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On the role of the atmosphere GCM in modelled El Niño errors

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Predicting the characteristics of El Niño events amplitude, evolution, occurrence and structure, and remote impacts for the next decades and centuries, is still a scientific challenge. Over the years, improvements in model formulation have led to a better representation of a number of key features of El Niño in coupled GCMs. Despite this progress, recent multi-model analysis show that serious systematic errors in the simulated mean climate, annual cycle and the natural variability persist in the tropics. Other studies show that the atmosphere GCM is a dominant source of errors in coupled models in these regions. Even though there are systematic common biases across the different CGCMs, these still exhibit a diversity of El Niño behavior that is well beyond the observed diversity of events.

Here we explore to which extent the atmosphere GCMs (and their systematic errors) are responsible for the modeled El Niño diversity in coupled GCMs. To that end, we restrict the study to one IPCC-class coupled GCM in which the atmospheric convection parameterization is modified, all other aspects being kept the same. The IPSL-CM4 model is hence run with two different convection schemes: the Kerry Emanuel scheme (KE) used in the IPCC AR4 and the Tiedke scheme (TI).

While the KE simulation exhibits a simulated El Nino with correct characteristics, the TI simulation has a suppressed interannual variability in most of the tropical Pacific. Reasons for these different behavior are investigated in two directions: 1) via the impact of a modified mean state and seasonal cycle and 2) via a change of anomalous cloud/wind stress responses to SST anomalies.