LAND COVER MAP OF KHUVSGUL LAKE NATIONAL PARK IN MONGOLIA FOR 2005-2019 FROM INTEGRATION LANDSAT AND MODIS DATA USING BFAST ALGORITHM

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Abstract: Khuvsgul Lake National Park was recorded in the Mongolian special protected network in 1992. The mission of this national park is to preserve in a standard state one of the world's largest freshwater lakes. The aim of this study was to generate land cover maps of Khuvsgul Lake National Park of Mongolia between 2005 and 2019 derived from the integration of MODIS and Landsat data using the breaks for additive season and trend (BFAST) algorithm. In this study, we used two sources remotely sensed data includes Landsat and MODIS. The spatial resolution of the Landsat 30m (ETM, OLI), and MODIS NDVI 250 m (MOD13Q1, 16-day composite, collection 006). MODIS NDVI data is coarser than Landsat imagery however, this data has a fine temporal resolution. The discrimination of the land cover class used a random forest classification approach based on the machine learning technique. To detect the annual dynamics of land cover and its change used the BFAST algorithm. The results showed that the overall accuracy between 2005 and 2019 every thirteen classes including alpine barren, alpine meadow, lower mountain steppe, temperate coniferous forest, open forest, riverine meadow, riverine forest, forest-steppe, steppe (dry and moderate dry), lake and ephemeral lakes, sand and barren land, 82.3% based on 52 training samples. Over the past fifteen years, the area of forest and meadow steppe decreased. In contrast, the area of steppe, lake, sand, and barren land increased.

Keywords: Land cover, Random Forest, BFAST, special protected area

Introduction

Land cover (LC) is the physical material at the surface Earth (Liu et al., 2020). The LC change affects surface characteristics, climate change, provision of ecosystem services (Reyers et al., 2009; Gibbard et al., 2005), energy balance, and biogeochemical cycles (DeFries et al., 1999). LC information is also vitally important in land management, nature conservation, food security, and emission carbon. However, land cover is highly periodic due to changes in human activities and vegetation phenology (Lambin et al., 2001).

Pervious LC mapping and monitoring are usually based on a single time. Because of the differences in data sources and mapping methods, the consistency of mapping results from different sources and times is lacking comparability, making it difficult to quantify the changes effectively (Friedl et al., 2010). The automatic mapping methods highly depend on the sample data set to its representatively due to the considerable heterogeneity (Li et al., 2014). This is a big challenge to mapping and monitoring at the regional, continental, and global scales.

Dynamics LC information in Mongolia including season, trend, remainder components, and cause-effect relationships remains poorly documented for detecting change within time series. Breaks for additive season and trend (BFAST) allows the method to assess the time

and number of abrupt changes in both trend and seasonal components of the vegetation phenology (Burrell et al., 2018). The aim of this study was to generate land cover maps of Khuvsgul Lake National Park of Mongolia between 2005 and 2019 derived from the integration of MODIS and Landsat data using the BFAST algorithm.

Data and Method

To generate an LC map from Landsat Enhanced Thematic Mapper Plus (ETM+), Operational Land Imager (OLI) data with a resolution of 30 m for the 2005 and 2019 together with 52 training samples. In order to collect the training samples, we selected the majority-class synthesis strategy. After the pre-processing as radiometric and atmospheric corrections, we used a random forest (RF) classifier for LC mapping the following performance of the RF classifier based on machine learning technique (Rodriques-Galiano et al., 2012; Pal, 2005). There was 500 tree with out-of-bag (OOB) error. The variables per splits were set to 0, as the square root of variables. The minimum size of a terminal node, the fraction of input to bag per tree, and random root was set to 1, 0.5, and 0, respectively. The classifier was trained using the training sample with data.

In order to detect the annual dynamics of land cover and its change used the BFAST algorithm. The BFAST algorithm integrates a decomposition model that decomposes the time series into trend, seasonality, and residuals components with an iterative algorithm to detect breakpoints using structural change methods. The BFAST algorithm is also free parameterization but requires a maximum number of breakpoints.

Result

The LC maps between 2005 and 2019 were generated derived from Landsat ETM+ and OLI imagery. The results showed that the overall accuracy between 2005 and 2019 every thirteen classes including alpine barren, alpine meadow, lower mountain steppe, temperate coniferous forest, open forest, riverine meadow, riverine forest, forest-steppe, steppe (dry and moderate dry), lake, and ephemeral lakes, sand and barren land, 82.3% based on 52 training samples (Figure 1). Over the past fifteen years, the area of forest and meadow steppe decreased. In contrast, the area of steppe, lake, sand, and barren land increased. To detect the annual dynamics of land cover and its change used the BFAST algorithm. Details of spatial and temporal dynamics (continuous or abrupt change) two types of land cover showed in Figure 2.

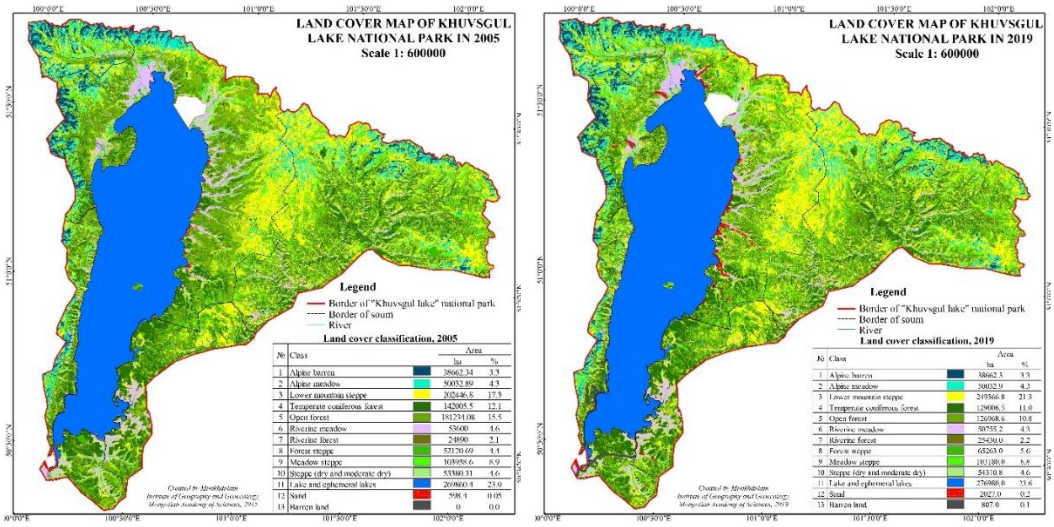

Figure 1. Land cover maps of Khuvsgul lake national park for 2005-2019

a) Temperate coniferous forest to open forest

b) Meadow steppe to barren land

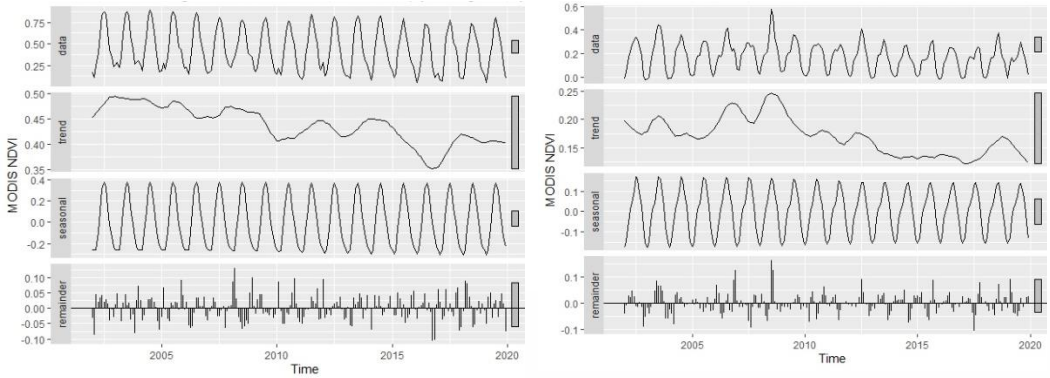

Figure 2. Detection of the land cover change derived from MODIS times series NDVI using BFAST algorithm

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