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TEMPORAL DIFFERENCE AND DENSITY-BASED LEARNING METHOD APPLIED FOR DEFORESTATION DETECTION USING ALOS-2 PALSAR-2

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Abstract of Research

Remote sensing has established as key technology for monitoring of environmental degradation such as forest clearing. One of the state-of-the-art microwave EO systems for forest monitoring is Japan's L-band ALOS-2/PALSAR-2 which provides outstanding means for observing tropical forests due its cloud and canopy penetration capability. However, the complexity of the physical backscattering properties of forests and the associated spatial and temporal variabilities, render straightforward change detection methods based on simple thresholding rather inaccurate with high false alarm rates. In this paper, we develop a framework to alleviate problems caused by forest backscatter variability. We define three essential elements, namely "structures of density", "speed of change", and "expansion patterns" which are obtained by differential computing between two repeat-pass PALSAR-2 images. To improve both the detection and assessing of deforestation, a "deforestation behavior pattern" is sought through temporal machine learning mechanism of the three proposed elements. Our results indicate that the use of "structure of density" can introduce a more robust performance for detecting deforestation. Meanwhile, "speed of change" and "expansion pattern" are capable to provide additional information with respect to the drivers of deforestation and the land-use change.

Details of Research Activity

International Geoscience and Remote Sensing Symposium, IGARSS 2018, the 38th annual symposium of the IEEE Geoscience and Remote Sensing Society (GRSS). The theme for IGARSS 2018 highlights the pressing demands for "Observing, Understanding and Forecasting. The Dynamics of Our Planet". The IGARSS 2018 is the biggest conference on remote sensing field, provides a good platform for researchers, scientists and the entire engineering community to meet each other and exchange ideas. 2200 participants were joining the IGARSS event from 22nd July to 28th July 2018. These large number of participant were the result of highly selective process, roughly the selection change is about 20 percent. The topic assigned for our paper was about big data for remote sensing. The decreasing of today's world forest leads many sectors of government and scientist community to provide methodologies to monitor forest cover change. In order to extract information about condition of forest change, the multi temporal dataset is necessary to collect. L-BAND SAR data is our main data analysis, derived by Japanese satellite. Besides classical optical satellite imagery, low-frequency synthetic aperture radar (SAR) has high potential to detect deforestation. In tropical forest regions, the use of microwave sensors can have significant advantages due to the cloud penetration capabilities. The Phased Array Type L-band SAR-2 (PALSAR-2), aboard the Japanese Advanced Land Observing Satellite (ALOS-2), the only low frequency in orbit, has a unique potential to observe deforestation activities. Generally, HV cross-polarization is the most suitable for detecting forest loss. To improve the deforestation detection performance, all these aspects as temporal changes, spatial variability and physical backscattering behaviors have to be taking into account. In addition, current common result of deforestation detection often merely displayed on form of forest cover and forest loss map. By contrast, new framework which also simultaneously able to assess the most important facets, such deforestation driver to land usage conversion remain non-prominent. We proposed two successive stages of adaptive space selection to detecting and discover deforestation behavior simultaneously based on temporal characteristics of backscattering value in tropical forest regions which often having significant variations. In the first stage, a "structures of density" of L-band SAR temporal gamma-naught is observed using empirical statistical models to deconstructs temporal pattern of

deforestation activity and it stages. After an appropriate area has been found, two dimensional spaces “speed of change” and “expansion patterns” are proposed to tract the deforestation drivers and land-use change after deforestation activity.

Research Activity’s Result and Discussion

We present and discussed our proposed algorithm to analyze deforestation phenomenon by L-BAND SAR data. There are one hundred poster presenters in our sessions. The goal of the learning method is to find pattern that can identify deforestation behavior on observed area. Instead of performing temporal differential computing with constant value, the representation point is selected from peak of density derived by temporal change. Obtaining representative magnitude of change by applying threshold uniformly to all PALSAR-2 gamma naught value remains challenging. Although filtering has been applied prior temporal difference process, certain noise caused by nature object response still remains and could possibly lead to miss-detection of deforestation area. The definition of density structure here is the degree of compactness of a temporal difference (magnitude of change) between two temporal PALSAR-2 imageries for identifying deforestation. Deforestation driver can be identified by it speed of change. Major driver of deforestation is either by forest fire or illegal logging. Formal definition of deforestation speed of change is the rate at which deforestation area spreads. Speed of wildfire in forest can move as fast as 22 kilometers. The discussion was very intense and interesting. Many researcher from field of Geologist to Data Scientist were actively exchanging their ideas toward our algorithm.

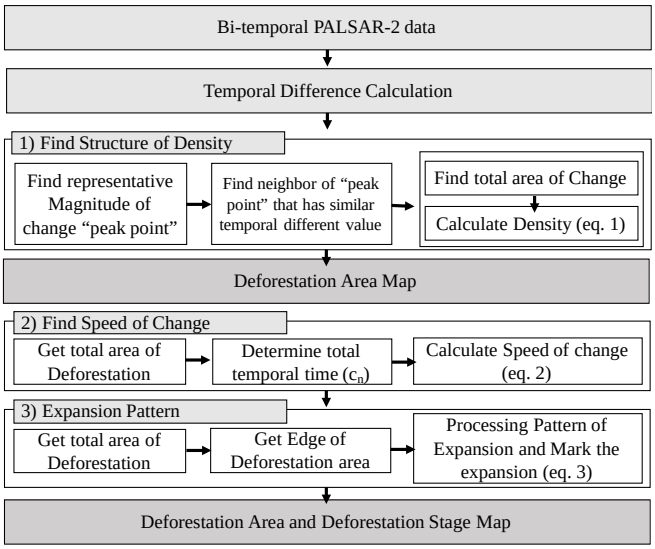

Figure 1. Proposed System Design.

Many interesting questions are coming, indicating that our topic has specific impact on the SAR society that focused on deforestation analysis. During the discussion we also discuss about several possibility to do more advanced research in term of disaster management, and future collaboration between international institutes are also being discussed and possible to realize in near future.

Figure 2. Presentation session and Join Discussion