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Atmospheric Chemistry and Physics Discussions



# *Interactive comment on* "The scale problem in quantifying aerosol indirect effects" *by* A. McComiskey and G. Feingold

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The primary concern raised by the referee is that the same WRF output is not used to quantify effects of all factors that impact estimates of indirect effects that we discuss. We have used WRF output to illustrate two of these factors but not for illustrating the impacts of separation of aerosol and cloud retrievals in space (time). In order to truly quantify the effect of separation, a continuous series of aerosol and cloud data is required, either in space or time, to evaluate the correlation of the two with increasing distance (time) from each other. Since the aerosol distributions used with the WRF output are prescribed independently of the cloud distributions, the two cannot be analysed in series. We do, however, make use of a continuous time-series of co-located aerosol and cloud properties to illustrate the impacts of this separation factor, which allows for

lagged cross-correlations at high resolution from a starting point where aerosol and cloud are known reasonably well to be coupled. We have also added an analysis of the MODIS scenes presented in this section to further illustrate the impacts of separation (see modified Fig. 9, new Table 2, and the associated discussions).

The idea of comparing the effects of each of these factors in a bar graph is appealing, however, we have found that the ultimate impact of any of the factors is variable and highly case dependent. We do not claim that the estimates of the first indirect effect should be of any particular value as we recognize that the variable impacts of these factors may compound or compensate each other depending on the particular conditions of the measurements. We discuss that these impacts will be dependent on cloud regime throughout the manuscript. To address the range of variability in the impacts would likely require a global analysis of all different cloud regimes over long time periods at an exhaustive range of scales – work that has been left for future analyses. Instead, this work is intended to stress that these factors should be considered when estimates and interpretations of indirect effects are made according to the particular circumstances of the analysis.

Additional discussions along these lines have been added to the manuscript in several places to present these ideas to the reader in a more straightforward manner.

Specific Comments: Sec 3.4, first para: The cloud optical depth distribution determined from the parcel model is not necessarily consistent with the WRF output in this case because the aerosol distribution is prescribed independently. The next paragraph addresses this issue explicitly. The other properties, liquid water path and updraft velocity, are taken directly from the WRF output (and are thus consistent). In the case of applying this method to data as is suggested in Sec 5, the resulting optical depth distribution would be consistent with the actual distribution if model conditions were appropriate, and could be evaluated by comparing modeled and observed distributions (as discussed in Sec. 5). A more rigorous explanation of the method has been added.



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Sec 4.1: please refer to above discussion

Figure 12: Page 26760, lines 14-15 state that the WRF output used is constrained by 10 g m-2 liquid water path bins. The correlation coefficient that corresponds to this set of data can be found in Fig 7b at the highest resolution. Text in Sec 4.2 has been edited to clarify these points.

Technical Comments: Thank you for locating typos in the text – the technical comments have been addressed.

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Interactive comment on Atmos. Chem. Phys. Discuss., 11, 26741, 2011.