



A Caveat Note on Tuning in the Development of Coupled Climate Models

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State-of-the-art coupled general circulation models (CGCMs) have substantial errors in their simulations of climate. In particular, these errors can lead to large uncertainties in the simulated climate response (both globally and regionally) to a doubling of CO₂. Currently, tuning of the parameterization schemes in CGCMs is a significant part of the development. It is not clear whether such tuning actually improves models. The tuning process is (in general) neither documented, nor reproducible. Alternative methods such as flux correcting are not used nor is it clear if such methods would perform better. In this study, ensembles of perturbed physics experiments are performed with the Globally Resolved Energy Balance (GREB) model to test the impact of tuning. The work illustrates that tuning has, in average, limited skill given the complexity of the system, the limited computing resources, and the limited observations to optimize parameters. While tuning may improve model performance (such as reproducing observed past climate), it will not get closer to the “true” physics nor will it significantly improve future climate change projections. Tuning will introduce artificial compensating error interactions between submodels that will hamper further model development. In turn, flux corrections do perform well in most, but not all aspects. A main advantage of flux correction is that it is much cheaper, simpler, more transparent, and it does not introduce artificial error interactions between submodels. These GREB model experiments should be considered as a pilot study to motivate further CGCM studies that address the issues of model tuning.