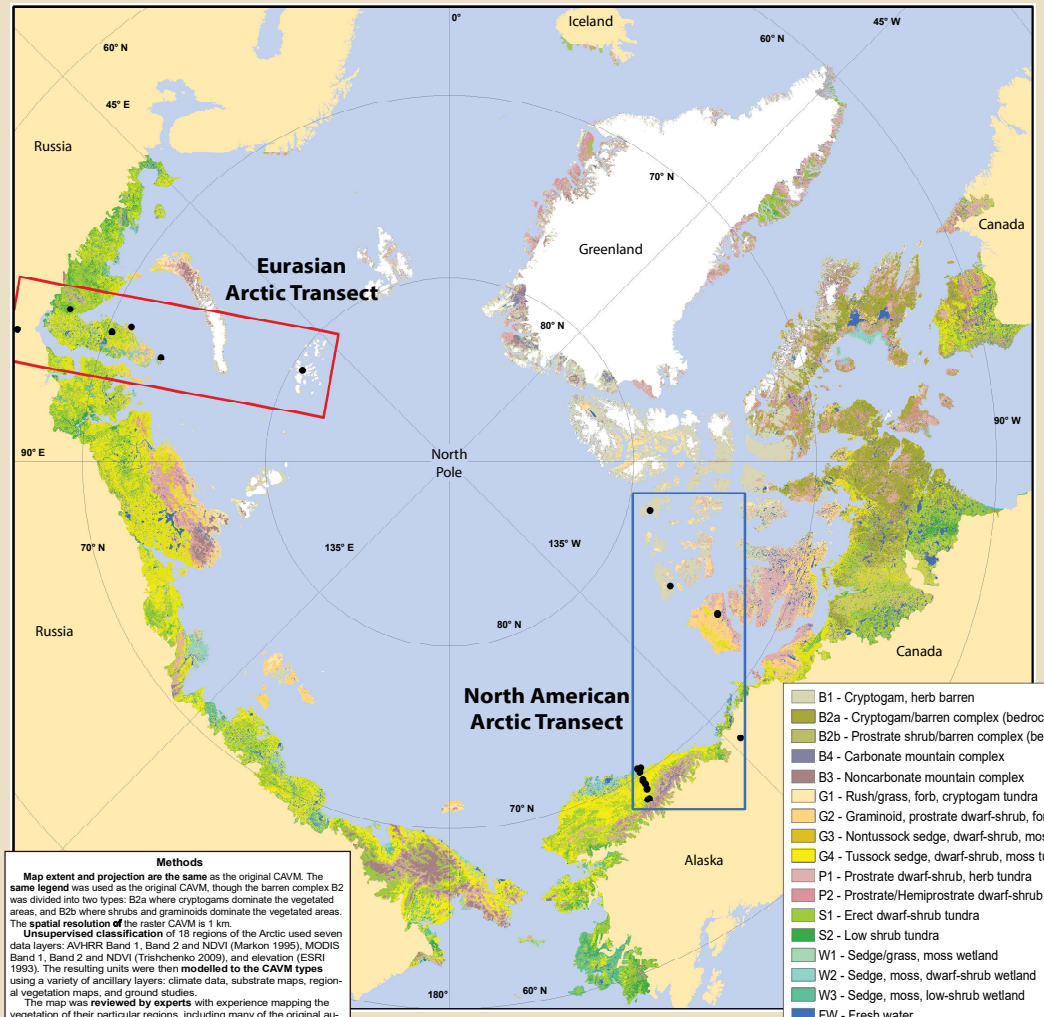
New Raster Version of the Circumpolar Arctic Vegetation Map (CAVM)

Martha K. Raynolds and Donald A. Walker
Institute of Arctic Biology, University of Alaska Fairbanks, mkraynolds@alaska.edu



Methods

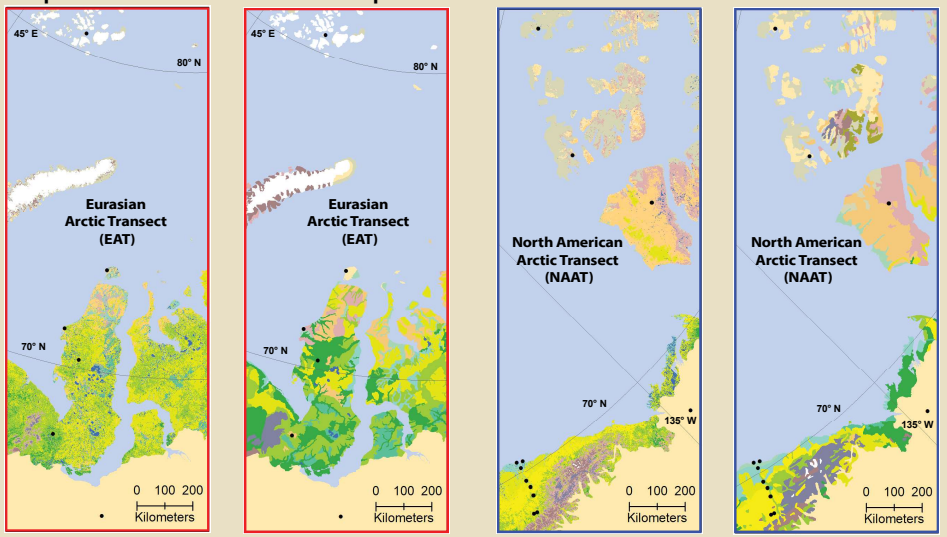
Map extent and projection are the same as the original CAVM. The **same legend** was used as the original CAVM, though the barren complex B2 was divided into two types: B2a where cryptogams dominate the vegetated areas, and B2b where shrubs and graminoids dominate the vegetated areas. The **spatial resolution of** the raster CAVM is 1 km.

Unsupervised classification of 18 regions of the Arctic used seven data layers: AVHRR Band 1, Band 2 and NDVI (Markon 1995), MODIS Band 1, Band 2 and NDVI (Trishchenko 2009), and elevation (ESRI 1993). The resulting units were then **modelled to the CAVM types** using a variety of ancillary layers: climate data, substrate maps, regional vegetation maps, and ground studies.

The map was **reviewed by experts** with experience mapping the vegetation of their particular regions, including many of the original authors of the CAVM. This expert input was used to revise and improve the map.

- B1 - Cryptogam, herb barren
- B2a - Cryptogam/barren complex (bedrock)
- B2b - Prostrate shrub/barren complex (bedrock)
- B4 - Carbonate mountain complex
- B3 - Noncarbonate mountain complex
- G1 - Rush/grass, forb, cryptogam tundra
- G2 - Graminoid, prostrate dwarf-shrub, forb tundra
- G3 - Nontussock sedge, dwarf-shrub, moss tundra
- G4 - Tussock sedge, dwarf-shrub, moss tundra
- P1 - Prostrate dwarf-shrub, herb tundra
- P2 - Prostrate/Hemiprostrate dwarf-shrub tundra
- S1 - Erect dwarf-shrub tundra
- S2 - Low shrub tundra
- W1 - Sedge/grass, moss wetland
- W2 - Sedge, moss, dwarf-shrub wetland
- W3 - Sedge, moss, low-shrub wetland
- FW - Fresh water
- SW - Saline water
- GL - Glacier
- NA - Non-Arctic

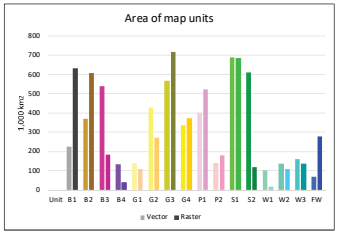
Comparison of raster and vector maps of the Eurasian and North American Arctic Transects

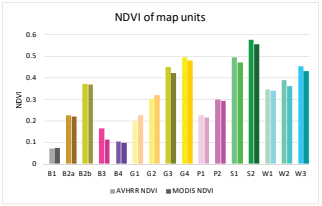


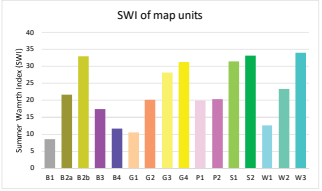
New Raster CAVM | Old Vector CAVM | New Raster CAVM | Old Vector CAVM

Introduction

A finer-resolution, raster version of the Circumpolar Arctic Vegetation Map (CAVM) was needed for modeling and other digital analyses. We used the same legend as the CAVM, which has proven to be effective for circumpolar analyses of vegetation. We also retained the extent of the CAVM, with the same treeline and coastline, and used the same Lambert Azimuthal Equal Area Polar Projection. Here we compare the area analyses of the new raster map and the old vector map. We also show the details of the map along two transects through all five Arctic bioclimate subzones in Eurasia and North America.



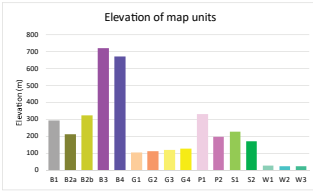




Results

Comparison of original CAVM and new Raster CAVM
The proportions of the land cover units on the two maps differed, mostly due to the spatial resolution of the two maps. There was four times as much water on the new raster map compared to the vector map, since many waterbodies smaller than the vector minimum polygon size could be mapped. Mountainous areas were mapped in much greater detail on the raster map, leaving less in the mountain complex types. Differences in interpretation can be seen in the reduction in low shrub tundra. The raster map now shows this type mainly occurring in narrow bands along river valleys.

Comparison of AHVRR and MODIS NDVI
The average NDVI of vegetation types on the Raster CAVM was very similar for both AVHRR and MODIS data. The lowest values occur in barren types (B1-4), and the highest values in dwarf-shrub types (S1, S2). Graminoid types that include shrubs (G3, G4) also have relatively high NDVI, as do wetland types that occur in the more southern areas that also have shrubs (W3).



Climate
Average summer warmth index (SWI) (°C) of vegetation types on the Raster CAVM show expected increases within the graminoid(G), shrub (P, S) and wetland (W) types. The coldest type (B1), occurs along with G1 in farthest north areas.

Elevation
Wetland types (W1, W2, W3) are found at the lowest elevations, and mountain complexes (B3, B4) at the highest elevations.

Conclusions

1. Successful mapping method. Unsupervised classification and modelling created a realistic map of vegetation distribution, using the same circumpolar legend developed for the CAVM.

2. Greater spatial resolution. The 1-km pixel raster CAVM provides much finer resolution than was possible with the original hand-drawn vector map.

3. Greater cover of finely dispersed cover types. Area comparison of vegetation units on the two maps shows greater cover of vegetation patches of 5 to 150 km diameter. The vector map shows greater cover of barren types (B1, B2), Low Arctic graminoid types (G3, G4), prostrate-shrub tundra (P1), and lakes (FW); with lower cover of High Arctic graminoid types (G1, G2), and much lower cover of mountain types (B4, B4) and low-shrub tundra (S2).

4. Temperature, elevation and NDVI characteristics of classes display expected patterns among the vegetation types.

5. The regions of the EAT and NAAT show considerable differences on the new raster map that will be fully evaluated in a new paper comparing the vegetation of the two transects.

ARCTIC BIODIVERSITY CONGRESS 2018
Rovaniemi, Finland 9-12 October 2018

References

ESRI (1993). Digital Chart of the World. In. Redlands, CA: Environmental Systems Research Institute, Inc.

Markon, C.J., Fleming, M.D., & Binnian, E.F. (1995). Characteristics of vegetation phenology over the Alaskan landscape using AVHRR time-series data. Polar Record, 31, 179-190

Trishchenko, A.P., Luo, Y., Khlopenkov, K.V., Park, W.M., & Wang, S. (2009). Arctic circumpolar mosaic at 250m spatial resolution for IPY by fusion of MODIS/TERRA land bands B1–B7. International Journal of Remote Sensing, 30, 1635-1641