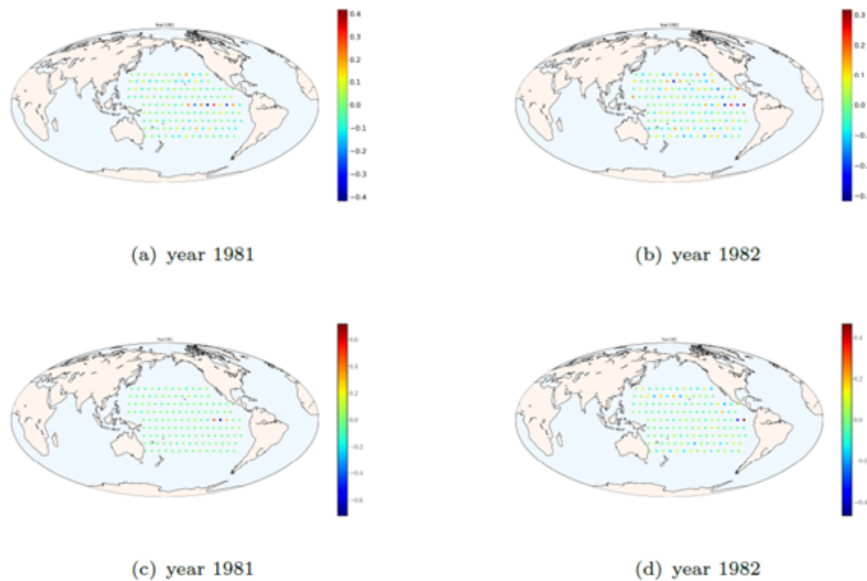
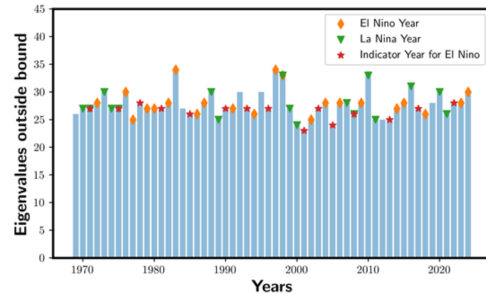


Exploring the El Nino Climate Phenomena Using Data-Driven Methods of Eigenvalue Statistics and Network Theory

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We integrate two methods (Network theory and Eigenvalue statistics) to investigate the complex El Nino/La Nina climate phenomena. We take the Tropical Pacific Ocean as the region under study and then construct threshold networks via correlation matrices of temperature time series data and compute the highest node degree, total number of links, and the clustering coefficients for the networks. All these properties can be used as indicators and we notice that geographical locations near the equator and the tropics are the most important for the El Nino. In the eigenvalue statistics, we use the eigenvalue density distribution and find that the number of eigenvalues outside the random matrix bounds (outliers) increase in the El Nino years. The Shannon entropy and IPR are calculated to find out the most localized eigenmodes. This leads to the observation that the eigenvector components corresponding to the smallest and second smallest eigenvalue are most localized. We find that these eigenvalues can be used as indicators. Analyzing the components of the smallest and second smallest eigenvectors, we confirm the network result by identifying the equatorial and tropical locations which are most important thus addressing the complexity of the El Nino climate phenomena.



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