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Spatiotemporal surface moisture dynamics on a coastal beach

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Surface moisture is a major limiting factor for aeolian sand transport on coastal beaches and, accordingly, understanding its spatiotemporal variability will aid in developing a predictive model for the input of wind-blown beach sand into the foredune. In our earlier work (Smit et al., 2017, Aeolian Research) we have illustrated that the reflectance signal of a near-infrared Terrestrial Laser Scanner (TLS) corresponds well to gravimetric surface moisture content (in %) over its full range. Here, we analyze TLS-derived surface moisture maps with a 1x1 m spatial and a 15-min temporal resolution and concurrent groundwater measurements collected during a falling and rising tide at Egmond beach, the Netherlands. The maps show that the beach can be conceptualized into three surface moisture zones. First, the swash zone, where the moisture content is always high (18% - 25%). Secondly, the intertidal zone, where the moisture content can vary between 5% – 25%. And thirdly, the back beach, which is always dry (3% - 7%). Temporal and spatial variations in surface moisture were linked strongly to the groundwater depth. Their relationship can be described well by a 'Van Genuchten-type' soil water retention curve. This opens up new opportunities to calculate surface moisture from groundwater measurements (or model predictions thereof) but also vice versa: to calculate groundwater depth with surface moisture measurements. Preliminary results already show corresponding patterns between measured and calculated surface moisture maps and groundwater depth maps. Concluding, the TLS-derived moisture maps and groundwater measurements clearly show that groundwater depth is a key control on spatiotemporal surface moisture variations.