

Analysis of Convective Structure from APR-2 and the DAWN Wind Lidar during the 2017 Convective Processes Experiment (CPEX): Impact of Assimilating DAWN Winds on the Precipitation and Flow Structure

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Abstract

During the May-June 2017 Convective Processes Experiment (CPEX), NASA DC-8-based airborne observations were collected from the JPL Ku/Ka-band Airborne Precipitation Radar (APR-2) and the 2-um Doppler Aerosol Wind (DAWN) lidar during approximately 100 flight hours. Frequent dropsonde data accompanied the DAWN observations for validation purposes, and to provide complement wind profiles in and near convection. For CPEX, the APR-2 provided vertical air motion and reflectivity in nearby precipitating regions where DAWN is unable to sense. Conversely, DAWN sampled vertical wind profiles in aerosol-rich, no-cloud regions surrounding the convection, but is unable to measure wind field structure within cloud.

In this presentation, these joint data are presented from the June 10 flight, including the APR2 precipitation structure and Doppler wind fields, and adjacent wind profiles from the DAWN and dropsonde data. A separate study was carried out with the NASA Unified WRF Ensemble Data Assimilation System (NU-WRF EDAS) modeling system to quantify the impact of the DAWN measurements on the analyzed variables and on the forecast when the DAWN observations were assimilated into the model. and how the impact depends on location and times of the instrument sampling. The impact on the analyzed fields was assessed by investigating the difference (Analyses – Forecast) of the vertical profile of the horizontal wind along the observation leg, and by investigating the innovations in the wind, temperature and humidity over the entire domain. The impact on the forecast was addressed by comparing the observed by APR-2 cloud field structure and vertical velocity with their model representation with and without assimilation of the DAWN measurements. After the assimilation, the subsequent forecast produced storms that were more similar to the observed. In particular, the forecast after the assimilation produced precipitation where there was none in the control run, more organized precipitation where there was some and more intense and organized cold pools. These particular findings highlight the importance of when and where the wind observations are taken, and will aid in assessing future requirements and limitations on the scale (horizontal and vertical) of the observations needed for a space-based DWL capability.

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