

Predicting tropical drought under global warming

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Abstract

In almost all climate model simulations, as the greenhouse gases increase, warmer troposphere and surface are found globally. In contrast, changes in precipitation exhibit positive and negative anomalies. Thus, the impacts of global warming on precipitation are difficult to detect when averaging the precipitation anomalies globally. Two mechanisms have been proposed for inducing such precipitation anomalies in the tropics: the rich-get-richer mechanism for positive anomalies and the upped-ante mechanism for negative anomalies. To detect the impacts of global warming on precipitation, the areas dominated by the upped-ante mechanism are examined first. In the upped-ante mechanism, dry inflow from non-convective regions tends to suppress convection and induce negative precipitation anomalies over margins of convective regions. To determine the margins of convective regions with dry inflow, a set of quantitative criteria was made based on current climate. These criteria are used to identify the regions where precipitation will be reduced in the future due to global warming. Comparing those margins and the areas with negative precipitation anomalies found in climate modal simulations, the consistency between these two regions may differ region by region, but negative precipitation anomalies are often found over margins of convective regions. These criteria for the margins are further used to examine the observation. Even though the results are still not statistically significant for most regions due to relatively short history of observations, the tendency of reduced precipitation over the margins is clear. More analyses among different climate model simulations in IPCC AR4 will be examined in the future.