

Interactive comment on “Terrain changes from images acquired on opportunistic flights by SFM photogrammetry” by Luc Girod et al.

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Hello and thank you for you comments and questions.

For your first remark, the notion of "remote glaciers" is indeed not related to our specific test survey, as Midtre Lovénbreen is indeed easily reachable by foot from Ny Ålesund (I have made the walk myself). The flights we hitchhiked on were however bound to Kronebreen, a glacier much harder to reach in the summer, especially away from its front, and the flight path goes somehow over Midtre Lovénbreen. The notion of remote glaciers infers that our method may be applied for the mass balance of other glaciers around the world where helicopters are required to reach areas nearby. Then one can simply place a camera during travel along with a simple hiking GPS to acquire decent DEMs for glaciological purposes.

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The procedure used to generate Fig3 is indeed based on sweeping the time offsets, first roughly (1s steps), then at a higher resolution (0.1s steps). Used as an error indicator is the fitting error between the position of each point in the time fitted GPS data and the final estimated camera position, as seen in Fig 7. The GPS data itself is a spline interpolation on the GPS logged positions (1Hz). The possibility to use "mm3d OriConvert" and "mm3d CenterBascule" as described in section 13.3.4.2 of the MicMac documentation to estimate the GPS delay was not available when the processing of this data was done, and would in any case not be the appropriate way to deal with the issue presented here, as it assumes a constant GPS delay, not an insufficient precision in the camera EXIF time tag. The final resolution of the DEMs are guided by the somehow low quality of the imagery, and the loss of correlation at full resolution, especially because of the snowy condition for the 2014 data (the actual mean GSD is about 0.56m in 2014 and 0.45m in 2015). To maximise the overlap in case of a higher flight speed/lower flight height, the images were captured in "wide" mode with the full resolution of the sensor of the GoPro H3+BE (4000*3000px). The overlap proved to be enough, and the distortion/variation in view angle at the edge of the images more a problem than a source of data, the images were cropped. Using another capture mode may have helped with the memory overflow (it was not tested), but no "central square" option is available ("Ultra Wide, Medium" is 7MP 3000 x 2250).

On the "sequel" comment: To be able to use our method, the flight path indeed needs to be non-linear. I would expect that if a pilot agrees to have a camera attached to their aircraft, they could also agree to perform some sort of turn (even a relatively small zigzag would be enough) during the acquisition. I am afraid that our method is not quite good enough for reliable "out of the window of an airliner" photogrammetry, an endeavor I would in any case not recommend due to the distortion caused by airplane windows (usually not so flat, and not so clean), and the very off-nadir view angle usually achievable (even if this can be dealt with).

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