Coastal Elevation Model of Penghu Archipelago Reconstructed by Remote Sensing Imageries and DTU10 Tide Model

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Coastal area is the home to many conservation animals and its environmental protection is an important issue all over the world. However, an efficient and broad coverage monitoring system for geodetic purposes in coastal region has not been well structured in most countries due to the spatiotemporal restriction of ground surveys. In this study, we demonstrate a monitoring approach using Sentinel-1/-2 and Landsat radar/optical imageries to reconstructed coastal elevation model for Penghu archipelago located in the west of Taiwan.

Penghu is formed with more than one hundred islands and islets with a total area of 127 km2. Besides, it is composed of hundreds of stone fishing weirs that form a unique coastal landscape. However, urban expansion and tourism industry have altered coastal terrain and threatened the ecological system in this area. Therefore, we develop a workflow that utilizes satellite imageries to track the long-term variation of the coastline. First, we collected multiple optical and radar satellite imageries, including Landsat series, Sentinel-1, and Sentinel-2, to identify water pixels. For optical satellite imageries, we calculate the Modified Normalized Difference Water Index (MNDWI), and for radar imageries we use the single-threshold of backscatter intensity for water classification. Next, we sum up all imageries to calculate water appearance probability of each pixel and convert it into actual elevation by introducing the DTU10 tide model. Finally, we produce an up-to-date coastal DEM with 10 m resolution by using pan-sharpened Landsat images and Sentinel series data. Our preliminary results have been validated with in situ data and the vertical root-mean-square error (RMSE) is at 40–50 cm level.

Keywords: Coastline, Remote Sensing, Radar, MNDWI, Water Identification, DTU10, Taiwan, Penghu