Session: C41 Poster: Th122B

An analysis of forced and internal variability under increasing CO2 in CCSM3

Zeng-Zhen Hu[†]; Arun Kumar; Bhaskar Jha; Bohua Huang
[†] Climate Prediction Center, NCEP/NWS/NOAA, USA
Leading author: Zeng-Zhen.Hu@NOAA.GOV

Changes in the mean state and internal variability in response to increase of greenhouse gas (GHG) and aerosol concentrations were investigated by comparing a suite of long term integrations of global warming scenario experiments (A1B runs) with the corresponding control experiments. These experiments were conducted at NCAR using a coupled climate system CCSM3. By examining the evolution of signal (standard deviation of ensemble mean anomalies) -to-noise (standard deviation of departures of individual member from their corresponding ensemble means) ratio (SNR) in the A1B runs, it is shown that SNR depends on variable, forcing intensity (GHG and aerosol concentrations), and geographical location. For global average, geopotential height at 200 hPa (H200) has the largest SNR, precipitation displays the lowest, and surface air temperature (TS) is in between. Geographically, SNR is larger in the tropical oceans than in the extra-tropics for H200 and TS, and it is relatively larger in high and low latitudes and smaller in mid-latitudes for precipitation. The SNR change is largely due to the forced mean state change in the A1B runs instead of the internal variability change. The TS and H200 response to the increase of GHG and aerosol concentrations is largely linear and can be well reconstructed using their linear trends. The precipitation response shows a minor linear trend and is less reproducible using its linear trend. Moreover, the spatial pattern and temporal evolution of the leading modes of internal variability of TS, H200 and precipitation are almost identical for the A1B and control runs. In the tropical Pacific Ocean, superimposed on a warming trend, amplitude of internal variability of El Niño-Southern Oscillation is slightly suppressed in the A1B runs. Slightly warm trend is seen in the Atlantic Multi-decadal Oscillation region with large intra-ensemble member spread in the A1B runs.