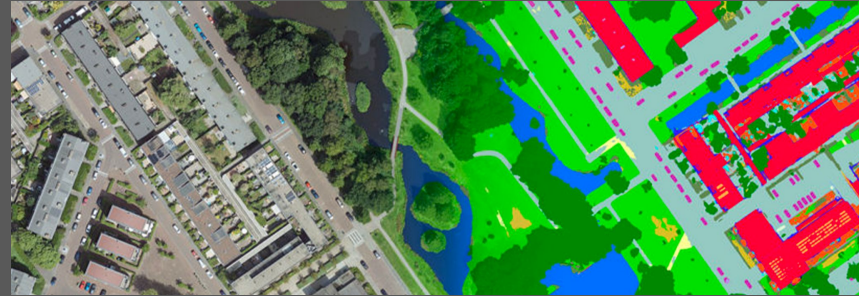


The Alan Turing Institute

Remote Sensing reading group

Favourite RS tools,
packages and software
23 May 2024

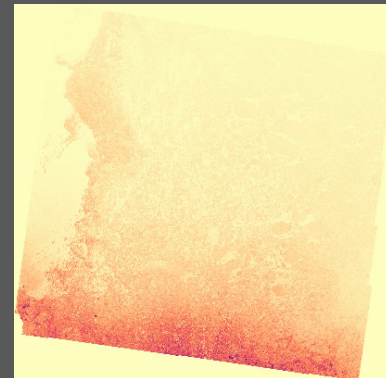
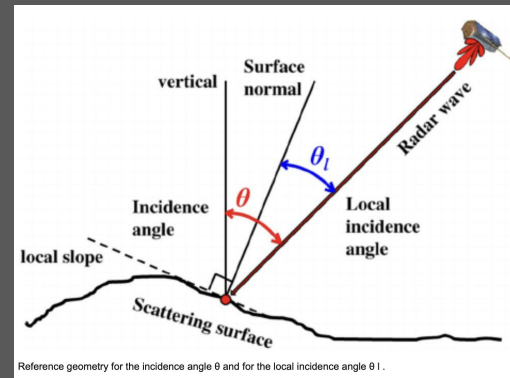
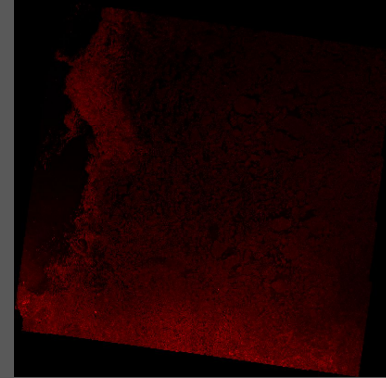
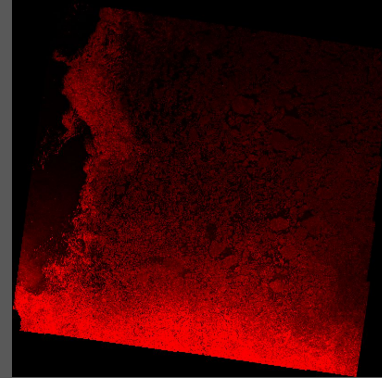


Outline

- Louisa van Zeeland | SNAP
- Thijs van der Plas | Geopandas
- John Francis | lidR
- Meilun Zhou | DeepForest
- Anna Zanchetta | Grass GIS
- Barbara Metzler | TorchGeo
- Alejandro Coca-Castro | Xarray
- Richard Walters | GMT

Sentinel Application Platform (SNAP)

- Python code to call SNAP
<https://github.com/wajuqi/Sentinel-1-preprocessing-using-Snappy>
- *Used on SAR scenes for incidence angle calibration*
- *Terrain correction, thermal noise removal, sigma0 calibration, apply orbit file, etc*



Geopandas

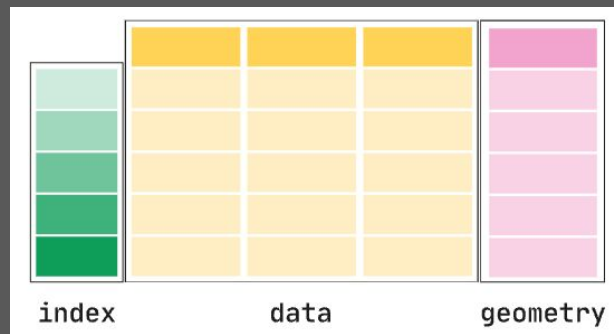
- [Python pkg](#)
- .shp files (points / polylines / polygons)

Handles .shp files in Python as
GeoDataFrame

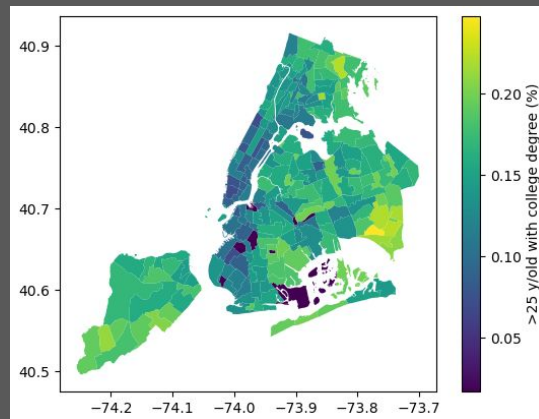
Geospatial operations (area,
distance, buffer, **overlay**,
dissolve, **sample**, etc.)

Plotting

[Rtree](#) included (gdf.sindex)



```
import geodatasets
import geopandas as gpd
gdf = gpd.read_file(geodatasets.get_path('geoda.nyc_neighborhoods'))
gdf['college_frac'] = gdf['college'] / gdf['poptot']
gdf.plot('college_frac', cmap='viridis', legend=True,
        legend_kwds={'label': ">25 y/old with college degree (%)"})
```



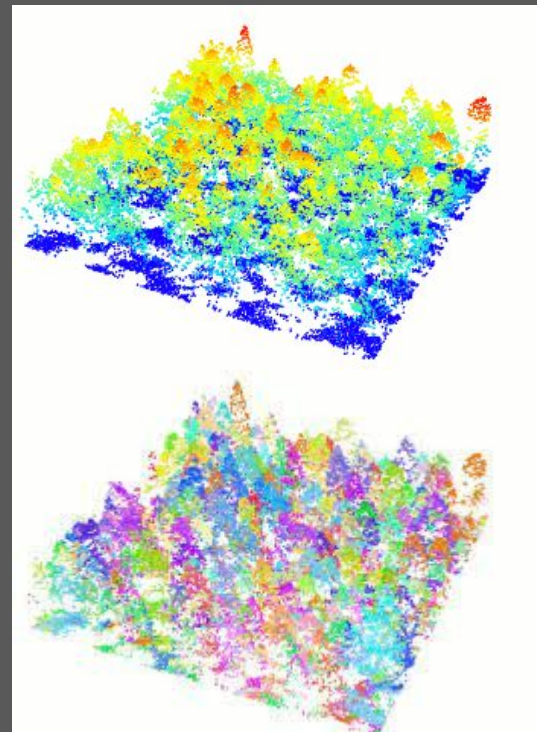


lidR

- [R package](#)
- .las .laz (point cloud data)

Package for manipulating and visualizing point clouds, with an emphasis on (but not limited to!) forestry application.

Allows for computation of metrics in area based approach, point filtering, artificial point reduction, classification from geographic data, normalization, individual tree segmentation, processing of large tile catalogs



DeepForest

- Python package developed by Ben Weinstein
- Works on RGB Imagery

Airborne Object Detection and Classification using RGB imagery

I work with DeepForest for tree crown detection for my thesis research

<https://deepforest.readthedocs.io/en/latest/>

<https://milliontrees.idtrees.org/>





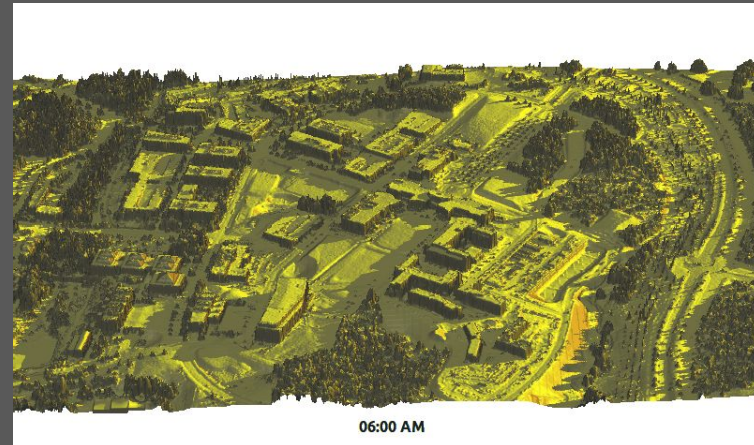
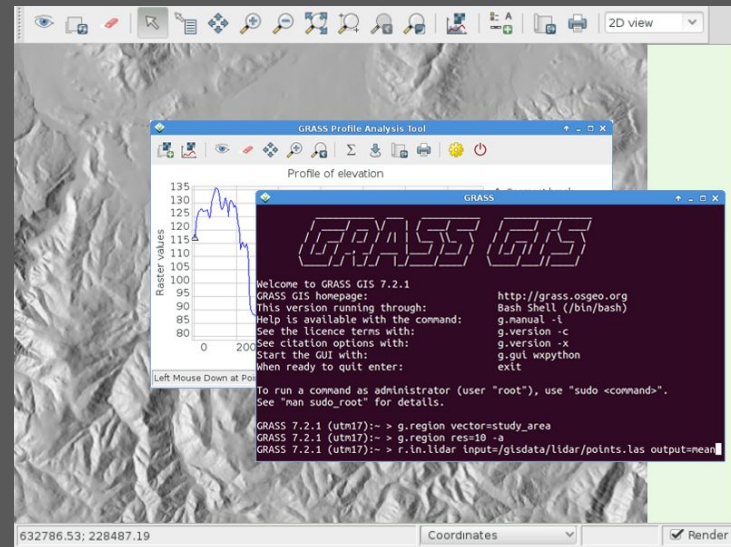
Grass GIS

- Bash, R, Python...
- Raster analysis (mainly)



- Free and Open Source Software (**FOSS**) affiliated project of **OSGeo Foundation**;
- Runs on Linux, Mac and Windows;
- GUI or a **command line syntax** (useful for automation and production);
- **500+ modules**

<https://grasswiki.osgeo.org/wiki/GRASS-Wiki>



TorchGeo

- [Python package](#)
- library for deep learning on geospatial data, built on PyTorch

Key features:

- Data loading: Datasets and samplers (20+)
- Geospatial operations (cropping, resampling,..)
- Pre-trained models (40+)



TorchGeo

BigEarthNet

```
CLASS torchgeo.datasets.BigEarthNet(root='data', split='train', bands='all', num_classes=19,
transforms=None, download=False, checksum=False) [SOURCE]
```

Sentinel-2

Weight	Channels	Source	Citation	BigEarthNet	EuroSAT	So2Sat	OSCD
ResNet18_Weights.SENTINEL2_ALL_MOCO	13	link	link				
ResNet18_Weights.SENTINEL2_RGB_MOCO	3	link	link				
ResNet18_Weights.SENTINEL2_RGB_SECO	3	link	link	87.27	93.14		46.94
ResNet50_Weights.SENTINEL2_ALL_DINO	13	link	link	90.7	99.1	63.6	

Xarray

- [Python package](#) (Pangeo ecosystem)
- Suited to N-dimensional arrays (labeled coordinates and dimensions)
- Build upon and extend the core strengths of NumPy and pandas
- Integrated with libraries for parallel computing (dask), vis (HoloViz) and common formats (netCDF, geoTIFF)
- Extensions for the RS/GIS community e.g [xarray-spatial](#) and [xdggs](#)

[7]: xarray.Dataset

► Dimensions: (time: 122479, y: 15360, x: 18432)

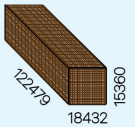
▼ Coordinates:


time	(time)	datetime64[ns]	1979-02-01T03:00:00 ... 2020-12-...	
x	(x)	float64	-2.304e+06 -2.304e+06 ... 2.304e+06	
y	(y)	float64	-1.92e+06 -1.92e+06 ... 1.92e+06	

▼ Data variables:

crs	()	S1	...	
sfcsheadsubrt	(time, y, x)	float64	dask.array<chunksizes=(224, 350, 350), meta=...	

	Array	Chunk
Bytes	252.30 TiB	209.35 MiB
Shape	(122479, 15360, 18432)	(224, 350, 350)
Count	1275605 Tasks	1275604 Chunks
Type	float64	numpy.ndarray



zwatbtabrt	(time, y, x)	float64	dask.array<chunksizes=(224, 350, 350), meta=...	
------------	--------------	---------	---	---

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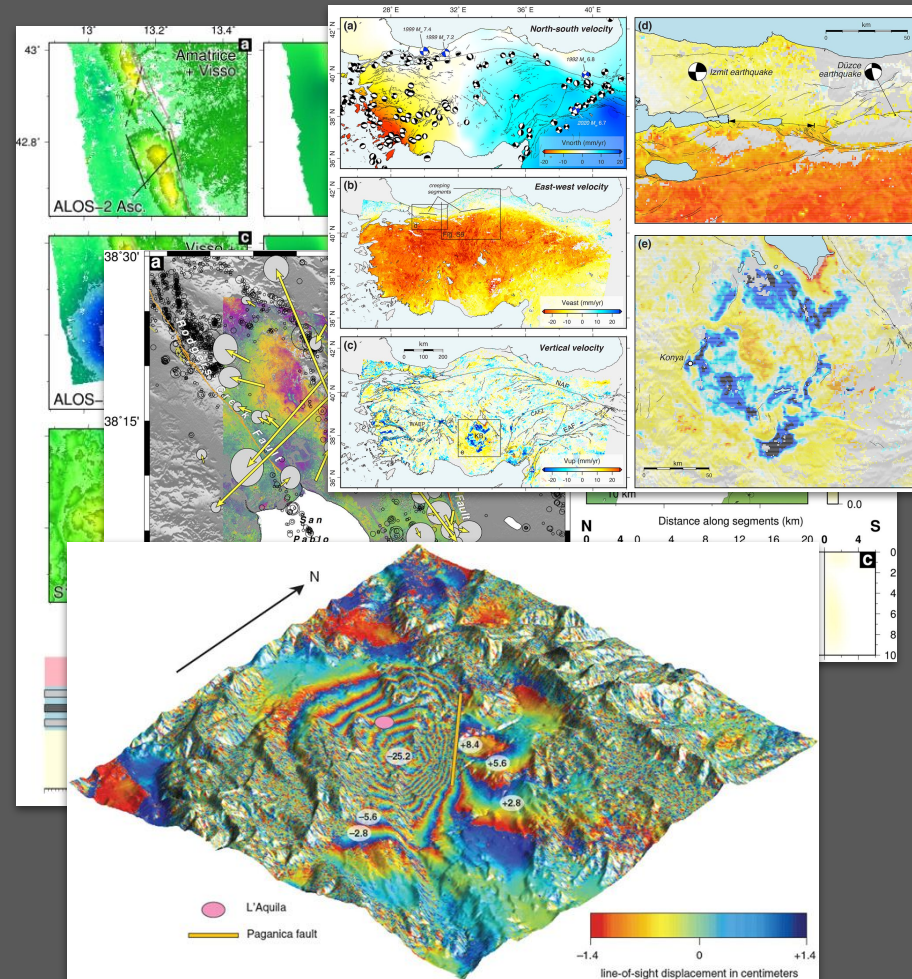


▼ Attributes:

Conventions : CF-1.6
GDAL_DataType : Generic
TITLE : OUTPUT FROM WRF-Hydro v5.2.0-beta2
code_version : v5.2.0-beta2
model_configur... retrospective
model_output_t... terrain_rt
proj4 : +proj=lc +units=m +a=6370000.0 +b=6370000.0 +lat_1=30.0 +lat_2=60.0 +lat_0=40.0 +lon_0=-97.0 +x_0=0 +y_0=0 +k_0=1.0 +nadgrids=@null +wktext +no_defs

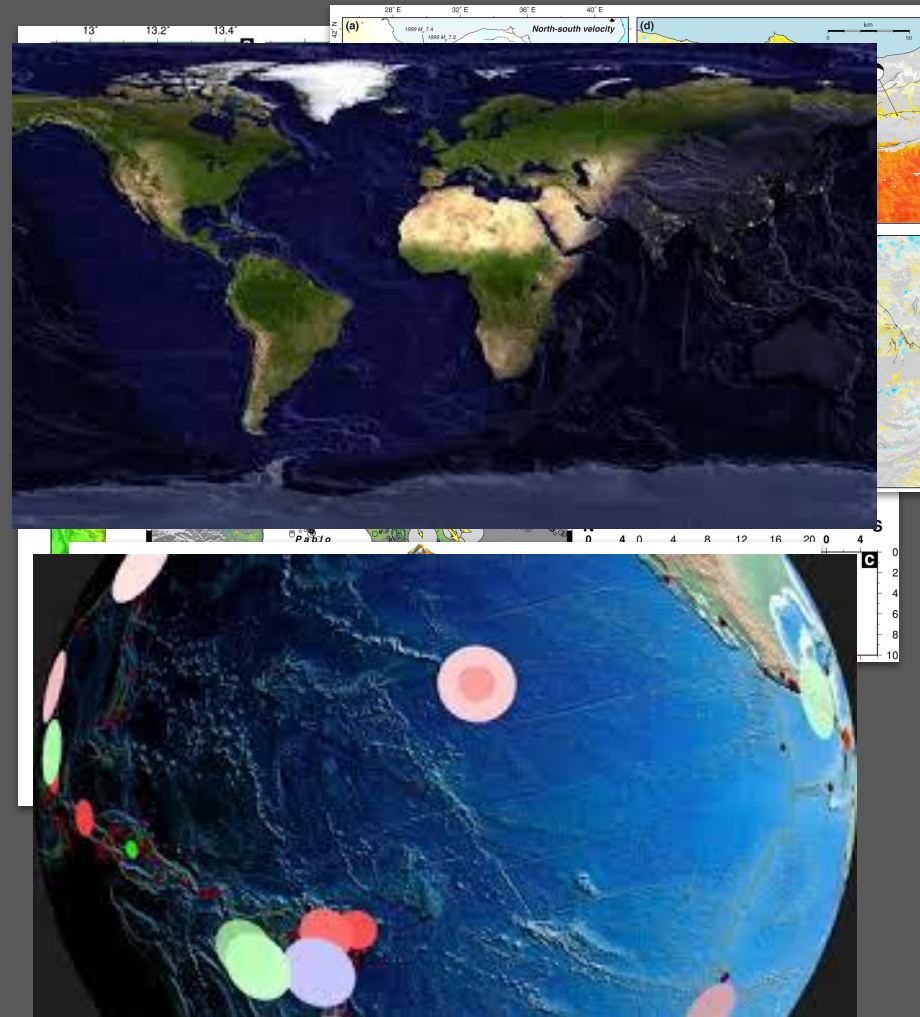
GMT (Generic Mapping Tools)

- Compiled C, runs under Linux, Win, Mac and wrappers for Python, Matlab, Julia, R....
- Geospatial analysis, plotting
- Open-source collection of command-line tools for manipulating geographic and Cartesian data sets (including filtering, trend fitting, gridding, projecting...) and producing high-quality illustrations from simple x-y plots via contour maps to artificially illuminated surfaces and 3D perspective views. Supports most map projections and transformations and includes supporting data such as coastlines, rivers, political boundaries etc.
- GMT + GDAL = ❤️
- One of the most used toolsets in Earth, Ocean, and Planetary sciences
- Written by two grad students @Lamont-Doherty (Columbia)
- In use for 40 yrs, ~2000 cites/yr, ongoing investment from NSF (~\$1M funding in last 5 yrs), new extensions/spin-offs PyGMT, GMTSAR
- <https://www.generic-mapping-tools.org/>
- <https://agupubs.onlinelibrary.wiley.com/doi/10.1029/2023C0000231>



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<name presenter>

<name tool>

- *<language>*
- *<data used for?>*

<Main features & applications>

*<screenshots code
/ output / .. (use
extra slides for
extra screenshots if
needed)>*