Estimation of tidal area changes in Bangladesh using satellite images

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Coastal mudflats have various roles such as for water-purification, for maintenance of biodiversity, and for physical protection of coastlines. The areal change of coastal mudflats greatly affects marine ecosystem. Besides the artificial factors, the main factors related to the change differ from each region, such as the amount of sediment transported by the incoming river and the coastal current. Thus, to predict the influence on the marine ecosystem, it is important to regularly investigate the factors of the areal change of mudflats for each region. However, the field surveys on site take a heavy burden on the time and the economy, especially in developing countries. In this research, we propose a new method to easily estimate the temporal transition of the mudflats area using satellite images to obtain easily.

In previous studies, the shorelines were estimated using satellite images such as PALSAR and Landsat to know the area of mudflats. There are also a few areas where tidal level measurements are not carried out regularly, and there are some cases where the accuracy cannot be guaranteed because some mudflats are far from the tide station. In addition, the shorelines of mudflats are often assessed visually, in which case the question remains in the objectivity of the data analyses.

In this study, we aim to establish a simple method to assess the areal changes of mudflats, by examining the areal changes of mudflats in Jahajir Char, Bangladesh; Jahajir Char area had doubled in 6 years, from 2007 to 2013. Using the data of low and high tidal level obtained from a near tide station, we have corrected the area of mudflats obtained from various indices of Landsat images.

As a starting analysis, we use typical water index (mNDWI) to estimate the area of mudflats. When 0.09 values of mNDWI as a threshold to distinguish the coastlines was adopted at high tidal situation, almost the same area with the previous report was estimated. On the other hand, considering a wetland at low tidal situation, we set to 0.30 values as a threshold often used as a boundary between wet and dry land. When the area of mudflats is defined the difference between the low and the high tidal area, the area was 29.3 km^2 in 2007, 13.4 km^2 in 2013, respectively. Using this analysis, however, has two problems.

First, we cannot take into account the difference between the shooting time of the satellite image and the actual low/high tide time. We plot the area of mudflats calculated from satellite images obtained at each month in 2013. Figure shows the relationship between the area of mudflats and the tidal level at the satellite images taken. By using this correlation, the area of mudflats at any time can be calculated. Second problem lies in when the water index is used, the threshold varies depending on the time of the tide level. This can be solved by combining other indices such as soil index and vegetation index.

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