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Lidar Observations and Data Assimilation of Low-Level Moist Inflows Causing Severe Local Rainfall Associated with a Mesoscale Convective System

Abstract

A ground-based Raman lidar can investigate the water vapor structure of low-level inflows which contribute to the formation of a mesoscale convective system (MCS). After a warm front passed, low-level moisture convergence contributed to the initiation and development of numerous convective clouds that composed the MCS. The lidar observations showed that the vertical profiles of the water vapor mixing ratio (WVMR) associated with low-level inflows into the MCS exceeded $20 g kg^{-1}$ below 500 m above sea level. This study conducted two assimilation experiments using a four-dimensional variational data assimilation system: one is to assimilate operational observational data (CNTL), and the other is to assimilate WVMR vertical profiles and operational observational data (TEST). The result indicates that the representation of the warm frontal surface is improved by the data assimilation of the WVMR vertical profiles. A comparison between TEST and CNTL showed that data assimilation of the WVMR vertical profiles not only modified the moisture field but also the wind field. Data assimilation of vertical profiles of the WVMR has positive and negative impacts on the WVMR and horizontal wind, respectively. Moreover, TEST had slight improvement in the 6-h precipitation forecast compared to CNTL.

Keyword

Raman lidar

Reference

Yoshida, Satoru, Tetsu Sakai, Tomohiro Nagai, Yasutaka Ikuta, Yoshinori Shoji, Hiromu Seko 及 Koichi Shiraishi.「Lidar Observations and Data Assimilation of Low-Level Moist Inflows Causing Severe Local Rainfall Associated with a Mesoscale Convective System」. *Monthly Weather Review 150*: 1781–98. https://doi.org/10.1175/MWR-D-21-0213.1.