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Prediction of peat depths using airborne radiometric data: optimization of ground surveys.

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The use of remote sensing data can lead to great efficiencies when mapping soil variables across broad regions. However, remote sensors rarely make direct measurements of the soil property of interest. Instead, an empirical model is required to relate the remote sensing data to ground measurements of the property of interest. We discuss how a survey of ground measurements required to calibrate such a model can be optimized. We make reference to the mapping of peat depth within the Dartmoor National Park (UK) using radiometric potassium data from an airborne survey of the region (http://www.tellusgb.ac.uk/). We expand the standard linear mixed model to accommodate nonlinear relationships between radiometric potassium and peat depths. The attenuation of the radiometric signal is seen to increase with peat depth, but the depth is particularly uncertain when the radiometric signal is small. When a spatial simulated annealing algorithm is used to optimize the locations for a survey of peat depth measurements to minimize the errors in the maps of peat depth upon use of the radiometric data, the complete range of the radiometric data are sampled but ground measurements are particularly focussed where the radiometric signal is small. We see that an optimized survey of 30 ground measurements combined with the radiometric data lead to more accurate maps than can be achieved from interpolation of more than 200 peat depth measurements.