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# Review of the relationships between ENSO and PDO

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The most important mode of interannual variability from ocean-atmosphere system is the El Niño / Southern Oscillation - ENSO, which has its effects observed on a global scale, influencing the thermal and rainfall regimes in various regions of the world. There is a discussion whether this phenomenon can be modulated by low frequency climate patterns, especially a dominant pattern of decadal variability over the Pacific related temporally and spatially to ENSO, called the Pacific Decadal Oscillation (PDO). Several studies tried to understand the relationships between the El Niño / Southern Oscillation (ENSO) and Pacific Decadal Oscillation (PDO), indicating that these two patterns are related and that each one affects the other. However, some questions remain regarding the timescales in which ENOS and ODP interacts, which pattern leads the other and what is the time lag. In addition, previous studies show that these interactions are not significant for the entire period where data are available (about 100 years), especially before 1950. Supporting these findings, Bunge & Clarke (2009) noted that the correlation between El Niño index, calculated by the conventional data of SST for Niño 3.4 region, and the Southern Oscillation Index, was too low for the period before 1950 when compared with the later period, therefore proposing a correction for this index. Attempting to understand better these interactions, the focus of this study was to examine the relationship between ENSO and PDO through the analysis of wavelet coherence (correlation) and phase (lag), comparing the ODP index, proposed by Mantua et al. (1997), with two other indices: the index calculated from the conventional data of SST from Niño 3.4 (Smith & Reynolds, 2003), and the index corrected by Bunge & Clarke (2009). The period of data selected for this study was 1900 to 2009. For the conventional data of El Niño, the results showed that ENSO and PDO only interact significantly at ENSO scale (4-7 years), and ENOS leads ODP for up to 2 years. Moreover, the region of coherence is not presented as a continuous band in wavelet, but is discontinuous, being significant during positive phase of PDO, approximately. There was no significant coherence in the other temporal scales. However, with the corrected data, it was noted that there is a significant coherence between the spectrum of ENSO and PDO, both in low and at high frequency. For high frequency, which is the approximate ENSO scale, the ENOS leads the ODP by months, presenting a more continuous spectrum compared to that one presented by conventional data. At low frequency, approximate ODP scale, it is ODP that leads ENSO, for up to 2 years. Thus, the corrected Niño 3.4 index seems to represent more realistically the relationships between ENSO and PDO than the conventional index, assuming that both patterns interact in different time scales, and that no one is dominated by the other.