Figure S1. Presentation of Unit Hydrographs (UHs) (column 1) and moulin discharges (column 2) of IDC2 during July 2015, as simulated by three surface meltwater routing models (SUH, RWF, and SRLF). Simultaneous RCM runoff (grey line) is shown to indicate the effect of surface meltwater routing process on moulin discharge.

Figure S2. Presentation of Unit Hydrographs (UHs) (column 1) and moulin discharges (column 2) of IDC3 during July 2015, as simulated by three surface meltwater routing models (SUH, RWF, and SRLF). Simultaneous RCM runoff (grey line) is shown to indicate the effect of surface meltwater routing process on moulin discharge.

Figure S3. Presentation of Unit Hydrographs (UHs) (column 1) and moulin discharges (column 2) of IDC4 during July 2015, as simulated by three surface meltwater routing models (SUH, RWF, and SRLF). Simultaneous RCM runoff (grey line) is shown to indicate the effect of surface meltwater routing process on moulin discharge.

Figure S4. Subglacial effective pressures for IDC2 as simulated by SHAKTI, with inputs to the subglacial system via a single moulin prescribed by the moulin discharges (shown in Figure S1) generated by the various surface meltwater routing models. The effective pressure shown is the spatial mean over the entire 1-km square domain which contains the moulin input at its center.

Figure S5. Subglacial effective pressures for IDC3 as simulated by SHAKTI, with inputs to the subglacial system via a single moulin prescribed by the moulin discharges (shown in Figure S2) generated by the various surface meltwater routing models. The effective pressure shown is the spatial mean over the entire 1-km square domain which contains the moulin input at its center.

Figure S6. Subglacial effective pressures for IDC4 as simulated by SHAKTI, with inputs to the subglacial system via a single moulin prescribed by the moulin discharges (shown in Figure S3) generated by the various surface meltwater routing models. The effective pressure shown is the spatial mean over the entire 1-km square domain which contains the moulin input at its center.

Figure S7. GIF of transient subglacial hydrology evolution with diurnal input variations from a moulin for IDC1 using the SUH routing method. This GIF shows the time evolution of the subglacial drainage system as modelled by SHAKTI over a 31-day simulation. An efficient drainage pathway rapidly forms from the moulin at the center to the outflow at the left edge of the domain, and the diurnal fluctuations are clearly reflected in the pulsation of its height, flux, head, and effective pressure. The other surface routing methods and drainage catchment areas yield qualitatively similar results, although the magnitudes of diurnal fluctuation vary between methods and ice thicknesses.

Figure S8. The average two-day cycle of moulin discharge (Q) for IDC2 during July 2015 derived from Figures S1 and S4. The daily minimum input in supraglacial moulin discharge (solid lines) corresponds generally to maximum effective pressure (dashed lines), and is followed within 5-6 hours by the daily minimum effective pressure (maximum subglacial water pressure). This suggests that the system shuts down due to creep with low meltwater input, and becomes highly pressurized as meltwater input increases again. As the new water inputs are accommodated, efficient pathways reform and effective pressure increases (subglacial water pressure decreases).

Figure S9. The average two-day cycle of moulin discharge (Q) for IDC3 during July 2015 derived from Figures S2 and S5. The daily minimum input in supraglacial moulin discharge (solid lines) corresponds generally to maximum effective pressure (dashed lines), and is followed within 5-6 hours by the daily minimum effective pressure (maximum subglacial water pressure). This suggests that the system shuts down due to creep with low meltwater input, and becomes highly pressurized as meltwater input increases again. As the new water inputs are accommodated, efficient pathways reform and effective pressure increases (subglacial water pressure decreases).

Figure S10. The average two-day cycle of moulin discharge (Q) for IDC4 during July 2015 derived from Figures S3 and S6. The daily minimum input in supraglacial moulin discharge (solid lines) corresponds generally to maximum effective pressure (dashed lines), and is followed within 4 hours by the daily minimum effective pressure (maximum subglacial water pressure). This suggests that the system shuts down due to creep with low meltwater input, and becomes highly pressurized as meltwater input increases again. As the new water inputs are accommodated, efficient pathways reform and effective pressure increases (subglacial water pressure decreases).