Supplement to “SoilKsatDB: global database of soil saturated hydraulic conductivity measurements for geoscience applications”
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1. Licence

2. Citation

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3. Data Description

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, 1,908 sites with 13,258 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 4,131 values from field measurement and 9,155 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 (11,584 measurements), bulk density (11,262 measurements), soil organic carbon (9,787 measurements), field capacity (7,382), and wilting point (7,411) are also included in the dataset.

The data are arranged in two file packages. The **first package ("sol_ksat")** presents the soil saturated conductivity data, the **second package ("sol_hydro")** gives additional soil physical properties (mainly information on soil water retention).

The first package "sol_ksat" consists of three files.

Note: Only the first two files (sol_ksat.pnts.horizons and sol_ksat.pnts_metadata_cl_pedo) **were used in the publication Gupta et al. 2021**: ": SoilKsatDB: global soil saturated hydraulic conductivity measurements for geoscience applications"). The third file (sol_ksat.points_horizons_rm) is for advanced and interested users that want to work with remote sensing based covariates (to link information on ksat to climate and topography and other soil formation properties).

- sol_ksat.pnts_horizons: provides a global compilation of Ksat values and the information described in Table 2 in Gupta et al., (2021). This data is provided in three different data formats (arff, csv, rds).
- sol_ksat.pnts_metadata_cl_pedo.csv: provides meta-information with Ksat methods and information of estimated soil pedologic unit and climatic region for each Ksat sample.
- sol_ksat.points_horizons_rm.rds: All ksat values overlaid on climatic, topographic, and vegetation based remote sensing data and extracted the corresponding values. These datasets can be used for spatial modeling for the future.

The second package "sol_hydro" consists of three files.

- sol_hydro.pnts_horizons: This is the dataset to show the all soil hydraulic properties dataset (soil saturated hydraulic conductivity, water content at 33kpa and 1500kpa). This data is provided in three different data formats (arff, csv, rds).
- sol_hydro.pnts_horizons_rm.rds: all values of soil hydraulic properties overlaid on climatic, topographic, and vegetation based remote sensing data and extracted the corresponding values. These datasets can be used for spatial modeling for the future.

3.1. Description of file “sol_ksat.pnts_horizons”

Table 1: Description and units of the variables listed in the database **sol_ksat.pnts_horizons.arff, .rds and .csv file** (unique ID, reference, longitude and latitude (decimal degree), minimum and maximum accuracy (m), top and bottom of soil sample (cm), horizon designation, bulk density (g cm^{-3}), moisture content at field capacity and wilting point (%), soil textural class, clay, silt and sand content (%), soil organic carbon content (%), soil acidity, saturated hydraulic conductivity measured in lab or field (cm day^{-1}), source of the data, location id and mean soil depth). NA is ‘no value’. Column names are also explained in main paper of Table 2a.

Headers	**Description**	**Units**
ID	Unique ID	----
site_key	Data set identifier (reference)	----
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 (database or other reference)	----
location_id	Combination of latitude and longitude	----
hzn_depth	Mean depth of soil horizon	----

3.2. Description of file "sol_ksat.pnts_metadata"

Table 2: Description and units of the variables listed in the database **sol_ksat.pnts_metadata_cl_pedo.csv** (unique ID, Ksat methods, lab and field, organic carbon (OC), soil texture, soil acidity (pH), bulk density (bd) methods, literature of measured soil properties methods, location accuracy methods, information on climate zone and soil taxonomy).

Headers	**Description**	**Units**
ID	Unique ID	----
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	----
location_accuracy_methods	Defined methods to provide the subjective minimum and maximum location accuracy	
climate_zone	Climate zone information: Arid, boreal, temperate, tropical and polar	----
great_group	Great group under soil taxonomy	----
suborder	Sub order under soil taxonomy	----
order	Order under soil taxonomy	----

3.3 References to the Ksat dataset

Data extracted from the literature (each dataset referred with the source in the Ksat dataset, look at site_key column):

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3.4. File package with data on additional soil hydraulic properties ("sol_hydro")

Table 3: Description and units of the variables listed in the database (**sol_hydro.pnts_horizons.arff, .rds and .csv file).**

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	----
uuid	Unique identifier	----
location_id	Combination of latitude and longitude	----

References:

1. Rubel, F., & Kottek, M. (2010). Observed and projected climate shifts 1901–2100 depicted by world maps of the Köppen-Geiger climate classification. Meteorologische Zeitschrift, 19(2), 135-141.
2. Hamel, P., Falinski, K., Sharp, R., Auerbach, D. A., Sánchez-Canales, M., & Dennedy-Frank, P. J. (2017). Sediment delivery modeling in practice: Comparing the effects of watershed characteristics and data resolution across hydroclimatic regions. Science of the Total Environment, 580, 1381-1388.