INCREASING ACCESSIBILITY AND INTEROPERABILITY OF SOIL DATA BY BUILDING UP AN INSPIRE COMPLIANT EUROPEAN SPATIAL DATA INFRASTRUCTURE

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ABSTRACT

The access, reuse and exploitation of digital environmental information have become an important concern for public and private bodies in recent years. Especially within the discussion of climate change this issue became more and more important world wide and particularly in Europe. The European Environmental Information Directive (COM 2003), the Directive for establishing an Infrastructure for Spatial Information (INSPIRE, COM 2007) as well as further initiatives of the EU like the Shared Environmental Information System (SEIS) emphasizes the need to make digital environmental information within Europe more accessible, usable and exploitable.

While INSPIRE and its Implementing Rules (IR) give the framework to establish a European spatial data infrastructure, vital obstacles in reference to harmonization and interoperability of data and services as well as in reference to the organisational structure are not removed yet. The project GS Soil "Assessment and strategic development of INSPIRE compliant Geodata-Services for European Soil Data" aims to make a contribution to remove these obstacles. Within the project 34 partners from 18 European member states are involved and the project is co-funded by the European Community programme eContentplus. The project duration is from June 2009 until May 2012.

The project GS Soil aims to contribute to improve the access to spatial soil data in terms of INSPIRE by establishing a European network for soil information. A central component of this network is the GS Soil Portal, a European web portal for soil data and metadata of the involved project partners. As basic technology for the GS Soil Portal, the software of the well established German Environmental Information Portal PortalU® will be used. Within the project the existing technology will be modified and communication interfaces will be added depending on the demands of the network.

Key words: Environmental information, Soil data, INSPIRE, European spatial data infrastructure, Spatial Data Interest Community

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1. INTRODUCTION

The project is co-funded by the European Community programme eContentplus with 4.1 M €. It is a programme from the European Commission DG Information Society and Media with the objective to make digital content in Europe more accessible, usable and exploitable. GS Soil is thereby allocated to the area of geographic information, where the focus is set on the aggregation of existing national datasets into cross border datasets, which will serve to underpin new information services and products, in particular with a view to reducing barriers related to one or more of the specific themes mentioned in annexes I-III of the INSPIRE Directive (European Union 2007). The focus of GS Soil is thereby set on soil and soil related data. In the eContentplus programme, GS SOIL is defined as a Best Practice Network for Geographic Information. The project duration is from June 2009 until May 2012.

The project consortium comprises 34 partners from 18 EU member states. Project Coordinator is the coordination center PortalU at the Lower Saxony Ministry of Environment and Climate Protection (Germany). Overall 24 partners out of the consortium are soil data providers and will make the data available for the project. Hence, a complex and high quality data basis in a European context is assured. The focus will be on data provided by national and regional institutions. Beyond that, European institutions are also involved via the advisory board.

The project GS Soil aims at establishing a European network to improve the access to spatial soil data for public sector bodies, private companies and citizens. The project considers aspects of data organization, data harmonization as well as semantic and technical interoperability in order to produce seamless geospatial information and to improve the data access for a wide community of different user groups. The structural specification for the description and harmonization of spatial soil data within Europe as well as the operation of a corresponding spatial infrastructure are main objectives of GS Soil.

The partners will establish and operate a network of services for spatial datasets and metadata. This network includes distributed services for data transformation, discovery, view and download. The final result of the project will be a central Soil Portal, where European soil data from heterogeneous sources will be bundled. In order to ensure cross-border usability of the portal and related services, aspects of multilingualism and data interpretation will be considered thoroughly. In this respect the harmonization of metadata is also a key topic within the project work.

The project will extensively support the implementation of the INSPIRE requirements on basis of available experience in selected European countries and regions on different organisational levels. Users will be able to discover, view and download soil data across Europe. The results of the project will be:

– A consolidated soil-related theme catalogue and consolidated soil-related theme content-framework standards,

- An INSPIRE compatible metadata profile for spatial soil datasets, dataset series and services,
- Generic application schemes for soil information,
- A web portal (GS Soil Portal) which provides access to all project soil data, including,
    - a view service which provides access to spatial soil data,
    - discovery and view of the INSPIRE conform metadata for the provided soil maps,
    - interoperable spatial soil datasets (for exemplary soil products),
    - case studies on cross-boarder delivery of harmonised soil data access,
    - Best practise guidelines for
        - creating and maintaining metadata for soil database,
        - and for data harmonisation.

In the following chapters the achievements out of the first year of project implementation will be summarized with a special focus on the GS SOIL portal prototype and its network.

2. GS SOIL THEME CATALOGUE AND DATA INVENTORY

The soil and soil related data available in the participating countries and at involved data providers were analyzed according to the kind, format, and intellectual property rights applied. By elaboration of best practice guidelines the provided and specific datasets will be systematically harmonized during the project running time. The improved access to soil information through the GS Soil Portal and the user requirements identification are the main objectives. This is the long-term perspective of the GS Soil Portal.

At the beginning of the project specific and generic requirements for soil information, services and products were identified by a range of user communities and stakeholders in the 18 participating countries. This requirement analysis resulted in a soil inventory and theme catalogue, which documents the current state and ability of data providers to meet the goal of data harmonization.

3. GS SOIL METADATA PROFILES

Information contained in the Implementing Rules for INSPIRE metadata is not sufficient enough to describe all spatial data theme specific aspects. Therefore, it has been planned, that each data specification should contain a metadata profile which is made with respect to those specific aspects of the spatial data theme (i.e. soils). A soil oriented metadata structure profile for soil geographic datasets, series and data services were developed following the INSPIRE IR for metadata, other international, and national standards (like the ISO 19100 series standards), and the needs of the data users.

On the other hand, there has been cooperation with the eContentplus project OneGeology-Europe to ensure that metadata structure for the soils will be tightly connected to the metadata structure for geology since these two themes are tightly connected.

The focus was also on data quality that is necessary for the soil spatial data theme. The results are directly defined in the soil metadata profiles. Additionally, recommendations were defined since this second part is not compliant to the existing ISO structure. Metadata structure developed in this project contains an example of the XML encoding soil specific resource.

4. HARMONISATION ACTIVITIES

Harmonization requires technically interoperable soil data, clear definitions of the parameters, and type and/or coding of the parameter values and possibly a minimum dataset that comprises any auxiliary information needed for meaningful or valid harmonization procedures. Based on the above described soil data and soil data types, data transfer structures have been developed that address technical interoperability by allowing the unambiguous exchange of soil data and their metadata. In a first step, soil feature types (soil-related object classes that can be described by attributes) have been identified. The second step has been to specify codification in data transfer files.
In the context of data harmonization this provides the framework to link up existing soil datasets from one country to another.

The level of spatial data consistency depends to a large proportion on provider-level harmonization efforts. Technically interoperable data with clear definitions can subsequently be semantically harmonized if harmonization procedures can be developed that transform datasets into a common parameter and codification space (both at the user and data provider level). For analytical data, this would require e. g. comparative studies between analytical methods or techniques. For soil profile descriptions, transformation would need translation of one description language into another.

Examples for such transformations will be thoroughly analyzed in order to identify, to which degree pre-harmonization is needed and how it can be implemented. Exemplary services will be developed with the objective to present homogeneous and meaningful data portrayal. The focus is on soil map legends and soil inventory data, because attribute and property data are crucial for developing evaluation and transformation services. The results will enter in a best practice guideline for soil data specification development under INSPIRE.

5. THE GS SOIL PORTAL (PROTOTYPE) AND ITS NETWORK

In the project work package 5 is responsible to set-up the GS Soil Portal and network of distributed services, using the existing technical infrastructure of the PortalU as basis.

In the GS Soil Portal all soil related information from web pages, over data bases to data catalogues will be made available and accessible. Search results will be ranked and listed in shared result lists and spatial soil data from OGC compatible Web Mapping Services (WMS) and Web Feature Services (WFS) will be visualized in a map viewer.

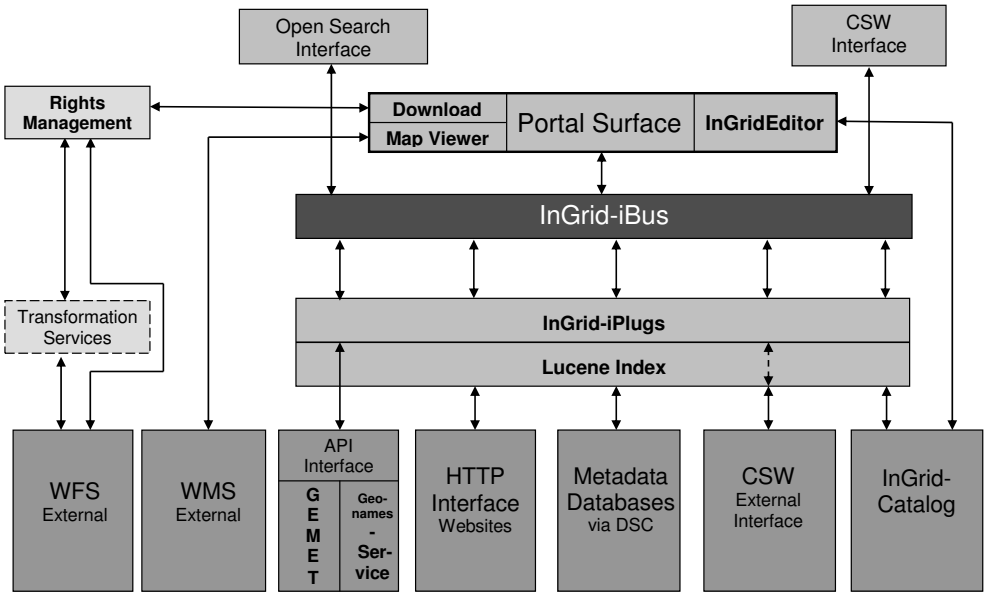

Figure 1: The architecture of the GS Soil portal (GS SOIL consortium, 2009)

The project results will enter in a best practice guideline for soil data specification development under INSPIRE. For all tasks within the project the GS Soil Portal will be used as platform for an improved access to the soil data.

GS Soil Portal has been built in an iterative cycle, adopting the relevant INSPIRE Implementing Rules (Network Services and related) and implementing the results of the other project work packages (general use cases and requirements, data specifications and application profiles / schemas, metadata). At the same time, general open tools and services will be provided for re-use by the project partners (data / service providers) and later technical integration (and testing) of services and underlying geospatial data sets. Particular focus will be placed on mutual harvesting (CS-W) with external systems.

The main activities covering the technical preparation for deployment and operational exploitation are divided into sub-tasks, which will be described in the following sub-chapters.

5.1 Definition and technical specification of the GS Soil Portal and network architecture

At the beginning of the project the design specifications of the GS Soil portal and its integrated network was defined as the technical framework for the portal and considered INSPIRE services as discovery, view, download and transformation services. In the overall process the view of the project data providers regarding their requirements and needs on the functionalities of the GS SOIL framework software via a questionnaire were collected.

After the feedback of the partners the general functional design of necessary tools and services was specified and design specifications for all SW and communication interfaces (portal and network services) were defined accordingly. Of major importance especially for the soil data providing partners was the identification of requirements on the services concerning rights management. While implementing the WMS and information these conditions need to be fulfilled also technically.

At this early stage already a set up a number of possible options for data transformation and harmonization was defined, which will be evaluated during project implementation and adopted to the necessary requirements. With special regards to the development of the GS SOIL portal the design specification also comprises information on the German Environmental Information Portal "PortalU", which builds the technical basis for the GS SOIL portal. Included are also use cases, established requirements (functional, software, hardware) and technical details.

5.2 Establishment of the GS Soil Portal

Based on the above described design specification, the GS SOIL portal prototype was established. The system is based on the software InGrid which is used to operate the German environmental portal "PortalU". The software is build on single components which communicate via internal interfaces based on TCP/IP.The task will set up multi-lingual portal user interface, catalogue systems, search functionalities and web mapping viewer. All interfaces to web services are be developed with regards to the INSPIRE Directive, the relevant implementing rules and technical guidance documents prepared and published by the European Commission. They are also based on the required ISO and OGC standards.

5.3 Provision of open tools and INSPIRE services for data providers

The objective of this task is to provide INSPIRE compliant services for data providers. A recommendation will be made for the implementation of GeoFOSS tools by the involved partner. For the collection and maintenance of metadata there are two options for the involved partners: the InGridEditor and GeoNetwork.

GS SOIL Portal will implement the following INSPIRE network services:

- Discovery service will make possible the search for spatial data sets and services on the basis of the content of the corresponding metadata and to display the content of the metadata. The discovery service interfaces are intended to allow users or application software to find information that exists in multiple distributed computing environments, including the World Wide Web (WWW) environment.

- View service will make possible, as a minimum, to display, navigate, zoom in/out, pan, or overlay viewable spatial data sets and to display legend information and any relevant content of metadata. As an additional option view service will attempt to implement a harmonized portrayal of soil data from all different providers through applying the WMS functionality Styled Layer Description (SLD).

- Download service will enable copies of spatial data sets, or parts of such sets, to be downloaded. Data sets will be pre-defined according to the view area and users will receive links to zip files that they will download.

The implementation of transformation services is discussed, which will enable spatial data sets to be transformed with a view to achieving interoperability. From an INSPIRE point of view, only the external transformation is of interest since the internal one is only visible to the data provider. Nevertheless the option of internal transformation seems much more applicable within the GS Soil project because of performance reasons on one hand and the need for very special transformation on the other hand.

It will be proved to apply a rights management system to the mentioned services. Thus, rights management extends those services by additional functionality such as access control and licensing, as required by the INSPIRE directive in Articles 13 and 14(4). The general functionalities of rights management-enabled service will provide rights management metadata, check authentication of requests, authorize requests.

5.4 Establishment of semantic service

This task considers aspects of the establishment of semantic interoperability in order to produce seamless geospatial information with improved data access for a wide community of different user groups. Semantic web service will aim to interchange of semantic data and to combine data from different sources and services without losing meaning.

Keywords and geographic names provided by thesaurus and gazetteer will play a decisive role in the search functionality of the GS SOIL Portal. The backbone of GS SOIL semantic service will be an external semantic service with an API to support thesaurus (GEMET) and gazetteer (GeoNames, GeoHash, OpenStreetMaps) items. It is connected to the software InGrid and the GS Soil Portal by an extended XML-interface.

The GS SOIL project thus follows herein the requirements of the Directive 2007/2/EC (INSPIRE) for the establishment of search criteria specified in art. 11 and in the INSPIRE Implementing Rule for Metadata-Content for the provision of key attributes and corresponding thesauri for multilingual searches.

5.5 Continuous integration of services and information

The task encompasses all activities related to the hosting, administration and integration of central services and customization of open tools.

5.6 Deployment and operational exploitation

This task covers all additional and preparatory activities for the deployment and operational use and maintenance of the GS Soil Portal:

- Preparation of guidelines and procedures for system administration and maintenance, including aspects related to quality control and metadata validation as well as rights and access control.

- Configuration interfaces, technical activities for deployment and operational use.

6. TESTING SCENARIOS AND INVOLVEMENT OF TARGET GROUPS

Another purpose is to identify the requirements of data provision for different target groups (e.g. public sector bodies, private companies and citizens) related to environmental issues/problems on different levels (metadata, application in planning procedures etc.). The general activities in the project to achieve it will be:

- to elaborate testing scenarios for target groups (within and outside the project consortium);
- to define evaluation criteria and key success factors for technical improvement of the GS SOIL Portal as well as for the practical implementation for target users.

Testing scenarios will provide user testing on practical application (for example: search for metadata using keywords, search for maps using keywords).

The results will obtain information about:

- requirements of data provision for different target user groups;
- advantages and disadvantages of the web portal;
- problems and gap analysis in comparison to the target user needs.

Based on the collected results, evaluation measures will be assessed and proposed for the improvement and quality check of the GS SOIL Portal.

In addition, a long-term operational plan assuring practical sustainability, further development of the GS SOIL Portal on European level, considering personal, technical, financial and content aspects will be developed.

7. DISSEMINATION AND ARENESS RISING

The project consortium aims to capture, integrate and transfer knowledge and experience gained during the project. Activities under this umbrella are related to the dissemination of the project achievements to a wider audience. In terms of dissemination different types of materials as leaflets, brochures, newsletters, etc. will be produced to inform actual and potential users about project progress and forthcoming events. These are target to a wider audience such as stakeholders, business people, etc. The most important tool for dissemination is the project website: www.gssoil.eu.

Activities for awareness rising are focused on potential target users of project results and members of the network, providing the basis for a tangible contribution to the processes of validation and best practice documentation. Also, clustering activities are foreseen as a tool for sharing knowledge, experiences and good practices with other related eContentplus-projects (e.g. OneGeology-Europe, Nature-SDIplus) as well as other EU-initiatives (e.g. INSPIRE, SEIS).

7.1 Multilingualism

The GS SOIL Portal, in which European soil data from heterogeneous sources will be bundled, will also ensure aspects of multilingualism. The currently implemented portal surface supports 10 EU languages (English, German, Portuguese, Dutch (fm. Belgium), Czech, Hungarian, Slovak, Bulgarian, Greek, Slovene) with an option to include any language of the project partners.

The support of the search by semantic and spatial functionalities will also be further developed to provide multilingualism.

8. CONCLUSION

Already the first year of implementing the eContentplus project GS SOIL "Assessment and strategic development of INSPIRE compliant geodata services for European soil data" by the large project consortium of 34 project partners out of 18 European member states already lead to powerful deliverables.

Major advances for the establishment of a European spatial data infrastructure for soil data by setting up the GS SOIL portal and network were made. In the following time period the consortium will further focus on the GS SOIL data specification and harmonization of test cases to provide interoperable and easy assessable data. The technical basis is already provided, but will be further adjusted to the needs of the user and target groups.

Finally, the GS SOIL consortium supports experts in the recently established INSPIRE Thematic Working Group (TWG) to develop data specification for the theme soil of the annex III of the INSPIRE Directive. The project provides and will further provide relevant reference material for discussion in the TWG.

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11. BIOGRAPHICAL NOTES OF THE AUTHORS

Mrs. Feiden is Diplom Geographer (University of Göttingen, Germany) and experienced coordinator in international project management. She gained specific experiences in the field of sustainable development, water management, spatial planning and geo-data issues in the last 8 years. She has valuable experience in building up transnational cooperation in the South East European Space and Central Europe due to her previous occupation as consultant in the framework of the EU-INTERREG-programme. As chief project manager at the Coordination Center PortalU Mrs. Feiden is in charge for the eContentplus-project GS SOIL "Assessment and strategic development of INSPIRE compliant Geodata-Services for European Soil Data" since 2009. She is responsible for the overall scientific coordination as well as the coordination of the 34 involved project partners out of 18 EU member states.

Mr. Kruse, who holds a PhD in physics (University Bremen, Germany), is head of the coordination centre PortalU in the Lower Saxony Ministry of Environment and Climate Protection. The German Environmental Information Portal (www.portalu.de) PortalU is a federal state cooperation from the German environmental administration to provide common access to public environmental information. Dr. Kruse is responsible for the overall coordination of the PortalU project partners (German federal government and 16 federal states), technical development of the portal and the presentation of the project to international partners. PortalU is mentioned as national best practice example within the EU Commission Communication towards SEIS to implement SEIS. Dr. Kruse represents the Cooperation Centre in the INSPIRE process as a technical expert for metadata.

Mrs. Valcheva has a Diploma in Informatics (Sofia University "Kliment Ohridski", B) and is experienced expert in IT technologies. As a manager of IT department in InfoLogica Company she is responsible for developing and implementing of information systems. Her previous occupation as Bulgarian PCP and NRCs for Information Systems in Bulgaria for the European

Environment Agency and Management of Bulgarian reporting to EEA via Reportnet brought a valuable experience in building Information system especially in the field of environment. Mrs. Valcheva is part of Infologica team which is partner in a project GS SOIL "Assessment and strategic development of INSPIRE compliant Geodata-Services for European Soil Data" and is in charge of building and setting up of technology solutions for INSPIRE and thesaurus services.

Mr. Georgi Georgiev is MSc of Information Science (Technical University, Sofia) and is a Managing Director of InfoLogica Company. He has more than 15 years experience in IT systems and strategy development. He has extensive experience in system engineering and good professional skill for design, realization and integrations of high technology solutions in networking and its systems. As Managing Director of InfoLogica he has gained valuable experience in project management and co-ordination for development projects of ICT Systems, design, development and maintenance of Information Systems based on technologies such as Relational Data Base Management Systems ,Data warehouse Technology, GIS systems, Expert and Knowledge Based System. In working on a number of projects for air pollution monitoring, permits issuing and reporting system, water monitoring systems Georgi Georgiev has gained valuable experience in development and implementation of Information Systems in the environment sector. Mr. Georgiev represents the Infologica company in INSPIRE project GSSOIL as a technological provider.

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For further information on the project please visit the website: http://www.gssoil.eu/.