

An Introduction to GIS Fundamentals

PART 2. QGIS fundamentals



QGIS: A Brief History

- Project began in 2002 as a GIS data viewer but has evolved into a fully functioning GIS Desktop that is Open Source
- Before the 2.0 release it was known as Quantum GIS and you will still hear people call it that
- Installation comes in 3 flavors - standalone and advanced for windows and packages for Linux:
- Operating Systems Supported: 4 Windows Mac Linux and Android
- Open Source: GNU General Public License (GPL) “which guarantees end users (individuals, organizations, companies) the freedoms to use, study, share (copy), and modify the software.”^[1]

[1] “GNU General Public License”. http://en.wikipedia.org/wiki/GNU_General_Public_License. Retrieved 11 September 2018



Training event (C1) of Daylighting rivers Florence Oct. 1st – 5th 2018

QGIS - The Good

Freely available desktop application

Lots of features

Works with different data types

A strong community developing new features and plug-ins

QGIS - The Bad

A bit bug-y sometimes

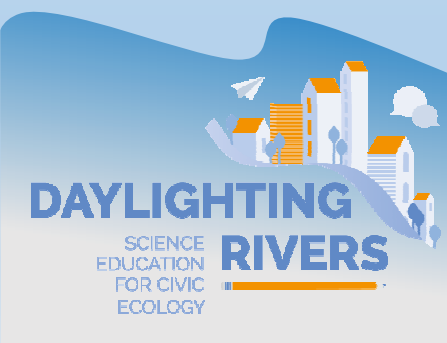
Visual style is a little confused

Features change between versions

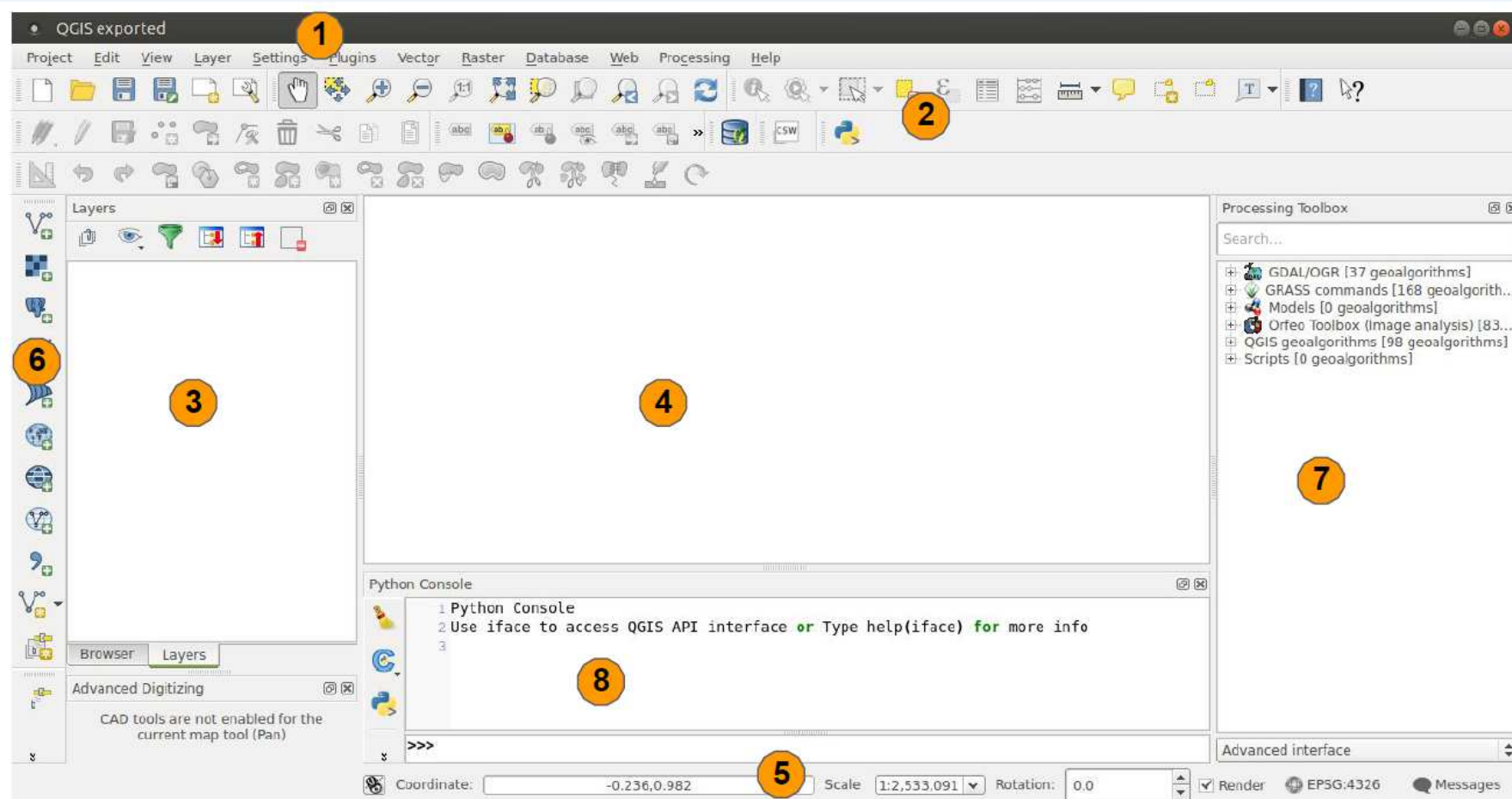
It will crash (but so will ArcGIS)

QGIS - The Bug-y

- Sometimes things get jumbled -> zoom out then zoom back in
- Things don't work properly -> close and restart
- Other problems that we'll find in class



QGIS Getting Started: the desktop interface

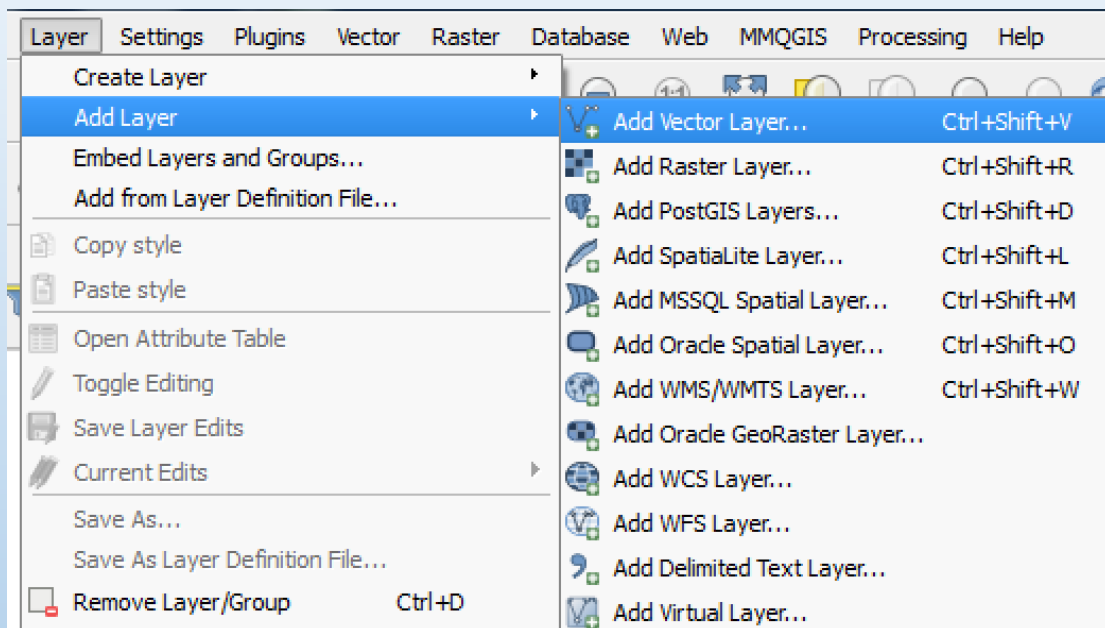


QGIS interface is divided in 5 main areas: 1. Menu Bar; 2. Tool Bar; 3. Map Legend (Panel);

4. Map Canvas; 5. Status Bar

Other added features: 6. Manage Layers Bar; 7. Toolbox Panel; 8. Python Console

Navigating the Interface: Layers



- Add vector Layer
- Add Raster Layer
- Add PostGIS Layer
- Add Spatialite Layer
- Add MSSQL Spatial Layer
- Add WMS/WMTS Layer
- Add WCS Layer
- Add WFS Layer
- Add Delimited Text Layer
- New Shapefile Layer/Spatialite Layer
- Create New GPX Layer

Navigating the Interface: Navigation and Attributes

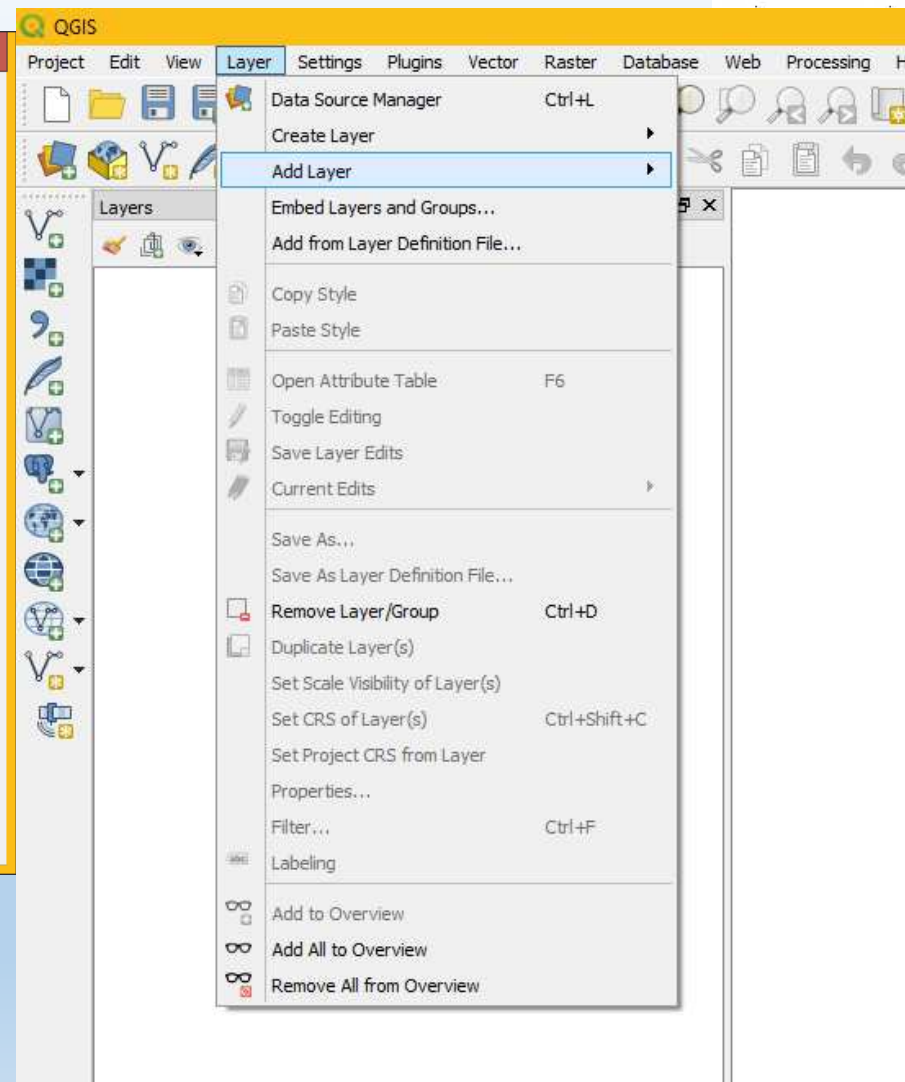
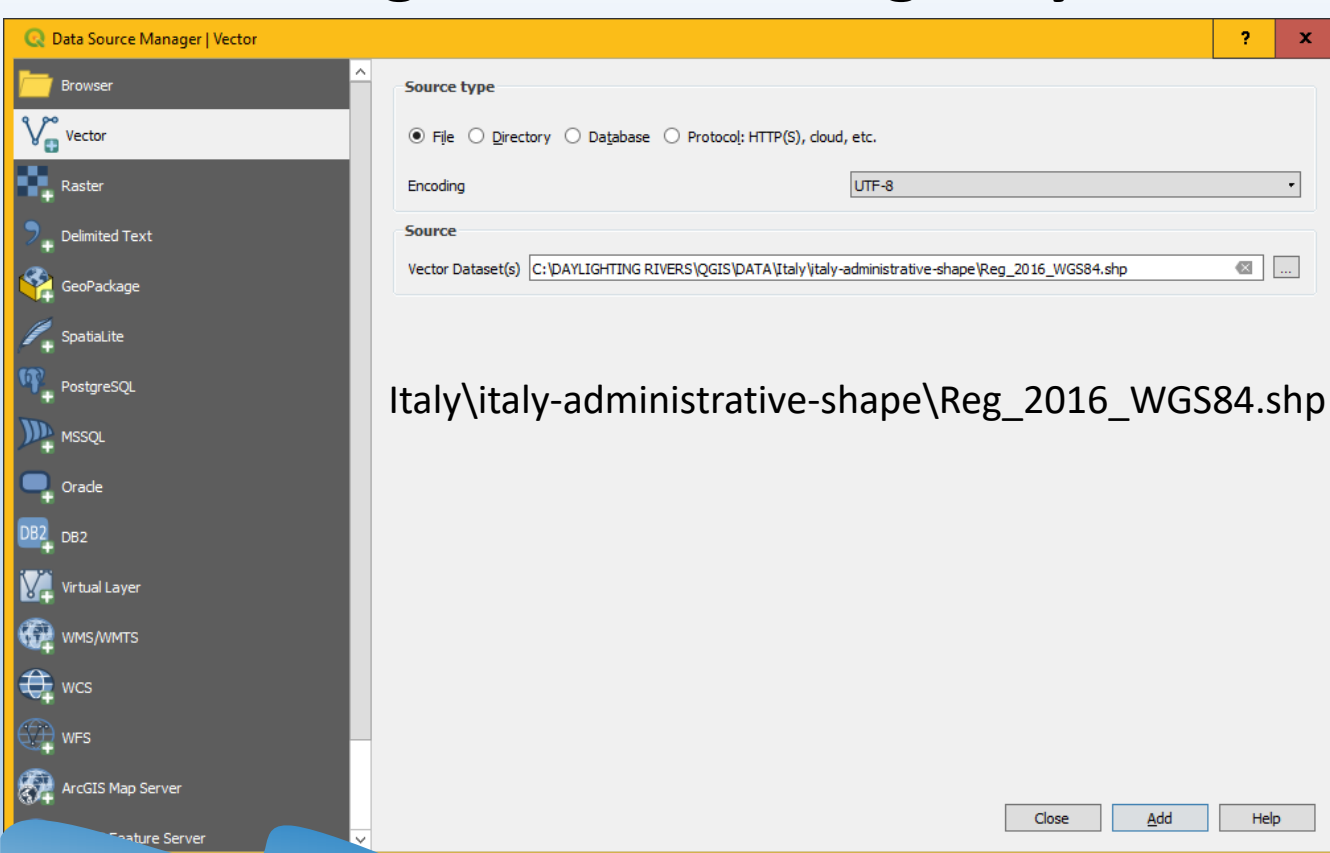


- Pan
- Pan Map to Selection
- Zoom In
- Zoom Out
- Zoom to Pixel Resolution
- Zoom to Full Extent
- Zoom to Selection
- Zoom to Layer
- Zoom to Last Extent
- Zoom to Next Extent
- Refresh



- Identify Features
- Run Feature Action
- Select Single Feature
- Deselect Features from All Layers
- Select Features using an Expression
- Open Attribute Table
- Open Field Calculator
- Measure Feature Tools
- Map Tips
- New Bookmark
- Show Bookmarks
- Annotation Tools

QGIS Getting Started: Adding a layer



QGIS Getting Started: Exploring attributes

Right click on the layer, > select «Open attribute table»

The attribute table for 'Reg_2016_WGS84' is displayed, showing 20 features. The table columns are COD_REG, REGIONE, SHAPE_Leng, and SHAPE_Area.

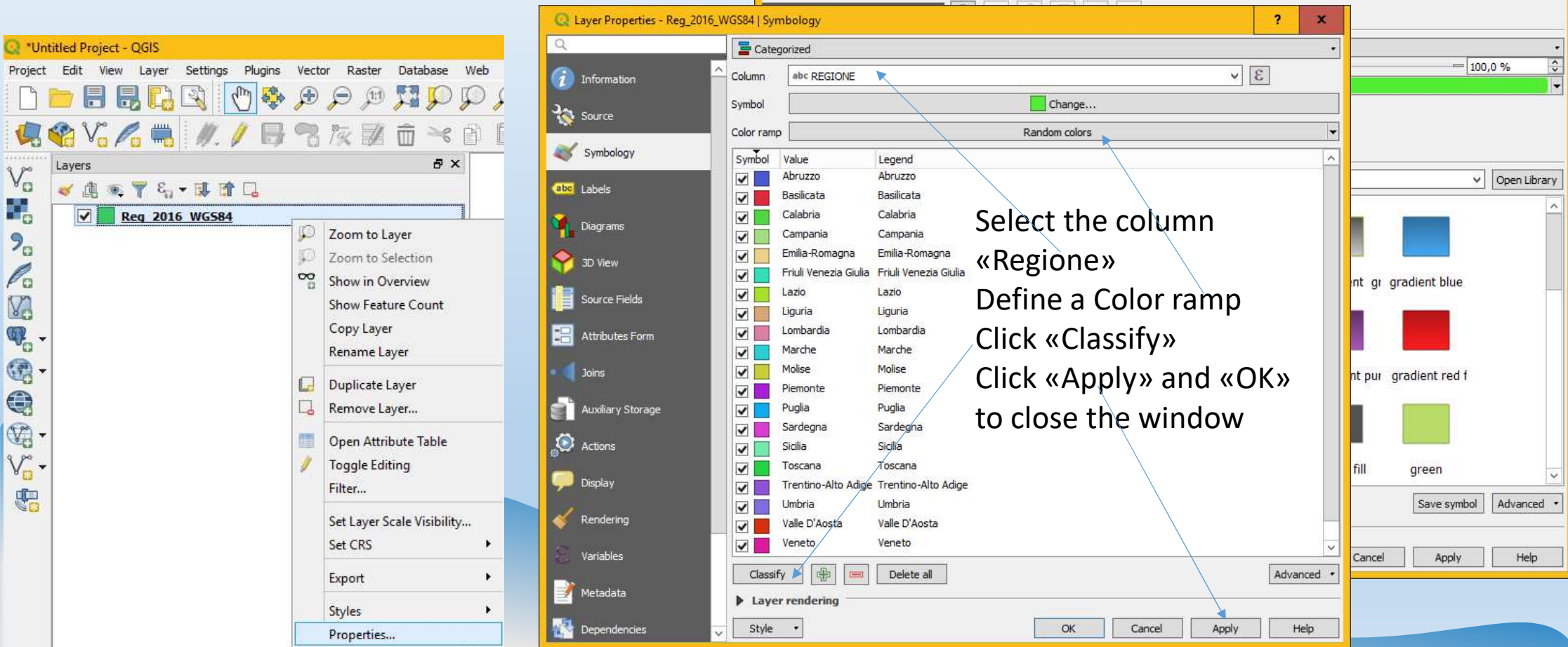
	COD_REG	REGIONE	SHAPE_Leng	SHAPE_Area
1	3	Lombardia	1511131,903930...	23863097447,00...
2	4	Trentino-Alto Adige	859873,1379769...	13604721582,50...
3	17	Basilicata	675750,7063110...	10073110438,20...
4	18	Calabria	934657,5450179...	15221614078,70...
5	20	Sardegna	2128723,504490...	24099792551,40...
6	19	Sicilia	1731333,013809...	25832016241,79...
7	13	Abruzzo	664538,0091580...	10831496160,50...
8	14	Molise	471197,6267489...	4460436575,640...
9	15	Campania	1090752,836720...	13670597003,79...
10	16	Puglia	1507342,394910...	19540517739,79...
11	9	Toscana	1545205,801179...	22986579578,09...
12	10	Umbria	671416,0412500...	8464223125,920...
13	11	Marche	711091,4950849...	9401183273,590...
14	12	Lazio	1201764,764320...	17231723450,40...
15	5	Veneto	1141797,633110...	18406854784,40...
16	6	Friuli Venezia Giulia	770142,8388320...	7862153894,409...
17	7	Liguria	1080307,228580...	5416134435,220...
18	8	Emilia-Romagna	1260948,843270...	22452207785,79...
19	1	Piemonte	1333428,214470...	25386696893,79...
20	2	Valle D'Aosta	325836,3681009...	3260854220,039...

1 legend entries removed.

Coordinate 1387223,5103081 Scale 1:4952390 Magnifier 100% Rotation 0,0 ° Render EPSG:32632

Styling Features

Right-click the layer and select the **Properties** option. Select "Simbology," and finally, choose "Categorized"



The screenshot shows the QGIS interface with the 'Layer Properties - Reg_2016_WGS84 | Symbology' dialog box open. The 'Categorized' tab is selected, and the 'Column' is set to 'REGIONE'. The 'Color ramp' is set to 'Random colors'. The 'Legend' table lists the regions of Italy with their corresponding colors.

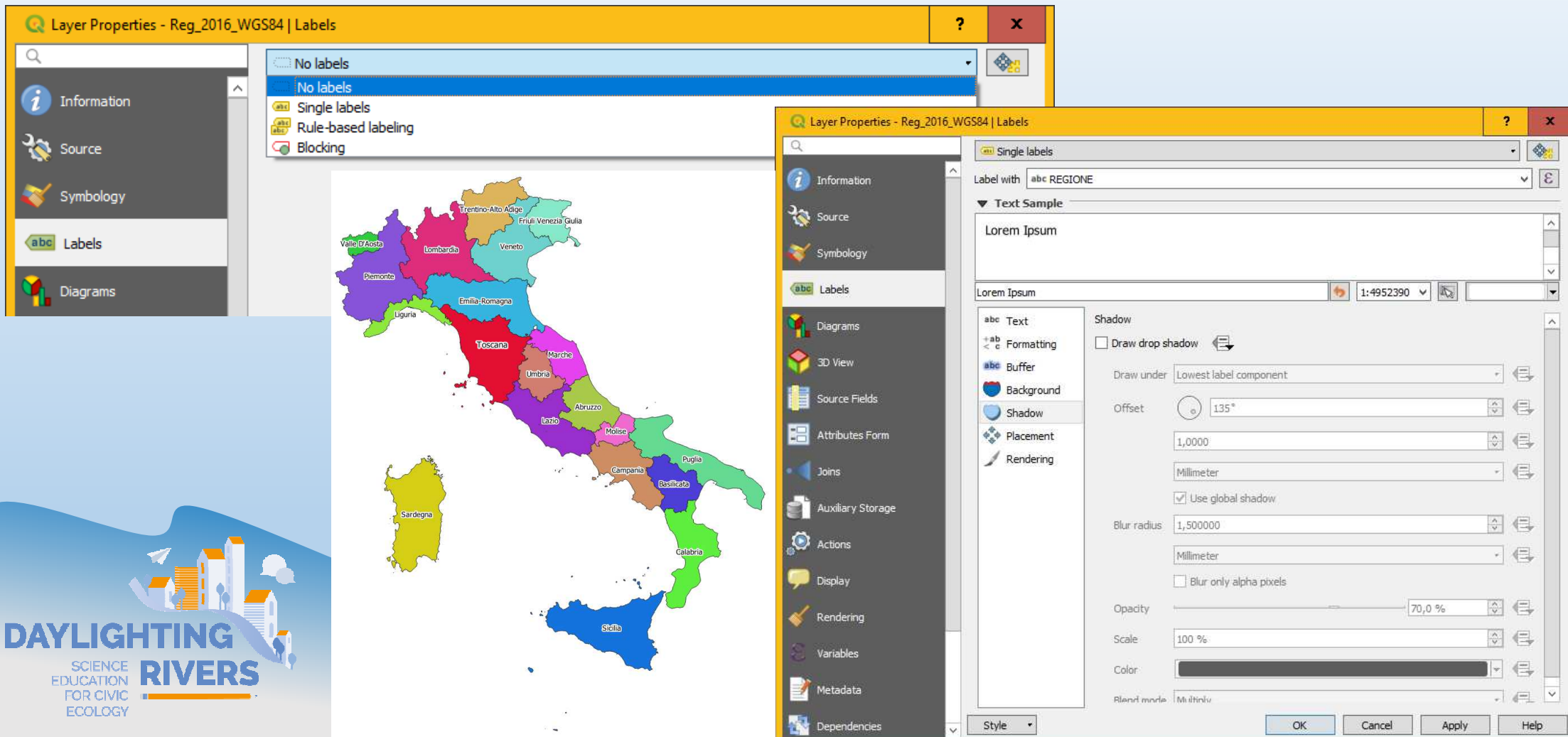
Symbol	Value	Legend
<input checked="" type="checkbox"/>	Abruzzo	Abruzzo
<input checked="" type="checkbox"/>	Basilicata	Basilicata
<input checked="" type="checkbox"/>	Calabria	Calabria
<input checked="" type="checkbox"/>	Campania	Campania
<input checked="" type="checkbox"/>	Emilia-Romagna	Emilia-Romagna
<input checked="" type="checkbox"/>	Friuli Venezia Giulia	Friuli Venezia Giulia
<input checked="" type="checkbox"/>	Lazio	Lazio
<input checked="" type="checkbox"/>	Liguria	Liguria
<input checked="" type="checkbox"/>	Lombardia	Lombardia
<input checked="" type="checkbox"/>	Marche	Marche
<input checked="" type="checkbox"/>	Molise	Molise
<input checked="" type="checkbox"/>	Piemonte	Piemonte
<input checked="" type="checkbox"/>	Puglia	Puglia
<input checked="" type="checkbox"/>	Sardegna	Sardegna
<input checked="" type="checkbox"/>	Sicilia	Sicilia
<input checked="" type="checkbox"/>	Toscana	Toscana
<input checked="" type="checkbox"/>	Trentino-Alto Adige	Trentino-Alto Adige
<input checked="" type="checkbox"/>	Umbria	Umbria
<input checked="" type="checkbox"/>	Valle D'Aosta	Valle D'Aosta
<input checked="" type="checkbox"/>	Veneto	Veneto

Annotations in the image:

- Right-click the layer and select the **Properties** option.
- Select "Simbology,"
- and finally, choose "Categorized"
- Select the column «Regione»
- Define a Color ramp
- Click «Classify»
- Click «Apply» and «OK» to close the window

Add labels to data

From Properties, select "Labels", "Show labels for this layer"



The screenshot shows the QGIS Layer Properties dialog for the layer 'Reg_2016_WGS84'. The 'Labels' tab is selected, and the 'Single labels' option is chosen. The 'Text Sample' section shows 'Lorem Ipsum' text. The 'Shadow' section is expanded, showing options for 'Draw drop shadow', 'Offset', 'Blur radius', 'Opacity', 'Scale', 'Color', and 'Blend mode'.

Layer Properties - Reg_2016_WGS84 | Labels

- Information
- Source
- Symbology
- Labels**
- Diagrams

Labels: No labels, Single labels, Rule-based labeling, Blocking

Label with: abc REGIONE

Text Sample

Lorem Ipsum

Shadow

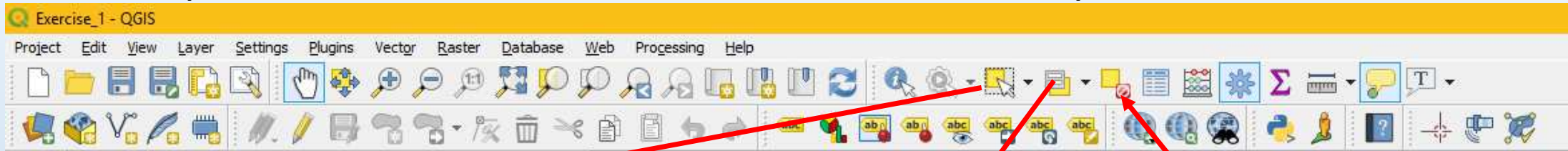
- ☐ Draw drop shadow
- Draw under: Lowest label component
- Offset: 135°
- 1,0000
- Millimeter
- ☒ Use global shadow
- Blur radius: 1,500000
- Millimeter
- ☐ Blur only alpha pixels
- Opacity: 70,0 %
- Scale: 100 %
- Color: [Color Picker]
- Blend mode: Multiply

OK Cancel Apply Help

DAYLIGHTING RIVERS
SCIENCE EDUCATION FOR CIVIC ECOLOGY

Data selection

From Properties, select "Labels", "Show labels for this layer"



- Select Feature(s)
- Select Features by Polygon
- Select Features by Freehand
- Select Features by Radius

Select with mouse on the map

- Select Features by Value... F3
- Select Features by Expression... Ctrl+F3
- Select All Features Ctrl+A
- Invert Feature Selection

Select from the attribute table

Reg_2016_WGS84 :: Features Total: 20, Filtered: 20, Selected: 1

	COD_REG	REGIONE	SHAPE_Leng	SHAPE_Area	Town_REGIONE	Town_TOWN
11	14	Molise	471197.6267489...	4460436575.640...	Molise	Campobasso
12	1	Piemonte	1333428.214470...	25386696893.79...	Piemonte	Torino
13	16	Puglia	1507342.394910...	19540517739.79...	Puglia	Bari
14	20	Sardegna	2128723.504490...	24099792551.40...	Sardegna	Cagliari
15	19	Sicilia	1731333.013809...	25832016241.79...	Sicilia	Palermo
16	9	Toscana	1545205.801179...	22986579578.09...	Toscana	Firenze
17	4	Trentino-Alto Adige	3.1379769...	13604721582.50...	Trentino-Alto Adige	Trento
18	10	Umbria	671416.0412500...	8464223125.920...	Umbria	Perugia
19	2	Valle D'Aosta	325836.3681009...	3260854220.039...	Valle D'Aosta	Aosta
20	5	Veneto	1141797.633110...	18406854784.40...	Veneto	Venezia

Show All Features

Select in the attribute table

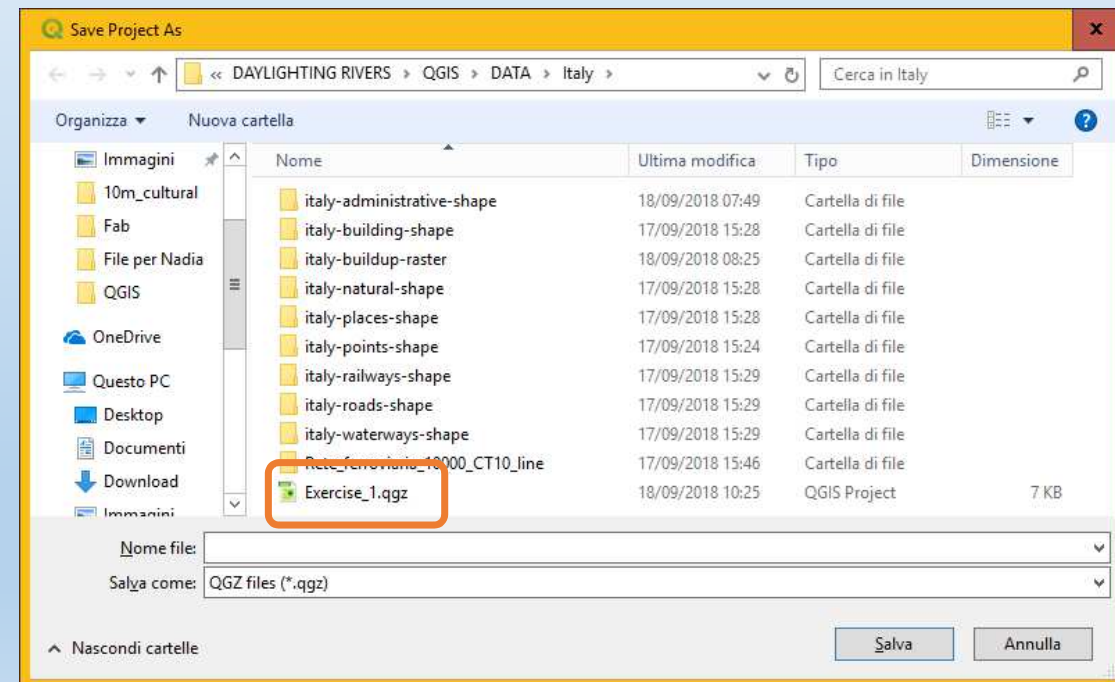
Your turn!

- ☐ Style the polygons however you'd like
- ☐ Change the outline color and/or add a pattern
- ☐ Style the labels
- ☐ Change the font, the font size, or other attributes

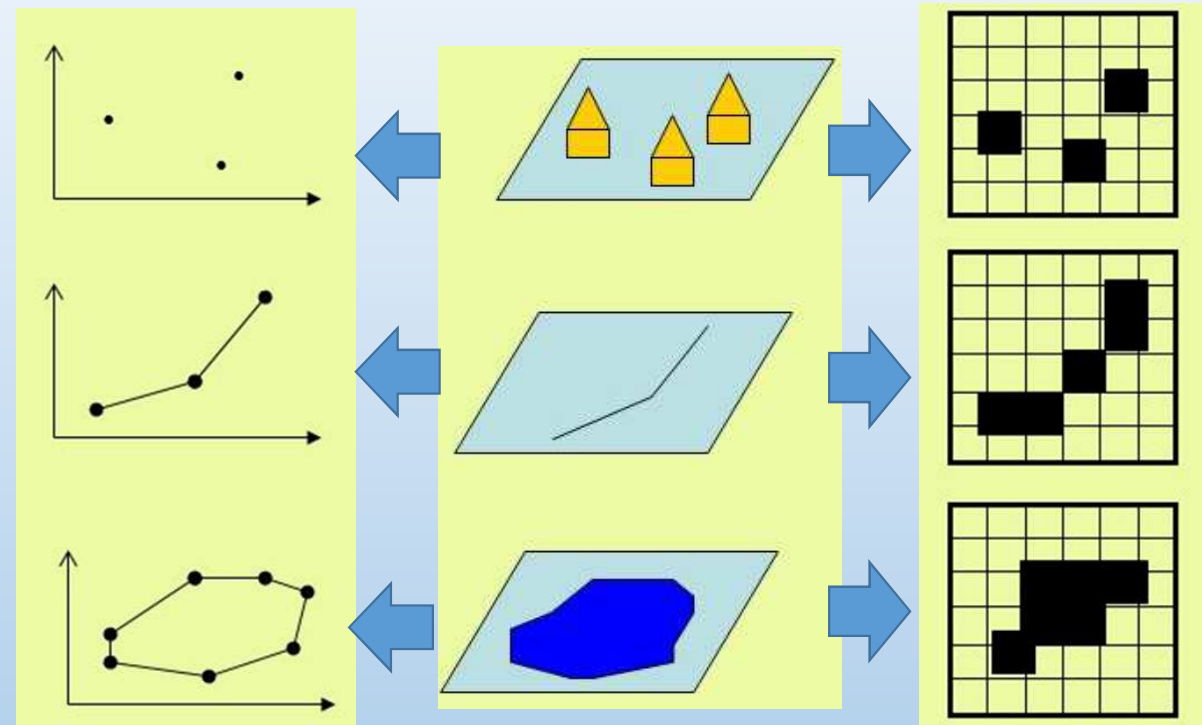
QGIS can save user sessions !

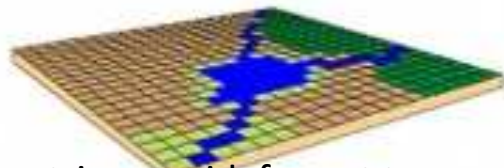
Project > Save


**Save a .qgs file. Can be opened in
a normal text editor**

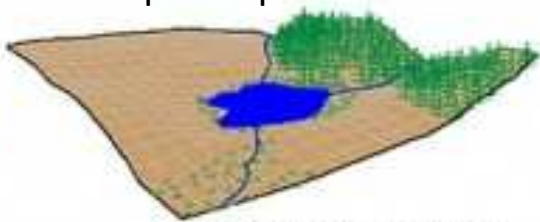


Data format: Vector vs. Raster



- RASTER** → 

Uses individual cells in a matrix, or grid, format to represents real world entities
- VECTOR** → 

Uses coordinates to store the shape of spatial data objects
- Real World** → 

Source: Defense Mapping School
National Imagery and Mapping Agency

«A raster model tells what occurs everywhere, a vector model tells where everything occurs»

Data format: raster vs. vector

Many features can be represented as rasters or vectors. You'll want to select the data type based on the nature of the data and the analysis you want to perform on it.

Conversion Between Data Models

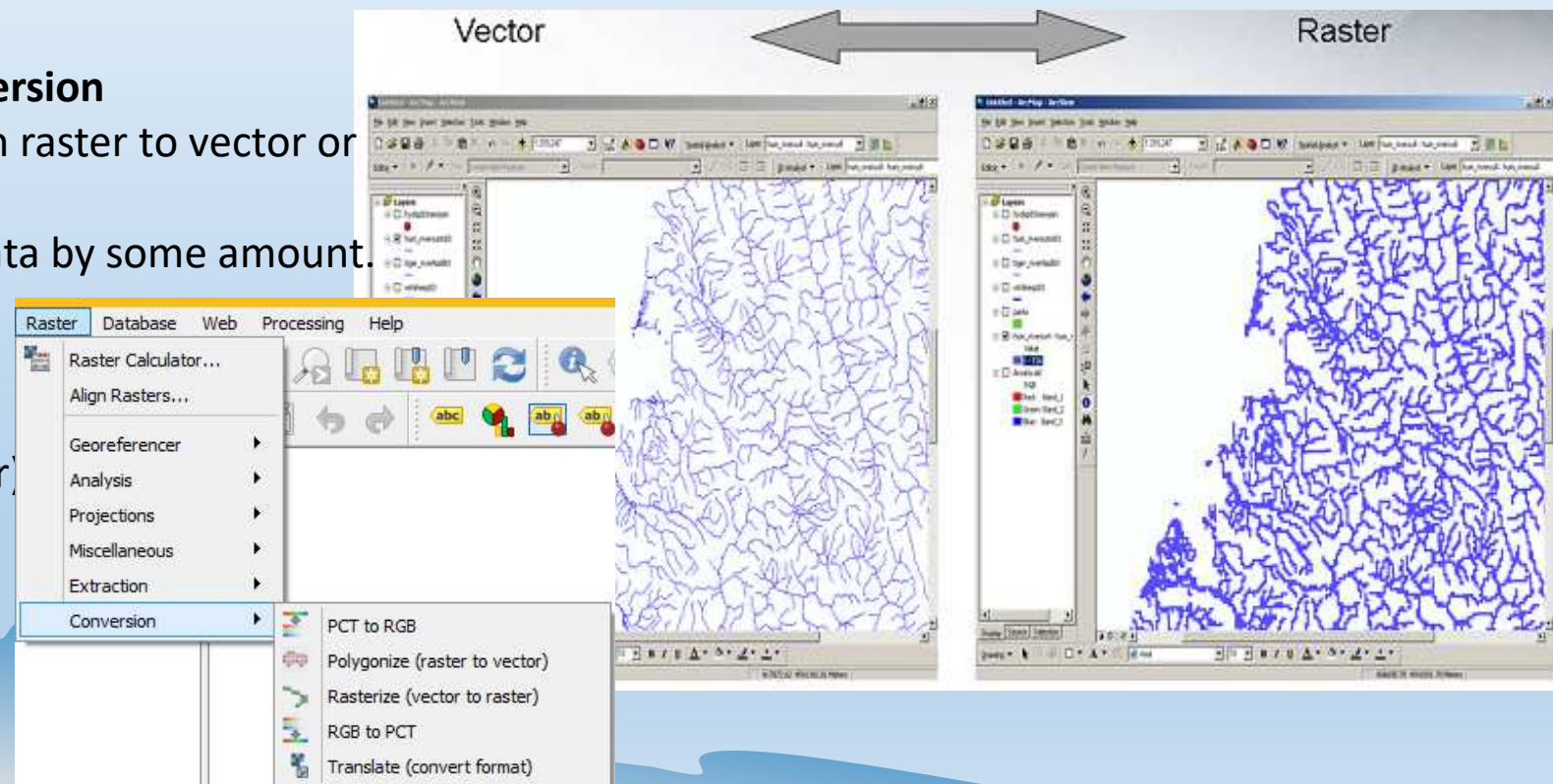
You can convert data between rasters and vectors but the nature of the data will be very different.

Problems Associated with Conversion

Whenever you convert data from raster to vector or vector to raster, you will degrade the data by some amount.

Issues include:

- ✓ Loss of detail
- ✓ Loss of accuracy
- ✓ Stair stepping (raster to vector)
- ✓ Changes to the original data



Training event (C1) of Daylighting rivers Florence Oct. 1st – 5th 2018

Choosing Between Data Models

"Raster is faster but vector is corrector". This is a common saying in GIS.

Raster data is useful when:

- ☐ Working with continuous data types: elevation, slope, satellite photos
- ☐ Good for large area analyses
- ☐ Good for surface analysis
- ☐ Mathematical modeling
- ☐ Spatial detail isn't important

Vector data is useful when:

- ☐ Working with discrete data types: trees, buildings, property boundaries
- ☐ Good for small study areas
- ☐ Spatial detail is important (When "close enough" isn't really good enough)
- ☐ When topology is needed for the analysis

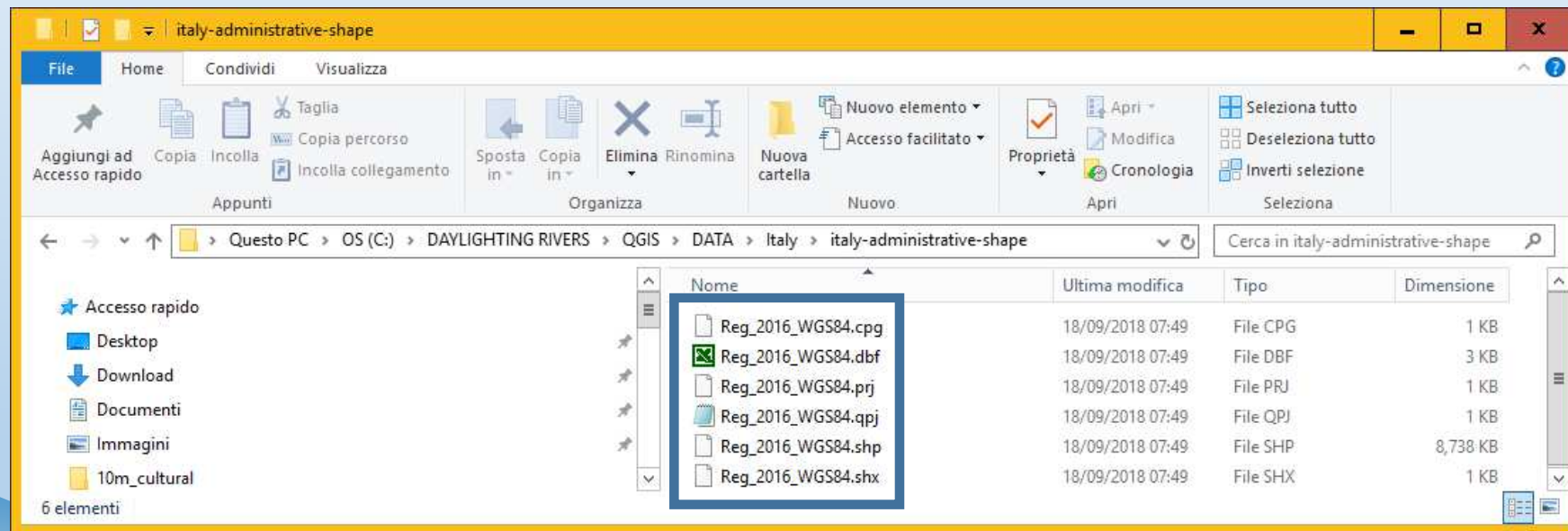
Other factors that can influence your decision include: Available storage: some rasters are really large; Expected types of analysis: some tools only work with raster or vector data; Expertise of human operators; Level of accuracy desired

Vector data

Shapefiles are the basic file for storing map elements

Stores vector data, like points, lines, and polygons

Multiple files comprise a "shapefile":



Vector data: Shapefiles

- .shp** - The main file that stores the feature **geometry**
- .dbf** - The dBASE table that stores the **attribute information** of features
- .prj** - The file that stores the **coordinate system information**
- .shx** - The index file that stores the index of the feature geometry
- .cpg** - Identifies the character set to be used
- .sbn** and **.sbx** - The files that store the spatial index of the features

In the original shapefile specification, projection information is stored in the .prj file in text format. QGIS is using .prj strings that are bound to **EPSG codes**. These EPSG codes are normally missing in prj files, which may lead to wrong CRS detection by QGIS. That's why QGIS writes its own **.qpj** projection file in addition.

.prj

```
PROJCS["NAD83_New_York_Long_Island_ftUS",  
GEOGCS["GCS_North_American_1983",  
DATUM["D_North_American_1983",  
SPHEROID["GRS_1980",6378137,298.257222101]],  
PRIMEM["Greenwich",0],  
UNIT["Degree",0.017453292519943295]],  
PROJECTION["Lambert_Conformal_Conic"],  
PARAMETER["standard_parallel_1",41.03333333333333],  
PARAMETER["standard_parallel_2",40.66666666666666],  
PARAMETER["latitude_of_origin",40.16666666666666],  
PARAMETER["central_meridian",-74],  
PARAMETER["false_easting",984250.0000000002],  
PARAMETER["false_northing",0],  
UNIT["Foot_US",0.30480060960121924]]
```

.qpj

```
GEOGCS["WGS 84",  
DATUM["WGS_1984",  
SPHEROID["WGS 84",6378137,298.257223563,  
AUTHORITY["EPSG","7030"]],  
AUTHORITY["EPSG","6326"]],  
PRIMEM["Greenwich",0,  
AUTHORITY["EPSG","8901"]],  
UNIT["degree",0.0174532925199433,  
AUTHORITY["EPSG","9122"]],  
AUTHORITY["EPSG","4326"]]
```

A **Spatial Reference System Identifier (SRID)** is a unique value used to unambiguously identify projected, unprojected, and local spatial coordinate system definitions. These coordinate systems form the heart of all GIS applications. QGIS implements the SRID (2700!) listed by the European Petroleum Survey Group (EPSG)

Vector data: Shapefiles

Have a few limitations:

- ❑ One geometry type (Point, Line, Polygon) per shapefile
- ❑ Column names can only be letters, numbers, and underscores "_"
- ❑ Column names can only be ten characters long

OBJECTID ^	C_DIG1	C_DIG1DESC	C_DIG2	C_DIG2DESC	C_DIG3	C_DIG3DESC	LU_CURRENT
40	9	Vacant or ...	92	Other/Unk...	0	NULL	2010
41	3	Industrial	31	Industrial	0	NULL	2010
42	9	Vacant or ...	92	Other/Unk...	0	NULL	2010
1	9	Vacant or ...	92	Other/Unk...	0	NULL	2010
2	9	Vacant or ...	92	Other/Unk...	0	NULL	2010
3	9	Vacant or ...	92	Other/Unk...	0	NULL	2010
4	9	Vacant or ...	92	Other/Unk...	0	NULL	2010
5	7	Park/Open ...	71	Park/Open ...	711	Park/Open ...	2011
6	9	Vacant or ...	92	Other/Unk...	0	NULL	2010

Name	Size	Type	Modified
osm_line.dbf	24.7 MB	Document	Feb 4
osm_line.prj	143 bytes	Unknown	Feb 4
osm_line.shp	1.5 MB	Unknown	Feb 4
osm_line.shx	37.1 kB	Unknown	Feb 4
osm_point.dbf	4.8 MB	Document	Feb 4
osm_point.prj	143 bytes	Unknown	Feb 4
osm_point.shp	24.9 kB	Unknown	Feb 4
osm_point.shx	7.2 kB	Unknown	Feb 4
osm_polygon.dbf	939.4 kB	Document	Feb 4
osm_polygon.prj	143 bytes	Unknown	Feb 4
osm_polygon.shp	4.6 MB	Unknown	Feb 4
osm_polygon.shx	1.5 kB	Unknown	Feb 4