On the frequency response of glaciers

M.P. Lüthi

VAW/ETH Zurich, 8092 Zurich, Switzerland

The reaction of glaciers with simple geometry to periodically changing climate is investigated with a full Stokes Finite Element model. The amplitude and phase lag of the response at the glacier terminus is similar to the results of the linearized theory (Nye, 1965; Hutter, 1983). The oscillation, however, is not centered around the steady glacier length, but around a shorter, thinner glacier, and relative amplitudes depend on oscillation frequency. Phase shifts between forcing and response are increasing along the flow line and typically are 50° upstream, and more then 180° at the terminus, for typical climate forcing periods of the order of the response time.

During the transition from a steady state to an oscillating climate, big transients of up to 20 oscillation periods are observed, until the glacier response becomes periodic. The size of the transients depends on the kinematic wave velocity, being shorter for small, short and steep glaciers.