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High-resolution flow characterization close to the sediment-water interface using the Vectrino II Profiler

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The flow close to the sediment-water interface (SWI) is an important abiotic factor shaping the living conditions in the benthic zone. Bottom shear is the main source of turbulence and mixing in this zone, which in turn governs the exchange of solutes and particles between water column and sediments. For most commercially available devices designed for field use fluid flow in the close vicinity of the SWI is hardly accessible. We tested the high resolution bistatic Vectrino II profiler (Nortek) for its applicability to characterize turbulent flow at the very close vicinity of the SWI in a run-of-the-river reservoir. The profiler allows the determination of the statistics of the three-dimensional flow field at a single point (sweet spot) as well as the determination of the time averaged flow velocity profiles at 1 mm resolution around the sweet spot. Therefore, in addition to the flow statistics provided by single point acoustic Doppler profilers, mixing coefficients as well as production of turbulent kinetic energy can be calculated using a single device. Fitting of semi-empirical relations to observed cospectra allowed eliminating artifacts as they result from coordinate system rotation during the calculation of Reynolds stress profiles at millimeter resolution. While most parameters showed characteristics of a constant stress layer, length scales indicated a slight anisotropy of the turbulent flow. In addition, we observed the zone of shear induced turbulence generation below 1 cm above the sediment-water interface indicated by the discrepancy of production and dissipation of turbulent kinetic energy - a task which is hard to achieve with other standard acoustic velocimeters which have either a lower spatial resolution or provide only single-point measurements.