Tropical-Extratropical Interactions Associated with East Asian Cold Air Outbreaks

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This study investigates interactions between East Asian cold air outbreaks (CAOs) and tropical variability during boreal winter (DJF). The definition of CAOs follows the recent definition that used isentropic coordinate. The CAO definition is based on anomalously large equatoward mass flux below θ=280 K crossing 45°N latitude. This location represents the maxima of extratropical direct (ETD) circulation in the viewpoint of mass-weighted isentropic meridional circulation (MIM; Iwasaki and Mochizuki 2012; Iwasaki et al. 2014; Shoji et al. 2014). Unlike most CAO studies, we utilize quantitative definition of cold air mass (CAM) to estimate the CAO.

EOF analysis on the seasonal-mean equatorward CAM flux in East Asia reveals two CAO types that can be easily distinguished as the western type CAO (90°-135°E) and eastern type CAO (135°-180°E). These CAOs are significantly associated with remote forcing in tropics. The western CAO tends to be in phase with La Nina event. Otherwise, eastern CAO is dominant in El Nino event.

In sub-seasonal scale, day-lagged analysis of CAO event enables us to identify the impact and precursor during CAO event. The impact of western CAO is robust on the development of precipitation downstream around South China Sea and Philippines. Otherwise, eastern CAO shows less impact possibly due to rapid disappearance over ocean. Remarkably, the preconditioning time of East Asian CAO is accompanied by large-scale organized convection in tropics. It is revealed that western CAOs favor to occur when the MJO arrives in Maritime Continent (MJO phase 4-5). On the other hand, eastern CAOs tend to occur when the MJO arrives in central Pacific (MJO phase 7-8). These results indicate potential precursors of CAO in East Asia. Particular attentions will be paid to the effectiveness of the precursors for medium- and long-range forecasts.

Key words: cold air outbreaks, winter monsoon, mjo, enso

References

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