GIS in Water Resources
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Project Summary:

For this project, I am investigating the performance of ArcGIS feature extraction tools in diverse physical landscapes. The study focuses on two basins, the first being the Eel River Basin in northern California, which is characterized by highly vegetative land and stark elevation variations. The second is the Le Sueur Basin in southern Minnesota has a low-relief terrain, and features meandering river channels. From each basin, I planned to delineate a sub-basin of approximately 1 km^2 in size utilizing the Hydrology tools in ArcGIS. Using these tools, I aimed to extract feature information for the sub-basin including: accumulation area, curvatures, and slopes. An analysis of the curvature data using quartile-quartile plots can be used to identify channel and ridge features in the sub-basins. Graphs of the accumulation areas versus slopes for the sub-basins can be used to identify the initiation area/channel head which corresponds to the inflection point on the graph. To complete the analysis, I will compare the results from these two sub-basins to illustrate GIS extraction tools' capabilities and limitations in diverse landscapes.

Project Progress:

To begin, I acquired LIDAR data for an approximately 16 sq. km region in the Eel river Basin from the NSF Open Topography portal. The DEM of this data is shown below.

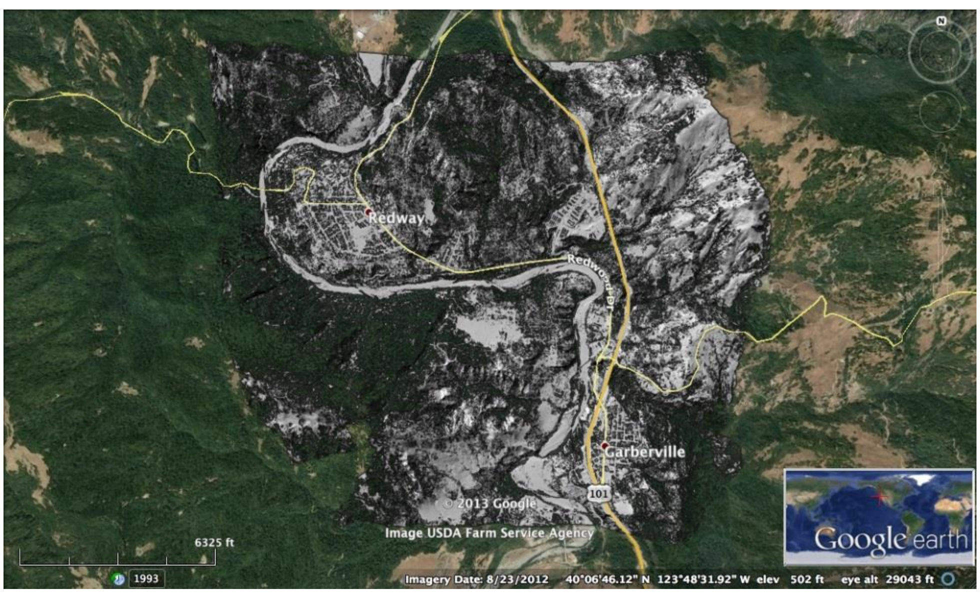

Figure 1. Sub-section of Eel River Basin, CA.

I also acquired an approximately 36 sq. km region in the Le Seuer Basin in Minnesota from Harish Sangireddy, a colleague in my research group. The hillshade of this data is show in the figure below.

Figure 2. Le Seuer Basin, MN.

I had planned on using the the HUC 12 Watershed Boundary Dataset from the USGS to clip an approximately 1 km^2 sub-basin from each data set. However, I found that the HUC sub-basins, which are the smallest available in from the USGS, were too large for my purposes.

I went ahead and calculated the slopes and curvatures for both of the large basins in ArcGIS, in order to get a preliminary idea of the results, while I tried to figure out a new way to delineate sub-basins of a smaller size. I then exported the curvature data as .tiff files, in order to perform analysis on them in MatLab. I graphed histograms and quantile-quantile plots in MatLab to visualize the distribution of the data, as well to look for signatures of channel and ridge features, which can be interpreted as deviations in linearity on the quantile-quantile plot.

The plot results for both basins are shown below:

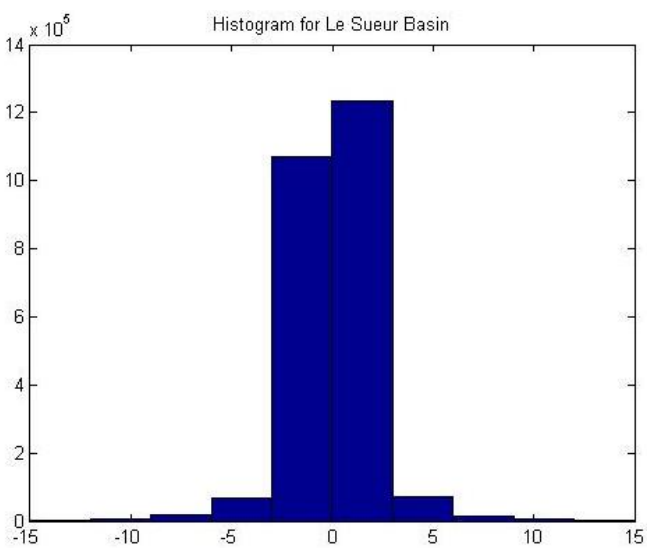

Figure 3. Histogram of curvature values for Le Seuer Basin, MN.

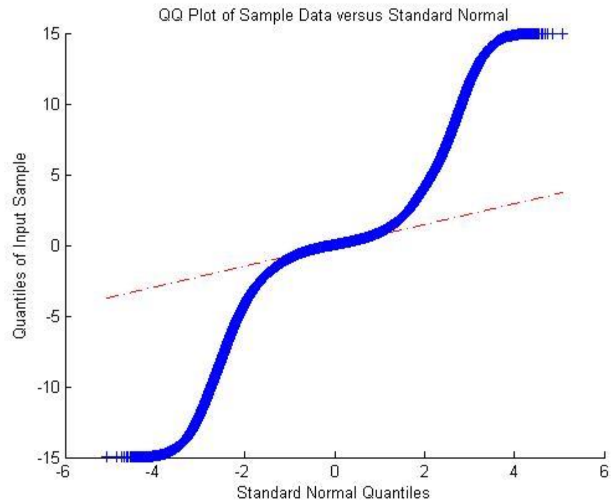

Figure 4. Q-Q plot of curvature values for Le Seuer Basin, MN.

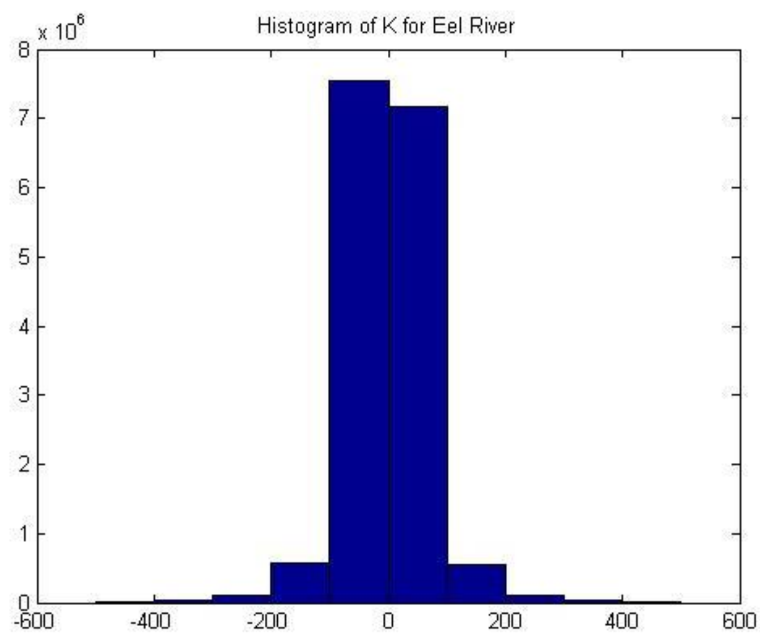

Figure 5. Histogram of curvature values for Eel River Basin, CA.

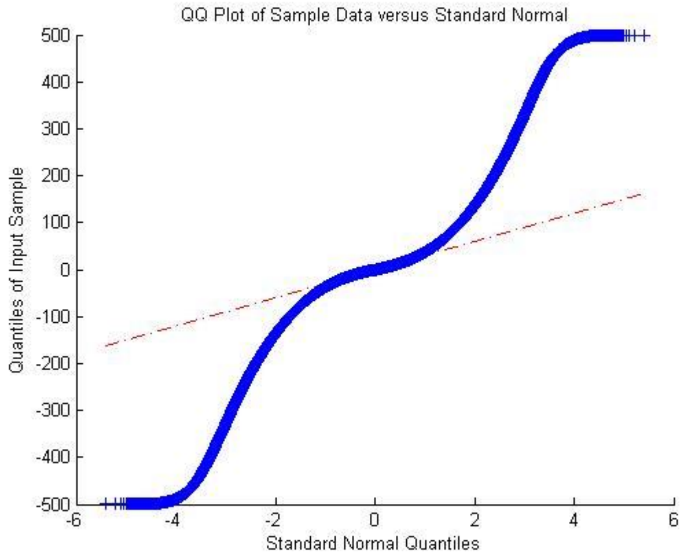

Figure 6. Q-Q plot of curvature values for Eel River Basin, CA.

After taking a closer look at the Eel Basin curvature data, I realized there was a problem with it. As seen in this plot of the values, there are a large number of "No Data" values within the basin extent. These appear as blue pixels in the plot below.

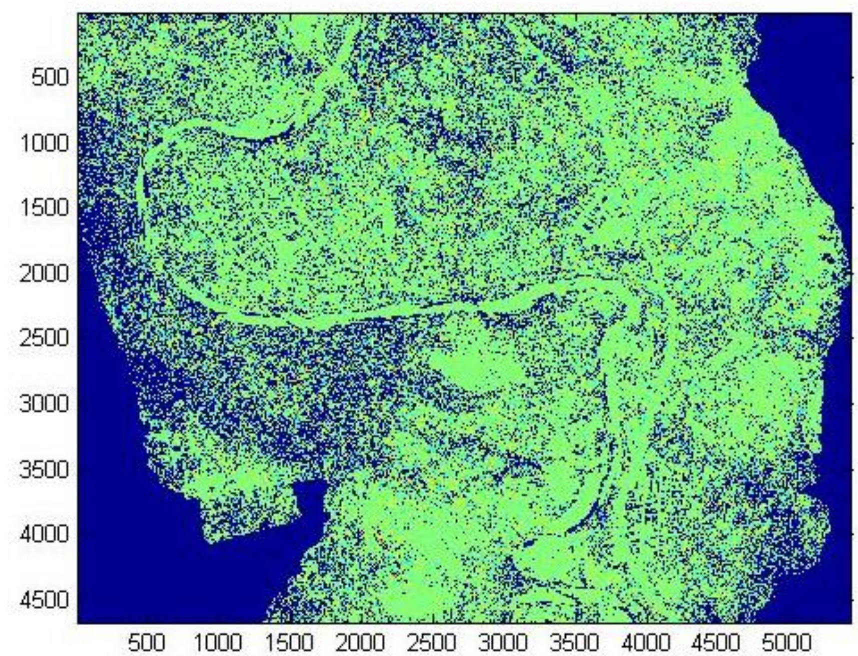

Figure 7. Plot of curvature values for Eel River Basin, CA.

After doing some research, I realized that I didn't select a triangulated dataset when I downloaded it from OpenTopography.com. In the triangulated dataset, the null values are assigned by interpolation from the surrounding pixel values with LIDAR data.

I re-downloaded a dataset for the Eel River. I also obtained the NHDPlus catchement dataset, to use for sub-basin delineation.

The new sub-basin I am working with from the Eel River Basin, and the sub-basin for the Le Seuer are shown below:

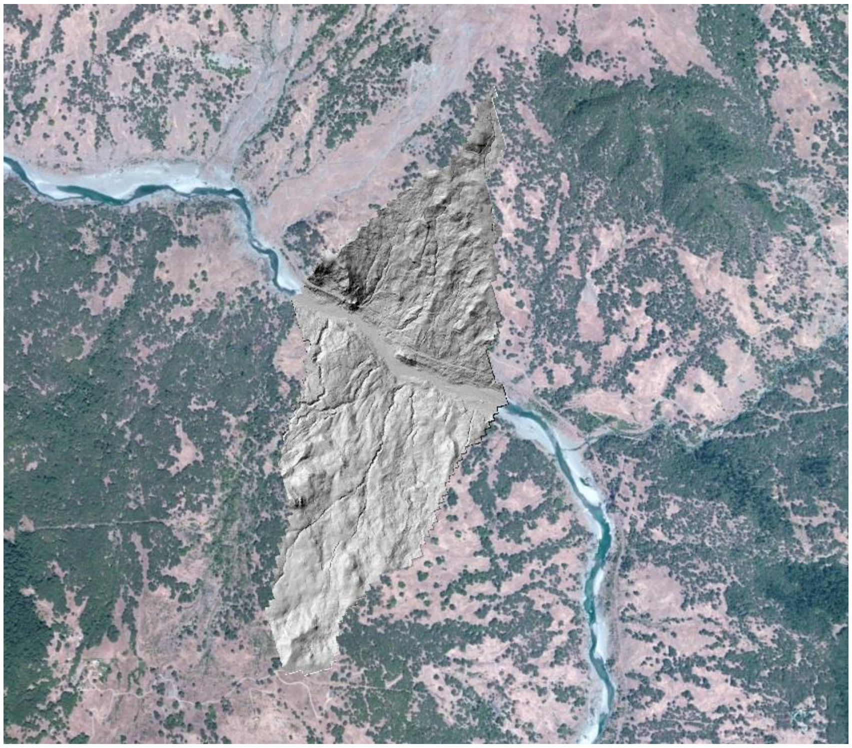

Figure 8. 1.7 km^2 sub-basin of the Eel River Basin.

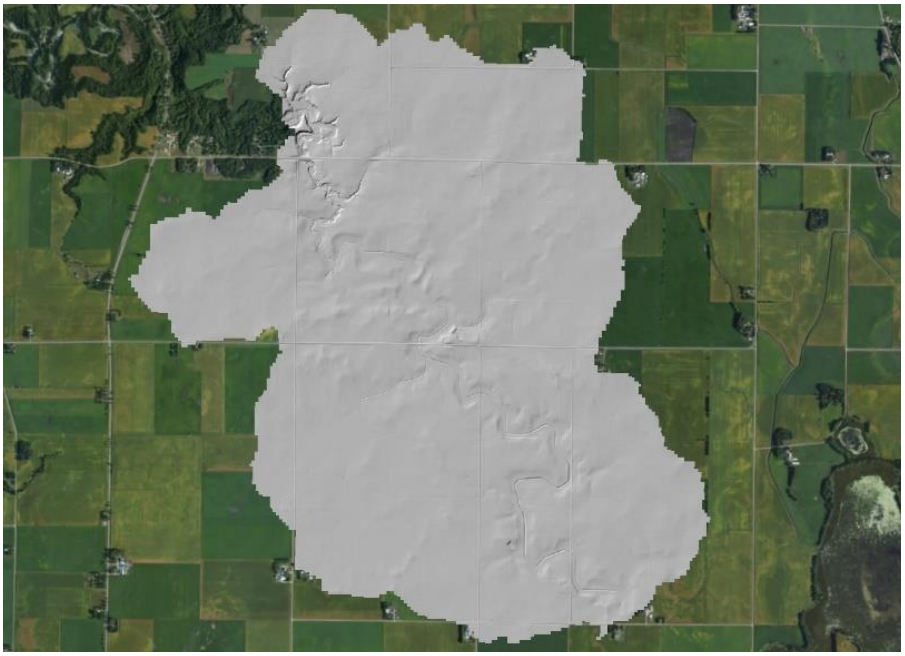

Figure 9. 17.9 km^2 sub-basin of Le Seuer Basin.

I chose a larger sub-basin for the Le Seuer than I had initially planned on because the smaller basins at the northern extent of the dataset do not appear to be characterized as much by very low-relief terrain with meandering features.

I plotted the histogram and curvature q-q plots for each of the new sub-basins.

For the Le Seuer:

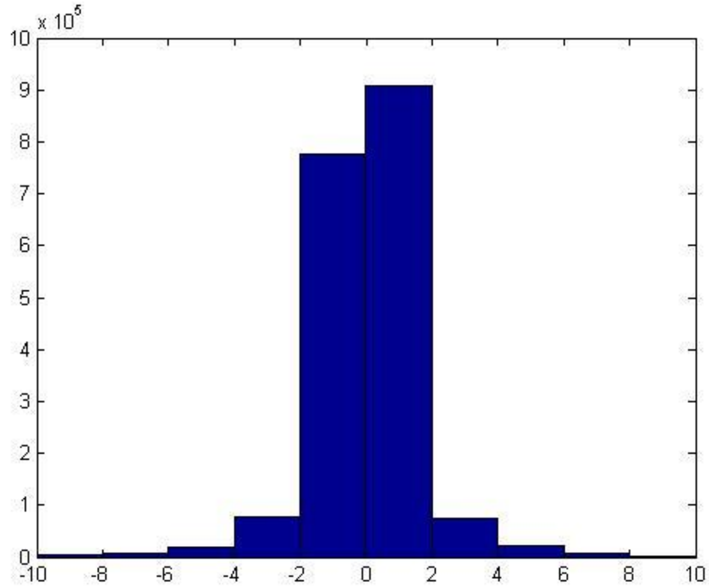

Figure 12. Histogram of curvature values for Le Seuer Basin, MN.

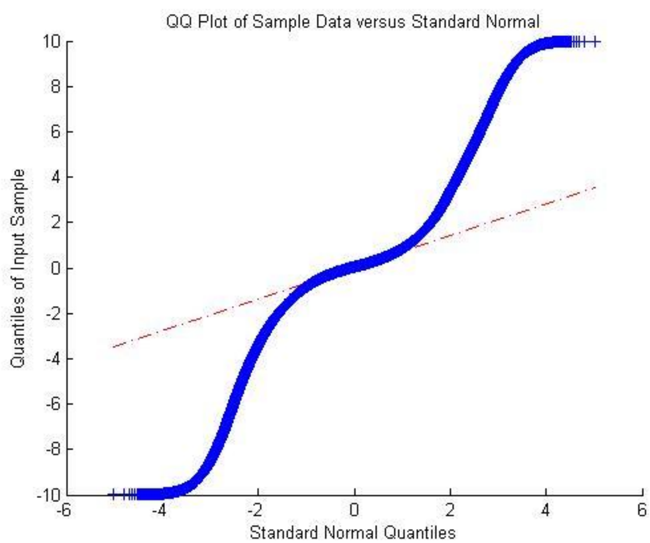

Figure 13. Q-Q plot of curvature values for Le Seuer Basin, MN.

For the Eel:

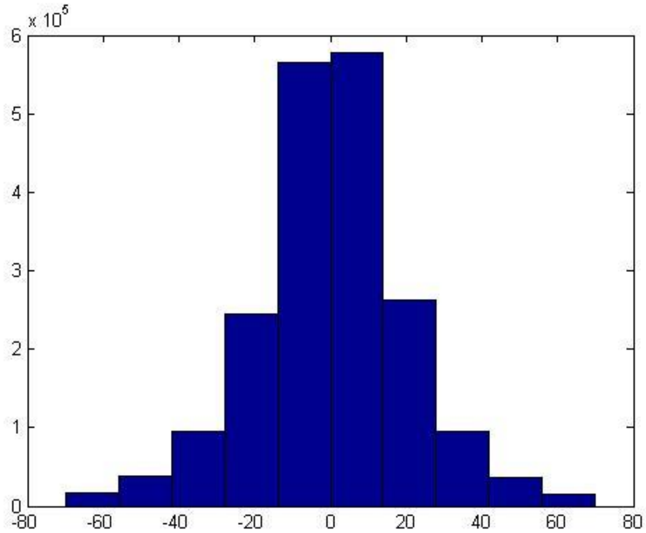

Figure 10. Histogram of curvature values for Eel River Basin, CA.

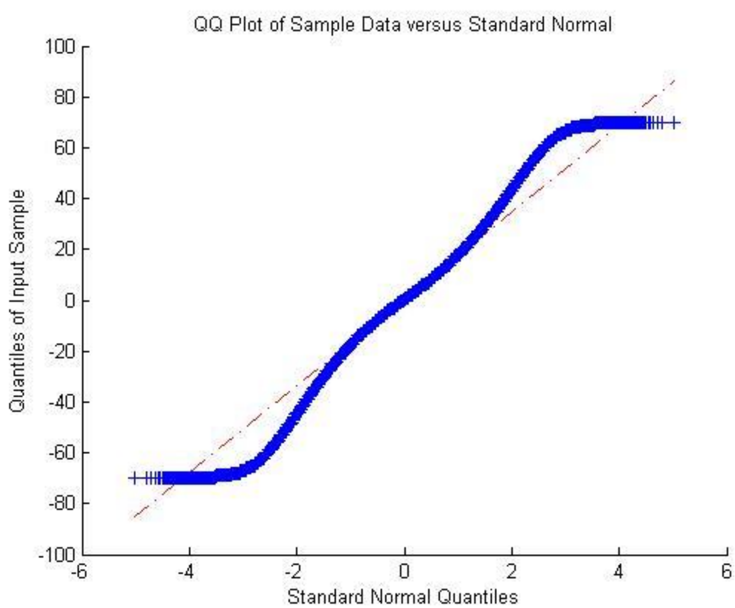

Figure 11. Q-Q plot of curvature values for Eel River Basin, CA.

I am now working on further evaluation of these curvature datasets. This will include re-editing the curvature data and interpreting these plots. In particular, it seems that the sub-basin of the Le Seuer has a good amount of erroneous data points, when looking at the deviations from linearity in the q-q plot. Also, now that I have the sub-basins that I am working with delineated, I will begin the accumulation area processing.