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Interactive comment on "CLABAUTAIR: a new algorithm for retrieving three-dimensional cloud structure from airborne microphysical measurements" *by* R. Scheirer and S. Schmidt

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Review on the manuscript ACP : CLABAUTAIR by R. Scheirer and S. Schmidt By J. L. Brenguier

This paper presents a useful technique for the extrapolation in a 3-D space of aircraft measurements taken along 1-D flight legs. The technique is well described and tested against a simulated cloud field with virtual measurements and against real in situ measurements taken during the INSPECTRO campaign. The performance of the technique at reproducing the vertical organisation of a convective system is remarkable.

General comments: The paper is well structured and short. The authors could however significantly improve the manuscript by correcting some assessments that are too optimistic about the performance of the extrapolation technique. They claim twice that "the algorithm generates 3-D cloud fields without any additional assumptions" (Sec. 1, line 24, and Sec. 2, line 5), while the quality of a scientific paper mainly relies on a capability of the authors to carefully examine the limitations of their technique. In fact, the assumptions are listed in the last paragraph of the paper (Sec. 5, line 21-26). I suggest to replace the two sentences in Sec. 1 and 2, by a discussion on the assumptions where it is necessary. The following issues shall be mentioned: - Advection of the cloud field during sampling : What is happening if the cloud system is advected during the measurements ? This does not seem to be a crucial assumption, as long as it is stated, as in the conclusion, that the scheme "supplies a cloud field whose statistical properties match the aircraft measurements", rather than a copy of the original field. One important question though is to test if the performance of the technique at reproducing the vertical organisation of a convective system is affected by advection. - Stationarity of the cloud system during the sampling : What is happening if the statistical properties of the cloud field evolve during the sampling. From this perspective, the validation of the scheme with virtual flight legs is totally unrealistic. A 3 km long leg last about 30 s, plus about 2 to 3 min for the turn. A sampling of 200 legs will therefore last between 8 and 13 hours. Even if a long endurance aircraft was used, cases that are stationary over such a period of time are rare! The validation would be more convincing and useful if the standard deviation was expressed as a function of the number of flight legs, with a focus on realistic numbers, namely of the order of 10, and how it improves at such low numbers, when adding more legs. - Horizontal isotropy : is an important issue that is partially addressed in the comparison of the flight patterns examples in Figure 2. - Vertical stratification : is addressed by assuming the cloud system is sampled with ascending and descending flight legs. Stratus and stratocumulus cloud systems generally show variable cloud base altitudes, that slightly complicate the sampling with an aircraft using altitude above ground as a reference (instead of altitude above cloud base).

Finally, I would remove the word “automatic” in the description of the technique because of the limitations above. The technique can be quite useful, but using it will always require a careful examination of its validity on a case by case basis.

Specific comments

Sec. 1, line 26: the statement that “LES simulations do not necessarily represent real or even realistic cloud fields” is not supported by the literature and should be removed. In fact, numerous published simulations show a score at reproducing the main features of the cloud systems that are as high as the scores of the technique developed here. The difference is rather on the amount of work to get such realistic LES simulations compared to the simple CLABAUTAIR scheme.

Sec. 1, line 9: The statement that “cloud droplets do not follow Poisson statistics” is wrong and shall be removed. Poisson statistics refers to random events, such as droplet counting with a single particle counter. With such a counter, the count of a droplet is always independent from the previous count and the process can be described by Poisson statistics. The droplet concentration is the physical parameter that determines the intensity of the Poisson counting process. If it changes during sampling, the Poisson process is no longer homogeneous and shall be referred to as a generalized Poisson process. The physical process that drives the variations of the droplet concentration has nothing to do with Poisson statistics. It involves convective motions and turbulence.

Sec. 2, line 17: what is a constant cloud ? replace “during which the cloud can be considered constant” by “during which the cloud system is statistically in a steady state”

Interactive comment on Atmos. Chem. Phys. Discuss., 4, 8609, 2004.