



## **What happened to the climatological intraseasonal evolution of the East Asian summer after the mid-1990s?**

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The East Asian summer shows a marked climatological intraseasonal evolution character as a part of the mid-latitude monsoon system. From early May to mid-summer, the East Asian summer monsoon rain band slowly migrates to the northward, resulting in Meiyu, Baiu, and Changma rainy season over China, Japan, and Korea, respectively. After the termination of the summer monsoon rain period, the northern part of the East Asian monsoon region experiences mid-summer monsoon break by which is followed the second rain period.

Such phase-locked intraseasonal evolution characteristics had undergone a significant decadal shift after the mid-1990s, resulting in a faster northward migration and stronger activity of the summer monsoon rain band, and a disappearance of the monsoon break period.

It is suggested in this study that the signals related to the changes in the East Asian summer intraseasonal evolution originate from the warmer northern hemisphere spring conditions. Relatively warmer sea surface temperature over the northern Indian Ocean and the Maritime continental region leads to an earlier onset of the northern hemispheric convective summer, which in turn enhances the East Asian monsoon frontal activity. Moreover, stronger monsoon convection in the subtropics induces the Gill-type Rossby response to the mid-latitude which significantly reduces the Asian jet. Weaker upper-level jet stream after the mid-1990s favors the faster northward migration of the rain band through inducing a boundary layer moisture convergence to the north of the monsoon rain band and through the positive anomalous vertical shear mechanism.

On the other hand, the disappearance of monsoon break largely depends on the change in the tropical cyclone genesis in recent years. Increased number of tropical cyclone over the South China Sea and South China enhances convective activity in these regions, which results in a mid-latitude barotropic response. As a result of the mid-latitude response, the northern part of the East Asian monsoon region is under a favorable condition for excessive rainfall during the monsoon break period.