



# Development of a Rapid Mangrove Zonation Mapping Workflow Using Sentinel 2-Derived Indices and Biophysical Dataset

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Moderate to high resolution satellite imageries are commonly used in mapping mangrove cover from local to global scales. In addition to extent information, studies such as mangrove composition, ecology, and distribution analysis require further information on mangrove zonation. Mangrove zonation refers to unique sections within a mangrove forest being dominated by a similar family, genus, or species. This can be observed both in natural and planted mangrove forests. In this study, a mapping workflow was developed to detect zonation in test mangrove forest sites in Katunggan-Ibajay (KII) Ecopark (Aklan), Bintuan (Coron), Bogtong, and Sagrada (Busuanga) in the Philippines and Fukido Mangrove Park (Ishigaki, Japan) using Sentinel-2 imagery. The methodology was then applied to generate a nationwide mangrove zonation map of the Philippines for year 2020. Combination of biophysical products, water, and vegetation indices were used as classification inputs including leaf area index (LAI), fractional vegetation cover (FVC), fraction of photosynthetically-active radiation (FAPAR), Canopy chlorophyll content ( $C_{ab}$ ), canopy water content ( $C_w$ ), Normalized Difference Vegetation Index (NDVI), modified normalized difference water index (MNDWI), modified chlorophyll absorption in reflectance index (MCARI), and red-edge inflection point (REIP). Mangrove extents were first mapped using either the Maximum Likelihood Classification (MLC) algorithm or the Mangrove Vegetation Index (MVI)-based methodology. The biophysical and vegetation indices within these areas were stacked and transformed through Principal Component Analysis (PCA). Regions of Interest (ROIs) were selected on the PCA bands as training input to the MLC. Results show that mangrove zonation maps can highlight the major mangrove zones in the study sites, commonly limited up to genera level only except for genera with only one known species thriving in the area. Four zones were detected in KII Ecopark: *Avicennia* zone, *Nypa* zone, *Avicennia* mixed with *Nypa* zone, and mixed mangroves zones. For Coron and Busuanga, the mapped mangrove zones are mixed mangroves, *Rhizophora* zone and sparse/damaged zones. Three zones were detected in Fukido site: *Rhizophora stylosa*-dominant zone, *Bruguiera gymnorrhiza*-dominant zone, and mixed mangrove zones. The zonation maps were validated using field plot data and