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Assimilation of Raman lidar profiles in an operational, convective-scale numerical weather prediction model

Abstract

High-impact weather like convective storms, fog, and low stratus is sensitive to the boundary-layer conditions. It is important to assimilate high-quality observations in the Planetary Boundary Layer (PBL) in Numerical Weather Prediction (NWP)models. However, there are a few of observing systems provide observations in PBL. Raman Lidar for Meteorological Observations (RALMO) which is located in Payerne, Switzerland provides the vertical profiles of temperature and water vapor mixing ratio with a high temporal and vertical resolution. To assess the impact of RALMO in an operational forecasting system, this study conducted experiments: REF_W(REF_S) that assimilated the MeteoSwiss operational observation data and RALMO_W(RALMO_S) that assimilated the data from RALMO and the MeteoSwiss operational observation data during two-week winter (summer) period. A verification with independent observations from a collocated, ground-based microwave radiometer shows that the analysis-departure standard deviation of the brightness temperatures in the humidity-sensitive channels is reduced by 20%–40% when assimilating RALMO profiles in addition to the operational observations. In addition, the author investigates the impact of assimilating RALMO instead of the collocated radiosonde observations and find that the humidity analysis is closer to the microwave radiometer observations than that of the reference assimilating the radiosonde observations. The results show the potential of Raman lidar to add to in regions without other profile observations. The impact of assimilating RALMO observations on forecasts up to +6 h is minor.

Keyword

RAman Lidar for Meteorological Observations (RALMO)

Reference

Crezee, B., Martucci, G., Leuenberger, D., Merker, C., Haefele, A. & Arpagaus, M. (2025) A ssimilation of Raman lidar profiles in an operational, convective-scale numerical weather prediction model. *Quarterly Journal of the Royal Meteorological Society*, **e5023**.Available from: https://doi.org/10.1002/qj.5023