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Intraseasonal Precipitation Variability in South America and how it is connected to Rossby Waves

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Wet season precipitation in the South America monsoon system exhibits a dipole-like variability between the South Atlantic convergence zone (SACZ) and southeastern South America (SESA) [2]. This variability affects areas, e.g. around Buenos Aires, São Paulo and Rio de Janeiro, that are both: important for regional food supplies and densely populated. Here, we want to investigate the mechanism behind this variability pattern.

In order to do so we analyze this complex interaction between SESA, SACZ and Rossby wave trains emanating from the southern Atlantic with phase synchronization techniques and a conceptual model. From nonlinear systems theory we know that if two oscillating systems are brought into contact, their phases may synchronize [6]. This concept can be applied to climatic time series as well [7]. For this data-driven phase synchronization approach we use NASA's Modern Era Restrospective analysis for Reasearch and Applications 2 (MERRA2) Reanalysis data [3]. First, we extract intraseasonal oscillations with Singular Spectrum Analysis (SSA) [4,5], then we reconstruct their corresponding phases with a Hilbert transform [6]. The resulting phase difference time series stay close to zero for the entire observation period and thus show the phase synchronicity between the two subsystems SACZ and SESA in South American and the Rossby Waves. Complementary to the data-driven approach, we also introduce a conceptual model that shows that the spatial pattern of a Principal Component Analysis of precipitation data can be explained by a traveling wave such as the Rossby Waves. Our approach shows that the dipolar precipitation pattern is not just caused by a direct interaction between the subsystems in SACZ and SESA, but is driven by the propagation of Rossby waves, which potentially has implications for the synoptic-scale weather forecast.

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