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Quantifying the Agreement Between Observed and Simulated Extratropical Modes of Interannual Variability

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Using Historical simulations of the Coupled Model Intercomparison Project-5 (CMIP5) models and multiple observationally-based datasets, we employ skill metrics to analyze the fidelity of the simulated Northern Annular Mode (NAM), the North Atlantic Oscillation (NAO), the Pacific North America pattern (PNA), the Southern Annular Mode (SAM), the Pacific Decadal Oscillation (PDO), the North Pacific Oscillation (NPO), and the North Pacific Gyre Oscillation (NPGO). We assess the benefits of a unified approach to evaluate these modes of variability, which we call the common basis function (CBF) approach, based on projecting model anomalies onto the observed empirical orthogonal function (EOF). The CBF approach circumvents issues with conventional EOF analysis, including the need to correct for arbitrary signs of EOF's, and the need to test if higher-order model modes better compare with the observed modes. Compared to conventional EOF analysis of models, the CBF approach indicates that models compare significantly better with observations in terms of pattern correlation and root-mean-squared-error (RMSE) than heretofore suggested. The skill metrics proposed in this study provide a useful summary of the ability of models to reproduce the observed EOF patterns and amplitudes. Additionally, the skill metrics can be used as a tool to objectively highlight where potential model improvements might be made. We advocate more systematic and objective testing of simulated extratropical variability, especially during the non-dominant seasons of each mode, when many models are performing relatively poorly. Time-permitting, analysis of power spectra of the principal component time series and diagnosis of the modes of variability in CMIP6 will be discussed.