

Multi-factor Analysis for Recharge Mapping Suitability
(MARMapS)
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MARMapS is a free, open-source tool for making interactive and transparent suitability maps. It is currently in development. For questions, bugs, feedback or comments please contact ggorski@ucsc.edu. The following document is a tutorial to demonstrate the tool, for general guidelines please see the MARMapS Readme doc. The application can be found <https://ggorski.shinyapps.io/marmaps/>

This tool was developed in collaboration with Daniel Goode, Michael van der Valk, and Andrew Fisher. Some data for the tutorial were generated by Sarah Beganskas.

Introduction and data sources

In this tutorial, we will upload three individual factors, select suitability thresholds for each individual factor, and generate a composite suitability map based on the three factors and the weights that we assign them. The three factors are 1) Soil Infiltration Capacity (m/day) generated using the SSURGO database 2) Modeled Runoff Availability (cm/yr) generated using Precipitation Runoff Modeling Scenario (PRMS), for more details see^[1] and 3) Land use from the National Land Cover Database. The mapped area is south of Santa Cruz, California, USA. All three factors have identical extent, resolution and geographical projection.

Uploading factors

1. Using the “Upload GeoTiff File” function select the file “01_Soil_IC.tif”.

MARMapS

Multi-factor Analysis for Recharge Mapping Suitability

MARMapS is a free, open source tool that facilitates the creation of landscape suitability maps. Use the options to the left to upload raster files and get started.

[Click here for instructions and a tutorial](#)

Factor Suitability Ranking [Weighting and Composite Mapping](#)

First Factor

Upload GeoTiff File

Browse... 01_Soil_IC.tif

Upload complete

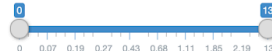
Upload Raster Codes

Browse... No file selected

Name

Units

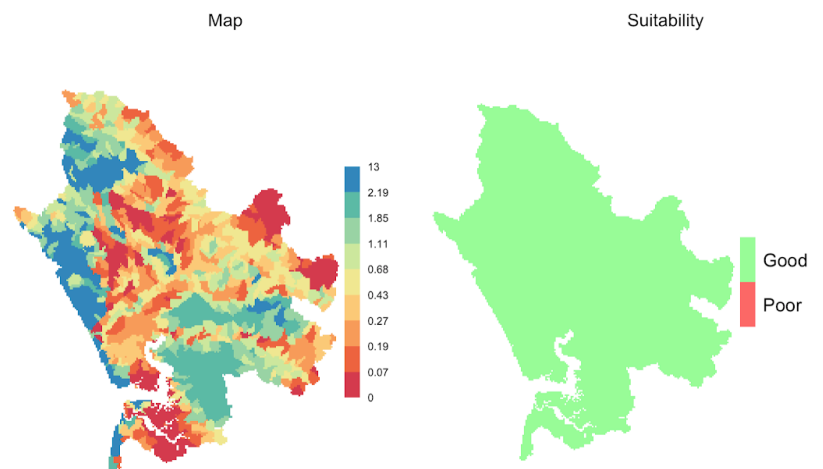
Good Range



Add New Range Classify

Choose Plotting Scale

Decile



2. Using the “Name” and “Unit” boxes on the left, title the factor *Soil IC* with units of *m/day*. *Soil IC* should appear above both maps, and *m/day* should appear above the legend and the slider bar.

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Factor Suitability Ranking

[Weighting and Composite Mapping](#)

First Factor

Upload GeoTiff File

Browse...

01_Soil_IC.tif

Upload complete

Upload Raster Codes

Browse...

No file selected

Name

Soil IC

Units

m/day

Good Range m/day



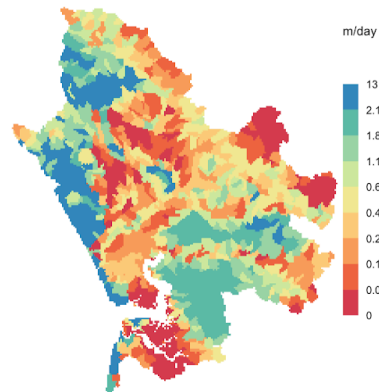
Add New Range

Classify

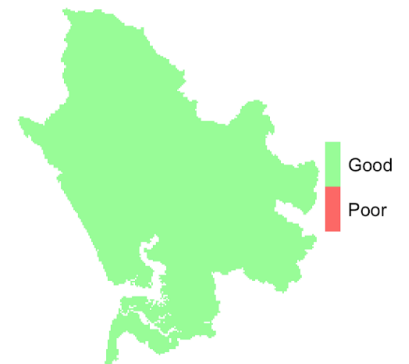
Choose Plotting Scale

Decile

Soil IC Map



Soil IC Suitability



Ranking data for suitability

- Using the “Choose Plotting Scale” drop-down menu, select a plotting scale that displays the data in the most effective way. In general, “Decile” is a good option as it selects the ranges based on the distribution of the data values, but other options are available.
- Select a “Good Range” using the slider bar to the left, if you want two discontinuous ranges, click “Add New Range” and a new bar will appear.
- Once you have selected your “Good Range”, click the “Classify” button and the suitability map on the right will update to reflect your selection.

First Factor

Upload GeoTiff File

Browse...

01_Soil_IC.tif

Upload complete

Upload Raster Codes

Browse...

No file selected

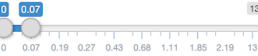
Name

Soil IC

Units

m/day

Good Range m/day



Good Range m/day



Add New Range

Classify

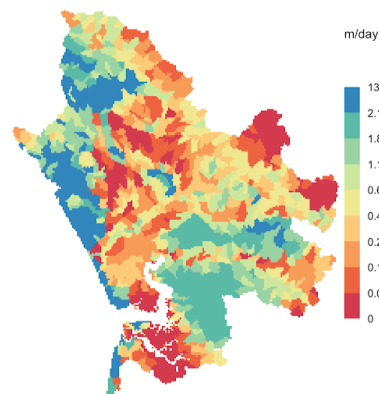
Choose Plotting Scale

Decile

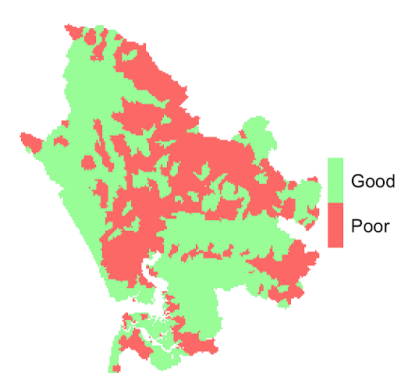
Add Factor

Remove Factor

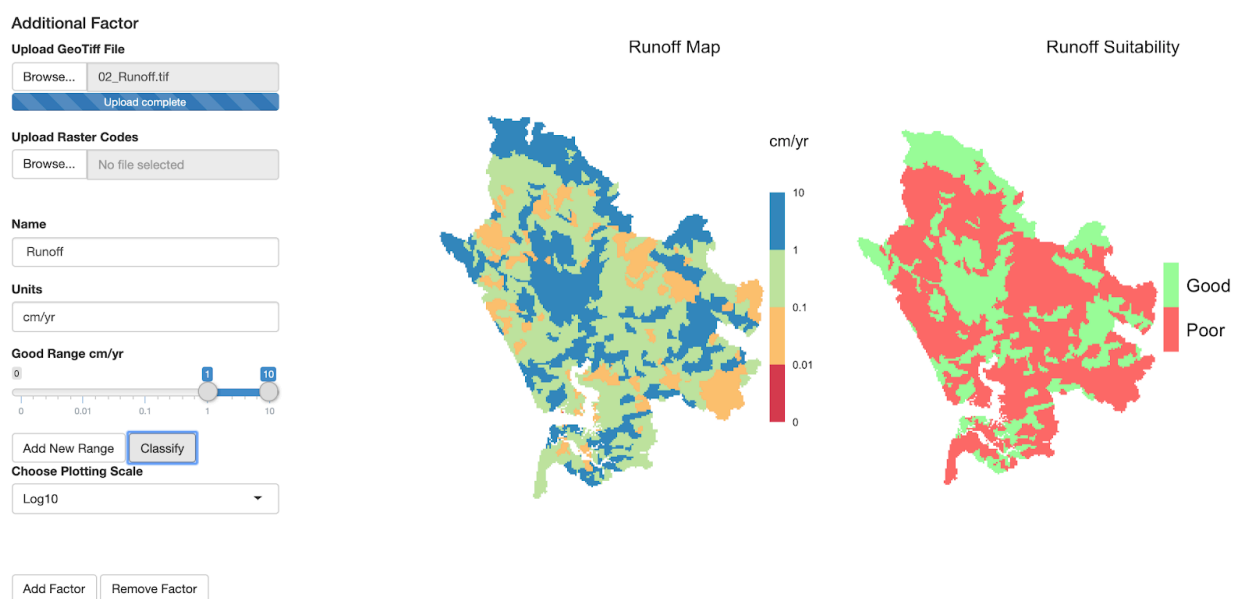
Soil IC Map



Soil IC Suitability



6. Click the “Add Factor” button and select the file named “02_Runoff.tif”. Name the factor *Runoff* with units of *cm/yr* and repeat steps 3-5 for the new factor.



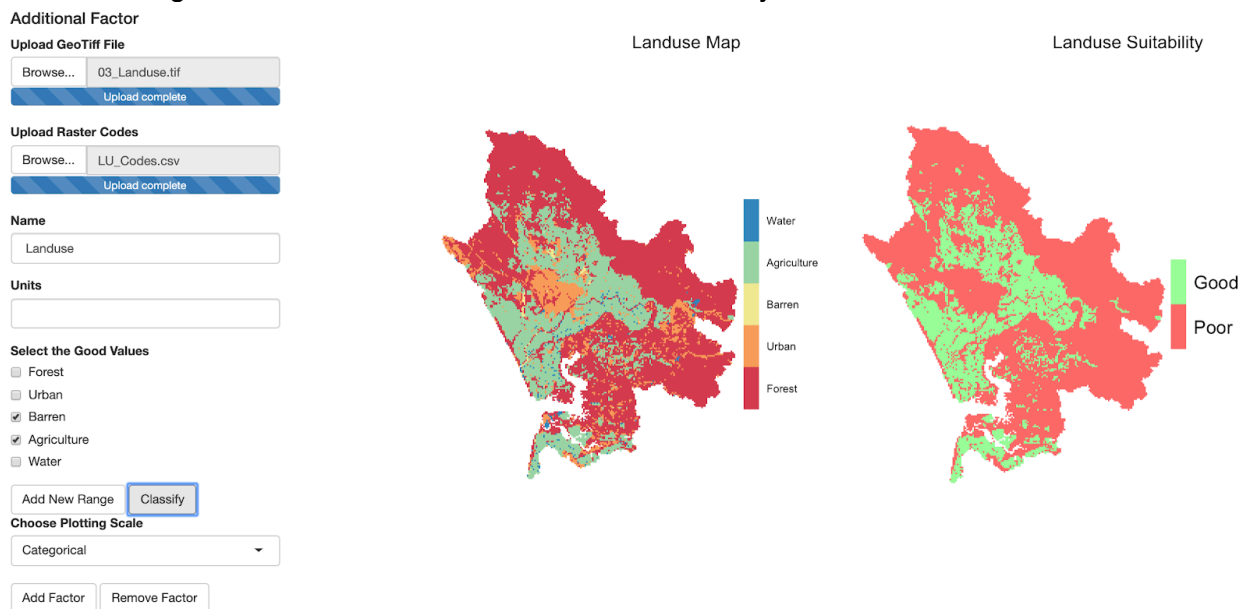
Uploading categorical data with raster codes

7. Click the “Add Factor” button and select the file named “03_Landuse.tif”. Name the factor *Landuse*.

8. From the “Choose Plotting Scale” dropdown menu, select “Categorical”.

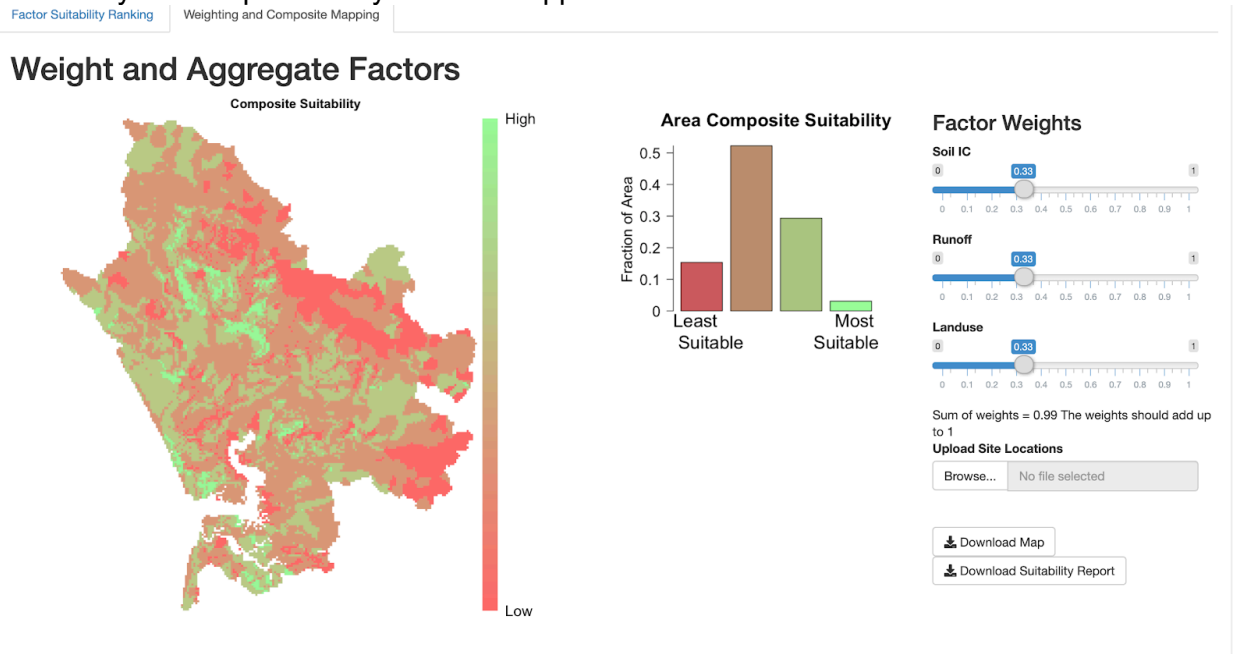
9. Click the “Upload Raster Codes” button and select the file “LU_Codes.csv”

10. Check the Agriculture and Barren boxes and click “Classify”



Aggregating factors for composite suitability

11. Click over to the “Weighting and Composite Mapping” tab. The three classified factors have been overlaid onto one map, and each factor has been given an even weight of 0.33. The bar plot labeled “Area Composite Suitability” shows the distribution of values across the mapped area, notice that there are 4 categories, with this configuration (0,0.33,0.66,1). The actual suitability values are not displayed on the barplot or the map legend because it is most useful to compare suitability values qualitatively within a mapped area.



Adjusting weights

12. Now give the factors unique weights and observe how the map and the distribution change in real-time, making sure that the weights always add up to 1. Set the Landuse weight at 0.9, and the other two at 0.05. Observe how the final map begins to look much more like the original, classified Landuse map from the first tab.

13. Assign the following weights, Soil IC = 0.2, Runoff = 0.7, and Landuse = 0.1. Now click back on the “Factor Suitability Ranking” tab, and reclassify the Runoff factor such that everything from 0.1-10 cm/yr is suitable. Be sure to click the “Classify” button to reclassify the factor.

14. Click back on the “Weighting and Composite Mapping” tab, and reassign the weights in step 13. Observe, how the distribution of suitability shifted towards more suitable values in the barplot, and the map became more green. This was because we classified more values as having suitable Runoff values.

Adding in site locations as point files

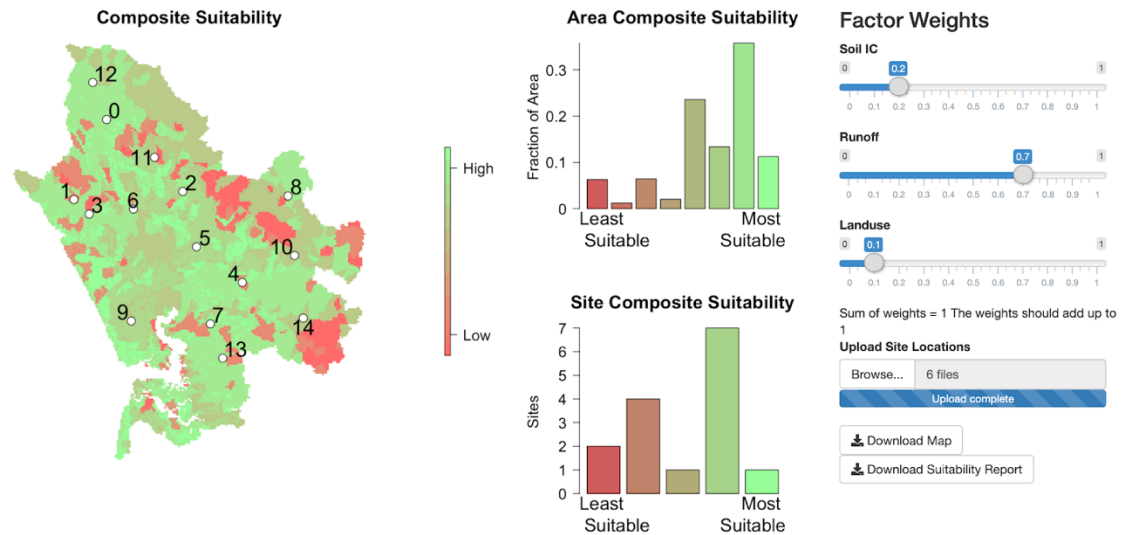
15. On the “Weighting and Composite Mapping” tab, click the “Upload Site Locations” button and navigate to the folder labeled “Site_Locations”. Select all six files in the folder and upload them together.

16. The sites will plot on the composite suitability map with a bar plot showing the number of sites that fall into each suitability category.

Factor Suitability Ranking

Weighting and Composite Mapping

Weight and Aggregate Factors



Map download

17. Lastly, use the “Download Map” button to download the composite suitability map as a .tiff file