The strengthening of Amazonian precipitation during the wet season driven by tropical sea surface temperature forcing

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Amazonian rainfall plays a critical role in the global climate system and the hydrological cycle. It is thus important to quantify changes in the Amazonian rainfall and clarify its mechanism. Previous studies indicate that the interannual variability of Amazonian precipitation could be largely attributed to variabilities in the South American monsoon system and the El Niño Southern Oscillation. However, the trend of the wet season tropical Amazonian precipitation during recent decades is not very well investigated. In this study, by combining both satellite and in situ observations, it is revealed that tropical Amazonian precipitation has significantly increased by~180 to 600 mm (in different datasets) in the wet season during the satellite era from 1979 to 2015. We then use a state-of-the-art atmospheric model to simulate the impact of the tropical sea surface temperatures (SSTs) on the precipitation changes. Results show that the multidecadal warming of the tropical Atlantic has contributed more than half of this precipitation change over the past three decades, while the east Pacific cooling plays a secondary role. We finally combine the simulation results and the reanalysis data to investigate the mechanisms of this process, i.e. the SST variability dramatically increases the convergence of the moisture transport over the Amazon region. The precipitation changes over the Amazon region largely impact on the local hydrological cycle and the ecosystem, and have important impacts on the global climate system by mediating the teleconnection between the Pacific and the Atlantic oceans. Our results show that the long-term change in the wet season Amazonian precipitation is important and deserves further investigation and discussion.

Keywords: convective precipitation, Amazon, tropical Atlantic, moisture convergence