低層噴流與地形急流對台灣鄰近地區梅雨鋒移動及強烈降水的影響

Impact of Low Level Barrier Jets on Mei-yu Frontal Movement and Heavy Rainfall Over Taiwan

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摘　要

5月至6月期間，台灣常受梅雨鋒面系統影響；鋒面處的對流活動與西南季風輸送的充沛低層水汽結合，往往引發強降水。當梅雨鋒面受大尺度天氣狀況或地形阻擋效應影響而在台灣附近移速減緩時，降水系統可能在同一區域長時間滯留，導致持續性降水及累積雨量增加，進而引發洪澇災害。本研究以2017年6月2日發生在台灣的一次強降水過程為例，探討了與梅雨鋒面相關的阻擋急流（barrier jet）如何影響鋒面的移動。研究利用天氣研究與預報（WRF）模式進行數值模擬，成功重現了觀測的鋒面結構與極端降水特徵。透過設計一系列敏感性試驗，系統地改變了阻擋急流的強度：在減弱阻擋急流的試驗中，保留台灣北部地形的同時削減或移除南部山地地形；在增強阻擋急流的試驗中，透過對上游西南氣流施加「強迫同化」（nudging）手段，增強了台灣西北沿海的阻擋急流。敏感性試驗結果表明，較強的阻擋急流能有效減緩梅雨鋒面向南移動的速度，並延長其在台灣附近的滯留時間。基於渦度方程式的進一步分析顯示，增強的阻擋急流不僅增加了低層水汽輸送並強化了鋒面輻合，還導致了更強的上升運動及更大的累積降水量。

關鍵字：地形急流;梅雨鋒;豪大雨

Abstract

During May and June, Taiwan is frequently affected by Mei-Yu frontal systems, in which frontal convection combined with abundant low-level moisture transported by the southwesterly monsoon often leads to heavy rainfall. When the Mei-Yu front slows down near Taiwan due to large-scale synoptic configurations or terrain-blocking effects, rainfall systems can persist over the same region for an extended period, resulting in prolonged precipitation and increased rainfall accumulation that may cause flooding. This study investigates how barrier jets associated with the Mei-Yu front influence frontal movement, using the heavy rainfall event on 2 June 2017 over Taiwan as a case study. Numerical simulations are conducted using the Weather Research and Forecasting (WRF) Model, which successfully reproduces the observed frontal structure and extreme rainfall. A series of sensitivity experiments is designed to systematically modify the intensity of the barrier jet. In these experiments, the barrier jet is weakened by retaining the terrain of northern Taiwan while reducing or removing the southern mountainous terrain, and strengthened by applying nudging to the upstream southwesterly flow, thereby enhancing the downstream barrier jet along the northwestern coast of Taiwan. Results from the sensitivity experiments demonstrate that a stronger barrier jet effectively slows the southward progression of the Mei-Yu front and prolongs its residence time near Taiwan. Further analysis based on the vorticity equation reveals that an enhanced barrier jet increases low-level moisture transport and strengthens frontal convergence, leading to stronger ascent and larger accumulated rainfall.

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Key words : Barrier Jet, Mei-Yu Front, Heavy Rainfall

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