Observing Land Surface Temperatures in Alaska Using a Forward Looking Infrared (FLIR) Camera

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ABSTRACT

As carbon and other greenhouse gases are being released into the atmosphere, climate change is enhanced. Direct measurements of greenhouse gases from aircraft and stationary observations, as part of the Carbon in the Arctic Vulnerability Experiment (CARVE), determine the rate of greenhouse gases being released into the atmosphere and drawn-down during ecosystem processes. Permafrost is an important component of the carbon and methane exchange with the atmosphere. In order to study the role of seasonal permafrost processes in the carbon cycle, stationary and aircraft data are gathered in Alaska. This data will help identify how thawing permafrost will affect the carbon cycle. In this summer program we will use thermal images from a forward looking infrared (FLIR) camera to characterize land surfaces underlain by permafrost during specific phases of the freeze-thaw cycle. The FLIR camera, flown during the 2013 CARVE campaign, records images of the surface skin temperature directly under the CARVE aircraft while it measures concentrations of atmospheric carbon dioxide, methane and ozone in the atmosphere. In future studies, measurements of the temperature and frozen or thawed state of various landscape components, including the soil and vegetation, will be combined with measurements of atmospheric gas concentrations to better understand the role of surface processes in the exchange of greenhouse gasses with the atmosphere in the Alaskan arctic.

BACKGROUND

During the summer Alaska's coldest tundra regions defrost, allowing vegetation to remain alive. When the summer arrives, massive regions of permafrost (frozen layer of soil) and glaciers (rivers of ice) release years of stored carbon dioxide into the atmosphere. The release of the carbon dioxide has caused drastic climate change around the world. During climate change, the temperature has risen from 2.7 to 4.5 degrees Fahrenheit allowing permafrost to defrost at a faster rate. Scientists want to discover how much carbon dioxide is released and how fast it is released into the atmosphere. In order for these measurements of greenhouse gases to be contained NASA has sent an aircraft aboard to collect seasonal variation around Alaska using a forward looking infrared (FLIR) camera. The CARVE team has sent test and science flights over the Alaska artic from 2011 to June of 2014. As the carbon cycle changes over the years, the earth will experience a drastic adaption.

Objectives:

- Identify FLIR images that have overlapping time series.
- Identify images that clearly show landscape features.
- Identify temperature characteristics of landscape components for each season.

METHODS

- **Alaska Station Map:**

I first launched ArcCatolog to add the WMS server and BDL WMS high resolution layer in order to access it in ArcMap. As the BDL WMS layer was added in ArcMap and we were able to observe Alaska. Then we were able to plot the SNOTEL stations in Alaska by creating an excel document to incorporate the longitude, latitude, elevation and station names. Then, I completed the map with a tittle, legend, scale bar and a north arrow.

- **Map for each month:**

After the stations were located on the map, the FLIR frame locations (when the FLIR camera was turned on) for a certain month were graphed. The dates were selected from the beginning and end of a month by using the select by attributes option on ArcMap. Then the months were made into a layer. The CARVE flight lines (parts of Alaska the air craft flew over) were graphed. Finally, a title, legend, north arrow, and a scale bar were added to finish the map.

- **Map with buffers and intersections:**

The season buffers were completed by selecting the attributes (beginning and end of a month) during fall, summer, and spring. Once we finished completing the buffers for each season they were put on the map with the frame locations, SNOTEL stations, and CARVE flight layers. As each seasonal buffer was collected, they were all put on the same map. Once the buffers for each season were uploaded the intersections were identified.

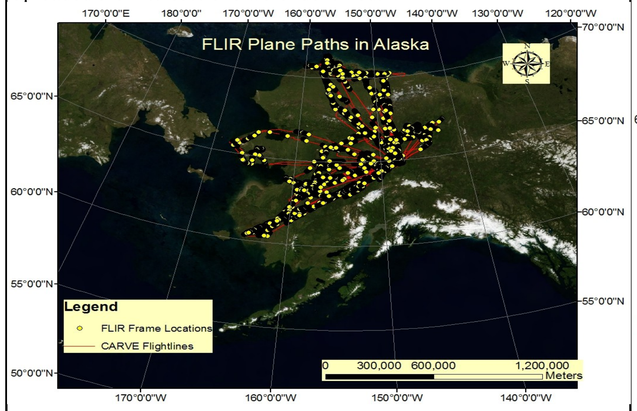

Figure 1: This map contains the flight paths and the time the plane turned on the FLIR camera to capture the temperature and the SNOTEL stations.

Figure 2: This map contains the flight paths for fall 2013 and all CARVE flights lines.

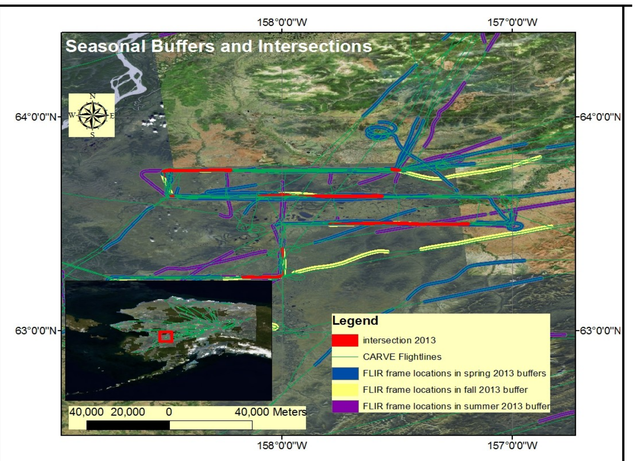

Figure 3: This map contains the buffers for all seasons as well as the CARVE flight lines and the buffers intersections.

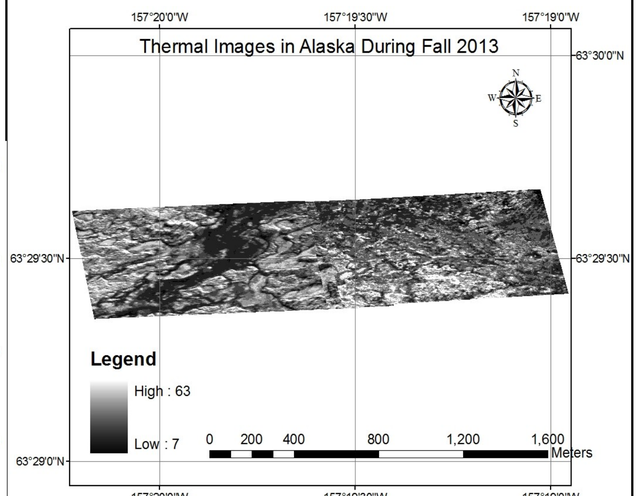

Figure 4: This map contain thermal images taken by the FLIR camera during Fall of 2013

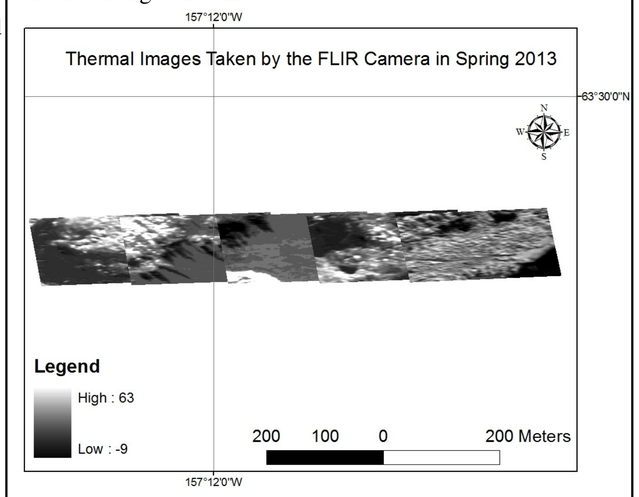

Figure 5: This map contains thermal images in Spring of 2013

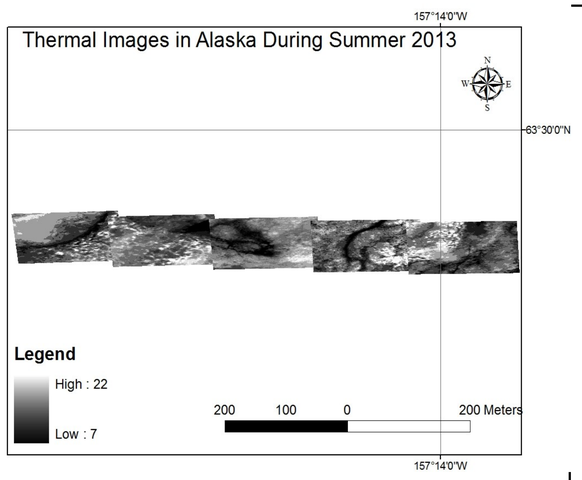

Figure 6: This map contains thermal images taken by a FLIR camera during Summer 2013.

CONCLUSIONS

We were able to find overlapping time series and found the area of interest, near Ophir, Alaska. We were able to observe FLIR Camera thermal images that have overlapping time series. In addition, we were able to observe landscape features that allowed us to identify land surface temperatures during each season.

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