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Spatial and temporal surface moisture dynamics on a coastal beach

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The surface moisture content on a coastal beach strongly influences aeolian sediment transport because it acts as primary control on the development of the fetch effect and increases the shear velocity threshold required to entrain sediment. However, the large spatial and temporal variability in moisture content are difficult to measure and, consequently, the key processes determining this variability are not well understood. Here, we study the spatial and temporal moisture variability on the narrow ($\sim$ 100 m during spring-tide ebb), barred beach of Egmond aan Zee, The Netherlands using measurements collected with an infrared terrestrial laser scanner (TLS; RIEGL VZ-400). Our earlier research has shown a robust negative relation between TLS reflection and gravimetric soil moisture contents for its full range (0% - 25%). This relation holds to about 80 m from the TLS. The TLS was deployed during several days in autumn 2015 for 6 hours during falling and rising tide with a 15- to 30-minute interval between individual 360° panorama surveys. Each survey produced O(10^6 - 10^7) reflection values, which we converted and averaged into surface moisture maps with a 0.25x0.25 m resolution. Preliminary analysis of the maps reveal that surface moisture varies highly in the intertidal zone (5% - 25%), but only little near the dune foot (2% - 5%). A striking result is the rapid desiccation of the intertidal sandbar when its crest is just below the high-tide level. Then, the surface-moisture content can decrease with a rate of $\sim$2.5% - 4% per hour, eventually reaching the same moisture content as the dry back beach. In contrast to the sandbar, the trough is constantly saturated as the groundwater table intersects the trough surface even during low tide. Moreover, surface moisture on the sandbar keeps on decreasing during rising tide until the bar inundates. Thus, no processes involving capillary forces are established in advance of the rising tide. The next step in our research is to investigate how tide-driven groundwater fluctuations, which were simultaneously measured using a cross-shore array of 10 groundwater wells, contributed to the observed surface-moisture variability.