An updated national-scale mangrove forest map in China Using Sentinel-1 and Sentinel-2 Time-Series Data with Google Earth Engine

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A high resolution mangrove map (e.g., 10-m), which can identify mangrove patches with small size (< 1 ha), is a central component to quantify ecosystem functions and help government take effective steps to protect mangroves, because the increasing small mangrove patches, due to artificial destruction and plantation of new mangrove trees, are vulnerable to climate change and sea level rise, and important for estimating mangrove habitat connectivity with adjacent coastal ecosystems as well as reducing the uncertainty of carbon storage estimation. However, latest national scale mangrove forest maps mainly derived from Landsat imagery with 30-m resolution are relatively coarse to accurately characterize the distribution of mangrove forests, especially those of small size (area < 1 ha). Sentinel imagery with 10-m resolution provide the opportunity for identifying these small mangrove patches and generating high-resolution mangrove forest maps. Here, we used spectral/backscatter-temporal variability metrics (quantiles) derived from Sentinel-1 SAR (Synthetic Aperture Radar) and sentinel-2 MSI (Multispectral Instrument) time-series imagery as input features for random forest to classify mangroves in China. We found that Sentinel-2 imagery is more effective than Sentinel-1 in mangrove extraction, and a combination of SAR and MSI imagery can get a better accuracy (F1-score of 0.94) than using them separately (F1-score of 0.88 using Sentinel-1 only and 0.895 using Sentinel-2 only). The 10-m mangrove map derived by combining SAR and MSI data identified 20,003 ha mangroves in China and the areas of small mangrove patches (< 1 ha) was 1741 ha, occupying 8.7% of the whole mangrove area. The largest area (819 ha) of small mangrove patches is located in Guangdong Province, and in Fujian the percentage of small mangrove patches in total mangrove area is the highest (11.4%). A comparison with existing 30-m mangrove products showed noticeable disagreement, indicating the necessity for generating mangrove extent product with 10-m resolution. This study demonstrates the significant potential of using Sentinel-1 and Sentinel-2 images to produce an accurate and high-resolution mangrove forest map with Google Earth Engine (GEE). The mangrove forest maps are expected to provide critical information to conservation managers, scientists, and other stakeholders in monitoring the dynamics of mangrove forest.