



AUTOMATING GIS PROCESSES



5 + 5 ECTS

GEOG-329-1 in Period 1 Basics of programming, data analysis and visualization (Geo-Python)

<https://geo-python.github.io>

GEOG-329-2 in Period 2 Spatial data manipulation, analysis and visualization (AutoGIS)

<https://autogis.github.io>



AUTOGIS TEAM 2020



Henrikki Tenkanen
(materials)



Vuokko Heikinheimo
(materials, lessons)



Emil Ehnström
(practical sessions)



Sonja Koivisto
(practical sessions)



OVERVIEW

During the Automating GIS processes course, the students learn to analyze geospatial data efficiently and systematically using the Python programming language. **The students learn the basic programming concepts and skills in Python, and learn to apply these skills to solving geographical questions**, building upon their previous knowledge about Geographical Information Systems (GIS). In addition to spatial analysis skills, **the students learn to use a version control system (git) and online repositories (GitHub) for documenting and communicating their analysis workflow**. The course consists of interactive lectures, weekly programming exercises and a final project.



LEARNING GOALS

- After completing this course, the students are able to
 - test and produce **modular code** in the Python programming language
 - **manage spatial data** programmatically (for example, reading different data formats, re-projecting, re-classifying and storing data),
 - **apply spatial analysis methods** in Python (such as buffering, network analysis and spatial joins)
 - create **visualizations** (graphs and maps) from geographic data using Python
 - design and implement a geographical **data analysis workflow**



GENERIC SKILLS

- After completing this course, the students are able to
 - Independently **search for information** regarding programming methods
 - **Apply new methods** based on online documentation
 - **Critically evaluate** the available methods and information sources
 - Understand the importance of **version control** for practical tasks and scientific purposes
 - **Communicate** their analysis workflow in written format
 - Complete assignments **on time** 😊



COURSE MATERIALS

Lessons <https://autogis.github.io>

Exercises <https://github.com/autogis-2020>

Slack: <https://geo-python-2020.slack.com>

→ new channels: #autogis-week*

CSC notebooks: <https://notebooks.csc.fi/>

→ AutoGIS 2020



COURSE TOPICS

1	Shapely and geometric objects (points, lines and polygons)
2	Managing spatial data with Geopandas (reading and writing data, projections, table joins)
3	Geocoding and spatial queries
4	Reclassifying data, overlay analysis
5	Visualization: static and interactive maps
6	OpenStreetMap data (osmnx) and Network analysis (networkx)
7	Course recap and preparing for the final assignment
Extra	Raster processing (rasterio), Python in QGIS



COURSE EVALUATION

- 6 weekly exercises (40 % of final assesment)
- Final assignment (60 % of final assessment)

Working in pairs is recommended for weeks 1-6

Final assignment is an individual task



DEADLINES

- Weekly exercises are due in one week's time (on Thursdays)
- Final assignment
 - 1st deadline: Thursday the **31st December 2020**
 - 2nd deadline Friday the **15th of January 2020**

You can choose either of these deadlines 😊. Those submitting early will get their credits earlier.

GIS IN PYTHON?

Examples



GLOBAL SPECIES RANGE DATA PROCESSING

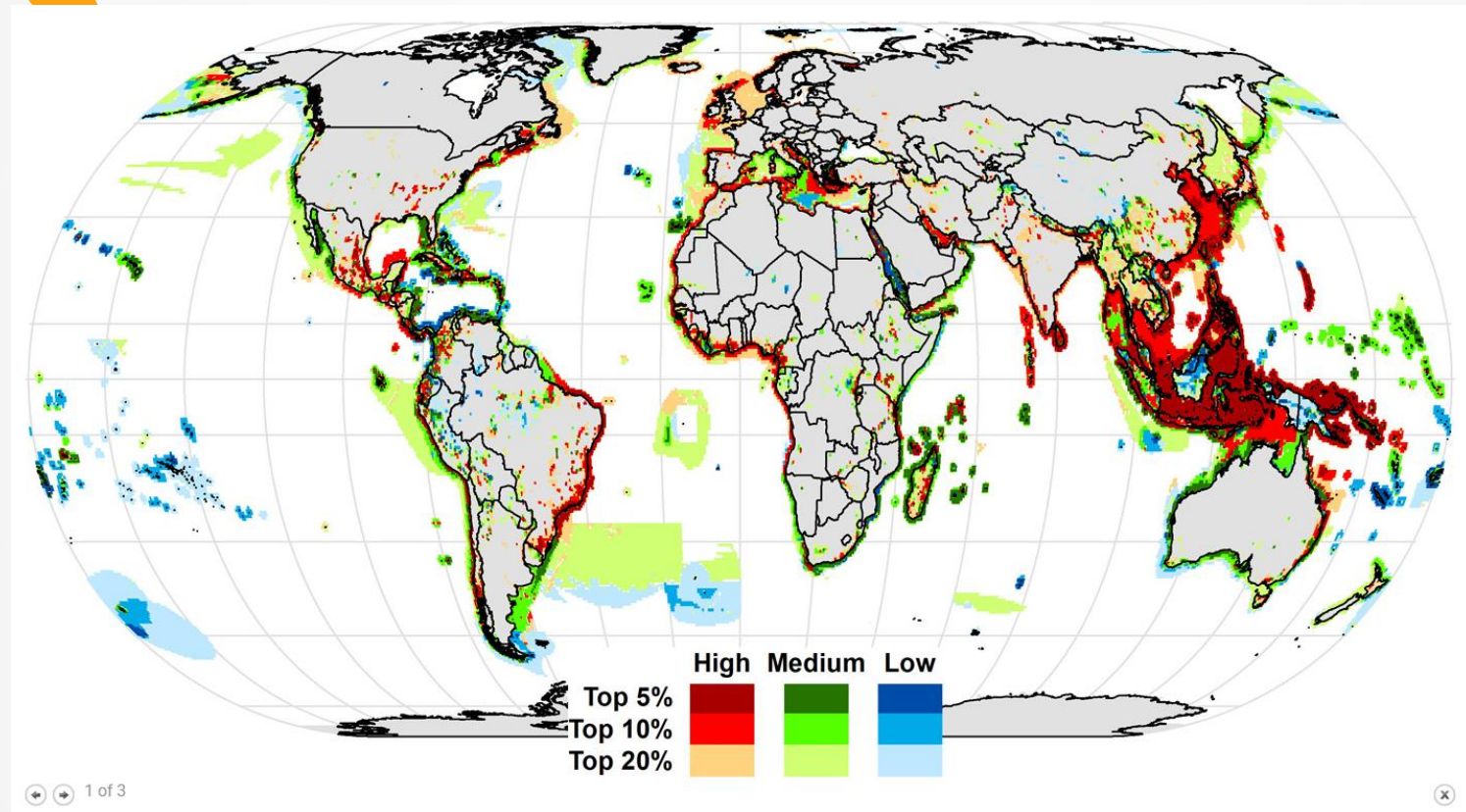
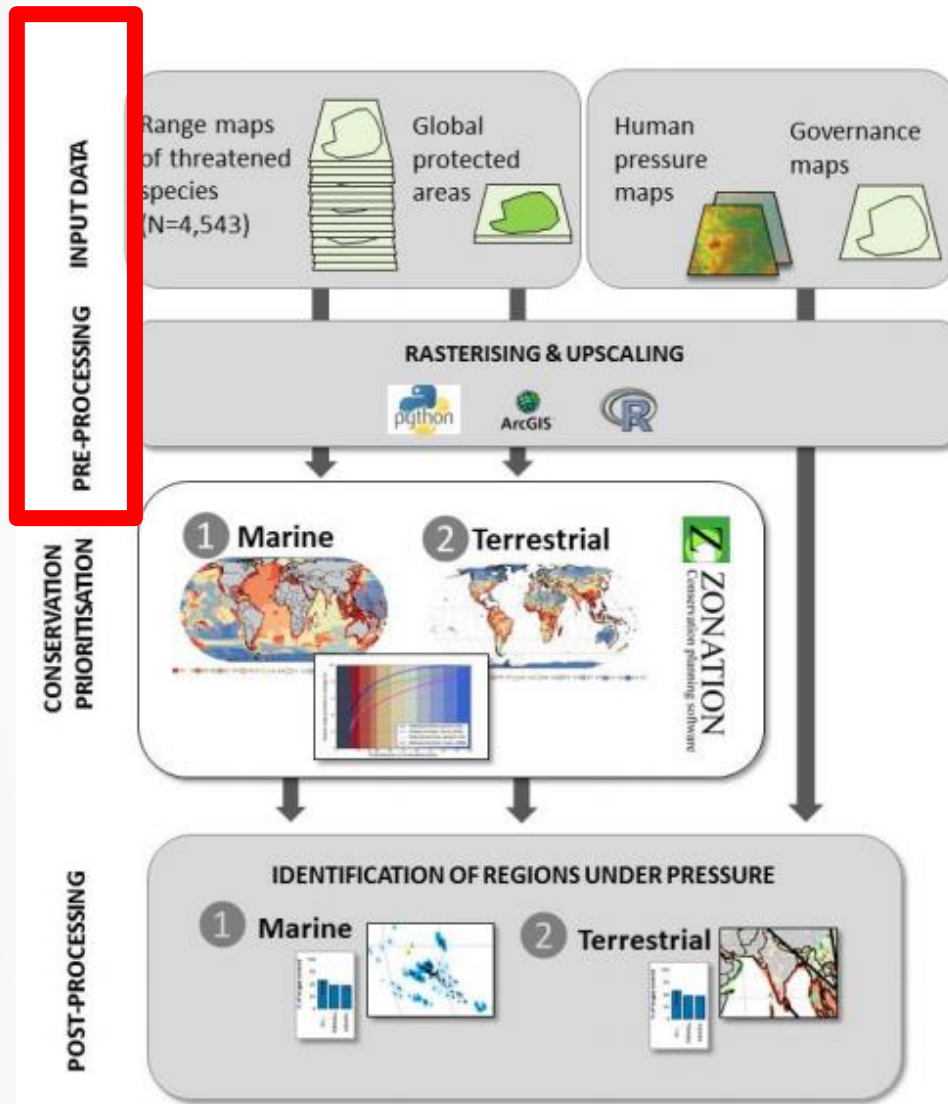


Fig. 1 Vulnerability of global conservation priority areas to unsustainable commercial harvesting.

Di Minin, E, Brooks, T, Toivonen, T, Butchart, S, Heikinheimo, V, Watson, J, Burgess, N, Challender, D, Goettsch, B, Jenkins, R & Moilanen, A 2019, 'Identifying global centers of unsustainable commercial harvesting of species', *Science Advances*, Vol 5, Nro 4, 2879. <https://doi.org/10.1126/sciadv.aau2879>



Di Minin et al. 2019. Fig. S1. Flowchart of the analysis.

```

# Import modules
import arcpy, os, string, sys, zipfile, gc, time
from arcpy import env
from arcpy.sa import *
import glob

# Check out any necessary licenses
arcpy.CheckOutExtension("spatial")

# Enable Arcpy to overwrite existing files
arcpy.env.overwriteOutput = True

#-----
#Messages:
#-----

def msg(Message):
    arcpy.AddMessage(Message)

# Set parameters
cell_factor = 2
cellCount = 4
dtype = "p"
#Resolution = str(16)

# input parameters via ArcToolbox:
Data = str(arcpy.GetParameterAsText(0)) #Data folder which contains the files
OutputFolder = arcpy.GetParameterAsText(1)
SnapRaster = arcpy.GetParameterAsText(2)
Resolution = str(arcpy.GetParameterAsText(3))

#####
# Define method for deleting existing file from the output directory if the

def ExDel(haettava, workspace):
    origWS = env.workspace
    env.workspace = workspace
    if arcpy.Exists(haettava):
        arcpy.Delete_management(haettava)
    env.workspace = origWS

#-----
# Environment settings
#-----
arcpy.env.extent = arcpy.Extent(-180, -90, 179.99999856, 89.99999928)
arcpy.env.snapRaster = SnapRaster

#-----
# LISTING .TIF FILES
#-----

msg("Listing files")

# Parse files within TOP folder only
DataList = glob.glob(os.path.join(Data, '*.tif'))

```

Input data from IUCN Red list



Pre-processing
using **Python 2.7.8** and arcpy:

- Subsetting
- Rasterizing
- "Upscaling"

→ see for example:

[Arcpy.PolygonToRaster_conversion\(\)](#)

SCHOOL DISTRICT OPTIMIZATION

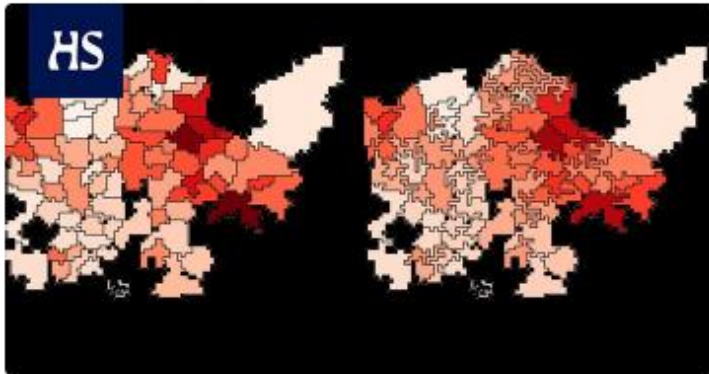
MSc Thesis, Hertta Sydänlammi, 2019

HS Helsingin Sanomat

Helsingiläisen opiskelijan poikkeuksellinen gradu kerää eriytymiselle jotain melko yksinkertaisilla tavoilla”

Graduntekijä rakensi tietokoneohjelman, joka laskee koulualueiden vieraskielisten lasten määrä tasoittuu.

Oct 16th (285 kB) ▾



“an optimization model that minimizes the variance of social variables between school districts by iteratively redrawing the districts’ borders.”

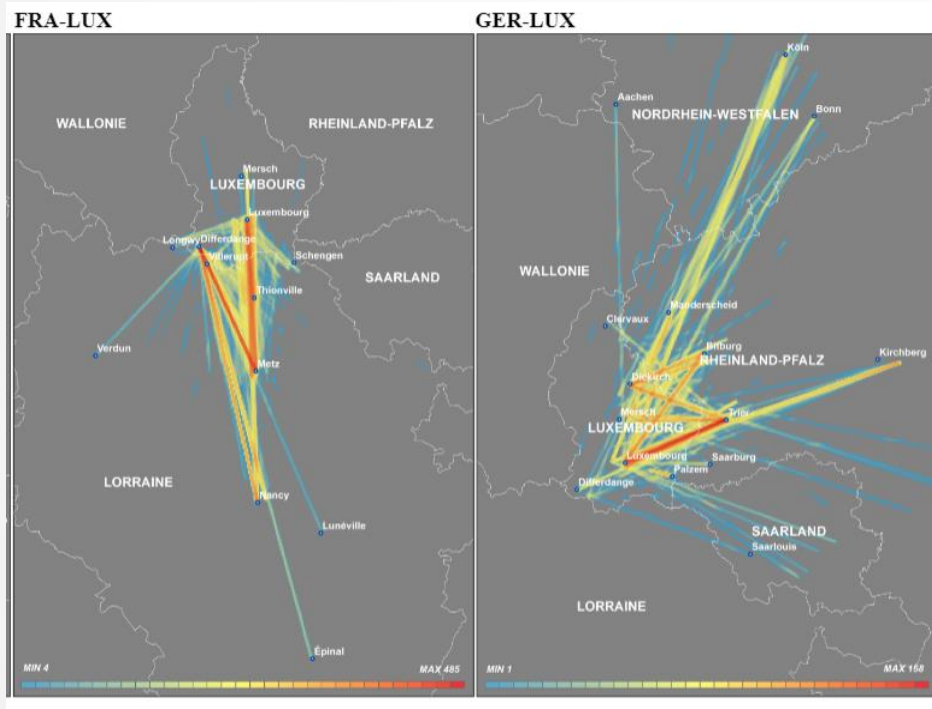
Thesis: <https://helda.helsinki.fi/handle/10138/302229>

Code: <https://github.com/herttale/School-district-optimization>

<https://www.hs.fi/kaupunki/art-2000006275047.html>

MODELING CROSS-BORDER MOBILITY USING TWITTER

MSc Thesis, Samuli Massinen, 2019



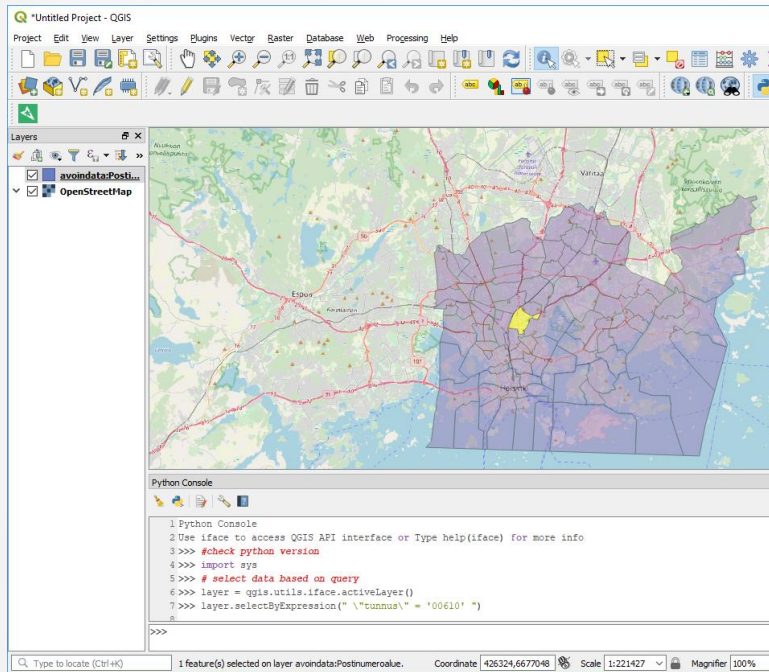
Thesis: <https://helda.helsinki.fi/handle/10138/306530>

Code: <https://github.com/DigitalGeographyLab/cross-border-mobility-twitter>

Cross-border movements in 2010-2018 between Luxembourg and surrounding areas.



PYTHON IN QGIS



Python console in QGIS



GeoCubes plugin:

<https://github.com/geoportti/GeoCubes-Finland-QGIS-Plugin>

LET'S GET STARTED!

<https://autogis.github.io>