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New Approach to Quantify How Well Climate Models Simulate Extratropical Modes of Interannual Variability

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Systematic and routine evaluation of multiple climate models in a collective manner is essential, especially when thousands of simulations will be available with the data burden increasing to Petabyte scale (e.g. CMIP6).

One challenge for Earth System Models is reproducing the observed characteristics of major modes of climate variability, e.g., the Northern Annular Mode (NAM), North Atlantic Oscillation (NAO), Southern Annular Mode (SAM), Pacific/North American Pattern (PNA), and the Pacific Decadal Oscillation (PDO), which have been defined in terms of leading modes of Empirical Orthogonal Functions (EOFs).

Traditionally, comparison of the leading EOF modes obtained from observations and models have been used for model validation. However, it is not always guaranteed that a model's first leading EOF mode corresponds to that of observations, especially when the leading modes are not clearly separated.

We applied an alternative method, named "Common Basis Function (CBF)" approach, in which we project the model anomalies onto the observed EOF to analyze the models in a common framework. A major benefit of this approach is that the difficulties of the standard EOF approach are circumvented, such that (1) we do not have to correct for arbitrary sign differences of a model mode compared to observations, (2) we do not have to develop a swapping protocol to try to ensure that the most applicable mode from a model is compared to observations, and (3) the issue of an observed mode being split across multiple model modes is moot.

We highlight these new climate variability statistics that have been produced with the PCMDI Metrics Package (PMP). We describe how the diagnostics and metrics have been incorporated into the PMP, and provide a demonstration of the database of results that can be exploited by modelers and researchers for uses, such as model development and the assessment of relative skill.

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