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A complexity analysis of Earth's radiation based on satellite observations

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The analysis of climate variability and change is generally carried out using momentum statistics such as trends, means, variance, etc. Those techniques are the cornerstone of any statistical analysis but they do not take into account the complexity of the system. Chaos theory opened paths to analyze those changes by expanding the ideas of information theory to reconstruct the dynamics of strange attractors, and the algorithms developed in that field can be applied to the Earth's system to study the complexity of climate and its evolution. Earth's emission of radiation can be described as a nonlinear system mixing deterministic processes with stochastic variations driven by solar radiation. In our analysis, we use the Approximate Entropy algorithm along with MERRA-2 data (Modern-Era Retrospective analysis for Research and Applications, Version 2) to evaluate the changes in the complexity of climate since 1980. Our analysis is performed with Earth's shortwave and longwave radiation data to quantify the changes in the nonlinearity of the system in the near past based on satellite observations.