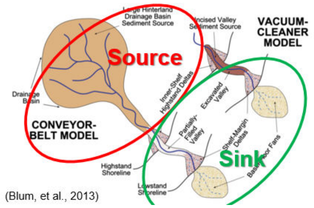
Calculating Drainage Basin Area in Paleoclimates

COLLEGE OF SCIENCE & ENGINEERING

Jacob Pate - Geology Major, School of Geology, Energy and, the Environment
Faculty Advisor: Tamie Morgan, SGEE

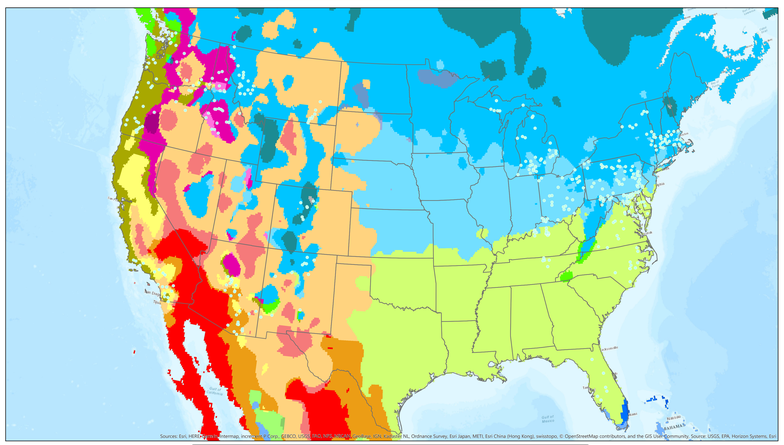
INTRODUCTION

When calculating source-to-sink sediment flux it is important to have an accurate and precise basin model. Most models today are too broad and don't accurately represent the true drainage basin area, therefore when calculating the sediment flux of a stream the numbers are highly skewed and inaccurate. By using over 300 stream gauge data points collected by Nicole Wilson, a graduate student at TCU, a database was made for modern fluvial systems. This database accurately and precisely maps and measures the area of a streams drainage basin within its paleoclimate. Having this data and drainage basin model is an important part when calculating source-to-sink sediment flux by taking the known climate area of the fluvial system and determining the bankfull duration of the system. For example in boreal climates they tend to be at bankfull flow for a longer duration of time than arid climates. This reduces the total error in calculation of the sediment flux for stratigraphic systems and creates more accurate drainage basin models.

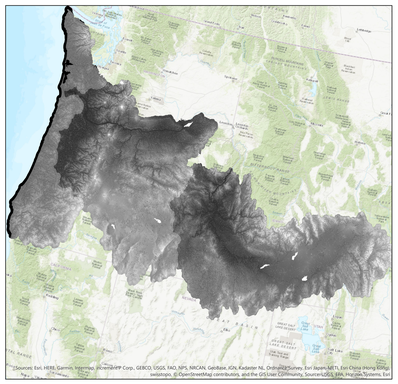


(Blum, et al., 2013)

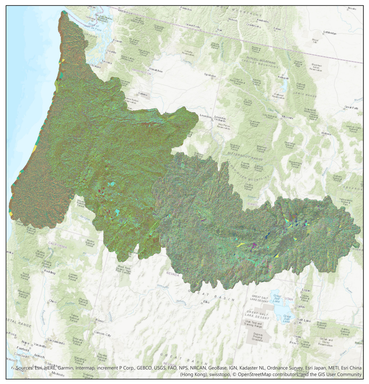
STUDY AREA



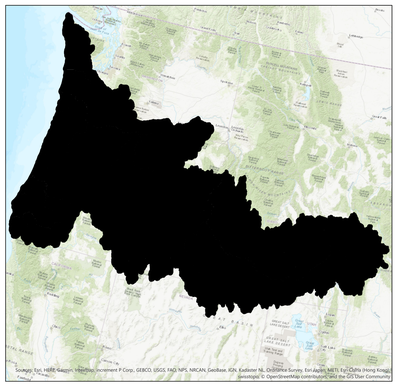
Analysis



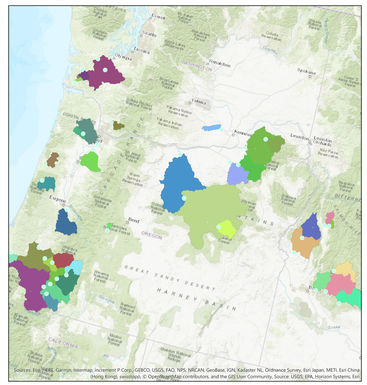
Step 1. Download the NHDPlusV2 drainage area hydrodem data. This data set is very large due to the vast area and the highly precise data collected by the US Geological Survey.



Step 2. Use the Flow Direction geoprocessing tool on the NHDplusV2 hydrodem layer. This tool takes the elevation data from the hydrodem layer and uses it to find the direction of the flow that a stream would take.



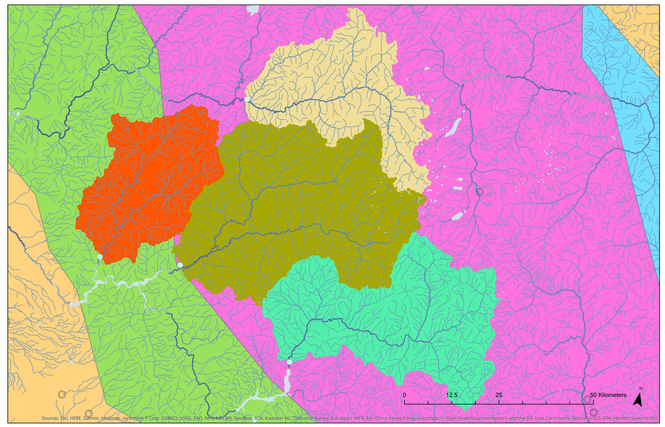
Step 3. Use the Flow Accumulation geoprocessing tool on your new Flow Direction layer. This tool uses the flow direction and the elevation to process the most accurate reading on where the flow is accumulating.



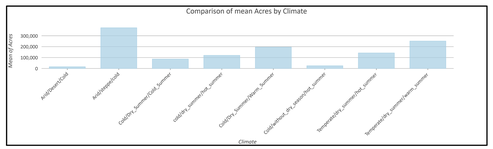
Step 4. Make sure that the stream gauge points are snapped to the Flow Direction layer. Then run the Watershed spatial analysis tool on your Flow Direction layer.

Credits:
Gauge data sources-HYDAT: The Water Survey of Canada (wsc), IDEAM: Institute of Hydrology, Meteorology and Environmental Studies, OPW: The Office of Public Works, USGS: United States Geological Survey: National Water Information System, given by Nicole Wilson TCU graduate student
NHDPlusV2data,accessed april 12,2018, at http://www.horizon-systems.com/nhdplus/.
Peel, M. C., Finlayson, B. L., and McMahon, T. A.: Updated world map of the Köppen-Geiger climate classification, Hydrol. Earth Syst. Sci., 11, 1633-1644, doi:10.5194/hess-11-1633-2007, 2007.
U.S. Geological Survey, 2017, USGS Sediment Data Portal available on the World Wide Web, accessed May 08, 2017, at URL https://cida.usgs.gov/sediment/.

Conclusion



By using the multiple geoprocessing tools, which mainly include Flow Direction, Flow Accumulation, and the Watershed Spatial Analysist tool, we can accurately map the drainage basin area of a particular fluvial system. By taking that area we then found the % of which climates that drainage basin lies within. When calculating total source-to-sink sediment flux the percentage of area within a certain climate is needed to get a more precise estimate.



Limitations

Time was the most limiting factor for this project. Due to the vast amount of data required to correctly build these drainage basin models the geoprocessing tools we use to make them take a long time to run. The section that I was able to finish in the northwest United States ran for multiple days on end before all of the geoprocessing tools were able to finish.