

Interactive comment on “Monitoring Tropical Debris Covered Glacier Dynamics from High Resolution Unmanned Aerial Vehicle Photogrammetry, Cordillera Blanca, Peru” by Oliver Wigmore and Bryan Mark

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Wigmore and Mark (2017) provide a detailed review of the methodology employed using a UAV for repeated mapping of the debris tongue of Llaca Glacier, Peru. The emphasis is on the methodology and I found this to be comprehensive and comprehensible. The level of detail provided by the UAV photogrammetry generated detailed maps of velocity and surface elevation change indicating the value of the approach. There is less emphasis on detailed review of the results. More attention should be given to the speed of supraglacial lake expansion and the volume of water they contain

C1

in Section 5.4, as this is both important but also another measure of the utility of the UAV. In Section 5.2 additional discussion of any ablation rates that could be derived in areas of low velocity such as the right panels in Figure 10 such as a zone mean would be useful. Below are specific comments, which are generally minor.

2-14: Differentiate Cordillera Blanca from Himalaya ie. The Himalayan glaciers are in a warmer/wetter environment.

3-10: Is this paragraph needed? Full glacier mass balance is discussed, but this study is not completing full glacier mass balance.

4-5: To improve the utility of one factor.

4-30: Remove this sentence since you have sufficient references without and there are so many videographers uses of UAV's ... "At higher elevations M. Willis (pers. com.) and S. Wernke (pers. com.) have had success using multicopter and fixed wing platforms for archaeological mapping in the Ecuadorian and Peruvian Andes respectively, at altitudes of up to 4000m. . .

5-26: Reference a specific glacier such as Vallunaraju which shares a divide and terminates at ~4750 m.

6-6: The lake cannot be classified as directly above Huez which is over 12 km from the glacier. The drainage channel also enters the Rio Santa downstream of the main city of Huez in the northern reaches of the city.

10-11: How does the ice loss compare to net annual ablation in this area? If unknown report that.

10-20: Any temperature records from near this portion of the glacier during melt season?

10-28: Any observation on melt pond albedo or water temperature. The overall water temperature statement is not applicable if the surface pond is connected to surface

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streams that lead to rapid turnover.

10:28: You note the change in position of cliffs and melt rates of such features. What about the rate of melt pond expansion? This is commented upon and would be important to note.

11-27: What about the impact of surface slope on the velocity gradient, there is close to twice the slope in the upper study area, as in the lower area of the study?

11-32: There is sufficient melt for lubrication of any of the lower reaches of these glaciers during the melt season. In this case there is likely partial flotation of the lower section of the glacier, which is less lubrication than having a drainage system that is full and hence higher basal water pressure.

12-23: Likely lake volume range?

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