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Measuring pH in low ionic strength glacial meltwaters

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pH is a fundamental indicator of the biogeochemical status of natural waters, but it remains challenging to measure reliably in the field. Glacial meltwaters are particularly problematic since they have low ionic strength, and pH values range from less than neutral (<7) to extremely high: pH 11 is not uncommon in supraglacial ecosystems and bulk runoff frequently exceeds pH 9 in the height of summer. Meltwaters are also at disequilibrium with the atmosphere, and so immediate measurement is necessary to capture the true pH of the system. Varying flow rates and changing temperature can affect pH, so these parameters and their impacts on the measurement technology in question must be quantified. There are three primary approaches to measuring pH in natural waters: potentiometric, spectrophotometric and fluorescent. We discuss their applicability to glacial systems, via a series of comprehensive laboratory tests at low temperatures and low ionic strengths. The Honeywell Durafet system, a potentiometric ion sensitive field effect transistor (ISFET) sensor which has been successfully demonstrated in long-term ocean monitoring, was the most effective in tests. We present the results of a 60 day deployment of the sensor in glacial outflows from the Greenland ice sheet, and demonstrate its superiority to traditional monitoring solutions.