Contribution ID: **151** Type: **keynote**

The influence of subglacial water on glaciological friction

Friday, 12 January 2018 10:35 (45 minutes)

The movement of continental and mountain-scale ice masses is usually modelled as a problem of viscous creep. The viscosity arises from temperature- and stress-dependent migration of defects through the polycrystalline structure of the ice, and the rheology is usually described as a power law fluid for the purposes of large-scale ice-sheet models. Much of the ice motion arises from effective slip at the bed. This may arise from actual sliding at the ice-bed interface, from enhanced ice deformation close to the bed, or from deformation of the bed istelf (where it comprises deformable glacial sediments). The slip is described mathematically by a glaciological sliding or friction law.

This presentation will review classical descriptions of the friction experienced by the flow of glacial ice over a hard bed, will highlight more recent work on the subject, and discuss opportunities for further understanding.

The ice-rock interface is typically close to the pressure-dependent melting point and a thin film of water resides between ice and rock. At a small (˜mm) scale, there is therefore little resistance to shear, and the macroscopic friction experienced by the glacier is thought to be primarily due to the requirement for ice to flow over or around roughness elements in the bed; effectively a type of form drag. Low stresses downstream of bumps in the bed can result in cavitation, with the ice peeling off from the bed to leave a water-filled cavity. Such cavitation on a large scale effectively reduces the ice-bed contact area and can result in a reduction of friction. We discuss conceptual models of this process and their implications in terms of the dependence of friction on ice speed, cavity pressure and volume. A crucial and unresolved question is the extent to which such cavities are hydraulically connected and can therefore evolve in response to meltwater that enters glaciers from the surface during the melt season. We will discuss observations of how glacier sliding varies in time, and hypotheses for the small-scale dynamics at the bed that give rise to these changes. We also discuss the role of bed deformation and the thermodynamic effects of regelation and viscous dissipation.

Significance statement

Glaciers and ice sheets are losing mass in response to climate change. The rate at which this happens is strongly controlled by how fast the ice can move. This talk reviews current knowledge about the glacial friction that controls this movement, and how it may change in the future.

Primary author: Prof. HEWITT, Ian (University of Oxford)

Presenter: Prof. HEWITT, Ian (University of Oxford)

Track Classification: Fundamentals of the Cryosphere