Mongolia Grassland Sustainability Evaluation Through Its Responsiveness to Precipitation From 2001 to 2019

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1. ABSTRACT
With 95 percent of the agricultural lands being pastures, the sustainability of grassland and herding activities is of great importance to Mongolia. In natural conditions, we can assume the vegetation growth falls into a good correlation with natural factors, and with impacts of urbanization and the trend of overgrazing, the relationship between factors like precipitation and grassland production is presumed to be changing and less correlated. This research utilizes monthly MODIS-NDVI for vegetation condition, monthly GSMaP data for precipitation, monthly KBDI data for droughtiness, and MODIS Snow coverage data for snow coverage to calculate the Pearson Coefficients. In the cases of Mongolia, the amount of vegetation growth we can observe is what's left of grazing activities and harvesting/grazing can be found in the monthly records even if much of the curve follows the natural order of growth and decay. Also, NDVI categorized as meaningful positive or negative groups are not that high in the Pearson Correlation scale with half of all the pixels displaying no correlation between vegetation growth and the chosen climatic factors according to the statistics further indicating third party interference during the research period. Which, given the economical and agricultural activities in Mongolia, it could be assumed that most of the interference is grazing. This research paves the way for further analyzing the possible factors and reasons behind such abnormalities.

Keywords: NDVI, GSMaP, MODIS, KBDI, Snow Coverage, Pearson Coefficients

2. BACKGROUND
With the advances of remote sensing and the accumulation of records, it is more and more convenient for us to conduct temporal research over large scales. According to the UN’s FAO Agency, pastures make up almost 95 percent of agricultural land among which about 70 percent have degraded to some extent (Mongolia at a Glance n.d.). Due to climate change, natural hazards, and overgrazing, there have been reports of increasing grassland degradation which put heavy risks upon the livelihood of many people in Mongolia. With the collapse of the Soviet Union, Mongolia underwent a social-economical transformation which led to a sharp increase in urbanization especially in the capital city of Ulaanbaatar shifting the burden of human activities across the country. With the transition into the market economy, the nomadic groups conducting animal husbandry rely more heavily on the raising of cash crops producing goods which further contributes to the overgrazing problem. Usually, with the increase of precipitation, the growth of vegetation would also increase, which in the products of remote sensing data, can be referred to as the normal difference in vegetation existence index, known as NDVI, an indicator widely used to monitor vegetation growth status and phenology patterns (Carlson and Ripley 1997; Zhao et al. 2011; Petrollini et al. 2015). However, in the cases of Mongolia, the amount of vegetation growth we can observe is what’s left of grazing activities and natural hazards, that might not be in good correlation with regards to precipitation, that is obtained from the GSMaP product. But what exactly is the reality in the past two decades concerning the responses of vegetation growth to precipitation is the first step to figure out how to correctly monitor and evaluate the current grassland and environmental preservation efforts and will be the focus of this study. We are using the collection of past 19 years of monthly records of NDVI and GSMaP data for vegetation growth and precipitation to conduct correlation analysis of those two factors on a national level with a few close-up analyses upon selected samples to evaluate the responsiveness of vegetation growth to precipitation in Mongolia. Apart from precipitation, we are also using KBDI(Kusche-Bryan Drought Index) and Snow Coverage Duration (later referred as SNOW) data to observe the vegetation’s response to those factors to conduct a more comprehensive evaluation of the sustainability in Mongolia.

4. RESULTS & DISCUSSION
In this paper, we try to evaluate the environmental sustainability by investigating the vegetation temporal responses to climatic factors like precipitation, droughts, and snow cover during the rainfall-processed and records of monthly records of NDVI, GSMaP, KBDI, and Snow Cover Duration data in the extent of two decades from 2001 to 2019. With the general spatial distribution characteristics of the data searched and understood, we further conducted correlation analysis of those variables in three pairs of bivariate Pearson Correlation analysis with sampling sites slicing into single pixels yearly and monthly records for vertical data investigation. And at the end, we did a bivariate correlation matrix of the three pairs of maps to verify that our results and data indeed sit in a realistic logical premise.

From the gathered results and statistics, we can conclude that the general spatial distribution of NDVI and Precipitation follows the patterns of decreasing in the direction from Northeast to Southwest while the KBDI and Snow Cover take a separated part of Southeast and Northwest component. These two distinct climatic patterns also show in the Pearson Correlation result we get, showing the NDVI-GSMaP pair has a meaningful correlation in the South while the NDVI-KBDI explains better in the North because water is the more limiting factor in the arid south and drought might impact the relatively humid North. NDVI-SNOW pair provides many points of interest to further integrate other possible sources of information like winter disasters. With the points sampled into the monthly and yearly records, patterns of potential irrigation and harvesting/grazing can be found in the monthly records even if much of the curve follows the natural order of growth and decay. Also, the pixels categorized as meaningful positive or negative group's correlation level distinguishes NDVI-SNOW pair.

5. REFERENCES

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