Modelling the Distribution of Circumpolar Arctic Vegetation

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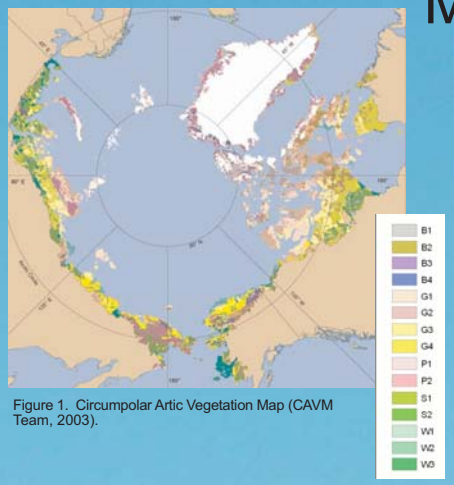

Figure 1. Circumpolar Artic Vegetation Map (CAVM Team, 2003).

How will arctic vegetation respond to climate change?

The Arctic is a very heterogeneous bioclimate zone, with vegetation varying from sparse, non-vascular dominated, low-growing vegetation in the coldest areas to dense tall shrubs in the warmest areas (Fig. 1). Each vegetation type results from a unique combination of environmental variables.

Climate and substrate are the main factors controlling vegegtation (Fig. 2). Temperature and precipitation are the major characteristics of climate. Permafrost, landscape age, elevation, and soil chemistry are some of the many variables affecting the substrate on which plants grow.

A better understanding of the environmental factors controlling the distribution of arctic vegetation will allow us to better predict the response of different areas to climate change.

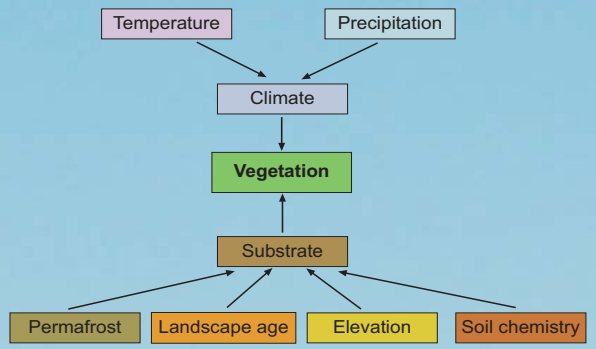

Figure 2. Some of the major environmental factors affecting arctic vegetation.

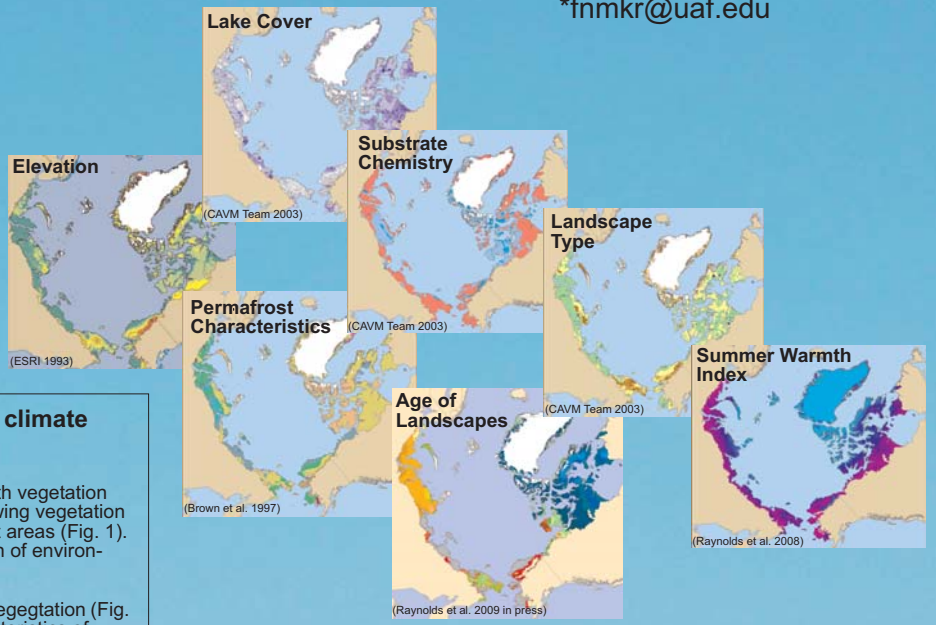

Figure 3. Maps of variables used as inputs for regression tree modelling.

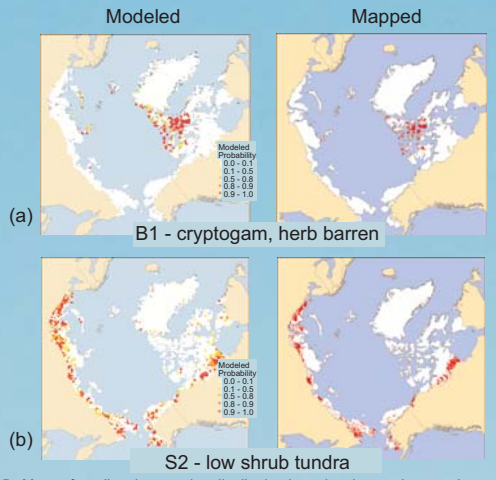

Figure 5. Maps of predicted vegetation distribution based on boosted regression tree models (left, grid points spaced every 50 km) compared with distribution shown on the CAVM (right) for (a) B1 - cryptogam, herb, barren and(b) S2 - low shrub tundra.

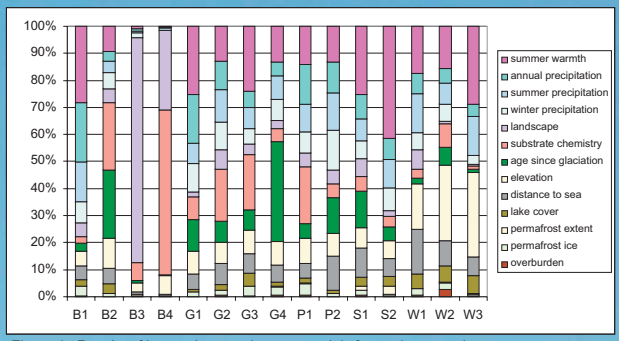

Figure 4. Results of boosted regression tree models for arctic vegetation types.

Using models to compare effects of many variables

Models can show us which environmental variables are most important for which vegetation type. We used Boosted Regression Tree modelling (Elith et al. 2008) to create separate models for each arctic vegetation type, based on a suite of maps of circumpolar environmental characteristics (Fig. 3, 4). The models all had high ROC values (> 0.95), and their validity can be checked visually by comparing maps predicted by the models with the CAVM mapped distribution (Fig. 5).

Conclusions

Temperature is an important factor controlling the distibution of all but barren vegetation types (B2, B3 and B4). The vegetation types most affected by precipitationare found in the High Arctic, where precipitation is low (B1, G1, P1, P2, W1). Vegetation types most controlled by substrate characteristics and least affected by climate are the mountain complexes (B3, B4), the cryptogam barren complex most commonly found on the Canadian Shield (B3), and tussock tundra (G4).

References

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