

Response to reviewers' comments on 'Impact of stochastic physics on the representation of atmospheric blocking in EC-Earth3' - Michele Filippucci, Simona Bordoni and Paolo Davini

Dear Dr. Grams,

Thank you for your decision to publish our work and for your time and consideration. We answered the technical comments of one of the two reviewers - which we report here - and we implemented the corrections in the manuscript. The reviewer's comments are reproduced in blue, and our responses are in black.

Please let us know if there is any additional information we can provide.

Reviewer comment

Thank you very much for your efforts in revising the manuscript and for providing detailed answers to my comments.

The presentation of the results is substantially improved and it was a pleasure to read the paper - congratulations. I just have a few minor comments; once these have been incorporated, I recommend the paper for publication.

Thank you for the time and effort spent helping us improve the manuscript. We believe the revision process has been very useful for improving our work.

- Abstract: Only very few information about the methods is given in the abstract. Consider adding a few details how you come to your results (e.g. Blocked-zonal flow decomposition).

In the second and last paragraph of the abstract we mentioned the blocked zonal flow decomposition. Moreover, we added a short sentence on the meridional transport of zonal momentum.

- Line 32: do you mean interactions across different scales? Then I would suggest to use the formulation "scale interactions" instead of "intra-scale interactions".

We implemented your suggestion in the manuscript.

- Lines 40 and 45: Consider moving away from your strong climate model perspective in the introduction, as stochastic perturbations were originally designed for numerical weather prediction.

We moved to the term 'general circulation models' rather than 'climate model'.

- Line 45: "Stochastically" instead of "Stochastic"

Done.

- Line 47: I don't think that Berner et al 2017 is the original reference. I would go for Buizza et al. 1999.

Done.

- Line 38-50: Please rephrase the middle part of the sentence ("[...] and the turbulent cascade proper of turbulent motion [...]). I'm not sure what you mean with "proper" here.

We apologize for the mistake. We changed it to 'characteristic of turbulent motion'.

- Line 50-52: This sentence is a bit lost without context and you don't give a reference here. Please consider moving the sentence a few lines down (e.g. put it after the sentence ending in line 58), where you actually give the explanation and reference for your claim.

We moved the sentence after line 58 as you suggested.

- Lines 59 and 72: "SPPT scheme" instead of "SPPT parametrization".

We changed from 'parameterization' to 'scheme' for 5 occurrences.

- Line 107: To make clear that both SKEB and SPPT are used, I would recommend to write "[...] in which both the SPPT and the SKEB schemes are used".

Thank you for this suggestion. We implemented it in the text.

- Line 161/162: Include what the variable X stands for in Eq. 3.

Done.

- Line 199: I think you mixed up the order of the sentence. Do you mean: "[...] tend to occasionally identify polar intrusions and tropical air masses as blocks [...]"?

Yes, we corrected it.

- Line 214: "[...] is affected by blocking." instead of "[...] is interested by blocking."?

We agree it is a better expression.

- All figures: Thank you for including units and labels to the figures. The color bars in all figures, however, always show differences between either your experiments and ERA5 or between the baseline and stochastic experiments, but you only give the variable itself (e.g. Figure 1: "Atmospheric blocking frequency difference (%)" instead of "Atmospheric blocking frequency (%)". Please change this for all figures where it is relevant.

We implemented the changes you suggested.

- Line 258: What do you mean with "wind intensity"?

By wind intensity we mean wind speed. We changed 'intensity' to 'speed' and we added: *i.e. the stronger the wind intensity, the larger the increase.*

- Line 300: "biases" instead of "bias"

Done.

Figure 5: The colorbar label says "Zonal momentum transfer", but shouldn't it be "Meridional transport of zonal momentum"?

Corrected as you suggested.

- Line 446: In this paper, not a more recent version of SPPT is investigated, but a all-new stochastic parametrization scheme, namely the stochsatically perturbed parametrizations (SPP). Please correct for this.

We changed the sentence to: *'The same mechanism has been observed by Deinhard and Grams (2023) for a new stochastic scheme, the Stochastically Perturbed Parameterization (SPP), which directly represents parameter uncertainty in parameterizations within the IFS model.'*