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The Mini Buoy: a novel hydrodynamics sensor for long-term deployments in coastal wetlands

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Hydrological monitoring is crucial for management and research in coastal wetlands. However, long-term monitoring is scarce due to the high cost of conventional hydrological equipment. The development of open-source and low-power sensors over the past decade presents an opportunity for enabling long-term, high spatial resolution monitoring of hydrodynamics in the intertidal zone. Here, we present the design, calibration, and application of one such sensor: the Mini Buoy. The Mini Buoy is a battery-powered accelerometer and data logger, contained in a standard centrifuge tube. The Mini Buoy floats upright when inundated, and moves freely about a tether anchored to the substrate. Acceleration is measured along a single axis of the buoy, and motion along the axis is used to measure inundation, currents, and waves. Deployments of up to 6 months are possible, and the buoy can measure current and wave orbital velocities as low as 0.05 m/s. Mini Buoys cost less than €350 to assemble, and the materials are globally available. We present the successful application of Mini Buoys in four contrasting scenarios: (1) characterising waves under calm and stormy conditions; (2) linking saltmarsh erosion-expansion patterns with hydrological exposure; (3) identifying high-resolution spatial variability of waves and currents along a saltmarsh edge; and (4) assessing the suitability of former aquaculture ponds for mangrove restoration. Mini Buoys are also being deployed along mangrove fringes across Vietnam, India, and Bangladesh, in order to detect thresholds in hydrodynamic forcing responsible for triggering erosion or progradation events. Mini Buoys offer an exciting and novel tool for coastal management worldwide.