

# ***Interactive comment on “Global Spectroscopic Survey of Cloud Thermodynamic Phase at High Spatial Resolution, 2005–2015” by David R. Thompson et al.***

## **Anonymous Referee #2**

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General comments This paper presents the first global study of cloud phase derived from shortwave infrared (SWIR) reflectance spectra at 30 m spatial sampling and spatial scaling properties of cloud phase. I found this paper interesting. The manuscript has been already revised based on previous reviewers' comments. I have only a few questions and comments. When I am referring page and figure numbers below, I am referring the latest version of revised manuscript (AC3 supplement).

1. Multilayered cloud systems: I found no description on how multilayered cloud systems are detected and handled in this study. In my view, “ice” cloud region shown in Fig. 2 looks like a multilayered cloud system with an optically thin, high cloud above

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an optically thick, low cloud deck. I am not sure on this because I am not an expert of this kind of imagery, but I was wondering why “ice” cloud region is more reflective than “mixed phase” cloud region. Satellite measurements show that multilayered cloud systems are quite common in the tropics and mid-latitude storm track regions. Thermal infrared measurements by AIRS are sensitive to the upper cloud, but the SWIR reflectance from Hyperion should be more sensitive to the lower cloud, depending on the optical thickness of upper cloud. If so, there should be more liquid cloud occurrence in Hyperion’s results than in AIRS, in specific latitude zones. Is this a possible reason for statistically significant Hyperion–AIRS differences in the tropics and mid-latitude storm track regions, as in Figs 7 and 8? The authors just mentioned that distributions from the two instruments generally agreed and the differences were ascribed to sampling error and spectroscopic sensitivity difference. In my opinion, if there is a statistically significant difference, that difference is valuable to be discussed and should be clarified in the manuscript. In that way, this comparison is not just a “sanity check” but more valuable.

2. On the comparison with AIRS: Oceanic and continental averages of cloud phase fraction can be derived from AIRS data. How can the difference between them explain the difference between results from the Hyperion and AIRS? It would be more insightful to compare the Hyperion’s results with AIRS oceanic and continental averages.

Specific comments Page 6, Line 30, “The mixed phase clouds were ... nearly absent from the tropics”: It seems to be not nearly absent.

Page 9, line 15, “thin cloud”: Is this an optically thin, high (or low) cloud?

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