Assessing Water Ecosystem Services and their Dependency on Land use changes

A Case Study of the Azov sea basin

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- Methodology
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Background

Project

- Part of Environmental Systems laboratory at CEU, Budapest, Hungary
- Ongoing since 2012, work in progress
- With Viktor Lagutov & Irina Gilfanova
- Focussed research on the Azov sea Basin

Project – Environmental Systems Laboratory at CEU

- **Project aim:**

To assess the development of Ecosystem Goods & Services

in the Azov Sea Basin with ArcSWAT Modelling

- **My Focus:**

To analyse Land Use and Land Cover changes in the basin

with Google Earth Engine as an input to the project

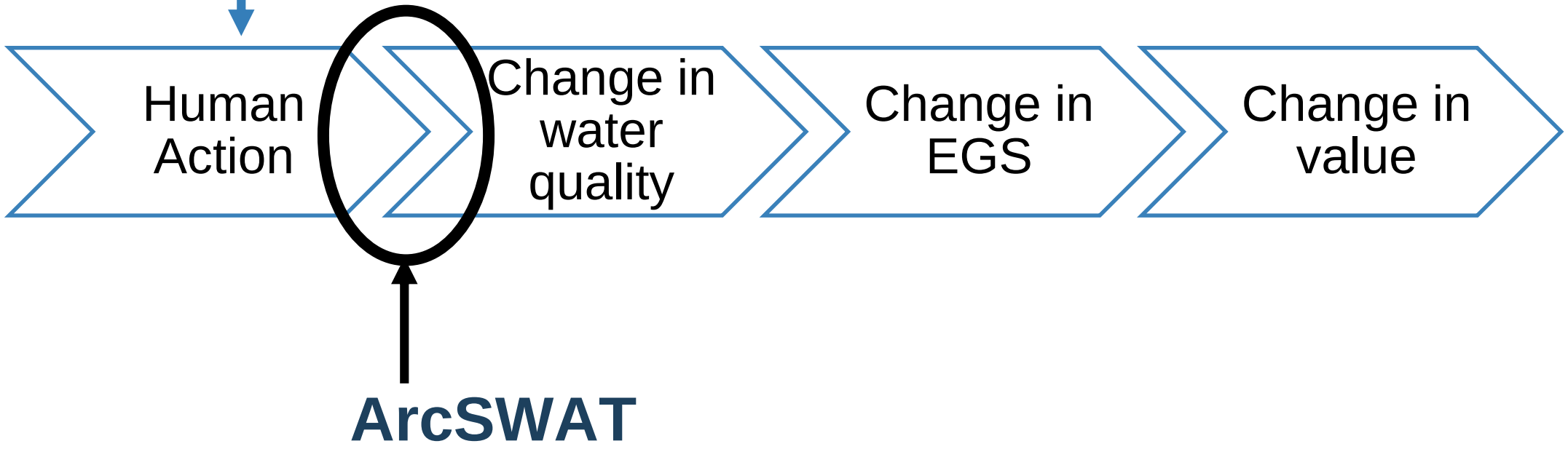
Sara Pruckner, February 2018
UN Conference Pakistan

The Azov Sea Basin

Sara Pruckner, February 2018
UN Conference Pakistan

(Lagutov and Lagutov 2010)

Google Earth Engine



(Keeler et al. 2012)

“What has been the influence

of land use and land cover changes

on ecosystem goods and services

of the Azov Sea basin in the past 30 years,

and how could this relationship develop in the future?”

Methodology Google Earth Engine

Methodology Google Earth Engine

- Supervised Landuse classification
- Using Landsat 8 images of August of different years,

clipped to the borders of the basin

landusemap2015_landsat8 | Get Link | Save | Run | Reset

```
1  // Look for adequate image filtered by date and cloud cover and region
2  var Azov_sea = ee.ImageCollection('LANDSAT/LC08/C01/T1_RT_TOA')
3                  .filterBounds(shape_basin)
4                  .filterDate('2015-08-01','2015-09-01');
5
6  var sorted = Azov_sea.sort('CLOUD_COVER', false).mosaic();
7
8  print(sorted);
9
10 //clip it to the exact region
11 var clipped = sorted.clip(shape_basin);
12
```

Creating Training Data

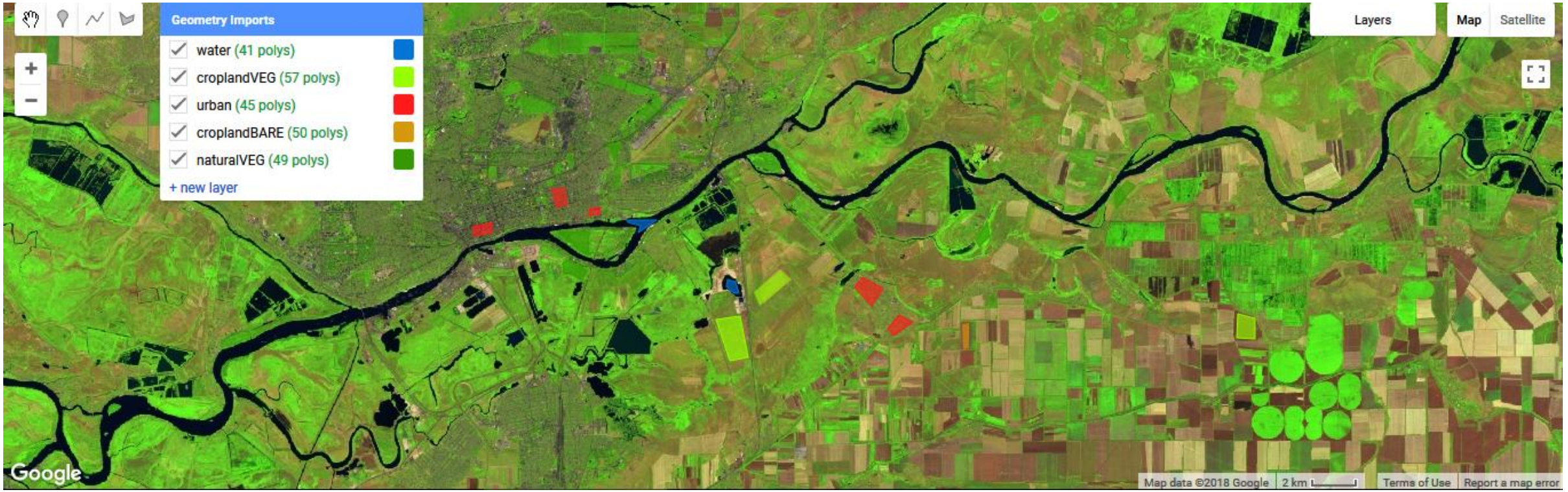
- Least cloudy picture available for time frame for every single point chosen

- Band combination 6-5-4 used for vegetation analysis

Landsat 8 Operational Land Imager (OLI) and Thermal Infrared Sensor (TIRS)	Bands	Wavelength (micrometers)
	Band 1 - Ultra Blue (coastal/aerosol)	0.435 - 0.451
	Band 2 - Blue	0.452 - 0.512
	Band 3 - Green	0.533 - 0.590
	Band 4 - Red	0.636 - 0.673
	Band 5 - Near Infrared (NIR)	0.851 - 0.879
	Band 6 - Shortwave Infrared (SWIR) 1	1.566 - 1.651
	Band 7 - Shortwave Infrared (SWIR) 2	2.107 - 2.294
	Band 8 - Panchromatic	0.503 - 0.676
	Band 9 - Cirrus	1.363 - 1.384
	Band 10 - Thermal Infrared (TIRS) 1	10.60 - 11.19
	Band 11 - Thermal Infrared (TIRS) 2	11.50 - 12.51

(Barsi et al. 2014)

Creating Polygons



Training classifier & Image classification

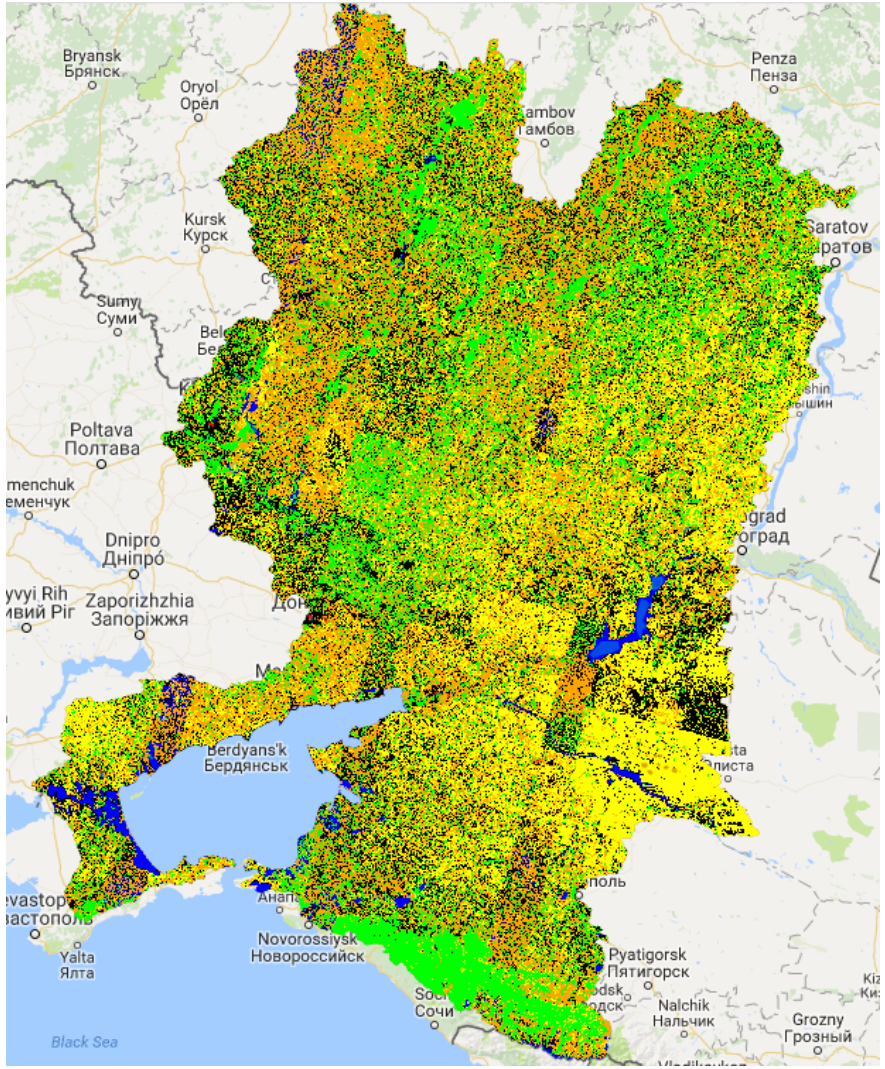
```
41  // Create a random forest classifier with custom parameters.
42  var classifier = ee.Classifier.randomForest().train({
43    features: training,
44    classProperty: 'class',
45    inputProperties: bands
46  });
47
48  // Train the classifier.
49  var trained = classifier.train(training, 'class', bands);
50
51  // Classify the image.
52  var classified = clipped.classify(trained);
53
54  // Create a palette to display the classes.
55  var palette =['0000FF', 'ffa500','000000','FFFF00','00FF00','f4f4f4'];
56
57  //0000FF is water is blue
58  //ffa500 is cropland with vegetation is orange
59  //00000 is urban is black
60  //ffff00 is bare land is yellow
61  //00ff00 is natural vegetation is green
62
63  // Display the classification result and the input image.
64  Map.addLayer(classified, {min: 0, max: 5, palette: palette}, 'Landuse Type 2015');
```

Different classifier types

Preliminary Results

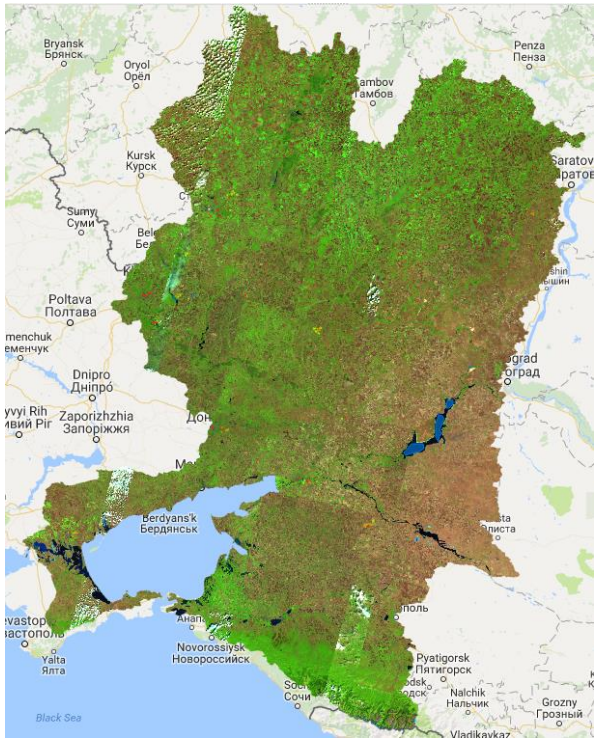
Land use analysis Google Earth Engine

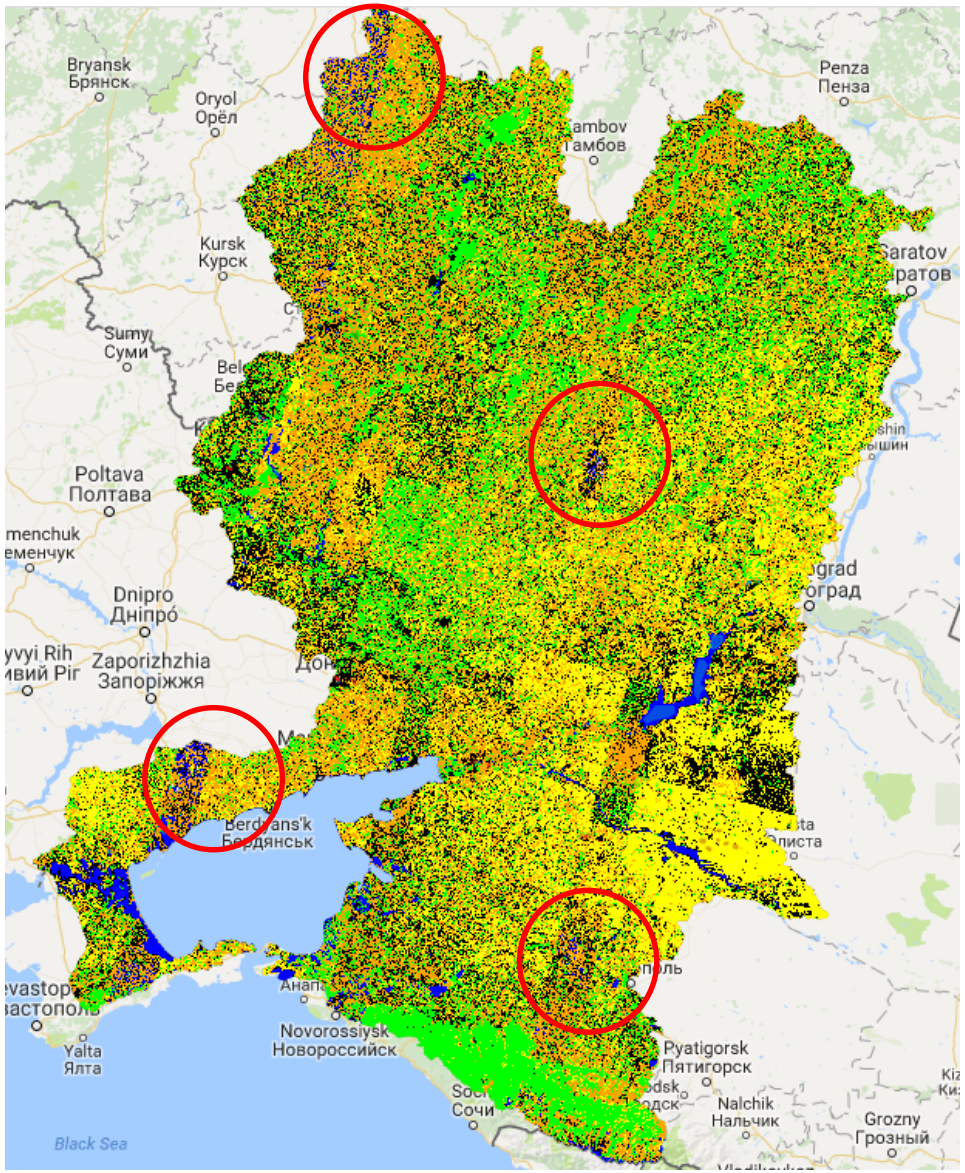
Black:	Urbanised areas
Green:	Naturally vegetated areas
Orange:	Cropland
Yellow:	Pasture/livestock
Blue:	Water



Land use analysis Google Earth Engine

Black: Urbanised areas
Green: Naturally vegetated areas
Orange: Cropland
Yellow: Pasture/livestock
Blue: Water





Accuracy Assessment

Legend:

0 = Water
1 = Vegetated Cropland
2 = Urban land
3 = Bare cropland/Pasture
4 = Natural vegetation/forest

Inspector Console Tasks

Resubstitution error matrix: JSON

List (5 elements) JSON

- 0: [139949,4,4,0,6]
- 1: [9,9279,91,37,122]
- 2: [11,134,2753,75,39]
- 3: [2,65,31,12232,25]
- 4: [6,113,55,27,11834]

Training overall accuracy: JSON

0.9951611900306948

Issues to solve

- Cloudless pictures vs. same month of the year
- More detailed land use training data for different years
- Separate accuracy assessment data
- Creating an input for ArcSWAT

References

- Barsi, J.A.; Lee, K.; Kvaran, G.; Markham, B.L.; Pedelty, J.A. The Spectral Response of the Landsat-8 Operational Land Imager. *Remote Sens.* **2014**, *6*, 10232-10251. doi:10.3390/rs61010232

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- Keeler, B. L., Polasky, S., Brauman, K. A., Johnson, K. A., Finlay, J. C., O'Neill, A., ... & Dalzell, B. (2012). Linking water quality and well-being for improved assessment and valuation of ecosystem services. *Proceedings of the National Academy of Sciences*, *109*(45), 18619-18624.

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Thank you for your attention!