The Cryosphere Discuss., 3, C431–C434, 2009
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The Cryosphere
Discussions



# *Interactive comment on* "Interaction between ice sheet dynamics and subglacial lake circulation: a coupled modelling approach" *by* M. Thoma et al.

**M. Thoma et al.**

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Received and published: 14 December 2009

> You use the pressure-depended freezing point in terms of local ice
> thickness (section 2.2), which implies the hydrostatic equilibrium. I
> think the effect of the non-hydrostatic term for this point is negligible,
> but you might mention this.

We adjusted the sentence to address the reviewer suggestion:
"Assuming isostasy above the subglacial lake, the bottom layer temperature is at the pressure-depended freezing point."

> Section 2.4 and figure 3. It is very hard to
> distingusih wheter the surface is flat or inclined.

True, the problem is, that the inclination is just very weak. We removed the expression ’significantly’ on p811,l4. In addition, we added a new figure, which shows (among other things) the ice surface slope and added:
"This effect is also visible in the geometry of the profiles in Figures 4 and in particular in Figure 5."

> Section 2.4 (P811 L11).
> It is not so clear to me why accelerated ice at the surface first slows
> down and accelerate again. Better explanation may be expected.

We reformulated the paragraph:
"The largest velocity gradients occur in the vicinity of the grounding line (Figures 5, 3b, 4a).
Convergence of ice towards the lake results in an accelerated ice flow which undulates at the lake’s edges because of significant changes in the ice thickness and ice sheet surface gradients (yellow and red line in Figure 5, respectively).
The surface velocity (green line in Figure 5) accelerates towards the lake until the ice sheet surface flattens. The velocity increase in deeper layers close to the bedrock (blue line in Figure 5) is suspended just before the frictionless lake interface is reached, because of a strong increase of the ice thickness filling the trough.
The maximum velocity is reached across the lake (Figure 3b, 4a, 5 ), where the basal friction is zero.
"

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Interactive Comment

> Your lake model is on a spherical coordinate. I do not critisize it, but
> is there any strong reason to apply the spherical coordinate model,
> especially to couple with a Cartesian coordinate model (ice part)?
The reason is quite simple: This lake model is based on a ocean general circulation model. To our knowledge there is no other lake model available suitable for suchlike studies.

> Very minor points P815/L17 ‘are are’ should be ‘are’
Corrected

> Figure 1 (a) Red (3/2) and blue (0/0) symbols
> are opposite in the legend.
Corrected

> Figure 3 (b) and others. The term ‘Depth’ for the
> vertical axis may not be correct (it seemed to me the distance from the
> surface).
We changed "Depth" to "z" in all figures.

> Figure 5 There are no coordinate information along the figures
> (nor the direction)
We added a northward pointing arrow to indicate the direction of the figure and modified the caption:
"b) Vertically integrated mass transport stream function,
positive values indicate a clockwise circulation,
negative values an anticlockwise circulation.
"

> Figure 7 (d) Almost all area is covered by red color. I
> think a better color scale helps to see the feature.
We adjusted the colorbar for Figures 5a and 7d to improve the appearance.

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Interactive comment on The Cryosphere Discuss., 3, 805, 2009.