

GEOGRAPHIC COORDINATES AND PROJECTION

Open the bash terminal and run

```
cd $HOME/SE_data
```

```
git pull
```

GEOGRAPHIC COORDINATES AND PROJECTION

Coordinate Reference Systems (CRS)

In general CRS can be divided into:

- **geographic coordinate reference systems** (angular coordinates).
- **projected coordinate reference systems** (cartesian or rectangular coordinates)

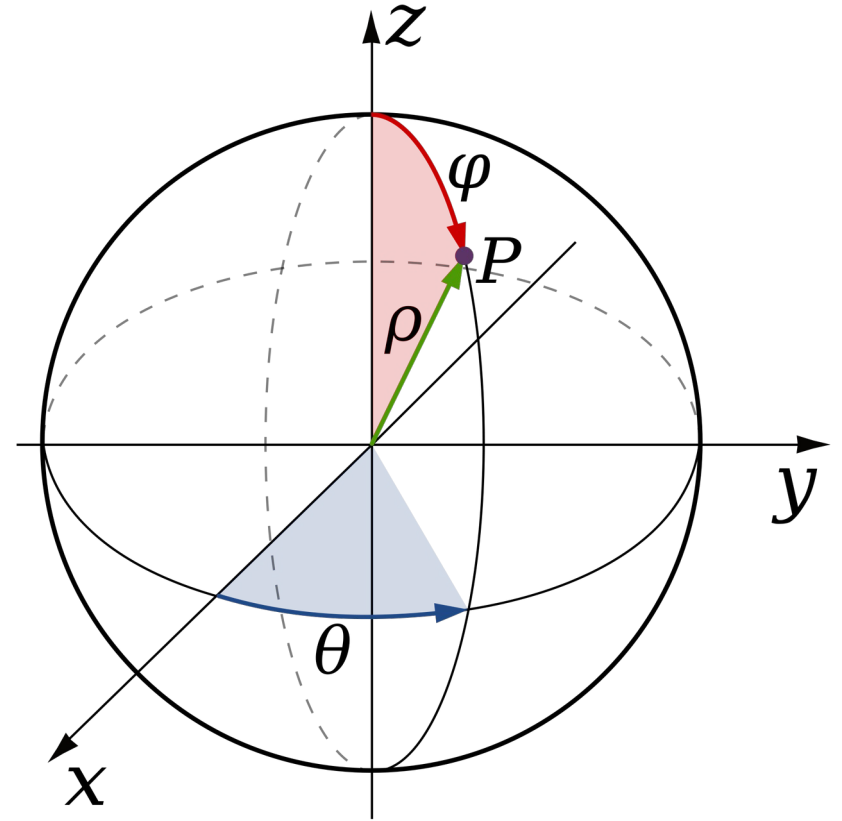
Geographic Coordinate Reference Systems (angular coordinates)

- 3D spherical representation.
- Measures in **angular degree**
- Earth has an **irregular spheroid** shape.
- we map the earth on a **Geodetic Datum** a reference ellipsoid with a given origin and orientation (2D angular coordinates)

Some Global Datums examples:

WGS84, World Geodetic System (default for GPS)

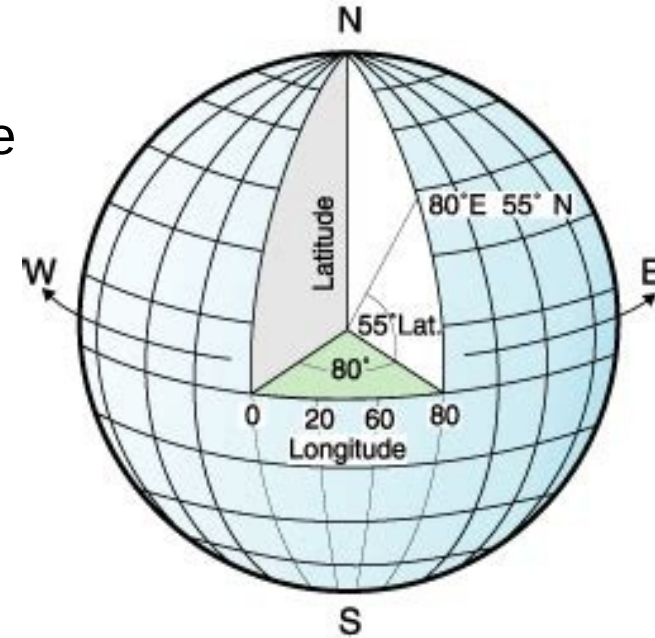
NAD83, North American Datum (very similar to WGS 84)



Geographic Coordinate Reference Systems (angular coordinates)

Features of the Geographic Coordinate Reference Systems

- Longitude
 - ✓ WEST-EAST (-180° $+180^\circ$; total 360°)
 - ✓ Longitude (x dimension) is getting smaller going from the Equator to the Poles
 - ✓ 1° Longitude = 111.32 km = 69.17 mi at the Equator
 - ✓ 1° Longitude / 120 = 0.008333 which is consider ~ 1 km
- Latitude
 - ✓ NORD-SOUTH ($+90^\circ$ -90° ; total 180°)
 - ✓ Latitude (y dimension) is similar going from the Equator to the Poles
 - ✓ 1° Latitude = 110.57 km = 68.71 mi at the Equator



Geographic Coordinate Reference Systems for raster or vector files

$1^\circ \text{ Longitude} / 120 = 0.008333$
 $111.32 \text{ km} \div 120 = 0.9276 \text{ km}$
which is consider $\sim 1\text{km}$

1 pixel cover 0.8605 km^2
and is getting smaller and smaller going towards the poles

Layer Properties - LST_MOYDmax_month3 | Information

Information

Source

Symbology

Transparency

Histogram

Rendering

Pyramids

Metadata

Legend

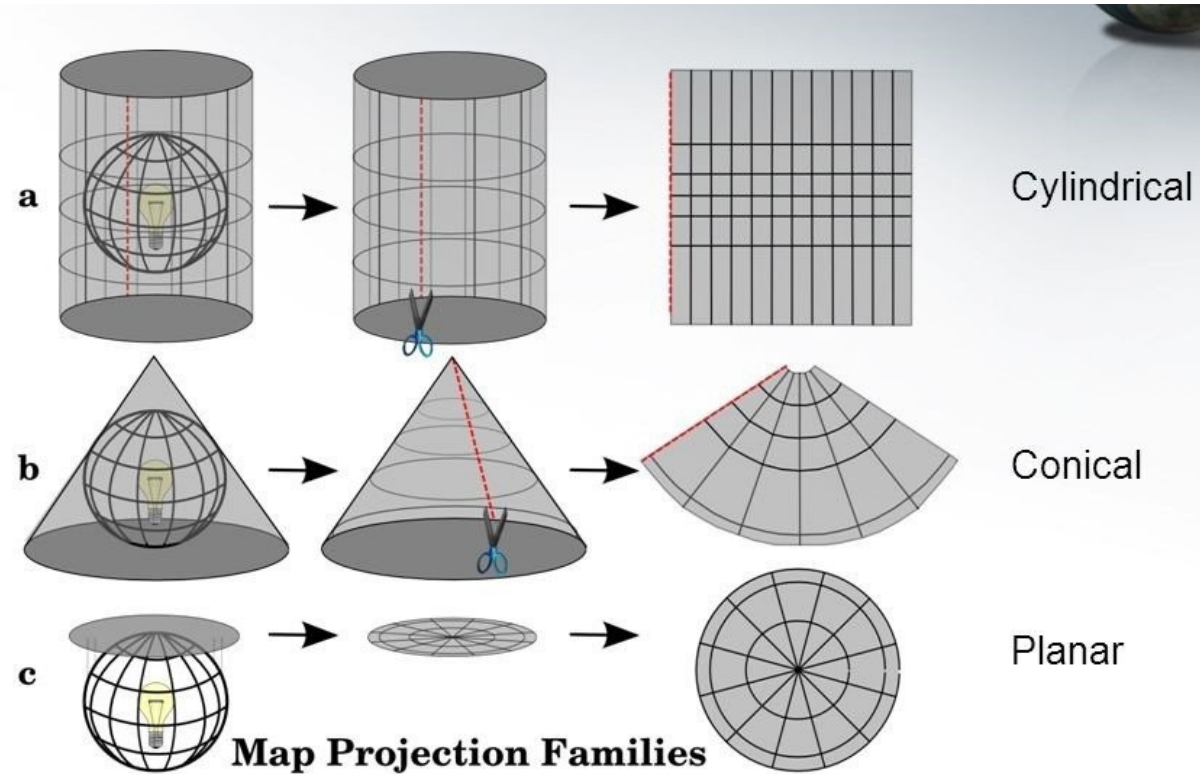
QGIS Server

Information from provider

Name	LST_MOYDmax_month3
Path	/home/selv/SE_data/exercise/geodata/LST/LST_MOYDmax_month3.tif
CRS	EPSG:4326 - WGS 84 - Geographic
Extent	26.999999999931788,-1.999999999969704 : 35.999999999928804,5.000000000027995
Unit	degrees
Width	1080
Height	840
Data type	Float32 - Thirty two bit floating point
GDAL Driver	GTiff
Description	
GDAL Driver Metadata	GeoTIFF
Dataset Description	/home/selv/SE_data/exercise/geodata/LST/LST_MOYDmax_month3.tif
Compression	LZW
Band 1	<ul style="list-style-type: none">STATISTICS_APPROXIMATE=YESSTATISTICS_MAXIMUM=55.457366943359STATISTICS_MEAN=35.041194651097STATISTICS_MINIMUM=12.587799072266STATISTICS_STDDEV=7.7379147697605STATISTICS_VALID_PERCENT=100
More information	<ul style="list-style-type: none">AREA_OR_POINT=AreaTIFFTAG_DATETIME=2015:05:19 16:31:35TIFFTAG_DOCUMENTNAME=/nobackupp8/gamatull/dataproc/LST/MYOD11A2_celsiusmean/LST_MOYDmax_month3.tifTIFFTAG_SOFTWARE=pktools 2.6.3 by Pieter Kempeneers
Dimensions	X: 1080 Y: 840 Bands: 1
Origin	27,5
Pixel Size	0.0083333333333333059131,-0.0083333333333333059131

Projected coordinate reference systems (Cartesian or rectangular coordinate reference systems)

- Map projections are never absolutely accurate representations of the spherical earth. As a result of the map projection process, every map shows distortions of angular conformity, distance and area.



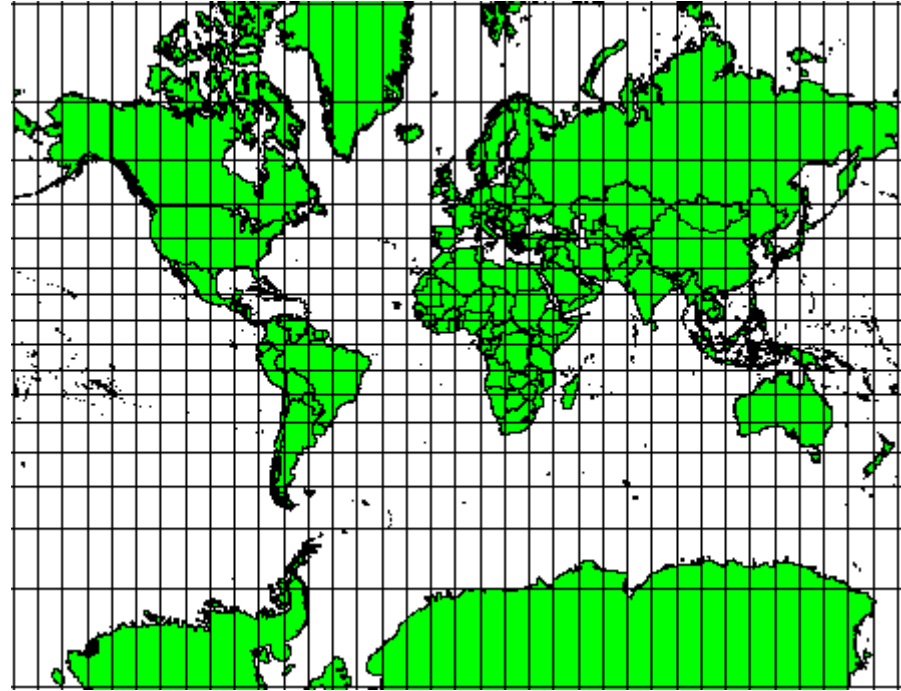
Map projections with angular conformity

They are commonly used for navigational or meteorological tasks.

Mercator projection

Lambert Conformal Conic projection

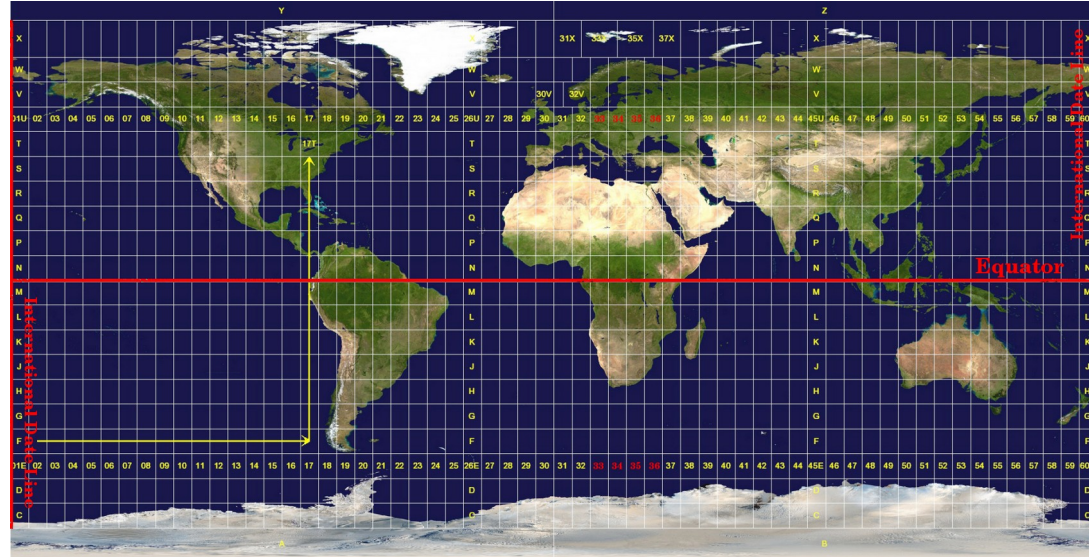
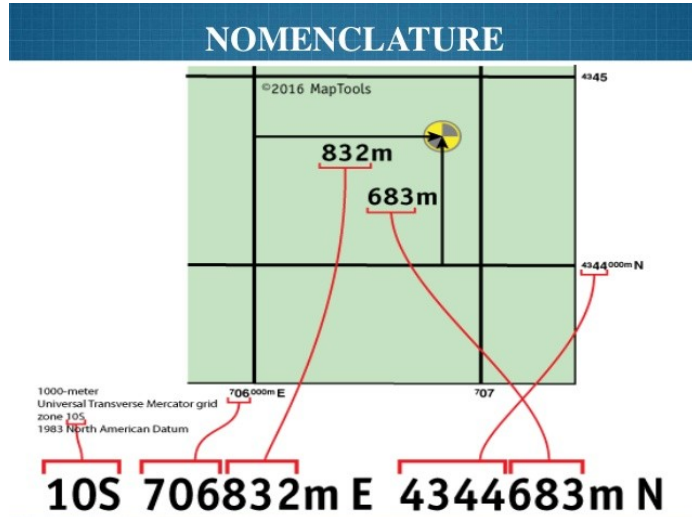
World Mercator projection with country going to true size



Map projections with angular conformity

Universal Transverse Mercator (UTM)

To avoid too much distortion, the world is divided into 60 equal zones (Fuse) that are all 6 degrees wide.
e.g. UTM 33S, UTM 3N



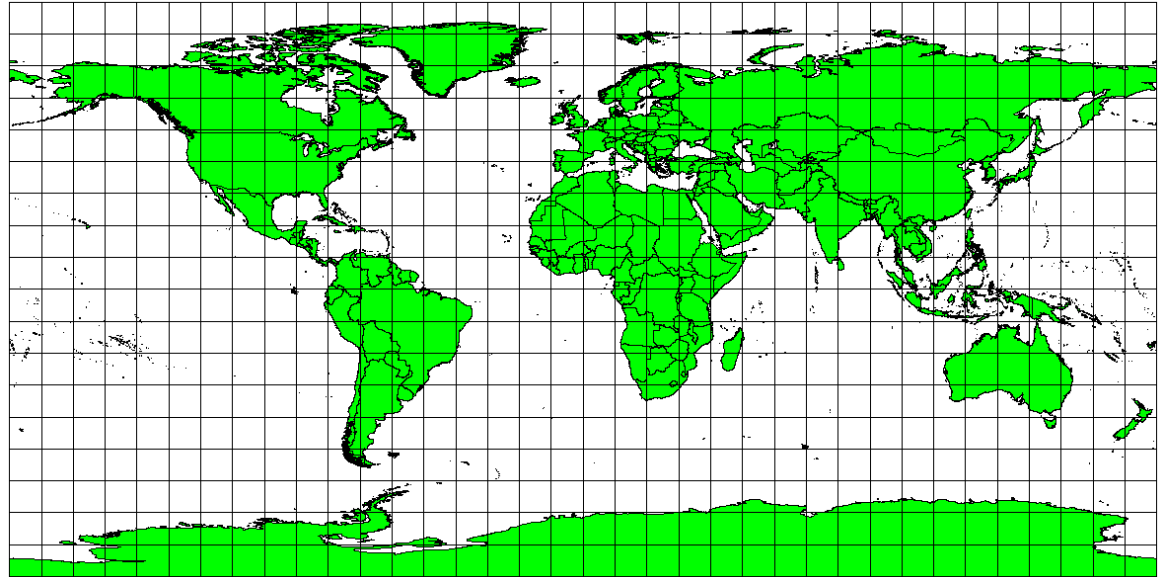
Map projections with equal distance

If your goal in projecting a map is to accurately measure distances

Plate Carree Equidistant Cylindrical

Equiarectangular projection

Azimuthal Equidistant projection



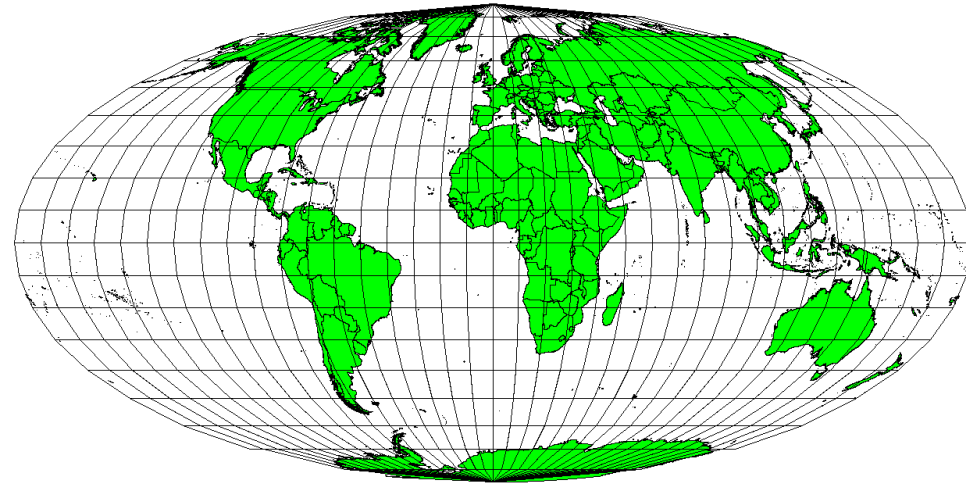
Map projections with equal areas

They are commonly used for navigational or meteorological tasks.

Alber's equal area,

Lambert's equal area

Mollweide Equal Area Cylindrical projections



CRS CODES

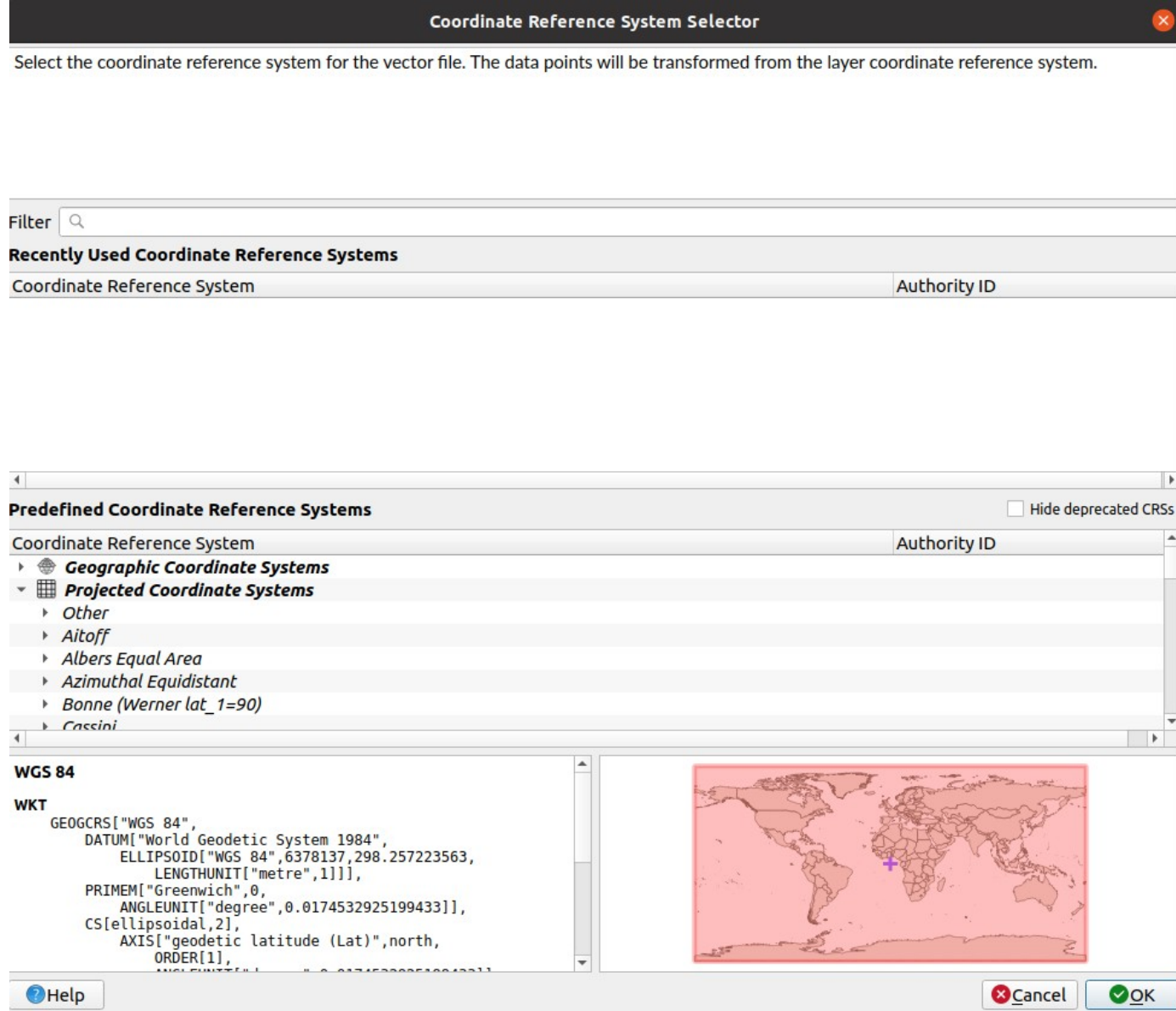
The CRS is defined by EPSG or SR-ORG or ESRI codes.

- EPSG stands for European Petroleum Survey Group and is an organization that maintains a geodetic parameter database with standard codes, the EPSG codes, for coordinate systems, datums, spheroids, units and such alike.
- SR-ORG are user defined projection.
- ESRI are projection defined by the ESRI company.
- The EPSG or SR-ORG or ESRI codes are defined at <https://spatialreference.org/>

CRS in QGIS



Define/Assign projection:
define a projection
parameters on the metadata
(the geographic features do
not change)

Warp/Reproject: change the
the projection parameters on
the metadata and on the file
(the geographic features
change)



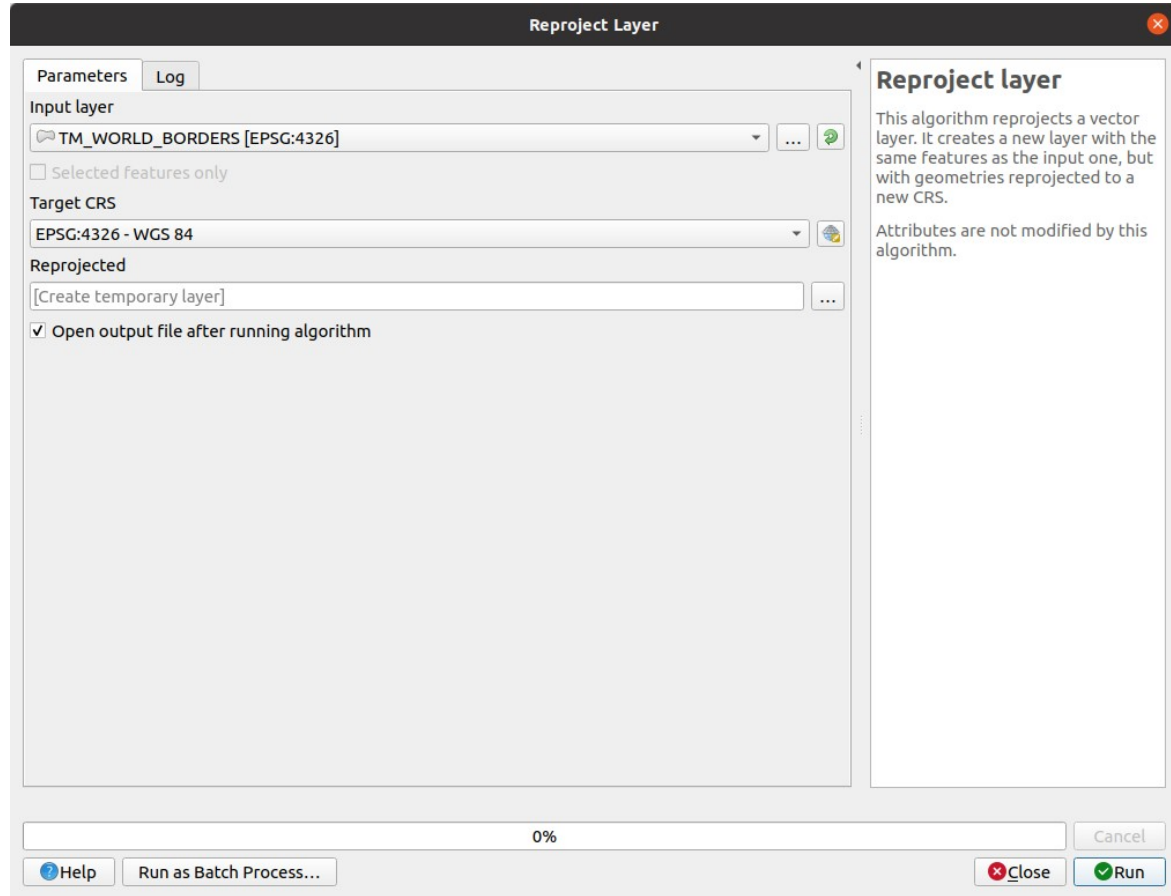
The CRS metadata can be stored in different file format

<https://spatialreference.org/ref/epsg/4326/>

- Well Known Text as HTML
- Human-Readable OGC WKT
- Proj4  `+proj=longlat +ellps=WGS84 +datum=WGS84 +no_defs`
- OGC WKT
- JSON
- GML
- ESRI WKT
- .PRJ File  `GEOGCS["GCS_WGS_1984",DATUM["D_WGS_1984",SPHEROID["WGS_1984",6378137,298.257223563]],PRIMEM["Greenwich",0],UNIT["Degree",0.017453292519943295]]`
- USGS
- MapServer Mapfile | Python
- Mapnik XML | Python
- GeoServer
- PostGIS spatial_ref_sys INSERT statement
- Proj4js format

Reproject vector

Vector > Data Management Tools > Reproject Layers

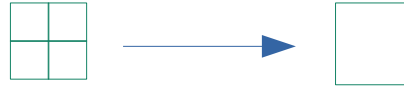


Resampling/Aggregate

Resampling/Aggregate/Disaggregate = change pixel resolution

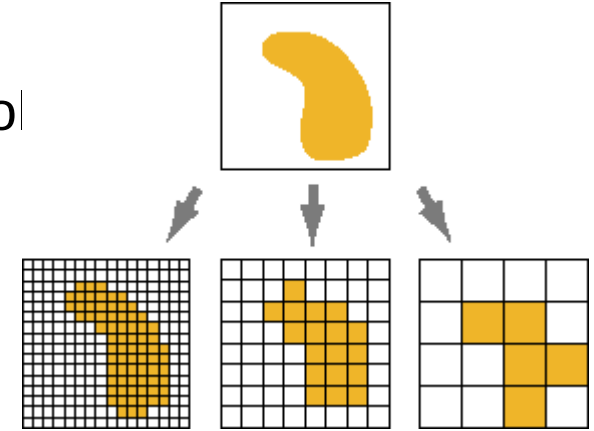
- Continuous data

- Nearest Neighbor
- Average
- Median
- Bilinear Interpolation (weighted average of the 4 surrounding cells)
- Cubic Convolution Interpolation (weighted average of the 16 surrounding cells)



- Categorical data

- Nearest Neighbor
- Count
- Majority



Reproject Raster

Raster > Projection > Warp (Reproj)

Warp (Reproject)

Parameters Log

Input layer
LST_MOYDmax_months5 [EPSG:4326] ...

Source CRS [optional]
...

Target CRS [optional]
...

Resampling method to use
Nearest Neighbour

Nodata value for output bands [optional]
Not set

Output file resolution in target georeferenced units [optional]
Not set

► Advanced parameters

Reprojected
[Save to temporary file] ...

☒ Open output file after running algorithm

GDAL/OGR console call

```
gdalwarp -r near -of GTiff /home/selv/SE_data/exercise/geodata/LST/LST_MOYDmax_months5.tif /tmp/processing_56b3feca2a18478a9bc20527c1015d49/086a4ffa3f87412ebb6524f471ceb4f/OUTPUT.tif
```

0%

Cancel

Help Run as Batch Process... Close Run

Additional material

[https://docs.qgis.org/3.16/en/docs/
gentle_gis_introduction/
coordinate_reference_systems.html](https://docs.qgis.org/3.16/en/docs/gentle_gis_introduction/coordinate_reference_systems.html)

Exercise

- Navigate in the `/home/user/SE_data/exercise/geodata/landsat_ct`
- Merge all the tif file in only one large tif
- Reproject the merged tif to match the projection of `/home/selv/SE_data/exercise/geodata/shp/USA_NAD27.shp`
 - Compress the output
 - Select the optima re-sampling method
 - Considering the original resolution is 0.0083333333 degree
 - Define the right target resolution
 - Crop the image in such a way that the tile border is a integer multiply of the defined pixel resolution