Reply to Review 3 (RC2):

The authors present a novel analysis of airborne (helicopter-based) vertical fluxes of aerosol particle number concentrations. Three separate techniques for deriving vertical fluxes are explored and a systematic discussion of their strengths and weaknesses are included. The authors present a fair assessment of the limitations of the techniques which will be valuable for future analyses. The paper focuses primarily on measurements of the entrainment flux of aerosol from the free troposphere, concluding that in the airmasses sampled here, entrainment could supply 30-40 particles/cm3 per hour to the MBL.

My only comment is that it would be helpful to expand on this last point a bit more to include a short discussion on the sources and sinks of particles in the MBL and the extent to which numbers of this magnitude (30 p/cm3 h) compare with what one might estimate for dry deposition to the ocean surface or that needed to sustain some of the larger NPF events that have been sampled at ENA. This might help the reader (and future scientists) get a better handle to the limitations of this approach in the context of the magnitude of the fluxes required to change particle concentrations in the MBL.

Thanks for the comment! Below, we included a short discussion here and also to the manuscript.

A simple way to estimate dry deposition to the ocean surface is multiplying the particle number concentration N (in cm^{-3}*) at the surface with the dry deposition velocity v_dry (in cm* s^{-1}*), i.e. dry deposition flux F_dry = - v_dry * N (in* $cm^{-2}\ s^{-1}$*)*

From Emerson et al. (2020, PNAS), for 100 nm particles one can estimate a dry deposition velocity to water in the range of v_dry = 0.01 cm/s to 0.2 cm/s.

For flight #3 on July 5th, we find a particle number concentration of about N = 400 cm^{-3} *at sea surface level, and we can estimate the dry deposition flux F_dry =* $-4\ cm^{-2}\ s^{-1}$ *to* $-80\ cm^{-2}\ s^{-1} = -0.04$ *to* $-0.8 \times 10^6\ m^{-2}\ s^{-1}$*.*

On that day, the EC and K theory flux estimates close to the surface are within this dry deposition flux range, i.e $F_{EC,bottom} = -0.4 \times 10^6\ m^{-2}\ s^{-1}$ *and* $F_{K,bottom} = -0.05 \times 10^6\ m^{-2}\ s^{-1}$*. The surface flux estimated by MLG,* $F_s = -18.8 \times 10^6\ m^{-2}\ s^{-1}$*, is about 25 times higher compared to the higher estimate. The entrainment flux* $F_e = -0.3 \times 10^6\ m^{-2}\ s^{-1}$ *and the fluxes close to the top of the MBL are in the same order of magnitude.*

We added to the manuscript:

*'The estimated fluxes were furthermore compared with the dry deposition flux F_dry using the approach F_dry = - v_dry * N (in* $cm^{-2}\ s^{-1}$*). From Emerson et al. (2020, PNAS), for 100 nm particles one can estimate a dry deposition velocity to water in the range of v_dry = 0.01 cm/s to 0.2 cm/s. For flight #3 on July 5th, the particle number concentration was about N = 400* cm^{-3} *at sea surface level leading to a dry deposition flux F_dry = - 4 to - 80* $cm^{-2}\ s^{-1} = -0.04$ *to* $-0.8 \times 10^6\ m^{-2}\ s^{-1}$*. On that day, the EC and K theory flux estimates close to the surface are within this dry deposition flux range, i.e* $F_{EC,bottom} = -0.4 \times 10^6\ m^{-2}\ s^{-1}$ *and* $F_{K,bottom} = -0.05$ *x*

10^6 m^{-2} s^{-1}. The surface flux estimated by MLG, F_s = -18.8 x 10^6 m^{-2} s^{-1}, is about 25 times higher compared to the higher estimate. The entrainment flux F_e = - 0.3 x 10^6 m^{-2} s^{-1} and the fluxes close to the top of the MBL are in the same order of magnitude.’

Emerson, E.W., Hodshire, A.L., DeBolt, H.M., Bilsback, K.R., Pierce, J.R., McMeeking, G.R., Farmer, D.K. (2020) Revisiting particle dry deposition and its role in radiative effect estimates. PNAS 117, 26076–26082. www.pnas.org/cgi/doi/10.1073/pnas.2014761117