Decadal predictions by FGOALS-g2

Bin WANG

Center for Earth System Science, Tsinghua University
LASG, Institute of Atmospheric Physics, Chinese Academy of Sciences, Beijing, China,
wab@lasg.iap.ac.cn
Mimi Liu, LASG, Institute of Atmospheric Physics, Chinese Academy of Sciences
Yongqiang Yu, LASG, Institute of Atmospheric Physics, Chinese Academy of Sciences
Lijuan Li, LASG, Institute of Atmospheric Physics, Chinese Academy of Sciences
Presenter : Bin Wang

This study designs the initialization and decadal prediction schemes based on the Grid-point Version 2 of Flexible Global Ocean-Atmosphere-Land System Model (FGOALS-g2), a state-of-the-art coupled climate system model, and performs sets of ensemble experiments of 10-year and 30-year hindcast using the FGOASL-g2 to examine the predictability of internal variations on decadal timescales. Prior to the experiments, a nudging-based initialization (simply 'ASSIM', hereinafter) of the upper-ocean state using historical observations of sea temperature and salinity is implemented to reduce the negative impact of initial uncertainty on hindcasts. The correctness of ASSIM is evaluated by comparing its results with the observations and those from one of the historical runs for 20th-Century climate simulation. To alleviate the impact of model biases in sea temperature and salinity on the overall performance of the coupled model through nonlinear interactions among different processes and among different components, a dynamic bias correction scheme for decadal predictions is proposed, which preliminarily shows positive effects in presenting the climatology and mean annual cycle of SST. Preliminary evaluations on skill of FGOALS-g2 in decadal prediction show that with the ICs from the initialization and the newly proposed dynamic bias correction scheme, the model presents skillful hindcasts in variations of sea surface temperature (SST) and surface air temperature (SAT) on decadal timescale, particularly in the decadal variations of Niño 3.4 SST anomaly index and regional SAT anomaly in China. FGOALS-g2 well simulates/predicts the global warming and global ocean warming in both the historical run (referred to as 'CTRL') and HCST, but it overestimates these warming in CTRL. HCST reduces the above overestimations and presents the warming closer to the observed. Also, a scheme to correct linear trend of 30-year hindcasts/forecast is proposed and the 30-year hindcasts and forecast are reconstructed in this study.

A prediction for SAT of future 30 years is analyzed after reconstruction, which shows a much slower and weaker warming during 2010-2029 than the RCP4.5 projection, but a rapid and sudden warming after 2029.