CS171 Project Proposal

Background and Motivation

Snowfall has been mentioned by several leading environmental agencies as an important indicator of climate change globally. In light of recent snow events in Boston (i.e. Boston having its snowiest year on record), we thought it would be interesting to visualize changes in snow patterns over time throughout the U.S. to see if recent patterns are actually abnormal, and could therefore indicate real changes in the earth's climate. We want to create a visualization that makes it easy for users to compare changes in snow patterns for the entire U.S. and smaller regions over time, and relative to each other. To accomplish this task, we plan on making use of the NASA MODIS dataset, which uses satellite imagery to create a dataset that provides snowfall data on the latitudinal/longitudinal level. In addition to relaying interesting information about snowfall, we decided to pursue working with the NASA MODIS dataset because we thought it presented interesting challenges related to visualizing large datasets. This dataset is also particularly appropriate for this task because it provides the data in a format that will make it easy to create a comprehensive map-view of snowfall in the United States. Additionally, one of our team members, Andrew Moran, is currently involved in a research project related to the utilization of this dataset.

Project Objectives

Our main goal is to create a detailed visualization of snowfall in the US from satellite imagery data. We want a very interactive and intuitive interface that makes it easy to discover snowfall patterns over time. With current concerns of climate change, we thought that users can potentially predict weather patterns based on previous measures in snowfall amount, coverage, duration, etc. This could eventually extend to making comparisons and drawing conclusions of snowfall in other regions of the globe. We plan to achieve this using a map-based layout. Remaining in the geospatial domain will allow us to experience the added utility of superimposing a large dataset on a well-known geographical display. The user will be given the freedom to browse any region of interest and request more detail via added navigation features (zooming, panning, etc). Creating our own map interface will give us more insight on how other common navigation tools work (e.g Google maps, Open StreetMap). In addition to usability, we plan to exploit the benefits of representing data in a tile-based format. This format allows data to be queried and aggregated faster, providing a rich/high resolution display with the reduced time cost. Also, this representation will allow our visualizer to remain running smoothly without the loss of detail. Enhanced performance is a large benefit, especially is there is potential to use this visualizer for other datasets.

Data

Data will be acquired from the NASA MODIS site. The NASA MODIS is a satellite instrument that records satellite imagery data. This data is stored in a 3D array indexed by latitude, longitude and time (taken from one week of MODIS measurements). We may limit the time range to minimize the scope of the data we are working with. To start, we will be visualizing global snowfall coverage. However, this can potentially be extended to other satellite imagery information such as vegetation estimates on land, phytoplankton populations in the ocean, etc. (Battle et al., unpublished, see attached)

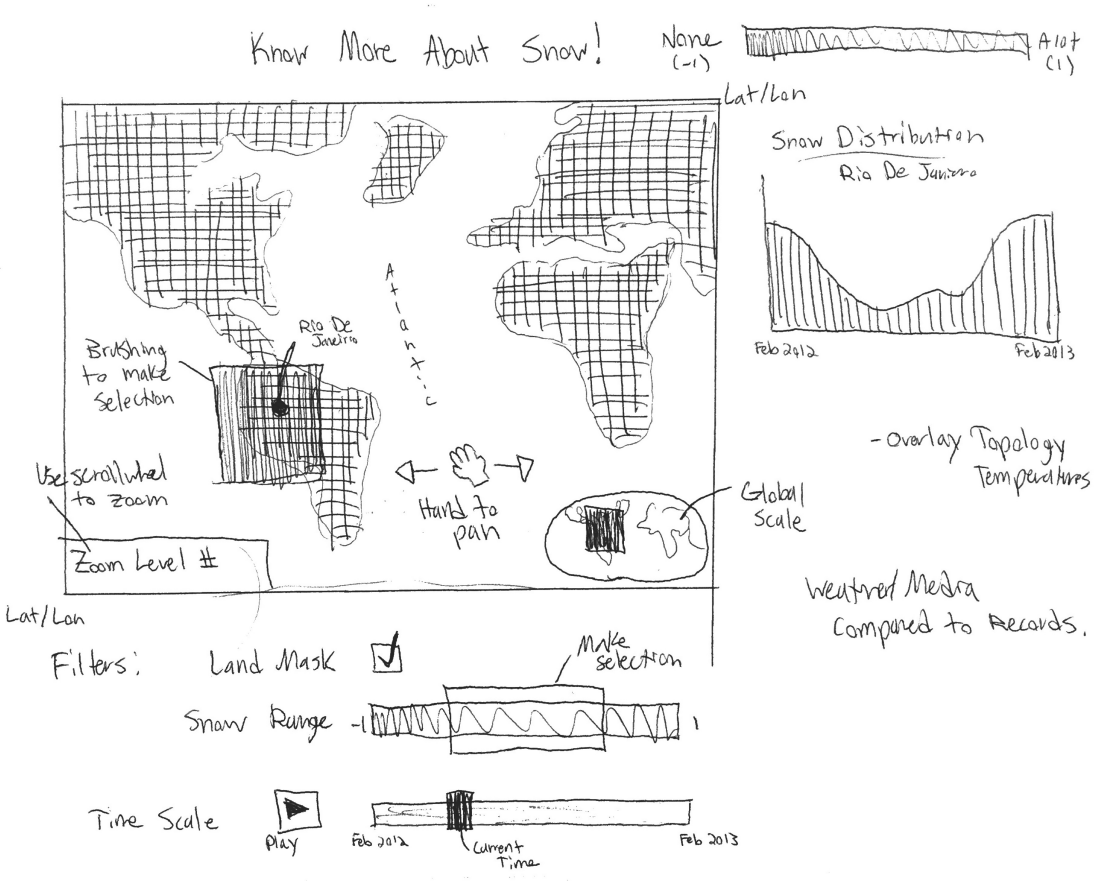
Data Processing

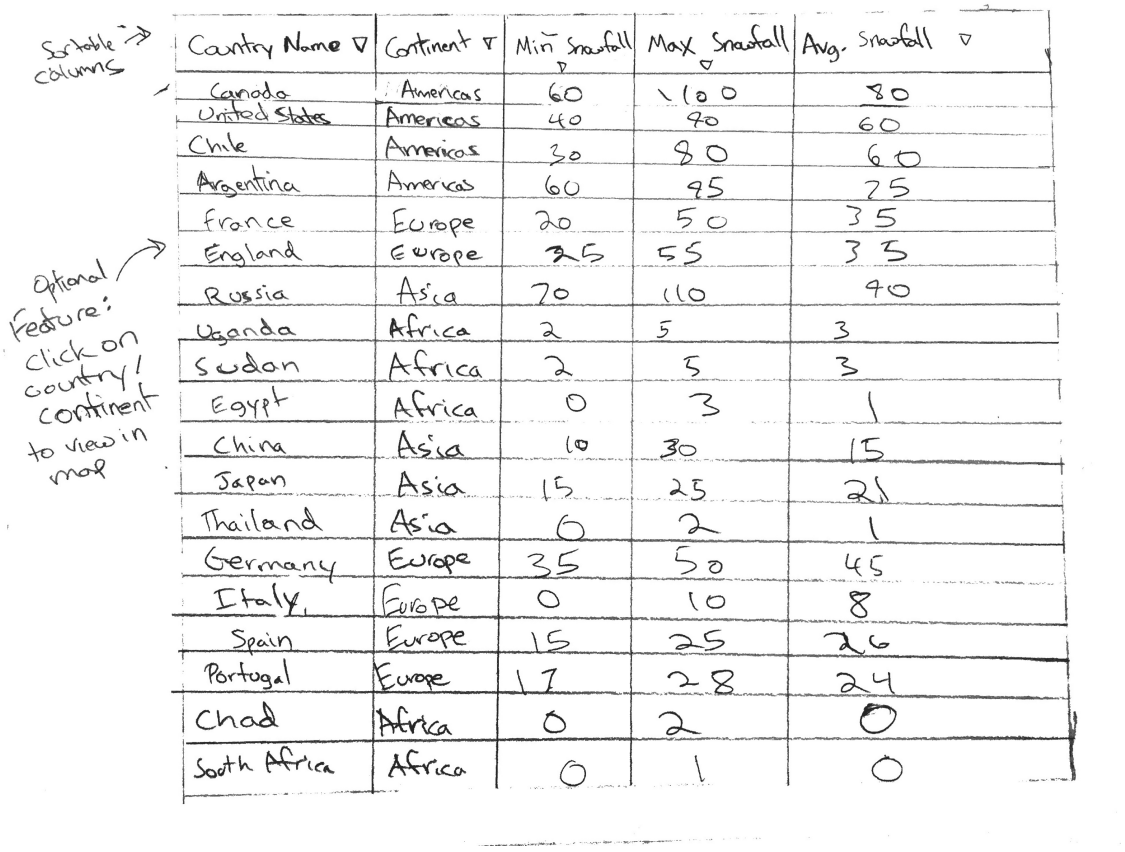
Not much data processing needs to be done besides reformatting the MODIS data into a tile format to help with zooming. We will be using numerical, array-based data so

extracting information would not require additional processing. If we extend to non-integer based data, we will utilize Google Refine. (Battle et al., unpublished, see attached).

Visualization

For our visualization, we plan to have a map of the US (with the plan of expanding to a map of the entire world, if we have time). We will use a pixel-based method where each pixel is colored according to the amount of snowfall in that lat/lon region. In our snowfall example, pixels are colored on a gradient corresponding to a low or high NSDI (Normalized Snow Difference Index) value. Similar to a Google Maps view, users can navigate by zooming & panning. Additional widgets (e.g., scales, radio buttons) on the bottom of the screen will help filter pixels by various characteristics recorded in the dataset (e.g., whether it is a land/ocean pixel, min/max snowfall). The map view will also include an additional view on the side that includes a graph of historical snowfall data for a selected region. Additionally, we will include a table-view of the data set with columns sortable by continent, country, and snowfall level.





Must-Have Features

- Zooming
- Panning
- Filtering - Choose min/max snowfall and only view regions that fall within this range; land/sea mask
- Selection/Brushing - change the view of a graph of the snowfall for the selected region.
- Tool-tips (hover over a pixel to view info specific to the tile/pixel)
- Timeline slider/play button
- Sortable table with data
- Only a map of U.S.

Optional Features

- Overlay height map data with NDSI data (similar to http://colorbrewer2.org/)
- Expand map to entire world
- Overlay of country borders
- Interchangeable MODIS data (Snowfall, vegetation, etc)
- Secondary map to show zoom level in relation to global scale
- Overlay of other relevant data sets (e.g. agriculture, wind speeds, weather-related diseases)
- Pre-set zoom features (e.g. person can select a country or continent from a drop down menu and view the zoomed version automatically on the map).

- Aggregate data by country and/or continent
- Small-secondary map that shows current zoomed-in position relative to the global map as a whole.
- Option to change the relative color scheme of a selected region (e.g. only scale based on the selected region vs. scaling for the whole globe).

Project Schedule

We plan to meet the milestones outlined on the course project page. Below is our project outline in accordance to key dates/milestones.

- W1 (Saturday, 04/11/15): Setup Repo for Development - Server/Client/Data
- W2 (Friday, 04/17/15): Simple Map-Based Visualization (color-coded by snowfall with tooltips), table with sortable columns **Milestone 1**
- W3 (Friday, 04/24/15): Fundamental Navigation (zooming,panning), time slider, filter by max/min snowfall **TF Review**
- W4 (Friday, 05/1/15): Feature Implementation (aggregation, filtering), additional views (graph of snowfall for selected region, separate view of zoomed in area).
- Tuesday, (05/5/15): any additional optional features we have not yet implemented, video
- **Final Submission**