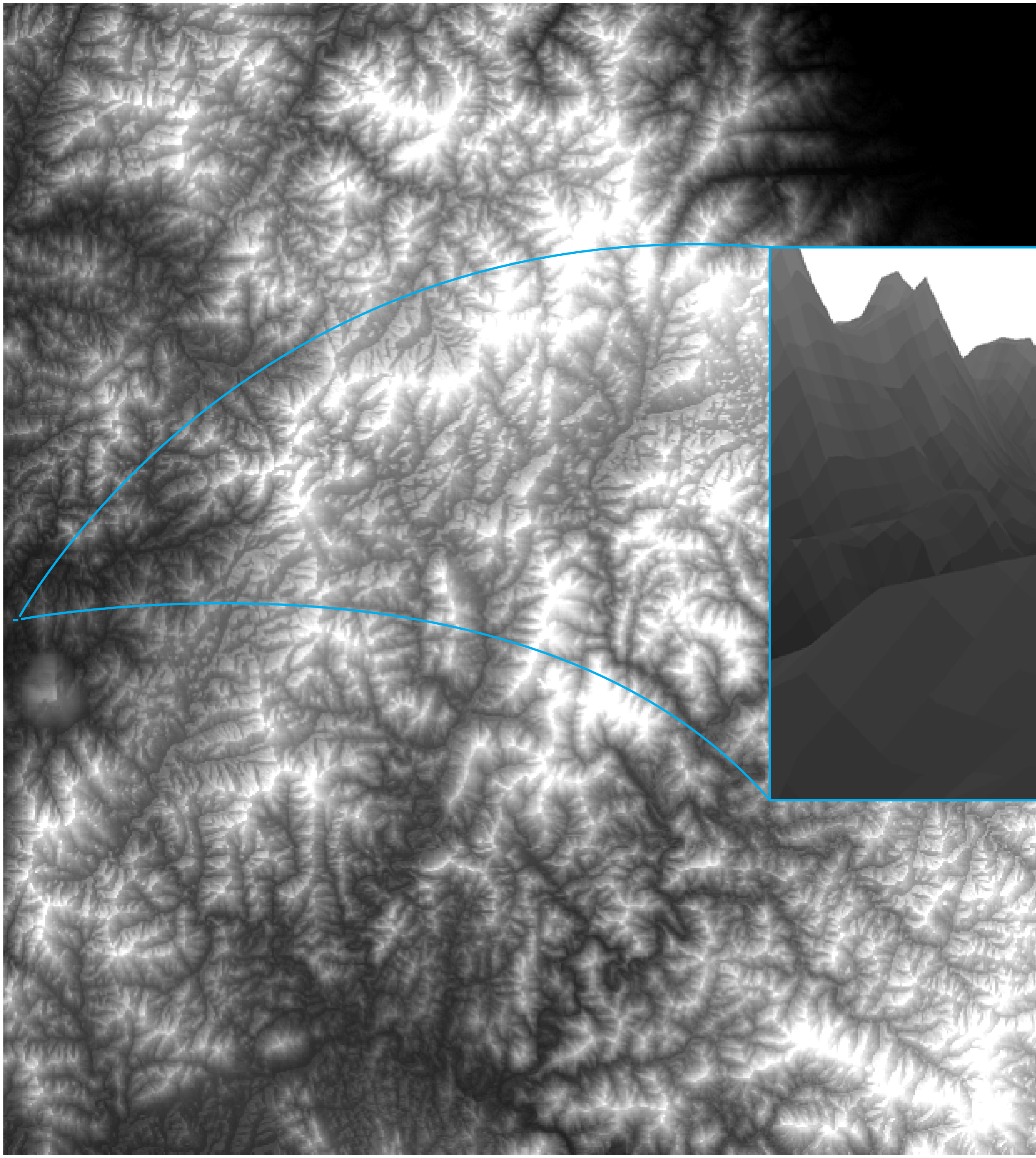
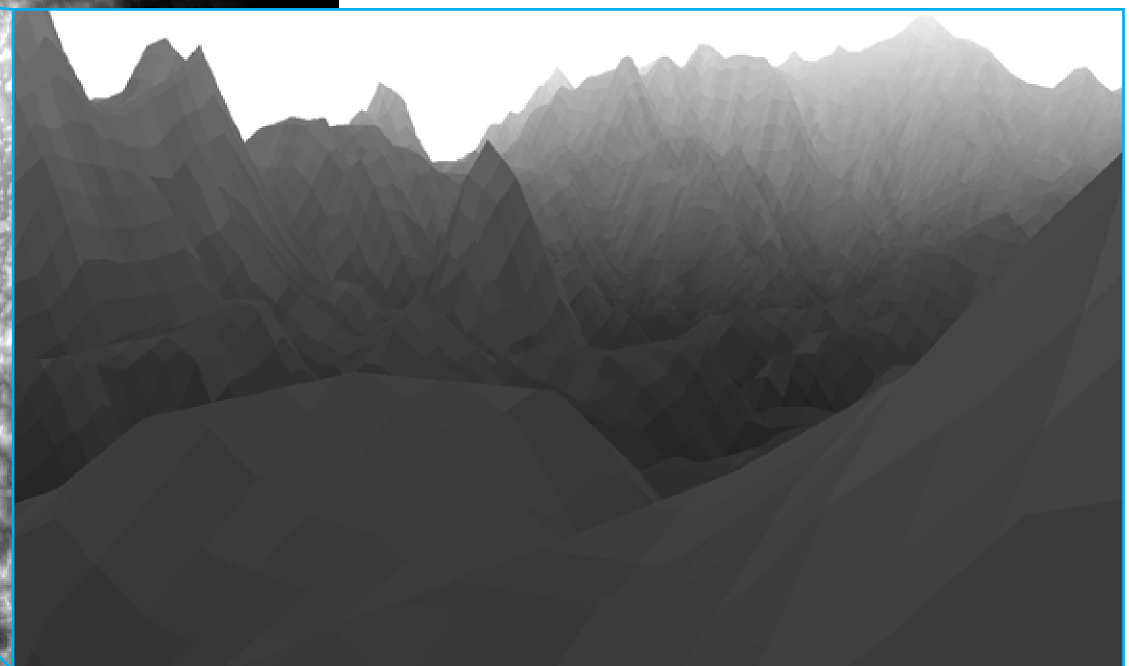
Zhao, Anbei + Edenhart-Pepe, Terra

Homework from the Worm's Eye (05)





"Let's agree to avoid the rough spots and try to come together wherever we can do so as smoothly as possible."

Legend

elevation

Value

High : 1569

Low : 0

NORTH

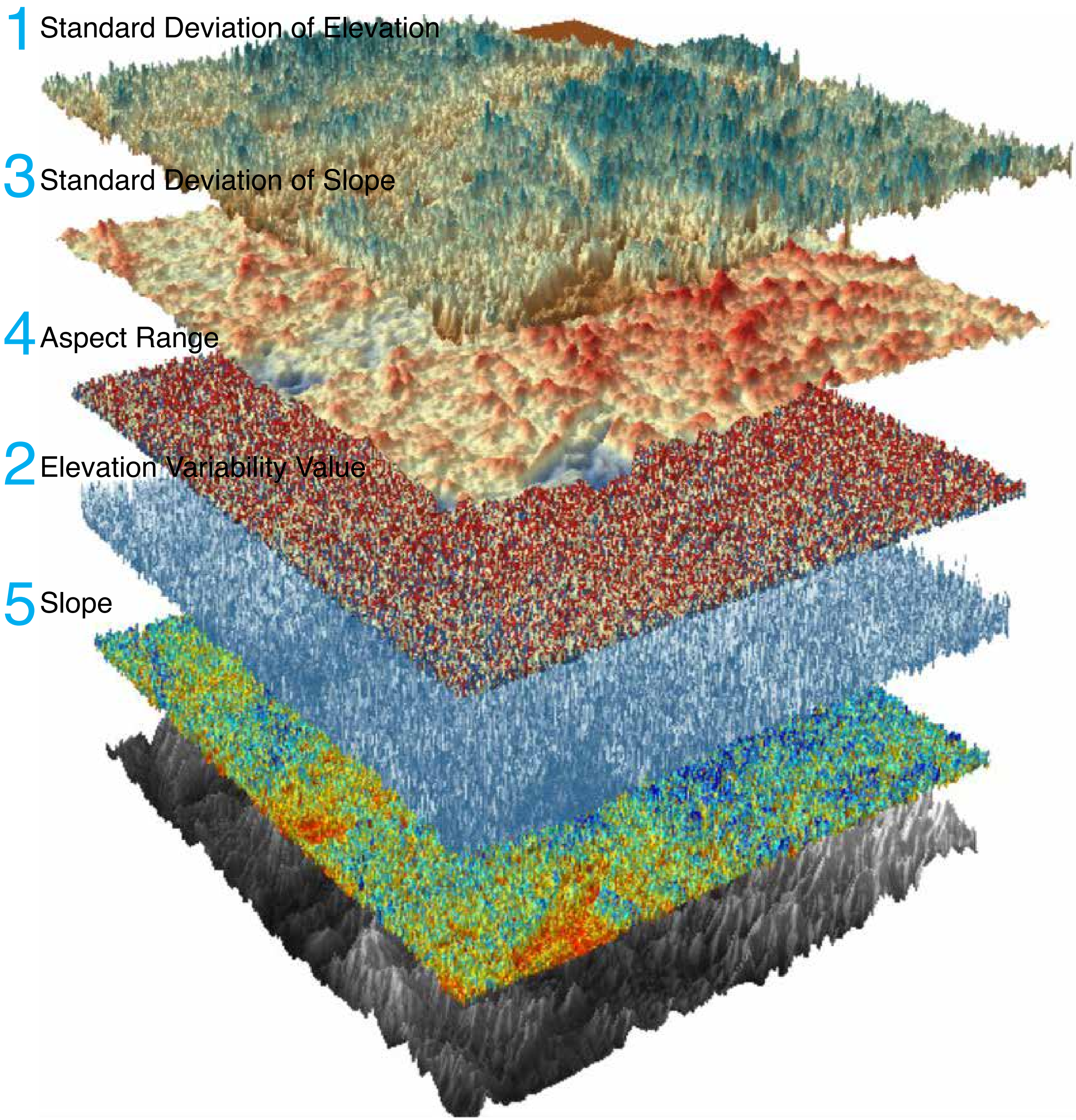
3.5 1.75 0 3.5 7 10.5 14 Miles

TASKS:

- Distinguish terrain by roughness.

- Determine an appropriate method for measuring roughness and explore how methodology manipulates maps at pixel -level (at the worm's eye level).

- Select the smoothest area for a practice in the diplomatic arts, assuming the nature of the place will influence the outcome of the meeting.



LOCATION SELECTION BASED ON TOPOGRAPHIC ROUGHNESS INDEX

BASICS

Roughness may be defined in many ways. For the purposes of this exercise, Roughness is defined as *irregular texture*. Roughness is determined by the difference in values from a center cell and the cells surrounding it.

INDEX

Our index of topographic roughness is determined by:

- Elevation I Many elevation changes over a neighborhood of pixels yields a rough surface.
- Aspect I A surface that has many directional changes in a neighborhood of pixels, is a rough surface.
- Slope I Rapid change in the degree of inclination within a neighborhood of pixels causes rough surfaces.

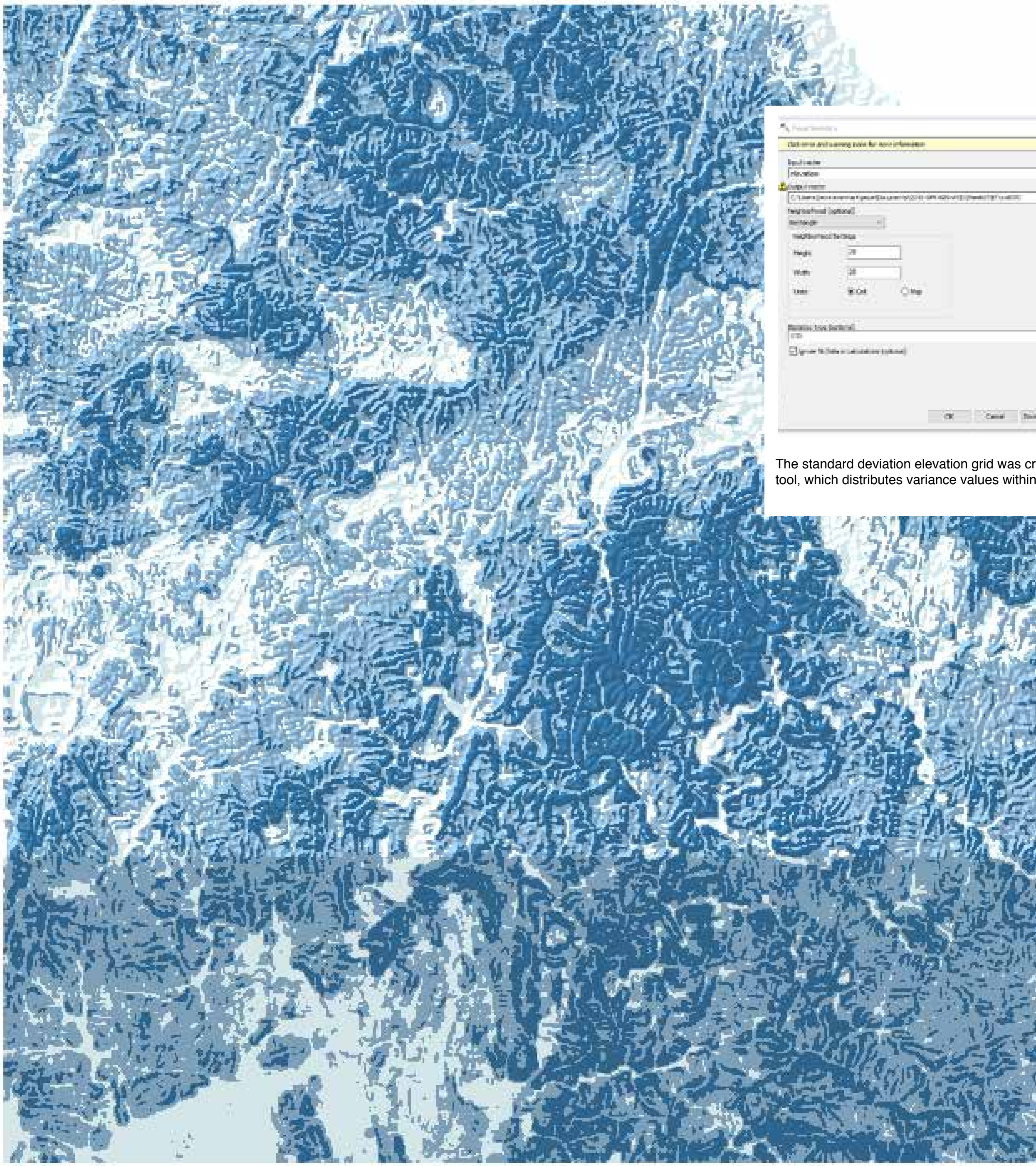
CONSIDERATIONS

When searching for a surface of contiguous smoothness large enough to facilitate a meeting at which successful diplomacy is potentially as perilous as the peaks in Pyeongchang County, South Korea, we thought it best to find a large-ish area. Generally, a 20 x 20 cell neighborhood was used due to desired size of output and pixel size in parent elevation grid.

We paid attention to scale, as well. The original elevation grid shows a large area. Some of the criteria outlined are more appropriate for large scale, others for small scale, e.g. a steep but smooth surface could have a higher roughness index than a flat but bumpy surface.

By weighting and combining all the criteria we address both local slope and relative ruggedness.

1 Standard Deviation of Elevation



The standard deviation elevation grid was created using focal standard deviation tool, which distributes variance values within the neighborhood.

The essential information to determining roughness by Elevation is the amount of elevation difference between adjacent pixels, not the relationship of elevation units to sea level. To generate a measure of relative roughness, the variation between each pixel relative to the mean of the neighborhood is measured by Standard Deviation of Elevation. The topographic position of each pixel is defined by its neighborhood through the use of Focal Statistics, Standard Deviation. Low results (low variance) indicate smooth topography. Farther from the mean (higher deviation) indicate rough topography.

Legend

EFocalSTD

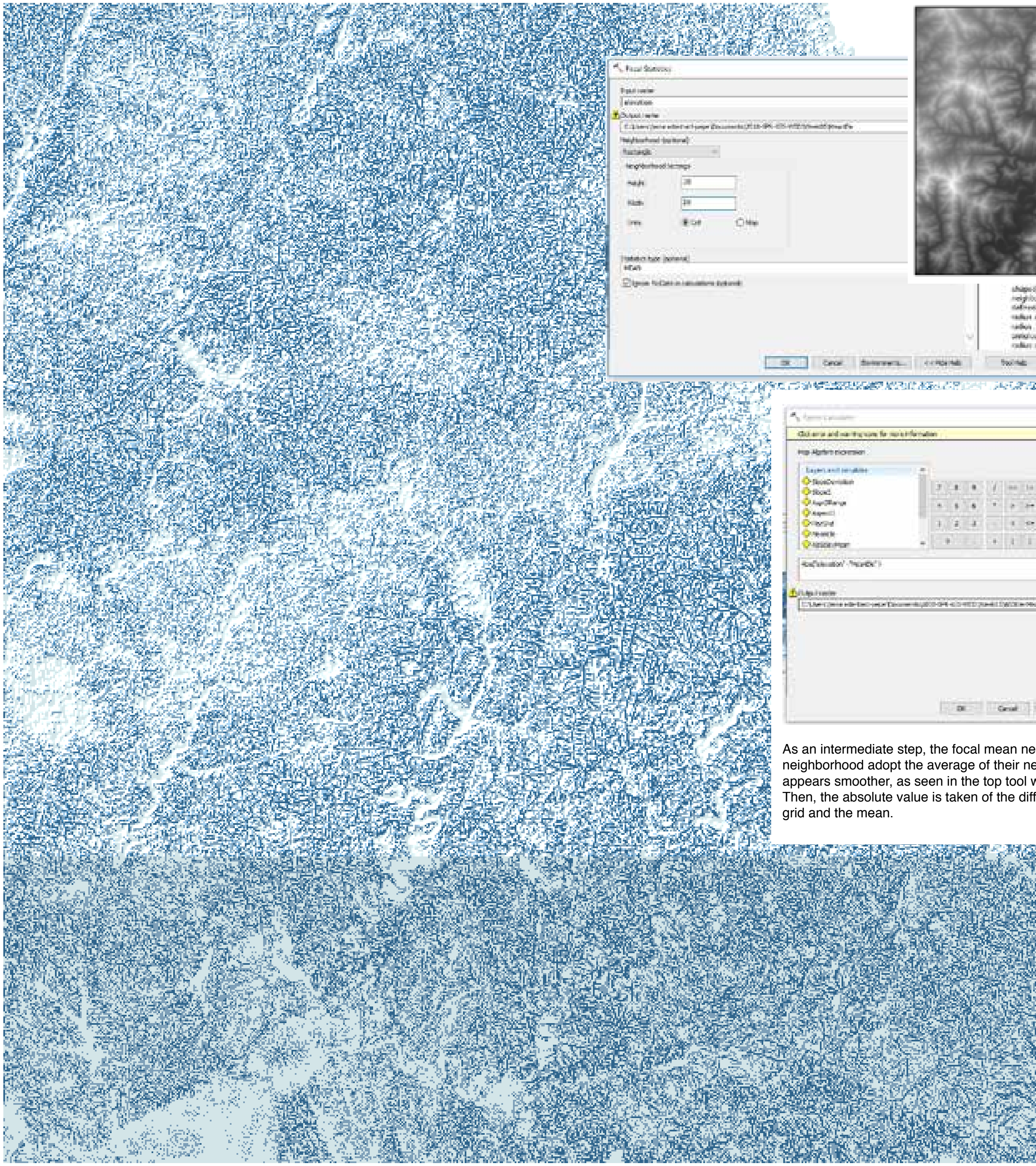
<VALUE>

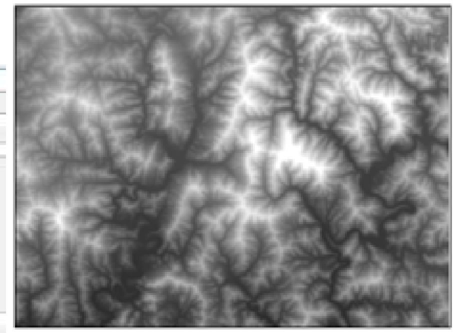
	Topographic roughness index
0 - 29.20620099	mild
29.206201 - 52.90179802	moderate
52.90179803 - 140.52040	roughest

3.5 1.75 0 3.5 7 10.5 14 Miles

NORTH

2 Elevation Variability Value





Another expression of roughness using elevation data is the calculation of the absolute value of the difference in elevation and mean elevation of the neighborhood.

First, Focal Statistics is used to calculate the mean elevation. Then Raster Calculator is used to find the absolute value, as described. This calculation captures the difference between original and average elevation values.

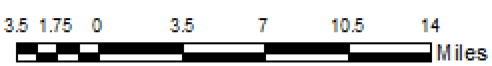
As an intermediate step, the focal mean neighborhood pixels and all pixels in the neighborhood adopt the average of their neighborhood. Effectively, the surface appears smoother, as seen in the top tool window and screenshot.
Then, the absolute value is taken of the difference between the original elevation grid and the mean.

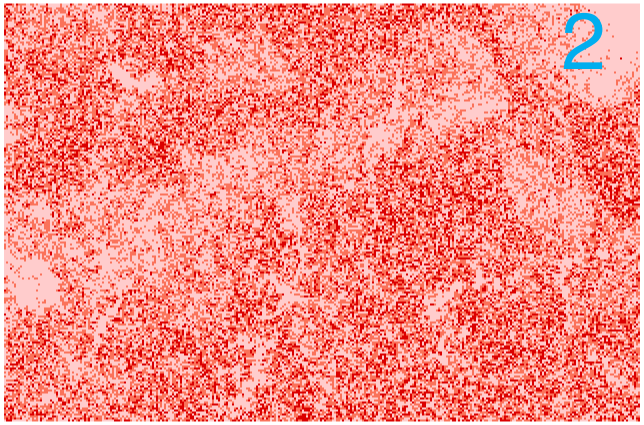
Legend

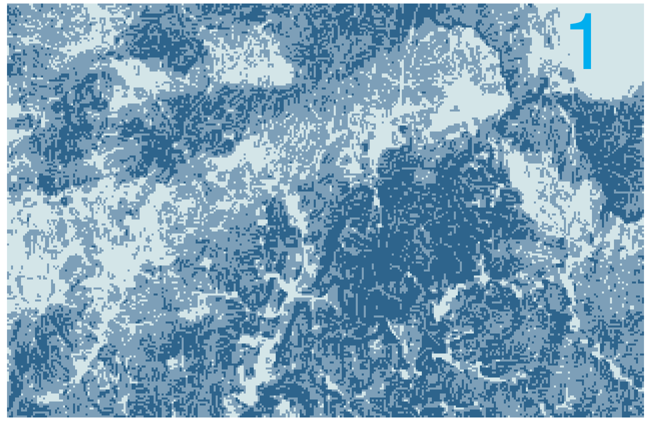
ABSElevMean

<VALUE>

	Topographic roughness index
0 - 7.317334942	mild
7.317334943 - 16.725337	moderate
16.72533702 - 66.640014	roughest

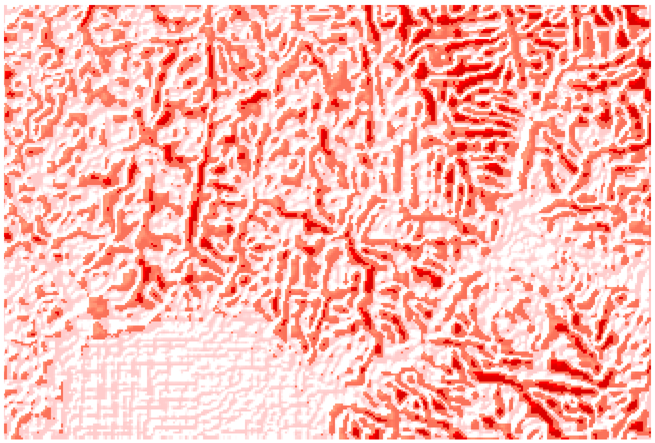


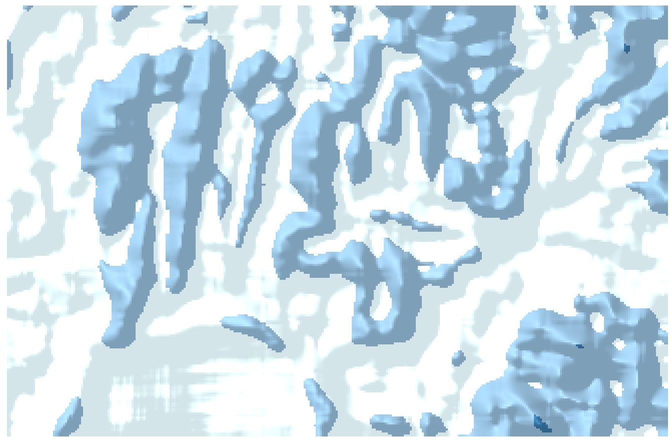




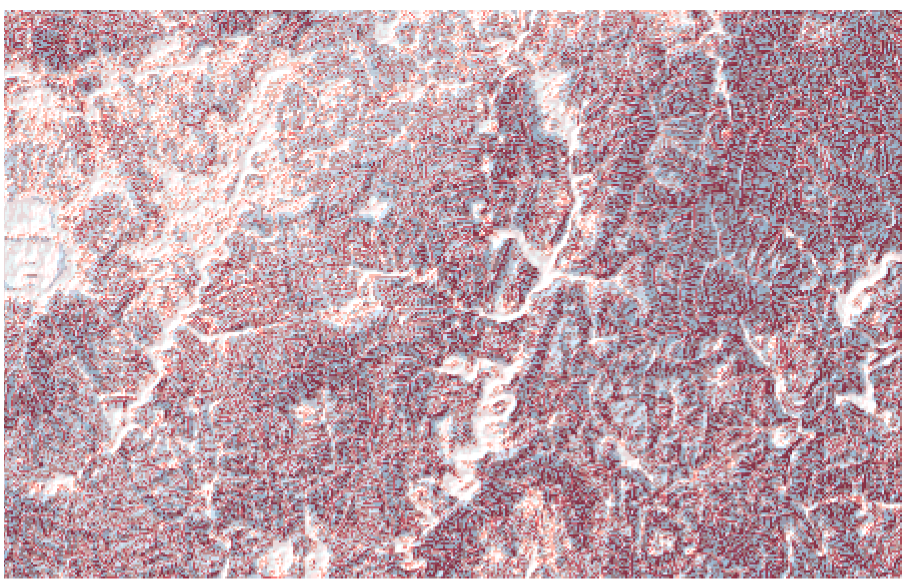
1 inch = 15.78 miles

In these two maps, the issue of scale is apparent. While map 1 shows general topographic roughness, map 2 illustrates the finer grain of the landscape. Although the scale difference is visibly apparent, both methods and maps delineate similar results. The three areas shown reflect roughest, moderate, and mild roughness.





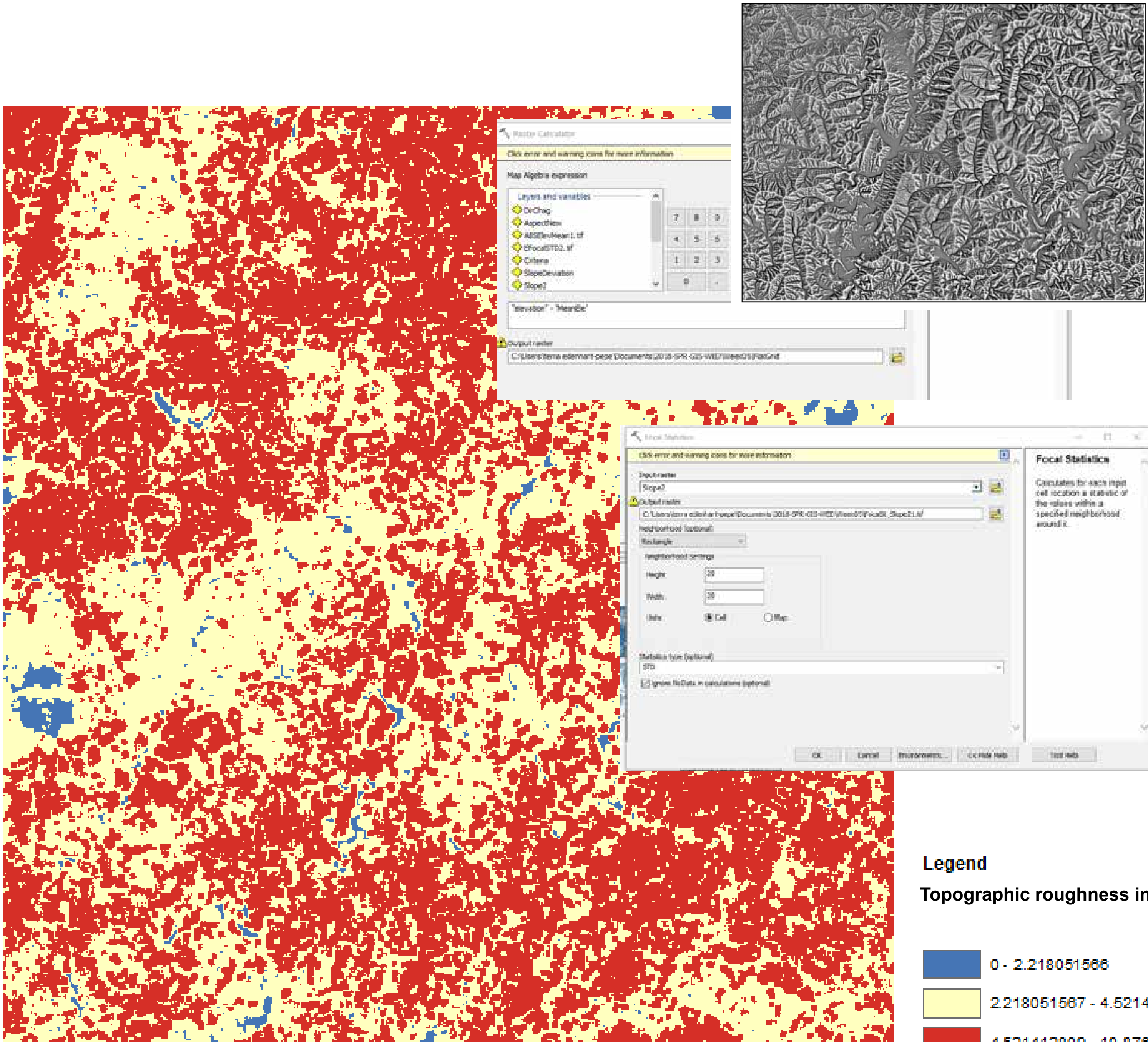
1 inch = 1.58 miles



1 inch = 7.71 miles

3 Standard Deviation of Slope

Since “roughness” is not the result of absolute slope, but the slopes relative to each other, the original terrain (elevation grid) is flattened. Using the flat grid, the next step is to calculate the standard deviation of slopes. Standard deviation of slopes, like standard deviation of elevation, provides information on relational variance of the surface.

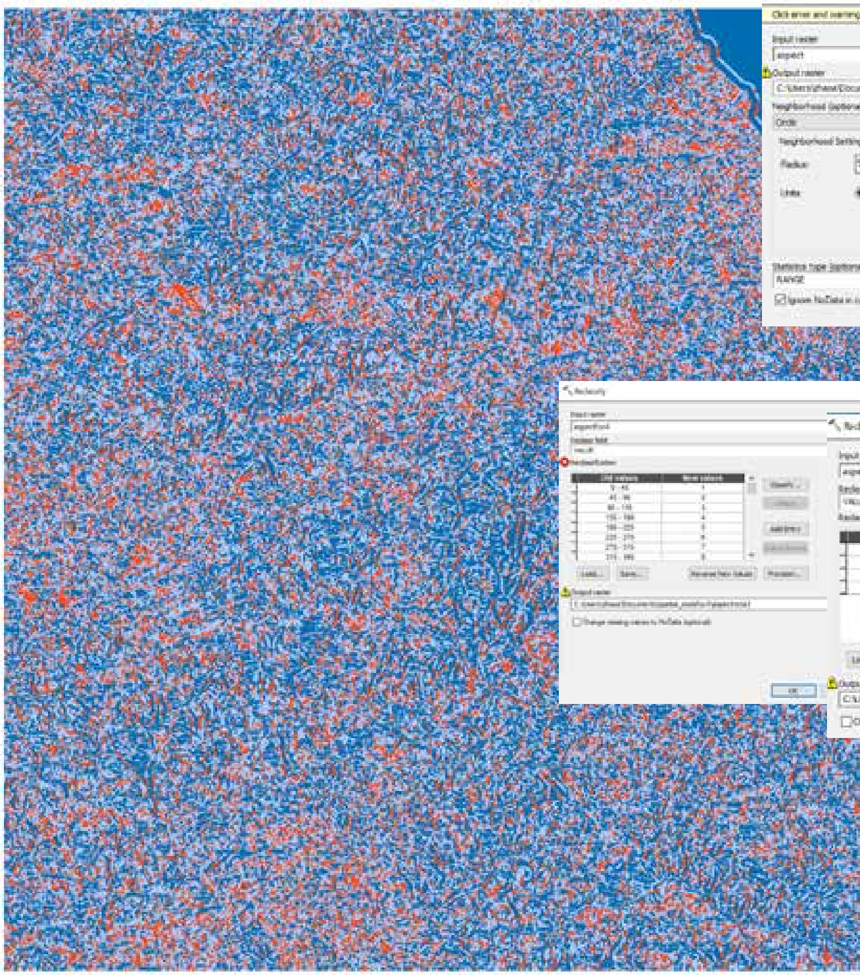


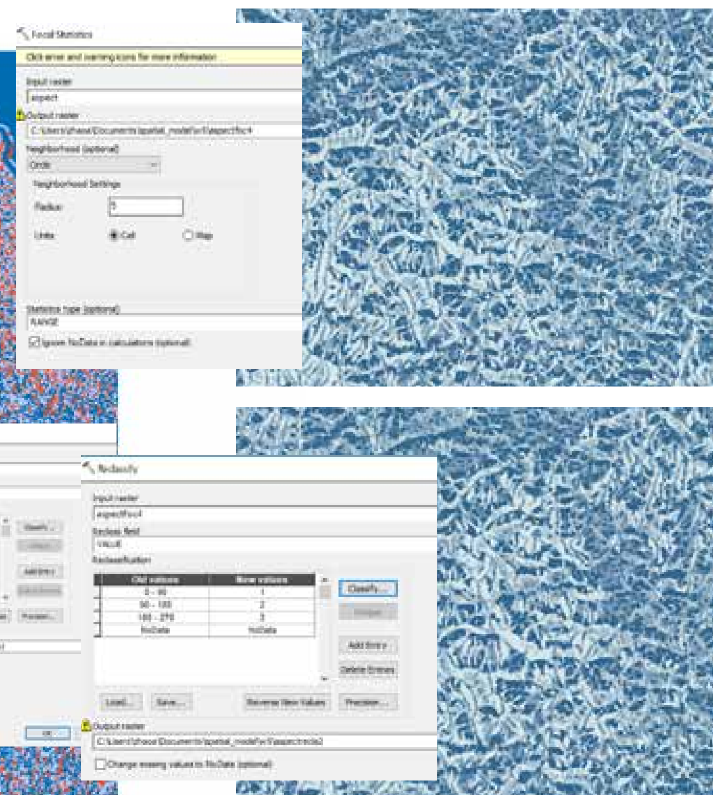
Legend

Topographic roughness index

(blue)	0 - 2.218051566	mild
(yellow)	2.218051567 - 4.521412808	moderate
(red)	4.521412809 - 10.87698364	roughest

4 Aspect Range





A surface that has many directional changes in a neighborhood of pixels, is a rough surface. Therefore, the aspect was used to determine local bumpiness by reviewing the range of changes in a given neighborhood.

The Aspect tool was first used to analyze the aspect of the flat terrain grid.

The resultant values represent the degree of aspect. Then, focal range was calculated from the aspect grid.

The values are subjected to reclassify twice. First, the values represent 5 degrees(0°, 90°, 180°, 270°,360°). Considering that if an angle A is more than 180°, in fact A should be (360-a)°. Finally, the values are reclassified into 3 classes (0°, 90°, 180°).

Topographic roughness index

(dark blue)	0°	mild
(light blue)	90°	moderate
(red)	180°	roughest

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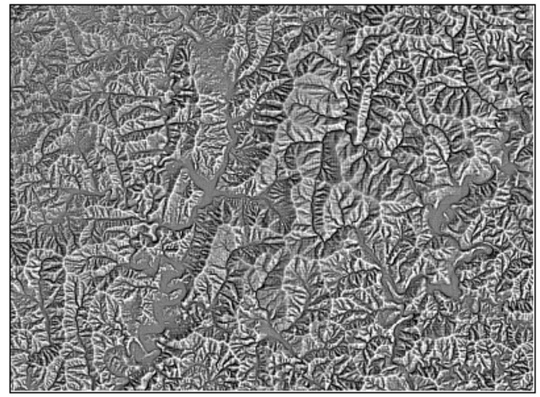
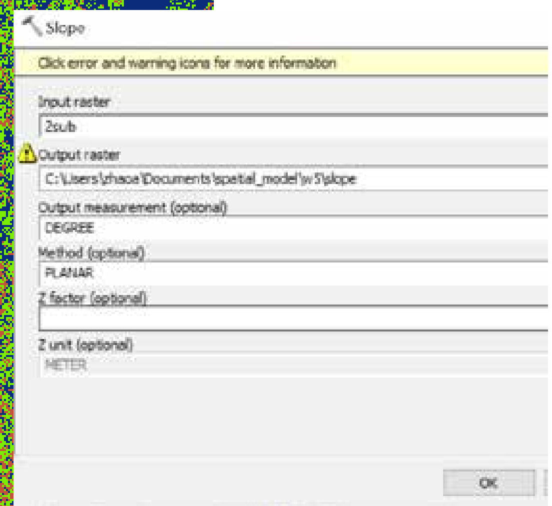
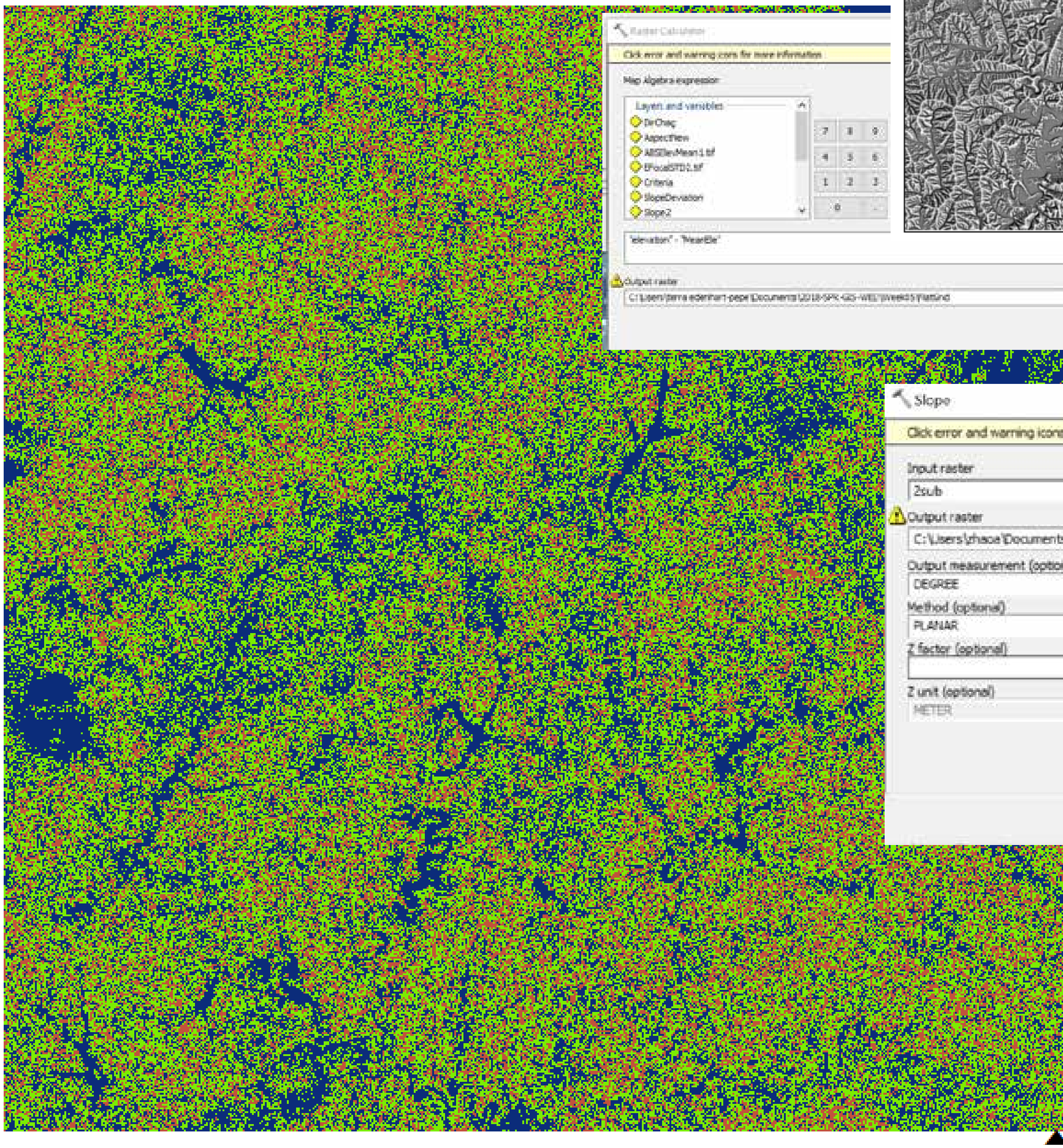
5 Slope

Since topographic complexity is a measure of roughness, adding slope to the measurement criteria was in order. The slope in the number 5 criteria grid was calculated from the flat terrain grid.



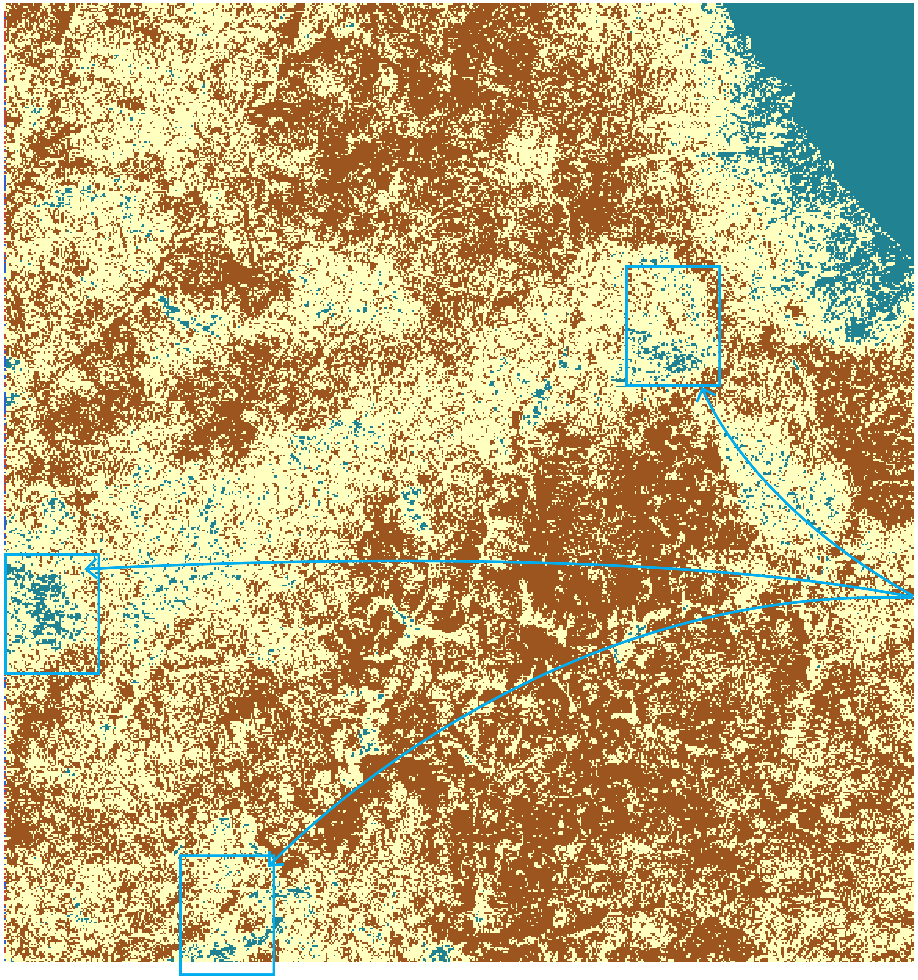


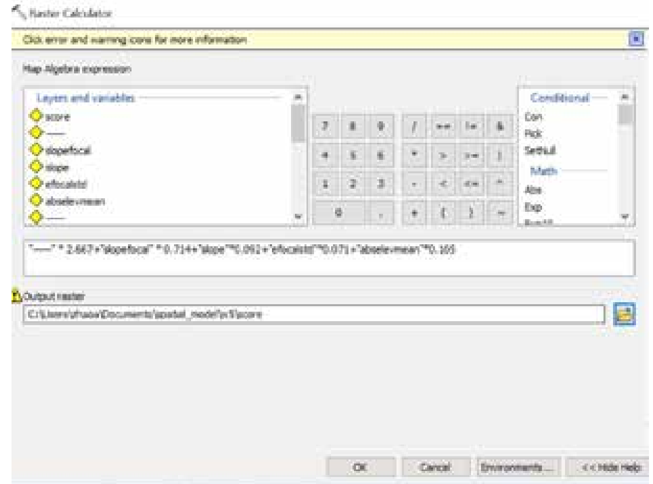


Legend

Topographic roughness index

0 - 6.530099996	mild
6.530099997 - 13.21947072	moderate
13.21947073 - 40.61403656	roughest





The Final Grid is the result of weighted criteria (5) combined with the use of Raster Calculator.

Standard deviation of Elevation:10

Elevation variability value: 7

Standard deviation of slope: 10

Aspect range: 8

Slope: 5

Raster calculator was used again to add the weighted criteria together for the final score.

location options

Legend

Topographic Roughness Index
(Weighted Score Results)

	2.667000055 - 9.71505639	Smooth
	9.715056391 - 16.03400345	Everything else
	16.03400346 - 33.65414429	Rough