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The Roots of Amazonia's Droughts and Floods: Complex Interactions of Pacific and Atlantic Sea-Surface Temperatures

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Abstract : Extreme droughts and floods in the Amazon have serious consequences for natural ecosystems and the human population in the region. The frequency of these events has increased in recent years, and projections of climate change predict greater frequency and intensity of these events. Understanding the links between these extreme events and different patterns of sea surface temperature in the Atlantic and Pacific Oceans is essential, both to improve the modeling of climate change and its consequences and to support efforts of adaptation in the region. The relationship between sea temperatures and events in the Amazon is much more complex than is usually assumed in climatic models. Warming and cooling of different parts of the oceans, as well as the interaction between simultaneous temperature changes in different parts of each ocean and between the two oceans, have specific consequences for the Amazon, with effects on precipitation that vary in different parts of the region. Simplistic generalities, such as the association between El Niño events and droughts in the Amazon, do not capture this complexity. We investigated the variability of Sea Surface Temperature (SST) in the Tropical Pacific Ocean during the period 1950-2022, using Empirical Orthogonal Functions (FOE), spectral analysis coherence and wavelet phase. The two were identified as the main modes of variability, which explain about 53,9% and 13,3%, respectively, of the total variance of the data. The spectral and coherence analysis and wavelets phase showed that the first selected mode represents the warming in the central part of the Pacific Ocean (the "Central El Niño"), while the second mode represents warming in the eastern part of the Pacific (the "Eastern El Niño The effects of the 1982-1983 and 1976-1977 El Niño events in the Amazon, although both events were characterized by an increase in sea surface temperatures in the Equatorial Pacific, the impact on rainfall in the Amazon was distinct. In the rainy season, from December to March, the sub-basins of the Japurá, Jutaí, Jatapu, Tapajós, Trombetas and Xingu rivers were the regions that showed the greatest reductions in rainfall associated with El Niño Central (1982-1983), while the sub-basins of the Javari, Purus, Negro and Madeira rivers had the most pronounced reductions in the year of Eastern El Niño (1976-1977). In the transition to the dry season, in April, the greatest reductions were associated with the Eastern El Niño year for the majority of the study region, with the exception only of the sub-basins of the Madeira, Trombetas and Xingu rivers, which had their associated reductions to Central El Niño. In the dry season from July to September, the sub-basins of the Japurá Jutaí Jatapu Javari Trombetas and Madeira rivers were the rivers that showed the greatest reductions in rainfall associated with El Niño Central, while the sub-basins of the Tapajós Purus Negro and Xingu rivers had the most pronounced reductions. In the Eastern El Niño year this season. In this way, it is possible to conclude that the Central (Eastern) El Niño controlled the reductions in soil moisture in the dry (rainy) season for all sub-basins shown in this study. Extreme drought events associated with these meteorological phenomena can lead to a significant increase in the occurrence of forest fires. These fires have a devastating impact on Amazonian vegetation, resulting in the irreparable loss of biodiversity and the release of large amounts of carbon stored in the forest, contributing to the increase in the greenhouse effect and global climate change.

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