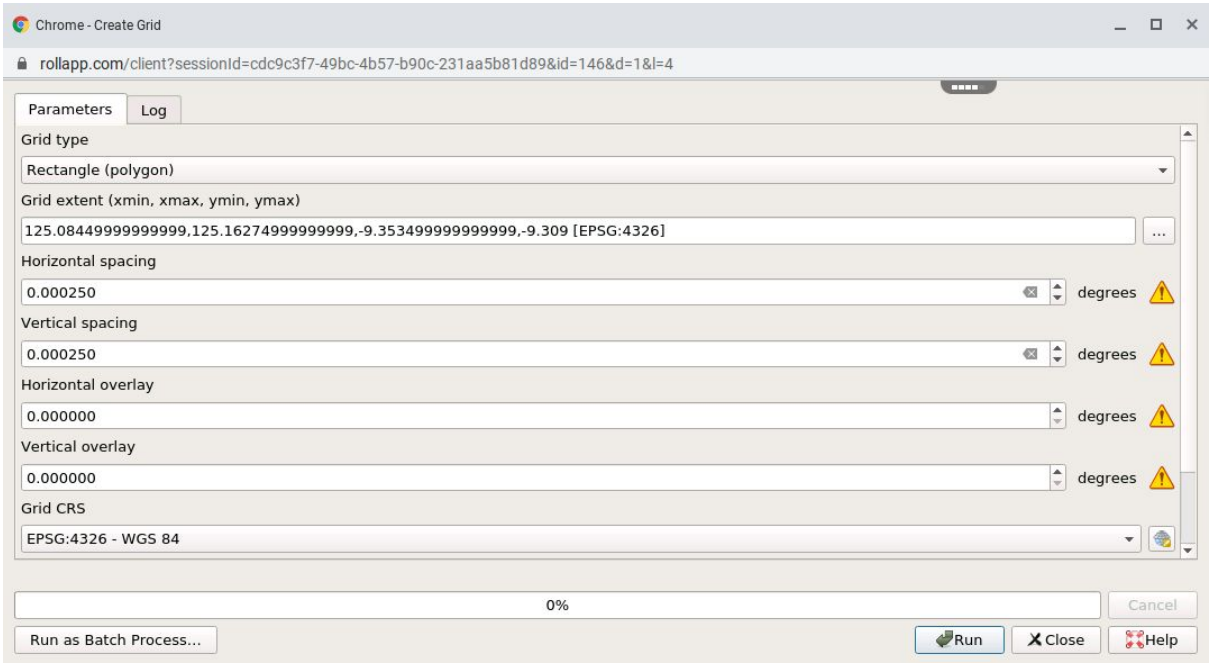
How to Develop Wildfire Maps

1. Develop an approach to estimate the size and location of the fires. This example will assume that a random location of 10% will burn down every 5 years.

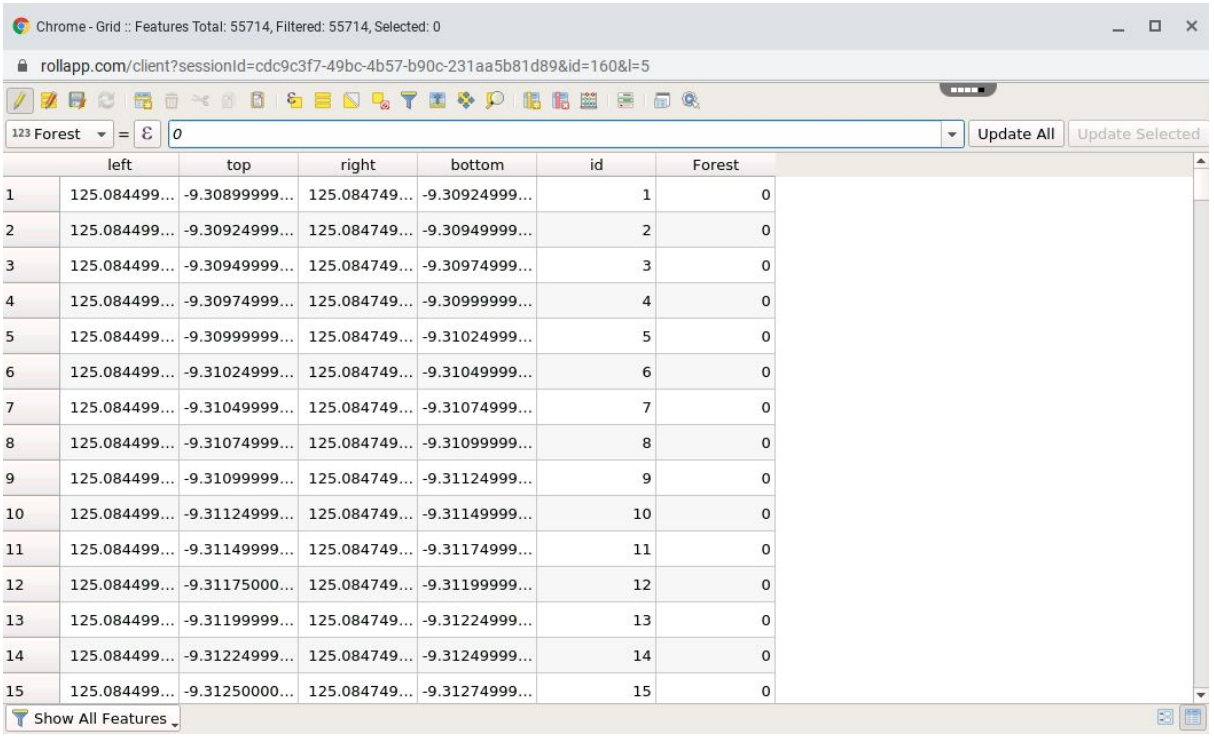
2. Load the latest historical observation called year_clip.TIF

1. Click Processing > Toolbox > Vector Creation > Create Grid



   a. Create a vector grid
   b. Ensure at least one map of the area is uploaded onto the workspace (like 2018 East Timor forest cover)
   c. Search and select “Create Grid” under “vector creation” toolbox
   d. Grid type = Polygon
   e. Grid extent = “use layer extent” and select the forest cover 2018 map
   f. Horizontal spacing and vertical spacing are pixel size: i.e. 0.00025
   g. Horizontal and Vertical Overlay = 0.000000
   h. Grid CRS = Should automatically select same projection as the layer you chose for extent (should be EPSG:4326 – WGS 84)
   i. Grid = >save as a file

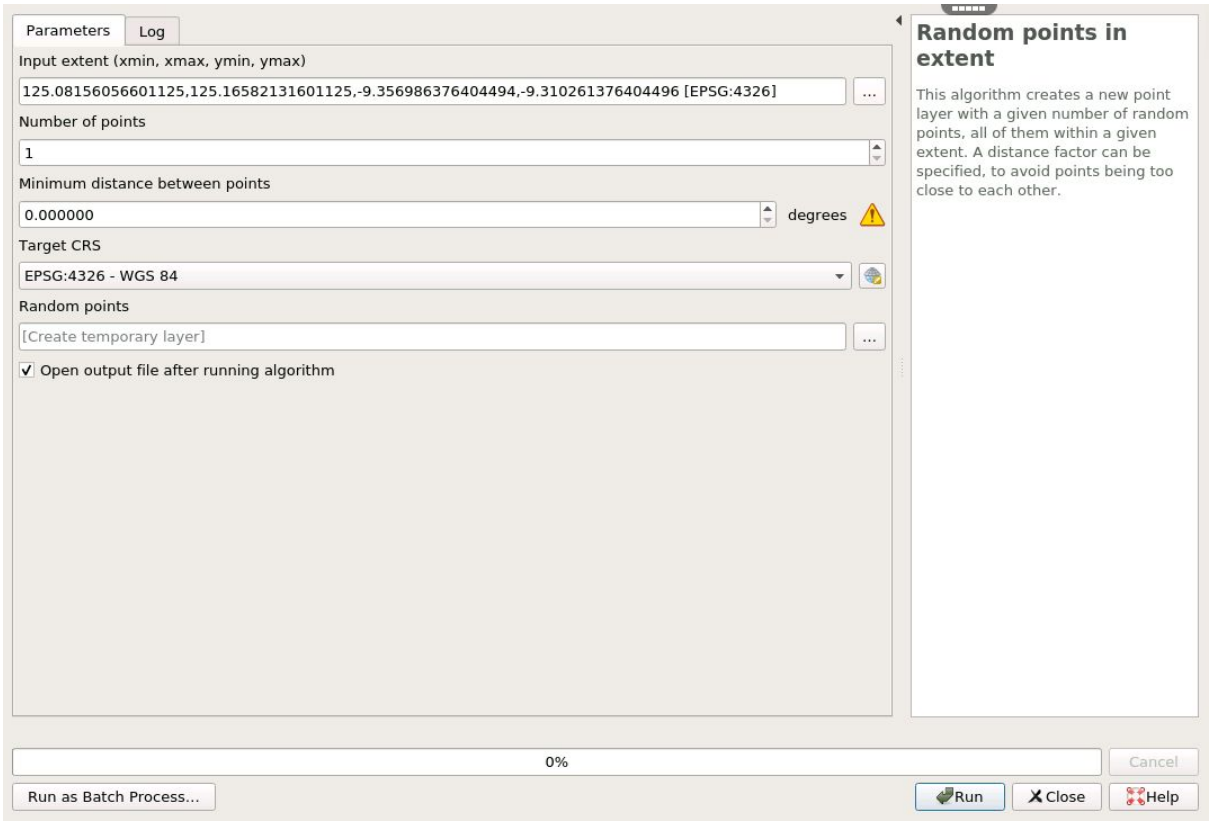
2. Create a Forest feature in the grid



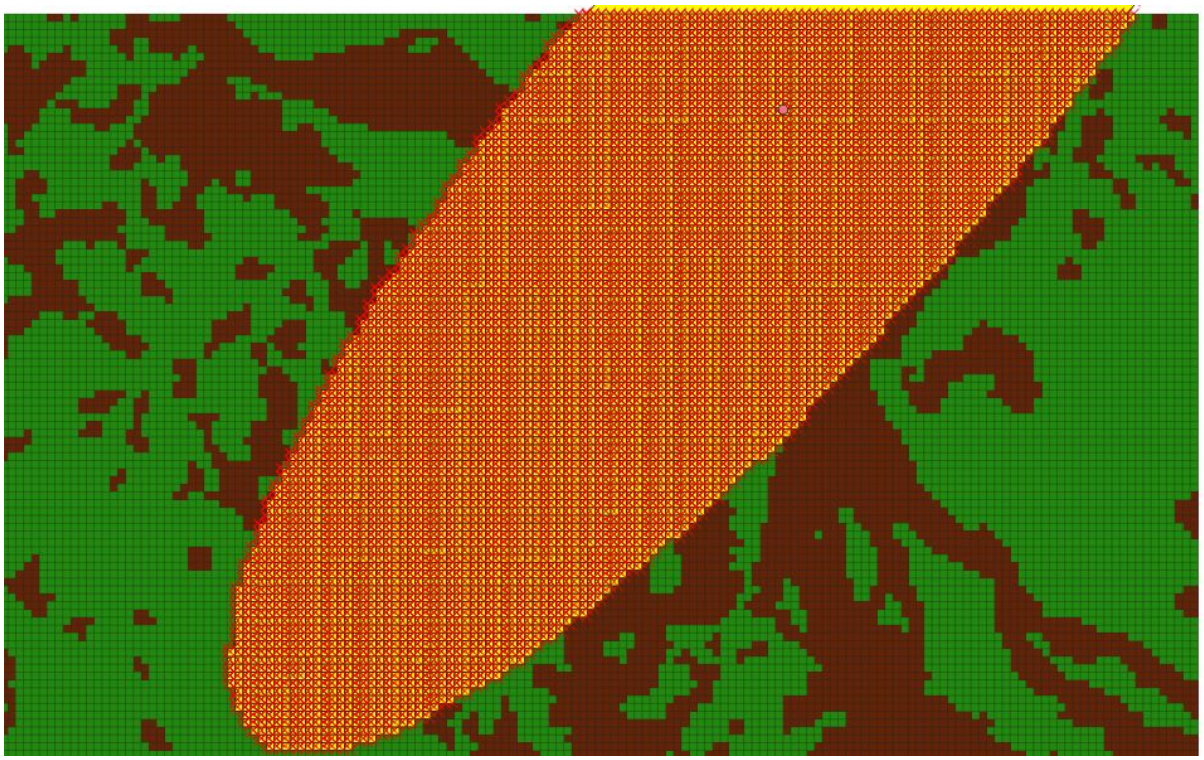
	left	top	right	bottom	id	Forest
1	125.084499...	-9.30899999...	125.084749...	-9.30924999...	1	0
2	125.084499...	-9.30924999...	125.084749...	-9.30949999...	2	0
3	125.084499...	-9.30949999...	125.084749...	-9.30974999...	3	0
4	125.084499...	-9.30974999...	125.084749...	-9.30999999...	4	0
5	125.084499...	-9.30999999...	125.084749...	-9.31024999...	5	0
6	125.084499...	-9.31024999...	125.084749...	-9.31049999...	6	0
7	125.084499...	-9.31049999...	125.084749...	-9.31074999...	7	0
8	125.084499...	-9.31074999...	125.084749...	-9.31099999...	8	0
9	125.084499...	-9.31099999...	125.084749...	-9.31124999...	9	0
10	125.084499...	-9.31124999...	125.084749...	-9.31149999...	10	0
11	125.084499...	-9.31149999...	125.084749...	-9.31174999...	11	0
12	125.084499...	-9.31175000...	125.084749...	-9.31199999...	12	0
13	125.084499...	-9.31199999...	125.084749...	-9.31224999...	13	0
14	125.084499...	-9.31224999...	125.084749...	-9.31249999...	14	0
15	125.084499...	-9.31250000...	125.084749...	-9.31274999...	15	0

a. Right click the new grid in navigation bar on left > open attribute table
b. Toggle editing (click on pencil in corner)
c. Select “create field”
d. Name = Forest
e. Type = Whole number (integer) (and wait for it to load)
f. Type 0 into the expression area and “Update All” > This will make the whole grid = 0
g. Click edit button (little pencil) and save changes
h. Exit attribute table

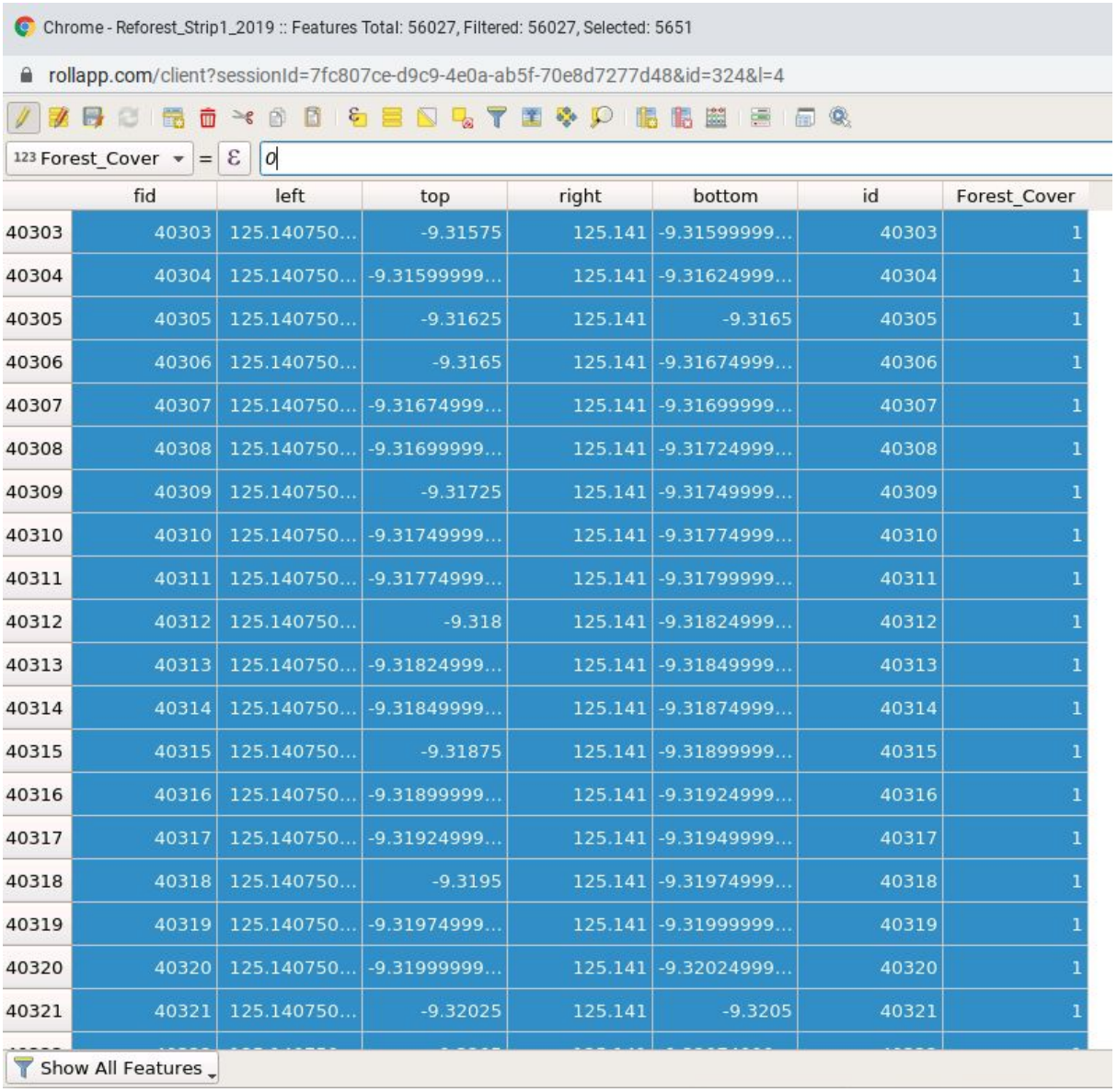
3. Select a random point. There are two options. QGIS can be used to select a random point in the project area. The coordinates of this point need to be entered into the spreadsheet to select the random angle for the ellipse. (See point 11 below for an alternative approach to the selection of a Random Point using QGIS.)



4. Select an ellipse with the size of the projected fire: i.e. about 5571 pixels. It is not possible to select exactly 5571. If the ellipse goes outside the project area continue to enlarge the ellipse until approximately 5571 pixels fall inside the project area. The easiest is to use “Add Ellipse from center and two points” which allows to set the angle of the ellipse. Try to approximate the angle randomly generated in the spreadsheet. The angle will only have a tiny influence on the resulting emission estimations (due to slightly different historical deforested areas.)

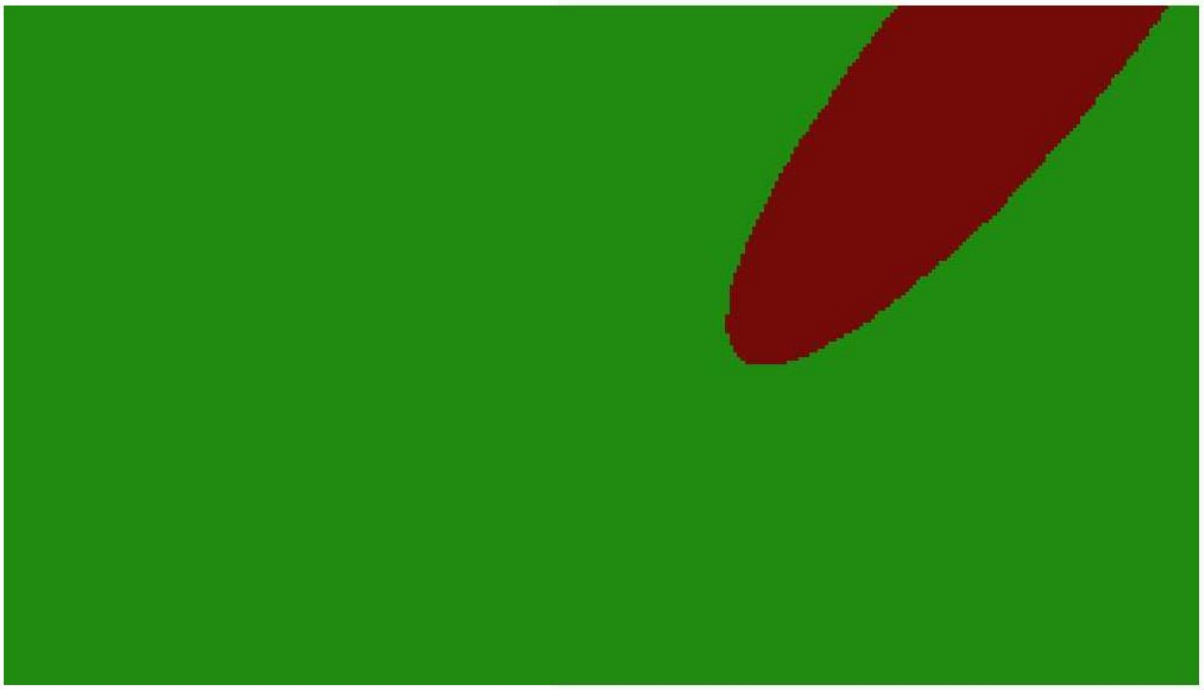


5. Turn the pixels inside the ellipse to no-forest: Open the Attributes Table of the Vector Grid. Toggle to editing mode. Select the Forest_Cover field and enter 0 (zero) in the Expression Field. Click “Update Selected”.

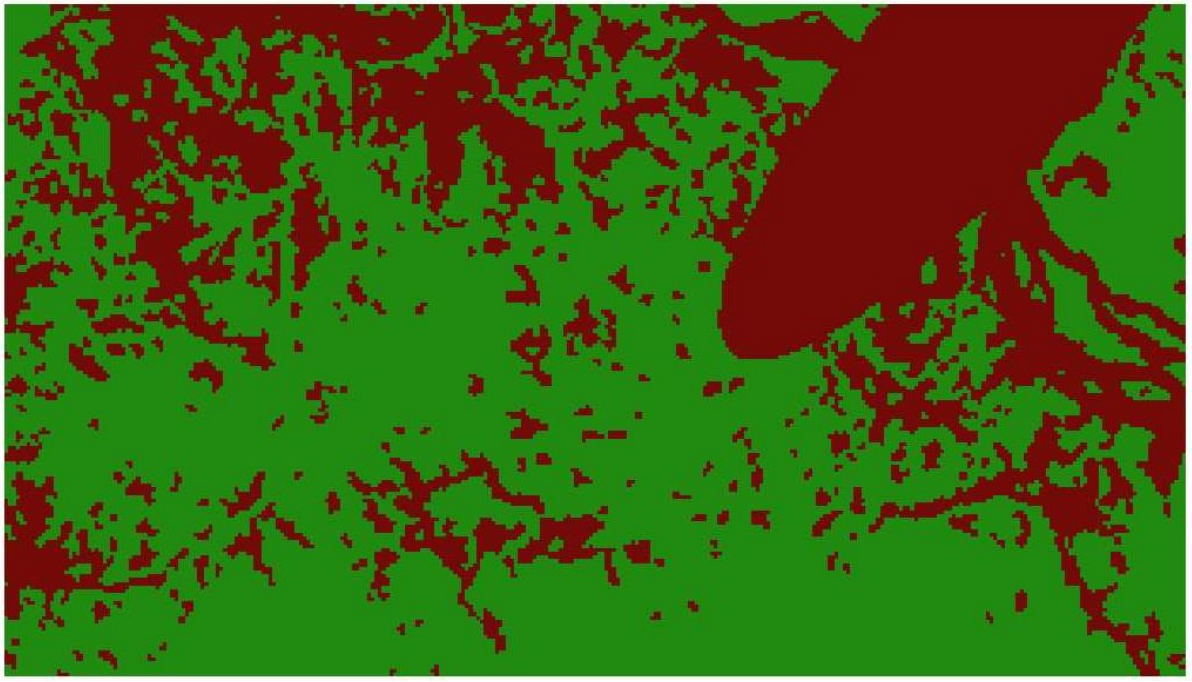


	fid	left	top	right	bottom	id	Forest_Cover
40303	40303	125.140750...	-9.31575	125.141	-9.31599999...	40303	1
40304	40304	125.140750...	-9.31599999...	125.141	-9.31624999...	40304	1
40305	40305	125.140750...	-9.31625	125.141	-9.3165	40305	1
40306	40306	125.140750...	-9.3165	125.141	-9.31674999...	40306	1
40307	40307	125.140750...	-9.31674999...	125.141	-9.31699999...	40307	1
40308	40308	125.140750...	-9.31699999...	125.141	-9.31724999...	40308	1
40309	40309	125.140750...	-9.31725	125.141	-9.31749999...	40309	1
40310	40310	125.140750...	-9.31749999...	125.141	-9.31774999...	40310	1
40311	40311	125.140750...	-9.31774999...	125.141	-9.31799999...	40311	1
40312	40312	125.140750...	-9.318	125.141	-9.31824999...	40312	1
40313	40313	125.140750...	-9.31824999...	125.141	-9.31849999...	40313	1
40314	40314	125.140750...	-9.31849999...	125.141	-9.31874999...	40314	1
40315	40315	125.140750...	-9.31875	125.141	-9.31899999...	40315	1
40316	40316	125.140750...	-9.31899999...	125.141	-9.31924999...	40316	1
40317	40317	125.140750...	-9.31924999...	125.141	-9.31949999...	40317	1
40318	40318	125.140750...	-9.3195	125.141	-9.31974999...	40318	1
40319	40319	125.140750...	-9.31974999...	125.141	-9.31999999...	40319	1
40320	40320	125.140750...	-9.31999999...	125.141	-9.32024999...	40320	1
40321	40321	125.140750...	-9.32025	125.141	-9.3205	40321	1

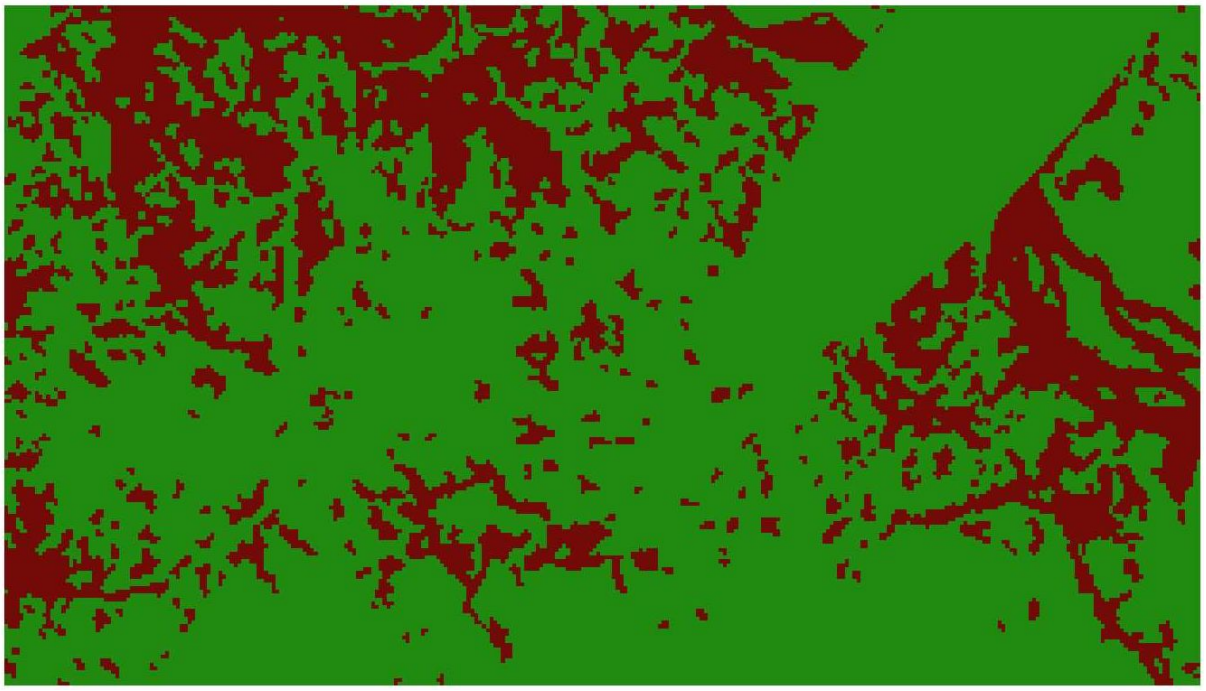
6. Rasterize the Burned Area: Transfer Vector Grid to TIFF Raster by selecting Toolbar>Raster>Conversion>Rasterize. Use the following settings:
    a. Input layer = your grid
    b. Field to use as burn in value = Forest (or Forest_Cover or whatever you named the reforested area.)
    c. Use fixed value to burn = click delete and “Not Set” should appear as the value
    d. Raster size units = georeferenced units
    e. Resolution is same pixel size i.e. 0.00025
    f. Output extent is the same as original TIFF map e.g. 2018_clip.tif
    g. Nodata value should be “Not Set”
    h. Click Run



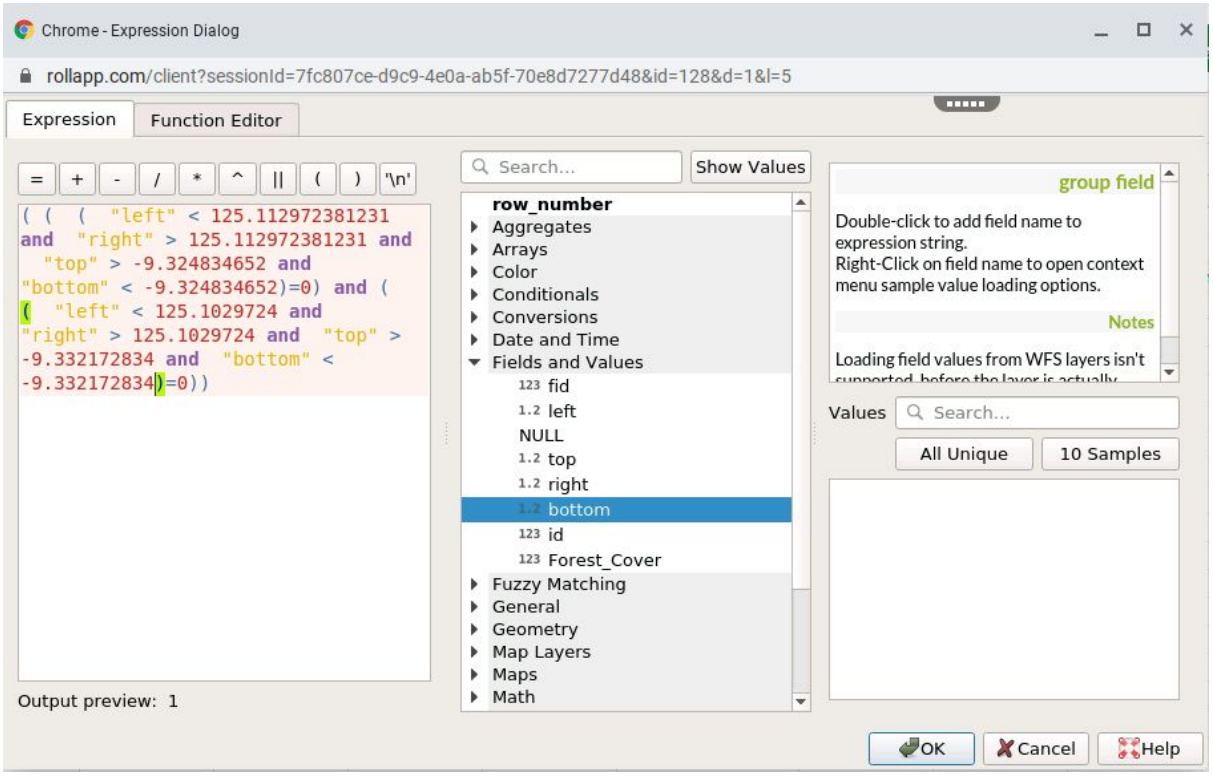
7. Combine Burned-Area-Raster with Raster of Existing situation, i.e. 2018_clip.tif: Select the Raster > Raster Calculator. Precise settings are mentioned in second cycle below. Save as forest fire of 2020.



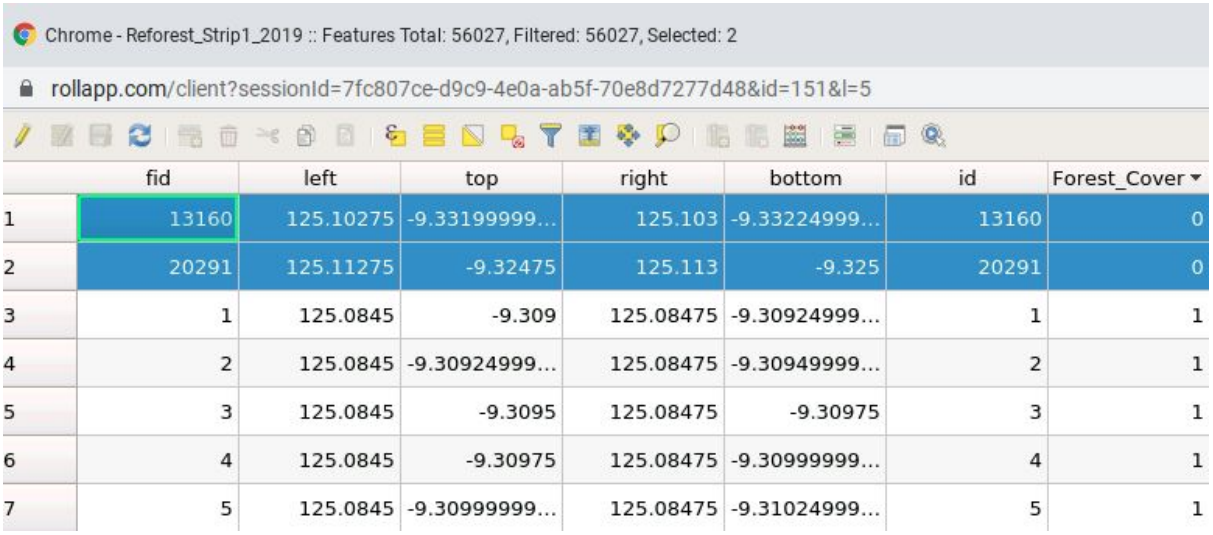
8. Turn the Burned-Area back to forest for the next year: i.e. 2021: Select the Raster > Raster Calculator. Precise settings are mentioned in second cycle below. Save as forest fire recovery of 2021.



9. This same map will be used for the next 4 years, i.e. 2021 until 2024.
10. In 2025, a new area of 10% will burn down so the same approach will be applied but using the 2021 map as the basis.
11. Below a different approach is demonstrated as the one selecting a random point in QGIS.
12. The spreadsheet can be used to generate the center of the ellipse and the angle randomly. Select the two points (generated randomly in the spreadsheet) by using the following formula in the expression dialogue of the attributes table. Since the Forest_Cover feature in the vector-grid is completely turned to value 1, we will use a formula to turn the values of the two randomly selected points to zero. The following formula can be used: If both are 0 (zero) i.e. not true, neither of the two points is in the cell concerned, so the value can remain 1. So enter the following in the Expression Field:
    a. For the coordinates of the first point: (“Left” < longitude and “Right” > longitude and “Top” > latitude and “Bottom” < latitude) = 0
    b. AND
    c. For the coordinates of the second point: (“Left” < longitude and “Right” > longitude and “Top” > latitude and “Bottom” < latitude) = 0

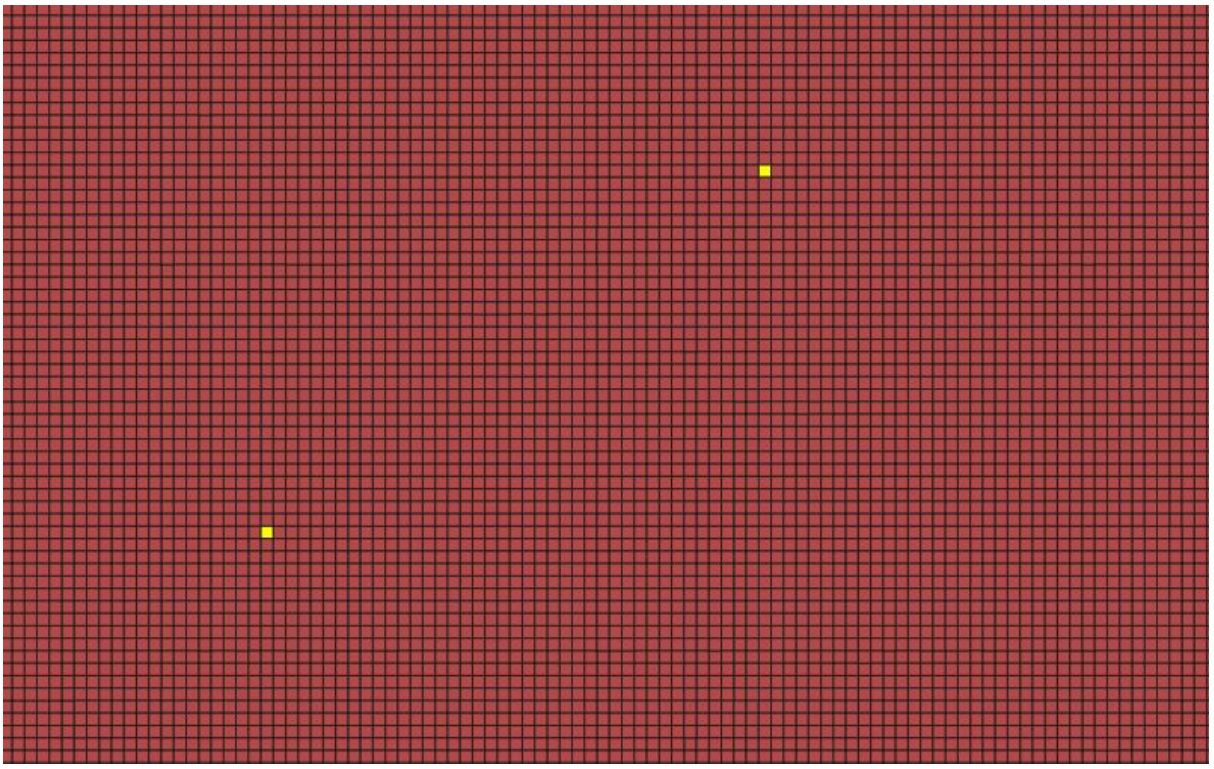


13. This will result in two pixels with a Forest_Cover value turned to 0 (zero). Sort the Attributes Table by ascending Forest_Cover value and select the two zero-value pixels.

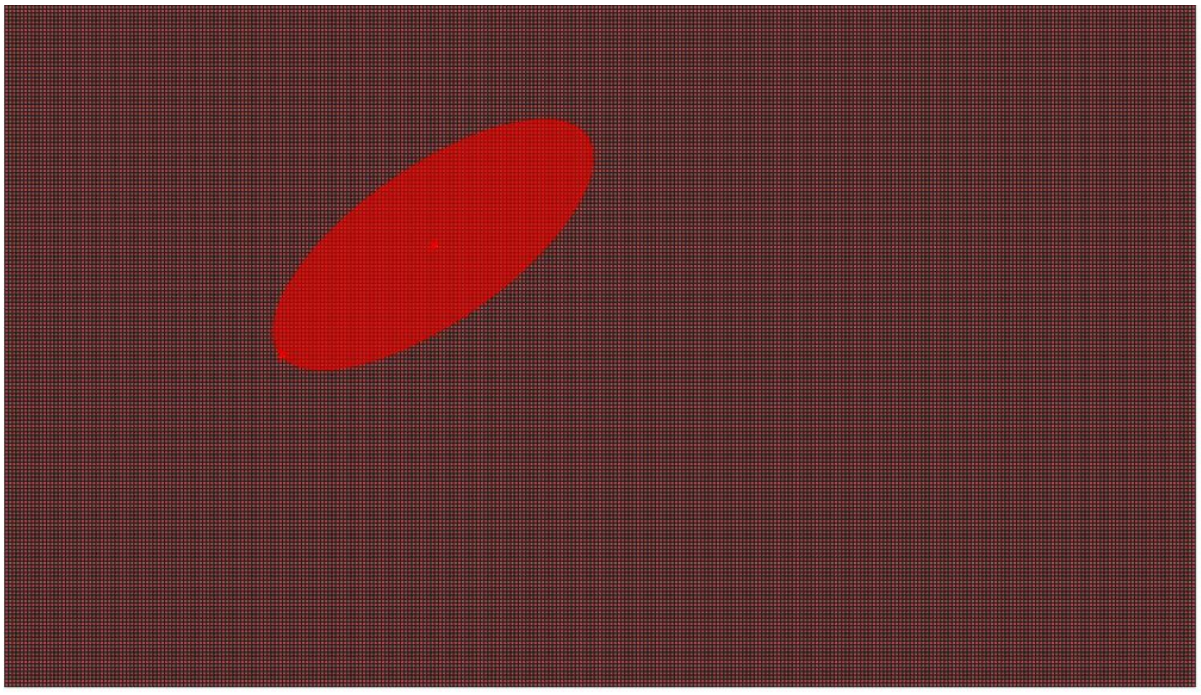


	fid	left	top	right	bottom	id	Forest_Cover
1	13160	125.10275	-9.33199999...	125.103	-9.33224999...	13160	0
2	20291	125.11275	-9.32475	125.113	-9.325	20291	0
3	1	125.0845	-9.309	125.08475	-9.30924999...	1	1
4	2	125.0845	-9.30924999...	125.08475	-9.30949999...	2	1
5	3	125.0845	-9.3095	125.08475	-9.30975	3	1
6	4	125.0845	-9.30975	125.08475	-9.30999999...	4	1
7	5	125.0845	-9.30999999...	125.08475	-9.31024999...	5	1

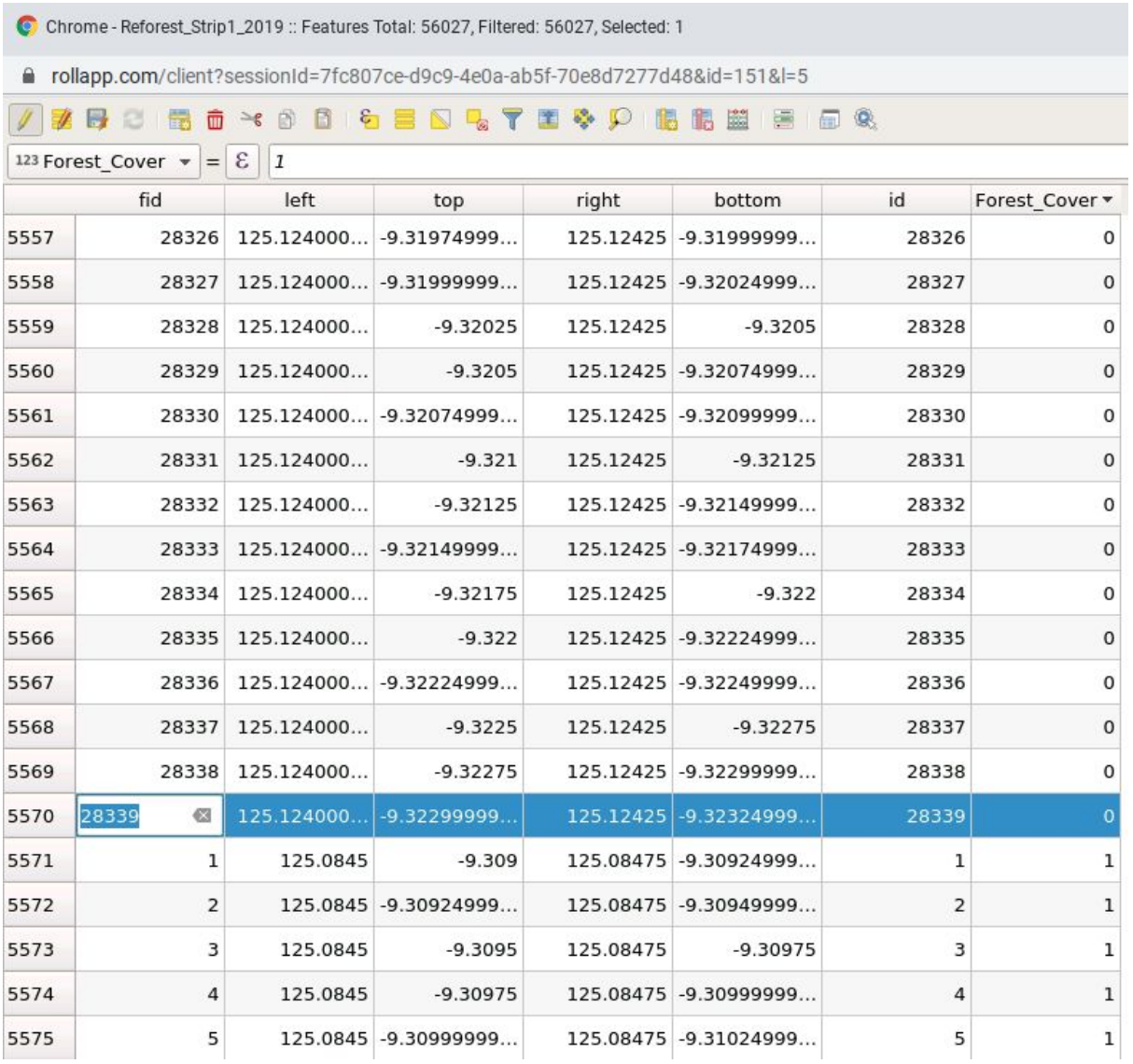
14. The selected pixels will be clearly visible on the vector-grid.



15. Draw an ellipse using the two points: the first as the center of the ellipse, the second as the angle.

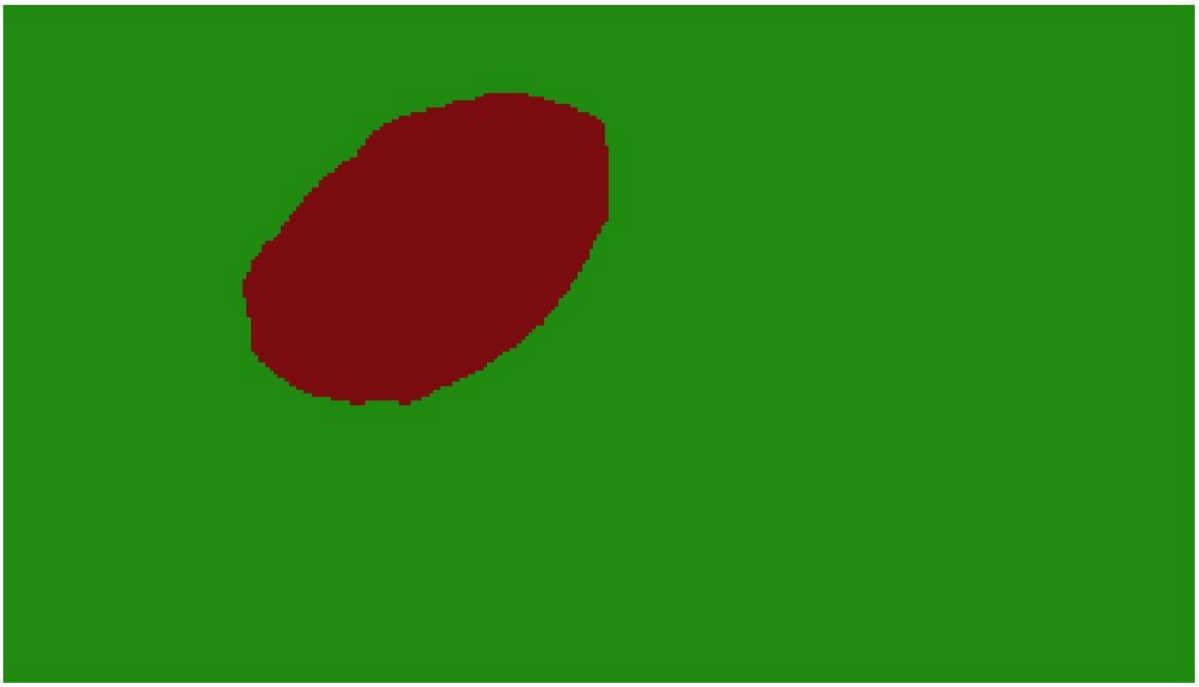


16. If necessary adjust the total number of selected pixels manually until approximately 5571 pixels are selected.

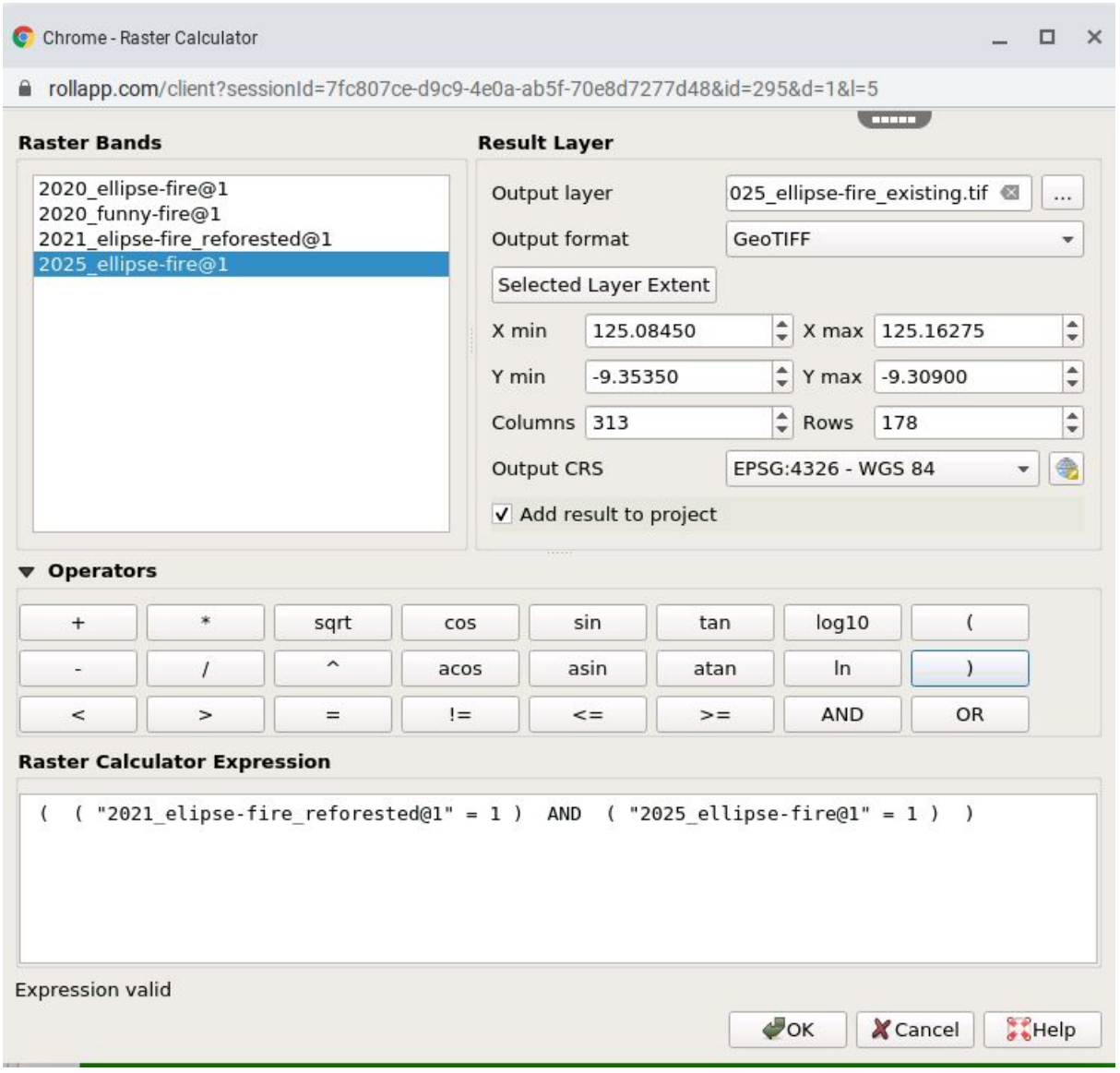


	fid	left	top	right	bottom	id	Forest_Cover
5557	28326	125.124000...	-9.31974999...	125.12425	-9.31999999...	28326	0
5558	28327	125.124000...	-9.31999999...	125.12425	-9.32024999...	28327	0
5559	28328	125.124000...	-9.32025	125.12425	-9.3205	28328	0
5560	28329	125.124000...	-9.3205	125.12425	-9.32074999...	28329	0
5561	28330	125.124000...	-9.32074999...	125.12425	-9.32099999...	28330	0
5562	28331	125.124000...	-9.321	125.12425	-9.32125	28331	0
5563	28332	125.124000...	-9.32125	125.12425	-9.32149999...	28332	0
5564	28333	125.124000...	-9.32149999...	125.12425	-9.32174999...	28333	0
5565	28334	125.124000...	-9.32175	125.12425	-9.322	28334	0
5566	28335	125.124000...	-9.322	125.12425	-9.32224999...	28335	0
5567	28336	125.124000...	-9.32224999...	125.12425	-9.32249999...	28336	0
5568	28337	125.124000...	-9.3225	125.12425	-9.32275	28337	0
5569	28338	125.124000...	-9.32275	125.12425	-9.32299999...	28338	0
5570	28339	125.124000...	-9.32299999...	125.12425	-9.32324999...	28339	0
5571	1	125.0845	-9.309	125.08475	-9.30924999...	1	1
5572	2	125.0845	-9.30924999...	125.08475	-9.30949999...	2	1
5573	3	125.0845	-9.3095	125.08475	-9.30975	3	1
5574	4	125.0845	-9.30975	125.08475	-9.30999999...	4	1
5575	5	125.0845	-9.30999999...	125.08475	-9.31024999...	5	1

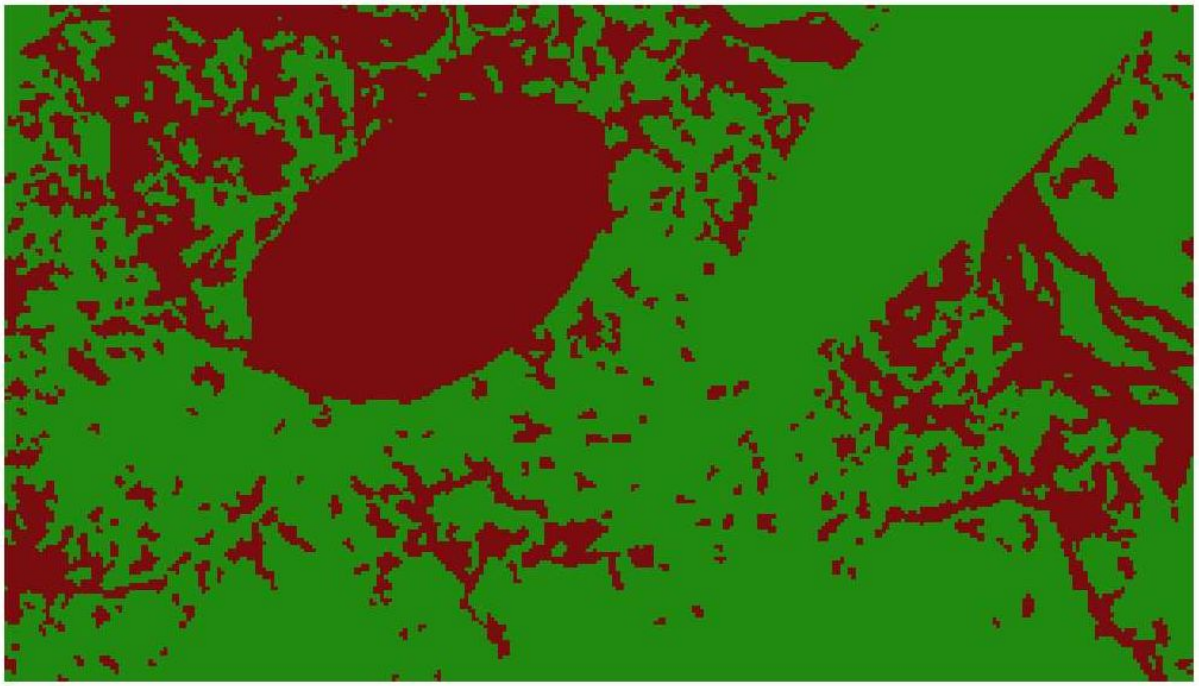
17. Rasterize the Burned-Area as explained above.



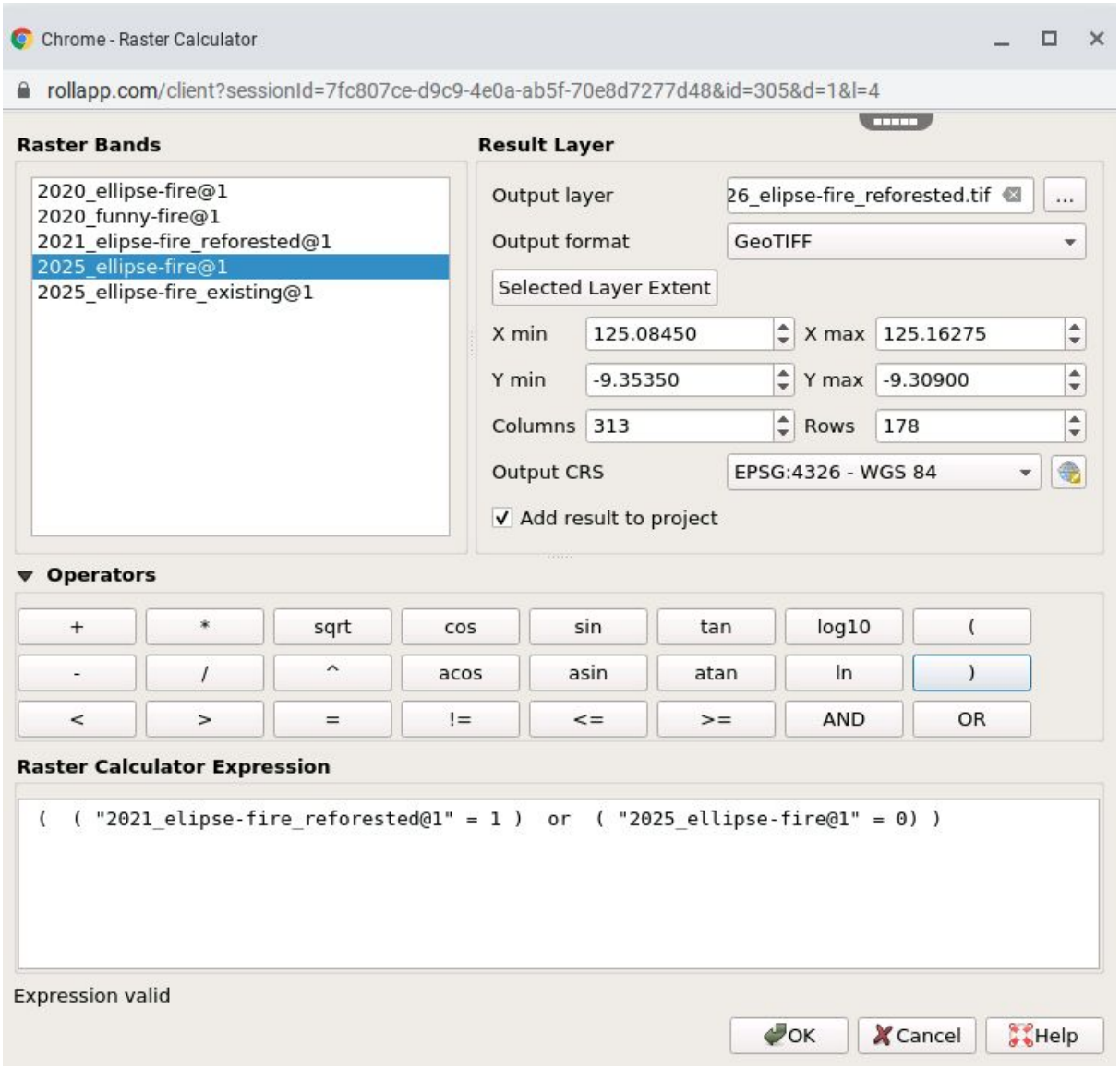
18. Combine Burned-Area-Raster with Raster of Existing situation after the previous wildfie, i.e. 2021_ellipse-fire_reforested and save as 2025_ellipse-fire_existing.tif : Select the Raster > Raster Calculator > use the following formula (So only if the pixel is forest in both rasters will it be forest in the new raster):



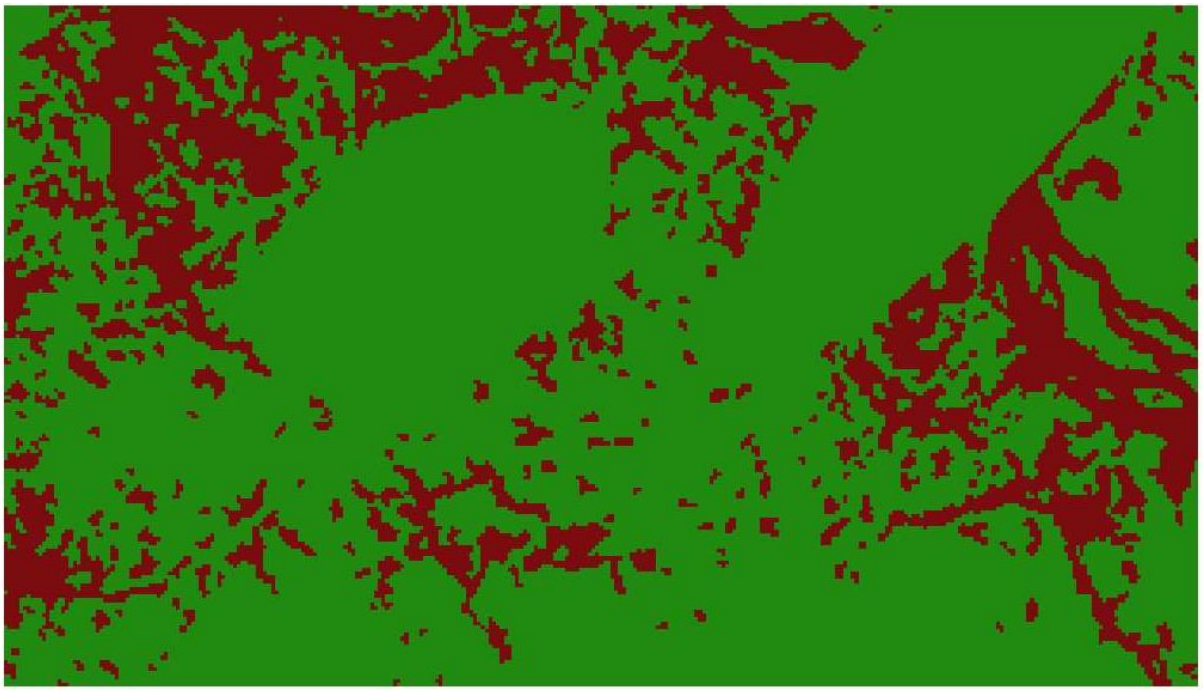
19. The resulting raster looks like this. Note the regrown area after the first fire.



20. Turn the Burned-Area back to forest for the next year and save as 2026_ellipse-fire_reforested.tif : Select the Raster > Raster Calculator > use the following formula (So forest will continue where it already existed AND it will grow where the burned area was):



21. The resulting raster looks like this. Note the two areas with forest regrowth after the fires.



22. This same map will be used for the next 4 years, i.e. 2026 until 2029.
23. In 2030, a new area of 10% will burn down so the same approach will be applied but using the 2026 map as the basis.
24. Apply the same process in 2035, 2040, and 2045