Geophysical Research Abstracts
Vol. 17, EGU2015-7151, 2015
EGU General Assembly 2015

Limitations and uncertainties of Fibre-optic Distributed Temperature Sensing (FO-DTS) for ecohydrological applications

Stefan Krause (1) and Theresa Blume (2)

(1) University of Birmingham, School of Geography, Earth and Environmental Sciences, School of Geography, Earth and Environmental Sciences, Birmingham, United Kingdom (s.krause@bham.ac.uk), (2) Helmholtz Centre Potsdam, GFZ – German Research Centre form Geoscience, Potsdam, Germany

FO-DTS has experienced rapid methodological development in recent years. The critical interpretation of uncertainties in FO-DTS monitoring requires a quantitative understanding of the impacts of signal-strength (the intensity of the temperature signal) and signal-size (the spatial extent of the temperature signal) on the accuracies of observed temperatures.
This paper investigates the signal-size and signal-strength dependent accuracy of FO-DTS monitored temperatures for different experimental designs and monitoring conditions. It combines controlled lab experiments of variable signal signal-size and -strength with field applications of different experimental setups and seasonally variable conditions hydrological and thermal patterns.
Accuracies in signal-strength, -size and -location varied substantially with the spatial extent of the monitored signal, causing potentially significant signal loss and signal dislocation. A critical deterioration of the accuracy of FO-DTS measured temperatures with reducing signal size was observed in particular for signal sizes close to the spatial sampling resolution. Our results indicate that the impact of signal-strength and signal-size on the measured temperature can't be distinguished without additional information of the actual signal-size, potentially leading to ambiguous interpretations of the size, strength and absolute location of signals.
Lab and field experiments confirmed that warm temperature signals of significantly larger spatial extent were required to provide measurements of equal qualitative and quantitative accuracy as cold signals, which is of high relevance for FO-DTS monitoring design in systems with seasonally variable thermal gradients. With decreasing signal size increasing temporal variance in observed temperatures indicates a risk of masking short-term tem- perature fluctuation, with critically implications for the monitoring accuracy in highly dynamic systems. The best signal-to-noise ratios in field experiments were achieved by a combined single-ended and double-ended measurement setup.