Relative contributions of weather systems to the changes of annual and extreme precipitation with global warming

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ABSTRACT

The global patterns of annual and extreme precipitation are projected to be altered by climate change. There are various weather systems which bring precipitation (e.g. tropical cyclone, extratropical cyclone, etc.). It is possible in some regions that multiple weather systems affect the changes of precipitation. However, previous studies have assessed only the changes of precipitation associated with individual weather systems. The relative contributions of the weather systems to the changes of precipitation have not been quantified yet. Also, the changes of the relative importance of weather systems have not been assessed.

This study present the quantitative estimates of 1) the relative contributions of weather systems (tropical cyclone (TC), extratropical cyclone (ExC), and "others") to the future changes of annual and extreme precipitation and 2) the changes of the proportions of precipitation associated with each weather system in annual and extreme precipitation based on CMIP5 generation GCM outputs. Weather systems are objectively detected from twelve GCM outputs and six models are selected for further analysis considering the reproducibility of weather systems. In general, the weather system which is dominant in terms of producing precipitation in the present climate contributes the most to the changes of annual and extreme precipitation in each region. However, there are exceptions for the tendency. In East Asia, "others", which ranks the second in the proportion of annual precipitation in present climate, has the largest contribution to the increase of annual precipitation. It was found that the increase of the "others" annual precipitation in East Asia is mainly explained by the changes of that in summer season (JJA), most of which can be regarded as the summer monsoon precipitation. In Southeast Asia, "others" precipitation, the second dominant system in the present climate, has the largest contribution to the changes of very heavy precipitation (>99.9 percentile daily precipitation of historical period). Notable changes of the proportions of precipitation associated with each weather system are found mainly in subtropics, which can be regarded as the "hotspot"oftheprecipitationregimeshift.

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