

Development of a hot water drilling system for subglacial and englacial measurements

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Abstract

Hot water drilling is a technique suitable for drilling boreholes in a glacier, especially those meant for installing instruments. This method is considerably faster than a mechanical drilling. Moreover, the hot water drilling system is easy to operate and can be constructed by assembling simple devices. This paper reports on the development of a hot water drilling system for temperate ice 100–200 m thick. The system consists of water basin, high-pressure pump, heater, tripod, pulley, hose, drilling stem and nozzle. The total weight of the system, including a 250 m length of hose, is approximately 300 kg. The system generates a hot water jet at a temperature of 60–76°C and a flow rate of 950–1000 l h⁻¹ using straight jet nozzles of 1.6, 2.0 and 2.5 mm diameter. The drilling system was tested at Rhonegletscher, Switzerland during the summers of 2007 and 2008. Eight boreholes with a total depth of 925 m were drilled in 2007, and twenty-four boreholes with a total depth of 1118 m were drilled in 2008. The mean drilling rates achieved for each borehole were in the range of 27–70 m h⁻¹, depending on the drilling depth, the distance between the drilling site and the heater, and the elevation difference between the drilling site and the pump. During drilling at the glacier, the diesel and petrol consumption rates of the heater and pump respectively were 6.9 l h⁻¹ and 1.8 l h⁻¹.