The Cryosphere Discuss., 9, C2311–C2313, 2015
www.the-cryosphere-discuss.net/9/C2311/2015/

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

Anonymous Referee #3

Received and published: 20 November 2015

This paper by Lipovsky and Dunham presents a modeling approach to high-frequency stick-slip seismicity beneath the Whillans Ice Stream. The authors focus on gliding harmonic tremor, which constitutes a superposition of microseismic stick-slip events as the rupture front of a large-scale stick-slip displacement spreads beneath the Whillans Ice Plain. With their frictional slider block model they can quantify parameters of the stick-slip asperities.

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-slider-block-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

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Whillans stick-slip motion is such peculiar phenomenon, presenting the model this way would help the reader better grasp the essence of the processes, which the authors model.

SPECIFIC COMMENTS

At several instances throughout the paper, the authors mention the state evolution 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?

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.

Page 5258, Lines 9-10: “Recursion halts when the time between peaks in the remaining time series approaches âĹij 10 s.” is not clear to me.

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.

Page 5263, last line: A references seems necessary here.

Page 5264: If I understand correctly, then the definition in Equation 16 is motivated from Equation 14. It would help to comment on this.

Page 5265: Why is there no reference for Equations 17 and 18?

Page 5266, Line 23: What are the “elastic components” and the “strength term”?

Page 5268, Equation 21: I may have misunderstood something, but I am getting an extra Rˆ2 when trying to reproduce this equation.

Page 5269, Line 4: Specify that D is measured with GPS.

Page 5270, Line 2: Include “L” after “state evolution distance”.

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Page 5271, Line 27: Explain “coordination number C = 9”.

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?

Page 5275, Lines 27-28: “Independent observations . . .”: Which observations are being referred to? Reference needed?

FIGURES

Figures do not seem to appear in the order they are mentioned.

Figure 1: Symbols and legend font should be larger. Highlight the “third red dot” directly in the figure. Caption: “red dots shows” → “red dots show”.

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?

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.

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