In the PINK. . .

…but not necessarily in the best of health. Fay Campbell is using fluorescent dyes to investigate glacial melt water.

Spreading dye onto the surface of the snowpack covering Haut Glacier d'Arolla (Swiss Alps).

More than two-thirds of the world's fresh water is stored in glaciers and ice sheets. When released, that water can be good or bad news for us humans. It is a vital resource, used for water supply and irrigation, and conveniently released in the summer, just when we need it most. Glacial melt water is also used to generate electricity at hydroelectric power stations, an important source of sustainable energy. But water draining suddenly from glaciers can cause catastrophic floods, risking human life and destroying buildings, roads and pipelines. And as the Earth's climate warms, melt water from glaciers and ice sheets will raise sea levels, and could disrupt ocean currents that redistribute heat around the planet.

What's more, the way in which water moves through a glacier can control its response to a warming climate. Glaciers flow downhill fastest when a layer of liquid water at the bottom acts like a hydraulic jack, lifting the ice off the ground. Flowing down-slope exposes more ice to warmer temperatures, melting ice that may not be replenished higher up.

Investigating water movement inside and beneath glaciers several hundred metres thick isn't easy. We know that water from melting snow and ice on the glacier surface disappears into cracks and holes in the ice called crevasses and moulins. It emerges from the front of glaciers through tunnels at their base. Exactly what happens in between is the big question, and one calling for some colourful research techniques!

One technique involves adding fluorescent dye, often vivid fuchsia pink or sunflower yellow, to water entering crevasses or moulins, and detecting it as it emerges again. We use the time this takes and the characteristics of the emerging dye pulse to deduce what type of flowpaths are being followed within the glacier. We can measure the dyes at very low concentrations, even when no colour is visible. Still, using the right amount requires a bit of care—enough to detect at the other end, but definitely not enough to leave the stream pink some distance down valley!

My own research is about how the layer of snow on top of a glacier affects water movement. I've spent two summers working at Haut Glacier d'Arolla in the Swiss Alps, camping at 2500m altitude and monitoring how the snowpack changes as it melts. I spread brilliant pink dye solution on the snow surface and look to see how long it takes to reach a snowpit several metres away and how the dye pulse spreads out as it travels. Because water percolates slowly through millimetre-wide pores between snow grains, the snowpack temporarily stores melt water. Lenses of semi-solid ice, formed when the developing snowpack repeatedly melts and refreezes during winter, further slow water movement into the rest of the glacier system and beyond. Flow patterns are very uneven, influenced by small-scale variations in snow grain size, shape and density. My research shows that changes in the snowpack as it melts might be important in changing runoff from the glacier. Understanding the complicated processes of water flow through glacial snowpacks is just one part of the scientific health check that these vast water stores need in a changing climate.

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