Today's exercise! Independent work 3!

Questions: ”Independent work 3” in Moodle
Deadline 21.11.2017
Data: ”*saana.csv*”; vascular plant species and abiotic condtions were surveyed on the Saana massif in north-western Finland (69°3′N 20°51′E) at ca. 700 m a.s.l., ca. 100–200 m above the birch treeline. Grid data of 1m x 1m quadrats.

Within each quadrat:
mesotopo = mesotopography
soil_moist = soil moisture
soil_temp = soil temperature
soil_ph = soil pH
veg_height = vegetation height
vasc_spr = species richness of vascular plants
Empher_cover = cover of *Empetrum hermpaphroditum* (crowberry)
Betnan = presence/absence of *Betula nana* (dwarf birch)
Cashyp = presence/absence of *Cassiope hypdnoides* (moss heather)
Empher = presence/absence of *Empetrum hermpaphroditum*
Gersyl = presence/absence of *Geranium sylvaticum* (woodland geranium)
Salret = presence/absence of *Salix reticulata* (snow willow)

Question 1:

Divide the *saana.csv* data randomly into two different datasets:

- model calibration data (70%)
- model evaluation data (30%)

Build the models based on the calibration data and test the predictive performance of the models using the evaluation data. What is the predictive performance of the GLM, GAM and GBM models for Betnan, Cashyp, Empher and Salret based on AUC-values of the model evaluation data? Use mesotopo, soil_moist, soil_temp and soil_ph as predictors.
Report the results in one short paragraph (max 5 sentences).

Question 2.

What is the predictive performance of the GLM, GAM and GBM models for veg_height and vasc_spr? Again, build the models using calibration data and test the models using evaluation data. Use Spearman correlation -values as the evaluation metrics. Use the same set of predictors that you used in question 1). Report the results in one short paragraph (max 5 sentences).

Question 3.

Characterize soil_moist, soil_temp, soil_ph, veg_height and vasc_spr conditions along the mesotopographic gradient using GAM. Model the values of these five responses at the valley bottom (mesotopo 1), mid-slope (mesotopo 5) and ridge-top (mesotopo 10). Present the results as an informative figure. Report the results in one short paragraph (max 5 sentences).

Question 4.

Does the cover of Empetrum hermaphroditum (Empher_cover) have an effect on the vasc_spr when all other predictors are controlled for? Use the same set of predictors as used in question 1). Use all three modelling frameworks to test the hypothesis. The main idea behind this question: as a dominant species Empher_cover might have a strong influence on the vegetation properties – can we see the effect? Please, test it! Report the results in one short paragraph (max 5 sentences).

Recommended reading for independent work 3!

le Roux, P. C., Aalto, J. and Luoto, M. (2013), Soil moisture's underestimated role in climate change impact modelling in low-energy systems. *Glob Change Biol*, 19: 2965–2975. doi:10.1111/gcb.12286

Global Change Biology

Global Change Biology (2013) **19**, 2965–2975, doi: 10.1111/gcb.12286

Soil moisture's underestimated role in climate change impact modelling in low-energy systems

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Abstract

Shifts in precipitation regimes are an inherent component of climate change, but in low-energy systems are often assumed to be less important than changes in temperature. Because soil moisture is the hydrological variable most proximally linked to plant performance during the growing season in arctic-alpine habitats, it may offer the most useful perspective on the influence of changes in precipitation on vegetation. Here we quantify the influence of soil moisture for multiple vegetation properties at fine spatial scales, to determine the potential importance of soil moisture under changing climatic conditions. A fine-scale data set, comprising vascular species cover and field-quantified ecologically relevant environmental parameters, was analysed to determine the influence of soil moisture relative to other key abiotic predictors. Soil moisture was strongly related to community composition, species richness and the occurrence patterns of individual species, having a similar or greater influence than soil temperature, pH and solar radiation. Soil moisture varied considerably over short distances, and this fine-scale heterogeneity may contribute to offsetting the ecological impacts of changes in precipitation for species not limited to extreme soil moisture conditions. In conclusion, soil moisture is a key driver of vegetation properties, both at the species and community level, even in this low-energy system. Soil moisture conditions represent an important mechanism through which changing climatic conditions impact vegetation, and advancing our predictive capability will therefore require a better understanding of how soil moisture mediates the effects of climate change on biota.

Keywords: arctic-alpine, community composition, soil wetness, species distribution models, species richness, topographic wetness index

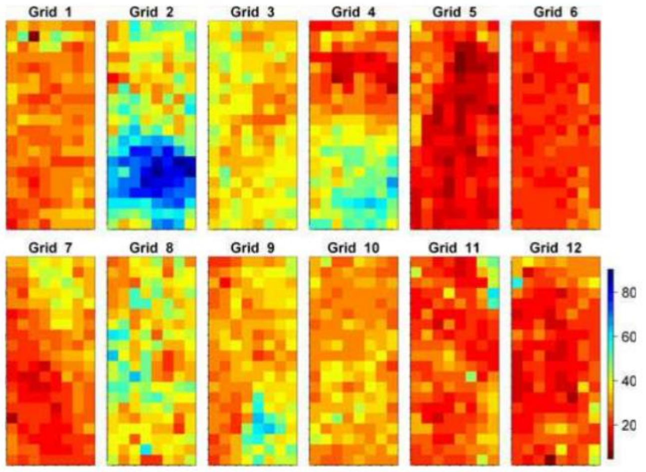

Fig. 1 Observed soil moisture (volumetric soil moisture;%) across the 12 study grids (each plot is 1 m^2, and each grid measures 8 × 20 m). Top row represents the six grids from the north-facing slope of the Saana massif, the bottom row the six grids from the south-facing slope.

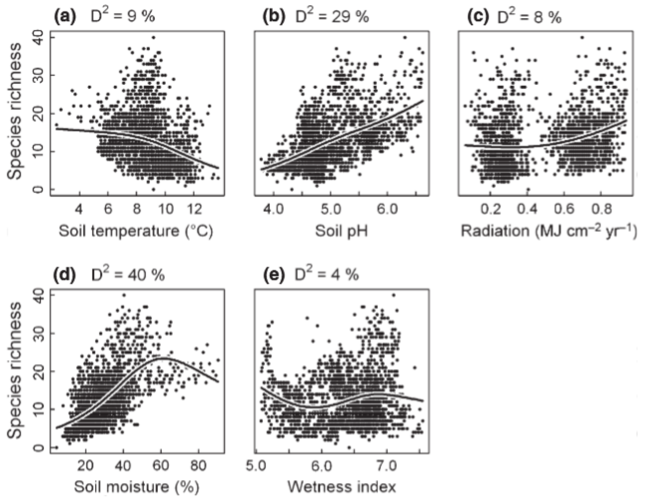

Fig. 4 Relationship between species richness and the five predictor variables. Fitted lines represent best generalized additive models, with the associated explained deviance (D^2) reported for each relationship (degrees of smoothness optimized during calculation; ranging between 2.5 and 3). See Fig. S1 for colour version distinguishing between northern and southern plots.