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THE PROSPECTS OF CALCULATION NORMALIZED DIFFERENCE SALINITY INDEX(NDSI) VIA LANDSAT 8 MULTISPECTRAL IMAGE USING GOOGLE EARTH ENGINE CODE EDITOR

Abstract

Due to the increasing amount of data per day and the possibility of using GIS technologies to collect and analyze them, the assessment of topical environmental issues such as salinity is becoming more accessible. In this paper the possibilities of soil salinity estimation in Google Earth Engine is presented for processing medium spatial resolution satellite images like Landsat in Sirdariya province of Uzbekistan. The result of NDSI (Normalized difference salinity index) is shown for 2022. It is implied, that the development of such approaches will speed up the data processing process and provide a unique opportunity to obtain reliable results while saving time and labor resources.

Key words

Soil salinity, remote sensing, Landsat 8 OLI, Uzbekistan, Google Earth Engine, NDSI

Аннотация

В связи с постоянным увеличением объема данных и появившейся возможностью применения ГИС-технологий для их сбора и анализа, оценка таких актуальных экологических проблем, как засоление почвы, становится более доступной. В данной работе представлены возможности оценки засоления почв в Google Earth Engine для обработки спутниковых

снимков среднего пространственного разрешения типа Landsat в Сырдарьинской области Узбекистана. Результат NDSI (нормализованного разностного индекса засоления) показан за 2022 год. Предполагается, что разработка подобного рода подходов ускорит процесс обработки данных и даст уникальную возможность получения достоверных результатов при экономии времени и трудовых ресурсов.

Ключевые слова

Засоление почвы, дистанционное зондирование, Landsat 8 OLI, Узбекистан, Google Earth Engine, NDSI

Introduction

There are two major environmental factors that essentially reduce plant productivity: drought and salinity [1,2,3}. The monitoring of soil salinity is essential for maintaining water quality and ensuring the sustainability of aquatic ecosystems. The normalized difference salinity index (NDSI) is a widely used method for estimating salinity levels especially in water bodies. The normalized difference salinity index (NDSI) is a widely used method for estimating salinity levels in water bodies [4]. It is calculated based on the spectral reflectance values of two wavelengths, one in the visible range and the other in the near-infrared range. With the advancement of remote sensing technology, it is now possible to calculate NDSI using Landsat 8 multispectral imagery and Google Earth Engine Code Editor.

Landsat 8 is a satellite that captures multispectral imagery with a spatial resolution of 30 meters. It has two sensors, Operational Land Imager (OLI) and Thermal Infrared Sensor (TIRS), which capture data in nine spectral bands. These spectral bands cover a wide range of wavelengths, from visible to thermal infrared, allowing for accurate estimation of various environmental parameters. Google Earth Engine Code Editor provides an easy-to-use platform for processing Landsat 8 imagery and calculating NDSI.

Methods and materials

The script was tested for Sirdarya region of Uzbekistan, which is located in the center of the country on the left bank of Syr Darya River. It borders with Kazakhstan, Tajikistan, Tashkent Region, and Jizzakh Region/ It covers an area of 4,276 square kilometres (1,651 sq mi) and is mostly desert, with the Starving Steppe taking up a significant part of the region's area. The great part of irrigated lands in Uzbekistan are affected by salinity problem in various levels. Due to the country's arid climate, and the geological and the hydrogeological conditions of irrigated areas. [5]

For fast and effective soil salinity calculations NDSI was calculated based on the spectral reflectance values of two wavelengths, one in the visible range and the other in the near-infrared range. With the advancement of remote sensing technology, it is now possible to calculate NDSI using Landsat 8 multispectral imagery and Google Earth Engine Code Editor. Landsat 8 is a satellite that captures multispectral imagery with a spatial resolution of 30 meters. The spectral bands cover a wide range of wavelengths, from visible to thermal infrared, allowing for accurate estimation of various environmental parameters (www.nasa.gov).

The scrip was developed for Google Earth Engine Code Editor which provides an easy-to-use method for processing Landsat 8 imagery and calculating NDSI. The calculation of NDSI involves subtracting the reflectance value at the near-infrared wavelength from that at the visible wavelength and dividing it by their sum. The resulting value ranges from -1 to 1, with negative values indicating low salinity levels and positive values indicating high salinity levels (Khan et al, 2005).

$$\text{NDSI} = \frac{R - NIR}{R + NIR} \quad (1)$$

After the necessary filtering is done in the Java programming language on the GEE code editor platform. Based on the NDSI calculation formula (1), selected items were added to the calculation. There is the written formula below.

Results

When applying the developed script, the image shown in Figure 1 was obtained. In this image, the most heavily saline areas are displayed in yellow, and the least saline ones are green. It was found that the area's most prone to salinization are located near water areas. It was also determined that about 80% of the entire territory is under the influence of salinity.

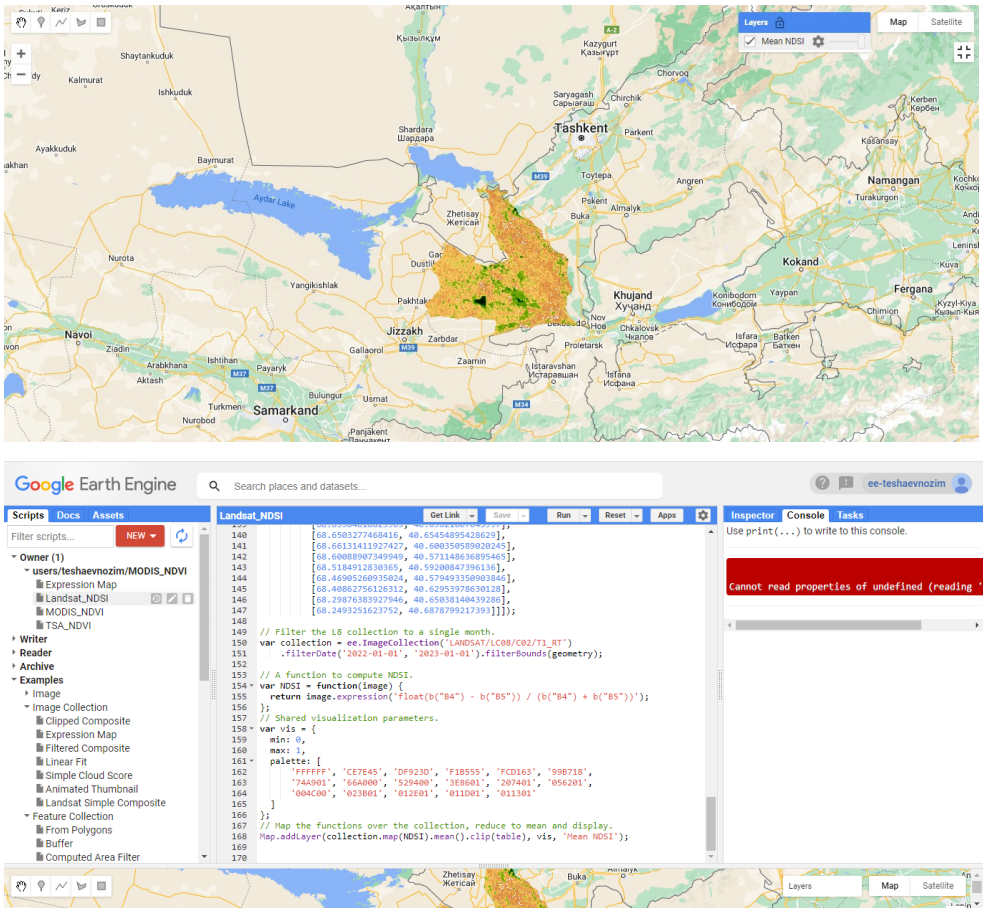

Figure 1. NDSI results for Sirdarya region.

Conclusion

In conclusion, the prospects of calculating NDSI for Landsat 8 OLI via Google Earth Engine Code Editor are promising. The platform provides an easy-to-use interface for processing Landsat 8 imagery and calculating NDSI, while also

providing functions for correcting atmospheric effects and other factors. This makes it a powerful tool for monitoring salinity levels in coastal and inland waters, contributing to the sustainable management of aquatic ecosystems. In ordinary way, most of scientists have been spending much time to assess spatial images. However, GEE can afford to save time and resources.

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