A HOMOGENIZED SOIL DATA FILE FOR GLOBAL ENVIRONMENTAL RESEARCH: A SUBSET OF FAO, ISRIC AND NRCS PROFILES

(Version 1.0)

N.H. Batjes (Editor)

July 1995

INTERNATIONAL SOIL REFERENCE AND INFORMATION CENTRE

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Correct citation:

Batjes, N.H. (ed.), 1995. A homogenized soil data file for global environmental research: a subset of FAO, ISRIC and NRCS profiles (Version 1.0). Working Paper and Preprint 95/10b, International Soil Reference and Information Centre, Wageningen.

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Working Paper and Preprint **95/10b**

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Abstract

A homogenized, global set of 1,125 soil profiles is presented. These profiles have been extracted from the database developed at ISRIC for a project on "World Inventory of Soil Emission Potentials" (WISE), as a contribution to the activities of the Global Soils Data Task Group of IGBP-DIS. The subset consists of a selection of 665 profiles originating from digital data files released by the Natural Resources Conservation Service (NRCS, Lincoln), 250 profiles obtained from the Food and Agriculture Organization (FAO, Rome), and 210 profiles from the reference collection of the International Soil Reference and Information Centre (ISRIC, Wageningen). All profiles are georeferenced and classified in the FAO-Unesco Legend whereby they can be linked to the edited and digital version of the FAO-Unesco Soil Map of the World. This data set is being released in the public domain for use by global modellers and other interested scientists. It is envisaged that the data set will be expanded by ISRIC when new, uniform soil profile data become available.

Keywords: soil profiles; WISE database

1. Introduction

The compilation and processing of large-scale data sets of the world's environmental resources, using well-documented procedures and standards, is crucial for many global modelling activities (e.g., Zuidema *et al.*, 1994). Staff at ISRIC have developed a uniform methodology for a global database of soil properties within the framework of WISE, a project on World Inventory of Soil Emission Potentials (Batjes and Bridges, 1994). During this project a wide range of profiles from all regions of the world have been screened for completeness and incorporated into the WISE data handling system. The profiles in WISE were compiled from 5 main sources: (a) ISRIC's Soil Information System, ISIS (Van de Ven and Tempel, 1994); (b) FAO's Soil Database System, SDB (FAO, 1989); (c) digital soil data set compiled by the Natural Resources Conservation Service (NRCS, formerly SCS) of the United States of America; (d) profiles obtained from an international data gathering activity coordinated by WISE project staff, in which national soil survey organisations were asked to supply descriptions and analyses of profiles representative of the units of the Soil Map of the World present in their countries; and, (e) suitable profiles gathered from survey monographs held at ISRIC's library. Special attention was given to the systematic compilation of data and recording of the laboratory methods by which the analytical results were obtained. All profiles are classified in the FAO-Unesco (1974) legend, whereby they can be linked to the spatial data shown on an edited and digital version of the Soil Map of the World (FAO, 1991).

This report describes a uniform set of 1,125 soil profiles, extracted from the WISE database, for use by global modellers. The selected profiles correspond with what has become known as the "international" profiles of the WISE database, and formed an ISRIC contribution to the activities of the Global Soils Data Task Group of IGBP-DIS (Scholes *et al.*, 1994). The set includes 665 profiles from the USDA-NRCS, 250 from the FAO-SDB and 210 from the ISRIC-ISIS databases.

Section 2 of this report describes the procedures for compiling and extracting the data set, and possible user groups are identified in Section 3. Appendix 1 is a listing of the countries from which the profiles originate. The FAO-Unesco (1974) classification of these profiles is listed in Appendix 2. Examples of listings of profiles derived from these data files are attached as Appendix 3, and the installation procedure is explained in Appendix 4. Appendix 5 presents the structure and attributes of the WISE database, Appendix 6 presents the database coding protocols and, finally, the country ISO codes are given in Appendix 7.

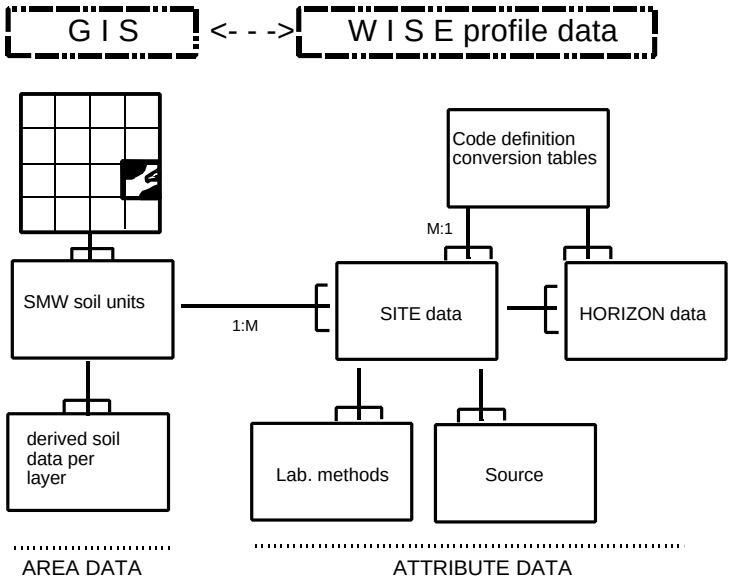

Fig. 1. Main database files of the WISE data handling system (M:1 stands for many to one relations, and 1:M for one to many relations)

2. Procedures

2.1 The WISE database

WISE 2.1 is a soil data handling system developed for IBM®-compatible computers. It includes a collection of over 90 compiled program modules for storing, editing, selecting and printing soil data. The individual modules for handling the soil profile data are linked in a user-friendly manner by a unified menu system (Fig. 1) .

All procedures are written in dBASE IV®, as are the structures for the database files (Batjes, 1995). The full WISE database holds a growing selection of globally distributed profiles considered to be representative of the soil units shown on a ½° latitude by ½° longitude version of the corrected and digitized 1:5 M FAO-Unesco Soil Map of the World.

2.2 List of soil attributes

The profile component of the WISE database includes information on: (a) soil classification and site data; (b) soil horizon data; (c) source of data; (d) the methods used for determining the analytical data; and, (e) a series of "code-definition" translation files (Batjes, 1995). The full complement of data selected for inclusion in the WISE profile database is listed in Table 1. The attributes shown are similar to those proposed for the European Soil Analytical Database (Madsen and Jones, 1995) and for a Global Soils Database to be developed under the aegis of IGBP-DIS (Ingram, 1993). The central aim of the WISE database is to provide a basic set of uniform soil data for a wide range of global studies, including assessments of crop production, soil vulnerability to pollution and soil gaseous emission potentials (Batjes *et al.*, 1995).

2.3 Data sources and description methods

The "international" data set holds profiles released by ISRIC-ISIS, FAO-SDB and USDA-NRCS. The profiles originating from ISIS have been compiled specifically to be representative of the map units of the Soil Map of the World, with special emphasis on the tropics. They have all been described using the *Guidelines for Soil Description* (FAO-ISRIC, 1990) and analysed in a uniform manner in the ISRIC laboratory (Van Reeuwijk, 1992). The profiles derived from the NRCS set originate from the USA and 41 other countries. Soil descriptions in this data set follow the methodology of the *Soil Survey Manual* (USDA, 1993), and the analyses have been

Table 1. List of attribute data held in WISE.

Site Data	Horizon Data
WISE_ID (unique identifier of profile)	WISE_ID + horizon_NO (unique reference number for horizon within a profile)
Soil classification and source	
FAO-Unesco classification (1974 legend)	General attributes
phase	horizon designation
topsoil texture class	depth, top
FAO-Unesco classification (1990a revised legend)	depth, bottom
phase	matrix colour (dry and moist)
USDA subgroup level classification	mottling
edition (year) of Soil Taxonomy	presence of roots
National classification	Chemical attributes*
source of data	organic carbon
name of laboratory where analyses were made	total N
soil profile description status	available P
date of description	pH-H_2O
	pH-KCl
Location	pH-$CaCl_2$
country	electrical conductivity (EC)
location of soil profile, descriptive	free $CaCO_3$
latitude (deg/min/s)	$CaSO_4$
longitude (deg/min/s)	exchangeable Ca^{2+}
altitude	exchangeable Mg^{2+}
	exchangeable Na^{+}
General site data	exchangeable K^{+}
major landform	exchangeable Al^{3+} + H^{+} (exchangeable acidity)
landscape position	exchangeable Al^{3+} (exchangeable aluminum)
aspect	cation exchange capacity (CEC)
slope	effective CEC (at field pH)
drainage class	base saturation (as percent of CEC)
groundwater depth	
effective soil depth	
parent material	Physical attributes*
Köppen climate classification	structure type
land use	particle size distribution:
natural vegetation	weight % sand
	weight % silt
	weight % clay
	stone and gravel content
	bulk density
	volume per cent water held at specified suctions
	hydraulic conductivity at specified suctions

WISE, World Inventory of Soil Emission Potentials; * Analytical methods are specified in a separate key-attribute file.

made at the Lincoln laboratory (USDA, 1984). These analytical methods compare well with those used at ISRIC (Kimble and Van Reeuwijk, *pers. comm.*, 1994). Whereas profiles originating from the SDB database (FAO, 1989) have been described using the same guidelines which ISRIC used, the chemical and physical analyses have taken place in different laboratories (FAO-Unesco, 1971-1981). Therefore, it is not always possible to compare all SDB data sets directly with those of NRCS and ISIS (see Vogel, 1994).

2.4 Criteria for accepting profile data

Strict criteria have been defined for accepting profiles into WISE: (a) completeness and apparent reliability of data; (b) traceability of source of data; (c) classifiable in the FAO-Unesco (1974) legend; and (d) geo-referenced within defined limits. Profiles from the "international" data holders have been off-loaded to WISE using an automated data-transfer facility (Tempel, 1994). Procedures, called map-files, have been developed for the transfer of data from the NRCS, SDB and ISIS databases to WISE 2.1 (Zunnenberg, *unpublished data*, 1994). Following the initial transfer to a WISE-compatible dBASE® format, the integrity of the transferred data was checked by a second computer module. It is only after this second operation that the "screened" data sets were appended to the main WISE database files. Inherently, the use of an automated transfer facility will encompass some loss of information (Tempel, 1994). The original reference number of a soil profile is documented in the WISE database files. In all cases, the source of data and laboratory where the analyses have been carried out are specified (see Appendix 3). The WISE attribute-definition files which are provided with the "international" data set should never be tampered with in any way, because this will affect the integrity of the database.

2.5 Selection of "international" profiles

An extraction module was written for the mechanical extraction of the "international" profiles stored in the WISE database. The selected profiles are from various regions of the globe, with few profiles originating from Europe (Table 2). A data set of European profiles is being compiled in a separate activity by the European Union (Madsen and Jones, 1995), but so far unresolved copyright matters seem to have hindered its release to third parties.

Table 2. Summary of number of profiles per broad geographic area (total= 1,125)

WISE area	Total
Africa	315
Australia and Pacific Islands	56
China, India, Indonesia & Philippines	280
Europe	7
North America	158
South America and Caribbean	241
South west and Northern Asia (Siberia)	68

Appendix 1 lists the countries from where the soil profiles originate. The classification of these soils is presented in Appendix 2. All profiles from the NRCS data set have been classified at ISRIC into the original (FAO-Unesco, 1974) and revised (FAO, 1990a) legend (see Spaargaren and Batjes, 1995). About 94 % of the 1,125 profiles are classified in the Revised Legend (FAO, 1990a) and about 88 % according to Soil Taxonomy (Soil Survey Staff, 1994 and earlier versions).

2.6 Sources of uncertainty

Initial printouts obtained from the NRCS, SDB and ISIS data sets after transfer into WISE sometimes contained distorted soil horizon designations and duplicate horizon depths. This was partly associated with the fact that soil horizon and sample depths were not always defined unambiguously in the source data files. Whenever possible, these "data issues" have been remedied manually with reference to the original data sets.

Differences in versions of USDA Soil Taxonomy used in the NRCS source files formed a difficulty when classifying profiles according to the FAO Legend. Similarly, different horizon designations are used in the various "international" data sets.

In some cases, profiles held in the source data files differed from those published elsewhere for the same profiles. This was the case for some NRCS profiles from Brazil, Korea and Zambia (see Spaargaren and Batjes, 1995), some SDB profiles from Botswana (see FAO, 1990b), and some ISIS profiles. This aspect illustrates the difficulty in preserving data integrity in digital files since their contents can easily be corrupted. In most cases, data sets obtained from NRCS, SDB and ISIS were taken at "face value" in view of the fact that they have been officially released for inclusion in the WISE database. Nonetheless, all transferred data sets have been submitted to WISE's computerized and rigorous data-checking scheme leading to rejection of some of the profiles (see Section 2.4).

In case of missing latitude-longitude references, approximate coordinates have been derived from the Times Atlas (1993), using general information on location (e.g., Machakos, Kenya).

3. Discussion and conclusions

Version 1.0 of the "international" data set is being released with the implicit understanding that the source will be acknowledged in all publications arising from use of the data. The "international" data set is particularly meant for those scientists who wish to study "primary" soil data. Files are presented in dBASE® IV format using the WISE database structure and coding conventions (see Batjes, 1995).

The "international" data sets held in WISE have been proposed to serve as the nucleus for a global profile data set to be developed by the Global Soil Data Task Group of IGBP-DIS (Scholes *et al.*, 1994). The data set discussed in this paper, with a selection of soil profiles from three major international holders of soil data — NRCS, FAO and ISRIC —, is to provide the initial soil profile data for this collaborative activity.

It is anticipated that new releases of the "international" data set will be prepared as new profile data are being added to the WISE database, notably about 400 profiles from ISRIC's project on National Soil Reference and Database Collections (NASREC).

The WISE database proper, which currently contains over 4,300 profiles, is being used by ISRIC to generate a series of uniform data sets of derived soil properties, linked to a ½° longitude by ½° latitude version of the edited and digital Soil Map of the World (FAO, 1991), for subsequent use by global modellers.

Acknowledgements

As with any collaborative activity, the WISE project has been carried out with the help of many people. The data held in the current "international" data set have been obtained from various organisations including: (a) the Natural Resources Conservation Service (USDA-NRCS, formerly SCS) at Lincoln, and J.M. Kimble in particular; (b) FAO's Land and Water Development Division (AGL), notably F.O. Nachtergaele; and (c) ISRIC, particularly J.H. Kauffman co-ordinator of the NASREC/ISIS project. Crucial, auxiliary software for the digital transfer of data obtained from these organisations to the WISE database structure was developed and tested at ISRIC by P. Tempel. The accompanying "map files" were elaborated by W. Zunnenberg. All profiles transferred from the NRCS data tape have been checked and classified in the FAO-Unesco system by O.C. Spaargaren under a subcontract with IGBP-DIS. All profiles derived from ISIS were manually checked by E.M. Bridges. Constructive comments on creating the "international" data set were received from W.V.P. van Engelen and L.R. Oldeman. The contributions of ISRIC's staff in the WISE project activities, and those of E.M. Bridges in particular, are gratefully acknowledged.

The WISE data handling system has been developed at ISRIC for a project on the Geographic Quantification of Soil Factors and Processes that Control Fluxes of Greenhouse Gases —known as World Inventory of Soil Emission Potentials (WISE)— with sponsorship from the Netherlands National Research Programme on Global Air Pollution and Climate Change (Project 851039).

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Appendices

Appendix 1. Number of profiles per country in "international"data set.

Country	Total
AR - Argentina	5
AU - Australia	15
BD - Bangladesh	3
BE - Belgium	1
BF - Burkina Faso	1
BI - Burundi	12
BR - Brazil	69
BW - Botswana	33
CA - Canada	2
CI - Cote d'Ivoire	12
CK - Cook Islands	1
CL - Chile	6
CM - Cameroon	34
CN - China	50
CO - Colombia	27
CR - Costa Rica	28
CU - Cuba	21
DE - Germany, Fed. Rep. of	1
DZ - Algeria	4
EC - Ecuador	16
FI - Finland	1
GN - Guinea	1
GT - Guatemala	11
GY - Guyana	3
HN - Honduras	8
ID - Indonesia	58
IN - India	49
IT - Italy	1
JO - Jordan	14
JP - Japan	4
KE - Kenya	32
KR - Korea, Republic of	15
LB - Lebanon	2
LS - Lesotho	15
MA - Morocco	5

Country	Total
ML - Mali	14
MX - Mexico	4
MY - Malaysia	2
MZ - Mozambique	1
NC - New Caledonia	1
NE - Niger	11
NG - Nigeria	1
NI - Nicaragua	21
NP - Nepal	5
NZ - New Zealand	5
PA - Panama	14
PG - Papua New Guinea	16
PH - Philippines	42
PK - Pakistan	37
PR - Puerto Rico	1
RO - Romania	1
RW - Rwanda	6
SB - Solomon Islands	1
SD - Sudan	46
SL - Sierra Leone	1
SN - Senegal	2
SV - El Salvador	5
SY - Syrian Arab Republic	6
TH - Thailand	35
TN - Tunisia	15
TO - Tonga	2
TW - Taiwan	0
UG - Uganda	12
US - United States	154
VE - Venezuela	6
WS - Samoa	14
YE - Yemen	26
ZA - South Africa	4
ZM - Zambia	37
ZW - Zimbabwe	16

Appendix 2. Soil units represented in "international" data set (FAO-Unesco, 1974).

A: Acrisols
Af= 53 Ag= 12 Ah= 34 Ao= 25 Ap= 15
B: Cambisols
Bc= 11 Bd= 25 Be= 36 Bf= 31 Bg= 7 Bh= 15 Bk= 32 Bv= 12 Bx= 0
C: Chernozems
Cg= 0 Ch= 1 Ck= 5 Cl= 0
D: Podzoluvisols
Dd= 1 De= 2 Dg= 0
E: Rendzinas
E = 3
F: Ferralsols
Fa= 10 Fh= 31 Fo= 25 Fp= 3 Fr= 16 Fx= 18
G: Gleysols
Gc= 1 Gd= 11 Ge= 25 Gh= 3 Gm= 10 Gp= 2 Gx= 4
H: Phaeozems
Hc= 10 Hg= 9 Hh= 47 Hl= 21
I: Lithosols
I = 0
J: Fluvisols
Jc= 14 Jd= 6 Je= 14 Jt= 7
K: Kastanozems
Kh= 1 Kk= 1 Kl= 0
L: Luvisols
La= 4 Lc= 33 Lf= 44 Lg= 7 Lk= 5 Lo= 38 Lp= 5 Lv= 3
M: Greyzems
Mg= 0 Mo= 1
N: Nitosols
Nd= 6 Ne= 15 Nh= 1
O: Histosols
Od= 3 Oe= 0 Ox= 0
P: Podzols
Pf= 0 Pg= 1 Ph= 6 Pl= 2 Po= 4 Pp= 4
Q: Arenosols
Qa= 3 Qc= 9 Qf= 3 Ql= 3
R: Regosols
Rc= 8 Rd= 6 Re= 16 Rx= 0
S: Solonetz
Sg= 4 Sm= 0 So= 20
T: Andosols
Th= 43 Tm= 14 To= 3 Tv= 20
U: Rankers
U = 0
V: Vertisols
Vc= 66 Vp= 38
W: Planosols
Wd= 0 We= 3 Wh= 0 Wm= 1 Ws= 7 Wx= 0
X: Xerosols
Xh= 7 Xk= 8 Xl= 11 Xy= 5
Y: Yermosols
Yh= 5 Yk= 4 Yl= 9 Yt= 0 Yy= 4
Z: Solonchaks
Zg= 1 Zm= 1 Zo= 11 Zt= 1

* For abbreviations see FAO-Unesco (1974), e.g. Af stands for Ferric Acrisols.

Appendix 3. Examples of listings of SDB, ISIS and NRCS profiles.

```
BR054                          W I S E   S O I L   P R O F I L E   D A T A   S H E E T                          21/06/95
                               ==================================================

SOIL CLASSIFICATION:
     FAO-Unesco Legend (1974):      Ferric Luvisol (Lf)        Phase: -- (-)                Topsoil texture: coarse (C)
     FAO-Unesco Legend (1990):      Ferric Luvisol (LVf)       Phase: -- (-)
     USDA Soil Taxonomy (19--):     -
     Local Classification System:   -

SOURCES:
     Source_ID:         FAO/SDB     Ref. page:     FAO-SDB profile: 021011
     Lab_ID:            XX01        Descr. status: routine description (2)
     Desc. (MM/YY):     01/66

SITE DATA:
     Location:          9 Km SW Marilia, Sao Paulo state (Brazil)
     Coordinates:       Lat.: S  22 deg. 19 min. -- sec.       Lon.: W 050 deg. 00 min. -- sec.
     Altitude:          620 m
     Landform:          -- (-)
     Position:          -- (-)
     Aspect:            -
     Slope:             - %
     Drainage class:    moderately well drained (M)
     Groundwater:       -1 to  -1 (cm)
     Eff. soil depth >  -1 (cm)
     Parent material:   sandstone, greywacke, arkose (SC2)  (Remarks: -)
     Koppen climate:    Equat. humid with dry season in low-sun season (driest month <60;Tcm > 18C) (Aw)
     Land use (LU):     -- (-)
     Main crop:         coffee (CF)
     Vegetation (VE):   -- (-)
     Remarks on LU/VE:  -

HORIZON DATA:
```

Horiz. Desig.	Depth (cm)	Org. C (%)	Tot. N (%)	Av. P	pH H2O	pH KCl	pH CaCl2	ECx	CACO 3 (%)	GYPS UM (%)	Exch. bases and acidity Ca	Mg	K	Na	Ac	Al	CEC (meq/100g)	ECEC	BS (%)
Ap	0- 20	0.40	0.05	2.3	6.3	-1.0	5.5	-1.00	-1.0	-1.0	3.0	0.2	0.1	0.0	-1.0	-1.0	4.0	-1.0	83
E	20- 42	0.10	0.02	2.3	6.6	-1.0	5.6	-1.00	-1.0	-1.0	1.8	0.2	0.0	0.0	-1.0	-1.0	2.5	-1.0	80
B1	42- 77	0.20	0.06	2.3	6.4	-1.0	5.3	-1.00	-1.0	-1.0	4.3	1.0	0.1	0.0	-1.0	-1.0	6.0	-1.0	90
B2	77- 97	0.20	0.02	2.3	6.2	-1.0	5.2	-1.00	-1.0	-1.0	3.5	0.9	0.1	0.0	-1.0	-1.0	5.4	-1.0	83
BC	97-209	0.10	0.02	2.3	6.4	-1.0	5.8	-1.00	-1.0	-1.0	2.6	0.7	0.1	0.0	-1.0	-1.0	4.4	-1.0	80

Horiz. Desig.	Colour Dry	Colour Moist	M	R	ST	Sand (%)	Silt (%)	Clay (%)	GR (%)	Bd	% vol/vol moisture held at a pF of 0.0	1.0	1.5	1.7	2.0	2.3	2.5	2.7	3.4	3.7	4.2	AWC (%v/v)	HCs (cm/hr)	HCu
Ap	-	5YR3/3	-	M	-	91	3	6	-1	-1.0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1.0	-1.0
E	-	5YR4/3	-	M	-	94	2	4	-1	-1.0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1.0	-1.0
B1	-	2.5YR4/4	C	M	SB	73	2	25	-1	-1.0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1.0	-1.0
B2	-	2.5YR3/6	F	F	-	74	2	24	-1	-1.0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1.0	-1.0
BC	-	5YR4/6	-	F	-	80	2	18	-1	-1.0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1.0	-1.0

```
     Abbr.: Av. P as mg P2O5/kg soil; ECx= electrical conductivity in dS/m; Ac= exchangeable (H + Al) in meq/100g;
            BS= base saturation (% of CEC); M= mottles; R= roots; ST= structure; GR = % > 2mm size; Bd= bulk density
            (g/cm3); HC= hydr. conduct., saturated (HCs) resp. unsat. (HCu) in cm/hr; AWC= av. moisture in v/v %; -1
            stands for missing numeric values and - for missing alphanumeric values.

REMARKS:
    SDB-profile= BR011.

REFERENCES:
     a) Source of profile data [FAO/SDB-2]:
        Various authors (see relevant FAO reports), 1994. Selected soils from FAO's Soil Data Base
        (SDB; May 94); transfer map-files prepared by W. Zunnenberg. Data from FAO, Rome.
```

b) Laboratory name and methods [XX01]:
General methods as described in FAO-Unesco Soil Map of the World.

Analytical method	Code and description
Organic Carbon:	OC01: Method of Walkley-Black (Org. matter = Org. C x 1.72)
Total Nitrogen:	TN01: Method of Kjeldahl
Available P:	TP99: Method not defined
pH-H2O:	PH02: pH 1:2.5 soil/water solution
pH-KCl:	PK02: pH in 1:2.5 soil/ M KCl solution
pH-CaCl2:	PC02: pH in 1:2.5 soil/1 M CaCl2 solution
Electr. conductivity:	EL04: Elec. conductivity in saturated paste (ECe)
CaCO3 content:	CA04: Calcimeter method (volumetric after adition of dilute acid)
Gypsum content:	GY01: Dissolved in water and precipitated by acetone
Exch. Ca, Mg, Na and K:	EX01: Various methods with no apparent differences in results
Exch. acidity and aluminum:	EA--: Not measured
CEC soil:	CS01: CEC in 1M NH4OAc buffered at pH 7
Effective CEC:	CE--: Not measured
Base saturation:	BS01: Sum of bases as percentage of CEC (method specified above)
Particle size analysis:	TE01: Pipette method, with appropriate dispersion treatment (c< 0.002 <si< 0.05 <sa< 2mm)
Bulkdensity:	BD--: Not measured
Soil moisture content:	MC--: Not measured
Hydraulic conductivity:	HC--: Not measured

BR069 W I S E S O I L P R O F I L E D A T A S H E E T 21/06/95

SOIL CLASSIFICATION:
FAO-Unesco Legend (1974): Ferric Luvisol (Lf) Phase: -- (-) Topsoil texture: coarse (C)
FAO-Unesco Legend (1990): Haplic Lixisol (LXh) Phase: -- (-)
USDA Soil Taxonomy (1992): Typic Kanhaplustalf
Local Classification System: Podzolico vermelho

SOURCES:
Source_ID: **ISIS**-0994 Ref. page: ISIS4 [BR001]
Lab_ID: NL01 Descr. status: reference pedon (1)
Desc. (MM/YY): 10/84

SITE DATA:
ocation: Rio de Janeiro, Itaguai (Brazil)
Coordinates: Lat.: S 22 deg. 45 min. 0 sec. Lon.: W 43 deg. 41 min. 0 sec.
Atitude: 45 m
Landform: plain (slope 0-8 %; relief int. < 100 m/km) (LP)
osition: lower slope (LS)
Aspect: -
Slope: 20 %
Drainage class: -- (-)
Groundwater: -1 to -1 (cm)
Eff. soil depth > 180 (cm)
Parent material: metamorphic rocks (M) (Remarks: Weathered rock)
Koppen climate: Equat. humid with dry season in low-sun season (driest month <60;Tcm > 18C) (Aw)
Land use (LU): extensive grazing (HE)
Main crop: -- (-)
Vegetation (VE): herbaceous (H)
Remarks on LU/VE: occ. subsistence farming

HORIZON DATA:

Horiz.	Depth	Org. C	Tot. N	Av. P	pH H2O	pH KCl	pH CaCl2	ECx	CACO 3	GYPS UM	Exch. bases and acidity Ca	Mg	K	Na	Ac	Al	CEC	ECEC	BS
Desig.	(cm)	(%)	(%)						(%)	(%)							(meq/100g)		(%)
Ap	0- 14	0.95	0.09	-1.0	4.5	4.1	-1.0	0.20	0.0	0.0	1.0	0.5	0.2	0.1	-1.0	-1.0	3.7	1.8	49
E1	14- 30	0.42	-1.00	-1.0	4.7	3.9	-1.0	0.05	0.0	0.0	1.0	0.3	0.0	0.1	-1.0	-1.0	2.1	1.4	67
E2	30- 38	0.38	-1.00	-1.0	4.9	3.9	-1.0	0.04	0.0	0.0	0.8	0.4	0.0	0.1	-1.0	-1.0	2.6	1.3	50
Bt1	38- 50	0.27	-1.00	-1.0	6.5	5.4	-1.0	0.02	0.0	0.0	0.8	2.3	0.1	0.1	-1.0	-1.0	3.9	3.3	85
Bt2	50- 80	0.34	-1.00	-1.0	5.8	4.4	-1.0	0.02	0.0	0.0	1.4	0.9	0.1	0.1	-1.0	-1.0	3.5	2.5	71
Bt3	80-100	0.18	-1.00	-1.0	5.8	4.2	-1.0	0.02	0.0	0.0	1.2	1.0	0.0	0.2	-1.0	-1.0	4.4	2.4	55
CB	100-157	0.13	-1.00	-1.0	5.6	3.9	-1.0	0.02	0.0	0.0	0.6	1.5	0.0	0.2	-1.0	-1.0	5.0	2.3	46
C	157-180	-1.00	-1.00	-1.0	5.5	3.4	-1.0	0.02	0.0	0.0	0.8	2.0	0.1	-1.0	-1.0	-1.0	7.7	2.9	38

Horiz.	Colour Dry	Colour Moist	M	R	ST	Sand (%)	Silt (%)	Clay (%)	GR (%)	Bd	% vol/vol moisture held at a pF of 0.0	1.0	1.5	1.7	2.0	2.3	2.5	2.7	3.4	3.7	4.2	AWC (%v/v)	HCs (cm/hr)	HCu (cm/hr)
Desig.																								
Ap	10YR6/2	10YR4/2	N	MV	SB	69	16	15	-1	-1.0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1.0	-1.0
E1	10YR6/3	10YR5/4	N	CV	MA	64	15	21	-1	1.57	36	35	29	-1	23	21	-1	18	15	-1	14	15	-1.0	-1.0
E2	10YR6/3	10YR5/4	N	VV	MA	61	13	26	-1	-1.0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1.0	-1.0
Bt1	5YR6/6	2.5YR4/6	N	VV	SB	28	12	60	-1	-1.0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1.0	-1.0
Bt2	2.5YR6/6	2.5YR4/6	N	VV	SB	35	16	49	-1	1.43	43	41	38	-1	35	33	-1	32	30	-1	27	11	-1.0	-1.0
Bt3	5YR6/6	4YR4/6	N	-	SB	38	20	42	-1	-1.0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1.0	-1.0
CB	7.5YR6/6	5YR4/6	N	-	MA	45	26	29	-1	1.54	41	40	38	-1	34	32	-1	30	24	-1	21	17	-1.0	-1.0
C	-	-	-	-	-	55	26	19	-1	-1.0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1.0	-1.0

Abbr.: Av. P as mg P2O5/kg soil; ECx= electrical conductivity in dS/m; Ac= exchangeable (H + Al) in meq/100g; BS= base saturation (% of CEC); M= mottles; R= roots; ST= structure; GR = % > 2mm size; Bd= bulk density (g/cm3); HC= hydr. conduct., saturated (HCs) resp. unsat. (HCu) in cm/hr; AWC= av. moisture in v/v %; -1 stands for missing numeric values and - for missing alphanumeric values.

REMARKS:
A deep, moderately well drained, red clay soil derived from gneiss; having a yellowish brown, porous, sandy (clay) loam topsoil. The B horizons show coating of illuvial clay and limited permeability.

REFERENCES:
a) Source of profile data [ISIS-0994]:
Various authors (see relevant ISRIC Country Reports), 1994. ISIS data set of September 1994 (J.H. Kauffman); transfer map-file produced by W. Zunnenberg. See: Van de Ven, T. and P. Tempel, 1994. ISIS 4 - User Manual. Technical Paper 15, ISRIC, Wageningen.

b) Laboratory name and methods [NL01]:
International Soil Reference and Information Centre (ISRIC) laboratory, Wageningen, The Netherlands.

Analytical method	Code and description
Organic Carbon:	OC01: Method of Walkley-Black (Org. matter = Org. C x 1.72)
Total Nitrogen:	TN01: Method of Kjeldahl
Available P:	TP18: Bray-I (acid soils) resp. Olsen (other soils)
pH-H2O:	PH02: pH 1:2.5 soil/water solution
pH-KCl:	PK02: pH in 1:2.5 soil/ M KCl solution
pH-CaCl2:	PC--: Not measured
Electr. conductivity:	EL04: Elec. conductivity in saturated paste (ECe)
CaCO3 content:	CA03: Method of Piper
Gypsum content:	GY01: Dissolved in water and precipitated by acetone
Exch. Ca, Mg, Na and K:	EX01: Various methods with no apparent differences in results
Exch. acidity and aluminum:	EA01: Exchangeable acidity (H+Al) in 1 M KCl
CEC soil:	CS01: CEC in 1M NH4OAc buffered at pH 7
Effective CEC:	CE01: Sum of exch. Ca, Mg, K and Na, plus exchangeable aluminium (in 1M KCl)
Base saturation:	BS01: Sum of bases as percentage of CEC (method specified above)
Particle size analysis:	TE01: Pipette method, with appropriate dispersion treatment (c< 0.002 <si< 0.05 <sa< 2mm)
Bulkdensity:	BD01: Core sampling (pF rings)
Soil moisture content:	MC01: sand/silt baths and porous plates, undisturbed samples (pF rings)
Hydraulic conductivity:	HC--: Not measured

BR097 W I S E S O I L P R O F I L E D A T A S H E E T 21/06/95

SOIL CLASSIFICATION:
FAO-Unesco Legend (1974): Humic Acrisol (Ah) Phase: -- (-) Topsoil texture: fine (F)
FAO-Unesco Legend (1990): Haplic Ferralsol (FRh) Phase: -- (-)
USDA Soil Taxonomy (1994): Humic Kandiudox
Local Classification System: [USDA-code: audparh]

SOURCES:
Source_ID: **NRCS**-USDA Ref. page: SCS profile code 8500725 (Brazil 7)
Lab_ID: US01 Descr. status: reference pedon (1)
Desc. (MM/YY): 04/85

SITE DATA:
Location: Highway SP127, Piracicaba-Rio Claro (Brazil)
Coordinates: Lat.: S 22 deg. 34 min. -- sec. Lon.: W 047 deg. 35 min. -- sec.
Altitude: 630 m
Landform: -- (-)
Position: middle slope (MS)
Aspect: -
Slope: 008 %
Drainage class: well drained (W)
Groundwater: -1 to -1 (cm)
Eff. soil depth > -1 (cm)
Parent material: slate, phyllite (peliticrocks) (MB1) (Remarks: Reworked pelitic colluvium from argillites/shales)
Koppen climate: Humid subtrop. with dry period in low-sun season (Tcm > 0C; Twm > 22C) (Caw)
Land use (LU): perennial field cropping (AP)
Main crop: sugarcane (SC)
Vegetation (VE): evergreen forest (FE)
Remarks on LU/VE: -

HORIZON DATA:

Horiz.	Depth	Org. C	Tot. N	Av. P	pH H2O	pH KCl	pH CaCl2	ECx	CACO 3	GYPS UM	Exch. bases and acidity Ca	Mg	K	Na	Ac	Al	CEC	ECEC	BS
Desig.	(cm)	(%)	(%)						(%)	(%)							(meq/100g)		(%)
Ap1	0- 11	4.54	0.35	-1.0	6.1	5.0	6.0	-1.00	-1.0	-1.0	18.1	2.3	1.0	-1.0	10.6	0.1	17.7	-1.0	-1
Ap2	11- 19	2.01	0.15	-1.0	5.3	4.7	5.1	-1.00	-1.0	-1.0	6.8	1.4	0.5	0.1	11.4	-1.0	11.6	-1.0	76
Bto1	19- 43	1.15	0.08	-1.0	4.6	4.3	4.4	-1.00	-1.0	-1.0	2.1	0.8	0.1	-1.0	11.2	1.1	7.4	-1.0	41
Bto2	43- 78	0.82	-1.00	-1.0	4.5	4.3	4.3	-1.00	-1.0	-1.0	0.9	0.4	-1.0	-1.0	10.9	1.2	6.8	-1.0	21
Bo1	78-190	0.47	0.04	-1.0	5.2	4.5	4.5	-1.00	-1.0	-1.0	0.2	0.2	-1.0	-1.0	10.1	0.4	5.9	-1.0	9
Bo2	190-290	0.25	-1.00	-1.0	5.3	4.4	4.4	-1.00	-1.0	-1.0	0.2	0.1	-1.0	-1.0	7.9	0.7	5.7	-1.0	7
BC	290-320	0.18	0.02	-1.0	5.2	4.0	4.2	-1.00	-1.0	-1.0	-1.0	0.2	-1.0	-1.0	8.8	2.6	6.8	-1.0	3

Horiz.	Colour Dry	Colour Moist	M	R	ST	Sand (%)	Silt (%)	Clay (%)	GR (%)	Bd	% vol/vol moisture held at a pF of 0.0	1.0	1.5	1.7	2.0	2.3	2.5	2.7	3.4	3.7	4.2	AWC (%v/v)	HCs (cm/hr)	HCu
Ap1	5YR3/3	5YR3/3	-	CM	GR	18	21	61	-1	-1.0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	22	-1	-1.0	-1.0
Ap2	5YR4/4	2.5YE3/6	-	CM	SB	17	16	67	-1	1.48	-1	-1	-1	-1	30	-1	29	-1	-1	-1	21	9	-1.0	-1.0
Bto1	2.5YR5/6	2.5YR3/6	-	CM	SB	11	12	77	-1	1.39	-1	-1	-1	-1	33	-1	32	-1	-1	-1	25	8	-1.0	-1.0
Bto2	2.5YR5/6	2.5YR4/6	-	CM	SB	11	13	76	-1	1.16	-1	-1	-1	-1	36	-1	34	-1	-1	-1	26	10	-1.0	-1.0
Bo1	2.5YR4/6	2.5YR4/6	-	F	GR	12	15	73	-1	1.22	-1	-1	-1	-1	36	-1	33	-1	-1	-1	26	10	-1.0	-1.0
Bo2	2.5YR5/6	10R4/6	-	F	-	15	23	62	-1	-1.0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	26	-1	-1.0	-1.0
BC	10YR5/6	10R5/6	-	F	-	14	34	52	-1	-1.0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	27	-1	-1.0	-1.0

Abbr.: Av. P as mg P2O5/kg soil; ECx= electrical conductivity in dS/m; Ac= exchangeable (H + Al) in meq/100g; BS= base saturation (% of CEC); M= mottles; R= roots; ST= structure; GR = % > 2mm size; Bd= bulk density (g/cm3); HC= hydr. conduct., saturated (HCs) resp. unsat. (HCu) in cm/hr; AWC= av. moisture in v/v %; -1 stands for missing numeric values and - for missing alphanumeric values.

REMARKS:
None.

REFERENCES:
a) Source of profile data [NRCS-USDA]:
Soil Survey Staff (Dr J.M. Kimble; FAO class. by Dr O.C. Spaargaren), 1994. Collection of profiles derived from data-tape provided by SCS laboratory (now NRCS) at Lincoln, NE. Soil Taxonomy ('75, '90, '94)

b) Laboratory name and methods [US01]:
Soil Conservation Service (now NRCS), Lincoln, Nebraska

Analytical method	Code and description
Organic Carbon:	OC01: Method of Walkley-Black (Org. matter = Org. C x 1.72)
Total Nitrogen:	TN01: Method of Kjeldahl
Available P:	TP18: Bray-I (acid soils) resp. Olsen (other soils)
pH-H2O:	PH02: pH 1:2.5 soil/water solution
pH-KCl:	PK02: pH in 1:2.5 soil/ M KCl solution
pH-CaCl2:	PC--: Not measured
Electr. conductivity:	EL04: Elec. conductivity in saturated paste (ECe)
CaCO3 content:	CA03: Method of Piper
Gypsum content:	GY01: Dissolved in water and precipitated by acetone
Exch. Ca, Mg, Na and K:	EX01: Various methods with no apparent differences in results
Exch. acidity and aluminum:	EA01: Exchangeable acidity (H+Al) in 1 M KCl
CEC soil:	CS01: CEC in 1M NH4OAc buffered at pH 7
Effective CEC:	CE01: Sum of exch. Ca, Mg, K and Na, plus exchangeable aluminium (in 1M KCl) *
Base saturation:	BS01: Sum of bases as percentage of CEC (method specified above)
Particle size analysis:	TE01: Pipette method, with appropriate dispersion treatment (c< 0.002 <si< 0.05 <sa< 2mm)
Bulkdensity:	BD01: Core sampling (pF rings)
Soil moisture content:	MC01: sand/silt baths and porous plates, undisturbed samples (pF rings)
Hydraulic conductivity:	HC--: Not measured

Appendix 4. Brief installation procedure

Installing WISE

The “international profile data set” is distributed mainly as “e-mail attachments”. The WISE 2.1 data handling system and "international profile data set" can be installed on IBM-compatible PC's (386 and up). The installation procedure must start from within the directory to which the installation files were transferred initially as e-mail attachments. The relevant files are WISSETUP.BAT and WISSETUP.ZIP. A shareware copy of PKZIP**#**, which is necessary to decompress WISSETUP.ZIP, is attached also.

To install the data set and data handling system from the DOS prompt (or with RUN option under WINDOWS) simply start in the directory where your e-mail files arrive (e.g. C:\E_MAIL):

C:\E_MAIL> **WISSETUP**

WISSETUP.BAT first creates C:\WISE, with appropriate subdirectories, to which the various program, system and data files will be copied. In order to access the data a copy of the proprietary dBASE IV language, version 1.5 and up, is needed. The datafiles proper however, being dbf-files, can be accessed with a range of software.

Prior to accessing the data set, a PATH must be set to the directory where dBASE IV resides on the C-drive (C:\DB4), as well as a path to C:\WISE, by adding the following statements to the AUTOEXEC.BAT file on the C-drive, e.g.:

PATH C:\; C:\DOS; .....; C:\DB4; C:\WISE; ..

The WISE data handling system was developed using dBASE IV, version 1.5. Please note that if version 2.0 of dBASE IV is used, the file C:\DB4\CONFIG.DB must be edited to include the following line:

LDCHECK = OFF

Once the above operations have been performed, the system must be re-booted so that the new path-configuration becomes operational.

At this stage the WISE 2.1 data handling system and "international profile data set" can be accessed by entering:

WISE

Full data base structure definitions, indexing conventions, and coding conventions may be found in Appendix 5 to 7 (from Batjes, 1995).

Appendix 5. Structure and attributes of WISE database files

A) WISE database files

Structure for database: WISESITE.DBF

Field Name	Type	Width	Dec	Description
WISE_ID	Character	5		Unique profile reference number
LAB_ID	Character	4		Unique laboratory reference number
SOURCE_ID	Character	10		Unique reference number for source of profile data
REFPAG	Character	50		Profile/page reference in source
HORNUM	Numeric	1		Number of horizons described for pit (Y/N, control variable)
FAO_74	Character	2		FAO-Unesco (1974), classification as code
PHA_74	Character	2		As above, but code for (main) phase
TOP_74	Character	1		As above, but code for topsoil textural class
FAO_90	Character	3		FAO-Unesco (1990), classification as code
PHA_90	Character	2		As above, but code for (main) phase
USCL	Character	50		USDA Soil Taxonomy classification, descriptive
USYR	Character	2		Year (version of Soil Taxonomy, e.g., 75, 94)
LOCAL	Character	50		Local classification, descriptive
DESCR	Character	1		Profile description status, code
DATE	Character	5		Date profile was first described
COUN	Character	2		ISO code for country of origin
LOCAT	Character	50		Location of profile, descriptive
LATIT	Character	1		Latitude of profile (N/S)
LATDEG	Character	2		degrees
LATMIN	Character	2		minutes
LATSEC	Character	2		seconds
LONGI	Character	1		Longitude of profile (E/W)
LONDEG	Character	3		degrees
LONMIN	Character	2		minutes
LONSEC	Character	2		seconds
ALTIT	Numeric	4		Elevation (m)
LFORM	Character	2		Landform, code
POSIT	Character	2		Position, code
ASPECT	Character	3		Aspect, code
SLOPE	Character	3		Slope at profile site (%)
DRAIN	Character	2		Drainage condition, code
GRWHI	Numeric	4		Average, highest groundwater level (cm)
GRWLO	Numeric	4		Average, lowest groundwater level (cm)
SOLDEP	Numeric	4		Average, soil depth to a physically limiting layer (cm)
PARMAT	Character	3		Parent material, code
PARREM	Character	50		Remarks on parent material, descriptive
KOPPEN	Character	3		Köppen climate classification, code
LANDUS	Character	3		Land use, code
CROPS	Character	2		Crops, code
VEGCOD	Character	2		Vegetation, code
VEGREM	Character	100		Remarks on either land use or vegetation, descriptive
REMARKS	Character	5		Data entry source code

Structure for database: WISEHOR.DBF

Field Name	Type	Width	Dec	Description
WISE_ID	Character	5		Unique soil profile number
HORIZ	Character	1		Unique horizon number (in combination with WISE_ID)
DESIG	Character	8		Horizon designation, coded acc. to local system
TOPDEP	Numeric	3		Upper depth of horizon (cm)
BOTDEP	Numeric	3		Lower depth of horizon (cm)
DCOLOR	Character	8		Dry matrix colour, Munsell code
MCOLOR	Character	8		Moist matrix colour, Munsell code
MOTTLE	Character	1		Mottling, code
ROOTS	Character	2		Roots abundance/size, code
ORGC	Numeric	5	2	Org. carbon (%, for method see keymethod.dbf)
TOTN	Numeric	5	2	Total Nitrogen (%)
PTOT	Numeric	5	1	Available phosphorus (mg P_2O_5 kg^{-1})
CACO3	Numeric	4	1	Calcium carbonate content (%)
GYPSUM	Numeric	4	1	Gypsum content (%)
PHH2O	Numeric	4	1	pH measured in water
PHKCL	Numeric	4	1	pH measured in KCl solution
PHCACL2	Numeric	4	1	pH measured in $CaCl_2$ solution
ECE	Numeric	5	2	Electrical conductivity (dS m^{-1} or mmho cm^{-1})
EXCA	Numeric	5	1	Exchangeable calcium (cmol(+) kg^{-1})
EXMG	Numeric	5	1	Exchangeable magnesium
EXNA	Numeric	5	1	Exchangeable sodium
EXK	Numeric	5	1	Exchangeable potassium
EXACID	Numeric	5	1	Exchangeable acidity
EXALUM	Numeric	5	1	Exchangeable aluminum
CECSOIL	Numeric	5	1	Cation exchange capacity (cmol(+) kg^{-1})
ECEC	Numeric	5	1	Effective CEC (cmol(+) kg^{-1}; 1 *M* KCl)
BSAT	Numeric	3		Base saturation, expressed as % of CEC
SAND	Numeric	2		Sand content (w/w%)
SILT	Numeric	2		Silt content (w/w%)
CLAY	Numeric	2		Clay content (w/w%)
GRAVEL	Numeric	2		Gravel content (v/v %)
STRUCT	Character	2		Soil structure, code
BULKDENS	Numeric	5	2	Bulk density (g cm^{-3})
PF	Character	1		Soil moisture content (Y/N, control variable)
PF00	Numeric	2		Soil moisture content (% v/v) held at pF 0
PF10	Numeric	2		As above, but at pF1.0
PF15	Numeric	2		As above, but at pF1.5
PF17	Numeric	2		As above, but at pF1.7
PF20	Numeric	2		As above, but at pF2.0
PF23	Numeric	2		As above, but at pF2.3
PF25	Numeric	2		As above, but at pF2.5
PF27	Numeric	2		As above, but at pF2.7
PF34	Numeric	2		As above, but at pF3.4
PF37	Numeric	2		As above, but at pF3.7
PF42	Numeric	2		As above, but at pF4.2
AWC	Numeric	2		Available water capacity
HC	Character	1		Hydraulic conductivity (control variable)
CONDSAT	Numeric	4	1	Saturated conductivity (cm hr^{-1})
CONDUNSAT	Numeric	4	1	Unsaturated conductivity (cm hr^{-1})

Structure for database: WISEANAD.DBF

Field Name	Type	Width	Dec	Description
WISE_ID	Character	5		Unique profile number
ADD	Character	254		Remarks on profile, descriptive

Structure for database: WISESOUR.DBF

Field Name	Type	Width	Dec	Description
SOURCE_ID	Character	10		Unique reference number for source of profile data
AUTHOR	Character	70		Author name and initials
AUTYR	Numeric	2		Year of publication
REFTIT	Character	100		Title of monograph/database, descriptive
REFPUB	Character	100		Series/publisher/year, descriptive

Structure for database: WISELAB.DBF

Field Name	Type	Width	Dec	Description
LAB_ID	Character	4		Unique laboratory code
LABNAM	Character	150		Reference to laboratory, descriptive

Structure for database: WISEATRIB.DBF

Field Name	Type	Width	Dec	Description
LAB_ID	Character	4		Unique laboratory code
ORGC	Character	2		Number-code of analytical method (KEYMETHO.DBF)
TOTN	Character	2		As above, but for total nitrogen
PTOT	Character	2		As above, but for 'available' phosphorus
CACO3	Character	2		As above, but for calcium carbonate content
GYPSUM	Character	2		As above, but for gypsum content
PHH2O	Character	2		As above, but for pH-water
PHKCL	Character	2		As above, but for pH-KCl
PHCACL2	Character	2		As above, but for pH-$CaCl_2$
ELECON	Character	2		As above, but for electrical conductivity
EXBAS	Character	2		As above, but for exchangeable Ca, Mg, K and Na
EXACID	Character	2		As above, but for exchangeable acidity
CECSOIL	Character	2		As above, but for CEC
ECEC	Character	2		As above, but for ECEC
BSAT	Character	2		As above, but for base saturation
TEXTURE	Character	2		As above, but for texture (definition of esd-sizes + method)
BULKDENS	Character	2		As above, but for bulk density
MOISTCON	Character	2		As above, but for moisture content (pF measurements)
HYDROCON	Character	2		As above, but for hydraulic conductivity

B) Key-description conversion files

Structure for database: KEYAREA.DBF

Field Name	Type	Width	Dec	Description
KEY	Character	2		Unique identifier for broad geographic area (e.g., AF for Africa)
REGION	Character	150		Description of broad geographic area

Structure for database: KEYCOUN.DBF

Field Name	Type	Width	Dec	Description
ISO	Character	2		Country ISO code
COUNTRY	Character	20		Country name, descriptive
REGION	Character	2		Unique identifier for broad geographic area

Structure for database: KEYCROPS.DBF

Field Name	Type	Width	Dec	Description
KEY	Character	2		Arable crops, code
CROPS	Character	25		As above, but descriptive

Structure for database: KEYDRAIN.DBF

Field Name	Type	Width	Dec	Description
KEY	Character	2		Soil drainage class, code
DRAIN	Character	40		As above, but descriptive

Structure for database: KEYFAO.DBF

Field Name	Type	Width	Dec	Description
KEYFAO90	Character	3		FAO-Unesco (1990) Revised Legend, code
FAOUNIT90	Character	20		FAO-Unesco (1974) Legend, code
KEYFAO74	Character	2		FAO-Unesco (1990) classification, descriptive
FAOUNIT74	Character	20		FAO-Unesco (1974) classification, descriptive

Structure for databases: C:\WISE\KEYFAO_1

Field Name	Type	Width	Dec	Description
KEYFAO74	Character	2		FAO-Unesco (1974) Legend, 1st level codes only
FAOUNIT74	Character	20		FAO-Unesco (1974) Legend, descriptive

Structure for database: KEYKOPPE.DBF

Field Name	Type	Width	Dec	Description
KEY	Character	4		Unique identifier for Köppen climate code (e.g., Aw)
KOPPEN	Character	115		Summary description of Köppen climate

Structure for database: KEYLANDF.DBF

Field Name	Type	Width	Dec	Description
KEY	Character	2		Landform, code
LFORM	Character	90		As above, but descriptive

Structure for database: KEYLUS.DBF

Field Name	Type	Width	Dec	Description
KEY	Character	3		Land use, code
LANDUS	Character	45		As above, but descriptive

Structure for database: KEYMETHOD.DBF

Field Name	Type	Width	Dec	Description
KEY	Character	4		Unique identifier code (such as "OC"+"01")
LABMETHOD	Character	175		Summary description of laboratory method

Structure for database: KEYMOTTL.DBF

Field Name	Type	Width	Dec	Description
KEY	Character	1		Soil mottling, code
MOTTLE	Character	20		As above, but descriptive

Structure for database: KEYPAREN.DBF

Field Name	Type	Width	Dec	Description
KEY	Character	3		Parent material, code
PARMAT	Character	50		As above, but descriptive

Structure for database: KEYPH74.DBF

Field Name	Type	Width	Dec	Description
KEY	Character	2		Code for FAO-Unesco (1974) phase
PHA_74	Character	15		As above, but descriptive

Structure for database: KEYPH90.DBF

Field Name	Type	Width	Dec	Description
KEY	Character	2		Code for FAO-Unesco (1990) phase
PHA_90	Character	15		As above, but descriptive

Structure for database: KEYPOSIT.DBF

Field Name	Type	Width	Dec	Description
KEY	Character	2		Site position, code
POSITI	Character	25		As above, but descriptive

Structure for database: KEYREGION.DBF

Field Name	Type	Width	Dec	Description
ISO	Character	2		Country ISO code
COUN	Character	20		Country name, descriptive
REGION	Character	2		Code for broad region (see KEYAREA.DBF)

Structure for database: KEYROOTS.DBF

Field Name	Type	Width	Dec	Description
KEY	Character	2		Roots abundance and size, code
ROOTS	Character	40		As above, but descriptive

Structure for database: KEYSTATU.DBF

Field Name	Type	Width	Dec	Description
KEY	Character	1		Profile description status, code
DESCR	Character	25		As above, but descriptive

Structure for database: KEYSTRUC.DBF

Field Name	Type	Width	Dec	Description
KEY	Character	2		Soil structure, code
STRUCT	Character	30		As above, but descriptive

Structure for database: KEYTEXT.DBF

Field Name	Type	Width	Dec	Description
KEY	Character	1		FAO-Unesco (1974) topsoil texture class, code
TOP_74	Character	15		As above, but descriptive

Structure for database: KEYVEGET.DBF

Field Name	Type	Width	Dec	Description
KEY	Character	2		Vegetation classification, code
VEGCOD	Character	30		As above, but descriptive

Structure for database: WIS_EXTE.DBF

Field Name	Type	Width	Dec	Description
FIELD_NAME	Character	10		Name of field
FIELD_TYPE	Character	1		Type of field (C, N, L)
FIELD_LEN	Numeric	3		Length of field
FIELD_DEC	Numeric	3		Decimal places
FIELD_IDX	Character	1		Index

Appendix 6. WISE 2.1 database coding protocols

A -- SITE ATTRIBUTES

WISE_ID:
Unique reference number for the soil profile in question, which consists of the country's ISO-3166 code (see Appendix 7) followed by 3 numbers (Example: BR022).

FAO-Unesco classification (1974):
Classification of profile according the 1 or 2 letter codes used in the Key to Soil Units (FAO-Unesco, 1974 p. 43-53), for example E for a Rendzina and Ge for an Eutric Gleysol. A thorough classification is crucial, because the code provides the main "key" for linking the profile data to the spatial database.

FAO-Unesco phase (1974, p. 5-7):
The main phase, specified using the codes presented below:

Code	Description
ST	stony
PE	petric
MK	petrocalcic
LI	lithic
MY	petrogypsic
PH	phreatic
X	fragipan
MQ	duripan
Z	saline
SO	sodic
CE	cerrado
MS	petroferric

Topsoil texture class:
Textural class of the upper 30 cm of the mineral soil (FAO-Unesco, 1974 p. 4-5), specified according to the codes below:

Code	Description	Range in % clay and sand
C	coarse	< 15% clay* and > 65% sand
M	medium	< 35% clay and < 70% sand or ≤ 85% clay if clay ≥ 15%
F	fine	> 35% clay

* Clay, silt and sand-size minerals as used in FAO-ISRIC (1990).

FAO-Unesco classification (1990):
These are to be encoded using the 3-letter codes of the Key to Major Soil Groupings and Soil Units (FAO-Unesco, 1990 p. 74-88), for example, HSf for a Fibric Histosol and ACp for a Plinthic Acrisol.

FAO-Unesco phase (1990, p. 68):
The main phase, specified using the codes presented below:

Code	Description	Code	Description
AN	anthraquic	PF	petroferric
DU	duripan	PH	phreatic
FR	fragipan	PL	placic
GE	gelundic	SO	sodic
GI	gilgai	RU	rudic
IN	inundic	SA	salic
SK	skeletic	TK	takyric
YR	yermic	LI	Lithic

USDA Soil Taxonomy:
The classification is to be specified at the subgroup level, as a text string with a maximum length of 50 characters (see Soil Survey Staff, 1994; abbreviate if necessary).

Version of USDA Soil Taxonomy:
Two characters indicating the version/year of USDA Soil Taxonomy (e.g., 75, 87, 90, 94).

Local soil classification:
The classification according to the National System, up to a maximum of 50 characters (abbreviate if necessary).

SOURCE_ID:
The unique SOURCE_ID provides an alphanumeric reference to the source from which the soil profile data were derived, for example a soil monograph or digital database. The format is free, provided the total length is less than 10 characters (e.g., AF5/34.1 for a source from the ISRIC library).

Ref. in source:
The page and number of the profile in the source represented by SOURCE_ID.

LAB_ID:
This unique code provides an alphanumeric reference to the laboratory where the measurements have been made. The LAB_ID consists of the country's ISO-code, followed by two numbers (Example: IN02). Further information on the analytical procedures that have been used to measure a certain attribute can be described on Form C, using the coding system held in the KEYMETHO.DBF database file.

Soil profile description status:
This code refers to the completeness of the soil descriptions and analytical data for the specified profile. The description status is determined after screening of the original profile description and the analytical data for possible inconsistencies. It may be seen as an indicator of the (likely) accuracy and reliability of the data shown. The following distinctions are made (modified after FAO-ISRIC, 1990).

Code	Description
1	ISIS or other Reference Pedon Description (additional information is provided under the heading SOURCE_ID).
2	Routine profile description in which no essential data are lacking from the description, sampling or analysis. The data give a good indication of the nature of the soil in the FAO-Unesco (1974) Legend.
3	Incomplete description in which certain relevant elements are missing from the description, an insufficient number of samples collected, or the reliability of the analytical data do not permit a complete characterization of the soil. The description is however useful for specific purposes and provides a satisfactory indication of the nature of the soil in the FAO-Unesco (1974) Legend.
4	Other descriptions in which essential elements are lacking from the description, preventing a satisfactory soil characterization and classification*.

* Generally not accepted for inclusion in WISE database unless soil unit is grossly under represented in global data set.

Date of description:
The date on which the profile was described, specified as month and year (MM/YY).

Country:
The country where the profile was described, specified according to the ISO-3166 codes (Example: NE for Niger, see Appendix 7).

Location:
Description of general location of profile (e.g., town, province), as text string of maximum 50 characters.

Coordinates of soil profile:
The full coordinates of the soil profile given as degrees, minutes and seconds latitude (N or S) and longitude (E or W). The coordinates can be derived from an appropriately detailed topographical map, and must be accurate to at least 25 km in view of their application in a ½° by ½° spatial database (A ½° by ½° degree grid corresponds approximately with 55 x 55 km at the equator). [**Note**: if only deg. min. is given in the database, this indicates the profile coordinates are approximative and derived from the Times Atlas (1993)].

Altitude:
The altitude of the soil profile relative to mean sea level, specified in meters. This information can be derived from a suitably detailed topographical map. (Note: 1 foot = 0.3048 m).

Landform:
This refers to the major landforms, which are described principally by their morphology and not by their genetic origin, or processes responsible for their shape. The first differentiating criterion is the dominant slope, followed by relief intensity as used in the SOTER manual (Van Engelen and Wen, 1993 p. 24-25):

Code	Landform	Description
L	Level land	Land with characteristic slopes of 0-8 %, and a relief intensity of less than 100 m per km.
S	Sloping land	Land with characteristic slopes of 8-30 % and a relief intensity of more than 50 m per slope unit. Areas with a limited relief intensity (< 50 m per slope unit) but slopes in excess of 8% are included, as are isolated mountains (relief intensity > 600 m) with slopes of 8-30 %.
T	Steep land	Land with characteristic slopes of over 30 % and a relief intensity of mostly more than 600 m per 2 km.
C	Land with composite landforms	Land made up of steep elements together with sloping or level land, or sloping land with level land, in which at least 20 % of the area consists of land with the lesser slope.

Codes for second level major landforms are used in the WISE database. The initial breakdown of major landforms is made according to the procedures of the SOTER Manual:

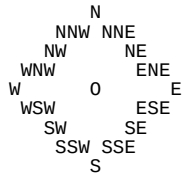
First level	Second level		Gradient	Relief intensity
L Level land	LP	plain	0-8%	< 100 m/km
	LL	plateau	0-8%	< 100 m/km
	LD	depression	0-8%	< 100 m/km
	LF	low-gradient footslope	0-8%	< 100 m/km
	LV	valley floor	0-8%	< 100 m/km
S Sloping land	SM	medium-gradient mountain	15-30%	> 600 m/2km
	SH	medium-gradient hills	8-30%	> 50 m/s.u.
	SE	med.-gradient escarpment zone	15-30%	< 600 m/2km
	SR	ridges	8-30%	> 50 m/s.u.
	SU	mountainous highland	8-30%	> 600 m/2km
	SP	dissected plain	8-30%	> 50 m/s.u.
T Steep land	TM	high-gradient mountain	> 30%	> 600 m/2km
	TH	high-gradient hill	> 30%	< 600 m/2km
	TE	high-grad. escarpment zone	> 30%	> 600 m/2km
	TV	high gradient valleys	> 30%	variable
C Land with composite	CV	valley	> 8%	variable
	CL	narrow plateau	> 8%	variable
	CD	major depression	> 8%	variable

Note: s.u. stands for slope unit. Where this is not clear from the gradient or relief intensity, the distinction between the various second level major landforms follows from the description.

Landscape position:
The physiographic position of the site where the profile is located, specified according to the following system (FAO-ISRIC, 1990 p. 7).

Code	Description
Position in undulating to mountainous terrain	
CR	Crest/top
UP	Upper slope
MS	Middle slope
LS	Lower slope
BO	Bottom (flat)
Position in flat or almost flat terrain	
HI	Higher part
IN	Intermediate part
LO	Lower part
BO	Bottom (drainage line)

Aspect:
The aspect of the site coded using the following format: N, NNE, NE, ENE, E, ..., NNW. In case of flat or almost level land, the aspect is indicated as O (letter) .



Slope gradient:
The slope refers to the inclination of the land immediately surrounding the site. The measured or estimated slope angle is specified to the nearest per cent.

Drainage class:
The internal drainage class is coded according to the conventions of FAO-ISRIC (1990 p. 20). In WISE, intergrades of two neighbouring drainage classes may be indicated by a combination of two codes. For instance "VP", represents a soil with very poor to poor internal drainage.

Code	Description
V	very poorly drained
P	poorly drained
I	somewhat poorly (imperfectly) drained
M	moderately well drained
W	well drained
S	somewhat excessively drained
E	excessively drained

Depth of groundwater table:
The measured or estimated depth to the groundwater table, if present/known, indicating both the mean highest and mean lowest values during the year. Depths are specified in centimetres from the surface. If the water-table always occurs at a great depth, this can by entering similar values for the both the mean high and low values (e.g., 200 cm).

Soil depth to rock:
The average measured or estimated depth, in cm, from the surface to a layer that *physically* precludes the development of most roots. Limitations of a chemical nature, such as high levels of salt/alkali, are not considered under this heading as they are often of a transient nature, being prone to change with agricultural practices.

Parent material/lithology:
The main parent rock/material over which the soil has been formed is coded using the categories considered in the SOTER manual and FAO-ISRIC (1990, p. 14). Additional codes, introduced in the context of the WISE project, and are indicated by an asterisk:

Major class	Group		Type	
I Igneous rocks	**IA**	acid igneous	**IA1**	granite
			IA2	grano-diorite
			IA3	quartz-diorite
			IA4	rhyolite
	II	intermediate igneous	**II1**	andesite, trachyte, phonolite
			II2	diorite-syenite
	IB	basic igneous	**IB1**	gabbro
			IB2	basalt
			IB3	dolerite
	IU	ultrabasic igneous	**IU1**	peridotite
			IU2	pyroxenite
			IU3	ilmenite, magnetite, ironstone, serpentine
M Metamorphic rocks	**MA**	acid metamorphic	**MA1**	quartzite
			MA2	gneiss, migmatite
			MA3*	slate, phyllite
			MA4*	schists
	MB	basic metamorphic	**MB1**	slate, phyllite (pelitic rocks)
			MB2	schist
			MB3	gneiss rich in ferro-magn. min.
			MB4	metamorphic limestone (marble)
S Sedimentary rocks	**SC**	clastic sediments	**SC1**	conglomerate, breccia
			SC2	sandstone, greywacke, arkose
			SC3	siltstone, mudstone, claystone
			SC4	shale
	SO	organic	**SO1**	limestone, other carb. rocks
			SO2	marl and other mixtures
			SO3	coals, bitumen and rel. rocks
	SE	evaporites	**SE1**	anhydrite, gypsum
			SE2	halite

(Parent material/lithology cont.)

Major class	Group	Type
U Unconsolidated	**UF**	fluvial
	UL	lacustrine
	UM	marine
	UC	colluvial
	UE	eolian
	UG	glacial
	UP	pyroclastic
	UO	organic
	UX*	soft laterite and ferruginous materials
	UY*	hardened laterite and ferruginous materials

* Additional, tentative codes

Remarks on parent material/lithology:
When necessary, additional remarks about the parent material can be specified as text on the proforma, with a maximum length of 50 characters.

Köppen climate classification:
The climate at the site is classified according to the Köppen system which considers precipitation effectiveness for plant growth as the major classification factor, and uses the appropriate seasonal values of temperature and precipitation to determine the limits of climatic groupings. The Köppen system figures a shorthand code of letters designating major climate groups, subgroups within these major groups, with further subdivisions to distinguish particular seasonal characteristics of temperature and precipitation (adapted from Strahler, 1969 p. 224; Times Atlas, 1993).

a) Major climate groups
The following major climate groups are considered:

Code	Classification and description
A	Tropical (rainy) climates: Average temperature of every month is above 18 °C. These climates have no winter season. Annual rainfall is large and exceeds annual evaporation.
B	Dry: Potential evaporation exceeds precipitation on the average throughout the year. No water surplus; hence no permanent streams originate in B climate zones.
C	Warm temperate (mesothermal) climates: Coldest month has an average temperature under 18 °C, but above -3 °C. The C climates thus have both a summer and a winter season.
D	Snow (microthermal) climates: Coldest month average temperature under -3 °C. Average temperature of the warmest month above 10 °C, that isotherm corresponding approximately with pole-ward limit of forest growth.
E	Ice climates: A polar climate type with average temperature in no month averaging over 10 °C. These climates have no true summer
H	Mountain/Highland climates

b) Subgroups

Subgroups within the major climate groups are designated by a second letter according to the following code:

Code	Description
S*	Steppe climate, a semiarid climate with about 380 to 760 mm of rainfall annually at low latitudes.
W	Desert climate. Arid climate. Most regions included have less than 250 mm of rainfall annually.
f	Moist. Adequate precipitation in all months. No dry season. This modifier is applied to major climate types A, C and D.
w	Dry season in winter of the respective hemisphere (low-sun season)
s	Dry season in summer of the respective hemisphere (high-sun season)
m	Rainforest climate despite a short dry season in monsoon type of precipitation cycle. Applies only to A climates.

* The letters S and W are applied only to the dry climates (i.e., BS and BW).

From combinations of the two letter groups, 12 distinct climates emerge as follows:

Code	Description
Af	Tropical rainforest (also Am a variant of Af)
Aw	Tropical savanna
BS	Steppe climate
BW	Desert climate
Cw	Temperate rainy (humid mesothermal) climate with dry winter
Cf	Temperate rainy (humid mesothermal) climate moist all seasons
Cs	Temperate rainy (humid mesothermal) climate with dry summer
Df	Cold snowy forests (humid microthermal) climate moist in all seasons
Dw	Cold snowy forest (humid microthermal) climate with dry winter
ET	Tundra climate
EF	Climates of perpetual frost (ice-caps)
H	Mountain/Highland climates (undifferentiated)

c) A third letter may be added to differentiate still more variations. Meanings are as follows:

Code	Description
a	With hot summer; warmest month over 22 ºC (C and D climates)
b	With warm summer; warmest month below 22 ºC (C and D climates)
c	With cool, short summer; fewer than four months over 10 ºC (C and D climates)
d	With very cold winter; coldest months below - 38 ºC (D climates only)
h	Dry-hot; mean annual temperature over 18 ºC (B climates only)
k	Dry-cold; climates annual temperature under 18 ºC (B climates only).

The unique, Köppen codes allowed in WISE are listed in file KEYKOPPE.DBF. For example BWk, which refers to a dry-cold, desert climate.

Current land use:

The current land use at the site is coded using the classes given by FAO-ISRIC (1990 p. 13), as below:

Code	Description
S	**Settlement Industry**
SR	Residential use
SI	Industrial use
ST	Transport
SC	Recreational use
SX	Excavations
A	**Crop Agriculture**
AA	Annual field cropping
AA1	Shifting cultivation
AA2	Fallow system cult.
AA3	Ley system cult.
AA4	Rainfed arable cult.
AA5	Wet rice cultivation
AA6	Irrigated cultivation
AP	Perennial field cropping
AP1	Non-irrigated cult.
AP2	Irrigated cult.
AT	Tree and shrub cropping
AT1	Non-irr. tree crop cult.
AT2	Irrigated tree crop cult.
AT3	Non-irrigated shrub crop cultivation
AT4	Irrigated shrub crop cultivation
H	**Animal Husbandry**
HE	Extensive grazing
HE1	Nomadism
HE2	Semi-nomadism
HE3	Ranching
HI	Intensive grazing
HI1	Animal Production
HI2	Dairying
F	**Forestry**
FN	Natural forest and woodland
FN1	Selective felling
FN2	Clear felling
FP	Plantation forestry
M	**Mixed farming**
MF	Agro-forestry
MP	Agro-pastoralism (cropping and livestock systems)
E	**Extraction and Collection**
EV	Exploitation of natural vegetation
EH	Hunting and fishing
P	**Nature Protection**
PN	Nature and game reserve
PN1	Reserves
PN2	Parks
PN3	Wildlife management
PD	Degradation control
PD1	Without interference
PD2	With interference
U	**Not Used and Not Managed**

Main corp (for arable uses):

The dominant crop is coded using the following list (adapted from FAO-ISRIC, 1990).

Code	Crop	Code	Crop	Code	Crop
BA	Barley	FR	Fruit trees	SO	Sorghum
BE	Beans	GR	Groundnut	SB	Soybean
CH	Cashew	MA	Maize	SC	Sugar cane
CA	Cassava	MI	Millet	SF	Sunflower
CO	Cocoa	OL	Oil/protein crops	SI	Sisal
CN	Condiments	OP	Oil palm	SP	Sweet potato
CC	Coconut	PE	Peas	SU	Sugar beet
CE	Cereals (unsp.)	PO	Potato	ST	Stimulants (unsp.)
CF	Coffee	RI	Rice	TC	Tuber crops (unsp.)
CT	Cotton	RB	Rice (flooded)	TE	Tea
CP	Cowpea	RT	Root crops (unsp.)	TB	Tobacco
FB	Fibre crops	RU	Rice (upland)	VE	Vegetables
FD	Fodder crops	RR	Rubber	WH	Wheat
				YA	Yams

Vegetation:
The natural vegetation at a site is described using the broad classes given by Unesco (1973), conforming with the coding conventions of SOTER:

Code	Description	Code	Description
F	**Closed Forest**	**D**	**Dwarf scrub**
FE	Evergreen forest	DE	Evergreen dwarf shrub
FS	Semi-deciduous forest	DS	Semi-deciduous dwarf shrub
FD	Deciduous forest	DD	Deciduous dwarf shrub
FX	Xeromorphic forest	DX	Xeromorphic dwarf shrub
		DT	Tundra
W	**Woodland**		
WE	Evergreen woodland	**H**	**Herbaceous**
WS	Semi-deciduous wood.	HT	Tall grassland
WD	Deciduous woodl.	HM	Medium grassland
WX	Xeromorphic woodl.	HS	Short grassland
		HF	Forb
S	**Scrub**	HE*	Hydromorphic vegetation
SE	Evergreen shrub		
SS	Semi-deciduous shrub		
SD	Deciduous shrub		
SX	Xeromorphic shrub		

* New code

Remarks on land use or vegetation:
Additional remarks, for instance about the crop rotation or felling history, can be entered as text with a maximum length of 100 characters.

Number of horizons:
This refers to the total number of horizons for which analytical data are available. The maximum number of horizons that can be accommodated per profile in the database is 9. However, physically, there is only place for 6 horizons on each data entry sheet.

B - HORIZON ATTRIBUTES

Horizon number:
This number is automatically created by the WISE input module. Data for the main horizons must be entered from the surface downwards. If more than 9 soil horizons are described in the original source, it may be necessary to 'regroup' this information to a smaller number. This should only be done for the subsoil, for example, by averaging numeric data for similar horizons such as a Btg1 and Btg2.

Horizon designation:
Whenever possible, the horizon designation should be given according to the terminology of FAO-ISRIC (1990).

Top (upper) depth:
Upper depth of horizon (cm). In case of a litter layer, use negative numbers (e.g., top depth of -20 cm to bottom depth of 0 cm). If the original depth of a horizon is given as e.g. 30/40 cm, the horizon depth is entered as (30+40)/2= 35 cm.

Bottom (lower) depth:
Lower depth of horizon (cm). If the lower depth of a profile is not indicated and analytical data are available for the last horizon, the assumption is that this horizon is 15 cm thick. For example, 75^{+} cm would imply a lower depth of 90 cm.

Organic carbon:
Organic carbon (% by weight) is specified with 2 decimal places. The code for the measurement method is to be specified separately on Form C. [**Note**: The codes for the analytical methods are held in KEYMETHO.DBF. The list of codes will grow as new analytical procedures are encountered during data collection. The most recent list can be printed with option <6> of the selection menu of WISE (see Section 4.5)].

Total Nitrogen:
Total nitrogen (% by weight) is rounded to 2 decimal places. The code for the measurement method is to be specified separately on Form C (see KEYMETHO.DBF).

Available P:
Available (extractable) P content, by weight, in mg P_2O_5 kg^{-1} soil. The code for the measurement method is to be specified separately on Form C (see KEYMETHO.DBF).

pH-H_2O:
Measured in water at a soil:water ratio which is to be specified in the 'analytical methods' key-file. One decimal is adequate.

pH-KCL:
Measured in 1 *M* KCl solution at the soil:solution ratio specified with the data. The code for the measurement method is to be specified separately on Form C (see KEYMETHO.DBF).

pH-$CaCl_2$:
Measured in 1 *M* $CaCl_2$ solution at the soil:solution ratio specified with the data. The code for the measurement method is to be specified separately on Form C (see KEYMETHO.DBF).

Electrical conductivity (EC):
Specify the EC for the horizon, indicating the soil:water ratio. The unit used is mS cm^{-1} or dS m^{-1}, originally mmho cm^{-1}, at 25 ^{o}C. The code for the measurement method is to be specified separately on Form C (see KEYMETHO.DBF).

$CaCO_3$:
Total $CaCO_3$ content (% by weight) is rounded off to the nearest integer. The code for the measurement method is to be specified separately on Form C (see KEYMETHO.DBF).

$CaSO_4$:
Total gypsum ($CaSO_4.2H_2O$) content, by weight %, is rounded off to the nearest integer. The code for the measurement method is to be specified separately on Form C (see KEYMETHO.DBF).

Exchangeable bases (Ca^{2+}, Mg^{2+}, K^+ and Na^+):
To be specified in cmol(+) kg^{-1}, using 1 decimal. The code for the measurement method is to be specified separately on Form C (see KEYMETHO.DBF).

Exchangeable acidity (Al^{3+} and H^+):
Obtained with a percolation of a soil sample with a 1 *M* KCl solution. Exchangeable acidity is measured by titration of the percolate, and exchangeable aluminum is determined separately in the percolate. Exchangeable acidity is specified in cmol(+) kg^{-1}, using 1 decimal. [**Note**: Values for exchangeable acidity, determined in 1 *M* KCl percolate, and extractable acidity, equilibrated with a $BaCl_2$-TEA buffer at pH 8.2, refer to different measurement methods!]

Exchangeable aluminum (Al^{3+}):
Exchangeable aluminum, in cmol(+) kg^{-1}, as determined separately in the percolate described above.

Cation exchange capacity (CEC):
CEC is given in cmol(+) kg^{-1}, using 1 decimal, according to the method specified on Form C.

Effective cation exchange capacity (ECEC):
ECEC is determined by summation of exchangeable bases and exchangeable acidity, and expressed in cmol(+) kg^{-1} using 1 decimal (i.e., ECEC= Exch[Ca^{2+} + Mg^{2+} + K^+ + Na^+] +

Exch[H^+ + Al^{3+}]). [**Note**: The above definition is used in the WISE database to conform with the definition of the ISRIC laboratory (Van Reeuwijk, 1990, p. 11.1)].

Base saturation (BS):
Specified as nearest integer, and calculated as sum of exchangeable cation bases (Ca^{2+}, Mg^{2+}, K^+ and Na^+) divided by the CEC, measured with the specified CEC method, times 100%.

Matrix colour, dry:
The dry colour is specified using the Munsell Colour Charts. Colour codes have the general form: hue, value, chroma (e.g., 5YR5/3). All "complex" Munsell codes must be rounded off. For example, 10YR3.5/1 would become 10YR4/1.

Matrix colour, moist:
The moist colour is specified using the Munsell Colour Charts (e.g., 5YR3/2).

Mottling:
Mottling in a horizon is characterized by its abundance (after FAO-ISRIC, 1990 p. 42).

Code	Description	% of occurrence
N	none	positive statement
V	very few	0-2 %
F	few	2-5 %
C	common	5-15 %
M	many	15-40 %
A	abundant	> 40 %

Roots:
The presence of roots is described using a two character code (FAO-ISRIC, 1990 p. 63). The first letter of this code refers to the overall size of the roots, and the second letter to their abundance (e.g., MC stands for many coarse roots).

- Abundance of roots (expressed as number of roots per square decimeter):

Code	Quantity	Description
O	no roots	0
V	very few	1-20
F	few	20-50
C	common	50-200
M	Many	> 200

- Description of root sizes:

Code	Description	Diameter (mm)
V	very fine	< 0.5 mm
F	fine	0.5-2 mm
M	medium	2-5 mm
C	coarse	> 5 mm
X	all	very fine roots to coarse

Soil structure:
The type of soil structure is described according to the classes of FAO-ISRIC (1990 p. 51):

Code	Description of class	Code	Description
SG	single grain	AS	angular and subangular blocky
MA	massive	SA	subangular and angular blocky
CR	crumb	SN	nutty subangular blocky
GR	granular	AW	angular blocky wedge-shaped
PR	prismatic	AP	angular blocky parallelepiped
PS	subangular prismatic	PL	platy
CO	columnar	RS	rock structure
AB	angular blocky	SS	stratified structure
SB	subangular blocky		

Particle size distribution:
The particle size distribution refers to the fine earth fraction only (< 2 mm). The weight percentages of sand-, silt- and clay-size materials are given as integers. The analytical procedure and 'esd' or equivalent spherical diameter for the clay-, silt-, and sand-size fractions must be documented on Form C. For example: pipette method, full dispersion; esd: <2 µm, < 50 µm and < 2 mm.

Stone and gravel content:
Give a visual estimate of the percentage of large rock and mineral fragments with a diameter larger than 2 mm, rounded off to the nearest 5 per cent.

Bulk density:
Bulk density (oven dry sample) is given as g cm^{-3}, using two decimals.

Soil water retention:
The *volume* percentage of water (MC) in the soil horizon, at the considered pF-values (i.e., 0.0, 1.0, 1.5, 1.7, 2.0, 2.3, 2.5, 2.7, 4.3, 3.7 and 4.2; see WISEHOR.DBF p. 27), is to be specified as an integer. The moisture content is expressed on a percent by volume basis:

MC (% by volume v/v) = MC (% by weight w/w) x bulk density (kg m^{-3})

Selected pF-values or suctions, at which the soil water retention measurements were made, can be entered on the data entry sheet. (Indicate which pF values are considered to correspond with the Field Capacity and the Permanent Wilting Point so that the Available Water Capacity (AWC) can be calculated). [*Note*: pF is the $\log_{10}$ [head(cm of water)], i.e. a head of 100 cm of water corresponds with a pF of 2.0. (1 bar = 1017 cm of water = 100 kPa = 0.987 atmosphere)]

Hydraulic conductivity:
Hydraulic conductivity or permeability (cm hr^{-1}) varies with soil moisture conditions (pF values). Two values can be entered: (a) saturated hydraulic conductivity, and (b) non-saturated hydraulic conductivity.

C ——– SOURCE OF DATA

SOURCE_ID:
Unique code for source (e.g., soil monograph or digital database).

Source:
Authors and initials, as text string (For example: Van Waveren, E.J. and Bos, A.B.).

Year:
Year data during which the profile data were collected/described (For example: 1988).

Title:
Title of source in which data are published, as text string (For example: ISRIC Soil Information System).

Series/publisher/year:
Self-explanatory, as text string (For example: Technical Paper 15, International Soil Reference and Information Centre, Wageningen).

LAB_ID:
Unique reference code for laboratory where analyses for relevant profile(s) were made (e.g., FR01).

Laboratory name:
Name of laboratory where analyses were made, as text string.

Coding system for analytical methods:

- Organic Carbon (OC__)
- Total Nitrogen (TN__)
- Available Phosphorus (TP__)
- pH-water (PH__)
- pH-KCl (PK__)
- pH-$CaCl_2$ (PC__)
- Electrical conductivity (EL__)
- Free CaCO3 (CA__)
- Gypsum (GY__)
- Exch. Ca, Mg, K, and Na (EX__)
- Exch. acidity and Aluminum (EA__)
- CEC soil (CS__)
- ECEC soil (CE__)
- Base saturation (BS__)
- Particle size distribution (TE__)
- Bulk density (BD__)
- Moisture content (MC__)
- Hydraulic conductivity (HC__)

Note: All codes, plus a brief description of the corresponding analytical procedures, are documented in KEYMETHO.DBF, for example "OC01" stands for "Method of Walkley-Black". This information can be printed with option <6> of the TOOLS menu.

Appendix 7. List of country ISO codes

AF	Afghanistan
AL	Albania
DZ	Algeria
AS	American Samoa
AD	Andorra
AO	Angola
AI	Anguilla
AQ	Antarctica
AG	Antigua and Barbuda
AR	Argentina
AM	Armenia
AW	Aruba
AU	Australia
AT	Austria
AZ	Azerbaijan
BS	Bahamas
BH	Bahrain
BD	Bangladesh
BB	Barbados
BE	Belgium
BZ	Belize
BJ	Benin
BT	Bhutan
BO	Bolivia
BW	Botswana
BV	Bouvet Island
BR	Brazil
IO	Brit. Ind. Ocean Territory
BN	Brunei Darussalam
BG	Bulgaria
BF	Burkina Faso
BU	Burma
BI	Burundi
BY	Belarus
CM	Cameroon
CA	Canada
CV	Cape Verde
KY	Cayman Islands
CF	Central African Republic
TD	Chad
CL	Chile
CN	China
CX	Christmas Island
CC	Cocos Islands
CO	Colombia
CG	Congo
CK	Cook Islands
CR	Costa Rica
HR	Croatia
CU	Cuba
CY	Cyprus
CS	Czechoslovakia
CI	Côte d'Ivoire
DK	Denmark
DJ	Djibouti
DM	Dominica
DO	Dominican Republic
TP	East Timor
EC	Ecuador
EG	Egypt
SV	El Salvador
GQ	Equatorial Guinea
EE	Estonia
ET	Ethiopia
FK	Falkland Islands
FO	Faroe (Islands)
FJ	Fiji
FI	Finland
FR	France
GF	French Guiana
PF	French Polynesia
TF	French Southern Territories
GA	Gabon
GM	Gambia
GE	Georgia
DE	Germany, Fed. Rep. of
GH	Ghana
GI	Gibraltar
GR	Greece
GL	Greenland
GD	Grenada
GP	Guadeloupe
GU	Guam
GT	Guatemala
GN	Guinea
GW	Guinea-Bissau
GY	Guyana
HT	Haiti
HM	Heard and McDonald Islands
HN	Honduras
HK	Hong Kong
HU	Hungary
IS	Iceland
IN	India
ID	Indonesia
IR	Iran, Islamic Republic of
IQ	Iraq
IE	Ireland
IL	Israel
IT	Italy
JM	Jamaica
JP	Japan
JO	Jordan
KH	Kampuchea, Democratic
KZ	Kazakhstan
KE	Kenya
KI	Kiribati
KR	Korea, Republic of
KP	Korea, Dem. Peopl. Rep.
KW	Kuwait
KG	Kyrgystan
LA	Lao, People's Democratic Rep.
LB	Lebanon
LS	Lesotho
LR	Liberia
LY	Libyan Arab Jamahiri
LI	Liechtenstein
LT	Lithuania
LU	Luxembourg
MO	Macau
MG	Madagascar
MW	Malawi
MY	Malaysia
MV	Maldives
ML	Mali
MT	Malta
MH	Marshall Islands
MQ	Martinique
MR	Mauritania
MU	Mauritius
MX	Mexico
FM	Micronesia

MD Moldova, Republic of
MC Monaco
MN Mongolia
MS Montserrat
MA Morocco
MZ Mozambique
NA Namibia
NR Nauru
NP Nepal
NL Netherlands
AN Netherlands Antilles
NT Neutral Zone
NC New Caledonia
NZ New Zealand
NI Nicaragua
NE Niger
NG Nigeria
NU Niue
NF Norfolk Island
MP Northern Mariana Islands
NO Norway
OM Oman
PK Pakistan
PW Palau
PA Panama
PG Papua New Guinea
PY Paraguay
PE Peru
PH Philippines
PN Pitcairn
PL Poland
PT Portugal
PR Puerto Rico
QA Qatar
RE Reunion
RO Romania
RU Russian Federation
RW Rwanda
LC Saint Lucia
WS Samoa
SM San Marino
ST Sao Tome and Principe
SA Saudi Arabia
SN Senegal
SC Seychelles
SL Sierra Leone
SG Singapore
SB Solomon Islands
SO Somalia
ZA South Africa
ES Spain
LK Sri Lanka
SH St. Helena
KN St. Kitts and Nevis
PM St. Pierre and Miquelon
VC St. Vincent and the Grenadines
SD Sudan
SR Suriname
SJ Svalbard and Jan Mayen
SZ Swaziland
SE Sweden
CH Switzerland
SY Syrian Arab Republic
TW Taiwan, Province China
TJ Tajikistan
TZ Tanzania, United Rep. of
TH Thailand
TG Togo
TK Tokelau
TO Tonga
TT Trinidad and Tobago
TN Tunisia
TR Turkey
TM Turkmenistan
TC Turks and Caicos Islands
TV Tuvalu
SU USSR
UG Uganda
UA Ukraine
AE United Arab Emirates
GB United Kingdom
US United States
UY Uruguay
UM US. Minor Outlying Islands
UZ Uzbekistan
VU Vanuatu
VA Vatican City State
VE Venezuela
VN Viet Nam
VG Virgin Islands (U.K.)
VI Virgin Islands (U.S.)
WF Wallis and Futuna Islands
EH Western Sahara
YE Yemen
YD Yemen, Democratic
YU Yugoslavia
ZR Zaire
ZM Zambia
ZW Zimbabwe

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