# Spatial distributions of NDVI and NDWI for Onigi rice terrace in Hasami using UAV

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## 1. INTRODUCTION

Photogrammetry by UAV is lower cost and higher resolution than satellite images. Flight is controlled by automatic navigation of *Litchi for DJI Mavic/Phantom/Inspire*. A wide range of land cover distribution maps can be created. In this study NDVI and NDWI in spring at Onigi rice terrace in Hasami were calculated using automatic navigation of UAV. The images of rice terrace are shown in Figs. 1 and 2. Then, time series of NDVI and NDWI will be obtained through the year using UAV.

## 2. METHODS

### 2.1 Creating the aerial route

A Phantom 4 was used for this study. A route was created using *Litchi for DJI Mavic/Phantom/Inspire*. The flight distance was 6.6 km, the flight time was 18 minutes, and the height was 150 m. The route diagram is shown in Fig. 3.

### 2.2 Taking the aerial images

On April 2, 2017, the aerial images were taken in the rice paddy with the same route in visible range, near infrared, short wavelength infrared. The RGB images were 476, near infrared were 468, and short infrared were 461. The band composition is shown in Table. 1.

### 2.3 Images analysis

3D models and orthophotos were created from the aerial images using PhotoScan. The spatial distributions of NDVI and NDWI were created using ArGIS from RGB and infrared images for vegetation and soil distribution maps in rice paddy fields. Each defined equation is shown in (1) and (2).

$$NDVI = \frac{Band4 - Band3}{Band4 + Band3} \quad (1)$$

$$NDWI = \frac{Band3 - Band5}{Band3 + Band5} \quad (2)$$

where Band 3 is red, Band 4 is near infrared and Band 5 is short infrared.

## 3. RESULTS

Figs. 4-7 show created orthophotos in a visible range, NDVI, NDWI distributions and DEM image. These four images were pasted on *base map* of ArcGIS. NDVI was the highest in the mountains and tea fields, and the lowest in rice fields and houses. NDWI was the highest in the mountains and the lowest in the houses.

## 4. DISCUSSION

NDVI and NDWI corresponded to land uses. Compared to manual navigation, automatic navigation was able to capture the whole area even with complicated routes. For a factor that these distributions could be created, the weather was sunny. With monthly data, water balance and vegetation production will be estimated.

## 5. CONCLUSIONS

Distributions of NDVI and NDWI using UAV can be produced at Onigi rice terrace in Hasami town. Automatic navigation was introduced to acquire data of flying routes with *Litchi for DJI Mavic/Phantom/Inspire*. With this method, the vegetation production and time series of water balance will be obtained.

## REFERENCES

S. Otsubo, S. Ogawa, H. Hidaka, and Y. Imamura, Survey on the vegetation cover and irrigation for rice terrace with UAV, *NAOSITE*, 47(88), pp7-12; 2017

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Table. 1 Band composition

| Band | Wavelength (nm) | Color |
|---|---|---|
| 1 | 450-520 | Blue |
| 2 | 520-600 | Green |
| 3 | 630-690 | Red |
| 4 | 720-900 | Near Infrared |
| 5 | 900< | Short Infrared |

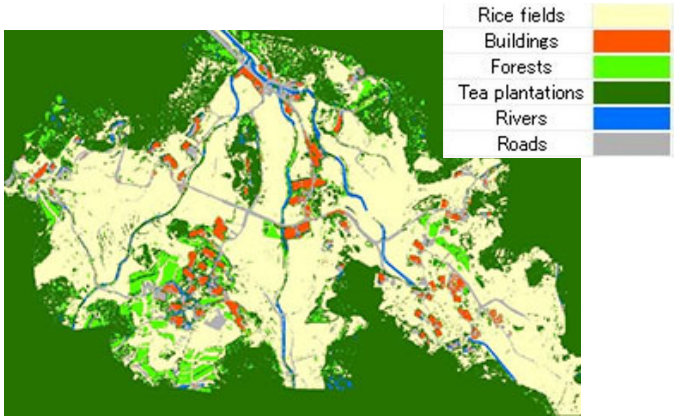
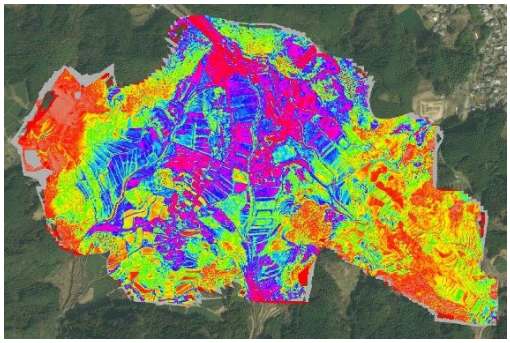



Fig. 1 Land use map

Fig. 2 Horizontal image of Onigi rice terrace

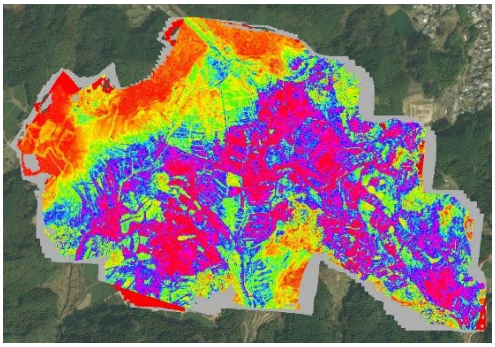
Fig. 3 Aerial route of Phantom 4 using *Litchi for DJI Mavic/Phantom/Inspire*

Fig. 4 Orthophoto in a visible range



low high

Fig. 5 NDVI spatial distribution



low high

Fig. 6 NDWI spatial distribution

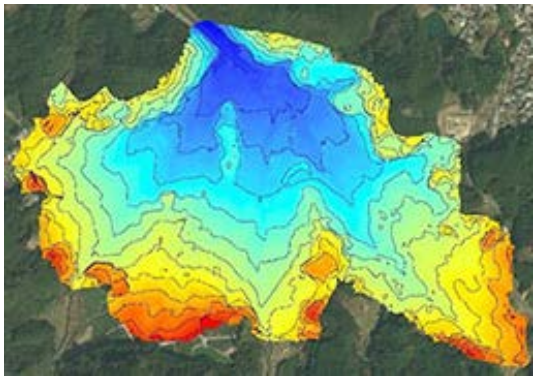


Fig. 7 DEM image