Arctic Explorer - Project Proposal

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https://github.com/dwootton/Arctic-Explorer

Background and Motivation

The concentration of sea ice plays an important role in creating global climate models due to its ability to influence the absorption of solar radiation. High concentrations of sea ice can reflect radiation and limit temperature increases. Low levels of sea ice result in more absorption which contributes to the warming of poles. As such, climate researchers must understand both aggregated statistics (total area coverage, average concentration, etc) as well as point based concentrations for sea ice. Using this information, researchers can better adjust models to account for the change in sea ice concentration.

Current tools to understand sea ice data fail to provide both the aggregated statistics and the spatial-temporal concentration of sea ice. Additionally, these tools fail to provide a useful view of the data- often displaying small projections that make it difficult to understand changes in concentration.

We therefore propose Arctic Explorer, a tool that will help researchers and the interested public visualize and gain insight about Sea Ice concentration in the arctic. As we will outline further below, our tool will display spatial-temporal concentration data on a map, some chosen aggregated data (total area coverage, total concentration, and average rate of change), as well as allow users to interact with the data and see time varying changes in concentration at locations they select.

Project Objectives

The relevant datasets demonstrate a story of shrinking ice caps from the 1970's until 2018. Current visualization tools fail to convey the extent of this change and limit the insight gained from the data. The aim of our project is to enable users to understand how sea ice concentration and its related statistics change over time. This can be accomplished through investigations into the following questions:

- How does global sea ice concentration change over months in a year? Over years in a decade?
- On average how does sea ice concentration change throughout a year? Throughout a decade?

- Are there specific locations that are changing more rapidly than others? Do they exhibit any unique temporal patterns?
- At a given latitude and longitude, what months of a year is that location free of ice? Is that pattern consistent across years?

From discussions with researchers in the Golding Lab, an interactive tool could assist in answering research questions that have historically been difficult to answer. Such questions would be particularly useful for the US Navy to better understand the presence of ice at specific locations and plan shipping routes.

Throughout the process, both of us want to develop our ability to work with spatial-temporal data. Additionally, we are interested in learning more about technologies to visualize this geographic data. Through

Data

Data will be collected from the NOAA Sea Ice Extent Dataset: ftp://sidads.colorado.edu/pub/DATASETS/NOAA/G02202_V3.

Data Processing

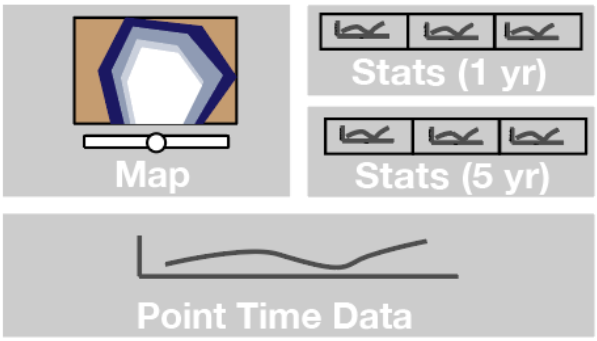
We don't expect to do much data cleanup. The data is already in a format intended for machine consumption.

It's very likely some of the visualization will rely on derived data. We may be porting a MATLAB script that computes sources and sinks (through Poisson's equation) to JavaScript to generate this derived data. Additionally, aggregated statistics will be calculated.

Visualization Design

Design Sheet 1:

Layout



Map A geomap of the arctic region. Contour map with white representing ice dark blue being ocean.

Stats Time series of aggregated statistics (rate of change, total coverage, and avg concentration).

P.T.D. Time series of concentration at the point selected on the map.

Title: Arctic Explorer
Author: Dylan and Ethan
Date: 10.26.18
Sheet: 1

Operations

Data Selection

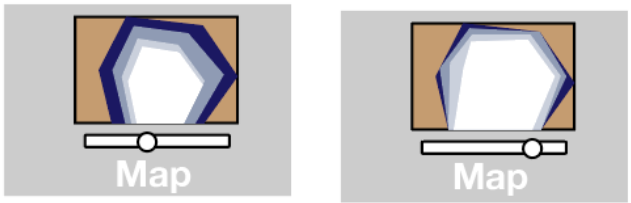
Data is selected by changing the slider on the map view. To assist in selection a user can 'fix' month or day.

Point Selection

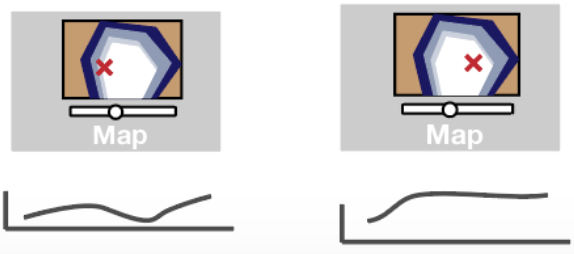
By clicking a location on the map, the Point Time Data chart will populate with temporal data for a given location.

Interaction

Data Selection



Point Selection



Discussion

+ Data Display

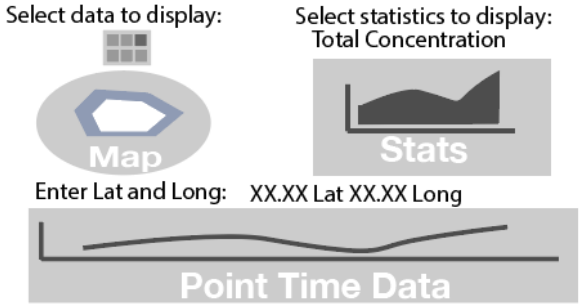
A large amount of data is displayed. The user can interact with the map to control the data that is displayed.

– Display Size

Given the large amount of info presented, the display could be overwhelming. Not all data would be useful to all users.

Design Sheet 2:

Layout



Map A projection of the arctic region. A colormap displays concentration.

Stats Area chart of selected statistic. Available statistics include average conc., total conc., and rate of change.

P.T.D. Time series of concentration at the point entered in the selector. NAN is present if data does not exist.

Title: Arctic Explorer
Author: Dylan and Ethan
Date: 10.27.18
Sheet: 2

Operations

Data Selection

Data is selected by selecting a specific date on the calendar provided above the projection.

Point Selection

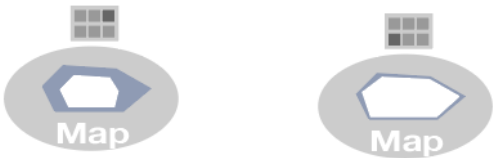
Point is selected by entering its lat and longitude coordinates.

Statistics Selection

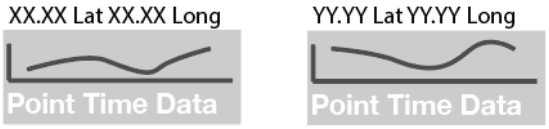
Statistic to display is selected via a drop down menu consisting of popular statistics.

Interaction

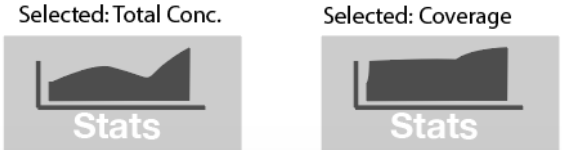
Data Selection



Point Selection



Statistic Selection



Discussion

+ Customizability

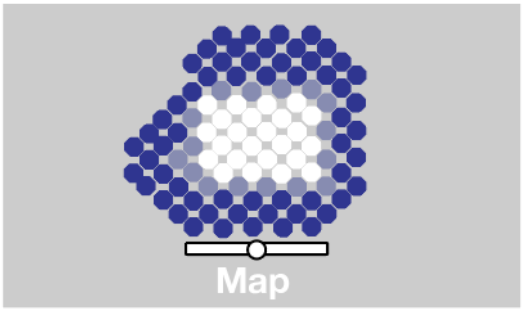
User is able to customize what they see. User can enter exact date and lat/long location to view data from.

– User work

User must manually select information. If user doesn't know lat long or an intersting date it can be difficult to explore data. User must manually select the statistic to view.

Design sheet 3:

Layout



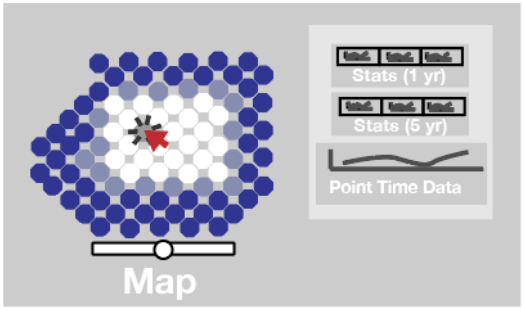
Map

A hexagonal binned map of the arctic region. A colormap displays concentration.

Interaction

Data Selection

Point Selection



On Click

A side panel fills with data about the location that was just clicked. This encompasses statistics and time data.

Title: Arctic Explorer
Author: Dylan and Ethan
Date: 10.27.18
Sheet: 3

Operations

Data Selection

Data is selected by moving the selector bar to the date of interest.

Point Selection

Point is selected by clicking a hexagon. The data is displayed in the side panel.

Discussion

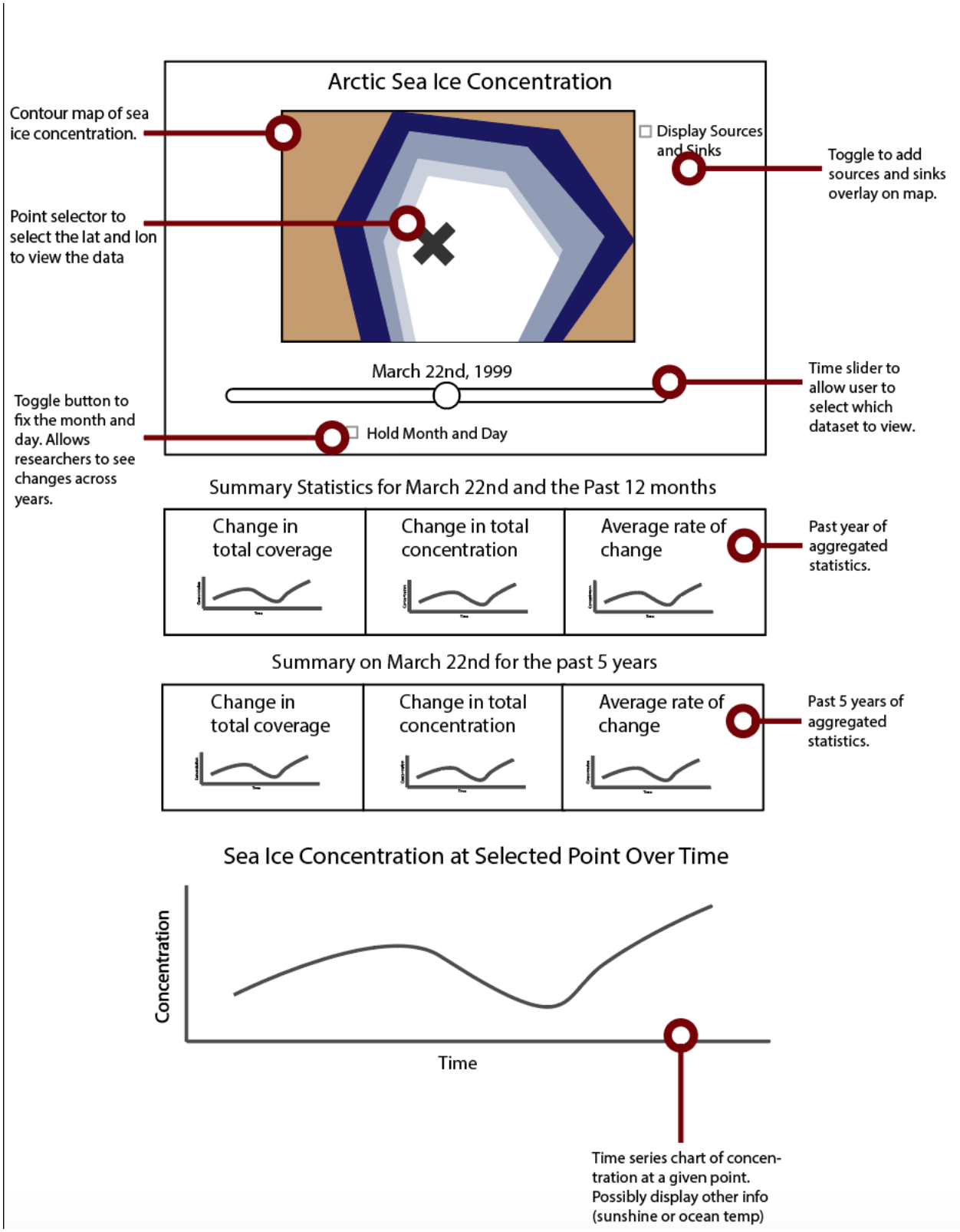
+ Minimal

User is not overwhelmed with unnecessary detail. The user can control how much data is displayed via interaction.

– Confusion

If the user isn't familar with the polar region, the binned map may be confusing. Additionally, if the binned map lacks info about context, even an expert may have a hard time understanding how the values correspond to actual locations.

Draft Design:



Must-Have Features

- Display of sea ice concentration.
- Slider to select calendar year.
- Display of aggregate statistics.

Optional Features

- Display of 1 years of time series data.
- Display of sea ice sources and sinks.
- Display of other climate data (temperatures or sunshine?).
- Brush or magic lens that allows zooming into a specific area.

Project Schedule

- Week 1 - (Oct 28th-Nov 3rd)
  - User interview with Dr. Golding.
  - Develop code to read the data format
  - Use either a database (MongoDB or CartoDB?) or a script pipeline to allow for the generation of data indexes and derived data
  - Develop contour map
- Week 2 - (Nov 4th-10th) - Project Milestone Due
  - Develop time series linked view
  - Add source sink views to the contour map
- Week 3 - (Nov 11th-17th)
  - Add in aggregated statistics
  - Add in interactivity for selecting point on contour map.
- Week 4 - (Nov 18th-24th)
  - UI/UX improvement
  - User testing
- Week 5 - (Nov 25th-30th) - Final Project Due