

東北季風下都卜勒雷達於台中梧棲漁港之大氣邊界層的現象討論

Doppler Lidar Observations of the Atmospheric Boundary Layer under the Northeast Monsoon at Taichung Harbor

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摘要

在2025年2月6日至2025年4月29日，本篇透過與氣象署借用的都卜勒雷達(Doppler Lidar - Halo Photonics Stream Line XR+)，觀測到多個東北季風期間大氣邊界層的現象，特別關注於當東北季風抵達此位置時之資料。在2025年2月8日整天的數據收集下，可見於地表上100m至1500m左右可達20m/s-25m/s之穩定高風速，風向角約穩定落在20°-30°；但是，當高度大於1500m之後，風向角會快速轉變至220°左右(西南風)，並隨著高度增加有漸漸變成西風的趨勢(270°)，也在抵達1500m離地高度前，風速在約700m高空之20-25m/s高風速會逐漸驟減至約0m/s。此處顯示的高空自由來流風速及風向轉換，於同時段澎湖馬公施放探空氣球之斜溫圖結果也可見這個現象的發生，此外，斜溫圖可見從1000m至1500m的高度，溫度是在增溫的，這逆溫層的現象，透過Richardson number估算約落在0.3，是穩定的大氣邊界層現象，較少的紊流現象發生。根據本研究觀察統計，當東北季風抵達時，這種大氣邊界層流場結構是頻繁出現的現象。

關鍵字：都卜勒雷達、東北季風、大氣邊界層

Abstract

During the period from February 6 to April 29, 2025, a Doppler Lidar (Halo Photonics Stream Line XR+), on loan from the Central Weather Administration (CWA), was employed to collect the data on the atmospheric boundary layer during the Northeast Monsoon season. On February 8, 2025, which was the day the Northeast Monsoon arrived, wind speeds steadily maintained around 20–25 m/s with wind directions relatively stable at 20°–30° at the elevation 100 m to 700 m. Between the elevation 700 m to 1500 m wind speed gradually decreased to 0 m/s with the wind direction remained. Above the elevation 1500 m, the wind direction shifted drastically to approximately 220° (southwesterly) and transitioned to 270° (westerly) with increasing altitude. This transformation in freestream wind speed and direction was also observed in the sounding balloon data released from Penghu Island at the same time. The temperature inversion layer, shown in a slant temperature profile, indicates a temperature increase from 1000 m to 1500 m altitude. Based on the estimation of a Richardson number of 0.3, this suggests a stable atmospheric boundary layer with minimal turbulence. The structure of the atmospheric boundary layer mentioned above was repeatedly seen in the scanning lidar data when the northeast wind prevailed.

Key words: Doppler Lidar, Northeast Monsoon, atmospheric boundary layer