Characterizing the quasi-biweekly variability of the anticyclone in the upper troposphere and lower stratosphere over the Asian summer monsoon region

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The anticyclone appearing in the upper troposphere and lower stratosphere (UTLS) over the Asian summer monsoon region, which is frequently referred to as the Asian monsoon anticyclone, South Asian high, or Tibetan high, is the important component of the monsoon system. Its significant sub-seasonal variability is also important, not only as one of the controlling factors of large-scale surface circulation and precipitation, but also as the essential process of the stratosphere-troposphere tracer exchange. Variabilities with a quasi-biweekly timescale have been identified so far in various studies. From the perspective of the anticyclone as low PV area on an isentropic surface, the typical variability pattern has been described as westward "eddy shedding" events occurring several times in one season (Popovic and Plumb, 2001). This study attempts to subjectively characterize the quasi-biweekly variability of the anticyclone using long-term reanalysis data, and discuss the relationship to various known variability patterns, which are identified in the domain, including eddy shedding.

The major pattern of variability is successfully obtained as the first two empirical orthogonal function (EOF) modes for a normalized geopotential height anomaly field with a period of 5-20 days at 100hPa, using the ERA-Interim reanalysis data for 1979-2016 June to September. These two modes have a statistically significant lag-correlation and their structures are longitudinally about 90^{o} out of phase, suggesting westward propagation of the perturbations. Taking advantage of the lag correlation, eight phases of the variability are defined using the principle components of the two EOF modes. Composite maps of the geopotential and OLR anomalies for each phase show the westward migration of an upper level trough and of an area with enhanced convective activity, which is partly similar to the result by previous studies which focus on convection over the Tibetan plateau (Fujinami and Yasunari, 2004; Wang and Duan, 2015). The composite map of low PV occurrences describes the significant westward elongation and subsequent retreat, showing the canonical life cycle of eddy shedding. On the other hand, the variability in the total area of low PV is not large, indicating that the role of convective forcing is not important. These results support the hypothesis that the variability is mainly controlled by dynamical instability of the anticyclone (Hsu and Plumb, 2000).

Key words: UTLS, Asian monsoon, stratosphere-troposphere interaction, atmospheric dynamics

References

Fujinami, H., and T. Yasunari, 2004: *Journal of the Meteorological Society of Japan* , **82(6)**, 1545–1564.

Wang, M., and A. Duan, 2015: *Journal of Climate*, **28(12)**, 4921–4940.

Hsu, C. J., and R. A. Plumb, 2000: *Journal of the atmospheric sciences*, **57(9)**, 1255–1276.

Popovic, J. M., and R. A. Plumb, 2001: *Journal of the atmospheric sciences*, **58(1)**, 93-104.