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TITLE: Structural characterisation of mangrove forests achieved through combining multiple sources of remote sensing data

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ABSTRACT:

Temporal information on mangrove extent, age, structure and biomass provides an important contribution towards understanding the role of these ecosystems in terms of the services they provide (e.g., in relation to storage of carbon, conservation biodiversity), particularly given the diversity of influences of human activity and natural events and processes. Focusing on the Matang Mangrove Forest Reserve (MMFR) in Perak Province, Peninsular Malaysia, this study aimed to retrieve comprehensive information on the biophysical properties of mangroves from spaceborne optical and Synthetic Aperture Radar (SAR) to support better understanding of their dynamics in a managed setting. For the period 1988 to 2016 (29 years), forest age was estimated on at least an annual basis by combining time-series of Landsat-derived Normalised Difference Moisture Index (NDMI) and Japanese L-band Synthetic Aperture Radar (SAR) data. The NDMI was further used to retrieve canopy cover (%). Interferometric Shuttle Radar Topographic Mission (SRTM) X/C-band (2000), TanDEM-X-band (2010?2016) and stereo WorldView-2 stereo (2016) data were evaluated for their role in estimating canopy height (CH), from which above ground biomass (AGB, Mg ha⁻¹) was derived using pre-established allometry. Whilst both L-band HH and HV data increased with AGB after about 8?10 years of growth, retrieval was compromised by mixed scattering from varying amounts of dead woody debris following clearing and wood material within regenerating forests, thinning of trees at ~15 and 20 years, and saturation of L-band SAR data after approximately 20 years of growth. Reference was made to stereo Phantom-3 DJI stereo imagery to support estimation of canopy cover (CC) and validation of satellite-derived CH. AGB estimates were compared with ground-based measurements. Using relationships with forest age, both CH and AGB were estimated for each date of Landsat or L-band SAR observation and the temporal trends in L-band SAR were shown to effectively track the sequences of clearing and regeneration. From these, four stages of the harvesting cycle were defined. The study provided new information on the biophysical properties and growth dynamics of mangrove forests in the MMFR, inputs for future monitoring activities, and methods for facilitating better characterisation and mapping of mangrove areas worldwide.

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