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Snow & Ice Dynamics
Class highlights for 5/14/18

We spent the first part of class reviewing the midterm, and then started in on the shallow shelf approximation (SSA). In the SSA, an ice shelf or 'shelfy-glacier' (i.e. glacier or ice stream underlain by water-laden sediment) is treated as a membrane in which shear stresses (like du/dz, a dominant stress in the shallow ice approximation, SIA) cannot be maintained. Membranes are thin and sheet-like (H<<L), such that stress and strain can be approximated in the vertical by a depth average. Following the SSA explanation in "Dynamics of Ice Sheets and Glaciers" by Ralf Greve, we started, as usual, with the conservation of momentum laws. Solving for deviatoric stresses, inserting these into the conservation of momentum equations, and integrating over depth, led us to a definition of the membrane stresses and a simplified pair of equations that are the basis of SSA. The next step would be to use constitutive relations to replace the membrane stresses with velocities. We then compared the SIA to the SSA and saw that the SIA is a local solution dependent on local variables, while the SSA is composed of two coupled equations that describe local conditions that are dependent on conditions within the entire domain, including the boundary conditions. Thus, it is more complex to solve the SSA and it is more sensitive to uncertainties at the boundaries and everywhere inside the domain.