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Scaling field data to calibrate and validate high resolution RADAR remote sensing models: Estimating above ground woody biomass in northern Namibia

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Mapping woody above ground biomass (AGB) is essential for modelling carbon dynamics, quantifying carbon stock changes and forest management decisions. Throughout Namibian savannahs, two vegetation change processes are widespread, yet their spatial and temporal impact on AGB remains little known: 1) deforestation and forest degradation, and 2) the encroachment of the herbaceous layers by woody strata. Both of these vegetation change processes impact ecosystem services and the economic use of the land. This study quantifies changes in AGB over an 8 year period for a region of Kalahari woodland savannah in northern Namibia. Data from 101 forest inventory plots collected during two field campaigns (2014-2015), were used to model woodland AGB with the regression tree-based algorithm (Random Forest), as a function of the Advanced Land Observing Satellite (ALOS) Phased Array L-band Synthetic Aperture Radar (PALSAR and PALSAR-2) and Landsat metrics for 2007 and 2015. The model explained 96% and 91% of the variance for 2007 and 2015, respectively. Results were validated independently using space-born LiDAR derived vegetation canopy height metrics (R2=79% and 72%). We find an overall gain in AGB despite wide-spread, small-scale deforestation. This is potentially attributable to extensive woody thickening, which is agreement with long-term field observations.