

Interactive comment on “Directional, Horizontal Inhomogeneities of Cloud Optical Thickness Fields Retrieved from Ground-Based and Airborne Spectral Imaging” by Michael Schäfer et al.

Anonymous Referee #1

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The paper uses established analysis techniques to examine inhomogeneity characteristics of two different types of cloud systems at different locations measured by radiometers that were either ground-based or aboard an aircraft. Two aspects of cloud inhomogeneity are examined: inhomogeneity that arises solely by the nature of the PDF of cloud optical thickness, i.e., inhomogeneity from one-point statistics that do not capture the spatial arrangement/coherence of individual cloud elements, and inhomogeneity that depends on the exact nature of the spatial arrangements. The study does not really provide new insights, but rather focuses on the information content of available radiometric cloud measurements and how much diversity exists in the observations (different days for the same general cloud type, different cloud types).

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Comments:

- Lines 46-60. A very incoherent paragraph. Cloud inhomogeneity effects on gridded fluxes are mixed with effects on satellite retrievals. Lines 49-50 talk about retrievals, and the next sentence talks about GCMs. Moreover, the first problem facing GCMs is not the lack horizontal photon transport, but the absence of subgrid variability, i.e., the unavailability of PDFs of cloud condensate for each layer. If such PDFs were available at least IPA calculations would in principle be possible (still no horizontal transport). The dissemination of confusion continues later on. In lines 55-58 the limitations of IPA compared to 3D are followed in lines 58-60 by an irrelevant example of errors found by Shonk and Hogan when comparing PPH and IPA.
- Lines 61-68. Here, cloud overlap is mixed into 3D effects and Monte Carlo discussion. Misleading. You can account for overlap perfectly, but still ignore 3D effects by performing IPA calculations on the perfectly overlapped cloud field.
- Lines 75-77. I'm sure that ECMWF models do not need the two point statistics of cloud structure (as derived by autocorrelation and power spectrum analysis), but some information on the PDF, i.e., the inhomogeneity parameters of section 3 derived from one point statistics, so invoking "spatial features" "below the meter scale" is again inappropriate.
- Lines 141-142: "However, the fact that rho_tau can exceed values of unity and depends on the average value might lead to misinterpretations." Why? I don't see anything wrong with values greater than unity.
- Lines 157-158: It would be simpler to say that chi is the scaling factor with which mean tau needs to be multiplied to approximate the IPA albedo.
- Page 7: One has to be careful when comparing inhomogeneity parameters across publications. First, pixel size matters. Second, and most importantly, the domain size matters. The bigger your reference domain, the wider the PDF, the larger the inhomogeneity.



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geneity. So this is by no means a trivial comparison.

- Lines 188-190. It's not a matter of directional dependence only. It's mostly a matter of spatial coherence of cloud condensate, in other words how the variability is distributed across scales.
- Lines 204-205: Why are negative autocorrelations ambiguous?
- Eq. (5): If the scale length is typically defined as the distance at which the autocorrelation drops to $1/e$, shouldn't the scale length of squared autocorrelation be defined as the distance where it drops to $1/e^2$?
- Lines 255-256: It's not that they are not well-suited, it's that by themselves they provide incomplete information, i.e., not the whole story.
- Power spectrum scale break analysis: Have the authors given any thought on whether the comparisons of scales in terms of physical units (m) makes sense when the pixel sizes are different? With pixel size varying, the extent to which the smoothing is resolved is also different, so I was wondering whether defining the scale lengths in terms of pixel number would bring the results closer together.

Typos and other minor stuff:

- Line 10: "VERtical" instead of "VERical". Also Line 97.

- Lines 120 and 272: I think you wanted to use "fingerprint" rather than "footprint". The term "footprint" in remote sensing indicates the resolution, i.e., pixel size.
- Line 328: "inhomogeneity".
- Line 337: "too small".

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