Decadal Climate Variability, Predictability, and Predictions - Focus on the Atlantic

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Over the coming decades changes in the climate system will reflect both the response of the climate system to changing radiative forcing and the natural variability of the climate system. Natural variability of the climate system can be comparable to or larger than the response to changing radiative forcing on regional spatial scales and decadal time scales, and thus is of major societal relevance. A significant scientific challenge is to assess the degree to which such decadal scale variability of the climate system is predictable, and to develop modeling and observational systems to realize whatever predictability exists. This challenge involves improved understanding of the characteristics of decadal variability, both from an observational and theoretical perspective, the development of models that are able to faithfully reproduce such variability, and appropriate observing and assimilation systems to initialize prediction systems.

We focus on efforts to improve our understanding of the mechanisms and predictability of decadal scale climate variability, particularly in the Atlantic and surrounding continental regions. The Atlantic Ocean is characterized by long time scale fluctuations of sea surface temperature that likely come about both from natural variability and changing radiative forcing. This oceanic variability in turn has a significant impact on the atmosphere, likely influencing the Indian and African monsoons, Atlantic tropical storm activity, and climate over North America and Western Europe. These Atlantic fluctuations serve as an important testbed for aspects of the development of a decadal prediction system.

We review the observational characteristics of Atlantic decadal variability, and summarize likely climatic relevance. We next discuss possible mechanisms for such variability, and efforts to assess the predictability of such variability. Finally, we outline efforts to develop a global decadal prediction system, including a pathway toward a prototype prediction capability for the Atlantic. Such a system will depend in part on the ability to predict natural variability of the climate system through utilization of the required observing, assimilation, and modeling systems. It will also depend strongly on the ability to predict future changes in radiative forcing, and the ability to simulate the response of the climate system to that changing radiative forcing, particularly the response to aerosols that can vary significantly on short time scales.