

1 Development and Analysis of Soil Water Infiltration Global Database

2 Mehdi Rahmati^{1,2,*}, Lutz Weiermüller^{2,3}, Jan Vanderborght^{2,3}, Yakov A. Pachepsky⁴, Lili Mao⁵,
3 Seyed Hamidreza Sadeghi⁶, Niloofar Moosavi², Hossein Kheirfam⁷, Carsten Montzka^{2,3}, Kris Van
4 Looy^{2,3}, Brigitta Toth⁸, Zeinab Hazbavi⁶, Wafa Al Yamani⁹, Ammar A. Albalasmeh¹⁰, Ma'in Z.
5 Alghzawi¹⁰, Rafael Angulo-Jaramillo¹¹, Antônio Celso Dantas Antonino¹², George Arampatzis¹³,
6 Robson André Armindo¹⁴, Hossein Asadi¹⁵, Yazidhi Bamutaze¹⁶, Jordi Batlle-Aguilar^{17,18,19},
7 Béatrice Béchet²⁰, Fabian Becker²¹, Günter Blöschl^{22,23}, Klaus Böhne²⁴, Isabelle Braud²⁵, Clara
8 Castellano²⁶, Artemi Cerdà²⁷, Maha Chalhoub¹⁷, Rogerio Cichota²⁸, Milena Císlerová²⁹, Brent
9 Clothier³⁰, Yves Coquet^{17,31}, Wim Cornelis³², Corrado Corradini³³, Artur Paiva Coutinho¹², Muriel
10 Bastista de Oliveira³⁴, José Ronaldo de Macedo³⁵, Matheus Fonseca Durães¹⁴, Hojat Emami³⁶, Iraj
11 Eskandari³⁷, Asghar Farajnia³⁸, Alessia Flammini³³, Nándor Fodor³⁹, Mamoun Gharaibeh¹⁰,
12 Mohamad Hossein Ghavimippanah⁶, Teamrat A. Ghezzehei⁴⁰, Simone Giertz⁴¹, Evangelos G.
13 Hatzigiannakis¹³, Rainer Horn⁴², Juan José Jiménez⁴³, Diederik Jacques⁴⁴, Saskia Deborah
14 Keesstra^{45,46}, Hamid Kelishadi⁴⁷, Mahboobeh Kiani-Harchegani⁶, Mehdi Kouselou¹, Madan
15 Kumar Jha⁴⁸, Laurent Lassabatere¹¹, Xiaoyan Li⁴⁹, Mark A. Liebig⁵⁰, Lubomír Lichner⁵¹, María
16 Victoria López⁵², Deepesh Machiwal⁵³, Dirk Mallants⁵⁴, Micael Stolben Mallmann⁵⁵, Jean Dalmo
17 de Oliveira Marques⁵⁶, Miles R Marshall⁵⁷, Jan Mertens⁵⁸, Félicien Meunier⁵⁹, Mohammad
18 Hossein Mohammadi¹⁵, Binayak P Mohanty⁶⁰, Mansonia Pulido-Pulido-Moncada⁶¹, Suzana
19 Montenegro⁶², Renato Morbidelli³³, David Moret-Fernández⁵², Ali Akbar Moosavi⁶³, Mohammad
20 Reza Mosaddeghi⁴⁷, Seyed Bahman Mousavi¹, Hasan Mozaffari⁶³, Kamal Nabiollahi⁶⁴,
21 Mohammad Reza Neyshabouri⁶⁵, Marta Vasconcelos Ottoni⁶⁶, Theophilo Benedicto Ottoni
22 Filho⁶⁷, Mohammad Reza Pahlavan Rad⁶⁸, Andreas Panagopoulos¹³, Stephan Peth⁶⁹, Pierre-
23 Emmanuel Peyneau²⁰, Tommaso Picciafuoco^{22,33}, Jean Poesen⁷⁰, Manuel Pulido⁷¹, Dalvan José
24 Reinert⁷², Sabine Reinsch⁵⁷, Meisam Rezaei^{32,93}, Francis Parry Roberts⁵⁷, David Robinson⁵⁷, Jesús
25 Rodrigo-Comino^{73,74}, Otto Corrêa Rotunno Filho⁷⁵, Tadaomi Saito⁷⁶, Hideki Suganuma⁷⁷, Carla
26 Saltalippi³³, Renáta Sándor³⁹, Brigitta Schütt²¹, Manuel Seeger⁷⁴, Nasrollah Sepehrnia⁷⁸, Ehsan
27 Sharifi Moghaddam⁶, Manoj Shukla⁷⁹, Shiraki Shutaro⁸⁰, Ricardo Sorando²⁵, Ajayi Asishana
28 Stanley⁸¹, Peter Strauss⁸², Zhongbo Su⁸³, Ruhollah Taghizadeh-Mehrjardi⁸⁴, Encarnación
29 Taguas⁸⁵, Wenceslau Gerales Teixeira⁸⁶, Ali Reza Vaezi⁸⁷, Mehdi Vafakhah⁶, Tomas Vogel²⁹,
30 Iris Vogeler²⁸, Jana Votrubova²⁹, Steffen Werner⁸⁸, Thierry Winarski¹¹, Deniz Yilmaz⁸⁹, Michael
31 H. Young⁹⁰, Steffen Zacharias⁹¹, Yijian Zeng⁸³, Ying Zhao⁹², Hong Zhao⁸³, Harry Vereecken^{2,3}

32 1) Department of Soil Science and Engineering, Faculty of Agriculture, University of Maragheh, Maragheh, Iran

33 2) Forschungszentrum Jülich GmbH, Institute of Bio- and Geosciences: Agrosphere (IBG-3), Jülich, Germany

34 3) ISMC International Soil Modeling Consortium

35 4) USDA-ARS Environmental Microbial and Food Safety Laboratory, Beltsville, MD 20705

36 5) Key Laboratory of Dryland Agriculture, Ministry of Agriculture, Institute of Environment and Sustainable
37 Development in Agriculture, Chinese Academy of Agricultural Sciences, Beijing 100081, PR China

38 6) Department of Watershed Management Engineering, Faculty of Natural Resources, Tarbiat Modares University,
39 Iran

40 7) Department of Environmental Sciences, Urmia Lake Research Institute, Urmia University, Urmia, Iran

41 8) Institute for Soil Sciences and Agricultural Chemistry, Centre for Agricultural Research, Hungarian Academy of
42 Sciences, Budapest, Hungary; University of Pannonia, Georgikon Faculty, Department of Crop Production and Soil
43 Science, Keszthely, Hungary

44 9) Environment Agency - Abu Dhabi, UAE

45 10) Department of Natural Resources and Environment, Faculty of Agriculture, Jordan University of Science and
46 Technology, P.O. Box 3030, Irbid 22110, Jordan

- 47 11) Univ Lyon, Université Claude Bernard Lyon 1, CNRS, ENTPE, UMR5023 LEHNA, F-69518, Vaulx-en-Velin,
48 France
- 49 12) Universidade Federal de Pernambuco, Centro Acadêmico do Agreste, Núcleo de Tecnologia, Caruaru, Brazil
- 50 13) Hellenic Agricultural Organization, Soil and Water Resources Institute, 57400 Sindos, Greece
- 51 14) Núcleo de Atividades em Engenharia de Biosistemas (NAEB), DSEA-UFPR, Curitiba, PR, Brazil
- 52 15) Department of Soil Science, Faculty of Agricultural Engineering and Technology, University of Tehran. Karaj,
53 Iran
- 54 16) Department of Geography, Geo-Informatics and Climatic Sciences, Makerere University, P.O. Box 7062,
55 Kampala, Uganda
- 56 17) UMR 1402 INRA AgroParisTech Functional Ecology and Ecotoxicology of Agroecosystems, Institut National de
57 la Recherche Agronomique, AgroParisTech B.P. 01 F-78850 Thiverval-Grignon France
- 58 18) UMR 8148 IDES CNRS/Université Paris-Sud XI Bât. 504 Faculté des Sciences 91405 Orsay Cedex, France
- 59 19) Innovative Groundwater Solutions (IGS), Victor Harbor, 5211, South Australia, Australia
- 60 20) LUNAM Université, IIFSTTAR, GERS, EE, F-44344 Bouguenais, France
- 61 21) Freie Universität Berlin, Department of Earth Sciences, Institute of Geographical Sciences, Malteserstr. 74-100,
62 Lankwitz, 12249, BERLIN, Germany
- 63 22) Centre for Water Resource Systems, TU Wien, Karlsplatz 13, 1040 Vienna, Austria
- 64 23) Institute of Hydraulic Engineering and Water Resources Management, TU Wien, Karlsplatz 13/222, 1040 Vienna,
65 Austria
- 66 24) Faculty of Agricultural and Environmental Sciences, University of Rostock, Germany
- 67 25) Irstea, UE RiverLy, Lyon-Villeurbanne Center, 69625 Villeurbanne, France
- 68 26) Pyrenean Institute of Ecology-CSIC. AV. Montañana 1005 // Av. Victoria s / n. 50059 Zaragoza//22700 Jaca,
69 Huesca. Spain
- 70 27) Soil Erosion and Degradation Research Group, Department of Geography, University of Valencia, Valencia, Spain
- 71 28) Plant and Food Research, Mount Albert Research Station, Auckland, New Zealand
- 72 29) Czech Technical University in Prague, Faculty of Civil Engineering, Thákurova 7, 166 29 Prague 6, Czech
73 Republic
- 74 30) Plant & Food Research, Palmerston North, New Zealand
- 75 31) ISTO UMR 7327 Université d'Orléans, CNRS, BRGM, 45071 Orléans, France
- 76 32) Department of Soil Management, UNESCO Chair on Eremology, Ghent University, Belgium
- 77 33) Department of Civil and Environmental Engineering, University of Perugia, Perugia, Italy
- 78 34) UniRedentor University Center. BR 356, 25, Presidente Costa e Silva, Itaperuna, Rio de Janeiro, Brazil
- 79 35) Embrapa Solos, Rua Jardim Botânico, 1.024, CEP 22040-060, Jardim Botânico, Rio de Janeiro, RJ, Brazil
- 80 36) Department of Soil Science, Faculty of Agriculture, Ferdowsi University of Mashhad, Mashhad, Iran
- 81 37) Dryland Agricultural Research Institute, Agricultural Research, Education and Extension Organization Maragheh,
82 East Azerbaijan, Iran
- 83 38) Scientific Member of Soil and Water Research Department, East Azerbaijan Agricultural and Natural Resources
84 Research and Education center, Iran
- 85 39) Agricultural Institute, Centre for Agricultural Research, Hungarian Academy of Sciences, Brunsvik str. 2., H-
86 2462 Martonvásár, Hungary
- 87 40) Life and Environmental Sciences, University of California, Merced, United States
- 88 41) Geographisches Institut, Universität Bonn, Germany
- 89 42) Institute of Plant Nutrition and Soil Science, Christian-Albrechts-University zu Kiel, Olshausenstr. 40, 24118 Kiel,
90 Germany
- 91 43) Instituto Pirenaico de Ecología, Spanish National Research Council (IPE-CSIC), Avda. Llano de la victoria 16,
92 Jaca (Huesca), 22700, Spain
- 93 44) Belgian Nuclear Research Centre, Engineered and Geosystems Analysis, Belgium
- 94 45) **Soil, Water and Land Use Team, Wageningen Environmental Research, Wageningen UR, 6708PB Wageningen,**
95 **The Netherlands**~~Soil Physics and Land Management Group, Wageningen University, Droevendaalsesteeg 4 6708PB,~~
96 ~~Wageningen, the Netherlands~~
- 97 46) Civil, Surveying and Environmental Engineering, the University of Newcastle, Callaghan 2308, Australia
- 98 47) Department of Soil Science, College of Agriculture, Isfahan University of Technology, Isfahan 84156-83111, Iran
- 99 48) Agricultural & Food Engineering Department, Indian Institute of Technology Kharagpur, Kharagpur – 721302,
100 West Bengal, India
- 101 49) State Key Laboratory of Earth Surface Processes and Resource Ecology, Faculty of Geographical Science, Beijing
102 Normal University, Beijing 100875 China

103 50) Research Soil Scientist, USDA Agricultural Research Service, P.O. Box 459, 1701 10th Ave., S.W. Mandan, ND
104 58554-0459, USA
105 51) Institute of Hydrology, Slovak Academy of Sciences, Bratislava, Slovakia
106 52) Departamento de Suelo y Agua, Estación Experimental de Aula Dei (EEAD), Consejo Superior de Investigaciones
107 Científicas (CSIC), PO Box 13034, 50080 Zaragoza, Spain
108 53) ICAR-Central Arid Zone Research Institute, Regional Research Station, Kukma – 370105, Bhuj, Gujarat, INDIA
109 54) CSIRO Land and Water, Glen Osmond, South Australia, Australia
110 55) PhD student at his first year. Soil Science Graduate Program (ufsm.br/ppgcs), Federal University of Santa Maria,
111 state of Rio Grande do Sul, Brazil
112 56) Federal Institute of Education, Science and Technology of the Amazonas – IFAM, Campus Center of Manaus,
113 Manaus, Brazil
114 57) Centre for Ecology and Hydrology, Environment Centre Wales, Deiniol Road, Bangor, Gwynedd LL57 2UW,
115 UK
116 58) ENGIE Research and Technologies, Simon Bolivarlaan 34, 1000 Brussels, Belgium
117 59) ~~Université catholique de Louvain, Earth and Life Institute-Environmental Sciences, Louvain-la Neuve,~~
118 ~~Belgium~~ ~~Université Catholique de Louvain, Earth and Life Institute Environmental Sciences, Louvain-la Neuve,~~
119 ~~Belgium~~
120 60) Dep. of Biological and Agricultural Engineering, 2117 TAMU, Texas A&M Univ., College Station, TX 77843-
121 2117
122 61) ~~Aarhus University, Department of Agroecology, Research Centre Foulum, Blichers Allé 20, P.O. Box 50, DK-~~
123 ~~8830 Tjele, Denmark~~ ~~Instituto de Edafología, Facultad de Agronomía, Universidad Central de Venezuela, Venezuela~~
124 62) Universidade Federal de Pernambuco (UFPE), Av. Prof. Moraes Rego, 1235 - Cidade Universitária, Recife - PE
125 - CEP: 50670-901. Brazil
126 63) Department of Soil Science, College of Agriculture, Shiraz University, Shiraz, Iran
127 64) Department of Soil Science and Engineering, Faculty of Agriculture, University of Kurdistan, Sanandaj, Kurdistan
128 Province, Iran
129 65) Department of Soil Science, Faculty of Agriculture, University of Tabriz, Tabriz, Iran
130 66) Department of Hydrology, Geological Survey of Brazil (CPRM), Av. Pauster, 404. CEP 22290-240 Rio de Janeiro
131 (RJ), Brazil
132 67) Department of Water Resources and Environment, Federal University of Rio de Janeiro, Avenida Athos da Silveira
133 Ramos, PO box: 68570, Rio de Janeiro, RJ, Brazil
134 68) Soil and Water Research Department, Sistan Agricultural and Natural Resources Research and Education Center,
135 Agricultural Research, Education and Extension Organization (AREEO), Zabol, Iran
136 69) Department of Soil Science, University of Kassel, Nordbahnhofstr. 1a, 37213 Witzenhausen, Germany
137 70) Department of Earth and Environmental Sciences, Catholic University of Leuven, Geo-Institute, Celestijnenlaan
138 200E, 3001 Heverlee, Belgium
139 71) GeoEnvironmental Research Group, University of Extremadura, Faculty of Philosophy and Letters, Avda. de la
140 Universidad s/n, 10071 Cáceres, Spain
141 72) Soil Science Department, Federal University of Santa Maria, state of Rio Grande do Sul, Brazil
142 73) Instituto de Geomorfología y Suelos, Department of Geography, University of Málaga, 29071, Málaga, Spain
143 74) Department of Physical Geography, Trier University, D-54286 Trier, Germany
144 75) Civil Engineering Program, Alberto Luiz Coimbra Institute for Postgraduate Studies and Research in Engineering
145 (COPPE), Federal University of Rio de Janeiro, Avenida Athos da Silveira Ramos, Rio de Janeiro, RJ, Brazil
146 76) Faculty of Agriculture, Tottori University, 4-101 Koyama-Minami, Tottori 680-8553, Japan
147 77) Department of Materials and Life Science, Seikei University, 3-3-1, Kichijoji-kitamachi, Musashino, Tokyo 180-
148 8633, Japan
149 78) Department of Soil Science, College of Agriculture, Isfahan University of Technology, Isfahan, Iran
150 79) Plant and Environmental Sciences, New Mexico State University, Las Cruces, New Mexico
151 80) Japan International Research Center for Agricultural Science, Rural Development Division, Tsukuba, Japan
152 81) Department of Agricultural and Bio-Resources Engineerin, Faculty of Engineering, Ahmadu Bello University
153 Zaria, Nigeria
154 82) Institute for Land and Water Management Research, Federal Agency for Water Management, Pollnbergstraße 1,
155 3252 Petzenkirchen, Austria
156 83) Department of Water Resources, ITC Faculty of Geo-Information Science and Earth Observation, University of
157 Twente, Enschede, the Netherlands
158 84) Faculty of Agriculture and Natural Resources, Ardakan University, Ardakan, Yazd Province, Iran

- 159 85) University of Córdoba, Department of Rural Engineering, 14071 Córdoba, Spain
160 86) Soil Physics, Embrapa Soils, Rua Jardim Botânico, 1026, 22460-00 Rio de Janeiro, RJ, Brazil
161 87) Department of Soil Science, Agriculture Faculty, University of Zanjan, Zanjan, Iran
162 88) Department of Geography, Ruhr-University Bochum, D-44799 Bochum, Germany
163 89) Engineering Faculty, Civil Engineering Department, Munzur University, Tunceli, Turkey
164 90) Bureau of Economic Geology, John A. and Katherine G. Jackson School of Geosciences, University of Texas at
165 Austin, University Station, Box X, Austin, TX
166 91) UFZ Helmholtz Centre for Environment Research, Monitoring and Exploration Technologies, Leipzig, Germany
167 92) College of Resources and Environmental Engineering, Ludong University, Yantai 264025, China
168 93) Soil and Water research Institute, Karaj, Iran
169 *) Correspondence to: Mehdi Rahmati (mehdirmti@gmail.com)

170 Abstract

171 In this paper, we present and analyze a **novel** global database of soil infiltration measurements, the Soil Water
172 Infiltration Global (SWIG) database, ~~for the first time~~. In total, 5023 infiltration curves were collected across all
173 continents in the SWIG database. These data were either provided and quality checked by the scientists who performed
174 the experiments or they were digitized from published articles. Data from 54 different countries were included in the
175 database with major contributions from Iran, China, and USA. In addition to its **extensive geographical coverage**~~global~~
176 ~~spatial coverage~~, the collected infiltration curves cover ~~a time span of~~ research from 1976 to late 2017. Basic
177 information on measurement location and method, soil properties, and land use were gathered along with the
178 infiltration data, ~~which makes~~ **making** the database valuable for the development of pedo-transfer functions for
179 estimating soil hydraulic properties, for the evaluation of infiltration measurement methods, and for developing and
180 validating infiltration models. Soil textural information (clay, silt, and sand content) is available for 3842 out of 5023
181 infiltration measurements (~76%) covering nearly all soil USDA textural classes except for the sandy clay and silt
182 classes. Information on ~~the~~ land use is available for 76 % of experimental sites with agricultural land use as the
183 dominant type (~40%). We are convinced that the SWIG database will allow for a better parameterization of the
184 infiltration process in land surface models and for testing infiltration models. All collected data and related soil
185 characteristics are provided online in *.xlsx and *.csv formats for reference, and we add a disclaimer that the database
186 is for use by public domain only and can be copied freely by referencing it. Supplementary data are available
187 at <https://doi.org/10.1594/PANGAEA.885492>~~https://doi.pangaea.de/10.1594/PANGAEA.885492~~. Data quality
188 assessment is strongly advised prior to any use of this database. Finally, we would like to encourage scientists to
189 extend/update the SWIG by uploading new data to it.

190 **Keywords:** Infiltration, Land surface models, Land use, Pedo-transfer functions

191 Graphical Abstract

192 <<Figure 1 about here>>

193 **1 Introduction**

194 Infiltration is the process by which water enters the soil surface and it is one of the key fluxes in the hydrological cycle
195 and the soil water balance. Water infiltration and the subsequent redistribution of water in the subsurface are two
196 important processes that affect the soil water balance (Campbell, 1985; Hillel, 2003; Lal and Shukla, 2004;
197 Morbidelli et al., 2011) and influence several soil processes and functions including availability of water and nutrients
198 for plants, microbial activity, erosion rates, chemical weathering, and soil thermal and gas exchange between the soil
199 and the atmosphere (Campbell, 1985). Infiltration plays a definitive role in maintaining soil system functions and as
200 it is a key process that controls several of the United Nations Goals for Sustainability (Keesstra et al., 2016). The
201 generation of surface runoff, a key factor in controlling floods, is also directly related to the infiltration process. Water
202 that cannot infiltrate in the soil becomes available for surface runoff. Two main mechanisms are responsible for the
203 generation of excess water that produce overland flow: Dunne saturation excess and Hortonian infiltration excess
204 (Sahoo et al., 2008). Dunne overland flow, or saturation excess, occurs when the soil profile is completely saturated
205 and precipitation can no longer infiltrate into soil. The Dunne mechanism is more common to near-channel areas or
206 is generated from partial areas of the hillslope where water tables are shallowest (Sahoo et al., 2008). On the other
207 hand, Hortonian overland flow is characterized by rainfall intensities exceeding the infiltration rate of the soil. In other
208 words, during a rainfall event, water infiltration at the soil surface and runoff are highly dependent on the boundary
209 conditions, namely, the rainfall intensity and the soil hydraulic properties. If the rainfall intensity is less than the soil
210 infiltrability soil infiltration rate, water will completely infiltrate into the soil without any runoff (Hillel, 2013). In this
211 case, the infiltration rate align with the rainfall intensity. Otherwise, if the precipitation intensity exceeds the soil
212 infiltration rate at a certain moment in time, excess water will be generated even if the soil profile is unsaturated. In
213 this case water will pond on the soil surface and becomes available for surface runoff. If this occurs, the boundary
214 condition at the soil surface undergoes a shift in the dominate flow process from one governed by capillary action, to
215 one governed by pressures of hydraulic head. Assuming that the water pressure heads remain constant at the soil
216 surface, the infiltration rate described by a decreasing function over time, tending towards the value of the hydraulic
217 conductivity, corresponding to the water pressure head at the surface (Angulo et al., 2016, Chow et al., 1988). In the
218 past decades, water infiltration tests, using either ponded or tension infiltrometers have been developed to quantify
219 the cumulative infiltration at the soil surface. In these cases, the 3D axisymmetric water infiltration corresponds to an
220 upper boundary defined by a constant water pressure head or a series of constant water pressure heads. For these
221 reasons, infiltration plays a definitive role in maintaining soil system functions and as it is a key process that controls
222 several of the United Nations Goals for Sustainability (Keesstra et al., 2016).

223 The infiltration process is quantified usually studied by determining the infiltrated amount of water which infiltrates,
224 versus over time, from which the cumulative infiltration, $I(t)$, [L], and the infiltration rate, $i(t)$, [$L T^{-1}$] can be derived.
225 $i(t)$ and $I(t)$ are related to each other by derivation (Campbell, 1985; Hillel, 2003; Lal and Shukla, 2004):

226
$$i(t) = \frac{dI(t)}{dt} \quad (1)$$

227 As stated above, the infiltration rate $i(t)$ is expected to decrease to a plateau defined by the value of the hydraulic
228 conductivity corresponding to the imposed water pressure head plus a term related to radial water infiltration (Angulo

229 et al., 2016). In the case of large rings, the final infiltration rate approaches the value of the hydraulic conductivity
 230 corresponding to the imposed water pressure head (gravity flow). Consequently, if water ponding is imposed at
 231 surface, $i(t)$ tends towards the saturated hydraulic conductivity. ~~In general, the soil infiltration rate decreases~~
 232 ~~nonlinearly over time and approaches a constant value after long infiltration time.~~ Infiltration into the soil is controlled
 233 by several factors including soil properties (e.g., texture, bulk density, initial water content), layering, slope, cover
 234 condition (vegetation, crust, and/or stone), rainfall pattern (Smith et al., 2002; Corradini et al., 2017) and time. As soil
 235 texture and soil surface conditions (e.g., cover) are independent of time at the scale of individual infiltration events,
 236 these characteristics can be assumed to be constant during the event. On the other hand, soil structure, especially at
 237 the soil surface, can rapidly change, for instance, due to tillage, grazing or the destruction of soil aggregates by rain
 238 drop impact. In dry soils, initial infiltration rates are substantially higher than the saturated hydraulic conductivity of
 239 the surface layer due to capillary effects which control the sorptivity of the soil. However, as infiltration proceeds, the
 240 gradient between the pressure head at the soil surface and the pressure head below the wetting front reduces over time
 241 so that the infiltration rate finally reaches a constant value that approximates saturated hydraulic conductivity (Chow
 242 et al., 1988).

243 Infiltration measurements have been largely used to estimate soil saturated hydraulic conductivity. This soil property
 244 is a key to correctly describe all the components of the soil and land surface hydrological balance, and is essential in
 245 the appropriate design of irrigation systems. ~~Within the literature it is clear that extensive efforts have been made to~~
 246 ~~estimate this property~~ Large efforts have been invested in literature to estimate this property from basic soil properties
 247 using pedo-transfer functions (PTFs). PTFs are knowledge-based rules or equations that relate simple soil properties
 248 to those properties of soil that are more difficult to obtain (Van Looy et al., 2017). Most of these efforts have been
 249 based on measurements made on samples of disturbed or undisturbed soil material. With this infiltration database,
 250 data is now made available that may contribute to better predict the saturated soil hydraulic conductivity and
 251 demonstrate the effect of e.g. vegetation and land management on the parameters of interest.

252 The Richards (1931), Eq. (2), written as a function of soil water content ~~which is often referred to as the Fokker-~~
 253 ~~Planck water diffusion equation~~ can be used to derive the closed-form expression of the infiltration rate in partially
 254 saturated soils.

$$255 \quad \frac{\partial \theta}{\partial t} = \frac{\partial}{\partial z} \left(D_z(\theta) \frac{\partial \theta}{\partial z} + K_z(\theta) \right) \quad (2)$$

256 where θ is the volumetric soil water content [$L^3 L^{-3}$], t is the time [T], z is the vertical depth position [L], $K(\theta)$ is the
 257 soil hydraulic conductivity [$L T^{-1}$], and $D(\theta)$ is soil water diffusivity [$L^2 T^{-1}$], which is defined by Eq. (3) (Childs and
 258 Collis-George, 1950; Klute, 1952):

$$259 \quad D_z(\theta) = K_z(\theta) \frac{\partial h}{\partial \theta} \quad (3)$$

260 where h is the matric potential in head units [L]. The exact relationships between soil water content, soil matric
 261 potential, and soil hydraulic conductivity are necessary to solve the Richards equation. Several solutions of the
 262 Richards equation and many empirical/conceptual/semi-analytical/physically-based models, e.g., Green and Ampt
 263 (1911); Philip (1957); Smith and Parlange (1978); Haverkamp et al. (1994); Corradini et al. (2017), have been

264 introduced to describe the infiltration process over time, even for preferential flows, e.g. Lassabatere et al. (2014).
265 Furthermore, several direct or indirect experimental systems have been introduced to measure soil infiltration ~~at~~ in the
266 laboratory or in the field under different conditions (Gupta et al., 1994; McKenzie et al., 2002; Mao et al., 2008a).
267 Data obtained from these systems can also be used to deduce soil saturated hydraulic conductivity directly.
268 Methods developed to measure and quantify water infiltration in soil are generally time consuming and costly.
269 Therefore, PTFs have been developed and applied by many researchers, e.g., Jemsi et al. (2013), Parchami-Araghi et
270 al. (2013), Kashi et al. (2014), Sarmadian and Taghizadeh-Mehrjardi (2014), and Rahmati (2017), in order to easily
271 parameterize infiltration models. However, these PTFs have been developed for specific regions often limiting their
272 applicability. As already mentioned, a large number of publications reporting soil infiltration data is available, but
273 these data are dispersed in the literature and often difficult to access. Therefore, the aim of this data paper is to present
274 and make available a collection of infiltration data digitized from available literature and from published or
275 unpublished data provided directly by researchers around the world. These data are accompanied by metadata, which
276 provide information about the location of the infiltration measurement, soil properties, and land management. Finally,
277 we will provide some first results highlighting the suitability of the database for further research. The main article is
278 also accompanied by a supplement providing more detailed information about the different methodologies to measure
279 soil infiltration. This is added because many of readers are likely not well-versed in soil infiltration, its limitations in
280 measurement and modeling. For more detailed information on this, readers could refer to Smith (2002), Corradini et
281 al. (2017), and Hopmans et al. (2006).

282 2 Method and Materials

283 2.1 Data collection

284 We collected infiltration measurements from ~~all over the globe~~ different countries/regions by contacting the data
285 owners or by extracting infiltration data from published literature. To do this, a data request was sent to potential data
286 owners through different forums and email exchanges. The flyer asked data owners to cooperate in the developm ent
287 of the SWIG database by providing infiltration data as well as metadata about experimental conditions (e.g. initial soil
288 moisture content at the start of the experiment, method used), soil properties, land use, topography, geographical
289 coordinates of the sites and any other information relevant to interpret the data and to increase the value of the database.
290 Infiltration data reported in literature were digitized and included in the database together with additional information
291 provided in these papers. The digitization approach is discussed in Sect. 2.2. In total, 5023 single infiltration curves
292 were collected of which 510 infiltration curves were digitized from 74 published papers (Table 1) and 4513 were
293 provided by 68 different research teams (Tables 2 ~~and 3~~) being published or unpublished data. The references and
294 correspondences for data supplied by direct communications with researchers are also reported in Tables 2 ~~and 3~~.
295 Therefore, users may refer to these references for detailed information about the applied methods or procedures.

296 <<Table 1 about here>>

297 <<Table 2 about here>>

298 <<Table 3 about here>>

299 **2.2 Data digitization**

300 In order to digitize infiltration curves reported in literature, screenshots of the relevant plots were taken, and figures
301 were imported into the *plot digitizer 2.6.8* (Huwaldt and Steinhorst, 2015). First, the origin of the axes as well as the
302 highest x and y -values were defined and the diagram plane was spanned. Then, all point values were picked out and
303 an output table with the $x - y$ pairs (time vs. infiltration rate or cumulative infiltration) was generated and stored.

304 **2.3 Database structure**

305 The SWIG database is prepared in *.xlsx with a backup file in *.CSV formats containing several datasets.
306 Supplementary data are available
307 at <https://doi.org/10.1594/PANGAEA.885492>~~https://doi.pangaea.de/10.1594/PANGAEA.885492~~. The first dataset,
308 named I_{cm} , contains cumulative infiltration data in centimeter units, and are referred to as I_{xxxx} , whereby $xxxx$ is the
309 identifier of the individual infiltration test. The corresponding time intervals in hours for the infiltration data are
310 labeled T_{Hour} and named T_{xxxx} . The constant or varying pressure or tension heads (if any) during infiltration
311 measurements are also reported in another dataset named $Tension_{cm}$. The database also contains additional variables
312 and information relevant to the infiltration data provided by data owners or digitized from articles, as listed in Table
313 43, and which is labelled *Metadata*. **Additional soil properties were determined by different standards, therefore data
314 harmonization might be needed for some of those, especially in case of water content at field capacity, pH or wet-
315 aggregate stability. Further information on measurement methods is available from references of the data.** Since the
316 geometric mean diameter (d_g) and standard deviation (S_g) of soil particle sizes are rarely measured, both parameters
317 were computed using the following equations (Shirazi and Boersma, 1984):

318
$$d_g = \exp(a), \quad a = 0.01 \sum_{i=1}^n f_i \ln D_i \quad (4)$$

319
$$S_g = \exp(b), \quad b^2 = 0.01 \sum_{i=1}^n f_i \ln^2 D_i - a^2 \quad (5)$$

320 where f_i is the percent of total soil mass having diameters equal to or less than **arithmetic mean of interval limits (D_i)**
321 **that define three main fractions (i) of clay, silt, and sand with mean values of 0.001, 0.026, 1.025 mm.** ~~M_i , i corresponds~~
322 ~~to clay, silt, and sand fractions having the arithmetic mean of two consecutive particle size limits of 0.01, 0.026, and~~
323 ~~1.025 mm, respectively.~~ For the infiltration data, where the soil texture is unknown, d_g and S_g could not be calculated
324 and the data field in the database was left empty. The database also contains the locations of the experimental sites in
325 another dataset named *Locations* that provides the approximate latitude and longitudes in decimal degree (dd.dd)
326 format. Tables 2 and 3 are also provided in the SWIG database in two other worksheets named *Ref. for digitized data*
327 and *Ref. for data provided by owner* for corresponding issues.

328 << Table 4-3 about here >>

329 **3 Results and Discussion**

330 **3.1 Spatial and temporal data coverage**

331 The SWIG database consists of 5023 soil water infiltration measurements spread over nearly all continents (Fig. 2).
332 Data were derived from 54 countries (Table 5.4). The largest number of data sources were provided by scientists in
333 Iran (n = 38), China (n = 23), and the USA (n = 15), whereby one data source might contain several water infiltration
334 measurements. The SWIG database covers measurements from 1976 to 2017. A sparse coverage was obtained for the
335 higher latitudes of the Northern Hemisphere (above 60°) including Norway, Finland, Sweden, Iceland, Greenland,
336 and Russia. The lack of reports with infiltration data from most countries of the former Soviet Union as well as the
337 Sahelian and Sahara countries is also notable, as well as the small number of infiltration data from Australia. Fig. 3
338 shows the number of samples by climatic zone (Rubel et al., 2017; Kottek et al., 2006). The majority of the data is
339 from warm temperate, fully humid climate (49%), arid steppe climate and warm temperate climate with dry summer
340 are the second and third most represented climate zones with 22 and 12 % respectively. Fig. 4 and 5 show the frequency
341 of experimental sites respectively by WRB and USDA soil taxonomy systems based on the SoilGrids dataset (Hengl
342 et al., 2017). Regarding the WRB classification system (Fig. 4), in total, 35 WRB reference soil subgroups are included
343 among experimental sites where 55% of the experimental sites comprised four subgroup classes of Haplic Acrisols
344 (8%), Haplic Luvisols (11%), Haplic Calcisols (15%), and Haplic Cambisols (21%). 29 soil suborders classes of
345 USDA soil taxonomy are included in this study (Fig. 5) with Udalfs (9%), Orthents (9%), and Ustolls (9%) .
346 ThusNevertheless, the wide spatial and temporal distribution of infiltration data from this database provides a
347 comprehensive view on of the infiltration characteristics of many soils in the world which can be used in future studies.

348 <<Figure 2 about here>>

350 <<Table 5-4 about here>>

351 <<Figure 3 about here>>

352 <<Figure 4 about here>>

353 <<Figure 5 about here>>

354
355 **3.2 Analysis of the database using soil properties**

356 Textural information (clay, silt, and sand content) are available for 3842 out of 5023 collected infiltration curves (~
357 76%). The infiltration measurements nearly cover nearly all soil textural classes according to the USDA classification,
358 except for the sandy clay and silt textural class (Fig. 3.6), which makes SWIG a valuable data source for comprehensive
359 studies. To complete the large dataset, the open-access SWIG database might be amended with information regarding
360 those soils poorly, or altogether unrepresented, by the existing database, including those less usually considered by
361 infiltration studies, such as soils with extremely high stone content it would still be desirable to know about those soils
362 with extreme textures (clays, very sandy and stony soils) that usually are less represented in studies focusing on their
363 infiltration characteristics (Table 6) as well as their hydrological and erosional response (Poesen, 2018). Loam, sandy

Formatted: Font: (Default) Times New Roman, 10 pt, Complex Script Font: Times New Roman, 10 pt

Formatted: Space After: 0 pt

364 loam, silty loam, and clay loam contributed with 19, 18, 14, and 13 % (Table 65) to the infiltration measurements,
365 respectively. Table 6-5 shows that infiltration measurements are almost equally distributed among textures when these
366 are categorized in three major classes: course- (1092), medium- (1238), and fine to moderately fine-textured soils
367 (1447). Table 7-6 reports on the soil properties that are available in SWIG and it gives some simple statistics such as
368 mean, minimum, maximum, median, and coefficient of variation. Bulk density (available for 66 % of infiltration
369 measurements) and organic carbon content (available for 62 % of infiltration measurements) are two other soil
370 properties besides texture that have the highest frequency of availability. Saturated hydraulic conductivity, initial soil
371 water content, saturated soil water content, calcium carbonate equivalent, electrical conductivity, and pH are available
372 in 22 to 38 % of infiltration data. The other soil properties have a frequency lower than 10 %.

373 <<Figure 3-6 about here>>

374 <<Table 6-5 about here>>

375 <<Table 7-6 about here>>

376 3.3 Infiltration measurements in the SWIG database

377 Different instruments were used to measure soil water infiltration (Table 8). About 32% (1595 out of 5023) of the
378 measurements were carried out using different types of ring infiltrometers. The most frequently used methods are the
379 disc infiltrometer methods (disc, mini-disc, and micro-disc, hood, and tension infiltrometers), which have been used
380 in about 51% of the experiments. About 5% of the data were submitted to the database without specifying the
381 measurement method (251 infiltration tests) and around 12 % of the measurements were carried out with other methods
382 not listed above (Table 87).

383 <<Table 8-7 about here>>

384 3.4 Land use classes represented in the SWIG database

385 Land use is known to potentially impact soil structure and then water infiltration into soils (e.g., Ilstedt et al., 2007;
386 Waterloo et al., 2007). Consequently, we collected information on the type of land use at all experimental sites where
387 available. ~~Since land use is one of the most important factors affecting soil surface processes including water~~
388 ~~infiltration in soils, we collected information on the type of land use at all the experimental sites when available.~~ In
389 general, the type of land use was reported in 3818 out of 5023 infiltration curves (~76 %) and this information is
390 reported in the *Metadata* dataset. For simplicity, we grouped all reported land use types into 22 major groups (Table
391 98). A frequency analysis showed that agricultural land use, i.e. cropped land, irrigated land, dryland, and fallow land,
392 is the most frequently reported land use in the database with about 53% (2019 out of 3818) of all land uses. With 22%,
393 grasslands are the second most frequently represented land use type. Pasture with 6 % and forest with 5 % are ranked
394 as third and fourth largest reported land use types. The 18 remaining land use types all together cover only 545
395 experimental sites (less than 15%).

396 <<Table 9-8 about here>>

397 **3.5 Estimating infiltration parameters from infiltration measurements**

398 In order to predict infiltration parameters from infiltration measurements, we classified the SWIG infiltration curves
 399 in two groups: i) infiltration curves that were obtained under the assumption of 1D infiltration and ii) infiltration curves
 400 that were obtained under 3D flow conditions. We fitted the three-parameter infiltration equation of Philip (Kutflele
 401 and Krejča, 1987), Eq. (6), to the 1D experimental data and the simplified form of Haverkamp et al. (1994), Eq. (7),
 402 to the 3D experimental data:

403
$$I_{1D} = St^{\frac{1}{2}} + A_1t + A_2t^{\frac{3}{2}} \quad (6)$$

404
$$I_{3D} = S\sqrt{t} + \left[\frac{2-\beta}{3} K_{sat} + \frac{\gamma S^2}{R_d(\theta_s - \theta_i)} \right] t \quad (7)$$

405 We reduced the number of parameters in Eq. (6) by defining $A_1=0.33 \times K_{sat}$ (Philip, 1957) and $A_2=A$ where A was
 406 assumed to be a constant. In Eq. (7), we put $\beta = 0.6$ (Angulo-Jaramillo et al., 2000) and the second term between
 407 brackets on the right hand side was assumed to be a constant. Therefore, we simplified the equations as follows:

408
$$I_{1D} = St^{\frac{1}{2}} + 0.33K_{sat}t + At^{\frac{3}{2}} \quad (8)$$

409
$$I_{3D} = S\sqrt{t} + 0.47K_{sat}t + At \quad (9)$$

410 In our analysis, we assumed that double ring infiltrometer measurements result in 1D infiltration conditions, while the
 411 different types of disc infiltration and single ring infiltrometer measurements lead to 3D flow conditions that can be
 412 captured by Eq. (9). As 1D or 3D infiltration conditions are not guaranteed for measurements made with rainfall
 413 simulators, Guelph permeameters, Aardvark permeameters, linear and point source methods as well as Hood
 414 infiltrometer measurements, these infiltration curves were not considered in our first analysis. By excluding these
 415 methods, 596 infiltration curves were excluded from the fitting to Eq. (8) and (9). In addition, 251 infiltration curves
 416 were also excluded from the fitting to Eq. (8) and (9) as no indication was available on the measurement method used.
 417 In total, 4178 infiltration curves were included in our analysis of which 828 infiltration curves reflected 1D and 3350
 418 were considered as the results of 3D infiltration. As no sufficient information was available on the properties of the
 419 sand contact layer, we did not correct 3D infiltration measurements. Finally, the selected infiltration curves were fitted
 420 to Eq. (8) or (9) using the lsqnonlin command in **Matlab™**.

421 The fitting results of Eq. (8) to the single infiltrometer data are shown in Table 409. R^2 values were higher than 0.9 in
 422 97 % of the cases and higher than 0.99 in 77 % of the cases. Fitting Eq. (9) to the 3D infiltration curves data, R^2 values
 423 higher than 0.9 and 0.99 were obtained in 94 and 68% of the cases, respectively. The statistics for the fitting process
 424 as well as the fitted parameters of two mentioned models are reported in the SWIG database in an additional dataset
 425 labelled *Statistics*. For infiltration curves excluded from the analysis, an empty cell is reported.

426 <<Table 409 about here>>

427 The average values of estimated K_{sat} and sorptivity (S), using Eq. (8) or (9) as well as measured K_{sat} for different soil
 428 texture classes extracted from the current database is reported in Table 410. The measured values of K_{sat} were

Formatted: Font: Italic, Complex Script Font: Italic

Formatted: Font: Italic, Complex Script Font: Italic, Subscript

429 obtained by other means by the contributors and tabulated in the SWIG database. More detailed information of how
430 K_{sat} was calculated in individual cases can be found in the references linked to those data points. Comparison between
431 estimated (K_{sat-es}) and measured (K_{sat-m}) values of K_{sat} (Table 4-10) reveals that there is reasonably good
432 agreement between measurements and estimation, except for loamy sand (with mean $K_{sat-es} = 62 \text{ cm h}^{-1}$ vs. K_{sat-m}
433 $= 25 \text{ cm h}^{-1}$), sandy loam (with mean $K_{sat-es} = 32 \text{ cm h}^{-1}$ vs. $K_{sat-m} = 41 \text{ cm h}^{-1}$), silt loam (with mean $K_{sat-es} = 27$
434 cm h^{-1} vs. $K_{sat-m} = 3 \text{ cm h}^{-1}$), and silty clay (with mean $K_{sat-es} = 26 \text{ cm h}^{-1}$ vs. $K_{sat-m} = 45 \text{ cm h}^{-1}$) textural classes.
435 However, the only significant difference between measured and estimated K_{sat} values was found for the silt loam
436 textural class (Table 4-10) applying an independent T test.
437 We also compared our estimated K_{sat} values from the infiltration measurements from the SWIG database with K_{sat}
438 values from databases that have been published in the literature (Table 4-11). The validity of our estimated Ks values
439 is confirmed by comparing the order of magnitude of difference between these values, and those tabulated in previous
440 studies, for the various different soil classes. Some of these databases like the one of Clapp and Hornberger (1978)
441 and Cosby et al. (1984) have been used to parameterize land surface models. Most of the K_{sat} values in the listed
442 databases have been obtained from laboratory lab-scale measurements often performed on disturbed soil samples. In
443 most of the reported databases K_{sat} is controlled by texture with the highest mean values obtained for the coarse
444 textured and the lowest mean values for the fine textured soils. This is not the case for the K_{sat} values obtained from
445 the SWIG database. Clayey soils have a mean value that is similar to the coarser textured soils. This may be partly
446 explained by the fact that the measurements collected in the SWIG database are obtained from field measurements on
447 undisturbed soils. It was observed that the standard deviation of K_{sat} in the SWIG database is typically larger than the
448 standard deviations obtained from the databases in literature. This indicates that texture is apparently not the most
449 important control on K_{sat} values. However, one would also pose that much of the lack of correlation between soil
450 texture and predicted K_{sat} from the SWIG database is related to the lack of soil structural information, such as macro
451 porosity quantification or other possible soil attributes. Indeed, many of the data sets presented in our paper on
452 saturated and near-saturated flow can be used to infer the 'state' of the soil's structure, namely its macroporosity, by
453 using the slope of the near-saturated conductivity curve, via Philip's 'flow-weighted mean pore-size' analysis. White
454 and Sully (1987) have discussed this in a great detail. Zhang et al. (2015) is another example of where tension
455 infiltrometers can be used to describe the temporal dynamics of the macroporosity which characterizes 'soil structure'.
456 This could inspire researchers to collect such information when conducting additional soil infiltration measurements,
457 and include this in the database in the future. This finding indicates that present parameterization in currently used
458 land surface models, which are mainly based on texture, may severely underestimate the variability of K_{sat} . In addition,
459 it shows that also mean values are not dominantly controlled by textural properties. Other land surface properties such
460 as land use, crusting, etc. may, in fact, turn out to be much more important.

461 <<Table 4-10 about here>>

462 <<Table 4-11 about here>>

Formatted: Font: Italic, Complex Script Font: Italic

Formatted: Font: Italic, Complex Script Font: Italic, Subscript

463 **3.6 Exploring the SWIG database using principal component analysis**

464 In order to demonstrate the potential of the SWIG database for analyzing infiltration data and for developing pedo-
465 transfer functions, principal component analysis (PCA) was performed and biplots were generated to show both the
466 observations and the original variables in the principal component space (Gabriel, 1971).

467 In a biplot, positively correlated variables are closely aligned with each other and the larger the arrows the stronger
468 the correlation. Arrows that are aligned in opposite directions are negatively correlated with each other and the
469 magnitude of the arrows is again a measure for the strength of the correlation. Arrows that are aligned 90 degrees to
470 each other show typically no correlation. Figures 4-7 and 5-8 show the results of two PCA. The first PCA (Fig. 4-7)
471 shows the relationship between soil textural properties, S and K_{sat} based on 3267 infiltration measurements. The first
472 two principal components explain 74.5% of the variability in the data. Figure 4-7 shows a positive correlation between
473 K_{sat} and S (0.527) and the largest values for both variables are found in clay soils. Clay content appears only to be
474 weakly correlated with K_{sat} and S as is also shown by the correlation coefficients of 0.112 and 0.025 respectively.
475 Figure 5 shows the biplot of soil textural properties— with K_{sat} , S , organic carbon content, and bulk density in the
476 principal component space - based on 1910 infiltration measurements. The first two principal components still explain
477 55% of the variability. Neither S nor K_{sat} showed appreciable correlations with available soil properties. Only K_{sat} and
478 S are correlated (arrows are aligned but small) with a value of 0.29. Organic carbon and bulk density show a negative
479 correlation with a calculated value equal to -0.51. It also shows that for example the sandy clay loam textural class
480 (yellow dots) shows a wide spread in organic matter content and bulk densities. These analyses show that the examined
481 basic soil properties do not contain enough information to properly estimate K_{sat} and S . However, the SWIG database
482 provides additional information like such as land use, initial water content and slope that might prove to be good
483 predictors. A further analysis in this respect is however beyond the scope of this paper. More importantly, the present
484 analysis in combination with the results provided in Table 12 shows that a texture dominated derivation of K_{sat} values,
485 as implemented in most land surface models, does not provide adequate means to estimate K_{sat} .

486 <<Figure 4-7 about here>>

487 <<Figure 5-8 about here>>

488 **3.7 Potential error and uncertainty in the SWIG database**

489 Similar to any other databases, the data presented in the SWIG database may be subject to different error sources and
490 uncertainties. These include: 1) transcription errors that occurred when implementing the measurement data into the
491 EXCEL spreadsheets, 2) inaccuracy and uncertainties in determining related soil properties such as textural properties,
492 3) violation of the underlying assumption when performing the experiments, and 4) uncertainty (variability) in
493 estimated soil hydraulic properties due to the different measurement methods. Unfortunately, none of these errors or
494 uncertainty sources are under the control of the SWIG database authors and quantification of these sources is often
495 difficult, since the required information is often lacking. The uncertainty and variability related to the applied
496 measurement techniques on for estimated soil hydraulic properties may be assessed as information on the applied

497 techniques is available; however, yet some of these methods may only have been used in few cases making a
498 statistical analysis difficult.

499 With respect to the transcription error, a strong effort has been made to double check data transcription to prevent or
500 at least to minimize any probable error of this nature. Values of soil properties such as textural composition are known
501 to vary strongly between different laboratories labs and measurement methods. This is especially true for the finer
502 textural classes like clay. Unfortunately, information on the measurement used to determine soil properties is most of
503 the time lacking mostly lacking or insufficient to assess the magnitude of errors or biases. Internationally, there are a
504 number of typically more than one standard methods used to measure soil properties and several methods may have
505 been applied to measure the reported soil characteristics properties. In this regard, no conversion has been made and
506 only raw data are reported in database. However, we have supplied the references for all data (if where available) that
507 can be used to ascertain which methodologies were used, if so desired. people can check the methodologies if needed.
508 Although supplying such information for each soil property may facilitate the use of the database, but it would have
509 required considerable will need a lot of additional work that could not be performed at this stage of development of
510 the database. Such a work could be the purpose of additions could form the basis of a second version of the database
511 that any readers should feel free to undertake to commence.

512 The uncertainty with respect to the effect of measurement techniques on quantifying the infiltration process itself may
513 be analyzed from the SWIG database as it provides information on the type of measurement technique used. This
514 analysis is however again beyond the scope of the this paper. Potential error and uncertainty sources with respect to
515 the use of different measurements are discussed in the supplementary material. The uncertainty on of estimated soil
516 hydraulic properties from infiltration measurements may be strongly controlled by the person performing the
517 experiment but may also be due the different measurement windows of the methods in terms of measurement volume.
518 The SWIG database provides information to quantify uncertainties introduced by difference in measurement volume
519 and this analysis will be closely related to the assessment of the representative elementary volume, REV (see e.g. the
520 work of Pachepsky on the scaling of saturated hydraulic conductivity).

521 Careful interpretation of the data, in respect to the details of the experimental and soil conditions, is also required
522 when utilizing the SWIG. For instance, the cases of soils coded 1211 – 1420 may at first seem odd, as they display
523 very low infiltration rates for soils of a very high (>95%) sand content; however, these unusual findings are explained
524 by the soils being recorded as displaying water repellent characteristics. Another case in the SWIG database that users
525 may find odd are the relatively low infiltration rates for some water repellent soils with very high sand content (>95%),
526 for example those soils coded 1211 to 1420. Thus, the user needs to carefully interpret the data to understand the soil
527 and experimental conditions. Another example is estimated values of K_{sat} from clayey soils showing high values of
528 K_{sat} (e.g., soils coded 3746 to 3833 in SWIG). The K_{sat} values for these soils were obtained using the single ring
529 infiltrometer method (Gonzalez-Sosa et al., 2010; Braud, 2015; Braud and Vandervaere, 2015), and were conducted
530 in the field under ponded conditions, with vegetation cut but roots left in place. Macropores can could have been
531 activated, leading to infiltration rate much higher than expected for clayey soils. Very There were also instances of
532 very high values were being obtained for forested land uses, and sometimes for grassland, probably explained by the
533 visible cracks in the soil surface present in those cases though cracks were visibly present in those cases.

534

535 3.8 Research potentials of the SWIG database

536 We envision that SWIG offers a unique opportunity and information source to 1) evaluate infiltration methods and to
537 assess their value in deriving soil hydraulic properties, 2) test different models and concepts for point scale and grid
538 scale infiltration processes, 3) develop pedo-transfer functions (PTFs) to estimate soil hydraulic properties such as the
539 Mualem van Genuchten parameters, 4) identify controls on infiltration processes, 5) validate global predictions of
540 infiltration from land surface models, 6) study more complex processes like preferential flow in soils, and 7) highlight
541 the state of the art on understanding of the relationships between infiltration and several soil surface characteristics,
542 for example the SWIG database has already contributed to the effectively can contribute to the scope of Morbidelli et
543 al. (2018) to advance the knowledge of infiltration over sloping surfaces.

544 We are confident that the SWIG database is just a first step in collecting and archiving infiltration data and we expect
545 that increasing amounts of more and more data will become available in the near future. These data will be archived
546 in SWIG and thus made available to the world-wide research community. In this regard, we are interested in receiving
547 existing or newly measured infiltration curves and for this purpose the corresponding author will serve as point of
548 contact or data can be made available through the International Soil Modeling Consortium, ISMC ([https://soil-
549 modeling.org/](https://soil-modeling.org/)), for further archiving in the SWIG.

550 4 Conclusion

551 We have collected 5023 infiltration curves from field experiments from all over the world covering a broad range of
552 soils, land uses and climate regions. We estimated saturated hydraulic conductivity, K_{sat} , and sorptivity from more
553 than 3000 infiltration curves and compared estimated K_{sat} values with values from different databases published in
554 literature. We showed that contrary to the assumption made in many land surface and global climate models, texture
555 is not the main controlling factor for K_{sat} . In addition, the variability in K_{sat} derived from these field measurements
556 is considerably larger than reported in the literature. The collected infiltration curves were archived as the SWIG
557 database on the PANGAEA platform and are therefore available world-wide available. The data are structured into
558 *.xlsx and *.csv files and include metadata information for further use. Data analysis revealed that infiltration curves
559 are lacking for clayey, sandy textured and stony soils. Also infiltration curve data are lacking for the Northern and
560 permafrost regions. Here additional efforts are needed to collect additional more data as these regions are particularly
561 sensitive to climate change which will clearly affect the soil hydrology.

562 Acknowledgments

563 - ~~Authors gratefully thank the International Soil Modeling Consortium (ISMC) and the International Soil and
564 Tillage Organization (ISTRO) for their help in distributing our call for data among researchers in the world.~~
565 First author thanks the International & Scientific Cooperation Office of University of Maragheh, Iran as well
566 as the Research Comitee and Baord Members of the University for their assist to conduct the current work.

Formatted: Font: (Default) Times New Roman, 10 pt,
Complex Script Font: Times New Roman, 10 pt

- 567 - The financial support received from the Forschungszentrum Jülich GmbH is gratefully acknowledged by the
568 first author.
- 569 - Authors gratefully thank the International Soil Modeling Consortium (ISMC) and the International Soil and
570 Tillage Organization (ISTRO) for their help in distributing our call for data among researchers in the world.
- 571 - Parts of data were gathered from the work that was supported by the UK-China Virtual Joint Centre for
572 Agricultural Nitrogen (CINAg, BB/N013468/1), which is jointly supported by the Newton Fund, via UK
573 BBSRC and NERC.
- 574 - The French Claduègne and Yzeron data sets were acquired during the ANR projects FloodScale (ANR-2011-
575 BS56-027) and AVuUR (ANR-07-VULN-01) respectively. Also,
- 576 - Parts of the database were made available through research work carried out in the framework of LIFE+
577 projects funded by the EC.
- 578 - The Spanish Ministry of Economy is acknowledged for support through project CGL2014-53017-C2-1-R.
579 CGL2014-53017-C2-1-R. The Czech Science Foundation is acknowledged for support through project No.
580 16-05665S. Authors are also greatfull for Prof. Dr. Atilla Nemes and Prof. Dr. Jan W. Hopmans for their
581 time and attentions on reviewing and commenting this article. We do believe that the article got improved
582 very well using their valuable comments.
- 583 - The Czech Science Foundation is acknowledged for support through project No. 16-05665S.
- 584 - Authors are greatfull for Prof. Dr. Atilla Nemes, Prof. Dr. Jan W. Hopmans and Prof Dr. Marnik Vanclooster
585 for their time and attentions on reviewing and commenting this article. Authors do believe that the article got
586 improved very well using their valuable comments.

587 References

- 588 Abagale, F. K., Abdulai, N., and Ojadiran, J. O.: Effect of shea waste slurry on soil physical porperties in peri urban
589 Tamale, Asian Journal of Science and Technology, 4, 36-41, 2012.
- 590 Abdallah, N. A., Wua, L. T., Widaa, A., and Elamin, M. B.: Rain infiltration into loess soil under different rain
591 intensities and slope angles, International Journal of Scientific Engineering and Applied Science (IJSEAS), 2, 179-
592 183, 2016.
- 593 Adindu Ruth, U., Igbokwe kelechi, K., Chigbu Timothy, O., and Ike-Amadi, C.: Application of Kostiakov's
594 Infiltration Model on the Soils of Umudike, Abia State-Nigeria, American Journal of Environmental Engineering, 4,
595 1-6, 2014.
- 596 Al-Azawi, S. A.: Experimental evaluation of infiltration models, Journal of Hydrology (New Zealand), 24, 77-88,
597 1985.
- 598 Al-Ghazal, A.: Effect of tractor wheel compaction on bulk density and infiltration rate of a loamy sand soil in Saudi
599 Arabia, Emir. J. Agric. Sci, 14, 24-33, 2002.
- 600 Al-Kayssi, A., and Mustafa, S.: Modeling gypsiferous soil infiltration rate under different sprinkler application rates
601 and successive irrigation events, Agricultural Water Management, 163, 66-74, 2016.

Formatted: Font: (Default) Times New Roman, 10 pt,
Complex Script Font: Times New Roman, 10 pt

Formatted: List Paragraph, Bulleted + Level: 1 +
Aligned at: 0.63 cm + Indent at: 1.27 cm

Formatted: Font: (Default) Times New Roman, 10 pt,
Complex Script Font: Times New Roman, 10 pt

Formatted: List Paragraph, Bulleted + Level: 1 +
Aligned at: 0.63 cm + Indent at: 1.27 cm

Formatted: Font: (Default) Times New Roman, 10 pt,
Complex Script Font: Times New Roman, 10 pt

Formatted: Font: (Default) Times New Roman, 10 pt,
Complex Script Font: Times New Roman, 10 pt

Formatted: Font: (Default) Times New Roman, 10 pt,
Complex Script Font: Times New Roman, 10 pt

Formatted: Font: (Default) Times New Roman, 10 pt,
Complex Script Font: Times New Roman, 10 pt

Formatted: (Complex) Persian, English (United States)

Formatted: Font: (Default) Times New Roman, 10 pt,
Complex Script Font: Times New Roman, 10 pt

Formatted: (Complex) Persian, English (United States)

Formatted: Font: (Default) Times New Roman, 10 pt,
Complex Script Font: Times New Roman, 10 pt

Formatted: Font: (Default) Times New Roman, 10 pt,
Complex Script Font: Times New Roman, 10 pt

602 Al Yamani, W., Green, S., Pangilinan, R., Dixon, S., and Clothier, B.: Sustainable Irrigation of Arid Forests in Abu
603 Dhabi using Groundwater and Treated Sewage Effluent, Integrated nutrient and water management for sustainable
604 farming, 2016.

605 Alagna, V., Bagarello, V., Di Prima, S., Giordano, G., and Iovino, M.: Testing infiltration run effects on the estimated
606 water transmission properties of a sandy-loam soil, *Geoderma*, 267, 24-33, 2016.

607 Angulo-Jaramillo, R., Vandervaere, J.-P., Roulier, S., Thony, J.-L., Gaudet, J.-P., and Vauclin, M.: Field measurement
608 of soil surface hydraulic properties by disc and ring infiltrometers: A review and recent developments, *Soil and Tillage
609 Research*, 55, 1-29, 2000.

610 [Angulo-Jaramillo, R.; Bagarello, V.; Iovino, M.; Lassabatère, L.: Infiltration Measurements for Soil Hydraulic
611 Characterization; Springer International Publishing: New York, NY, USA, ISBN 978-3-319-31786-1, 2016.](#)

612 Arriaga, F. J., Kornecki, T. S., Balkcom, K. S., and Raper, R. L.: A method for automating data collection from a
613 double-ring infiltrometer under falling head conditions, *Soil Use and Management*, 26, 61-67, 10.1111/j.1475-
614 2743.2009.00249.x, 2010.

615 Arshad, E. I., Sarki, E. A., and Khan, E. Z. A.: Analysis of Water Transmission Behaviour in Sandy Loam Soil under
616 Different Tillage Operations of Mould Board Plough applying/Using Different Infiltration Models, *International
617 Journal for Research in Applied Science & Engineering Technology (IJRASET)*, 3, 254-266, 2015.

618 Ayu, I. W., Soemarno, S. P., and Java, I. I.: Assessment of Infiltration Rate under Different Drylands Types in Unter-
619 Iwes Subdistrict Sumbawa Besar, Indonesia, *Assessment*, 3, 2013.

620 Battle-Aguilar, J., Schneider, S., Pessel, M., Tucholka, P., Coquet, Y., and Vachier, P.: Axisymmetrical Infiltration in
621 Soil Imaged by Noninvasive Electrical Resistivity, *Soil Science Society of America Journal*, 73, 510,
622 10.2136/sssaj2007.0278, 2009.

623 Berglund, E. R., Ahyoud, A., and Tayaa, M. H.: Comparison of soil and infiltration properties of range and afforested
624 sites in northern Morocco, *Forest Ecology and Management*, 3, 295-306, 1980.

625 Bertol, I., Barbosa, F. T., Bertol, C., and Luciano, R. V.: Water infiltration in two cultivated soils in Southern Brazil,
626 *Revista Brasileira de Ciência do Solo*, 39, 573-588, 2015.

627 Bhardwaj, A., and Singh, R.: Development of a portable rainfall simulator infiltrometer for infiltration, runoff and
628 erosion studies, *Agricultural water management*, 22, 235-248, 1992.

629 Bhawan, J. V.: Infiltration studies in sher-umar river doab in narmada basin, National Institute of Hydrology, Jal
630 Vigyan bhawan, India, 1997.

631 Biro, K., Pradhan, B., Buchroithner, M., and Makeschin, F.: The Effects of Different Land Use Types on Soil
632 Compaction and Infiltration Rate in the Drylands Vertisol of Gadarif Region, Sudan, *Tropentag: World Food System
633 — A Contribution from Europe*, 2010.

634 Bowyer- Bower, T.: Effects of rainfall intensity and antecedent moisture on the steady- state infiltration rate in a
635 semi- arid region, *Soil Use and Management*, 9, 69-75, 1993.

636 Campbell, G. S.: *Soil physics with BASIC: transport models for soil-plant systems*, Elsevier, 1985.

637 Casanova, M. P.: Influence of slope gradient and aspect on soil hydraulic conductivity measured with tension
638 infiltrometer, MSc, Department of Soil Sciences Swedish University of Agricultural Sciences, Uppsala, 52 pp., 1998.

639 Chalhoub, M., Vachier, P., Coquet, Y., Darwish, T., Dever, L., and Mroueh, M.: Caractérisation des propriétés
640 hydrodynamiques d'un sol de la Bekaa (Liban) sur les rives du fleuve Litani, *Étude et gestion des sols*, 16, 67-84,
641 2009.

642 Chartier, M., Rostagno, C., and Pazos, G.: Effects of soil degradation on infiltration rates in grazed semiarid rangelands
643 of northeastern Patagonia, Argentina, *Journal of Arid Environments*, 75, 656-661, 2011.

644 Childs, E. C., and Collis-George, N.: The permeability of porous materials, *Proceedings of the Royal Society of
645 London A: Mathematical, Physical and Engineering Sciences*, 1950, 392-405,

646 Chow, V., Maidment, D., and Mays, L.: *Applied hydrology*, 572 pp, Editions McGraw-Hill, New York, 1988.

647 Cichota, R., Vogeler, I., Snow, V. O., and Webb, T. H.: Ensemble pedotransfer functions to derive hydraulic properties
648 for New Zealand soils, *Soil Research*, 51, 94, 10.1071/sr12338, 2013.

649 Clapp, R. B., and Hornberger, G. M.: Empirical equations for some soil hydraulic properties, *Water resources research*,
650 14, 601-604, 1978.

651 Commandeur, P. R., Wass, E. F., Forests, B. C. M. o., II., C.-B. C. P. A. o. F. R. D. F., and Service, C. F.: *Rainfall
652 Simulation, Soil Infiltration and Surface Erosion on Skidroad Surfaces*, Nelson Forest Region, Government of British
653 Columbia, 1994.

654 Coquet, Y.: *Etude in situ des phénomènes de retrait-gonflement des sols: application à deux sols tropicaux peu
655 gonflants*, 1996.

656 Corradini, C., Morbidelli, R., Govindaraju R. S.: *Infiltration Modeling*, Vijay P. Singh (ed), *Handbook of Applied
657 Hydrology Second Edition*, McGraw-Hill, New York, pp. 45-1; 45-9, ISBN: 9780071835091, 2017,

658 Coquet, Y., Vachier, P., and Labat, C.: Vertical variation of near-saturated hydraulic conductivity in three soil profiles,
659 *Geoderma*, 126, 181-191, 10.1016/j.geoderma.2004.09.014, 2005.

660 Cosby, B., Hornberger, G., Clapp, R., and Ginn, T.: A statistical exploration of the relationships of soil moisture
661 characteristics to the physical properties of soils, *Water resources research*, 20, 682-690, 1984.

662 Coutinho, A. P., Lassabatere, L., Montenegro, S., Antonino, A. C. D., Angulo- Jaramillo, R., and Cabral, J. J.:
663 Hydraulic characterization and hydrological behaviour of a pilot permeable pavement in an urban centre, Brazil,
664 *Hydrological Processes*, 30, 4242-4254, 2016.

665 Dasgupta, S., Mohanty, B. P., and Köhne, J. M.: Soil Hydraulic Conductivities and their Spatial and Temporal
666 Variations in a Vertisol, *Soil Science Society of America Journal*, 70, 1872, 10.2136/sssaj2006.0201, 2006.

667 Delage, P., Zadjajoui, A., Cui, Y. J., Ghabezloo, S., Pereira, J. M., and Tang, A. M.: Numerical modelling of infiltration
668 profiles in the silt Tlemcen (Algeria), *E3S Web of Conferences*, 9, 11015, 10.1051/e3sconf/20160911015, 2016.

669 Di Prima, S., Lassabatere, L., Bagarello, V., Iovino, M., and Angulo-Jaramillo, R.: Testing a new automated single
670 ring infiltrometer for Beerkan infiltration experiments, *Geoderma*, 262, 20-34, 10.1016/j.geoderma.2015.08.006,
671 2016.

672 Dušek, J., Lichner, L., Vogel, T., and Štekauerová, V.: Transport of iodide in structured soil under spring barley during
673 irrigation experiment analyzed using dual-continuum model, *Biologia*, 68, 10.2478/s11756-013-0249-4, 2013.

674 Fakhre Nikche, A., Vafakhah, M., and Sadeghi, S. H. R.: Efficiency Evolution of Different Infiltration Models in
675 Different Land Use and Soil Classes using Rainfall Simulator, *Iranian Soil and Water Science*, 24, 183-193, 2014.

676 Fakouri, T., Emami, H., and Ghahremani, B.: Estimation of cumulative infiltration using particle size distribution in
677 different agricultural landuses, *Journal of Water Researches in Agriculture*, 26, 379-390, 2011a.

678 Fakouri, T., Emami, H., and Ghahremani, B.: Effects of different landuses on soil water infiltration, *Journal of Water
679 Researches in Agriculture*, 25, 195-206, 2011b.

680 Fan, R., Zhang, X., Yang, X., Liang, A., Jia, S., and Chen, X.: Effects of tillage management on infiltration and
681 preferential flow in a black soil, Northeast China, *Chinese geographical science*, 23, 312-320, 2013.

682 Fodor, N., Sándor, R., Orfanus, T., Lichner, L., and Rajkai, K.: Evaluation method dependency of measured saturated
683 hydraulic conductivity, *Geoderma*, 165, 60-68, 2011.

684 Gabriel, K. R.: The biplot graphic display of matrices with application to principal component analysis, *Biometrika*,
685 58, 453-467, 1971.

686 Gharaibeh, M. A., Ghezzehei, T. A., Albalasmeh, A. A., and Ma'in, Z. A.: Alteration of physical and chemical
687 characteristics of clayey soils by irrigation with treated waste water, *Geoderma*, 276, 33-40, 2016.

688 Ghavimi Panah, M. H., Sadeghi, S. H. R., and Younesi, H.: Role of superficial biochar mulch produced from dairy
689 factory waste on infiltration and runoff in small experimental plots, *Iranian Journal of Soil and Water Research*, 48,
690 905-916, 2017.

691 Giertz, S., Junge, B., and Diekkrüger, B.: Assessing the effects of land use change on soil physical properties and
692 hydrological processes in the sub-humid tropical environment of West Africa, *Physics and Chemistry of the Earth,
693 Parts A/B/C*, 30, 485-496, 2005.

694 Gonzalez-Sosa, E., Braud, I., Dehotin, J., Lassabatère, L., Angulo-Jaramillo, R., Lagouy, M., Branger, F.,
695 Jacqueminet, C., Kermadi, S., and Michel, K.: Impact of land use on the hydraulic properties of the topsoil in a small
696 French catchment, *Hydrological Processes*, n/a-n/a, 10.1002/hyp.7640, 2010.

697 Green, W. H., and Ampt, G.: Studies on Soil Physics, *The Journal of Agricultural Science*, 4, 1-24, 1911.

698 Gupta, R., Rudra, R., Dickinson, W., and Wall, G.: Spatial and seasonal variations in hydraulic conductivity in relation
699 to four determination techniques, *Canadian Water Resources Journal*, 19, 103-113, 1994.

700 Hatzigiannakis, E., and Panoras, A.: Report of results STU, physical, -chemical and hydraulic properties of soil, *Action
701 6: Assess land degradation caused by erosion in a pilot agricultural area*, 433p, 2011.

702 Haverkamp, R., Ross, P. J., Smettem, K. R. J., and Parlange, J. Y.: Three-dimensional analysis of infiltration from the
703 disc infiltrometer: 2. Physically based infiltration equation, *Water Resources Research*, 30, 2931-2935,
704 10.1029/94WR01788, 1994.

705 Hazbavi, Z., and Sadeghi, S.: Potential effects of vinasse as a soil amendment to control runoff and soil loss, *Soil*, 2,
706 71, 2016.

707 Hengl, T., de Jesus, J. M., Heuvelink, G. B., Gonzalez, M. R., Kilibarda, M., Blagotić, A., ... & Guevara, M. A.:
708 *SoilGrids250m: Global gridded soil information based on machine learning*. *PLoS one*, 12(2), e0169748, 2017.

709 Hillel, D.: Introduction to environmental soil physics, Academic press, ~~2003~~2013.

710 Hopmans, J. W., Parlange, J. Y., Assouline, S.: Infiltration, Jacques W. Delleur (ed.), *The handbook of groundwater
711 engineering*, CRC Press, Taylor & Francis Group, Boca Raton, New York, US.

712 Holzapfel, E. A., Mariño, M. A., Valenzuela, A., and Diaz, F.: Comparison of infiltration measuring methods for
713 surface irrigation, *Journal of irrigation and drainage engineering*, 114, 130-142, 1988.

714 Hu, X., Li, Z.-C., Li, X.-Y., and Liu, L.-y.: Quantification of soil macropores under alpine vegetation using computed
715 tomography in the Qinghai Lake Watershed, NE Qinghai–Tibet Plateau, *Geoderma*, 264, 244-251, 2016.

716 Huang, L., Zhang, P., Hu, Y., and Zhao, Y.: Vegetation succession and soil infiltration characteristics under different
717 aged refuse dumps at the Heidaigou opencast coal mine, *Global Ecology and Conservation*, 4, 255-263,
718 10.1016/j.gecco.2015.07.006, 2015.

719 Huang, M., Barbour, S. L., Elshorbagy, A., Zettl, J. D., and Cheng Si, B.: Infiltration and drainage processes in multi-
720 layered coarse soils, *Canadian Journal of Soil Science*, 91, 169-183, 2011.

721 Igbadun, H., Othman, M., and Ajayi, A.: Performance of Selected Water Infiltration Models in Sandy Clay Loam Soil
722 in Samaru Zaria, *Global Journal of Researches in Engineering: J General Engineering*, 16, 8-14, 2016.

723 Ilstedt, U., Malmer, A., Verbeeten, E., and Murdiyarto, D.: The effect of afforestation on water infiltration in the
724 tropics: a systematic review and meta-analysis. *Forest Ecology and Management*, 251(1-2), 45-51, 2007.

725 Jačka, L., Pavlásek, J., Pech, P., and Kuráz, V.: Assessment of evaluation methods using infiltration data measured in
726 heterogeneous mountain soils, *Geoderma*, 276, 74-83, 10.1016/j.geoderma.2016.04.023, 2016.

727 Jacques, D.: Analysis of water flow and solute transport at the field scale, PhD diss, 2000.

728 Jacques, D., Mohanty, B. P., and Feyen, J.: Comparison of alternative methods for deriving hydraulic properties and
729 scaling factors from single- disc tension infiltrometer measurements, *Water Resources Research*, 38, 2002.

730 Jemsi, S., Sayyad, G., Jafarnejadi, A., and KashefiPour, S. M.: Development of infiltration rate pedotransfer
731 functions using artificial neural networks and multiple linear regressions for Khuzestan province in south of Iran,
732 *International Journal of Agriculture*, 3, 766, 2013.

733 Kashi, H., Emamgholizadeh, S., and Ghorbani, H.: Estimation of soil infiltration and cation exchange capacity based
734 on multiple regression, ANN (RBF, MLP), and ANFIS models, *Communications in soil science and plant analysis*,
735 45, 1195-1213, 2014.

736 Kavousi, S., Vafakhah, M., and Mahdian, M.: Evaluation of some infiltration models for different land uses in kojour
737 watershed, *Iranian of Irrigation & Water Engineering*, 4, 1-13, 2013.

738 Keesstra, S. D., Quinton, J. N., van der Putten, W. H., Bardgett, R. D., and Fresco, L. O.: The significance of soils and
739 soil science towards realization of the United Nations Sustainable Development Goals, *Soil*, 2, 111, 2016.

740 Khan, G. S., and Strosser, P.: Soil survey of Pakistan, 1-95, 1998.

741 Kheirfam, H., Sadeghi, S. H. R., Zarei Darki, B., and Homae, M.: Controlling rainfall-induced soil loss from small
742 experimental plots through inoculation of bacteria and cyanobacteria, *Catena*, 152, 40-46, 2017a.

743 Kheirfam, H., Sadeghi, S. H. R., Homae, M., and Zarei Darki, B.: Quality improvement of an erosion-prone soil
744 through microbial enrichment, *Soil and Tillage Research*, 165, 230-238, 2017b.

745 Kiani-Harhegani, M., Sadeghi, S. H. R., and Asadi, H.: Comparing grain size distribution of sediment and original
746 soil under raindrop detachment and raindrop-induced and flow transport mechanism, *Hydrological Sciences Journal*,
747 2017.

748 Klute, A.: Some theoretical aspects of the flow of water in unsaturated soils, *Soil Science Society of America Journal*,
749 16, 144-148, 1952.

750 Kottek, M., Grieser, J., Beck, C., Rudolf, B., and Rubel, F.: **World map of the Köppen-Geiger climate classification**
751 **updated. *Meteorologische Zeitschrift*, 15(3), 259–263, 2006**

752 Kutilek, M., and Krejča, M.: Three-parameter infiltration equation of Philip type, *Vodohosp. Čas*, 35, 52-61, 1987.

753 Lassabatere, L., Angulo-Jaramillo, R., Goutaland, D., Letellier, L., Gaudet, J., Winiarski, T., and Delolme, C.: Effect
754 of the settlement of sediments on water infiltration in two urban infiltration basins, *Geoderma*, 156, 316-325, 2010.

755 Lassabatere, L., Yilmaz, D., Peyrard, X., Peyneau, P. E., Lenoir, T., Šimůnek, J., and Angulo-Jaramillo, R.: New
756 analytical model for cumulative infiltration into dual-permeability soils, *Vadose Zone Journal*, 13, 2014.

757 Latorre, B., Peña, C., Lassabatere, L., Angulo-Jaramillo, R., and Moret-Fernández, D.: Estimate of soil hydraulic
758 properties from disc infiltrometer three-dimensional infiltration curve. Numerical analysis and field application,
759 *Journal of Hydrology*, 527, 1-12, 2015.

760 Li, X.-Y., Zhang, S.-Y., Peng, H.-Y., Hu, X., and Ma, Y.-J.: Soil water and temperature dynamics in shrub-encroached
761 grasslands and climatic implications: results from Inner Mongolia steppe ecosystem of north China, *Agricultural and*
762 *forest meteorology*, 171, 20-30, 2013.

763 Lichner, L., Eldridge, D., Schacht, K., Zhukova, N., Holko, L., Sir, M., and Pecho, J.: Grass cover influences
764 hydrophysical parameters and heterogeneity of water flow in a sandy soil, *Pedosphere*, 21, 719-729, 2011.

765 Lichner, L., Hallett, P. D., Drongová, Z., Czachor, H., Kovacik, L., Mataix-Solera, J., and Homolák, M.: Algae
766 influence the hydrophysical parameters of a sandy soil, *Catena*, 108, 58-68, 10.1016/j.catena.2012.02.016, 2013.

767 Lichner, L., Holko, L., Zhukova, N., Schacht, K., Rajkai, K., Fodor, N., and Sándor, R.: Plants and biological soil
768 crust influence the hydrophysical parameters and water flow in an aeolian sandy soil/Vplyv rastlín a biologického
769 pôdneho pokryvu na hydrofyzikálne parametre a prúdenie vody v piesočnatej pôde, *Journal of Hydrology and*
770 *Hydromechanics*, 60, 309-318, 2012.

771 Liebig, M., Tanaka, D., and Wienhold, B. J.: Tillage and cropping effects on soil quality indicators in the northern
772 Great Plains, *Soil and Tillage Research*, 78, 131-141, 2004.

773 Lipiec, J., Kuś, J., Słowińska-Jurkiewicz, A., and Nosalewicz, A.: Soil porosity and water infiltration as influenced
774 by tillage methods, *Soil and Tillage Research*, 89, 210-220, 10.1016/j.still.2005.07.012, 2006.

775 Ma, D., Zhang, J., Horton, R., Wang, Q., and Lai, J.: Analytical method to determine soil hydraulic properties from
776 vertical infiltration experiments, *Soil Science Society of America Journal*, 2017.

777 Machiwal, D., Jha, M. K., and Mal, B.: Modelling infiltration and quantifying spatial soil variability in a wasteland of
778 Kharagpur, India, *Biosystems Engineering*, 95, 569-582, 2006.

779 Machiwal, D., Dayal, D., and Kumar, S.: Estimating Water Balance of Small Reservoirs in Arid Regions: A Case
780 Study from Kachchh, India, *Agricultural Research*, 6, 57-65, 2017.

781 Mallmann, M. S.: Water infiltration in soil conditioned by use of cover crops, M. Sc., *Soil Science*, Federal University
782 of Santa Maria, Santa Maria, 72 pp., 2017.

783 Mao, L., Bralts, V. F., Pan, Y., Liu, H., and Lei, T.: Methods for measuring soil infiltration: State of the art,
784 *International Journal of Agricultural and Biological Engineering*, 1, 22-30, 2008a.

785 Mao, L., Lei, T., Li, X., Liu, H., Huang, X., and Zhang, Y.: A linear source method for soil infiltrability measurement
786 and model representations, *Journal of Hydrology*, 353, 49-58, 2008b.

787 Mao, L., Li, Y., Hao, W., Zhou, X., Xu, C., and Lei, T.: A new method to estimate soil water infiltration based on a
788 modified Green–Ampt model, *Soil and Tillage Research*, 161, 31-37, 10.1016/j.still.2016.03.003, 2016.

789 Matula, S.: The influence of tillage treatments on water infiltration into soil profile, *Plant Soil and Environment*, 49,
790 298-306, 2003.

791 McKenzie, N., Coughlan, K., and Cresswell, H.: *Soil physical measurement and interpretation for land evaluation*,
792 Csiro Publishing, 2002.

793 Medinski, T., Mills, A., and Fey, M.: Infiltrability in soils from south-western Africa: effects of texture, electrical
794 conductivity and exchangeable sodium percentage, *South African Journal of Plant and Soil*, 26, 157-163, 2009.

795 Mertens, J., Jacques, D., Vanderborght, J., and Feyen, J.: Characterisation of the field-saturated hydraulic conductivity
796 on a hillslope: in situ single ring pressure infiltrometer measurements, *Journal of Hydrology*, 263, 217-229, 2002.

797 Mertens, J., Madsen, H., Feyen, L., Jacques, D., and Feyen, J.: Including prior information in the estimation of
798 effective soil parameters in unsaturated zone modelling, *Journal of Hydrology*, 294, 251-269,
799 10.1016/j.jhydrol.2004.02.011, 2004.

800 Mertens, J., Madsen, H., Kristensen, M., Jacques, D., and Feyen, J.: Sensitivity of soil parameters in unsaturated zone
801 modelling and the relation between effective, laboratory and in situ estimates, *Hydrological Processes*, 19, 1611-1633,
802 10.1002/hyp.5591, 2005.

803 Miller, K., Elliott, J., and Friday, N.: *Soils infiltration data for selected Wyoming watersheds, 1998-1999*, DTIC
804 Document, 2005.

805 Mohammed, A. M. E., Mohamed, H. I., and Elramlawi, H. R.: Comparison of infiltration measuring techniques for
806 furrow irrigation in cracking clay soil, *Journal of Hydrology*, 8, 0-0, 2007.

807 Mohanty, B., Kanwar, R. S., and Everts, C.: Comparison of saturated hydraulic conductivity measurement methods
808 for a glacial-till soil, *Soil Science Society of America Journal*, 58, 672-677, 1994.

809 Morbidelli, R., Corradini, C., Saltalippi, C., Flammini, A., and Rossi, E.: Infiltration-soil moisture redistribution under
810 natural conditions: experimental evidence as a guideline for realizing simulation models, *Hydrology and Earth System
811 Sciences*, 15, 2937, 2011.

812 Morbidelli, R., Saltalippi, C., Flammini, A., Cifrodelli, M., Picciafuoco, T., Corradini, C., and Govindaraju, R. S.: In
813 situ measurements of soil saturated hydraulic conductivity: Assessment of reliability through rainfall-runoff
814 experiments, *Hydrological Processes*, 31, 3084-3094, 10.1002/hyp.11247, 2017.

815 Morbidelli, R., Saltalippi, C., Flammini, A., and Govindaraju, R. S.: Role of slope on infiltration: a review, *Journal of
816 Hydrology*, 2018.

817 Muhamad, A., 田中正, Budi Indra, S., and Satyanto Krido, S.: Infiltration characteristics of tropical soil based on
818 water retention data, *水文・水資源学会誌*, 21, 215-227, 2008.

819 Murray, C. D., and Buttle, J. M.: Infiltration and soil water mixing on forested and harvested slopes during spring
820 snowmelt, Turkey Lakes Watershed, central Ontario, *Journal of Hydrology*, 306, 1-20, 10.1016/j.jhydrol.2004.08.032,
821 2005.

822 Naeth, M., Chanasyk, D., and Bailey, A.: Applicability of the Kostiaikov equation to mixed prairie and fescue
823 grasslands of Alberta, *Journal of range Management*, 18-21, 1991.

824 Nívar, J., and Synnot, T. J.: Soil infiltration and land use in Linares, NL, Mexico, *Terra Latinoamericana*, 18, 2000.

825 Nikghalpour, M., Asadi, H., and Gorji, M.: Evaluation of spatial distribution of water infiltration rate and its relation
826 with some physical and chemical properties in the Kuhin region, *Journal of Soil Researches (Soil and Water Science)*
827 30, 201-213, 2016.

828 Ogbe, V., Jayeoba, O., and Ode, S.: Comparison of Four Soil Infiltration Models on A Sandy Soil in Lafia. Southern
829 Guinea Savanna Zone of Nigeria, *Production Agriculture and Technology (PAT)*, 7, 116-126, 2011.

830 Ojha, S., Machiwal, D., and Purohit, R.: Infiltration modeling in submergence area of a water harvesting structure: a
831 case study, *Indian Journal of Soil Conservation*, 41, 8-13, 2013.

832 Oliveira, M. B. d.: Performance analysis of infiltration equations and of methods of determination of field capacity
833 for soils at a watershed in the São José de Ubá county (state of Rio de Janeiro, Brazil), Master of Science, Civil
834 Engineering Program, Alberto Luiz Coimbra Institute for Postgraduate Studies and Research in Engineering, Federal
835 University of Rio de Janeiro, COPPE/UFRJ, Rio de Janeiro, RJ, Brasil, 2005.

836 Omuto, T. C., Minasny, B., McBratney, A. B., and Biamah, E. K.: Nonlinear mixed effect modelling for improved
837 estimation of water retention and infiltration parameters, *Journal of Hydrology*, 330, 748-758,
838 10.1016/j.jhydrol.2006.05.006, 2006.

839 Othman, M., and Ajayi, A.: Infiltration Characteristics of Organic Amended Soils, *Global Journal of Research In*
840 *Engineering*, 16, 2016.

841 Pachepsky, Y., and Park, Y.: Saturated hydraulic conductivity of US soils grouped according to textural class and bulk
842 density, *Soil Science Society of America Journal*, 79, 1094-1100, 2015.

843 Pahlavan-Rad, M.R. Study on spatial variability of soil infiltration and saturated hydraulic conductivity in the lands
844 of Sistan plain using geostatistical and random forest methods. Annual report. Sistan Agricultural and Natural
845 Resources Research and Education Center, Zabol, Areo Iran, 2017. Parchami-Araghi, F., Mirlatifi, S. M., Ghorbani
846 Dashtaki, S., and Mahdian, M. H.: Point estimation of soil water infiltration process using Artificial Neural Networks
847 for some calcareous soils, *Journal of Hydrology*, 481, 35-47, <http://doi.org/10.1016/j.jhydrol.2012.12.007>, 2013.

848 Perkins, S. R., and McDaniel, K. C.: Infiltration and Sediment Rates Following Creosotebush Control With
849 Tebuthiuron, *Rangeland Ecology & Management*, 58, 605-613, 10.2111/05-048r1.1, 2005.

850 Philip, J.-R.: The theory of infiltration: I. The infiltration equation and its solution, *Soil science*, 83, 345-358, 1957.

851 Poesen, J.: Soil erosion in the Anthropocene: Research needs, *Earth Surface Processes and Landforms*, 43, 64-84,
852 2018.

853 Pulido Moncada, M., Helwig Penning, L., Timm, L. C., Gabriels, D., and Cornelis, W. M.: Visual examinations and
854 soil physical and hydraulic properties for assessing soil structural quality of soils with contrasting textures and land
855 uses, *Soil and Tillage Research*, 140, 20-28, 10.1016/j.still.2014.02.009, 2014.

856 Qi, D. H., and Liu, Z. Q.: Soil Infiltration Characteristics under Different Land at Western Yunnan Plateau, *Advanced*
857 *Materials Research*, 2014, 694-697,

858 Qian, F., Cheng, D., and Liu, J.: Analysis of the Water and Soil Erosion and Infiltration Characteristic in Ziquejie
859 Terrace, IERI Procedia, 9, 13-19, 10.1016/j.ieri.2014.09.034, 2014.

860 Quadri, M., Angulo-Jaramillo, R., Vauclin, M., Clothier, B., and Green, S.: Axisymmetric transport of water and
861 solute underneath a disk permeameter: Experiments and numerical model, Soil Science Society of America Journal,
862 58, 696-703, 1994.

863 Rahmati, M.: Reliable and accurate point-based prediction of cumulative infiltration using soil readily available
864 characteristics: a comparison between GMDH, ANN, and MLR, Journal of Hydrology, On Press,
865 <https://doi.org/10.1016/j.jhydrol.2017.05.046>, 2017.

866 Rawls, W., Yates, P., and Asmussen, L.: Calibration of selected infiltration equations for the Georgia Coastal Plain,
867 Report ARS-S-113 July 1976. 110 p, 2 fig, 8 tab, 25 ref, 1 append., 1976.

868 Rei, I., Kazufumi, I., Yuki, I., Tatsuro, S., and Yukihiro, S.: Evaluation of Infiltration Capacity and Water Retention
869 Potential of Amended Soil Using Bamboo Charcoal and Humus for Urban Flood Prevention, Journal of Earth Science
870 and Engineering, 6, 10.17265/2159-581x/2016.03.002, 2016.

871 Rezaei, M., Seay, T., Seuntjens, P., Joris, I., Wesley Boënné., Van Meirvenne, M, Cornelis, W.: Predicting saturated
872 hydraulic conductivity in a sandy grassland using proximally sensed apparent electrical conductivity, Journal of
873 Applied Geophysics, 126, 35-41, 2016a.

874 Rezaei, M., Seuntjens, P., Shahidi, R, Joris, I., Wesley Boënné., Al-Barri, B., Cornelis, W.: The relevance of
875 in-situ and laboratory characterization of sandy soil hydraulic properties for soil water simulations, Journal of
876 Hydrology, 534, 251–265, 2016b.

877 Richards, L. A.: Capillary conduction of liquids through porous mediums, Journal of Applied Physics, 1, 318-333,
878 1931.

879 Robinson, D. A., Jones, S. B., Lebron, I., Reinsch, S., Domínguez, M. T., Smith, A. R., Jones, D. L., Marshall, M. R.,
880 and Emmett, B. A.: Experimental evidence for drought induced alternative stable states of soil moisture, Scientific
881 reports, 6, 20018, 2016.

882 Rodrigo-Comino, J., Sinoga, J. R., González, J. S., Guerra-Merchán, A., Seeger, M., and Ries, J.: High variability of
883 soil erosion and hydrological processes in Mediterranean hillslope vineyards (Montes de Málaga, Spain), Catena, 145,
884 274-284, 2016.

885 Rodrigo-Comino, J., Taguas, E., Seeger, M., and Ries, J. B.: Quantification of soil and water losses in an extensive
886 olive orchard catchment in Southern Spain, Journal of Hydrology, 556, 749-758, 2018.

887 Rubel, F., Brugger, K., Haslinger, K., and Auer, I. The climate of the European Alps: Shift of very high resolution
888 Köppen-Geiger climate zones 1800-2100. *Meteorologische Zeitschrift*, 26(2), 115–125, 2017

889 Ruprecht, J., and Schofield, N.: Infiltration characteristics of a complex lateritic soil profile, Hydrological processes,
890 7, 87-97, 1993.

891 Sadeghi, S., Hazbavi, Z., and Younesi, H.: Sustainable watershed management through applying appropriate level of
892 soil amendments, 2nd International Conference on Sustainable Watershed Management, SUWAMA, 2014, 183-185,

893 Sadeghi, S. H. R, Moghaddam, E., and Khaledi Darvishan, A.: Effects of subsequent rainfall events on runoff and soil
894 erosion components from small plots treated by vinasse, Catena, 138, 1-12, 2016a.

895 Sadeghi, S. H. R., Kheirfam, H., Homaei, M., Zarei Darki, B., and Vafakhah, M.: Improving runoff behavior resulting
896 from direct inoculation of soil micro-organisms, *Soil and Tillage Research*, 171, 35-41, 2017a.

897 Sadeghi, S. H. R., Hazbavi, Z., and Kiani-Harchegani, M.: Controllability of runoff and soil loss from small plots
898 treated by vinasse-produced biochar, *Science of the Total Environment*, 541, 483-490, 2016b.

899 Sadeghi, S. H. R., Hazbavi, Z., Younesi, H., and Bahramifar, N.: Trade-off between runoff and sediments from treated
900 erosion plots and polyacrylamide and acrylamide residues, *Catena*, 142, 213-220, 2016c.

901 Sadeghi, S. H. R., Kiani-Harchegani, M., and Asadi, H.: Variability of particle size distributions of upward/downward
902 splashed materials in different rainfall intensities and slopes, *Geoderma*, 290, 100-106, 2017b.

903 [Sahoo, A. K., Dirmeyer, P. A., Houser, P. R., and Kafatos, M.: A study of land surface processes using land surface
904 models over the Little River Experimental Watershed, Georgia." *Journal of Geophysical Research: Atmospheres*
905 113\(D20\), 2008](#)

906 Saito, T., Yasuda, H., Suganuma, H., Inosako, K., Abe, Y., and Kojima, T.: Predicting Soil Infiltration and Horizon
907 Thickness for a Large-Scale Water Balance Model in an Arid Environment, *Water*, 8, 96, 10.3390/w8030096, 2016.

908 Sándor, R., Lichner, L., Filep, T., Balog, K., Lehoczky, É., and Fodor, N.: Spatial variability of hydrophysical
909 properties of fallow sandy soils, *Biologia*, 70, 10.1515/biolog-2015-0182, 2015.

910 Sarmadian, F., and Taghizadeh-Mehrjardi, R.: Estimation of infiltration rate and deep percolation water using feed-
911 forward neural networks in Gorgan Province, *Eurasian Journal of Soil Science*, 3, 1, 2014.

912 Sauwa, M., Chiroma, A., Waniyo, U., Ngala, A., and Danmowa, N.: Water transmission properties of a sandy loam
913 soil under different tillage practices in Maiduguri, Nigeria, *Agric. Biol. J. North America*, 4, 227-251, 2013.

914 Schaap, M. G., and Leij, F. J.: Database-related accuracy and uncertainty of pedotransfer functions, *Soil Science*, 163,
915 765-779, 1998.

916 Scotter, D., Clothier, B., and Sauer, T.: A critical assessment of the role of measured hydraulic properties in the
917 simulation of absorption, infiltration and redistribution of soil water, *Agricultural water management*, 15, 73-86, 1988.

918 Sepehrnia, N., Hajabbasi, M. A., Afyuni, M., and Lichner, L.: Extent and persistence of water repellency in two Iranian
919 soils, *Biologia*, 71, 1137-1143, 2016.

920 Sepehrnia, N., Hajabbasi, M. A., Afyuni, M., and Lichner, L.: Soil water repellency changes with depth and
921 relationship to physical properties within wettable and repellent soil profiles, *Journal of Hydrology and*
922 *Hydromechanics*, 65, 99-104, 2017.

923 Sharifi Moghaddam, E., Sadeghi, S. H. R., and Khaledi Darvishan, A.: Small plot soil hydrologic components as
924 affected by application of vinasse organic residue, *Iranian Journal of Soil and Water Research*, 45, 499-508, 2014.

925 Shirazi, M. A., and Boersma, L.: A unifying quantitative analysis of soil texture, *Soil Science Society of America*
926 *Journal*, 48, 142-147, 1984.

927 Shukla, M., Lal, R., and Ebinger, M.: Tillage effects on physical and hydrological properties of a typic Argiaquoll in
928 central Ohio, *Soil Science*, 168, 802-811, 2003.

929 Shukla, M., Lal, R., Ebinger, M., and Meyer, C.: Physical and chemical properties of soils under some piñon-juniper-
930 oak canopies in a semi-arid ecosystem in New Mexico, *Journal of arid environments*, 66, 673-685, 2006.

931 Sihag, P., Tiwari, N., and Ranjan, S.: Estimation and inter-comparison of infiltration models, *Water Science*, 2017.

932 Smith, R., and Parlange, J. Y.: A parameter- efficient hydrologic infiltration model, *Water Resources Research*, 14,
933 533-538, 1978.

934 Smith, R. E., Smettem, K. R., and Broadbridge, P.: *Infiltration theory for hydrologic applications*, American
935 Geophysical Union, 2002.

936 Sorman, A. U., Abdulrazzak, M. J., and Ugas, M. A. S.: Application of infiltration models to field data from Wadi
937 Tabalah, Saudi Arabia, *Application of Tracers in Arid Zone Hydrolog*, 232, 305-316, 1995.

938 Su, L., Wang, Q., Shan, Y., and Zhou, B.: Estimating Soil Saturated Hydraulic Conductivity using the Kostikov and
939 Philip Infiltration Equations, *Soil Science Society of America Journal*, 80, 1463-1475, 2016.

940 Sukhanovskij, Y. P., Vytovtov, V. A., Prushchik, A. V., Solov'eva, Y. A., and Sanzharova, S. I.: Assessment of soil
941 infiltration capacity by using portable rainfall simulator, *Byulleten Pochvennogo instituta im. V.V. Dokuchaeva*, 78,
942 26-35, 2015.

943 Suzuki, K.: Estimation of Snowmelt Infiltration into Frozen Ground and Snowmelt Runoff in the Mogot Experimental
944 Watershed in East Siberia, *International Journal of Geosciences*, 04, 1346-1354, 10.4236/ijg.2013.410131, 2013.

945 Teague, N. F.: Near surface infiltration measurements and the implications for artificial recharge, *Masters of Science*,
946 Geological Sciences, San Diego State University, San Diego, 2010.

947 Teixeira, W. G., Schroth, G., Marques, J. D., and Huwe, B.: Unsaturated Soil Hydraulic Conductivity in the Central
948 Amazon: Field Evaluations, 283-305, 10.1007/978-3-319-06013-2_13, 2014.

949 Thierfelder, C., Stahr, K., and Edgar, A. C.: Soil crusting and sealing in the Andean Hillsides of Colombia and its
950 impact on water infiltration, Wollny, C.; Deining, A.; Bhandari, N.; Maass, B.; Manig, W.; Muuss, U.; Brodbeck,
951 F.; Howe, I.(eds.). *Technological and Institutional Innovations for Sustainable Rural Development: Deutscher*
952 *Tropentag 2003: International research on food security, natural resource management and rural development: Book*
953 *of abstracts*, Georg-August-Universität Göttingen, October 8-10, 2003., 2003.

954 Thierfelder, C., and Wall, P. C.: Effects of conservation agriculture techniques on infiltration and soil water content
955 in Zambia and Zimbabwe, *Soil and Tillage Research*, 105, 217-227, 10.1016/j.still.2009.07.007, 2009.

956 Thierfelder, C., Chivenge, P., Mupangwa, W., Rosenstock, T. S., Lamanna, C., and Eyre, J. X.: How climate-smart is
957 conservation agriculture (CA)? – its potential to deliver on adaptation, mitigation and productivity on smallholder
958 farms in southern Africa, *Food Security*, 9, 537-560, 10.1007/s12571-017-0665-3, 2017.

959 Uloma, A., Onyekachi, C., Torti, E., and Amos, U.: Infiltration characteristics of soils of some selected schools in aba,
960 nigeria, *Archives of Applied Science Research*, 5, 11-15, 2013.

961 van der Kamp, G., Hayashi, M., and Gallén, D.: Comparing the hydrology of grassed and cultivated catchments in the
962 semi-arid Canadian prairies, *Hydrological Processes*, 17, 559-575, 10.1002/hyp.1157, 2003.

963 Van Looy, K., Bouma, J., Herbst, M., Koestel, J., Minasny, B., Mishra, U., Montzka, C., Nemes, A., Pachepsky, Y.,
964 and Padarian, J.: Pedotransfer functions in Earth system science: challenges and perspectives, *Reviews of Geophysics*,
965 2017.

966 Vogel, T., and Cislserova, M.: A scaling-based interpretation of a field infiltration experiment, *Journal of hydrology*,
967 142, 337-347, 1993.

968 Vogeler, I., Cichota, R., Sivakumaran, S., Deurer, M., and McIvor, I.: Soil assessment of apple orchards under
969 conventional and organic management, *Soil Research*, 44, 745-752, 2006.

970 Votrubova, J., Dohnal, M., Vogel, T., Tesar, M., Jelinkova, V., and Cislerova, M.: Pondered infiltration in a grid of
971 permanent single-ring infiltrometers: Spatial versus temporal variability, *Journal of Hydrology and Hydromechanics*,
972 65, 244-253, 2017.

973 Wang, G., Fang, Q., Wu, B., Yang, H., and Xu, Z.: Relationship between soil erodibility and modeled infiltration rate
974 in different soils, *Journal of Hydrology*, 528, 408-418, 10.1016/j.jhydrol.2015.06.044, 2015a.

975 Wang, L., Zhong, C., Gao, P., Xi, W., and Zhang, S.: Soil Infiltration Characteristics in Agroforestry Systems and
976 Their Relationships with the Temporal Distribution of Rainfall on the Loess Plateau in China, *PLoS One*, 10,
977 e0124767, 10.1371/journal.pone.0124767, 2015b.

978 Wang, T., Xu, H.-l., and Bao, W.-m.: Application of isotopic information for estimating parameters in
979 Philip infiltration model, *Water Science and Engineering*, 9, 287-292, 10.1016/j.wse.2017.01.005, 2016.

980 Waterloo, M. J., Schellekens, J., Bruijnzeel, L. A. and Rawaqa, T. T.: Changes in catchment runoff after harvesting
981 and burning of a *Pinus caribaea* plantation in Viti Levu, Fiji. *Forest Ecology and Management* 251 (1-2): 31-44, 2007.

982 Weynants, M., Montanarella, L., Tóth, G., Arnoldussen, A., Anaya Romero, M., Bilas, G., Borresen, T., Cornelis, W.,
983 Daroussin, J., Gonçalves, M., Haugen, L., Hennings, V., Houskova, B., Iovino, M., Javaux, M., Keay, C. A., Kätterer,
984 T., Kvaerno, Si., Laktinova, T., Lamorski, K., Lilly, A., Makó, A., Matula, S., Morari, F., Nemes, A., Patyka, N. V.,
985 Romano, N., Schindler, U., Shein, E., Slawinski, C., Strauss, P., Tóth, B., Wösten, H.: European HYdropedological
986 Data Inventory (EU-HYDI). Luxembourg: Publications Office of the European Union, EUR – Scientific and Technical
987 Research series, 2013. ~~Weynants, M., Montanarella, L., Toth, G., Arnoldussen, A., Anaya Romero, M., Bilas, G.,
988 Borresen, T., Cornelis, W., Daroussin, J., and Gonçalves, M. D. C.: European HYdropedological Data Inventory (EU-
989 HYDI), EUR Scientific and Technical Research series, 2013.~~

990 White, I., and Sully, M.J.: Macroscopic and microscopic capillary length and time scales from infiltration. *Water*
991 *Resource Research*, 23:1514-1522, 1987.

992 Wu, G.-L., Yang, Z., Cui, Z., Liu, Y., Fang, N.-F., and Shi, Z.-H.: Mixed artificial grasslands with more roots improved
993 mine soil infiltration capacity, *Journal of Hydrology*, 535, 54-60, 2016.

994 Yang, J.-L., and Zhang, G.-L.: Water infiltration in urban soils and its effects on the quantity and quality of runoff,
995 *Journal of Soils and Sediments*, 11, 751-761, 10.1007/s11368-011-0356-1, 2011.

996 Yilmaz, D., Lassabatere, L., Angulo-Jaramillo, R., Deneele, D., and Legret, M.: Hydrodynamic characterization of
997 basic oxygen furnace slag through an adapted BEST method, *Vadose Zone Journal*, 9, 107-116, 2010.

998 Zhang, J., Jiao, J., and Yang, J.: In situ rainfall infiltration studies at a hillside in Hubei Province, China, *Engineering*
999 *Geology*, 57, 31-38, 2000.

1000 Zhang, Y., and Schaap, M. G.: Weighted recalibration of the Rosetta pedotransfer model with improved estimates of
1001 hydraulic parameter distributions and summary statistics (Rosetta3), *Journal of Hydrology*, 547, 39-53, 2017.

1002 Zhang, Z., Lin, L., Wang, Y., and Peng, X.: Temporal change in soil macropores measured using tension infiltrometer
1003 under different land uses and slope positions in subtropical China, *Journal of Soils and Sediments*, 16, 854-863,
1004 10.1007/s11368-015-1295-z, 2015.

1005 Zhao, H., Zeng, Y., Lv, S., and Su, Z.: Analysis of Soil Hydraulic and Thermal Properties for Land Surface Modelling
1006 over the Tibetan Plateau, *Earth Syst. Sci. Data Discuss.*, 2018, 1-40, 10.5194/essd-2017-122, 2018.
1007 Zhao, H. H., Zeng, Y. Y., and Su, Z. B.: Soil Hydraulic and Thermal Properties for Land Surface Modelling over the
1008 Tibetan Plateau, Dataset, <https://doi.org/10.4121/uuid:61db65b1-b2aa-4ada-b41e-61ef70e57e4a>, 2017.
1009 Zhao, Y., Peth, S., Hallett, P., Wang, X., Giese, M., Gao, Y., and Horn, R.: Factors controlling the spatial patterns of
1010 soil moisture in a grazed semi-arid steppe investigated by multivariate geostatistics, *Ecohydrology*, 4, 36-48,
1011 10.1002/eco.121, 2011.

Table 1- References used to extract infiltration curves and metadata

No	Dataset		Reference	No	Dataset		Reference	No	dataset		Reference
	From	To			From	To			From	To	
1	295	317	Miller et al. (2005)	26	4516	-	Delage et al. (2016)	51	4692	-	Ayu et al. (2013)
2	318	322	Adindu Ruth et al. (2014)	27	4517	4518	Ruprecht and Schofield (1993)	52	4693	4699	Rei et al. (2016)
3	542	544	Alagna et al. (2016)	28	4519	4520	Bertol et al. (2015)	53	4700	4702	Omuto et al. (2006)
4	545	-	Angulo-Jaramillo et al. (2000)	29	4521	4523	Naeth et al. (1991)	54	4703	4706	Návar and Synnott (2000)
5	546	548	Su et al. (2016)	30	4524	4529	Huang et al. (2011)	55	4707	-	Scotter et al. (1988)
6	549	550	Quadri et al. (1994)	31	4530	4537	van der Kamp et al. (2003)	56	4708	4720	Khan and Strosser (1998)
7	551	553	Qi and Liu (2014)	32	4538	-	Jačka et al. (2016)	57	4721	4724	Lipiec et al. (2006)
8	554	558	Huang et al. (2015)	33	4539	4568	Matula (2003)	58	4725	-	Suzuki (2013)
9	559	568	Al-Kayssi and Mustafa (2016)	34	4569	4586	Casanova (1998)	59	4726	4728	Sukhanovskij et al. (2015)
10	1421	1432	Bhardwaj and Singh (1992)	35	4587	4593	Holzapfel et al. (1988)	60	4729	4749	Al-Ghazal (2002)
11	1433	1435	Berglund et al. (1980)	36	4594	4605	Wang et al. (2015b)	61	4750	-	Sorman et al. (1995)
12	1436	1443	Wu et al. (2016)	37	4606	4611	Mao et al. (2016)	62	4751	4764	Bowyer-Bower (1993)
13	1444	1446	Chartier et al. (2011)	38	4612	-	Wang et al. (2016)	63	4765	4788	Medinski et al. (2009)
14	1447	1456	Sihag et al. (2017)	39	4613	4615	Qian et al. (2014)	64	4789	4792	Latorre et al. (2015)
15	1457	1460	Machiwal et al. (2006)	40	4617	4619	Fan et al. (2013)	65	4793	4795	Biro et al. (2010)
16	1461	1466	Igbadun et al. (2016)	41	4620	-	Zhang et al. (2000)	66	4796	4799	Mohammed et al. (2007)
17	1467	1469	Mohanty et al. (1994)	42	4621	4623	Wang et al. (2015a)	67	4800	4815	Abdallah et al. (2016)
18	1470	1472	Sauwa et al. (2013)	43	4624	4633	Yang and Zhang (2011)	68	4816	4819	Murray and Buttle (2005)
19	1473	1476	Arshad et al. (2015)	44	4634	4657	Wu et al. (2016)	69	4820	4831	Zhang et al. (2015)
20	1477	1488	Bhawan (1997)	45	4658	4663	Ma et al. (2017)	70	4832	4837	Perkins and McDaniel (2005)
21	1489	1495	Uloma et al. (2013)	46	4664	4681	Thierfelder et al. (2003)	71	4838	4841	Arriaga et al. (2010)
22	1496	-	Al-Azawi (1985)	47	4682	4683	Commandeur et al. (1994)	72	4842	4857	Thierfelder et al. (2017)
23	1497	1499	Ogbe et al. (2011)	48	4684	4686	Di Prima et al. (2016)	73	4858	4867	Thierfelder and Wall (2009)
24	1500	1507	Teague (2010)	49	4687	4688	Angulo-Jaramillo et al. (2000)	74	4868	4879	Abagale et al. (2012)
25	4506	4515	Muhamad et al. (2008)	50	4689	4691	Machiwal et al. (2006)				

Table 2- References and correspondence for data supplied by data owners

No.	Dataset		Contact person	Email for contact	Reference
	From	To			
1	1	135	M. Rahmati	mehdirmti@gmail.com	Rahmati (2017)
2	136	294	A. Farajnia	farajnia1966@yahoo.com	Unpublished data
3	323	376	M. Shukla	shuklamk@nmsu.edu	Shukla et al. (2003 & 2006)
4	377	426	S. H. R. Sadeghi	sadeghi@modares.ac.ir	Sadeghi et al. (2014, 2016a, b, c, 2017a, b), Hazbavi and Sadeghi (2016), Kheirfam et al. (2017a, b) Sharifi Moghaddam et al. (2014); Ghavimi Panah et al. (2017); Kiani-Harchegani et al. (2017)
5	427	466	M. H. Mohammadi	mhmohmad@ut.ac.ir	Unpublished data
6	467	505	F. Meunier	felicien.meunier@uclouvain.be	Unpublished data
7	506	541	N. Sepehrnia	n.sepehrnia@gmail.com	Sepehrnia et al. (2016 & 2017)
8	569	817	D. Moret-Fernández	david@eead.csic.es	Unpublished data
9	818	940	M. Vafakhah	vafakhah@modares.ac.ir	Kavousi et al. (2013); Fakher Nikche et al. (2014)
10	941	1060	A. Cerdà	artemio.cerda@uv.es	Unpublished data
11	1061	1079	J. Rodrigo-Comino	rodrigo-comino@uma.es	Rodrigo-Comino et al. (2016); Rodrigo-Comino et al. (2018)
12	1080	1112	H. Asadi	ho.asadi@ut.ac.ir	Nikghalpour et al. (2016)
13	1113	1119	K. Bohne	klaus.bohne@uni-rostock.de	Unpublished data
14	1120	1125	L. Mao	leoam@126.com	Mao et al. (2008b; 2016)
15	1126	1166	L. Lichner	lichner@uh.savba.sk	Dušek et al. (2013), Lichner et al. (2011; 2012; 2013)
16	1167	1210	M. V. Ottoni	marta.ottoni@cprm.gov.br	Oliveira (2005)
17	1211	1420	R. Sándor	sandor.rencsi@gmail.com	Fodor et al. (2011); Sándor et al. (2015)
18	4476	4485			
19	1508	1519	A. Stanley	ajayistan@gmail.com	Igbadun et al. (2016); Othman and Ajayi (2016)
20	1520	1521	A. R. Vaezi	vaezi.alireza@gmail.com	Unpublished data
21	1522	1536	A. Albalasmeh	aalbalasmeh@just.edu.jo	Gharaibeh et al. (2016)
22	1537	1578	D. Machiwal	dmachiwal@rediffmail.com	Machiwal et al. (2006, 2017) , Ojha et al. (2013)
23	1579	1592	H. Emami	hemami@um.ac.ir	Fakouri et al. (2011a, 2011b)
24	1593	1895	J. Mertens	jan.mertens@engie.com	Mertens et al. (2002, 2004, 2005)
25	1896	2115	D. Jacques	diederik.jacques@sckcen.be	Jacques (2000); Jacques et al. (2002)
26	2116	2139	J. Votrubova	jana.votrubova@fsv.cvut.cz	Votrubova et al. (2017)
27	2140	2143	J. Batlle-Aguilar	jorbat1977@hotmail.com	Batlle-Aguilar et al. (2009)
28	2144	2179	R. A. Armindo	rarmindo@ufpr.br	Unpublished data
29	2180	2209	S. Werner	steffen.werner@rub.de	Unpublished data
30	2210	2255	S. Zacharias	steffen.zacharias@ufz.de	Unpublished data
31	2256	2281	S. Shutaro	sshiraki@affrc.go.jp	Unpublished data
32	2282	2304	T. Saito	tadaomi@muses.tottori-u.ac.jp	Saito et al. (2016)
33	2305	2354	R. Taghizadeh-M.	rh_taghizade@yahoo.com	Unpublished data

Table 32– References and correspondence for data supplied by data owners (eContinued by Table 2)

No.	Dataset		Contact person	Email for contact	Reference
	From	To			
34	2355	2356	W. G. Teixeira	wenceslau.teixeira@embrapa.br	Teixeira et al. (2014)
35	3644	3647			
36	2357	2436	Y. Zhao	yzhaosoils@gmail.com	Zhao et al. (2011)
37	2437	2475	A. A. Moosavi	aamousavi@gmail.com	Unpublished data
38	2476	2552	Y. A. Pachepsky	Yakov.Pachepsky@ars.usda.gov	Rawls et al. (1976)
39	2553	2643	A. Panagopoulos	panagopoulousa@gmail.com	Hatzigiannakis and Panoras (2011) + unpublished data
40	2644	2649	B. Clothier	Brent.Clothier@plantandfood.co.nz	Al Yamani et al. (2016)
41	2650	2710	C. Castellano	ccastellanonavarro@gmail.com	Unpublished data
42	3507	3597			
43	2711	2756	F. Becker	fabian.becker@fu-berlin.de	Unpublished data
44	2757	2765	I. Vogeler	iris.vogeler@plantandfood.co.nz	Vogeler et al. (2006); Cichota et al. (2013)
45	2766	2788	R. Morbidelli	renato.morbidelli@unipg.it	Morbidelli et al. (2017)
46	2789	2832	S. Giertz	sgiertz@uni-bonn.de	Giertz et al. (2005)
47	2833	2868	T. Vogel	vogel@fsv.cvut.cz	Vogel and Cislerova (1993)
48	2869	2948	W. Cornelis	Wim.Cornelis@ugent.be	Pulido Moncada et al. (2014); Rezaei et al. (2016a, b)
49	2949	3386	Y. Coquet	yves.coquet@univ-orleans.fr	Coquet (1996); Coquet et al. (2005); Chalhoub et al. (2009)
50	3705	3709			
51	3387	3506	B. Mohanty	bmohanty@tamu.edu	Dasgupta et al. (2006)
52	3598	3643	D. J. Reinert	dalvan@ufsm.br	Mallmann (2017)
53	3648	3657	M.R. Pahlavan Rad	pahlavanrad@gmail.com	Pahlavan-Rad (2017)
54	3658	3680	T. Saito	tadaomi@muses.tottori-u.ac.jp	Unpublished data
55	3681	3704	X. Li	xyli@bnu.edu.cn	Li et al. (2013); Hu et al. (2016)
56	4497	4505			
57	3710	3745	Y. Bamutaze	yazidhibamutaze@gmail.com	Unpublished data
58	3746	3833	I. Braud	isabelle.braud@irstea.fr	Gonzalez-Sosa et al. (2010); Braud (2015); Braud and Vandervaere (2015)
59	3907	4011			
60	3834	3874	M. R. Mosaddeghi	mosaddeghi@yahoo.com	Unpublished data
61	3875	3906	S. B. Mousavi	b_mosavi2000@yahoo.com	Unpublished data
62	4012	4026	M. Pulido	manpufer@hotmail.com	Unpublished data
63	4027	4457	F. P. Roberts	frapar@ceh.ac.uk	Unpublished data
63	4458	4475			
64	4486	4496	T. Picciafuoco	picciafuoco@hydro.tuwien.ac.at	Morbidelli et al. (2017)
65	4880	4886	M. A. Liebig	mark.liebig@ars.usda.gov	Liebig et al. (2004)
66	4887	4936	Y. Zeng	y.zeng@utwente.nl	Zhao et al. (2017, 2018)
67	4937	5018	L. Lassabatere	laurent.lassabatere@entpe.fr	Lassabatere et al. (2010); Yilmaz et al. (2010); Coutinho et al. (2016)
68	5019	5023	I. Eskandari	eskandari1343@yahoo.com	Unpublished data

Table 34- Description of the variables listed in database

Column	Supplies:	Dimension
<i>Code</i>	Data set identifier with 4 digits from 0001 to 5023	
<i>Clay</i>	Mass of soil particles, < 0.002 mm	%
<i>Silt</i>	Mass of soil particles, >0.002 and < 0.05 mm	%
<i>Sand</i>	Mass of soil particle, > 0.05 and < 2 mm	%
<i>Texture</i>	1: Sand; 2: Loamy sand; 3: Sandy loam; 4: Sandy clay loam; 5: Sandy Clay; 6: Loam; 7: Silt loam; 8: Silt; 9: Clay loam; 10: Silty clay loam; 11: Silty clay; 12: Clay	
<i>Gravel</i>	Mass of particles larger than 2 mm	%
<i>dg</i>	Geometric mean diameter	mm
<i>Sg</i>	Standard deviation of soil particle diameter	
<i>OC</i>	Soil organic carbon content	%
<i>Db</i>	Soil bulk density	g cm ⁻³
<i>Dp</i>	Soil particle density	g cm ⁻³
<i>Ksat</i>	Soil saturated hydraulic conductivity	cm h ⁻¹
<i>Theta_sat</i>	Saturated volumetric soil water content	cm ³ cm ⁻³
<i>Theta_i</i>	Initial volumetric soil water content	cm ³ cm ⁻³
<i>FC</i>	Soil water content at field capacity	cm ³ cm ⁻³
<i>PWP</i>	Soil water content at permanent wilting point (1500 kPa)	cm ³ cm ⁻³
<i>Theta_r</i>	Residual volumetric soil water content	cm ³ cm ⁻³
<i>WAS</i>	Wet-aggregate stability	%
<i>MWD</i>	Aggregates mean weight diameter	mm
<i>GMD</i>	Aggregates geometric mean diameter	mm
<i>EC</i>	Soil electrical conductivity	dS m ⁻¹
<i>pH</i>	Soil acidity	-
<i>Gypsum</i>	Soil gypsum content	%
<i>CCE</i>	Soil calcium carbonate calcium equivalent	%
<i>CEC</i>	Soil cation exchange capacity	Cmol _c kg ⁻¹
<i>SAR</i>	Soil sodium adsorption ratio	-
<i>DiscRadius</i>	Applied disc radius (if any)	mm
<i>Instrument</i>	Applied instruments for infiltration measurement: 1: Double ring; 2: Single ring; 3: Rainfall simulator; 4: Guelph permeameter; 5: Disc infiltrometer; 6: Micro-infiltrometer; 7: Mini-infiltrometer; 8: Aardvark Permeameter; 9: Linear source method; 10: Point source method; 11: Hood infiltrometer; 12: Tension infiltrometer; 13: BEST method	
<i>Vegetation cover</i>		%
<i>Land use</i>	Dominant land-use or land cover type of the experimental site	
<i>Rainfall intensity</i>	Simulated rain intensity	mm h ⁻¹
<i>Slope</i>	The mean slope of the soil surface	%
<i>Treatment</i>	Applied treatment in experimental site	
<i>Crust</i>	Yes: existence of crust; No: no crust layer	
<i>Sand contact layer</i>	Yes: sand contact layer is applied during infiltration measurement; No: no sand contact layer	

1019

Table 45- Countries and the number of data sources (n) contributing to the database

Country	n	Country	n	Country	n
Iran	38	Austria	2	Indonesia	1
China	23	Chile	2	Iraq	1
USA	15	Ghana	2	Japan	1
Brazil	9	Morocco	2	Jordan	1
Spain	9	Namibia	2	Kenya	1
France	9	New Zealand	2	Lebanon	1
Germany	8	Pakistan	2	Malawi	1
India	8	Russia	2	Mexico	1
Canada	7	Senegal	2	Mozambique	1
United Kingdom	7	Slovakia	2	Myanmar	1
Hungary	6	South Africa	2	Netherland	1
Nigeria	6	Sudan	2	Poland	1
Greece	5	Zambia	2	Scotland	1
Belgium	4	Argentina	1	Tanzania	1
Italy	4	Australia	1	Telangana	1
Czech Republic	3	Benin	1	UAE	1
Saudi Arabia	3	Cameroon	1	Uganda	1
Australia	2	Colombia	1	Zimbabwe	1

1020

1021 Table 56- Number of soils in each soil USDA textural class for which infiltration data are included in the database.

Group	Soil texture class	Availability
Coarse-textured soils		1092
	Sand	291
	Loamy sand	111
	Sandy loam	690
Medium-textured soils		1238
	Loam	716
	Silt loam	522
	Silt	0
Fine to moderately fine-textured soil		1476
	Clay loam	514
	Clay	352
	Silty clay loam	253
	Sandy clay loam	226
	Silty clay	131
	Sandy clay	0

1022

1023

1024 Table 67- Soil properties, number of data entries in the database (out of 5023 soil water infiltration curves in total),
 1025 and their statistical description

Soil properties	Availability	Fr (%)	Mean	Min	Max	Median	CV (%)
Clay (%)	3842	76	24	0	80	20	64
Silt (%)	3842	76	36	0	82	37	52
Sand (%)	3842	76	41	1	100	38	63
Bulk density (g cm ⁻³)	3295	66	1.32	0.14	2.81	1.35	20
Organic carbon (%)	3102	62	3	0	88	1	200
Saturated hydraulic cond. (cm h ⁻¹)	1895	38	41	0	3004	3	426
Initial soil water content (cm ³ cm ⁻³)	1569	31	0.17	0	0.63	0.14	68
Saturated soil water content (cm ³ cm ⁻³)	1400	28	0.44	0.01	0.87	0.45	24
Carbonate calcium equivalent (%)	1399	28	14	0	56	8	101
Electrical conductivity (dS m ⁻¹)	1113	22	25	0	358	1	249
pH	1081	22	7.4	4.7	8.6	7.6	12
Particle density (g cm ⁻³)	438	9	2.52	1.73	2.97	2.56	9
Gypsum (%)	380	8	4	0	49	3	137
Cation exchange capacity (cmol _c kg ⁻¹)	357	7	17	3	26	18	21
Wet-aggregate stability (%)	309	6	61	5	96	63	37
Residual soil water content (cm ³ cm ⁻³)	263	5	0.10	0.001	0.38	0.06	86
Mean weight diameter (mm)	258	5	1	0.10	2.75	1.0	54
Gravel (%)	243	5	18	0	92	15	84
Sodium adsorption ratio	156	3	5	0	89	1	351
Soil water content at FC (cm ³ cm ⁻³)	74	1	0.28	0.12	0.54	0.27	34
Soil water content at PWP (cm ³ cm ⁻³)	64	1	0.18	0.05	0.36	0.20	47
Geometric mean diameter (mm)	73	1	0.6	0.4	0.8	0.6	18

1026 Fr: Frequency (%), Min: Minimum, Max: Maximum, CV: coefficient of variation.

1027

Table 78- Instruments used to measure soil infiltration curves

Instrument/method used	Infiltration curves	
Ring	Double ring	828
	Single ring	570
	Beerkan (BEST)	197
Overall	1595	
Infiltrometer	Disc	607
	Mini-disc	1140
	Micro-disc	36
	Hood	23
	Tension	752
Overall	2558	
Permeameter	Guelph	181
	Aardvark	50
Overall	231	
Rainfall simulator	374	
Linear source method	10	
Point source method	4	
Not reported	251	
Sum	5023	

1028

1029

Table 89- Number of infiltration curves with a given land use types

Land use	n	Land use	n
Agriculture	2019	Vineyards	22
Grassland	821	Upland	11
Pasture	229	Pure Sand	10
Forest	204	Brushwood	6
Garden	152	Road	5
Bare	99	Agro-pastoral	4
Urban Soils	82	Park	3
Savanna	41	Salt-marsh soil	3
Abandoned farms	39	Afforestation	2
Idle	32	Campus	2
Shrub	30	Residential	2
Available	3818	Unknown	1205

1030

1031

Table 9+0- Accuracy analysis of empirical models fitted to experimental data of infiltration

Infiltration type	n	R ²				RMSE (cm)				R ² >	R ²
		Mean	Min	Max	STD	Mean	Min	Max	STD	0.90	>0.99
1D	828	0.985	0.529	1	0.049	0.900	1.3e-4	69.30	3.31	801	640
3D	3350	0.975	0.032	1	0.066	0.449	5.5e-12	98.95	2.95	3136	2276
All	4178	0.977	0.032	1	0.063	0.538	5.5e-12	98.95	3.03	3937	2916

1032

STD: standard deviation

1033

Table 104- Estimated or measured average values of infiltration parameters for different textural classes extracted from the current database

Texture class	Estimated by Eq. (8) or (9)							Measured				Independent T test between measured and estimated K_{sat}	
	n [§]	S (cm h ^{-0.5})			K_{sat} (cm h ⁻¹)			n [§]	K_{sat} (cm h ⁻¹)			df	T value
		Mean	Median	STD	Mean	Median	STD		Mean	Median	STD		
Sand	291	2.3	0.26	4.3	42.2	15	134.5	229	43.6	24	149	518	0.10 ^{ns}
Loamy sand	92	10.6	5.7	17.5	61.4	10	173.2	63	24.6	8.2	72	153	1.59 ^{ns}
Sandy loam	500	9.2	2.95	15.7	32	3.1	94.5	424	41.2	5.7	166	922	1.05 ^{ns}
Silt loam	409	9.4	1.5	19.1	26.5	1.7	61.7	165	2.9	0.96	5.1	572	4.90 ^{**}
Loam	583	7.9	2.4	12.9	7.8	0.28	26.7	270	4.9	1.18	13.7	851	1.69 ^{ns}
Sandy clay loam	185	5.9	2.1	8.6	7.4	1.4	12.8	84	5.4	2.24	6.9	267	1.35 ^{ns}
Silty clay loam	250	3.2	0.64	12.5	10.6	1.7	24.1	64	12.3	2.42	63.2	312	0.32 ^{ns}
Clay loam	467	6.8	2.1	13.6	8.3	2.3	20	166	7.6	2.97	21.3	631	0.38 ^{ns}
Sandy clay	-	-	-	-	-	-	-	-	-	-	-	-	-
Silty clay	121	7.7	2.2	13.4	26.2	7.8	61.5	54	44.8	6.97	88.2	173	1.59 ^{ns}
Clay	333	14.6	1.7	39.5	354.3	1.3	1268.5	79	148.8	2.94	458.4	410	1.42 ^{ns}
Silt	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	4179	8.5	2.6	18.2	46	1.8	374.8	1895	41	3.4	174	-	-

§: the number soils included in calculation

ns: insignificant and **: significant at 1 % probability level

STD: standard deviation

1034
1035
1036
1037

Table 1142- Comparison of the estimated K_{sat} values from current database (SWIG) with measured K_{sat} values presented in literature

Texture class	Data source	Clapp and Hornberger (1978)	Rosetta3 (Zhang and Schaap, 2017)	Cosby et al. (1984)	Rawls database (Schaap and Leij, 1998)	Ahuja database (Schaap and Leij, 1998)	UNSODA database (Schaap and Leij, 1998)	US soils K_{sat} data (Pachepsky and Park, 2015)	EU-HYDI database (Weynants et al., 2013)
		K_{sat}	$logK_{sat}/STD$	$logK_{sat}/STD$	$logK_{sat}/STD$	$logK_{sat}/STD$	$logK_{sat}/STD$	$logK_{sat}/STD$	$logK_{sat}/STD$
		(cm min ⁻¹)	(log ₁₀ cm day ⁻¹)	(log ₁₀ in h ⁻¹)	(log ₁₀ cm day ⁻¹)	(log ₁₀ cm day ⁻¹)	(log ₁₀ cm day ⁻¹)	(log ₁₀ cm h ⁻¹)	(log ₁₀ cm day ⁻¹)
Sand	Literature	1.056	2.81/0.59 (253)	0.82/0.39	2.71/0.51 (97)	3.01/0.45 (82)	2.70/0.74 (129)	1.57/0.71 (115)	0.71/1.45 (264)
	SWIG	0.704	3.01 /3.51 (291)	1.22 /1.73	3.01 /3.51 (291)	3.01 /3.51 (291)	3.01 /3.51 (291)	1.63 /2.13 (291)	3.01 /3.51 (291)
Loamy sand	Literature	0.938	2.02/0.64 (167)	0.30/0.51	1.91/0.61 (135)	2.09/0.69 (19)	2.36/0.59 (51)	1.03/0.42 (76)	0.80/1.41 (234)
	SWIG	1.033	3.17 /3.63 (92)	1.39 /1.84	3.17 /3.63 (92)	3.17 /3.63 (92)	3.17 /3.63 (92)	1.79 /2.25 (92)	3.17 /3.63 (92)
Sandy loam	Literature	0.208	1.58/0.67 (315)	-0.13/0.67	1.53/0.65 (337)	1.73/0.64 (65)	1.58/0.92 (79)	0.66/0.54 (169)	1.17/1.34 (825)
	SWIG	0.534	2.89 /3.36 (500)	1.10 /1.58	2.89 /3.36 (500)	2.89 /3.36 (500)	2.89 /3.36 (500)	1.51 /1.98 (500)	2.89 /3.36 (500)
Silt loam	Literature	0.043	1.28/0.74 (130)	-0.4/0.55	1.04/0.54 (217)	1.24/0.47 (12)	1.48/0.86 (103)	0.11/0.87 (215)	0.89/1.45 (714)
	SWIG	0.442	2.80 /3.17 (409)	1.02 /1.39	2.80 /3.17 (409)	2.80 /3.17 (409)	2.80 /3.17 (409)	1.42 /1.79 (409)	2.80 /3.17 (409)
Loam	Literature	0.042	1.09/0.92 (117)	-0.32/0.63	0.99/0.63 (137)	0.83/0.95 (50)	1.58/0.92 (62)	0.12/0.79 (81)	1.69/1.76 (411)
	SWIG	0.129	2.27 /2.81 (583)	0.49 /1.02	2.27 /2.81 (583)	2.27 /2.81 (583)	2.27 /2.81 (583)	0.89 /1.43 (583)	2.27 /2.81 (583)
Sandy clay loam	Literature	0.038	1.14/0.85 (13)	-0.2/0.54	1.29/0.71 (104)	0.81/0.80 (36)	0.99/1.21 (41)	0.12/0.94 (139)	0.73/1.45 (128)
	SWIG	0.124	2.25 /2.49 (185)	0.47 /0.70	2.25 /2.49 (185)	2.25 /2.49 (185)	2.25 /2.49 (185)	0.87 /1.11 (185)	2.25 /2.49 (185)
Silty clay loam	Literature	0.010	1.04/0.74 (46)	-0.54/0.61	0.87/0.55 (47)	1.09/0.78 (21)	1.14/0.85 (21)	-0.15/0.75 (83)	0.35/1.50 (364)
	SWIG	0.178	2.41 /2.77 (250)	0.62 /0.98	2.41 /2.77 (250)	2.41 /2.77 (250)	2.41 /2.77 (250)	1.03 /1.39 (250)	2.41 /2.77 (250)
Clay loam	Literature	0.015	0.87/1.11 (58)	-0.46/0.59	0.67/0.58 (77)	0.79/1.08 (48)	1.84/0.89 (25)	-0.03/0.94 (109)	1.10/1.54 (284)
	SWIG	0.139	2.30 /2.68 (467)	0.52 /0.90	2.30 /2.68 (467)	2.30 /2.68 (467)	2.30 /2.68 (467)	0.92 /1.3 (467)	2.30 /2.68 (467)
Sandy clay	Literature	0.013	1.06/0.89 (10)	0.01/0.33	1.33/0.33 (9)	-0.03/1.28 (2)	- (-)	-0.77/1.22 (21)	0.81/1.56 (5)
	SWIG	-	- /- (-)	- /-	- /- (-)	- /- (-)	- /- (-)	- /- (-)	- /- (-)
Silty clay	Literature	0.006	0.98/0.58 (14)	-0.72/0.69	0.82/0.55 (12)	1.15/0.16 (5)	0.92/0.71 (12)	-0.72/0.95 (22)	0.18/1.32 (349)
	SWIG	0.439	2.80 /3.17 (121)	1.02 /1.39	2.80 /3.17 (121)	2.80 /3.17 (121)	2.80 /3.17 (121)	1.42 /1.79 (121)	2.80 /3.17 (121)
Clay	Literature	0.008	1.17/0.92 (60)	-	0.94/0.31 (34)	1.03/0.83 (31)	1.41/0.15 (27)	-0.17/0.71 (115)	-0.08/1.41 (737)
	SWIG	5.906	3.93 /4.48 (333)	2.15 /2.70	3.93 /4.48 (333)	3.93 /4.48 (333)	3.93 /4.48 (333)	2.55 /3.10 (333)	3.93 /4.48 (333)
Silt	Literature	-	1.64/0.27 (3)	-	1.43/- (3)	- (-)	1.75/0.20 (3)	- (-)	-0.29/1.56 (11)
	SWIG	-	- /- (-)	- /-	- /- (-)	- /- (-)	- /- (-)	- /- (-)	- /- (-)

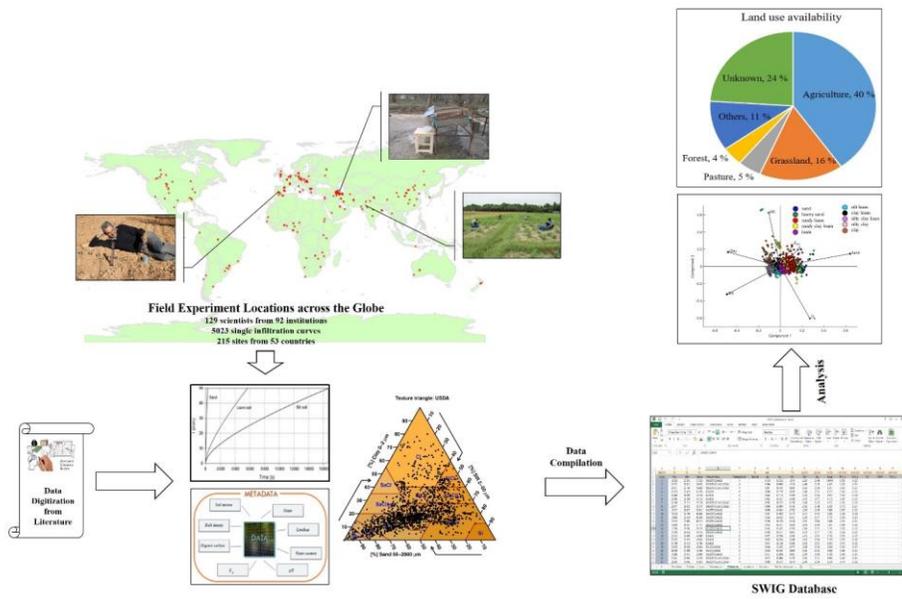
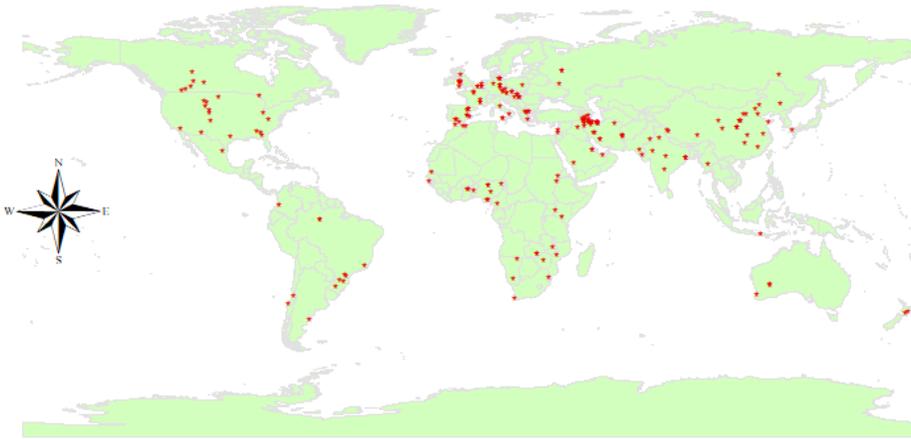


Figure 1- Graphical Abstract

Formatted: Font: (Default) Times New Roman, 10 pt,
Complex Script Font: Times New Roman, 10 pt

1040
1041
1042

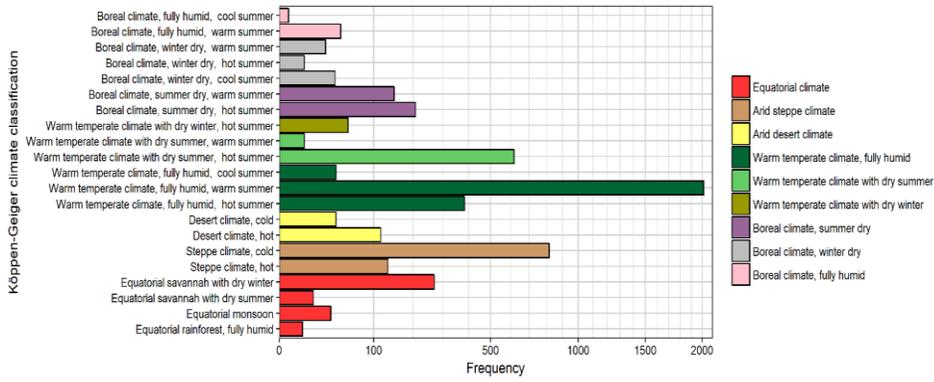


1043

1044

Figure 2- Global distribution of infiltration measuring sites that were included in the database

Formatted: Font: (Default) Times New Roman, 10 pt,
Complex Script Font: Times New Roman, 10 pt



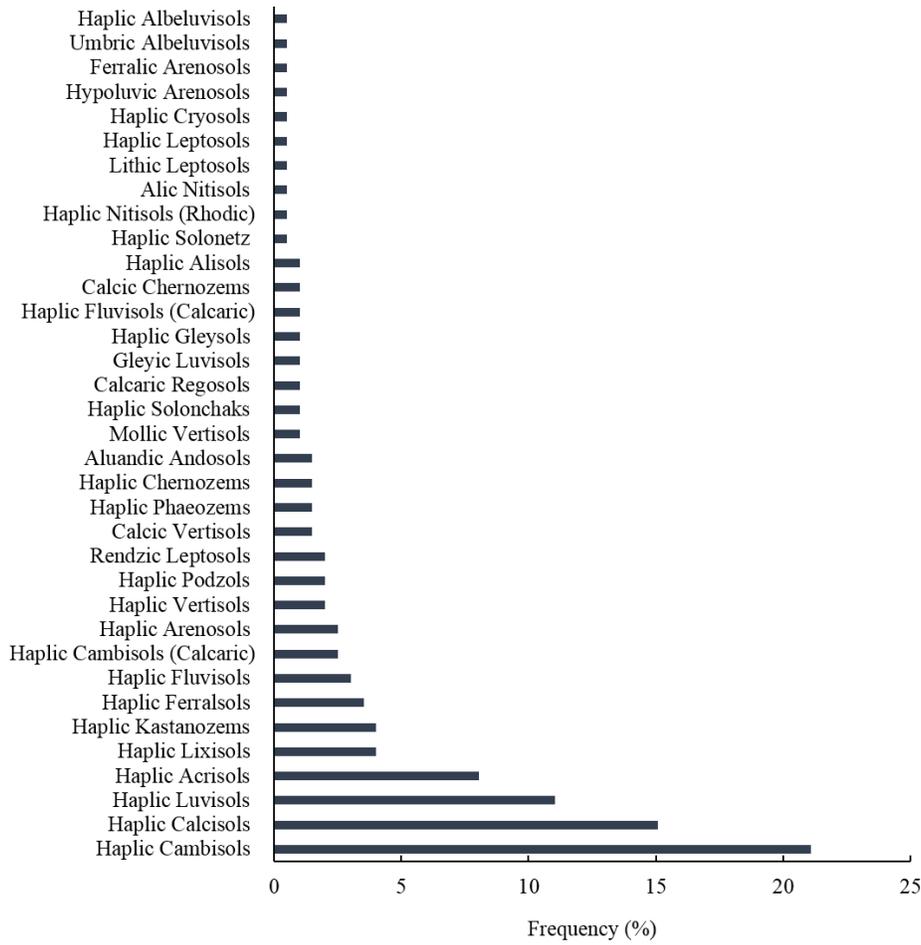
1045

1046

1047

Figure 3- Number of samples by Köppen-Geiger climatic zones (Rubel et al., 2017; Kottek et al., 2006)

Formatted: Font: (Default) Times New Roman, 10 pt,
Complex Script Font: Times New Roman, 10 pt



1048

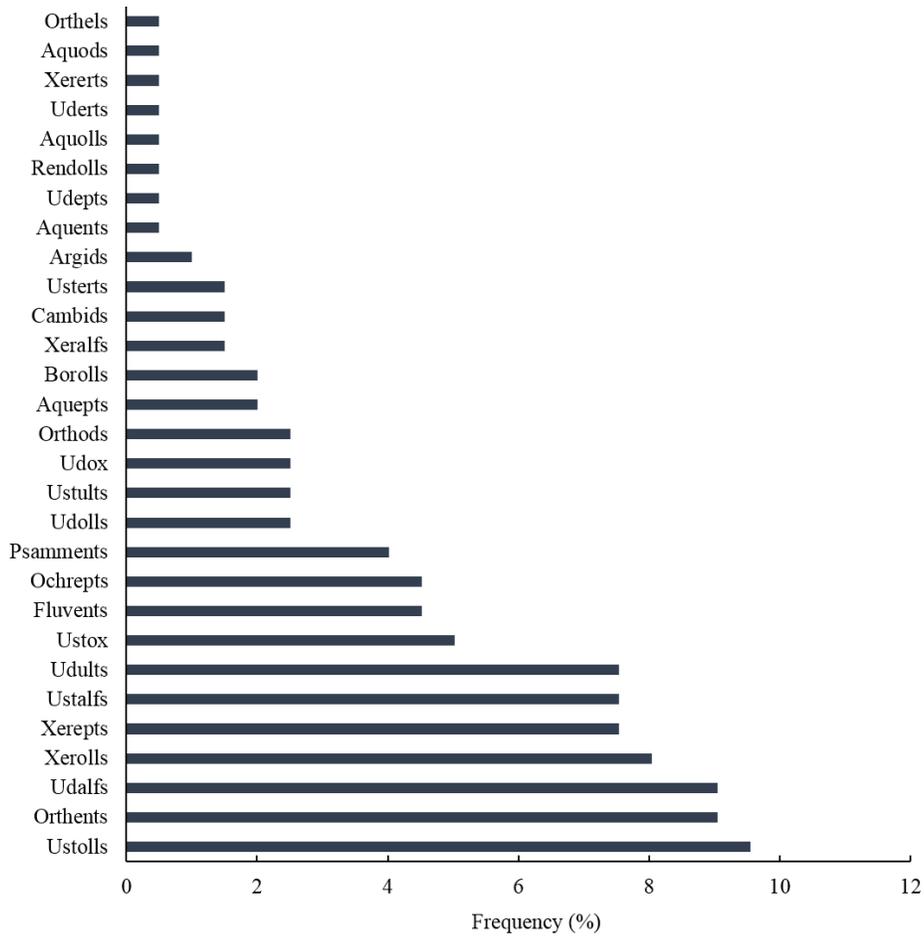
1049

1050

Figure 4- Frequency of WRB reference soil subgroups in experimental sites derived from SoilGrids (Hengl et al., 2017)

Formatted: Font: (Default) Times New Roman, 10 pt, Complex Script Font: Times New Roman, 10 pt

Formatted: Font: (Default) Times New Roman, 10 pt, Complex Script Font: Times New Roman, 10 pt



1051

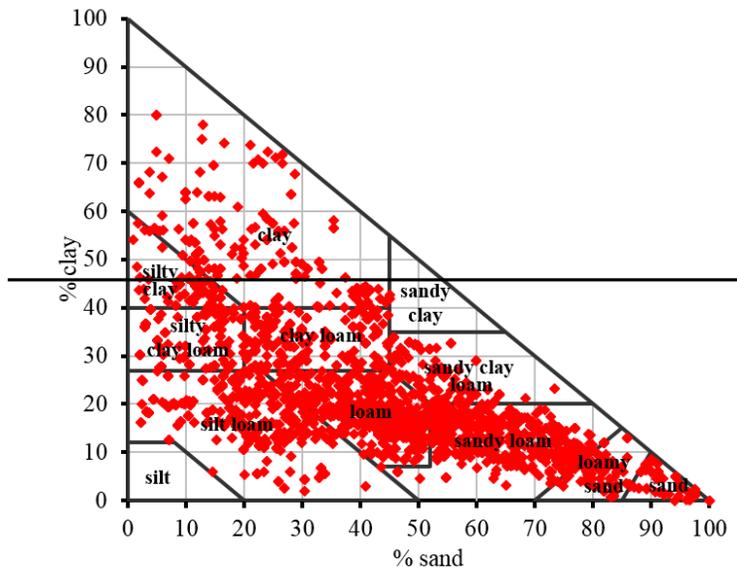
1052

1053

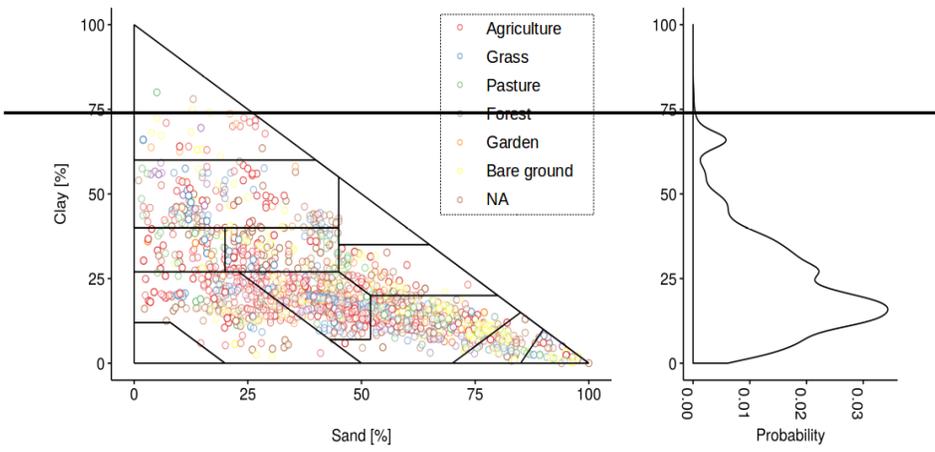
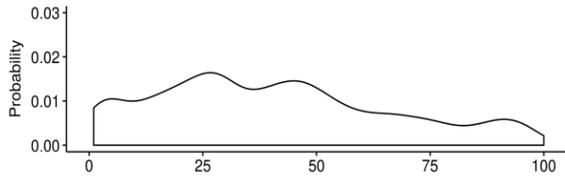
Figure 5- Frequency of USDA soil suborders in experimental sites derived from SoilGrids (Hengl et al., 2017)

Formatted: Font: (Default) Times New Roman, 10 pt, Complex Script Font: Times New Roman, 10 pt

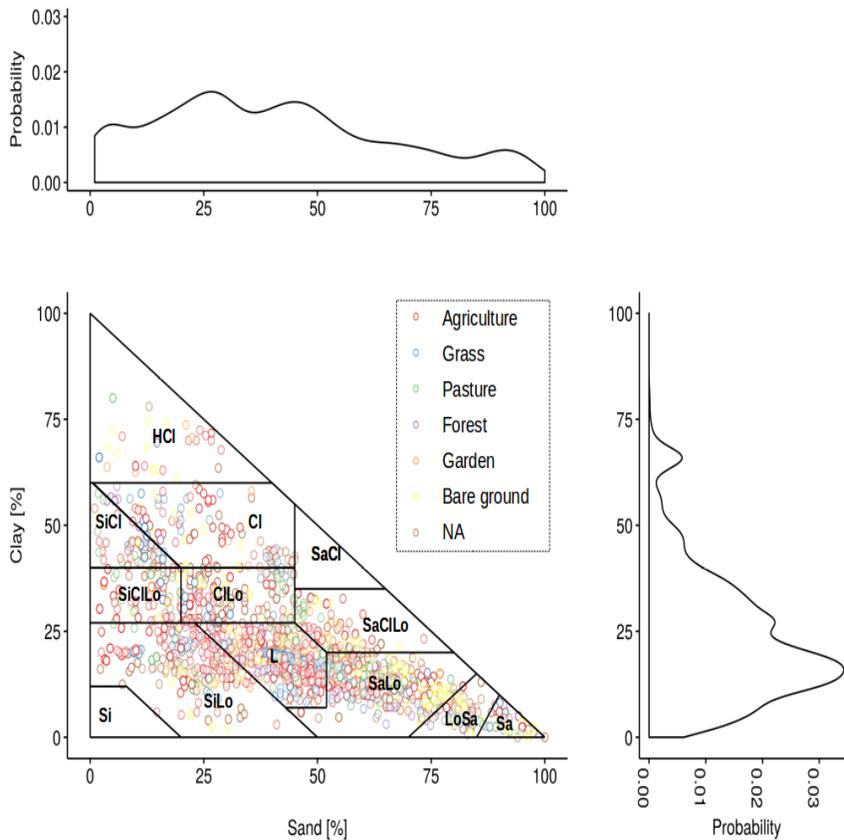
Formatted: Font: (Default) Times New Roman, 10 pt, Complex Script Font: Times New Roman, 10 pt



1054

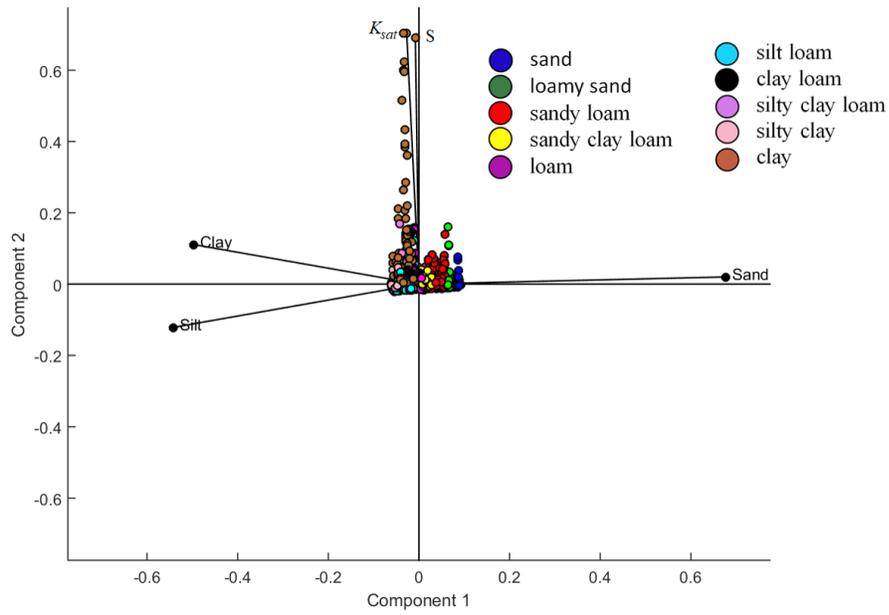


1055



1056
 1057 Figure 3-6 - Textural distribution of soils and probability density functions of clay (on the right) and sand (on the
 1058 top) particles of soils (plotted on USDA textural triangle) for which infiltration data are included in the database.
 1059 Dots are colored according to their corresponding land use.

1060 HCl: Highly clayey; SiCl: silty clay; Cl: clay; SiClLo: silty clay loam; ClLo: clay loam; SaCl: sandy clay; SaClLo:
 1061 sandy clay loam; L: loam; Si: silty; SiLo: silty loam; SaLo: sandy loam; LoSa: loamy sand; and Sa: sandy
 1062



1063

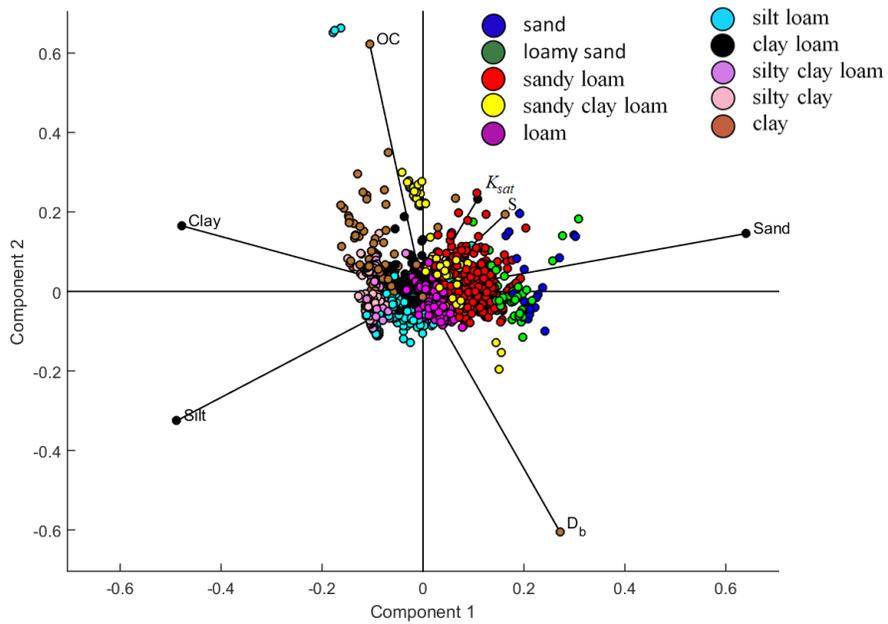
1064

Figure 47- The relationships between clay, silt, sand contents and estimated hydraulic parameters (S and K_{sat})

Formatted: Font: Italic, Complex Script Font: Italic

Formatted: Font: Italic, Complex Script Font: Italic

Formatted: Font: Italic, Complex Script Font: Italic, Subscript



1065

1066

1067

1068

Figure 58- The relationships between clay, silt, sand contents, D_b , and OC and estimated hydraulic parameters (S and K_{sat})

Formatted: Font: Italic, Complex Script Font: Italic

Formatted: Font: Italic, Complex Script Font: Italic, Subscript

Formatted: Font: Italic, Complex Script Font: Italic

Formatted: Font: Italic, Complex Script Font: Italic

Formatted: Font: Italic, Complex Script Font: Italic