# The mysterious interior of glaciers

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Studies on glacier dynamics have been widespread for many years.
State-of-the-art methods are now used to observe and measure glacier processes and properties. These techniques not only allow to look at the ice surface but also to go deeply into the glacier interior.
Our current understanding of the internal structure of the glaciers and its spatial variations is based on interpretations of geophysical measurements, including mainly radar surveys. These results are verified point by point only, by drilling in snow, firn layers and ice, and also through temperature profiling. However, the most reliable verification is possible during direct explorations of cryokarstic systems and features created inside glaciers by the circulation of meltwater in the ablation zone.
Despite the glacier movement, newly created icy corridors, wells and chambers remain in the same place for many years. Natural laboratories and scientific tools can be installed in these systems to gather information on the speed of deformations around the empty spaces in ice, with regard to temperature changes and water levels. The monitoring of the chemical composition of water flowing through channels and englacial wells is also possible. It allows estimating the fraction of ablation waters that percolated to the glacier interior in the accumulation zone and hereby affects its 'internal supply'.
Such research has been conducted for more than a decade for glaciers located close to the Hornsund Polish Polar Station in southern Spitsbergen, Svalbard. A vast majority of these glaciers are polythermal, with complicated thermal structure. The layers of cold ice usually extend from the glacier surface down to a depth of 100 meters. Year-round measurements of water levels in corridors and wells were correlated with precise GPS data from individual basins of the Hans Glacier. The observed 'water pillow' not only increase the glacier velocity but also causes rapid jumps in its movement, which are recorded by seismic stations as 'icequakes'. Sources of these seismic waves are located mainly at the boundary between cold and warm ice, in the region periodically saturated with water.
The ability to study englacial processes allows understanding of the dynamics of changes observed at the surface, including surges, mini-surges, sudden water bursts at the glacier foreground, or creation of glacier-derived naled in frontal areas of some glaciers.
Measurements of water retention in selected parts of the glacier also provide valuable information for technical projects concerning not only all-year water supply for mountain shelters or villages but also hydropower issues.