Water Quality Survey in the Isahaya Bay using UAV

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1. Introduction

Recently, in the Isahaya Bay, a critical problem with the worse environmental system occurred as well as rapid water conversion. However, remote sensing on water quality estimate in the Isahaya bay was still not enough. In this paper, 6 items of water quality were examined with high spatial resolution.

2. Methods

The data were made through four processes. First, RGB and Infrared data were acquired by UAV in the field directly, and the ocean temperature data were acquired from Japan Coast Guard and a thermal camera. Second, from obtaining water quality and acquiring water image data, multivariable analysis was applied to get water quality regression lines. Third, for mapping of water quality, water quality regression equations by multivariable analysis were substituted into PhotoScan. Finally, all the data were summarized from water quality correlation.

3. Results

The multivariable analysis was applied for water quality data using bands 1, 2, 3, and 4 to get regression equations. Water quality was estimated by these equations, and then, the water quality indices are shown in Table 1. Water quality index distributions are summarized in Fig.1. (a) is combined photos by UAV. (b) is salt content distribution, and it shows the river flows into the bay. Thus, the Isahaya Bay was water conversion state. (c) is chlorophyll-a distribution. There were much Chlorophyll-a on the sea, while a little in the river. (d) is conductivity. Conductivity in the river was lower than the Conductivity is almost proportion to salt content. (e) is turbidity distribution. Turbidity comes from mostly soils. (f) is pH distribution. pH depends on carbon dioxide, which relates chlorophyll-a.

4. Discussion

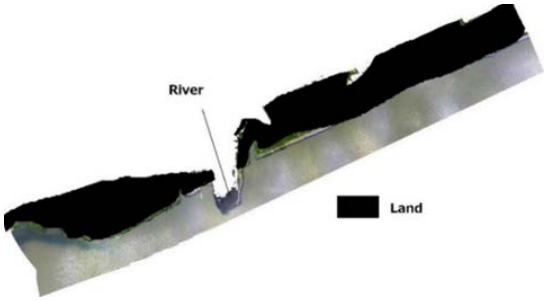
Phantom 4 can fly at a height of about 300m if you have permission to apply. Considering an angle of view for UAV, the horizontal range is about 600m. To capture bands of IR and RGB, it is important to obtain the maximum altitude. PhotoShop can pile up IR and RGB images. However, because of time-consuming work, it should be desirable to automate. Photoscan can combine 3D, but it is impossible to make band4 as a layer in 3D state. Photoshop can resolve this problem because of making a layer as orthophoto. As you apply IR filter to UAV, it is difficult to pilot the UAV, thus you must pilot it visually. Also, UAV shouldn’t be piloted on a rainy day.

5. Conclusion

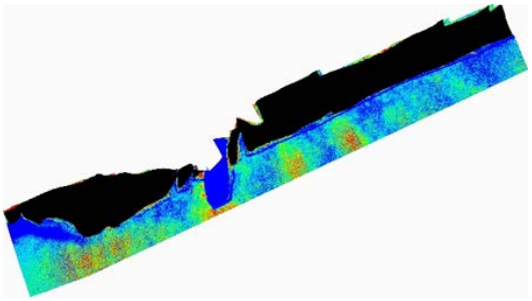
The water quality analysis was carried out with regression equations by multivariable analysis for UAV photographs and water sampling tests. In the Isahaya bay, the correlation among water quality indices was very high and water quality could be estimated each other. Finally, water quality distributions each index were obtained with high spatial resolution using UAV RGB and IR regression equations.

References

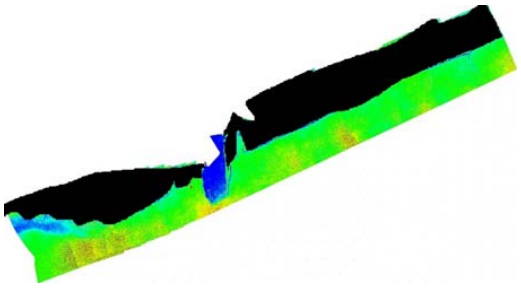
S. Otsubo, S. Ogawa ,H. Hidaka, G. Yamada,
Present State of UAV and Applications for Civil Engineering, *NAOSITE*, 46(87), pp43~49; 2016.



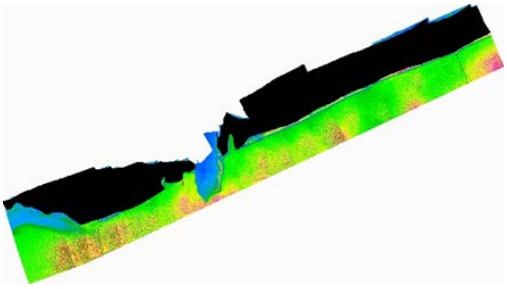
(a) Orthophoto



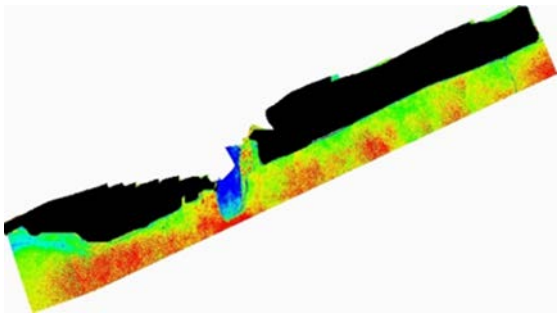
(d) Conductivity



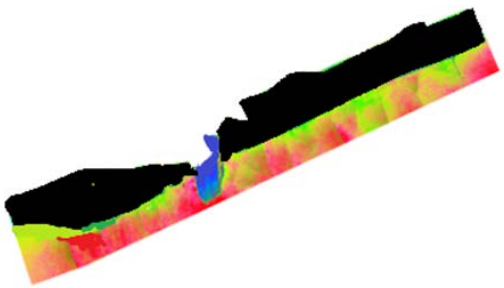
(b)salt content



(e)Turbidity



(c)chlorophyll-a



(f)pH

Fig.1 Spatial distributions of water quality indices using UAV in the Isahaya Bay

Table.1 Multivariable analysis results of water quality index

Chlorophyll-a (μ g/l)	-2.53band1+3.85band2-1.35band3＋0.65band4-57.7(R=0.84)
Conductivity(μS/cm)	0.01band1-0.01band2＋0.01band3-0.002band4＋0.113 (R=0.50)
Turbidity	－6.39band1＋8.59band2-3.06band3+1.52band4-35.3 (R=0.82)
DO (%)	26.7band1-68.7band2+8.16band3+6.55band4＋3073 (R=0.662)
Water temperature (ºC)	0.03band1-0.06band2＋0.01band3+0.01band4＋21.5 (R=0.71)
pH	-0.02band1+0.03band2-0.01band3+0.002band4＋8.35 (R=0.75)