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A new low-cost device for the continuous measurement of peatland surface motion ("LoCoMotion")

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The surface of both wet and drained peatlands is permanently in motion due to both physical and biological processes. For a long-time, manually measured changes in surface elevation have been used as a proxy for carbon losses. High resolution measurements, however, are needed to avoid misinterpretation of such, e.g., annual, measurements, to improve process understanding and, potentially, to inform remote sensing approaches which are increasingly used to detect surface motion.

So far, different methods have been employed to determine surface motion in a high temporal resolution, but the devices are either costly, demand extensive maintenance or acquire data sets (photos) requiring comparatively complicated data analysis. As we intended to measure surface motion in the German peatland monitoring programme and are thus establishing numerous monitoring sites distributed all over Germany, low costs and low energy demand are necessary. Furthermore, the device needs to be robust enough for year-round measurements and require little maintenance as monitoring sites could usually only be visited once a year. Finally, we aimed at high precision and simple data sets which can be easily handled and analysed. As none of the existing measurement approaches met our requirements, we developed a new device based on the potentiometric measurement of cable length combined with an affordable data logger.

Here, we intend to introduce this new measurement device and demonstrate its suitability to acquire high-quality data sets on surface motion under different conditions regarding land use, hydrology and peat properties. Using case studies with data from different sites, we first tested the temperature stability and the comparability with established approaches (peat camera, double pressure sensors). To ensure the reproducibility at small spatial scale, we employed three replicate sensors within short distance at three contrasting peatlands. Further, we compared three anchoring methods. To determine the limits of our method, we tested the applicability to a site with presumably little surface motion (very shallow peat-derived soil).

Results show no influence of air temperature on measurement results and good comparability with established devices. Depending on site conditions, different anchoring methods might be chosen. At all sites, surface motion was plausible given the water level, peat properties and

weather conditions. We could detect surface motion even for shallow peat-derived soils. Further, we could also show for all three peatlands that the three replicate sensors show the same results unless distances to drainage pipes differ. Overall, the newly developed LoCoMotion device can be recommended for peatland research.