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The Role of Atmospheric Stabilities and Moisture Convergence in the Enhanced Dry Season Precipitation over Land from 1979 to 2021

Abstract

Between 1979 and 2021, global ocean regions experienced a decrease in dry season precipitation, while the trend over land areas varied considerably. Some regions, such as southeastern China, the Maritime Continent, eastern Europe, and eastern North America, showed a slight increasing trend in dry season precipitation. This study analyzes the potential mechanisms behind this trend by using the fifth major global reanalysis produced by ECMWF (ERA5) data. The analysis shows that the weakening of downward atmospheric motions played a critical role in enhancing dry-season precipitation over land. An atmospheric moisture budget analysis revealed that larger convergent moisture fluxes lead to an increase in water vapor content below 400 hPa. This, in turn, induced an unstable tendency in the moist static energy profile, leading to a more unstable atmosphere and weakening downward motions, which drove the trend toward increasing dry season precipitation over land. More water vapor in the low troposphere is because of higher moisture convergence and moisture transport from ocean to land regions. In summary, this study demonstrates the intricate elements involved in altering dry season rainfall trends over land, which also emphasizes the importance of comprehending the spatial distribution of the wet-get-wetter and dry-get-drier paradigm.

Keyword

Atmospheric Stabilities

Moisture Convergence

Reference

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