Geophysical Research Abstracts
Vol. 20, EGU2018-8093, 2018
EGU General Assembly 2018

3D progression of multidecadal climate variability signals

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The global climate has strong variability in the multidecadal frequency range, with a typical period of 50-80 years. The variability has had the strongest manifestation in the North Atlantic in the 20th century, but similar variability occurs in all basins. Physical mechanisms behind the variability are not well understood. In this presentation, we shed more light on the physics occurring deep in the ocean and high up in the atmosphere.

We employ climate models developed at the MPI-M to study the variability. We also present novel methods to evaluate the model against the short observational time series of sea surface temperatures and the even shorter ones for subsurface temperatures. Obtaining phase and location information of the variability increases the degrees of freedom even for a single-shot realization and we indeed find that the the observed variability matches climate model realizations with high statistical significance.

The three-dimensional propagation of the variability signal through the ocean is tracked with a progression going down to a depth of about 1 km in one half-cycle. Key mechanisms propagating the temperature signal driven by El Niño Southern Oscillation and other regional oscillations are presented. We also present the implications for cloud cover, radiative anomalies and stratospheric variability.