Geophysical Research Abstracts
Vol. 18, EGU2016-3804, 2016
EGU General Assembly 2016

Novel in situ chemical sensing technologies for icy environments

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A dramatic development in subglacial science in recent decades has been the considerable international effort aimed at improving understanding of the hidden subglacial aquatic environments beneath ice sheets. These include a diverse range of lakes, rivers, shallow and deep sediments. Technology challenges associated with the exploration of these and other icy environments are substantial because of their remote nature, extreme conditions and the requirement for sterile/clean access and sampling. In situ sensors provide an alternative to sample recovery and return for monitoring in situ conditions and are available for many analytes, but they are frequently unsuitable for deployment in icy environments. Low temperatures, freeze-thaw cycles, remote locations, low concentration and low ionic strength meltwaters challenge technologies designed for non cryospheric systems. The UK NERC-funded DELVE programme (DeEveLopment and Validation of in situ chemical sensors for icy Ecosystems) was launched with the goal of developing and testing the first suite of geochemical sensors for icy ecosystems, with a focus on redox sensitive species and dissolved nutrients. All sensors were subject to testing at low temperatures, including freeze-thaw cycling, and the response to low concentration and low ionic strength was quantified. Here we report high resolution, continuous data derived from a suite of biogeochemical sensors which were deployed to a large proglacial river draining the Greenland Ice Sheet during the 2015 melt season. These data show that these sensors have strong potential for more challenging deployment to the basal regions of ice sheets.