

# Brief introduction to GIS and Remote Sensing

Hackathon for Innovation in Satellite & Climate  
Data

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# GIS

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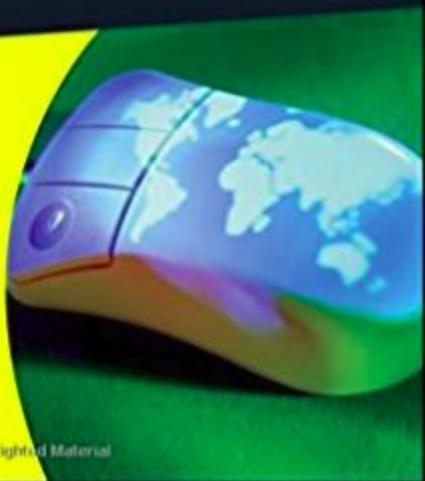
## Learn to:

- Use GIS technology as it applies to your business
- Retrieve, analyze, and interpret geographic data
- Recognize geographic patterns and distributions
- Design and implement a GIS

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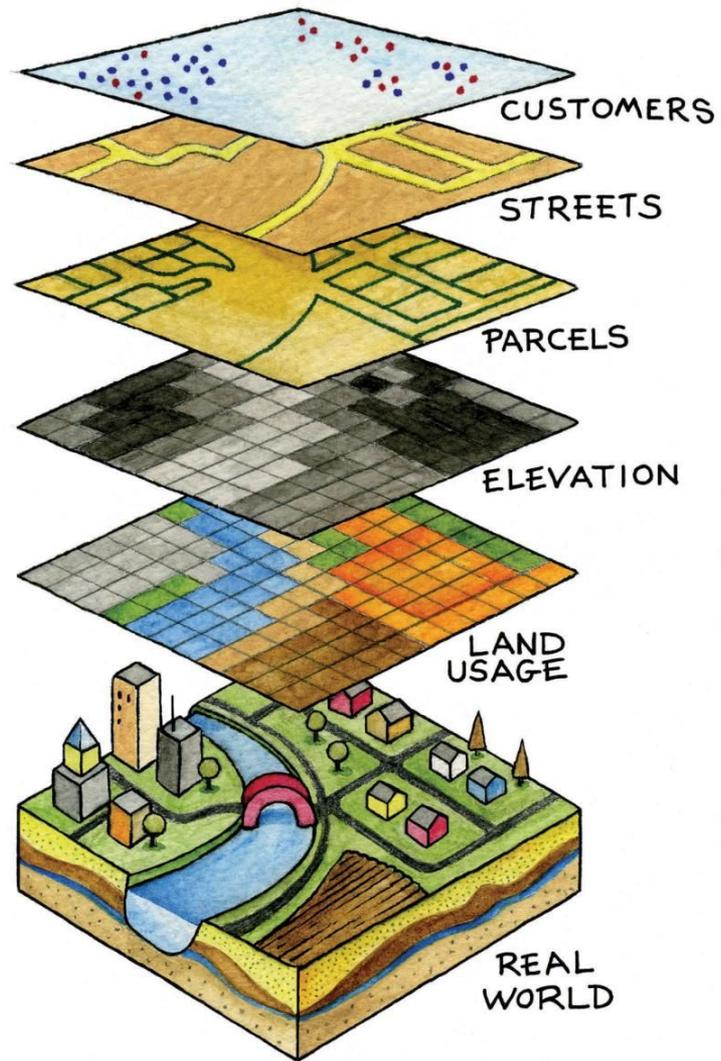
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**Remote sensing**  
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# GIS



# GIS

A geographic information system (GIS) is a system designed to capture, store, manipulate, analyze, manage, and present spatial or geographic data.

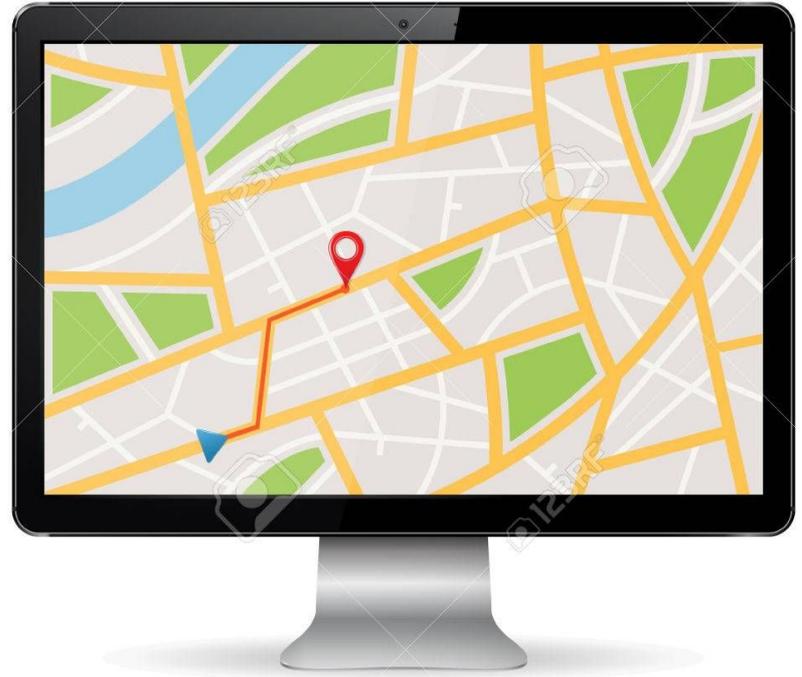
In general, the term describes any information system that integrates, stores, edits, analyzes, shares, and displays geographic information.

# GIS

- It's information system
- It can handle spatial attribute of the data
- It consists of
  - Software
  - Hardware
  - Data
  - People

# GIS

Maps in the computers



# GIS data models

- Rasters
  - Used for continuous-changing data phenomena
  - Elevation
  - Temperature
  - Earth observation data
  - ...
  - Sentinel data
- Vectors
  - Used for discrete data phenomena
  - Polygon features (Cadastre, land use)
  - Linear features (streets, rails, wires)
  - Points
  - OpenStreetMap

# Raster data

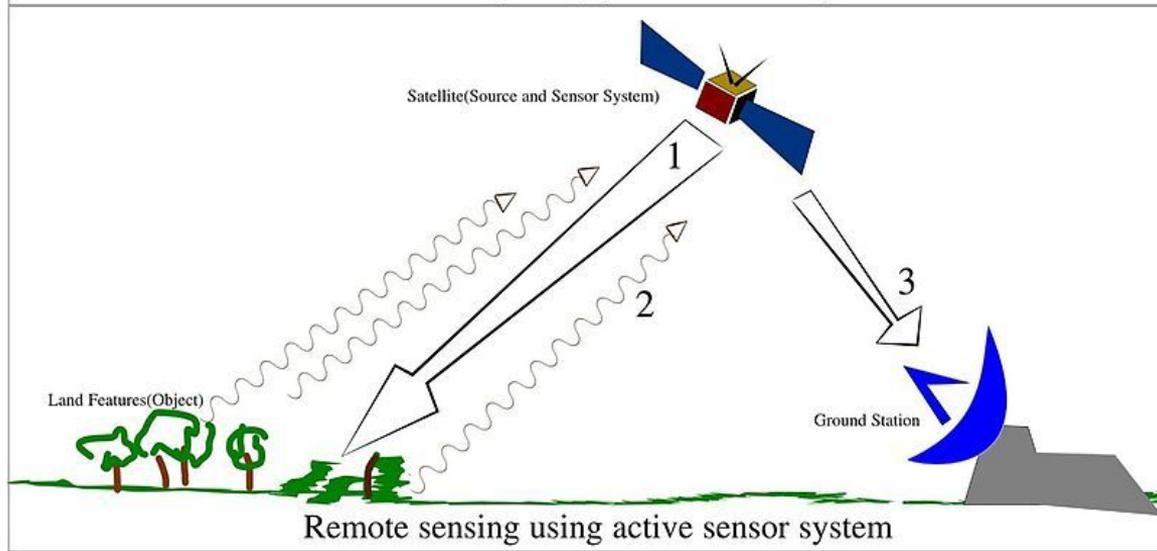
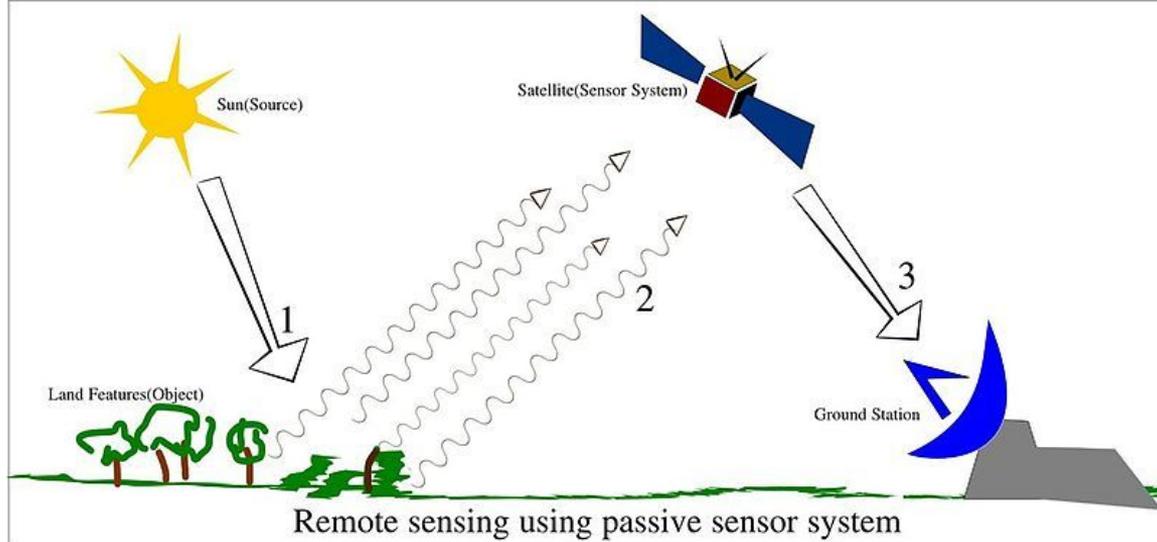
In its simplest form, a raster consists of a matrix of cells (or pixels) organized into rows and columns (or a grid) where each cell contains a value representing information, such as temperature. Rasters are digital aerial photographs, imagery from satellites, digital pictures, or even scanned maps.

<http://training.gismentors.eu/open-source-gis/formaty/rastr.html>

# Remote sensing

Remote sensing is the acquisition of information about an object or phenomenon without making physical contact with the object and thus in contrast to on-site observation.

In current usage, the term "remote sensing" generally refers to the use of satellite- or aircraft-based sensor technologies to detect and classify objects on Earth, including on the surface and in the atmosphere and oceans, based on propagated signals (e.g. electromagnetic radiation).



# Data sources

- [https://en.wikipedia.org/wiki/Remote\\_sensing\\_satellite\\_and\\_data\\_overview](https://en.wikipedia.org/wiki/Remote_sensing_satellite_and_data_overview)
- <https://scihub.copernicus.eu/> - Sentinel data hub
  - <https://dhr1.cesnet.cz/#/home> - Czech mirror (50 scenes/day limit)
- <http://sentinel-pds.s3-website.eu-central-1.amazonaws.com/> - Sentinel on AWS

# Remote sensing and raster data

- Various formats (150+)
- Multi band
- Various data types (Boolean, Byte, Int, UInt, ...)

# Tools



# QGIS - for visualisation and basic analysis

<http://qgis.org>

# GRASS GIS - For heavy data processing

<http://grass.osgeo.org>

# GDAL - Swiss army knife for geodata

- Format conversion
- Warping
- Basic processing
- Python bindings
- <http://gdal.org>

# Rasterio

- Python library
- Command line tools
- Numpy bindings
- <https://mapbox.github.io/rasterio/>
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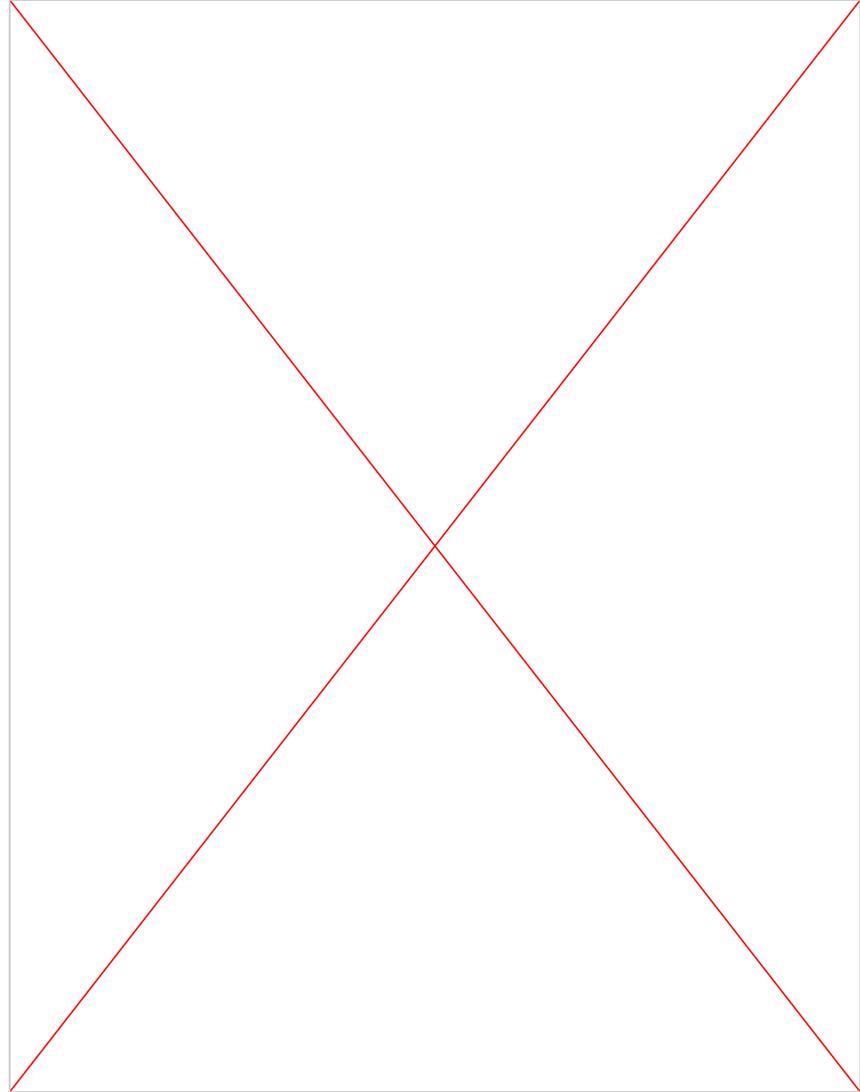
# Numpy and Scipy

- Python libraries for matrix/image processing
- [http://www.scipy-lectures.org/advanced/image\\_processing/](http://www.scipy-lectures.org/advanced/image_processing/)

# Coordinate reference systems

A spatial reference system (SRS) or coordinate reference system (CRS) is a coordinate-based local, regional or global system used to locate geographical entities. A spatial reference system defines a specific map projection, as well as transformations between different spatial reference systems.

<http://training.gismentors.eu/open-source-gis/soursystemy/index.html>

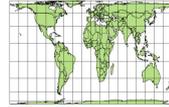




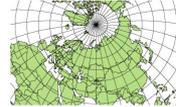
Mollweide-Projektion



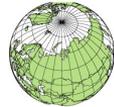
Mercator-Projektion



Peters-Projektion



Längentreue Azimutalprojektion



Senkrechte Umgebungsperspektive



Robinson-Projektion



Gnomonische Projektion



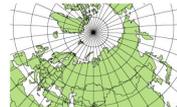
Flächentreue Kegelprojektion



Zylinderprojektion nach Miller



Hammer-Attoff-Projektion



Stereographische Projektion



Behrmann-Projektion



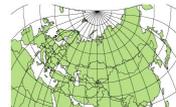
Hotine Oblique Mercator-Projektion



Sinusoidale Projektion



Transverse Mercator-Projektion



Cassini-Soldner-Projektion

# How to deal with various CRSs

- Define one target CRS (WGS84, Mercator, ...)
- Convert data to target CRS e.g. gdalwarp
  - `gdalwarp -t_srs "+init=epsg:4326" input.tif output-wgs84.tif`

# Next steps

- Download and install GDAL <http://gdal.org>
- Download and install QGIS <http://qgis.org>
- Register to <https://scihub.copernicus.eu/>
- Start downloading data
- Unzip && open in QGIS
- Hack

# There is more

- Atmospheric correctio

<https://earth.esa.int/web/sentinel/user-guides/sentinel-2-msi/processing-levels/level-2>

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