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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Quantifying the Direct Radiative Effect of Absorbing Aerosols for Numerical Weather Prediction: A case study" *by* Mayra I. Oyola et al.

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To: Reviewer 2 Atmos. Chem. Phys., http:// editor.copernicus.org/ From: Dr. Mayra I. Oyola mayra.oyola.ctr@nrlmry.navy.mil

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Dear Reviewer 2,

We are appreciative that you have considered reviewing our article: "Quantifying the Direct Radiative Effect of Absorbing Aerosols for Numerical Weather Prediction." for

publication in the Journal of Atmospheric Chemistry and Physics. Thank you for your time and effort to make of this a much stronger manuscript. The comments and questions (along with associated changes) have been addressed below and are also reflected in the manuscript. Reviews: 1. The beginning of Section 2.6 now reads (lines 194-211): "HSRL aerosol observations are matched spatiotemporally to the closest NAAPS/NAVGEM analyses profiles. All versions of NAAPS used on this paper contain extinction (α) and AOD profiles from the surface to 100 hPa at 22 (now 35) sigma levels of variable vertical resolution (higher resolution in the lower atmosphere). In order to perform comparisons between model and observed fields, the HSRL data are "reduced" to the same model vertical resolution by employing a nearest neighbour classification constrained to model top and bottom. Besides the aerosol, FLG requires input of atmospheric background fields. P, T, q, and O3 profiles are obtained from NAVGEM's previous analysis time to the flight overpass. The case study presented here (19 August 2013), uses profiles from the analyses corresponding to 15 and 18 UTC. There are four different aerosol profiles used as input: one from HSRL (taken as the true) and three that are obtained from the closest NAAPS analysis (which matches NAVGEM's analysis time). Besides extinction, both the HSRL and NAAPS datasets also contain aerosol speciation profiles. Therefore, each extinction profile is paired to a corresponding speciation profile that is matched to the FLG internal optical properties as described below. Each of the NAAPS analyses profiles correspond to a different assimilation version, as described in Section 2.2 (NAAPS 3D, NAAPS OPS, NAAPS FREE). A control run (NOAER) is set in a similar fashion, but with no aerosol feedback included. Radiative transfer calculations on FLG are performed on each profile from surface to TOA (0.1 hPa), and we assume there is no significant aerosol loading above the 100 hPa level (aerosol layers above 100 hPa are padded to 0). This is consistent with the current HSRL observations from SEAC4RS, which are simultaneously constrained to aircraft height and surface elevation (the top of the HSRL observations is generally obtained within 7-10 km AGL)".

2. Captions have been modified to contain further explanation of what is depicted.

They are delineated in blue in the draft. 3. The explanation for this is given in the opening of Section 3.1, with along with the added line: "Although the SEAC4RS field study spanned over several weeks, the necessary collocation of the aircraft observations, combined with requisite of cloud free conditions from which to most accurately apply the broadband radiometer measurements, occurred on 19 August 2013. The comparisons shown in this paper are all based on this date/time, given that this was the one window of opportunity where all of the instruments were synergistically and strategically operating. Additionally, the case matched an high-loading aerosol event that warranted attention. Figure 1 shows the composite of HSRL-2 vertical profiles of aerosol backscatter coefficient at 532 μm sampled during the flight that day. The enhanced area of laser backscattering near 40° N corresponds with a transported smoke plume that serves as focus of the study. The composite flight track in Fig. 1 depicts the HSRL taking off from Ellington Field outside of Houston, Texas (29.61° N, 95.16° W, 9.7 m MSL), through the state of Texas and the Thunder Basin Grassland in Wyoming, whose landscape contains intermingled mixed and short-grass prairies in a semi-arid climate. This flight sampled the most extensive and thick smoke plume observed during SEAC4RS. Within this plume, a profile with an observed peak AOD of 0.73 was sampled at 44.24°, -104.61°, at an aircraft cruising altitude of 9.6 Km. The plume containing this profile was partially a product of large-scale smoke transport from fire activity in Wyoming, Nebraska, and South Dakota. Back-trajectory analysis for this case (not shown), demonstrate the air mass originated near the fire regions, less than 24-hrs before the research flight". Technical corrections: 1. Sentence 286 has been changed to read: "R strongly influences the SW RT estimates. From Figs. 3-6, despite obtaining near-closure in the SWâĘŞ term (Figs. 3a, 4a, 5a, 6a), only the outputs with the MAIAC 555 μm BRF (Fig. 5a) approach closure in the SWâĘŚ. That is, here we compare radiances with the airborne NRL radiometers mounted on the DC-8". 2. Units have been added to Tables 2 and 3 as requested.

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