



Relationships between interdecadal variability and extreme precipitation events in South America during the monsoon season

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This study aims to clarify the impact of interdecadal climate oscillations (periods of 8 years and longer) on the frequency of extreme precipitation events over South America in the monsoon season (austral spring and summer), and determine the influence of these oscillations on the daily precipitation frequency distribution. Interdecadal variability modes of precipitation during the monsoon season are provided by a continental-scale rotated empirical orthogonal function analysis for the 60 years period 1950-2009. The main disclosed modes are robust, since they are reproduced for different periods. They can produce differences around 50% in monthly precipitation between opposite phases. Oceanic and atmospheric anomalous fields associated with these modes indicate that they have physical basis. The first modes in spring and summer display highest correlation with the Interdecadal Pacific Oscillation (IPO) SST mode, while the second modes have strongest correlation with the Atlantic Multidecadal Oscillation (AMO) SST mode. However, there are also other influences on these modes.

As the most dramatic consequences of climate variability stem from its influence on the frequency of extreme precipitation events, it is important to also assess this influence, since variations in monthly or seasonal precipitation do not necessarily imply significant alterations in their extreme events. This study seeks to answer the questions: i) Do opposite phases of the main interdecadal modes of seasonal precipitation produce significant anomalies in the frequency of extreme events? ii) Does the interdecadal variability of the frequency of extreme events show similar spatial and temporal structure as the interdecadal variability of the seasonal precipitation? iii) Does the interdecadal variability change the daily precipitation probability distribution between opposite phases? iv) In this case, which ranges of daily precipitation are most affected?

The significant anomalies of the extreme events frequency in opposite phases of the interdecadal oscillations display spatial patterns very similar to those of the corresponding modes. In addition, the modes of extreme events frequency bear similarity to the modes of seasonal precipitation, although a complete assessment of this similarity is not possible with the daily data available. The Kolmogorov-Smirnov test is applied to the daily precipitation series for positive and negative phases of the interdecadal modes, in regions with high factor loadings. It shows, with significance level better than 0.01, that daily precipitation from opposite phases pertains to different frequency distributions. Further analyses disclose clearly that there is much greater relative impact of the interdecadal oscillations on the extreme ranges of daily rainfall than in the ranges of moderate and light rainfall. This impact is more linear in spring than in summer.

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