Session: C10 Poster: M33B

The interaction between Congo River freshwater discharge and Tropical Atlantic Variability

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Congo River discharges a huge amount of freshwater into the ocean, affecting the sea surface salinity (SSS) of Eastern Equatorial Atlantic (EEA). A stratified surface layer forms due to the less dense freshwater, and vertical mixing is reduced, diminishing the entrainment of cooler water from deeper layers to the surface in a region characterized by strong upwelling. The present work makes use of numerical experiments to investigate the effect of freshwater flow on Tropical Atlantic Variability (TAV). Three sets of ensemble runs using the fully coupled Community Earth System Model version 1.0 (CESM 1.0) are performed. River runoff at the grid point corresponding to the Congo River mouth is once set to zero, once to twice and another to four times its value. Ensemble experiments start in March and terminate in October, in order to evaluate the effects during the main upwelling season. Compared to a control run with no change of Congo discharge, the first experiment show drastic increase of SSS in EEA, spreading over Gulf of Guinea through surface currents. The absence of freshwater causes the modification of mixed layer depth in the region, due to exacerbation of vertical mixing between surface ocean and deeper layers. Consequently, sea surface temperature (SST) of the entire region collapses, with possible consequences on the onset of the West African Monsoon. Instead, in case of excessive freshwater flow, salinity is very low and the so-called barrier layer between surface and sub-surface waters is much thicker. In particular, the four-times discharge experiment leads to drastic changes of the ocean circulation. Accordingly, SST anomaly resulting by excess of river runoff is positive and spreads across the entire Tropical Atlantic. The interaction processes between Congo River discharge, salinity, temperature and ocean circulation play an effective role in influencing the interannual variability in the Tropical Atlantic region. Our results add a new source of variability in the area, which was often neglected by previous studies.