



EGUsphere, referee comment RC2
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Comment on egusphere-2022-778

Anonymous Referee #2

Referee comment on "Weather pattern dynamics over western Europe under climate change: predictability, information entropy and production" by Stéphane Vannitsem, EGU sphere, <https://doi.org/10.5194/egusphere-2022-778-RC2>, 2022

Review of "Weather pattern dynamics over Western Europe under climate change: Predictability, Information Entropy and Production" by S. Vannitsem (Nonlinear Processes in Geophysics)

In this manuscript, the author analyzed the entropy and its production in the information theory to study the impact of climate change on the weather patterns over Western Europe. In historical data for the period 1885-2000, the author found a decreasing trend of the block entropy except afterward of 1980, which suggests a less diverse set of pairs of events. In addition, an increasing trend of the entropy production for 6 and 8 weather patterns indicates a time-asymmetry related to the irreversibility of the process. The analysis of the UK Met Office CMIP5 model showed a wide range of the block entropy evolution depending on the realization. These findings suggest that the degree of irreversibility is increasing under climate change.

The manuscript is well written with a clear structure. I believe this study would contribute to understand how climate change affects the weather pattern over Western Europe. In addition, the application of block entropy to climate model runs would be useful index to evaluate climate models. However, I have concerns due to the lack of the discussion that connects the obtained results and weather events.

Major comments:

Discussions that connect the (information) entropy production to atmospheric dynamics would be helpful to deepen our understanding of climate change impact on the weather regime. The authors wrote that the production of information entropy is related to irreversibility of the system, and its trend would be associated with the heat production/dissipation in the thermodynamic entropy. I wonder if the production of information entropy is associated with the irreversible processes in the large-scale atmospheric dynamics, like irreversible mixing of momentum that occurred at the Rossby wave breaking. Modulation of Rossby wave breaking is known to be associated with the transition of weather regime (Michel and Riviere, 2011).

Minor comments:

Line 12: A quantitative assessment of the change of the entropy production (10% in the RCP2.6 and 30-40% in the RCP8.5) is missing in the result and conclusion.

Line 110-114: As the main finding using the 15 model runs shows the diverged block entropy evolution depending on the realization, it would be useful for readers to briefly describe the difference in the realizations between 15 runs. (The difference is only in parameterization? or also in boundary conditions?)

Line 124: "A clear trend ... is visible, and χ^2 tests ... are highly significant". Please provide the evidence (figure/table) of this sentence.

Figures: labels (e.g. (a), (b),...) are too small to see. Please consider put larger labels in the upper left of the figure.

Figures 4-5: Legend would be useful.

Reference:

Michel, C., & Rivière, G. (2011). The Link between Rossby Wave Breakings and Weather Regime Transitions, *Journal of the Atmospheric Sciences*, 68(8), 1730-1748.