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Inter-Annual and Decadal Variability of Atmospheric Regime Properties in Seasonal Forecast Ensembles from ECMWF and CCSM3

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Regimes in the atmospheric circulation have been identified in both model output and analyses as a way of categorizing low frequency intra-seasonal variability. Previous work has suggested that the regime properties (identity of patterns, frequency of occurrence) can depend on SST (sea-surface temperature), especially in the Pacific Ocean, leading to inter-annual variability that is potentially predictable. While decadal changes in regime properties have been noted from reanalyses, it is hard to establish statistical significance. Hence the use of ensembles of seasonal forecasts from realistic coupled models is especially valuable.

While the existence of regimes should be linked to variations in stability properties in different parts of the attractor of the appropriate dynamical system, most methods used to identify them in complex models or analyses have ignored this linkage.

The goals of this talk are to: (a) present a modest step towards incorporating the local stability of the attractor (via a measure of baroclinic eddy strength) into the methodology of identifying regime properties; (b) describe the regimes and their properties from state-of-the-art coupled seasonal ensemble forecasts from the European Centre for Medium-Range Weather Forecast (ECMWF) System3 model (for 45 years), from the National Center for Atmospheric Research Community Climate System Model CCSM3 (for 20 years), and from reanalyses of ECMWF (for 45 years), for both Pacific – North American and Atlantic – European regions; (c) assess the inter-annual variability of regime properties and relationships to SST; (d) establish whether the decadal variability in regime properties found in reanalyses in previous work is successfully modeled, and to establish its significance and robustness. Implications for assessing potential changes in regime properties in climate change scenario simulations will be discussed.