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A new mathematical framework for atmospheric blocking events[1]
VALERIO LUCARINI, University of Reading, ANDREY GRITSUN, Institute of Numerical Mathematics, Russian Academy of Science — We propose a new framework for the mathematical properties of atmospheric blocking events . The occurrence of blockings is associated with conditions featuring anomalously high instability. Longer-lived blockings are very rare and have typically higher instability. In the case of Atlantic blockings, predictability is reduced at the onset and decay of the blocking event, while it is higher in the mature phase. Blockings are realised when the trajectory of the system is in the neighbourhood of a specific class of unstable periodic orbits (UPOs). UPOs corresponding to blockings have, indeed, a higher degree of instability compared to UPOs associated with zonal flow. The analysis of UPOs elucidates that the model features a very severe violation of hyperbolicity, due to the presence of a substantial variability in the number of unstable dimensions: atmospheric states can differ a lot in term of their predictability. The lack of robustness associated with the violation of hyperbolicity might be a basic cause contributing to the difficulty in representing blockings in numerical models and in predicting how their statistics will change as a result of climate change. This corresponds to fundamental issues limiting our ability to construct very accurate numerical models of the atmosphere

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