Spatial Patterns of Land Surface Temperature and NDVI, and their Relation to Vegetation Distribution on the Yamal Peninsula

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Donald A. Walker
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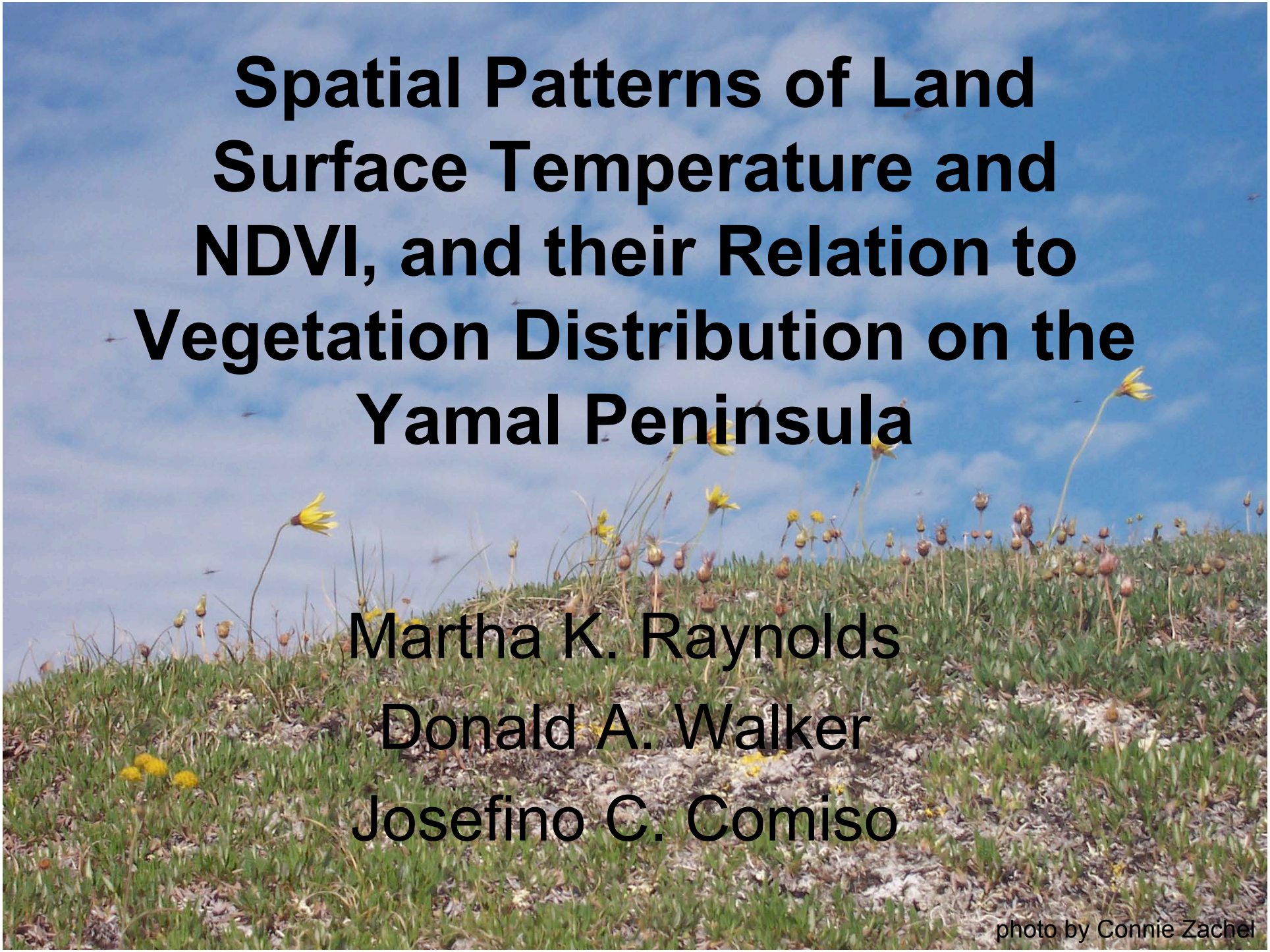
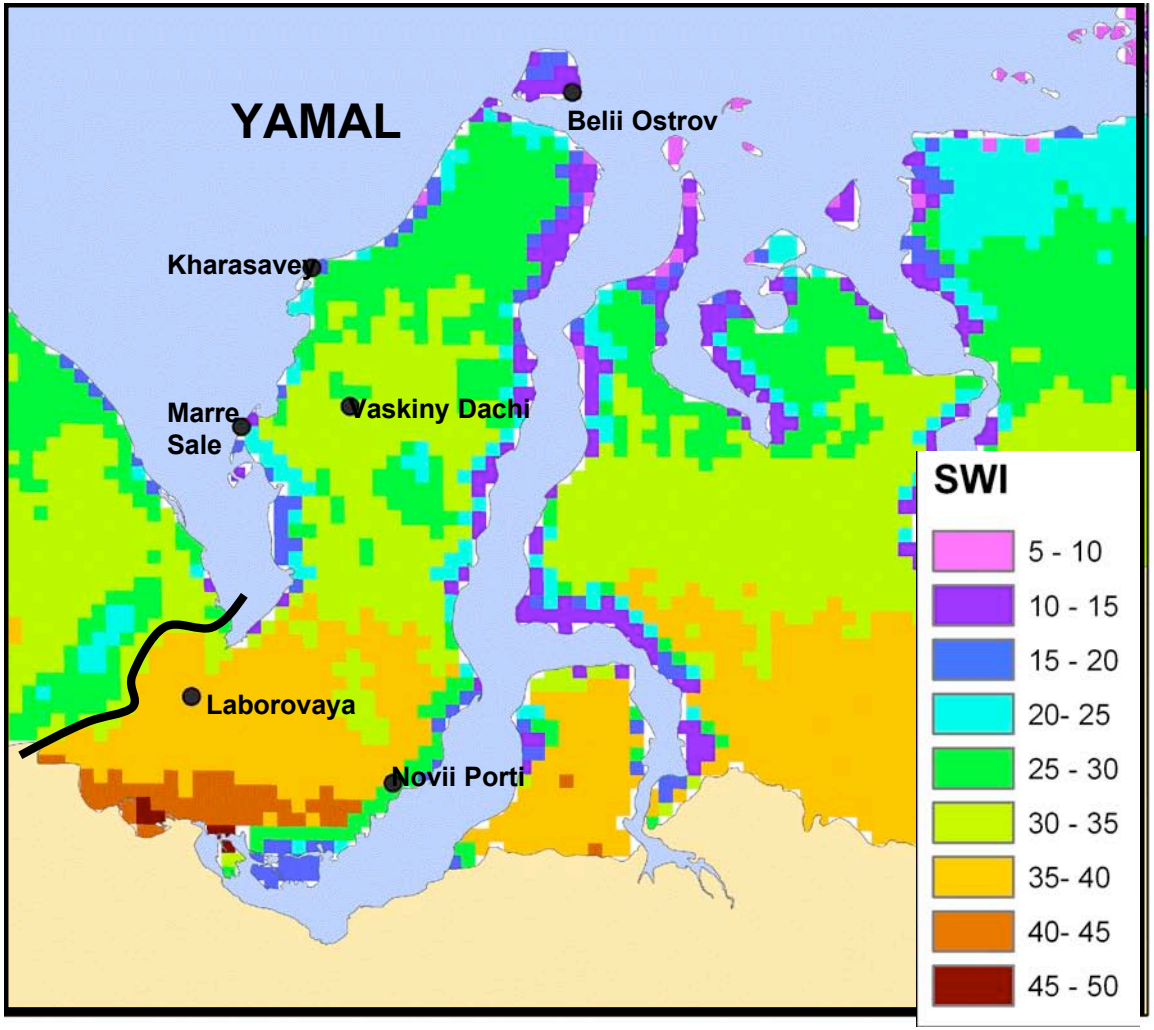
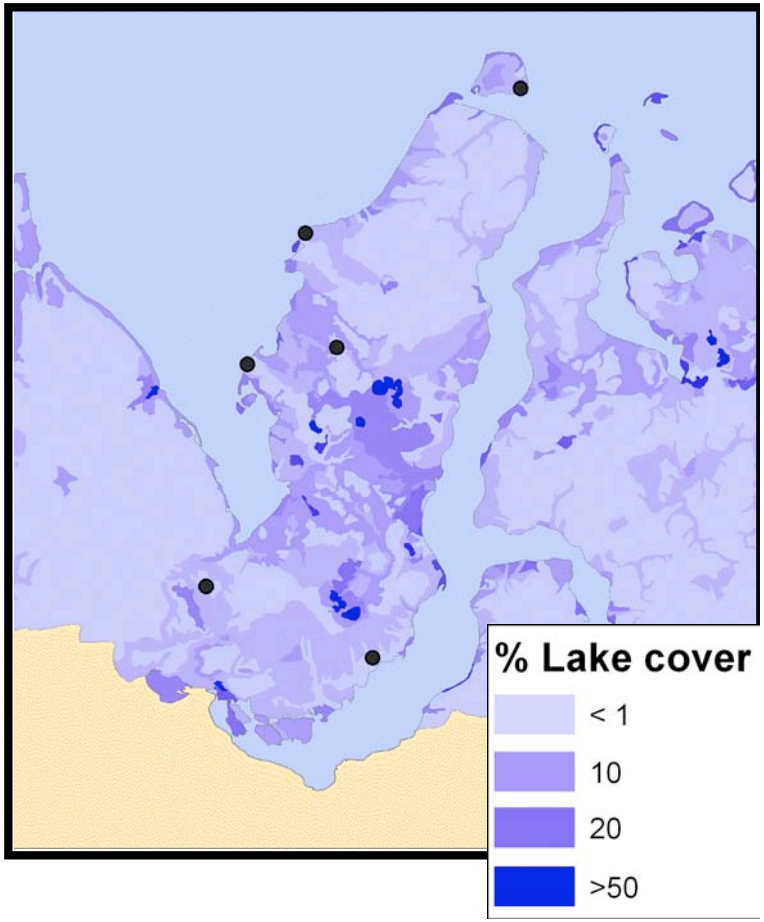
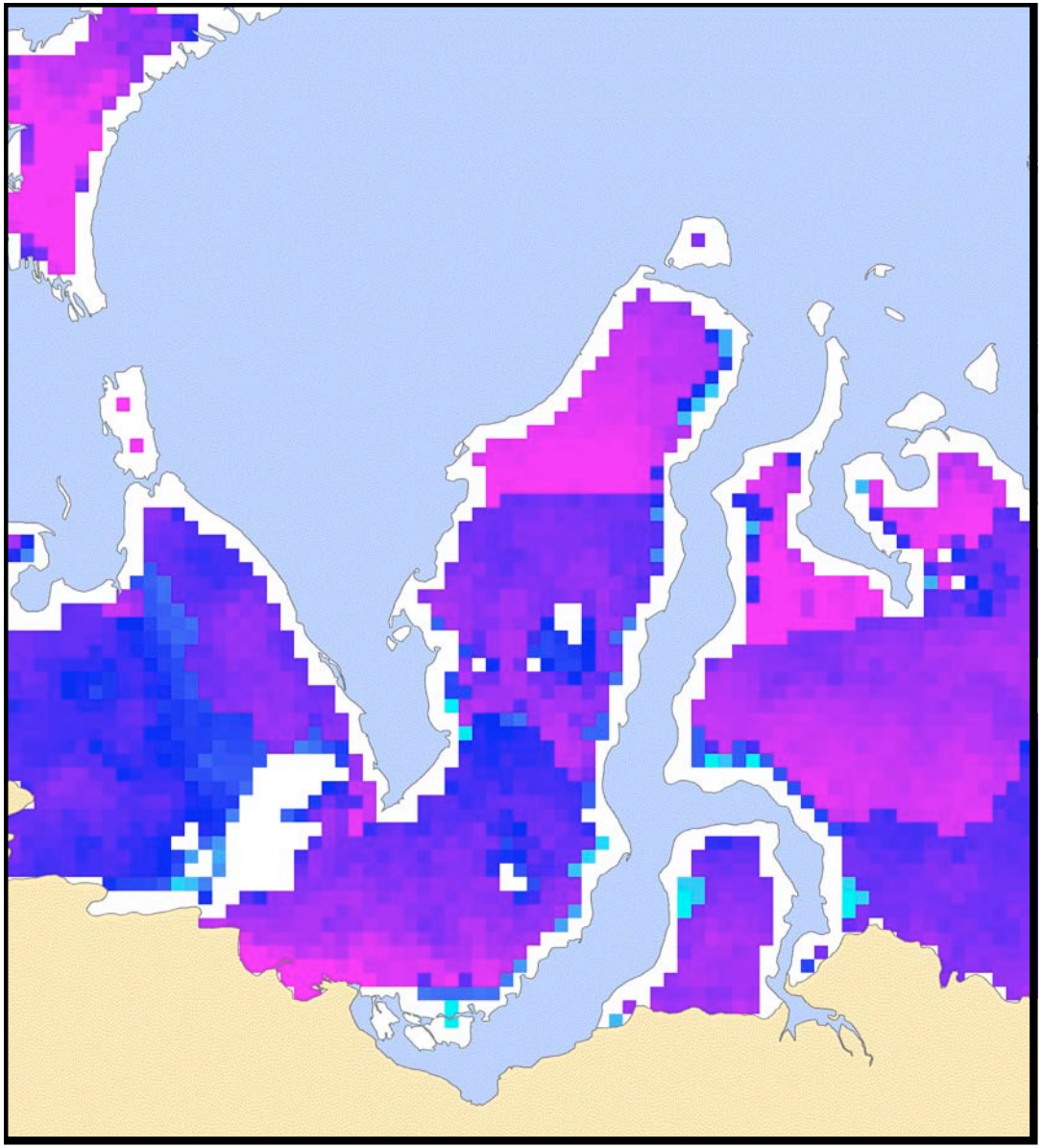




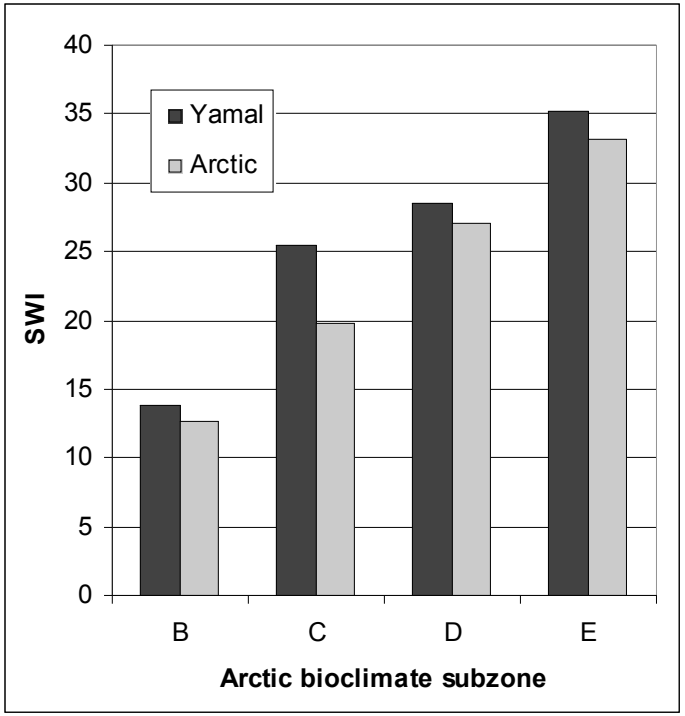
Summer warmth index (SWI) of Yamal Peninsula, based on satellite-derived land-surface temperatures (mean of 1982-2003, Raynolds et al. 2008 (in press))



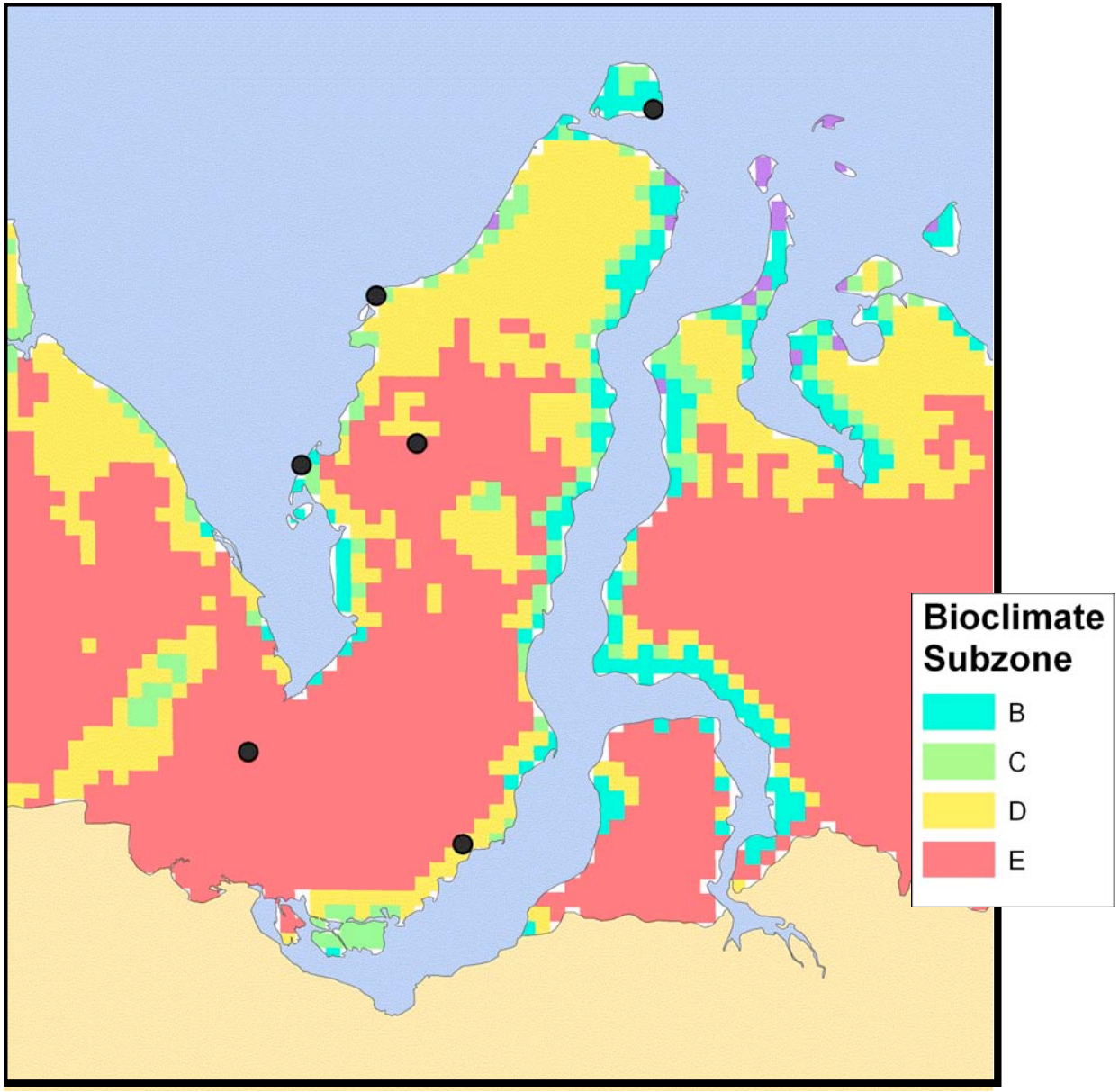
Percent lake cover from CAVM (2003)



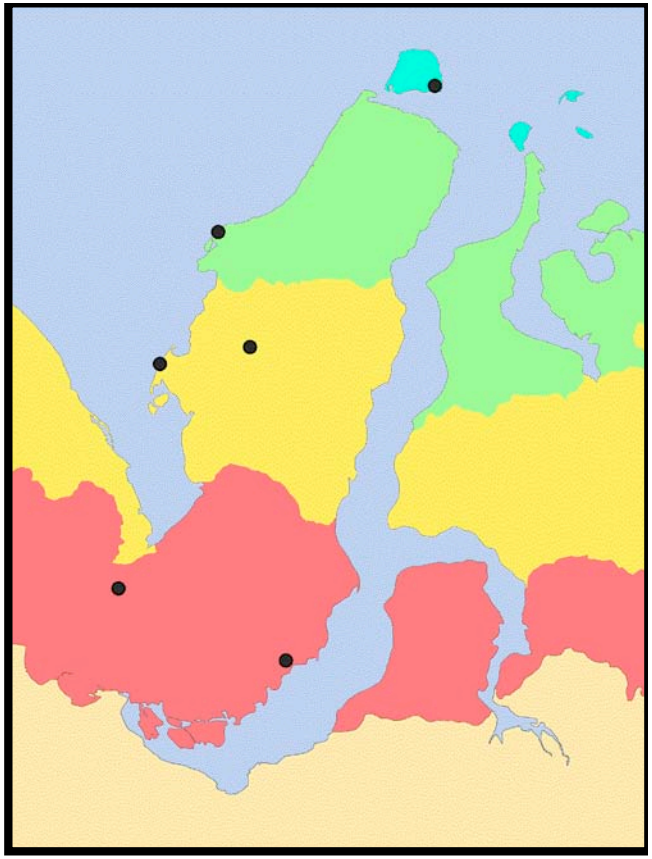
Temperatures (SWI) within CAVM bioclimate subzones, excluding coastal areas, lakes and mountainous areas (pink – warmer, blue – colder, white - excluded)



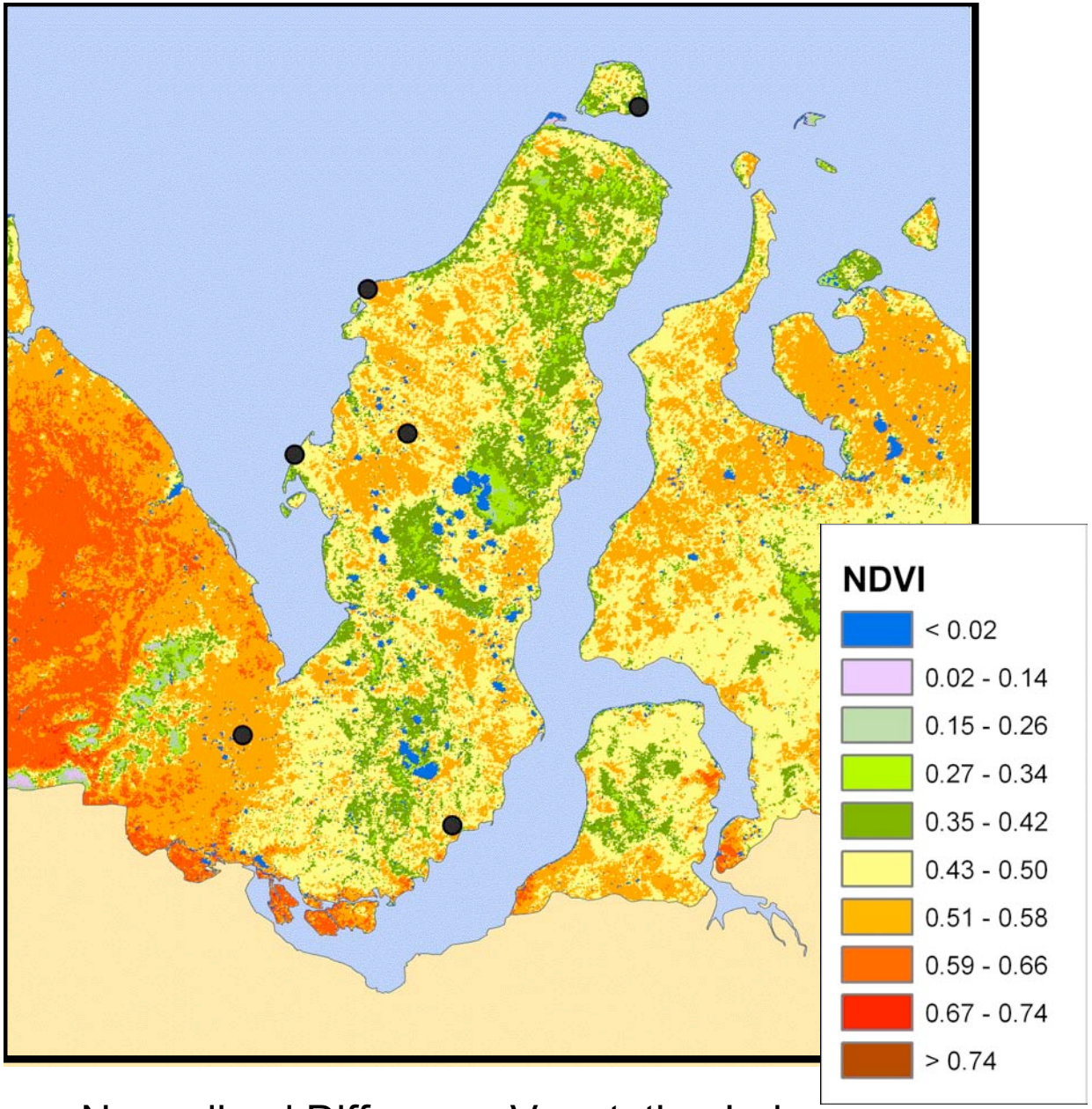
Average SWI within bioclimate subzones for Yamal Peninsula and entire Arctic land area.



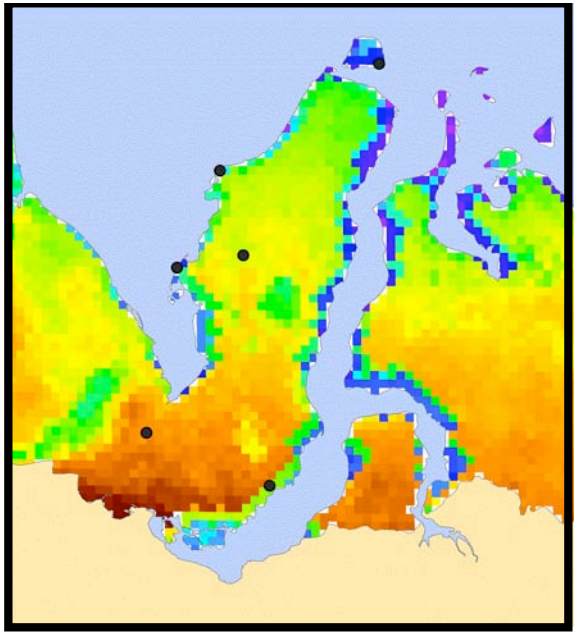
Bioclimate subzones as mapped by SWI



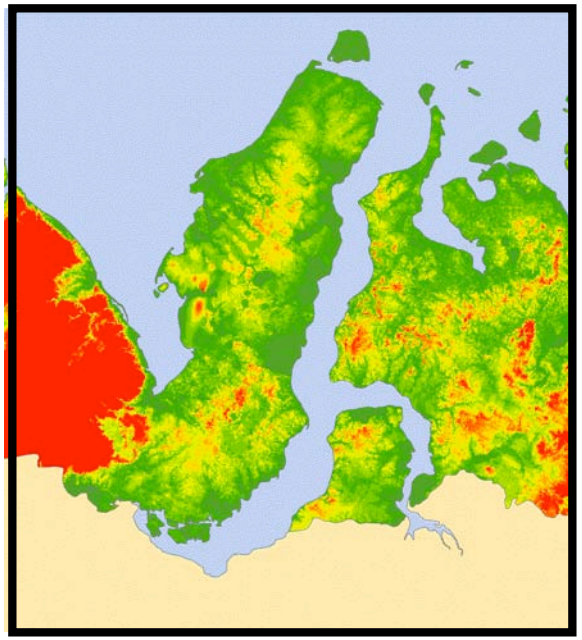
bioclimate subzones as mapped by CAVM



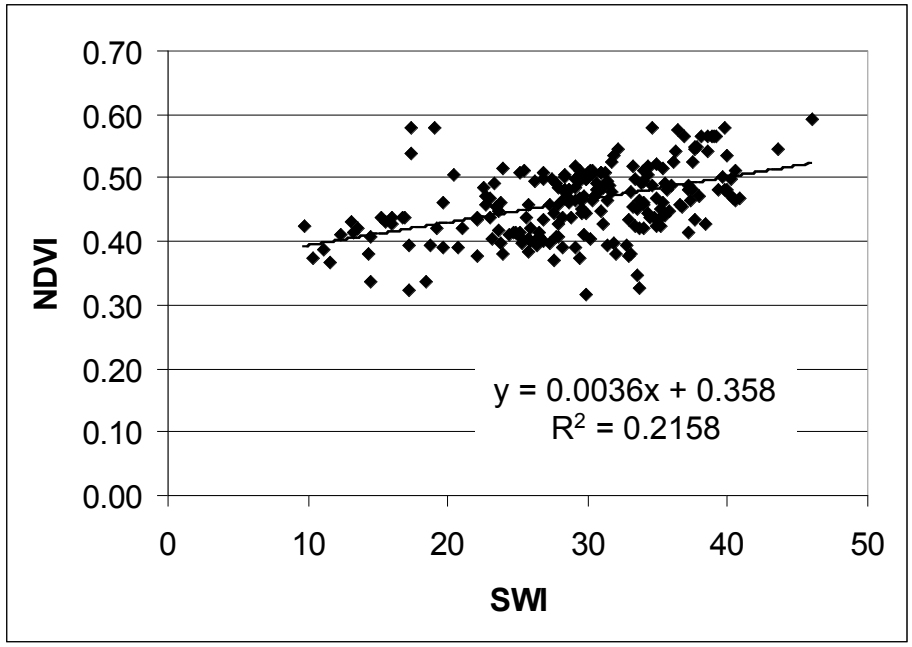
Normalized Difference Vegetation Index
NDVI = (NIR – R) / (NIR + R)



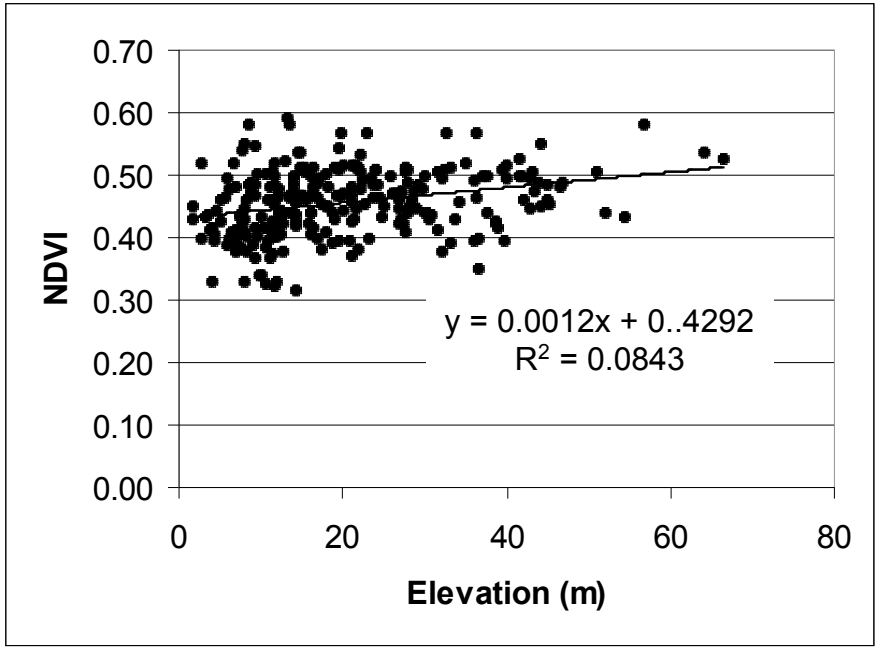
Temperature (SWI)



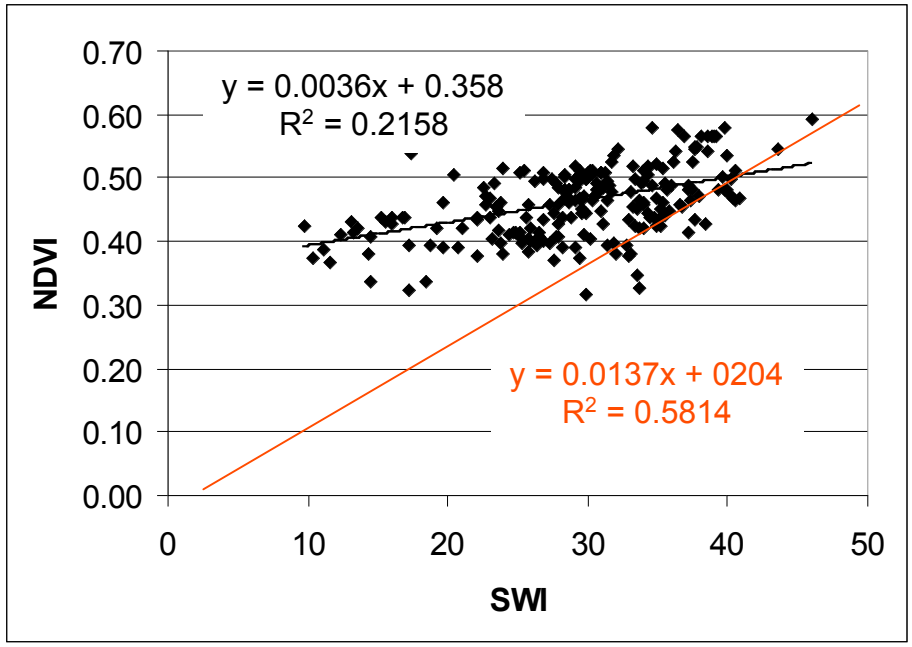
Elevation



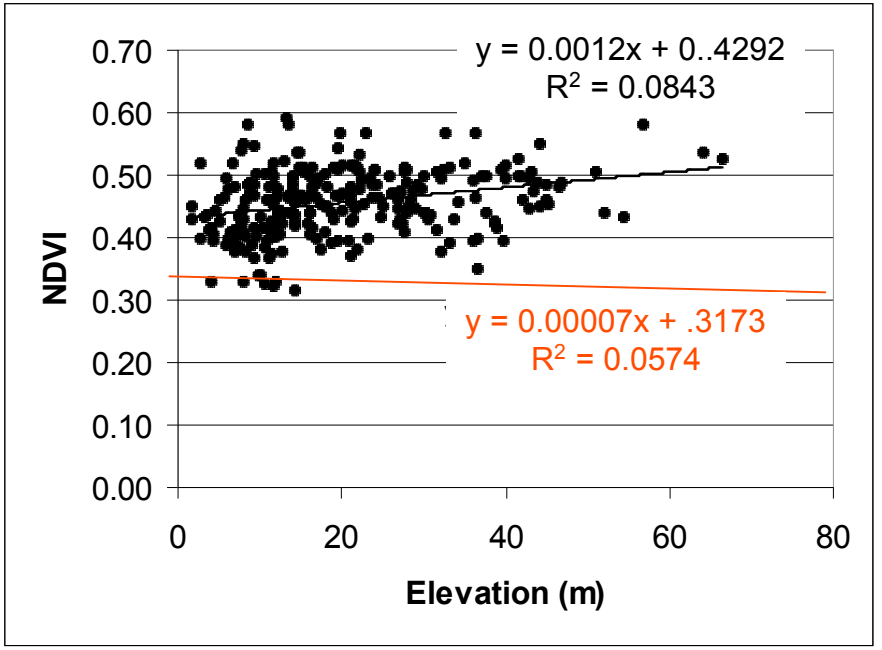
Regression relationship between NDVI and SWI of CAVM polygons on the Yamal Peninsula. Polygons with NDVI < 0.3 (lakes) were excluded.



Regression relationship between NDVI and elevation of CAVM polygons on the Yamal Peninsula. Polygons with NDVI < 0.3 (lakes) were excluded, and polygons over 70 m elevation (foothills of the Urals) were excluded to clarify the relationship on the Peninsula itself.



Regression relationship between NDVI and SWI of CAVM polygons on the Yamal Peninsula. Polygons with values < 0.3 (lakes) were excluded.



Regression relationship between NDVI and elevation of CAVM polygons on the Yamal Peninsula. Polygons with values < 0.3 (lakes) were excluded, and polygons over 70 m elevation (foothills of the Urals) were excluded to clarify the relationship on the Peninsula itself.

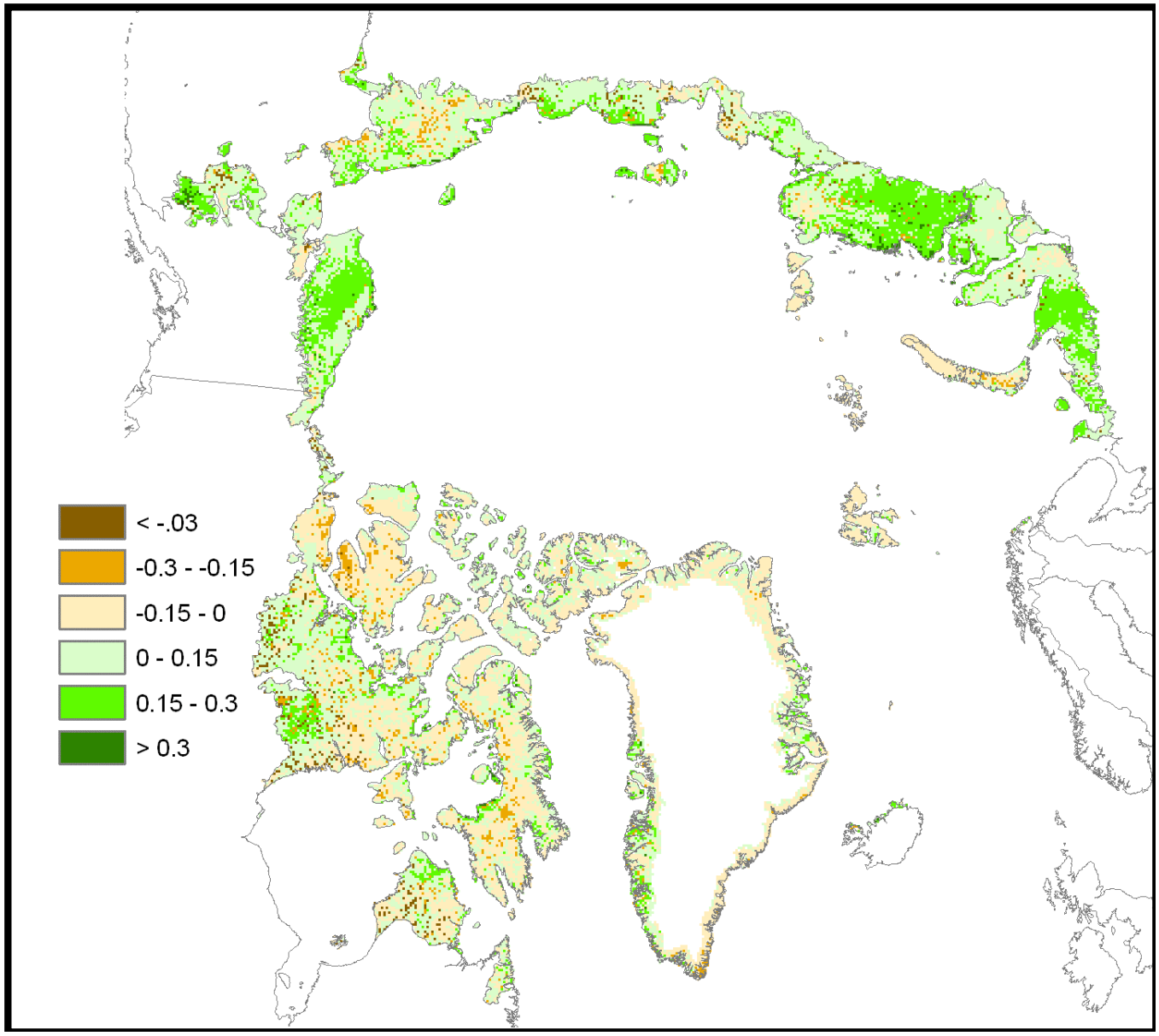
Red lines show the relationship for the Arctic as a whole

Arctic as a whole has steeper increase of NDVI with SWI

Arctic as a whole shows decrease of NDVI with elevation

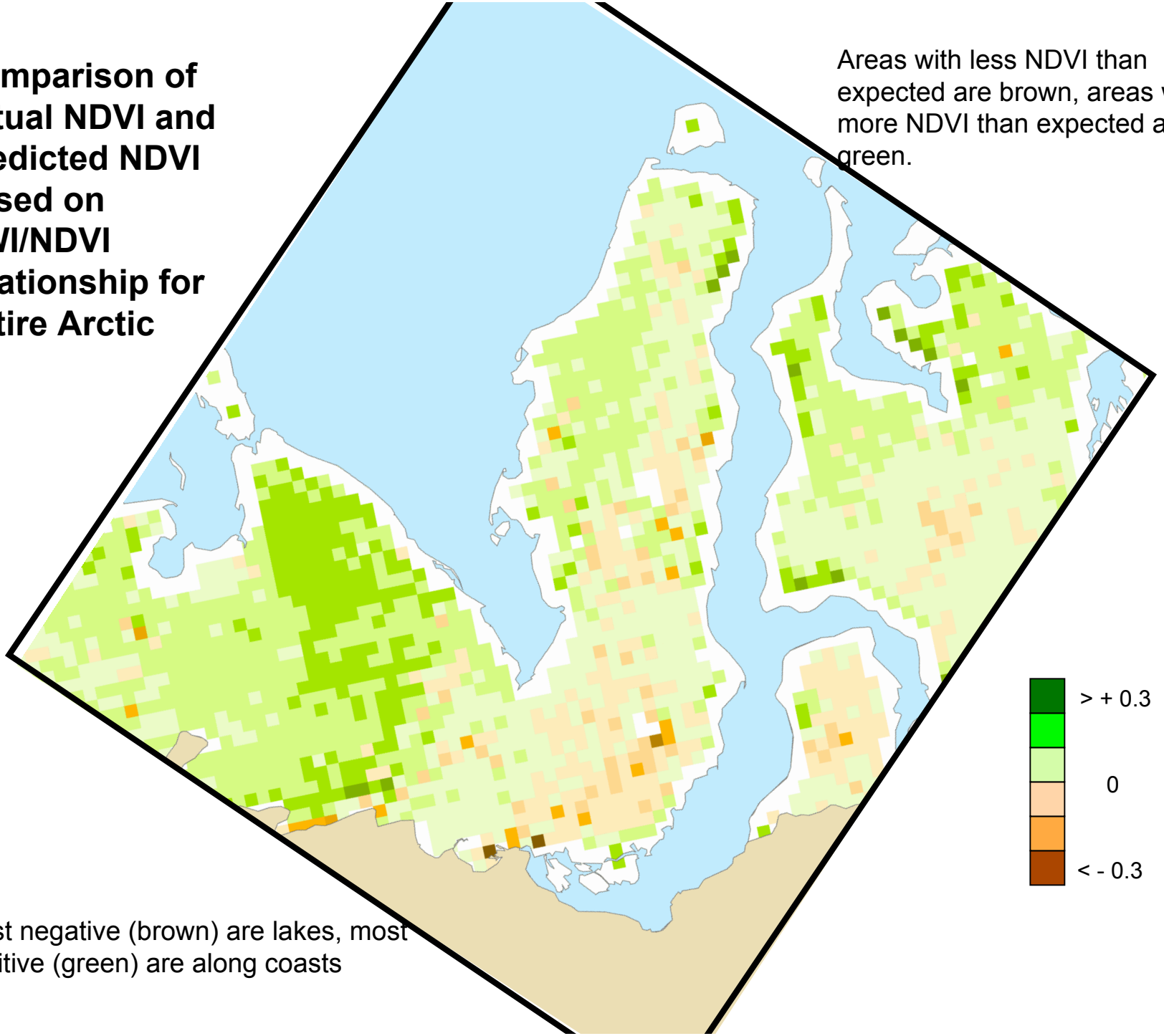
Expected NDVI value as calculated by SWI regression equation

Areas with less NDVI than expected are brown, areas with more NDVI than expected are green.

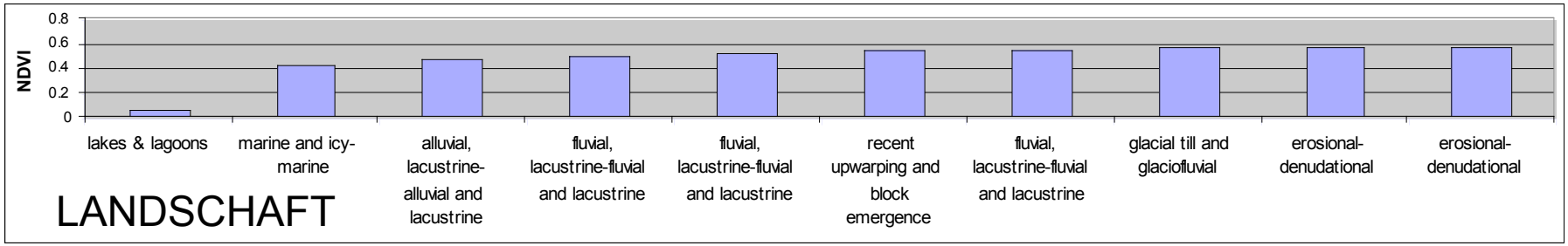


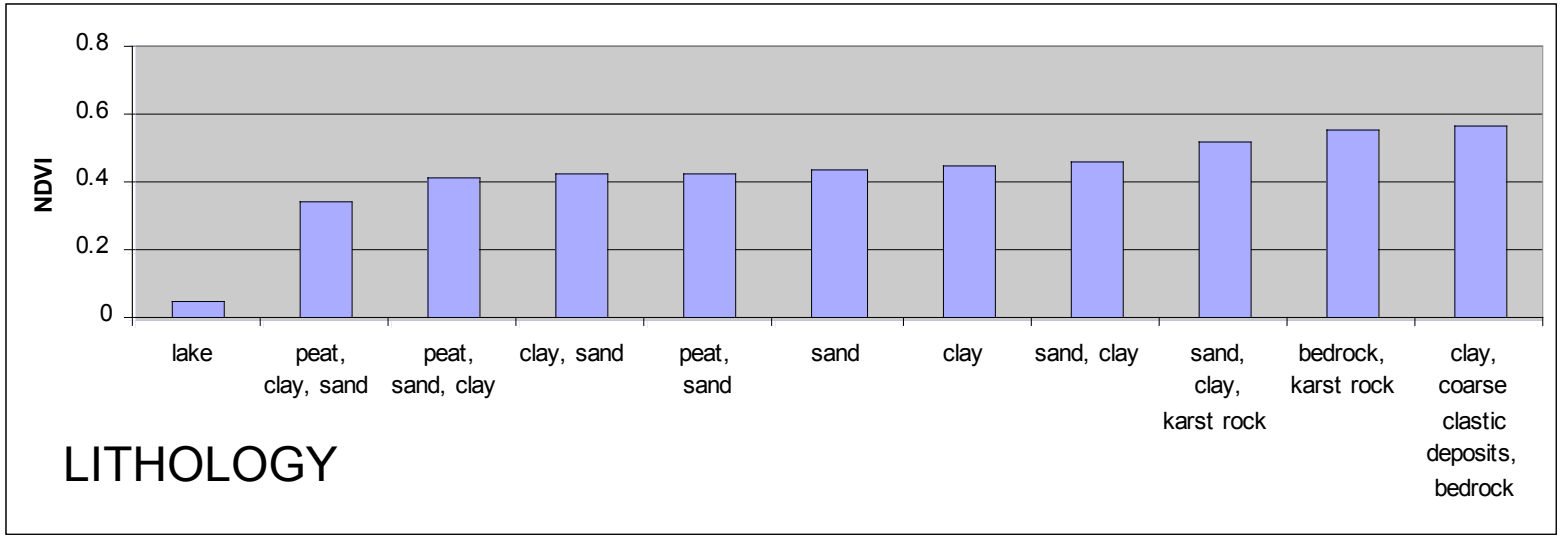
Comparison of actual NDVI and predicted NDVI based on SWI/NDVI relationship for entire Arctic

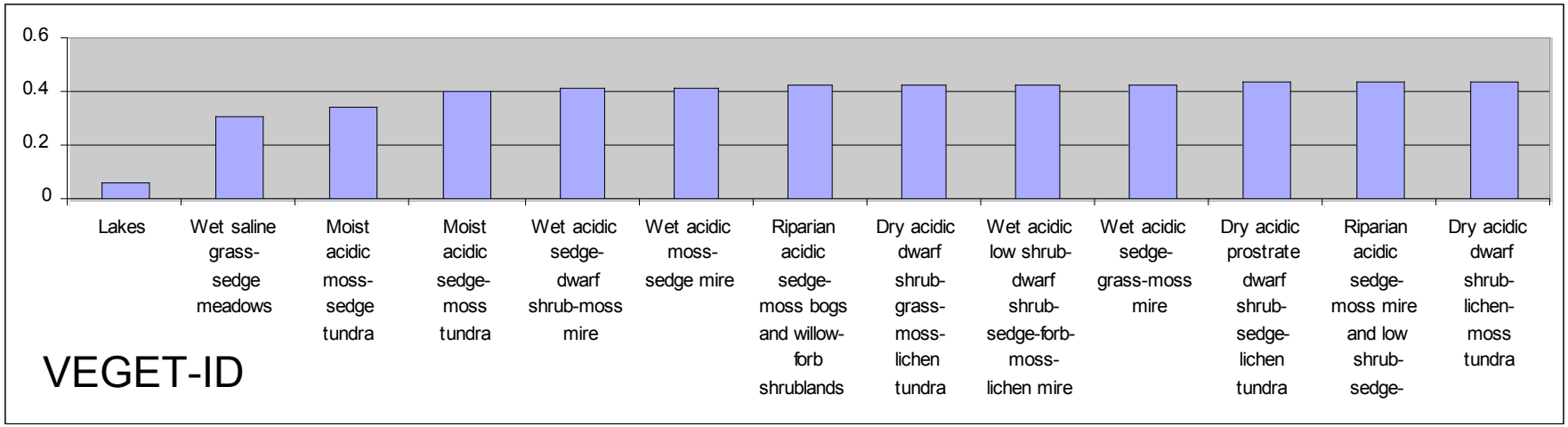
Areas with less NDVI than expected are brown, areas with more NDVI than expected are green.

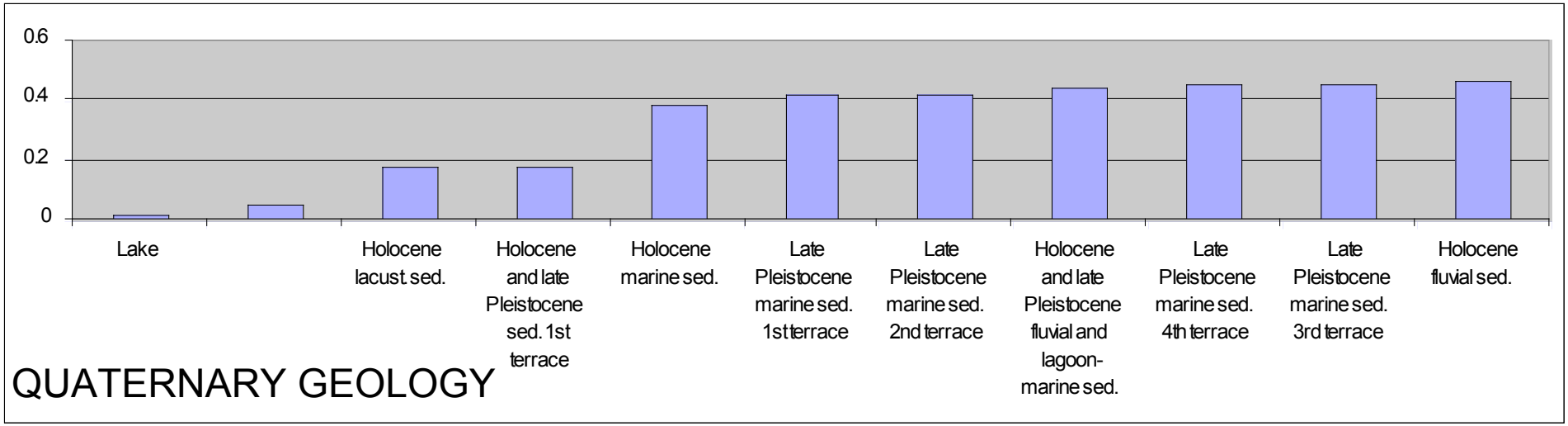


Most negative (brown) are lakes, most positive (green) are along coasts

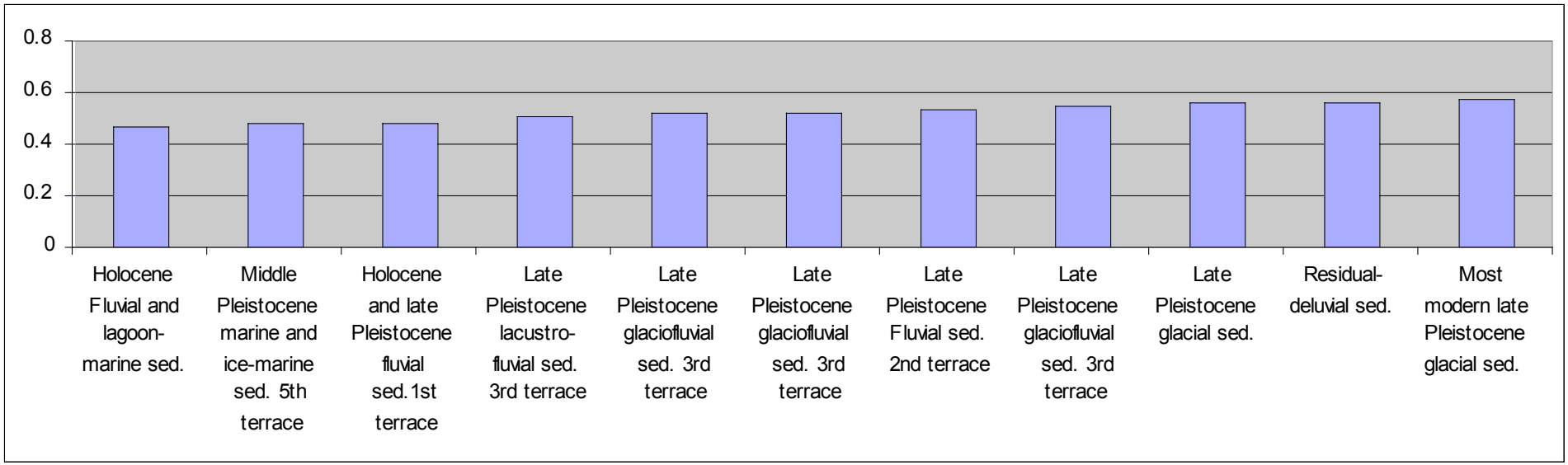

NDVI
0.8
0.6
0.4
0.2
0
lakes & lagoons
marine and icy-marine
alluvial, lacustrine-alluvial and lacustrine
fluvial, lacustrine-fluvial and lacustrine
fluvial, lacustrine-fluvial and lacustrine
recent upwarping and block emergence
fluvial, lacustrine-fluvial and lacustrine
glacial till and glaciofluvial
erosional-denudational
erosional-denudational
LANDSCHAFT


NDVI
0.8
0.6
0.4
0.2
0
lake
peat, clay, sand
peat, sand, clay
clay, sand
peat, sand
sand
clay
sand, clay
sand, clay, karst rock
bedrock, karst rock
clay, coarse clastic deposits, bedrock
LITHOLOGY

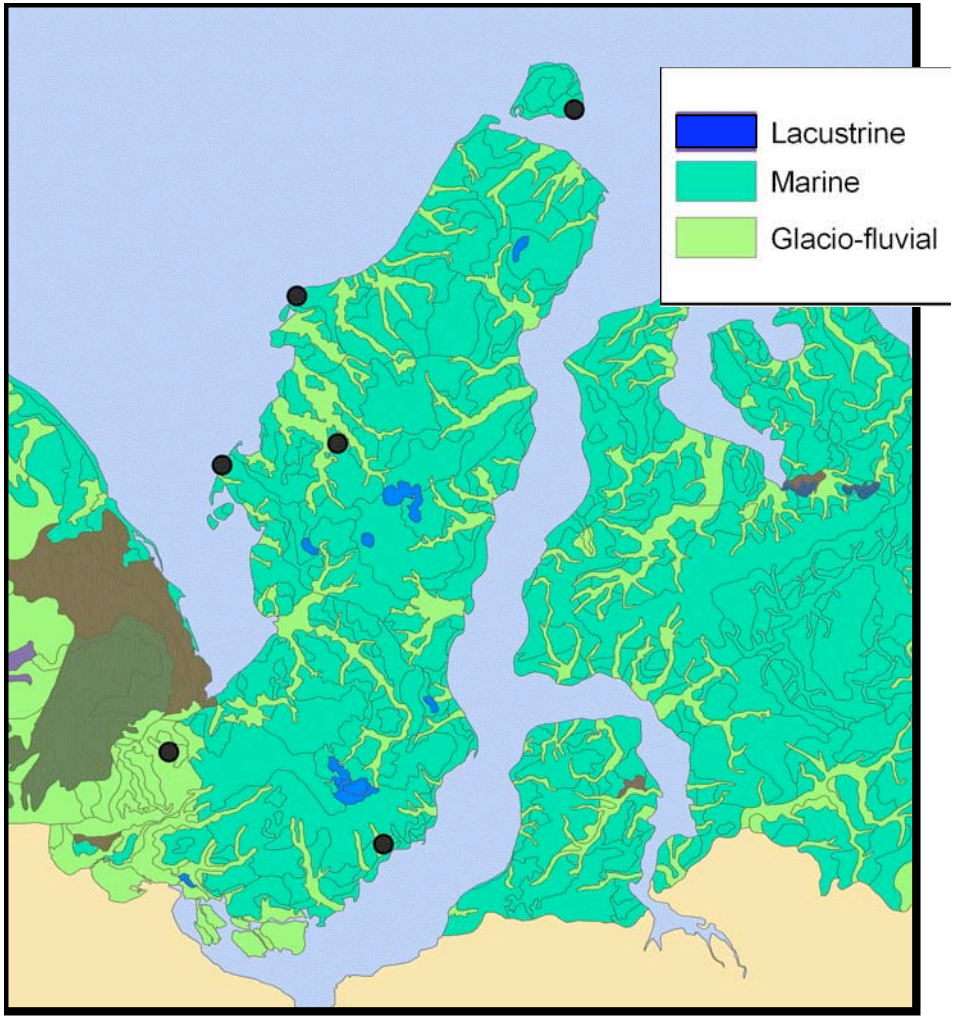

0.6
0.4
0.2
0
Lakes
Wet saline grass-sedge meadows
Moist acidic moss-sedge tundra
Moist acidic sedge-moss tundra
Wet acidic sedge-dwarf shrub-moss mire
Wet acidic moss-sedge mire
Riparian acidic sedge-moss bogs and willow-forb shrublands
Dry acidic dwarf shrub-grass-moss-lichen tundra
Wet acidic low shrub-dwarf shrub-sedge-forb-moss-lichen mire
Wet acidic sedge-grass-moss mire
Dry acidic prostrate dwarf shrub-sedge-lichen tundra
Riparian acidic sedge-moss mire and low shrub-sedge-
Dry acidic dwarf shrub-lichen-moss tundra
VEGET-ID



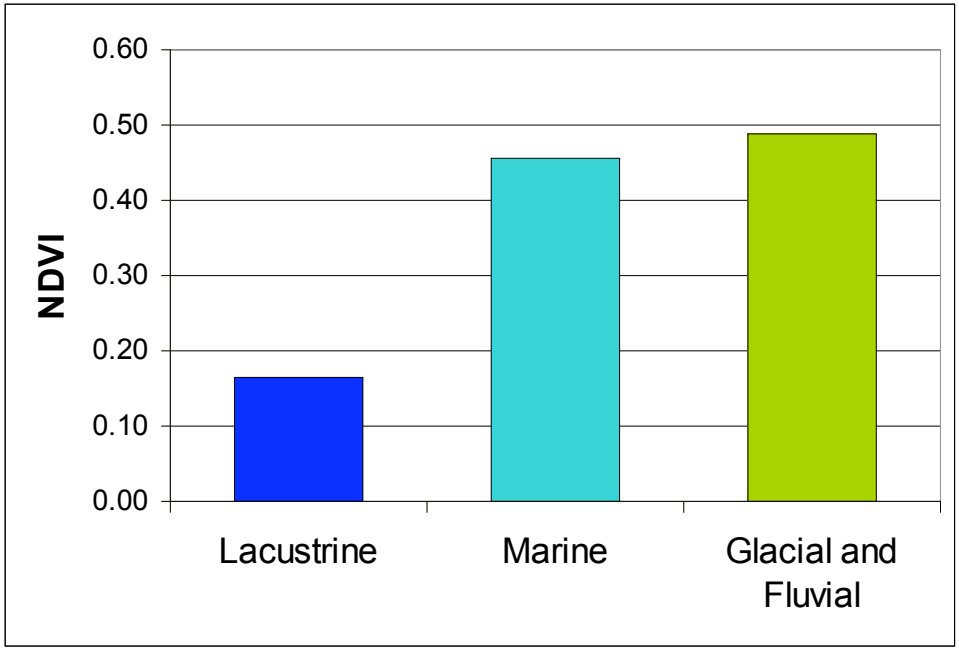
QUATERNARY GEOLOGY



Quaternary geology (continued)

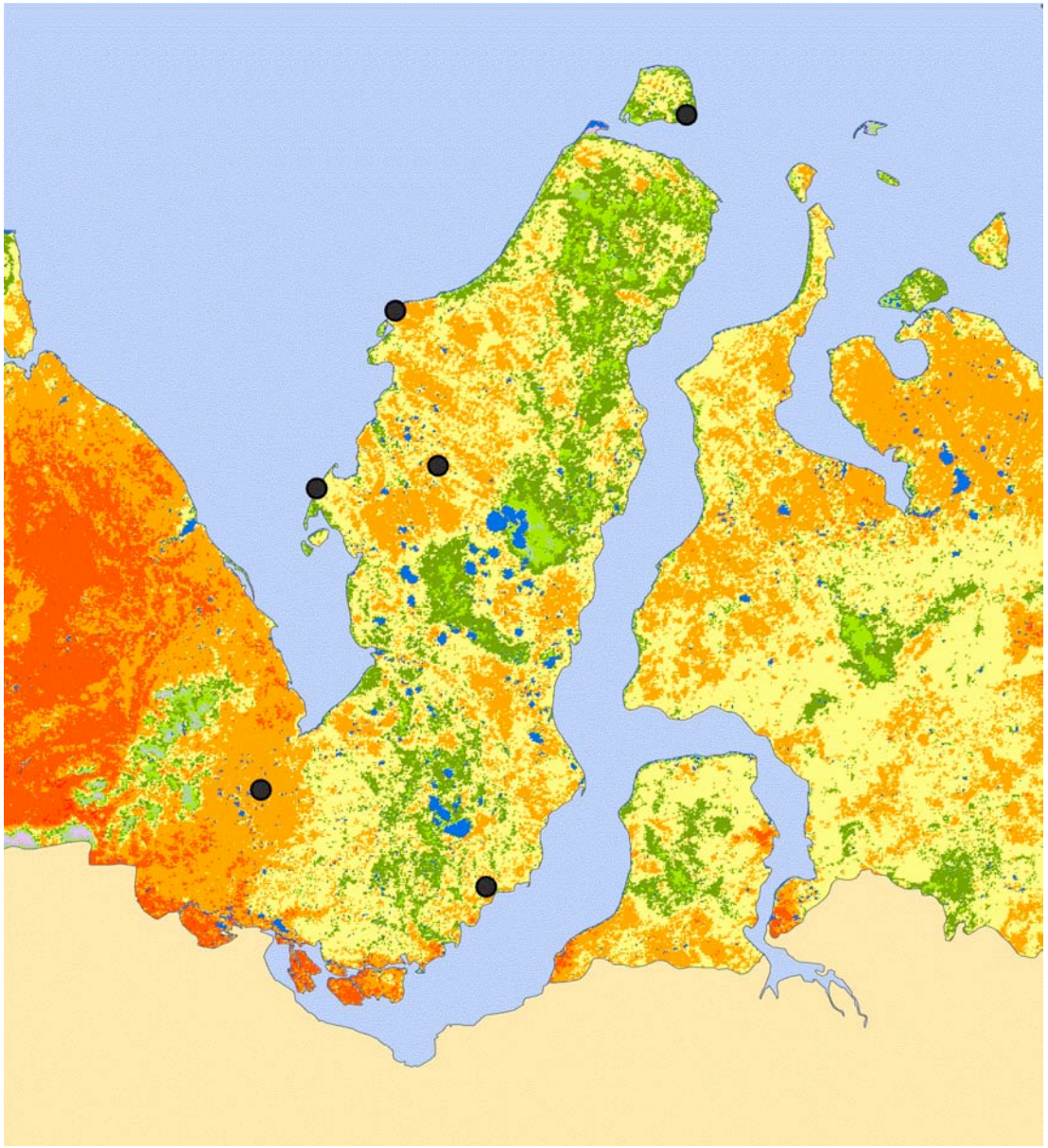


QUATERNARY GEOLOGY

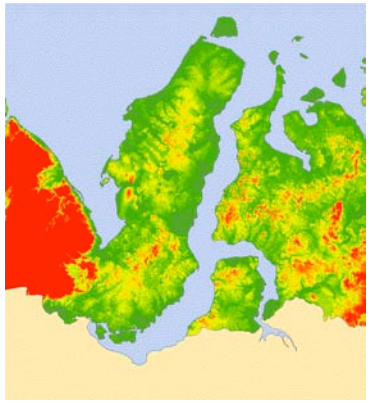


Results from General Linear Model

	Df	Deviance	Residual Df	Residual Deviance	% Deviance accounted for	Signi-ficance
Null			280	2.06516		
Elevation	0.60322	0.60322	279	1.46194	**29.21**	< 2e-16 ***
Land-schaft	0.40732	0.40732	278	1.05462	**19.72**	< 2e-16 ***
Lithology	0.10083	0.10083	277	0.9538	**4.88**	2.91e-07 ***
Veget-ID	0.08868	0.08868	276	0.86512	**4.29**	3.50e-06 ***
SWI	0.03856	0.03856	275	0.82655	**1.87**	1.12e-04***
Lake area	0.03245	0.03245	274	0.7941	**1.57**	9.34 e-04***
TOTAL					**61.55**	

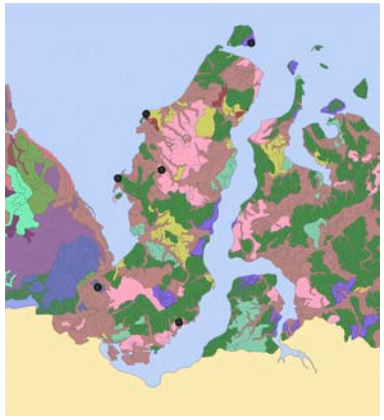


NDVI



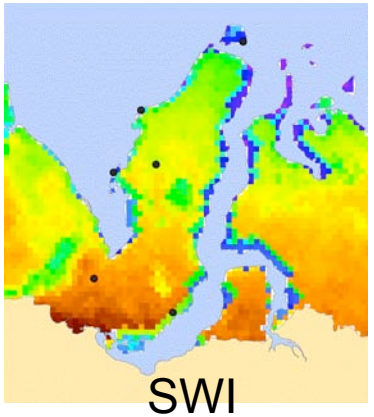
elevation

landschaft

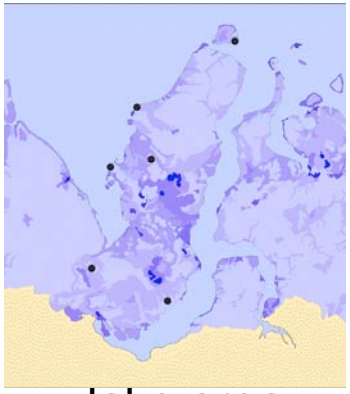


lithology

veget-id



SWI



lake area

Summary

•Bioclimate subzones as mapped by satellite surface temperature extend farther north than the boundaries mapped by the CAVM, especially in the interior of the Yamal Peninsula

•NDVI is highest in foothills of Ural Mountains, lowest in areas with many lakes. Variation in NDVI is due to combination of many different factors

Further questions

•Effects of reindeer on NDVI

•Relationship/usefulness of these data to other studies

THANK YOU

Acknowledgements

University of Alaska International Polar Year (IPY) graduate fellowship through the Cooperative Institute for Arctic Research (CIFAR) with funds from NOAA under cooperative agreement NA17RJ1224 with the University of Alaska.

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