Enhancing our physical understanding of climatic processes using improved climate models

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More frequent extreme climate events have become a major global challenge. To mitigate the human and economic costs of these events, climatologists consistently create future climate predictions. These projections help policy makers develop actionable climate policies to avoid the most dangerous climate change effects. Because of the high data volume required for accurate forecasts, scientists rely on supercomputer-run climate models to make predictions and to project changes in the climate system. However, an incomplete physical understanding of the Earth's dynamic climatic processes remains a major limitation regarding climate model usability.

Chibuike Ibebuchi from the Institute of Physical Geography, University of Würzburg, conducted a recent study, published in *Advances in Atmospheric Sciences,* that applied a synoptic climatological statistical modeling approach called "circulation typing with fuzzy rotated principal component analysis."

This new technique is designed to enhance the physical understanding of the mechanisms through which teleconnections, such as the sub-tropical Indian Ocean Dipole, impacts seasonal rainfall variability in southern Africa, a region that is vulnerable to climate extremes. Circulation typing considers both space and time for rainfall anomalies.

Ibebuchi believes that climate modeling and projection improvements can advance with more research studies that aim toward gaining a better physical understanding of climate processes on the synoptic and global scales. Furthermore, research should analyze how the synoptic and large-scale climate processes interact with regional climates. Researchers can achieve this by enhancing techniques for effectively breaking down climate data sets through space and time to unravel the distinct (continuous) variability associated with the climate system.

More specifically, for these subsequent studies, Ibebuchi aims toward developing and optimizing existing statistical methods for decomposing, or breaking down data sets to unravel physically meaningful climate forecasting signals. This includes diagnosing misrepresentations in climate modeling processes.

More information: Chibuike Chiedozie Ibebuchi, Circulation Patterns Linked to the Positive Sub-Tropical Indian Ocean Dipole, *Advances in Atmospheric Sciences* (2022). DOI: 10.1007/s00376-022-2017-2

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