

# ***Interactive comment on “A Double ITCZ Phenomenology of Wind Errors in the Equatorial Atlantic in Seasonal Forecasts with ECMWF Models” by Jonathan K. P. et al.***

**Anonymous Referee #2**

Received and published: 27 February 2019

Summary: This study presents an attempt to quantify the bias of the ECMWF models in forecasting the equatorial westerly wind, which is caused by an unexpected double ITCZ development during the spring season. The main conclusion of this study is that this westerly wind bias is linked to an incorrect representation of the cross-equatorial meridional flows and the rainfall bias near the equator in the ECMWF models. While I could see the value of this type of work in examining different model biases for future model development and improvement, my general concern about this study is that it still lacks somewhat more in-depth diagnostic analyses that could really help identify the root of biases in the EMCWF model, which are needed for further improving the models. A conclusion such as the westerly wind bias is related to a rainfall bias is not

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totally satisfying, because after all one may wonder where this rainfall bias comes from? Likewise, I do not fully see a demonstrated physical mechanism that could shed light into how the bias in the cross-equatorial flows could induce bias in the westerly wind. Having said that, I would suggest the authors to provide some additional analyses to help readers better gain more understanding into the biases in the ECMWF model as well as the physical mechanisms underlying the connection between the westerly wind bias and rainfall/cross-equatorial flow bias. Below please find my several specific concerns that highlight such a lack of analysis and/or physical explanations. These few places not exclusive, but they could at least highlight the main concern mentioned above.

#### Specific concerns

1. Page 5-6: Please add some possible mechanisms/analyses that explain why the wet bias in April to the south of the equator increases in both the strength and the extent later in May-June in S4 model. The authors appear to attribute the westerly wind bias to this strengthening of the moisture bias, but in the end readers would be very interested in knowing why the S4 model could develop such as moisture (i.e., wetter) bias in the first place, and how this is dynamically linked to the westerly wind bias.
2. Page 8, line 12-17: I agree that there is some correspondence between the development of a double ITCZ and the rainfall bias pattern shown in Figure 3b. However, I again do not see an explanation why this rainfall bias leads to, or at least connected to, the formation of the double ITCZ. Is the double ITCZ a manifestation of the rainfall bias, or there is indeed a physical/dynamical reason that could allow us to see how the rainfall bias accounts for this double ITCZ development? I should note that this lack of physical explanation is not only seen in this paragraph alone, but several other places as well (see, e.g., comment # 2 above). Anytime I came across this type of discussion in this work, I was hoping that I could see some more insights in the next paragraphs. However, the subsequent discussions are always shifted to showing different figures. Perhaps most readers will be left with some wondering what we actually learn from



these discussions beyond seeing some evidence in these plots.

3. It appears that there are a number of previous studies that studied the springtime westerly wind bias in GCMs and suggested that model errors in both the oceanic and atmospheric components are the cause for the westerly wind bias. I am wondering if this current study could provide a step further beyond the previous findings, i.e. specifically pinpoint where the error sources in the ECMWF models are (physics, resolution, boundary conditions, ...). More discussions about this would be helpful for readers.

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Interactive comment on *Atmos. Chem. Phys. Discuss.*, <https://doi.org/10.5194/acp-2018-1316>, 2019.

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