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Quantifying roughness density of vegetation and nebkha dunes in the Chihuahuan Desert, New Mexico, USA using terrestrial laser scanning

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The roughness density and patterning of vegetation and nebkha dune elements in semi-arid environments has important implications for aeolian sediment transport. These individual elements often form complex spatial patterns, which are traditionally quantified as a single density or lambda value based on mean shrub height, breath and number of elements within a defined surface area. Measurements of height and width are undertaken using traditional surveying techniques or based on remote sensing imagery analysis, which are limited in their ability to capture the true frontal area of vegetation and dune elements, as well as the relationship between solid and flexible frontal area components. Here we use terrestrial laser scanning (TLS) to quantify three-dimensional plant and dune distributions, determining height and width values for individual elements in three different vegetation communities at the Jornada Experimental Range in the Chihuahuan Desert, New Mexico, USA. These communities include a creosote vegetated surface without dunes, an incipient mesquite nebkha dune environment and a mature mesquite nebkha dune site. TLS measurements compare well to manual measurements using DGPS and survey levels, but have the advantage that larger areas can be systematically quantified more efficiently. More importantly, TLS derived surface, dune and vegetation DEMs enable us to accurately characterise individual dune and shrub frontal areas under different wind directions, improving traditional lambda calculations.