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Application of Proper Orthogonal Decomposition Method on foF2 Data from IRI model for the Latin American region

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Proper Orthogonal Decomposition (POD) is a mathematical technique used to extract dominant patterns or modes of variation from high-dimensional datasets. In this study focused on Latin America's foF2 (maximum frequency of the F2 ionospheric layer) data, POD is employed to decompose the time series into fundamental components that contribute to its variability.

The foF2 data series used in this study covers a time period from 1960 to 2022 and extends from 30°N to 90°S and from 120°W to 20°E. The spatial resolution of the grid used is 3°x3°, providing detailed coverage of the Latin American region. These data were generated using the International Reference Ionosphere (IRI) (Bilitza *et al.*, 2022), an empirical model of the ionosphere that utilizes data from a global network of instruments such as ionosondes, satellites, and rockets. The IRI is widely adopted as a standard model within the scientific community.

By applying the POD method to the foF2 data series for Latin America, the main components contributing to the observed variability can be identified. These components may include temporal trends, seasonal cycles, short-term fluctuations, and spatial patterns. The orthogonal decomposition allows for the separation and individual analysis of these components, providing a deeper understanding of the underlying processes affecting foF2 variability. This is particularly useful for identifying anomalies, atypical behavioral patterns, or significant changes over time and space. Understanding and characterizing these patterns can provide valuable insights into the underlying processes and dynamics of the ionosphere, which directly contributes to our understanding of space weather conditions.

References

Bilitza, D., Pezzopane, M., Truhlik, V., Altadill, D., Reinisch, B. W., & Pignalberi, A. (2022). The International Reference Ionosphere model: A review and description of an ionospheric benchmark. Reviews of Geophysics, 60.