Development of forestry application using deep learning technology

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Introduction

Forestry is the science and craft of creating, managing, planting, using, conserving and repairing forests, woodlands, and associated resources for human and environmental benefits

Ukrainian forest

Studies show that 16% of the territory of Ukraine is covered with forest. Main forestry problem is forest's account. Because of the large territory there are no way to perform temporal analysis of green area.
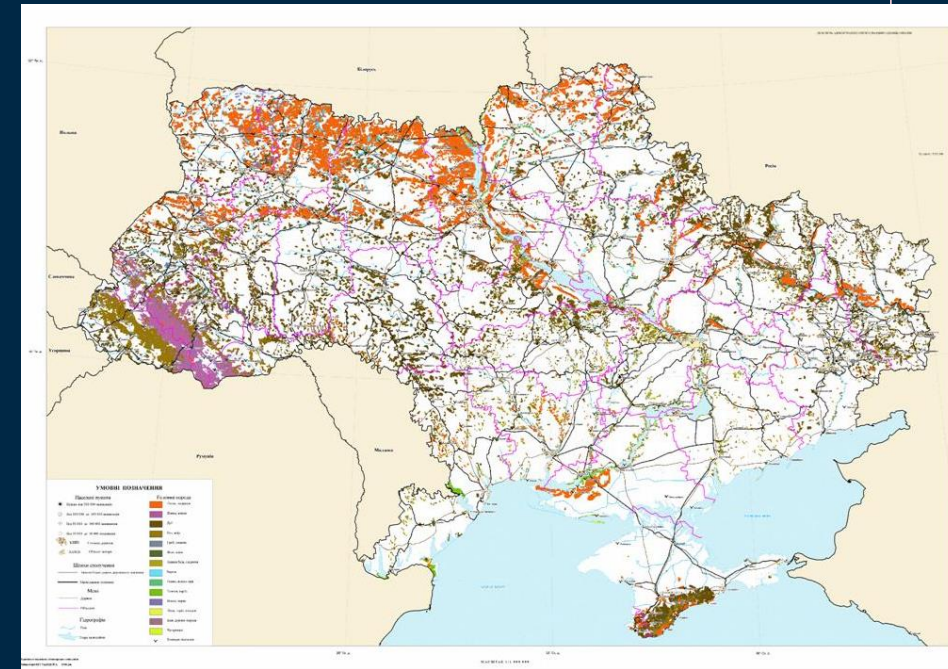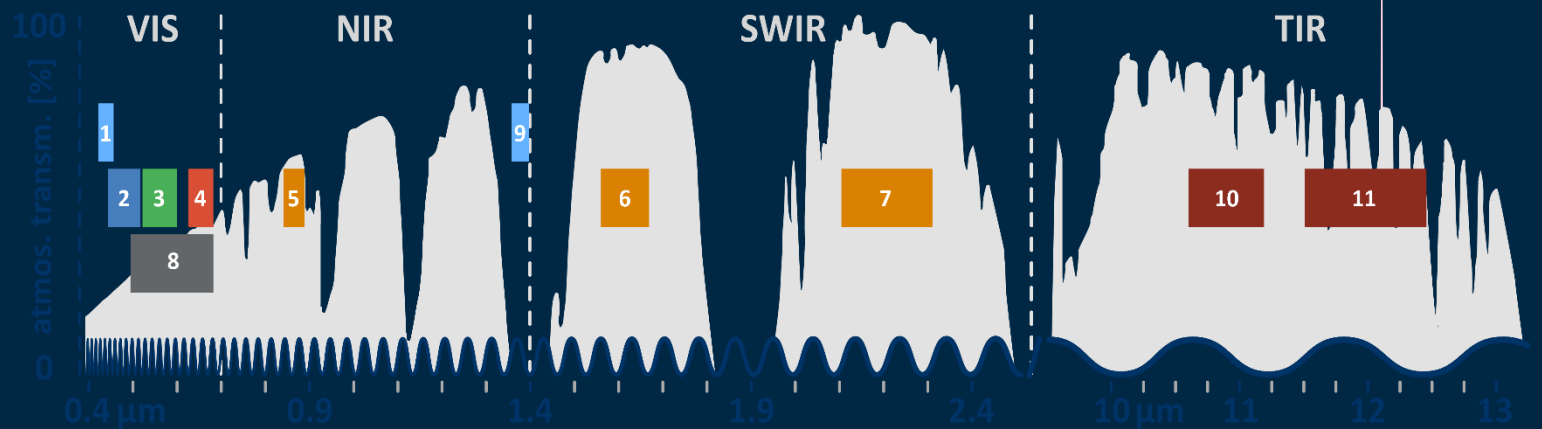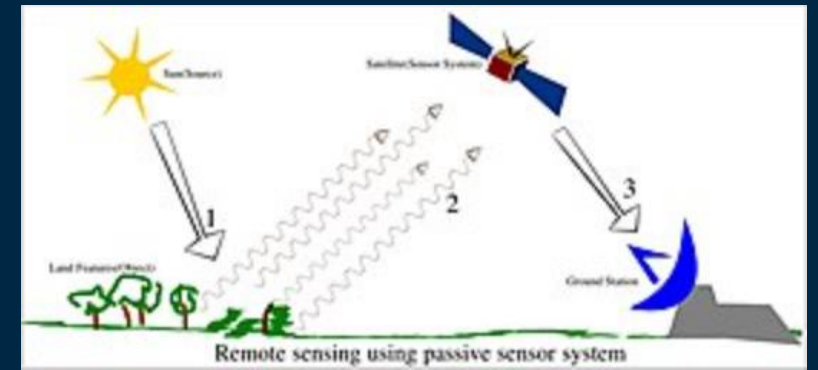
self-seeding

One of the problems of deforestation is the lack of control over self-seeding forests. The law doesn't define such areas as forests.

Remote sensing

Landsat 8 is an American Earth observation satellite launched on 11 February 2013. Satellite operates with 11 spectral bands.

Remote sensing using passive sensor system

Spectral Indices

Spectral indices are combinations of spectral reflectance from two or more wavelengths that indicate the relative abundance of features of interest. Vegetation indices are the most popular type, but other indices are available for burned areas, man-made (built-up) features, water, and geologic features.


RGB Image   Spectral Index Map

Spectral Indices

Index	Formula	Description
NDVI	$$\frac{NIR - Red}{NIR + Red}$$	This index is a measure of healthy, green vegetation.
EVI	$$2.5 \cdot \frac{NIR - RED}{NIR + 6 \cdot Red - 7.5 \cdot Blue + 1}$$	An improvement over NDVI. Optimizing the vegetation signal in areas of high leaf area index (LAI).
GNDVI	$$\frac{NIR - Green}{NIR + Green}$$	This index is more sensitive to chlorophyll concentration than NDVI.
GOSAVI	$$\frac{NIR - Green}{NIR + Green + 0.16}$$	This index was originally designed with color-infrared photography to predict nitrogen requirements for corn.
GRVI	$$\frac{NIR}{Green}$$	This index is sensitive to photosynthetic rates in forest canopies, as green and red reflectances are strongly influenced by changes in leaf pigments.
NDWI	$$\frac{Green - NIR}{Green + NIR}$$	This index is sensitive to changes in vegetation canopy water content.

NDVI

Normalized Difference Vegetation Index quantifies vegetation by measuring the difference between near-infrared (which vegetation strongly reflects) and red light (which vegetation absorbs).
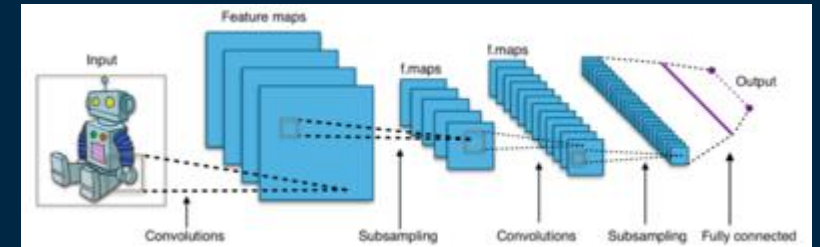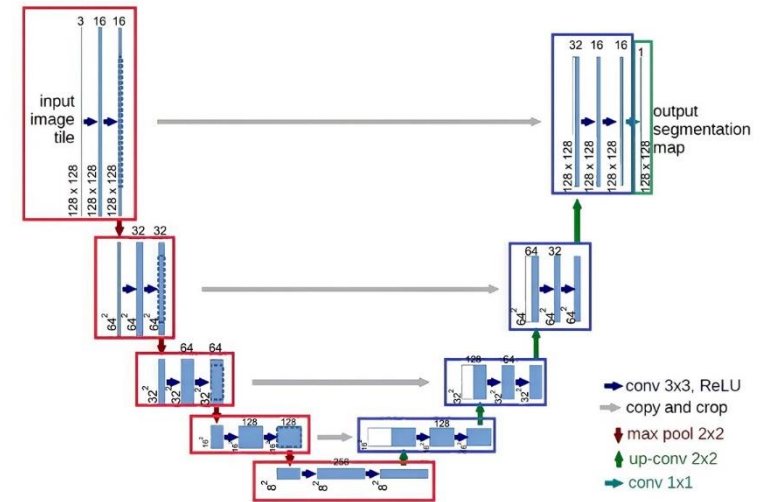
$$NDVI = \frac{NIR - Red}{NIR + Red}$$
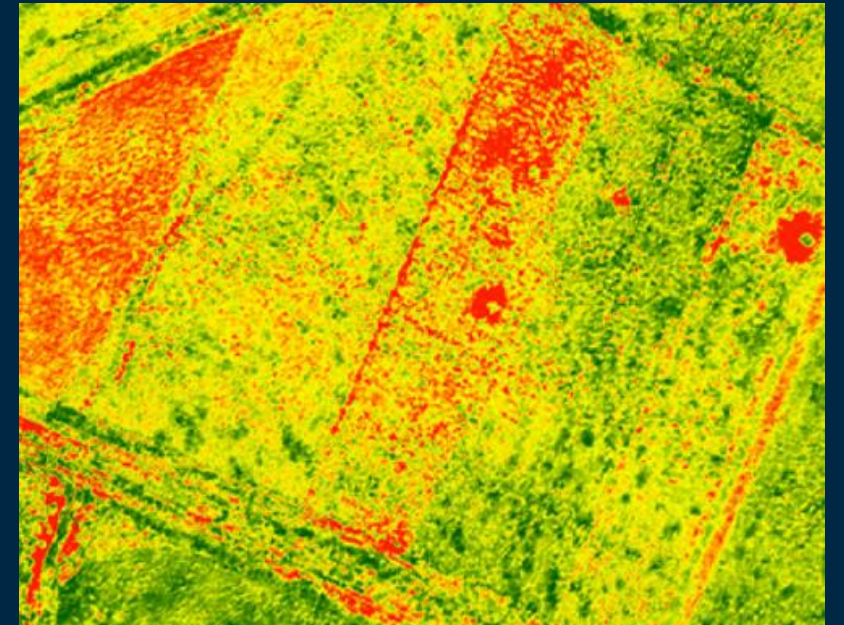
Convolutional neural network

A CNN is a kind of network architecture for deep learning algorithms and is specifically used for image recognition and tasks that involve the processing of pixel data.

U-Net

The u-net is convolutional network architecture for fast and precise segmentation of images.
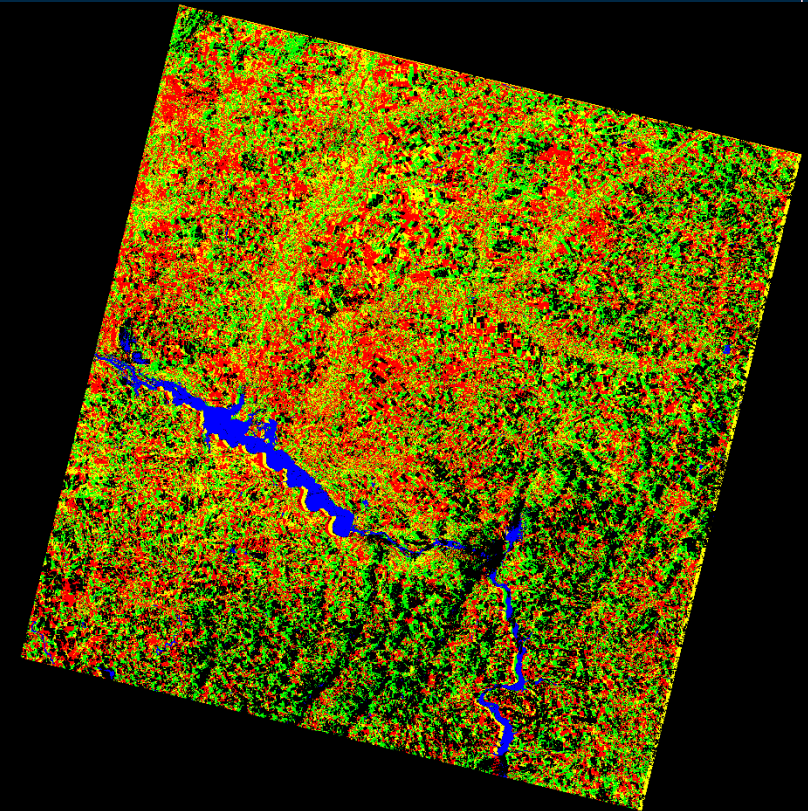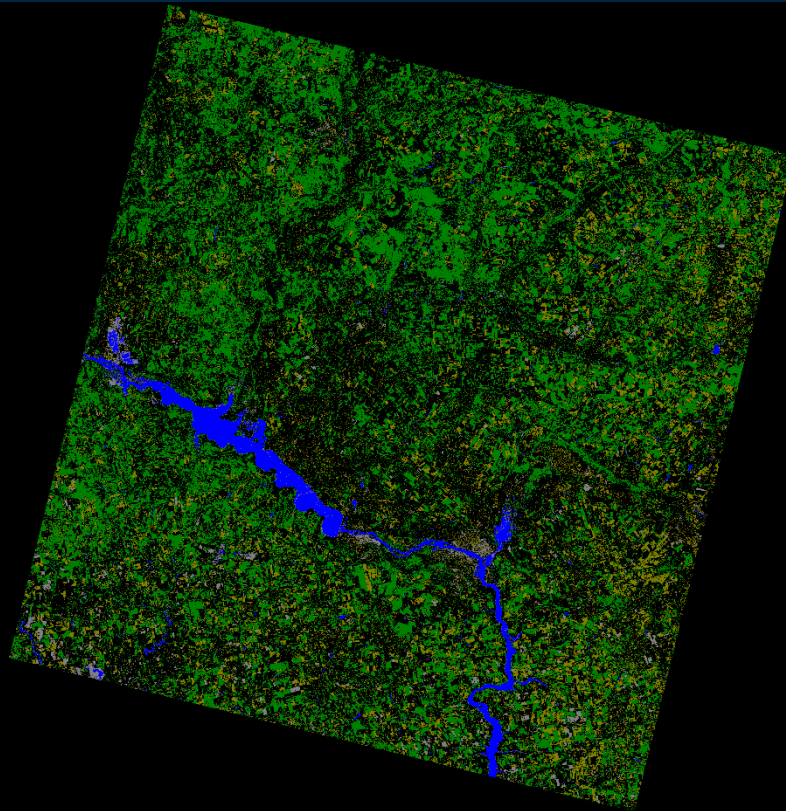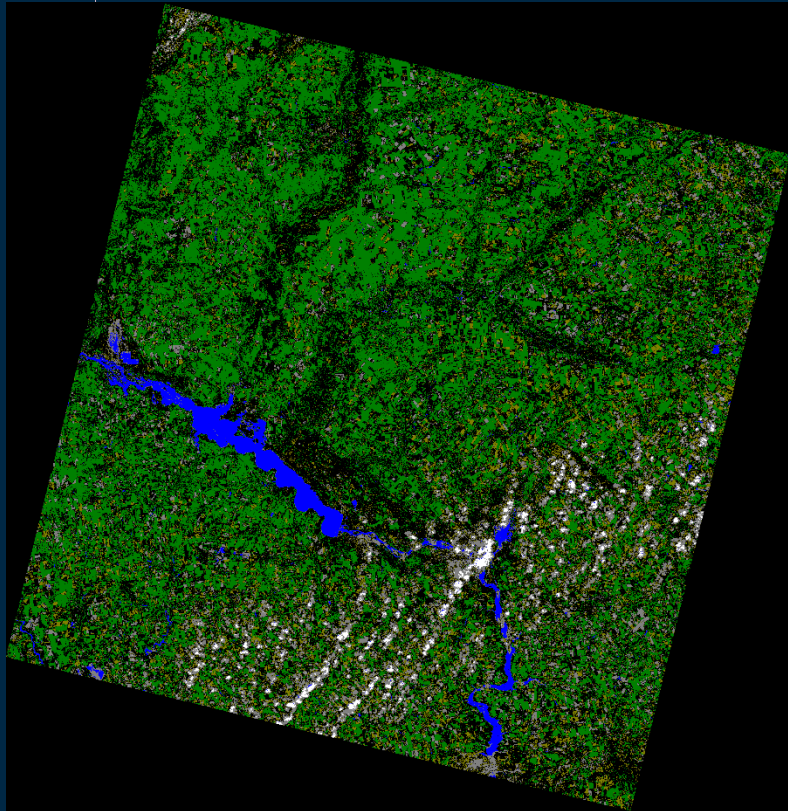
NDVI Comparison

NDVI 1 NDVI 2 De-forestation map

Results

Epoch	acc	val_acc
1	0.597701	0.275717
2	0.676601	0.671473
3	0.709687	0.465044
4	0.741385	0.711727
5	0.755574	0.724296
6	0.764761	0.720006
7	0.771894	0.759499
8	0.772648	0.752585
9	0.776196	0.747615
10	0.797096	0.768763
11	0.808844	0.765107
12	0.818919	0.766805
13	0.815919	0.767057
14	0.819919	0.770547
15	0.8274	0.790663
16	0.82325	0.780683
17	0.827235	0.790712
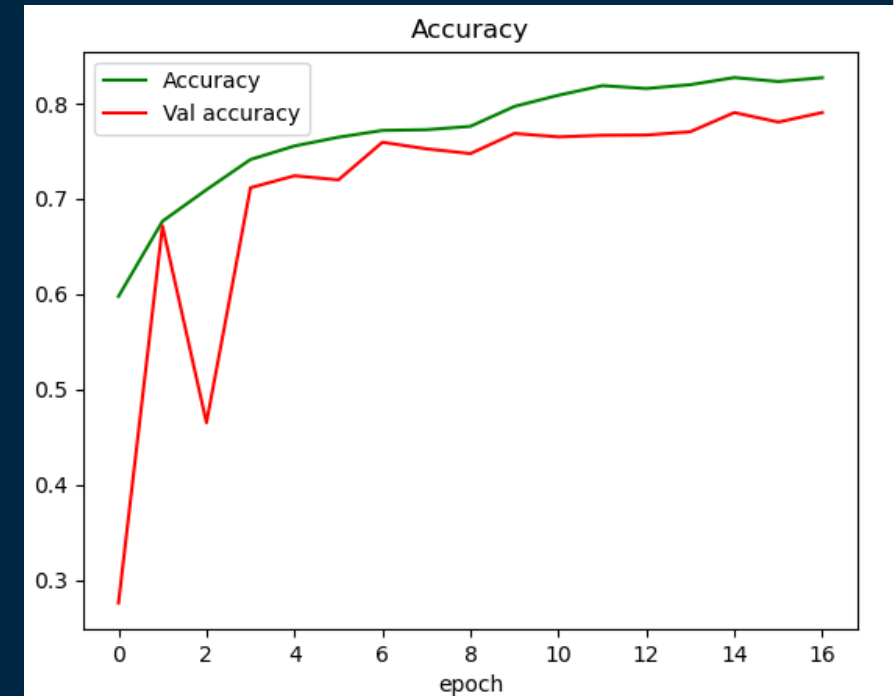
Conclusion

Top 1 score around 80% was achieved. As the result of analysis and synthesis of necessary methods and technologies model of geoinformation system was created to determine vegetation changes on the territory of Ukraine.

Thank you for your attention!