The Cryosphere Discussions

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Reply on RC1

James Dillon and Kevin Hammonds

Author comment on "Brief Communication: Initializing RAMMS with High Resolution LiDAR Data for Avalanche Simulations" by James Dillon and Kevin Hammonds, The Cryosphere Discuss., https://doi.org/10.5194/tc-2020-368-AC1, 2021

The authors would like to sincerely thank Anonymous Referee #1 for their thoughtful comments and careful review of our manuscript.

Regarding the first point of concern, we agree that processes such as snow erosion and entrainment can significantly alter the sliding surface topography within the track of the avalanche, as has been shown with in situ and remote measurements from previous avalanche dynamics studies (Sovilla and Bartelt, 2002, Sovilla et al. 2006, and others). However, evaluating how well RAMMS-Operational or -Extended handle the mechanisms of snow entrainment is not within the scope of our study. Rather, our focus is on demonstrating how the incorporation of high spatial and temporal resolution model inputs can better represent the initial conditions of the sliding surface, as well as variable snow depth and vegetation distribution. A snow surface in the track and runout zone – the initial conditions of the sliding surface at the time of avalanche onset - is often quite different topographically from the ground surface beneath due to variable snow accumulation and redistribution. We intuitively note that a better representation of those initial conditions is useful and a relevant consideration given RAMMS' sensitivity to such inputs. This is in support of previous work (Buhler et al. 2011), where higher-spatial resolution DEMs were suggested, as it was noted that coarser resolution DEMs failed to represent complex topography in release zones and avalanche tracks. That said, because this article is only a brief presentation of a novel initialization methodology and subsequent sensitivity analysis, you are correct in that we are not able to conclude at this time that initializing RAMMS with high resolution LiDAR data significantly improves its results in an operational setting. In order to study this, several back-calculations of well-documented avalanches would be required. We will make this clear in our revised manuscript.

With regards the second point of concern, in our inability to observe the full runout extent of the avalanche, we agree that this is an unfortunate byproduct of our study site and scanning location. In future work, we suggest the utilization of an observable runout area for relevant avalanche sizes when selecting sites and scanning locations. However, because of the consistent manner in which friction coefficient values were increased equally across all of our simulations, we maintain that any difference in runout extent between simulations is due to the outlined variability of model inputs and/or the influence of those inputs on the spatial distribution of friction coefficient values in our study area. Thus, we found this to be a reasonable, although perhaps not ideal, solution for the incorporation of runout extent into our sensitivity analysis.