



## Quantifying vegetation and geomorphic patterns within nebkhā dune fields using terrestrial laser scanning

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Vegetation and sand in semi-arid and coastal sediment starved environments typically interact and form nebkhā dunes. We examine the typical dune and vegetation patterns that form with varying amounts of sediment availability and nebkhā maturity at Jornada in the Chihuahuan Desert, New Mexico, USA using terrestrial laser scanning (TLS) to separate the plant and sand elements. Manual and automated TLS shrub height extractions compare well at all sites ( $p=0.48-0.94$ ) enabling the quantification of both solid and plant roughness element components. We find that there is a switch in orientation of the dune elements with respect to dominant wind direction from perpendicular to parallel as the landscape develops from an incipient to mature configuration and mesquite-nebkhā streets are enhanced. As the nebkhā dunes develop the surface coverage of bare sand increases and dune surfaces exceed the size of their companion shrubs. Roughness density also increases at the mature dune site. Over a three year period up to 20cm of erosion was measured on the upwind faces of the mature nebkhā dunes, in agreement with the dominant annual wind direction. However, deposition patterns were more diffuse and influenced by the vegetation patterns. TLS is a useful tool for examining complex sand-vegetation interactions and dune field development.