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Predictive modelling of savannah woody cover: A multi-temporal and multi-sensor machine learning investigation

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Effective monitoring of the Earth's ecosystems requires the availability of methods for quantifying the structural composition and cover of vegetation. This is especially important in heterogeneous environments, such as semi-arid savannahs which are naturally comprised of a dynamic mix of tree, shrub, and grass components. The fractional coverage of woody vegetation is a key ecosystem attribute in savannahs, particularly given current concerns over the invasion of grasslands by shrub species (shrub encroachment), or the over-exploitation of woody biomass for fuelwood. Remote sensing has a clear role to play in monitoring semi-arid environments, and in recent years the number of both spacebourne sensors and collected scenes has increased dramatically allowing for multi-temporal and multi-sensor investigations.

Here we employ a statistical learning framework to assess the potential of optical and radar imagery for predicting fractional woody cover. We test a number of different model combinations in the Kruger National Park, South Africa. Our results show that combining Landsat and PALSAR data produces the most accurate predictions (R2 =0.65, P < 0.001, RMSE =0.094). However, this was only marginally more effective than a model using multitemporal Landsat data from the wet and dry seasons (R2 = 0.64 < 0.001,RMSE = 0.094). When a single temporal epoch is employed, dry season data consistently and significantly outperforms imagery from the wet period. These results are an important addition to the growing literature on fractional cover prediction.