December 2020

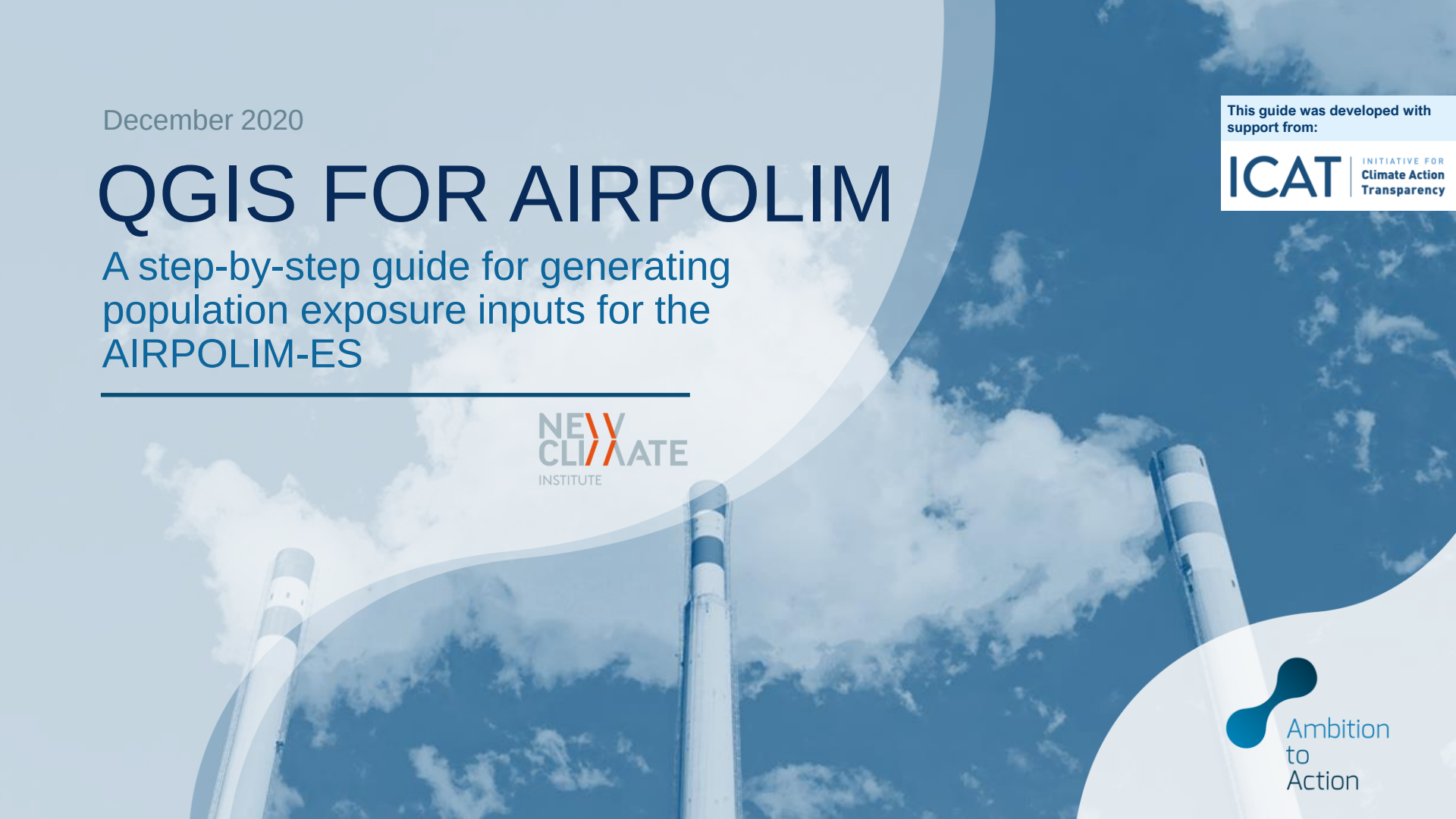
QGIS FOR AIRPOLIM

A step-by-step guide for generating population exposure inputs for the AIRPOLIM-ES

NEW CLIMATE INSTITUTE

This guide was developed with support from:

ICAT INITIATIVE FOR Climate Action Transparency



Ambition to Action

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This guide was developed with funding from the Initiative for Climate Action Transparency

Background and introduction

AIRPOLIM-ES and population exposure analysis in QGIS

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Air Pollution Impact Model for Electricity Supply

AIRPOLIM-ES

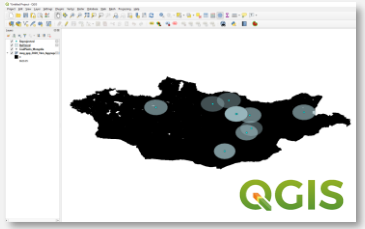
compass toolbox

- Tool to estimate the health impacts of air pollution from different sources of electricity generation
- Focuses on air pollution caused by electricity generation from coal- and gas-fired power plants
- Compares the magnitude of health impacts under different scenarios across both existing and planned plants
- Interactive web application available for a number of countries

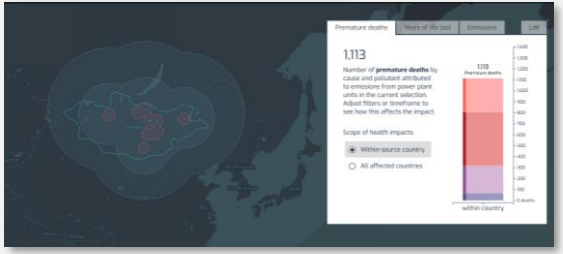
Find the tool and additional materials here.

Linking QGIS and AIRPOLIM-ES

- **Population exposure** to air pollution is a **key input** for analysing health impacts with the AIRPOLIM-ES
- **Geographic Information System** (GIS) software is needed to conduct spatial analysis to derive population exposure estimates, e.g. with the open-source QGIS



From QGIS to AIRPOLIM-ES



Background and introduction

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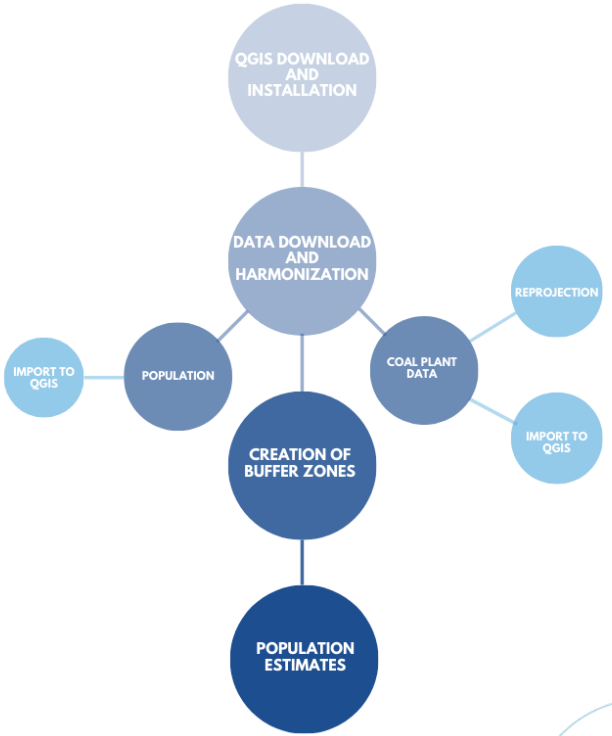
Aim and objectives

- The purpose of these guidelines is to give **step-by-step guidance** for AIRPOLIM-ES users to derive population estimates for any desired country through spatial analysis in QGIS
- The guidelines can be used without any prior experience with QGIS or other geospatial analysis tools
- All data required is available open-source and can be accessed online



Software download and installation

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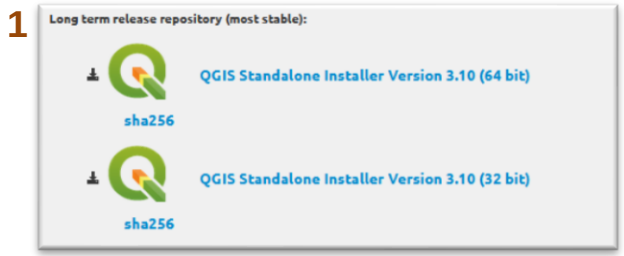
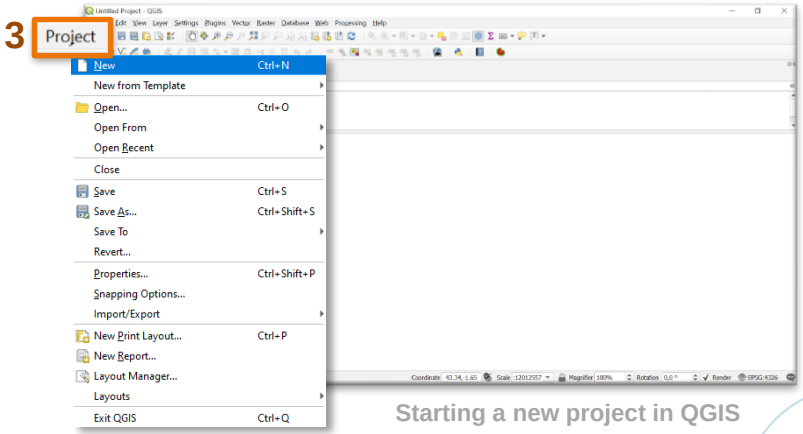
Getting started with QGIS

1. QGIS is available for Windows, macOS, Linux or Android from the following **link**[1]
2. Once downloaded, **follow given instructions** for installation
3. After installation is completed, open the tool and **start a new project**



QGIS download



Starting a new project in QGIS

[1] *This guide was developed using **Version 3.10**, please note that some of the steps might differ in older or newer versions of QGIS*

Population data

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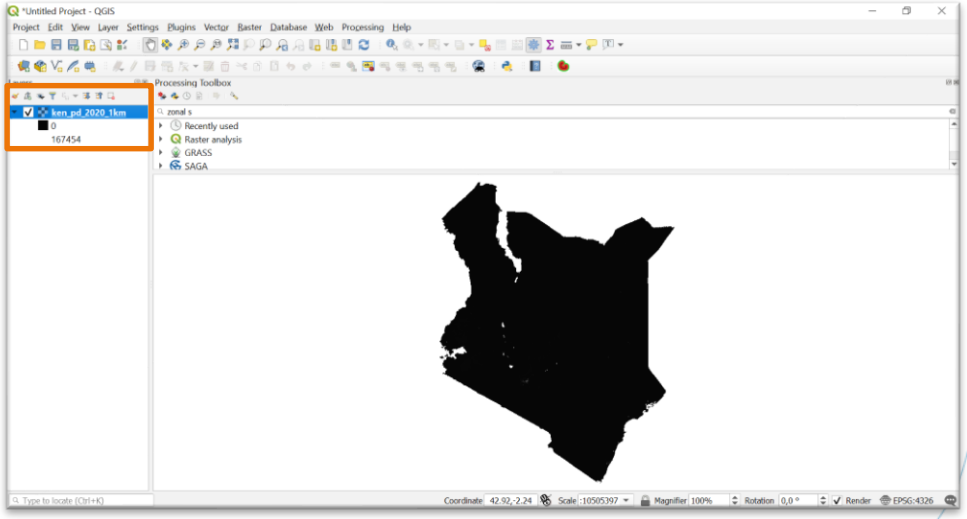
Data download and transferring to QGIS

1. *Population Counts* data for the **most recent year** is downloaded for the **desired country** from **WorldPop**[1]

2. For the selected country, choose *Data & Resources,* download and save the **.tif** file to your computer

3. In QGIS, **drag and drop** the downloaded .tif file

   The population layer will be added as a **raster layer to the layers list** and displayed in QGIS



Population density layer added to QGIS

[1] *Recommendation to use "Unconstrained individual countries" data at 1km resolution*

Coal power plant data

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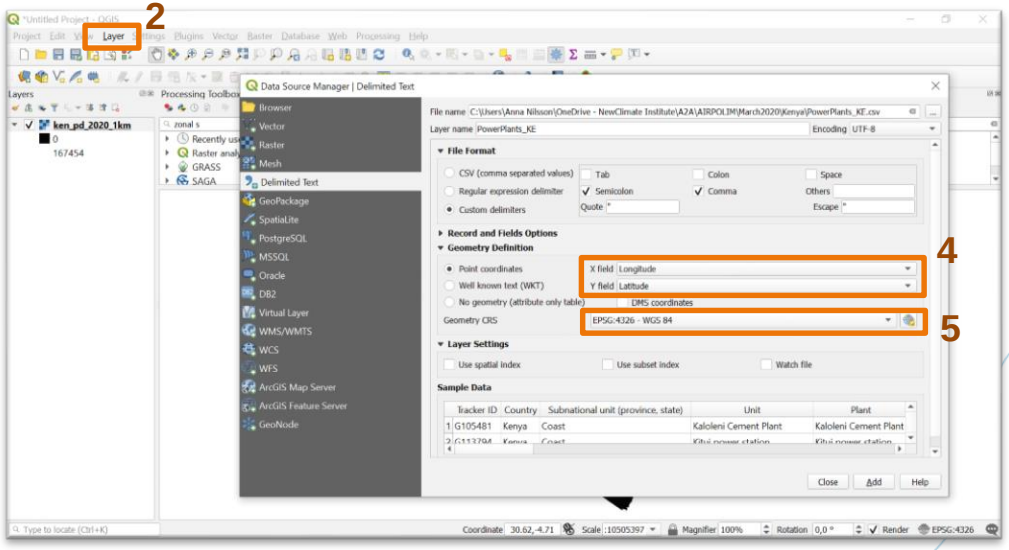
Data download and creation of point vector layer in QGIS

1. Coal power plant data for the **desired country** is e.g. downloaded from the Global Coal Plant Tracker[1] and saved as a .**csv file**
2. In QGIS, navigate to *Layer* > *add layer* > *add delimited text layer*
3. Select the .csv file containing the coal plant data
4. Make sure that the *x-field* is directed to the longitude coordinates, and the *y-field* to the latitude coordinates
5. If you must choose a CRS the global default CRS is EPSG:4326 - WGS 84
6. Select *Add*



Adding the csv file as a point vector layer to QGIS

[1] *Any coal power plant data can be used but must at least include plant name, latitude and longitude*

Coal power plant data

Data download and creation of point vector layer in QGIS

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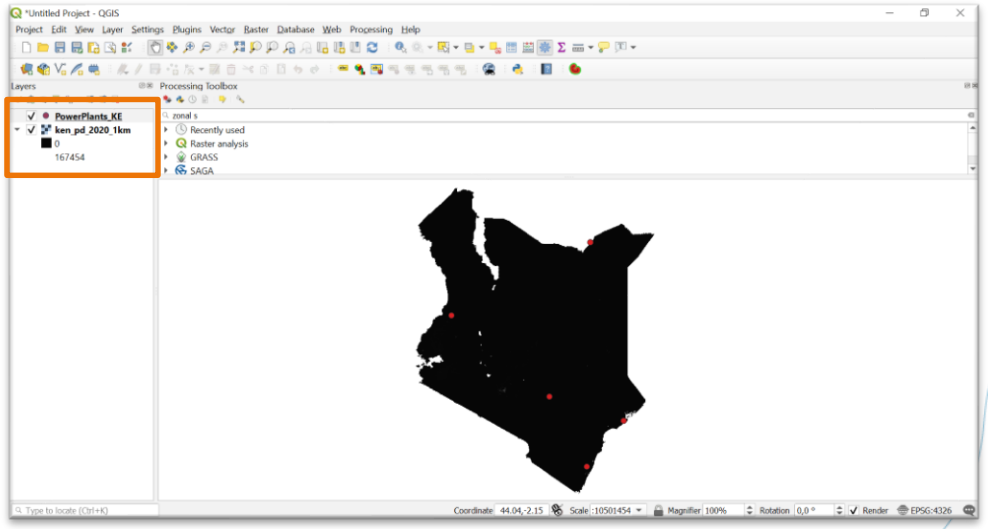
1. A new vector layer is generated and **added to the layers list** in QGIS

2. The power plants should now be **displayed as points**

3. Make sure that the points match with the actual location of the power plants on the population density layer (*e.g. that no plants are located outside country borders and double checking a few examples*)



Coal plants added as point to QGIS

Coal power plant data

Reprojection of point vector layer in QGIS

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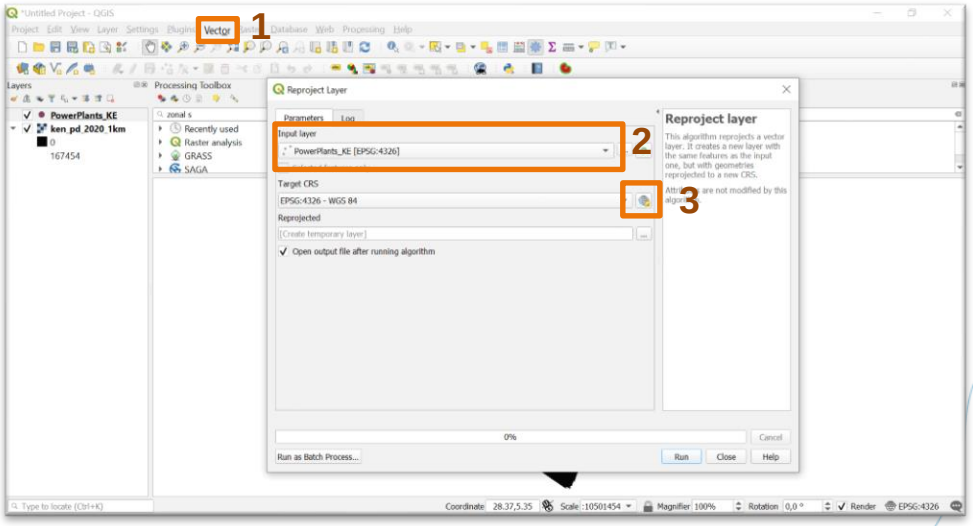
In order to create the buffer zones, the coal plant layer must be **reprojected** from degrees to meters

1. In QGIS, select the coal plant layer by marking it in the layers list and then navigate to *Vector* > *Data Management Tools* > *Reproject layer*

2. Select the coal plant layer as the input layer. **A target CRS that fits the geographical location** of the country must then be identified. (see next slide)



Reprojection the point vector layer in QGIS

Coal power plant data

Identification of target CRS

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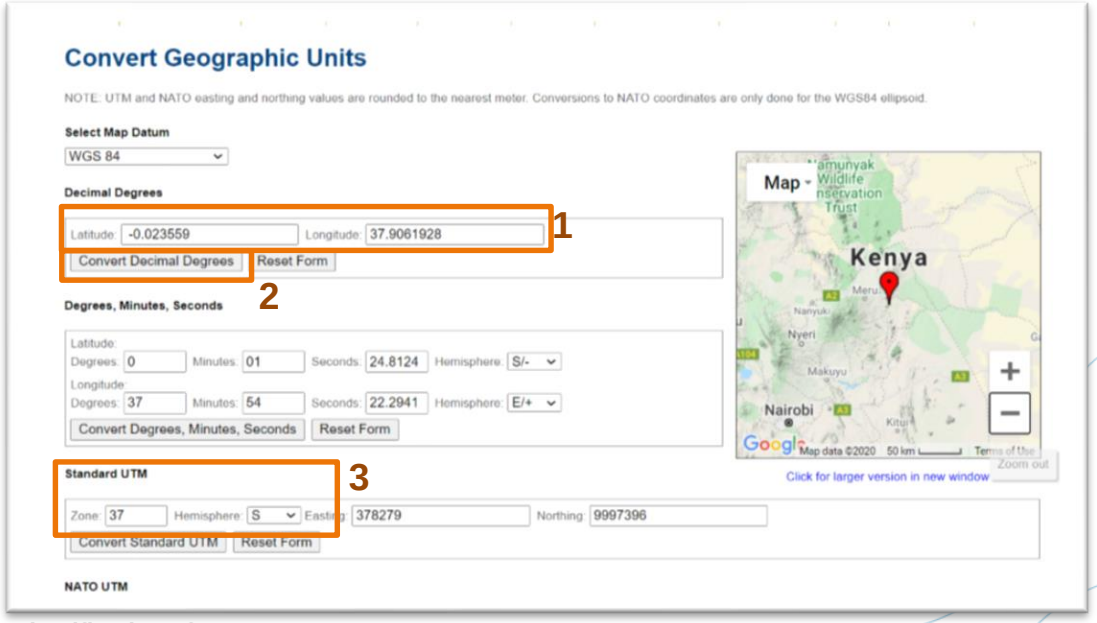
The selected CRS should be a **UTM type,** or other which **reprojects to meters**. On **this** page (or similar):

1. Insert the approximate **coordinates** of where your **power plant data is located**
2. Select *Convert Decimal Degrees*
3. The *UTM zone* and *hemisphere* will be displayed under ***Standard UTM***. This will be the **input to QGIS**



Identification of target CRS

Coal power plant data

Selection of target CRS in QGIS

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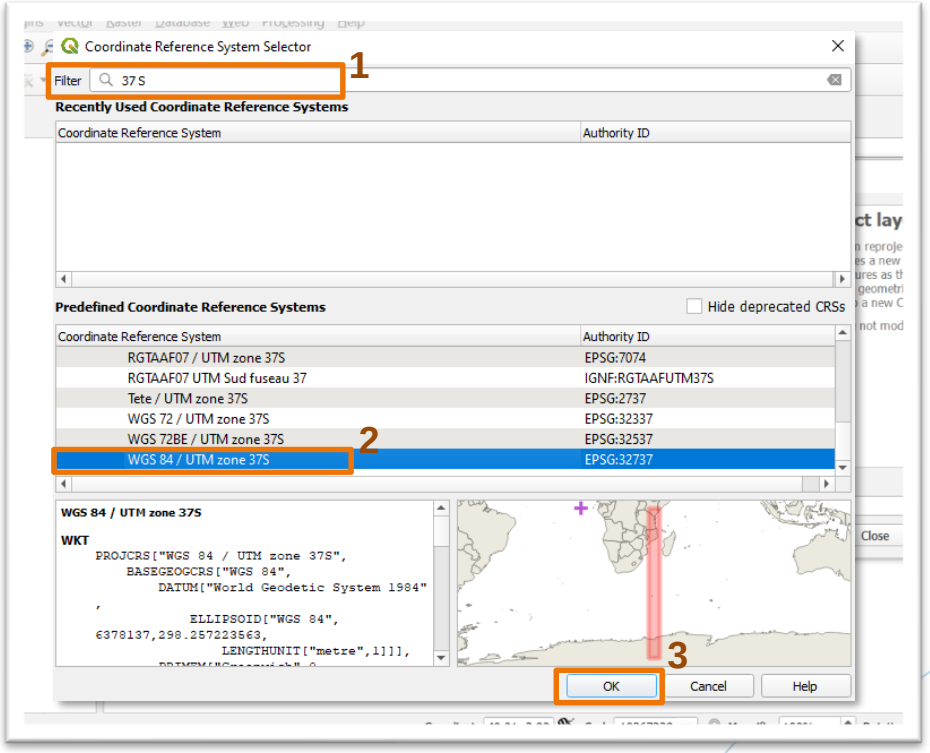
1. In QGIS, navigate to target CRS (*see slide 8, step 3*). In the filter window, insert the UTM zone and hemisphere obtained in the previous step.

2. Find and select the **desired target UTM**

3. Select *OK > Run*

   A new vector layer named *Reprojected* will be generated and added to the layers list.



Selection of target CRS in QGIS

Coal power plant data

Reprojection of point vector layer in QGIS

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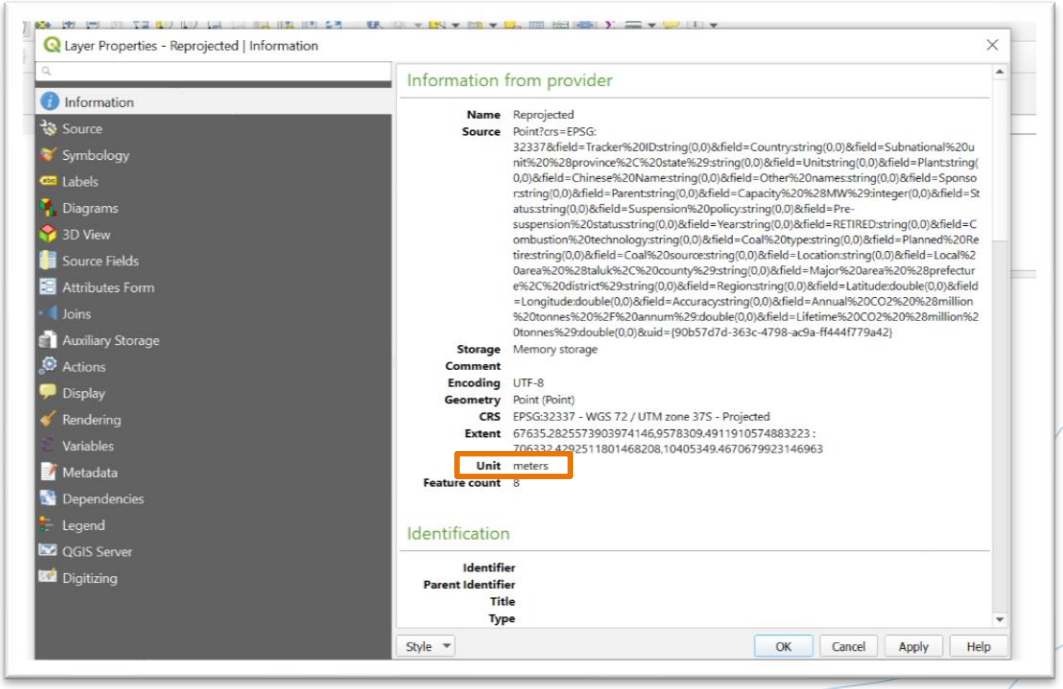
- To make sure that the point layer has been reprojected from **degrees** to **meters**, right click on the *Reprojected* layer and select *Properties* > *Information*
- Under *Unit,* the displayed unit should be **meters**



Layer properties in QGIS

Distance buffer zones

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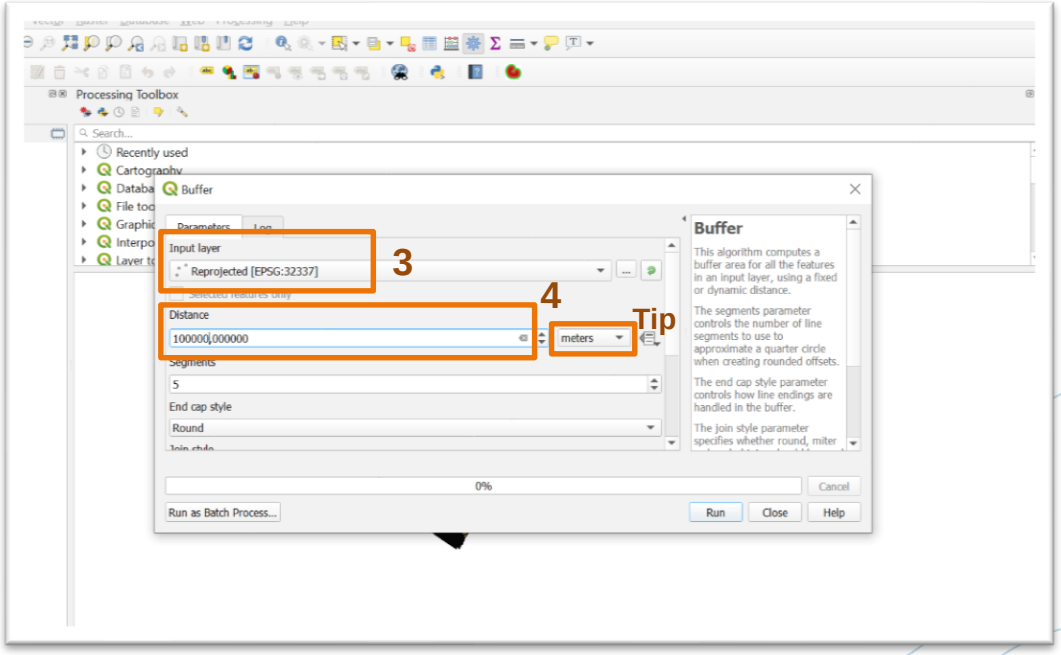
Developing buffer zones in vector in geoprocessing tools

1. Select the **reprojected layer** containing the coal plant data by marking it in the list of layers
2. In QGIS, navigate to *Vector > Geoprocessing tools > Buffer*
3. Select the **reprojected** layer as the **input** layer
4. Input the **desired radius** and select *Run*, repeat this step for all for buffer zones

The required distances for AIRPOLIM-ES are:

- 100 km
- 500 km
- 1000 km
- 3300 km

Tip: You can change meters to kilometers.



Definition of buffer radius in QGIS

Distance buffer zones

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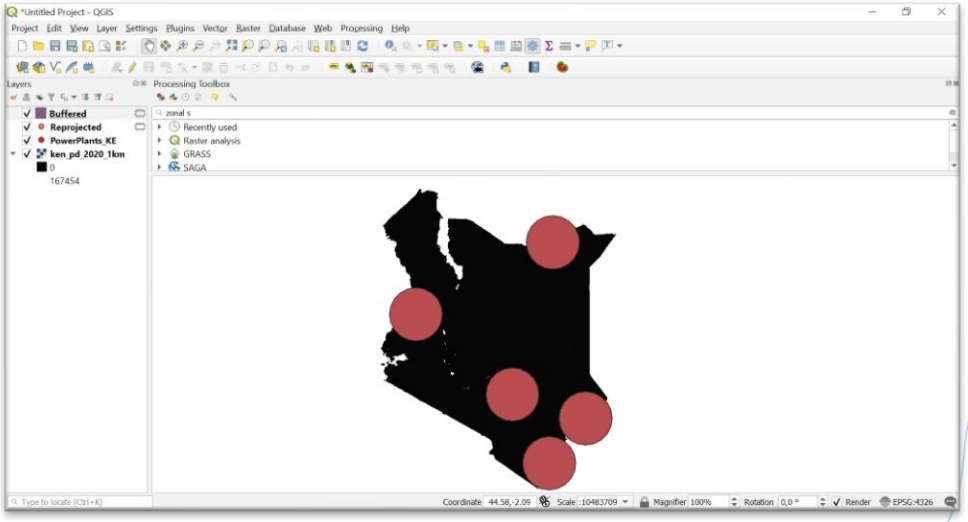
Developing buffer zones in vector in geoprocessing tools

- Buffer zones will be generated as new vector layers named *Buffered*
- The *Buffered* layer will be used in the next step to derive the population estimates
- These steps need to be recreated for each of the buffer zones

Tip:

Layers can be renamed to e.g., Buffer_100km, Buffer_500km, etc. to differentiate between different buffer zones more easily. Right click on the layer in the list > *Rename Layer*



Creation of the first buffer zone in QGIS

Please note: *Depending on the size of the buffer zone and the location of the country buffers might not be round but display as distorted circles.*

Population estimates

Derive sum using zonal statistics

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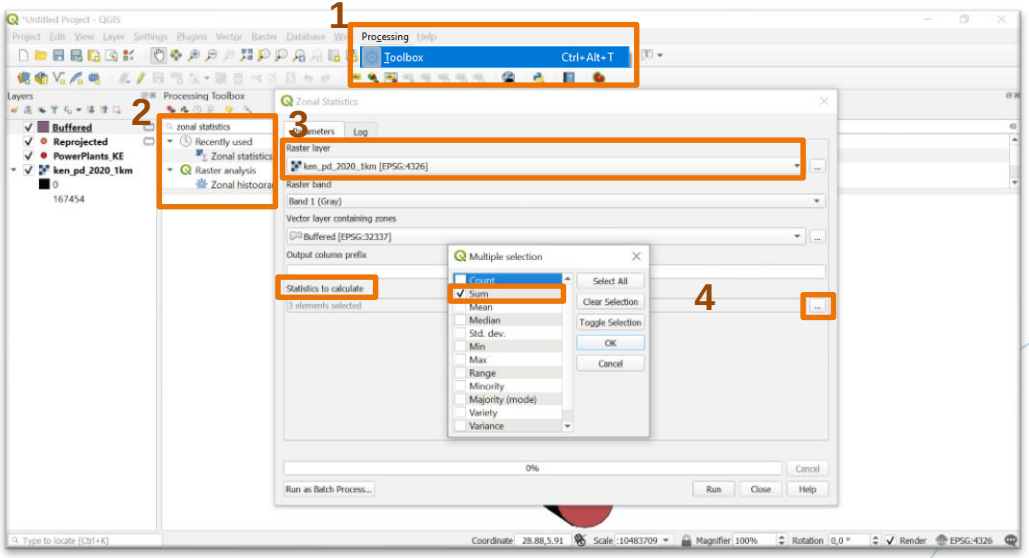
1. In QGIS, navigate to *Processing > Toolbox*
2. In the search field, search for *Zonal Statistics* and select it
3. Select the **population layer** as the **input raster** layer
4. Under *Statistics to calculate,* tick *Sum*
5. Click *Run.*
   Note: Depending on the size of the distance band, number of power plants and processing speed of your computer, this process **might take a few minutes or up to several hours**. In some cases it may be best to run overnight.



Zonal statistics in QGIS

Population estimates

Extracting the data for input to AIRPOLIM-ES

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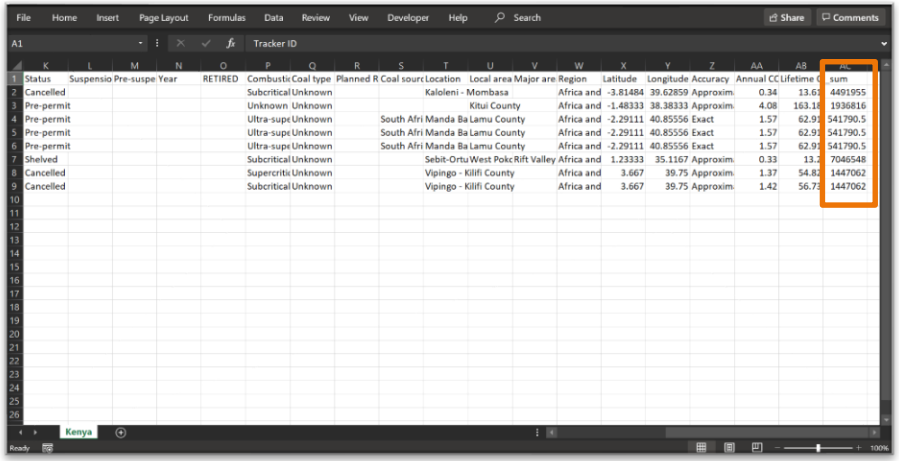
1. Once the processing in zonal statistics is complete, **right click the buffer layer** and go to *Export>Save Features As*...

2. Save the file as **.csv** to your computer

3. The **saved file will contain the generated population** estimates per power plant under the *_sum* column

Note: The obtained population estimates give the total population residing within the full radius of the respective buffer zone (e.g. 0 - 1,000 km). To obtain the population count in the desired distance band (e.g. 500 - 1,000 km), the population count in the full buffer zone must be subtracted by the population count in the previous buffer zone. This will be the case **for all distance bands except for the first one.**



Status	Suspensio	Pre-suspe	Year	RETIRED	Combustic	Coal type	Planned R	Coal sourc	Location	Local area	Major are	Region	Latitude	Longitude	Accuracy	Annual CC	Lifetime C	sum
Cancelled					Subcritical	Unknown			Kaloleni - Mombasa			Africa and	-3.81484	39.62859	Approxim	0.34	13.61	4491955
Pre-permit					Unknown	Unknown			Kitui County			Africa and	-1.48333	38.38333	Approxim	4.08	163.18	1936816
Pre-permit					Ultra-supe	Unknown		South Afri	Manda Ba	Lamu County		Africa and	-2.29111	40.85556	Exact	1.57	62.91	541790.5
Pre-permit					Ultra-supe	Unknown		South Afri	Manda Ba	Lamu County		Africa and	-2.29111	40.85556	Exact	1.57	62.91	541790.5
Pre-permit					Ultra-supe	Unknown		South Afri	Manda Ba	Lamu County		Africa and	-2.29111	40.85556	Exact	1.57	62.91	541790.5
Shelved					Subcritical	Unknown			Sebit-Ortu	West Pokc	Rift Valley	Africa and	1.23333	35.1167	Approxim	0.33	13.2	7046548
Cancelled					Supercritic	Unknown			Vipingo - Kilifi County			Africa and	3.667	39.75	Approxim	1.37	54.82	1447062
Cancelled					Subcritical	Unknown			Vipingo - Kilifi County			Africa and	3.667	39.75	Approxim	1.42	56.73	1447062

Population estimates extracted to csv file

Population estimates for all affected countries

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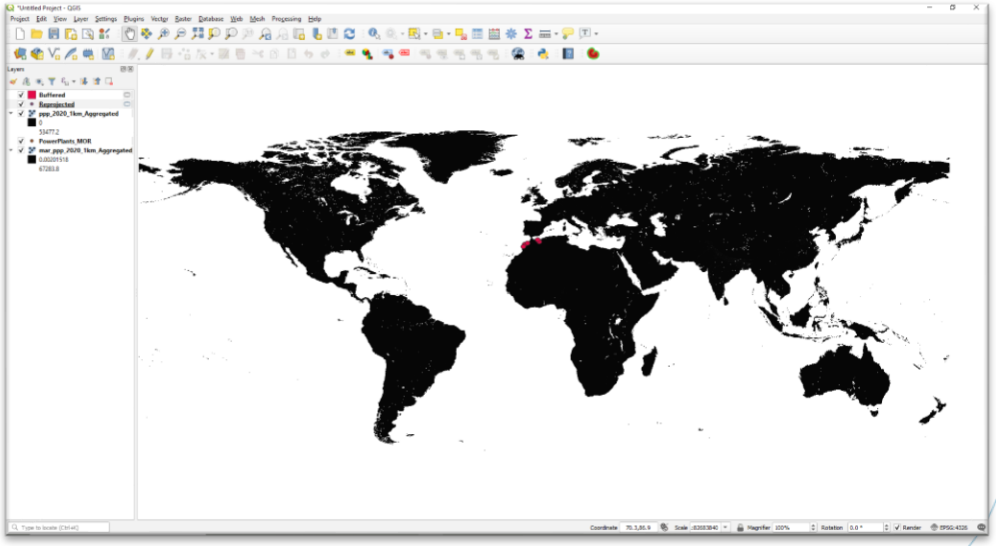
Additional steps if estimates for populations in other affected countries are required

1. *Population Counts* data for the **most recent year** is downloaded for the **whole world** from **WorldPop,** using the *Unconstrained global mosaics* at 1km resolution

2. Choose *Data & Resources,* download and save the **.tif** file to your computer

3. In QGIS, drag and drop the downloaded .tif file into the **existing project**

4. **Replicate steps on slides 15 & 16** to derive population exposure estimates for all affected countries, now simply **using the world population layer as the input raster layer** (slide 15, step 3)



Population density layer for the whole world added to QGIS

Please note: *Depending on the number of power plants etc. QGIS may take a long time to run the zonal statistics – it may be best to run overnight in some cases.*

QUESTIONS / COMMENTS / FEDBACK?

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