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ESM 215 Winter 2019

Exercise 2: Physical environmental controls on land cover pattern

1. **Summarize your results using a tree diagram like that in the papers.**

   Attached.

2. **Discuss your results. How strong is the relationship between land cover and physical environmental variables?**

   Of the three environmental variables we are looking at (geology, radiation, and flow accumulation), geology is the most strongly associated with the vegetation in the study area, followed by radiation and then flow accumulation. The mutual information analysis found that geology co-occurs with vegetation 16% percent of the time. While 16% may seem like a small amount, given the complexity of the environment with many possible predictor variables, this result indicates a strong relationship between vegetation and environmental variables. In other landscapes that are simpler with fewer explanatory variables, like an expansive tundra plain or homogenous boreal forest, 16% might be considered a weak relationship. Ernoult *et al.* 2003 found a strong relationship between land cover and physical variables —land uses closely followed the topography and geology. In the future, with more detailed data and better methods we will be able to increase the explanatory power of environmental variables.

3. **Compare your findings to those of Davis and Dozier (1990).**

   My findings were similar to those of Davis and Dozier (1990). I found that the four geology classes accounted for16% of the information in the vegetation data. Davis and Dozier found that their nineteen land classes accounted for 18.5% of the vegetation data. Furthermore, the hierarchy of explanatory environmental variables was similar to my analysis, with geology being the most powerful explanatory variable followed by radiation (or insolation as it is referred to in the paper). Davis and Dozier did not include flow accumulation in their analysis, likely because it is a weak explanatory variable — as I found in my analysis.

4. **Summarize the strengths and weaknesses of Mutual Information Analysis for establishing land cover-environment associations? What alternatives would you consider?**

Strengths:

- Reduces the amount of intensive field sampling needed, allowing for more practical ability to test with a larger random sample than field methods alone.
- Can be easily compared with existing ecological association studies of the region in question.
- Useful for relating biodiversity to complex landscapes, especially are larger scales.
- Land classes are scalable depending on the level of detail of environmental variables used. For example, a general geology or soils map could be used for general classification, or a finer detail map that includes texture, organic content, depth, etc. can be used to create more specific classes.
- Less subjective than other classification methods.
- With improving remote sensing technology, mutual information is a practical way to study land classes of large and/or difficult to access areas.

Weaknesses:

- Dependent upon the accuracy and detail of the cartographic maps being used for the analysis. Davis and Dozier mention that a 30-m resolution DEM was too course to reliably use microtopography to construct accurate land classes.

Alternatives:

- Controlled experiments could be used to identify causal connections between land cover and environmental variables. However, this would be expensive and time intensive.
- USDA Ecomap is a comprehensive methodology, which if used would allow you to fit your landscape classification into an accepted hierarchy, rather than a unique system just for your area. However, this would only be useful if working at a large scale.
- Other statistical analyses such as a contingency matrix or PCA can analyze associations between categories.
- If you are only interested in a specific species, you could create a simpler classification system. For example, which areas are suitable for species X?

Classses 3 Geology 1 2 5 6
4 Radiation 1 2 3
5 Flow 1 2 3