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Forecasting and assessment of land conditions using neural networks

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This paper proposes a method for predicting and assessing land conditions based on satellite image processing using neural networks. In some regions, mainly based on agriculture and cattle breeding, the threat of irreversible soil changes has appeared, in particular desertification, which can lead to serious environmental and economic problems. Therefore, it is necessary to identify both the current state of land and to predict its state in the near future in order to assess the need for preventive work and its scale.

The essence of the proposed method is the application of neural networks for both prediction and segmentation of land images by type. This process can be divided into two stages:

1. Predicting what the situation will be in a few years;
2. Segmentation of the original and predicted images to determine quantitative and qualitative changes.

In other words, first the possible state of the lands of interest in a certain time interval is predicted from the available image, and then the changes are evaluated. We propose to use a neural network of Encoder-Decoder type for prediction and a network of U-Net type for segmentation.

Since there are no training datasets for land state estimation, we generated them ourselves. Images from the open database of Sentinel-2 satellite were chosen as the data source. The choice of this source is due to the fact that the results of primary segmentation of satellite images for specified regions are also stored in the specified database. Images are pre-segmented into 11 basic classes: vegetation, bare soil, water, etc. A second network is trained precisely to determine these 11 classes.

Satellite images of the area where desertification processes are particularly prominent were downloaded for the work. The data refer mainly to the summer period of 2017 - 2020. Thus, the predictive network can make a prediction for 3 years ahead, but it is possible to repeat the procedure and find out what could be in 6 years.

The paper presents a method that allows not only to analyze the state of the areas of interest for the past time, but also to assess the situation that has not yet come.

Summary

This paper considers the application of neural networks for prediction and assessment of desertification-prone lands from satellite images. The Encoder-Decoder type network is responsible for prediction, and the U-Net type network is responsible for segmentation of the image into 11 basic classes. Datasets from the Sentinel-2 satellite open database were generated for training. The presented method allows making a qualitative and quantitative assessment of possible changes, which can be useful for planning preventive works.

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