Replies to Anonymous Referee #2

"Assimilation of DAWN Doppler Wind Lidar Data During the 2017 Convective Processes Experiment (CPEX): Impact on the Precipitation and Flow Structure"
Svetla Hristova-Veleva et al. (AMT-2020-503)

General comments:

This manuscript investigates the impact of the assimilation of DAWN derived winds in the NASA NU-WRF EDAS data assimilation system on the precipitation forecast structure. Benefits are analyzed by investigating direct forecasts of the precipitation field as well as by performing a detailed study of the analysis increments in terms of moisture, temperature and wind fields. Results are verified against APR-2 and GPM satellite observations available during the time of the experiment.

Although results are limited to the analysis of a single flight event (one day of data assimilation experiments), this manuscript is well organized, and results are discussed with a great level of detail. I recommend the publication of this study after a couple of clarifying questions listed below are addressed.

Specific comments:

Coming from a data assimilation background, I was sometimes confused by the use of "simulation" and "assimilation". Is the word "simulation" used for verification purposes only rather than for the use of a forward model to perform data assimilation?

In this paper, a simulation refers to the WRF model forward integration, which may/may not have the initial conditions corrected by DAWN observations assimilated. Whereas assimilation is the procedure that combines the information in DAWN observations and in so-called "background" states from a forward model forecast to produce a corrected initial condition for further model forward integration.

Also, it is not clear whether the assimilation is conducted in the regional system, in the global model that provides initial and boundary conditions, or in both. Was the assimilation just conducted in the NCEP's data assimilation and forecast system? If the answer is "yes", did you attempt to conduct direct data assimilation into the NU-WRF system? If the answer is "no", in which of the two domains was the assimilation conducted? Was it a 2-way nested configuration? If would be interesting to investigate the impact of the assimilation of the observations in the WRF system as well as to analyze the benefits that come directly from the assimilation in the global system through improved initial and boundary conditions.

*The lateral boundary conditions from NCEP already have the conventional data and all other operational data streams assimilated (DAWN data is **not** part of this). This is a standard and*

*necessary procedure for a regional model to run. In this paper, the assimilation is conducted in the regional system: NU-WRF EDAS (developed at NASA Goddard, see the brief description in the manuscript, and references within). The ensemble data assimilation (using conventional observations **and** DAWN observations) is carried out in the domain 1. The WRF model forward integration is configured as 1-way nesting. When the regional model integrates forward, the domain **interior** states evolve differently and could drift away comparing to the global analysis. Thinking this way, the data impact (such as from the conventional data) at the boundary is lost in the domain interior, thus justifying the existence of regional data assimilation in the domain (i.e., no assimilation at or near the boundary). Technically, one could say that the conventional data are thereby "assimilated twice". A more meaningful way would be to view this as "a re-enforcement of the data constraint in the regional model interior". Regarding the last point, since DAWN data is from a short field campaign period and very limited spatial coverage, it is beyond the scope of this work to investigate the data impact in a global assimilation system.*