ISRIC World Soil Information
Beiträge zu e-SOTER

Hannes I. Reuter & Vincent van Engelen

ISRIC World Soil Information

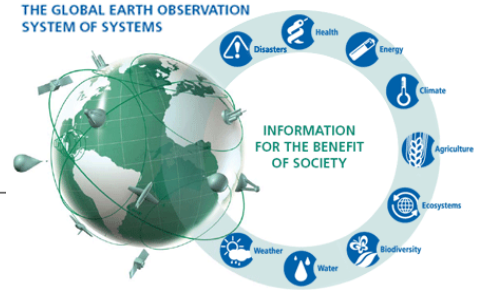
e-SOTER

World Data Centre for Soils WDC Wageningen ICSU WORLD DATA SYSTEM

Symposium Bodeninformation
- Grundlage für Bodenschutz, Wirtschaft und Forschung –
Dresden 12-13.10.2011

ISRIC objectives

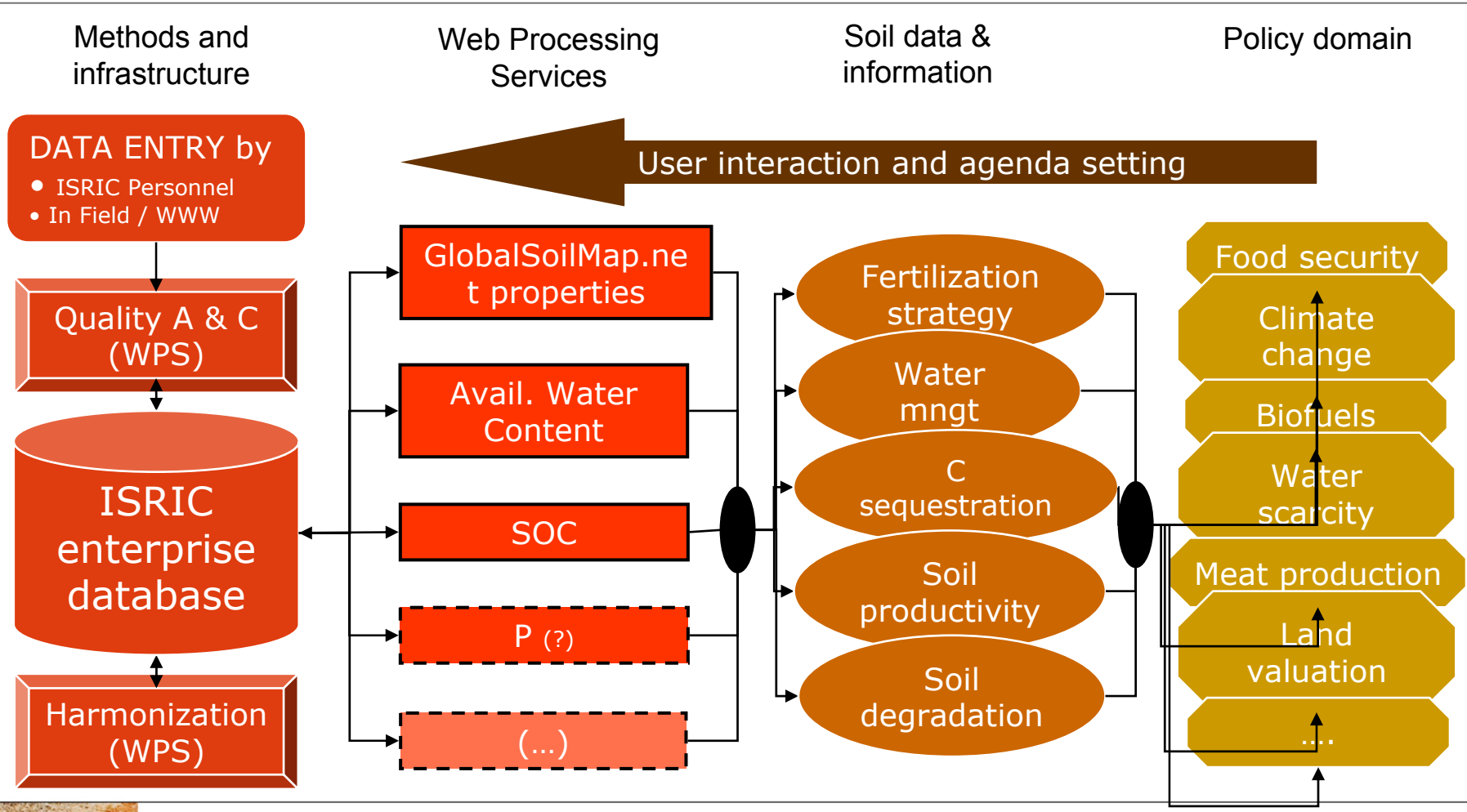
1. collect, maintain and develop quality-assessed soil data
2. make soil data freely available, as ICSU WDS - Soils
3. maintain and develop a global collection of reference soil monoliths with samples
4. exhibit soil information in the World Soil Museum; education
5. use soil and auxiliary data for studies on global and topical issues (applied research)
6. inform global conventions, general public and decision makers with science-based soil information
7. strengthen collaboration with (inter)national institutions



Decision makers and managers must have access to the information they need, when they need it, and in a format they can use

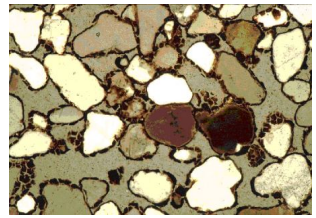
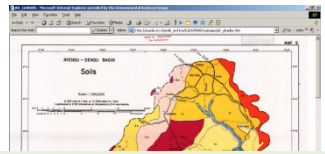
(Group on Earth Observations, 2010)

Linking ISRIC soil information to policy



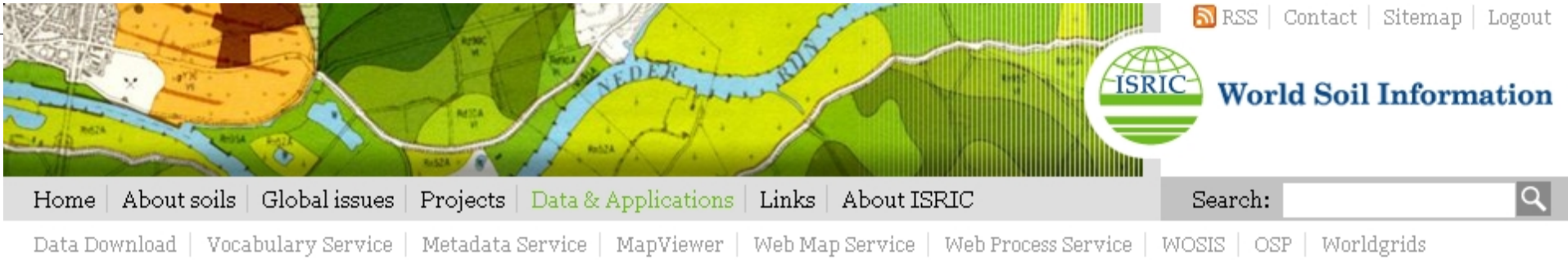
SC:Reuter&Bindraban, 2011

Soil information by ISRIC: *On-site*

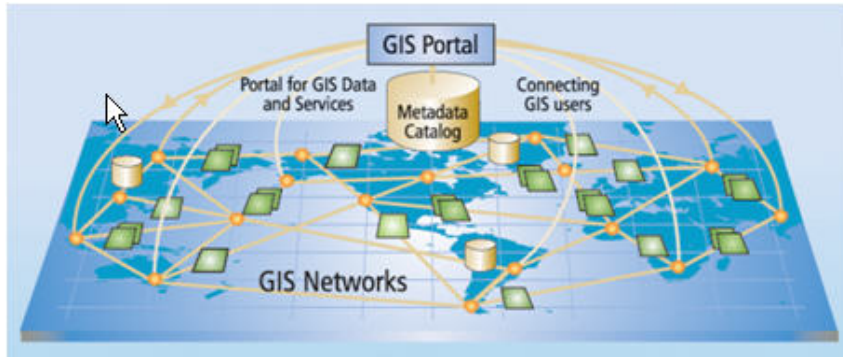
COLLECTIONS		
World Soil Reference Collection	- fully analysed samples ~950 monoliths - thin sections - transparencies - digital images	
Special collections	- Glinka Memorial – monoliths - Schmidt-Lorenz – thin sections - Jongerius-STIBOKA – thin sections - Kubiena – hand specimens	
ISRIC library	- Grey literature - Specialist texts	
ISRIC maps	- Soil and the world	

An important aspect is our ***data rescue program***, safeguarding older data sources which may be at risk of loss or deterioration, and digitizing these materials

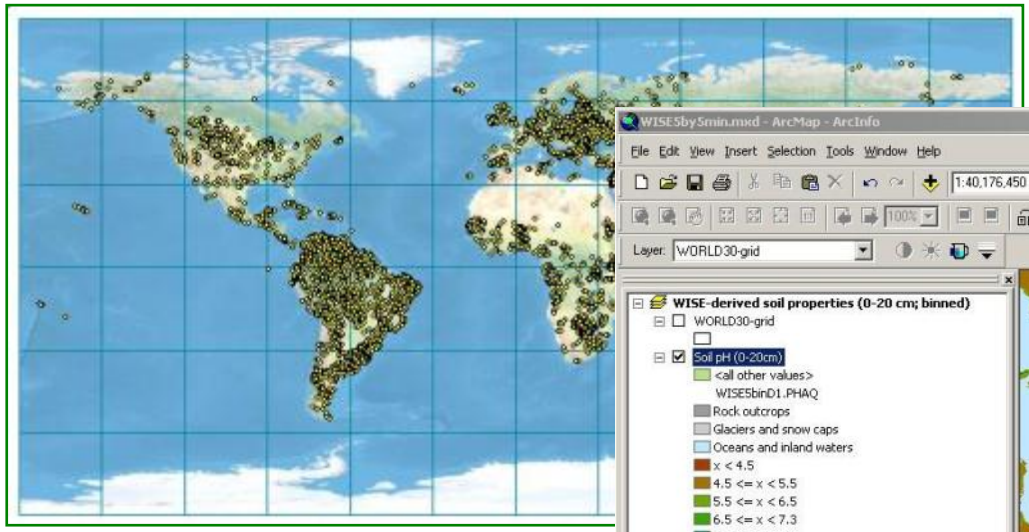
June 2011: Restructured website

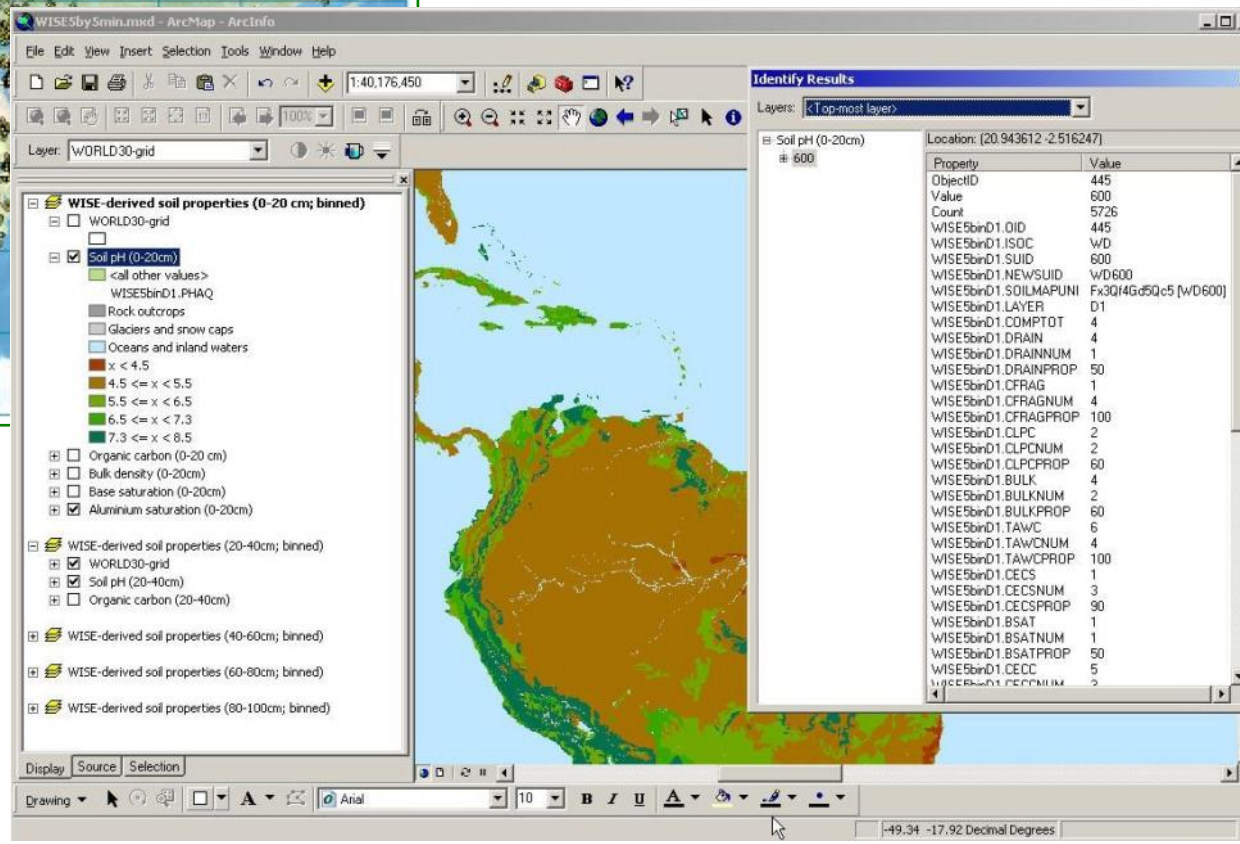


- Free access to a range of services/facilities:
  - Data Download service
  - Metadata service
  - Map viewer
  - Web mapping service (WMS)
  - Web processing service (WPS)
  - World Soil Information Service
  - World grids
  - Global Soil Information Facility (GSIF)
- Several facilities are in the development stage



Digital soil databases

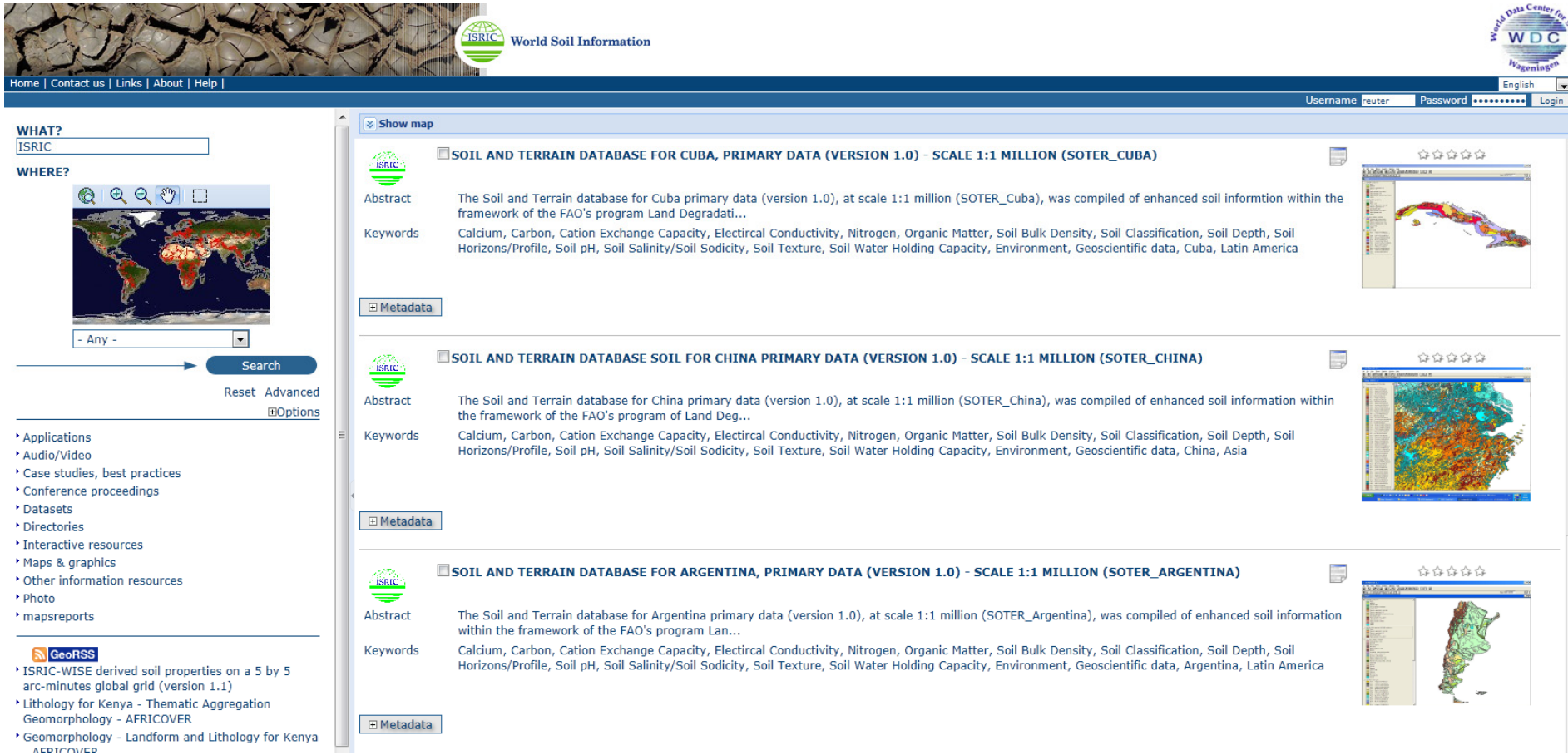




Quality-assessed
point data &
area-class maps
(WISE, SOTER, HWSD)

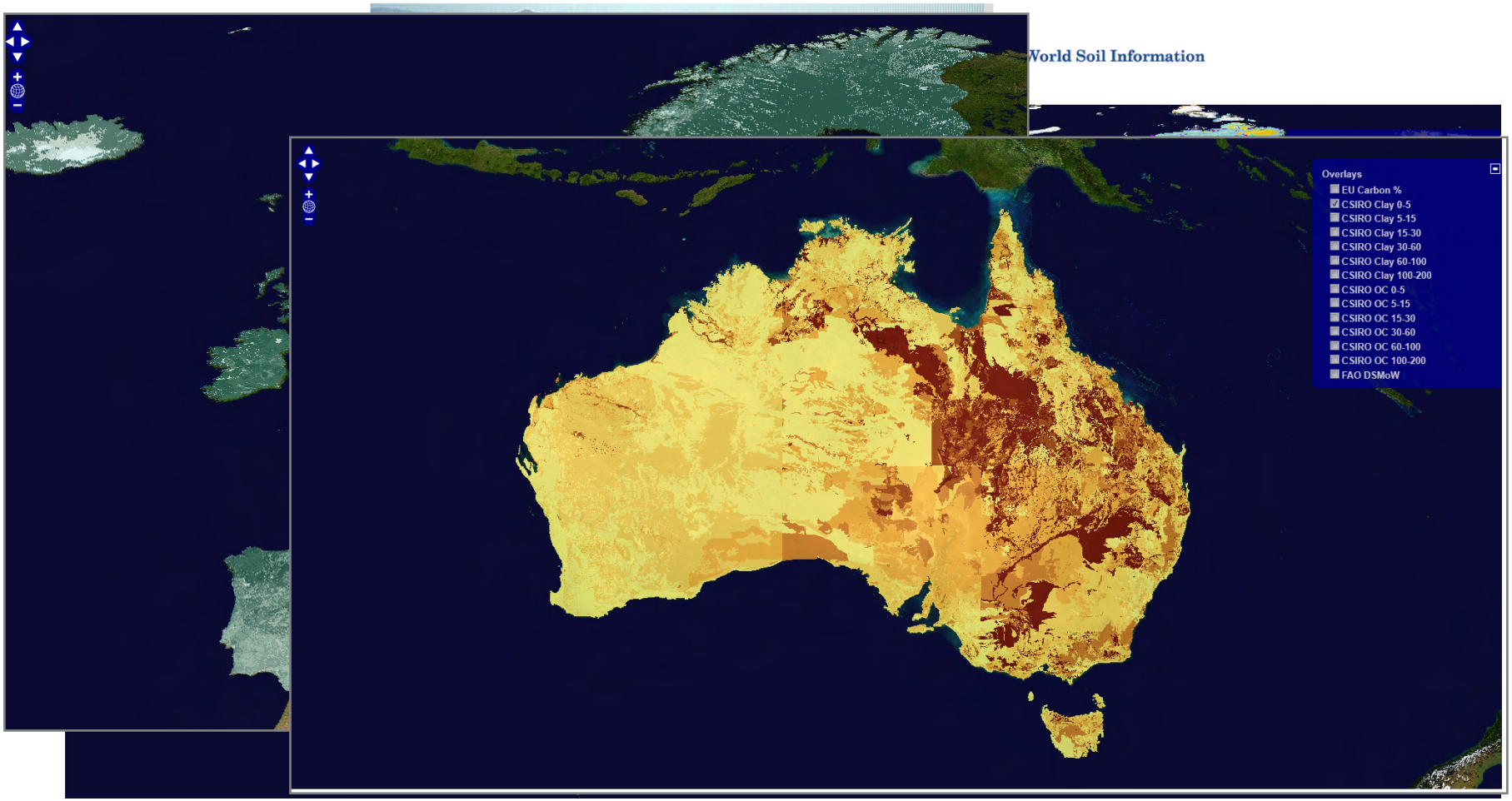
- Welche Bodeninformationen sind verfügbar ?

MetaData Service *(operational)*



- Wie visualisiere ich diese ?

OneSoil Map Viewer *(under development)*



- Wie prozessiere ich diese ?

Web Processing Service *(production/development)*

- Capability to compute soil functions or parameters of interest in the Soil Science domain
- Four different services are currently available:

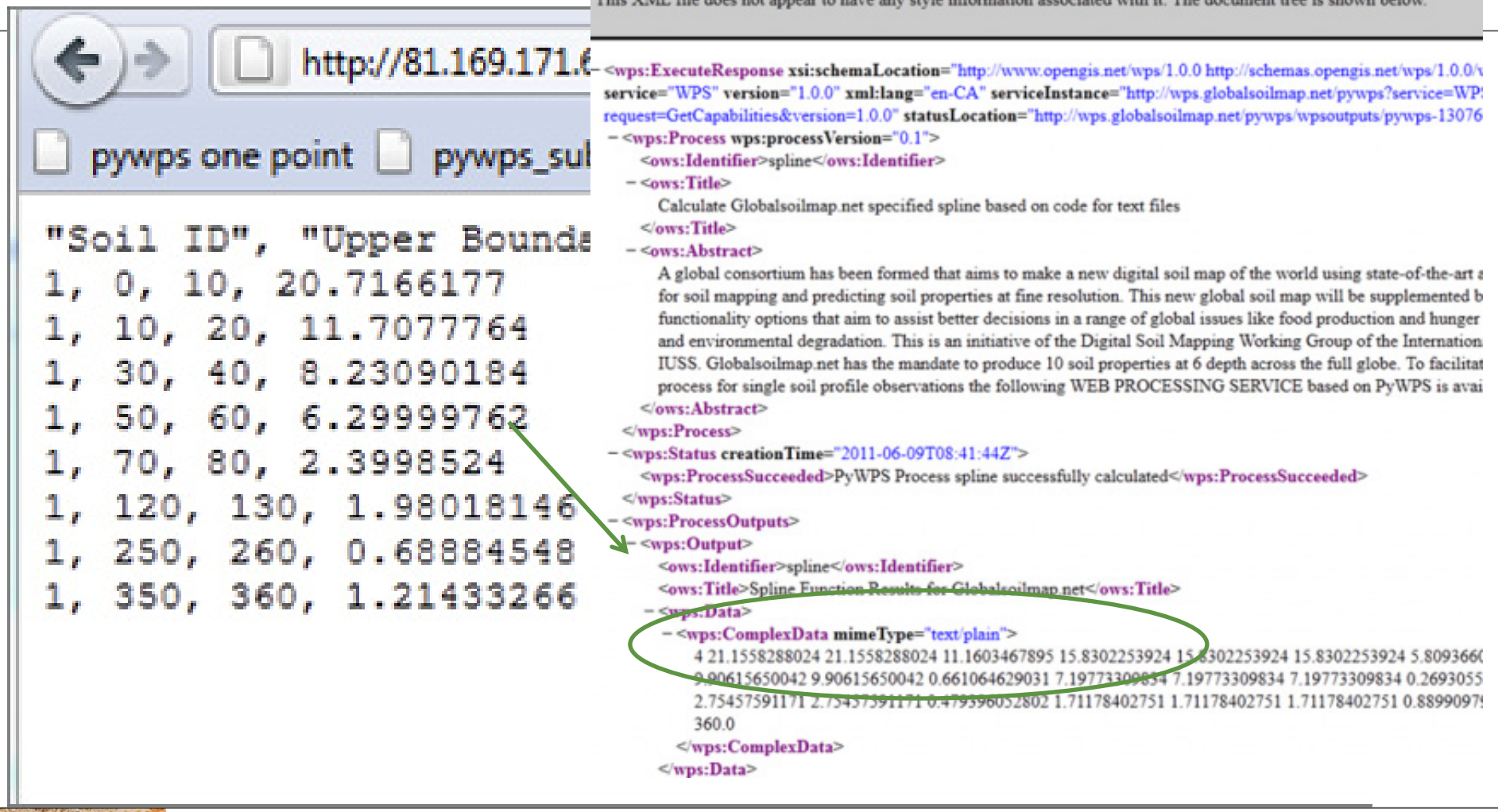
  a) ***Interpolation*** of quantitative soil profile properties using a *spline function*

  b) ***extraction*** of:
  - ***point information*** of soil information or auxiliary data sources for a given location on the planet
  - soil information or auxiliary data sources for a ***given area*** on the earth specified by the corner coordinates

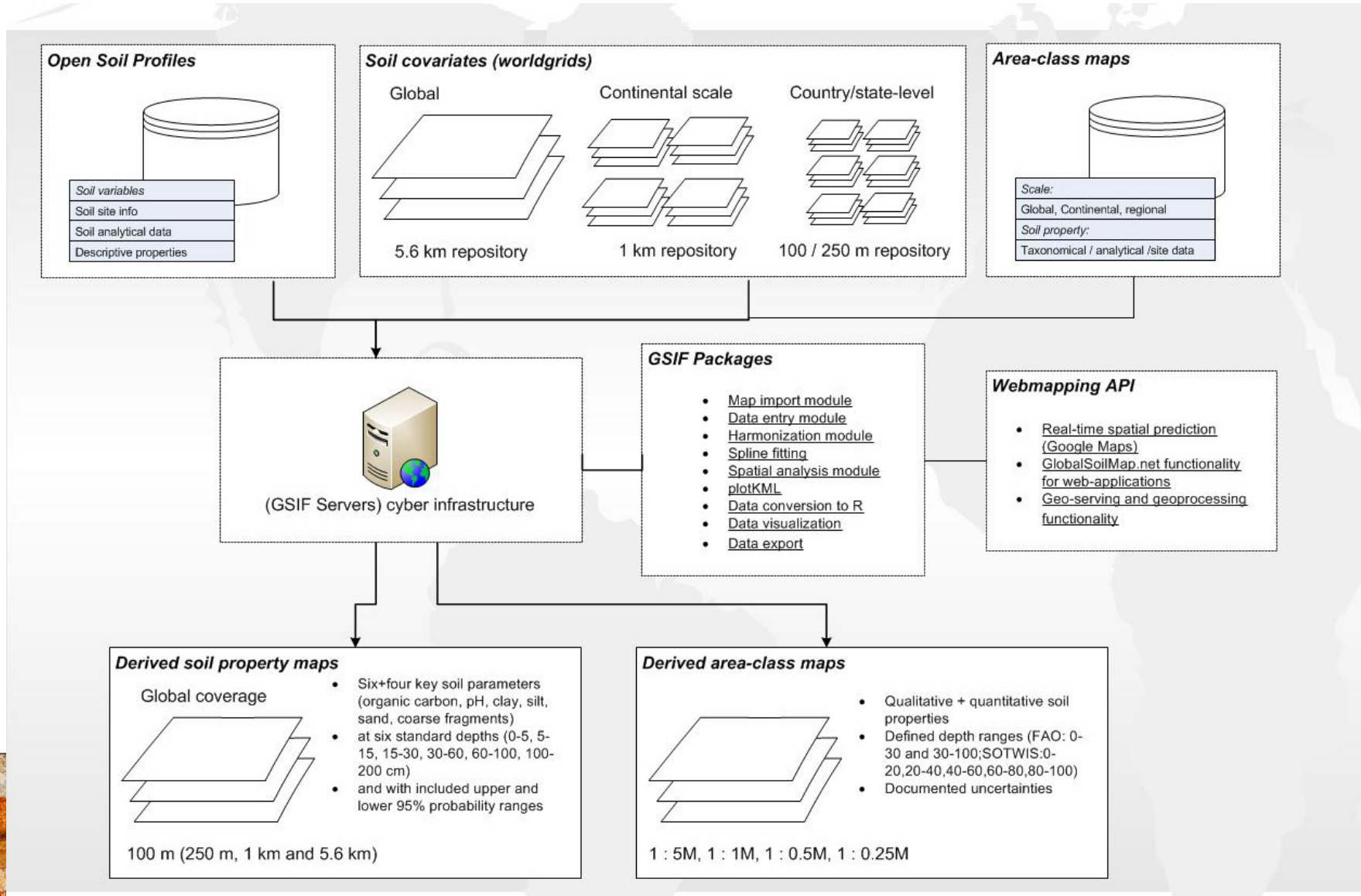
  c) ***overlay*** of two raster data sources to provide statistical information for a predefined zone-grid (e.g. watershed, countries) for soil information or auxiliary data sources

- WPS delivers OGC conforming XML file(s)

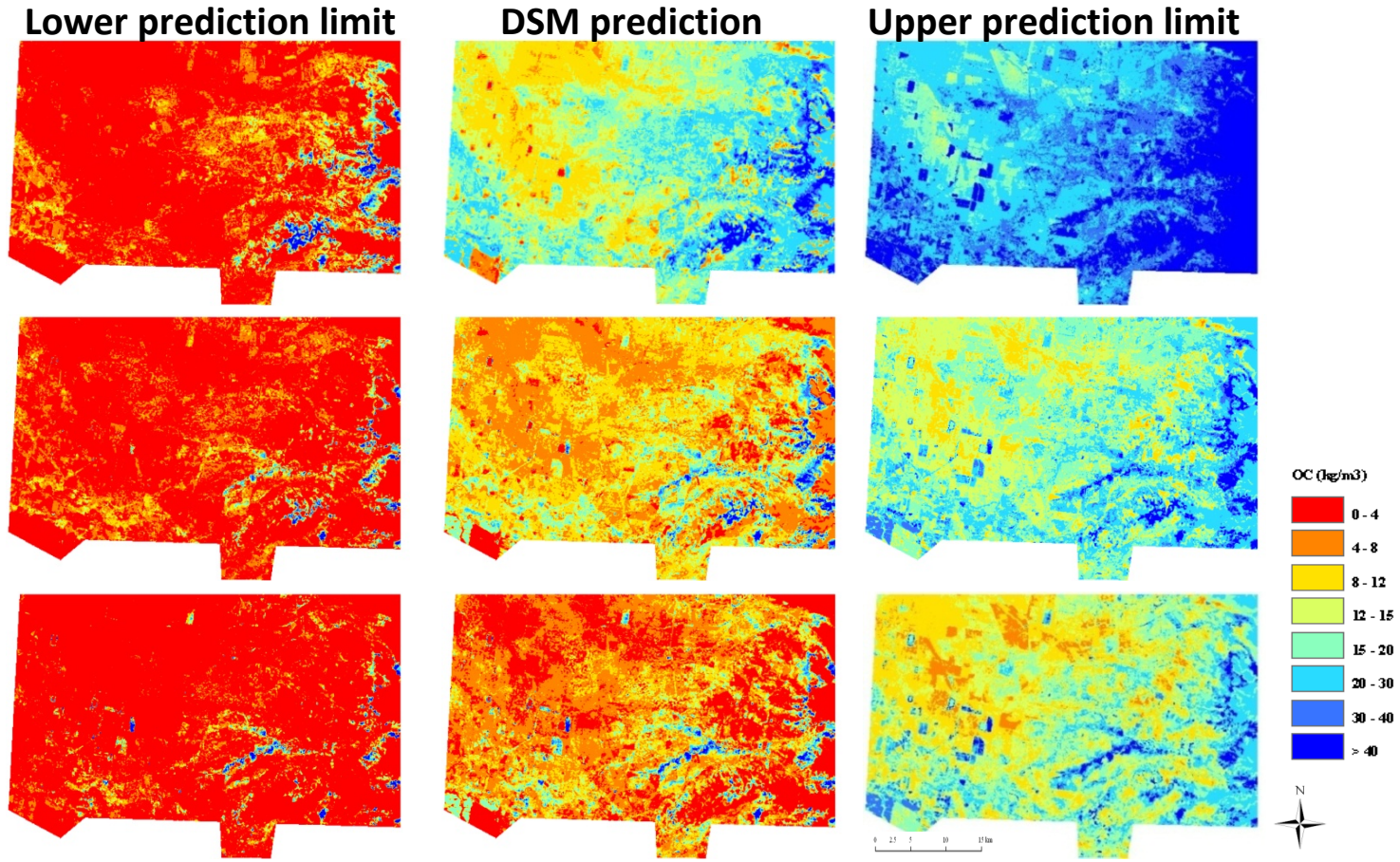
Web Processing Service *(production / development)*



Global Soil Information Facility *(under constr.)*

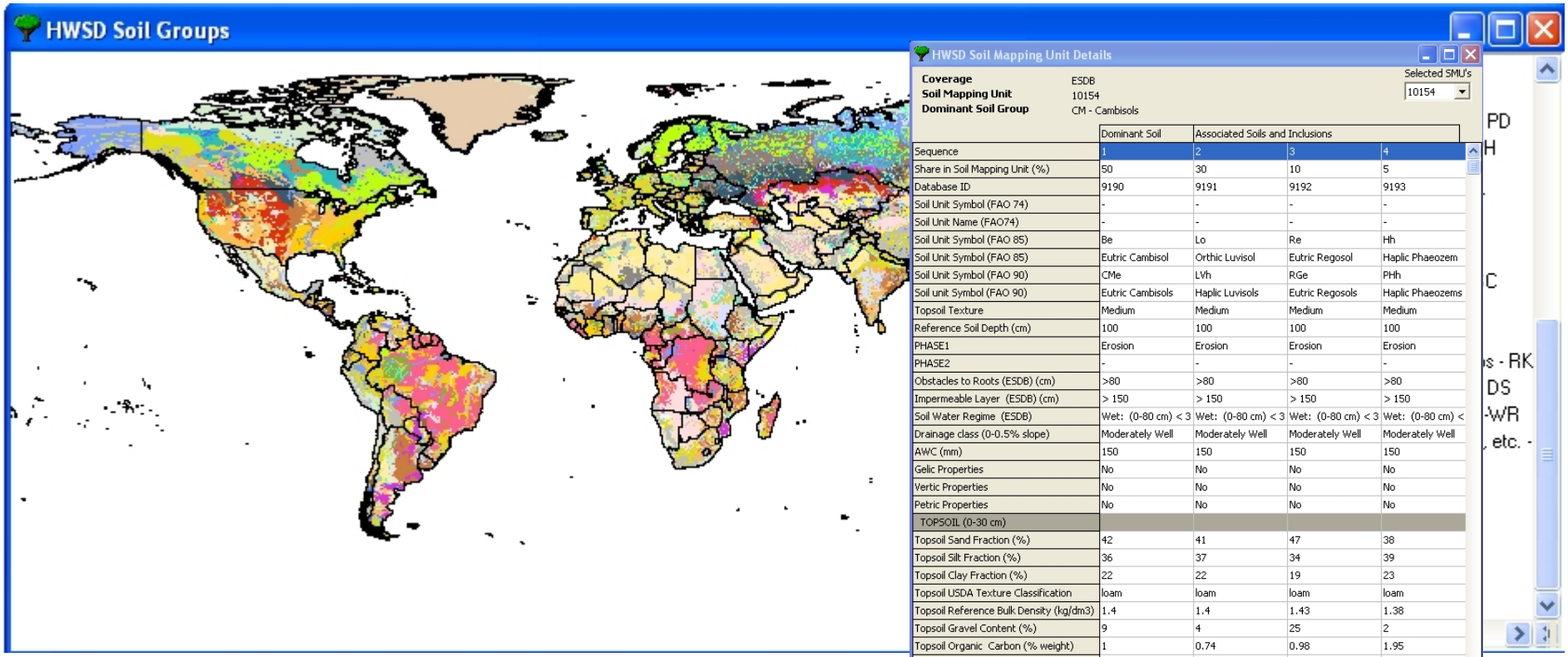


Derived soil property maps



Slide Credit: Alex McBratney

Derived area-class maps



HWSD Soil Mapping Unit Details

Coverage ESDB
Soil Mapping Unit 10154
Dominant Soil Group CM - Cambisols

Selected SMU's: 10154

	Dominant Soil	Associated Soils and Inclusions		
Sequence	1	2	3	4
Share in Soil Mapping Unit (%)	50	30	10	5
Database ID	9190	9191	9192	9193
Soil Unit Symbol (FAO 74)	-	-	-	-
Soil Unit Name (FAO74)	-	-	-	-
Soil Unit Symbol (FAO 85)	Be	Lo	Re	Hh
Soil Unit Symbol (FAO 85)	Eutric Cambisol	Orthic Luvisol	Eutric Regosol	Haplic Phaeozem
Soil Unit Symbol (FAO 90)	CMe	LVh	RGe	PHh
Soil unit Symbol (FAO 90)	Eutric Cambisols	Haplic Luvisols	Eutric Regosols	Haplic Phaeozems
Topsoil Texture	Medium	Medium	Medium	Medium
Reference Soil Depth (cm)	100	100	100	100
PHASE1	Erosion	Erosion	Erosion	Erosion
PHASE2	-	-	-	-
Obstacles to Roots (ESDB) (cm)	>80	>80	>80	>80
Impermeable Layer (ESDB) (cm)	> 150	> 150	> 150	> 150
Soil Water Regime (ESDB)	Wet: (0-80 cm) < 3	Wet: (0-80 cm) < 3	Wet: (0-80 cm) < 3	Wet: (0-80 cm) <
Drainage class (0-0.5% slope)	Moderately Well	Moderately Well	Moderately Well	Moderately Well
AWC (mm)	150	150	150	150
Gelic Properties	No	No	No	No
Vertic Properties	No	No	No	No
Petric Properties	No	No	No	No
TOPSOIL (0-30 cm)				
Topsoil Sand Fraction (%)	42	41	47	38
Topsoil Silt Fraction (%)	36	37	34	39
Topsoil Clay Fraction (%)	22	22	19	23
Topsoil USDA Texture Classification	loam	loam	loam	loam
Topsoil Reference Bulk Density (kg/dm3)	1.4	1.4	1.43	1.38
Topsoil Gravel Content (%)	9	4	25	2
Topsoil Organic Carbon (% weight)	1	0.74	0.98	1.95
Topsoil pH (H2O)	6.6	6.5	6.4	6.4
Topsoil CEC (clay) (cmol/kg)	55	47	40	55
Topsoil CEC (soil) (cmol/kg)	16	13	12	20
Topsoil Base Saturation (%)	93	91	78	87
Topsoil TEB (cmol/kg)	14	11	14	12.4
Topsoil Calcium Carbonate (% weight)	0	0	0	0
Topsoil Gypsum (% weight)	0	0	0	0
Topsoil Sodicity (ESP) (%)	2	1	1	1
Topsoil Salinity (ECe) (dS/m)	0.1	0.1	0.1	0.1
SUBSOIL (30-100 cm)				

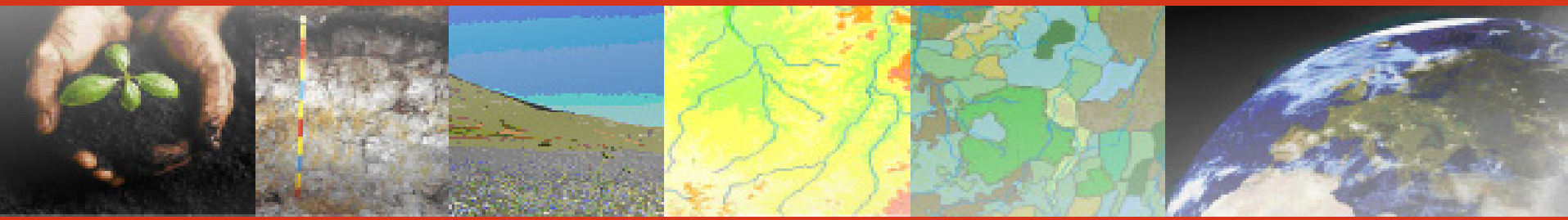
http://www.iiasa.ac.at/Research/LUC/External-World-soil-database/HTML/

e-SOTER

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

FP7 project # 211758

ISRIC World Soil Information



General overview

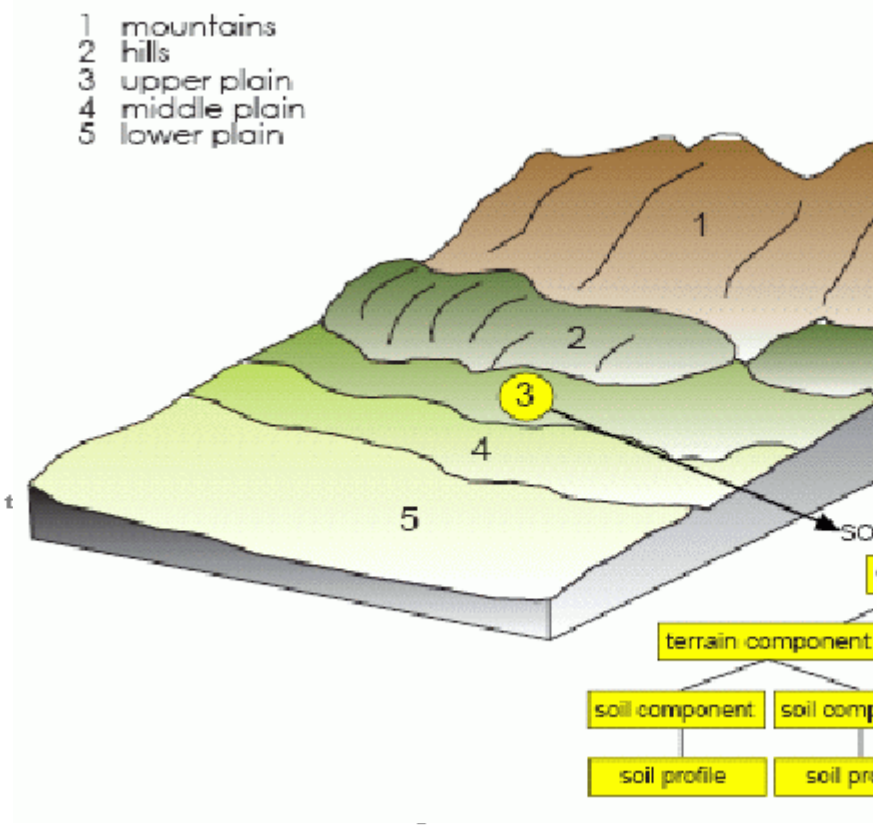
European Commission involved in initiatives which are developing and improving the access of Europe to Earth observation capacities:

- Global Earth Observation System of Systems (GEOSS)
- Global Monitoring for Environment and Security (GMES)
- Infrastructure for SPatial InfoRmation in Europe (INSPIRE)

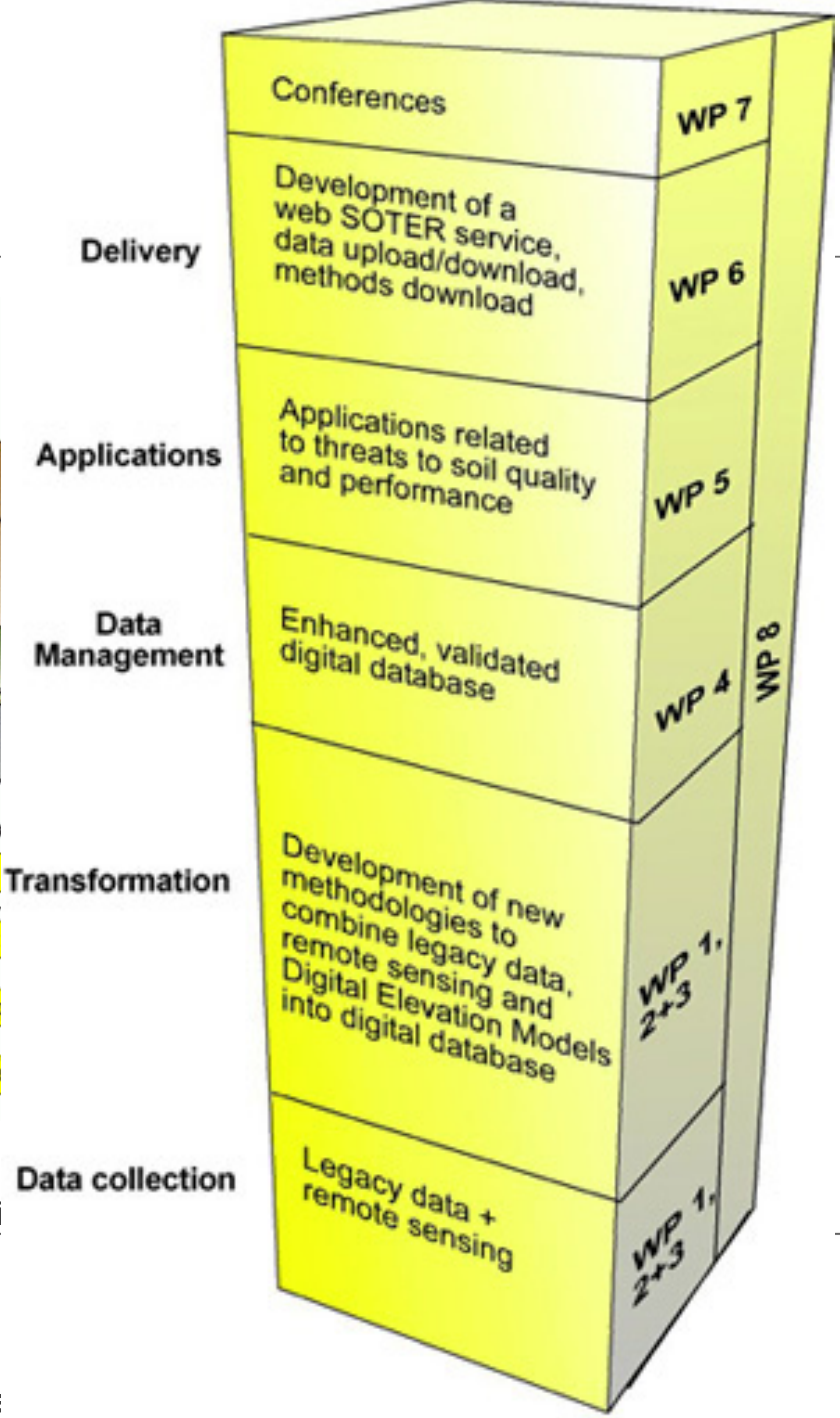
Specific research activities for GEOSS for environment and sustainable development with a soils link (GEOSS Work plan 2007-2008):

- Supporting sustainable agriculture and combating desertification
- Supporting a global soils and terrain database at scale 1:1 M

SOTER unit



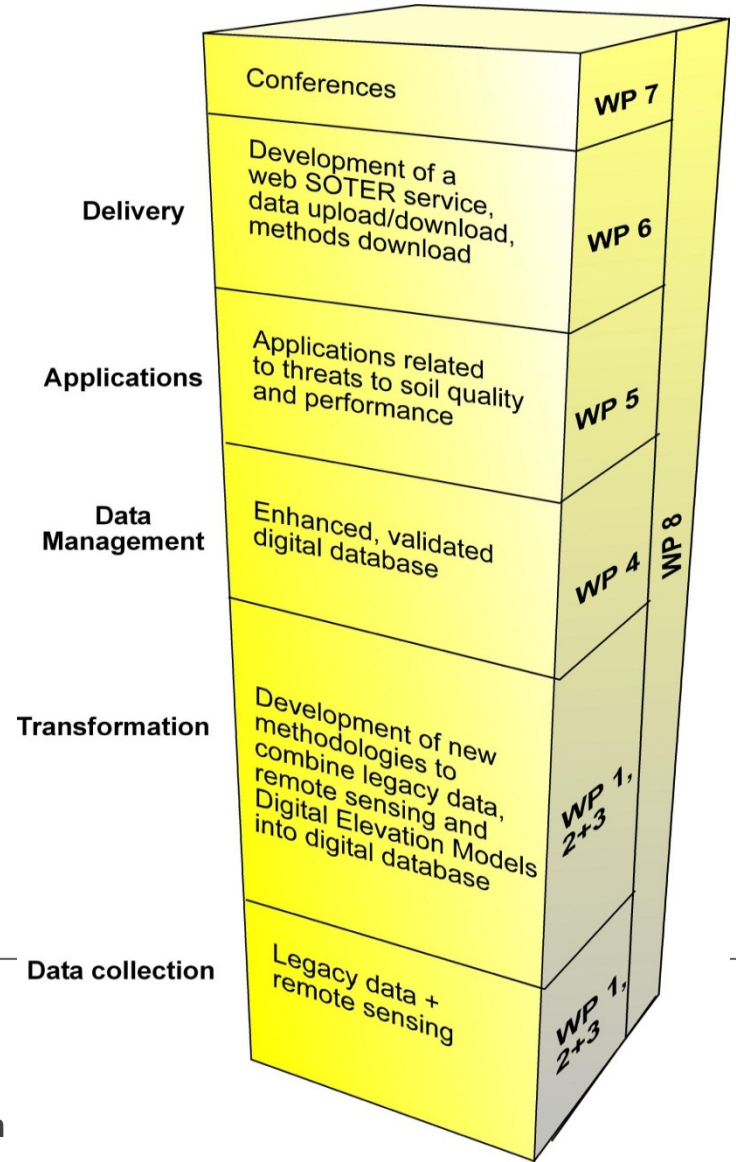
SOTER units, their terrain components (tc), attributes, and locati



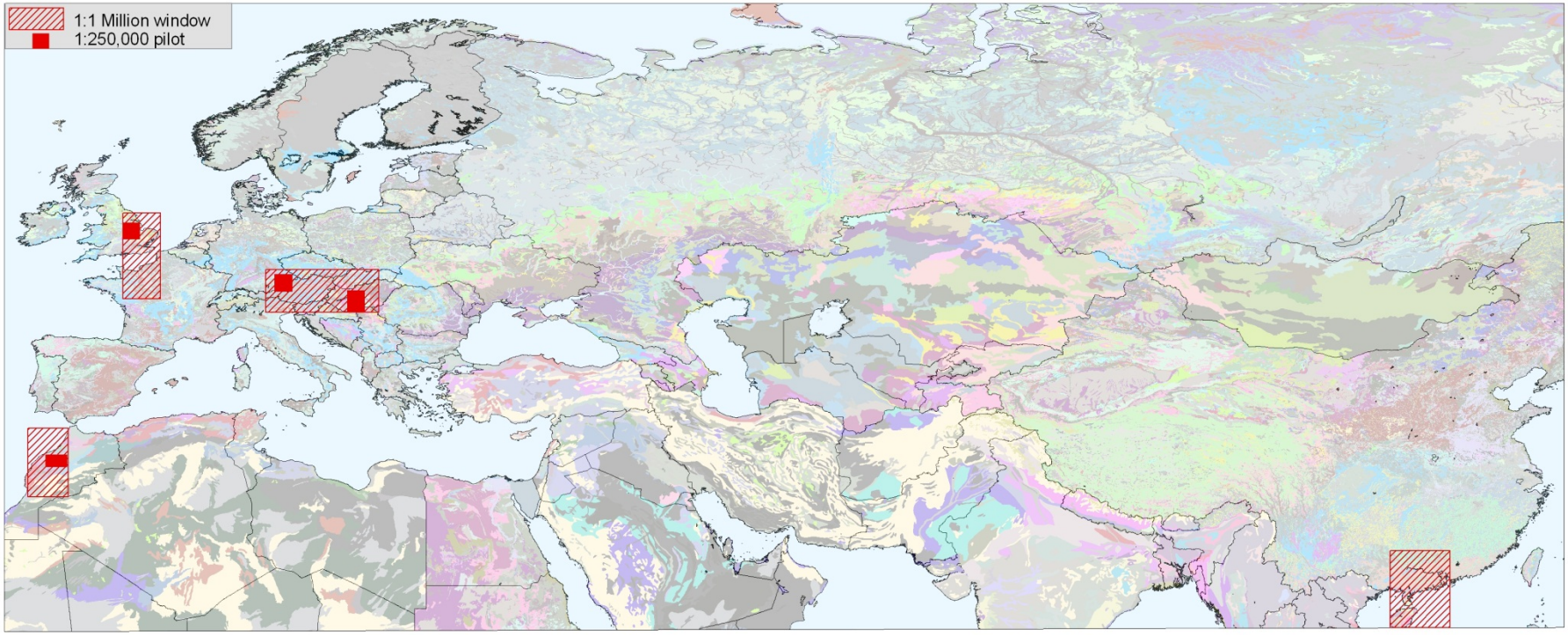
e-SOTER Project

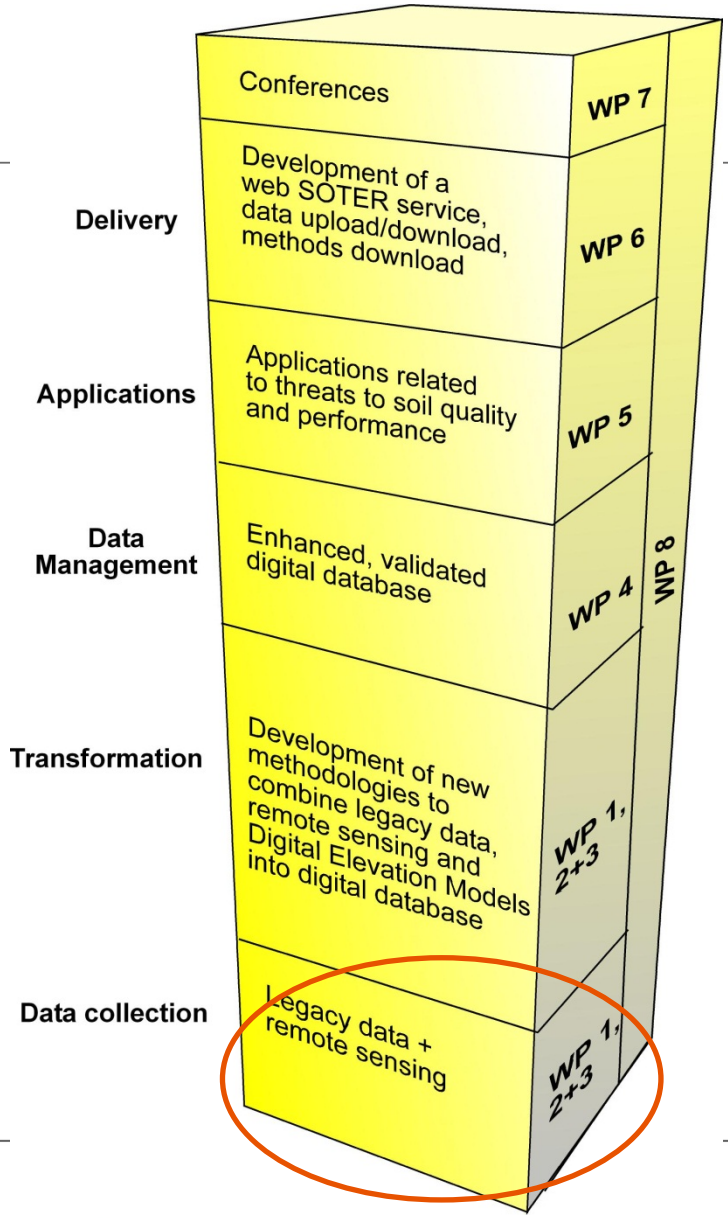
Components of a comprehensive Soil Observing System:

- data collection
- transformation
- data management
- interpretations
- delivery

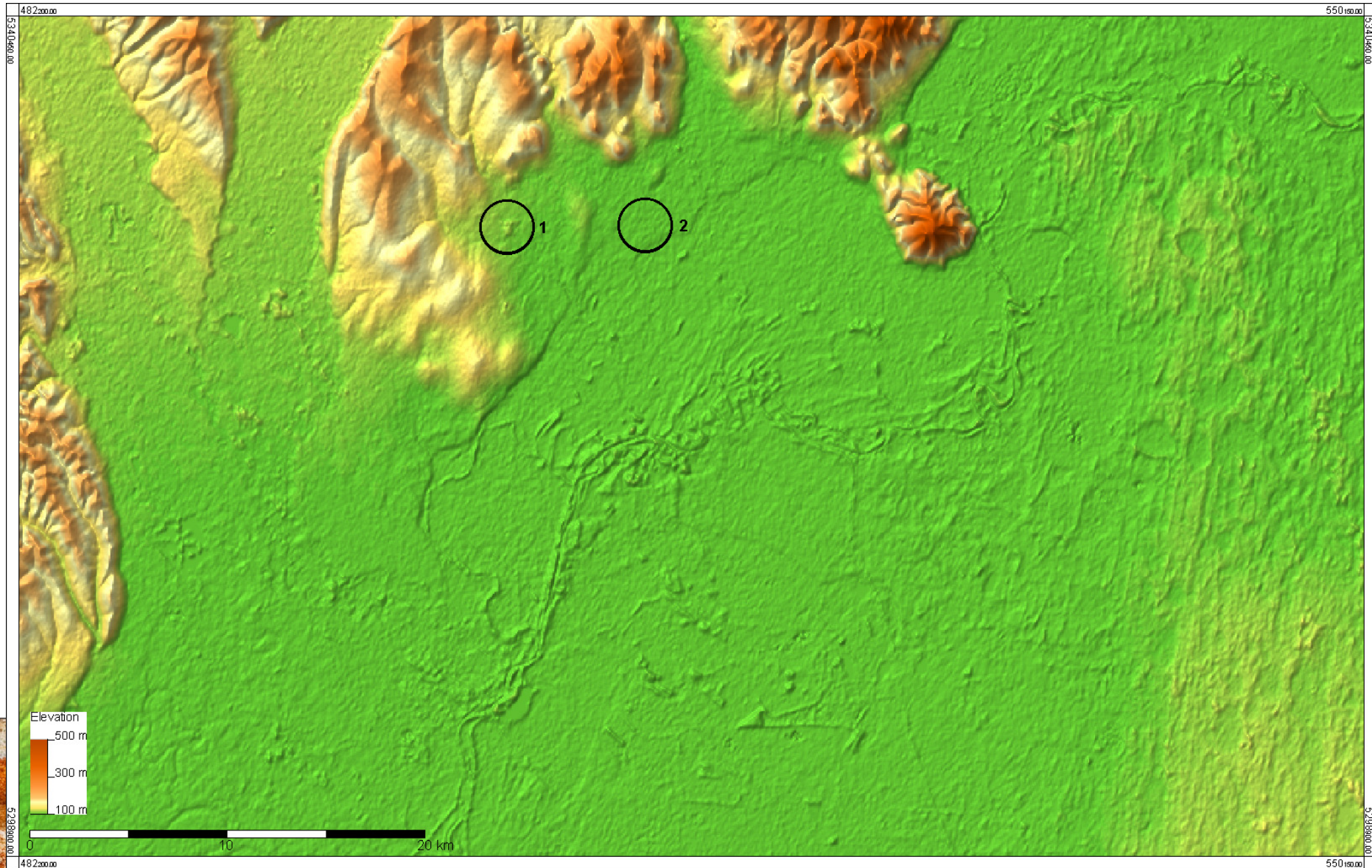


Windows and pilots




Conferences
WP 7
Delivery
Development of a web SOTER service, data upload/download, methods download
WP 6
Applications
Applications related to threats to soil quality and performance
WP 5
Data Management
Enhanced, validated digital database
WP 4
WP 8
Transformation
Development of new methodologies to combine legacy data, remote sensing and Digital Elevation Models into digital database
WP 1, 2+3
Data collection
Legacy data + remote sensing
WP 1, 2+3

Status December 2010



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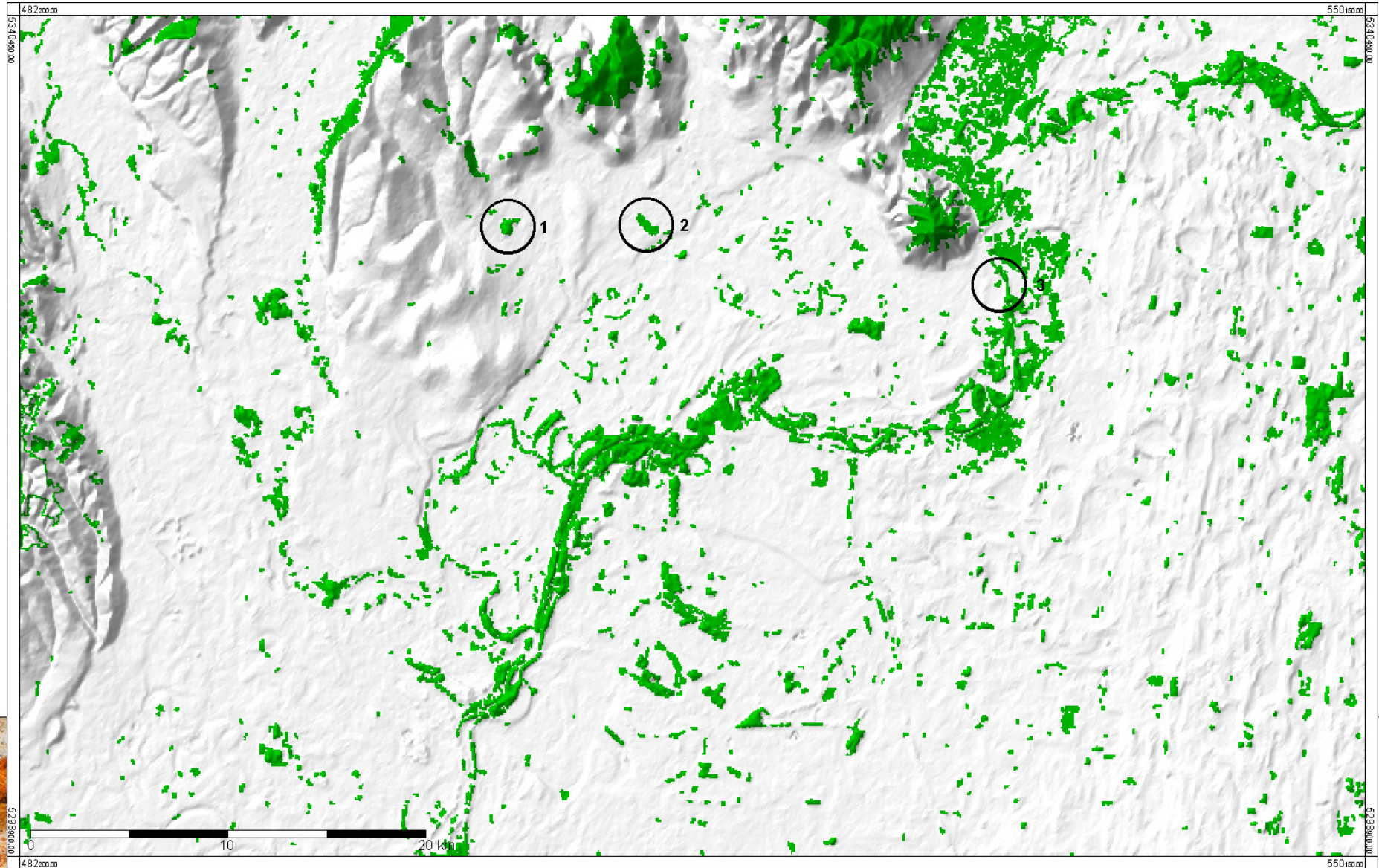

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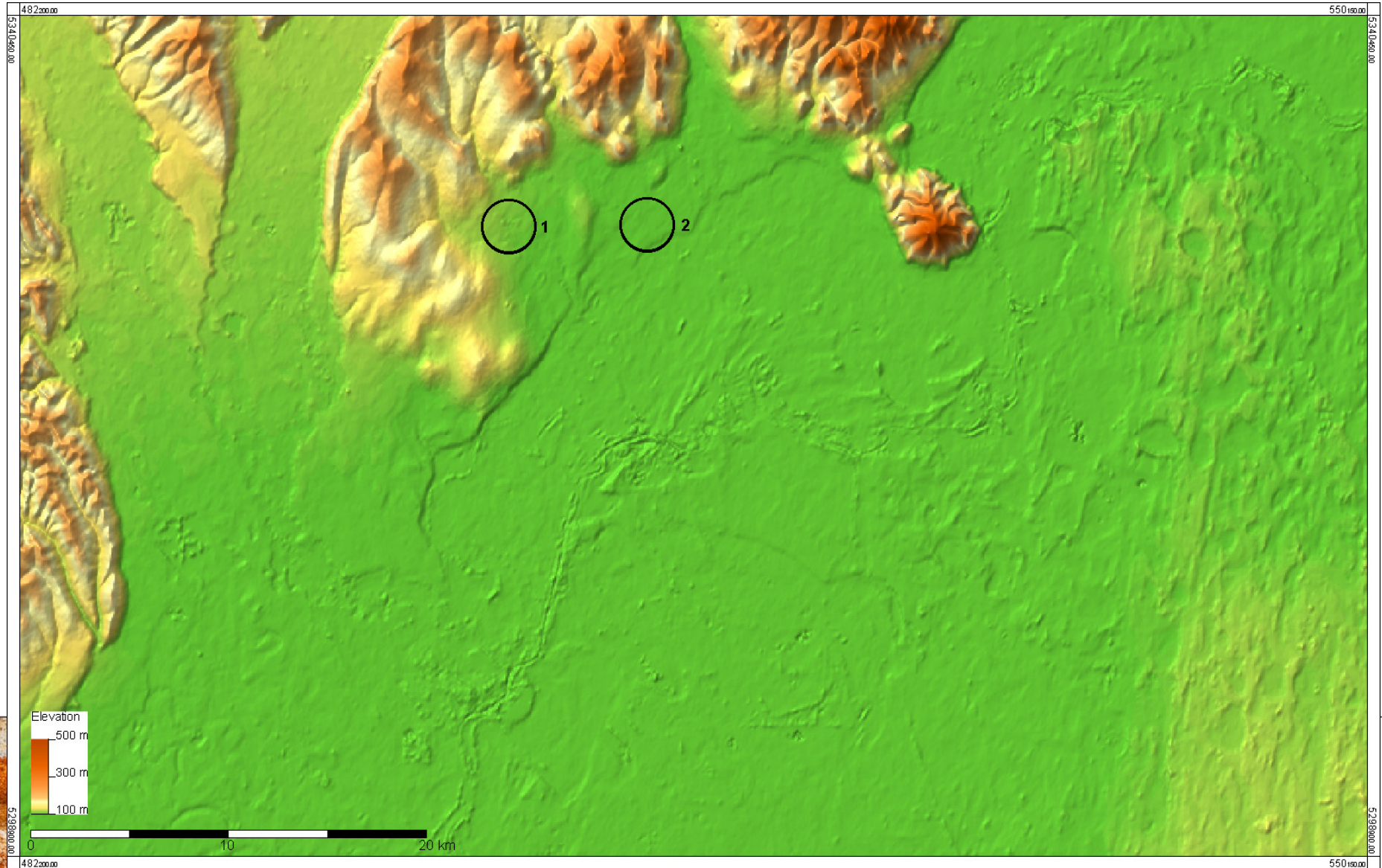

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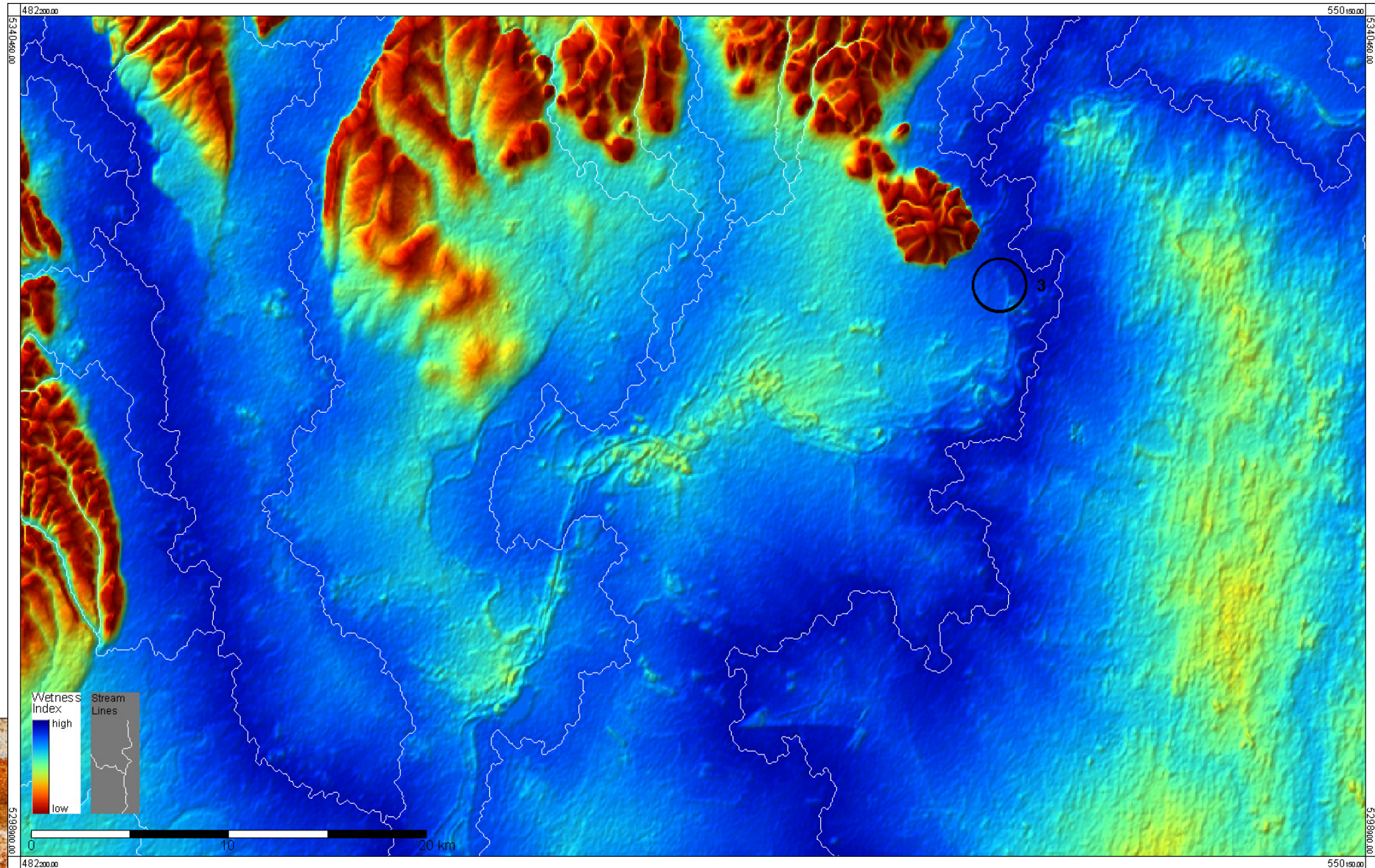

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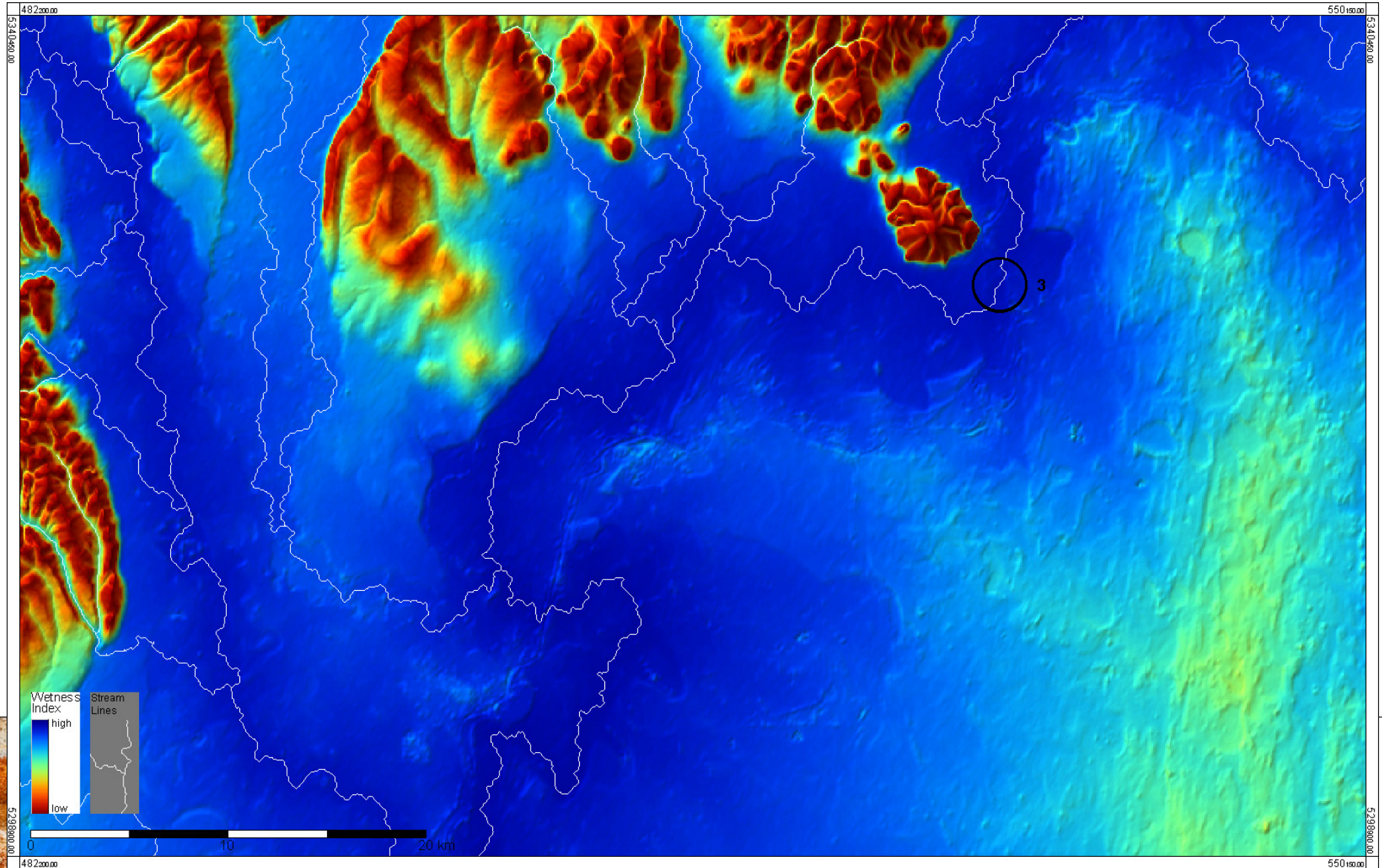

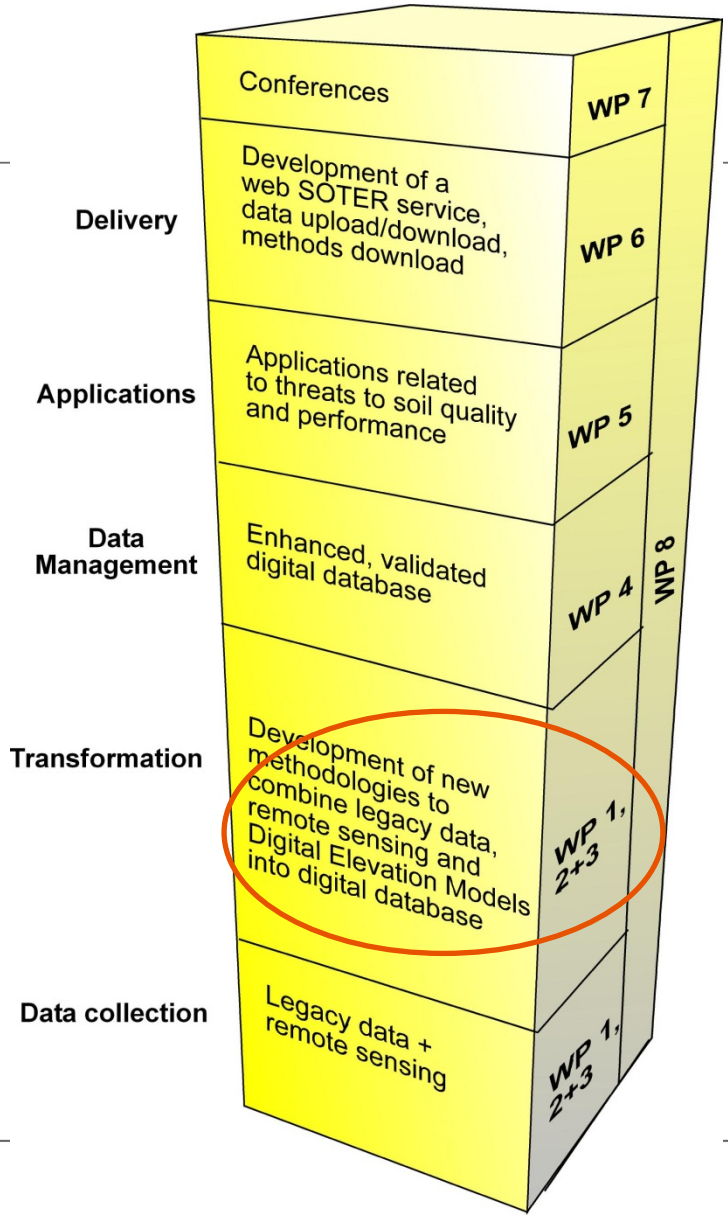
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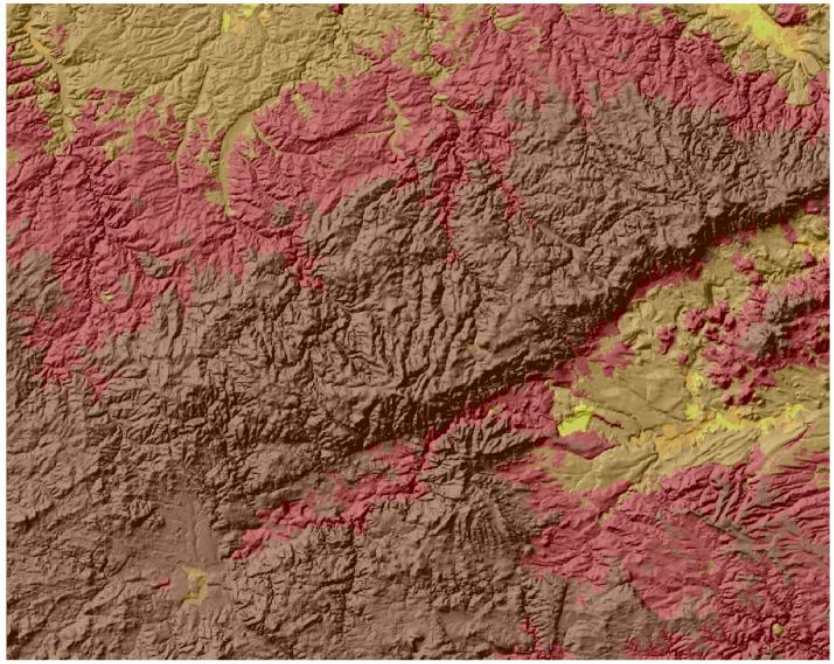
Cluster analysis on peak sheds combined with slope break analysis
Chemnitz pilot area



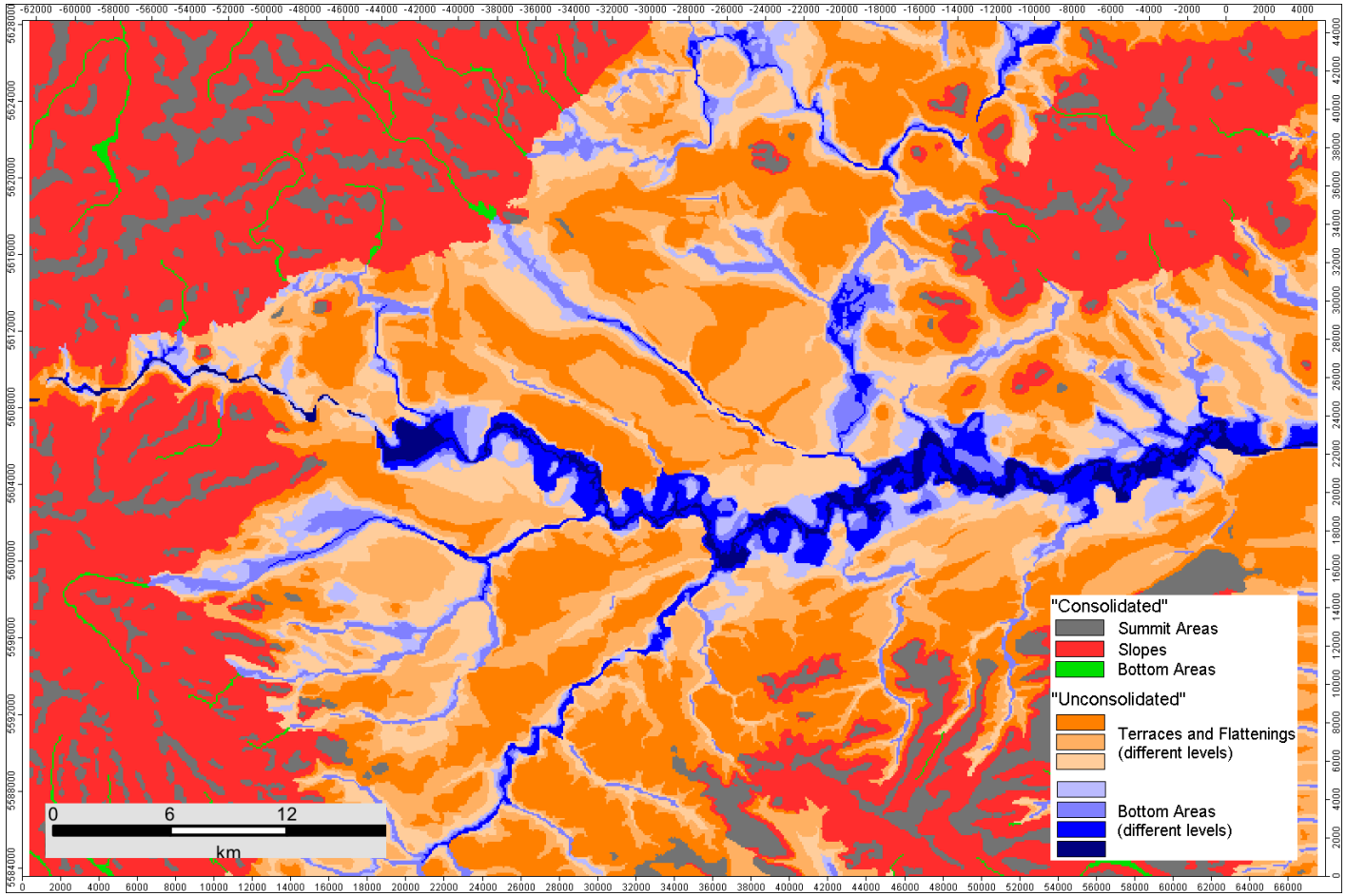
Legend

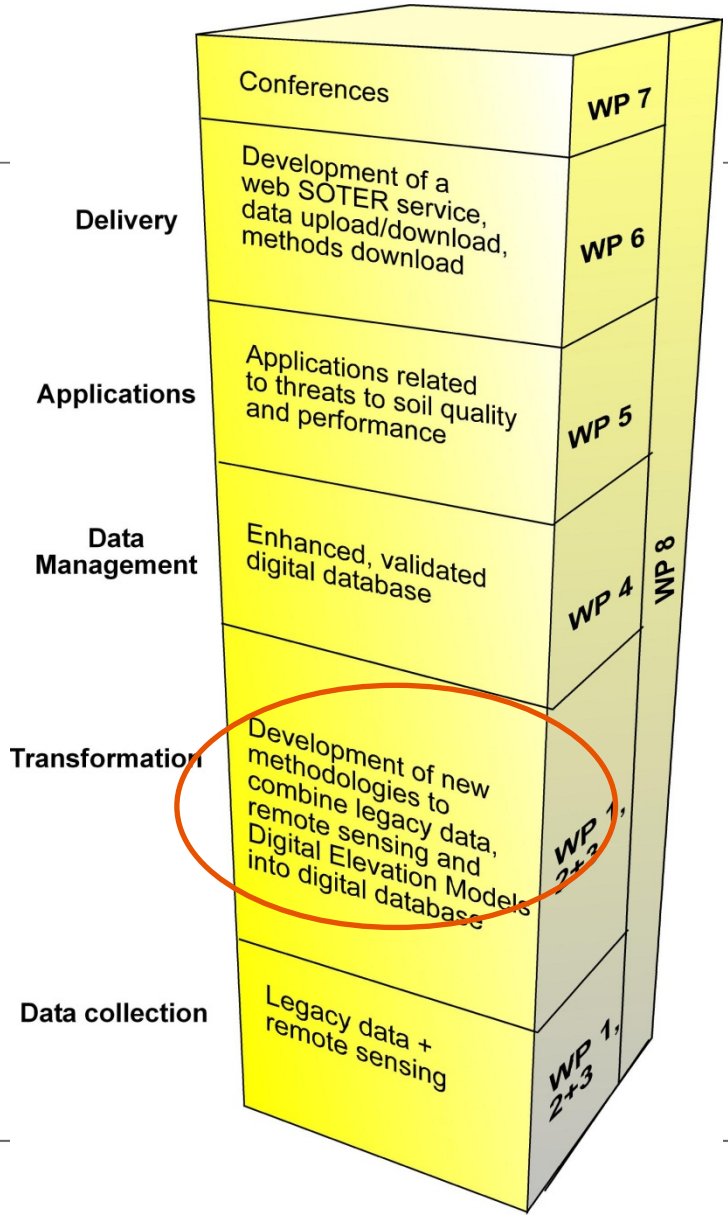
K-means clustering

Cluster No

- high_1
- high_2
- high_3
- high_4
- high_5
- low_1
- low_2
- low_3
- low_4
- low_5
- low_6
- low_7

preliminary results of terrain classification

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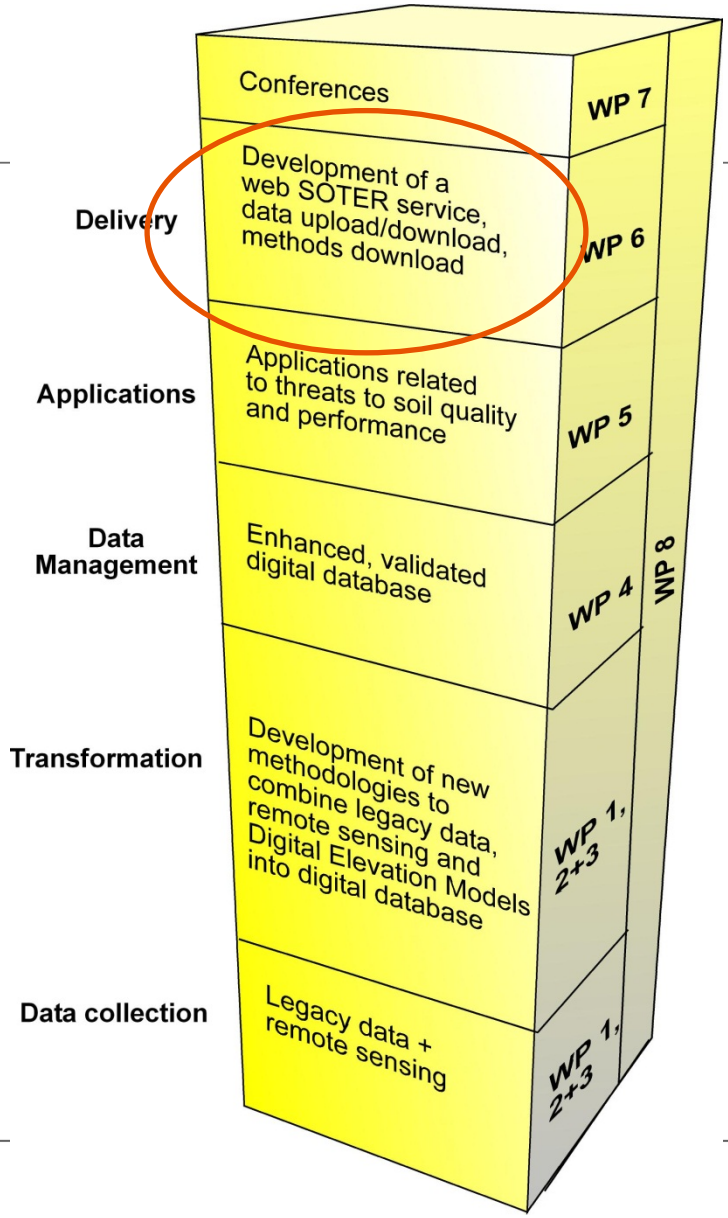
2009 Production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e-SOTER outputs

- knowledge, databases and algorithms
- thematic maps directly derived from the database
  - e.g. pH map, soil map,
- thematic map based on interpretations of the database (applications)
  - e.g. land evaluation, erosion risk map, or
- assessments in combination with other linked maps or databases
  - e.g. land degradation assessment

Concluding remarks

- Importance of soils and soil information is increasingly recognised in major global issues
- Increased demand for quality-assessed soil information by other scientific disciplines, policy and society
- Within the ICSU World Data System (WDS), ISRIC will continue to ensure the long-term stewardship and provision of quality-assessed data and data services to the international science community and policy community and other stakeholders
- e-SOTER provides knowledge, databases and algorithms for the European contribution to the completion of the World SOTER database

Think globally – Act locally

We can do this – through collaboration and sharing of information

ISRIC World Soil Information

e-SOTER addresses four major barriers to a comprehensive soil observing system:

- Morphometric descriptions - enabling quantitative mapping of landforms as opposed to crude slope categories. This will build upon EU- initiated DEM landform classification procedures (Dobos *et al.* 2005);
- Soil parent material characterization and pattern recognition by remote sensing - enabling separation of soil processes within the landscape;
- Soil pattern recognition by remote sensing;
- Standardization of methods and measures of soil attributes to convert legacy data already held in the European Geographical Soil Database and various national databases to a common standard - so that they may be applied, e.g. in predictive and descriptive models of soil behavior.

General overview

Two major research thrusts:

- Improvement of the current SOTER methodology at scale 1:1 million by using moderate-resolution optical remote sensing systems to delineate *geo-botanical* units and to associate them statistically with existing parent material/geology and soil information
- Advanced methodologies applied at scale 1:250 000 using geomorphic landscape analysis, geological re-classified remote sensing, and a remote sensing approach of soil

Advances in:

Transformation

- e-SOTER will transform the pre-existing data and bring new information with remote sensing interpretation and DEM analysis to enhance all three components of the SOTER database: landform, parent material and soil information:

- *Landform:* At the 1:1 million scale, landform units will be derived from analysis of the SRTM 90m DEM. The morphometric analysis will elaborate the SOTER landform definitions introduced by Dobos *et al. (2005)*.

  At the 1:250 000 scale, alternative methods to derive terrain parameters will be explored, in particular the comparative advantages of applying rule-based (MacMillan *et al.* 2000) and object-based segmentation techniques to the natural continuum (Köthe and Bock 2006); and fixed definitions as opposed to flexible definitions related to individual landscapes.

Transformation (continued)

- *Soil parent material:* At the 1:1 million scale, delineation of parent material units will employ optical, medium-resolution satellite imagery, constrained by landform and anchored to available geological data.

  At the 1:250 000 scale, soil parent material will be determined from remote sensing data.

General overview

Advances in:

Transformation (continued)

- *Soil characterization*: At the 1:1 million scale, research will follow a pragmatic approach: 1) spatial patterns using available, optical medium-resolution satellite data, trained with existing soil mapping; 2) attribute data using the World Reference Base taxonomic units as carriers of information from documented to unknown sites, and harmonizing national datasets to create a common reference point.

  At the 1:250 000 scale, advanced remote sensing methods like airborne radiometrics and image spectrometry, airborne medium-resolution remote sensing, and low-resolution satellite data will be used to develop predictors for soil properties using two approaches: 1) classification and regression-tree analysis, and 2) evidential reasoning.

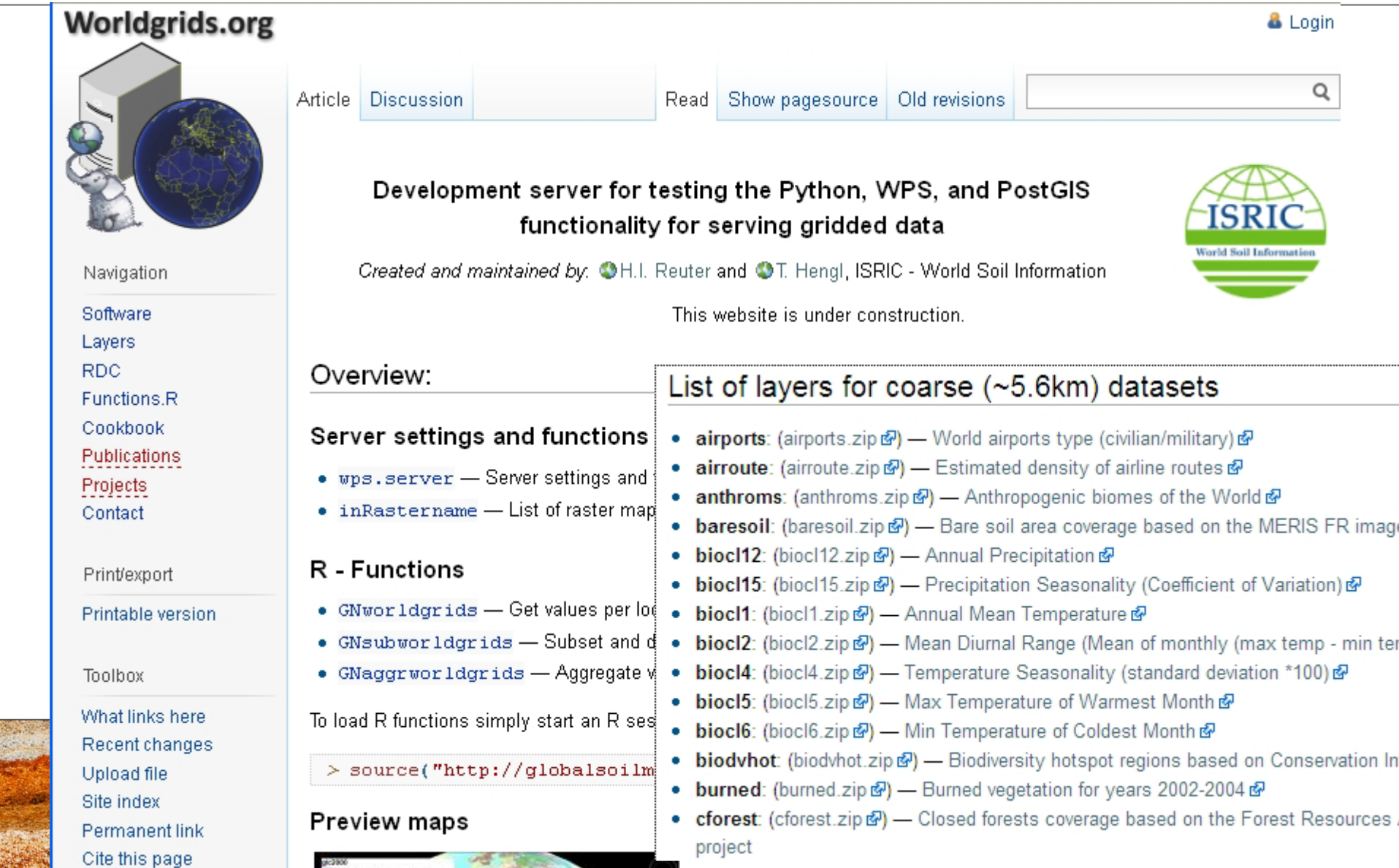
Interpretations

- *e-SOTER* data will be used to run models that address threats defined in the EU Soil Thematic Strategy. Comparison will be made with runs made with the existing European Soil Database

Delivery

- The results of e-SOTER will be available through a web service of a data portal, providing the basis for a Global Soil Observatory. Linkage with the GEOSS architectural principles and interoperability arrangements will be sought

Worldgrids *(operational)*



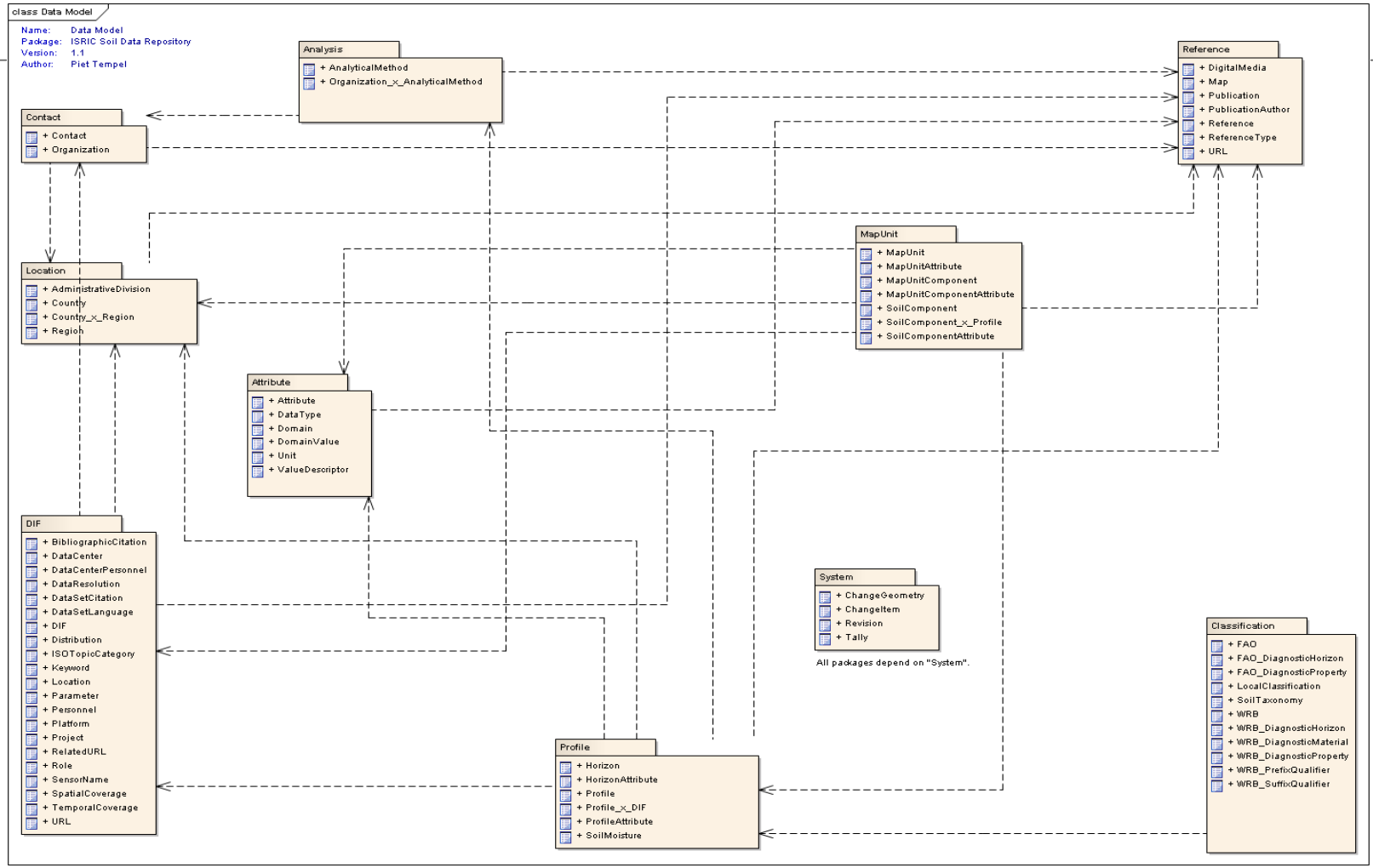
Worldgrids *(operational)*

- Provides a repository of gridded predictors with global or at least partial global coverage
- As WDC for Soils, ISRIC facilitates the collation and use of multi-thematic gridded repositories of Digital Soil Mapping (DSM) covariates
- Contains over 100 grid maps at a 5.6 km resolution; 1 km resolution maps are currently being added to the repository
- Functionalities include querying, extraction, and creating of an overlay of a user-specified zone grid and a defined covariate map

World Soil Information Service *(under review)*

- All data managed or maintained by ISRIC will be made available online from one central database environment in one uniform format
- WoSIS will contain validated and authorized data with defined and registered accuracy and quality
- Spatially-enabled RDMS design is under external review (End of Sept. 2011)
- After adjustments, it will go into production and be accessible through different services (e.g., Data Entry, MetaDataService, WMS, WPS, …)

World Soil Information Service *(under review)*



Work package No	Work package title	Type of activity	Lead beneficiary No	Person-months	Start month	End month
1	Development of a landform and parent material platform methodology	RTD	2	90	1	18
2	Development of a methodology to integrate soil data from legacy and RS sources	RTD	7	102	1	24
3	Improvement of SOTER spatial and attribute data	RTD	5	94	1	31
4	Accuracy assessment of terrain and soil platforms	RTD	6	21	1	40
5	Applications	RTD	6	32	1	40
6	Development of an e-SOTER dissemination platform	RTD	4	46	1	42
7	Stakeholder conferences	OTHER	1	1	19	41
8	Project management	MGT	1	25	1	42
	TOTAL			410		

General overview

Work package	WP1	WP2	WP3	WP4	WP5	WP6	WP7	WP8	TOTAL per Beneficiary
ISRIC	6	6	-	-	-	2	1	19.4	34
UniMis	39	14	8	-	-	-	-	0.4	61
BGR	7	2.5	12	1	3	10	-	0.4	36
JRC	5	5	9	-	8	13	-	0.4	40
CU	1	1	21	2	-	12	-	0.4	37
Alterra	-	-	-	13	10	-	-	0.4	23
SIU	4	36	2	-	-	-	-	0.4	42
Scilands	9	-	15	-	-	-	-	0.4	24
INRA	10	1	-	-	3	-	-	0.4	14
UNOTT	-	-	-	-	-	9	-	0.4	9
CULS	-	5	5	5	3	-	-	0.4	18
ISSCAS	7	24	-	-	-	-	-	0.4	31
ENA	2	8	3	-	5	-	-	0.4	18
WU	-	-	19	-	-	-	-	0.4	19

General overview

	WP nr	Heading	Tasks
RTD	1	**Development of a landform and parent material platform methodology**	1. To develop a complete, artifact-cleaned digital elevation model based on available DEM data 2. Landform classification according to the SOTER criteria and the development of terrain units. 3. Delineation of soil parent material units 4. The combination landform and soil parent material units into terrain units
	2	**Development of a methodology to integrate soil data from legacy and RS sources**	1. Generating spatial soil information for the four 1:1 M Windows 2. Compilation of the soil data base for the 1.1M windows: Collection, harmonization and import of the semantic soil information
	3	**Improvement of SOTER spatial and attribute data**	1. Research on improved analysis of DEM applying natural breaks 2. Research on RS analysis for parent material 3. Research on RS for semantic soil data

General overview

	WP nr	Heading	Tasks
RTD	4	**Accuracy assessment of terrain and soil platforms**	1. Design of validation strategy: 2. Collection of independent validation data 3. Validation of SOTER outputs for test windows 4. Quantification of uncertainty about the inputs to the SOTER methodology 5. Application of uncertainty propagation analysis
	5	**Applications**	1. Identifying the major threats in each pilot area 2. Gathering data (both input for models, and for evaluation of results) 3. Comparing original soil map/database and SOTER 4. Comparing different scales of SOTER
	6	**Development of an e-SOTER dissemination platform**	1. Research on analysis of data specification and exchange rules (XML) and development of concept rules for SoTerML (OGC) 2. Soil profile and analytical data management (Global Pedon Database; semantic map data base) 3. Development, setup and implementation of a global/ European *e-SOTER* portal 4. Transfer of methods developed by WP1-3 into Algorithm Database and Incorporation into *e-SOTER* Portal 5. Publication of European Dataset as DVD or Publication as a EUR-Report

General overview

	WP nr	Heading	Tasks
Other	**7**	**Conferences**	1. Conference to present outcome of WP 1 and 2 2. Wrap up and hand-over conference
Management	**8**	**Project management**	1. Management and coordination of all activities within the project 2. Administration, reporting to and liaise with the EU.