
Decadal changes in the Madden-Julian Oscillation: A source for decadal changes in high-latitude climate

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Abstract

The Madden-Julian Oscillation (MJO) activity has strengthened in the Western Pacific but weakened in the Indian Ocean during the last few decades associated with the profound warming and changes in the large-scale circulation over the Indo-Pacific warm pool. The changes in the location and strength of MJO convection have been found to play a role in the Arctic amplification. This talk will highlight that decadal changes in MJO have also contributed to recent climate changes over Antarctica. While West Antarctica has experienced the most significant warming in the world, a profound cooling trend in austral summer was observed over East Antarctica from 1979 to 2014. Previous studies attributed the Antarctic temperature changes to high-latitude atmospheric dynamics, stratospheric ozone change, and tropical sea surface temperature anomalies. We show that up to 20%–40% of the observed summer cooling trend in East Antarctica was forced by MJO changes. Both observational analysis and climate model experiments indicate that the decadal changes in the MJO led to the net cooling trend over East Antarctica through modifying atmospheric circulations linked to poleward-propagating Rossby wave trains. It is to note that most of the models in the CMIP6 neither reproduce the summer cooling trend over East Antarctica nor the decadal changes in MJO heating feature observed in the recent decades. Thus, further studies should investigate whether the observed changes are internally generated or radiatively forced and to what extent the uncertainty in the simulated Antarctic SAT change can be ascribed to the biases of MJO simulation at the multi-decadal timescale.

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