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The Cryosphere Discussions
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Interactive comment on "Modelling debris transport within glaciers by advection in a full-Stokes ice flow model" *by* Anna Wirbel et al.

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General Comments

With its focus on numerics and bench marking, this would be an exemplary submission to the EGU journal *Geoscientific Model Development*. As a contribution to *TC Discussions* it stands out as being mainly concerned with a numerical model and, at this stage of progress, not much concerned with the Cryosphere.

Clearly this submission represents a significant step along a much longer path that will ultimately lead to real-world science questions. The authors address these concerns on Page 8: "Direct evaluation of our advection model against real world glacier cases is not possible at present because (i) comprehensive field measurements of englacial

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debris transport are not available and (ii) simulating the full glacier system would require further model development...." According to the contributors' guidelines for *TC* the journal invites "papers on all aspects of frozen water and ground on Earth" and "numerical modelling" is one of the main subject areas, I conclude that *TCD* is an appropriate target for this submission but it would be interesting to have wider discussion of this point because it could influence the future direction of the journal.

The authors should be commended for their exhaustive approach. It is proper that we test our tools before applying them and, by doing such a thorough job of this they establish a firm foundation for moving forward with debris transport modelling following the agenda that they describe.

Specific Comments

The authors have left very few stones unturned so I don't have concerns about the general soundness of this contribution. For me the main source of confusion was whether a dimensional or dimensionless treatment was being followed. I got the impression that in fact both points of view were being taken but that the dividing lines were unclear. For example, the debris diffusivity D has dimensions $\mathrm{m}^{-2}\,\mathrm{s}$ (as it appears in Equation 5a) but on Page 9, Line 14 $D = 10^{-6}$ suggests it has become dimensionless for the LeVeque test. Contributing to this confusion is the fact that time steps of 0.01π and 0.1π (dimensionless?) and mesh sizes of $L = 0.15\,\mathrm{m}$ are discussed on the same page. Please clarify here and elsewhere.

Technical Corrections

Figure 1 The caption should read "Kennicott Glacier" (spelling)

P03, L29 "Eulerian" (not Eularian)

P10, L04 $917\,\mathrm{kg\,m}^{-3}$

P10, L30 $x = 1800\,\mathrm{m}$ and $x = 1900\,\mathrm{m}$

P20, L19 Bozhinskiy et al. (1986): Check caps style

P20, L28 Glen (1955): Check caps style

P21, L07 John and Novo (2011): Check caps style

P21, L28 LeVeque (1996). Caps style

P22, L15 Nye (1957): Caps style

P22, L35 Ostrem (1959): Caps style

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