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DATA TRANSFER BETWEEN DISPARATE SOIL DATABASES

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TIONAL SOIL REFERENCE AND INFORMATION CENTRE

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Working paper, prepared for the workshop "Soil Data for Global Change Research"
IGBP/DIS Global Soils Data, Montpellier, 29 September - 1 October 1994

P. Tempel
September 1994

ISRIC
PO Box 353
6700 AJ Wageningen
The Netherlands

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FORMULATION OF THE PROBLEM

Over the past 60 - 70 years, a vast amount of soil data has been collected at places all over the world, by soil surveyors using a variety of methods. Subsequently these (for the greater part local) soil data have been published in soil monographs, but the last two decades also increasingly in computerized record-keeping systems or databases.
The result of all these soil data collecting efforts has been the development of many mutually isolated ***soil data islands***.

In general, values from different data islands, or data sources, for a specific attribute are usually not considered throughout comparable to one another, due to what can be called inter data island heterogeneity, or external heterogeneity. Causes of this heterogeneity are several: differences in emphasis on alternative properties, the definition of layers, horizons and attributes, field methods used, analytical methods used etc.
However, since soil properties are contributory to many aspects of ***Global Change***, like changes in climate, atmospheric chemistry, hydrology, terrestrial ecosystems and land use, comprehensive soils information at a global scale is needed by scientists in a wide variety of disciplines studying these changes.
Thus, information will be required from as many soil data sources as possible, since these data sources are predominantly of a regional nature (e.g. the many national soil databases). In addition, the data in the resulting soils information pool must be accurate, reliable, retrievable, and above all consistent.

Generally, it would be of tremendous value if we could lump together selected attribute data from disparate soil datasets by means of common data transfer functions.

SOIL DATA EXCHANGE REQUIREMENTS AND PREDICAMENTS

One all important prerequisite for any data exchange scheme, and thus also for the successful exchange of soil data, has not been met. To recognize and resolve conflicts in the different definitions and user applications of the data, a central ***soil data repository*** should be defined first. This will force all data collectors and users to look at the whole of available data in order to come to an agreement on definitions and relationships. Only then, consistent results in any evaluation and analysis using data from various data sources can be guaranteed. Also, only then the transfer of data between databases will be unambiguous and accompanied by a minimum loss of information.

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[1] International Soil Reference and Information Centre (ISRIC), P.O.Box 353, 6700 AJ Wageningen, The Netherlands.

The terminology in use in soil science often lacks consistency in definition and symbolic notation. Nearly every organisation involved in the collection and dissemination of soil data devised its own "vocabulary", standards and procedures to describe soils, herewith effectively limiting the application scope of the data to the organisation itself.

A universally accepted attribute or data-element directory must be set up, as well as a code set directory specifying all allowable values for the data-elements and their formats. The UN EDIFACT[2] standard may well serve here as a model. This standard not only defines the objects to be described and the attributes describing them, but also ***standard messages*** (e.g. an invoice), to be interpreted as "data parcels" with a required structure. These data parcels are supplied with a header that contains meta-data (data on the data) conveying information on origin of the data, their accuracy, a time stamp, responsible organisation etc. This standard could well be expanded to include the electronic interchange of scientific data, if necessary split up per discipline.

The problems one may encounter when transferring data-elements from one data-island (a source database) to another data-island (a target database), have been assessed at ISRIC where the data exchange mechanism for four pedon databases has been examined more closely; ISIS, FAO-ISRIC SDB, SOTER and WISE.
All four databases are dBASE compatible, thus facilitating the development of a common data transfer facility - a customary dBASE application.
When moving information in the form of a data-element value from the source database to an anticipated target database, this information may be

- completely lost - i.e. information loss is 100%
- succesfully transferred - no information is lost in the data transfer
- partially lost - information loss is somewhere between 0 and 100%

An example of the first situation is a source database attribute that is not supported by the target database. This also applies to data-elements in both source and target database that are vaguely similar, but conceptually not similar enough to justify a data value transfer. For example, are the SOTER attribute "map_ID" and the SDB attribute "Sheet number" interchangeable? This kind of problem is mainly caused by deficient attribute definitions.

A data transfer without information loss will occur if, for example both source and target database use identical classifications for a certain attribute. In general attributes that can be exchanged freely without loss of information are clearly understood; there is no ambiguity in their meaning.
A loss of precision when transferring numeric values from a source to a target database is not considered a loss of information since the information content for this data element is maximized in the target database. The same applies to the conversion of a distinct data-element value from the source database to a class value in the target database.

A partial loss of information may occur in one of the following three situations

1) converting an attribute class code from the source database to an attribute class code in the target database, and the two classification systems used do not coincide, i.e. some or all class limits do not coincide and classes may overlap. The ISRIC data transfer facility uses a fairly simple decision rule for the conversion of class codes, namely maximum class overlap / likelihood;
2) converting an attribute class code from the source database to a distinct attribute value in the target database. The decision rule applied here is to use the class midpointvalue. However, range information will belost in this case.
   Open classes pose a problem, because they do not have a midpoint value: providing an expert estimate, or no exchange of data for this attribute are the only possible options;

[2] EDIFACT: Electronic Data Interchange For Administration, Commerce and Transport.

3) the definitions, or concepts of one or more values for an attribute in source and target database diverge. A typical example is site attribute "Landform".

A problem of a more practical nature encountered in the evaluation of in-between databases data transfer was the inadequate amount of space reserved for an attribute string value in the target database. In most cases the original source string will simply be truncated, thus causing a partial loss of information. Another anomaly can occur with dates; dates may be differently specified in source and target database: as day+month+year, month+year, or only year, as a date, a string, or as a numerical value.

Finally the aggregation and/or deaggregation of multi-attribute field values will require special provisions in a data transfer facility. For example, latitude can be stored in two different ways: hemisphere, degrees, minutes and seconds are stored in four separate data fields: N/S, DD, MM and SS; or as a single value in one data field: N/SDDMMSS.

EXCHANGE PROCEDURE

At a meeting held in Silsoe in 1992, the IGBP-DIS Soils Database working group took the first steps toward defining the specific requirements and characteristics of a soils dataset for global change research. There was a consensus to start developing a well-organized, high quality global data set of existing soil profiles. These pedons would be retrieved initially from five key international databases which have been, or are being developed at the moment: FAO, USDA-SCS, ISRIC, EC, and ORSTOM / CIRAD. At a later stage profiles from national databases could be added.
Subsequently, some method should be devised to bring together all these individual soil pedons from different data sources into one comprehensive and coherent dataset. This can be achieved either directly or indirectly.

Profile description language

The IGBP-DIS working group initially proposed to develop an intermediate meta-language system, appropriately referred to as a profile description language (***PDL***), with an associated lexicon. The use of a PDL would avoid limiting the database to particular software or hardware, and allow for easy E-mail data transfer in which participants exchange "data parcels" or data messages worded in PDL. This PDL is an approach not wholly uncommon in electronic data interchange and as such is this PDL a promising data exchange tool. However, far more attention should be paid first to the development of the lexicon as it is the overture to a real soils data-element repository. Full use should be made of the experiences gained in other fields with data exchange/interchange (in practice, experiences gained with EDI).

LandSlide

In February 1993, ISRIC initiated the development of an automated data transfer facility. This data transfer facility has been assigned the preliminary name "LandSlide". In September 1993 a first beta version (0.1) of LandSlide was available for in-house testing.
LandSlide is based on a direct transfer of data from a dBASE source database to a dBASE target database. The dBASE system ***de facto*** defines an internal file format, the transfer facility ensures the proper conversion of each source data value to its associated target data value. Prime advantage of this approach is that only one conversion is needed: from source data value directly to target data value. In case of an intermediate exchange data file or database, two conversions are needed: from source to intermediate to target. As was seen before, every conversion may entail a loss of information. Disadvantages are that only dBASE files can be processed, and that every transfer (from a source database to a target database) requires its own map file. If the structure of a database is modified, all map files in wich this database acts as a source or target, must be adapted.
Also, it eludes the necessity to come to a universallly accepted standard (but this could be interpreted both as an advantage and as a disadvantage).

LandSlide is a dBase IV application for the transfer of pedon data between two or more dBase pedon databases. At this moment LandSlide enables a fully automatic transfer of pedon data between

- FAO-ISRIC Soil Database, version 2.0 (SDB2)
- Global and National Soils and Terrain Digital Databases (SOTER)
- ISRIC Soil Information System (ISIS) Version 4.0
- WISE database Version 1.0

In a later stage of the development of LandSlide, other (dBase-based) databases will be added. Alternatively, non-dBASE files can be off-loaded first to dBASE format, after which appropriate map files can be developed, as was done with the transfer of USDA-SCS data to WISE.

LandSlide only requires the database (.DBF) and index (.NDX/MDX) files of the ***source*** databases. The ***target database files*** are located in subdirectories (one for each supported target database) of the LandSlide system directory. The target database files are identical to those in the original pedon databases, with the exception of FAO/ISRIC SDB2. In every SDB2 database file with a SAMPLENO field, field width has been changed from 1 to 6. None of the target database files is indexed.

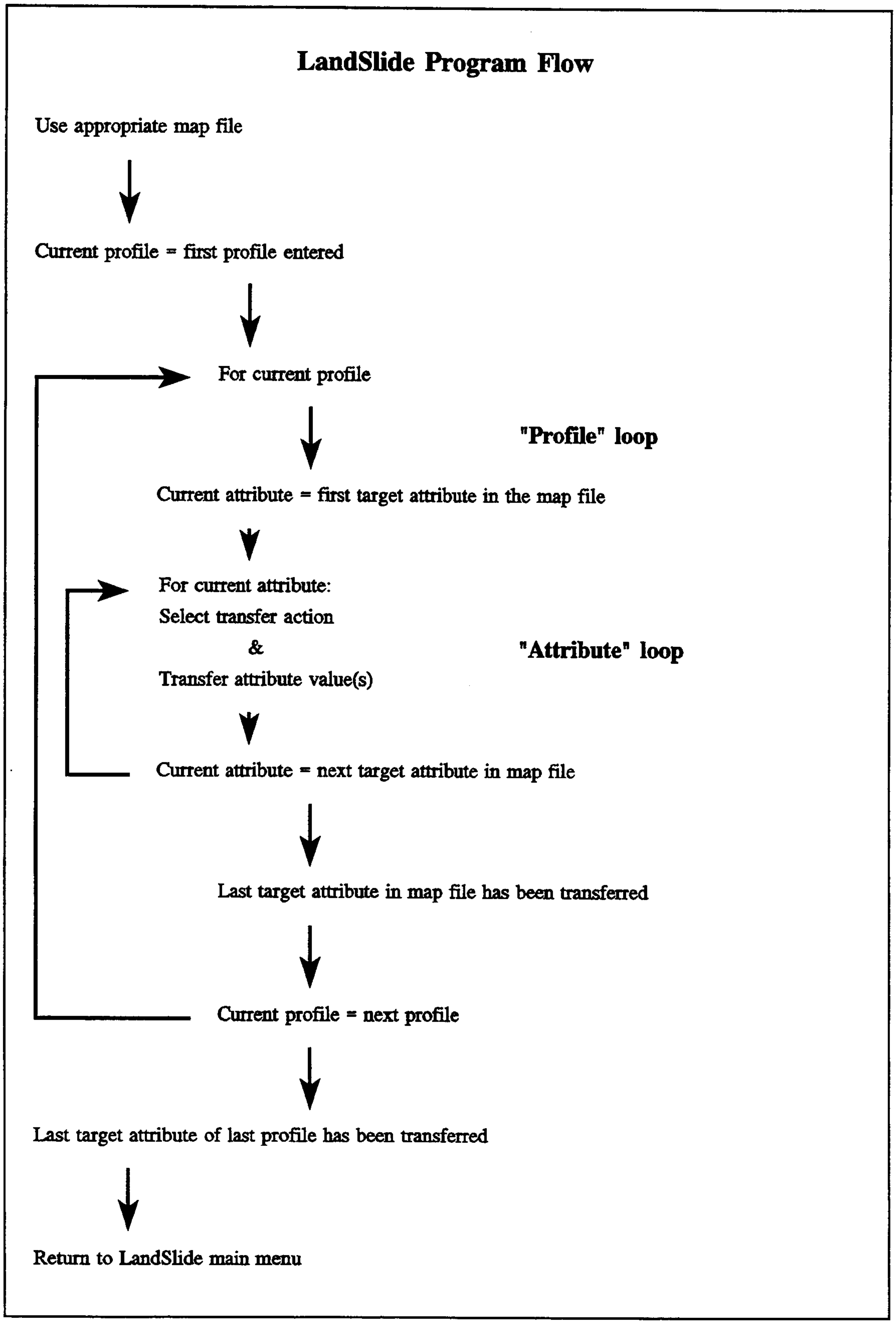
A ***data transfer session*** starts with the selection of the source database and the target database. A source database can never be used as the target database at the same time. After confirmation, or alteration, of the source data path, LandSlide will ask for the identification codes, or tags, of the profiles to be transferred. Next, the program will start with the actual transfer of data from source to target, on a ***profile by profile*** basis.
In short, LandSlide cycles through the next steps when transferring disparate pedon attributes from source to target. LandSlide will:

(1) Read the information required for the attribute data transfer from the map file;
(2) Go to the source data directory and open the appropriate database file (if not already open);
(3) Retrieve the attribute value(s) (from the appropriate data field) for the current profile. The profile identification code acts as the key value to locate the proper records in the source database file;
(4) If necessary calculate or convert the source data value(s) to (a) new target data value(s), using the directions stored in the map file.
(5) Go to the target data directory and open the appropriate database file (if not already open);
(6) Store the data value in the appropriate data field of the target file;
(7) return to the map file for the next pedon attribute.

These steps are repeated for every target database attribute ("attribute" loop) and for every user-specified profile identification code ("profile" loop) as is shown in the flow chart on the next page.

The map file

In Landslide nearly every aspect of attribute data transfer for a particular source/target database combination is governed by a ***map file***. A particular transfer can be customized by editing the appropriate map file. New map files, imperative when new source or target databases are added to LandSlide, can be created freely.
Basically, a map file contains directions that determine **from where** and **in what way** a specific attribute must be transferred **to where.** There is a specific map file for every source/target database combination (e.g. four times three makes 12 map files for 4 different databases).
Map files are mere dBase database (.dbf) files consisting of 8 data fields. The map files currently available contain from 250 up to 1500 records. The data fields in a map file are (table 1):


LandSlide Program Flow
Use appropriate map file
Current profile = first profile entered
For current profile
"Profile" loop
Current attribute = first target attribute in the map file
For current attribute:
Select transfer action
&
Transfer attribute value(s)
"Attribute" loop
Current attribute = next target attribute in map file
Last target attribute in map file has been transferred
Current profile = next profile
Last target attribute of last profile has been transferred
Return to LandSlide main menu

Field name	Type	Width	Common use
S_FILE	Character	8	Name of source database file
S_INDEX	Character	8	Name of source database file index
S_FIELD	Character	10	Name of the source data field
S_VALUE	Character	12	Value of the source data field
T_FILE	Character	8	Name of the target database file
T_FIELD	Character	10	Name of the target data field
T_VALUE	Character	25	Value of the target data field
C_STATUS	Character	80	Remark with regard to the transfer

Table 1.
The data fields of a map file

From where

Map file fields S_FILE and S_FIELD specify the names of the source database file and source attribute. A special dBase procedure opens the source database file, if not open already, using the index or tag specified in field S_INDEX. Following, all source attribute values for one particular profile are read and stored in a memory array appropriately named the "barrow"

To where

Likewise, map file fields T_FILE and T_FIELD specify the names of the target database file and target attribute. Again, a special dBase procedure opens the target database file, if not open already. However, no index or tag is specified this time. All target database files are located in one directory.

In what way

In what way relevant attribute data are transferred from the source database to the target database is primarily governed by keywords in map file field S_FIELD. These keywords or "cases" address specific sets of commands ("procedures") that take care of the actual transfer and possible processing of the attribute data. Nothing but the nature of source and target attribute determine the line of action, (i.e. procedure) to be undertaken, and thus the action keyword associated with it:

Keyword	Action
NULL	NULL denotes a target field with no counterpart in the source database. In the map file a default null value for the target field may be entered in field T_VALUE. If no default null value is specified, a NULL record may be omitted from the map file.
FIXED	FIXED denotes a target field with a fixed value, to be specified in field T_VALUE of the map file. FIXED is equivalent to NULL with a default null value for the target field.
COMPOSE	COMPOSE denotes a multi-attribute target field with multiple single-attribute counterparts in the source database. That is, the value for the target field is composed of two or more single-attribute source fields. Possibly the single-attribute values have to be recoded first (by means of a lookup table in the map file, or a special procedure).
COMPOSITE	COMPOSITE denotes a single-attribute target field with a multi-attribute ("composite") counterpart in the source database. The values for the target fields have to be extracted from their corresonding multi-attribute source field values, and possibly recoded (by means of a lookup table in the map file, or a special procedure).
FUNCTION	FUNCTION denotes a target field whose associated source field values need specific processing before they can be stored in the corresponding field of the target database file. The name of the procedure working on the source field values is stored in field S_VALUE of the map file. When FUNCTION is encountered in the map file, i.e S_FIELD has value "FUNCTION", the program runs the procedure in field S_VALUE of the map file.
MAP	Attribute data exchange from source to target is possible right away for the attribute in T_FILE. The exchange can be either - DIRECT: direct exchange of an attribute value from source field to target field; - KEY: recoding of source field values to target field values by means of a lookup table in the map file, or a special procedure.
CLASSIFY	CLASSIFY denotes a source field whose values need to be classified before they can be stored in the corresponding field of the target database file.
OTHERWISE	No specific action undertaken by the program. Thus if a keyword other than the ones specified above is encountered in the map file, the program simply ignores it and skips to the next map file entry.

Table 2.
Map file keyword and associated action

The procedure specified by the action keyword may use additional information that is stored in the map file: the name of a special procedure, a field width, the name of a primary key field, a lookup table, etc.

Map file customization by the user

Once a user is familiar with the layout of a map file, he can alter map file entries as deemed necessary. For example, arbitrary code conversions in a map file lookup table may be changed to the user's liking. He may also add the name of a self-written dBASE procedure in a FUNCTION action, or delete the transfer for an attribute alltogether (by specifying a NULL action, or removing the attribute from the map file).

The log file

During a data transfer session arbitrary conversions will be recorded in the log file. The log file is also a plain dBase database (.dbf) file, called LOG.DBF.
The structure of this file is:

Field name	Common use
PROFID	Profile_ID
T_FILE	Name of the target file
RECNUM	Relative record number for profile PROFID
T_FIELD	Name of the target field
T_VALUE	Target value
REMARK	Nature of arbitrary conversion

Table 3.
The data fields of the log file

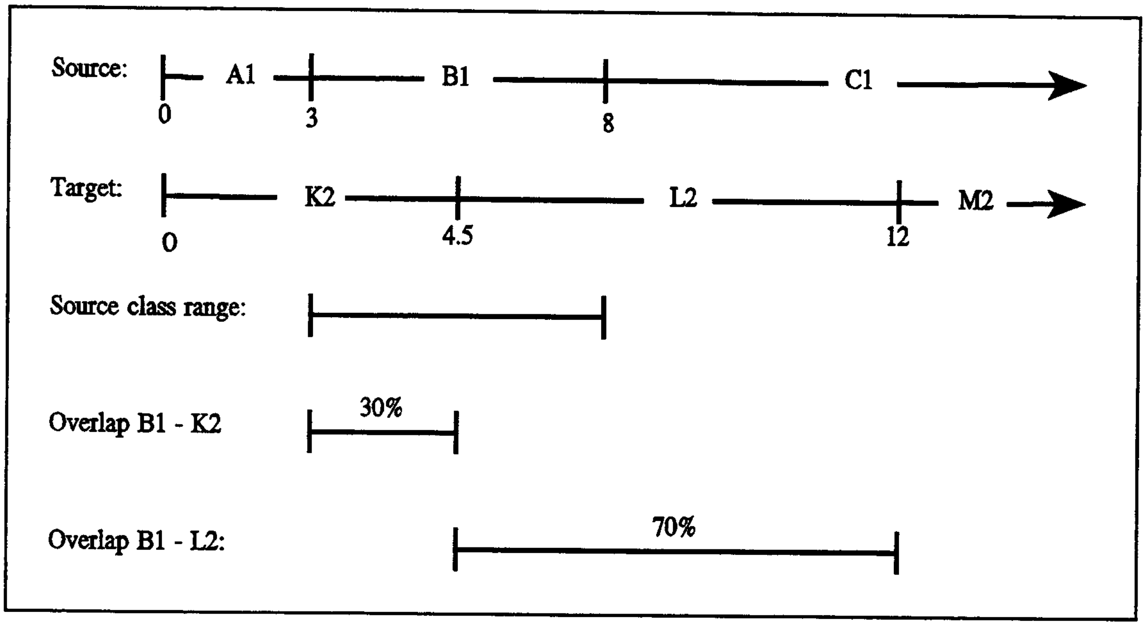
An attribute value in the target database can be modified afterwards to the user's liking, using log file entries to locate the undesired source-to-target data conversion in the appropriate target database file and target field. Following is an example log file entry that resulted from the transfer of profile "bra10" from ISIS (source) to FAO-ISRIC SDB2 (target):

PROFID	T_FILE	RECNUM	T_FIELD	T_VALUE	REMARK
bra10	SDBHORIZ	5	MOT1	C	Mottles abundance class overlap 56%

Table 4.
An example record from the log file

The remark field indicates that the mottles abundance class limits in the target database do not coincide with those in the source database: class overlap is merely 56%, meaning that on average 56% of the transferred mottles abundance class codes in the target database will be in the proper class, i.e. on average 56% of all source database cases from this particular class interval will be transferred to the correct class interval in the target database.

Class overlap is the maximum overlap of a source database class with all corresponding target database classes. An example:
Source class B1 limits range from 3 to 8. Corresponding target class limits however, range from 0 to 4.5 and from 4.5 to 12, (see figure)



Obviously, source database class value B1 is most likely to fall in target database class L2, assuming that actual values - i.e. not classified - in both source and target database are uniformly distributed over class interfalls. In case of a class overlap of 50%, class value conversion should be based, if possible, on the name of the classes whenever possible: e.g. Very Fine should be transferred to Very Fine, not to Fine. Otherwise class value conversions will be arbitrary.

In all, 5 different types of remarks (1-5) can be entered in the log file:

1 *Source database attribute has no equivalent in target database*
2 *Class overlap xxx %, source class is xxx*
3 *Source database attribute is xxx*
4 *Any other information concerning the transfer*
5 *Source profile code has been modified into shorter target profile code, source code is xxx*

Type 3 remarks refer to data transfers accompanied with a substantial loss of detail. For example, the conversion of value "dolerite" for attribute "Parent material type" to value "volcanic rock", though correct, entails a substantial loss of detail. For that reason the original source attribute code is written to the log file. Type 4 remarks refer to all other arbitrary conversions not covered by one of the other remark types.
Keep in mind that any remark with regard to a particular conversion has to be entered in the map file first in order to appear in the log file when this particular conversion takes place.
The number of entries in the log file may easily exceed 1000 or more, depending on the source-target daytabase combination. Transfering information from ISIS to SDB produces the most log file entries, on average some 25 per profile.

Our example log file entry refers to a class value "C" for mottle abundance in profile "bra10". With this information the 5th record in target database file SDBHORIZ with profile id "bra10" can be located. Subsequently field MOT1 may be edited (see next page).

LOG

PROFID	T_FILE	RECNUM	T_FIELD	T_VALUE	REMARK
bra10	SDBHORIZ	5	MOT1	C	Mottles abun...

SDBHORIZ

PRNO	HRNO	...	MOT1	MOT2	...
...	...	...	...	...	...
eak07	...	...	N	...	...
bra10	...	...		...	...
bra10	...	...	F	...	...
bra10	...	...	F	...	...
bra10	...	...	C	...	...
bra10	...	...	C	...	...
bra10	...	...	N	...	...
...	...	...	...	...	...

Figure 2.
Relation between relative record number (RECNUM) and
target database entry

CONCLUSION

The findings in this paper with regard to data exchange may not seem very spectacular, and rather obvious. That is certainly correct. Likely, the real problem will not be in the formulation of some common standard for the exchange of soil data.

A large number of institutions and organisations has been involved in the collection of soil data now for many years, and in the course of time have developed their own means of describing soils, their own "Profile Description Language". Usually this language has firmly taken root in the organisation. The real challenge will be in convincing data collectors and distributors to accept some universally agreed standard, and strictly adhere to it.

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APPENDIX A

Equivalent attributes matrix for:

- FAO-ISRIC Soil Database, version 2.0 (SDB2)
- Global and National Soils and Terrain Digital Databases (SOTER)
- ISRIC Soil Information System (ISIS) Version 4.0
- WISE database Version 1.0

ISIS	SDB	SOTER	WISE
ISRIC profile code	Profile code	Profile_ID	Profile reference number
country			Country of origin
Description date (month.year)	Date	Sampling date	Date of first description
	Sheet number		
		Map_ID	
		Map_title	
		Publication year of map	
		Map scale	
		Minimum latitude mapped	
		Maximum latitude mapped	
		Minimum longitude mapped	
		Maximum longitude mapped	
		Type of map	
	Grid number		
			Number of horizons in pit
		Number of reference profiles	
		(SOTER) Map unit_ID	
		Terrain component number	
		Terrain component data_ID	
		Soil component number	
		Soil component relationships	
		Permanent water surface (%)	
		Proportion od SOTER unit (%)	
		Profile database owner	
			Reference to data source
		Reference to soil laboratory	Reference to soil laboratory
		Anal. mehod introduction date	
		Reference to attrib. analyzed	
		Reference to analysis method	
Author(s)	author		author
Site location description	Location, descriptive		Location of profile
Latitude (DMS)	Latitude (DMS)	Latitude (decimal degrees)	Latitude (DMS)
Longitude (DMS)	Longitude (DMS)	Longitude (decimal degrees)	Longitude (DMS)
Altitude	Elevation	Elevation	Elevation
FAO soil unit_74	FAO soil unit_74	FAO classification + version	FAO classification_74
FAO soil unit_88	FAO soil unit_88	FAO classification + version	FAO classification_90
	FAO soil unit_88, 3rd level	FAO classification + version	FAO classification_90
Final classification			
			Profile description status
	Status		
FAO soil phase_74	FAO phase	Phase	(Main) phase, '74 or '90
FAO soil phase_88	FAO phase	Phase	(Main) phase, '74 or '90
USDA great group_75	Soil Taxonomy great group	Soil Taxonomy	Soil Taxonomy
USDA great group_85	Soil Taxonomy great group	Soil Taxonomy	Soil Taxonomy
USDA subgroup_75	Soil Taxonomy subgroup	Soil Taxonomy	Soil Taxonomy
USDA subgroup_88	Soil Taxonomy subgroup	Soil Taxonomy	Soil Taxonomy

ISIS	SDB	SOTER	WISE
USDA texture class_75 USDA texture class_85 USDA mineralogy_75 USDA mineralogy_85	Soil Taxonomy texture Soil Taxonomy texture Soil Taxonomy mineralogy Soil Taxonomy mineralogy Soil Taxonomy reaction class		
ST soil temperature regime_75 ST soil temperature regime_85 ST soil moisture regime_75 ST soil moisture regime_85	Soil climate ST temperature regime ST temperature regime ST moisture regime ST moisture regime		
Diagnostic horizons Diagnostic properties Local classification	Soil unit Local soil series Survey area	Diagnostic horizon Diagnostic property National classification	Local classification
Koppen climate classification Parent material Accumulation/deposition mode Texture of parent material	Parent material + rock type	General/surface lithology Texture non-cons. parent mat.	Koppen climate class code Parent material Top soil textural class
Depth of lithological boundary Degree/status of weathering Resistance to weathering Additional remarks parent mat.		Depth to bedrock	Remarks on parent material
Regional landform	Landform	Major landform Minimum elevation Maximum elevation Slope gradient Relief intensity	Landform
		Hypsometry Dissection Local surface form Average height Covereage - meso relief	
Topography of site surrounding Physiographic unit Slope gradient of site Physiographic position of site	Topography Land element Slope gradient class Position of site	Regional slope Dominant slope Length of slope Position in terrain	Slope at profile site Position
Form of the slope Aspect (exposure) of the site Kind of micro-relief Micro-relief pattern Micro-relief height variation	Slope form Micro topography	Form of slope	Site aspect

ISIS	SDB	SOTER	WISE
		Surface organic matter	
Rock outcrops	Rock outcrops	Surface rockiness	
	Rock outcrops height		
Surface stoniness	Surface stones abundance	Surface stoniness	
Average size of stones	Surface stones size		
Shape of stones			
Surface cracking			
Slaking of aggregates	Surface sealing/crusting	Sensitivity to capping	
Evidence of salt			
Evidence of alkali			
Soil depth	Effective soil depth	Rootable depth	Average soil depth
Depth of groundwater table	Actual water table depth	Depth to groundwater table	
Upper limit groundwater table	Minimum water table depth		Av. lowest groundwater depth
Lower limit groundwater table	Maximum water table depth		Av. highest groundwater depth
Kind of water table	Water table kind		
Upper limit of stagn. layer			
Lower limit of stagn. layer			
(Minimal) permeability	Permeability		
Estimated runoff			
	External drainage	Surface drainage	
Flooding frequency	Flooding frequency	Frequency of flooding	
	Flooding duration	Duration of flooding	
		Start of flooding	
Nature of the flood water			
Drainage class	Drainage class	Drainage	Drainage condition
Moisture condition in profile	Moisture conditions		
Erosion type	Erosion/deposition type	Erosion/deposition type	
Degree/intensity of erosion	Erosion/deposition intensity	Degree of erosion	
		Area affected by erosion	
Aggradation			
Present stability of slope			
Land use: type	Land use type	land use	land use
		Date of observation	
		Propoprtion of SOTER unit	
Land use: Major crops	Crop		Crops
Land use: Irrigation		Land use	Land use
Land use: Rotation scheme		Land use	Land use
Land use: Improvements	Human influence		
Major vegetation type	Vegetation type	Vegetation	Vegetation
		Date of observation	
Present status of vegetation		Proportion of SOTER unit	
	Grass cover		
	Species		

ISIS	SDB	SOTER	WISE
Remarks on veg. and land use			Remarks on veg. and land use
Add. site / profile remarks	Remarks		
Horizon serial number	Horizon number	Horizon number	Horizon number
Horizon designation	Horizon designation	Horizon designation	(local) horizon designation
Upper limit of horizon	Depth, upper boundary		Upper depth of horizon
Lower limit of horizon	Depth, lower boundary	Lower depth of horizon	Lower depth of horizon
Width of horizon boundary	Boundary width	Distinctness of transition	
Topography of horizon boundary	Boundary topography	Distinctness of transition	
Munsell dry soil matrix colour	1st/2nd colour	Dry colour	Dry matrix munsel code
Munsell moist soil matrix colo	1st/2nd colour	Moist colour	Moist matrix munsel code
Soil structure type or form	Structure type	Type of structure	Soil structure
Soil structure size	Structure size	Size of structure elements	
Soil structure grade	Structure grade	Grade of structure	
Relationship structure forms	Relation 1st/2nd structure		
Estimated field texture < 2mm	1st/2nd texture	particle size class	
Estimated field texture >= 2mm	1st/2nd texture	particle size class	
	percent. clay, field estimate		
Organic matter: kind			
Organic matter: decomp. rate			
Consistence when dry	Consistenc dry		
Consistence when moist	Consistenc moist		
Consistence wet: stickiness	Stickiness		
Consistence wet: plasticity	Plasticity		
Consistence other (after USDA)			
Pores: quantity	Pores abundance		
Pores: size	Pores size		
Pores: continuity			
Pores: distribution			
Pores: form			
Pores: orientation			
	1st/2nd voids type		
Total porosity (CANSIS, 1982)	Porosity		
Roots: quantity (CANSIS, 1982)	Roots abundance		Roots abundance
Roots: size	Roots size		Roots size
Roots: location			
Effervescence agent			
Free CaCO3 content	Carbonates		Calcium carbonate content
Effervescence location			
Field determined pH	Field pH		
Mottles: abundance	Mottles abundance		
Mottles: size	Mottles size		
Mottles: contrast	Mottles contrast		
Mottles: boundary	Mottles boundary		
Mottles: Munsell colour	Mottles colour		
Cutans features: quantity	Cutans quantity		

ISIS	SDB	SOTER	WISE
Cutans features: Thickness	Cutans contrast		
Cutans features: Kind	Cutans nature		
Cutans features: Location	Cutans location		
Inclusions: Quantity	Nodule abundance		
Inclusions: Type	Nodule kind		
Inclusions: Size	Nodule size		
Inclusions: Hardness	Nodule hardness		
Inclusions: Shape	Nodule shape		
Inclusions: Composition	Nodule nature		
	Nodule colour		
Mineral fragments: Quantity	Rock fragments abundance	Abundance of coarse fragments	Gravel content (v/v%)
Mineral fragments: Size	Rock fragments size	Size of coarse fragments	
Mineral fragments: Weathering	Rock fragments weathering		
Mineral fragments: Composition	Rock fragments nature		
	Rock fragments shape		
Pans: Kind	Cement./compaction nature		
Pans: Cementation	Cement./compaction grade		
Pans: Continuity	Cement./compaction continuity		
Pans: Structure	Cement./compaction structure		
Biological activity: Abundance	Biological features quantity		
Biological activity: Kind	1st/2nd biol. features kind		
	Horizon remarks		
(Nearest) climate station code			
Distance between site and clim			
Climate staion direction from			
Relevance of climatic data to			
ISRIC profile code			
Sample number			
Depth to the top of the sample			
Depth to the bottom of the sam			
Coarse fraction > 2mm: 2-lette			
Proportion of very coarse sand	Very coarse sand	Very coarse sand	
Proportion of coarse sand	Coarse sand	Coarse sand	
Proportion of medium sand	Medium sand	Medium sand	
Proportion of fine sand	Fine sand	Fine sand	
Proportion of very fine sand	Very fine sand	Very fine sand	
Total sand fraction	Total sand	Total sand	Sand content
Proportion of coarse silt	Coarse silt		
Proportion of fine silt	Fine silt		
Total silt fraction	Total silt	Silt	Silt content
Total clay fraction < 2um	Clay	Clay	Clay
Dispersable clay	(Basic) infiltration rate	Infiltration rate	
Bulk density	Bulk density	Bulk density	Bulk density
Soil moist. content at pF 0.0			Soil moist. content at pF 0

ISIS	SDB	SOTER	WISE
Soil moist. content at pF 1.0			Soil moist. content at pF 1
Soil moist. content at pF 1.5	Water retention at 0.03 bar		Soil moist. content at pF 1.5
	Water retention at 0.05 bar		Soil moist. content at pF 1.7
Soil moist. content at pF 2.0	Water retention at 0.10 bar		Soil moist. content at pF 2.0
Soil moist. content at pF 2.3			Soil moist. content at pF 2.3
	Water retention at 0.30 bar	Soil moist. content at 33 KPa	Soil moist. content at pF 2.5
Soil moist. content at pF 2.7		Soil moist. content at ? KPa	Soil moist. content at pF 2.7
	Water retention at 1.00 bar	Soil moist. content at ? KPa	
Soil moist. content at pF 3.4		Soil moist. content at ? KPa	Soil moist. content at pF 3.4
	Water retention at 3.00 bar	Soil moist. content at ? KPa	
Soil moist. content at pF 4.2	Water retention at 5.00 bar	Soil moist. content at ? KPa	Soil moist. content at pF 3.7
	Water retention at 15.00 bar	Soil mois. content at 1500 KPa	Soil moist. content at pF 4.2
			Available water capacity
		Infiltration rate	
		Hydraulic conductivity	Sat. hydraulic conductivity
			Unsat. hydraulic conductivity
Specific surface			
pH (H2O)	pH water	pH H2O	pH measured in water
pH (KCl)		pH KCl	pH measured in KCl solution
	pH CaCL2		pH measured in CaCL2 solution
	Phosphorus	P2O5	Total phosphorus
	Total CaCO3	Total carbonate equivalent	
Free CaCO3	Effective CaCO3		
	Total CaSO4	Gypsum	Gypsum content
Organic carbon	Organic carbon	Total carbon	Organic carbon
Organic nitrogen	Nitrogen	Total nitrogen	Total nitrogen
Exchangeable Ca++	Exchangeable calcium	Exchangeable Ca	Exchangeable calcium
Exchangeable Mg++	Exchangeable magnesium	Exchangeable Mg	Exchangeable magnesium
Exchangeable Na+	Exchangeable sodium	Exchangeable Na	Exchangeable sodium
Exchangeable K+	Exchangeable potassium	Exchangeable K	Exchangeable potassium
Sum of exchangeable cations			
Exchangeable acidity		Exchangeable acidity	Exchangeable acidity
Exchangeable Al++		Exchangeable Al	Exchangeable aluminium
CEC Soil	CEC soil	CEC soil	Cation Exchange Capacity
CEC Clay	CEC clay		
CEC Organic matter			
Effective CEC			Effective CEC
Base saturation	Percentage base saturation		Base saturation
Aluminium saturation			
	Fixed potassium		
		Phosphate retention	
Electrical Conductivity	Electro conductivity	Electrical conductivity	Electrical conductivity
Soluble salts: Ca++	Soluble calcium		
Soluble salts: Mg++	Soluble magnesium		
Soluble salts: K+	Soluble potassium		

ISIS	SDB	SOTER	WISE
Soluble salts: Na+	Soluble sodium		
Soluble salts: HCO3-	Soluble HCO3		
Soluble salts: CO-			
Soluble salts: Cl-	Soluble Cl		
Soluble salts: SO4--	Soluble SO4		
Soluble salts: NO3-	Soluble NO3		
	Soluble borium		
	Soluble CO3		
	SAR		
Electrical Conductivity: ECe	Electro conductivity		
Electrical conductivity: ECs	Electro conductivity		
pH value	pH		
Presence of Kalonite		Clay mineralogy	
Presence of Montmorilonite/ill		Clay mineralogy	
Presence of Vermiculite		Clay mineralogy	
Presence of Chlorite		Clay mineralogy	
Presence of Smectite		Clay mineralogy	
Presence of Halloysite		Clay mineralogy	
Presence of Mixture		Clay mineralogy	
Presence of Quartzite			
Presence of Feldspar			
Presence of Gibbsite			
Presence of Goethite			
Presence of Hematite			
Fe, dithionite extractable			Fe, dithionite extractable
Al, dithionite extractable			Al, dithionite extractable
Si, pyrophosphate extractable			
Fe, ammonium oxalate extract.			
Al, ammonium oxalate extractab			
Si, ammonium oxalate extractab			
Mn, ammonium oxalate extractab			
Fe, pyrophosphate extractable			
Al, pyrophosphate extractable			
C, pyrophosphate extractable			
ISIS profile code			
Sample number			
SiO2 soil			
Al2O3 soil			
Fe2O3 soil			
CaO soil			
MgO soil			
K2O soil			
Na2O soil			
TiO2 soil			
MnO2 soil			

ISIS	SDB	SOTER	WISE
P205 soil			
Ignition soil loss			
Ratio SiO2 : Al2O3 soil			
Ratio SiO2 : Fe2O3 soil			
Ratio SiO2 : R2O3 soil			
Ratio Al2O3 : Fe2O3 soil			
Climate station code (ISO code			
Climate station name			
ISO code for the country where			
Longitude East or West			
Longitude degrees			
Longitude minutes			
Latitude North or West			
Latitude degrees			
Latitude minutes			
Climate station altitude			
Climate station code (ISO coun			
Data type			
Number of years of record			
Mean annual over the years			
Data January			
Data February			
Data March			
Data April			
Data May			
Data June			
Data July			
Data August			
Data September			
Data October			
Data November			
Data December			
ISIS profile code			
Sample number			
Light fraction			
Heavy fraction			
Quartz			
Feldspar			
Mica			
Mineral : A			
Mineral : B			
Mineral : C			
Mineral : D			
Mineral : E			
Mineral : F			

ISIS	SDB	SOTER	WISE
Mineral : G			
ISRIC profile code			
Sample number			
SiO2 clay			
Al2O3 clay			
Fe2O3 clay			
CaO clay			
MgO clay			
K2O clay			
Na2O clay			
TiO2 clay			
MnO2 clay			
P2O5 clay			
Ratio SiO2 : Al2O3 clay			
Ratio SiO2 : Fe2O3 clay			
Ratio SiO2 : R2O3 clay			
Ratio Al2O3 : Fe2O3 clay			
Ignition loss clay			