Mapping organic soils in the frame of climate reporting under IPCC

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Background

IPCC definitions for organic soils (simplified)

- Soils with approx. 12% Corg in the upper 20cm

The German soil classification system distinguishes

- Bog soils with peat > 30 cm (> 15% Corg)
- Fen soils with peat > 30 cm (> 15% Corg)
- Soils with peat < 30 cm
- Soils with 9 – 15% Corg in the upper layer
Actual situation in Germany

Up to now, the soil map of Germany at a scale of 1:1.000.000 is the reference for GHG reporting ...

<table>
<thead>
<tr>
<th>landuse</th>
<th>SM1000</th>
</tr>
</thead>
<tbody>
<tr>
<td>organic soils[ha]</td>
<td>361,373</td>
</tr>
<tr>
<td>arable land[%]</td>
<td>29,7</td>
</tr>
<tr>
<td>grassland[%]</td>
<td>38,0</td>
</tr>
<tr>
<td>forest[%]</td>
<td>19,3</td>
</tr>
<tr>
<td>rest[%]</td>
<td>13,0</td>
</tr>
</tbody>
</table>
Actual situation in Germany

Up to now, the soil map of Germany at a scale of 1:1,000,000 is the reference for GHG reporting …

<table>
<thead>
<tr>
<th>landuse</th>
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<th>GK200</th>
</tr>
</thead>
<tbody>
<tr>
<td>organic soils[ha]</td>
<td>361,373</td>
<td>288,134</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>landuse</th>
<th>SM1000</th>
<th>GK200</th>
</tr>
</thead>
<tbody>
<tr>
<td>arable land [%]</td>
<td>29,7</td>
<td>12,9</td>
</tr>
<tr>
<td>grassland [%]</td>
<td>38,0</td>
<td>55,9</td>
</tr>
<tr>
<td>forest [%]</td>
<td>19,3</td>
<td>18,1</td>
</tr>
<tr>
<td>rest [%]</td>
<td>13,0</td>
<td>13,2</td>
</tr>
</tbody>
</table>

SM1000
(Soil map of Germany at a scale of 1:1,000,000)

GK200
(Geological map of Germany at a scale of 1:200,000)
### Actual situation in Germany

Up to now, the soil map of Germany at a scale of 1:1,000,000 is the reference for GHG reporting ...

<table>
<thead>
<tr>
<th>organic soils[ha]</th>
<th>SM1000</th>
<th>GK200</th>
<th>MOS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>361,373</td>
<td>288,134</td>
<td>328,696</td>
</tr>
<tr>
<td>equals MOS</td>
<td>40 %</td>
<td>72 %</td>
<td>-</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>landuse</th>
<th>SM1000</th>
<th>GK200</th>
<th>MOS</th>
</tr>
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<tr>
<td>arable land[%)</td>
<td>29,7</td>
<td>12,9</td>
<td>9,9</td>
</tr>
<tr>
<td>grassland[%)</td>
<td>38,0</td>
<td>55,9</td>
<td>58,6</td>
</tr>
<tr>
<td>forest[%)</td>
<td>19,3</td>
<td>18,1</td>
<td>18,6</td>
</tr>
<tr>
<td>rest[%)</td>
<td>13,0</td>
<td>13,2</td>
<td>12,9</td>
</tr>
</tbody>
</table>

**SM1000**
(Soil map of Germany at a scale of 1:1,000,000)

**GK200**
(Geological map of Germany at a scale of 1:200,000)

**MOS**
(newly compiled data on organic soils at a scale of 1:25,000)
Problems to cope with

• No homogeneous large scale data available area wide

• Available legacy data ...
  
  • are distributed over a multitude of agencies and authorities

  • differ in terms of classification / nomenclature
    – pedological data
    – geological data
    – agricultural data
    – forestal data
    – specific mire inventories
Spatial mapping / compilation

We separate the “spatial” mapping from pedological characterization …

pedological data

geological data

agricultural data

silvicultural data

mire inventories

extract soil classes according to IPCC definitions

assess with respect to soil data quality and actuality

only best for one site

avoid increase of area

hierarchical compilation

organic soils DB

approx. complete, spatially accurate

still needs ground verification

⇒ randomized topsoil samples for Corg analysis

⇒ focus on “shallow” and non-peat sites

⇒ derive soil class specific correction values
Pedological characterization

... and do the pedological characterization by estimates on the specific site genesis

- Soil profiles differ with respect to site genesis
- Site genesis is related to geomorphic setting
- Estimates on genesis are possible based on hydrology, geomorphology, ...
- These data are available area-wide for Germany
We collect parameters describing the geomorphic setting manually ...

- coastal situation (y/n)
- contact to lakeshore (y/n)
- valley situation (y/n)
- along slope toe and higher than receiving stream (y/n)
- lies within floodplain (y/n)
- regional setting (e.g. quaternary glacial formed, ...)

... others are calculated in GIS ...

- mean height (GIS / DTM25)
- mean slope (GIS / DTM25)

... existing soil data is maintained ...

- peat thickness
- soil type
... and we combine them in an index based approach to make estimates on site genesis.

percolation

Paludification

Peat

Gyttja

Sand / Mineral Soil
Results I (Verification of estimated genesis)

- Soil profiles from the early 20th century
- Analysis on depth dependent substrate distribution

*estimated genesis: percolation*

*estimated genesis: coastal*
Results II (Verification of estimated genesis)

- Soil profiles from the late 90s of the 20th century
- Analysis on depth dependent substrate distribution

estimated genesis: percolation

estimated genesis: coastal

- degraded peat
- sedge peat
- reed peat
- other peat
- gyttja
- sand
- clay
Results III (Verification of estimated genesis)

- Soil profiles from the late 90s of the 20th century
- Analysis with respect to landuse (grassland) and the degree of decomposition (1-3: fibric; 4-7 hemic; 8-10 sapric)
Mapping results (SW-Germany)

Geological map (1:200,000)

Newly compiled map of organic soils (1:25,000 – 1:50,000)
Regionalization and modelling

+ estimated genesis

**Idealized soil profile for sites with est. percolation regime**
samples: 417

<table>
<thead>
<tr>
<th>depth [dm]</th>
<th>substrate</th>
<th>deg. decomp.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>sapric amorphous peat</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td>sapric amorphous peat</td>
<td>8-10</td>
</tr>
<tr>
<td>3</td>
<td>sapric amorphous peat</td>
<td>8-10</td>
</tr>
<tr>
<td>4</td>
<td>hemic sedge peat</td>
<td>6-7</td>
</tr>
<tr>
<td>5</td>
<td>hemic sedge peat</td>
<td>6-7</td>
</tr>
<tr>
<td>6</td>
<td>hemic sedge peat</td>
<td>6-7</td>
</tr>
</tbody>
</table>

**Characteristic soil properties**

<table>
<thead>
<tr>
<th></th>
<th>X</th>
<th>ku 1,8</th>
<th>ku 2,0</th>
<th>ku 2,2</th>
<th>ku 2,6</th>
<th>kf</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>8</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td>median</td>
<td>36,400</td>
<td>0,492</td>
<td>0,155</td>
<td>0,022</td>
<td>0,004</td>
<td>2,295</td>
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<tr>
<td>average</td>
<td>32,775</td>
<td>0,762</td>
<td>0,477</td>
<td>0,215</td>
<td>0,013</td>
<td>2,384</td>
</tr>
<tr>
<td>standard deviation</td>
<td>8,949</td>
<td>0,779</td>
<td>0,666</td>
<td>0,400</td>
<td>0,017</td>
<td>0,795</td>
</tr>
<tr>
<td>n</td>
<td>21</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>19</td>
</tr>
<tr>
<td>median</td>
<td>37,000</td>
<td>0,786</td>
<td>0,372</td>
<td>0,151</td>
<td>0,016</td>
<td>0,721</td>
</tr>
<tr>
<td>average</td>
<td>35,299</td>
<td>0,966</td>
<td>0,446</td>
<td>0,151</td>
<td>0,018</td>
<td>1,518</td>
</tr>
<tr>
<td>standard deviation</td>
<td>9,510</td>
<td>0,751</td>
<td>0,424</td>
<td>0,136</td>
<td>0,013</td>
<td>1,369</td>
</tr>
<tr>
<td>n</td>
<td>15</td>
<td>11</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>12</td>
</tr>
<tr>
<td>median</td>
<td>21,700</td>
<td>0,617</td>
<td>0,274</td>
<td>0,090</td>
<td>0,015</td>
<td>1,074</td>
</tr>
</tbody>
</table>
Conclusions

What is possible …

• Higher spatial accuracy and completeness
• Homogeneous pedological characterization
• Regionalization or modelling with linked soil properties now possible
• Data will be available for entire Germany in late summer

What is not possible …

• No replacement for site specific investigation
• Typical soil profiles only for common site genesis
• No new delineation of boundaries
Thank you very much for your attention!!

This project is part of the joint research project 'Organic soils', funded by the vTI (Federal Research Institute for Rural Areas, Forestry and Fisheries)

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