Model errors in ensembles

Model drift analysis to understand the causes of systematic errors in climate prediction systems

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Evaluating climate models and understanding the source of errors is crucial since most of our science relies on numerical modeling. Indeed, it is important to identify the limits of the models we use to provide climate predictions and projections to increase the confidence of our scientific results. In the climate community, multi-model studies have been conducted in order to identify and understand sources of errors in climate models, focusing often on climate simulations from the CMIP archive.

One interesting approach aimed at understanding the physical mechanisms causing models systematic errors is the analysis of drifts. These can be defined as the sequence of physical processes involved in the bias adjustment of the model. As climate models simulate an imperfect climate, drifts are often present when models are initialized from observed conditions to produce climate predictions. Model drifts are usually removed through more or less sophisticated techniques for skill assessment in climate forecast, but they are rarely analysed. Beyond statistical predictability issues, the dynamical study of model drift and associated bias adjustment is also crucial, since the rate of the bias development and its spatial pattern can provide a useful information on physical processes connected to model systematic errors that potentially affect the skill scores. Furthermore, this can give some clues to understand the model behavior, which can provide some guidance for model improvements.

Here I show trough several studies how the physical analysis of the drift can help to understand the mechanisms that lead to the set-up of some model systematic biases. The examples shown here focused on processes occurring in different regions of the world (Tropical Atlantic, Tropical Pacific and North Atlantic), involving short timescales, like fast SST growth errors in the tropical oceans; or much longer timescales as the ocean gyre and thermohaline circulation adjustments in the North Atlantic.