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Constrained Maximum Entropy Prodution Principle as a radiative-convective parametrization

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Abstract The representation of the atmospheric convection induced by radiative forcing is a longstanding question mainly because turbulence plays a key role inthe transport of different quantities such as energy. Recent works have tried to use the hypotheses based on empirical Maximum Entropy Production (MEP) as a parametrization for convective phenomenona [4]. However, such an approach does not yield a realistic vertical transport of energy because some fondamental processes of atmospheric convection are not expressed in terms of constraint in the optimization problem. In order to verify this assumption, we have included mechanical constraints in the MEP optimization protocol, by taking into account more realistic energy budgets than in the classical MEP procedure. Our model optimizes the entropy production due to convective energy exchanges for a 1D atmospheric column with respect to the mechanical constraint of the mass flux positivity, and takes into account different forms of energy : thermal , geopotential and latent energy for a saturated profile. Computations were done for different prescribed atmospheric compositions, corresponding to different climatic conditions. We discuss the effects of different energy forms in the optimization entropy production procedure. These considerations provide more realistic results, namely for tropical climate where vertical motions are more important. As a general result, the inclusion of the geo-potential constraints results in stratification in the high atmosphere which was not described with the previous, unconstrained, MEP. Our observations allow us to conclude that the addition of a simple mechanical constraint clearly improves the MEP predictions. However, whether a constrained version of MEP is valid for the radiative-convective problem, as well for others phenomena, is still an open question.

References

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