Geospatial Analysis of the Pattern of Floodplain, Geomorphology, Land Use, and Riparian Vegetation in the Tuolumne River Watershed

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USDA Internship: May 18, 2012 – May 18, 2013

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Report Submission: March 15, 2014
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Acknowledgements

This project was supported by Agriculture and Food Research Initiative Competitive Grant no. 2011-38422-31204 from the U.S. Department of Agriculture (USDA) National Institute of Food and Agriculture. I would like to give thanks to my advisors Dr. Austin Avwunudiogba and Dr. Peggy Hauselt for guidance, sharing skills and exposure to hands on training with fieldwork. I would also like to thank Aldo Garcia, Michael Machado and Joshua Buchanan for working hard and sharing the experience.

Executive Summary

The purpose of this study was to gain information on the Stanislaus, Tuolumne, and Merced rivers of the Central Sierra Nevada Watersheds (CSNW). Central California has undergone decades of agricultural cultivation and urban developments have exerted profound impacts on hydro-geomorphic characteristics of the CSNW. Under the directions of Drs. Avwunudiogba and Hauselt, four watershed interns researched the CSNW. We obtained various spatial data sets including a digital elevation model, soil data, national hydrographic data, land use data, and land cover data from various online public databases. To analyze changes, a series maps were created using geospatial technology in ESRI’s ArcGIS version 10.1-10.2. These maps identified the hydro-geomorphic characteristics of the CSNW and may be beneficial for future studies. We collected soil samples along the Tuolumne River. To disseminate our results we wrote a manuscript describing the atlas of CSNW maps for the Journal of Maps (rejected), and we presented the maps at the 2013 California Geographical Society Meeting in San Luis Obispo and the WRPI 2013 Meeting in Long Beach.

Project Objectives:

California’s CSNW is of great importance to the San Joaquin Valley. There has been significant modification due to human impact such as agriculture, dam construction, urbanization, and other activities. It is of great importance to maintain a natural ecosystem in the CSNW for humanity and to the organisms that depend on this environment along the rivers.

As Interns, we obtained skills and experience that will potentially be beneficial for future works. We became familiar with the use of online sources of geospatial data related to watershed and water resources management. Data processing and analysis was performed using the GIS software ESRI ArcGIS 10.1. We also, performed basic hydrologic modeling task such as generating watershed boundaries from DEMs, and integrating land use data.
Unfortunately, we were not able to obtain LIDAR data to help assess the effects of urbanization on stream channel characteristics. We then as a team went on various field work expeditions and physically gathered data by observing current land use and riparian vegetation pattern within the floodplain, photographed river markings, collected soil samples and hydrologic soil properties (infiltration, soil moisture, penetrometer resistance, etc.) (Figure 1).

In addition to the original objectives, we also attempted to disseminate our results. We wrote a manuscript for the peer-reviewed Journal of Maps. We presented the maps at the 2013 California Geographical Society Meeting in San Luis Obispo and the WRPI 2013 Meeting in Long Beach.

Project Approach:

As an intern, I was exposed to various online sources and publicly available Geographic Information System (GIS) data sets. I became familiar with data processing and analysis using the GIS software ESRI ArcGIS 10.1. I helped create a series of maps that identify the hydro-geomorphic characteristics of the CSNW.

I was exposed and guided on various types of fieldwork techniques and the methods. My Advisor, Dr. Avwunudigba and intern team took various visits along the Tuolumne River to observe and photograph the impacts of agricultural cultivation and urban development on the hydro-geomorphic characteristics of the CSNW (Figure 1 & 2). Also, our team was guided by Advisor, Dr. Hauselt on conducting fieldwork in the Stanislaus National Forest where I performed various procedures collecting hydrologic soil properties and soil samples (Figure 3). We used several methods to collect soil properties and soil samples such as, a shear strength-measuring tool, a soil penetrometer, a rubber mallet with a soil corer, etc. (Figure 4, 5, 6, 7,8 & 9).

Project Outcomes:

Our results are a series of maps that provide various characteristics of the CSNW and a foundation for future studies. Ten maps were created for gaining information on the CSNW. The type of maps created were Reference, Land Use, Land Cover, DEM, Slope, Aspect and various Soil Classifications types. A variety of posters were also created and presented using our maps, research data and cartography skills to display. We presented the maps at the 2013 California Geographical Society Meeting in San Luis Obispo and the WRPI 2013 Meeting in Long Beach.
Beach (Figure 10). We wrote a manuscript for the peer-reviewed *Journal of Maps*. The editors suggested that we revise and re-submit the manuscript. We are still revising it. See appendix of the manuscript.

Conclusions

CSNW is of great importance, not only to the San Joaquin Valley of California, but to humanity and to the organisms that depend on the natural ecosystem of the Stanislaus, Tuolumne, and Merced River. Our study is of particular interest, given the recent Rim Fire. As interns, being given the chance to obtaining knowledge and experience of the CSNW though the USDA WRI was beneficial on many levels. We have developed skills to continue our works in research; we have gained knowledge through exposure of online sources of geospatial data related to watershed and water resources management, and experience of becoming familiar with ArcGIS. This has increased not only our education, but our value as prospective employees for a career with the USDA. I have begun a Master’s of Interdisciplinary Science in Geospatial Analysis at CSU Stanislaus, and I am still interested in potential careers/internships with the Forest Service and NRCS.
Figure 1: CSU Stanislaus, WRPI Watershed Management Interns; Aldo Garcia, Oleta Piecuch, Michael Machado and Joshua Buchanan along the Tuolumne River.
Figure 2: Dr. Avwunudogba and intern team along the Tuolumne River discussing the impacts of agricultural cultivation and urban development on the hydro-geomorphic characteristics of the CSNW.
Figure 3: Fieldwork in the Stanislaus National Forest where we performed various procedures collecting hydrologic soil properties and soil sample.

Figure 4: (Self) Using infiltration technique.

Figure 5: Shear strength-measuring tool used to record the torque at which the soil broke loose.
Figure 6: Preparing site to gather soil sample using a rubber mallet and a soil corer.

Figure 7: Soil sample

Figure 8: Heading out for site 3 in the Stanislaus National Forest.

Figure 9: Performing various methods to gather soil properties and samples at site 3.
Figure 10: Presenting map at the 2013 California Geographical Society Meeting in San Luis Obispo.