Quantum

Soil Erosion detection

Test-task

Netipa Nikita

Kiev - 2023

Introduction

Soil erosion is a natural process, but it becomes a problem when it happens at an unsustainable rate, leading to the loss of fertile topsoil, reduced water quality, and land degradation.

Soil erosion detection can be done using various methods, including remote sensing, field surveys, and simulation models. Remote sensing techniques involve analyzing satellite or aerial imagery to detect changes in land cover, vegetation, and topography over time. Field surveys involve physically inspecting the land to identify erosion features such as gullies, rills, and landslides. Simulation models use mathematical algorithms to predict soil erosion rates based on factors such as rainfall, slope, soil type, and land use.

The detection of soil erosion is an important step in preventing further land degradation and preserving the natural resources of the land. By identifying areas of high erosion risk, appropriate measures can be taken to prevent or reduce erosion, such as terracing, contouring, crop rotation, and the use of cover crops.

Solution

1. Data Preparation

Each field from .shp file was cutted from a map. For this purpose, Rasterio has a function called **mask**.

```
for num, row in train_df.iterrows():
    try:
      masked_image, out_transform = rasterio.mask.mask(src, [mapping(row['geometry'])], crop=True, nodata=0)
      img_image = reshape_as_image(masked_image)
      img_path = os.path.join(outfolder, str(num) + '.png')
      img_image = cv2.cvtColor(img_image, cv2.COLOR_RGB2BGR)
      cv2.imwrite(img_path, img_image)

    except Exception as e:
      failed.append(num)
print("Rasterio failed to mask {} files".format(len(failed)))
```

Img. 1. Code snippet for cropping the raster image.

Rasterio failed to mask 435 files from 936.

Since only 334 had corresponding description the images were labled manually into two categories 1: "Normal" and 2: "Erosion".

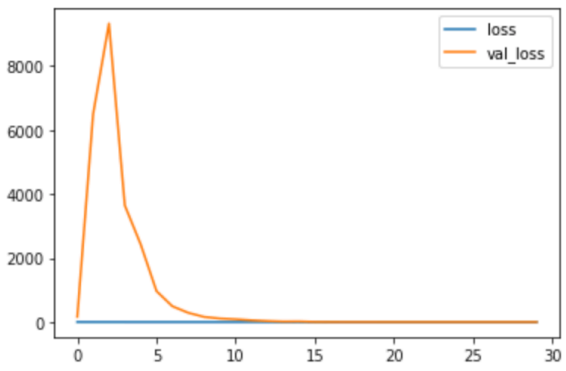
2. Model Training

Classification task was solved with the help of transfer learning. InceptionV3 with weights in feature generation layers pretrained on imagenet was chosen as a model.

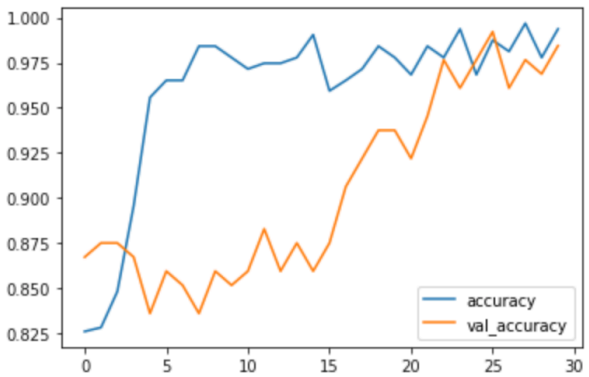
Optimizer - Adam

Loss function - Categorical Crossentropy

Training results:



Img. 2. Loss.



Img. 3. Accuracy.

Conclusion

During the work on the project, I created a neural network model for classifying field images by the presence of soil erosion using Keras.

Proposals for Soil Erosion task

1. Spectral indices like Vegetation Index (NDVI), Soil-Adjusted Vegetation Index (SAVI), and Normalized Difference Water Index (NDW) could be used to create additional features.
2. It could be useful to compare satellite images from different time periods to detect changes in land cover. This approach can be used to track the progress of soil erosion over time.