Review of M. Schäfer, et al. paper "Directional, Horizontal Inhomogeneities of Cloud Optical Thickness Fields Retrieved from Ground-Based and Airborne Spectral Imaging" submitted to ACP

The paper provides a thorough analysis of cloud inhomogeneity. It also provides a fresh look on many approaches developed earlier. It is easy to read and follow. I enjoyed reading it as many other papers by this Leipzig group that I used to follow earlier. The paper definitely deserves to be published in ACP after some revision and I'm sure that it will be well cited.

However, in addition to the comments and suggestions listed below, my main concern with the paper is the lack of a clear statement on what new we were supposed to learn at each step of both (the one-point and the two-points) analyses provided in the paper. What is the main message the authors want us to take home after reading it? I got a feeling that the paper is much more descriptive than conclusive. I'd like to see a list of bullets/statements, at least, in the 'Summary and Conclusion' section.

The list of references is very rich but, as always, is incomplete. I would definitely add two more very relevant papers. The first one is

Davis, A., Marshak, A., Gerber, H., and Wiscombe, W., 1999: Horizontal structure of marine boundary-layer clouds from cm– to km–scales. J. Geophys. Res. 104, 6123-6144.

In this paper the authors discuss the structure of marine stratocumulus clouds down to 4-cm scale using both spectral and structure function analyses. Another paper is

Barker, H.W., B. A.Wielicki, and L. Parker, 1996: A parameterization for computing grid-averaged solar fluxes for inhomogeneous marine boundary layer clouds. Part II: Validation using satellite data. J. Atmos. Sci., 53, 2304–2316.

(May be also the Part 1). This paper, I believe, was the first to use the ratio $\nu=(<\tau>/\sigma_\tau)^2$ to quantify cloud inhomogeneity.

Small-scale break $\xi_{\tau,S}$. I wonder if the small-scale noise can be reduced by averaging over all cases or over all columns (or rows) in one case. Also, please, compare the location of your small-scale breaks with the once reported by Davis et al. (1999). It was not clear for me what could be learned about cloud structure from the reported small-scale breaks. How does your conclusion depend on pixel size and uncertainty in observations? Please summarize.

Large-scale break $\xi_{\tau,L}$. After Fig. 7, I'd recommend to mention that

$$\text{CARRIBA } \xi_{\tau,L} << \text{VERDI } \xi_{\tau,L}$$

especially, for the most homogeneous cases of C-02 and C-03. This is partly because $\xi_{\tau,L}$, as the radiative smoothing scale, is the harmonic mean of the cloud geometrical thickness and the transport mean free path. Both factors are much smaller for

Arctic stratus than for cirrus. I'd also recommend comparing the theoretical values of the radiative smoothing scale with the observed ones, $\xi_{\tau,L}$.

Retrieval of τ. I know that several references on the retrieval processes are given. However, the way τ-field has been retrieved is important for understanding the analysis provided in the paper. The main question is how much the retrieved τ-field is influenced by 3D radiative effects. I'd recommend to briefly describing here the retrieval processes. Another point, I was not convinced that from analyzing the structure of the retrieved cloud optical depth fields for inhomogeneity, one can learn something new compared to the analysis of the measured fields of radiance. I'd recommend, in parallel to, say, Figs. 5 or 6 (or even 7), showing some results of the analysis of energy spectra for the radiance fields.

Decorrelation length ξ_τ. I wonder why did you use 1/e for the squared autocorrelation function rather than $1/e^2$.