SOTER unit delineation using SRTM and MODIS data

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Assessing land degradation processes

Degree and extent of physical deterioration in Central and Eastern Europe (map 1)

Degree and extent of wind erosion in Central and Eastern Europe (map 3)
Objectives

To derive a quantitative, DEM based procedure to delineate SOTER physiographic units at the scale of 1:1 million, following and translating the original criteria defined in the SOTER Manual of Procedure.
SOTER

Mapping Units are defined by physiography and lithology

Physiography is characterized by four differentiating features:
1. Slope
2. Relief intensity
3. Hypsometry (the combination of relief intensity and altitude)
4. Dissection
SRTM DEM - based Procedure

Continuous slope layer (90m)       Continuous RI layer (90m)       Continuous hypsometry layer (90m)       Continuous PDD layer (90m)

Reclassified layers (90 m)

Block majority (block size: 990 m, grid resolution 90 m)

Resampling to the block size of 990 m

Focal majority with 4 and 6 cells radius circles

Combination of the four layers

Focal majority with 3 cells radius circles

Elimination of the polygons under the size threshold using the minimum Euclidean distance procedure and line simplification

Final terrain unit polygon system
The second phase....

Delineation of parent material
Disaggregation of the hierarchy

Transforming the four hierarchical level to four independent properties:

1. Consolidation status
2. Texture
3. Carbonate status
4. Genetics

Overlaying and combining the four layers

NO LOSS OF INFORMATION
Disaggregation of the hierarchy

Transforming the four hierarchical level to four independent properties:

1. Consolidation status
2. Texture
3. Carbonate status
4. Genetics

Overlaying and combining the four layers
RS approach for
Consolidated/unconsolidated
and
texture layers
Covariates for the development of the thematic PM layers

• RS image classification
  – MODIS-multitemporal 8 days composites
  – 11 bands, visible to the thermal spectra
  – 5 dates
  – PCA and DAFE to reduce the number of channels from 55 to 15
  – LST algorithms
  – NDVI
  – Geology driven band ratios

• Digital terrain model
  – SRTM, slope%, Relief intensity, Groundwater distance, PDD, Wetness index, Up/Low land index
Consolidated (yellow)
Unconsolidated (blue) parent materials

appa: 0.69
The texture map for the CE window

Kappa: 0.61

Legend
- texture_ce
- Class_Name
  - water
  - loam
  - peat
  - gravel
  - sand
  - background
  - clay

N

0 100 000 200 000 Meters
Genetic classes for PM classification

Digital terrain modeling approach
Classifying the SOTER genetic classes

– Fluvial/alluvial
  Plain, low slope and low relief intensity, close to the groundwater level

– Marine and esturine
  Follows the seashoreline and characterized with 0-10 meter elevation along the seashore

– Colluvial
  Form a plain to concave surface, with significant slope

– Glaciofluvial
  Alluvial, with slightly higher relief

– Glacial till

– Lacustrine
  Along the existing lakes within a given vertical distance over the lake water level

– Eolian
  Unconsolidated, higher relief, higher above the groundwater level, not influenced by the fluvial activities.
Central Europe
Soil data derivation and allocation procedure within WP2
Traditional SOTER approach

- Soil Information is presented on the Soil Component level as pure/consociation or associations/complexes
- The associations and complexes are characterized with their percentage of coverage within the SOTER polygon
- The associations were defined after correlating/translating the national classification units into FAO/WRB and the percent coverage were estimated using expert judgment
The e-SOTER approach

- Stratification of the major landscape elements/physiographic units into four major categories defined by the SOTER polygon definition
- Selection of the significant diagnostic features, (materials), horizons for the corresponding landscape/climate category (the climate-based stratification is not yet defined fully)
  - Spaargaren, O., Schad, P., E. Micheli. 2010. Guidelines for constructing small-scale map legends using the World Reference Base for Soil Resources
Stratification rules

Terrain Unit CE

- Surfcond = "water" or "Water"
- Hypsclass > 6 or "Mountain"
- Hypsclass < 7

Riclass = 1

- Surfcond = "consolidated" or "Hill"

Riclass > 1 or "Hill"

- Texture = "clay" or "loam" or Genetics = "peat" or "Fine Plain"
- Texture = "gravel" or "sand" or "Coarse Plain"
The stratified Central European pilot window
The e-SOTER approach

- The development of a training dataset indicating the existence or non-existence of the significant diagnostics for the selected training locations
- Development of an environmental covariate dataset (MODIS/SRTM derivatives)
- Fuzzy membership classification for each diagnostics showing the likelihood of occurrence of a certain diagnostic for the supporting pixel area, continuous layers of occurrence likelihood for each pixels
- Calculating the percentage for each diagnostics within the polygons
The e-SOTER approach

• Development of simplified classification rules/pedotransfers
• Classification/interpretation of the soil types for each pixels based on the existing diagnostics using the classification rules
• Calculating the percentages of each soil units
The provisional SOTER database

• Polygons
  – Terrain and parent material based uniform units
  – Bases for interpreting the environments, variables, stratification tool
  – Easy way to visualize the major soil properties in a scale of 1:1M
The provisional SOTER database

• Raster layers (90-500m resolution)
  • Terrain derivatives
  • Texture classes
  • Major diagnostic features relevant for the scale (likelihood)
  • MSG of the WRB
  – Raster layers are used to delineate the homogeneous landscape/physiographic unit
  – Maintained also as raster layers backing up the polygon database
Thanks