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Different flavors of the Atlantic Multidecadal Variability

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The existence of fluctuations describing the alternation of warm and cold phases in North Atlantic Sea Surface Temperatures (NASSTs) paced at a typical timescale of $\sim$ 50–90 years has been assessed by observational, paleo and numerical climate simulations-based studies. This component of NASST variability is thought to be predominantly internally-generated in the North Atlantic basin and is often referred to as "Atlantic Multidecadal Variability" (AMV).

In this contribution, we illustrate the distinctive traits of differently-defined AMV indices evaluated for a set of unperturbed as well as externally-forced millennial climate simulations conducted with an ensemble of Earth system models differing in both resolution and complexity. Using millennial unperturbed simulations allows investigating purely internally-generated NASST variability and several multidecadal fluctuations. We aim at assessing how differently-defined AMV indices capture different flavors of simulated multidecadal NASST variability as well as of its hemispheric atmospheric signature and implications for ocean dynamics.
We show that although all representations of the AMV maintain strong multidecadal variability, they depict different characteristics of simulated low-frequency NASST variability, evolve differently in time and relate to different hemispheric teleconnections. Due to such multifaceted signatures in the ocean-surface as well as in the atmosphere, reconstructions of past AMV may not unambiguously reproduce multidecadal NASST variability.
We demonstrate that AMV features under simulated externally-forced pre-industrial climate conditions are not clearly distinguishable, within a linear framework, from AMV features in corresponding unperturbed simulations. This prevents a robust diagnosis of the simulated pre-industrial AMV as a predominantly internal rather than externally-forced phenomenon. We conclude that a multi-perspective approach in the statistical construct employed for its description can foster our physical understanding of multidecadal NASST variability, hence of the origin and climatic implications of the AMV.