Do spatial models improve peat depth predictions?

Dylan M. Young[1], Lauren E. Parry[2], Duncan Lee[3], Surajit Ray[3]

[1]School of Geography, University of Leeds, [2]School of Interdisciplinary Studies, University of Glasgow, [3]School of Mathematics and Statistics, University of Glasgow.

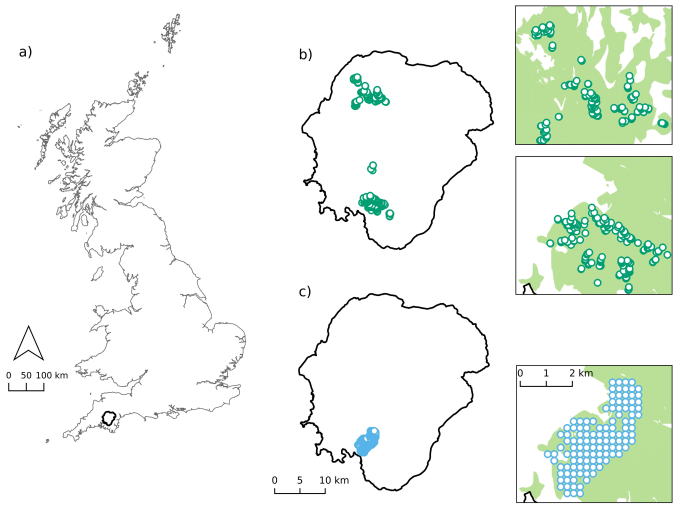
Background and method:

Peatlands form as a result of a complex network of interactions between external factors such as the climate and topography, and internal physical and biogeochemical processes. And there are occasions where either external factors or internal processes predominate.

Predicting peat depth accurately is an important part of assessing the magnitude of carbon (C) stocks. Yet few attempts to predict peat depth account for both internal and external processes.

We hypothesized that a geostatistical (spatial) model would act as a proxy for internal peatland processes especially in features such as plateaus. But we also wished to assess the impact of the approach used to sample depth measurements.

We therefore compared linear and spatial models both with elevation (m asl) and slope (°) as the external covariates. We also compared these models using two different sampling approaches (gridded and stratified).



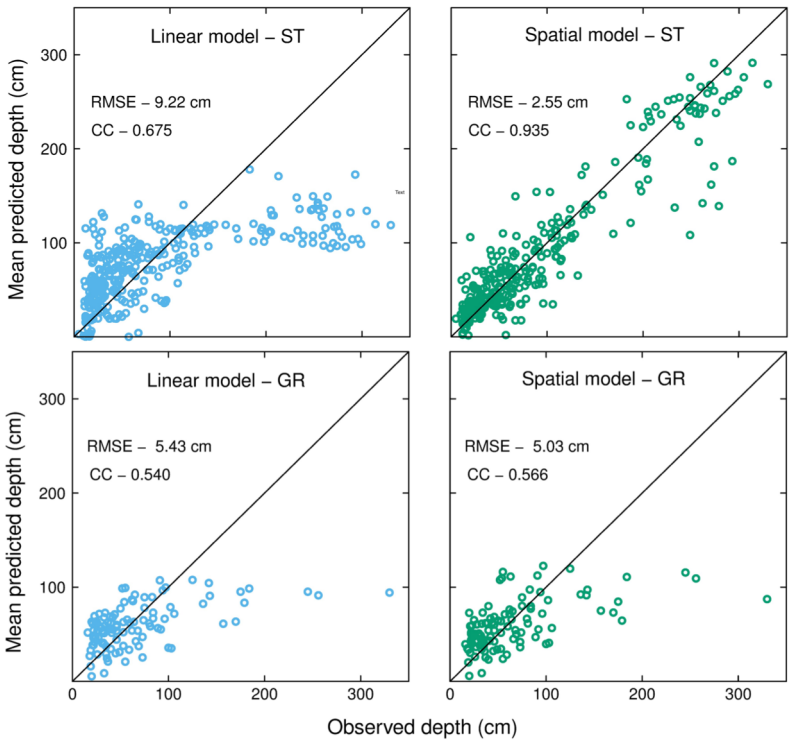
a) Study area in Dartmoor National Park. b) Location of stratified peat depth measurements, and c) location of gridded peat depth measurements. See paper for data attribution.

Results:

- The spatial model performed better* than the linear model with all combinations of covariates and sampling approaches.
- But the spatial model performs only moderately better when depth observations are made too far apart (see dataset GR).
- Predictions and their errors in areas of deep peat were improved with the spatial model.
- The linear model performed well in locations where slope was the dominant factor in peat formation but poorly in areas of deep peat.

Conclusions:

- Spatial models along with key covariates should, where feasible, be used for peat depth predictions.
- Peat depth sampling design should be carefully considered. The design should take into account the factors that covary with depth that could be omitted in gridded approaches.
- It is likely that stratified approaches will produce more suitable datasets than low spatial resolution grids.
- Datasets should be checked to ensure they are suitable for use with spatial models (i.e. that observations are spatially dependent).
- If needed, current datasets can be supplemented with additional sampling to improve prediction errors and therefore C stock estimates.



Sampling approaches; ST = stratified, GR = gridded (250 m intervals). RMSE = root mean square error, CC = Pearson's correlation coefficient.

* By better we mean smaller RMSE, narrower prediction intervals (not shown here), and higher CC.

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