

# The Utilization and Creating of UV distribution map using a high resolution satellite image

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Recently, there has been a growing interest in environmental issues in the world. Japan Meteorological Agency publish the UV forecast distribution map. However, it cannot show clearly the situation of ultraviolet amount at local areas. Therefore, in this study, we proposed the method of creating localized ultraviolet distribution map using a high resolution satellite image and digital terrain model. This ultraviolet distribution map is in consideration of the state of the land cover and the shade by trees. Additionally questionnaire survey was conducted about the interest in ultraviolet and Evaluation of ultraviolet distribution map created in this study. As a result, it was indicated that ultraviolet distribution map is effective in promoting of ultraviolet protect.

Keywords: satellite image, Ultraviolet, Land cover classification

## A new fire risk indicator for Indonesia

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Fires in dry season of Indonesia has become a serious problem. Most of Indonesian land is covered with peat moss, which occurs the expanding of fires due to the burning itself. Furumoto et al. showed that seasonal changes of soil water content in Indonesia estimated through the 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 fires will occur. Thus, the soil water content, reflecting the amount of precipitation in the area, can become the indication of the risk of fires. Our study aims to develop a new remote sensing index reflecting the fire risk using through the directional measurements of soil spectra. We have prepared the peat moss (in Canada, Sri Lanka and Indonesia) of several soil water contents measured (Field pro, WD-3). We obtained the reflectance spectra with 400-1050nm (light source: halogen lamp, spectroscope: self-made) from the respective peat moss. There are the features for obtained spectra, the reflectance difference between wet and dry in ultraviolet (infrared) is smaller (larger). The results indicate that a new fire risk indicator for the soil covered with peat can be favorable to use the ultraviolet wavelength range, such as a new deep blue band on Landsat 8. It can be essential to know precisely the surface water content of soil through the spectral measurements on the ground. The resulting satellite images calculated by our original index appears to reflect the risk of fires rather than well-known indices such as Normalized Difference Water Index and Normalized Difference Soil Index. In conclusion, we have developed a new fire risk indicator that highly reflects to the degrees of soil water content for peat soil. We will show the results of spectral measurements for several water contents of soil sampling in Indonesia.

Keywords: Fire, Peat soil, Indonesia, Satellite remote sensing, Reflection spectrum

## Research for annual travel-route changes of reindeer living around the Arctic Circle using satellite remote sensing

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There are nomads who hunt wild reindeer for a living in the Arctic Circle around Siberia. Recently, the reindeer has been changing the travel-route, having an animal behavior going along the conventional route for pasture. Thus, the livelihood of nomads who hunt them has been menaced. To solve this problem, Tatsuzawa investigated the travel-route of some groups of wild reindeer by installing GPS transmitter on them. Almost all travel-route of reindeer groups, however, remain unclear, because the area of Arctic Circle is large. Previous works reported that the reason of changing the travel-route must be a global warming, forest fire, thunder, and flood, however they only discuss their circumstances. The purpose of this study is to research for annual travel-route changes of reindeer living around the Arctic Circle using satellite remote sensing. At first, we supposed that an annual change of summer-growing pasture affects the changes of reindeer travel-route. we have analyzed images of Landsat7,8(Resolution;30m) using typical vegetation index of NDVI (Normalized Difference Vegetation Index) to compare with travel-route taken with GPS transmitter. Our results show that reindeer travels in vast field when the value of NDVI is higher in the north area(~100km), away from staying in summer, on the basis of data obtained in July and August 2010-2012. The changes of NDVI can be related to the amount of snow in winter near Siberia. Landsat series has a temporal resolution of 16 days, however, errors can be occurred by the image calculation due to the amount of moisture in the air, spices of the vegetation, etc. Thus, we have also analyzed annual changes of NDVI using MODIS satellite images, which the temporal resolution is one day.

Keywords: Arctic Circle, reindeer, satellite remote sensing

## Assessing crop classification from Sentinel-2A MSI data

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Crop classification maps are useful for managing agricultural fields, which are developed and managed through a variety of social actions or policies. Furthermore, they can hugely impact biogeochemical and hydrologic cycles, climate, ecosystem functions, the economy and human health.

The Sentinel-2A satellite was launched on 23 June 2015 and provides the opportunity for crop type identifications. It carries the MultiSpectral Instrument (MSI), which has 13 spectral bands ranging from 433 nm to 2190 nm including three visible bands, three red edge, two near-infrared (NIR) and two short wave infrared (SWIR) bands except for the three atmospheric bands (i.e. Band 1, Band 9 and Band 10).

Especially, the SWIR bands have a great potential for evaluating photosynthetic capacity (e.g. maximal carboxylation rate,  $V_{cmax}$ ) and that may lead to an improvement in crop type identification.

In this study, six crop types (i.e. beans, beet, grass, maize, potato and winter wheat) were identified using MSI data acquired on August 11, 2016, except the atmospheric bands. Accurate classification may be possible with currently existing supervised learning models. A comparison among the kernel-based extreme learning machine (KELM), the multi-layer perceptron and the random forests was performed and the hyperparameters of them were tuned using Bayesian optimization, which is a framework used to optimize hyperparameters of noisy, expansive black-box functions and it defines a principled approach to modelling uncertainty.

As the results, it was found that KELM performed better, achieving an overall accuracy of 90.3 %.

Keywords: Kernel-based extreme learning machine, hyperparameters

# A UAV-based approach to estimate the uncertainty in GNSS locations over a broad-spatial scale

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Location data obtained by GNSS-based telemetry has been widely used for estimating the movement patterns, home range size, and resource selection of free-ranging animals. Although the GNSS-based telemetry has advantages over conventional VHF radio telemetry in terms of positional accuracy and precision, it is still important to define the confidence interval of the estimation by accounting for the uncertainty in location data. Since the uncertainty in GNSS locations is mainly induced from GNSS signal interruption by rugged terrain and off-terrain objects such as buildings and tree canopies, Canopy Openness (CO) has been commonly used as the first-order approximation of the GNSS signal interruption probability (GNSS-SIP). However, applicability of the CO is limited in specific locations where hemispherical images were taken for estimating CO. To evaluate the uncertainty in GNSS locations for free-ranging animals, an alternative method must be employed.

This study examined the potential of a UAV-based approach to estimate the degree of uncertainty in GNSS locations over a broad-spatial scale. A set of high-spatial-resolution aerial images acquired from the UAV platform was used to derive a Digital Surface Model (DSM) and a quasi-DSM. The DSM represents bare ground surface and includes all objects on it, while quasi-DSM is identical to the DSM except for tree canopies. Morphometric Protection Index (MPI) was derived from the DSM. Elevation Mask (EM) was then derived from the DSM and quasi-DSM to be used in GSILIB software for predicting the values of Geometrical Dilution of Precision (GDOP) and number of satellites (NSAT).

The degree of conformity of the MPI to CO was confirmed by a simple linear regression model, and the CO was successfully estimated from MPI over a broad spatial range. However, because the MPI was calculated based on the DSM, the following problems remained unsolved: (1) the CO predicted from MPI represents only the CO at top of the terrain or off-terrain objects; and (2) it cannot consider the effect of GNSS signal transmission through an object or gaps among objects. In contrast, the GDOP and NSAT, which were derived from the DSM and quasi-DSM via the EM, were found to be capable of more properly estimating the positioning accuracy and precision. This might be attributed to the fact that the GDOP and NSAT were predicted taking into account the GNSS satellites constellation and the effect of GNSS signal transmission through a tree canopy and gaps among canopies. In conclusion, the UAV-based approach would be a promising method to estimate the degree of uncertainty in GNSS locations over a broad-spatial scale.

Keywords: GDOP, NSAT, Elevation Mask, Canopy Openness, Morphometric Protection Index

## The latest trend of low-priced UAV

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The visualization of the environmental information is important from the viewpoint of disaster prevention to keep the security of inhabitants. Videos taken from the airplane conveyed the horror of the recent great disaster which attacked the various places in kysyu Japan, the Kumamoto Earthquake of 2016.

Numerous engineers and researchers were shocked by the images. Moreover, many real-time movies and images of this disaster exist. Especially in the past several years, other disasters caused by extreme weather because of our changing climate, such as heavy typhoons, rain cataracts, flurries, and tornadoes, also cause widespread destruction. When these disasters or earthquakes occur, rapid situational assessment is crucially important, but it is difficult because transportation systems including roads and railways often shut down under those circumstances. Therefore, a monitoring system that provides information immediately when a disaster occurs is required. When a disaster occurs, monitoring from an uncrewed aerial vehicles (UAV) or satellite is effective.

Keywords: UAV, multicopter, disaster prevention