Combined effect of the AO and MJO on cold temperature over Asia and the predictability

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The combined effect of the Madden-Julian oscillation (MJO) and Arctic oscillation (AO) on the temperature variation over Asia is investigated using the thermodynamic budget equation. The physical process responsible for surface cold anomaly is different for northern and southern Asia. Cold anomaly appears in most of Asia 20-25 days after the MJO phase 6 (corresponding to the phase 2-3). However, more strengthened cold anomaly occurs over northern Asia under the negative AO state and it is caused by advection of temperature anomaly by climatological northerly wind associated with the East Asia winter monsoon flow. On the other hand, much stronger cold anomaly is seen over southern Asia under the positive AO state for the same lag day of the initial MJO phase 6. Aside from the subtropics and lower midlatitudes upward overturning circulation forced by the tropical MJO, the weakening of the East Asia subtropical jet by the positive AO induces additional upward motion over southern Asia to adjust the thermal wind balance. The combined effect also influences on the occurrence of extreme cold event. Under the negative (positive) AO phase, the extreme cold event occurrence probability over northern (southern) Asia increases by 90% (60%) compared to that for all winter days. The cold event occurrence probability for the combined modes is about the twice that for only MJO impact, suggesting that an incorporation of both modes enhance the predictability of extreme cold event.

Key words: The Madden-Julian oscillation, The Arctic oscillation, extreme cold event, combined effect, thermodynamic budget equation

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