

用200百帕位勢高度來探討南亞高壓的變化特徵

Characteristics of the South Asian High Variability Revealed by 200hPa Geopotential Height

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摘要

南亞高壓 (SAH) 是亞洲夏季在上對流層最重要的反氣旋環流系統。本研究旨在分析南亞高壓的變異性及其與中緯度波動的關係。我們使用200 hPa的位勢高度 (Z200) 作為分析南亞高壓的變數，並以1979-2022在44年的氣候平均值覆蓋了 20-35°N, 40-110°E 區域範圍的12520 gpm等值線作為界定南亞高壓的參考值，發現該區域內，最大Z200易出現在伊朗高原 (45-65°E) 和青藏高原 (80-100°E) 兩個地方。透過對南亞高壓區域Z200的EOF分析，發現了其時空的變化特徵可用三個主模態描述。第一模態的空間特徵顯示出單極結構，中心位於伊朗高原的北部。第二模態的空間特徵呈現出東西方向反相位變化的二極結構，兩個變化中心分別在伊朗高原北部和青藏高原東北部。第三模態的空間特徵在東西方向呈現三極結構，反映了西風噴流中波導效性的波列特徵。上述結果顯示南亞高壓Z200的主要變化位置，是位於其北部邊界亞洲西風噴流區，並受到活躍擾動向南延伸的影響。這些模態在時間的變異性上顯示出兩個明顯的時間尺度：準雙週 (10-20天) 和準月度 (20-40天)。南亞高壓上的準雙週變化，主要受到與嵌入在西風噴流波導中的渦旋和波列的影響，與這些擾動的向南延伸。中緯度地區擾動主要出現在60-90°E之間和 90-120°E之間兩個地方，源自50°N並向南延伸，分別影響伊朗高原北部和青藏高原東北部兩個南亞高壓的變化中心。而南亞高壓上的準月度變化，則受到上游烏拉山脈附近的阻塞高壓或低壓槽 (40-70°N, 30-60°E) 影響，這個地區同時也是歐亞大陸上阻塞高壓好發的地方。最後，由 1989年夏季個案，證實了觀察每日高度場、風場距平等氣候變數，可清楚辨識南亞高壓的準雙週變化和西風噴流波導中的渦旋，以及60-90°E和90-120°E的中緯度擾動向南延伸的影響，顯示了解南亞高壓主模態有助於詮釋中高緯度波動和亞洲季風區天氣與氣候變化的關係。

關鍵字：亞洲夏季季風、南亞高壓、準雙週振盪

Abstract

The South Asian High (SAH) is the most important upper tropospheric summer system over Asia. This study aims to analyze the variability of the SAH and its relationship with the mid-latitude waves. The SAH in this study is represented by the geopotential height at 200 hPa (Z200). Its extent is defined by the 12520-gpm contour at 200 hPa, which covers the region of (20-35°N, 40-110°E) based on the 44 years of climatological mean. Within this region, the maximum Z200 tends to occur over the Iranian Plateau (45-65°E) and the Tibetan Plateau (80-100°E). The SAH variability is further investigated by EOF analysis of the Z200 over the SAH region. The spatial pattern of the first mode displays a monopole structure with its center to the north of the Iranian Plateau. The spatial pattern of the second mode exhibits a dipole structure in east-west direction. The dipole structure comprises the primary variation center over the northeast of the Tibetan Plateau, accompanied by a secondary variation center with a reverse sign to the north of the Iranian Plateau. The variation centers of SAH variability are all located near its northern boundary where the Asian westerly jet exists. The tripole spatial structure in east-west direction of the third mode reflects geographical enhancement of the eddies trapped within the jet stream waveguide. The temporal variability of the leading modes shows two distinct timescales: quasi-biweekly (10-20 days) and quasi-monthly (20-40 days). The quasi-biweekly perturbations over the SAH appear as the perturbations intruding from higher latitudes to the north of the Iranian Plateau and the northeast of the Tibetan Plateau. The quasi-monthly perturbations are strongly influenced by blocking or trough patterns between 30-60°E, situated to the northwest of the Iranian Plateau. The wave train passing through the north of the SAH, characterized by several eddies trapped within the jet stream waveguide, can be observed on both the 10-20-day and the 20-40-day timescales. Finally, we use the 1989 summer to illustrate that the variability of the SAH on the quasi-biweekly timescale is associated with eddies embedded in the jet stream waveguide, with some influenced by the southward penetration of mid-latitude waves originating from 50°N or further north in the longitude range of 60-90°E and 90-120°E.

Key words : Asian summer monsoon, South Asian High, Quasi-biweekly oscillations