High-resolution imaging and inversion of 3D wavefield data for layered media

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Distributed Temperature Sensing (DTS) calibration with confidence intervals

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Temperature measurements along fiber-optic cables have shown their value in a range of geophysical applications. DTS devices are becoming so user-friendly that 'everyone' is able to perform temperature measurements along kilometers of fiber, but it remains difficult to obtain *accurate* temperature measurements. Quantification of the accuracy is important as it varies along the cable and over time and is different for each setup. The accuracy decreases as the measured signal decays farther down the fiber, the accuracy decreases with higher temperatures, and the device's sensitivity fluctuates over time. Furthermore, the uncertainty in the estimated temperature is affected by the estimation of the parameters that relate the measured Stokes and anti-Stokes scattering to temperature.

We present a calibration framework that provides confidence intervals to the calibrated temperature. First, the noise variance in the (anti-) Stokes scattering is estimated directly from the measurements. Second, the temperature along the fiber is calibrated to reference sections with a known temperature. The calibration is weighted by the noise variance in the signal, so that reference sections close to the DTS device have a larger influence on the parameter estimation than sections with a weaker signal. Third, the uncertainty from the (anti-) Stokes scattering and the parameter uncertainty are projected to confidence intervals.

The procedures for single-ended and double-ended setups are wrapped into a Python package, available on github.com/dtscalibration together with documentation and example notebooks.