Review of "Aircraft based Stereographic Reconstruction of 3D Cloud Geometry" by Kölling et al.

Summary:

This manuscript presents a new method for reconstructing cloud geometry using multiple nadir pictures from an aircraft. This paper also showcases its first application to 2 field campaigns, and a first verification using an active lidar system.

General Comments:

This manuscript showcases a novel technique of using well known computer vision techniques to reconstruct cloud geometry and is a valuable contribution to science. This referee suggests this paper should be published, following some revisions, see below for the major and minor issues. The overall content of the paper is well formed, but the introduction and concluding sections require multiple typo corrections. The included comparison to lidar is well received, although the choice of a large area of cloud top height comparison should be revisited.

Major issues:

- Verification of the method uses a dubious assumption of cloud homogeneity within 150m of the lidar measurement, refinement should be done, and subsequent conclusions of the lidar representing higher clouds is put into question.
- "cloud surface" has not been defined, yet it underpins this manuscript. Cloud surface is not what the feature selection algorithm is used, but rather cloud surface edges. Clarification should be done.

Minor issues:

- Title of the manuscript is slightly misleading, common wording for this methodology is 'Structure-from-Motion', see Westoboy et al., 2012 (amongst others)
- Point selection algorithm choice has not been described. Some description of these selection points, for finding the corners would be a welcomed addition to this manuscript.
- Figure 3 is nearly useless without a better frame of reference. Please include a frame of reference marker. It may be useful to put and 'x-y-z' axis in Fig. 2, and the rotated version of which in Fig. 3.
- Figure 5 should have a colorbar to denote the color scheme of the cloud height.
- Last paragraph of section 3 describe transformation of a point cloud to cartesian 3D, but does reference the use of the aircraft navigation, or potential sources of errors from it.
- Section 4.2 is using data from a status cloud deck to infer cross track stability of the measurement. Further evidence of the status cloud deck's vertical stability should be presented to reinforce this point. If no other is available, is it possible to use a ground target instead of the cloud to cross track stability? Related remarks in the conclusion should be amended
- Last paragraph of the conclusions should be inserted in the methods as well, and references to the appendix.
- A note on the spectral aberrations (if any) would be useful in the appendix A.

Here are some specific points to be addressed:

- P.1 line 10, typo: “comparson” should be “comparison”
- P.1 line 16, what the authors describe is unclear: “where observed clouds and observer are at different locations,… “
- P. 1 line 21, why is the term “Finally, …” used at the start of the sentence? Flow of the entire paragraph should be reevaluated.
- P. 1 line 25, “by Ewald (2016); Ewald et al. (2018)” should be “by Ewald (2016) and Ewald et al. (2018)”
- P.1 line 26, Unclear grammar to what “it is shown […]” is referencing, Is it “Ewald et al. (2018) showed that […]” ?
- P. 6 caption of figure 2. Unknown symbol of ‘^’ on top of ‘=’, please define or use more widely known character.
- P. 8 line 3, grammatically unsound “because due to the […]”, please rephrase.
- P. 8 line 5, please be more precise in this sentence “these clouds can still be tracked in the presence of sunglint.” - related conclusion remarks should also be ammended
- P. 12 line 3, “active remote sensing in the nadir perspective” seems odd, maybe: “nadir pointing active remote sensing”
- P. 12 line 5, please remove capitalization of “Because”
- P. 12 line 7, typo: “requirment” should be “requirement”
- P. 12 line 20, “in stead” should be “instead”

References:

Westoby, M. J., Brasington, J., Glasser, N. F., Hambrey, M. J. and Reynolds, J. M.: ‘Structure-from-Motion’photogrammetry: A low-cost, effective tool for geoscience applications, Geomorphology, 179, 300–314, doi:10.1016/j.geomorph.2012.08.021, 2012.