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Entropy Production and Fluctuation Theorem in General Circulation Models

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Central to modeling nonequilibrium forced dissipative systems such as the atmosphere is the physically consistent representation of subgrid-scale processes. While common representations of these processes are usually based on heuristic arguments, there is not yet any true law these representations adhere to. This study will investigate the Fluctuation Theorem as a potential candidate for such a law to be applied to general circulation models. To this end model runs of the ICON-IAP at varying resolutions are used, which is coarse-grained to compute the entropy production rates through turbulent dissipation. The probabilities of entropy production rates are then investigated to determine their adherence or similarity to the Fluctuation Theorem. Using this approach, this study's aim is to learn about the possible applicability of the Fluctuation Theorem to subgrid-scale parametrizations in models of the atmosphere. Should this study reveal that the Fluctuation Theorem holds for macroscopic systems or that it has an equivalent in macroscopic nonequilibrium systems such as the atmosphere, a new, significant degree of certainty could be brought to the representations of subgrid-scale processes.