A multivariate probabilistic framework for tracking the fluctuation of the global land monsoon domain

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Abstract:　　Monsoons are significantly affected by climate fluctuations, and thus global land monsoon domains vary remarkably between years. However, monsoon domain is typically defined from long-term climatology, and fails to reflect the annual fluctuation of monsoon coverage. The objective of this study was to determine a copula-based multivariate probabilistic framework to calculate the probability of global land monsoon domain by combining two precipitation characteristics (i.e., the local summer-minus-winter precipitation rate and the proportion of summer precipitation). The level of probability captures the interannual fluctuation variation of global land monsoon domain.

Results showed that the probability distribution of a monsoon well reflected the spatiotemporal extent of the monsoon domain. The probability inside the monsoon domain was high and decreased rapidly at the monsoon domain boundary. The probability at the boundary of the multi-year average monsoon domain was mostly between 0.2 to 0.5 (average of 0.37). Average probability at the multi-year average boundary of the Australia monsoon region was the lowest (0.32), while the average probability of the South Asia monsoon region was the highest (0.46). A lower probability level indicates higher interannual variability at the multi-year average boundary. The probability change reflected the coverage and boundary change of the monsoon. Over the past 80 years, monsoon coverage changes were largely located at the boundary areas and were quite different amongst different monsoon regions.

The probabilistic framework proposed and analyzed in this study allows for joint consideration of multiple variables and characteristics, and provides insight about the annual fluctuation of global land monsoon domain. This framework will increase our understanding of the temporal variations of monsoon domain under future changing climate.

Keywords:　*Monsoons, multivariate probabilistic frameworks, copula*