CIRCUMPOLAR ARCTIC VEGETATION AND GREENESS: A SPATIAL ANALYSIS OF THE DISTRIBUTION PATTERNS AND THE EFFECTS OF CLIMATE AND SUBSTRATE

A

DISSERTATION

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By

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Abstract

This objective of the research presented in this dissertation was to better understand the factors controlling the distribution of arctic vegetation, and their effects on present and potential future spatial distribution of that vegetation. The research uses the Circumpolar Arctic Vegetation Map (CAVM) and other recently available circumpolar data sets. I used geographical information system (GIS) software to overlay the CAVM with a satellite greenness index (normalized difference vegetation index, NDVI) and environmental factors that are most important in controlling the distribution of arctic vegetation, including summer temperature, landscape age, precipitation, snow cover, substrate chemistry (pH and salinity), landscape type, elevation, permafrost characteristics, distance to sea. I also used boosted regression tree modeling techniques to understand the relative importance of different environmental characteristics for different vegetation types and for different regions.

Some of the most valuable results of this research are the maps, charts and tables that summarize and display the spatial characteristics of arctic vegetation. The data for arctic land surface temperature and landscape age are important new resources for researchers. These results are available electronically, not only providing summary data, but also GIS data with a spatial context (www.arcticatlas.org). The results emphasize the value and reliability of NDVI for studying arctic vegetation. The spatial analysis corroborated the relationship between increases in NDVI and temperature seen over the

satellite record. Summaries of arctic biomass based on NDVI match those based on extrapolation from ground samples. The modeling confirmed the importance of summer temperatures in controlling arctic vegetation. It also demonstrated the importance of the age of landscapes in understanding the spatial distribution of arctic vegetation, and the importance of the interactions between vegetation and soils in modifying the soil and permafrost characteristics and thus changing the environment for plants.

As the world continues to focus on the Arctic as an area undergoing accelerated warming due to global climate change, this study's documentation of existing vegetation types and their relationship to the factors most important in controlling their distribution will become more and more valuable.

Table of Contents

Page

SIGNATURE PAGE .....**Error! Bookmark not defined.**

TITLE PAGE i

Abstract 2

List of Figures .....**Error! Bookmark not defined.**

List of Tables .....**Error! Bookmark not defined.**

Acknowledgements .....**Error! Bookmark not defined.**

Chapter 1 – Introduction .....**Error! Bookmark not defined.**

1.1 General introduction .....**Error! Bookmark not defined.**

1.2 Circumpolar Arctic Vegetation Map .....**Error! Bookmark not defined.**

1.3 Research presented in this dissertation .....**Error! Bookmark not defined.**

1.3.1 NDVI.....**Error! Bookmark not defined.**

1.3.2 Temperature .....**Error! Bookmark not defined.**

1.3.3 Permafrost .....**Error! Bookmark not defined.**

1.3.4 Glaciation .....**Error! Bookmark not defined.**

1.3.5 Modeling .....**Error! Bookmark not defined.**

1.4 Limitations of the scope of this research .....**Error! Bookmark not defined.**

1.5 Availability of research results .....**Error! Bookmark not defined.**

Chapter 2 NDVI patterns and phytomass distribution in the circumpolar Arctic..... **Error! Bookmark not defined.**

2.1 Abstract ..... **Error! Bookmark not defined.**

2.2 Introduction ..... **Error! Bookmark not defined.**

2.3 Methods ..... **Error! Bookmark not defined.**

2.3.1 Overview of the Circumpolar Arctic Vegetation Map .. **Error! Bookmark not defined.**

2.3.2 NDVI ..... **Error! Bookmark not defined.**

2.3.3 CAVM maps ..... **Error! Bookmark not defined.**

2.3.4 Analysis of NDVI ..... **Error! Bookmark not defined.**

2.3.5 Estimates of phytomass from NDVI ..... **Error! Bookmark not defined.**

2.4 Results ..... **Error! Bookmark not defined.**

2.4.1 NDVI ..... **Error! Bookmark not defined.**

2.4.2 Phytomass ..... **Error! Bookmark not defined.**

2.5 Discussion ..... **Error! Bookmark not defined.**

2.5.1 Sources of variation in NDVI and phytomass . **Error! Bookmark not defined.**

2.5.2 Modeling distribution of arctic vegetation ..... **Error! Bookmark not defined.**

2.6 Conclusion ..... **Error! Bookmark not defined.**

2.7 Figures ..... **Error! Bookmark not defined.**

2.8 Tables ..... **Error! Bookmark not defined.**

2.9 Acknowledgments ..... **Error! Bookmark not defined.**

2.10 References...**Error! Bookmark not defined.**

Chapter 3 Relationship between satellite-derived land surface temperatures, arctic vegetation types, and NDVI.....**Error! Bookmark not defined.**

3.1 Abstract.....**Error! Bookmark not defined.**

3.2 Introduction.....**Error! Bookmark not defined.**

3.3 Methods.....**Error! Bookmark not defined.**

3.3.1 Temperature data set.....**Error! Bookmark not defined.**

3.3.2 CAVM classified attributes.....**Error! Bookmark not defined.**

3.3.3 NDVI data.....**Error! Bookmark not defined.**

3.3.4 Analysis.....**Error! Bookmark not defined.**

3.4 Results.....**Error! Bookmark not defined.**

3.4.1 SWI .....**Error! Bookmark not defined.**

3.4.2 NDVI as a function of SWI .....**Error! Bookmark not defined.**

3.4.3 General linear model of NDVI .....**Error! Bookmark not defined.**

3.5 Discussion.....**Error! Bookmark not defined.**

3.5.1 Warmest parts of the Arctic.....**Error! Bookmark not defined.**

3.5.2 NDVI as a function of SWI .....**Error! Bookmark not defined.**

3.5.3 Residuals of NDVI as a function of SWI regression..... **Error! Bookmark not defined.**

3.5.4 Effects of environmental characteristics on NDVI..... **Error! Bookmark not defined.**

3.5.5 NDVI as a function of SWI for different arctic vegetation types.....**Error! Bookmark not defined.**

3.6 Conclusions.....**Error! Bookmark not defined.**

3.7 Figures.....**Error! Bookmark not defined.**

3.8 Tables.....**Error! Bookmark not defined.**

3.9 Acknowledgements.....**Error! Bookmark not defined.**

3.10 References.....**Error! Bookmark not defined.**

Chapter 4 – Circumpolar relationships between permafrost characteristics, NDVI, and arctic vegetation types.....**Error! Bookmark not defined.**

4.1 Abstract.....**Error! Bookmark not defined.**

4.2 Introduction.....**Error! Bookmark not defined.**

4.3 Methods.....**Error! Bookmark not defined.**

4.3.1 The permafrost map.....**Error! Bookmark not defined.**

4.3.2 Satellite data (AVHRR NDVI).....**Error! Bookmark not defined.**

4.3.3 The vegetation map.....**Error! Bookmark not defined.**

4.3.4 Analysis.....**Error! Bookmark not defined.**

4.3.5 Interdependence of data sets.....**Error! Bookmark not defined.**

4.4 Results.....**Error! Bookmark not defined.**

4.5 Discussion.....**Error! Bookmark not defined.**

4.6 Conclusions.....**Error! Bookmark not defined.**

4.7 Figures.....**Error! Bookmark not defined.**

4.8 Tables.....**Error! Bookmark not defined.**

4.9 Acknowledgments.....**Error! Bookmark not defined.**

4.10 References.....**Error! Bookmark not defined.**

Chapter 5 – The effects of deglaciation on circumpolar distribution of arctic vegetation .....**Error! Bookmark not defined.**

5.1 Abstract .....**Error! Bookmark not defined.**

5.2 Introduction.....**Error! Bookmark not defined.**

5.3 Methods.....**Error! Bookmark not defined.**

5.3.1 Landscape age since emergence .....**Error! Bookmark not defined.**

5.3.2 Circumpolar Arctic Vegetation Map .....**Error! Bookmark not defined.**

5.3.3 NDVI data.....**Error! Bookmark not defined.**

5.3.4 Analysis.....**Error! Bookmark not defined.**

5.4 Results.....**Error! Bookmark not defined.**

5.5 Discussion.....**Error! Bookmark not defined.**

5.6 Conclusions.....**Error! Bookmark not defined.**

5.7 Figures.....**Error! Bookmark not defined.**

5.8 Tables.....**Error! Bookmark not defined.**

5.10 References.....**Error! Bookmark not defined.**

Chapter 6 – Environmental controls of present distribution of arctic vegetation and likely response to climate change .....**Error! Bookmark not defined.**

6.1 Abstract.....**Error! Bookmark not defined.**

6.2 Introduction.....**Error! Bookmark not defined.**

6.3 Methods.....**Error! Bookmark not defined.**

6.4 Results.....**Error! Bookmark not defined.**

6.5 Discussion.....**Error! Bookmark not defined.**

6.5.1 The models.....**Error! Bookmark not defined.**

6.5.2 Relevance to climate change.....**Error! Bookmark not defined.**

6.6 Conclusion .....**Error! Bookmark not defined.**

6.7 Acknowledgements.....**Error! Bookmark not defined.**

6.8 References.....**Error! Bookmark not defined.**

6.9 Figures.....**Error! Bookmark not defined.**

6.10 Tables.....**Error! Bookmark not defined.**

Appendix 6.1.....**Error! Bookmark not defined.**

Appendix 6. 2.....**Error! Bookmark not defined.**

Chapter 7 – Conclusion.....**Error! Bookmark not defined.**

7.1 Biogeography of circumpolar arctic vegetation.....**Error! Bookmark not defined.**

7.1.1 Origin of arctic vegetation .....**Error! Bookmark not defined.**

7.1.2 Categorization of arctic vegetation .....**Error! Bookmark not defined.**

7.1.3 Environmental controls of arctic vegetation types..... **Error! Bookmark not defined.**

7.1.4 Environmental controls of NDVI.....**Error! Bookmark not defined.**

7.2 Response of arctic vegetation to climate change .....**Error! Bookmark not defined.**

7.2.1 Results of studies of plant physiology and experiments. **Error! Bookmark not defined.**

7.2.2 Documented changes in arctic vegetation.....**Error! Bookmark not defined.**

7.2.3 Relationship of spatial patterns to climate response..... **Error! Bookmark not defined.**

7.3 Limitations of prediction of changes in tundra vegetation ... **Error! Bookmark not defined.**

7.4 References.....**Error! Bookmark not defined.**