Towards a consistent dynamics in a GCM perturbed physics ensemble

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A perturbed physics ensemble of a General Circulation Model consist of a large number of model runs obtained by varying the GCM physical parameters within their physically acceptable range. This ensemble provides a new ground to explore the possible range of future climates, and eventually use this information to asses potential impacts of future climate change.

However, due to the way a perturbed physics ensemble is constructed, many of its models fail to reproduce feasible climates. In some cases, the failure is quite dramatic (i.e., extremely fast oscillations between very hot and very cold climates) and the model can be easily discarded. This sort of extreme behavior is pressumably and indication that the combination of perturbed parameters in those particular model runs has driven the GCM out of the physically meaningfull phase space. Other models might not present such an extreme and therefore easily identifiable incorrect behaviour, but still fail to reproduce the dynamical properties of the climate system inflating the range of possible future climates. Our goal is to develop techniques to detect these models and eleminate them from the ensemble.

It is clear that in general, a simple comparison of the mean state of the atmosphere of a given model run and that of the observed climate does not guarantee that the dynamical properties of the model are consistent with those of the real system. On the other hand, we would expect that an analysis involving the dynamical correlations of model and observed climate will in principle be able to select those model runs that are able to reproduce the correct dynamics in the past.

In this work we analyse the scaling properties of different climate variables using detrended fluctuation analysis [Eichner et al. (2003)] for each of the climatepredic-

tion.net perturbed physics ensemble model runs, and compare them with the scaling properties of the observed records at different spatial scales. We explore the viability of this approach to ensure that the perturbed physics ensemble comprises only models that are physically consistent with the observed climate.

Eichner J.E. et al. (2003): Power-law persistence and trends in the atmosphere: A detailed study of long temperature records. Physical Review Letters 68.046133