

Interactive comment on “The Impact of Climate on Surging at Donjek Glacier, Yukon, Canada” by William Kochtitzky et al.

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This comment is focused primarily on section 4.3. I commend the authors for using a combination of ice core accumulation records, transient snowline observations and ice surface elevation change to examine the relationship between mass balance, climate variables and surge cycle. These are independent observations of surface mass balance and consequent transmission downglacier. The snowline section can provide more context and a stronger record that ties into the declining mass balance and reduced surge volume.

344: Suggested clarification and supporting references. . . . Transient snowline should be used instead of simply snowline. “Our remote sensing analysis illustrates that the

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summer transient snowline (TSL) in the center flow unit of Donjek Glacier has migrated up-glacier by 55 m yr⁻¹ horizontally and risen by ~1.0 m yr⁻¹ in elevation over the period 1951 to 2017 (Figures 6 and 7a). The increase in TSL elevation during this period has been observed on other glaciers in the region including Brady Glacier and Taku Glacier (Pelto et al, 2013a and 2013b). Over the study period the TSL was lowest in 1977 (Figure 7a), with an accumulation area of 337.3 km² and an Accumulation Area Ratio (AAR) of 75.3%. The TSL reached its highest average elevation of ~2550 m a.s.l. in 2017, corresponding to an AAR of 68.4%. The higher TSL is indicative of a reduced surface mass balance.”

349 The following statement needs supporting details to illustrate how Donjek Glacier is different based on the observation dates when the maximum TSL is achieved and if there is any trend in the timing of the TSL or any migration rate observations available, that would support the statement below.

“Even though some TSL measurements were made early in the ablation season, we do not find our TSL measurements to be biased by timing of the observation, as TSL elevations in the late melt season were not consistently different from those early in the melt season (Figure 7a).”

Suggested considerations: Define early melt season versus late melt season. Has there been a shift in the timing of TSL maximum? Is there a migration rate that can be identified for July and for August?

The TSL does migrate upward through the summer on many Alaskan glaciers. The migration rate has been observed Brady and Taku Glacier for the July-September period. On Taku Glacier “Mean rise of the TSL for 16 periods averages 3.7 md⁻¹ during the July–September period, for the elevation range between 750–1100 m” (Pelto et al 2013a). On Brady Glacier the TSL migration rate is 3.6 md⁻¹, the snowline has also risen 145 m (Pelto et al 2013b). The elevation range observed for this migration has been from 900-1300 m. The elevations are much higher on Donjek Glacier which also

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has a less temperate climate. The result is the maximum TSL elevation is achieved earlier in the year, this does need to be better established. The earlier maximum is evident in 2015 the TSL reaches a maximum on July 25 and is lower by Aug. 3 after a summer snow event. In 2017 the TSL is above 2500 m by late July and shifts little up to Aug. 15 as noted by the authors, but is lower by 8/24 after a late summer snow event. In 2018 the snowline again reaches +2500 m by Aug. 1 and by Aug. 11 is again lowered by a late summer snow event. This implies there is a limited TSL migration rate after late July.

539: It is noted that the timing of surge events has been consistent, but the size has continued to decline. Should it be added that “This decline in surge volume coincides with a rising snowline indicative of reduced mass balance.” The reduced mass balance is evident regionally Das et al (2014) and Larsen et al (2015) as well as on Donjek Glacier. This could be observed at 465 too.

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