The Interdecadal Bipolar Oscillation: A Potential Driver for Rapid Antarctic Climate Transitions

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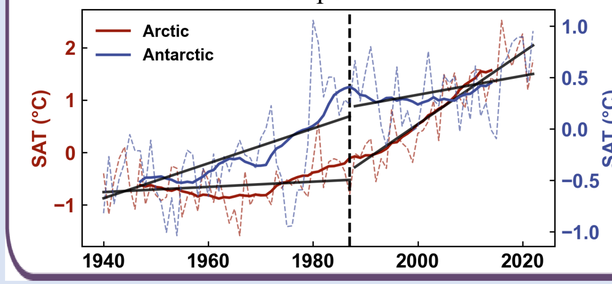
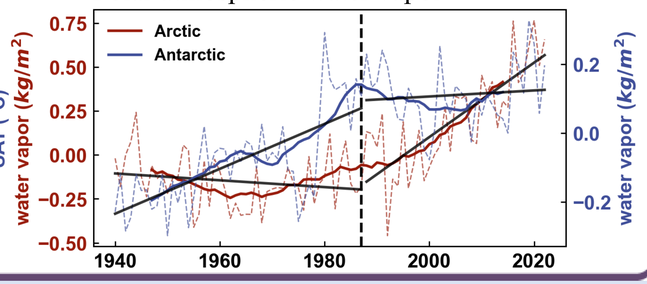
Background: Asymmetric polar climate change

- Polar climate change is asymmetric, with a late-1980s regime shift from **Antarctic**-dominated to **Arctic**-dominated warming and moistening.
- We ask whether an atmospheric water vapor mode links these contrasting polar trajectories and modulates future climate risk.

Polar surface air temperature

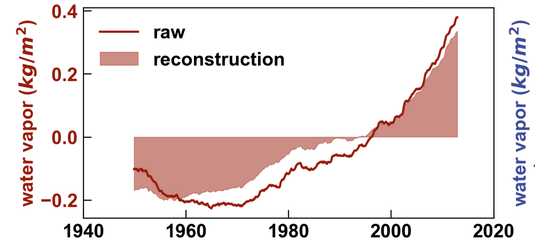


Polar atmospheric water vapor

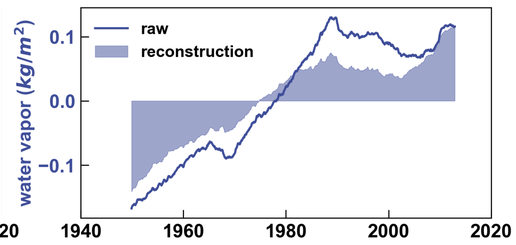


Two dominant modes of interdecadal polar water vapor variability

Arctic interdecadal water vapor



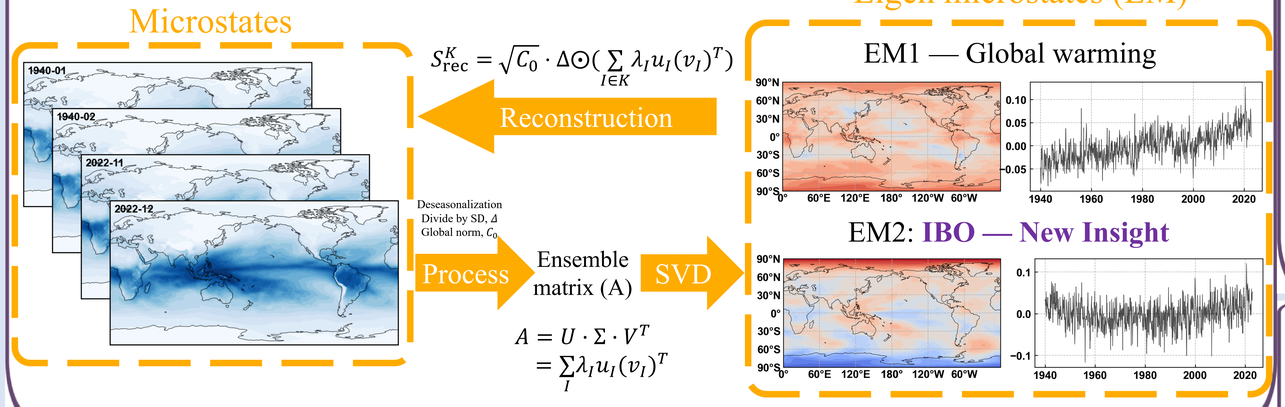
Antarctic interdecadal water vapor



- **Two leading modes** largely explain polar water vapor variability.
- **IBO** represents a **60–80-year bipolar seesaw** oscillation that **links the two poles and explains their asymmetric climate evolution** over the past eight decades.

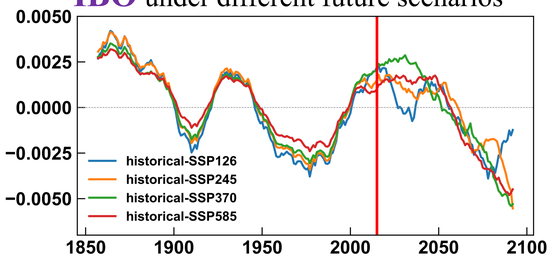
Eigen microstate theory

- Using ERA5 and CMIP6, we identify two leading modes of global atmospheric water vapor variability during 1940–2022: a globally synchronous change mode and the **Interdecadal Bipolar Oscillation (IBO)**.

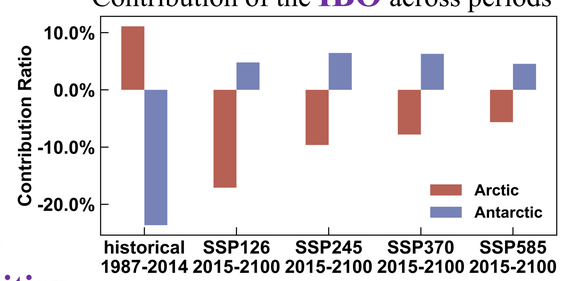


Future polar climate change

IBO under different future scenarios



Contribution of the **IBO** across periods



- The **IBO** is undergoing a **phase transition**.
- **Antarctic**: The future superposition of the IBO and the globally synchronous mode may drive rapid moistening, **signaling accelerated climate change**.
- **Arctic**: The future IBO may partly offset the globally synchronous mode, potentially slowing climate change.

Selected Reference

1. Wang, H. *et al.* The Interdecadal Bipolar Oscillation: An Atmospheric Water Vapor Mode Driving Asynchronous Polar Climate Change. Preprint at https://doi.org/10.48550/arXiv.2601.14733 (2026).