Warming, Vegetation, & Remote Sensing:

The Use of NDVI to Track the Influence of Climate Change on Arctic and Alpine Plant Communities

Charlotte Copp
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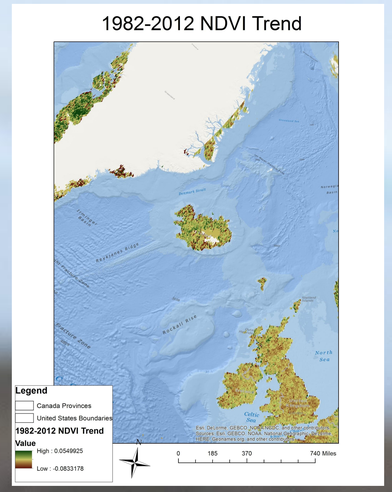
How will climate change alter tundra communities in Ísafjörður, Iceland and alpine communities in the White Mountains, New Hampshire?

Background

- **Anthropogenic climate change**, caused by greenhouse gases produced by burning fossil fuels.
- Every continent, not including Antarctica, has observed an increase in mean surface temperature, and anthropogenic forcings have contributed to this rise (IPCC 2014).
- **Normalized Difference Vegetation Index** (NDVI) is collected by satellites. NDVI is an indicator of the green vegetation that is related to vegetation growth status (Zeng et al. 2013).
- With rapid warming across the globe, it is becoming more important to track the impacts.

What effect will climate change have on plant communities?



Results

NDVI

- There are noticeable changes in NDVI which could be a result of varying weather from year to year and changes in land management styles.
- The comparison of NDVI data of arctic and alpine vegetation shows that communities similar in makeup can vary in resilience to climate change.

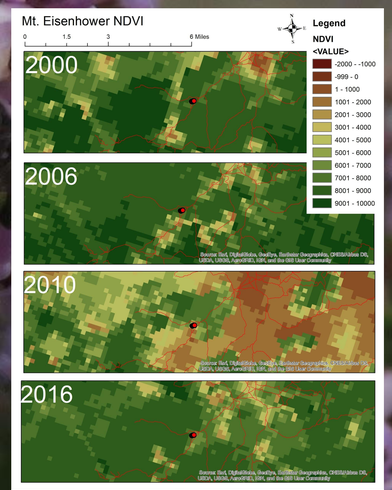
Plant Surveys

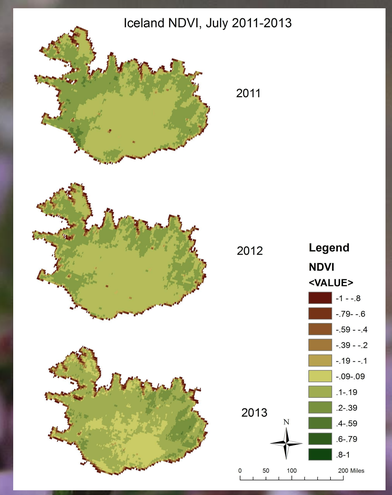
- Increased precipitation and warmer surface temperatures have the biggest influence on arctic and alpine plant communities.
- This growth of communities can generate an increasing threat of invasive species on native plants

White Mountains, NH & Iceland

The **"free atmosphere"** on the peaks in the White Mountains, NH allows for some of the arctic plants, that were transported during the last glacial maximum, to stay because the is a hospitable climatic environment (Siedel et al. 2009).

Iceland has a relatively mild coastal and arctic climate compared with other arctic communities due to the effect of the thermohaline circulation. This allows communities, like Ísafjörður in the Westfjords, to host a variety of plant species, many rare and only appearing in this part of Iceland.





Comparison & Generalization

- It is necessary to get a sense of larger patterns of vegetation change across alpine areas, world wide.
- Direct human impact like clear cutting of forests and intense land transformation around Mt. Kilimanjaro have a dramatic effect on NDVI (Detsch 2016).
- NDVI trends in the Himalayas have been consistent with ground-based phenological observations, showing an advancement in growing period correlated with increases in winter and spring temperatures (Xu et al. 2009).
- Similar to the Arctic and the alpine regions of the White Mountains, NH, expanding shrub cover has been reported in the Italian alps at elevations of over 2500 meters (Carlson et al. 2017).

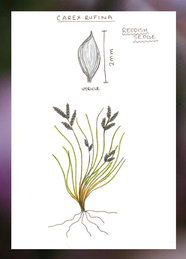
Procedure

NDVI

- NDVI trend maps ranging from 1982-2012
- The NDVI data, which show vegetation activity, were averaged annually for the Arctic growing season (June, July, and August) and some have a resolution of 8 km (Guay et al. 2014).

Plant surveys

- Surveys on two different mountain peaks in NH, and one fjord wall in Iceland
- This was to done to create a scale of my research from satellite data to single plant species.
- Acts as a form of *ground truthing* (Manzel 2002).



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Next Steps & Future Research

What we want to hear is that there is a simple solution to support species conservation in the face of climate change, but this research is showing that even though there are similarities between arctic and alpine vegetation communities, there are differences in the way we should manage them.

This solution may seem unsettling, but it suggests that we need to be attentive to regional differences between land management styles, microclimates, and species composition, and create local strategies to support species conservation. What we need to do to continue is to learn what the differences and the complexities are and work with those differences to create a solution.