Mixture Analysis of Abandoned Paddies Using Multi-temporal MODIS and Landsat-8 OLI Data

*Asahi Sakuma[1], Hiroto Shimazaki[1]

1.National Institute of Technology, Kisarazu College

Increase of abandoned farmlands is gaining attention in Japan as a problem causing difficulties such as: expansion of breeding habitat potentially preferred by vermin; increase of small parcels where illegal dumping occurs; and deterioration of rural landscapes. To address this problem, it is important to periodically survey the extent and distribution of abandoned farmlands over a broad spatial range. However, conventional surveying methods are labor intensive and time-consuming, requiring surveyors to cover every parcels often situated in hostile locations.
Remote sensing provides us with a low cost, repeatable alternative means for broad-scale mapping of abandoned paddies. A previous study suggested that Normalized Difference Vegetation Index (NDVI) derived from remotely-sensed data could have potential to discriminate an abandoned paddy from a paddy area since the difference in NDVI becomes significant at the period s of one month after planting and two months after harvesting. Normalized Difference Water Index (NDWI) was also applied successfully to detecting changes in agricultural activity in a paddy area. However, the success of previous studies depends on acquiring data not affected by cloud contamination at the suitable timing in terms of crop calendar. To avoid adverse effects of cloud contamination and the variability of crop calendar we proposed the use of MODIS NDVI and NDWI time-series. However, the typical size of abandoned paddy is quite small when compared to the MODIS spatial resolution.
The objective of this study is to assess the detection limit of an abandoned paddy using the time-series data derived from MODIS surface-reflectance products. First we refined the MODIS reflectance time-series by removing the effects of cloud contamination based on the Savitzky-Golay filter applied to NDVI time-series. Second a simple linear mixture model was employed to estimate the reflectance time-series of pure pixel for each of the underlying end-member land-cover types using the landcover map derived from Landsat 8 OLI data as a reference. Third we simulated a set of temporal signatures of NDVI and NDWI for mixed pixels, assuming that areal fraction of abandoned paddy varied gradually from 0 % to 100 % at different end-member compositions. Finally we explored the minimum fraction of abandoned paddy in a pixel, where the signal relevant to cessation of agricultural activity might be detected. Preliminary results showed that successful detection could be limited to the pixel dominated by abandoned paddy areas.

Keywords: Mixture Analysis, Abandoned Paddy, MODIS

Classification and Regression Tree Analysis of the Relationship between the Yellow Dust Concentration and TOA Reflectance observed with GOSAT CAI Sensor

*Tatsu-hiro Ogawa[1], Hiroto Shimazaki[1]

1.National Institute of Technology, Kisarazu College

Yellow dust, which is also known as yellow sand or Asian dust, is a seasonal meteorological phenomenon commonly observed in East Asia during the months of spring. The dust originates from the deserts of southern Mongolia and northern China and is then carried eastward by prevailing winds, passing over China, North and South Korea, and Japan, as well as parts of the Russian Far East. Although the major components of the dust are sand and materials from the earth’s crust, the possible adverse health effects of high concentration of the dust has been becoming a public concern for the regions in East Asia. To address the problem of transboundary air pollution, collecting and visualizing the data of dust concentrations is of importance as a first step. Satellite remote sensing has contributed to the near real-time monitoring of air pollutants over a broad spatial scale. The Thermal And Near-infrared Sensor for carbon Observation (TANSO) - Cloud and Aerosol Imager (CAI) sensor on board the Greenhouse gases Observing SATellite (GOSAT), which was designed to estimate the types and optical thickness of aerosols, is expected to have capability to detect the Yellow dust concentrations. However, its capability has not yet been confirmed well. This study statistically explored the relationship between the Yellow dust and the top-of-atmosphere (TOA) reflectance of wavelengths from near-ultraviolet (0.380 mm) to near-infrared (1.60 mm) observed by GOSAT CAI sensor, aiming to obtain fundamental information to generate an imagery product that visually enhances the Yellow dust concentrations. First we transformed the radiance in the CAI L1B product to the TOA reflectance, which was considered in this study as a response variable. Second we collected a suite of predictor variables which were expected to have some impact on the variation of TOA reflectance. The predictor variables concerning atmosphere conditions include: (1) the total amount of the Yellow dust above the ground, which was calculated from the estimates of the Chemical weather FORecasting System (CFORS); and (2) the clear-sky confidence level retrieved from the CAI L2 product. The predictor variables regarding land- and sea-surface conditions include: (1) the land-surface reflectance; and (2) sea-surface reflectance data. Both of them were retrieved from the CAI L3 product. Third the response and predictor variables were linked together by match-up processing in terms of time and location. Finally we employed a recursive partitioning approach known as Classification and Regression Tree (CART), where the resulting model could be represented graphically as a decision tree. Preliminary results of the CART analysis with the match-up data showed the relationship between the predictor and response variables to be different for each band. Findings from the resultant decision trees would provide us with a clue of how to deal with each band to generate an imagery product that visually enhances the Yellow dust concentrations over a broad spatial scale.

Keywords: Classification and Regression Tree, Yellow dust, GOSAT CAI

Mapping Bamboo Forest Distribution using Multi-temporal Landsat-8 OLI Data and Random Forest Classification Algorithm

*Naoki Hara[1], Hiroto Shimazaki[1]

1.National Institute of Technology, Kisarazu College

In recent years, the spatial distribution of bamboo forest has been expanding rapidly in various areas in Japan, resulting from cessation of appropriate forest management. Expansion of bamboo forest is considered as a problem that will cause difficulties such as: increase of the breeding habitat potentially preferred by vermin; and deterioration of traditional rural landscapes. To address this problem, it is essential to have a reliable information about the spatial distribution of bamboo forest over a broad spatial scale. Satellite remote sensing is expected to have potential to periodically identify the extent and distribution of bamboo forest over a nationwide scale. This study estimates land-use and land-cover (LULC) class using Landsat-8 OLI data to generate a LULC map product including a bamboo forest class. We used the Landsat-8 OLI multi-temporal imagery acquired in the period from 2013/09/01 to 2014/08/19. Random Forest classification algorithm was employed for each scene first, and a set of multi-temporal classification results were then aggregated based on probably vector approach. Classification accuracy of the final LULC map was accessed in terms of Cohen's Kappa coefficient. The result showed that the classification accuracy was fair to good (Kappa coefficient = 0.65), which was lower than expected. Future work includes: (1) refining the training data; (2) exploring the best combination of features; and (3) assessing the appicability of our approach to other areas.

Keywords: Landsat-8 OLI, Land Use and Landcover, Random Forest

Accuracy Assessment of Geospatial Data obtained using an UAV-based System with Autonomous Flight Capability

*Jun-nosuke Okamoto[1], Hiroto Shimazaki[1]

1.National Institute of Technology, Kisarazu College

Unmanned Aerial Vehicle (UAV) has been increasingly becoming an important tool for collecting geospatial data in various industrial and research domains. Very high spatial-resolution imagery acquired from UAV has made the land surveying in small areas more flexible and cost-effective, as compared to conventional methods with a Total Station or a Terrestrial Laser Scanner. However, the UAV specifically designed for land surveying applications is still expensive and having exaggerated specifications and, this might be an obstacle to introduce UAV into educational institutions. To improve the educational opportunity of the UAV surveying method, reliable UAV equipment at reasonable cost are needed.
This study preliminary evaluated the positional accuracy and attribute accuracy of geospatial products derived from a set of digital imagery, which was obtained using a commercially-available inexpensive small UAV-based system. First, ground control points (GCPs) to be used for georeferencing geospatial products and reference points to be used for validation of positional accuracy were deployed over the entire study site, and their 3-dimensional coordinates were measured with static GNSS surveying method and radiation method with Total Station. Second, three types of geospatial products, i.e., (1) orhtomosaic image, (2) Digital Surface Model (DSM), and (3) landcover map, were generated using a set of imagery obtained by Ricoh GR mounted on Phantom 2 Vision +. Third, positional accuracy of orthomaic image and DSM was assessed based on the Root Mean Square Error (RMSE) between the Photo Identifiable Features (PIFs) on the geospatial products and the reference points. Fourth, attribute accuracy of landcover map was assessed based on Cohen's kappa coefficient. Preliminary results showed that the positional accuracy and attribute accuracy were both acceptable for educational purposes.

Keywords: Unmanned Aerial Vehicle, Geospatial Data, Accuracy Assessment

Study on the changes in farming calendar of winter wheat in North China Plain

Jiang Yu[1], *Akihiko Kondoh[2]

1.Graduate School of Science, Chiba University, 2.Center for Environmental Remote Sensing,Chiba University

Variation of farming calendar needs to be considered in global warming. Except rice, as the second crop, there are large cultivation areas and production amounts of wheat in China. North China Plain is one of the main wheat produce base. In this study, the objectives are to clarify variation of farming calendar, crop acreage of winter wheat and changes reasons using satellite remote sensing data in North China Plain. As results, from PAL and SPOT/VEGETATION NVDI data, variation of farming calendar and annual crop acreage changes of winter wheat are cleared from 1982 to 2012. Sowing season is delayed owing to autumn mean temperature, precipitation and breed improvement.And then temperature change in autumn got impact on the winter wheat which sowing in September, make them grow too fast can not against the cold in winter.And because of that ,winter wheat can not grow well in green up time.It agrees with previous research results. Green seasons become faster as the increasing temperature in spring. In addition, crop acreage changes correspond to statistical data, and spatial and temporal distribution of winter wheat is also cleared.

Keywords: North China Plain, farming calendar, winter wheat

Study on land use change of Horqin area using Multitemporal LANDSAT images

*BAOYIN BUHE[1], GERILE HASHEN[2], Akihiko kondoh[1], Chiharu Hongo[1], Eisaku Tamura[1]

1.Center for Environmental Remote Sensing, Chiba University, 2.Graduate School of Science, Chiba University

Since 2000, a series of aggressive environmental protection policies, such as ecological emigration, returning farmland to grassland and forest, and grazing prohibition, have been implemented in Inner Mongolia Autonomous Region of China. At the same time, Inner Mongolia has been designated a target area under China's Western Development Strategy, Consequently, the region’s land use and cover types after 2000 have been strongly affected by the socioeconomic development. In this study, using remote sensing data, the author analyzed the changes in vegetation cover, including the agricultural land use change, in Inner Mongolia Autonomous Region since 2000.

Keywords: Horqin area, land use change, Landsat, Inner Mongolia Statistical Yearbook, ArcGIS

Prediction of the Forest Fire Danger in Indonesia using Remote Sensing and Spectral Measurements

*Hikaru Suzuki[1], Yuito Takahashi[1], Tetsushi Ota[1], Asahi Hashimoto[1], Natsumi Kamada[1], Moka Akita[1], Yuka Ogino[1], Hasegawa Yoko[1], Nobuyasu Naruse[1,2], Yukihiro Takahashi[2,3]

1.Global Science Campus, Hokkaido University, 2.Institute for the Advancement of Higher Education, Hokkaido University, 3.Graduate School of Science, Hokkaido University

To minimize forest fires in tropical area is extremely important, because the fire has a large influence on global warming or biodiversity. Although most of the forest fires are caused artificially, the surface soil water, reflecting the amount of precipitation in the area, would be also related to the fire. Furthermore, plants under a drying stress can be the cause of fire. If we observe the degrees of surface soil water and the level of the stress, we can predict where the forest fire occurs.

In the previous study, Furumoto et al. showed that NDVI (Normalized Difference Vegetation Index) values differ between the wet and the dry season in Kalimantan Island in Indonesia. They found the correlation between the NDVI values and the amount of precipitation in the area. They also pointed out there's a time lag of 1-2 months between the change of rainfall and NDVI values. However, this makes it difficult for us to judge immediately whether the forest fire will occur. On the other hand, the degrees of surface soil water are also related to the fire; since Indonesia is covered with peat moss, the soil also burns when the fire occurs. The degrees of surface soil water have been detected by infrared satellite images with a poor spatial resolution so far, which is not enough to discuss in detail the correlation between the degrees of surface soil water and the cause of the forest fires. Thus, we have to consider the degrees of surface soil water in a high spatial resolution for the prediction of the fire.

The purpose of this research is to predict the region of the forest fires in Indonesia using satellite imaging and spectral measurements. To develop a new index of higher correlation with the forest fires, we actually grow Indonesian plants in a different degree of soil water condition.

First, using Landsat 7 and 8 images, we calculated the NDVI and SAVI (Soil Adjusted Vegetation Index). The study area was 100×250 m around Martapura, in South Sumatra Island in Indonesia. We found that the vegetation indices obtained from the areas covered with grass are lower than those of tree area. In addition, both indices dropped significantly in the year of El Niño happened. The fact indicates that the decrease of precipitation can be influenced on the vegetation indices around the area. There was a meaningful difference between SAVI and NDVI values. Moreover, the change rate of vegetation indices from the grass was larger than that of the tree, which is suggested that the reflection spectra obtained from the grass is strongly affected by the drying stress.

Next, we compared the forest fire regions in 2015, using the website of NGO "Eyes On The Forest", with the area having low vegetation index. The satellite images having 0-0.3 values of SAVI corresponded to the area that forest fire happened.

Keywords: Indonesia, forest fire, vegetation index, surface soil water, spectrum, remote sensing

Elucidation of changes of reindeer travel-route around Lena River by satellite remote sensing

*Takeru Sakka[1], Tatsuya Tashiro[1], Hinako Telengut[1], Haruki Takanashi[1], Mahki Takanari [1], Itsuki Kida[1], Fiolenta Marpaung[1], Takahiro Yoshii[1], Yuka Ogino[1], Masataka Imai[1,3], Nobuyasu Naruse[1,2], Yukihiro Takahashi[1,3]

1.Global Science Campus, Hokkaido University, 2.Institute for the Advancement of Higher Education, Hokkaido University, 3.Graduate School of Science, Hokkaido University

There are nomads who hunt reindeers for a living in the Arctic Circle of Siberia. The trade of the meat and the fur has become one of the most important industries. Recently, the reindeer, which has an animal behavior going along the conventional route for pasture, has been changing the travel-route. Thus, the livelihood of nomads who lives by hunting them has been menaced. The reason of changing the travel-route must be a global warming resulting from the vegetation change of the pasture. To track the travel-route, some reindeers were installed GPS devices in Sakha Republic in Russia [1]. Almost all positions of reindeer groups, however, remain unclear, because Siberia is a vast field.
The aim of this study is to elucidate changes of wild reindeer travel-route in Siberia by satellite remote sensing; 1) through the seasonal change of vegetation of the pasture, and 2) through the direct survey of reindeer groups by satellite image analyses. The study area was selected around Lena River and Olenyok valley in Sakha Republic, Russia. This work focused on 1).
First, We have investigated the effects of climate change on vegetation around Lena River where the travel-route of wild reindeer was observed. Although there is a report that the annual difference of vegetation discussed using MODIS data in Siberia, we use Landsat 7,8 images to distinguish the travel-route in higher special resolutions. We have calculated the normalized difference vegetation index (NDVI) from satellite images of the corresponding area of 2010-2015. From the result, only in 2010 and 2015, the period that NDVI value becomes a peak, had clearly shifted by about one month. It is reported that El Niño occurred during these years, leading to abnormal summer weather in the region. This result supports that the change of the wild reindeer travel-route frequently occurs due to the change in activation timing.

Keywords: Vegetation, Remote sensing, NDVI, Reindeer, Lena river

Correlation between forest fires in Indonesia and soil water content through the satellite imaging and the direct spectral measurements of soil

*Asahi Hashimoto[1], Moka Akita[1], Tetsushi Ota[1], Yuito Takahashi[1], Natsumi Kamada[1], Hikaru Suzuki[1], Yoko Hasegawa[1], Yuka Ogino[1], Nobuyasu Naruse[1,2], Yukihiro Takahashi[1,3]

1.Global Science Campus, Hokkaido University, 2.Institute for the Advancement of Higher Education, Hokkaido University, 3.Graduate School of Science, Hokkaido University

In recent years, the smoke caused by the forest fires in Indonesia has become a serious problem. It affects the arrival and departure of airplanes. Moreover, a health problem has occurred in neighboring countries. Especially, El Niño in 2015, which scaled one of the largest, has reduced the precipitation in Indonesia, consequently increasing the forest fire significantly. Although most of the forest fires are caused artificially, the surface soil water, reflecting the amount of precipitation in the area, would be also related to the fire. Since Indonesia is covered with peat moss, the soil also burns when the fire occurs, and this makes the fire last for a long time. In the previous study, Furumoto et al. estimated the amount of soil water in Indonesia using the typical vegetation index of NDVI (Normalized Difference Vegetation Index). However, there's a time lag of 1-2 months between the change of rainfall and NDVI values, which makes it difficult for us to judge immediately whether the forest fire will occur. The degrees of surface soil water have been detected by infrared satellite images with a poor spatial resolution so far. It is not enough to discuss in detail the correlation between the degrees of surface soil water and the cause of the forest fires.
This study aims to establish a method to discover the correlation between the regions of the forest fires and the surface soil water with a high spatial resolution using remote sensing. Our approach is 1) the direct spectral measurements of soil with a several soil water content and 2) the satellite image analysis.
First, three areas of satellite images were used; Blang Pidie, Riau, and Martapura. Each area locates in Pulau Smatera. We estimated the soil water content using NDWI (Normalized Difference Water Index), NDSI (Normalized Difference Soil Index). The seasonal change of NDWI and NDSI was observed by about 0.3. This result indicates that we can distinguish between the wet and dry season. We found that the forest fires occur a lot in each area from September to October (the end of dry season). This suggests that there is a correlation between the forest fires and the soil water content. We also made the two dimensional maps of NDWI and NDSI, to make sure the correlation between the forest fires and the indices. Moreover, considering that the land of Indonesia is covered with peat moss, we measured the spectra from peat moss actually.

Keywords: Forest fire, Indonesia, Soil water, Remote sensing, Reflection spectrum

Development of monitoring method of coffee leaf rust *(Hemileia vastatrix)* using remote sensing

*Naoya Katsuhama[1], Kazuyuki IKEDA[1], Takahiro Yoshii[1], Fiolenta Marpaung[1], Masataka Imai[1,3], Kensuke Watanabe[1,3], Nobuyasu Naruse[1,2], Yukihiro Takahashi[1,3]

1.Global Science Campus, Hokkaido University, 2.Institute for the Advancement of Higher Education, Hokkaido University, 3.Graduate School of Science, Hokkaido University

The value of coffee is the second largest followed by oil in the world trade market, and coffee has been a major crop in a number of countries. However, since 2008, coffee rust fungus *(Hemileia vastatrix)* has expanded its infection in Latin America and become a major threat to the coffee industry. Coffee leaf rust infection spreads fast through the air. Early logging and burning infected trees are only effective countermeasures against the infection, as there is no effective pesticide or breed that satisfies both coffee leaf rust resistance and flavor. Research on the coffee leaf rust has been paid attention for a long time. However, many of the studies remained in developing coffee leaf rust resistance breeds or ecology of coffee leaf rust. Remote sensing by satellite can monitor the wide range of fields cheaper and faster. Researchers on monitoring coffee leaf rust using remote sensing technology have been carried out since 1970s. However, their accuracy have been unsatisfied, and therefore more precise researches using up-to-date satellite images are expected.
Purpose of this research is to develop effective discovering method of coffee leaf rust infected areas using remote sensing. First, NDVI (Normalized Difference Vegetation Index) around the Cuchumatanes Mountains, Republic of Guatemala, was computed using Landsat7 satellite images. Based on previous researches, fields with different damage stages were set as test sites. As a result, seasonal changes, i.e. dry and rainy season, of NDVI were observed in all test sites regardless of their damage stages. In addition, NDVI of test sites with damages tended to be lower than the sites without damages as time advances. NDVI obtained from no damage sites tended to show a constant value except for the seasonal changes regardless passage of time. These results support that NDVI is lowered by infection of coffee leaf rust. The monitoring method in this research could be applied to other crops and vegetation.

Keywords: Republic of Guatemala, coffee leaf rust, remote sensing, NDVI

Estimation of the rice-planting field in Bangladesh by satellite remote sensing

*Genta Suzuki[1], Eiki Furuta[1], Masato Yamazaki[1], Tomomi Teraoka[1], Tadashi Okami[1], Hirokazu Fujiwara[1], Nobuyasu Naruse[1,2], Yukihiro Takahashi[1,3]

1.Global Science Campus, Hokkaido University, 2.Institute for the Advancement of Higher Education, Hokkaido University, 3.Graduate School of Science, Hokkaido University

The increase of rice production has been saved many people in the world. Bangladesh has also continued to increase. The amount of rice production in Bangladesh is 5 times as much as that of one in Japan. Recently the problem arises that rice price has been instable due to a large increase of rice production. Maintaining a high rice price can be also a political issue, because rice agriculture is one of the most important industry in Bangladesh. Although Food and Agriculture Organization of United Nations (FAO) have researched the amount of rice production in Bangladesh so far, these data are unreliable, because unofficial figures have been supplied by governments through publications in foreign countries and FAO questionnaires.
Satellite remote sensing is effective to research the area of rice field. We can research it regularly and continuously with low cost. Especially, the microwave remote sensing has a large merit to be observable in spite of the weather. However, since the microwave image data is expensive, research institutions have been limited to observe continuously in developing countries. This study aims to establish the way to research the rice field using satellite images for free. At first, we are calculated the seasonal change of NDVI values in the area of the (BRRI Bangladesh Rice Research Institute), which idea is based that the harvest season of rice in Bangladesh can be reflected to the NDVI values. As a result, the NDVI values significantly dropped by 0.2-0.25 from November to December, which corresponds to the dry season, although the number of samples was small due to a lot of clouds. Since double cropping is common in Bangladesh, we have captured the one of the two. Based on the results of the test area, we deduced the area of the rice-planting field of Bangladesh. It should be noted that we exclude that of potatoes, sugar cane, and forest area.

Keywords: Remote Sensing, rice-planting, NDVI, Bangladesh

Analysis of the flooded area in the Great East Japan Earthquake by MODIS thermal infrared data

*Takashi Nonaka[1], Yuki Uchida[1], Keishi Iwashita[1]

1.College of Industrial Technology, Nihon University

In the past several years, many previous studies have been conducted by the researches to analyze the backscattering differences of the synthetic aperture radar (SAR) data between pre- and post-event to estimate the flooded area. However, the data acquisitions were restricted only after the occurrence of the event in general. On the contrary, low-resolution optical sensor such as MODIS acquires images every day although the objects on the ground are visible only during clear days. The goal of this study was to monitor the flooded area continuously till the recovery phase, and determine to utilization of the optical Earth Observation (EO) satellite data.
The purpose of this study was to obtain the knowledge for estimating the wide flooded area from satellite thermal infrared data. We developed the methodology to estimate the flooded area using land surface temperature (LST) data, and evaluated the area by applying it to the case of the Great East Japan Earthquake. The test sites were Ishinomaki-shi, Sendai-shi of Miyagi Prefecture, and Souma-shi of Fukushima Prefecture. Firstly, the analysis of LST just after the earthquake was conducted both daytime and nighttime. Subsequently, we found that the LST of the flooded area at nighttime was higher than unflooded area. Secondly, we conducted the unsupervised classification in extracting the flooded area utilizing LST data of only after the earthquake. From the analysis of the threshold temperature, we revealed that it was different about 1 degree by the area. Finally, we evaluated the classification accuracy both qualitatively and quantitatively. By comparing the referenced data, the producer’s accuracy, user’s accuracy, and total accuracy were revealed for each site. The outcome of this study suggests that the observation of the temporal changes of the flooded area is possible by the continuous monitoring by the EO satellite data.

