Discrete analysis for the America west coast rainfall predictability using El Niño/Southern Oscillation relationships

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Abstract: The objective of the study was to determine the probability of occurrence of wet or dry season events, based on the phase of El Niño/Southern Oscillation (ENSO) phenomenon using multinomial response logit and logit regression models (Agresti, 2002). The study used monthly time series of the Pacific equatorial sea surface temperature (SST), a sea level pressure index (SOI) (Fig. 1) and rainfall anomalies over a 2.5x2.5 degrees grid along the west coast of Central and South America (Fig. 2), for latitudes starting at 25°N, through 45°S, since 1951 to 2011. An ENSO index (NSO) was defined as predictor and rainfall as response. Series were first transformed into trimesters, replacing data by the three months average of the seasons **DJF – MAM –JJA - SON.** Data was categorized into terciles to construct non symmetrical three way contingency tables, including a time lagged categorization of the predictor variable (NSO) (Fig. 3). Two types of latitudinal profiles of the predictability (association), for the West Coast of Central and South America, using ENSO as predictor were generated as results. One using the categorized NSO index, using a multinomial response logit model to estimate the probabilities at the corners, of the contingency tables, representing the chances of extreme events of rainfall, given the El Niño and La Niña events and a second using multinomial response logit regression models, to estimate the same rainfall events, but using the NSO as a continuous predictor. in which the NSO index was used as continuous predictor. The analysis was performed for all the contingency tables, particularly for the "corner cells" and the results were plotted as latitudinal profiles (Figs. 4, 5 & 6).

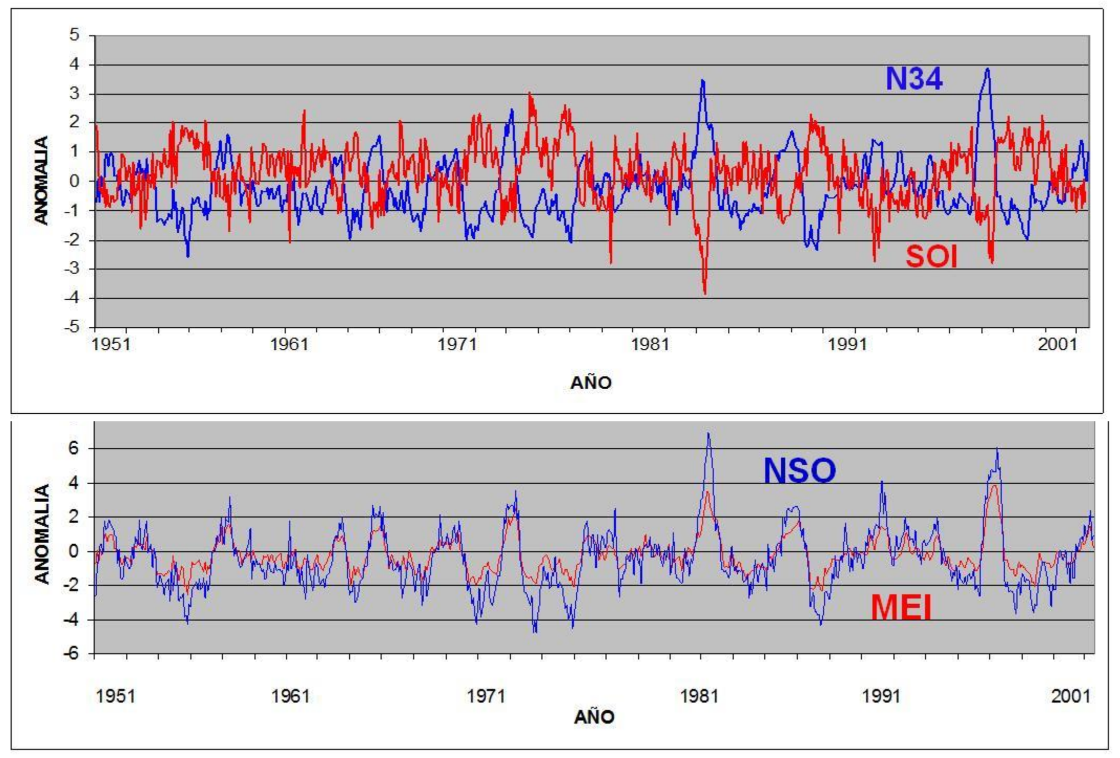


Fig. 1 – Time Series associated with ENSO (NSO). **Top**, NSO index was defined as the difference NSO = N34-SOI. **Bottom**, NSO series compared to the MEI series. This index enhances the dipole relationship between N34 and the SOI.

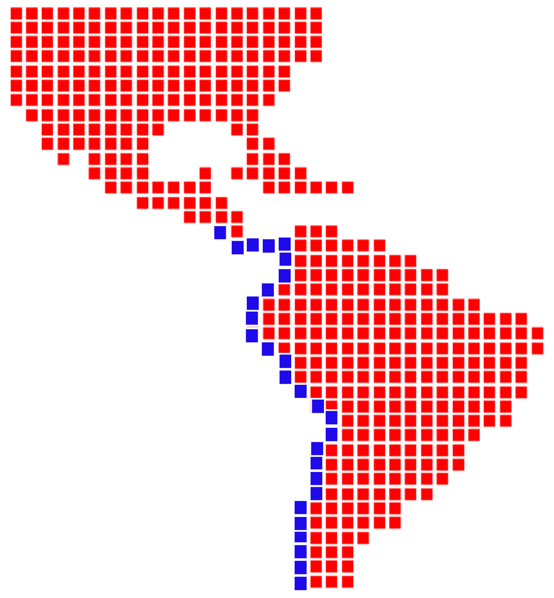
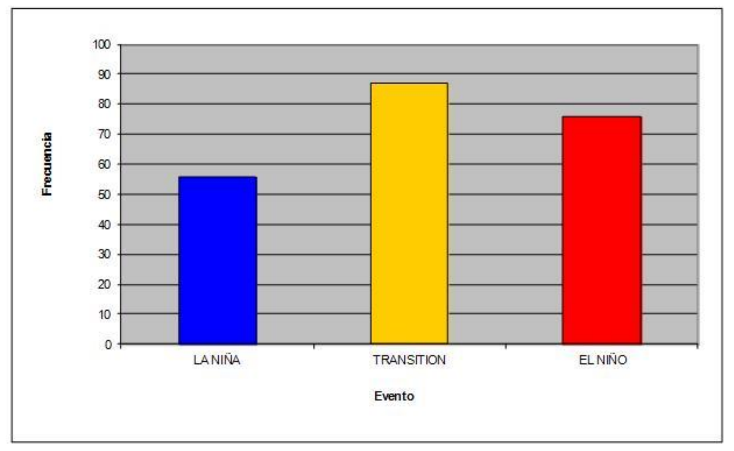


Fig. 2 – Monthly average rainfall from 2.5°x2.5° cells, located along the West Coast of Central and South America were used (blue squares, Chen et al., 2002).

Terciles approach

a)

EL NIÑO
TRANSITION
LA NIÑA



FREQUENCY	56	87	76
PROPORTION	0.275	0.426	0.373

	NSO TERCILES		
RAINFALL TERCILES	N_1 (COOL)	N_2	N_1 (WARM)
R_1 (DRY)	P_{11}	P_{12}	P_{13}
R_2	P_{21}	P_{22}	P_{23}
R_1 (WET)	P_{31}	P_{32}	P_{33}

b)

Fig. 3 –. **a)** Empirical probability for the El Niño (N_3), Neutral (N_2) and La Niña (N_1) categories of NSO index. **b)** Typical 3x3 contingency table for terciles used in the analysis.

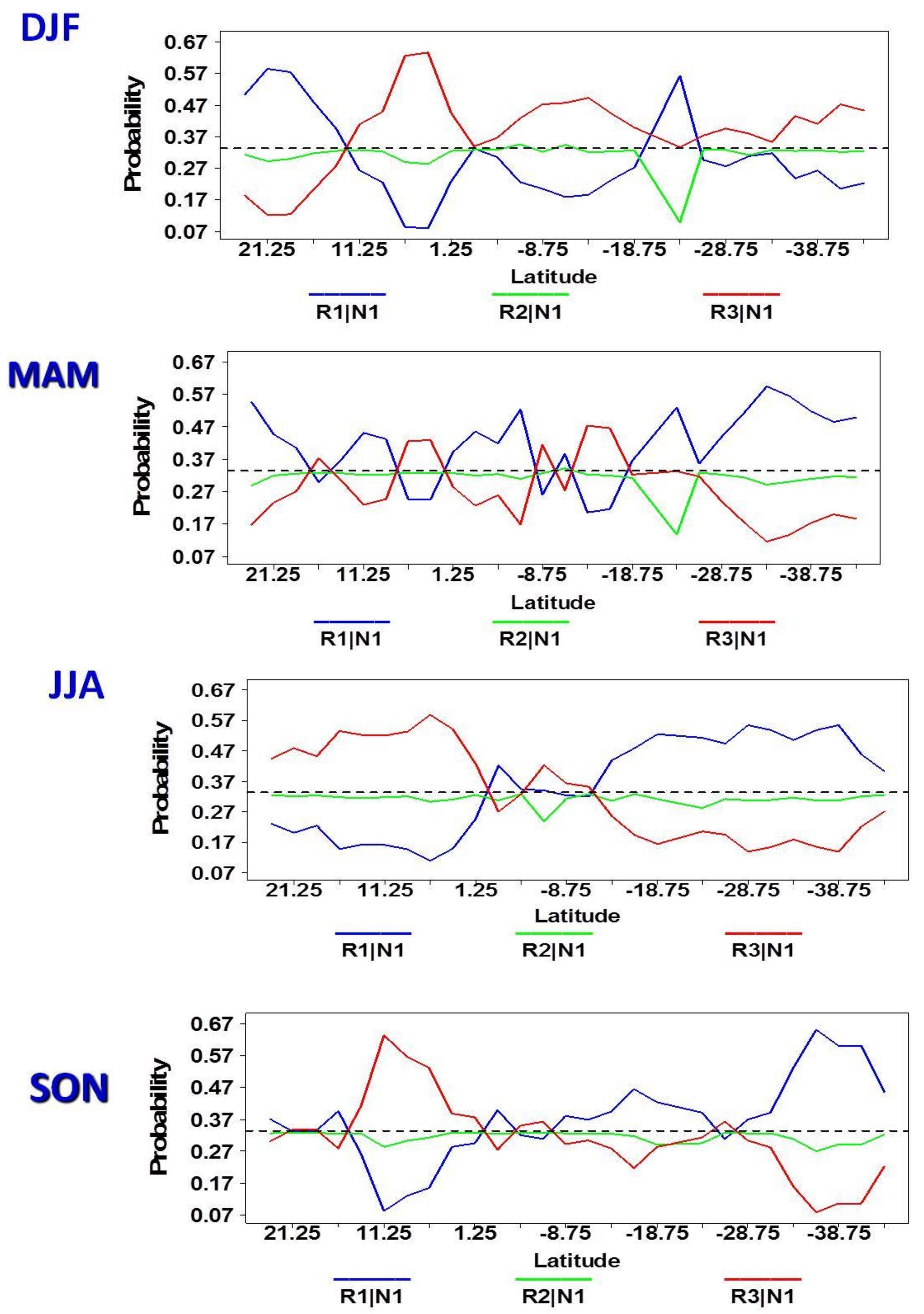


Fig. 4 – Probability of rain given a cold episode.

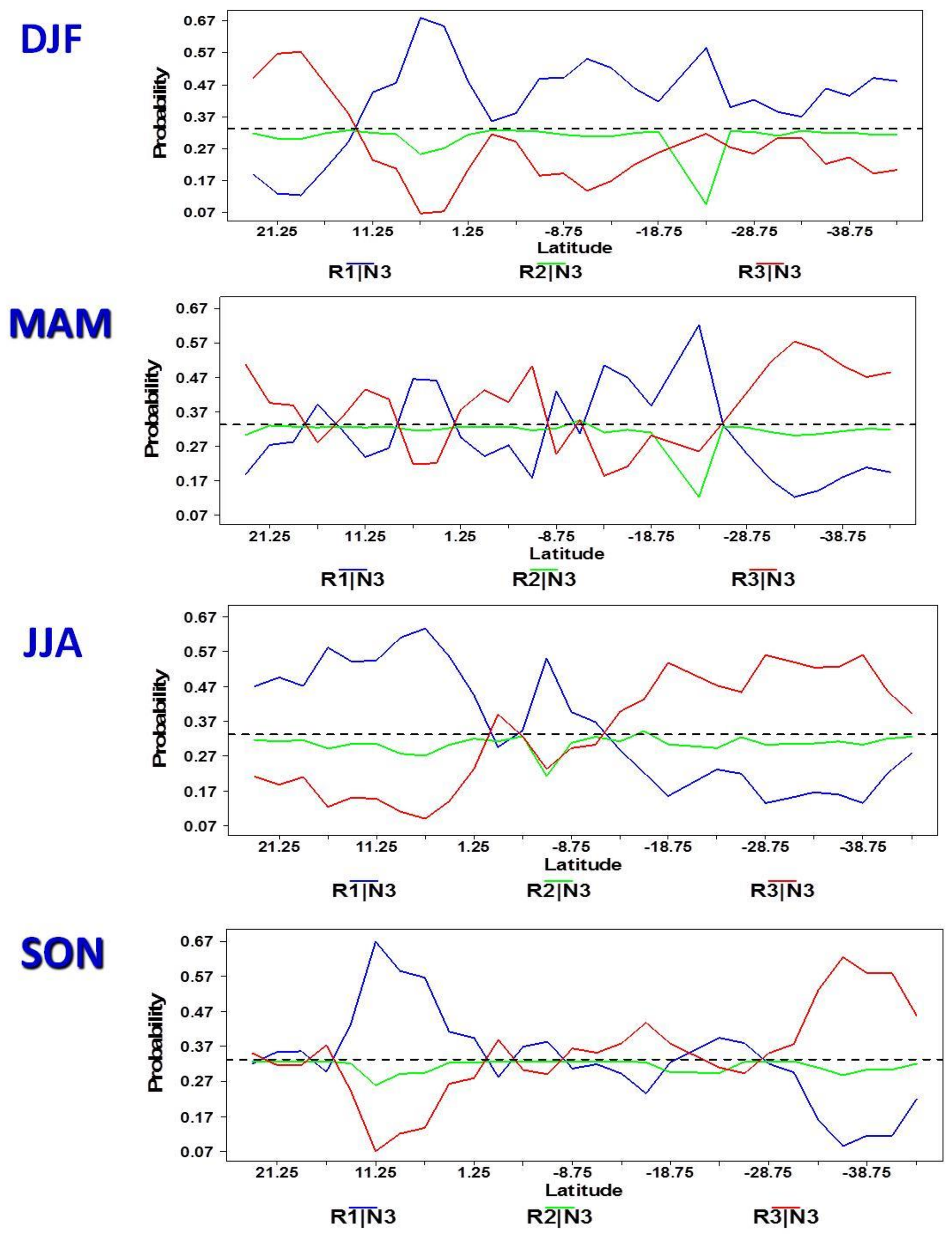


Fig. 5 – Probability of rain given a warm episode.

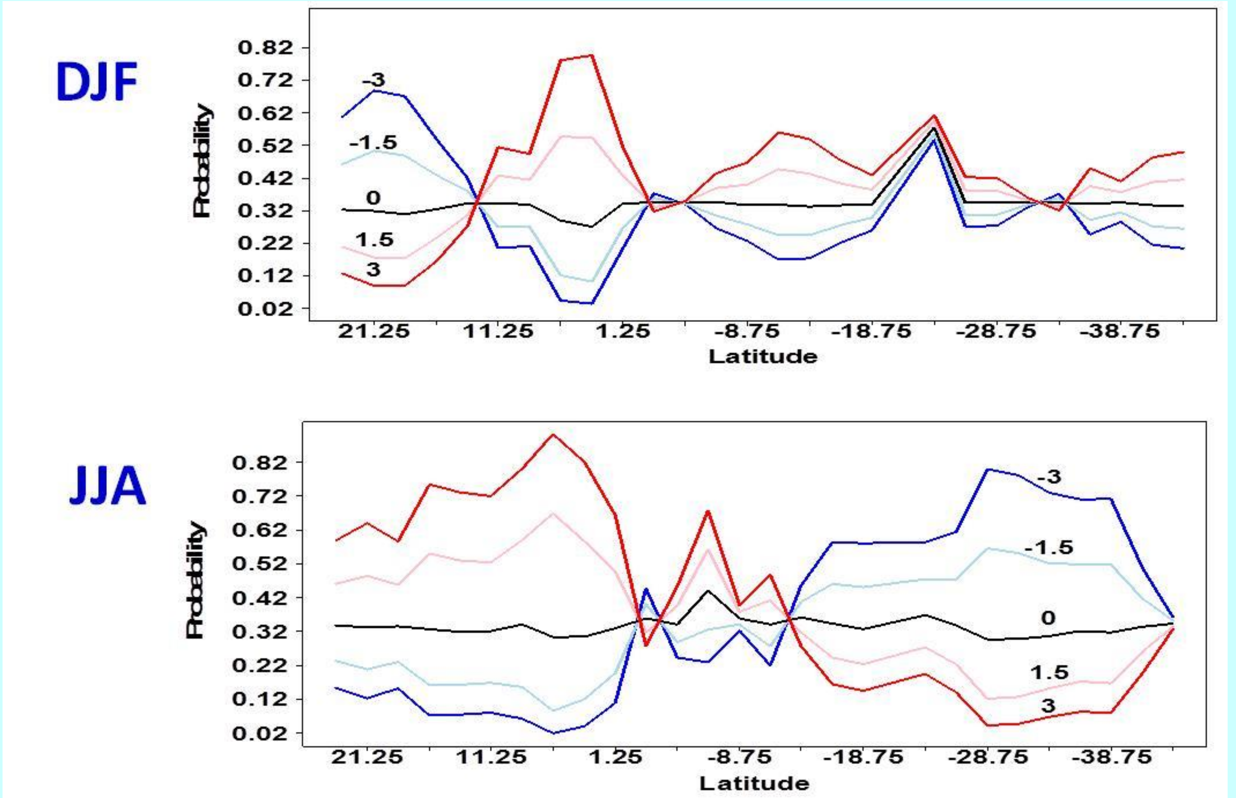


Fig. 6 – Probability of a dry (R1) using NSO as continuous predictor, for anomalies from +3 through -3 °C.

References:

-Agresti A. 2002. Categorical Data Analysis. A Wiley-Interscience Publication, John Wiley and Sons.

-Chen, M., P. Xie, J. E. Janowiak and P. A. Arkin, 2002: Global land precipitation: A 50-yr monthly analysis based on gauge observations. J. Hydrometeor., 3, 249-266.

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Poster will be available after the event at: http://kerwa.ucr.ac.cr/