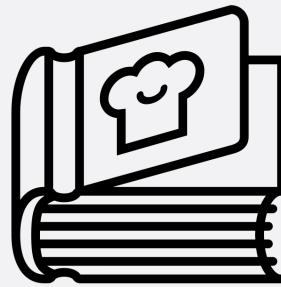


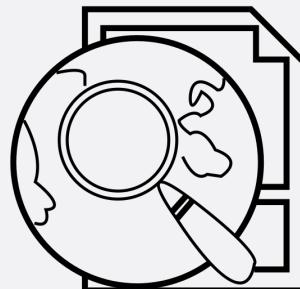
# Geospatial concepts

Maurizio Napolitano  
[\(napo@fbk.eu\)](mailto:(napo@fbk.eu))

# the GIS cookbook



Projections



Data Model

Distribution protocols



Spatial Analysis

Rendering

# Flat earth?

**Flat Earth Society**

@FlatEarthOrg

Encouraging the spread of ideas and free thought since 1865! Read the FAQ: [faq.tjes.org](http://faq.tjes.org) Visit us: [tjes.org](http://tjes.org)

[tjes.org](http://tjes.org)

Iscritto a dicembre 2013

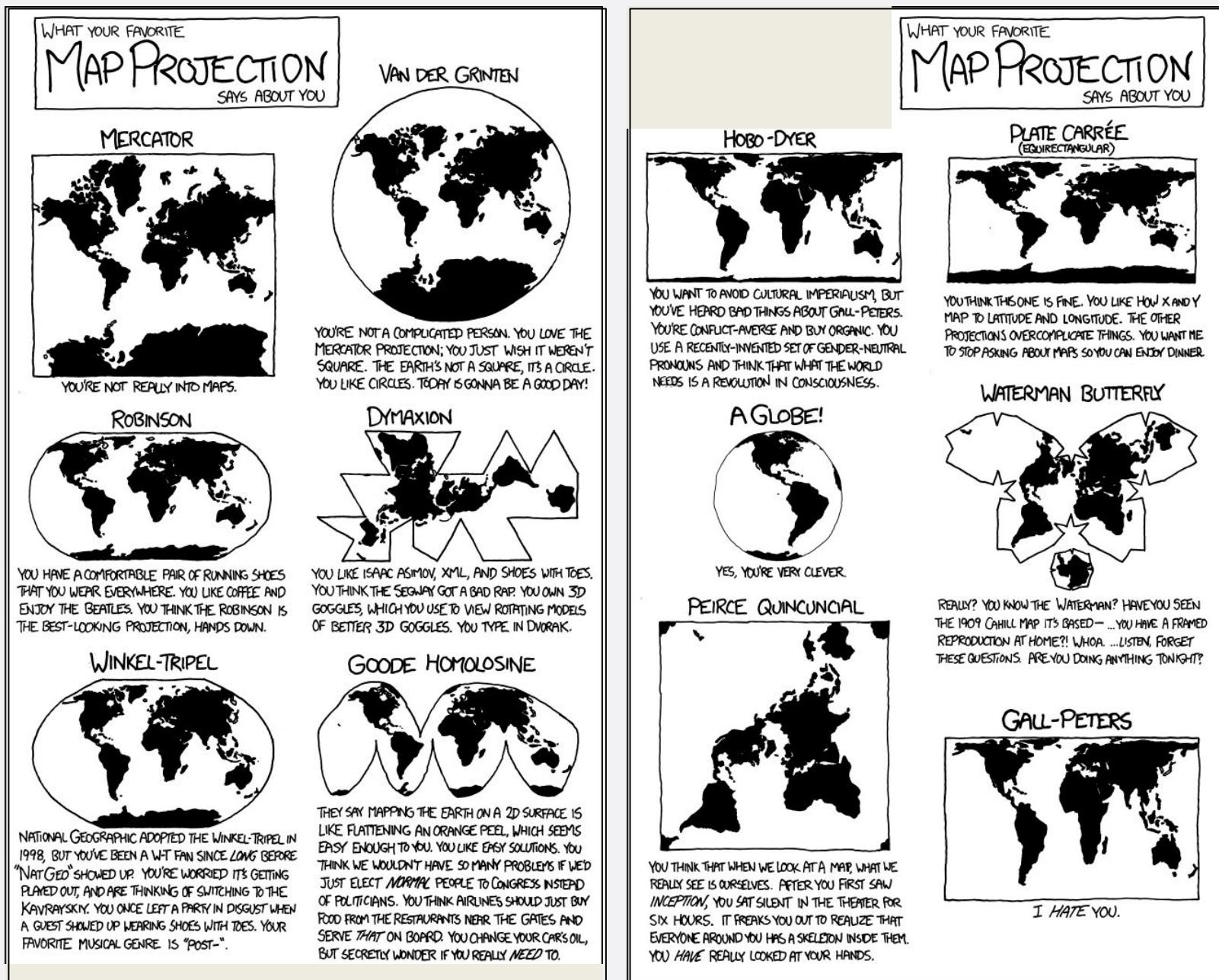
Invia Tweet Messaggio

352 foto e video

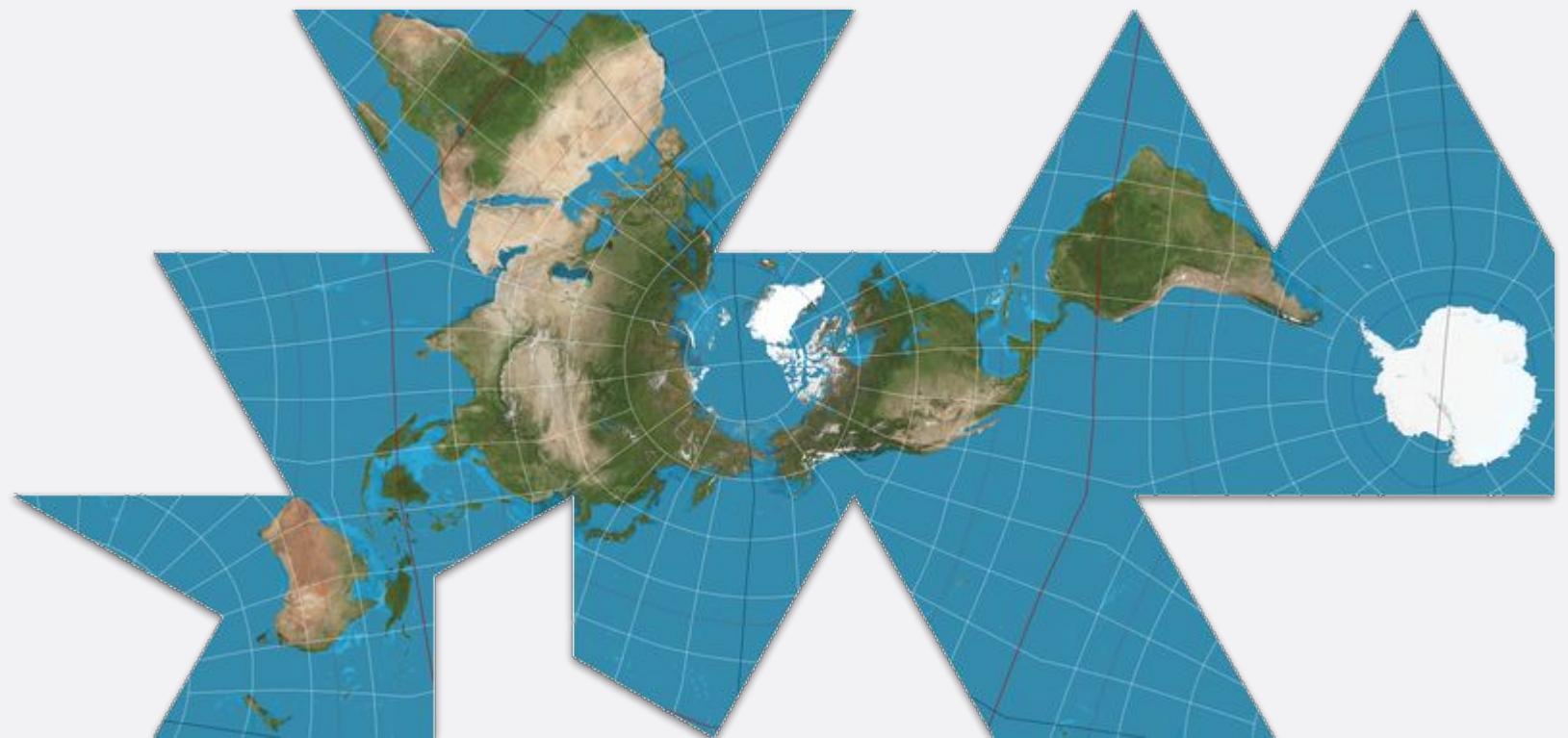
Tweet 4.607 Following 208 Follower 56.100 Mi place 638 Segui ...

Tweet	Tweet e risposte	Contenuti
Tweet fissato <b>Flat Earth Society</b> @FlatEarthOrg · 1 giu In risposta a @NewYorker One has to wonder about the state of our mainstream media when staunch empiricism is described as "post-truth" by major outlets. Traduci il Tweet	146 19 71	
<b>Flat Earth Society</b> @FlatEarthOrg · 5 h <a href="http://facebook.com/FlatSoc">facebook.com/FlatSoc</a> <a href="http://tjes.org">tjes.org</a>		

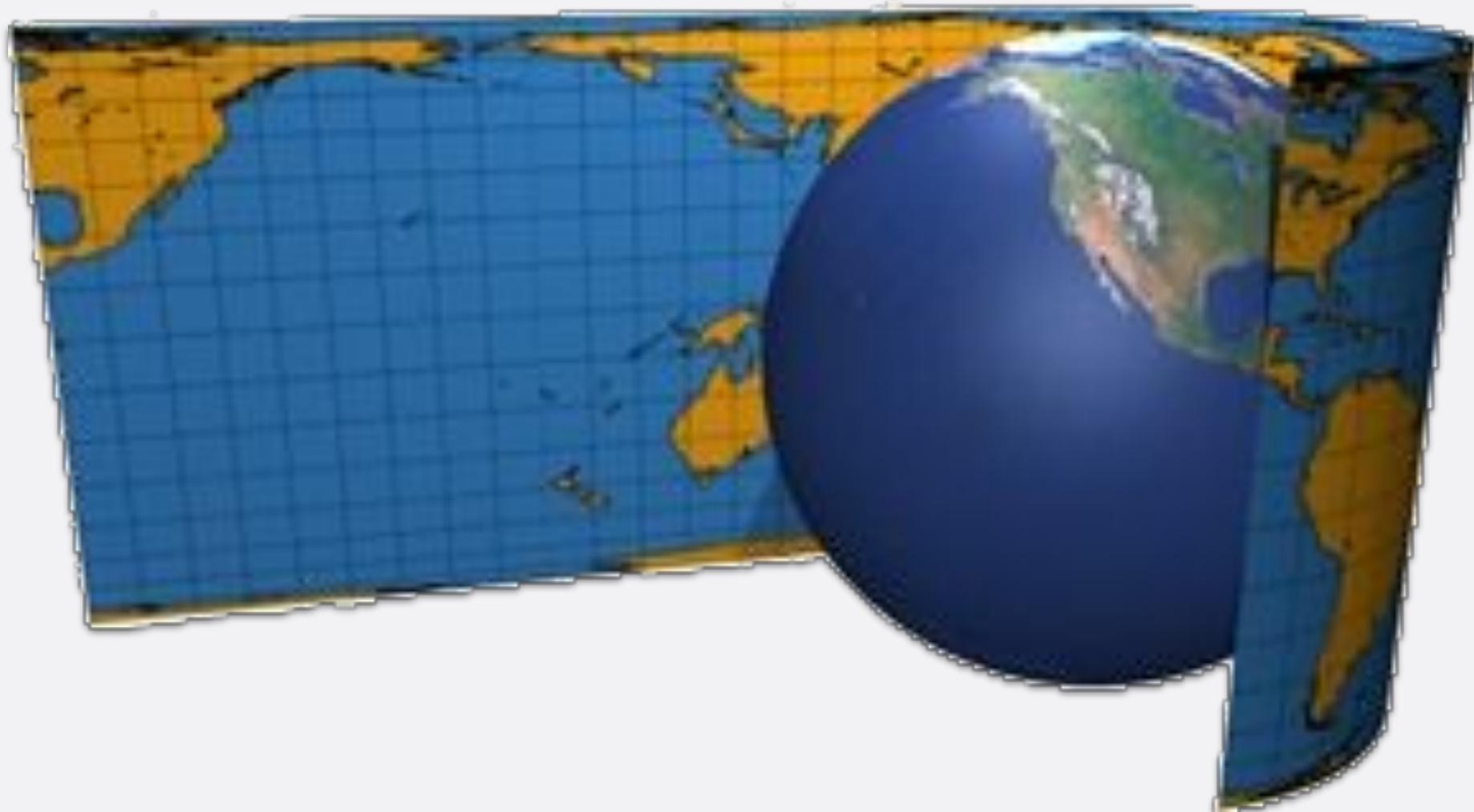
# Projections



# Dymaxion

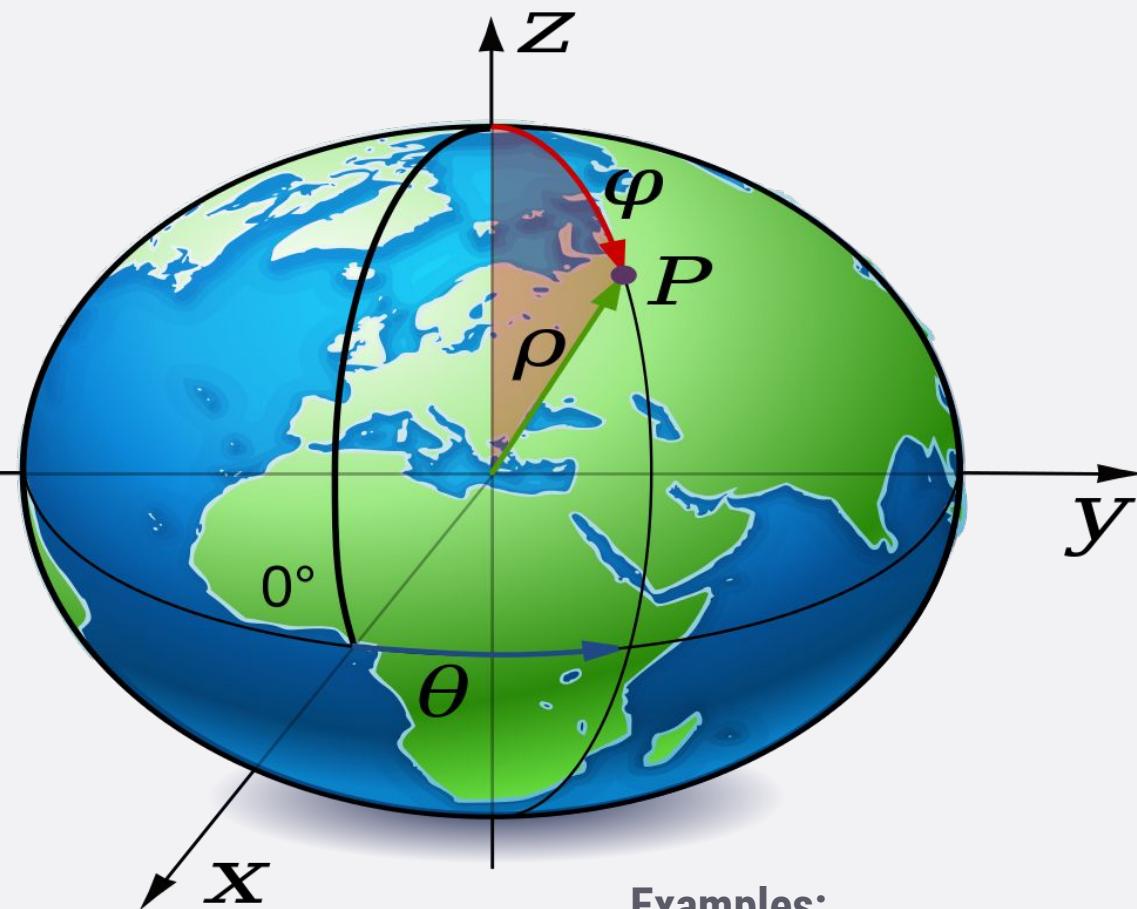


# Cylindrical projection

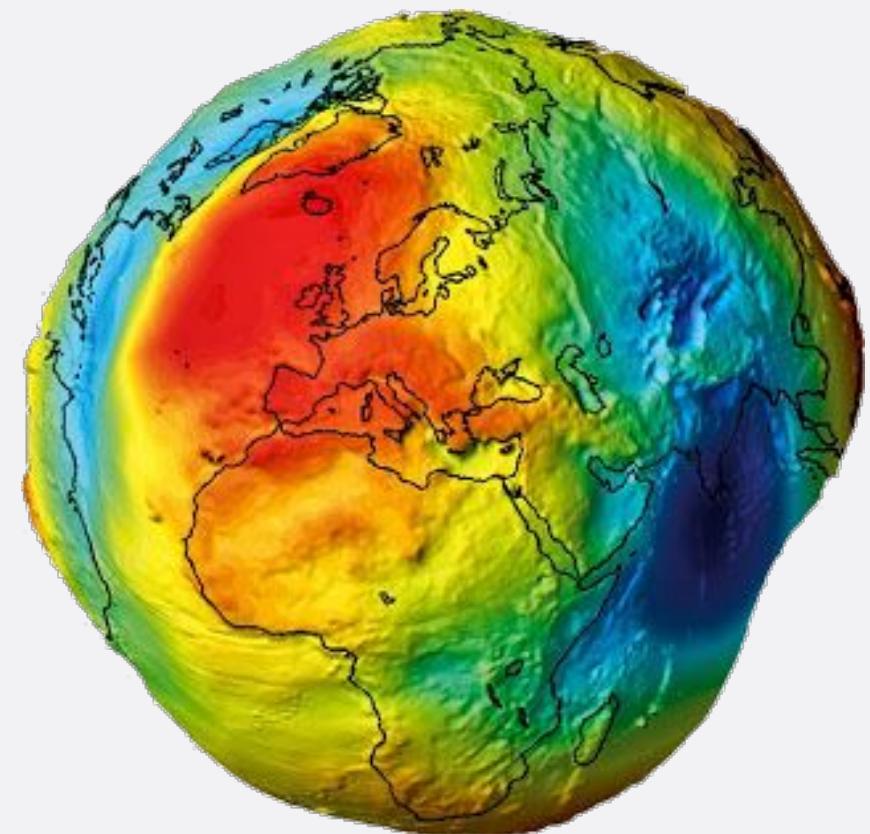


# Datum

oblate spheroid



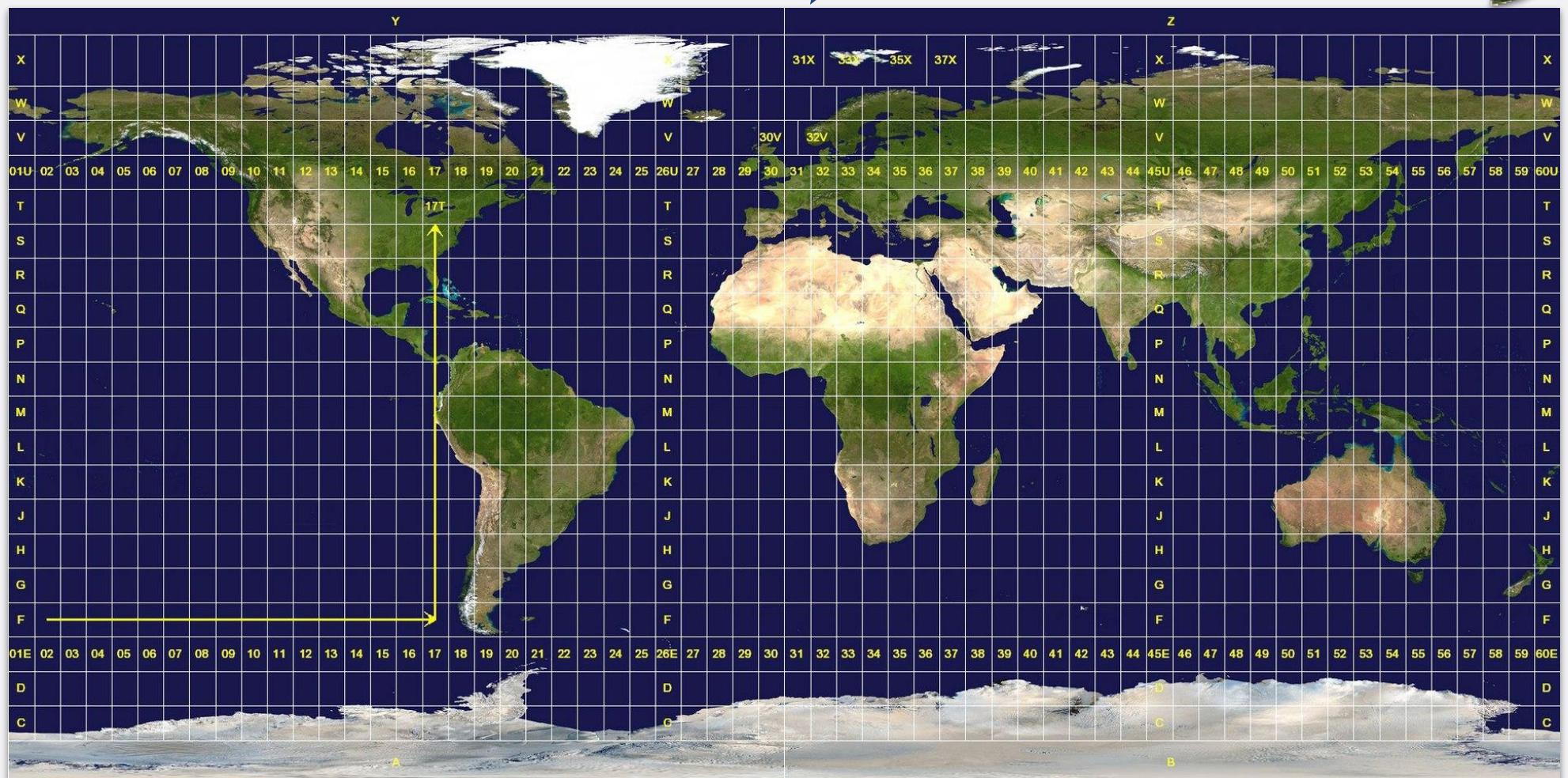
geoid



Examples:

- Rome 40
- European Datum 1950
- European Terrestrial Reference System 1989
- World Geodetic System 1984

# Universal Transverse Mercator



# The most used for the web

## EPSG:4326 - WGS84

- Degree (lat/long)
- WGS84

## EPSG: 3857 - Web Mercator

- Meters
- WGS84
- World without polos

former EPSG: 900913 Google  
Mercator  
(digit version of the word Google)



# EPSG???



International  
Association  
of Oil & Gas  
Producers

former  
**European Petroleum Survey Group**

<http://www.epsg.org/>



<http://spatialreference.org/>



<http://epsg.io/>



# DATA MODELS

## Discrete Data

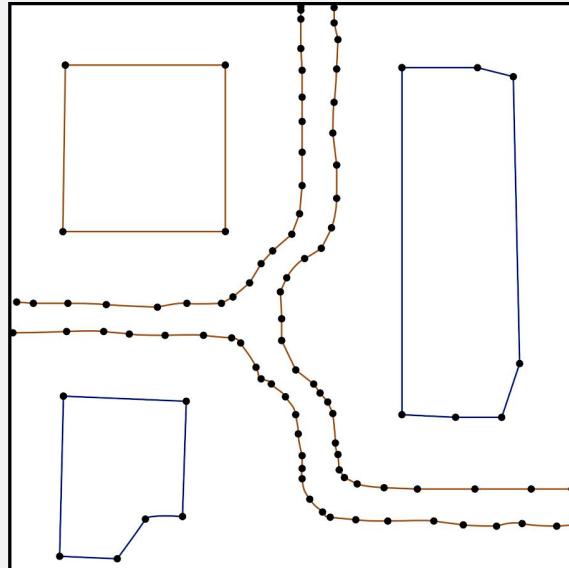
Vectors with attributes

Eg.

Points

Lines

Polygons



## Continuous Data

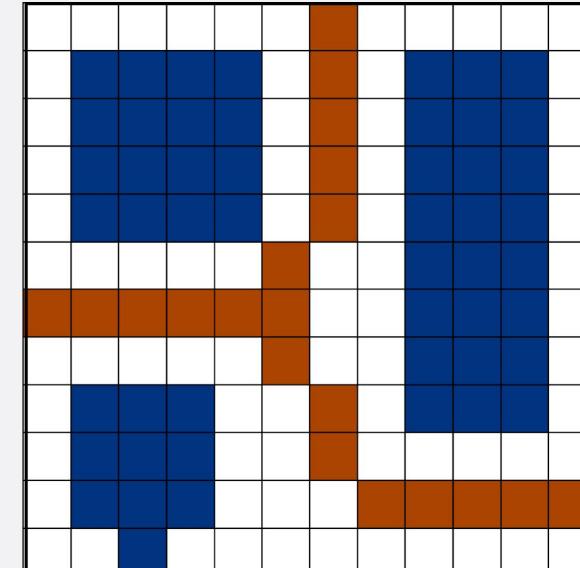
Matrix

Eg.

Digital Elevation Models

Solar Power Cells

Orthophotos



# Example RASTER

GRID IMAGE



VALUES

	<b>25</b>	<b>75</b>	<b>125</b>	<b>175</b>
<b>275</b>	NA	NA	5	2
<b>225</b>	NA	20	100	36
<b>175</b>	3	8	35	10
<b>125</b>	32	42	50	6
<b>75</b>	88	75	27	9
<b>25</b>	13	5	1	NA

ASCII Grid Format

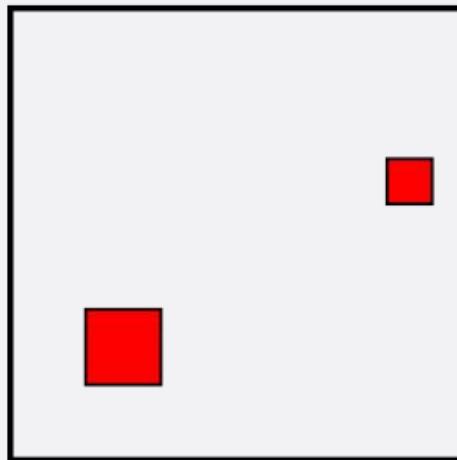
```
ncols          4
nrows          6
xllcorner     0.0
yllcorner     0.0
cellsize       50.0
NODATA_value -9999
-9999 -9999 5 2
-9999 20 100 36
3 8 35 10
32 42 50 6
88 75 27 9
13 5 1 -9999
```



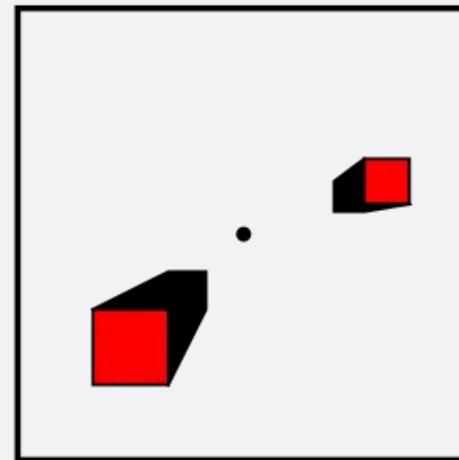
# Orthophoto

an aerial photograph that has been geometrically corrected and georeferenced

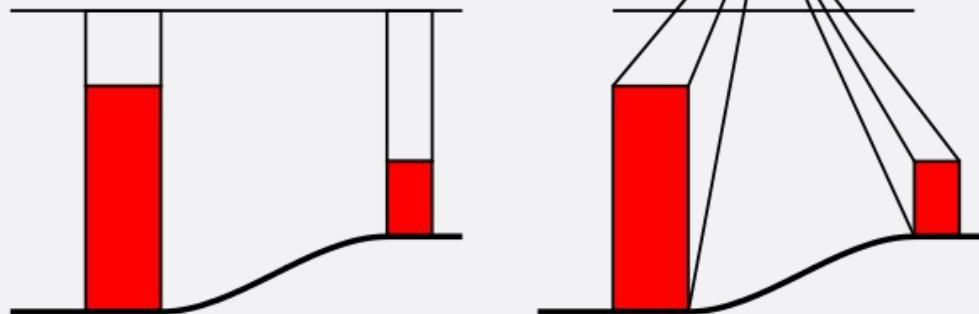
Orthographic view



Perspective view



Datum plane



# (geo)TIFF



TIFF

0.1000000000

0.0000000000

0.0000000000

-0.1000000000

655950.0500000000

5114049.9500000002

TFW = Tiff World File

Pixel Resolution

Rational Components  
rotation options  
set to zero in the  
case of an  
unrotated mapsheet

Easting and  
Northing of the  
upper left pixel  
(0,0 in image  
coordinates).

a TIFF needs a TFW file with the same name

Eg.

orthophoto.tif

orthophoto.tfw

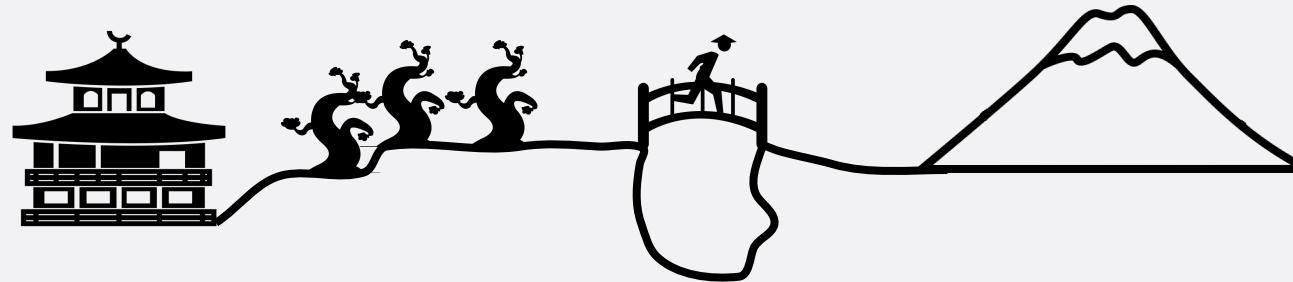
a GeoTIFF contains all the information in an only  
one file .tiff

The spatial reference system is a external  
information

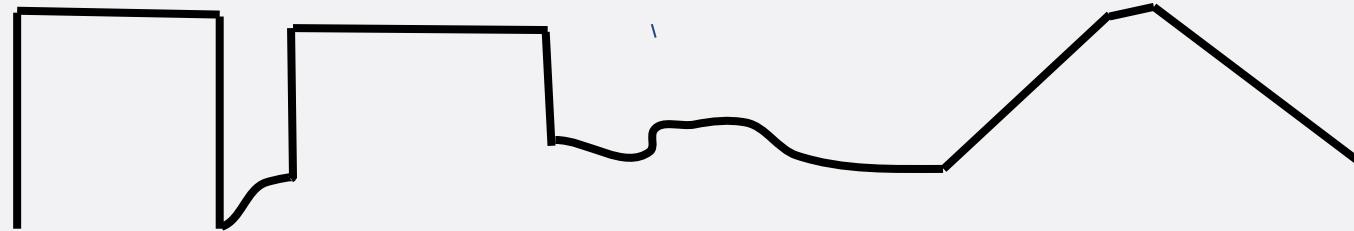
# DSM vs DTM

DEM is often used as a generic term for DSMs and DTMs

## Real World



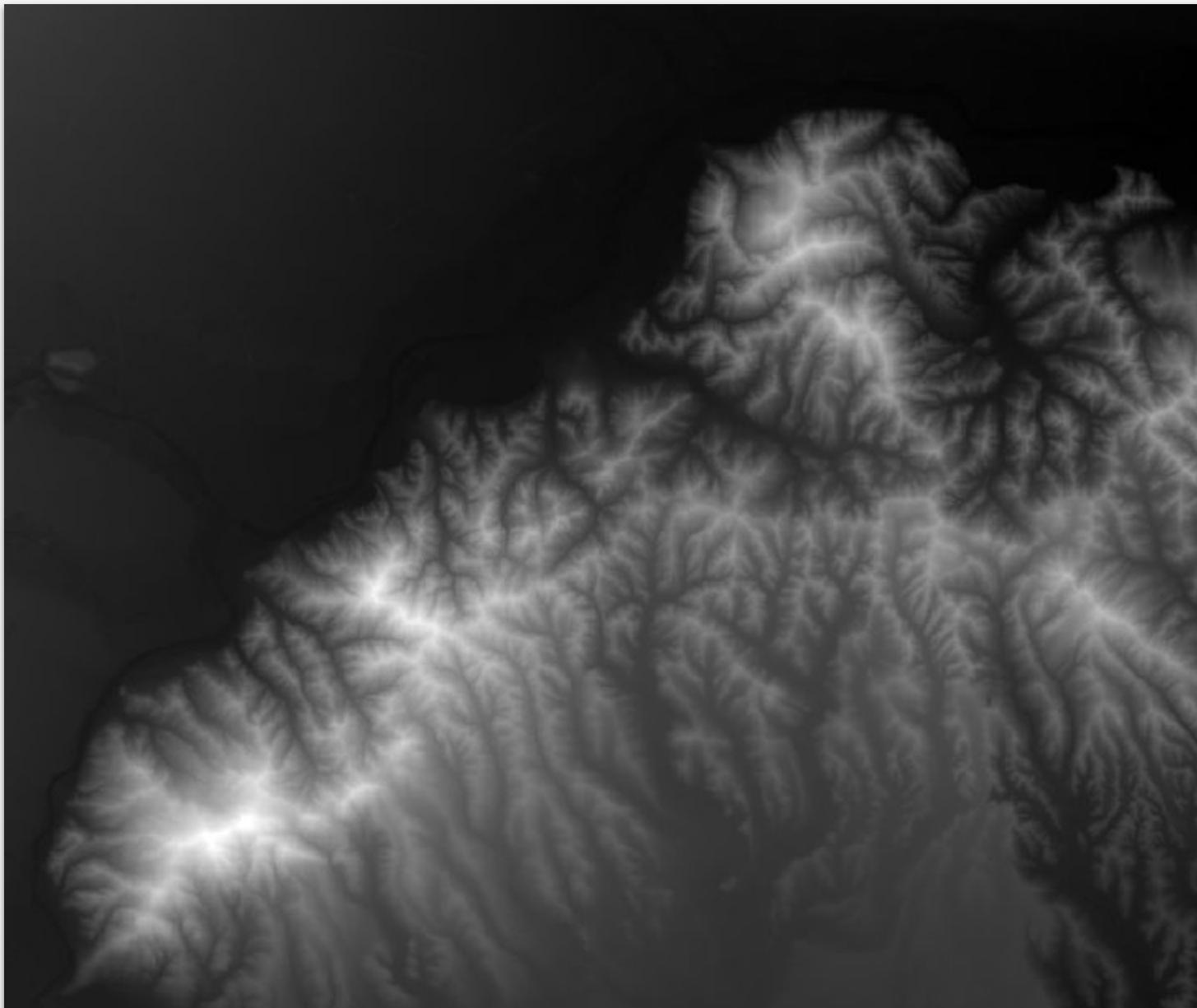
## Digital Surface Model (DSM)



## Digital Terrain Model (DTM)



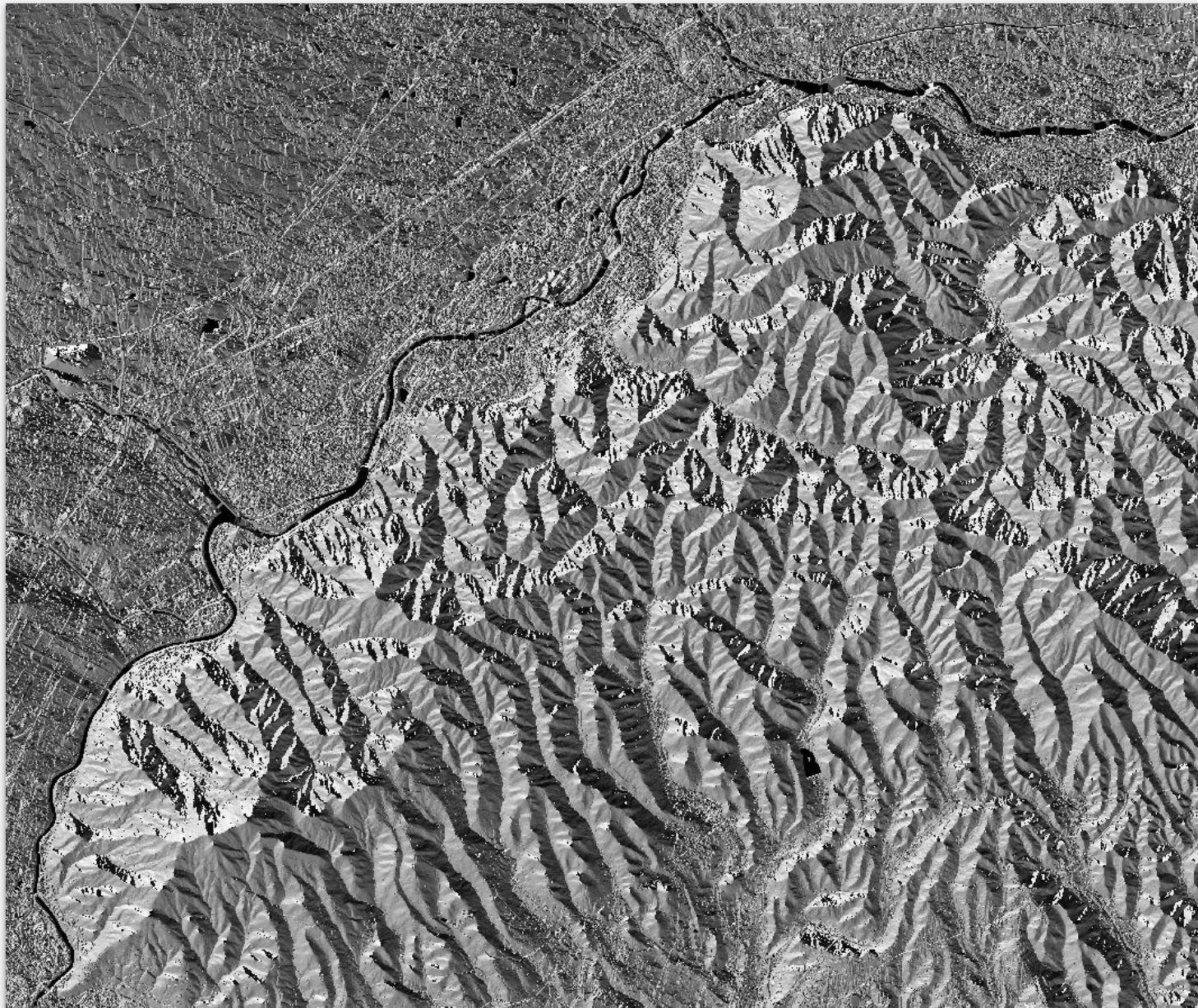
# DTM - shades of gray



# DTM - slope



# DTM aspect



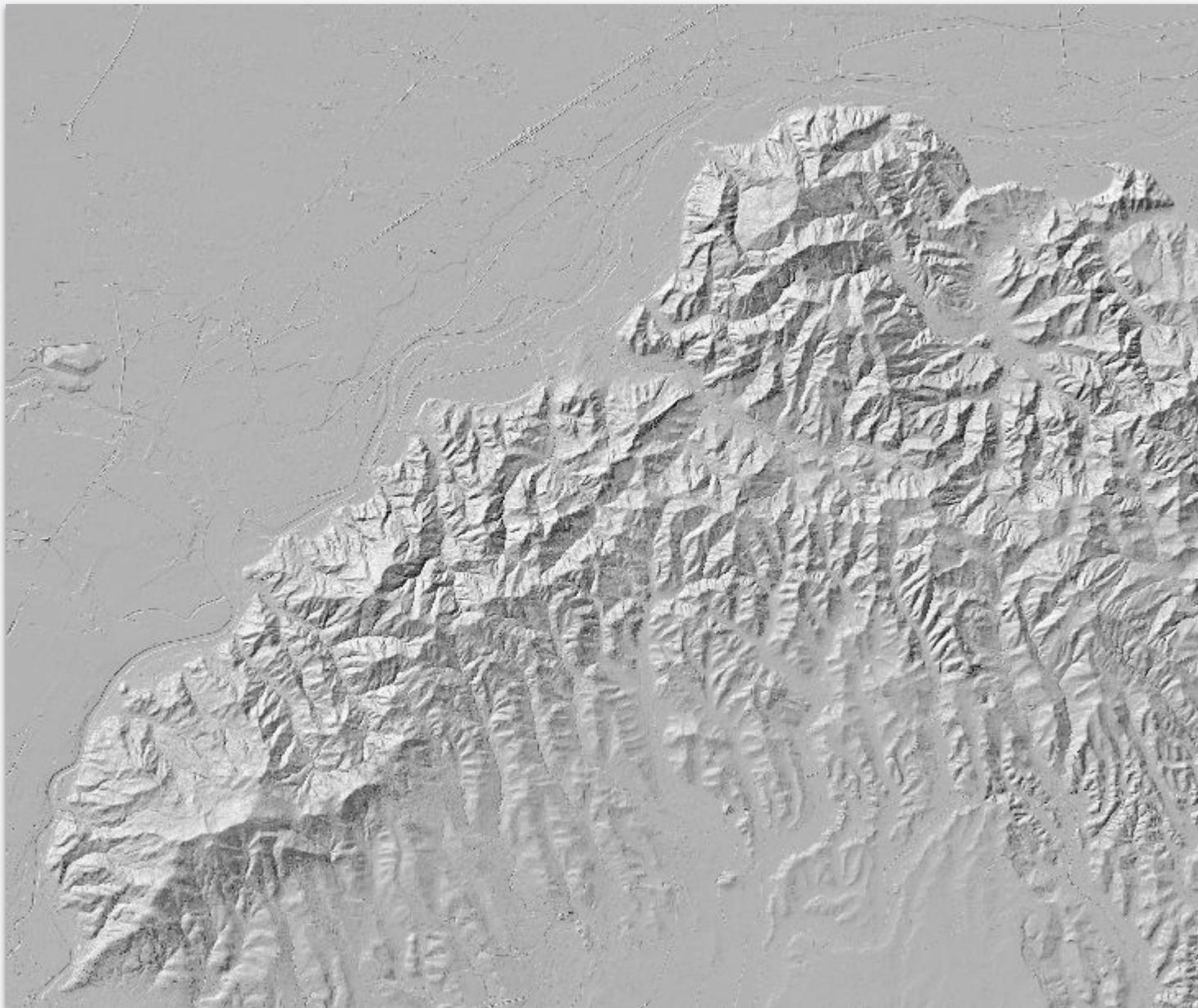
aspect is the compass direction that a slope faces



@napo



# DTM Hillshade



simulation of lighting intensity with a shading effect from an azimuth and altitude of light  
it can be used to produce the impression of the terrain relief.

# Example Vector

```
{  
  "type": "FeatureCollection",  
  "features": [  
    {  
      "type": "Feature",  
      "geometry": {  
        "type": "Point",  
        "coordinates": [  
          11.1215698,  
          46.0677293  
        ]  
      },  
      "properties": {  
        "name": "Fontana dell'Aquila",  
        "amenity": "drinking-water"  
      }  
    }  
  ]  
}
```



# Points



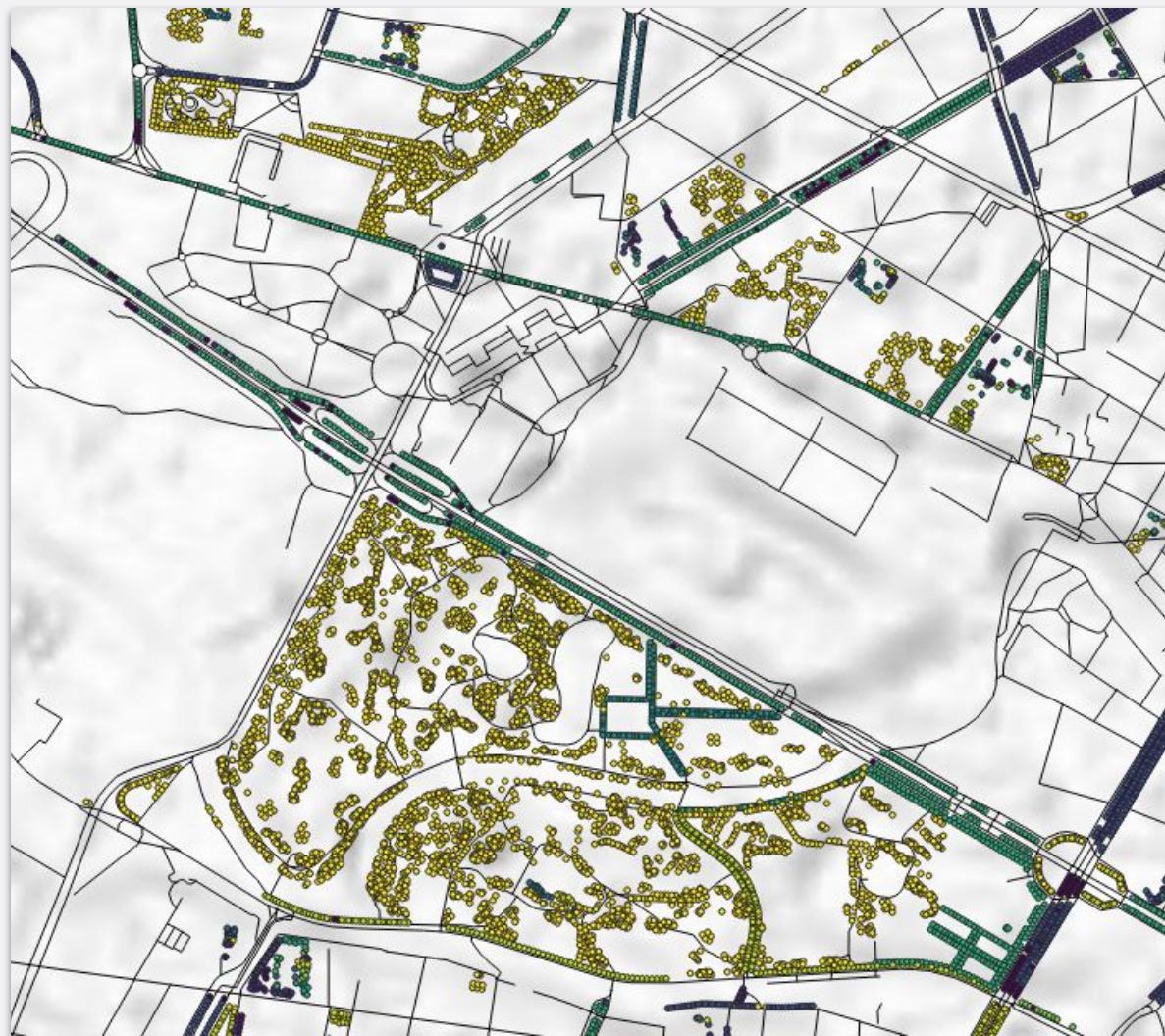
# Lines



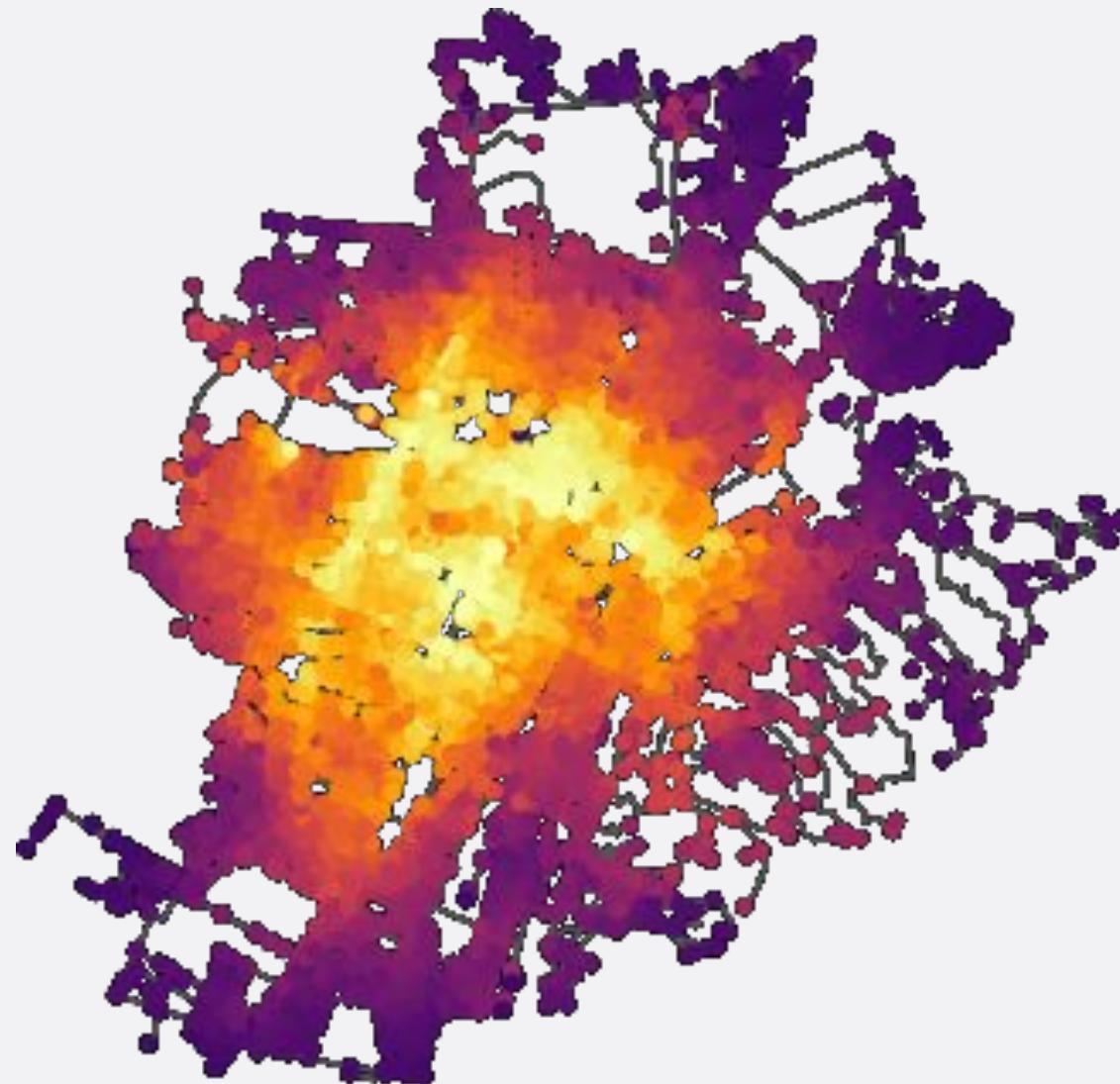
# Overlay



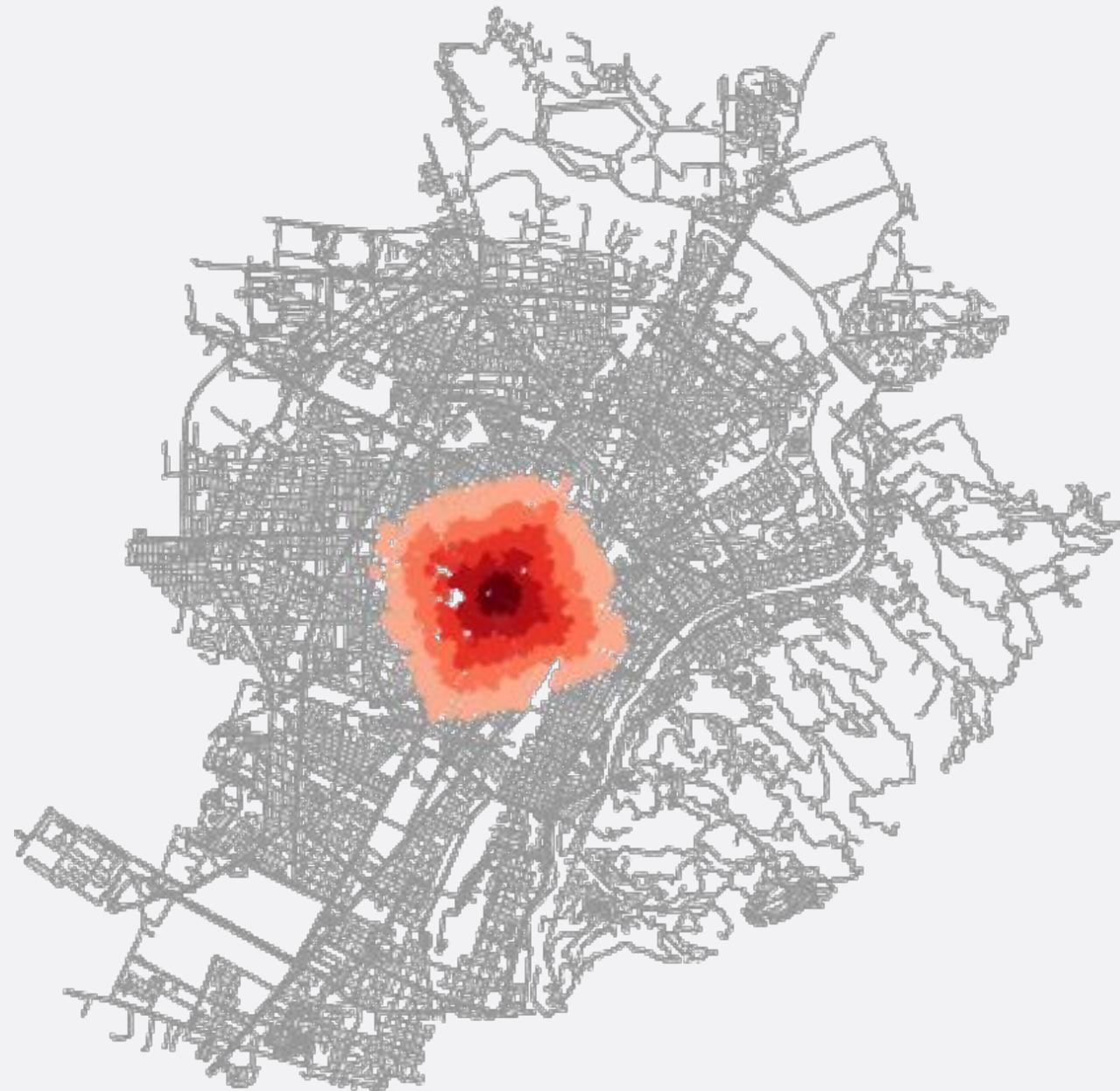
# Queries



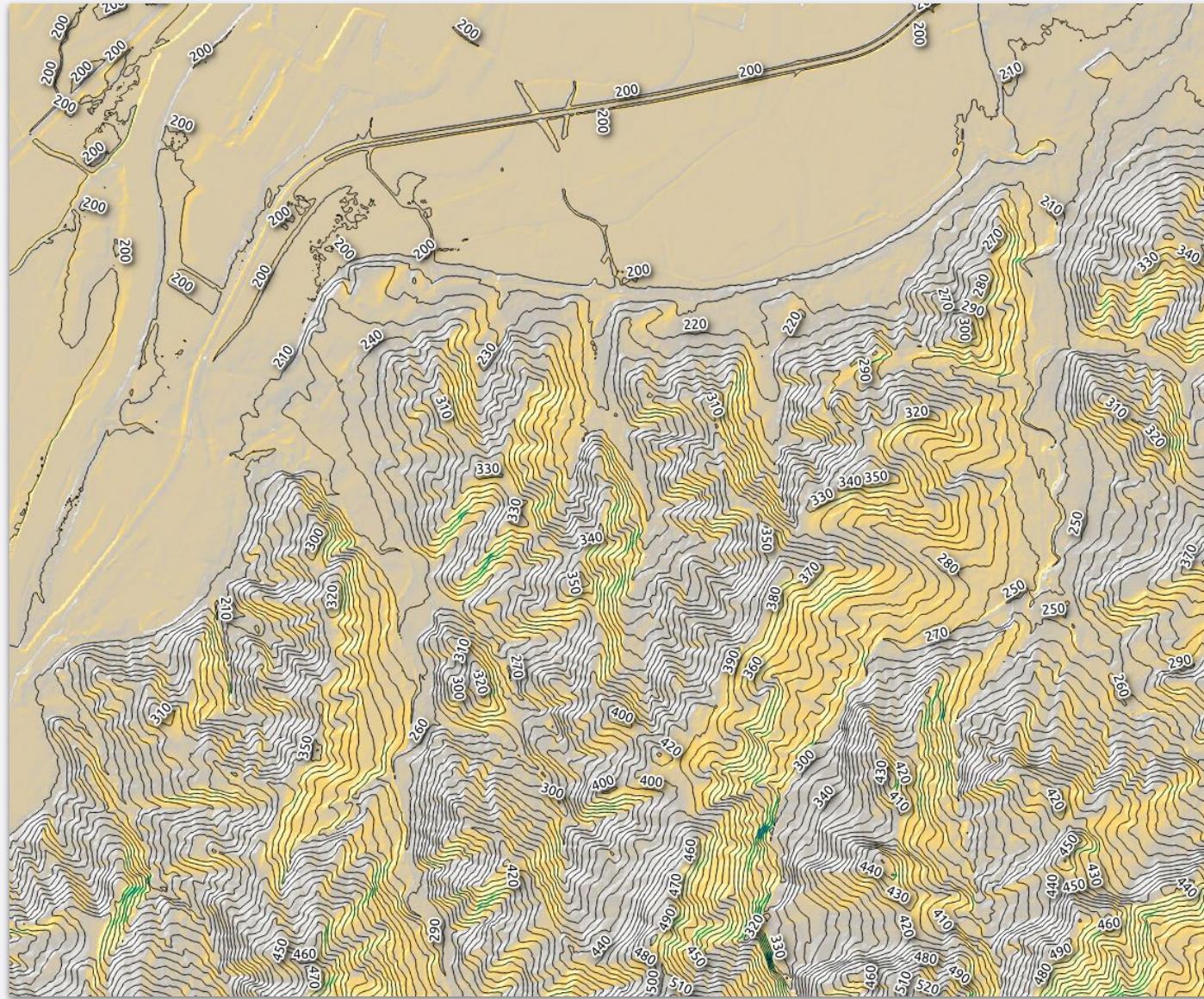
# Network Analysis



# Isochrones



# Raster to Vector



the dark lines are created from the DTM values where the altitude is the same (**isopleths**)

# Formats

## Vectors

- ESRI Shapefile
- WKT
- GeoJSON
- KML
- ...

## Raster

- Ascii Grid
- GeoTiff
- MBtiles

...



<http://www.gdal.org/>

# ESRI Shapefile

## Standard de facto

from 3 to 7 files with the same name and different extension

**filename.shp** →  
**filename.shx** →  
**filename.dbf** →  
**filename.prj** →

geometry  
index  
table  
projection

# The future is in GeoPackage



## GeoPackage



### An Open Format for Geospatial Information

GeoPackage is an open, standards-based, platform-independent, portable, self-describing, compact format for transferring geospatial information.

The GeoPackage Encoding Standard describes a set of conventions for storing the following within an SQLite database:

- vector features
- tile matrix sets of imagery and raster maps at various scales
- attributes (non-spatial data)
- extensions

To be clear, a GeoPackage is the SQLite container and the GeoPackage Encoding Standard governs the rules and requirements of content stored in a GeoPackage container. The GeoPackage standard defines the schema for a GeoPackage, including table definitions, integrity assertions, format limitations, and content constraints. The required and supported content of a GeoPackage is entirely defined in the standard. These capabilities are built on a common base and the extension mechanism provides implementors a way to include additional functionality in their GeoPackages.

Since a GeoPackage is a database container, it supports direct use. This means that the data in a GeoPackage can be accessed and updated in a "native" storage format without intermediate format translations. GeoPackages that comply with the requirements in the standard and do not implement vendor-specific extensions are interoperable across all enterprise and personal computing environments. GeoPackages are particularly useful on mobile devices such as cell phones and tablets in communications environments where there is limited connectivity and bandwidth.

The screenshot shows the homepage of the Open Geospatial Consortium (OGC) website. The header features the OGC logo and navigation links for About, Membership, Standards & Resources, Innovation, and News & Events. A prominent banner on the right side of the page displays the text "Making Location Information Findable, Accessible, Interoperable, and Reusable" over a background image of a satellite view of Earth. The OGC logo is also present in the bottom right corner of the banner.

## About OGC

The Open Geospatial Consortium (OGC) is an international consortium of more than **500** businesses, government agencies, research organizations, and universities driven to make geospatial (location) information and services FAIR - Findable, Accessible, Interoperable, and Reusable.

OGC's member-driven consensus process creates [royalty free, publicly available, open geospatial standards](#). Existing at the cutting edge, OGC actively analyzes and anticipates emerging [tech trends](#), and runs an agile, collaborative Research and Development (R&D) lab - the [OGC Innovation Program](#) - that builds and tests innovative prototype solutions to members' use cases.

**The OGC Vision:**  
*Using location, we connect people, communities, technology, and decision-making for the greater good.*

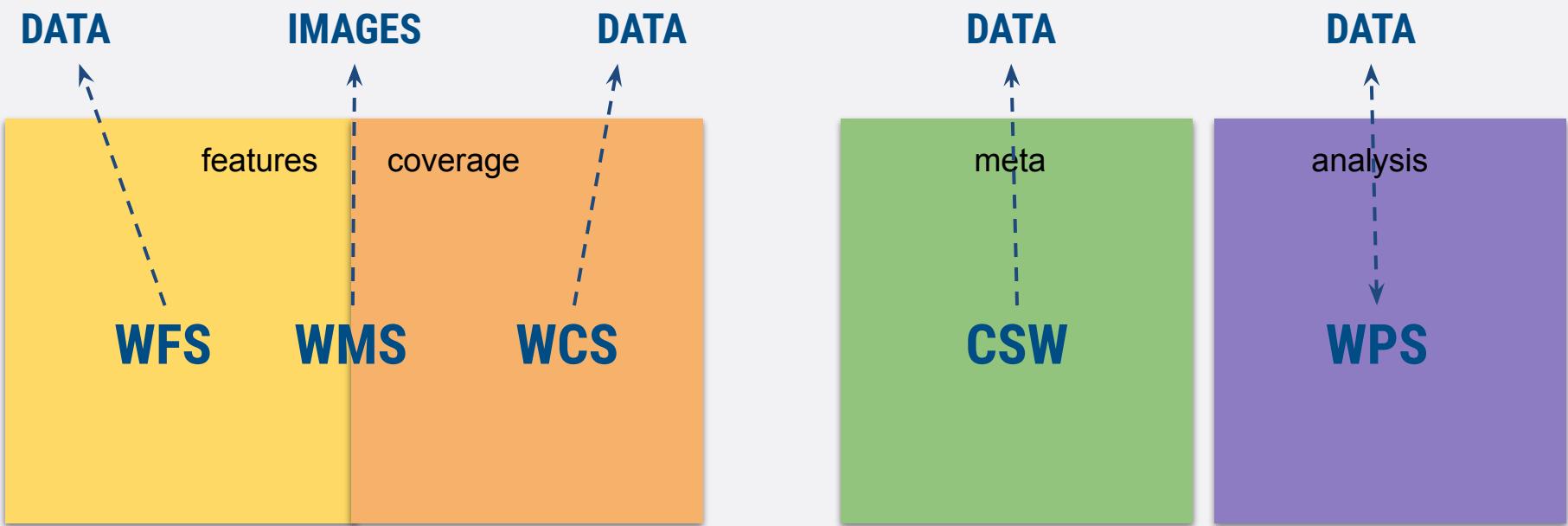
**The OGC Mission:**  
*Make location information more Findable, Accessible, Interoperable, and Reusable (FAIR).*

**The OGC Approach:**  
*A proven collaborative and agile process combining consensus-based standards, innovation projects and partnership building.*

**The OGC Values:**

- We are open, diverse, inclusive, and accessible*
- We value our technical excellence and innovation*
- We are passionate about the greater good*
- We are community-driven and we are fair, respectful, and responsible to our members*
- We always honor our commitments and aim to exceed expectations*

# OGC Protocols



- |            |   |                             |
|------------|---|-----------------------------|
| <b>WMS</b> | - | Web Map Service             |
| <b>WFS</b> | - | Web Feature Service         |
| <b>WCS</b> | - | Web Coverage Service        |
| <b>WPS</b> | - | Web Processing Service      |
| <b>CSW</b> | - | Catalog Service for the Web |



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INSPIRE Video



The INSPIRE Directive: a brief description

Focus On

# INSPIRE

## CONFERENCE

### 2020



DUBROVNIK - CROATIA

Latest News

**22/09/2020**  
Have your say: Evolution of the access to spatial data for environmental purposes.

**15/05/2020**  
News on the INSPIRE Conference 2020

**23/03/2020**  
INSPIRE Re3gistry software and INSPIRE registry service update

All News

Events

**03/06/2020**  
INSPIRE Conference 2020

**22/10/2019**  
Inspire Helsinki 2019

**07/05/2019**  
Webinar: INSPIRE good practices – Alternative Encodings

All Events

Quick Links

INSPIRE LIBRARY



INSPIRE ROADMAP



INSPIRE GEOPORTAL



INSPIRE IN YOUR COUNTRY



INSPIRE COMMUNITY FORUM



FIND YOUR SCOPE



INSPIRE REGISTRY



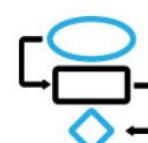
INSPIRE LEGISLATION



INSPIRE THEMES



INSPIRE IN PRACTICE



INSPIRE VALIDATOR



INSPIRE TRAINING



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15/05/2020 News on the INSPIRE Conference

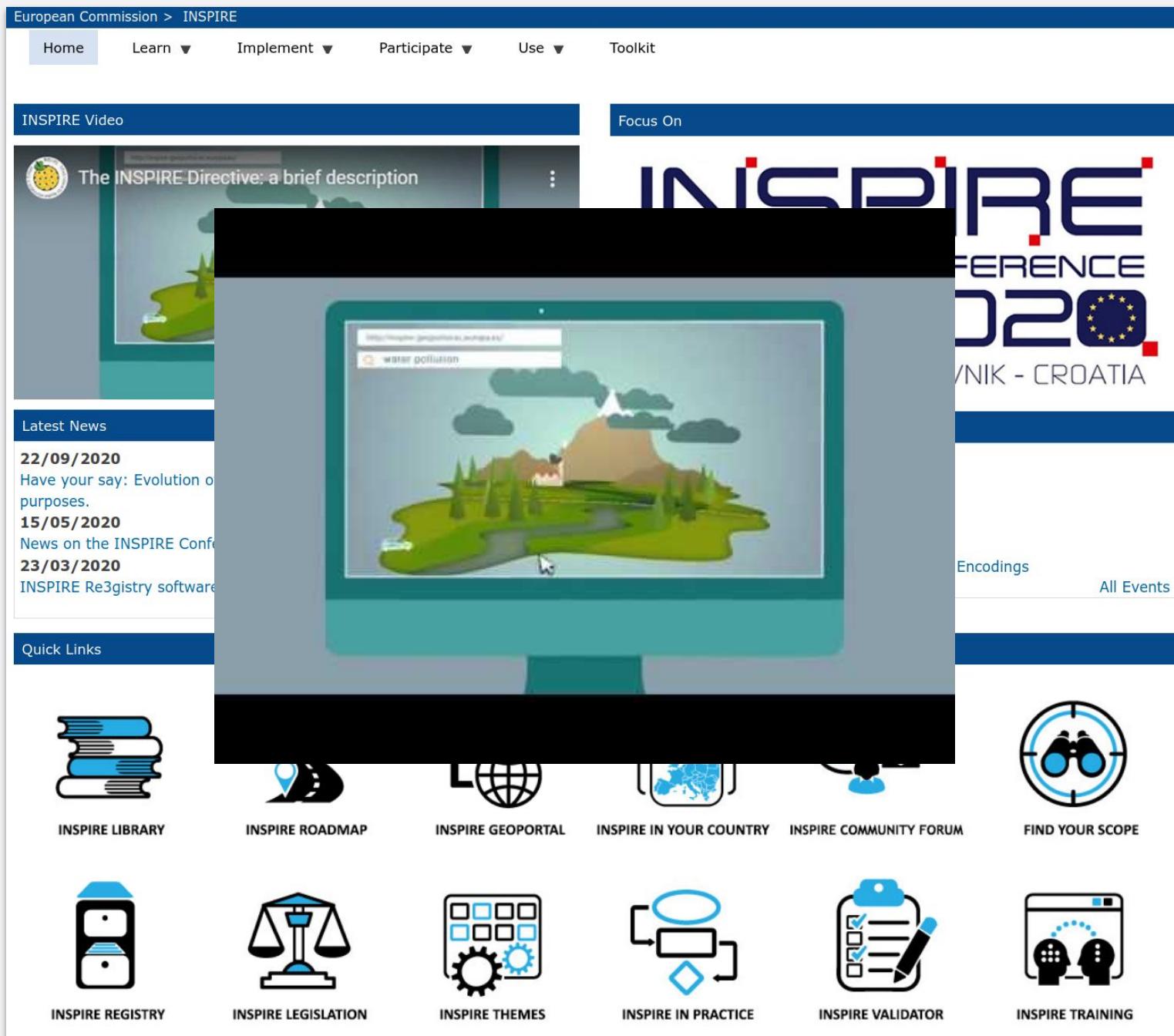
23/03/2020 INSPIRE Re3gistry software

Encodings All Events

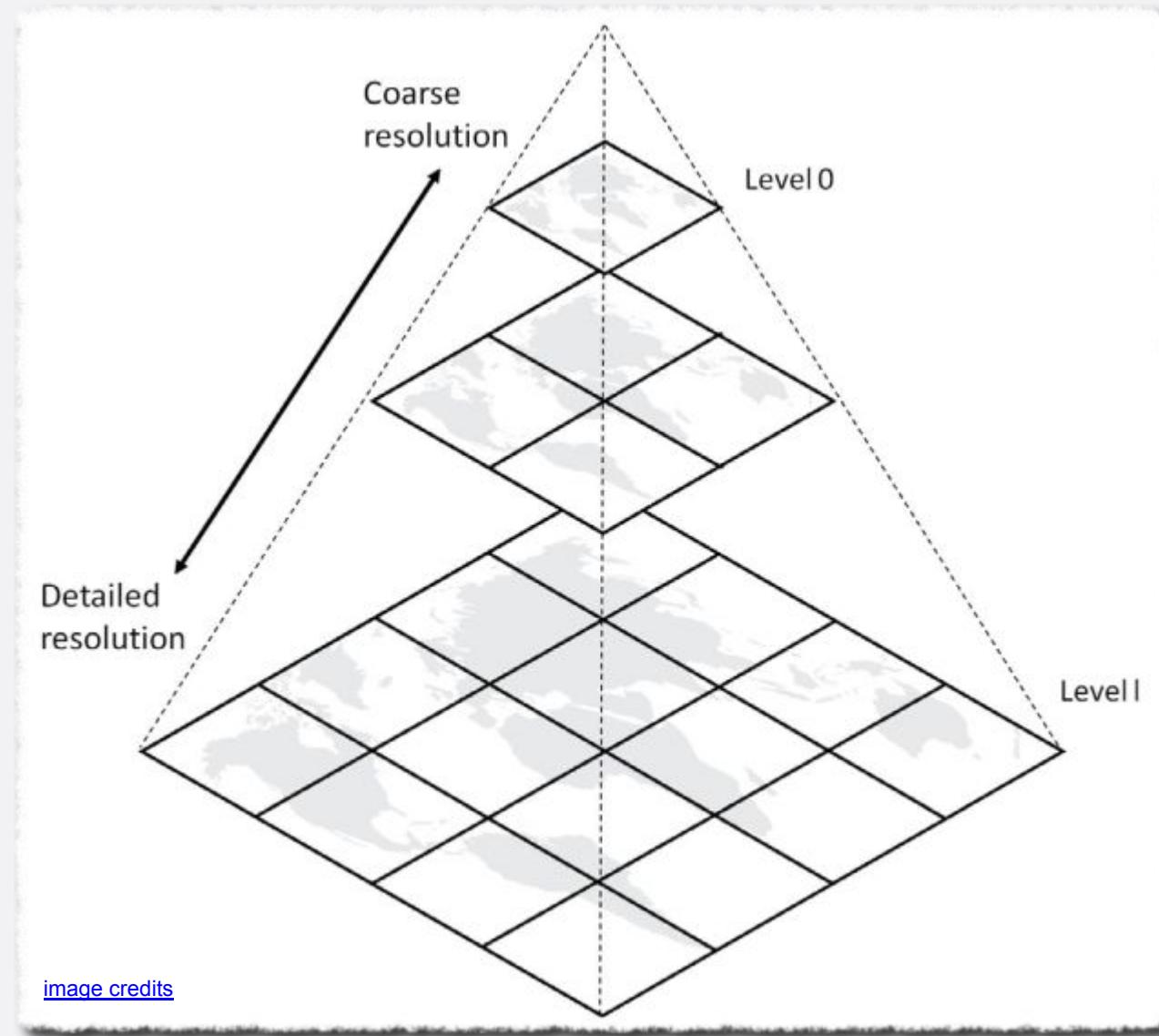
Quick Links

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INSPIRE REGISTRY INSPIRE LEGISLATION INSPIRE THEMES INSPIRE IN PRACTICE INSPIRE VALIDATOR INSPIRE TRAINING



# TMS



## Tile Map Service



# Contacts



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@napo

## Acknowledgements

Icons - from the Noun Project. Authors: Yuvika Koul, Juraj Sedlák , Gene Stroman, David, Adrien Conquet, Evangeline White, Vanila, kinkakuji Chanut is Industrie, Wahyu Prihantoro  
images - wikipedia, openstreetmap