Site terrain using Elk for Grasshopper

Elk is a free plugin for ***Grasshopper*** to process GIS data from two sources: the open street maps (OSM) and shuttle radar topography mission (SRTM). ***Elk*** was developed by ***Timothy Logan***.

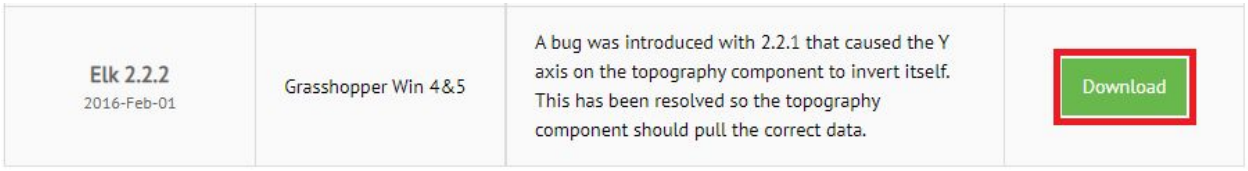
"OpenStretMap.org is an open/crowd sourced website of mapping data. It allows you to export XML formatted data of a selected area and then ***Elk*** will organize and construct collections of point and tag data so that you can begin creating curves and other ***Rhino/Grasshopper*** geometry.

USGS is a science organization that provides access to a large range of scientific data pertaining to the earth. ***Elk*** uses data that originates from the ***Shuttle Radar Topography Mission*** (SRTM) of 2000. This was a shuttle mission where most of the earth was scanned for elevation and packaged in 1°x1° tiles." [1]

Elk is not currently under active development, but it is an open source project. You can find it here: *Link to elk open source project*

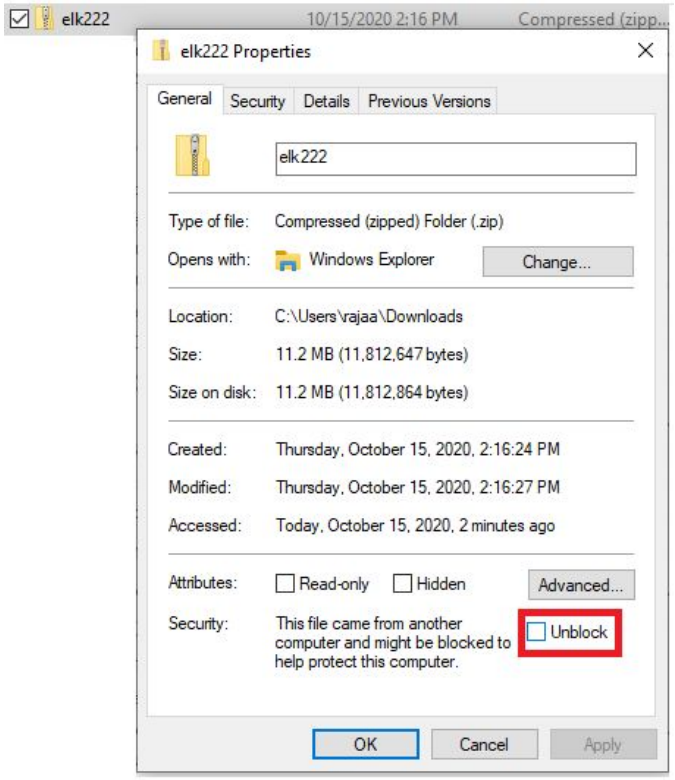
Download and setup

Download the latest ***Elk*** zip file from ***Food4Rhino***. Note that although the last version states that it was built for Rhino 4 and 5, ***Elk*** still runs in later versions. The following steps were documented in December 2020.
https://www.food4rhino.com/app/elk

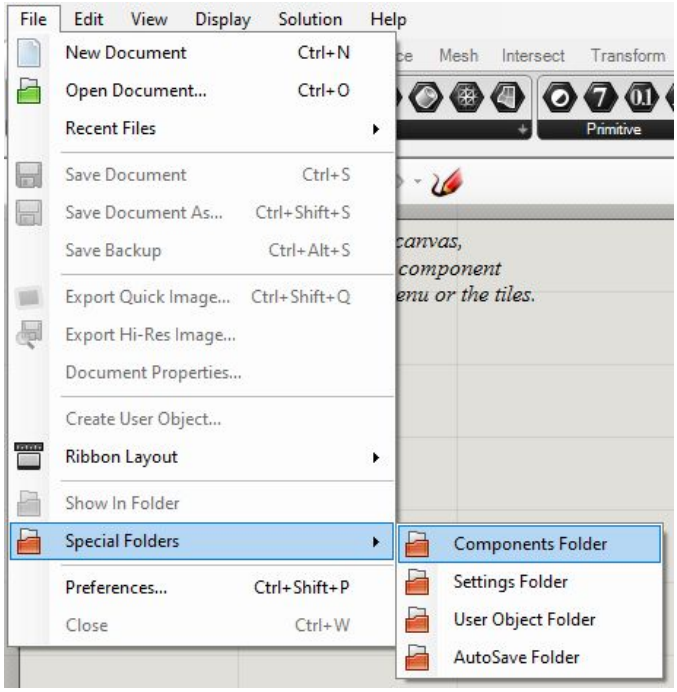


Make sure to ***Unlock*** the downloaded zip file before extracting the content by right-mouse-click, then go to ***Properties***. In the dialog, check the ***Unlock*** checkbox, then click ***Apply***:

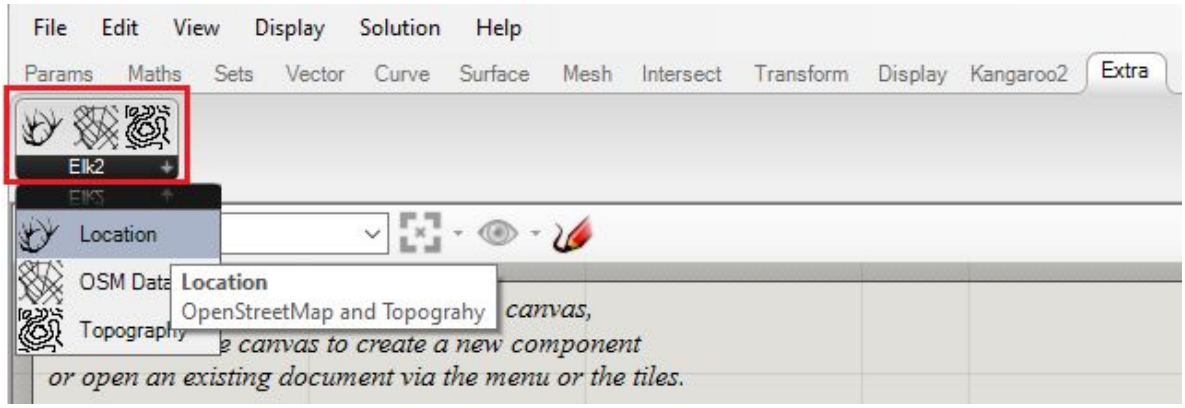
[1] From Elk download site: https://www.food4rhino.com/app/elk



Move the downloaded and unlocked ***Elk*** zip file file to the ***Grasshopper*** component libraries folder and extract all files (you can open it through an open session in ***Grasshopper*** under ***File>Special Folders> Components Folder***.

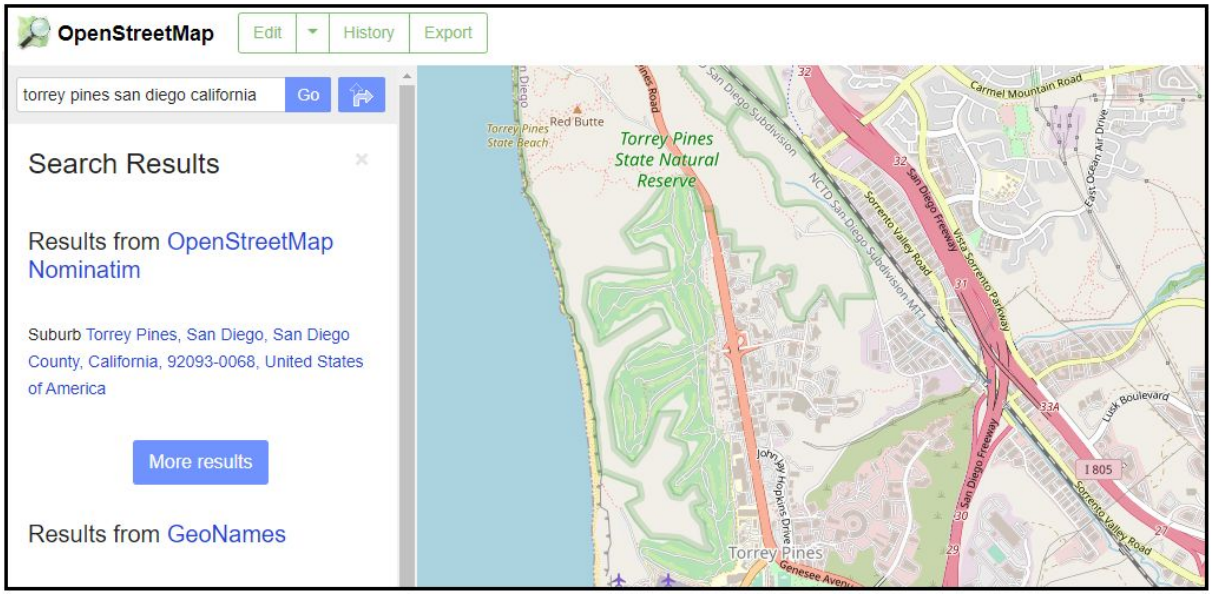


Open Grasshopper, and you will see a new ***Extra*** tab with ***Elk*** components inside:

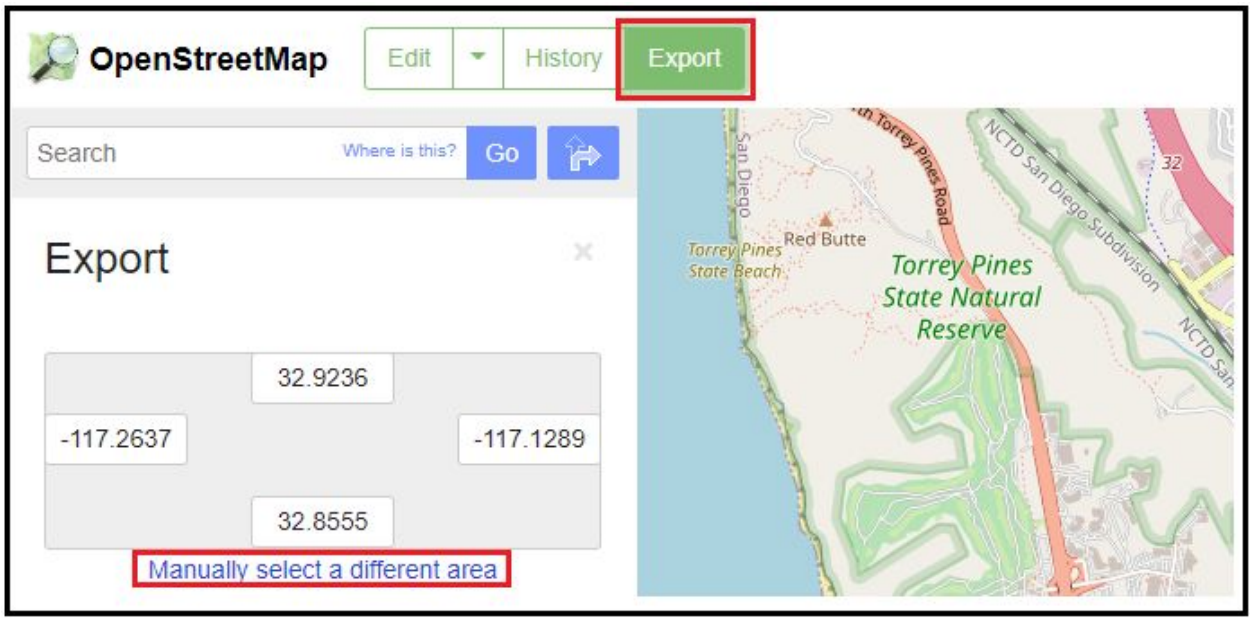


Elk Workflow

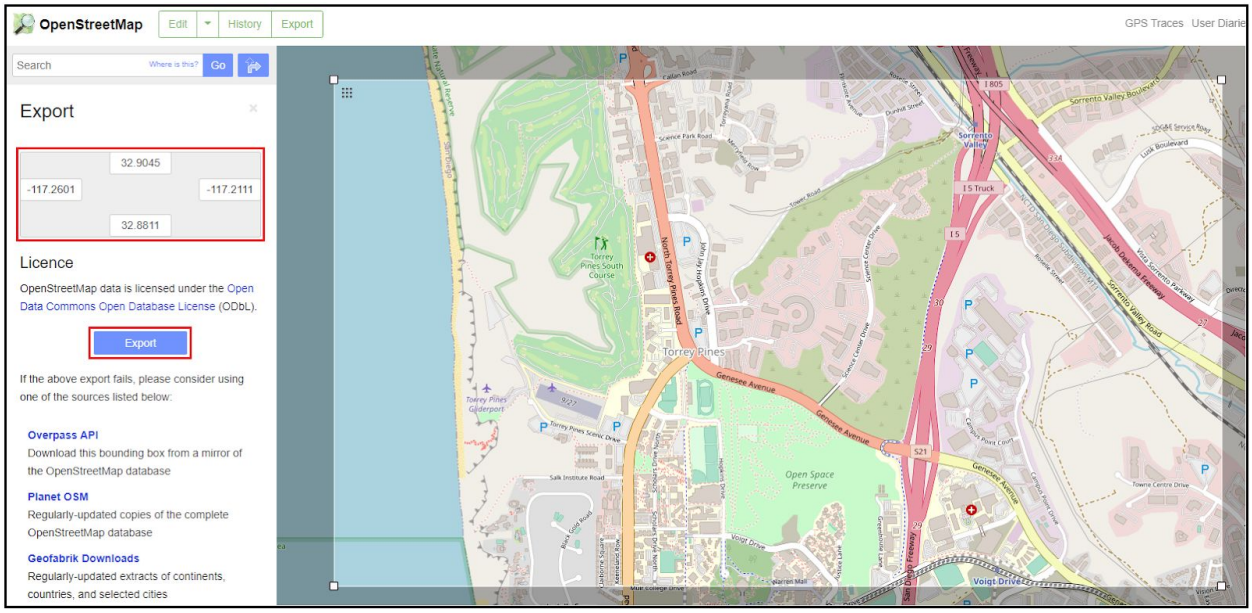
The first step is to download the open street map (***osm***) file for the area you are interested in. All maps are located in https://www.openstreetmap.org/ which is an open source website and anyone can edit and download at any location around the world. Here are the general steps to get the ***osm*** file for the ***Torrey Pines*** location in ***San Diego***.
First go to https://www.openstreetmap.org and search for "***Torrey Pines San Diego California***". You will get the following map:



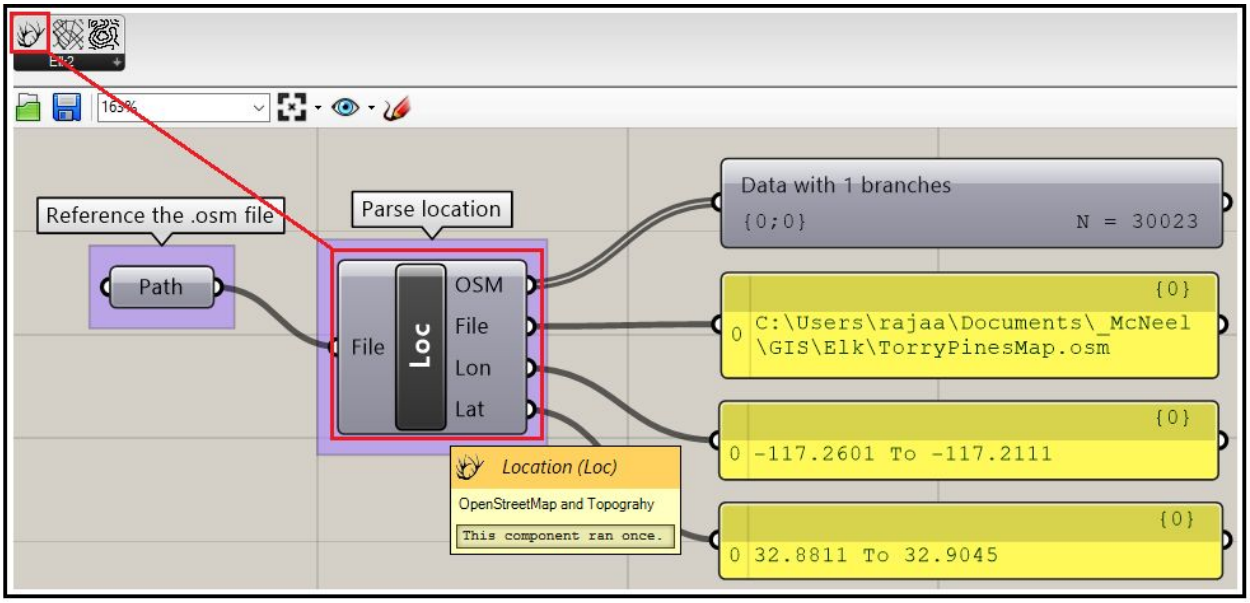
Click ***Export*** to view the exact latitude and longitude of the area visible on the screen. You can specify a region within your map by clicking on and directly editing the lat/long numbers or by clicking on ***Manually select a different area*** to window select the area of interest.



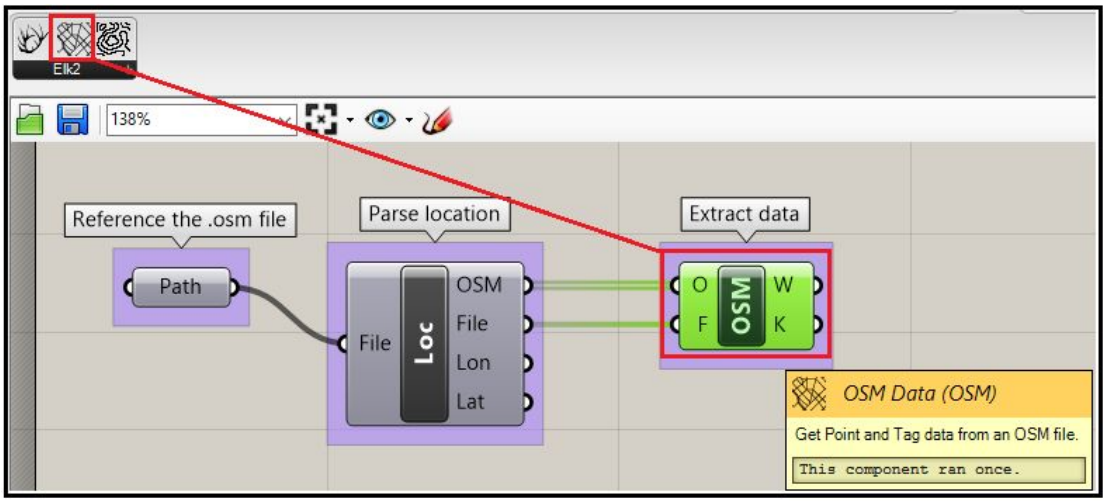
Once you select a region or exact coordinates, you can click ***Export*** to download the ***maps.osm*** file which is the file that ***Elk*** uses.



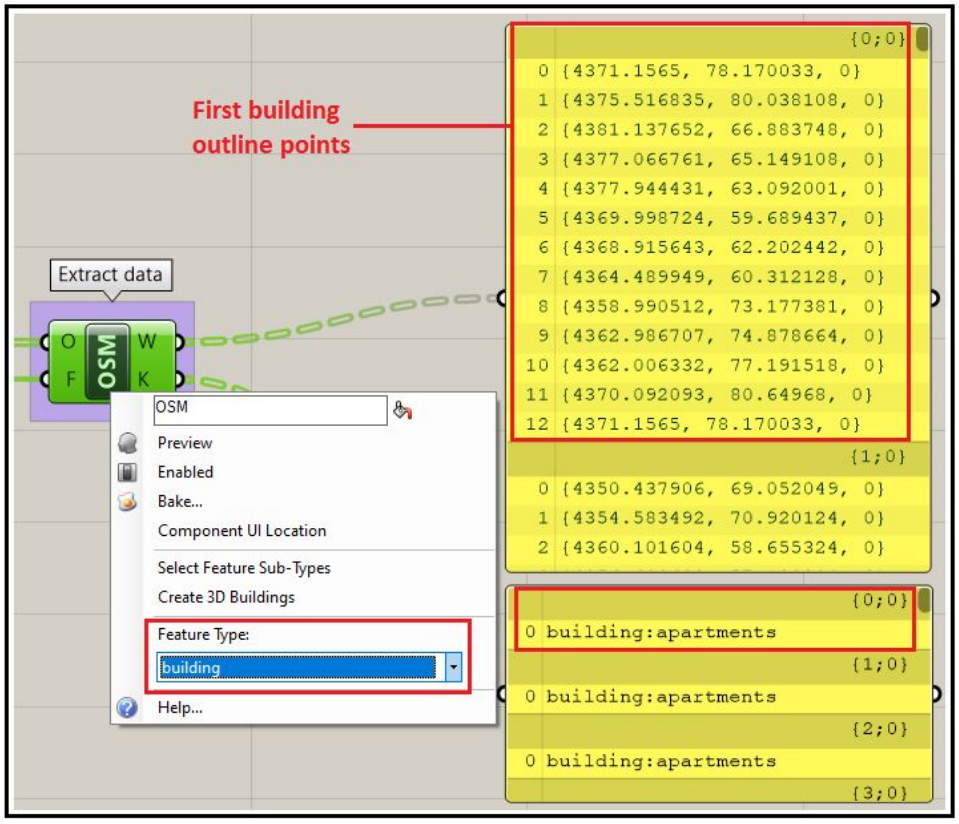
Using Elk in Grasshopper, the ***Location*** component helps import the ***osm*** data. The input in the osm file path and the output include the latitude and longitude and the osm-points which are 3D points with an osm defined IDs.



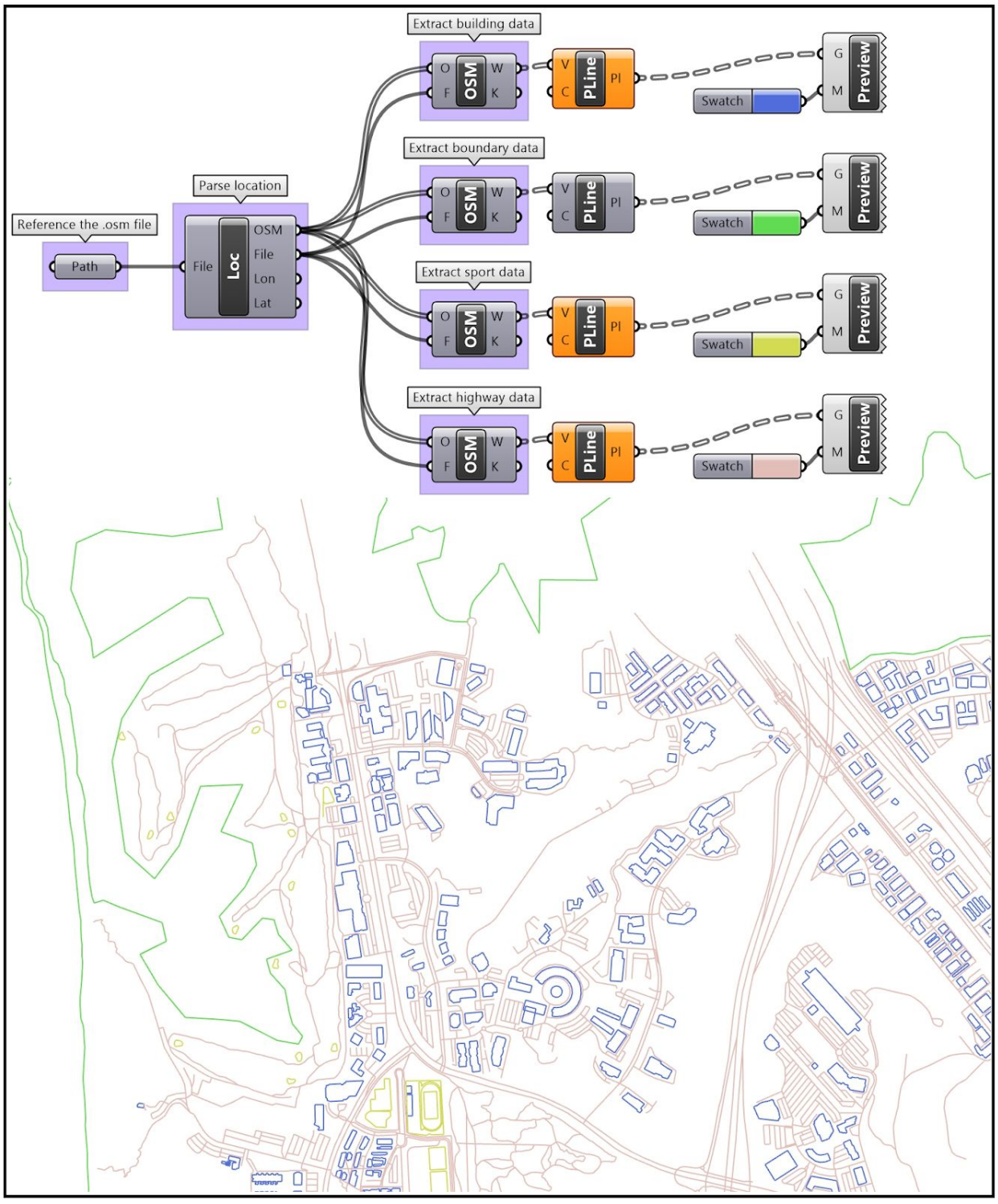
Next, you need The ***OSMData*** component to start organizing and collecting the data from the ***OSM*** file. It takes the ***OSM*** and ***File*** as inputs from the ***Location*** component and outputs one specified feature in the component itself.



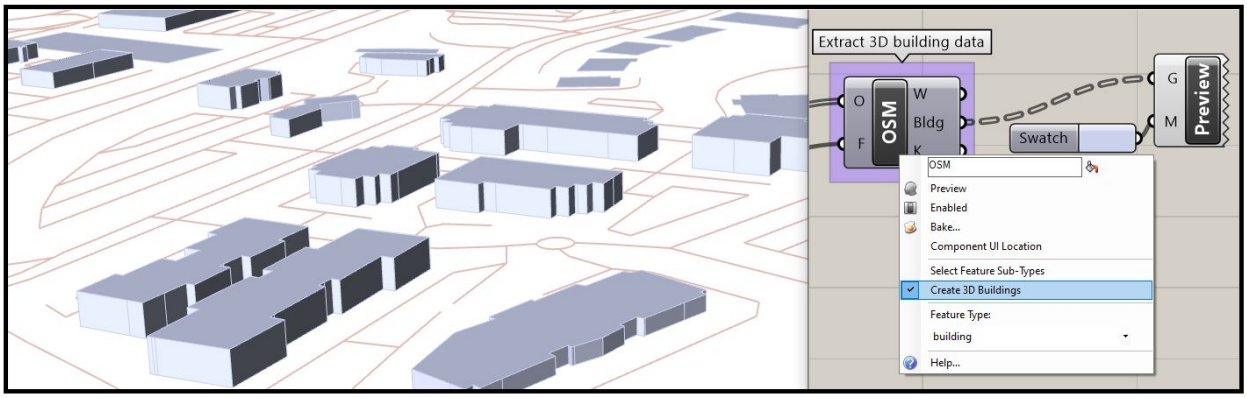
The feature type is set Building by default, and it outputs all building types. The first output includes the post set that represents the outline of the building and the second is a list of information about each building. It can include only a description, but sometimes it also includes other information such as the building type, source of information and height, but that varies among different buildings in the list.



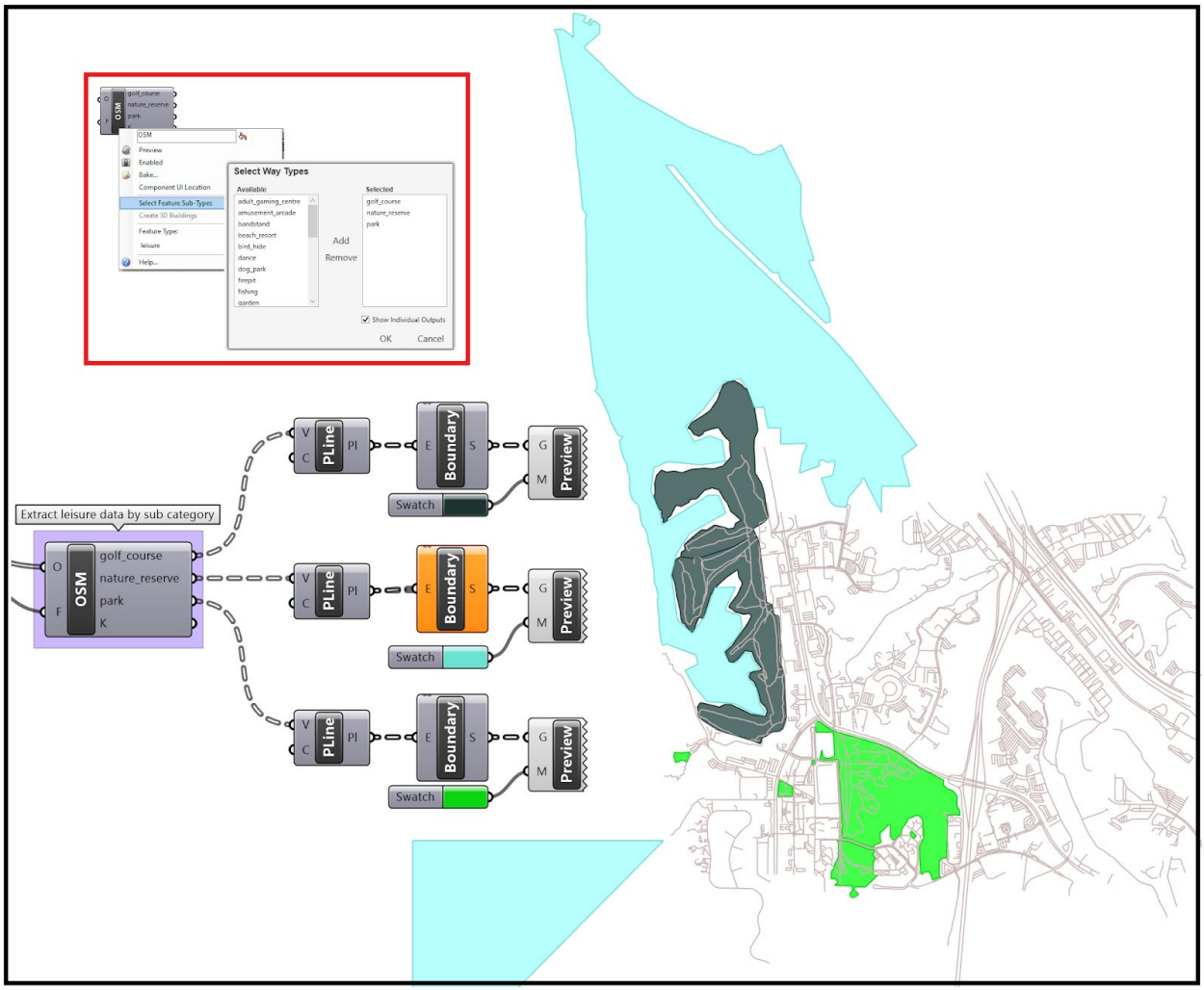
You can use multiple ***Elk OSM*** components and set to different features. You can also use the ***GH PLine*** component to connect the points of each output. Sometimes the output consists of one point and the ***PLine*** component might give a warning in that case, but that does not affect the output for the rest of the list.



The OSM component is highly customizable and offers different output options based on what ***Feature Type*** it is set to through the component menu. For example, if the ***Feature Type*** is set to ***buildings***, then you can add an output for the 3D building geometry. Notice that not all buildings come with height information and hence some remain flat.



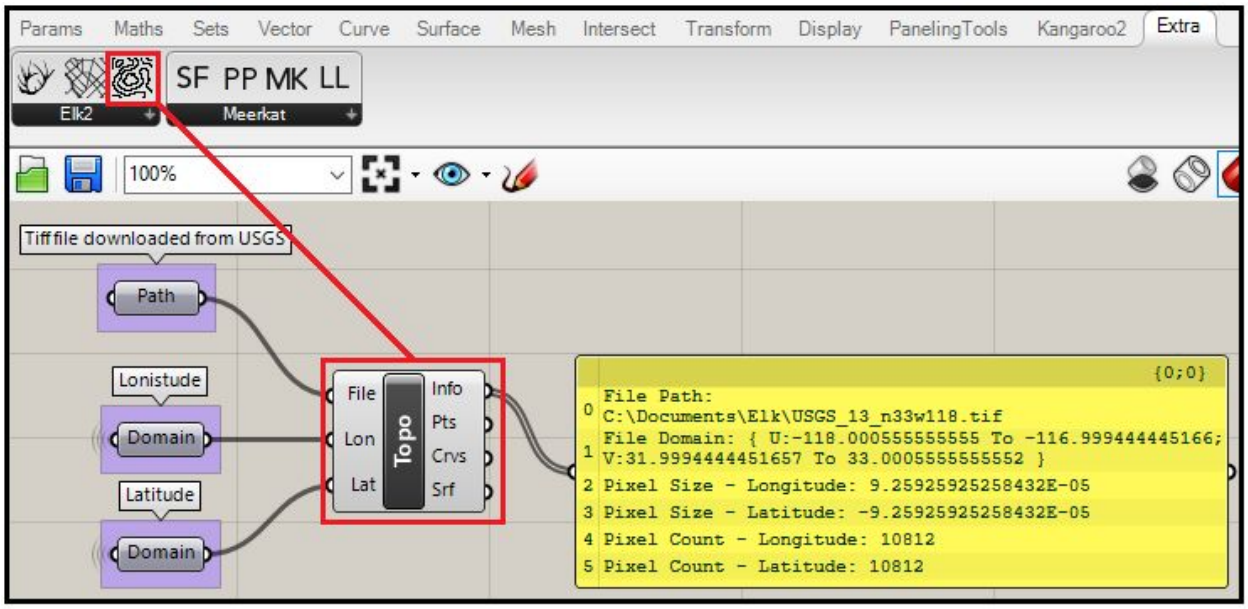
The OSM component allows setting a ***Sub-Types*** for any given ***Feature Type***. For example, the feature type ***building*** includes ***sub-types*** such as ***commercial*** and ***residential***. In the following example, we extract golf courses, nature reserves and parks from the ***leisure*** feature type then color-code them.



The third major component in ***Elk*** is the topography component (***Topo***) that uses data from multiple sources using three file formats. The first is from the ***United States Geological Survey*** (USGS) which uses ***.img*** file format. The second is related to image files and is called ***GeoTiff*** with data accessed

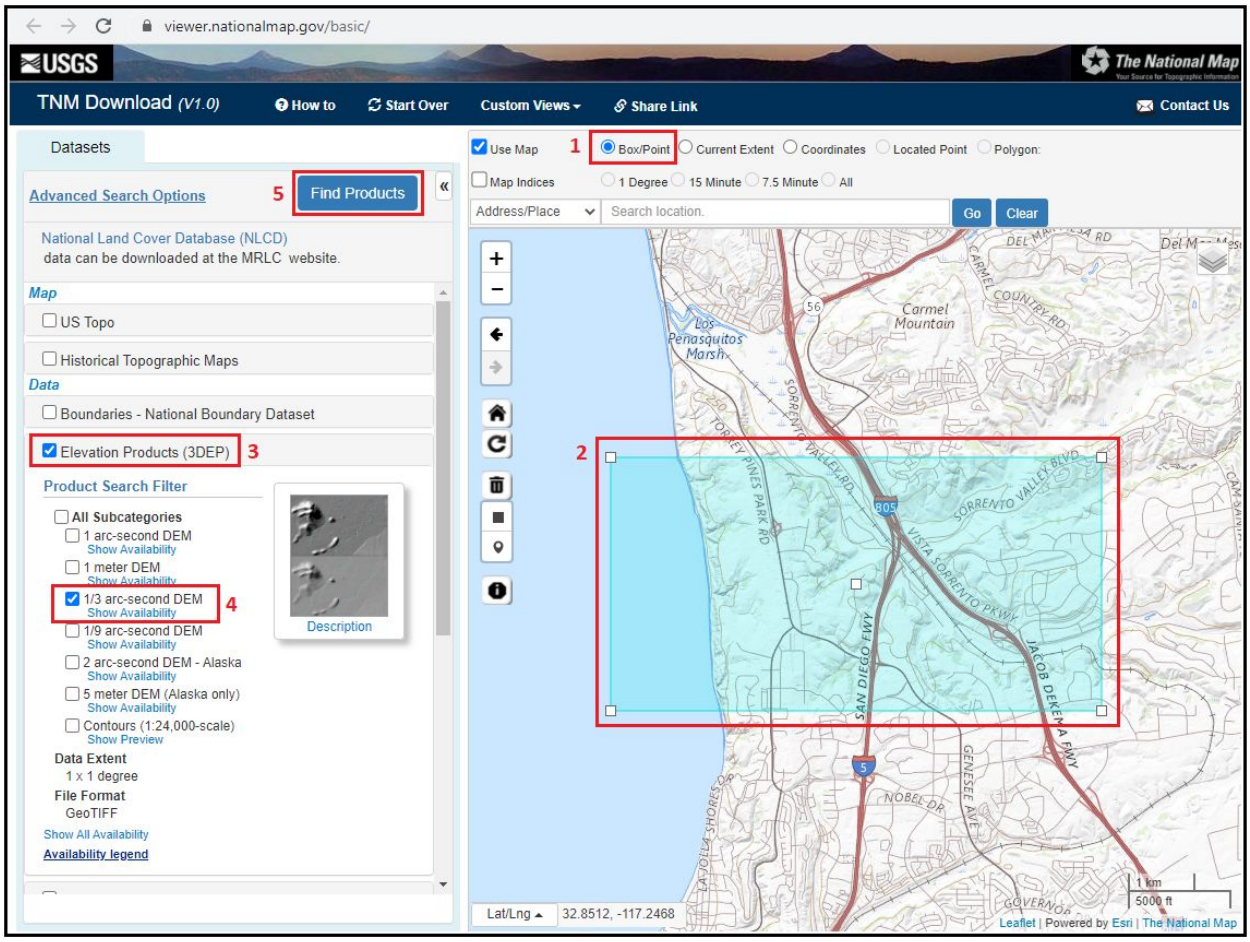
from ***USGS Earth Explorer***. Last, you can use digital elevation models from the ***Shuttle Radar Topography Mission*** (SRTM) where most of the earth was scanned for elevation and packaged in 1°x1° tiles that you can get from and the file format is ***.hgt***. This is where the topology files is found:

1. ***IMG*** and ***GroTiff*** Inside the ***USA*** Only: https://viewer.nationalmap.gov/basic/
2. ***Global IMG*** and ***GroTiff*** data: https://earthexplorer.usgs.gov/
3. **HGT** files**:** https://www2.jpl.nasa.gov/srtm/

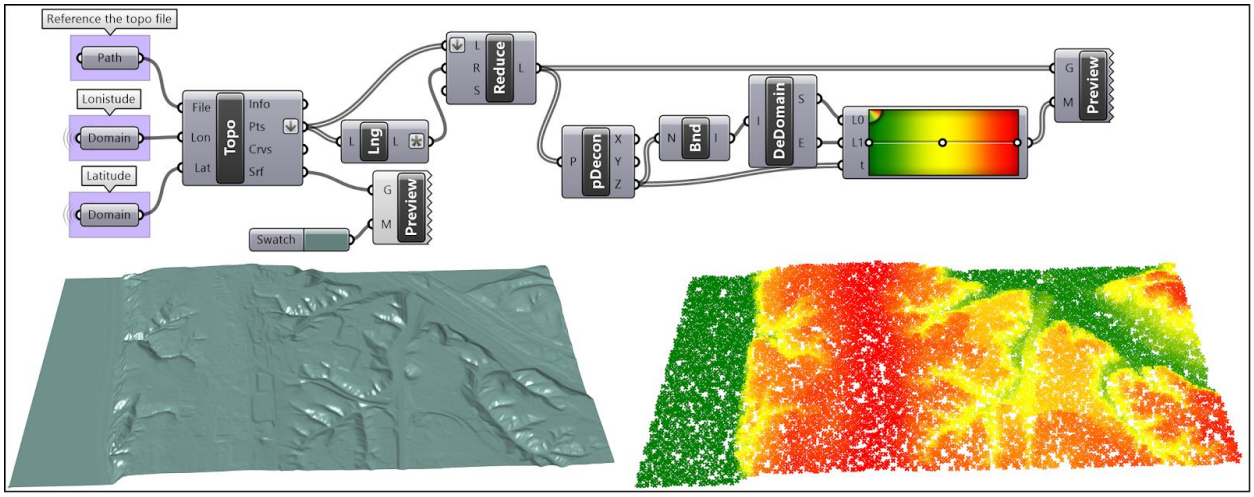


The first step is to get the ***Tiff*** or ***IMG*** file for the ***Torrey Pines*** region in ***San Diego*** from the USGS website. This offers the best resolution images. Zoom to the desired area and follow the steps in the image below. Note that you might need to create an account to login and get the desired maps.

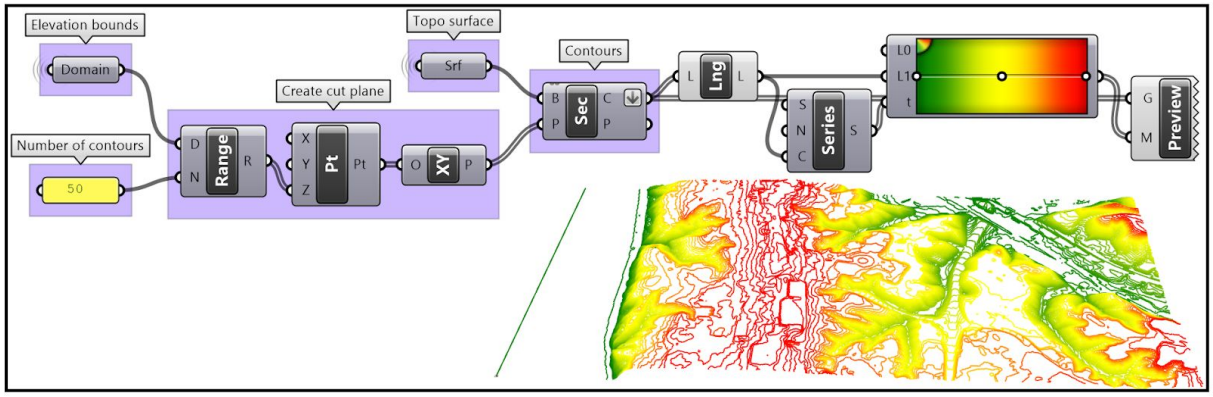
1. Set to Box/Point located in the area above the map
2. Window select the area of interest on the map
3. Select "Elevation Products
4. Select ⅓ arc-second DEM
5. Click ***Find Products***



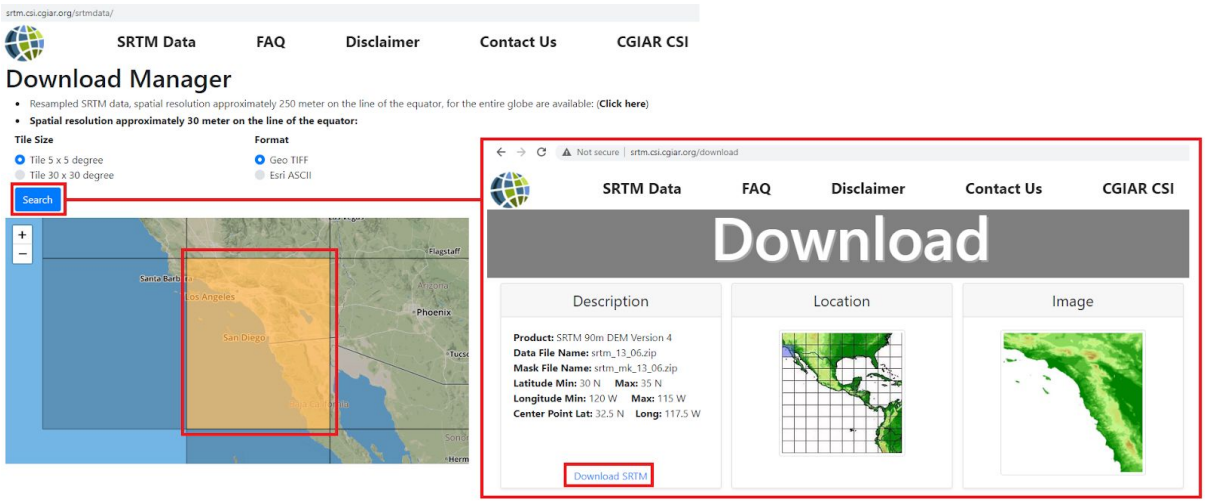
The ***Elk*** topology component outputs 3 data types: **Points, Curves** and a **surface**.
The surface output is the one that is useful to use.You can also color points by z elevation of points to get a quick overview of the topology but make sure to check the size of pointset and reduce if necessary to manage processing time.



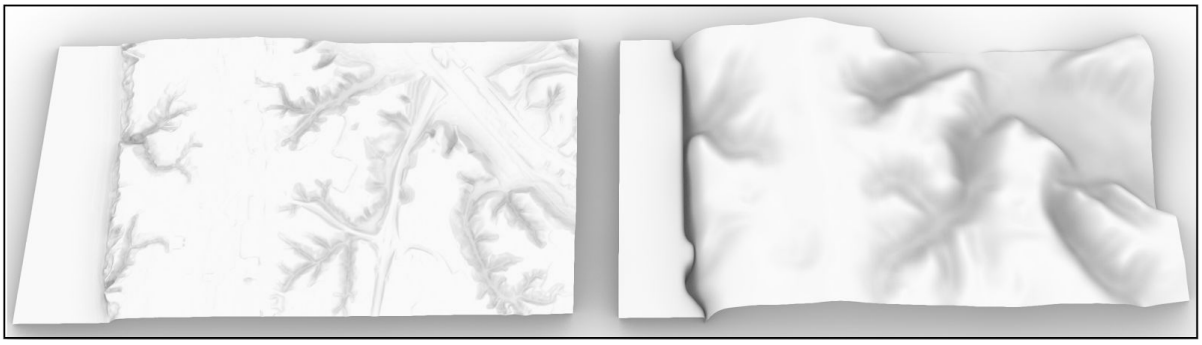
The curves do not represent contours and are generally not useful to use. You can however extract the topography from the surface and the minimum and maximum z elevation from points as in the following.



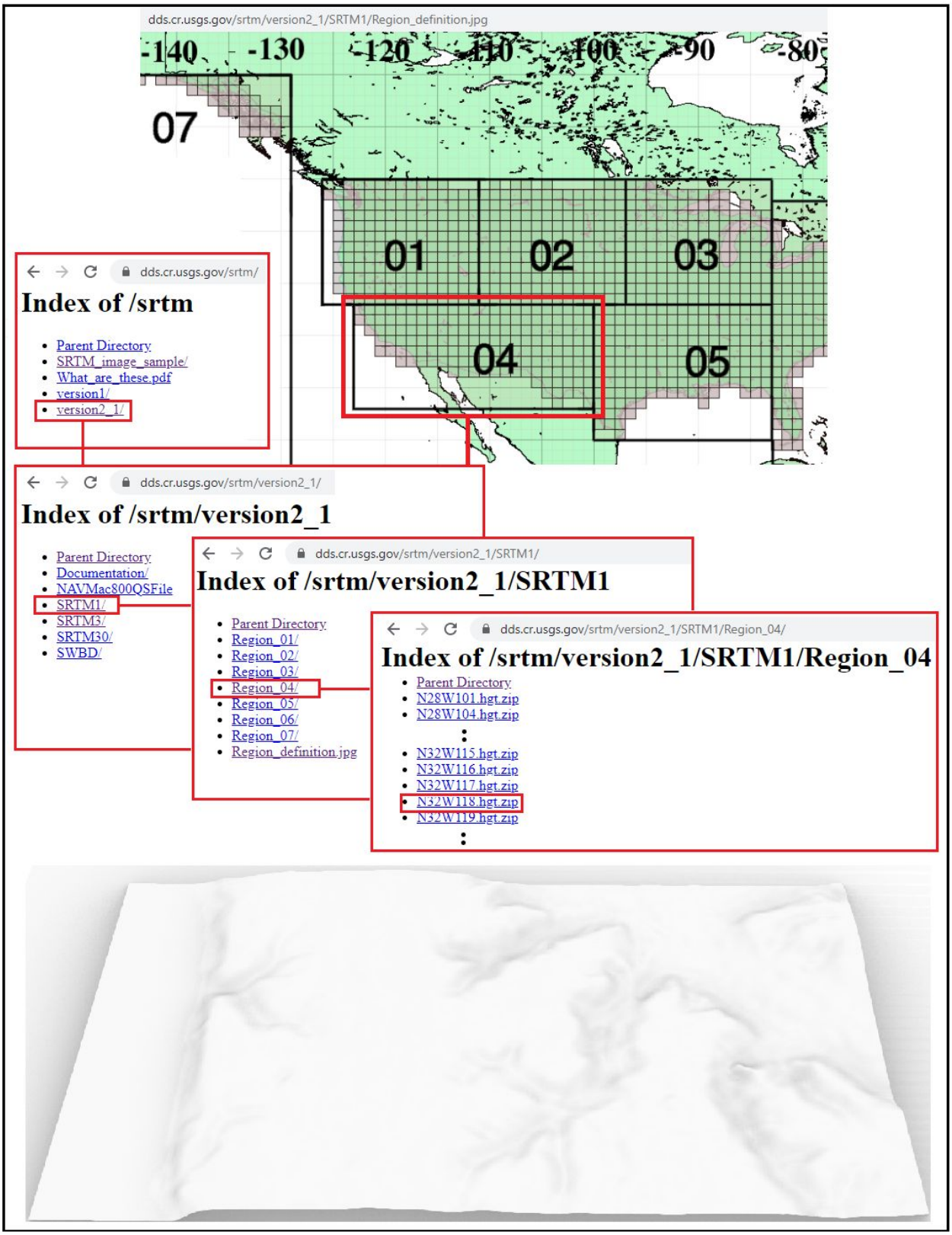
You can get the ***TIFF*** file from the ***SRTM*** site:



The images acquired from the ***NASA Shuttle Radar Topography Mission*** digital topographic have lower resolution than the one available from ***USGS***. This shows a comparison between the two. The left is the topo surface from the tiff file downloaded from ***USGS*** and the image on the right shows the result from the file downloaded from ***SRTM***. For some applications this might be sufficient, but if you need the topography for a smaller site, then you will need to pay attention to resolution.



Elk topography accepts ***HGT*** files.


dds.cr.usgs.gov/srtm/version2_1/SRTM1/Region_definition.jpg
-140
-130
-120
-110
-100
-90
-80
07
01
02
03
04
05
dds.cr.usgs.gov/srtm/
Index of /srtm
Parent Directory
SRTM_image_sample/
What_are_these.pdf
version1/
version2_1/
dds.cr.usgs.gov/srtm/version2_1/
Index of /srtm/version2_1
Parent Directory
Documentation/
NAVMac800QSFile
SRTM1/
SRTM3/
SRTM30/
SWBD/
dds.cr.usgs.gov/srtm/version2_1/SRTM1/
Index of /srtm/version2_1/SRTM1
Parent Directory
Region_01/
Region_02/
Region_03/
Region_04/
Region_05/
Region_06/
Region_07/
Region_definition.jpg
dds.cr.usgs.gov/srtm/version2_1/SRTM1/Region_04/
Index of /srtm/version2_1/SRTM1/Region_04
Parent Directory
N28W101.hgt.zip
N28W104.hgt.zip
N32W115.hgt.zip
N32W116.hgt.zip
N32W117.hgt.zip
N32W118.hgt.zip
N32W119.hgt.zip