

Earth Surf. Dynam. Discuss., author comment AC3
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Reply on RC2

Stefan Hergarten

Author comment on "Modeling glacial and fluvial landform evolution at large scales using a stream-power approach" by Stefan Hergarten, Earth Surf. Dynam. Discuss.,
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Dear Marc Jaffrey,

thanks for your comments! You speak a lot about "an extensive body of literature", "known glacier dynamics", and "the glaciology community". Unfortunately, it is difficult for me to recognize what you refer to. I tried to find out from your own work in this field, but only found a conference poster about basin-wide glacial erosion rates. Although I like the concept proposed there, I could not find out where the fundamentals of my work basically differ from what you assume, and I also cannot see how the concept of a mass balance differs as you claim.

Let me just comment on your point highlighted by boldface line numbers :

"60-65: This is false. The author makes a critical assumptions here defining the model presented which is a critical misunderstanding of glacier dynamics and the Shallow Ice-sheet approximation. The ratio of the depth averaged velocity and sliding velocity is categorically not controlled by ice thickness, not even a second order control. Sliding velocity is a complex issue which from a dynamic's perspective, the principal first order controls are effective water pressure, bed temperature, bed roughness and a host of other bed parameters and processes. From a mathematical and numerical simulation perspective sliding velocity is treated independently with a sliding law, a Robin type boundary condition, which is typically defined in terms of the aforementioned bed processes, not ice thickness. The author seems to be unaware of glacier dynamics. Since the assumptions in 60-65 are crucial to the theoretical underpinning of the model the rest of the work, regardless of the care taken with the numerical simulation, is unfounded."

This is just what is typically assumed for the sliding and deformation velocities (not "depth averaged velocity" as you state). I agree that the factors of proportionality in Eqs. (4) and (5) depend on what you mention, but nevertheless the (quite old) model ICE-CASCADE and to some extent also the state-of-the-art model iSOSIA use these relations. They are also used in more theoretical considerations, e.g., Prasicsek et al. (2018), doi 10.1029/2017JF004559 and Deal & Prasicsek (2021) doi 10.1029/2020GL089263. You are free not to like this approach and propose alternative concepts. In general, however, I would find it more useful to bring your own ideas to the scientific audience than just tearing down other researchers' work on a keyword level.

Best regards,
Stefan Hergarten