**A generative adversarial network-based anomaly detection in Japanese paddy fields using Sentinel-2**

Ogawa S.1 and Matsuoka M.2\*

1Master Course Student, Graduate School of Engineering, Mie University, Japan

2Associate Professor, Graduate School of Engineering, Mie University, Japan

\*matsuoka@info.mie-u.ac.jp

***ABSTRACT***

Global warming and extreme weather have caused a serious problem in rice growth. In addition, the decline in the number of farmers has led to the necessity of managing expansive tracts of farmland. Hence, it is important to quickly detect anomalies in farms and take appropriate action. Machine learning-based anomaly detection is currently utilized in the medical and manufacturing fields, thus there is a possibility of its utilizations in the field of remote sensing as well. The objective of this study is to detect anomalies in paddy fields over a wide area using satellite images based on generative adversarial network (GAN). We used the Multispectral Instrument (MSI) onboard Sentinel-2 observed on 17 July 2023, in the middle of the rice growing season. The target area was the entire Okayama Prefecture, and paddy field pixels were identified by farmland parcel polygon data. The considerable outliers, represented by clouds, were removed manually. To distinguish anomaly, the Mahalanobis' distance (MD) was calculated for each pixel using 10 bands with the spatial resolution of 10 m and 20 m. Anomalous pixels were determined based on the threshold for MD. We modified the fast Anomaly Detection with Generative Adversarial Networks (f-AnoGAN) from image-based to spectral-based architecture. We could generate similar spectral reflectance for normal paddy field pixels using the full-connected neural network, and could detect the anomalous pixels that have different spectra from those normal pixels. This study shows that anomaly detection by GAN is comparable to classification by MD. The detection accuracy will be shown at the symposium with the comparison of MD-decided anomaly. it is necessary to verify how the paddy fields differ depending on the degree of anomality. (277words)

**Keywords:** Anomaly detection, generative adversarial network (GAN), Mahalanobis distance (MD), paddy field, Sentinel-2