Ice sheet water models: routing, timing, and pressure distribution

Sasha P. Carter (spcarter@ucsd.edu)[1], Helen A Fricker (hafricker@ucsd.edu)[1], William H. Lipscomb (lipscomb@lanl.gov)[2], Stephan H. Price (sprice@lanl.gov)[2]
Jesse Johnson (jesse.johnson@mso.umt.edu)[3]
Donald D. Blankenship (blank@ig.utexas.edu)[4]

(1) Institute of Geophysics and Planetary Physics (IGPP), Scripps institution of Oceanography, University of California at San Diego, mail code 0225 9500 Gilman Drive, La Jolla, CA 92093
(2) Los Alamos National Laboratory, Group T-3, Mail Stop B216, Los Alamos, NM 87545
(3) Department of Computer Science, Social Science Building, Room 417, The University of Montana, Missoula, MT 59812-5256
(4) University of Texas at Austin John A and Katherine G Jackson School of Geosciences Institute for Geophysics, J.J. Pickle Research Campus, Bldg. 196; 10100 Burnet Road (R2200), Austin, TX 78758-4445

Ice sheet basal hydrology and its relation to basal sliding continues to constitute a source of significant uncertainty in ice sheet modeling. Most basal water models currently employed construct the hydraulic head surface; the sum of the basal elevation and the normalized water pressure, assuming water pressure is equal to overburden pressure everywhere. Although this assumption of zero effective pressure is valid for the centers of large subglacial lakes, it implies an absence of basal traction anywhere water is present while producing a water distribution in which most basal water is confined to narrow channels one grid cell across, and consequently unable to support widespread the basal sliding observed in major ice streams. Given that effective pressure tends to increase with water depth, the initial concentration of water in narrow channels predicted by current models will tend to spread laterally if effective pressure is taken into consideration. Here we explore an iterative algorithm to obtain more realistic predictions of water sheet thickness, velocity and effective pressure, in the context of the GLIMMER CISM Ice sheet model and its application to the Siple Coast region.