

以多部掃描式光達合成高解析度邊界層三維大氣風場並反演熱力場的 可行性評估

A feasibility study of using multiple scanning lidars to synthesize high resolution boundary layer three-dimensional wind fields and to retrieve thermodynamic parameters

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摘 要

本研究在觀測系統模擬實驗的理想架構下，探討利用多部掃描式光達合成解析度至百公尺等級之邊界層三維風場的可行性，並計算根據合成風場反演所得之三維熱力場(即：溫度與氣壓擾動)的準確度。在風場合成方面，是使用WISSDOM (Wind Synthesis System using Doppler Measurements)，在熱力場反演部分，則是使用Terrain-Permitting Thermodynamic Retrieval Scheme (TPTRS)，兩者都具有可在複雜地形上直接運算的優點。

本研究的成果可應用於邊界層變化即時監測、午後對流前兆、大氣污染物擴散評估、對流尺度劇烈天氣預報、風機發電效益推估、機場飛航安全、數值模式驗證等

關鍵字：掃描式光達、風場合成、熱動力反演、邊界層

Abstract

The purpose of this research is to investigate the feasibility of using multiple scanning lidars to synthesized high resolution (~ 100 m) three-dimensional wind, followed by evaluating the accuracy of the retrieved thermodynamic parameters (i.e. pressure and temperature perturbations). All numerical tests are conducted under the idealized Observation System Simulation Experiment (OSSE) framework. WISSDOM (Wind Synthesis System using Doppler Measurements) and Terrain-Permitting Thermodynamic Retrieval Scheme (TPTRS) are the systems utilized for the wind synthesis and thermodynamic retrieval, respectively. Both systems possess the capability of resolving terrain.

Wide applications are expected from the results of this study, including boundary layer monitoring, precursor of afternoon thunderstorm, assessment of atmospheric pollutants diffusion, convective scale severe weather forecast, efficiency of wind energy, airport aviation safety, and numerical model verification.

Key words: scanning lidar, wind synthesis, thermodynamic retrieval, boundary layer