The Cryosphere Discuss.,
doi:10.5194/tc-2016-228-RC1, 2016

The Cryosphere Discussions
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EGU

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

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Received and published: 4 December 2016

This paper outlines a study in which a pair of detailed and relatively accurate digital elevation models are produced and georeferenced with cheaply-acquired photographs and surveyed camera positions. Given the proliferation of consumer-grade digital cameras and handheld GPS devices, and the power and versatility of modern computer vision algorithms, I believe this is an important research direction for the study of landscape change.

However, the method presented is not novel, as the authors claim: "The novelty in our method is the ability to link GNSS data to images without a physical or electronic link." (Abstract)

In fact, it very closely resembles the method we used in Welty et al. 2013 "Cameras as

clocks", Section 5.1. (https://www.igsoc.org/journal/59/214/j12J126.pdf) We took pictures from an airborne platform using a consumer-grade digital camera, collected GPS positions with a handheld receiver, used SfM algorithms to compute the relative scene and camera geometry, calculated the time offset between the GPS clock display and the image capture times recorded by the camera (and the offset between the GPS clock display and a calibrated reference clock display), used the calculated time offset to interpolate camera positions using the image capture times and the GPS tracklog, and georeferenced the scene using the best-fitting 7-parameter transformation between the relative SfM camera positions and interpolated world camera positions. We repeated the last steps for a range of time offsets – calculating the camera position errors and DEM elevation errors (using a same-day conventional reference DEM) as validations of the time offset we had estimated.

The only deviation from our method that I can identify is that you fitted piecewise-linear lapse times to the embedded image capture times rather than use the embedded capture times as reported by the camera. This is a clever solution for a camera set to time lapse mode if the camera only reports capture time to 1-second precision. Although you don't actually specify if this was the case for the GoPro you used – is the SubSecTimeOriginal EXIF field blank? – Figure 2 suggests this is the case. So I would strongly recommend stressing and expanding on this specific, novel aspect of the method and otherwise placing your work in the context of what has already been done.

The IceCam may provide an other opportunity to build on previous work. The Canon 5D Mark II cameras it uses are consumer-grade (albeit more costly than the GoPro) and thus it would be very instructive, as a comparison to using an independent GPS tracklog, to describe in detail how its GPS system is linked to image capture by the cameras for robust camera positions.

Finally, I'm curious why you chose to rely on scene-based calibration instead of calibrating the single camera in "the lab" using a known scene geometry (typically, a checker-

board pattern) and freely available software? This would reduce the number of free parameters in the SfM bundle adjustment.

I'm not familiar with the study region, and the research being undertaken there, to speak to the significance of the results.

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The attached pdf includes many smaller comments, questions for clarification, and suggested edits. The annotations were made in Adobe Acrobat X v10.1.16. If they are not readable, I can try to provide them in another format.

Please also note the supplement to this comment:
http://www.the-cryosphere-discuss.net/tc-2016-228/tc-2016-228-RC1-supplement.pdf

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