

## ***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 your numerous comments and corrections.

The method presented here is indeed inspired and built upon the work made in "Cameras as clocks", and we absolutely agree that this should be more obvious in the text. The main improvement is indeed the ability of our variation to deal with unreliable time stamps and unstable lapse times.

You raise the question of sub-second time reporting in camera through the <SubSecTimeOriginal> EXIF tag, and this is a valid point. However, this tag is not standard and absent on most low end camera (including the GoPro used in our test) that I would be willing to strap with a makeshift attachment to an aircraft. This tag is also, when present, of arguable precision and accuracy, even on costly apparatus, as you have

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shown on Fig 2 of "Cameras as clocks". The potential use of that tag will be mentioned in the revised version of the paper.

Concerning the IceCam, a thorough description of the system and data quality is out of the scope of this paper and was discussed in the cited (Divine et al., 2016) paper.

Concerning the reliance on on-scene calibration: GoPros (and most cameras) are not thermally stable in their calibration, and the vibration of the aircraft is probably also affecting the stability of the lens. "Lab" calibration of the camera was attempted but did not improve the quality of the model.

About the main in line comments in the supplementary file: -page 2 line 25 : external intervalometer are indeed available, but requiring them in our method makes it harder to put in action (Can we expect people to have one in there pockets? How to safely and reliably attach it to the aircraft and to the camera?). Some modern cameras also have wireless connectivity and a smartphone may be able to act as an intervalometer, but this is not yet generalized (and in our very specific case, impossible to use because Ny Ålesund is a radio silent area). -page 4 line 11: the cameras were pointed at a 60hz computer screen displaying a clock with 0.01s precision. While hardly a scientific instrument, this is reliable enough for our purpose. -page 5 line 1: because the exif time tag is only precise to a second, it may be off to up to 0.99...s, equivalent to tens of meters of travel. We therefore need to overpass the simple read of the exif tag. The equation for just reading the exif ( "Time(i)=TimeEXIF(i)" ) could be displayed here but is not of great interest. As detailed further, the first equation is not good enough to work out the "real" times. -page 5 line 20: agreed, it will be made more obvious. -page 8 line 9: given the appearance of the terrain, it is not always easy to manually notice sub pixel motion blur. In any case, the effects were not noticeable. -page 9 fig 6 : A close-up picture of the GoPro attached to the cargo hook will replace the product shot (see attached figure). -page 10 line 1 : this is a typo, the z-axis (nadir) is of course the axis in question. -page 10 fig 7: the bumps are the four large ones in the blue line (z-axis), text will be made clearer. -page 14 line 5: we mean bias, since we believe is it

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most likely from the submergence/emergence of the glacier, not captured by the in-situ mass balance stake measurements.

The smaller grammatical, syntactic and figure design comments will be taken into account.

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Interactive comment on The Cryosphere Discuss., doi:10.5194/tc-2016-228, 2016.

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**Fig. 1.** New hardware image showing the GoPro in situation

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