Harmonization of methods and measurements

Rainer Baritz
National contributions with harmonized data to ....

- Improve cross-border and continental representation for various policy areas (Pillar 4) (e.g. soils as a resource, soil hazard)
- Improve frame conditions for research (Pillar 3) and data for developing soil management options (Pillar 1)
- Global Soil Partnership (GSP) action plans
- Soil in related interest areas, e.g. Earth Observation GEOSS
Approach

- GSP Pillar 5 as basic structure for harmonization

- Experiences from European and other international networks
  
  EIONET - Soil
  
  IUSS WGs

- Experiences from national and European projects
  
  TC 190 Soil Quality
  
  Forest Soil Expert Panel
  
  GS Soil

⇒ Significant basis and progress on harmonization in Europe
Plan of Action Pillar 5 Harmonization

Harmonization of soil data

- Soil description, classification & mapping
  - Soil profile description
  - Soil classification
- Exchange of digital soil data
  - Soil information model
  - Vocabulary service
- Interpretation
  - Land suitability classification
    - Pedotransfer functions
  - Soil quality indicators
- Soils analysis
  - Analytics
    - Sampling and sample processing
    - Quality assurance
Plan of Action Pillar 5 Harmonization

Key priorities for harmonization

- Soil Description, classification and mapping
- Soil sampling and analysis
- Interoperability: Exchange of digital soil information
- Interpretation and evaluation: indicators, pedotransfer functions and rules
Experiences for transforming properties from local data bases into „European format“ exists for many countries:

- Standard forms for the compilation of soil profile data in the European Soil Database (ESDB): Proforma I and II (estimated and measured data)
- 1,897 complete soil profiles, which are linked to 1,077 STUs (35 % of EU-15; Hiederer et al. 2006) (only ca. 600 in WISE/ISRIC; no WFS)

<table>
<thead>
<tr>
<th>Site description</th>
<th>soil temperature regime</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>surface characteristics, relief</td>
</tr>
<tr>
<td></td>
<td>Parent material (Lithology)</td>
</tr>
<tr>
<td></td>
<td>Humus form</td>
</tr>
<tr>
<td></td>
<td>Land use and vegetation</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Profile description</th>
<th>Horizon symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Horizon boundary depth – upper limit / lower limit (cm)</td>
</tr>
<tr>
<td></td>
<td>Munsell colour of matrix and mottles</td>
</tr>
<tr>
<td></td>
<td>Horizon soil texture class</td>
</tr>
<tr>
<td></td>
<td>Peat type; degree of decomposition</td>
</tr>
<tr>
<td></td>
<td>Carbonate content</td>
</tr>
<tr>
<td></td>
<td>stone content</td>
</tr>
<tr>
<td></td>
<td>soil structure</td>
</tr>
</tbody>
</table>
### Soil Description

**GS Soil test cases**
- Soil horizon designation
- Carbonate content
- Stoniness
- Particle size and soil texture class (comparisons of texture triangles and class lists):

**Country vs. FAO soil profile description**
- Germany
- France, Bulgaria, Germany
- Slovakia
- USDA, SOTER, SGDBE, Belgium, Finland, France, Romania, Germany
- Slovakia, Bulgaria, Germany

**Texture class translation**

*Nemes et.al. 1999*
## Soil Description

### Example: Carbonate content, Bulgaria

<table>
<thead>
<tr>
<th>FAO Guidelines 2006 Tab. 38</th>
<th>Bulgaria</th>
<th>Carbonate Content, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>N Non calcareous</td>
<td>Безкарбонатни</td>
<td>Non calcareous 0</td>
</tr>
<tr>
<td>SL Slightly calcareous</td>
<td>Бедно карбонатни</td>
<td>Poorly calcareous 0&lt;1</td>
</tr>
<tr>
<td>MO Moderately calcareous</td>
<td>Средно карбонатни</td>
<td>Moderately calcareous2&lt;5</td>
</tr>
<tr>
<td>ST Strongly calcareous</td>
<td>Богато карбонатни</td>
<td>Richly calcareous 10&lt;20</td>
</tr>
<tr>
<td>EX Extremely calcareous</td>
<td>Много богато карбонатни</td>
<td>High reachly calcareous20&lt;40</td>
</tr>
</tbody>
</table>

Example: Texture triangles

![Texture triangles](image-url)
Soil Classification – WRB in Europe

Understanding of national classification systems

<table>
<thead>
<tr>
<th>National term</th>
<th>Taxonomic category</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ordnung</td>
<td>Order</td>
<td>Highest Level in the Austrian Soil Systematics, differentiating between terrestrial and hydromorphic conditions of soil forming processes</td>
</tr>
<tr>
<td>Bodentypengruppe</td>
<td>Soil type group</td>
<td>Collective of genetically related soil types. (e.g. Moore)</td>
</tr>
<tr>
<td>Bodentyp</td>
<td>Soil type</td>
<td>The soil type characterises soils with common genesis, soil dynamic and horizon sequence. (e.g. Niedermoor, Übergangsmoor, Hochmoor)</td>
</tr>
<tr>
<td>Zusatz</td>
<td>Addition</td>
<td>Additions describe subordinate characteristics of other soil types which are not prominently characteristic for the actual soil type. (e.g. vererdetes Hochmoor)</td>
</tr>
</tbody>
</table>

Identification of a common taxonomic level

Test cases referencing to WRB

Application to national soil maps

[Germany/Switzerland: automated WRB translation tool which can be extended...]
Soil mapping

GS Soil: Simplified nested system for harmonizing soil maps

ESBN: 1:250,000 mapping guideline: unfortunately: hardly applied

**Ongoing:** validation activities of the concept (where SOTER and DSM fits the nested system)
Soil analysis

Status in Europe:

ICP Forests/FSEP: MANUAL on soil sampling and analysis (mostly ISO reference methods)
(2007: 42 Parameters, 5 samples; 51 labs registered

Other calibration exercises ...

National correlations: Few examples:
– Wet oxidation – dry combustion (various countries)
– Germany (GAFA): different extractions (BaCl2 vs. NH4Cl)
– Comparisons of acid extractions (e.g. BGR (2005): Aqua regia vs. HF)

Van Ranst et al. (1999); Ad hoc AG Boden (1999)
### Soil analysis

#### Pillar 5 concept:

<table>
<thead>
<tr>
<th>Laboratories</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Analytical methods</strong></td>
</tr>
<tr>
<td>1. Most frequently used method</td>
</tr>
<tr>
<td>2. ISO or other national standard</td>
</tr>
<tr>
<td>3. Available machinery and local expertise decides on the method used</td>
</tr>
<tr>
<td><strong>Method documentation</strong></td>
</tr>
<tr>
<td><strong>Sample pre-processing</strong></td>
</tr>
<tr>
<td><strong>QA/QC procedures</strong></td>
</tr>
<tr>
<td><strong>Method selection/recommendation</strong></td>
</tr>
<tr>
<td><strong>Best practice manual / updating</strong></td>
</tr>
<tr>
<td><strong>Standard or reference samples</strong></td>
</tr>
<tr>
<td><strong>Capacity building</strong></td>
</tr>
<tr>
<td><strong>Method correlation</strong></td>
</tr>
<tr>
<td><strong>→ Interlaboratory comparisons</strong></td>
</tr>
<tr>
<td><strong>→ Best suitable method</strong></td>
</tr>
<tr>
<td><strong>→ Conversion factors</strong></td>
</tr>
<tr>
<td><strong>→ Archiving (samples/data)</strong></td>
</tr>
<tr>
<td><strong>→ Calibration</strong></td>
</tr>
</tbody>
</table>

**Where are remaining harmonization needs?**

**What is the status in Europe?**

**Who can do such activities?**

**Where are remaining needs for Europe?**
Soil analysis

⇒ Remaining challenges and needs for Europe: ensure future comparability; new methods require continued action (isotopes, spectroscopy, soil biology, mineralogy); expand the use of standards

⇒ Get overview of existing testing and calibration labs (DIN EN ISO/IEC 17025)

⇒ „Go global“: Support of other regional partnerships
Interoperability – exchange of digital soil data

Multiple ways to generate data (methods, nomenclature)

Multiple ways to store data

Exchange standards:
  a) Soil thesaurus
  b) INSPIRE soil specifications;
  c) ISO 28258

Transformation into structured XML-export files
Availability of interoperable via web services
Interoperability – exchange of digital soil data

⇒ Activities in Europe (and recently: Australia/NZ) are the motor for building infrastructure for web-based data communication (and standards development)

⇒ But: very little data is available in general, no measured data via web services (e.g. lack of contribution to GEOSS)

⇒ Limited familiarity and routine application of standards (experiences: GS Soil documentation)

⇒ How far are the data harmonized by content?

⇒ Support/participate IUSS WG Soil Information Standards (test bed and improvement for ISO/compatibility of national solutions/standards; session WCSS 2014)

Website: ISRIC
Indicators and applied methods

Indicator development: EIONET-Soil/ENVASSO
Adaptation/extension of experiences to Sustainable Development, Climate Change ongoing

⇒ Level of application: = insufficient !! (lack of monitoring)
⇒ Lack of baselines („good status“) and thresholds

(Huber et al. 2008, modified)
Indicators and applied methods

Models are needed to estimate parameters difficult to measure, and to extrapolate processes for larger areas: **pedo-transfer functions (PTF)**
pedotransfer rules (PTR)

- Pillar 5 lists 3 different kinds of PTF

Catalogue of agree and coordinated methods für Europe is not available; applications to national DB vary, thus country results cannot be compared.
Conclusions

- Multiple tasks for a network of data centres and labs (which network? Capacity of national contributors for Europe/globe? Active participation in international activities such as standardization is very limited)

- Requires very active and well-staffed European data centre/node with coordination and support tasks

- Project results such as ENVASSO and GS Soil are under-utilized

- Significant effect of European activities at the global level already; but too few players; continuity is not ensured