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The development of climate models: tuning vs. flux corrections

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Current state-of-the-art coupled general circulation models (CGCMs) have substantial errors in their main climate representations. In particular they have large uncertainties in the simulated climate sensitivity on regional and global scale to a doubling of CO_2 that result from model errors. The current approach in developing CGCMs and dealing with the error in it involves substantial amount of tuning of uncertain parameters of sub-scale process that need to be parameterized. This tuning process is neither documented, nor reproducible nor is it clear if it indeed improves the model performance. Alternative methods such as flux correcting are not used nor is it clear if such methods would perform better. In the study presented here we will perform perturbed physics experiments with the simplified globally resolved energy balance (GREB) model to test the different ideas of dealing with model errors in the development of models. It will be illustrated that tuning of CGCM is very likely to fail given the complexity of the system, the limited resources and the limited observations to optimize parameters. While tuning will improve the models performance on the cost function (such as the observed past climate), it will not get closer to the 'true' physics nor will it improve future climate change projection. In turn, not tuning or flux correcting is not only much cheaper and simpler, but it will actually perform better in nearly all aspects. This, however, varies whether one is focussed on regional or global scales.