Determining subsurface suspended sediment mechanisms through surficial remote sensing techniques, South Korea

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Satellite imagery provides information on the spatial distribution of surficial suspended sediment over broad scales in coastal environments. An outstanding challenge is to determine the extent to which surficial sediment distributions can be linked to sedimentary processes occurring near the seabed. Recent research indicates that dense sediment suspensions at the bottom of tidal channels off the southwest coast of South Korea limit upward turbulent mixing of sediment to the sea surface. This research investigates whether this sub-surface sediment process is detectable using sea surface reflectance as measured by the Landsat 8 satellite. The project's hypothesis is that the magnitude and variance of sea-surface reflectance will be lower in channels than in ridges due to dense suspensions in channels that limit vertical mixing. On the ridges, this process would not occur, because dense suspensions would flow into adjacent channels under the influence of gravity. As a result, reflectance would be higher and more variable at shallower depths. To assess this hypothesis, sea surface reflectance at 655 nm and 865 nm wavelengths were used as proxies for suspended sediment concentration in 15 cloud-free and atmospherically corrected Landsat 8 images collected from 2013–2018.

Reflectance in both bands was extracted over a tidal channel and over an adjacent tidal ridge. The reflectance from these two points was assessed for statistical correlation with depth and with other environmental variables, including sea level, wind speed, recent precipitation levels, and stage in the tidal cycle. Results indicate that depth exerts primary control on the mean and standard deviation of the reflectance, consistent with the project's hypothesis. Secondary controls on reflectance are wind speed and sea level. I propose that higher windspeeds are associated with larger reflectance due to re-suspension over fringing tidal flats and that the correlation of higher water levels with reduced reflectance is caused by sediment supply limitation.

In order to see if these methods can identify other areas with similar suspended sediment processes, two secondary sites – located in Gyeonggi Bay, South Korea and the Gulf of Khambhat, India have been analyzed. Preliminary results show that similar primary and secondary reflectance patterns appear in the Landsat 8 imagery. While further field work is needed to study the effects of tidally-dependant suspended sediment stratification on surface sediment concentration and associated reflectance, results indicate that remote sensing may be applicable to detection of subsurface suspended sediment processes.

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