Proceeding Series of the Brazilian Society of Computational and Applied Mathematics, v. 8, n. 1, 2021.

Trabalho apresentado no XL CNMAC, Evento Virtual - Co-organizado pela Universidade do Mato Grosso do Sul (UFMS).

Proceeding Series of the Brazilian Society of Computational and Applied Mathematics

Distinction index between distributions to classify meteorological events

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The South Atlantic Convergence Zone (SACZ) is a meteorological phenomenon that influences directly the rainy season of the Subtropical zone of South America [3]. The SACZ is characterized by an intense convergence zone oriented northwest-southeast which occurs more frequently between November and March [4]. Due to its stationarity, some SACZ is related to extreme rainfall episodes that are followed by landslides and floods, as it occurred in the Mountain Region of Rio de Janeiro in 2011. This landslide case caused the death of 905 people, 345 missing and 34.600 homeless [2].

Forecasting SACZ events has been developed applying statistical and subjective criteria. Quadro (1994) [4] determined the SACZ based on the intensity and persistence of the precipitation and the satellite brightness temperature. Both Rosa et al. (2020) [5] and Ambrizzi e Ferraz (2015) [1] used thresholds for Outgoing Longwave Radiation and precipitation. Although it is well known that moisture content in SACZ episodes is high [4], there is no work using this variable.

This work aims to use the specific humidity (SH) in the medium level of the atmosphere as a variable to distinguish No-SACZ and SACZ episodes and we also propose an index to evaluate its distinctive quality. To accomplish that, SH reanalysis data set from 2006-2016 within the latitudes 25/20ºS and longitude 45/38ºW provided by NCEP/NCAR was used [6]. The SACZ days were selected using precipitation data from 26 pluviometers of the AlertaRio system and to classify a day as SACZ at least 4 of the stations had to register an accumulated rainfall of 30 mm/day.

Using this criterion, we found 36 time steps as SACZ: 6 during October-November (ON), 15 during December-January (DJ), and 15 February-March (FM). As the rainfall is the result of the previous atmosphere state, therefore the time steps immediately before the one which was classified as SACZ, are also considered, resulting in 72 time steps.

To distinguish No-SACZ from SACZ, the 11-year climatology (mean) and the 11-year standard deviation (std) for each grid point and bimester were calculated. Then, the following threshold was determined by equation (1):

$$L1 = mean + 1 * std \tag{1}$$

The percentage of the domain that was above L1 was computed for all the time steps of both No-SACZ and SACZ datasets. Figure 1 shows the histogram distribution for SH at 400 hPa level for ON. Although, visually the proposed method shows an efficient distinction, an index I (equation 2) was calculated to measure the quality of the variable and the thresholds to act as classifiers.

$$I = 1 - \frac{intersection}{200} \tag{2}$$

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The *intersection* term of equation (2) refers to the sum of the intersection between the two columns of the histogram intersection for each bin of the domain area. In the case of the overlap of the two histograms, the I index will be 0.5 and if there is no intersection, the index will be 1. For SH during the ON months, the index I value is 0.84.

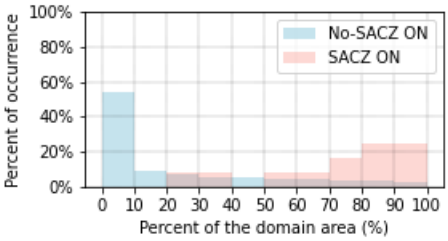

Figure 1: SH Distribution for L1 threshold

Combining the index value and the histogram seen in Figure 1, we can conclude the method and the variable used to distinguish SACZ and No-SACZ events are effective, whereas the most SACZ episodes are found on the bin intervals above 50% of the domain area, confirming that the atmosphere in SACZ days have much more moisture content in mid-levels when comparable with No-SACZ days.

Acknowledgements

The authors would like to acknowledge CNPq for the financial support.

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