Exploration of basal condition in winter by numerical glacier hydrological model -Preliminary results-

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Ice surface speed is a combination of ice deformation and basal sliding (including sediment deformation under the glacier). Well-known spring/summer speed-up cannot be explained by ice deformation and can only be induced by basal sliding. Faster basal sliding is attributed to higher basal water pressure, which reduces the effective pressure (ice-overburden pressure minus basal water pressure) and lubricates the interface between ice and bed. Many observations and modeling have been performed so far, and basal condition plays a key role in driving seasonal changes in ice speed.
Applying offset tracking method to satellite radar images, we found winter speed-up signals of surge-type glaciers at two distinct setting, Yukon Territory in Canada (Abe and Furuya, 2015) and West Kunlun Shan, in Northwestern Tibet (Yasuda and Furuya, 2015). In Yukon, the winter speed-up from fall to winter was seen at many surge-type glaciers during their quiescent phases. In West Kunlun Shan, seasonal modulations were identified at two active surging glaciers, which are faster from fall to winter and slower from spring to summer. These findings tell us that we have to consider some mechanisms that can increase basal water pressure even at low water flux in winter.
Werder et al (2013) developed the 2D subglacial drainage system model (GlaDS), which consists of R-channel conduit and distributed cavity system. Using this model, we have examined how the drainage system evolves from spring to summer, and how it does in the following winter, as well as effective pressure changes. We could show that the effective pressure drops at the same time as the onset of meltwater input. After that, the subglacial drainage system evolves and reaches a steady state. Immediately after the onset of the melting season, spring/summer speed-up event occurs. At the end of the season, when meltwater input ceases, the effective pressure remains a high value in winter. This is because there is no water input and the channels close due to creep closure.
In our presentation, we will show the time evolution of the drainage system during melting season, and discuss how it does in winter with some assumptions.

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