

Review of “A preliminary analysis of tropical anvil-cloud dynamics from EarthCARE”

This manuscript explores how two related retrievals of in-cloud vertical velocity from the new EarthCARE satellite vary as a function of the amount of frozen condensate measured by the same satellite, which is used as a proxy for different regions within tropical clouds. Then, they conclude by presenting a simple model of the cloud meso-scale circulation, constrained by the retrievals discussed earlier.

They present a very clear and thorough narrative, providing good discussion of relevant limitations and challenges. The analysis presented offers a useful basis for future work making use of EarthCARE retrievals. Additionally, the estimated cloud meso-scale circulation is an interesting and novel application of the new data product. The scope of this paper is highly relevant for publication in ACP.

It seems, however, that the results presented are highly sensitive to the particle size distribution assumed when deriving particle fall speeds. This is addressed in the manuscript, but mainly in relation to differences between the two retrievals. There are also a few (minor) instances where the clarity of the manuscript can be improved. Therefore, I recommend this paper for publication if the following comments can be addressed.

Specific comments

1. As discussed in section 3.3, the results presented are highly sensitive to the assumed particle size distribution (PSD) when deriving particle fall speeds (w_t). This is nicely demonstrated by the difference between the two JAXA w_t retrievals, but does not provide much context for the robustness of the w_t retrievals more generally. I suggest the following additions:

(a) Presently, the reader is directed to Sato et al (2025) and Nakajima et al (2026) for technical algorithm details for deriving w_t and w_a , but I think the method description would benefit from more detail. Could you specify which observables are used to derive the coincident PSD, what assumptions are made, and how reliable this estimate is assessed to be (including estimates of the modelled PSD uncertainty and any planned or past validation activities of the input or resulting EarthCARE products)?

(b) I would posit that the ESA particle sedimentation velocity product provides a stronger indication of the retrieval uncertainty of the CPR w_t than the CPR-ATLID w_t , as the assumptions used to derive it are different, while between the CPR w_t and ATLID-CPR w_t only the input products, not the retrieval algorithm, differ.

- i. Could you add a small section in which you compare the JAXA (or ESA) w_t and w_a retrievals?

- ii. If this is infeasible, it would be great to detail why this was not done, how you expect the retrievals to differ, and how that might impact your results.

This would be immensely helpful to your audience. The Doppler w_a product is of great scientific interest, but having three different retrievals adds to confusion over its reliability. Context on when, how and why the retrievals differ (as nicely done here for the JAXA products) would offer an excellent basis for future work and its interpretation in our field.

- 2. Along-track composites have the potential to add important detail to analyses such as this paper compared to phase-space diagrams as explored for IWP. But they remain imperfect as they aggregate cloud lifetime, different locations in the cloud shield, both upwind and downwind anvil outflows, and multiple cores of different age. Can you please clarify how you handle multiple IWP “cores” in one track? You state that columns with $IWP > 10^3 \text{ g m}^{-2}$ are excluded, but do you exclude parts of the track that are closer in proximity to another core? (I.e., is it distance from **nearest** core?) It also would be nice to clarify that the composites should not be assumed to represent a typical convective cloud, as by aggregating we get a distorted picture unless more effort is made to control for differences in cloud sampling.

Technical corrections

Title: Should it be “A preliminary analysis of tropical anvil-cloud dynamics [in/using] EarthCARE” (instead of “... from EarthCARE”)?

L4: I don’t think it’s quite right to say they are “... found to represent a smooth transition...” as this wasn’t directly assessed, and smoothness is a result of aggregating.

L14: “high-cloud **amount at any one time** is about...”?

L37: Why define “EC-CPR” if you just use “CPR” later?

L40: This doesn’t parse quite right. I think you mean “EarthCARE not only succeeds CloudSat, offering new temporal sampling, but benefits from enhanced technologies...” or similar

L90: Can you re-write this so that the language is more specific “averaged out” is not clear to me, and this is an important point.

L146: “a striking updraft” Adjectives like “striking” are subjective (also L160 “excellent detectability” what’s excellent about it?), I would reserve these for times when you really want to emphasise a result that is well evidenced (e.g., L175 “remarkably different patterns despite...”).

Figure 2: this is interesting, how does that compare to past estimates of IWP? It might be nice to add a statement about that.

Figure 3: I would make the colour bar identical between b,c and d, as these variables are comparable. Alternatively, I would at least make the colours the same (blue for c as in b and d).

L198-205: It is not clear how these translate to the derived w_t (see comment 1a), please add a sentence linking this section to the introduction of how the PSD is derived from the EarthCARE products.

L289: “ATLID-CPR” you elsewhere use “CPR-ATLID”, perhaps double-check the full text to ensure consistency.