蘭嶼機場於顯著東北風情況下之氣流特性分析

Analysis of airflow characteristics in Lanyu airport under significant northeasterly situations

吳孟軒[1] (Wu M.-S.) 郭家利[2] (Guo J.-L.) 林悅祺[3] (Lin Y.-C.) 黃建翔[4] (Huang C.-H.)
宋恩承[5] (Song E.-C.)

[1,2,3,4,5]民用航空局飛航服務總臺

[1,2,3,4,5]Air Navigation and Weather Services, Civil Aviation Administration

摘　要

蘭嶼機場在冬季盛行東北季風時氣流不穩定，造成飛行勤務難以進行。為提供飛航從業單位作為行程規劃及預報作業之參考，本研究統整蘭嶼機場在各種盛行風向風速下的氣流特性，尤其以盛行東北風時為重點，並試圖找出島上各測站風資料與機場亂流之間的關聯性。本研究收集自107年10月1日至111年3月31日期間中央氣象署在蘭嶼設置的三個測站以及民用航空局蘭嶼機場跑道兩端的風資料。這些資料透過視覺化以了解風速計所在地附近的風場氣候特性。渦流消散率立方根(EDR)利用機場風資料透過三種方法計算，其中結構函數法所計算出的EDR其統計量較為適中，因此做為機場亂流強度與各測站風關聯性的分析標的，並以ICAO建議的EDR數值為標準來區分亂流強度。蘭嶼機場氣流及亂流特性分析顯示，蘭嶼機場13跑道(R13)– EDR在春、秋、冬季的平均與標準差大於31跑道(R31)，夏季差異不明顯。R13在春、秋、冬季主要風向(西北及東北風)上亂流較強，夏季主要風向(西風)上亂流較弱；R31各季節亂流較強的風向與主要風向不同，不過在春、秋、冬季的主要風向(東北東風)接近或等於跑道正側風，使得盛行東北風時R13與R31有各自造成航空器操作困難的因子。氣象署氣象站風與蘭嶼機場亂流關聯性分析顯示，蘭嶼氣象站在冬季主要風向(北-東北風)及其他季節風向為西北-北風與東北-東風時，機場亂流較強。蘭嶼高中測站在春、秋季為主要風向時(西北-東風)，機場亂流較強，但冬季各風速風向時機場亂流強度差異小。蘭嶼燈塔測站在春、夏、秋季的主要風向(北北東-東北風)機場亂流較強；冬季時不論何種風速風向，機場亂流強度差異小。

關鍵字：東北季風、蘭嶼機場、亂流、渦流消散率

Abstract

The airflow of northeasterly monsoon over Lanyu airport in winter is unsteady, which causes many difficulties in flight services. To proffer aviation industry suggestions on flight plan scheduling and flight weather forecast operation, this research integrated airflow characteristics in Lanyu airport under different prevailing wind directions and speeds, especially emphasized on prevailing northeasterly, and attempted to clarify relevance between airport turbulence and wind data from anemometers which are installed at weather stations scattered over the island. In this research, wind data are collected from three weather stations of Central Weather Administration (CWA) in Lanyu, and from two anemometer masts near the runway end in Lanyu airport of Civil Aeronautics Administration (CAA), with duration started from Oct. 10, 2018 to Mar. 31, 2022. Wind data were visualized to understand wind field characteristic in the vicinity of anemometers. The cubic root of eddy dissipation rate (EDR) was calculated via three methods. Among them, EDR evaluated by structural function (SF) method, which has moderate statistics, was chosen to analyze the relevance between airport turbulence intensity and weather station wind. Turbulence intensity was classified based on specific values suggested by ICAO. Analysis of airflow and turbulence characteristics in Lanyu

airport showed that EDR average and standard deviation during spring, autumn and winter at Lanyu airport runway 13 site (R13) were larger than at runway 31 site (R31) but no significant difference during summer. R13 experiences stronger turbulence in dominant wind direction (northwest and northeast winds) during spring, autumn, and winter, while weaker in dominant wind direction (west winds) during summer. At R31, the stronger turbulence is felt when wind direction is aside from dominant wind direction during each season. However, during spring, autumn, and winter, dominant wind direction (east-northeast winds) is close or equal to direct crosswind direction, this makes R13 and R31 possess different factors hindering aircraft operation. Analysis of CWA weather station wind and airport turbulence relevance indicated that stronger turbulence is more likely to occur at the airport during winter in dominant wind direction of Lanyu weather station (north to northeast winds) but also some wind directions(northwest to north and northeast to east) during other seasons. The airport experiences stronger turbulence when wind direction at Lanyu High School Station in dominant wind direction during spring and autumn (northwest to east winds), while airport turbulence intensity changes scarcely with station wind direction and wind speed during winter. In dominant wind direction (north-northeast to northeast) during spring, summer and autumn at Lanyu Lighthouse Wind Station, the airport experiences stronger turbulence, but again, turbulence intensity is almost the same regardless of wind direction and speed during winter.

Key words : Northeasterly Monsoon, Lanyu Airport, Turbulence, Eddy Dissipation Rate