OBSERVATION OF SUSPENDED SEDIMENT ALONG THE NORTH OF TAIWAN COASTAL WATER REGION FROM THE FORMOSAT-5 HIGH-RESOLUTION IMAGERY

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This extended abstract describes the use of the Formosat-5 (FS5) high-resolution imagery to observe suspended sediment along the coastal water belongs to the north of Taiwan.

1) Context/Purpose

Formosat-5 (FS5) was launched on August 25, 2017, continues the mission of its predecessor, Formosat-2, which was decommissioned in August 2016. FS5 is operated by the National Space Organization (NSPO), Taiwan, and provides high-resolution images with the spatial and temporal resolution are 4-m resolution multispectral (color) and one-day visiting, respectively [1]. There is not any study to consider FS5 to determine the optical characteristics of water in coastal regions. Therefore, we propose the use of the satellite for observation of suspended sediment (SS) concentrations in Taiwan's coastal water regions. We believe the key findings of this study will be a significant contribution to not only the 42nd Asian Conference on Remote Sensing but also the scientific community.

2) Methods and materials

The data processing consists of two steps: removing the atmosphere's influence and calculating suspended sediment concentration.

We propose a simple approach to convert the digital number (DN) into remote sensing reflectance (Rrs) using linear regression based on five different ground targets belong to the north of Taiwan. These targets include 60 samples were divided into two categories, namely bright targets and dark targets [2],[3]. The bright targets included the surface materials such as asphalt, concrete, roofs. The dark targets included vegetation and the surfaces of lake water. The remote sensing reflectance (Rrs) of ground targets derived from the Landsat-8 Operational Land Imager (OLI) satellite images were atmospherically corrected using the Fast Line-of-sight Atmospheric Analysis of Spectral Hypercubes (FLAASH) model in the ENVI application [4].

Suspended sediment concentrations were computed by using a model developed for Taiwan coastal waters with a good agreement between transformed data and observed SS concentrations. To ensure a developed model makes sense, we set the smallest correlation coefficient for each band to be 0.82 ($R^2 \geq 0.82$). We used nine designated positions from the Environmental Protection Administration (EPA) located in Taiwan's north coastal waters to develop the model. SS values from EPA were transformed by using data from Landsat-8 images at the same positions [5].

3) Results and Discussion

The results of removing the atmosphere's influence part indicated that linear regression performed well done on the four bands of the images between FS5 and OLI. Particularly, the largest correlation coefficient was obtained by the red band ($R^2 = 0.94$), whereas the smallest correlation coefficient was obtained by the blue band ($R^2 = 0.87$). Furthermore, we used the spectral profiles belonging to both vegetation and water objects to cross-check from the blue to NIR band. The results regarding spectral profiles provide good performance in spectral forms.

The results also indicated that the remote sensing reflectance of FS5 images can be useful for estimating SS concentration (g/m^3) in the north of Taiwan coastal water region with both green band ($R^2 = 0.83$) and red band ($R^2 = 0.85$).

$$SS = 392.80 * \mathrm{Rrs(Green)} - 5.63 \quad (1)$$

$$SS = 425.97 * \mathrm{Rrs(red)} - 3.02 \quad (2)$$

Both equations (1) and (2) provided $R^2 > 0.82$, so they make sense for computing suspended sediment concentration. We decide to choose equation (2) for Taiwan's coastal water region.

There are some issues such as the accuracy assessment, discussion of SS algorithms, and cross-check of SS derived from FS5 with in-situ measurements that need fully investigated in the future.

4) Conclusions

The linear regression provided a good relationship between FS5 and OLI with the coefficients of determination for blue, green, red, and near-infrared bands with a range of (0.87-0.94). It indicates that the remote sensing reflectance derived from the FLAASH provides a good bridge to convert DN to Rrs conversion aim to remove atmospheric effects on FS5 images. The results also suggested that after removing the effect of atmospherics, suspended sediment concentration in the north of Taiwan coastal water region can be observed by using the red band of FS5 high-resolution imagery.

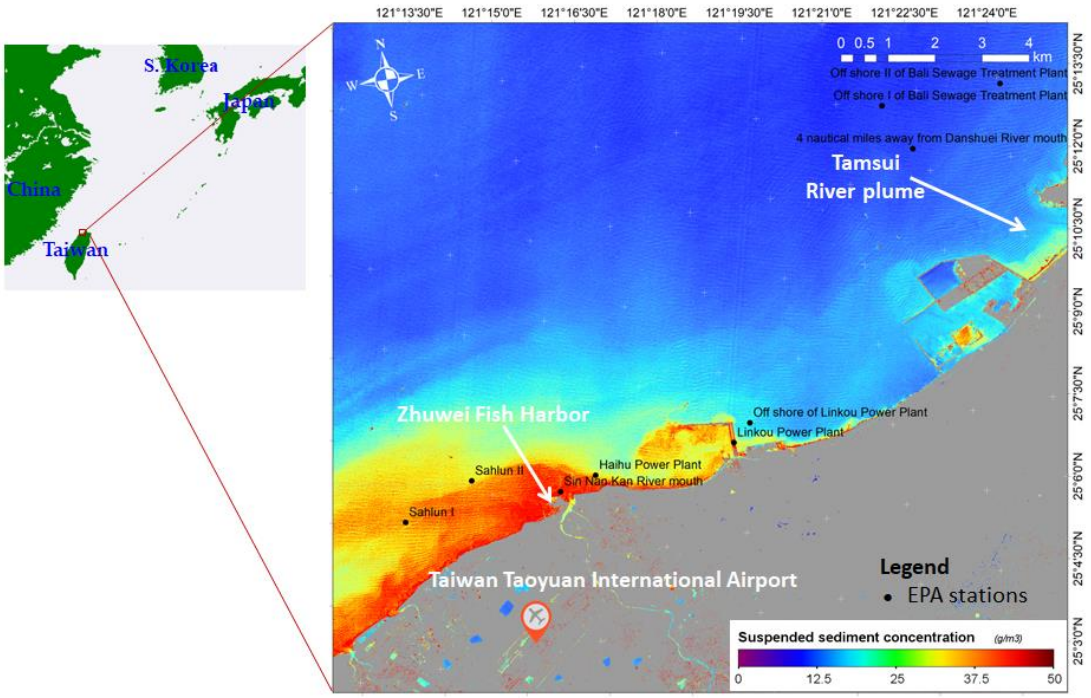

Figure1. FS5-derived SS concentrations in the north of Taiwan coastal water region

Keywords: Formosat-5, suspended sediment, coastal water, Taiwan.

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