Abstract:

Accurate estimates of papyrus (Cyperus papyrus) biomass are critical for an efficient papyrus swamp monitoring and management system. The objective of this study was to test the utility of random forest (RF) regression and two narrow-band vegetation indices in estimating above-ground biomass (AGB) for complex and densely vegetated swamp canopies. The normalized difference vegetation index (NDVI) and enhanced vegetation index (EVI) were calculated from field spectrometry data and fresh AGB was measured in 82 quadrats at three different areas in the iSimangaliso Wetland Park, South Africa. NDVI was calculated from all possible band combinations of the electromagnetic spectrum (350 and 2500 nm), while EVI was calculated from possible band combinations in the blue, red, and near infrared of the spectrum. Backward feature elimination and RF regression were used as variable selection and modelling techniques to predict papyrus AGB. Results showed that the effective portions of electromagnetic spectrum for estimation AGB of papyrus swamp were located within the blue, red, red-edge, and near-infrared regions. The three best selected EVIs were computed from bands located at (i) 445, 682, and 829 nm, (ii) 497, 676, and 1091 nm, and (iii) 495, 678, and 1120 nm. These indices produced better predictive accuracies (R2 = 0.90; root mean square error of prediction (RMSEP) = 0.289 kg m−2; 7.99% of the mean) than the best selected NDVIs (R2 = 0.85; RMSEP = 0.343 kgm−2; 9.49% of the mean) that were calculated from bands located at (i) 739 and 829 nm, (ii) 739 and 814 nm, (iii) 744 and 789 nm, and (iv) 734 and 909 nm. The results of the present study demonstrate the utility of narrow-band vegetation indices (EVI and NDVI) and RF regression in estimating papyrus AGB at high density, a previously challenging task with broadband satellite sensors.