The Cryosphere Discuss., 9, C2592–C2597, 2015
www.the-cryosphere-discuss.net/9/C2592/2015/

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

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Received and published: 24 December 2015

1 Main comments

Two comments from the reviewer prompted us to substantially clarify several aspects the Whillans Ice Plain tremor episodes. The first point, mentioned in two related comments, concerns the range of expected parameter values:

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

This comment prompted us to make several changes:

- All parameters are now calculated in time series and shown in Figure 5.
- We have made histograms of all inferred and observed parameters to show their variability. These are shown in Figures 4 and 5.
- In calculating the full temporal evolution of effective pressure, we found that our previous estimate of effective pressure was too large by a factor of 3 to 10.
- We have also added additional discussion in Section 6.3 that clearly describes how we arrive at a range of possible bed shear wave speeds.

The second major criticism addressed Section 7, which concerns the variation of seismic particle velocity amplitudes between single- and double-wait time events:

> *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.*

This criticism motivated several changes:

- We revisited the data and established a more firm observational basis for the attributes of double wait time events. The result is found in updates to Figure 4, and Figure 5, which now show histograms of the inferred and observed parameters.
- We have included discussion of the statistical significance of differences between double and single wait time events. We find that there is a statistically significant difference in tremor episode seismic particle velocity amplitudes and that this difference is not significantly related to inferred slip per event.

- We have re-written the beginning of Section 7 to more be more concise.

2 Other comments

1. *Page 5256 Line 1: "Low" is a relative term, can the authors provide a reference for comparison.*
   We have changed the wording of this paragraph.

2. *Page 5256 Line 25: Only low-tide events are skipped*
   We have rephrased this paragraph and included this point.

3. *Page 5257 Line 8: I'm not sure the phrase "nearly every event" is useful, can the authors be more exact?*
   We have clarified this language.

4. *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.*
   We have added an appropriate reference to clarify this point.

5. *Page 5259 Line 19: Provide reference*
   We have added referred the reader to a later section where this phenomenon is discussed in greater detail.

6. *Page 5260 Line 6: I think there should be some statement here such as "...assuming all motion occurs during stick-slip events".*
   We have added these exact words to the manuscript.

7. *Page 5261 Line 1: "...Q for ice..."*
   We have added these exact words to the manuscript.

8. *Page 5261 Line 6: Why 315 for Q when above you say the range is 400-1000?*
   The idea is that $Q = 315$ is the value at which attenuation would become important. We have clarified this point.

9. *Page 5263 Line 4: Provide a reference.*
   We have added an appropriate reference.

10. *Page 5263 Line 10: Or for a constant rupture velocity seismic amplitudes are only dependent on slip.*
    We have updated the text.

11. *Page 5265 Section 5.2: There should be a reference here on rate-state friction, perhaps to a Dieterich paper?*
    We have added a reference before Eq. (17).

12. *Pager 5265 Line: Equation 18. To avoid confusion, should μ be used instead of f for friction since f is already used in equation 3?*
    We agree and have made this change.

13. *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.*
We have expanded this paragraph with more detail describing how the range of bed shear wave speeds was derived.

14. *Page 5270 Section 6.4: Should this section come before 6.3 since it is needed in the estimates of effective pressure (equation 19)?*
We prefer to keep the current ordering because most readers will be more familiar with effective pressure than state evolution distance.

15. *Line 5271 Line 3: "...they have similar average slip per event..."*
We have added these exact words to the manuscript.

16. *Line 5271 Line 14: I think 14 MPa and 18 MPa are reversed.*
Yes, these were reversed and we have made the appropriate correction.

3 Figures and Tables

1. *Table1: What is the bed shear wave speed?*
We have not included G_b in this table because it is estimated and not held fixed.

2. *Figure 1: The stations need to be labeled!*
We have labeled station BB09 since it is the only station from which we plot seismic data. We feel that labeling all other stations in the figure would not

significantly enhance the figure in the context of the manuscript.

3. *Figure 4: This is the fundamental not interevent frequency.*
We have changed this language for consistency, although we note that the fundamental frequency generally has the interpretation as the interevent frequency.

4. *Figure 4 and 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.*
We have substantially altered the layout of these two figures.

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