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研　究　主　論　文　抄　録

論文題目　　梅雨前線帯における降水の経年変動特性に関する包括的研究
（　Interannual variability of the Baiu precipitation　）

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主論文要旨

The aim of this work is the comprehensively understanding for interannual variability of the Baiu precipitation. This work focuses on the following three open questions.

(Part I)

The Baiu frontal activity clearly shows spatiotemporal differences in its interannual variability. This part examines the physical mechanisms behind these differences in June. On interannual time scales, the Baiu front can be divided into three subregions: (1) the western Baiu (WB), (2) the central Baiu (CB), and (3) the eastern Baiu (EB). Time-series analysis revealed that the dominant periods in these three subregions are long eastward periods of approximately 2 years in the WB, 4 years in the CB, and 6 years in the EB.

The biennial oscillation of the Asian monsoon controls the interannual variation in the WB through specific meridional circulation in the western North Pacific (WNP), whereas the El Niño/Southern Oscillation (ENSO) forces the interannual variation in the CB through the Pacific–East Asian teleconnection. The interannual variation in the EB is controlled by mid-latitude atmospheric circulations, not by effects from the tropics. The summertime North Atlantic Oscillation (NAO) with a 6-year period excites the stationary Rossby waves, the energies of which reach Japan through the strong upper tropospheric westerlies over Eurasia. Geopotential height anomalies then appear around Japan with an equivalent barotropic structure that modifies the precipitation in the EB.

(Part II)

This part examines dominant mechanisms in interannual variability of the Baiu precipitation in July, and these are compared with those in June. The interannual variability of the Baiu precipitation in July has a quasi-biennial and 4-year tendency. The former is linked to the

Tropospheric Biennial Oscillation (TBO), and the latter is synchronized with the ENSO. Although interannual variability of the Baiu precipitation in June has similar periodicity, the continuity of anomalies from June to July is insignificant. This discontinuity appearing in both the TBO and the ENSO tendencies is caused by different physical processes.

The sea surface temperature anomalies (SSTAs) in the tropical Pacific associated with the TBO tendency displays similar spatial patterns between June and July. However, SSTAs in the western subtropical Pacific, which is regraded as the northward spread of SSTAs from the maritime continent, is a key for modification of interannual variability of the Baiu precipitation in July in the TBO tendency. The SSTAs control the strength of the western North Pacific summer monsoon (WNPSM), and modify the interannual variability of the Baiu precipitation in July through the anomalous meridional circulations.

In the ENSO tendency, SSTAs in the Indian Ocean remaining to early summer control interannual variation of the Baiu precipitation in July. The SSTAs induce anomalous convection there and force equatorial Kelvin waves. The waves act to enhance anomalous atmospheric circulations in the western subtropical Pacific, and the anomalous circulations modify the axis of monsoon westerlies, resulting in interannual variation of the Baiu precipitation in July.

(Part III)

Interannual variations of both the Baiu precipitation and tropical cyclone (TC) activity in the WNP are controlled by large-scale atmospheric circulations associated with the ENSO and the TBO of the Asian monsoon. This part examines covariability between the Baiu precipitation and the TC activity through the ENSO and the TBO.

In years when SSTAs are negative in the eastern tropical Pacific with respect to the ENSO, the number of TCs increases near the Philippines in the Baiu season, June and July. On the other hand, in years of negative SSTAs in the eastern tropical Pacific related to the TBO, the strength of TCs is enhanced to the southeast of Japan. Each of these two TC activities enhances a cyclonic circulation there, which shifts the axis of monsoon westerlies and contributes to the Baiu precipitation anomalies. These modifications are dependent on the phase of the ENSO and the TBO. In years of positive SSTAs in the eastern tropical Pacific, the anomalous TC activity is small and sometimes has opposite effects on the atmospheric circulations of the ENSO and the TBO. Thus, the Baiu precipitation covaries with the TC activity through the large-scale atmospheric circulations of the ENSO and the TBO only in these specific phase.