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Interactive comment

Interactive comment on "A Microphysics Guide to Cirrus – Part II: Climatologies of Clouds and Humidity from Observations" *by* Martina Krämer et al.

Anonymous Referee #1

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This manuscript presents a comprehensive review of airborne in-situ and satellite remote sensing climatologies of cirrus clouds and water vapour. It combines previous as well as new insitu databases that help clarify detailed properties of tropical and midlatitude cirrus and their responses and across a very important altitude range 5-20km. The links to satellite-borne data sets offers a benchmark for the model community to identify and begin to improve uncertainties in cirrus feedbacks.

The scale of the database and attention to detail is an impressive, particularly with respect to the review and update of in situ database quality control for known and ongoing issues with respect to small ice quantification due to artefacts in measurements. This is

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particularly important in assessing error contributions to small ice concentrations providing confidence in the interpretation of different cirrus generation mechanisms currently being discussed, in-situ and liquid origin processes. These are well described although there is still much to be understood. The summary section on characteristics and distribution of in-situ origin and liquid origin cirrus linked to the previous Kramer et al. publication is very useful and helps to clarify the very large, sometimes overwhelming data sets. Despite some of the issues with previous measurements/data sets I found Figure 4 e.g. very encouraging showing a consistent relation between cirrus ice crystal concentration and mean ice mass radius and ice water content IWC.

The limitations of the data sets are discussed in good detail ins section A2.2 which is an important point for data users to be mindful of due to the impact on the uncertainties on concentrations/counting statistics and frequencies of occurrence of small cirrus ice crystals due to the very different sample volumes of the different instruments used in the analysis. Improving instrument response for small ice crystals still remains a challenge for in situ instruments especially for non-grey-scale imaging probes so merging data sets under varying environments needs to be treated with caution. The key issues are however explained - integration times dictated by different instrument sample volumes might limit detection of cirrus spatio-temporal inhomogeneities and hence interpretation of formation mechanisms. It was good to see the possible effects of this discussed and also those due t ice shattering (Figure 18 e.g.) which provides a useful benchmark for new data sets to compared with.

Figures 5 and 6 presented a nice overview of the data sets and how the different formation mechanisms contribute (minor typo in the Figure 5 legend, "summery" should be summary) versus clear sky conditions and as a function of region.

Minor typo Figure 7, plate Nice vs T, Nice units given as 1/ccm. This should be changed to cm-3 to be consistent with previous and subsequent figures.

The final results are perhaps not surprising and consistent with previous - i.e. "across

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all latitudes, the thicker liquid origin cirrus predominate at lower altitudes, while at higher altitudes the thinner in-situ cirrus prevail." However, this study does provide a comprehensive database with estimates of radiative forcing ranges constrained by well described uncertainties.

Whilst this paper is extremely long and comprehensive it would have been useful to height potential uncertainties in some satellite retrievals, particularly with regard lack of sub-cloud top processes but likely this is not an issue for many of the cirrus discussed here.

All in all this is an excellent and very comprehensive review and analysis of our understanding of cirrus.

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