Soil organic carbon and total nitrogen on the Herschel Island

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Study area
• Upscaling point data
Permafrost coring
CNS and TOC analyses

- 128 samples from 12 cores
- 5 cm thickness on every 10 cm of core
- Analyses of Total Organic Carbon and Total Nitrogen with combustion method
Carbon and nitrogen contents

TOC Gravimetric Content (%)

TN Gravimetric Content (%)

Depth
Carbon and nitrogen contents

Soil organic carbon and total nitrogen storage in 1 meter

<table>
<thead>
<tr>
<th>Site</th>
<th>SOC Storage 1 m (kg/m²)</th>
<th>TN Storage 1 m (kg/m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avadlek</td>
<td>0.22</td>
<td>5.07</td>
</tr>
<tr>
<td>PG2150</td>
<td>91.02</td>
<td>78.87</td>
</tr>
<tr>
<td>PG2151</td>
<td>44.98</td>
<td>33.90</td>
</tr>
<tr>
<td>PG2163</td>
<td>33.90</td>
<td>36.47</td>
</tr>
<tr>
<td>PG2152</td>
<td>5.85</td>
<td>39.49</td>
</tr>
<tr>
<td>PG2154</td>
<td>2.57</td>
<td>28.35</td>
</tr>
<tr>
<td>PG2155</td>
<td>3.45</td>
<td>4.27</td>
</tr>
<tr>
<td>PG2156</td>
<td>2.62</td>
<td>16.32</td>
</tr>
<tr>
<td>PG2159</td>
<td>1.71</td>
<td>11.92</td>
</tr>
<tr>
<td>PG2162</td>
<td>2.31</td>
<td>20.86</td>
</tr>
<tr>
<td>PG2157</td>
<td>3.73</td>
<td></td>
</tr>
<tr>
<td>PG2158</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

kg/m²

SOC storage 1 m (kg/m²), TN storage 1 m (kg/m²)
Carbon and nitrogen contents

Soil organic carbon and total nitrogen storage in 1 meter

<table>
<thead>
<tr>
<th>Terrain Type</th>
<th>SOC storage 1 m (kg/m²)</th>
<th>TN storage 1 m (kg/m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spits and beaches</td>
<td>5.51</td>
<td>0.22</td>
</tr>
<tr>
<td>Wet polygonal terrain</td>
<td>84.95</td>
<td>4.56</td>
</tr>
<tr>
<td>Hummocky tussock tundra</td>
<td>38.45</td>
<td>3.99</td>
</tr>
<tr>
<td>Slightly disturbed uplands</td>
<td>39.49</td>
<td>3.45</td>
</tr>
<tr>
<td>Alluvial fans</td>
<td>42.48</td>
<td>3.44</td>
</tr>
<tr>
<td>Moderately disturbed terrain</td>
<td>14.12</td>
<td>2.01</td>
</tr>
<tr>
<td>Strongly disturbed terrain</td>
<td>20.86</td>
<td>3.73</td>
</tr>
</tbody>
</table>

SOC = Soil Organic Carbon, TN = Total Nitrogen
Supervised classification

- 21 training units
- 40 ground truth points
- Maximum likelihood classification
RapidEye

- Horizontal resolution 6.5 m
- 5 bands
  - 440 – 510 nm (Blue)
  - 520 – 590 nm (Green)
  - 630 – 685 nm (Red)
  - 690 – 730 nm (Red Edge)
  - 760 – 850 nm (Near IR)
Spectral differentiation

- Blue
- Green
- Red
- Red Edge
- Near IR

Radiance ($W \cdot sr^{-1} \cdot m^{-2}$)

- Spits and beaches
- Wet polygonal terrain
- Hummocky tussock tundra
- Slightly disturbed uplands
- Alluvial fans
- Moderately disturbed terrain
- Strongly disturbed terrain
Ecological classification

- 4 x 4 circle majority filter
Ecological classification

- 75% agreement between ground truth points and classification
There is 3,9 Tg of soil organic carbon and 0,4 Tg of total nitrogen in first meter of soil on Herschel Island.
Drivers of differences in SOC storages

- Spits and beaches unit was excluded
- 11 cores used

<table>
<thead>
<tr>
<th></th>
<th>Elevation</th>
<th>Slope</th>
<th>Moisture</th>
<th>NDVI</th>
<th>Disturbance</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOC 0-100cm</td>
<td>r / rho</td>
<td>-0.136</td>
<td>-0.676</td>
<td>0.686</td>
<td>0.226</td>
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<tr>
<td></td>
<td>R-squared</td>
<td>0.019</td>
<td>0.456</td>
<td>0.47</td>
<td>0.051</td>
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<tr>
<td></td>
<td>p-value</td>
<td>0.69</td>
<td>0.023</td>
<td>0.02</td>
<td>0.504</td>
</tr>
</tbody>
</table>
Retrogressive thaw slumps
Flume measurements on thaw slump

Photo: S. Weege
Erosion dynamics 2012-2013

Elevation decrease (m)
Thank you for your attention
Spectral differentiation
Spectral differentiation

Blue Green Red Red Edge Near IR Slope

Radiance (W·sr$^{-1}$·m$^{-2}$) and Slope (°)

- Spits and beaches
- Wet polygonal terrain
- Hummocky tussock tundra
- Slightly disturbed uplands
- Alluvial fans
- Moderately disturbed terrain
- Strongly disturbed terrain