Jia et al. 2015; Bombardi t al. 2019). The argument here is that an increase in spatial resolution leads to an improvement of the model's representation of precipitation. Right. But ultimately, we want the model to be able to predict precipitation. Considering the computational cost of climate simulations and potentially negative effects of increasing spatial resolution, should we really advocate for simulations to be performed with higher spatial resolution? Just some thoughts on the matter would suffice.

Becker, E., H.van den Dool, and Q.Zhang, 2014: Predictability and forecast skill in NMME. J. Climate, 27, 5891–5906, https://doi.org/10.1175/JCLI-D-13-00597.1.

Bombardi, R. J., L. Trenary, K. Pegion, B. Cash, T. DelSole, and J. L. Kinter, 2018: Seasonal Predictability of Summer Rainfall over South America. J. Climate, 31, 8181–8195, https://doi.org/10.1175/JCLI-D-18-0191.1.

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