Improving peat depth/soil carbon stock mapping for Scotland

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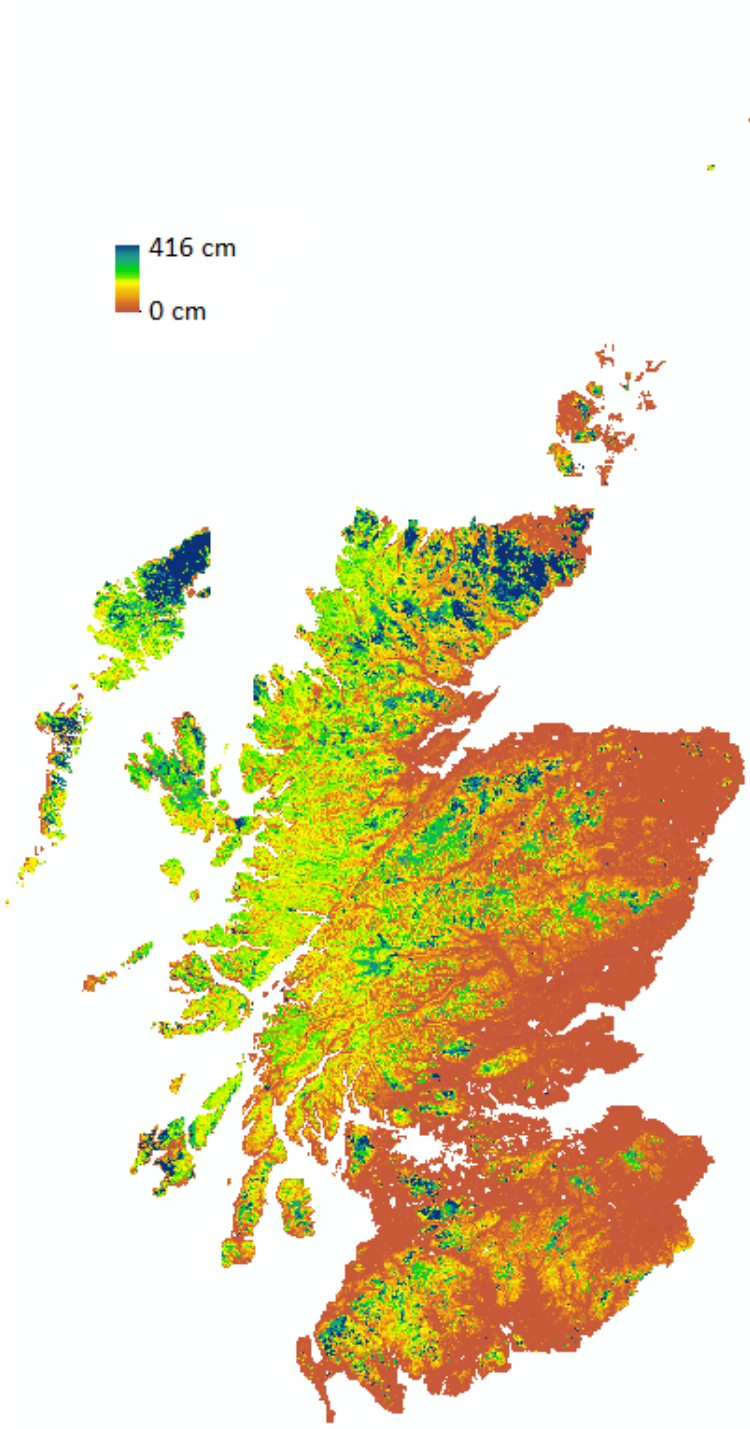
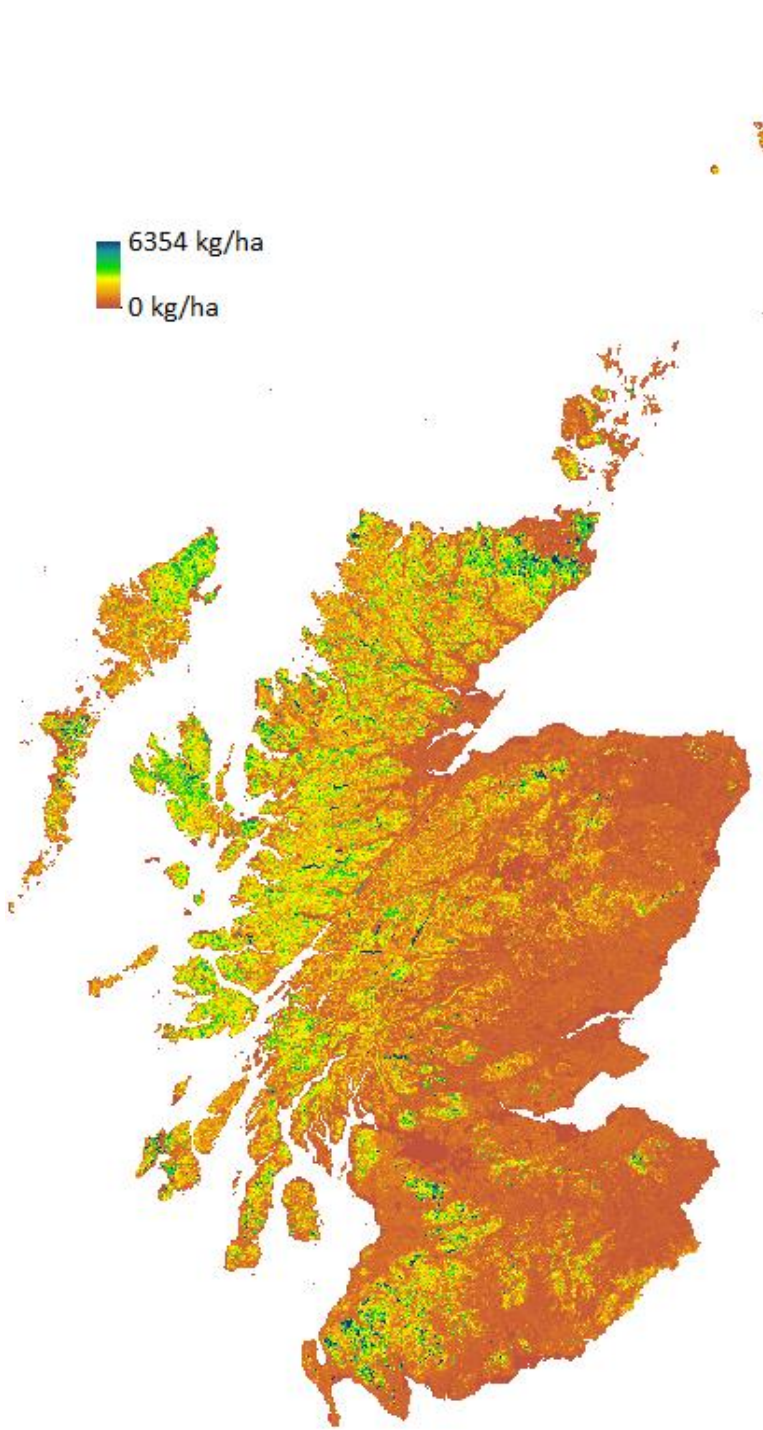
What we have

- 100 metre resolution maps of peat depth and carbon stock
- Mapped using Scottish Soil Database and early Peatland Action data
- Aitkenhead, M.J., Coull, M.C., 2019. Mapping soil profile depth, bulk density and carbon stock in Scotland using remote sensing and spatial covariates. European Journal of Soil Science. 10.1111/ejss.12916





What do we need?

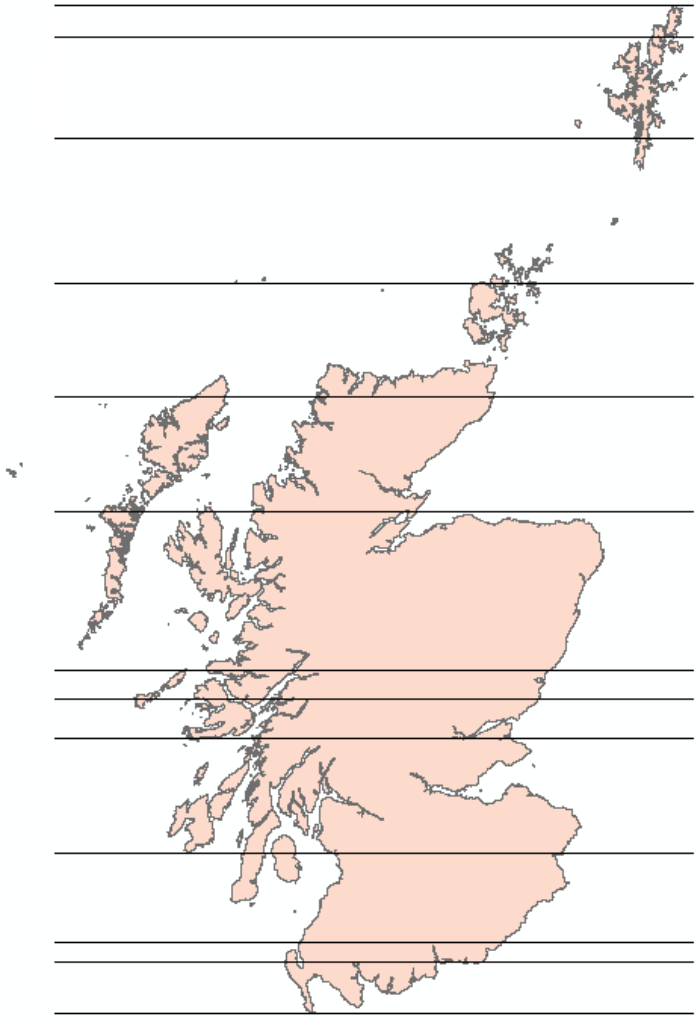
- Finer spatial resolution
  - 100m not good enough for highly variable landscapes
- Better information ‘down the profile’
  - Carbon storage and accumulation at depth
  - C stocks in non-peat soils (e.g. wet grassland)

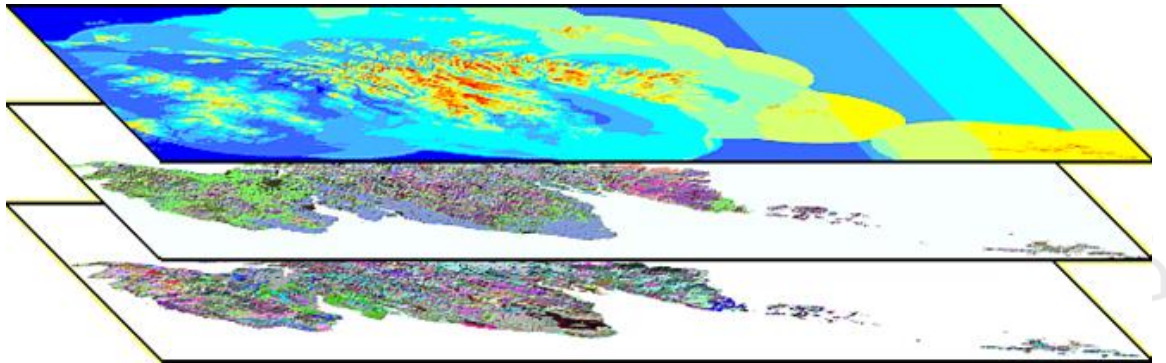
How do we do it?

- DSM (Digital Soil Mapping)
- Link soil properties (density and carbon concentration) to soil-forming factors
- Use the model to predict these properties at each location and depth
- Scottish Soils Database has data for >3000 soil profiles

What do we need?

- Soil forming factor datasets
- At 10 metre resolution
- Topography is the major factor that changes at such small scales
- Climate
- Geology
- Vegetation/land cover
- Remote sensing





The model works

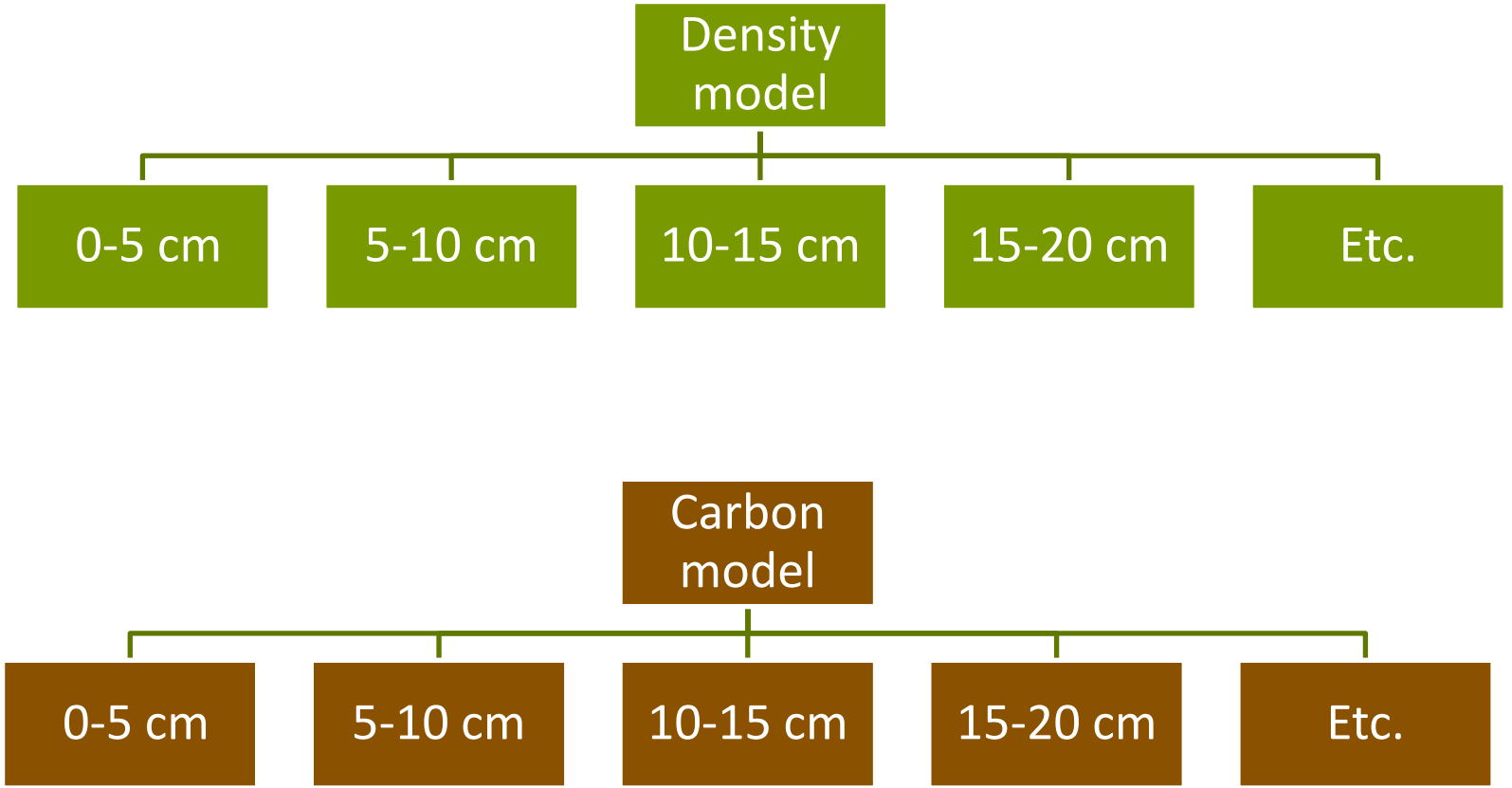
- Accuracy of bulk density model: $R^2 = 0.78$
- Accuracy of carbon concentration model: $R^2 = 0.74$
- Spatial datasets prepared (1.5 TB data)
  - Harmonised grids
  - Rapid access
  - HPC-ready
  - Flexible for inclusion of new remote sensing data

Maps to be created

- Every 5 cm depth (2.5, 7.5, 12.5 etc…)
- 10 metre spatial resolution
- Bulk density and carbon concentration
  - Allows carbon stock per unit volume to be calculated
  - BD & C also useful for e.g. erosion, crop growth modelling, hydrology etc.
- When density/carbon reach values indicating “not soil”, stop
  - Density >1400 kg m^{-3} OR C < 0.1%

Computational requirements

- Significant! (200x previous, which took 2 months on a PC)
- High Performance Computing (>1000 CPU cores)

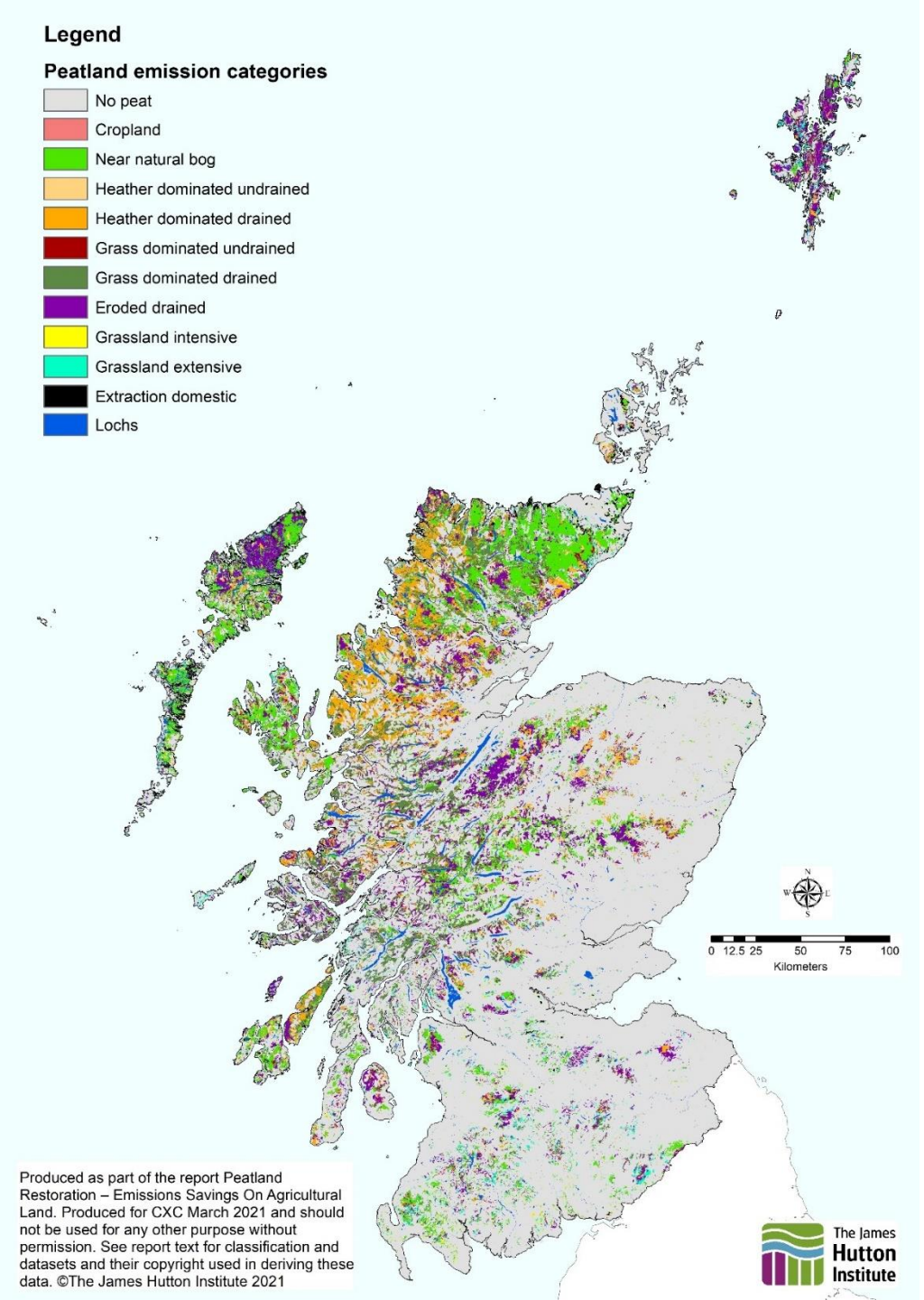


Why will this help?

- Small bog areas
- Edges of bogs
- More **accurate** carbon stock assessment
- More **precise** carbon stock assessment
- Better targeting of restoration
- Better understanding of C stock in peat vs non-peat soils

Why will this help?

- Alignment with land cover/land use maps (10-20 metre scale)
- Topographic/drainage conditions better informed
- Alignment with peat condition mapping (existing and future)
- Baseline data for Tier 3 GHG emissions and restoration monitoring



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