The Cryosphere Discussions

Interactive
Comment

Interactive comment on "The ISMIP-HOM benchmark experiments performed using the Finite-Element code Elmer" *by* O. Gagliardini and T. Zwinger

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Received and published: 2 April 2008

The paper gives a good account of various solution methods and their impact on model performance and accuracy, and therefore is interesting to modelers solving the full ice flow equations with finite element codes.

Unfortunately, details on the most interesting parts of the solution algorithm are missing. The clearness and value of the paper would be greatly enhanced by a detailed description of the methods to calculate the evolving surface geometry (page 81), and the choice of the solver for the nonlinearity (page 84; fixed point iteration, Newton scheme..). Also the choice of the preconditioner merits a description.

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Interactive Discussion

Discussion Paper

As a general comment it should be noted that the accuracy of a code (page 77, line 12) can only be established if a solution is known in analytic form. In that respect the statements of the authors about model accuracy should be reformulated.

The paper would benefit by streamlining the English by a native speaker.

Minor comments

p78,l5 Define $\sigma = \tau + p$.

p80,l20 P2P1 usually denotes triangular Taylor-Hood elements, as opposed to the quadratic Q2Q1 elements. Maybe it would be best using the generic term "Taylor-Hood elements".

p81,l15 On what domain is equation (10) solved. One would guess on a 2D domain representing the surface, but it would be helpful to state this explicitly. Only then the statement about the body force [p80,l8] is meaningful.

p82,l6 replace "but do not apply to very large system" by "is not feasible on a very large system".

p82,l15 It is not clear which algorithm to solve the nonlinear system has been used. Is it a fixed point iteration, a Newton-Raphson solver? What about preconditioning?

p83,l1 replace "...over time as long as a steady state is reached" with "until a steady state is reached".

p84,l15 The CPU time also depends a lot on the bandwidth structure and condition number of the system matrix, which depends on the choice of finite elements and preconditioner.

p84,l19 replace "The in..." with "The".

p85,l25 is ϵ_{NL} the relative (scaled) or the absolute velocity change?

p86,l25 replace "method conduct to" with "method lead to"

Interactive comment on The Cryosphere Discuss., 2, 75, 2008.