Combined Effect of ENSO-Like and Atlantic Multidecadal Oscillation SSTAs on the Interannual Variability of the East Asian Winter Monsoon

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Introduction

The East Asian winter monsoon (EAWM) is one of the most dominant climate systems in East Asia. have examined the dynamic interactions between the EAWM and the variability in sea surface temperature anomalies (SSTAs) in the Pacific; anomalies characterized by El Niño–Southern Oscillation (ENSO) and the Pacific decadal oscillation (PDO). The covariability of the EAWM with Pacific SSTAs has experienced reciprocating changes. the modulation of the PDO on the ENSO–EAWM relationship provided by previous studies are multifarious. Indeed, there is also a teleconnection between Atlantic and Pacific SSTs. For example, **the Atlantic Ocean acts as a pacemaker for the Pacific SST mean state and variability**, and Atlantic multidecadal oscillation (**AMO) favors a low-frequency variability of winter climate in East Asia that resembles a EAWM-related change in climatic background** For this issue, this study aims **identify the combined effect of the ENSO-like SSTAs and the AMO on the interannual change in the EAWM**.

Methodology

Monthly mean observations and reanalysis dataset :

Datasets: **CRU TS dataset, NOAA-CIRES Reanalysis dataset, NOAA Extended Reconstructed SST dataset, and Kaplan's SST dataset.**

U.S. CLIVAR Drought Working Group:

Model: **GFDL, CCM3, and CAM3.5 (forced by the following SST**

Experiments	Boundary conditions
PwAn run	El Niño-like SST anomaly + monthly SST climatology (1901-2004)
PcAn run	La Niña-like SST anomaly + monthly SST climatology
PnAw run	warm AMO SST anomaly + monthly SST climatology
PnAc run	Cold AMO SST anomaly + monthly SST climatology
PwAw run	El Niño-like SST anomaly + warm AMO SST anomaly + monthly SST climatology
PwAc run	El Niño-like SST anomaly + cold AMO SST anomaly + monthly SST climatology
PcAw run	La Niña-like SST anomaly + warm AMO SST anomly + monthly SST climatology
PcAc run	La Niña-like SST anomaly + cold AMO SST anomly + monthly SST climatology
PnAn run (control run)	monthly SST climatology

Result

1. Modulation of the Pacific-EAWM relationship by AMO in observations

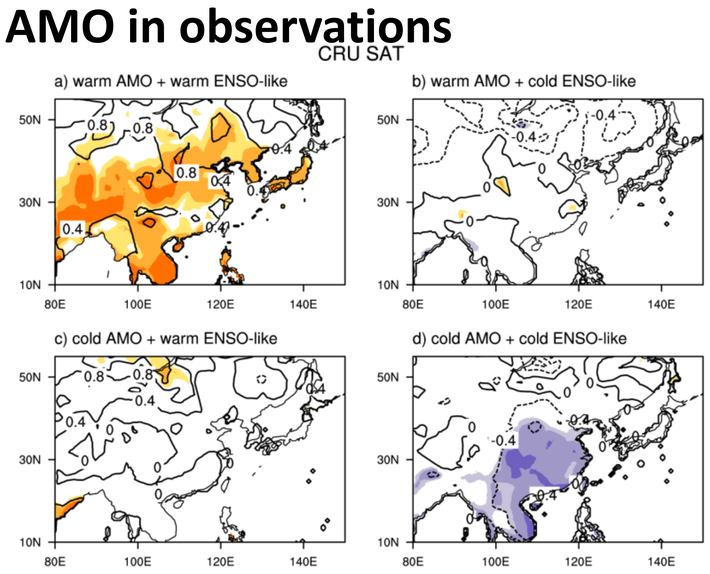
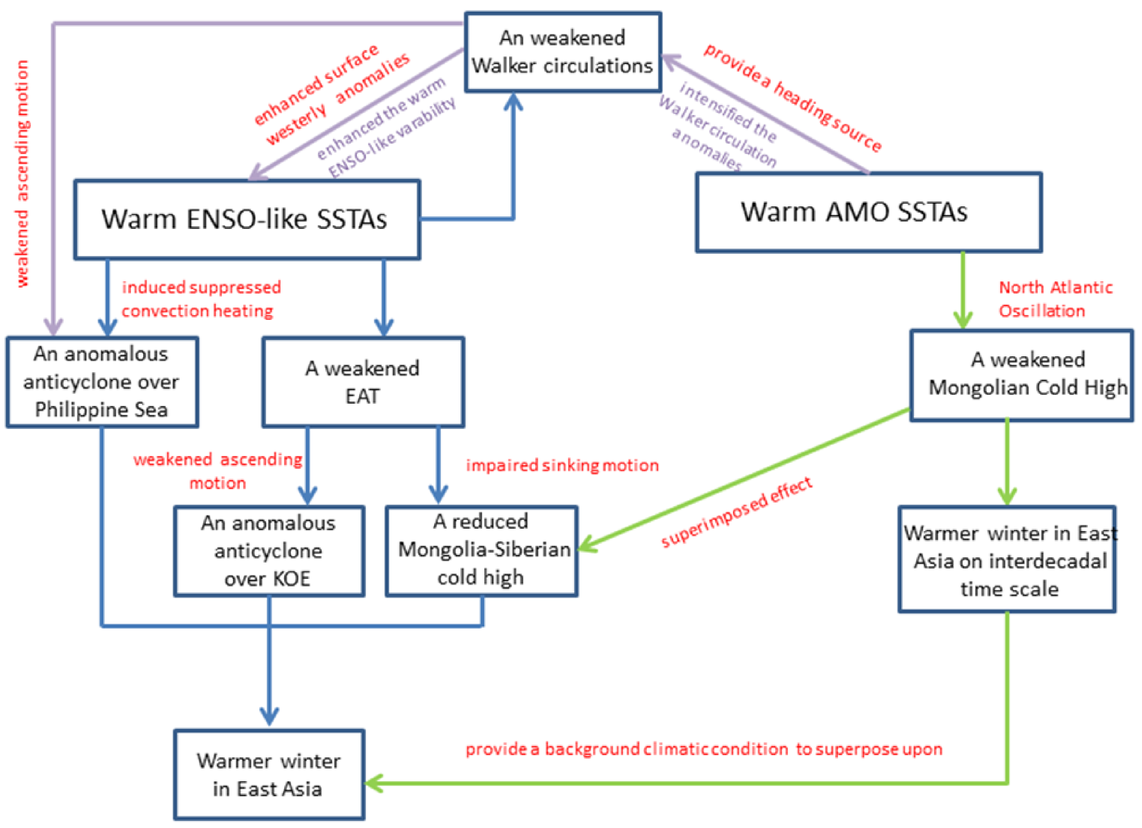


Fig. 1 *(a) Composite maps of differences in the winter SAT (8C) between warm ENSO-like SSTAs and climatology, using the CRU TS3.2 dataset. (b) As in (a), but between cold ENSO-like SSTAs and climatology. (c),(d) As in (a) and (b), respectively, but using the NOAA dataset. Light, medium, and dark shadings indicate the 90%, 95%, and 99% confidence levels, respectively.*

- **Stronger-than-normal** EAWM-related anomalies occurred when the ENSO-like SSTAs and AMO were **in phase**, while the anomalies related to the EAWM tended to exhibit relatively **weaker features** when the ENSO-like and AMO SSTAs were **out of phase**;
- Simulated results are consistent with observations.

2. Physical mechanism

Fig. 2 *A schematic diagram for the combined effect of the warm ENSO-like and warm AMO SSTAs on the interannual variability of the EAWM*



Conclusion

This study found that the AMO affects the influence of ENSO-like sea surface temperature anomalies (SSTAs, which contain the variability of both El Niño–Southern Oscillation and Pacific decadal oscillation) on the interannual change in EAWM. In the both observations and simulations, the out-of-phase relationship between the variations in ENSO and the EAWM was significantly intensified when the AMO and ENSO-like SSTAs were in phase. In contrast, when the ENSO-like and AMO SSTAs were out of phase, the anomalies related to the EAWM tended to exhibit relatively weaker features.