

Interactive comment on “Quantifying Hail Size Distributions from the Sky: Application of Drone Aerial Photogrammetry” by J. S. Soderholm et al.

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Referee: Tomeu Rigo Received and published: 11 December 2019

Dear authors, your manuscript presents a novelty in hail size research, taking profit of capabilities of drones and photography treatment techniques. Having in mind the review criteria of the journal, I'm considering that it has an excellent scientific significance and good scientific and presentation qualities. Besides, the paper answers positively to all the questions made in the same web. However, I think that there are some points that you must solve before the acceptance of the paper

Hello Dr Tomeu Rigo, Thank you for the kind words and constructive review! Your feedback is much appreciated.

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Question 1: There are some typos: L1: "HailPixel." (the dot must be placed after the ")
L6 of the page 3: ((Fig. 1a) - remove one (

Reply: After some investigation we have confirmed that the comma is to be placed inside the quotes on L1, page 1 (<https://www.grammarly.com/blog/quotation-marks/>). The additional bracket from L6, page 3 has been removed.

Question 2: I think that your technique can be useful for more aspects that the cited in the text:for instance, for identifying the whole area affected by hail. I understand that your technique can discriminate between hail/non-hail pixels and then, you can delimitate the hail path. In the same way, do you think that this is applicable in real-time? If your answer is positive, explain it in the text, because this could help in many fields, in those areas commonly affected by hail events, such identification of damaged agriculture production or for insurance interests, among others.

Reply: This is a very interesting idea to sample the hail swath extent/coverage rather than the hail size distribution. To sample at the resolution required for retrieving hail size, we had to fly the drone very low to the ground (10m), limiting the sample area to a few hundred meters. To collect aerial imagery that covers a significant portion of a hail swath (or say a farm or suburb), you would probably need to use a fixed wing drone, which provides greater endurance, flight speed and altitude performance than a quadcopter. Real-time extraction of information from the imagery would be more challenging, but not impossible. The authors thank the reviewer for this suggestion but believe this is outside the scope of this paper and expect it will be attempted at some point by hail researchers.

Question 3: When you introduce hail-pads, you forget to mention automatic hail-pads (see, e.g.Martin Löffler-Mang, Dominik Schön, Markus Landry, Characteristics of a new automatic hail recorder, Atmospheric Research, V. 100, Issue 4, 2011, Pp. 439-446, ISSN0169-8095, <https://doi.org/10.1016/j.atmosres.2010.10.026>.)

Reply: The reference to Löffler-Mang 2011 description of an impact disdrometer design

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has been added to L3, p2

Question 4: - In data and approach, please provide numbers (L25 pg 2): which size and density can be considered as thresholds?

Reply: A lower threshold for the hail diameter is now suggested in L33 p2 and p6 L23. Providing an estimate for a maximum concentration threshold is not feasible as it depends on the hail size distribution. The author's suggestion of 30% coverage on p6 L24 should provide sufficient guidance for the concentration limits.

Question 5: - Where is the hail-pad used for the comparison located? You should indicate in a figure.

Reply: The authors believe showing the location of the hail pad and hail survey location on a map would have little value to the article, as the focus is not on the physical setting or spatial variability, but the technique. The exact location of the hail pad has been added in L5 p3, and the location of the aerial survey in L14 p3 for reference.

Question 6: - It results difficult to me understand which is the final size of the pixel, the one you use in fig 2c

Reply: The final pixel size of the orthomosaic has been added to the paper in L24 p3 to clarify the pixel size used in the analysis.

Question 7: - Those parts of the manuscript that are not referring to your work should be moved to the introduction, where the state-of-art is presented: e.g. L 1-5 of page 4, or some previous results used in your discussion.

Reply: Thank you for this suggestion. L1-5 of p4 have been moved to the introduction in p2 L16-20. For the discussion, the citations to other work are an essential part of this section and the author feels that duplicating or moving these citations in the introduction wouldn't add much value for the reader.

Question 8: - León is not placed in France (L18 Page 5)

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Reply: Thank you, this has been corrected to Spain :)

Question 9: - I think that you could do an effort and give more applicabilities to your research, such the cited previously in my repport, including some references about this point Botzen,W. J. W., Bouwer, L. M., & Van den Bergh, J. C. J. M. (2010). Climate change and hailstorm damage: Empirical evidence and implications for agriculture and insurance. *Resource and Energy Economics*, 32(3), 341-362. Changnon, S. A., Changnon, D.,Fosse, E. R., Hoganson, D. C., Roth Sr, R. J., & Totsch, J. M. (1997). Effects of recent weather extremes on the insurance industry: major implications for the atmospheric sciences. *Bulletin of the American Meteorological Society*, 78(3), 425-436. Sánchez,J. L., Fraile, R., De La Madrid, J. L., De La Fuente, M. T., Rodríguez, P., & Castro,A. (1996). Crop damage: The hail size factor. *Journal of Applied Meteorology*, 35(9),1535-1541. Hohl, R., Schiesser, H. H., & Aller, D. (2002). Hailfall: the relationship between radar-derived hail kinetic energy and hail damage to buildings. *Atmospheric Research*, 63(3-4), 177-207.)

Reply: Thank you for this suggestion. An additional sentence has been added to the introduction to highlight the application of improving hail size distribution knowledge. Citations to Changnon et al. 1997, Sanchez et al. 1996 and Hohl et al. 2002 has been added to support this. P1 L15-17.

Question 10: - In my opinion, you need to separate more clearly the part of your work from other previous techniques, and, besides, to present, maybe in a table, the technical characteristics of the analysed imagery

Reply: Thank you for making this point. Two additional sentences have been added to the summary to highlight that this technique provides a significantly larger hailstone sample size that leads to more robust statistics (p7 L7-9). These sentences include the sample area and sample size of the analysed imagery.

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