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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1   Main comments

The paper is clearly written and most parts can be followed even by those readers, who do not have a background in stick-slip dynamics. To my mind, the paper is near publication quality. Most of my comments are minor as specified below. The main point of criticism concerns a better presentation of the model. Although the spring-sliderblock-cartoon is more than familiar to most people, it will still provide clarification in the current paper if the different elements (e.g. pulling velocity, spring) are labeled according to the Whillans Ice Stream scenario (e.g. GPS velocity, elastic moduli). Since the Whillans stick-slip motion is such peculiar phenomenon, presenting the

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*model this way would help the reader better grasp the essence of the pro-
cesses, which the authors model.*

Good idea. We have added a spring-slider schematic to Figure 2.

2 Specific Comments

1. *At several instances throughout the paper, the authors mention the state evolu-
   tion distance L. Although this quantity is formally defined on Lines 19-20, what
   makes it so important? What would be the implications of higher/lower values of
   L?*
   We have added a discussion of these issues to Section 5.2.

2. *Page 5257, Lines 1-5: It may help the reader to know from the beginning that the
   signals of a single tremor stick-slip source are never observed on more than one
   station.*
   We agree that this is an important point. In trying to rewrite this section, we found
   it difficult to explain that the signal is not observed on multiple stations before
   having described the actual signal first. For this reason we have not made this
   statement in the mentioned paragraph (Page 5257, Lines 1-5).

3. *Page 5258, Lines 9-10: "Recursion halts when the time between peaks in the
   remaining time series approaches 10 s." is not clear to me.*
   Because of noise in the data, simply using all peaks results in an under-estimate
   of amplitudes. To avoid this, we make a vector of peaks, and then calculate a
   second vector by applying the peak finder to this vector of peaks. This is done
   repeatedly until the spacing between peaks is about 10s. We have modified the

text to reflect this point.

4. *Page 5259, Lines 14-15: "This loading occurs within the ice column which causes most motion during large-scale slip events to occur in the ice rather than in the earth." This seems to contradict Figure 2 suggesting that the till side is the more compliant material on the bimaterial stick-slip fault planes.*
The net motion after many seismic cycles consists of a translation of the ice, with no net motion of the till.

5. *Page 5263, last line: A references seems necessary here.*
We have added an appropriate reference.

6. *Page 5264: If I understand correctly, then the definition in Equation 16 is motivated from Equation 14. It would help to comment on this.*
Yes, Eq.(16) is motivated from (14). We have commented on this in the manuscript.

7. *Page 5265: Why is there no reference for Equations 17 and 18?*
We have added an appropriate reference.

8. *Page 5266, Line 23: What are the "elastic components" and the "strength term"?*
We have clarified the terms to which we refer.

9. *Page 5268, Equation 21: I may have misunderstood something, but I am getting an extra R^2 when trying to reproduce this equation.*

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Good catch! This equation should have G_* in place of k. We fixed this typo and verified that it didn't propagate into any other equations.

10. *Page 5269, Line 4: Specify that D is measured with GPS.*
    We have clarified this point.

11. *Page 5270, Line 2: Include "L" after "state evolution distance".*
    We have added this improvement.

12. *Page 5271, Line 27: Explain "coordination number C = 9".*
    We have clarified this definition.

13. *Page 5275, Lines 25-26: " a stiffening bed implies a shift towards more stable conditions": can this be shown with the inequality in Equation 19?*
    Yes, this can be inferred from (19). We have clarified this point in the text.

14. *Page 5275, Lines 27-28: "Independent observations . . .": Which observations are being referred to? Reference needed?*
    Appropriate references were already included, and we have clarified the explanation in the text.

3 Figures

1. *Figures do not seem to appear in the order they are mentioned.*
   The figures now appear in the order in which they are referenced.

2. *Figure 1: Symbols and legend font should be larger. Highlight the "third red dot" directly in the figure. Caption: "red dots shows" [to] "red dots show".*
We have made all of these recommended improvements.

3. *Figure 2: This figure should be annotated better: "15 minute duration" of what? What are the red bars in the Panel B pictures? What do the arrows represent? Displacement or velocity? Creep or strain rate?*
We have improved the annotations in the caption of Figure 2.

4. *Figure 3: I suggest directly labeling Panels A and B as "Observation" and "Model". Figure 4: The subscript font in Panel A?s y-label is too small.*
We have made both of these changes.

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