Coupling high resolution data and national baseline estimates for farm scale soil carbon auditing

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*Why audit soil C?*

Land management practices that sequester soil C mitigate climate change with co-benefits of improved soil productivity.
How to audit soil C?

• Use a national or regional model to guide downscaling, for stratification.

• Optimised soil sampling of strata through time.

Soil carbon stocks (t/ha)

- 20
- 65
- 110
- 155
- 200

(McNeill et al, 2013)
The national model provides a baseline soil C stock value of 93.77 tC/ha to 0.3 m (90% confidence interval 54.4 - 133.15 tC/ha to 0.3 m)
High resolution datalayers

- LiDAR-DEM & terrain attributes used to disaggregate the national model.
- *Dissever R package* downscales using a common grid, on a block by block basis, with mass preservation.
- Added value to the national model, and provides framework for farm-scale soil sampling.
Disaggregating the national model

- Inputs: national model (1-km pixels) + high resolution covariates (< 10-m pixels)
- *dissever* R package
- Outputs: downscaled soil C map (25-m pixels) for 218 ha sub-catchment area
Strata and sampling locations

- Stratify the downscaled soil C raster
- Use the Ospats method which is guided by predicted values and associated error variances (de Gruijter et al., 2016)
- Value of Information guides the no. of strata and sampling positions
- Stratified Simple Random Sampling
90% CI of predicted SOCs (Ospats v random)

subsample (n) of 42 soil cores; 500 simulations

<table>
<thead>
<tr>
<th>No. cores</th>
<th>random</th>
<th>Ospats</th>
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<tbody>
<tr>
<td></td>
<td>SOCS (tC/ha)</td>
<td>CI</td>
</tr>
<tr>
<td>11</td>
<td>100.65</td>
<td>22.70</td>
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<tr>
<td>42</td>
<td>100.64</td>
<td>10.72</td>
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Reported SOC stocks \( \textit{(Ospats vs random)} \)
Conclusions

• A method has been developed that uses high resolution covariate data to downscale a national soil C model (dissever R package).

• The dissevered map enables optimal stratified soil sampling to determine unbiased baseline estimates of SOC stocks for the farm at Time 1 (Ospats, de Gruijter et al., 2016).

• Resampling at Time 2 provides a statistically robust and transparent method for farm-scale soil C auditing.

• Farm management strategies that sequester soil C effectively mitigate climate change.