

Interactive comment on “A long-term satellite study of aerosol effects on convective clouds in Nordic background air” by M. K. Sporre et al.

Anonymous Referee #1

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GENERAL COMMENTS:

Please include page numbers and line numbering in your manuscripts. This is really annoying.

This is an interesting study that looks at cloud top effective-radii/temperature correlations to infer profiles of effective radii in convective cloud fields at two northern European sites. A unique element that strengthens the study is the use of ground-based aerosol and precipitation datasets.

The paper deserves to be published following major revisions. My primary concern is the need for more statistical evidence, primarily related to the results in Figure 4 and Figure 8. The claims made about aerosol effects on precipitation are particularly poorly

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defended without more rigorous analysis.

SPECIFIC COMMENTS:

Abstract: ‘indirect aerosol effect’ has typically referred to an influence that aerosol have on cloud albedo. Here you really look at two effects: (1) a direct microphysical effect of aerosol on droplet size and (2) an indirect aerosol effect on precipitation intensity. Try to be precise. The use of these poorly defined terms is too often used without clarity.

Abstract: Clouds with greater vertical extent have the highest precipitation rates and are most sensitive to aerosol perturbations

Sec 2.2. ‘Therefore, the Level 1B data from band 31 (10.780-11.280 μm) and 32 (11.770-12.270 μm) have been used to calculate the CTT at a 1 km horizontal resolution.’ You need to provide the details or references for this calculation yourself.

Sec 2.5: ‘The 30th percentile of the variation in r_e with height has been studied here since this represents clouds early in their development, which are less influenced by ice formation’. It is not clear to me what this means.

Sec 2.5: ‘Clouds with less ice formation are preferred, since the measurements at both stations focuses on CCN’. Does this mean that ‘ice’ clouds are removed from the analysis? Be clear. The word preferred is very inexact. I have the same complaint with sec 2.2.

Sec 3.2: ‘However, the cloud profiles do seem to be affected by the humidity at 1000 hPa. A lower SH results in smaller droplet sizes at lower levels of the profiles (Fig. (4j) to (4l)) and dividing the profiles according to RH produces similar results (not shown)’. I think that this actually strengthens your argument for aerosol effects on r_e because the dependence of r_e on SH and N80 is of opposite signs but table 4 shows that SH and N80 are positively correlated. You should discuss this.

Sec 3.2 and Figure 4: I can see that the profiles are different. You should really demonstrate that these differences are statistically significant. Possible they are significant at

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some levels and not at others. You could draw dashed lines for the insignificant heights and solid lines for levels where the differences are significant.

Section 3.3: 'The strong correlation between ΔT_{14} and dT is expected since the vertical extent of the profile also limits the ΔT_{14} and this correlation is hence an artifact of the method'. I don't understand this statement. Can you clarify please?

Section 3.3: 'The w'. Define w. Why specifically talk about w here as opposed to the other variables. The message of this entire paragraph is not entirely clear to me.

Table 3: The table is overwhelming. I think that this table might be easier to look at if it were 2 tables; one for each location.

Sec 3.3: 'The COT profiles were also divided according the same parameters but neither aerosols nor meteorological parameters were found to separate the profiles from each other to any great degree.' How can this be? Figure 4 shows an apparent strong correlation between r_e and N80. If the differences in fig 4 are not significant you need to mention this. Also if you can't show a statistically significant relationship between N80 and r_e then the whole premise of the paper unravels. This seems like a major problem or miscommunication that needs to be dealt with.

Abstract: 'Furthermore, an increase in aerosol loadings results in a suppression of precipitation rates' Your data in Table 4 are not significant and don't support this.

Fig 8: You need to provide significance testing here.

Sec 3.4: 'Furthermore, an increase in aerosol loadings results in a suppression of precipitation rates'. Again you need to do significance testing.

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 13853, 2013.