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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Aerosols-cloud microphysics-thermodynamics-turbulence: evaluating supersaturation in a marine stratocumulus cloud" *by* F. Ditas et al.

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First of all we want to thank both reviewers for their helpful comments and their positive evaluations of this work.

1) radiation

Referee 2 addresses the radiative impacts on cloud droplet in stratocumulus clouds. Marquis & Harrington (2005) pointed out that radiative heating and cooling rates for cloud droplets can vary by 2 to -15 K h^{-1}, depending on radiative fluxes, droplet

diameter and droplet location with reference to cloud top and cloud base. This leads to a temperature difference between droplet and environment resulting in a different equilibrium supersaturation (S_{eq}). Since the reported measurement flight was conducted between 16:30 and 17:45 CET strong shortwave heating can be neglected. Nevertheless, longwave radiative cooling can not be precluded. Our observations show that the majority of droplets are smaller than 20 μm in diameter. The calculations of Marquis & Harrington (2005) show that for droplets in this size range the equilibrium supersaturation of droplets in the uppermost 50 m of the SC is changed to values on the order of $S_{eq} = \pm\, 0.01$% (Fig. 6 in Marquis & Harrington, 2005), which is less than 10% of the estimated variability from our measurements. Furthermore, the radiative impact on S_{eq} depends also on the amount of time an air parcel remains at cloud top, and therefore, on cloud dynamics (Hartman & Harrington, 2005).

At the end of page 29791 we added following: "Within the framework of this work we did not consider radiative effects on the equilibrium supersaturation (S_{eq}) arising from radiative cooling or heating of the cloud droplets. Marquis & Harrington (2005) pointed out that radiative heating and cooling rates for cloud droplets can vary by 2 to -15 K h^{-1}, depending on radiative fluxes, droplet diameter and droplet location with reference to cloud top and cloud base. Since the reported measurement flight was conducted between 16:30 and 17:45 CET strong shortwave heating can be neglected. Nevertheless, the majority of our observed droplets size between 5 and 20 μm in diameter. For droplets in this size range the equilibrium supersaturation in the uppermost 50 m of a stratocumulus cloud can be changed to values on the order of $S_{eq} = \pm\, 0.01$% (Fig. 6 in Marquis & Harrington, 2005), which is less than 10% of the estimated variability from our measurements."

2) activated fraction η

We attached a new plot (Fig. 1) with η and a fitted error function to clarify the error-function-like behavior of η. As the abscissa in Fig. 6 is plotted on a logarithmic scale we use here $log_{10}(D_\mathrm{p})$ as x values as input. The resulting parameters are $\mu = 2.06$, which corresponds to $D_\mathrm{p} = 115$ nm and $\sigma = 0.126$ with a very good correlation of $R^2 = 0.99$.

3) physical meaning of 50% activation diameter

If we had a single updraft and perfect homogeneous aerosol composition we would expect a step function for the activated fraction. As discussed in the paper this is not the case. To find a meaningful value for the activation diameter we chose the diameter where the activated fraction is 0.5. This definition is meant to characterize the typical diameter and does not have any special meaning otherwise.

4) The comments of referee 1 are answered in the author comment C14876.

Hartman, Christopher M., Jerry Y. Harrington, 2005: Radiative Impacts on the Growth of Drops within Simulated Marine Stratocumulus. Part I: Maximum Solar Heating. J. Atmos. Sci., 62, 2323–2338. doi: http://dx.doi.org/10.1175/JAS3477.1

Marquis, J., and J. Y. Harrington (2005), Radiative influences on drop and cloud condensation nuclei equilibrium in stratocumulus, J. Geophys. Res., 110, D10205, doi:10.1029/2004JD005401.

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 29777, 2011.

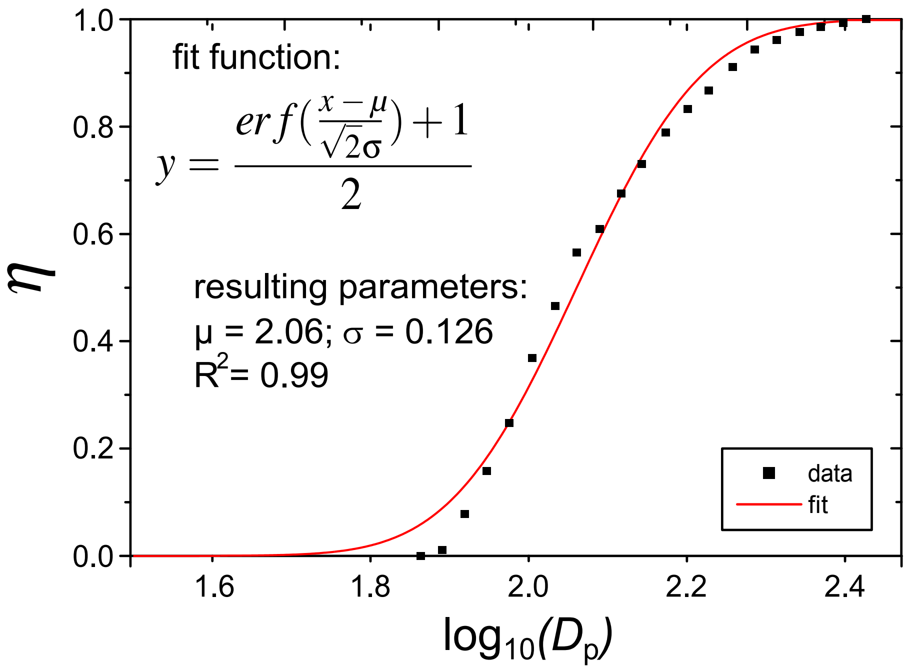

Fig. 1. Activated fraction \eta as function of diameter (black boxes). Red line indicates a fittet error function.