

***Interactive comment on* “Does precipitation susceptibility vary with increasing cloud thickness in marine stratocumulus?” by C. R. Terai et al.**

Anonymous Referee #1

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Review of “Does precipitation susceptibility vary with increasing cloud thickness in marine stratocumulus?” by Terai et al.

The aim of this work was to push forward the examination of the precipitation susceptibility metric (i.e. how aerosol perturbations influence precipitation) for marine stratocumulus clouds using an airborne dataset collected during VOCALS off the western coast of South America. The work addresses relevant scientific questions within the scope of ACP. The work presents novel data analysis techniques, most specifically the decomposition of the original metric into sub-components that focus on precipitation fraction and precipitation intensity. This has not been performed before and important results and conclusions were obtained that warrant publication. The manuscript does a good job of highlighting the importance of the sensitivity of results in a study of this

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nature to choices that can be made in the data analysis process (i.e. consideration of precipitating and non-precipitating clouds together versus just precipitating clouds; averaging lengths; bin widths; etc). The manuscript is very well-written, organized, and provides a sufficient amount of background information. I recommend publication after the authors consider the comments below:

(i) The work presents highly valuable susceptibility numbers, which currently are scarce in the literature, especially when derived from aircraft measurements. At least one other stratocumulus dataset has been used to quantify precipitation susceptibility values (Lu et al., 2009). It would be helpful to compare the values in the VOCALS region to those in the Lu study, which also used airborne measurements. When doing this comparison, it should also be noted that different data analysis methodologies may have been applied in the two studies. Another recent study examining precipitation susceptibility that should be mentioned is that of Bangert et al. (2011) (i.e. see their Figure 11).

Lu et al. (2009), Marine stratocumulus aerosol-cloud relationships in the MASE-II experiment: Precipitation susceptibility in eastern Pacific marine stratocumulus, *J. Geophys. Res.*, 114, D24203, doi:10.1029/2009JD012774.

Bangert et al. (2011), Regional scale effects of the aerosol cloud interaction simulated with an online coupled comprehensive chemistry model. *Atmos. Chem. Phys.*, 11(9): 4411-4423.

(ii) Do the authors believe that the “SI” metric (rather than “SR”) is more similar to the precipitation susceptibility quantified in previous studies that were cited by the authors (e.g. Sorooshian et al., 2009; Jiang et al., 2010), albeit probably with different minimum rain rate thresholds? If so, it may be worth mentioning this and considering this at least in the comparison with data from previous studies such as the Lu et al. study in the comment above. In this regard, it is interesting that the authors noted (Pg 33397 Line 3-20) that SI exhibited a maximum at an intermediate LWP value in Figure 7 for the 5

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km analysis. Figure 8 also shows a susceptibility maximum at an intermediate LWP value. Was this behavior in SI evident in the 10 km and 20 km analyses? This also raises the question as to whether direct comparisons should be made for the LWP-dependent (or H-dependent) behavior of susceptibility for different warm cloud regimes that also may have different ranges in LWP or thickness. I suggest that if the authors have more thoughts about this, it would be worthwhile to add some discussion in the last paragraph of the manuscript where they start to get into these issues. This could be helpful to inform future studies examining precipitation susceptibility. Also, can the authors clarify what is meant by sampling artifacts (Line 18, pg 33397)?

(iii) Page 33397, line 7: Do the authors intend to say “from the first to the second LWP bin”? This is what Figure 7 indicates to this reviewer.

(iv) Page 33399, line 22-23: Can another issue be that different LWP-dependent (or H-dependent) behavior of precipitation susceptibility exists for different cloud types evolving in different meteorological/thermodynamic conditions?

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 33379, 2011.

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