Assessing Vegetation Fluctuations in Conjunction with the North Atlantic Oscillation Index

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Abstract

The North Atlantic Oscillation (NAO) is a climatic phenomenon that has a strong influence on the westerly wind and storm tracks in the northern Atlantic Ocean. In the positive NAO phase, the West Fjords region of Iceland experiences larger amounts of rainfall, which in turn contributes to a higher instance of erosion. In a typical year, the area receives between 30 mm (in the warmer months) and 65 mm (in the cooler months) of rainfall per month. The area is associated with sparse, low-lying vegetation and bare rock. Little is known about how the NAO effects the vegetation in the West Fjords. This project sets SPOT vegetation data against monthly fluctuations in the NAO and compares vegetation during positive and negative NAO events. The NAO seems to have significant effect on vegetation only during seasonal transition periods, i.e. early spring and autumn.

Introduction

Lake Vatnsdalsvatn is located in the West Fjords region of Iceland (Figure 1). The area's soils are largely composed of balsaltic andosols, which tend to be very prone to erosion. Because of the region's continuous low temperatures, bacterial activity is low in the West Fjords, resulting in soils that have extremely high organic matter contents. The soil is mineral and moisture rich, and could theoretically support extensive plant life, but only prairie-like grasses and shrubs can survive in Iceland's harsh climate. Erosion rates for the area are high because of frequent landslides and humus formation. In addition to natural contributors to erosion, the introduction of sheep farming by Norse settlers over 1,000 years ago (a tradition which still continues in Iceland's rural areas) has caused Icelandic flora to be predominantly composed of various grasses, which are not as useful for erosion prevention as more robust species would be (Arnalds 2008).

According to the NAO index obtained from the Icelandic Meteorological Office, NAO patterns seem to have begun to change beginning in 1980 (Icelandic Meteorological Office 2013). Because the soil erosion rates are high in the area, it is very helpful to keep a record of how vegetation fluctuates with the changing climate patterns.

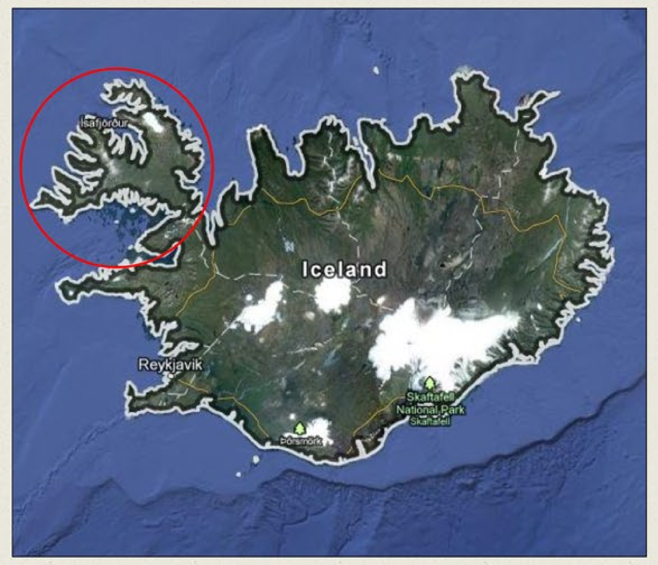


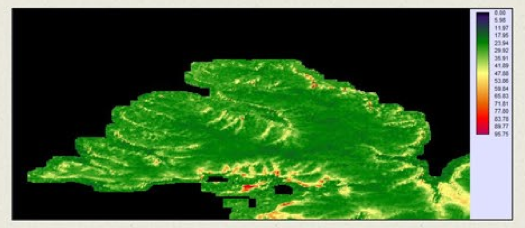
Figure 1: West Fjords, Iceland.

Methods

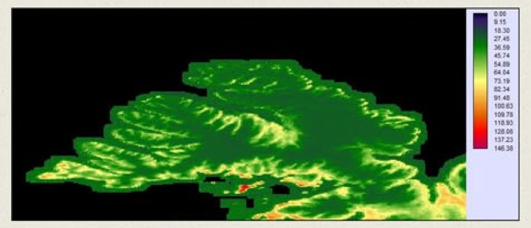
Background data was gathered from the Icelandic Meteorological Service and the Global Land Cover Facility, which provided the raw SPOT vegetation data. Monthly vegetation images were gathered for individual months from 1998 to 2012. All images were processed using Idrisi Selva image processing software. A table of monthly NAO index values from 1998 to 2012 was obtained from the Icelandic Meteorological Office's website.

From the information provided by the NAO index (which provided positive and negative fluctuation values for the NAO), months of positive and negative fluctuation were determined. For each month from February to October (an error occurred with the November-January data), an average vegetation image was created for positive and negative index years using Idrisi's image calculator. Once positive and negative images for each month were created been created, they were compared to their like month counterpart (i.e. the positive February index image was compared with the negative index February index image, the positive March with the negative March, etc.) and the percent change between the two was calculated. This calculation was also performed with Idrisi's image calculator.

Positive NAO Images



February



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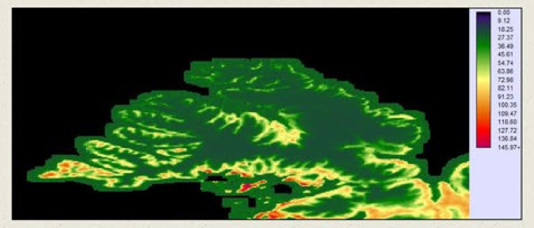
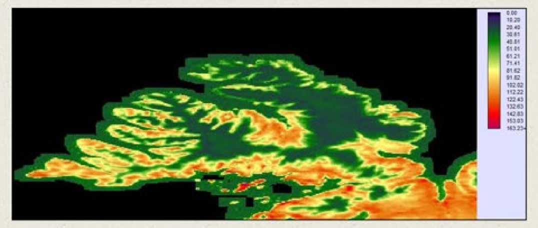
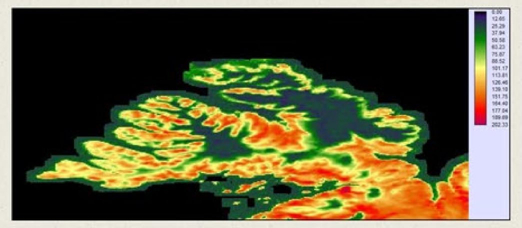


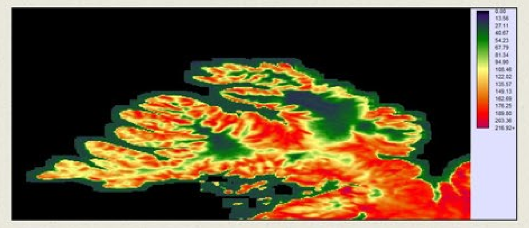
April



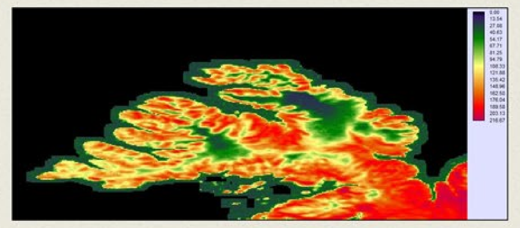
May



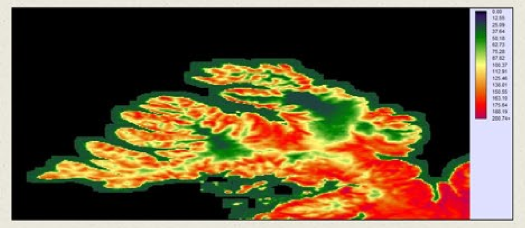
June



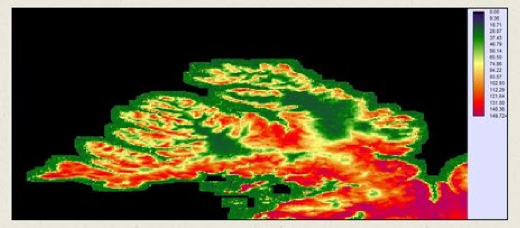
July



August

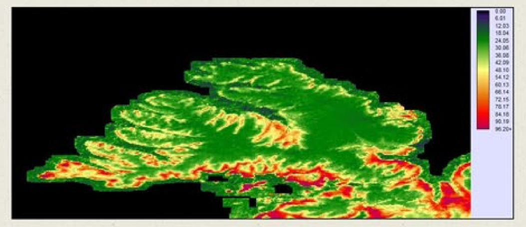


September

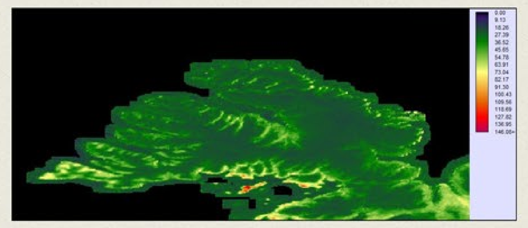


October

Negative NAO Images



February



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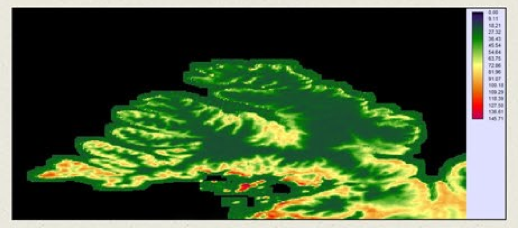

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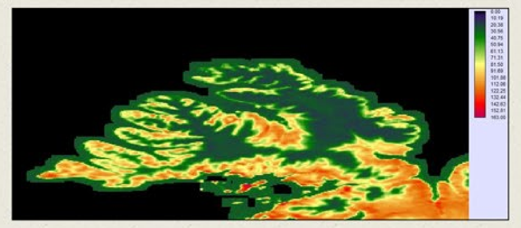

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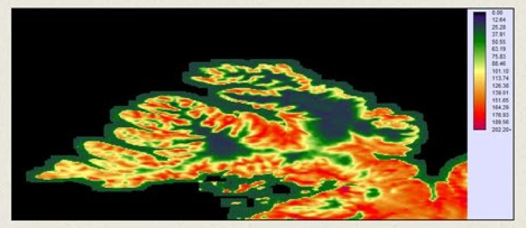

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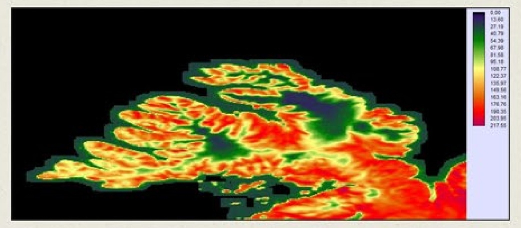

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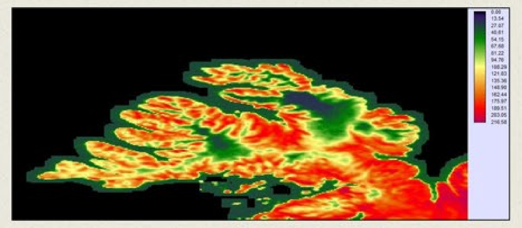

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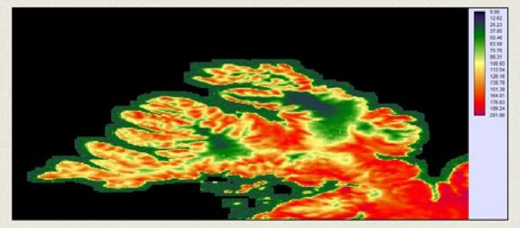
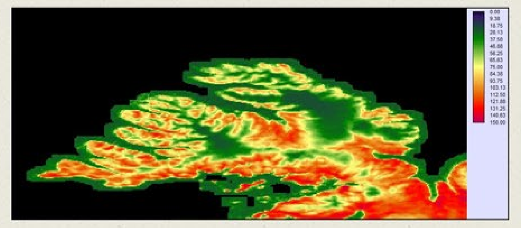


September



October

Results

During the majority of the year, NAO fluctuations did not greatly effect the vegetation of the West Fjords. However, during transitional months (periods in early spring and mid-to-late autumn) fluctuated quite a bit.

February and April had higher vegetation numbers during negative NAO periods, while October and September had higher values during positive NAO fluctuations. Below are the percent differences between the positive and negative images for February, March, April, September and October.

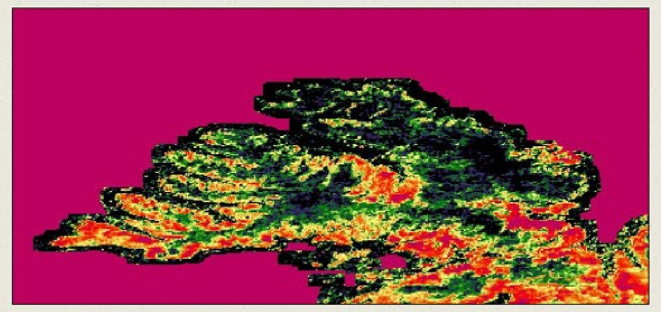


Figure 2: Percent NAO difference for February.

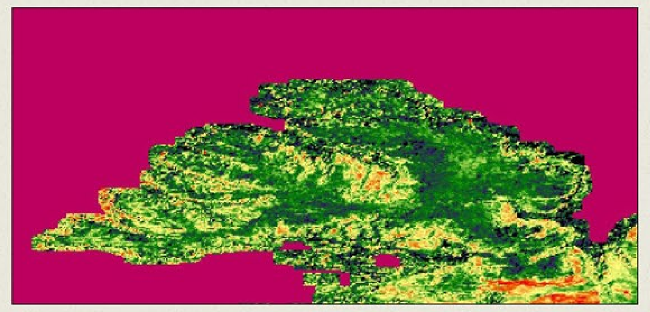


Figure 3: Percent NAO differences for March.

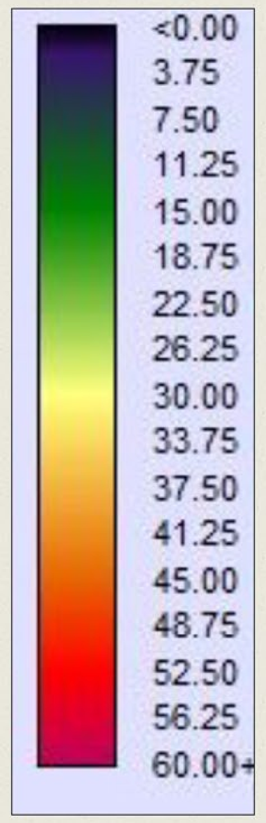


Figure 4: Percent NAO difference for April.

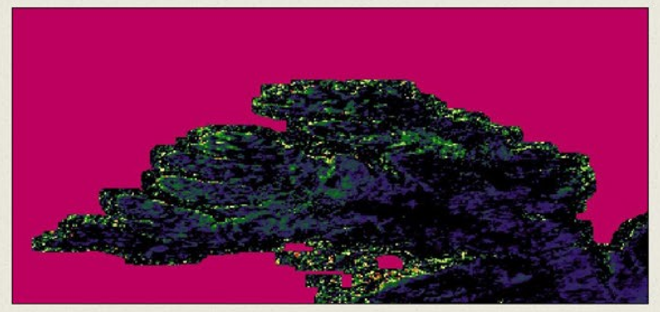


Figure 5: Percent NAO differences for September.

Figure 6: Percent NAO differences for October.

References

Arnalds, O. 2004. Volcanic Soils of Iceland. *Catena* 56 (1), 3-20.

Icelandic Meteorological Office. 2013. *Longer Series for Selected Stations: Stykkisholmur* [Data File]. Retrieved from http://en.vedur.is/climatology/data/ .