AUTOMATING GIS PROCESSES

Course code **GEOG-329**

10 ECTS in total

Period 1 Basics of programming, data analysis and visualization (Geo-Python)
https://geo-python.github.io

Period 2 Spatial data management, analysis and visualization (AutoGIS)
https://autogis.github.io

AUTOGIS-TEAM 2019

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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-2019

Slack: https://geopython2019.slack.com

→ new channels: #autogis-week*

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

→ AutoGIS 2019

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	Raster processing (rasterio), Python in QGIS demo

GIS IN PYTHON?

Examples

GLOBAL SPECIES RANGE DATA PROCESSING

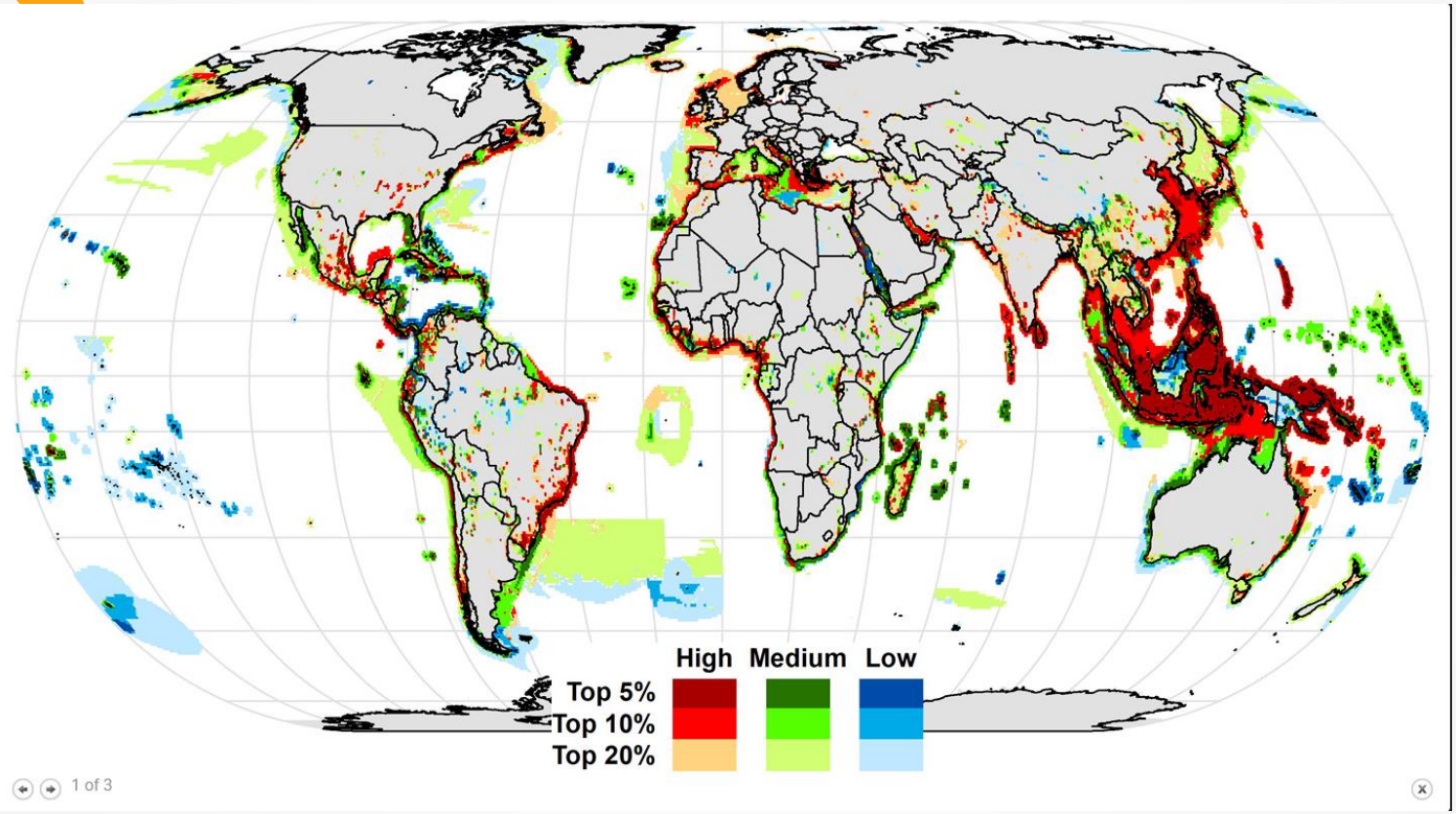
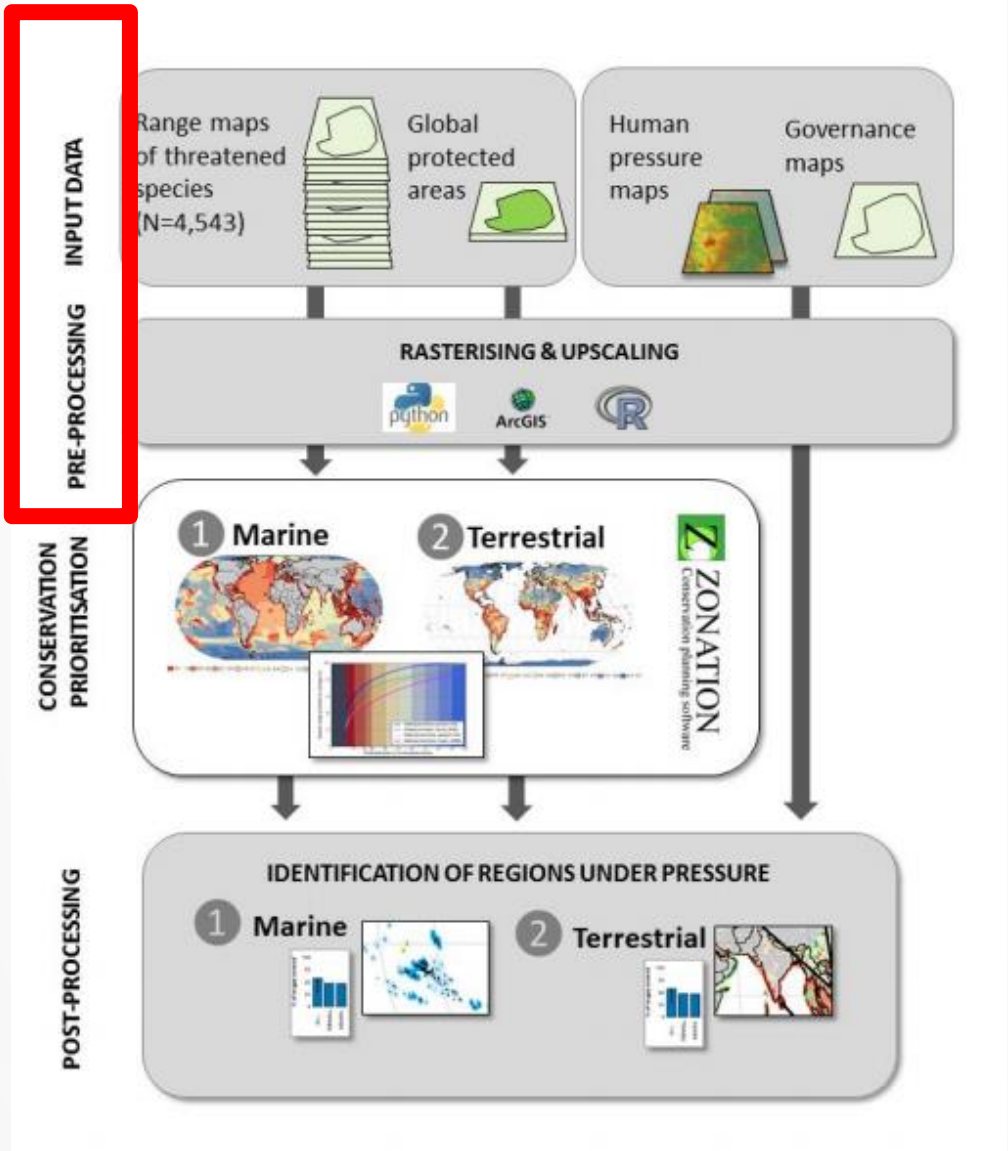


Fig. 1 Vulnerability of global conservation priority areas to unsustainable commercial harvesting.

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.

Data from IUCN Red list

Pre-processing in Python:

- Subsetting
- Rasterizing
- ”Upscaling”

→ Done using arcpy, see for example:

Arcpy.PolygonToRaster_conversion()

```
# 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):               #Writes a message into the info streem in ArcGIS
    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 that will be aggreg
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 file already exists

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'))
```

Python 2.7.8 and arcpy

SCHOOL DISTRICT OPTIMIZATION

MSc Thesis, Hertta Sydänlammi, 2019

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

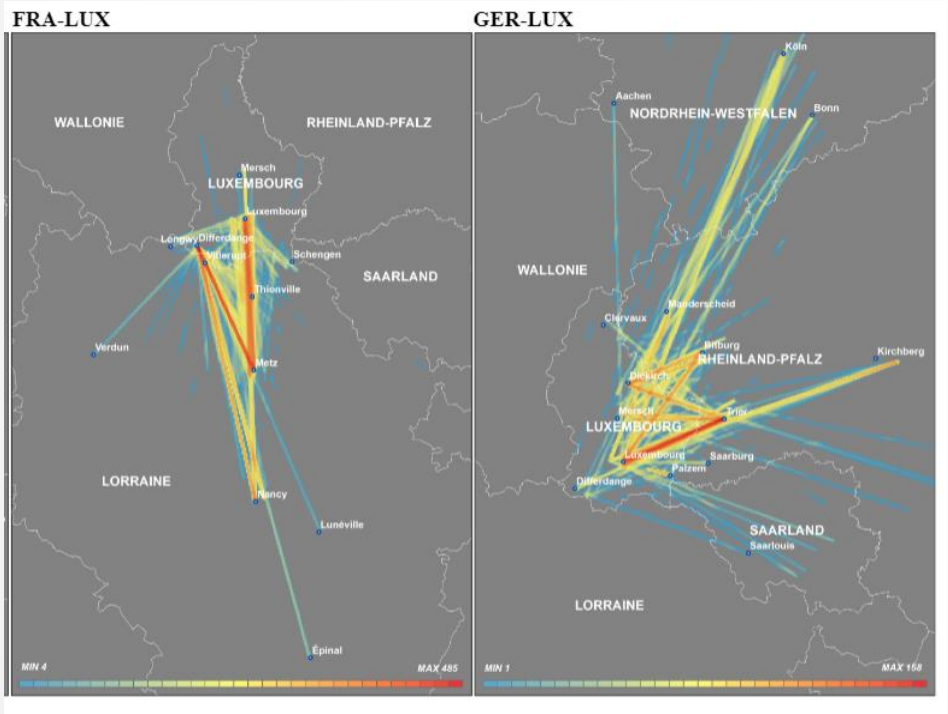
"an optimization model that minimizes the variance of social variables between school districts by iteratively redrawing the districts' borders."

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

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

MODELING CROSS-BORDER MOBILITY USING TWITTER

MSc Thesis, Samuli Massinen, 2019

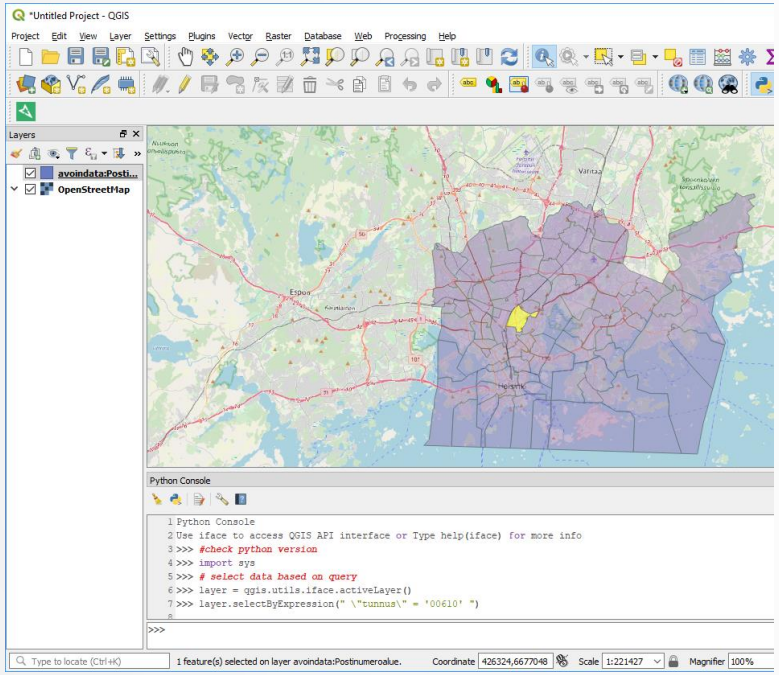


Cross-border movements in 2010-2018 between Luxembourg and surrounding areas.

Thesis: (soon available at) https://ethesis.helsinki.fi/

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

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