MAPPING TERRAIN ROUGHNESS FOR OLYMPICS

Modeling Geographic Space

Kefan Long Assignment-5

Goals

> ***Your task is to help propose location for Winter Olympic Games in South Korea.***
>
> ***"Let's agree to avoid the rough spots and try to come together wherever we can do so as smoothly as possible"***

So our basic task is to map the smoothest part and propose it as the ideal place for holding this event.

Understanding of the Roughness

Before we did the project, we should at first define the word "roughness", especially for an Olympic Games.

What kind of roughness	Translation in GIS
Athletes can't compete in a steep place	*Slope "Roughness"-the slope should be small and uniformed in the neighborhood*
Bridges should be avoided	*Elevation "Roughnees"- the site shouldn't be in a higher ridge than its neighborhood*
Rough land surface are going to be avoided	*Elevation "Roughness"2-the site shouldn't deviate too much from its neighborhood's*
Athletes	*Aspect "Roughness"-the aspect should be uniformed in the neighborhood.*

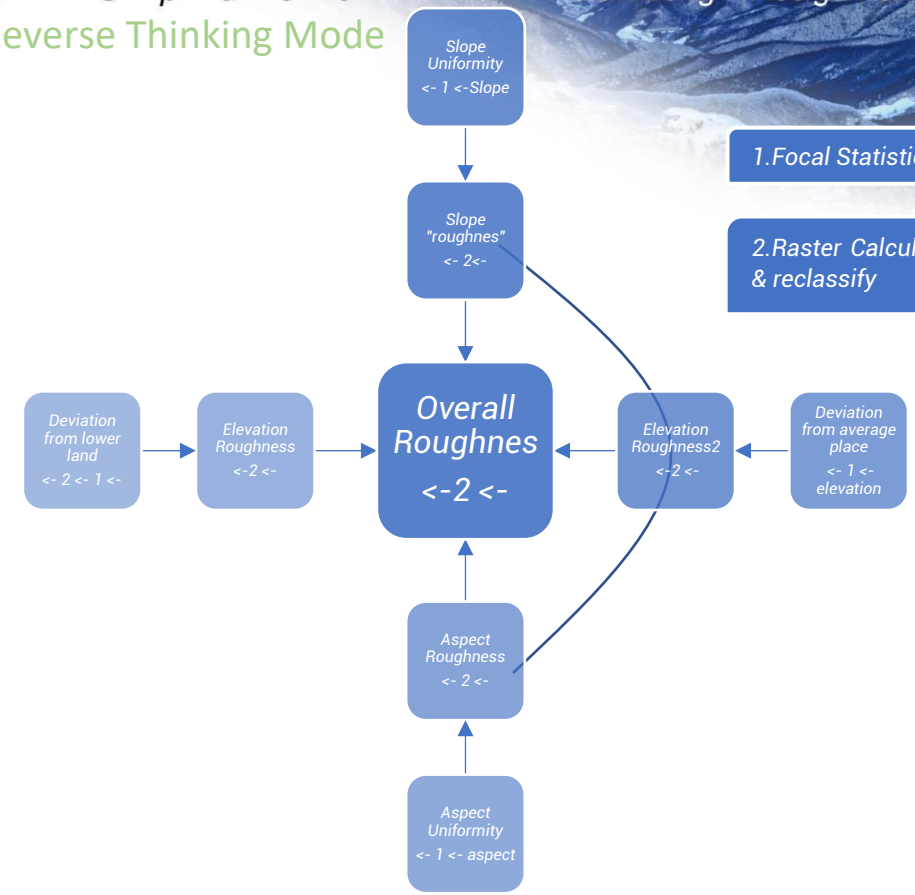
Final Step of Solution – Reclassify of all "Roughness"

Based on the requirement and understanding of the roughness, our final step should weight all different kinds of roughness according to their importance in holding Olympics. Then we use raster calculator to sum up a total score of each pixels, and use reclassify to categorize them as "roughest", "smoothest", "in-between".

Since final step mentions the weight of different roughness, we have to give the weight according to its importance for holding the event.

Roughness	Slope Roughness	Elevation Roughness	Elevation Roughness2	Aspect Roughness
Weight	*4*	*Avoid ridges*	*3*	*1*

Reverse Thinking Mode



Environment Preparation

Before we do the major steps in ArcMap, we should *set "Environment Settings-Processing Extent-Same as layer elevation"*, so that we will not miss any content of the elevation.

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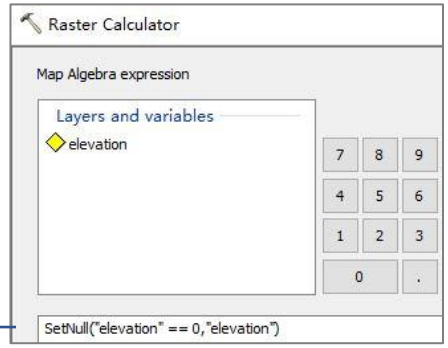
Also, we should at first exclude all the pixels of "0"s, because they are below sea level and can not be used for siting the event under any circumstances.



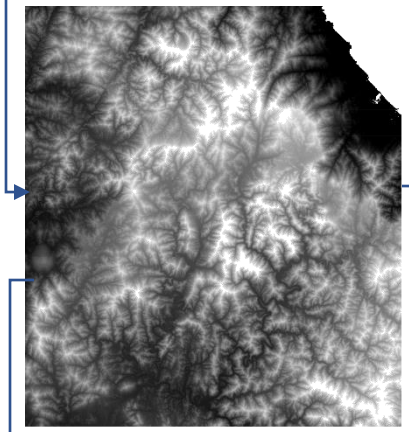
The formula is:

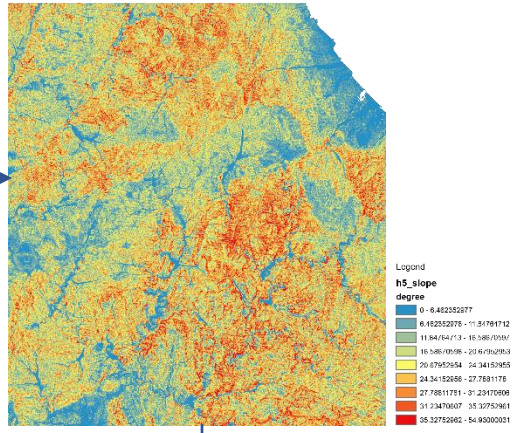
SetNull("elevation" == 0, "elevation")

This formula will make sure that we exclude the 0 pixels.

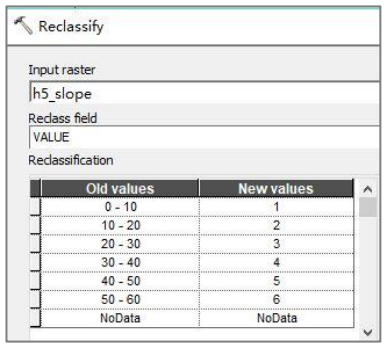
Factor 1: Slope Roughness

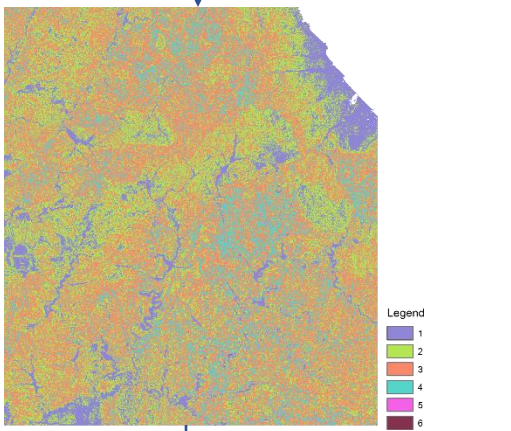
Step 1-1: Slope



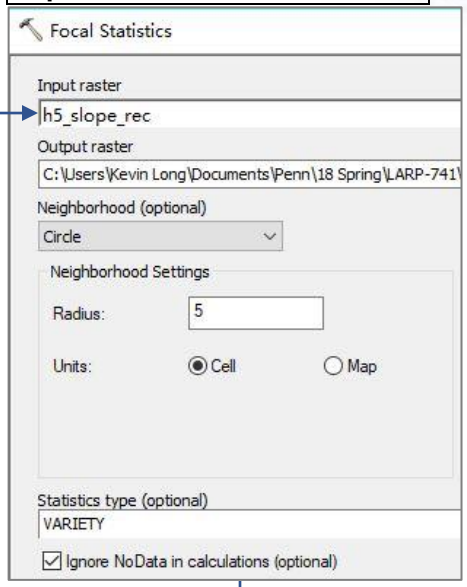


Step 1-2: Reclassify

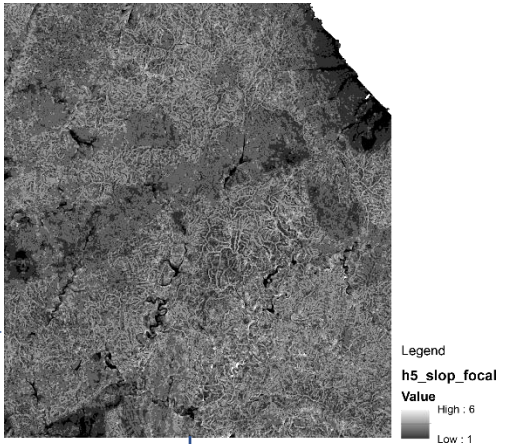




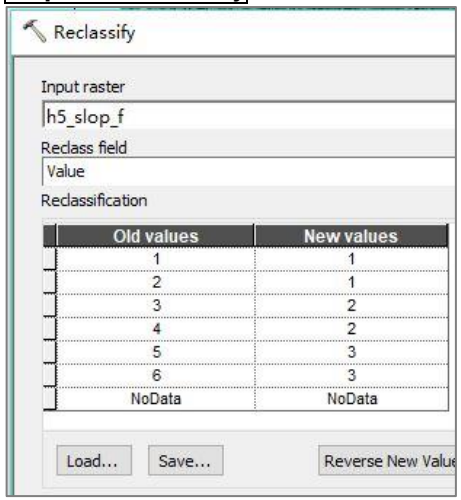
Step 1-3: Focal Statistics-VARIETY

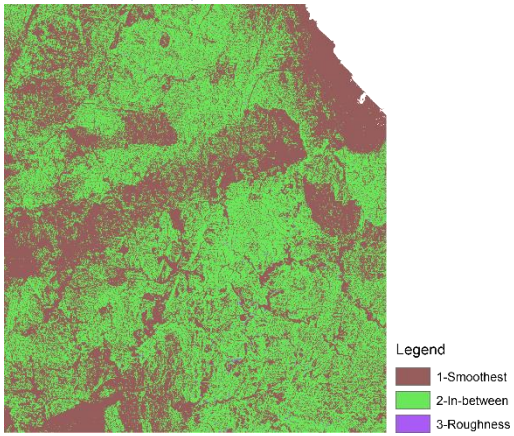


Attention: Considering the scale of the event, all the focal statistics use the same neighborhood method: Circle with radius 5 cells. In real world, it covers about 53,000 m².



Step 1-4: Reclassify





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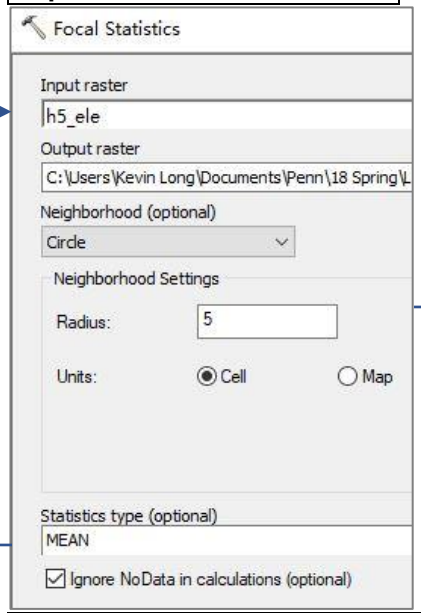
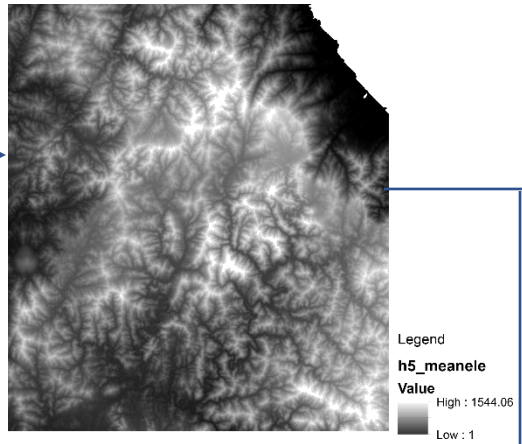
Factor 2: Elevation Roughness

In this factor, we are looking at the elevation in the neighborhood, and try to exclude the ridge pixels, which seems inappropriate for an Olympic event to happen. Thus, the ridge pixels we find can consider "roughest" in the task.

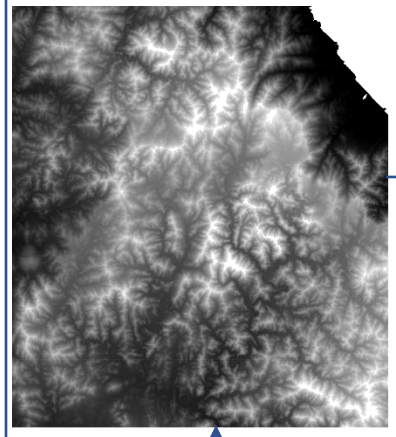
Step 2-1: Focal Statistics-MEAN

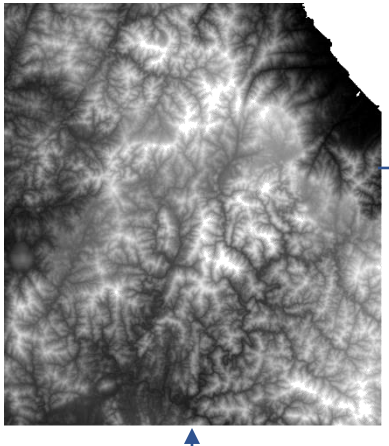




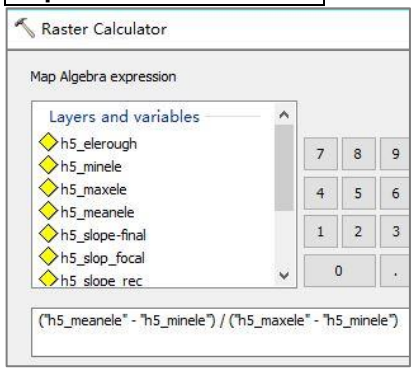
Step 2-2:Focal Statistics-MIN&MAX

Do the same focal statistics, but change the *"standard type"* to *"MAX"* and *"MIN"* to find the maximum & minimum of the neighborhood

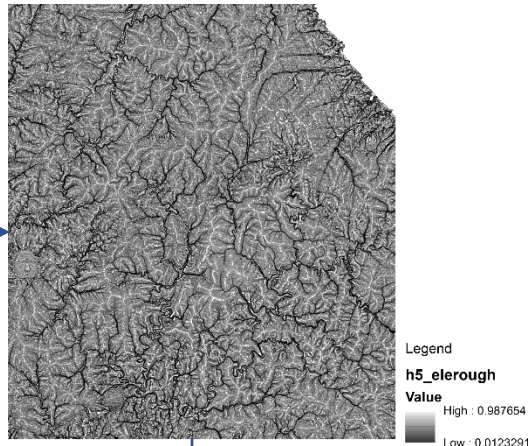




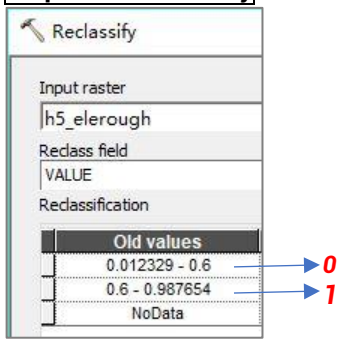
Step 2-3:Raster Calculator

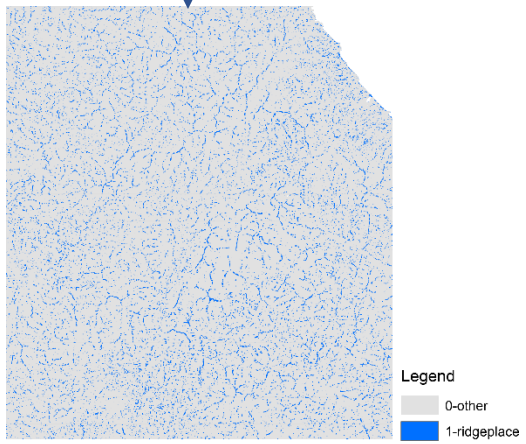


The formula is:
("h5_meanele"-"h5_minele")/("h5_maxele"-"h5_minele")
Basically, the higher the resulted value, the pixel is more likely to be a ridging place.



Step 2-4 : Reclassify





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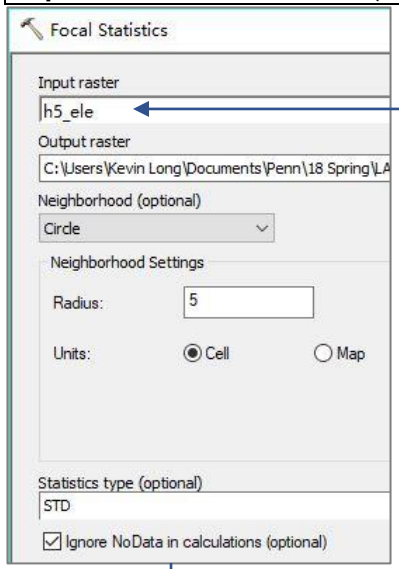
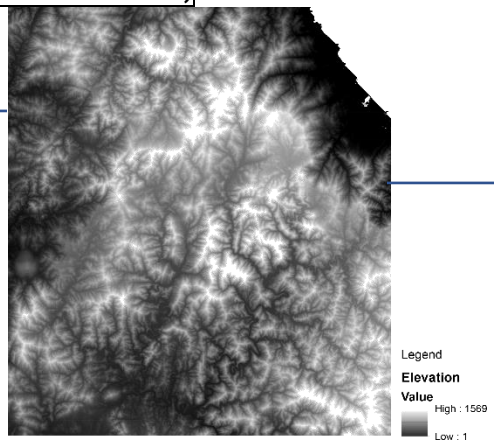
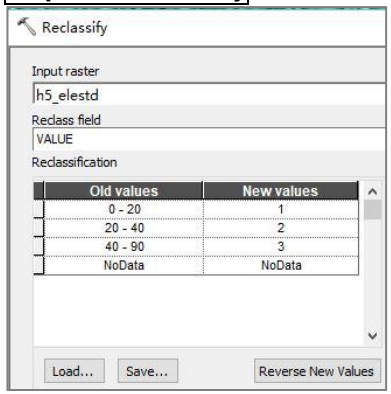
Factor 3: Elevation Roughness2

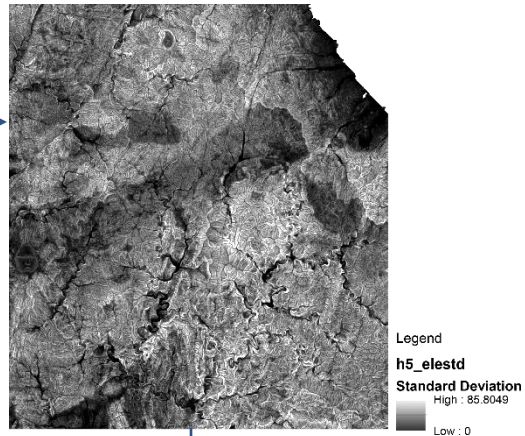
Step 3-1: Focal Statistics-STD(Standard Deviation)

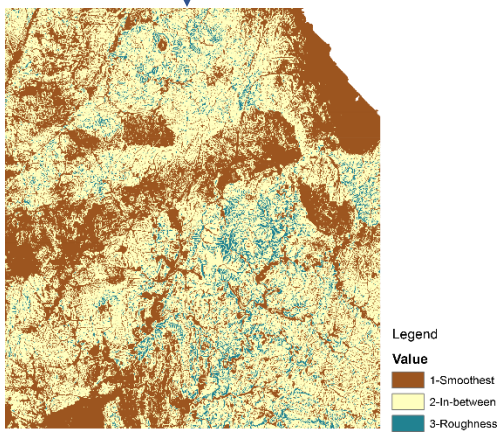




Step 3-2: Reclassify





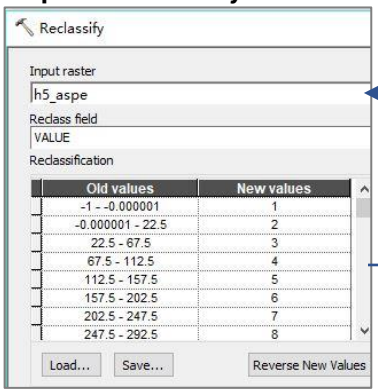


Factor 4: Aspect Roughness

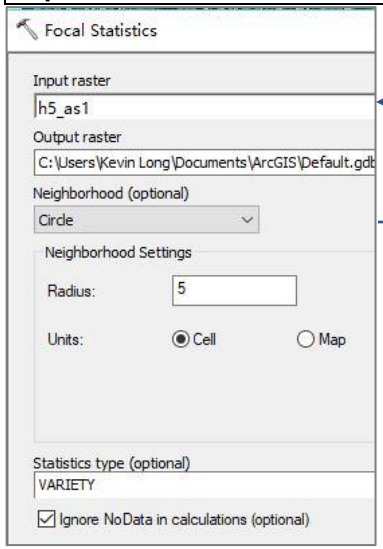
Step 4-1: Aspect

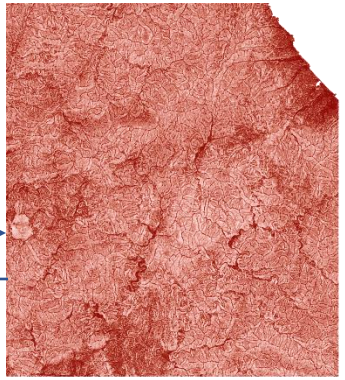
Create an aspect layer using elevation raster

Step 4-2: Reclassify



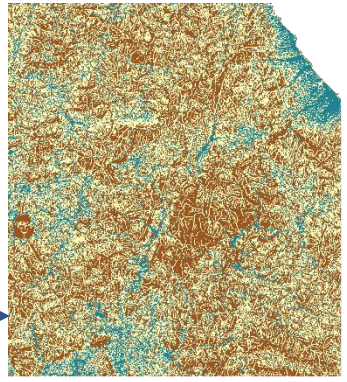
Step 4-3: Focal Statistics-Variety





Step 4-4: Reclassify

We reclassify ***(1 – 4) ->1***
(5 - 7) -> 2
(8 - 10) -> 3



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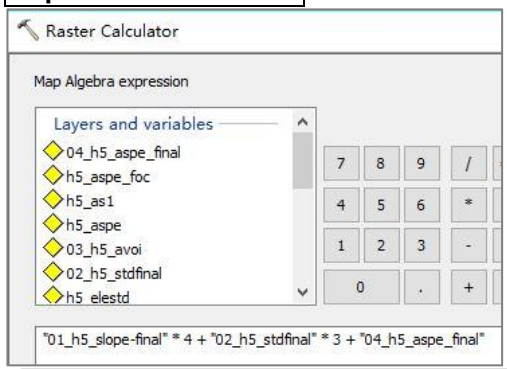
Final Step: Generating Roughness Map

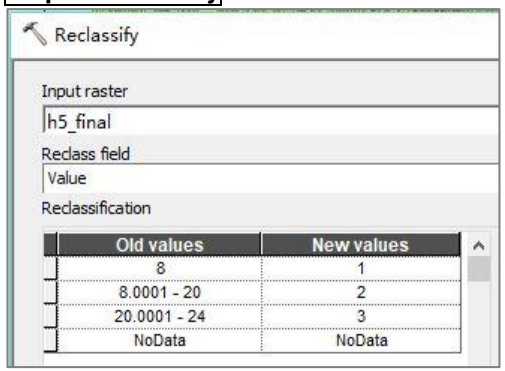
Step 1: Raster Calculator



The formula is :

*Factor1 * 4 + Factor3 * 3 + Factor 4 * 1*

Step 2: Reclassify

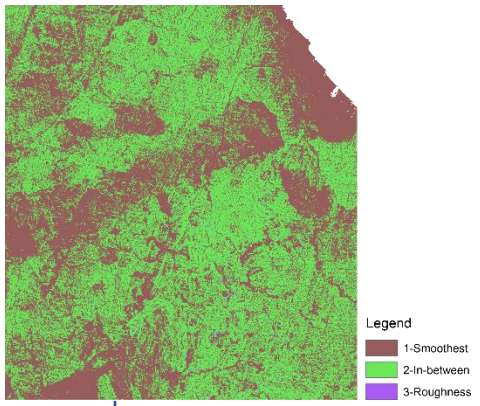


Step 3: Overlapping with factor 2

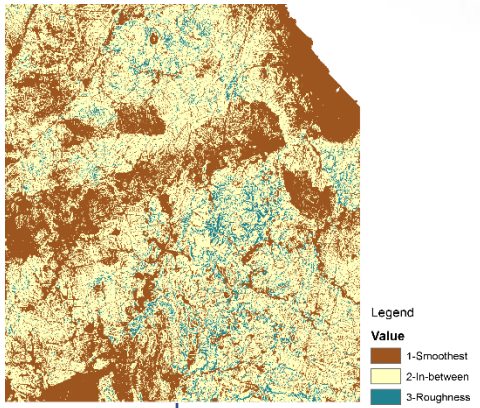
Change the grey color in final raster of factor 2 and set the grey as hollow, and change the ridge color the same as “roughest” category in the step 2. Finally overlap this map to the reclassified map, and we get the target grid.

The red circle is the right place to make this event happen!!!

Factor 1



Factor 3



Factor 4