Emilie is a 3rd year undergrad student in Earth Sciences and Physical Geography. Having only completed two years of University, she is still exploring her interests, but has developed an early fascination with Earth's physical processes shaping the cryosphere and the way humans have and will potentially influence them.

Summer Research Internship Abstract

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October 14, 2016

1 Purpose

There has been recent interest in building large permafrost databases that combine data from multiple sites with measurements taken by various people. The difficulties associated with analysing these collections are numerous and include the variability of instrumentation and methods of measurement used, differing collection dates and inconsistent site descriptions.
The purpose of this project was to analyse the permafrost temperature database being put together at NTGS (Northwest Territories Geological Survey). This database has two main components, raw temperature data and site descriptions with variables such as topography, vegetation types, soil types and more. Since this database is still in its early stages of development, it could prove useful to attempt analysis so as to pinpoint issues. This could then help in the development of guidelines for data collection, improving the consistency and quality of data. The goal of my analysis was to find trends in ground temperature variations according to different site variables.

2 Processing the data

Figure 2: Temperature time series at multiple depths as created by the GTDPAL Jupyter notebook

In order to complete the analysis, the data is first put through a program developed in Python by Thao Le-Phong, a computer systems engineer undergrad student. This program cleans and orders the data for a given site to create an interactive temperature time series and a single database file with a consistent format. The database files created can be viewed and modified in an SQLite browser. Each file contains three tables, a "stats" table of computed annual statistics for every site, a "meta" table containing all metadata and a "raw" table.

Single or multiple database files can be analysed using scripts I have written in R, a statistical computing software. Two types of visual outputs are produced: an interactive map of all sites and plotted data of sites meeting specific requirements. The map produced is a kmz file that can be viewed in Google Earth as seen in figure 3. The plots are created within R but can then be saved as an image as seen in figure 4.

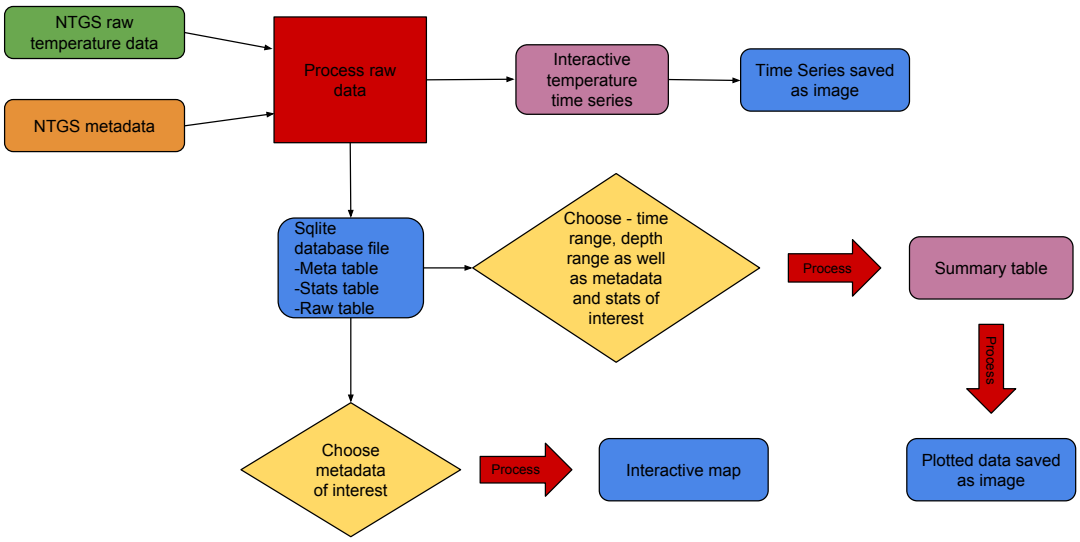

Figure 1: Database processing steps and options

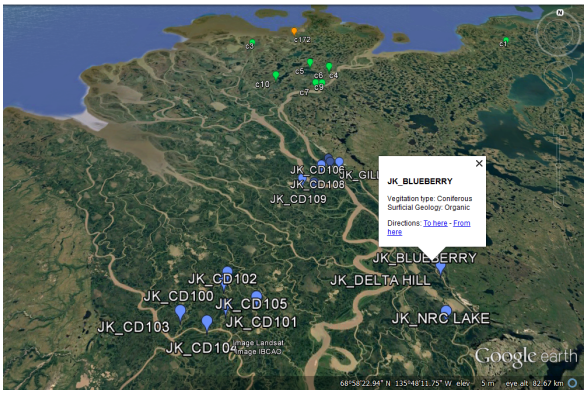

Figure 3: Screenshot of a kmz file created from NTGS data

3 Findings

It is difficult to evaluate and study coarse-scale variation with this database due to the close proximity of most sites. However, it was still possible to look at temperature variations on a fine scale. These variation are evaluated by comparing temperature data from adjacent sites. Many site variables were tested for trends. These include slope aspect, anthropogenic disturbances and soil and vegetation types. However, these tests were restricted by inconsistencies and incomplete datasets. Vegetation height was easiest for plotting as most sites contained this information. As seen in figure 4, mean annual ground temperatures (MAGT) seem to be higher in sites with taller vegetations. One of the most interesting findings from my analysis, is the very high temperatures seen in first year sites. It is evident that the disturbance caused by the creation of a site temporarily disturbs the temperature regime of the frozen ground.

4 Outcome

Though I did find interesting results throughout my analysis, I believe that one of the most significant outcomes were the skills I developed. Combining forces and creating large permafrost databases can be very useful for current and future permafrost research. Being one of the only people in Canada to work on a project like this has allowed me

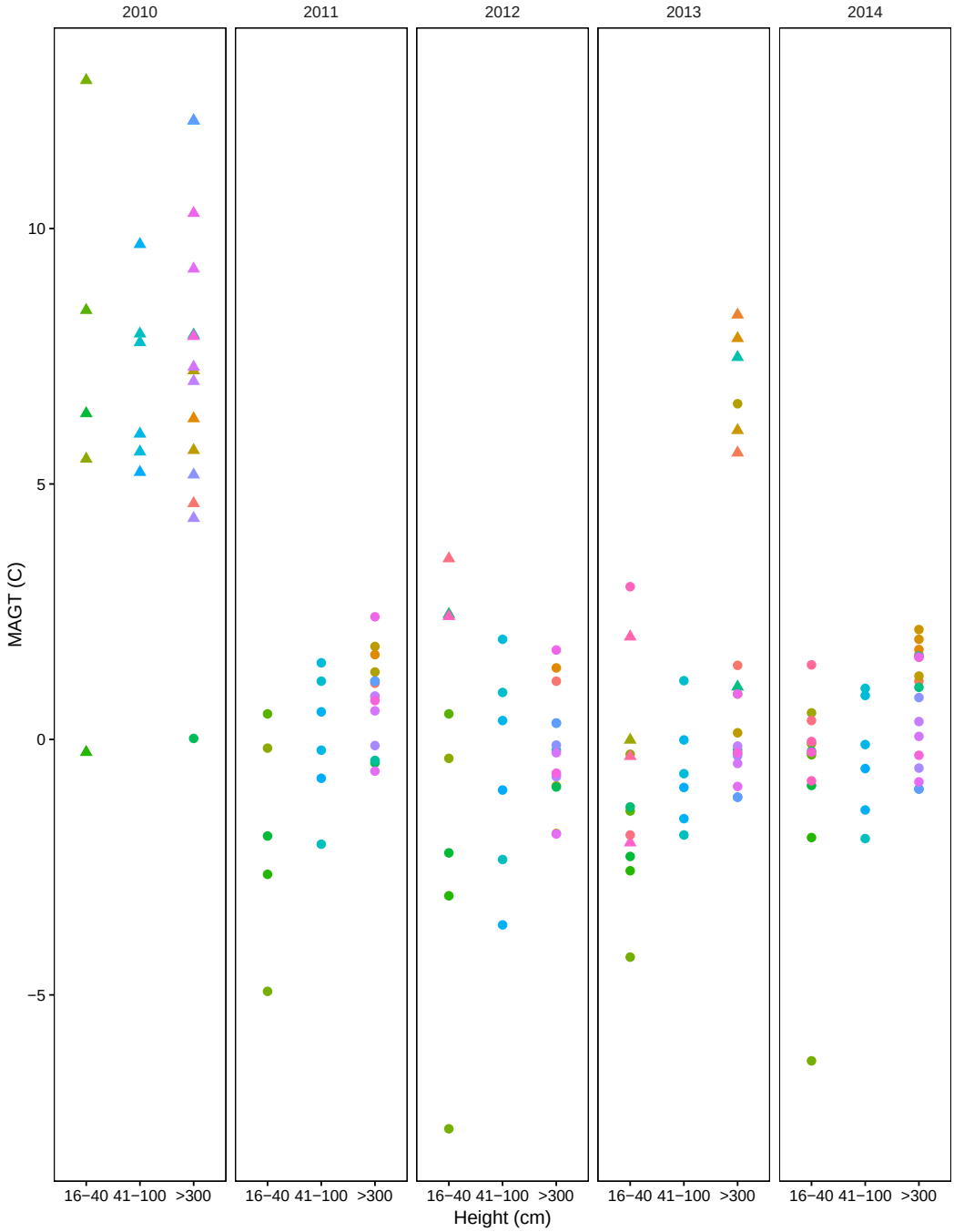

Figure 4: Plot of MAGT temperatures calculated from raw NTGS ground temperature data for 39 different sites situated south-west of Fort McPherson. The triangular shape indicates the first year of installation and the circular indicates all other years.

become knowledgeable in a domain that is gaining interest around the world. This project is far from over and I look forward to continuing my work.