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The interaction of tropical and extratropical airmass controlling East Asian summer monsoon progression

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China receives most of its rainfall during the East Asian summer monsoon (EASM). The EASM is a complex, multi-phase and multi-scale phenomenon, influenced by both tropical and mid-latitude dynamics and by the presence of major orography, such as the Tibetan Plateau. The EASM front, displaying a steep gradient in equivalent potential temperature, neatly separates tropical and extratropical air masses as the monsoon marches northwards, particularly in the *Mei Yu* stage. Many questions are still open on the dynamics of EASM evolution. Recent work on the Indian monsoon has indicated a new approach, focusing on the interaction between competing air masses that shapes monsoon progression. Drawing from that approach, we apply Eulerian and Lagrangian methods to the ERA5 reanalysis dataset to provide a comprehensive study of the seasonal evolution of the EASM and of its front.

A new frontal detection algorithm is used to perform a front-centred analysis of EASM evolution, allowing to clearly identify and depict the four main stages of evolution of the EASM, in agreement with recent studies. The dynamics of interaction between monsoon and mid-latitude air masses at the EASM front are then investigated, highlighting the key tropical and extratropical processes, at both upper and lower levels. The sub-tropical westerly jet (STWJ) over east Asia has a primary role in controlling the strength and the poleward progression of the EASM front, in particular during *Mei Yu*. This upper-level mid-latitude forcing acts in conjunction with the low-level moist-air advection from the tropics, modulated by the seasonal cycle of the South Asian monsoon and by the location of the Western North Pacific subtropical high. The *Mei Yu* stage is distinguished by an especially clear interaction between tropical and extratropical air masses that converge at the EASM front, with the importance of remote moisture sources for the advection of moist tropical air also highlighted. Composites of the years with highest and lowest latitude of the EASM front at *Mei Yu* are also assessed, outlining the processes behind the interannual variability of the poleward progression of the EASM front. Their analysis reveals the influence of the STWJ on the strength of the mid-latitude flow impacting on the northern side of the EASM front. In turns, this affects the extent of the warm moist advection on the southern side and the distribution and intensity of resultant rainfall over China.

Thus, using a mix of diagnostics tools and methods of analysis, in this study we identify the key airmasses, and related processes, that characterise seasonal EASM progression and variability.

Clarifying their roles and joint influences in the evolution of this complex, multi-scale and multi-stage phenomenon we also highlight the dynamics of the tropical-extratropical interaction that occurs at the front, particularly during its *Mei Yu* northward migration.