Supplement to "SoilKsatDB: global database of soil saturated hydraulic conductivity measurements for geoscience applications"

(https://doi.org/10.5281/zenodo.3752721)

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1. Licence

2. Citation

When using the data please cite:

Gupta, S., Hengl, T., Lehmann, P., Bonetti, S., and Or, D.: Supplement to" SoilKsatDB: global compilation of soil saturated hydraulic conductivity measurements for geoscience applications", Zenodo, https://doi.org/10.5281/zenodo.3752721, 2020.

The data are supplementary material to: (if applicable)

Gupta, S., Hengl, T., Lehmann, P., Bonetti, S., and Or, D., (2020): SoilKsatDB: global database of soil saturated hydraulic conductivity measurements for geoscience applications. Earth Syst. Sci. Data Discuss., submitted.

3. Data Description

Abstract:

Saturated soil hydraulic conductivity (Ksat) is a key parameter in many hydrological and climatic modeling applications, as it controls the partitioning between precipitation, infiltration, and runoff. Ksat is often determined using pedotransfer functions developed using soil basic properties such as soil texture and bulk density due to the unavailability of the measured Ksat dataset. However, many

datasets of measured Ksat values are available in the literature, but significant efforts are required to standardize the databases. In this work, 1,910 sites with 13,267 Ksat measurements were assembled from published literature and other sources, standardized, and quality-checked to provide a global database of soil saturated hydraulic conductivity (SoilKsatDB). Ksat data include 4,133 values from field measurement and 9,162 values from laboratory measurements. In particular, different types of infiltrometers were used for field measurements, whereas constant or falling head methods were predominantly used in laboratory analyses. The SoilKsatDB covers most global regions, with the highest data density from North America, followed by Europe, Asia, South America, Africa, and Australia. In addition to Ksat, other soil variables such as soil texture (11,591 measurements), bulk density (11,269 measurements), soil organic carbon (9,787 measurements), field capacity (7,389), and wilting point (7,418) are also included in the dataset.

3.1. File description

Table1: Description and units of the variables listed in the database (**sol_ksat.pnts_horizons.arff, .rds and .csv file**).

Headers	Description	Units
ID	Unique ID	----
site_key	Data set identifier	----
longitude_decimal_degrees	Ranges up to +180 degrees down to -180 degrees	Decimal degree
latitude_decimal_degrees	Ranges up to +90 degrees down to -90 degrees	Decimal degree
location_accuracy_min	Minimum value of location accuracy	m
location_accuracy_max	Maximum value of location accuracy	m
hzn_top	Top depth of soil sample	cm
hzn_bot	Lower depth of soil sample	cm
hzn_desgn	Horizon designation	----
db	Bulk density (Oven Dry)	g/cm^3
w3cld	Soil water content at 33 kPa (field capacity)	vol %
w15l2	Soil water content at 1500 kPa (wilting point)	vol %
tex_psda	Soil texture classes based on USDA	----
clay_tot_psa	Mass of soil particles, < 0.002 mm	%
silt_tot_psa	Mass of soil particles, > 0.002 and < 0.05 mm	%
sand_tot_psa	Mass of soil particle, > 0.05 and < 2 mm	%
oc_v	Soil organic carbon content	%
ph_h2o_v	Soil acidity	----

Ksat_lab	Soil saturated hydraulic conductivity from lab	cm/day
Ksat_field	Soil saturated hydraulic conductivity from field	cm/day
source_db	Sources of the datasets	----
location_id	Combination of latitude and longitude	----
hzn_depth	Mean depth of soil horizon	----

Table2: Description and units of the variables listed in the database (**sol_ksat.pnts_metadata.csv**).

Headers	**Description**	**Units**
ID	Unique ID	----
site_key	Data set identifier	----
longitude_decimal_degrees	Ranges up to +180 degrees down to -180 degrees	Decimal degree
latitude_decimal_degrees	Ranges up to +90 degrees down to -90 degrees	Decimal degree
Ksat method	Methods used to estimate the Ksat	----
Lab_field	Ksat value belong to lab or field	----
oc_method	Methods used to estimate the organic carbon	----
tex_method	Methods used to estimate the soil texture	----
ph_method	Methods used to estimate the pH	----
bd_method	Methods used to estimate the bulk density	----
ksat_method_publication	Ksat method literature	----
oc_method_publication	Organic carbon methods literature	----

tex_method_publication	Soil texture methods literature	----
bd_method_publication	Bulk density methods literature	----
ph_method_publication	pH methods literature	----

Table3: Description and units of the variables listed in the database (**sol_ksat.pnts_cl_pedo.csv**).

Headers	**Description**	**Units**
ID	Unique ID	----
site_key	Data set identifier	----
longitude_decimal_degrees	Ranges up to +180 degrees down to -180 degrees	Decimal degree
latitude_decimal_degrees	Ranges up to +90 degrees down to -90 degrees	Decimal degree
source_db	Sources of the datasets	----
climate_zone	Climate zone information: Arid, boreal, temperate, tropical and polor	----
great_group	Great group under soil taxonomy	----
suborder	Sub order under soil taxonomy	----
order	Order under soil taxonomy	----

Table 4: Description and units of the variables listed in the database (**sol_hydro.pnts_horizons.arff, .rds and .csv file**). Please avoid the confidence degree column for spatial accuracy, use location accuracy min, and max columns.

Headers	**Description**	**Units**
site_key	Data set identifier	----
usiteid	Site Id	----

site_obsdate	Date of sample acquired	----
longitude_decimal_degrees	Ranges up to +180 degrees down to -180 degrees	Decimal degree
latitude_decimal_degrees	Ranges up to +90 degrees down to -90 degrees	Decimal degree
location_accuracy_min	Minimum value of location accuracy	m
location_accuracy_max	Maximum value of location accuracy	m
labsampnum	Number of sample	----
layer_sequence	Layer sequence	----
hzn_top	Top depth of soil sample	cm
hzn_bot	Lower depth of soil sample	cm
hzn_desgn	Horizon designation	----
db_13b	Bulk density (33kPa)	g/cm^3
db	Bulk density (Oven Dry)	g/cm^3
COLEws	Coefficient of Linear Extensibility (COLE) whole soil	ratio
w6clod	Soil water content at 6 kPa	vol %
w10cld	Soil water content at 10 kPa	vol %
w3cld	Soil water content at 33 kPa (field capacity)	vol %
w15l2	Soil water content at 1500 kPa (wilting point)	vol %
w15bfm	Water Content 1500 kPa moist	wt %
adod	Air-Dry/Oven-Dry	ratio

wrd_ws13	Water Retention Difference whole soil, 1500-kPa suction and an upper limit of usually 33-kPa	cm^3 / cm^{-3}
cec7_cly	CEC-7/Clay ratio	ratio
w15cly	CEC/Clay ratio at 1500 kPa	ratio
tex_psda	Soil texture classes based on USDA	----
clay_tot_psa	Mass of soil particles, < 0.002 mm	%
silt_tot_psa	Mass of soil particles, > 0.002 and < 0.05 mm	%
sand_tot_psa	Mass of soil particle, > 0.05 and < 2 mm	%
oc_v	Soil organic carbon content	%
ph_kcl	pH, 1N KCl	ratio
ph_h2o_v	Soil acidity	----
cec_sum	Sum of Cations (CEC-8.2)	cmol(+)/kg
cec_nh4	NH4OAc, pH 7 (CEC-7)	cmol(+)/kg
wpg2	Coarse fragments >2-mm	% wt
Ksat_lab	Soil saturated hydraulic conductivity from lab	cm/day
Ksat_field	Soil saturated hydraulic conductivity from field	cm/day
source_db	Sources of the datasets	----
confidence_degree	Reliability on the data set based on spatial locations	----
uuid	Unique identifier	----
location_id	Combination of latitude and longitude	----

hzn_depth	Mean depth of soil horizon	----

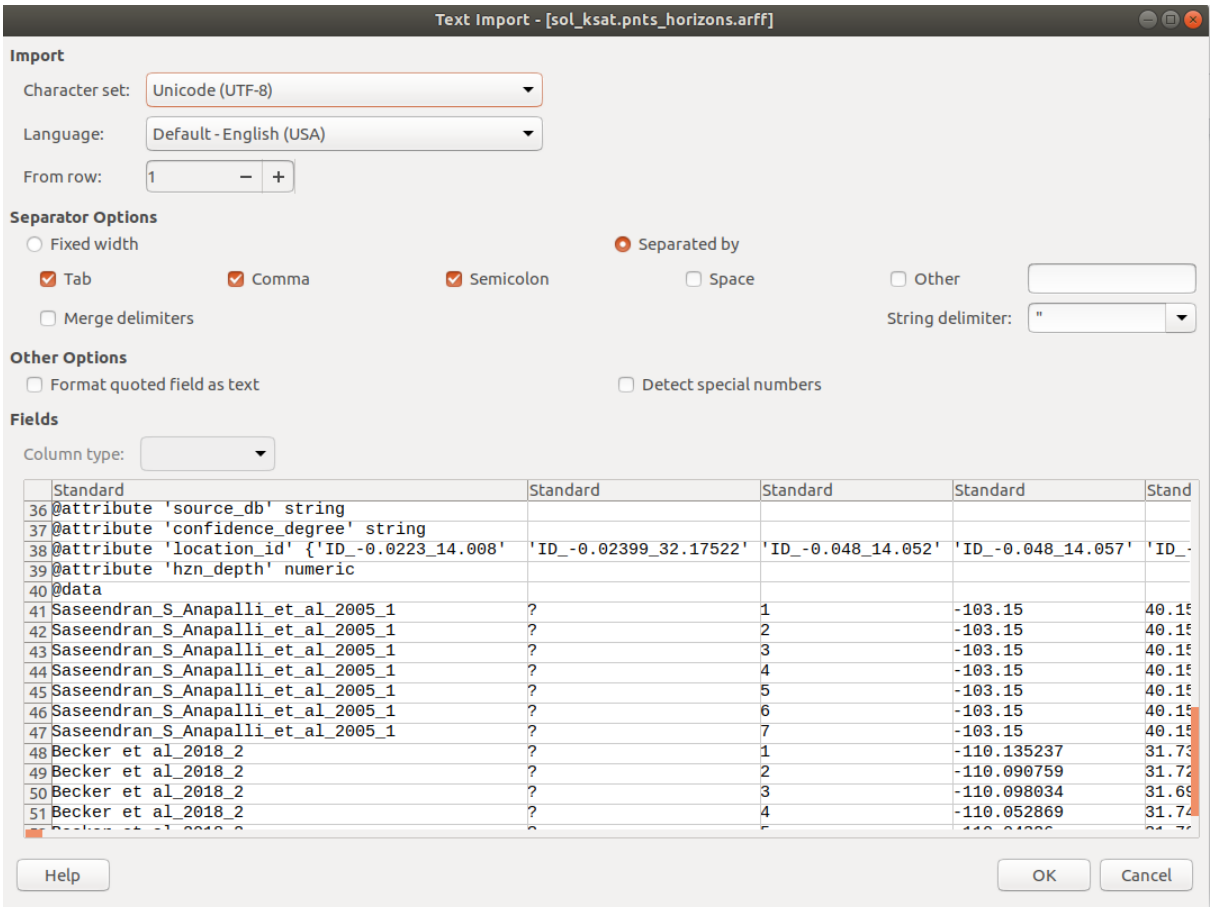
3.2. File inventory

Files mentioned in Zenodo.

Table 5: Example for an associated "List of Files"

File name	Description
sol_ksat.pnts_horizons.arff	ARFF format: Only Ksat dataset
sol_ksat.pnts_horizons.csv.gz	CSV format: Only Ksat dataset
sol_ksat.pnts_horizons.rds	RDS format : Only Ksat dataset
sol_ksat.pnts_metadata.csv	Described methods for Ksat, OC, Bulk density, pH and soil texture.
sol_ksat.pnts_cl_pedo.csv	Information related to climate zone and pedological units. Climate information based on Köppen-Geiger climate zones map (Rubel and Kottek, 2010, Hamel et al., 2017) and Pedological units based on openlandmap.org.
sol_hydro.pnts_horizons.arff	ARFF format: This is the dataset to show the all soil hydraulic properties dataset (soil saturated hydraulic conductivity, water content at 33kpa and 1500kpa). Please visit the link to see the distribution of points and the import steps. https://gitlab.com/openlandmap/compiled-ess-point-data-sets/-/tree/master/themes/sol/SoilHydroDB
sol_hydro.pnts_horizons.csv.gz	CSV format: All soil hydraulic properties dataset
sol_hydro.pnts_horizons.rds	RDS format : All soil hydraulic properties dataset

We provided both ARFF and CSV format. Note that the ARFF file format is the default format used by OpenML.org and several other organizations (hence a recommended standard for multi-platform data exchange). An ARFF-file is de facto a CSV with a specific header. Read more about ARFF at: https://www.cs.waikato.ac.nz/~ml/weka/arff.html. ARFF files can be imported into Python and Matlab, i.e. they work cross-platform. One can also open the file using Open Office or similar tabular data editors:



	Standard	Standard	Standard	Standard	Stand
36	@attribute 'source_db' string				
37	@attribute 'confidence_degree' string				
38	@attribute 'location_id' {'ID_-0.0223_14.008'	'ID_-0.02399_32.17522'	'ID_-0.048_14.052'	'ID_-0.048_14.057'	'ID_-
39	@attribute 'hzn_depth' numeric				
40	@data				
41	Saseendran_S_Anapalli_et_al_2005_1	?	1	-103.15	40.15
42	Saseendran_S_Anapalli_et_al_2005_1	?	2	-103.15	40.15
43	Saseendran_S_Anapalli_et_al_2005_1	?	3	-103.15	40.15
44	Saseendran_S_Anapalli_et_al_2005_1	?	4	-103.15	40.15
45	Saseendran_S_Anapalli_et_al_2005_1	?	5	-103.15	40.15
46	Saseendran_S_Anapalli_et_al_2005_1	?	6	-103.15	40.15
47	Saseendran_S_Anapalli_et_al_2005_1	?	7	-103.15	40.15
48	Becker et al_2018_2	?	1	-110.135237	31.73
49	Becker et al_2018_2	?	2	-110.090759	31.72
50	Becker et al_2018_2	?	3	-110.098034	31.69
51	Becker et al_2018_2	?	4	-110.052869	31.74

Figure1. Example: to open the arff file in tabular data editor. “?” referred as a NA.

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