Climate Visualization
for
Natural Resources

Alpha Prototype Report

Center for Sustaining Agriculture and Natural Resources

Mentors

Keyvan Malek, Giridhar Manoharan, and Kirti Rajagopalan

Gemini

Matt Bourland, Hasnain Mazhar, Ryan Torelli and Roosevelt Young

Course: CptS 421 Software Design Project I

Instructor: Aaron Crandall

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I. Introduction

The Center for Sustaining Agriculture and Natural Resources (CSANR) [1] has requested a web-based tool for aiding sustainable practices of agriculture in the face of climate change. The primary user group is agricultural professionals of the United States who advise agricultural producers on crop and livestock selection, growing and rearing practices, and pest management.

In 2016, a design team delivered one feature toward development of the decision tool. During the 2017-18 academic year, a second design team is undertaking development of an additional feature.

This design project aims to build a feature that shows through data visualization how climate change impacts land used for cattle production. The feature comprises a map of the United States and a series of graphs. The map visualizes data on a large spatial scale and the graphs visualize data on a smaller, aggregated spatial scale.

The data contains values for a set of environmental factors over decades at locations across the United States. The values range over time from the past to the future, where future values have been forecast by computational models of climate. The data was curated by the US Department of Agriculture, Forest Service, and has been reported in a peer-reviewed publication [2].

The outcome of the design project is delivery of one feature for extension of a web-based decision tool. The feature, hereafter called Rangelands, visualizes climate change on lands in the United States and will be made available to the public at no cost.

This document contains five additional sections:

> *Section II* presents a description of the alpha prototype in its current state
> *Section III* presents a demonstration of the alpha prototype including our mentor's feedback on the demonstration.
> *Section IV* presents future work that we are planning for next semester
> *Section V* presents a glossary of specialized terms
> *Section VI* presents references

# II. Alpha Prototype Description

II.1.1.   Splash Page
II.1.1.1.   Functions and Interfaces Implemented

The splash page is mostly complete. The functionality that is currently implemented is the drop down menus, the map, the boundaries, the legend, and the click and direct to data view page. We have some refinement to do. For example when the user experiences some lag when they click on an area before being directed to the data view page.

II.1.1.2.   Preliminary Tests

The testing that we have done in this feature so far is just system testing. This included clicking on all of the boundaries to ensure that the data view page was able to be reached from the splash page. We also tested the drop down menus. For example we wanted to ensure that selecting a different boundaries caused a change in overlay on the splash page. The following

are two images showing this test. The first is displaying the state boundaries and the second is displaying the county boundaries.
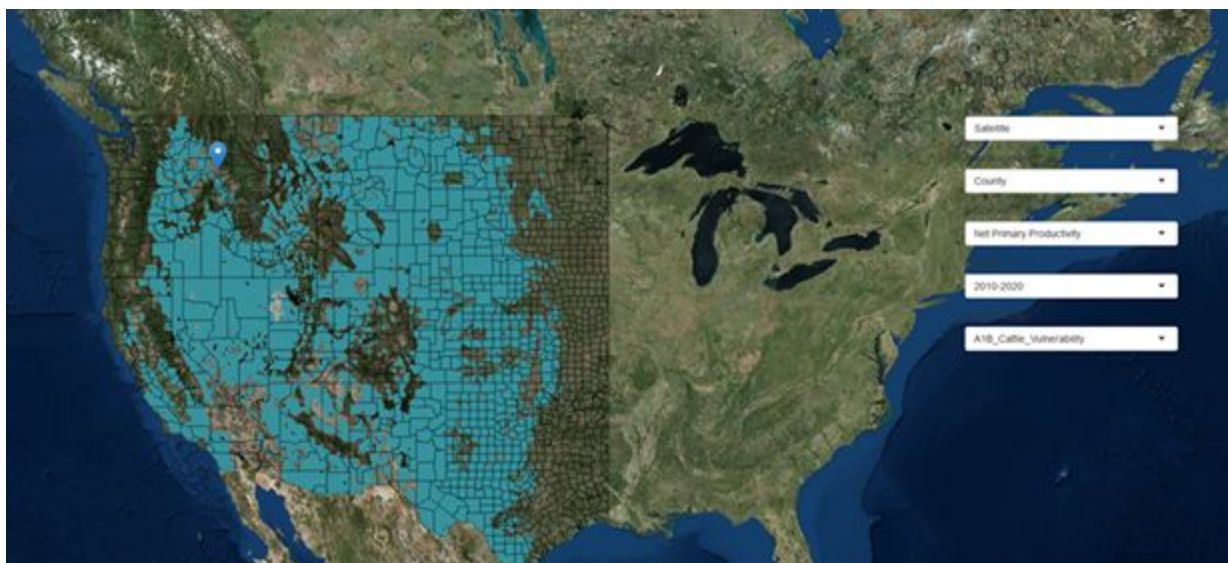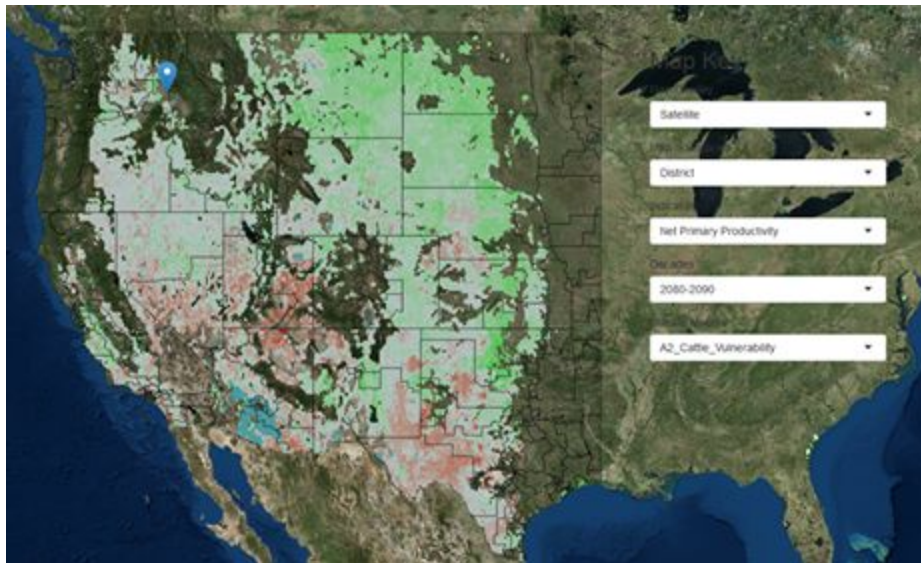
II.2.   Server
II.2.1.1.   Functions and Interfaces Implemented

None of the server is implemented yet. The work that remains is to determine our hardware requirements (how much space is needed), upload data set to server, and upload our final product to the server.

II.2.1.2.   Preliminary Tests

No testing has been done for the server yet as it is not implemented.

II.3.   Data View Page
II.3.1.1.   Functions and Interfaces Implemented

The functionality that is implemented on the data view page is a basic box plot of the sample data. We still need the data from our sponsor (in the correct format). The work that remains to be done is to make it so that the data view page is generated from what area the user selected, the indicators they selected, and the time period they selected. We are also going to poll our stakeholders to determine what information they would like to see on this page and add information accordingly.

II.3.1.2.   Preliminary Tests

The testing that has taken place on this system is just system testing. We clicked on every boundary to be sure that the data view page was able to be generated from every area that it should be. The following is a screenshot showing what the data view page looks like currently.
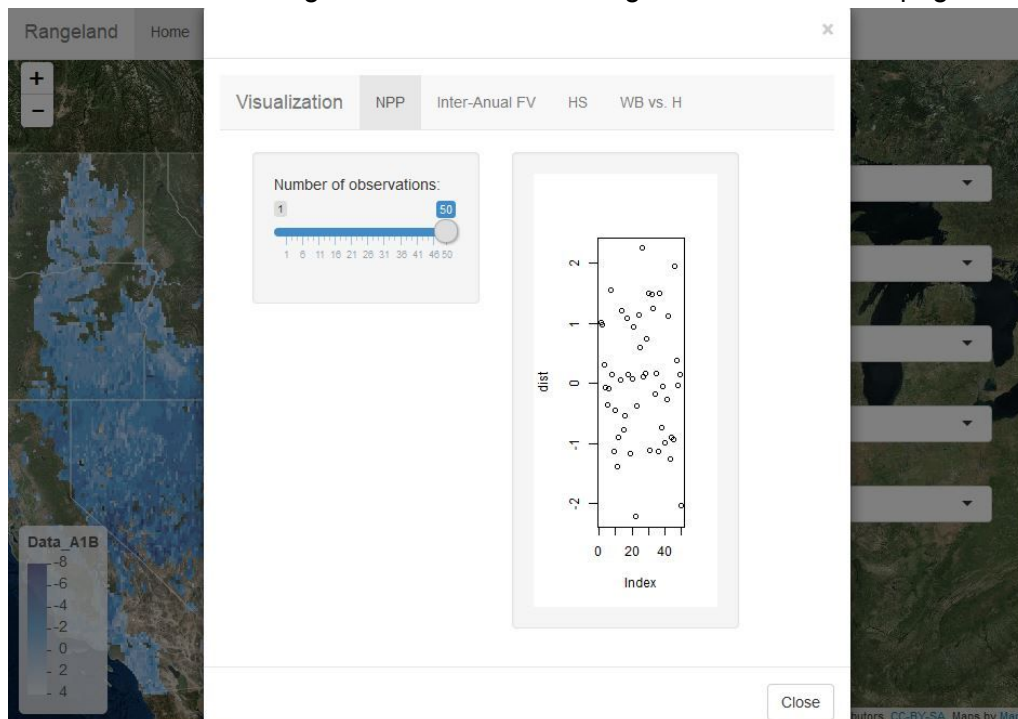
III. Alpha Prototype Demonstration

We showed our mentor a live demonstration showing the current state of the tool. The tool was run on one of our machines instead of over the internet because we do not yet have root access to the server. We started with the splash page showing that our map, menus, legend, and clicking functions were all in place. After that we proceeded to select an indicator, a time period, and a boundary and clicked on an area to be directed to the data view page. Our mentor had a few great suggestions for our prototype. First, to fix the lag when hovering over boundaries, he suggesting adding a 0.25 second delay to query the displaying of the name of the boundary. This way when a user move their cursor across the map, it does not waste processing power showing the names of all of the boundaries they crossed. Then when a user does want to select a boundary, they must simply stop and hover over the boundary that they want to select for 0.25 seconds before the name pops up. Our mentor also suggested that we poll our stakeholders to find out what exactly they want to see on the data view page. Currently the page does not contain a lot of information. Our mentor asked us what additional information we thought should

be on the data view and we all agreed that none of us had a clue. Finally, our mentor asked if we were planning on adding any more functionality to our splash page. We all agreed that we would not add any more functionality to our splash page unless it was specifically asked for by our sponsor. In the initial stage of eliciting requirements, our sponsor asked that our product look and feel as much like the climate visualization tool as possible. We have achieved that objective.

IV. Future Work

The tasks that we have planned for second semester are:
- Incorporate New Dataset
- Plot Indicators
- Indicators Descriptions
- Produce User Help Tutorial
- Test Browser Compatibility
- Performance Optimization
- Refactor Design
- Parse Data
- Determine Hardware Requirements
- Integrate with previous teams work

Our plan to complete this work is to start by incorporating the new dataset and refactoring the design. At the same time we will need to complete the related tasks of parsing the data and determining the hardware requirements of our system. After our dataset is incorporated, we can plot the indicators, create indicator descriptions, produce a user help tutorial, test browser compatibility, optimize performance, and finally integrate our product with last years system. The following is a schedule detailing when these tasks will be completed and the order that they will happen.
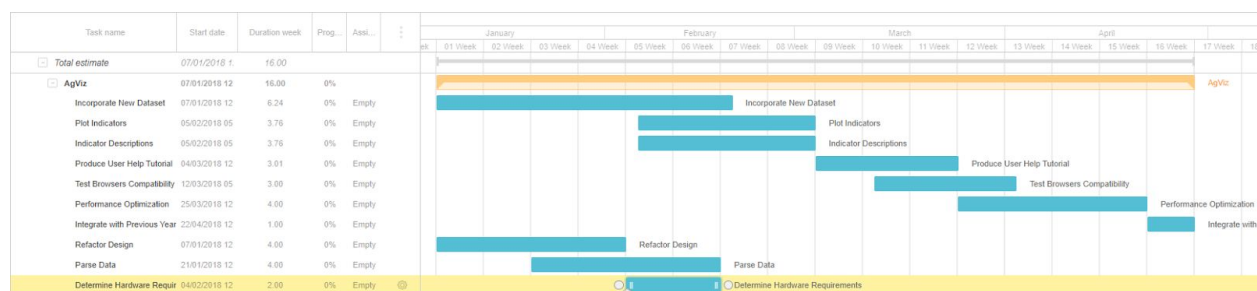
V. Glossary

Agriculture Professional - Crop consultant who advises on crop choices or university extension staff member that advises on best practices

Net Primary Productivity - The amount of carbon uptake after subtracting Plant Respiration (RES) from Gross Primary Productivity (GPP). GPP is the total rate at which the ecosystem capture and store carbon as plant biomass, for a given length of time

Interannual Variability - Value describing the interannual standard deviation in annual average forage quantity for a region

Heat Stress - Negative effects on cattle due to higher than usual temperatures

Relative Fraction of Woody vs Herbaceous Plants - Ratio of inedible to edible plants

Leaflet - Open-source JavaScript library for interactive maps

Rangeland - Open country used for grazing or hunting animals

Shiny - An open-source R package that provides an elegant and powerful web framework for building web applications using R

VI. References

[1] CSANR. (2017). *Center for Sustaining Agriculture and Natural Resources* [Online]. Available: http://csanr.wsu.edu