

## ***Interactive comment on “Ice cloud microphysical trends observed by the Atmospheric Infrared Sounder” by Brian H. Kahn et al.***

### **Anonymous Referee #1**

Received and published: 4 April 2018

This work investigates tendencies in the ice cloud frequency, effective radius ( $r_{ei}$ ), optical depth ( $\tau$ ) and cloud top temperature in retrievals from the Atmospheric infrared sounder. The authors also analyze tendencies in the information content of the retrieval ruling out possible artifacts. Significant trends are found in the effective size, increasing over most of the globe, and also in other variables. The authors also show that  $r_{ei}$  is correlated with the column water vapor, and surface winds and temperature, particularly for opaque clouds suggesting an strong role of convection on the observed trends. Clouds are very sensitive to changes in the atmospheric state and trends in cloud properties may signal important systematic changes in Earth's climate. Hence this work is highly relevant to the atmospheric community and within the scope of ACP. The methods are sound and valid and the results interesting. I have some comments

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on the organization of the work and in some places where more explanation and further analysis is required. After those are addressed this paper would be suitable for publication.

Comments: The paper reads a little bit like two separate works, with the second one starting in Section 5. Are the authors trying to use their analysis of convective processes to explain the observed tendencies? How do Figures 7-10 relate to the previous ones? I'd encourage the authors to work on making a consistent point throughout the paper.

How do the results compare to other instruments? They authors use MODIS and DARDAR in the analysis of the second part of the paper, but they seem to abstain of comparing the decadal trends from those products against their results. Are the tendencies from AIRS similar, at least qualitatively, to those of MODIS and DARDAR?

Page 11 Line 3. Please define the effective cloud fraction.

Section 5.1. The terms opaque and transparent seem ambiguous here. The authors draw a direct correlation between the covered area and the optical thickness of the clouds. But transparent cirrus (which most of the time refer to low optical depths) can be extended or simply cover a small fraction of the grid cell. Please clarify.

Section 5.2 and also in Section 5.3. Please add a paragraph explaining what you expect to see in the histograms (e.g., Figure 8) and how to interpret them. They are not obvious at all.

Page 11 Line 28. Here and in other places. It is not clear what the "reduction" is referring to. What is the control in this case? Please clarify.

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Interactive comment on Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2017-1216>, 2018.

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