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Phase Synchronization of Precipitation in South America to Rossby Waves

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The dominant mode of interseasonal precipitation variability in subtropical South America is the dipole of the South Atlantic Convergence Zone (SACZ) and southeastern South America [1]. It affects a highly populated area that is also of significant importance for the regional food supplies. In this study we show how this phenomenon is coupled to the southern-hemisphere Rossby Waves trains.

As a proxy for the Rossby Waves we choose the geopotential height at 250 HPa, averaged over a box in the Southern Atlantic. For the SACZ dipole, we investigate the precipitation in South Eastern Brazil (SEBRA) and southeastern South America (SESA). For all variables we use daily reanalysis data from NASA's Modern Era Restrospective analysis for Research and Applications 2 (MERRA2) which is provided on a 1/3°x2/3° grid [2]. We analyse this data by first extracting the interseasonal oscillations with Signal Spectrum Analysis (SSA)[3,4] and then reconstructing their corresponding phases with a Hilbert Transformation [5]. The resulting phase difference time series stay close to zero for the entire observation period and thus prove the phase synchronicity between the South American precipitation dipole and the Rossby Waves. By comparing our results to surrogate data both for the SSA (Monte Carlo SSA [6]) and the phase differences, we show the significance of our findings and additionally validate them by cross checking them with other methods.

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