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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Spectral optical layer properties of cirrus from collocated airborne measurements – a feasibility study" *by* F. Finger et al.

Anonymous Referee #1

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Review of Finger et al., ACPD 2015

General comments

The study titled "Spectral optical layer properties of Cirrus from Collocated Airborne Measurements – A Feasibility Study" by F. Finger et al. describes vertically-collocated spectral solar radiation measurements above and below cirrus using a towing sonde attached to a research aircraft. These are the first measurements of this kind for cirrus clouds. From these measurements, cirrus spectral optical layer properties were derived and discussed in detail for one case study. 1D radiative transfer simulations were made using different settings to estimate the influence of ice particle shape, effective radius,

and optical thickness on the cirrus layer properties. Also, the impact of an observed low level cloud on the cirrus layer properties is discussed. The new aspect – vertically collocated aircraft-borne spectral solar radiation measurements above and below cirrus cloud with the help of a towing sonde – should be emphasized more clearly.

Specific comments

Abstract Line 18-21: Clearly, the quantification of effects of a low level cloud on the cirrus layer optical properties depend on the optical thickness/altitude of the low level cloud. – Mention the optical thickness of the low level cloud and say that the found differences in cirrus properties are only true for a low level cloud with these properties. Maybe add how an optically thicker/thinner and geometrically lower/higher low cloud changes the found impact.

p.19047 Line 10ff: cirrus inhomogeneities are described in the motivation – where do you analyze their impact on layer properties?

p.19047 Line 15ff: Here you describe impact of ice crystal size and shape on remote sensing retrievals – make extra paragraph to distinguish from impact of cirrus inhomogeneities.

p.19048 Line 10: If I understand correctly, you are presenting the first collocated spectral radiation measurements above and below cirrus with a towing sonde to derive optical layer properties here? – Highlight here that this is the new contribution of this paper!

p.19049 Line 7ff: Explain why you assure horizontal stabilization of the irradiance sensor mounted on top of the aircraft to measure downwelling irradiances but not of the sensor measuring upward irradiances mounted on the wingpod.

p.19053 Line 8ff: Describe Fig.6 more in detail – strong variations of mean particle diameter are obvious, comment on them, they represent cloud inhomogeneities.

p.19058 Line 1: Explain why you choose this measured particle number size distribu-

tion and not a different one.

p.19058 Line 26: Radiative forcing of Solid Columns and Droxtals is strongest (not lowest!), they exhibit the strongest negative forcing. Be careful in describing your results properly.

p.19060 Line 2: Choosing a water cloud with tau = 45 at 1.5-1.75km comes a bit out of the blue. – Where do you take those values from? A 250m thick water cloud with tau = 45 seems unrealistic.

p.19060 Line 21f: Clarify that the "overestimation of the cooling effect of the cirrus" refers to the single-layer cirrus case. How often do we have conditions of cirrus with underlying clouds? – Quantify. Also comment on if previous studies in which cirrus radiative forcing was estimated paid attention to single-layer only cirrus or if they potentially overestimated the cooling effect by not excluding multi-layer conditions.

Technical corrections

p.19047 Line 24: spaceborne instead of space-borne p.19048 Line 6: explain acronym HELIOS p.19049 Line 9: replace "keep" with "assure" p.19049 Line 9: remove "the" in front of "top" p.19049 Line 12: this wingpod p.19049 Line 16: "rough", not "coarse" p.19049 Line 25: "measurement method" instead of "method"? p.19052 Line 10: Explain why you only analyzed four out of twelve measurement flights and why only results of one flight are presented here. p.19053 Line 5: Not entirely true. Fig5d) shows decrease of diameter below 9.2km. p.19053 Line 9f: What do you mean by "shifted distribution maximum"? – The increase of particle size? Please phrase more cleary. I think in line 10 you mean with decreasing height. p.19053 Line 14: I doubt that "the entire" flight is shown: Minimum altitude is 7.8km. p.19054 Line 7f: Logically, you it is better to mention case I first and case II afterwards. p.19054 Line 10: This sentence about simulations seems a bit out of place - I thought you were explaining the measurements in the text and graphs here? Please adjust/clarify. p.19054 Line 23: "itself" instead of "only" p.19056 Line 3: Rephrase sentence to "The layer properties of this

thin cirrus show only small variations". p.19056 Line 4: Add percentage variation of transmissivity. p.19056 Line 9: "resulting in Rtop variations" instead of "with varying Rtop" p.19057 Line 4: Leave out "see" and brackets p.19057 Line 15: What do you mean by "8 Elements" etc? Clarify. p.19058 Line 15f: rearrange sentence for clarity. p.19058 Line 23f: I assume you again mean with respect to reference case (droxtals). Please mention. p.19060 Line 18: Use "single-layer" instead of undisturbed. p.19061 Line 23f: add ". . .under multi-layer conditions" after factor of 2

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 19045, 2015.