Disentangling Internal and External Contribution to Atlantic Multidecadal Variability over Past Millennium

Shih-Wei Fang*[1], Myriam Khodri[2], Claudia Timmreck[3], Davide Zanchettin[4], and Johann Jungclaus[5]

[1]Max-Planck-Institut für Meteorologie, Hamburg, Germany – Bundesstraße 53, 20146 Hamburg, Germany

[2]IRD/IPSL/Laboratoire d'Océanographie et du Climat, France – IRD – 4, place Jussieu 75005 Paris FRANCE, France

[3]Max Planck Institute for Meteorology (MPI-M) – Max Planck Institute for Meteorology (MPI-M) Bundesstraße 53 20146 Hamburg Germany Telefon: (+49 40) 41173 - 0 Telefax: (+49 40) 41173 - 298, Germany

[4]University of Ca' Foscari [Venice, Italy] – Dorsoduro, 3246, 30123 Venice, ItalyUniversita di Venezia - CaFoscari, Italy

[5]Max Planck Institute for Meteorology – Hamburg, Germany

Abstract

The Atlantic Multidecadal Variability (AMV) modulates the North Atlantic surface ocean variability and affects decadal climate evolution up to the global scale; however, the underlying mechanisms of the AMV remains debated. We use a multi-model ensemble of transient past-millennium and unperturbed preindustrial control simulations contributing to the Paleoclimate Modelling Intercomparison Project - Phase 4 (PMIP4) to decompose the AMV signal into its internal and external components. The internal component of AMV exhibits no robust behavior across simulations during periods of major forcing such as strong volcanic eruptions, whereas the externally-forced component of AMV responds to volcanic eruptions with an immediate radiative cooling followed, in some simulations, by a sequence of damped multidecadal oscillations. This indicates that the intrinsic mechanism underlying the AMV is distinguishable from its response to external forcing. The internal component of AMV is tightly connected with the Atlantic meridional overturning circulation (AMOC) and controls the variations of AMV. The external component of AMV explains about 25% of the variance in the past millennium simulations, though less-consistency is found between models. Our results further indicate that the spatial imprint of external volcanic forcing on North Atlantic sea-surface temperatures differs from the surface pattern of the internal AMV contributing to the lack of robustness for the AMV pattern.

Keywords: internal variability, external forcing, solar irradiance, volcanic impact, Atlantic Multi, decadal Variabiltiy

*Speaker