Atmos. Meas. Tech. Discuss.,
doi:10.5194/amt-2020-503-RC1, 2021

Atmospheric Measurement Techniques Discussions

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

Anonymous Referee #1

Received and published: 5 January 2021

Review of: Assimilation of DAWN Doppler Wind Lidar Data During the 2017 Convective Processes Experiment (CPEX): Impact on the Precipitation and Flow Structure

Authors: Svetla Hristova-Velev, Sara Q. Zhang, F. Joseph Turk, Ziad S Haddad, Randy C. Sawaya

Summary This paper demonstrates the impact of assimilating DAWN airborne Doppler wind lidar observations on a high resolution, convection allowing model simulation of a developing cluster of convective cells over the tropical Atlantic. Significant impacts

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to the initial analysis and subsequent forecast are shown, where convection was not present in the control but was relatively robust (though delayed a bit in time) and in general agreement storm vertical structure depicted by APR-2 and GPM DPR observations. The paper is straightforward and well-written. I feel that it is acceptable for publication after the following generally minor comments are addressed.

Comments Line 45, “in the first place” instead of “on the first place”

Line 79, times -> time

Line 98, Zhang et al 2018 seems to be related to the NOAA P-3 DWL, not DAWN.

Line 101, recommend defining what you mean by “sparsely-sampled”

Line 135, I’m guessing that the environments weren’t 100% cloud free given the tropical environment being sampled. DAWN has the ability to pulse through some tenuous cloud as well. So I’d recommend this being rephrased as “wind profiles in aerosol-rich, clear or broken cloud regions surrounding the convection”. You address make a similar statement to what I recommend below in lines 146-147, so it would be good to be consistent with your statements.

Line 147, recommend “off-nadir” rather than “elevation” which could be interpreted to be 60 degrees coming out of the aircraft by some unfamiliar readers

Line 155-158, is GPM data at all assimilated into the boundary condition analyses or coarser grids in your simulation (i.e. is it part of the NCEP “conventional observations” in Table 1, and “clear sky radiances” in line 190)? Or are the simulations entirely independent of GPM, and putting DAWN into the mix made the MCS simulation look a lot more like GPM than the control.

Line 188, Blue seems like it is depicting both areas with little aerosol and cloud obscuration. You should consider depicting the two sources of DAWN data dropout with differing colors to better inform the readers.

Figure 2, vertical axis should be made the same across all 4 panels to be consistent and to enable comparisons across segments

Page 13-14, I don't feel that you've adequately explained the nuances associated with Ka and Ku band reflectivity. Some places Ku only is shown (Fig 5), others both bands are shown. It would be helpful to provide a couple sentence explanation of the chaaracteristics of these multiple wavelength data.

Line 316, is this 1.8 km "blind spot" common for APR-2 and -3 instruments, or was this due to a instrument specific scan mode setting at the time of this flight?

Line 328, delete the 11a that has been crossed out

Figures 7-12, though it is demonstrated that the control generated almost no precip where there should have been some, I recommend you explicitly state somewhere that the profiles are from the run with DAWN assimilation.

Figure 16, I'm not seeing observational evidence of enhanced moisture, seems to look more like precipitation features rather than a moisture image. I recommend you reconsider this figure and the text that goes with it.

Figure 18, should the temperature anomaly in color shading in Figure 18b be aligned in some sense with the cold pool boundary? I am seeing a disconnect and am confused. I realize that the dropsondes revealed a cold pool there but I'm guessing a more substantial cold pool would have been found near the precip in the lower right quandrant of the domain had you released dropsondes there. Perhaps the red line is not particularly important because it confuses the interpretation of Fig 18b,

Line 547, the sentence beginning with "It resulted in modification of near surface convergence" seems a lot like line 549, "it led to increase of the near surface convergence". Was this an inadvertant repeat, or are there important nuances in the transition between the two sentences that I'm not understanding?

Line 550, you state that convection was not present in the control run, and then line

553 you state that precipitation was not present in the control run. Along the lines of the previous comment, perhaps you could review the paragraph beginning with line 545 and streamline the messaging. It's a very important paragraph to your summary so its necessary to be clear with your statements.

Line 560, you note that this was a single case, but the final sentence of the previous paragraph, you note that Cui et al found similar results as you, in that convection was better predicted through DAWN assimilation, after two different cases. So perhaps an opening sentence of the paragraph should be something along the lines of: "These findings add to the growing body of evidence that suggests that assimilation of high resolution, high precision Doppler wind lidar profiles into convection allowing models improves analysis of environmental conditions favoring convective storm development and upscale growth. Nevertheless, longer assimilation periods and more flight dates are needed to generalize impacts across a diversity of cases and convective regimes." Then the "this is challenging" and other subsequent statements can remain in place.

Building onto the statements above about CPEX cases, I don't see much motivation in the Intro or text near beginning of the paper for why you selected this particular case, aside from the fact that Turk et al also featured it. Was this one of the few cases where convection developed near in space/time to a region where the DC-8 flew? Some additional description regarding this point would be worthwhile.

Line 568, though you do include the Bedka et al 2020 reference, perhaps a statement about the fact that HALO provides aerosol and water vapor profiles. You make a statement in prior sentences about how aerosol information was lacking in CPEX 2017, and mentioning HALO's capability will close the loop.

Line 567, CPEX-AW is the NASA component of the overall ESA "Tropical Aeolus Cal/Val Campaign", you may want to ping NASA HQ sponsors to determine the best verbiage for describing CPEX-AW. Defining the -AW part in your text would be warranted as well.

General question, how are you assigning observational error to the DAWN wind? Is this based on the results from Greco et al 2020, or are you treating the data like a radiosonde in the assimilation process?

General comment, my impression of ensemble forecasts is that initial conditions are tweaked a tiny bit in each run and the outcome of the ensemble is a probability or likelihood of an event happening based on agreement between the ensemble members. Table 1 indicates this is a 48 member ensemble. But we're only seeing what seems to be one model run from the control and assimilation. Are these ensemble means we're seeing in this paper? I don't see this in the text anywhere but I may have missed something. Some expansion on this in the text would be worthwhile.

General comment 2, do you have any thoughts on why convection was delayed for about an hour in the run with DAWN assimilation. Perhaps you could offer a hypothesis for this in the text? Do you feel that if the DC-8 were on station in this region at say 16 UTC, then the model simulation would have had the correct timing for the convection?

Data Availability, DAWN data is archived at the NASA Langley ASDC: https://asdc.larc.nasa.gov/project/CPEX Is the APR-2 data archived somewhere accessible, rather than the "available upon request" statement?

Acknowledgements, I recommend you credit Michael Kavaya as PI of DAWN and the DAWN team (and Simone Tanelli and the APR-2 team as well) for collecting the data used in your study. "The DC-8 flight support team" does not adequately credit folks associated with the instruments.

Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2020-503, 2020.

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