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Reducing Model Systematic Error over Tropical Pacific through SUMO Approach

Mao-Lin Shen (1), Noel Keenlyside (1), Frank Selten (2), Wim Wiegerinck (3), and Gregory Duane (4)

(1) University of Bergen, Geophysical Institute, Bergen, Norway (earnestshen@gmail.com), (2) Royal Netherlands Meteorological Institute, Global Climate Netherlands, (3) Donders Institute for Brain, Cognition and Behaviour, Radboud University Nijmegen, The Netherlands, (4) University of Colorado, Atmospheric and Oceanic Sciences United States

Numerical models are key tools in the projection of the future climate change. However, state-of-the-art general circulation models (GCMs) exhibit significant systematic errors and large uncertainty exists in future climate projections, because of limitations in parameterization schemes and numerical formulations. We take a novel approach and build a super model (i.e. an optimal combination of several models): We coupled two atmospheric GCMs (AGCM) with one ocean GCM (OGCM). The two AGCMs receive identical boundary conditions from the OGCM, while the OGCM is driven by a weighted flux combination from the AGCMs. The atmospheric models differ only in their convection scheme. As climate models show large sensitivity to convection schemes, this approach may be a good basis for constructing a super model. We performed experiments with a machine learning algorithm to adjust the coefficients. The coupling strategy is able to synchronize atmospheric variability of the two AGCMs in the tropics, particularly over the western equatorial Pacific, and produce reasonable climate variability. Furthermore, the model with optimal coefficients has not only good performance over the surface temperature and precipitation, but also the positive Bjerknes feedback and the negative heat flux feedback match observations/reanalysis well, leading to a substantially improved simulation of ENSO.