EGU2020: "Big data and machine learning in geosciences",
Sharing Geoscience Online, 7th May, 2020.

Riverscape Classification by Using Machine Learning in Combination with Satellite and UAV Images

Hitoshi MIYAMOTO[1)], Takuya SATO[2)], Akito MOMOSE[1,2)], and Shuji IWAMI[2)]

1) Shibaura Institute of Technology (SIT), Tokyo, Japan
2) CTI Engineering Co., Ltd, Tokyo, Japan

芝浦工業大學 SHIBAURA INSTITUTE OF TECHNOLOGY Established 1927

株式会社 建設技術研究所

CONTENTS

芝浦工業大學 SHIBAURA INSTITUTE OF TECHNOLOGY Established 1927

株式会社 建設技術研究所

INTRODUCTION Background and Purpose

Kurobe River @3k, 28th,Nov,2017

Kurobe River @3k, 28th,Nov,2017

Vegetation overgrowth and forest expansion have become a serious engineering problem for river management in Japan and around the world.

- decreasing ***Water Flow Capacity at Flooding***
- changing ***Groundwater*** **Levels,**
  Hyporheic **Processes,**
  Sediment and Nutrient Cycles,
  Riparian Ecosystems and
  Original Riverine Landscapes

From both viewpoints of **flood control** and **ecological conservation**, it would be necessary to **continuously monitor the vegetation dynamics** for a long period of time.

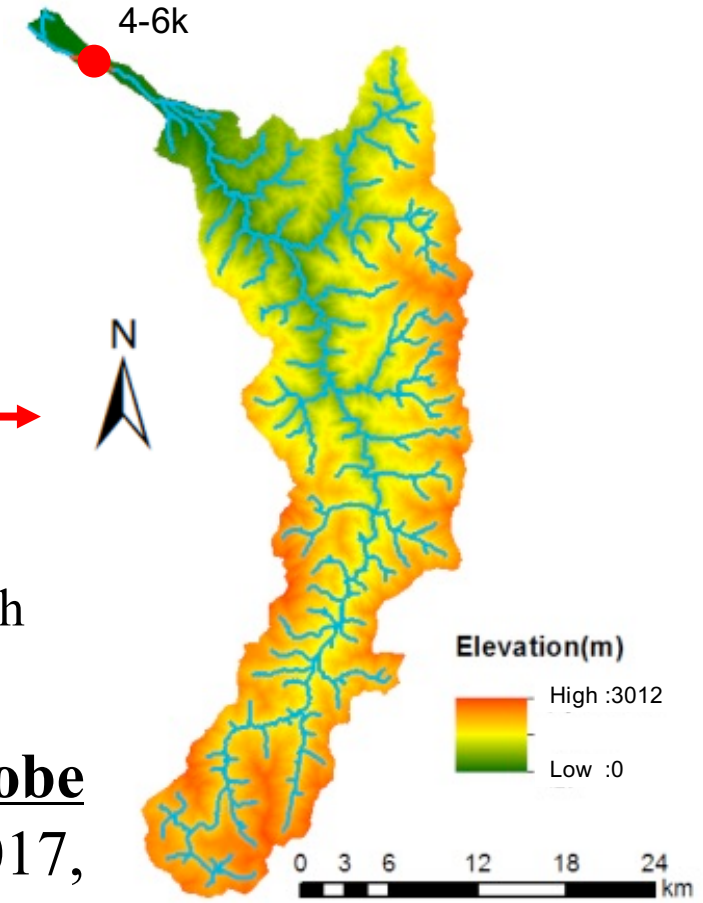
- Technical Development :
  AI Technology
  UAV (unmanned aerial vehicle) Measurement
- High Availability:
  Satellite Images

This presentation examined **a new method for classifying riverine land covers** by using **the machine learning technique** applied to both **the satellite and UAV images** in a Kurobe River channel.

FIELD SITE AND IMAGES (1) River

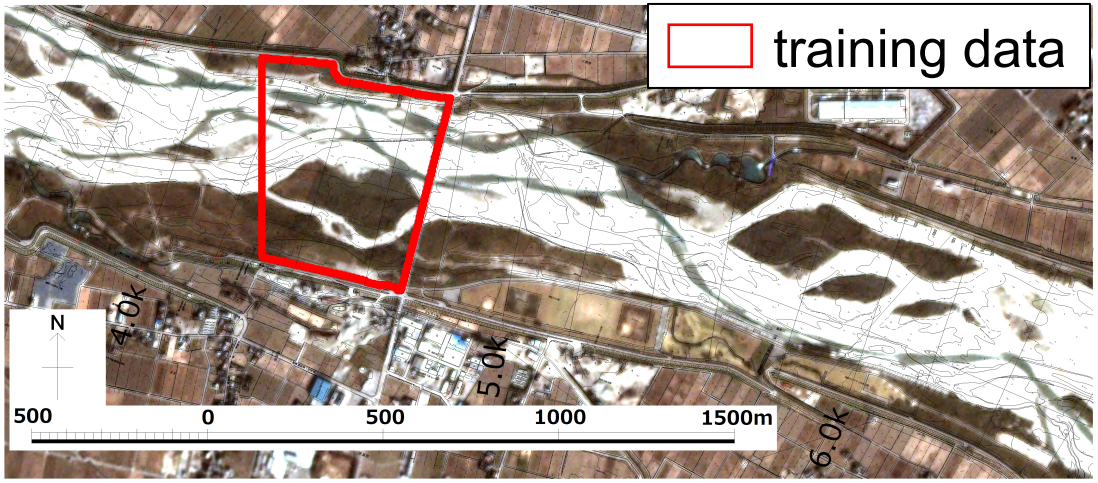
Field Site: **Kurobe River**, Central Japan

@ channel location:
4-6 km upstream from the river mouth



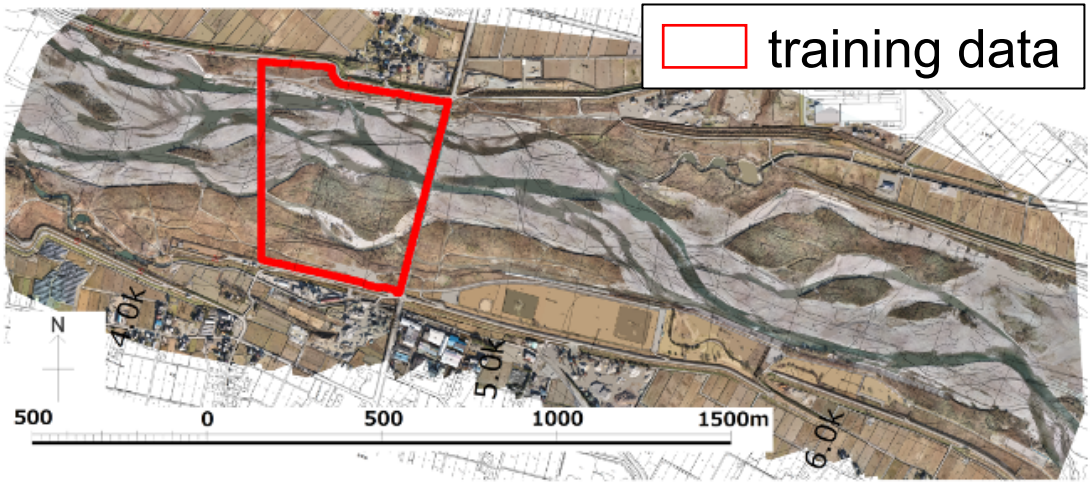
✓ The UAV images were taken in the **Kurobe River** channel on November 28th, 2017, which was ***a braided channel with a well-vegetated gravel bed***.

FIELD SITE AND IMAGES (2) Images



Satellite Image, 7th Nov., 2017 (from Planet Company)

- ✓ RGB, Near Infrared
- ✓ Spatial Resolution: 3.0m × 3.0m



UAV Image, 28th Nov., 2017

- ✓ RGB, Near Infrared
- ✓ Spatial Resolution: 3.5cm × 3.5cm

METHODS (1) Outline

UAV and Satellite Image Processing to Make RGV and NDVI

Creating the Training and Validation Image Data

Land Cover Classification by a Machine Learning

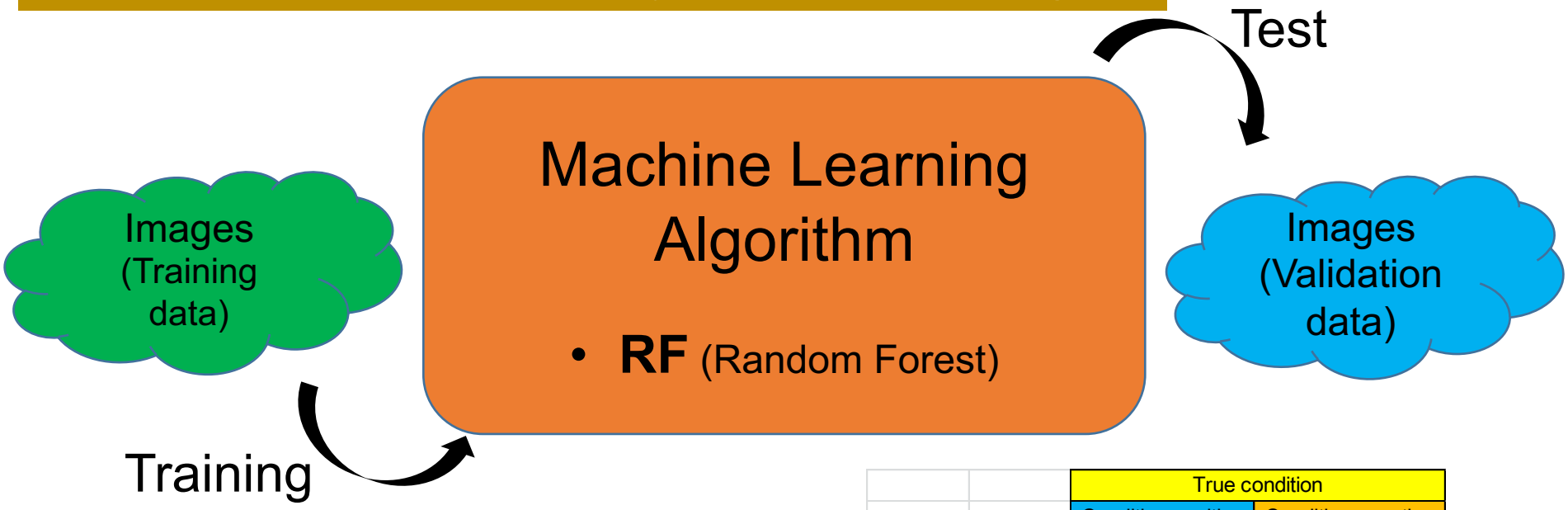
Evaluating Accuracy of the Present Methods

芝浦工業大學 SHIBAURA INSTITUTE OF TECHNOLOGY Established 1927

株式会社 建設技術研究所

METHODS (2)Random Forest and F-measure

Land Cover Classification by a Machine Learning



$$F-measure = \frac{2Recall \cdot Precision}{Recall + Precision}$$

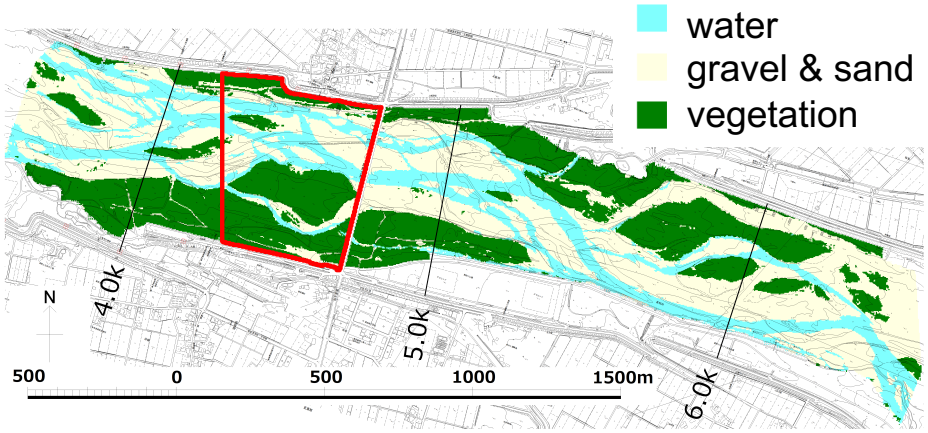
$$Precision = \frac{TP}{TP + FP} \qquad \text{Recall} = \frac{TP}{TP + FN}$$

		True condition	
		Condition positive	Condition negative
Predicted condition	Predicted condition positive	TP (True positive)	FP (False positive)
	Predicted condition negative	FN (False negative)	TN (True negative)

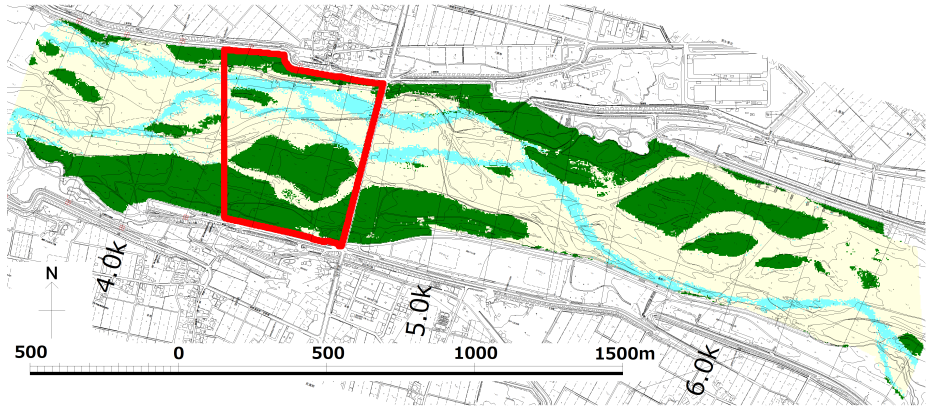
- The machine learning Algorithm used here was **RF (Random Forest)** in the scikit-learn.
- The **F-measure** was used to evaluate the accuracy and compare the results of the land cover classification with different combination of the UAV and Satellite images.

RESULTS AND DISCUSSION (1)

AI Land Cover Classification using only Satellite Images



Validation data



Land cover classification by
RF with Satellite Images (RGB+NDVI)

Table. Evaluation of Accuracy by F-measure

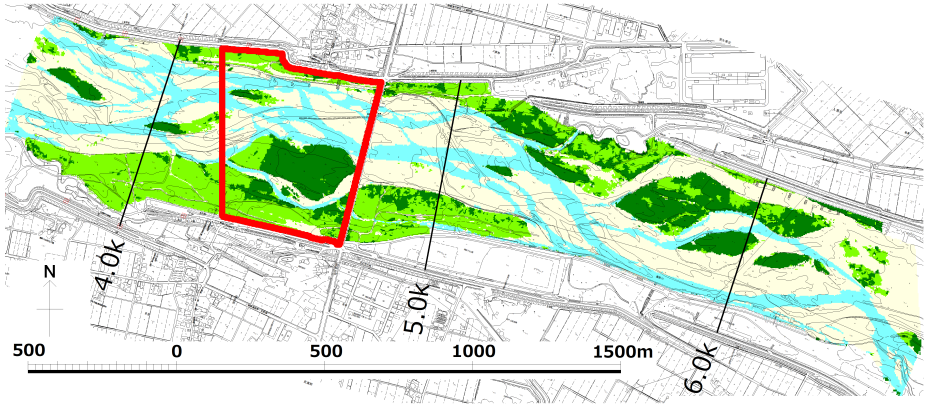
Land Cover	Data Set used in the Machine Learning		
	RGB	NDVI	RGB+NDVI (shown in left)
Water	0.48	0.57	0.58
Gravel & Sand	0.82	0.82	0.83
Vegetation	0.89	0.92	0.92
All	0.78	0.80	0.81

- ✓ Land covers classified into water, gravel & sand, and vegetation.
- ✓ Overall F-measure was 0.81 for the RGB+NDVI usage.
- ✓ Difficult to classify trees and grass from only satellite image information due mainly to low spatial resolution.

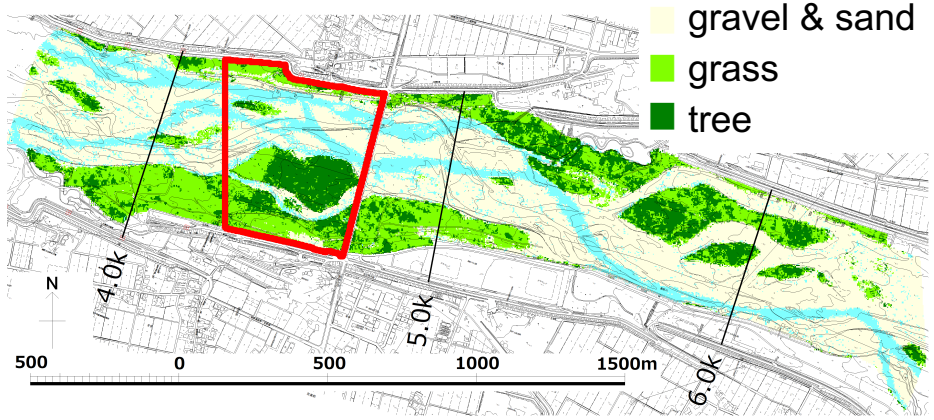
芝浦工業大學 SHIBAURA INSTITUTE OF TECHNOLOGY Established 1927
株式会社 建設技術研究所

RESULTS AND DISCUSSION (2)

AI Land Cover Classification using UAV & Satellite Images



Validation data



Land cover classification by
RF with UAV & Satellite Images (RGB+NDVI)

F-measure

Land Cover	Data Set for ML.
	RGB+NDVI
water	0.66
gravel & s.	0.83
grass	0.70
tree	0.65
All	0.74

Comparison of Image Data Difference

Land Cover	Training Data Set for ML. (RGB + NDVI)	
	Satellite	UAV (vegetation <- tree + grass)
water	0.58	0.66
gravel & s.	0.83	0.83
vegetation	0.92	0.93
All	0.81	0.83

- ✓ Land covers classified into water, gravel & sand, **grass, and tree**.
- ✓ Overall F-measure was 0.74 for the RGB+NDVI usage.
- ✓ Able to classify trees and grass from Satellite image plus **UAV image information as a training data.**

芝浦工業大學 SHIBAURA INSTITUTE OF TECHNOLOGY Established 1927
CTI 株式会社 建設技術研究所

CONCLUDING REMARKS

- This presentation examined a new method for **classifying riverine land covers** by using the **machine learning technique** applied to both the **satellite and UAV images** in a Kurobe River channel.
- The method used **Random Forests (RF)** for the classification with **RGBs and NDVIs** of the images in combination.
- In the process, the **high-resolution UAV images** made it possible to create accurate training data for the land cover classification of **the low-resolution satellite images**.
- The results indicated that the **combination of the high- and low-resolution images in the machine learning** could effectively detect waters, gravel/sand beds, **trees, and grasses** from the satellite images with a certain degree of accuracy.
- These results could actively support the effectiveness of the **present machine learning method in the combination of satellite and UAV images** to grasp the most critical areas in **riparian vegetation management**.

Thank you for reading!

科研費 KAKENHI

This work was partially supported by JSPS KAKENHI Grant Number 16H04422.

芝浦工業大學 SHIBAURA INSTITUTE OF TECHNOLOGY Established 1927

株式会社 建設技術研究所