



# Understanding the multidecadal Northern Hemisphere climate variability from the perspective of damped Coupled stratosphere/troposphere/Ocean oscillation

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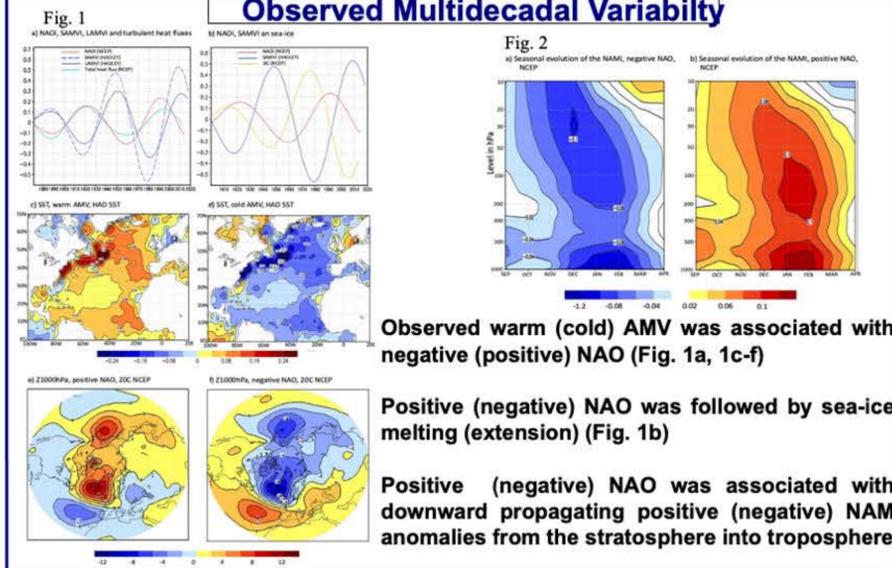
## Introduction

Northern Hemisphere (NH) climate has experienced various coherent wintertime multidecadal climate-trends in stratosphere, troposphere, ocean and cryosphere. However, the overall mechanistic framework linking these trends is not well established.

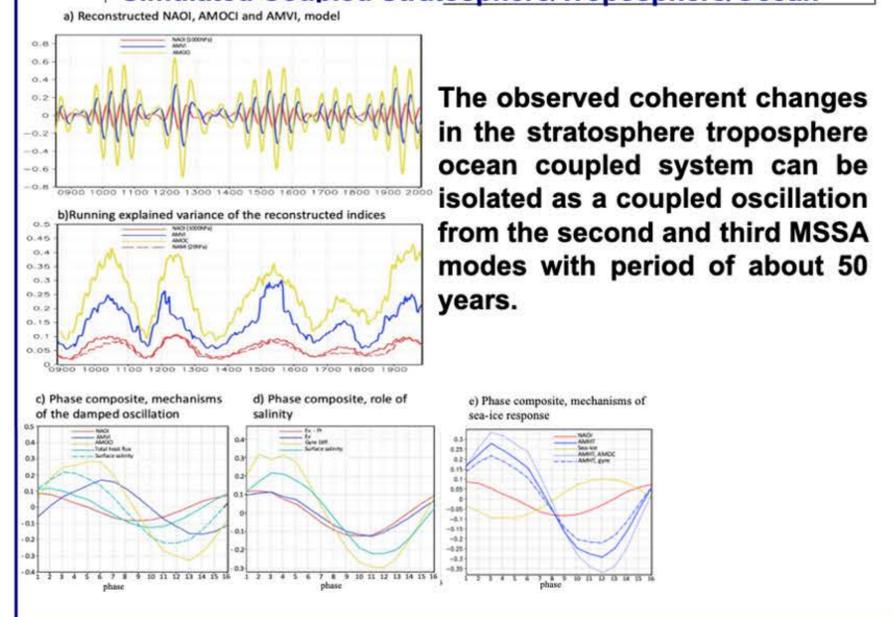
## Data and Models

Coupled transient last millennium experiments using MPI-ESM model  
Combined Multichannel Singular Spectrum Analysis (MSSA) applied to Z20hPa (NDJ), Z100hPa(JFM). SST(JFB) and annual mean AMOC

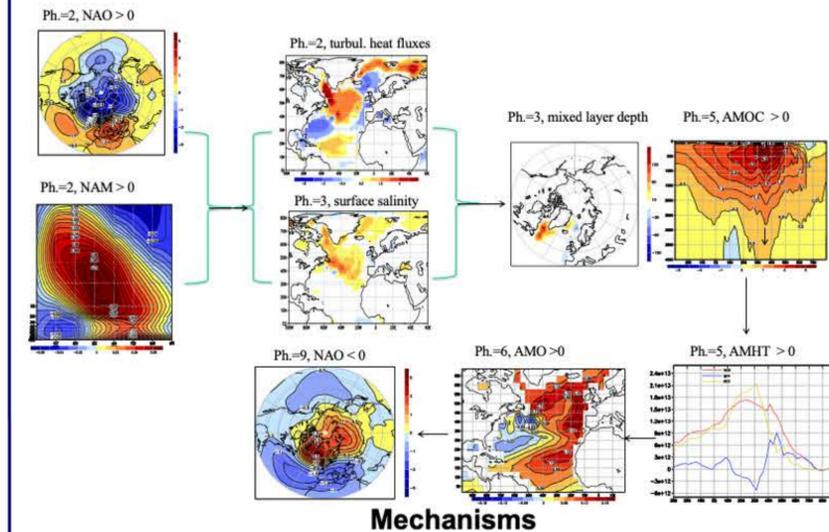
## Observed Multidecadal Variability



## Simulated Coupled Stratosphere/Troposphere/Ocean



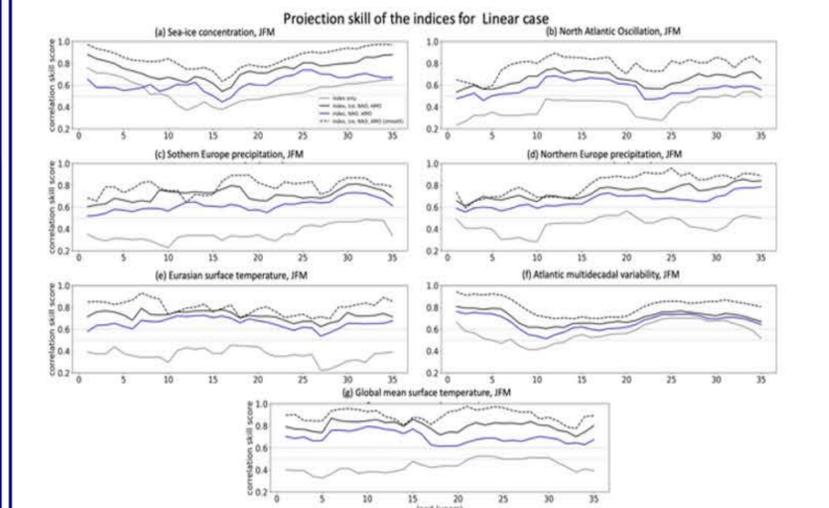
## Mechanisms



## Mechanisms

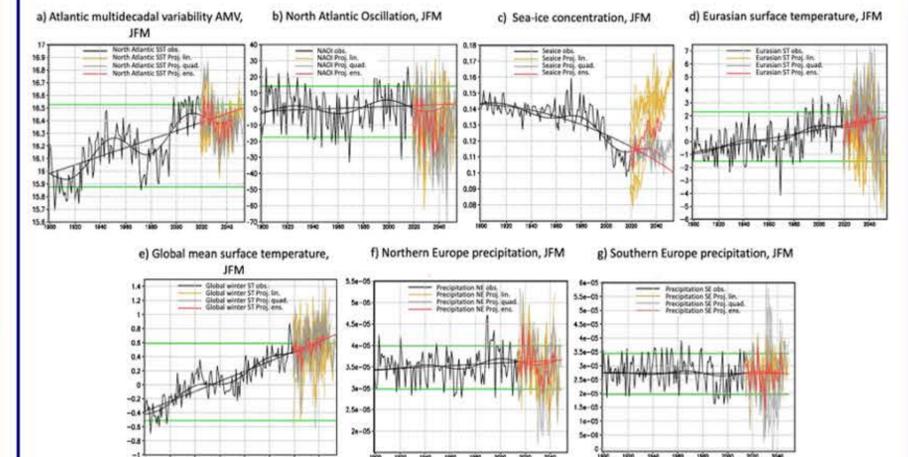
Positive NAO enhances the upward turbulent heat flux (phase 1-2) and salinity (phase 3-4, due to changes in wind-driven subtropical Atlantic gyre) over Labrador sea (phase 3-6), which strengthens the AMOC (phase 4-7) and wind-driven circulation (phase 2-5). The net result is an increase of the poleward oceanic heat-transport leading to Arctic sea-ice melting, Arctic warming amplification, and large-scale Atlantic warming. This initiates wave-induced negative NAM and stratospheric warming

## The coupled variability enhances the decadal climate projection



The atmosphere/ocean coupled variability enhances the statistical decadal-to-multidecadal projection of all the climate component involved

## Projected near future NH climate



Multi-regression model that considers the coupled Atmosphere/Ocean variability projects:

- (1) North Atlantic, Eurasian and global multidecadal cooling that decelerate the long-term warming trends.
- (2) Further weakening of the NAO that leads to enhanced (reduced) precipitation in the South (North) of Europe.
- (3) Sea-ice extension that dampens the long-term sea-ice melting.

## Conclusions

- There is coherent multidecadal variability in the coupled stratosphere troposphere ocean system including sea-ice
- This coupled variability can be isolated as coupled stratosphere troposphere ocean oscillation
- The consideration of this coupled variability increases the skill of the decadal-to-multidecadal predictability
- The statistical prediction model projects a further weakening of North Atlantic Oscillation and long-lasting hiatus in wintertime Arctic-sea-ice and surface temperature