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The Cryosphere Discussions

Interactive comment on "Tremor during ice stream stick-slip" *by* B. P. Lipovsky and E. M. Dunham

Anonymous Referee #2

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The work by Lipovsky and Dunham represents the application of solid-earth theory to better understand glacially generated seismic tremor on the Whillans Ice Stream. They show that by measuring the characteristics of seismic waveforms, inferences can be made about the nature of the ice-bed interface, in particular, the effective normal pressure. In general, the paper is well written and robust, providing an interesting new way to study the subglacial environment.

While paper presents a series of equations that are used to produce numerical simulations of ice stream tremor, I feel the main success is distillation of these equations into several analytical relationships, as a result, while impressive, the simulations (figure 3) are almost superfluous. In particular, the main insights of the paper originate from equation 21 that relates tremor amplitude to bed shear modulus. My main suggestion is that the influence of parameter choices on range of viable effective pressures (figure 6) could have been better characterized.

Below I make several comments that I think will improve the clarity of the presentation.

Comments: Page 5256 Line 1: "Low" is a relative term, can the authors provide a reference for comparison.

Page 5256 Line 25: Only low-tide events are skipped

Page 5257 Line 8: I'm not sure the phrase "nearly every event" is useful, can the authors be more exact?

Page 5258 Line 27: Provide a brief statement comparing to WIS ice-stream scale stick-slip where it has been shown double wait time events have been shown to slip further.

Page 5259 Line 19: Provide reference

Page 5260 Line 6: I think there should be some statement here such as "...assuming all motion occurs during stick-slip events".

Page 5261 Line 1: "...Q for ice..."

Page 5261 Line 6: Why 315 for Q when above you say the range is 400-1000?

Page 5263 Line 4: Provide a reference.

Page 5263 Line 10: Or for a constant rupture velocity seismic amplitudes are only dependent on slip.

Page 5265 Section 5.2: There should be a reference here on rate-state friction, perhaps to a Dieterich paper?

Pager 5265 Line: Equation 18. To avoid confusion, should mu be used instead of f for friction since f is already used in equation 3?

Page 5268 Last Paragraph. This section should be expanded to explain in more detail to discuss to relationship between G and density and shear-wave speed, since there is not a unique relationship between the two.

Page 5269 Section 6.3: I think more extensive discussion of parameters and their influence on effective pressure is required. Figure 6 is for just one set of values, how much can this line change given “reasonable” values?

Page 5270 Section 6.4: Should this section come before 6.3 since it is needed in the estimates of effective pressure (equation 19)?

Page 5270 equation 24: As in section 6.3, provide a range of estimate for L assuming reasonable parameter values.

Page 5271 Section 7. In my opinion, this section could be left out of the paper since it doesn’t attempt to explore a larger dataset. While the observation of variation in G with wait time is intriguing, the double wait time events on 1-19 and 1-26 show no such behavior as the double wait-time event on 1-14.

Line 5271 Line 3: “. . ...they have similar average slip per event. . .”

Line 5271 Line 14: I think 14 MPa and 18 MPa are reversed.

Figures and Tables: Table1: What is the bed shear wave speed?

Figure 1: The stations need to be labeled!

Figure 4: This is the fundamental not interevent frequency.

Figure 4 & 5: Would these figures be better combined with a 5 panels in one column? This would make it easier to directly compare the different panels.

Interactive comment on The Cryosphere Discuss., 9, 5253, 2015.