Modelling of a marine glacier and ice-sheet-ice-shelf transition zone based on asymptotic analysis

Chugunov V., Wilchinsky A.
Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

Abstract

All parts of a two-dimensional, isothermal, stationary marine glacier (grounded ice sheet, ice shelf and transition zone) with constant viscosity are analysed by perturbation methods. In so doing, all zones of different flow patterns can be considered separately. Correlations between spatial scales for all parts can be expressed in terms of the typical ice-surface slope distant from the ocean, which reflects exterior conditions of the glacier's existence. In considering the ice-sheet-ice-shelf transition zone, a small parameter characterizing the difference between ice and water densities is used. Such an analysis allows us to find boundary conditions at the grounding line for the grounded ice mass. Glacier-surface profiles are determined by numerical methods. The grounding-line position found by using the boundary conditions derived in this paper differs from that obtained by using Thomas and Bentley's (1978) boundary conditions by about 10% of the grounded ice-stream length.