e-SOTER

Regional pilot platform as EU contribution to a Global Soil Observing System

Enhancing the terrain component in SOTER database

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Overview

• Overview of tested methods for terrain analysis
  – Benchmark datasets
  – New methods
    • Physical entities (hill shed analysis)
    • Homogenous segments (object-based segmentation)

• Assessment
  – Cramer’s V statistic
  – Bayesian Networks

• Recommendations for e-SOTER
One of the ways to overcome the limitations of grid based methods is incorporation of objects into methodology of landform classification.

Limitations:
- Sensitive to grid size
- Sensitive to window size
- Scale of the landscape may not be represented by the combination of the two factors
Physical entities

- Peak sheds
  - Generated by hill shed analysis (MacMillan, 2003)
  - Analysis of water flow in the inverted elevation
  - Represent scale of processes in the landscape
- Hill slope analysis
  - Associated with hill shed analysis
  - Provides polygons representing up to 6 major slope breaks
  - Polygons can be aggregated to target 1:250,000 mapping scale

Legend:
- Peak sheds
- Slope breaks
  - Upper slope
  - Lower slope

Peak sheds

Peak sheds + slope breaks
Homogenous objects

Generated from SRTM elevation values using eCognition Developer. The ESP tool (Dragut et al., 2010) was used to segment elevation values into homogenous objects at 3 levels reflecting various scales of terrain features.
Concept of object based approach

- Dissection of landscape into objects
  - physical entities
  - homogenous objects
- Basic statistics for each object
  - Elevation, slope
- K-means analysis – higher level of landforms
- K-means analysis – lower level of landforms
- Post-processing
  - Refinement to target mapping scale
  - Hammond classification scheme
Cluster maps based on physical entities
Cluster maps based on homogenous objects
Application of Hammond classification scheme

- Hammond classifiers:
  - Slope – occurrence of slope <8%
  - Local relief
  - Profile type – occurrence of lowlands
- Each cluster was characterised with the values of the three classifiers extracted within:
  - peak sheds
  - object-oriented segmentation
- Three-character code applied to ranges of Hammond classifiers (Dikau et al., 1991) → landform subclass
- **Landform class and type** assigned to each subclass
Assessment – Validation datasets

NATMAP 1:250k (255)

NATMAP soilscapes 1:250k (27)

RCP regions 1:? (76)

National Character Areas 1:? (106)

Map (22)

SOIL

SOIL-SCAPE/ LANDSCAPE
Assessment – Cramer’s V

- Similarity measure between maps of different legends and different number of classes (Rees, 2008)

\[ V = \frac{\sum \sum (O_{ij} - E_{ij})^2}{E_{ij}} \]

- Calculated for pairs of landform datasets and validation datasets

- Multidimensional scaling of V between a landform dataset and all validation datasets

- 3D graphs visualising similarity or dissimilarity

- List of distances in all dimensions
Assessment – Bayesian Networks

- Bayesian Belief Networks set to predict validation datasets with the use of various landform maps obtained in the project
- ‘Sensitivity to findings’ lists for each validation dataset – ordering according to the value of entropy reduction
- Indication of importance of each landform map
- Based on a sub-sample of regular points (~300k observations)
Discussion of validation results

• Both methods give different but not dissimilar results

• **Bayesian Networks** favour approaches based on homogenous objects

• **Cramer’s V statistic** finds more value in approaches based on physical entities.
References:


• Iwahashi J., Pike R.J., Automated classifications of topography from DEMs by an unsupervised nested-means algorithm and a three-part geometric signature, Geomorphology, 86, 409-440, 2007


Thank you!