A partial coupling approach to isolate the roles of the atmosphere and ocean in coupled climate interactions

Climate interactions are largely the result of the coupling between its two dynamic components; the atmosphere and ocean. The traditional approach of studying the roles of the atmosphere and ocean is often with stand-alone (atmosphere-only, ocean-only or slab) models, which often treat the other climate components as a boundary conditions (SSTs, surface fluxes, or heat convergence). This approach thus, ignores the feedback from the dynamical response of the other climate components in the coupled interaction, and as a result, overestimate or underestimate the roles of the ocean or atmosphere. Here, I will describe a new partial coupling approach that disentangles the fully coupled interaction while simulating both atmosphere and ocean dynamical responses, allowing the isolation of the individual roles of the atmosphere and ocean, as well as the coupled feedbacks between. This method essentially removes the impact of the ocean dynamical response from coupling with the atmosphere, thereby allowing only a one-way coupling, rather than the two-way fully coupled interaction. Comparing the partially coupled and the fully coupled simulations shows that the ElNino-like tropical SST response and the ITCZ response to CO2 increase are caused by the ocean circulation feedback in the fully coupled air-sea interaction.