Changes of the precipitation and the Monsoon Transitional Zone in East Asia: past and future

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The monsoon transitional zone (MTZ) in East Asia is the transitional belt between humid and arid regionsand is characterized bysharp climate and biome gradients. Thisbelt is considered to be "interface fragile" to natural disastersand climate changes.However, significant attention is not given to the variationof the MTZ in East Asia. Thus, there is an urgent need to address the precipitation variation and the associated MTZ changes, especially during rainy season.

A decadal change of summer rainfall in the MTZ of East Asia is observed around 1999. This decadal change is characterized by an abrupt decrease of summer rainfall of about 18% of the climatological average amount leading to prolonged drought in the region. Three different drought indices, the standardized precipitation index, the standardized precipitation evapotranspiration index, and the self-calibrating Palmer Drought Severity Index, present pronounced climate anomalies during 1999-2007, indicatingdramatic drought exacerbation in the region after the late 1990s. This decadalchange in the summer rainfall may be attributable to a wave-like teleconnection pattern from Western Europe to Asia. A set of model sensitivity experiments suggests that the summer warming sea surface temperature in North Atlantic could induce this teleconnection pattern over Eurasia,resulting in recent drought in the MTZ region.

With the CMIP5 simulation results, a focused and detailed survey of MTZhas been conducted. Inthe historical period, the MTZ experienced coastward migration with increasing aridity throughoutMTZ. Furthermore, precipitation fluctuation mainly contributes to interannual variability of MTZ whereas potentialevaporation behavior dominates its long-term trends. In global warming scenario period, there will becontinuing southeastward displacement for the front edgebut the opposite northwestward movement is projected forthe rear one, as a consequence of significant drying trendsin the humid zone together with regime shifts towardshumid conditions in the arid zone. Moreover, interannual variability of MTZ is expected tobecome stronger, resulting in more frequent occurrences ofextreme swings. Finally, it is noted that uncertainty arisingfrom climate models dominates in the MTZ than dispersedemission scenarios, in contrast to the situation in humidand arid zones.

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