

# Towards a new harmonized global soil database

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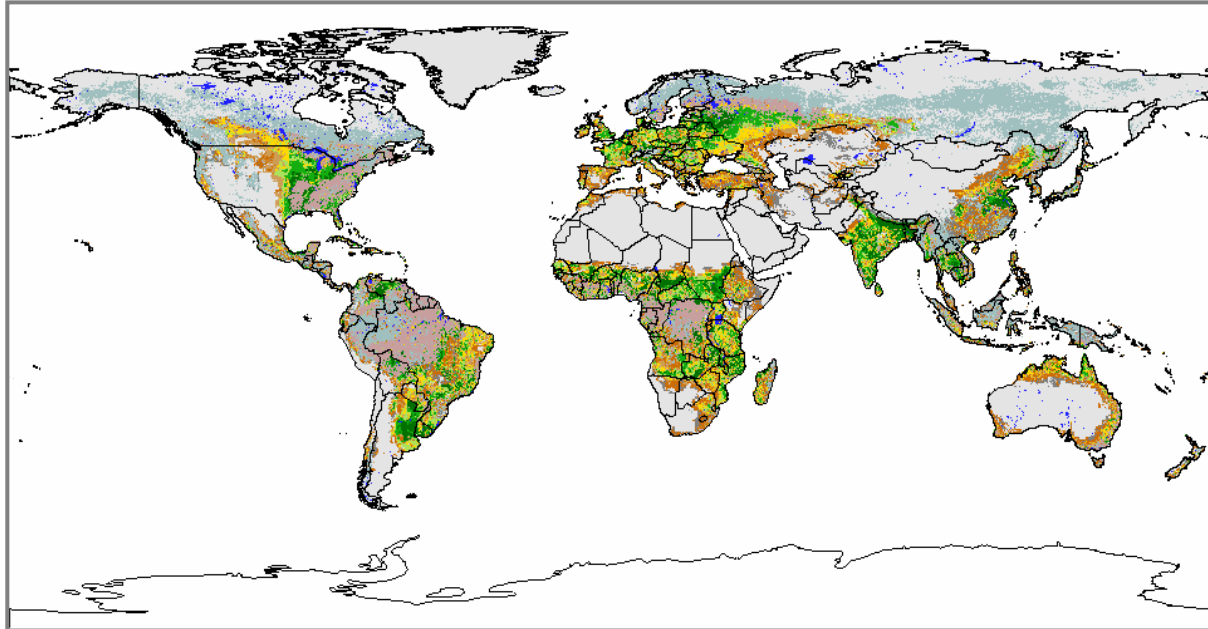
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# Background

The Global agro-ecological zone study (GAEZ) is a long standing initiative of FAO since 1978 to evaluate biophysical constraints and potentials for crop growth and determines the yield potential of crops worldwide under different land management conditions.



# Global AEZ-2007

- As part of an ongoing significant update of the global Agro-ecological zones study, FAO and IIASA since 2004 have prepared a number of new digital products:

- Enhanced terrain module (aggregated 5' grid slope and aspect based on 90m SRTM analysis)
- Improved climatic modules (including 40 year LGP and T variations)
- Expansion of number of crops evaluated (256 crops including varieties)
- More management options (6 including water harvesting)

IIASA and FAO have also produced a **new global harmonized soil database** by combining the major regional soil/SOTER maps/databases produced over the last 10 years and using soil profile information derived from WISE and other sources.

- The prototype product is ready and will be finalized by September 2007 as part of a new GAEZ product on-line.
- The resolution of all the databases in the GAEZ is 5 by 5 arc-minutes (although the original scale/resolution of the products may be smaller or larger).

# A harmonized global soil database: cooperation and competition

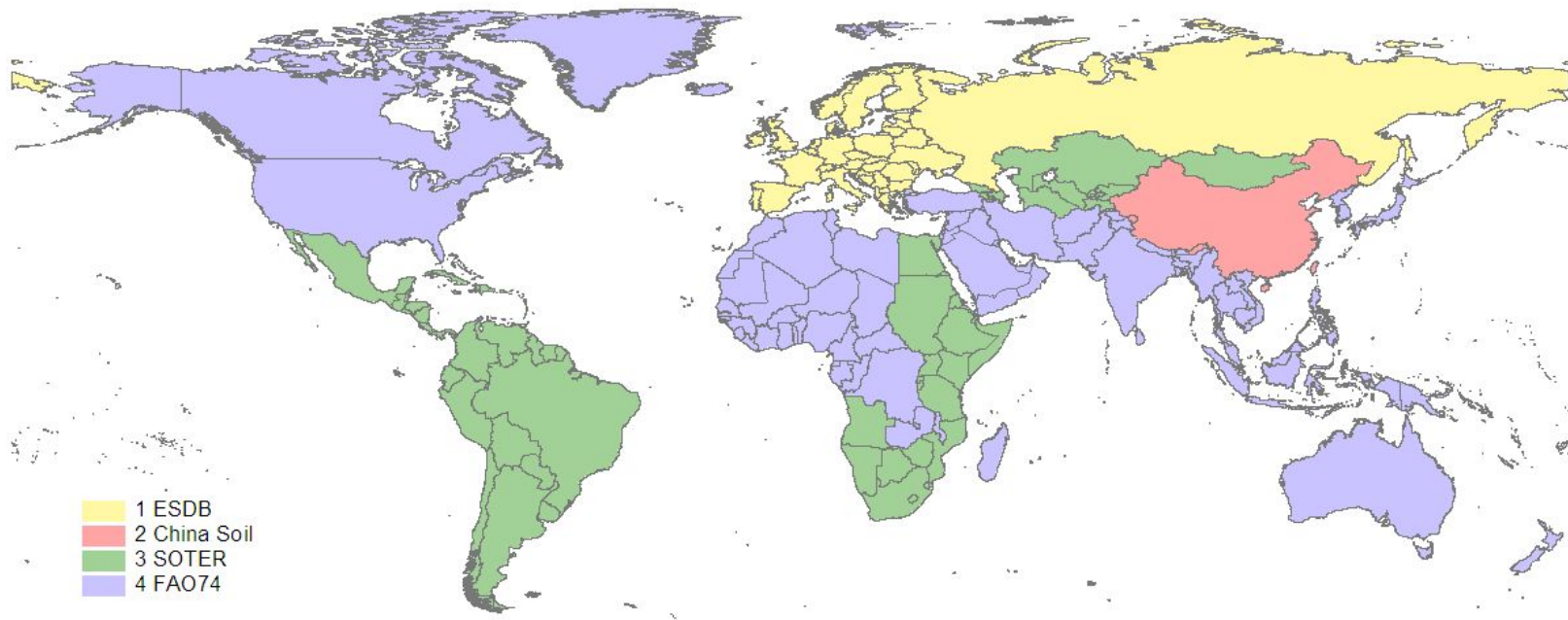
Nearly thirty years after completing the FAO/UNESCO soil map of the world the digital version remains the only global harmonized source of soil information. Over the last decade regional initiatives have considerably enhanced the soil information in certain regions (Europe, the Northern Circumpolar soil map and the various SOTER regional databases).

A meeting took place in December 2006 in the US to explore possibilities to launch a major initiative to produce a similar map as the global database discussed here with possible funding of the Bill Gates foundation. ESNB and IRSIC attended the meeting but the actual status of the Global Digital Soil Map project as it is known and the approach to be applied is unclear.

The ESNB Digital mapping project.

# Sources for the harmonized global soil database

(WORLD SOIL DATABASE 2007)



# Sources for the harmonized global soil database

## (WORLD SOIL DATABASE 2007)

- SOTER: SOTER attributes + FAO soil unit specific attributes, (USDA texture classes, petric, vertic, gelic properties) and drainage.
- ESDB: ESDB (pedotransfer) attributes + WISE – FAO '90 attributes + FAO soil unit specific attributes (USDA texture, petric, vertic and gelic properties), drainage, ESDB soil phases.
- CHINA: China attributes + WISE – FAO '90 attributes + FAO soil unit specific attributes (USDA texture, petric, vertic and gelic properties), drainage, and China/FAO '90 soil phases.
- DSMW: WISE – FAO '74 attributes + FAO soil unit specific attributes (USDA texture, vertic and gelic properties) drainage and FAO '74 soil phases.

# Standardized Soil Attributes

## WORLD SOIL DATABASE 2007

- Soil depth\*\*
- Organic Carbon\*
- pH(H<sub>2</sub>O)\*
- CEC soil\*
- CEC clay fraction\*
- TEB\*
- Base saturation\*
- ESP\*
- Calcium carbonate\*
- Gypsum\*
- Sand fraction\*
- Silt fraction\*
- Clay fraction\*
- ECe\*
- USDA Texture
- Reference Bulk Density
- Soil Drainage\*\*
- Gelic properties\*\*
- Vertic properties\*\*
- Soil Phase information\*\*\*

\* As specified in "Soil data from WISE for use in Global and Regional AEZ Studies" (Version 1.0)

\*\* Derived from soil unit, soil texture, soil phase and terrain slope data.

\*\*\* Additional information for DSMW, ESDB, and China

## WORLD SOIL DATABASE 2007

	Description	Units	Occurrence			
			ESDB	CHINA	SOTWIS	FAO74
ID	Internal database ID	numerical	v	v	v	v
COVERAGE	Source used for GSOIL2007	code	v	v	v	v
COUNTRY	Country Code (ISO 3166)	code	v	v	v	v
MU_GLOBAL	Mapping Unit Code (Global)	numerical	v	v	v	v
MU_SOURCE	Mapping Unit Code (Source)	code	v	v	v	v
MU_SLOPE	Mapping unit specific slope classes	code				v
SU_SYM74	Soil Unit Symbol (FAO 74)	symbol				v
SU_SYM85	Soil Unit Symbol (FAO 85)	symbol	v			
SU_SYM90	Soil Unit Symbol (FAO 90)	symbol	v	v	v	v
SU_CODE74	Soil Unit Code (FAO 74)	code				v
SU_CODE85	Soil Unit Code (FAO 85)	code	v			
SU_CODE90	Soil Unit Code (FAO 90)	code	v	v	v	
CHINA_CODE	Soil unit code China	code		v		
T_TEXTURE	Top-soil Texture	code	v	v	v	v
PHASE1	Soil Phase 1	code	v	v		v
PHASE2	Soil Phase 2	code	v	v		v
SOIL-DEPTH_LIM1	Obstacle to roots (ROO)	code	v			
SOIL-DEPTH_LIM2	Impermeable Layer (IL)	code	v			
SOIL_WATER_REGIME	Soil water regime	code	v			
PERMAFROST	Permafrost Zone	code				v
PETRIC	Petric Conditions	flag	v	v	v	
GELIC	Gelic conditions	flag	v	v	v	v
VERTIC	Vertic Properties	flag	v	v	v	v
DEPTH	Soil depth	cm			v	
REF_DEPTH	Reference Soil depth	cm	v	v	v	v
AWC	Reference AWC	mm/m	v	v	v	v
AWC_CLASS	Reference AWC Class	code	v	v	v	v
SEQ	Sequence	numerical	v	v	v	v
SHARE	Share of Mapping Unit	%	v	v	v	v

GENERAL SOIL INFORMATION



**FAO-IIASA-ISRIC-JRC-China**  
**WORLD SOIL DATABASE 2007**

	Description	Units	Occurrence			
			ESDB	CHINA	SOTWIS	FAO74
T_GRAVEL	% Gravel/Coarse Fragments/Volume Stones	volume %	v	v	v	v
T_SAND	% Sand	%	v	v	v	v
T_SILT	% Silt	%	v	v	v	v
T_CLAY	% Clay	%	v	v	v	v
T_USDA_TEX_NAME	USDA Texture Class Name	name	v	v	v	v
T_USDA_TEX_CLASS	USDA Texture Code	code	v	v	v	v
T_REF_BULK_DENSITY	Reference Bulk Density	kg/dm3 or g/cm3	v	v	v	v
T_OC	Organic Carbon	% weight	v	v	v	v
T_PH_H2O	Soil reaction	numerical	v	v	v	v
T_CEC_CLAY	Cation exchange capacity (clay)	cmol/kg	v	v	v	v
T_CEC_SOIL	Cation exchange capacity (soil)	cmol/kg	v	v	v	v
T_BS	Base Saturation	%	v	v	v	v
T_TEB	Total exchangeable bases	cmol/kg	v	v	v	v
T_CACO3	Calcium carbonate	% weight	v	v	v	v
T_CASO4	Gypsum content	% weight	v	v	v	v
T_ESP	Exchangeable sodium percentage	%	v	v	v	v
T_ECE	Electrical conductivity	dS/m	v	v	v	v

**TOP SOIL INFORMATION**

**FAO-IIASA-ISRIC-JRC-China**  
**WORLD SOIL DATABASE 2007**

	Description	Units	Occurrence			
			ESDB	CHINA	SOTWIS	FAO74
S_GRAVEL	% Gravel	volume %	v	v	v	v
S_SAND	% Sand	%	v	v	v	v
S_SILT	% Silt	%	v	v	v	v
S_CLAY	% Clay	%	v	v	v	v
S_USDA_TEX_NAME	USDA Texture Class Name	name	v	v	v	v
S_USDA_TEX_CLASS	USDA Texture Code	code	v	v	v	v
S_REF_BULK_DENSITY	Reference Bulk Density	kg/dm3 or g/cm3	v	v	v	v
S_OC	Organic Carbon	% weight	v	v	v	v
S_PH_H2O	Soil reaction	numerical	v	v	v	v
S_CEC_CLAY	Cation exchange capacity (clay)	cmol/kg	v	v	v	v
S_CEC_SOIL	Cation exchange capacity (soil)	cmol/kg	v	v	v	v
S_BS	Base Saturation	%	v	v	v	v
S_TEB	Total exchangeable bases	cmol/kg	v	v	v	v
S_CACO3	Calcium carbonate	% weight	v	v	v	v
S_CASO4	Gypsum content	% weight	v	v	v	v
S_ESP	Exchangeable sodium percentage	%	v	v	v	v
S_ECE	Electrical conductivity	dS/m	v	v	v	v

**SUB SOIL INFORMATION**

# Example of the database (1)

ID	COVER A G E	MU_GL O B A L	SU_SY M 74	SU_CO D E7 4	T_TEXT U R E	PHASE 1	PHASE 2	PERMA F R O S T	DRAIN A G E	SEQ	SHARE
1	4	1015	Zo	31	3	0	0	0	0	1	40
2	4	1015	So	36	2	0	0	0	0	2	30
3	4	1015	Jc	147	2	0	0	0	0	3	10
4	4	1015	X	45	2	0	0	0	0	4	5
5	4	1015	X	45	2	0	0	0	0	5	5
6	4	1015	Zg	34	2	0	0	0	0	6	10

# Example of the Database (2)

T_GRA V E L	T_SAN D	T_SILT	T_CLA Y	T_USDA_ TEX _NA ME	T_USD A T E X C L A S S	T_REF B U L K D E N S I T Y	T_OC	T_PH_ H 2 O	T_CEC C L A Y	T_CEC S O I L	T_BS	T_TEB
4	16	31	53	clay_(light)	3	1.22	0.58	8.3	45	27	100	50.8
6	48	28	25	loam	9	1.39	0.66	8.1	46	16	100	21.1
10	35	47	18	loam	9	1.41	0.6	8	65	14	100	19.8
4	45	32	23	loam	9	1.4	0.52	7.9	50	15	100	22.6
4	45	32	23	loam	9	1.4	0.52	7.9	50	15	100	22.6
6	36	43	21	loam	9	1.39	0.42	8.1	48	11	100	13.9

# Example of the Database (3)

T_CAC	T_CAS	T_ESP	T_ECE	S_GR	S_SAN	S_SILT	S_CLA	S_TEX	S_USDA_TEX_NAME	S_USDA_TEX_CLAS	S_REF	S_OC
3	4			AVEL	D		Y				BULK DENSITY	
10.6	1.3	41	5.9	6	22	27	51	3	clay_(light)	3	1.24	0.4
5.8	0	13	0.6	8	40	27	33	3	clay_loam	5	1.33	0.29
11.7	0.2	2	0.7	11	37	45	18	2	loam	9	1.42	0.4
6.2	0	2	0.4	3	42	30	28	2	clay_loam	5	1.36	0.3
6.2	0	2	0.4	3	42	30	28	2	clay_loam	5	1.36	0.3
9.5	6.5	46	14.5	5	37	39	24	2	loam	9	1.37	0.3

# Example of the database (4)

S_PH_H2O	S_CEC_CL AY	S_CEC_SOI L	S_BS	S_TEB	S_CACO3	S_CASO4	S_ESP	S_ECE
8.1	48	27	100	58.3	9	0.5	43	14.8
8.5	57	19	100	35.7	7.4	0.1	39	2.7
8.1	84	13	100	20.7	12.2	0.3	3	0.5
8	45	15	100	29.1	9	0.1	3	0.7
8	45	15	100	29.1	9	0.1	3	0.7
8.1	46	12	100	18.2	12.3	4.1	54	2.8

Additional data  
possible to include in the  
**World Soil Database 2007**

**1. Land cover/land use shares (5' grid)**

(Rain-fed cultivated land, Irrigated cultivated land, Forest land, Pasture land, Barren/slightly vegetated land, Water, Urban land).

**2. Terrain slope and aspect distributions (5' grid)**

(From digital elevation data produced by the NASA Shuttle Radar Topographic Mission (SRTM)).

**3. Soil qualities for agriculture (5' grid)**

(Nutrient availability, Nutrient retention capacity, Rooting conditions, Oxygen availability, Excess salts, Toxicity and Workability, (Soil erodibility))

**4. Rural and urban population distribution (5' grid)**

# Conclusion: some Questions to discuss

1. Is there interest by ESNB to peer review this prototype database?
2. Is there interest for such a separate FAO/IIASA product be co-authored/published by ESNB (JRC) and ISRIC?
3. Should the product be enhanced beyond 2007?
  - a/ The inclusion of SOTERCAF (Central Africa) published recently by FAO/ISRIC/UGent
  - b/ North American data such as those published in the Circumpolar Database.
  - c/ The global SOTER terrain module now produced by ISRIC/FAO under GLADA
4. Is there a fundamental problem that by publishing this product we harm other initiatives such as the Global Soil Map?



Thank You