Fig 1

THE EUROPEAN SOIL DATABASE

THE EUROPEAN SOIL DATABASE AT SCALE 1:1,000,000 IS PART OF THE EUROPEAN SOIL INFORMATION SYSTEM (EUSIS). IT IS THE RESULTING PRODUCT OF A COLLABORATIVE PROJECT INVOLVING ALL THE EUROPEAN UNION AND NEIGHBOURING COUNTRIES.

It is a simplified representation of the diversity and spatial variability of the soil coverage. The methodology used to differentiate and name the main soil types is based on the terminology of the F.A.O. legend for the Soil Map of the World at scale 1:5,000,000. This terminology has been refined and adapted to take account of the specificities of the landscapes in Europe. It is itself founded on the distinction of the main pedogenetic processes leading to soil differentiation: brunification, lessivage, podzolisation, hydromorphy, etc.

Soil database

The database contains a list of Soil Typological Units (STU). Besides the soil names they represent, these units are described by variables (attributes) specifying the nature and properties of the soils: for example the texture, the water regime, the stoniness, etc. The geographical representation was chosen at a scale corresponding to the 1:1,000,000. At this scale, it is not feasible to delineate the STUs. Therefore they are grouped into Soil Mapping Units (SMU) to form soil associations and to illustrate the functioning of pedological systems within the landscapes. Each SMU corresponds to a part of the mapped territory and as such is represented by one or more polygons in a geometrical dataset.

Data

Harmonisation of the soil data from the member countries is based on a dictionary giving the definition for each occurrence of the variables. Considering the scale, the precision of the variables is weak. Furthermore, these variables were estimated over large areas by expert judgment rather than measured on local soil samples. This expertise results from synthesis and generalisation tasks of national or regional maps published at more detailed scales, for example 1:50,000 or 1:25,000 scales. Delineation of the Soil Mapping Units is also the result of expertise and experience. Heterogeneity can be considerable in European regions. The spatial variability of soils is very important and is difficult to express at global levels of precision. Quality indices of the information (purity and confidence level) are included with the data in order to guide usage. The European Soil Database documentation is presented in the Data section of the European Soil Portal.

As a result, the European Soil Database consists of both a geometrical dataset and a semantic dataset (set of attribute files) which links attribute values to the polygons of the geometrical dataset. How map polygons, SMU's and STU's are linked together is illustrated (Fig. 2).

Soil map representation

Maps are views of a geographical database. In particular, soil thematic maps are views of a soil geographical database. Maps always convey only part of the information available in the database. When the structure of the database is made complex, decisions have to be taken on how to present these views. In particular, when SMUs are complex (i.e. soil associations), decisions have to be taken on what to present in views representing STU characteristics.

Soil typology

In the context of the European Soil Bureau Network (ESBN), the experience acquired in the co-ordination of the 1:1,000,000-scale European Soil Database has guided to the conclusion that soil information is

FIG. 1: The green landscapes of Belgium, the Netherlands and Luxembourg – collectively known as Benelux – as seen by Envisat, along with a corner of France and the south-east coast of the United Kingdom across the English Channel (La Manche). Sedimentary outflow from the River Thames is clearly seen – the same phenomena can be seen at smaller scales at the other river mouths in the image. (Image was acquired by Envisat's Medium Resolution Imaging Spectrometer (MERIS) in Full Resolution mode.Courtesy ESA)
FIG. 2: Information organisation in the soil geographical database of Europe.
FIG. 3: Grid Example of how the pixel cells (size 1km) may be represented in a higher resolution Grid (or raster) of 10km.

described in different ways from one member state to another. The basic definition of the entities "Soil Typological Units" and "Soil Mapping Units" lead to different interpretations of the basic soil information. Therefore, updating the existing version of the 1:1,000,000 Soil Database is complex (Fig.2). Soil complexity is translated into the Soil Database through the relation of the Soil Mapping Units (SMU) and Soil Typological Units (STUS). One SMU is found in 1 or more polygons and contains 1 or more Soil Typological Units (STU).

Subsequently, the Manual of Procedures for the Georeferenced Soil Database of Europe proposed that soil-landscape models and soil typological units should be rationalised within large "natural" (instead of Administrative) units having similar morphological and climatic factors that are responsible for the variation of soils.

Those theoretical approaches have been tested in various pilot areas during the implementation of the new 1:250,000 scale Georeferenced Soil Database of Europe. However, this approach requires highly qualified staff and perfect syncrhonisation of the activities between different data providers. In practice and in a real world the situation is much more different.

Multi-Scale Soil Information System (MEUSIS) - and the pixel approach

In the context of the European Soil Bureau Network activities, it is planned to update the Manual of Procedures for the 1: 250,000 scale georeferenced soil database of Europe in order to make elaboration and updates of soil related maps easier and more straightforward. The basic principles of the MEUSIS are based on existing local and national Information systems, databases and know-how. Important steps towards this approach are the coherence among the methods and the comparability of the data.

Traditionally, the European Soil Database has been distributed in vector format. More recently, interest was expressed for deriving a raster version of this database (Fig. 3). The advantages of the raster approach in the specific case of MEUSIS are listed below:

- Each Cell has an ID and its geographic location is determined by its position in the matrix cell. The only other information stored is the point of origin (bottom Left corner) of the raster;
- It is fairly easy to store data and to perform data analysis; the concept is suitable to prioritising correlation topics.
- It is easy to integrate data from different data sources or different data types. As a result the soil data can be integrated with other environmental indicators.
- The pixel approach implies that the data can be easily be updated.
- The structure is suitable to perform upscaling (bottom-up) from local to regional, national and European Level.

The main disadvantage of the raster approach is that this technique is less precise in representing the Real World which means that it is not suitable for representing soil coverage complexity and that it is not easy to persuade the general public about the use of this technique.

In the following example, (Fig. 3), there is a Grid Example of how the pixel cells (size 1km) may be represented in a higher resolution Grid (or raster) of 10km.

New approach

Also, in this new approach the STU concept is basic and the future raster-based European Soil Database would include this important information. The SMU column may be removed, as the basic relationship

Pixel_Id	SMU	% Pixel Area	STU	% SMU
4526_2618	1	68	ZBM1	32
4526_2618	1	68	SDP1	23
4526_2618	1	68	ORN	45
4526_2618	2	32	CIA1	70
4526_2618	2	32	LCE	30

Example of the future raster based Soil database (PIXEL – STU Table)

would be the percentage of STU in the Pixel ID. The basic concept in the new approach is the 30

In the above-mentioned example the 1st STU would obtain 32% of the 68% (in total 22%) of the whole pixel 4526_2618. The whole MEUSIS concept is presented in the European Soil Portal.

Panos Panagos *works at the Joint Research Centre of the European Commission, Institute for Environment and Sustainability, Ispra (VA) – Italy. Email: panos.panagos@jrc.it SOil Map Server (SOMIS): http://eusoils.jrc.it*

European Soil Portal - Data: http://eusoils.jrc.it/data.html
European Soil Portal - MEUSIS: http://eusoils.jrc.it/projects/Meusis/main.html

Fig 2

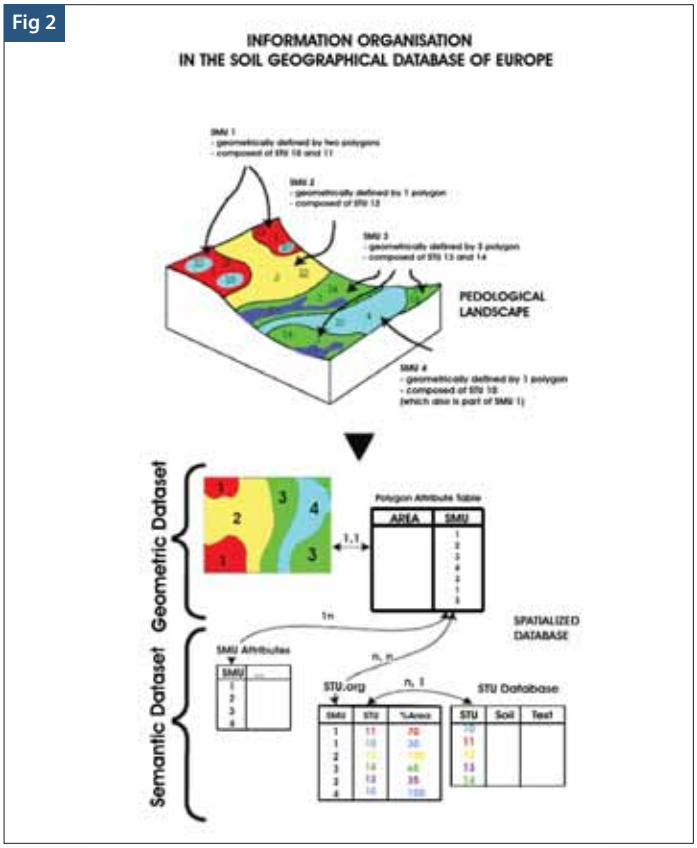

Fig 3