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Earth System Science Data Discussions

Interactive comment on "Long-term records of glacier surface velocities in the Ötztal Alps (Austria)" *by* Martin Stocker-Waldhuber et al.

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Stocker-Waldhuber et al (2019) provide the context for a rare long term glacier velocity record in the Ötztal Alps. Because mass balance records exist on some of the glaciers for significant periods it is evident that velocity change is useful for identifying responses to climate caused mass balance change. This type of record is an important data set to report. The specific comments below are focused primarily on clarity. I encourage more scrutiny of the stone line velocity error assessment on HEF. Also the 1919 velocity on HEF is that plausible?

2-6: "...and estimates of the state of regional glacier inventories are needed, glacier flow velocities which can be derived from remote sensing data are an important pa-

rameter that provides essential information on dynamic response, which is part of the mass balance evolution of a glacier."

2-21: Replace "but" with "that"

2-31: provide a descriptive sentence on KWF similar to that for GPF, the main glacier rests on a wide but hilly plateau and the tongue descends through a narrow valley.

3-10: provide a descriptive sentence on TSF similar to that for GPF.

3-30: What is the size range of the stones?

4-11: . . . calculated to the lower end of the stake, its base point."

4-24: define better what is "lower cm-level" 5-10 cm?

5-17: The error assessment on HEF should be better stated. That 5% is used is okay, what is this in terms of cm per year for the most rapid areas of motion? I do wonder if the 5% is realistic for stone slippage, or too large at areas of rapid motion, slippage should not be that different based on velocity alone for example stone slippage in 1980 at 5 m per year is much different than for the 1920's maximum of 120 m, yet the stone slippage mechanism should have changed little.

5-24: Is this maximum velocity for a point or a line?

5-25: The increase in velocity implies a major mass balance change, based on other observed and reported changes in this record, and would suggest more than a minor advance would occur. Here or in the discussion could you identify why the terminus change or mass balance changes was not as significant as the velocity change would imply. What was the velocity in 1918 and 1920? If the change to 1919 is really large is that acceleration plausible or the ensuing deceleration?

6-8: The two following sentences conflate actual velocity and temporal velocity change. Be consistent in reporting the difference in the second sentence. "The surface velocity of the glacier increased, but with decreasing magnitudes from the terminus (L10) to

the uppermost stake (L1) within the accumulation area. This means an increased velocity gradient along the glacier, with maximum of about 90 m per year at the terminus declining to a few metres per year at the highest elevations."

6-14: Worth commenting on the velocity response in Figure 4 where terminus velocity response was large simply to declining positive mass balance after 1978, and a significant change in velocity near the ELA at L6 did not occur until negative mass balances occurred around 1985.

6-16: Reference for the higher ELA, should provide a quantity for this shift as well.

6-21: There is an insignificant velocity decline through time on TSF (54-56) which is contrast to the other glaciers, why?

6-26: ". . . with a larger decline in velocity at the upper profile (71-75) than at the terminus."

7-22: To identify state is it not the deviations in velocity that identify changes in state, simply the actual velocity measurements at a moment in time would not be useful in determining the state of an unknown glacier " This means that changes in observed velocity, especially at ablation stakes. . .. . ."

7-32: The conclusion of peak in velocity in the summer deserves closer definition and referencing. Most alpine glaciers have a velocity peak sometime early-mid summer as the drainage network matures, and a decline late in summer. The extent to which any of these four differ from this is important to note. Given the annual data for HEF and KWF is may only be GPF and TSF where such comment can be made.

8-5: The rapid response in terms of velocity is documented in studies that look at terminus response time of glaciers which lag both velocity and mass balance. There is useful response time data for the Alps that can be cited here ie. Huss (2012). This would enhance the value of the statement and the methods applied here.

8-5: The following statement is incomplete and not accurate, please modify. In fact

ELA is sometime above the summits, surface mass balance observations still provide an accurate measure. The date that the transient snow line goes above the glacier is also a measure that provides value. "As conventional parameters like ELA tend to be above summit for the investigated glaciers under current conditions and specific mass balance is affected by rapid changes in area."

Figure 4-6: Each of these figures have numerous time series that simply are hard to distinguish with gray scale lines. A color scheme is recommended which can be based on zone of the glacier as well.

Huss, M.: Extrapolating glacier mass balance to the mountain-range scale: the European Alps 1900–2100, The Cryosphere, 6, 713– 727, doi:10.5194/tc-6-713-2012, 2012

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