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Analysis of extreme rainfall in South America associated with Madden-Julian Oscillation

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Since the early Twentieth Century, the scientific community has recorded the observation of atmospheric and oceanic oscillations related to climatic behavior in remote areas with influence on intraseasonal, interannual and decadal scales, as indicated by [Walker, (1924); Bjerkness (1969); Gutzler and Wallace (1981); Rogers and Van Loon (1978, 1979)].
On the intraseasonal scale, Madden-Julian Oscillation (MJO) plays a key role in the modulation of rainfall in the tropics and subtropics (Kayano et al., 2009) being characterized by an east shift in a zonal large-scale and thermally direct cell on the Pacific Ocean. This oscillation was first detected in the work of Madden and Julian (1971, 1972) through the application of spectral analysis on daily radiosonde data provided by the National Center for Atmospheric Research (NCAR), for the stations at Canton island. The analysis allowed the detection and documentation of oscillations with periods from 40 to 50 days with strong associations between the surface pressure, zonal wind and temperature at different atmospheric levels.
Although Souza and Ambrizzi (2006) indicate that South America (SA) has its convective activity altered due to the passage of the MJO, at the present moment, the existing models of climate prediction have not been able to correctly reproduce the propagation of the MJO. This study aims to analyze the periods of occurrence of extreme precipitation and drought in SA associated with OMJ and check the ability of Regional Circulation Model (RegCM4) to simulate this climate variability both diagnostically and prognostically.
Daily rainfall data compiled by Liebmann and Allured (2005) will be used for the period 1978-2005 for the detection of MJO influence on SA precipitation. The analysis of atmospheric fields (wind at 200 and 850 hPa and omega at 500 and 850 hPa) of the Reanalysis I data set (Kalnay, 1996) obtained from the Physical Sciences Division (PSD) will be performed in order to verify the relationships between the propagation of MJO and atmospheric circulation patterns associated with precipitation anomalies in SA.
The data processing will be based on statistical techniques. Checking consistency of data regarding rainfall will be done on monthly, quarterly and annual scales. For detection of intraseasonal variability, Lanczos filter (Duchon , 1979) and the Fourier transform will be used, both with the purpose of data filtering in order to emphasize the frequencies of interest for the study. Subsequently, the atmospheric model RegCM4, developed by NCAR (Giorgi et al. 2012), will be used in order to simulate SA rainfall as a function of MJO, to verify the model's detection capacity for this variability.
It is hoped that a greater understanding of the MJO and its influence on the precipitation of SA will be gained through the statistical studies and dynamic techniques employed. Additionally, the use of RegCM4 model may prove able to capture the MJO in the tropical region efficiently, thus contributing to the prediction of precipitation.