Supporting Information for

Analyzing dual porosity in soil hydraulic properties using soil databases for pedotransfer function development

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126 soil samples that are identified to have bimodality in this study were refitted using unimodal model $\boldsymbol{\theta}(h)+K(h)$ with K_0 fitted. For the $K(h)$ dataset, $|h| < 6$cm were not included for the optimization, which is a threshold value of pressure head that differentiates macroporous from matrix flow in $K(h)$ dataset. This fitting procedure was proposed by Weynants et al. (2009). According to the AIC values shown in Appendix Table A2, 116 out of 126 samples were best fitted by the bimodal $\boldsymbol{\theta}(h)+K(h)$ fitting case, accounting for 92% of the soil samples, suggesting the superiority of the bimodal model to characterize the soil hydraulic characteristic dataset.

For the ratio of structural and textural conductivity, K_s/K_0 values range from 1 to 1933 with a mean value of 57, suggesting a large variation in the structural conductivity and matrix conductivity and also indicating the presence of macroporosity in the samples of the soil database. We note that five samples in the Vereecken dataset have the same values of the fitted K_0 and measured K_s. This might result from the limited $K(h)$ dataset near saturation for these samples. For the unimodal case of jointly fitting $\theta(h)+K(h)$, the fitted K_s values are significantly higher than the observed K_s values.

Table A1: Akaike information criteria (AIC) for all soil samples and fitting strategies. The lowest AIC values are highlighted in green.

Code	Unimodal			Bi-modal	
	θ(h)	θ(h)+K(h) Ks fixed	θ(h)+K(h) Ks fitted	θ(h)	θ(h)+K(h)
2560	27.1	-21.0	-55.9	24.5	-21.6
2561	27.5	-37.2	-57.8	68.2	-38.4
2611	7.3	-21.2	-49.5	45.4	-49.8
2612	30.7	-49.3	-62.7	29.4	-55.0
2751	19.0	-7.3	-37.5	29.2	-93.2
2752	28.4	-14.6	-38.1	43.8	-67.0
4650	62.3	10.9	12.4	41.2	10.2
4651	69.5	-16.0	-13.4	92.9	-19.8
4660	88.0	-50.8	-54.5	79.6	-102.4
4661	79.3	2.6	-0.6	72.5	-167.8
4670	-1.5	-66.0	-83.6	59.0	-109.0
4671	-3.9	-126.5	-130.5	10.5	-119.3
4672	61.9	-26.2	-73.8	76.5	-126.1
4673	-5.5	-104.1	-137.0	39.4	-190.9
4680	102.7	63.4	27.9	105.7	-10.2
4681	102.4	-9.3	12.6	113.2	-88.1
p_02-0	86.0	28.3	28.5	87.4	30.7
p_02-1	82.6	-52.0	-48.9	84.1	-43.7
p_03-0	69.9	-80.0	-67.9	85.9	-58.5
p_04-0	113.8	49.9	46.1	111.8	64.7
p_04-1	84.8	41.2	46.7	75.4	53.0
p_04-5	37.2	-19.8	-26.1	48.8	-28.3
p_08-3	85.5	-185.0	-201.2	103.8	-230.3
p_08-4	63.8	-112.3	-80.5	63.4	-101.8
p_08-5	68.8	-159.7	-156.6	103.1	-203.6
p_12-3	24.3	-72.1	-106.5	38.7	-117.8
p_12-4	39.0	-146.0	-131.7	61.5	-108.2
p_13-2	52.4	-101.5	-87.6	39.6	-175.6
p_13-3	55.3	-133.7	-128.7	95.9	-174.7
p_14-0	70.5	-47.0	-25.3	69.0	-98.3
p_14-1	45.1	-25.1	-25.3	49.6	-63.2
p_14-2	68.0	-44.4	-28.4	60.2	-125.9
p_14-3	38.3	-81.5	-81.7	45.8	-173.6
p_14-4	81.7	-143.3	-86.2	85.6	-159.8
p_14-5	60.2	-121.3	-93.9	97.9	-128.2
p_15-0	72.3	-37.3	-8.0	38.1	-42.7
p_15-1	76.1	-48.3	-12.3	46.8	-63.7
p_15-2	61.0	-45.9	-27.8	59.6	-75.9
p_15-5	78.9	-58.0	-30.0	57.0	-121.8
p_15-6	85.6	-55.5	-28.2	71.2	-85.0
p_16-0	67.3	-192.7	-188.2	107.5	-168.6
p_16-2	81.1	-125.2	-122.9	99.8	-118.2
p_16-3	67.8	-79.3	-71.0	90.4	-84.5
p_16-4	75.7	-99.1	-97.0	77.5	-102.4
p_16-5	72.8	-77.3	-76.0	88.4	-121.7
p_17-3	52.0	-75.6	-87.1	73.8	-117.1
p_20-0	113.4	-7.0	-34.6	127.8	-45.6
p_20-1	159.6	-56.3	-99.5	172.7	-123.0
p_21-1	25.3	-53.9	-48.0	69.1	-68.7
p_22-0	55.0	-4.5	-1.9	101.4	-56.0
p_22-1	89.9	-92.5	-91.7	100.0	-93.3
p_22-2	65.1	-62.0	-60.5	68.8	-59.1
p_22-3	49.1	-85.7	-64.6	66.7	-85.1
p_23-0	45.1	-20.8	-27.8	58.4	-45.1
p_23-2	29.4	-72.3	-70.0	47.3	-77.4
p_24-2	Inf	-2.5	-13.4	Inf	85.4
p_28-0	62.2	-114.9	-112.1	62.5	-109.5
p_28-1	62.4	-57.3	-57.1	65.4	-66.3
p_28-2	24.4	-75.3	-75.4	73.8	-96.3
p_28-4	65.6	-89.5	-87.5	85.3	-108.8
p_29-4	75.9	-34.3	-31.2	94.8	-23.3
p_30-3	108.1	-109.2	-106.9	122.5	-96.9
p_31-2	54.1	-49.0	-40.3	66.5	-48.0
p_31-4	60.8	-96.1	-90.3	84.5	-83.4
p_31-5	50.0	-148.3	-131.7	53.1	-140.3

Code	Unimodal			Bi-modal	
	θ(h)	θ(h)+K(h) Ks fixed	θ(h)+K(h) Ks fitted	θ(h)	θ(h)+K(h)
p_32-1	74.7	-20.3	-8.8	27.5	-89.7
p_32-2	23.9	-86.5	-83.9	80.8	-92.1
p_32-4	22.3	-71.9	-74.3	73.2	-101.8
p_32-5	53.4	-93.7	-91.6	64.0	-154.6
p_33-0	9.6	-131.5	-150.2	75.5	-297.9
p_33-1	65.8	-131.1	-105.5	87.2	-133.8
p_38-1	103.6	-149.7	-157.0	123.6	-159.9
p_38-3	40.2	40.2	34.7	81.7	37.7
p_39-0	66.1	-90.6	-92.1	73.0	-97.5
p_39-2	32.6	-60.8	-57.2	79.5	-74.3
13	33.9	-51.3	-57.9	53.0	-123.4
14	25.6	1.0	4.3	37.8	-71.4
15	28.2	25.9	28.6	57.4	-5.1
16	35.2	11.9	13.0	46.6	-14.6
17	38.9	-71.7	-69.5	54.8	-78.5
18	40.2	-49.0	-44.2	56.1	-37.9
19	45.5	-47.0	-44.2	60.9	12.9
20	44.9	-25.8	-4.9	67.6	-37.1
21	30.8	-119.5	-97.8	46.2	-111.7
22	37.4	-58.3	-52.9	57.1	-112.4
23	27.6	0.1	1.8	49.0	6.7
24	40.1	-44.5	-41.3	64.0	-41.3
25	39.7	19.8	20.7	69.4	-22.2
26	43.6	-4.4	3.5	49.4	-19.4
27	44.6	14.2	17.1	79.7	-34.0
28	25.2	-118.2	-90.2	60.9	-91.1
29	31.5	-22.7	-18.7	51.7	-98.4
30	39.3	-72.6	-70.6	37.5	-87.7
31	39.9	-2.5	2.1	42.3	23.7
32	34.7	-14.1	-9.8	66.2	-3.5
33	36.6	27.8	17.8	64.9	53.7
34	10.2	-14.3	-27.5	54.7	-18.5
35	30.3	-4.0	-4.0	23.8	-45.1
36	54.2	-186.9	-193.7	84.5	-203.8
37	52.4	-81.3	-68.0	66.0	-109.1
38	37.8	18.6	-6.0	19.8	-67.7
39	15.8	-55.0	-50.4	35.4	-73.3
40	55.3	16.6	11.6	33.2	-23.4
41	47.8	-61.8	-46.0	37.4	-165.3
42	28.1	-38.6	-42.1	24.1	-45.0
43	42.8	14.6	-9.2	56.9	-86.5
44	38.4	-119.5	-112.0	43.0	-132.3
45	20.1	-17.8	-16.0	39.7	-68.5
46	17.4	-11.9	-10.7	60.0	17.8
47	33.3	-173.1	-169.6	72.3	-83.9
48	19.0	-10.4	-9.1	66.6	-2.8
49	44.7	-10.3	-15.3	64.8	0.1
50	29.5	-36.1	-34.0	28.8	-73.0
51	27.1	-20.3	-20.4	32.9	-94.2
52	29.1	-39.1	-49.8	50.0	-49.9
53	16.5	-78.2	-74.8	23.6	-25.6
54	58.2	-29.7	-23.5	31.7	3.7
55	35.4	-67.8	-55.9	55.8	-140.2
56	33.0	22.9	9.2	46.6	18.8
57	49.3	-78.6	-69.3	63.5	-70.3
58	49.3	-53.0	-30.4	66.6	-83.0
59	35.5	-58.1	-43.7	43.9	-80.3
60	29.9	17.1	20.4	33.4	-31.7
61	57.4	55.7	54.6	44.6	-11.4
62	32.0	24.2	27.0	39.6	-59.2
63	26.5	4.6	9.3	54.6	-71.9
64	44.6	-22.2	-19.5	70.2	-47.4
65	34.7	-31.6	-28.4	48.7	-40.6
66	37.0	-80.4	-74.1	57.2	-94.3
67	42.0	-91.2	-79.6	71.7	-81.4

Code	Unimodal			Bi-modal	
	θ(h)	θ(h)+K(h) Ks fixed	θ(h)+K(h) Ks fitted	θ(h)	θ(h)+K(h)
68	33.4	-60.4	-70.3	57.0	-89.0
69	59.5	-79.5	-98.4	56.2	-196.2
70	53.4	-24.4	-25.8	53.6	-54.8
71	1.1	-45.4	-49.8	38.8	-122.5
72	23.6	-31.8	-33.5	40.5	-22.6
73	26.7	-5.8	-5.5	48.2	-6.4
74	37.6	38.0	9.3	42.4	-7.5
75	48.3	-81.5	-69.6	70.5	-116.9
76	49.6	-0.7	-2.0	77.9	-1.6
77	37.2	-1.9	0.3	49.4	-52.0
78	45.5	-6.8	0.4	48.6	19.4
79	33.5	-18.9	-21.3	54.5	-24.3
80	55.0	56.5	53.7	63.3	71.3
81	79.9	57.4	53.7	61.0	53.4
82	34.1	-94.7	-88.5	56.4	-149.4
83	37.7	-140.4	-129.1	49.6	-87.5
84	39.1	-101.7	-95.5	55.4	-124.6
85	53.6	-59.3	-63.5	57.4	-49.1
86	51.6	-131.8	-136.9	23.0	-189.2
87	37.6	-22.6	-21.8	58.1	-117.1
88	43.9	-31.9	-29.2	38.4	-27.4
89	60.8	-55.9	-60.5	47.4	-143.2
90	41.5	-0.8	1.6	82.3	0.3
91	77.4	76.3	54.1	73.7	65.4
92	39.5	-56.5	-56.2	57.3	-49.8
93	33.1	-46.8	-48.6	58.7	-64.4
94	52.1	41.3	38.4	65.0	39.2
95	42.8	48.1	38.0	64.9	36.8
96	40.6	10.1	11.6	44.9	-59.3
97	40.7	25.2	25.9	Inf	-5.5
98	40.0	24.8	25.8	109.6	34.3
99	35.0	-53.0	-52.0	59.0	-80.5
100	30.7	25.4	28.8	45.1	17.8
101	50.1	61.0	55.1	61.7	10.9
102	12.9	-5.2	-3.4	37.6	-33.8
103	60.3	64.0	59.9	63.9	44.9
104	22.9	11.0	10.8	45.0	-7.4
105	47.8	-6.2	-3.0	58.2	-4.9
106	60.9	50.4	45.9	56.0	-25.9
107	35.2	28.0	30.3	49.5	34.0
108	25.2	-43.4	-41.6	25.1	-39.1
109	47.0	16.3	3.7	74.4	-11.0
110	6.1	-43.6	-41.7	31.0	-23.1
111	38.6	5.1	8.2	42.3	3.4
112	35.9	-28.8	-26.3	49.4	13.1
113	43.9	-61.3	-62.5	64.2	-73.2
114	36.8	-5.9	-2.4	51.9	13.6
115	25.7	-19.5	-16.4	62.4	-1.9
116	14.7	-51.3	-53.3	36.3	-40.4
117	33.0	-46.7	-12.6	50.8	-18.7
118	72.8	-41.6	-24.3	60.8	-174.5
119	41.1	-38.6	-34.3	47.1	-6.0
120	22.3	-40.6	-47.6	40.3	-54.1
121	18.3	-69.2	-72.7	38.5	-63.7
122	25.7	20.5	22.8	38.8	-0.8
123	27.8	20.2	23.1	49.4	-17.1
124	48.0	41.0	41.8	76.7	-51.6
125	40.2	-88.8	-76.6	61.4	-120.4
126	26.4	-32.4	-31.4	54.7	-79.8
127	30.5	-47.3	-29.4	56.1	-40.9
128	29.9	-43.7	-42.4	69.2	-79.9
129	45.8	-68.8	-65.9	66.9	-12.4
130	57.3	-124.7	-134.1	70.6	-121.4
131	40.7	44.0	38.8	58.2	28.7

Table A2: AIC values of unimodal $\boldsymbol{\theta}(h)$+$K(h)$ K_0 fitted and bimodal $\boldsymbol{\theta}(h)$+$K(h)$ fitting strategies for the 126 soil samples that are identified to have bimodality. The lowest AIC values are highlighted in green. Fitted K_0 indicating matrix flow at 0 capillary head and observed K_s values are also listed for each sample.

code	Unimodal $\boldsymbol{\theta}$(h)+K(h) K_0 fitted	Bimodal $\boldsymbol{\theta}$(h)+K(h)	K_0	K_s	code	Unimodal $\boldsymbol{\theta}$(h)+K(h) K_0 fitted	Bimodal $\boldsymbol{\theta}$(h)+K(h)	K_0	K_s	code	Unimodal $\boldsymbol{\theta}$(h)+K(h) K_0 fitted	Bimodal $\boldsymbol{\theta}$(h)+K(h)	K_0	K_s
2611	-7.5	-49.8	26.49	39.83	p_28-4	-83.8	-108.8	6.61	6.61	63	14.3	-71.9	38.23	100
2751	-4.8	-93.2	23.18	25.92	p_32-1	-55.1	-89.7	2.92	1097.5	64	-10.7	-47.4	23.98	60
2752	2.6	-67.0	7.93	14.947	p_32-2	-81.9	-92.1	19.46	50.1	65	61.5	-40.6	0.30	28
4650	46.5	10.2	503.53	586.7	p_32-4	-96.8	-101.8	3.75	47.5	66	59.7	-94.3	0.03	1.8
4651	-2.1	-19.8	77.33	190.1	p_32-5	-152.3	-154.6	1.19	77.3	68	35.2	-89.0	0.59	2
4660	-26.7	-102.4	229.43	625.5	p_33-0	-279.1	-297.9	0.53	14.42	69	-21.9	-196.2	7.24	10.02
4661	24.0	-167.8	1062.32	1140	p_33-1	-108.1	-133.8	8.14	268.4	70	10.9	-54.8	1.02	4.165
4670	-48.3	-109.0	68.09	88.99	p_38-1	-142.1	-159.9	5.58	5.579	71	-3.1	-122.5	3.22	11.48
4672	-3.8	-126.1	1.81	2.419	p_39-0	-83.6	-97.5	14.10	14.1	73	53.2	-6.4	208.30	500
4673	5.0	-190.9	0.86	4.329	p_39-2	-62.3	-74.3	2.95	17.433	74	55.3	-7.5	22.20	50
4680	154.9	-10.2	2615.78	3845	13	-24.6	-123.4	0.03	0.05	75	79.1	-116.9	81.83	90
4681	150.1	-88.1	793.83	1668	14	20.4	-71.4	81.06	150	77	6.0	-52.0	11.50	20
p_04-5	-28.7	-28.3	11.09	35.3	15	29.7	-5.1	21.76	100	79	3.5	-24.3	63.81	97
p_08-3	-229.1	-230.3	3.64	29.93	16	19.7	-14.6	17.23	102	81	59.7	53.4	266.10	680
p_08-5	-204.6	-203.6	1.70	142.6	17	8.7	-78.5	0.44	0.72	82	35.0	-149.4	1.06	7
p_12-3	-118.2	-117.8	5.73	26.74	20	80.3	-37.1	189.74	300	84	58.5	-124.6	2.29	2.5
p_13-2	-125.8	-175.6	1.61	52.4	22	63.8	-112.4	345.68	900	86	4.8	-189.2	12.89	14.12
p_13-3	-172.7	-174.7	2.62	164.8	25	27.9	-22.2	17.08	23	87	42.8	-117.1	12.53	46.88
p_14-0	-76.6	-98.3	0.97	304.1	26	36.6	-19.4	28.34	40	89	-51.3	-143.2	2.69	160.7
p_14-1	-45.3	-63.2	2.53	80.85	27	27.1	-34.0	78.74	100	93	13.9	-64.4	3.38	7
p_14-2	-82.3	-125.9	1.50	332.5	29	34.0	-98.4	1.36	8.5	95	51.4	36.8	151.74	220
p_14-3	-126.3	-173.6	2.76	54.4	30	72.4	-87.7	69.04	110	96	53.7	-59.3	294.43	331.1
p_14-4	-178.1	-159.8	0.72	139.8	35	26.6	-45.1	63.34	169.8	97	49.5	-5.5	167.02	169.2
p_14-5	-121.7	-128.2	1.00	58	36	-63.3	-203.8	0.47	1.047	99	44.8	-80.5	2.59	10.52
p_15-0	-54.7	-42.7	1.45	1209.3	37	-8.3	-109.1	16.93	37.15	100	28.7	17.8	19.79	40
p_15-1	-70.6	-63.7	0.72	674.9	38	54.8	-67.7	112.30	118.3	101	59.6	10.9	9.85	295
p_15-2	-54.7	-75.9	1.02	71.5	39	-17.4	-73.3	3.82	5.105	102	1.5	-33.8	77.75	110
p_15-5	-88.3	-121.8	1.02	858.7	40	60.3	-23.4	135.12	257	103	66.0	44.9	235.10	300
p_15-6	-40.4	-85.0	1.86	869.4	41	62.1	-165.3	63.04	97.23	104	24.7	-7.4	30.13	90
p_16-3	-67.8	-84.5	2.67	12.4	42	-5.0	-45.0	10.08	48.02	106	59.6	-25.9	276.76	320
p_16-4	-103.5	-102.4	11.58	72.9	43	22.7	-86.5	6.05	6.191	109	102.3	-11.0	91.78	117.9
p_16-5	-85.8	-121.7	11.43	155.01	44	37.7	-132.3	5.49	17.84	111	12.0	3.4	33.18	75
p_17-3	-112.7	-117.1	0.19	2.5	45	-15.6	-68.5	13.36	144.5	113	-1.6	-73.2	0.47	2.6
p_20-0	-44.5	-45.6	0.91	6.55	50	33.5	-73.0	89.03	96.38	118	21.3	-174.5	4.60	10.96
p_20-1	-49.6	-123.0	1.05	1.05	51	34.9	-94.2	60.80	138	120	-27.6	-54.1	6.19	38.62
p_21-1	-44.0	-68.7	12.42	33.9	52	-38.2	-49.9	6.09	12	122	38.7	-0.8	19.73	180
p_22-0	-104.1	-56.0	0.88	1692.8	55	-45.1	-140.2	0.13	0.3	123	29.9	-17.1	170.93	200
p_22-1	-93.9	-93.3	84.22	188.1	58	92.1	-83.0	558.94	999	124	41.3	-51.6	197.53	650
p_23-0	-54.7	-45.1	80.94	2687.5	59	60.5	-80.3	31.30	35	125	75.8	-120.4	75.69	95
p_23-2	-72.4	-77.4	13.29	59.7	60	25.6	-31.7	332.61	550	126	42.5	-79.8	4.31	9
p_28-1	-52.3	-66.3	1.75	1.75	61	57.1	-11.4	466.51	800	128	19.9	-79.9	31.29	36.14
p_28-2	-82.0	-96.3	10.95	64	62	29.8	-59.2	96.47	100	131	46.5	28.7	41.20	55

Table A3. The number of samples, mean sand, clay fraction and bulk density (BD), mean values for bimodal soil hydraulic parameters of θ_s, α_1, n_1, α_2, n_2, w, τ, K_s from Priesack and Durner (2006) based on Mualem-van Genuchten model in USDA soil textural classes. α_1 and n_1 are for the macropore domain, whereas α_2 and n_2 are for the matrix domain. It is noted that α_1, n_1, α_2, n_2, K_s are log10 transformed before calculating mean values, and then the values are anti-log transformed. 53 soil samples that are identified to have bimodality by the lowest AIC with soil texture information available are used for the statistical analysis.

Soil texture	number (-)	Sand (%)	Clay (%)	BD (g/cm^3)	θ_s (cm^3/cm^3)	α_1 (1/cm)	n_1 (-)	α_2 (1/cm)	n_2 (-)	w (-)	τ (-)	K_s (cm/day)
Clay	5	14.06	56.20	1.239	0.538	0.695	1.296	0.0038	1.142	0.151	-4.833	655.822
Clay loam	2	23.25	32.70	1.265	0.489	1.000	1.152	0.0122	1.152	0.162	-5.751	564.283
Loam	9	41.99	16.76	1.462	0.422	0.099	2.601	0.0020	1.275	0.234	-3.072	17.506
Silty loam	29	15.34	15.21	1.477	0.424	0.205	1.832	0.0024	1.331	0.227	-2.695	59.505
Sandy loam	1	55.40	18.60	1.280	0.487	0.036	2.502	0.0004	1.295	0.181	4.235	25.920
Silt	2	10.38	9.25	1.465	0.435	0.086	1.762	0.0040	1.272	0.235	-1.962	111.538
Sand	5	93.36	2.30	1.541	0.377	0.088	2.887	0.0114	1.411	0.570	-0.562	308.788

Table A4. The number of samples, standard deviation of sand, clay fraction, bulk density (BD), soil hydraulic parameters of θ_s, α_1, n_1, α_2, n_2, w, τ, K_s from Priesack and Durner (2006) based on Mualem-van Genuchten model in USDA soil textural classes. It is noted that α_1, n_1, α_2, n_2, K_s are log10 transformed before calculating standard deviation, and is not anti-log transformed. 53 soil samples are used for the statistical analysis.

Soil texture	number (-)	Sand (%)	Clay (%)	BD (g/cm^3)	θ_s (cm^3/cm^3)	α_1 (1/cm)	n_1 (-)	α_2 (1/cm)	n_2 (-)	w (-)	τ (-)	K_s (cm/day)
Clay	5	3.18	11.69	0.205	0.064	0.329	0.126	0.473	0.014	0.084	5.689	0.832
Clay loam	2	0.78	0.42	0.049	0.018	0.000	0.021	0.944	0.021	0.006	4.211	0.675
Loam	9	8.10	4.11	0.219	0.073	0.682	0.430	0.907	0.025	0.226	3.049	0.675
Silty loam	29	7.87	3.41	0.048	0.019	0.597	0.267	0.542	0.037	0.160	1.691	0.815
Sandy loam	1	0.00	0.00									
Silt	2	3.65	3.18	0.064	0.026	1.193	0.196	0.028	0.005	0.106	2.749	0.139
Sand	5	1.67	1.30	0.110	0.025	0.449	0.145	1.209	0.117	0.328	1.338	0.597

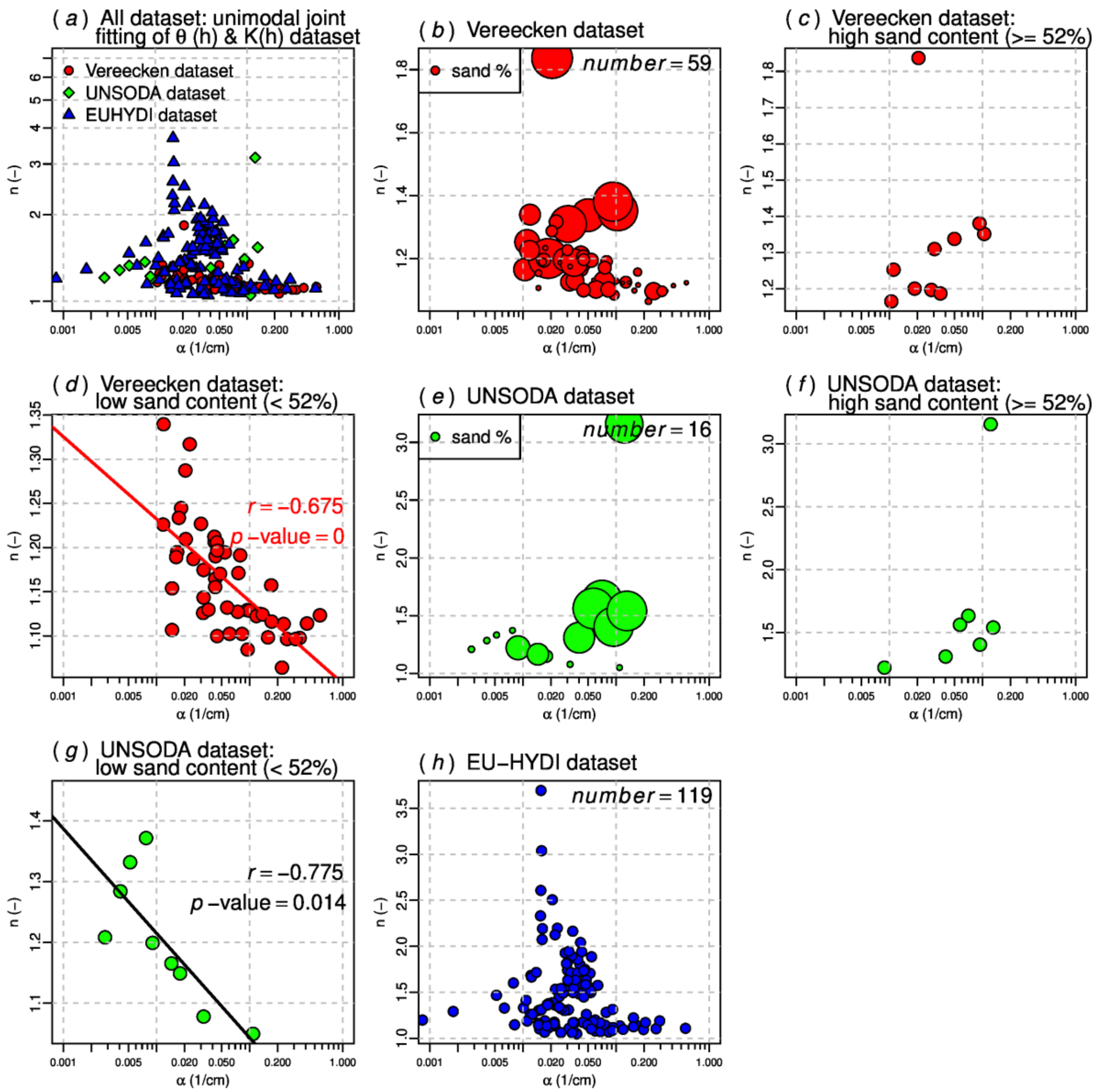

Figure A1. The relationship between van Genuchten α (cm^{-1}) versus *n* (-) from the unimodal joint fitting of soil water retention curve and hydraulic conductivity curve (Equations 1 and 2) to the retention dataset and hydraulic conductivity dataset. (a) The case for all datasets including the Vereecken, UNSODA, and EUHYDI dataset; (b), (c), and (d) The cases for the entire, high sand (>= 52%), and low sand (<52%) content dataset from the Vereecken dataset; (e), (f) and (g) The cases for the entire, high sand (>= 52%), and low sand (<52%) content dataset from the UNSODA dataset; (h) The case from the EU-HYDI dataset.

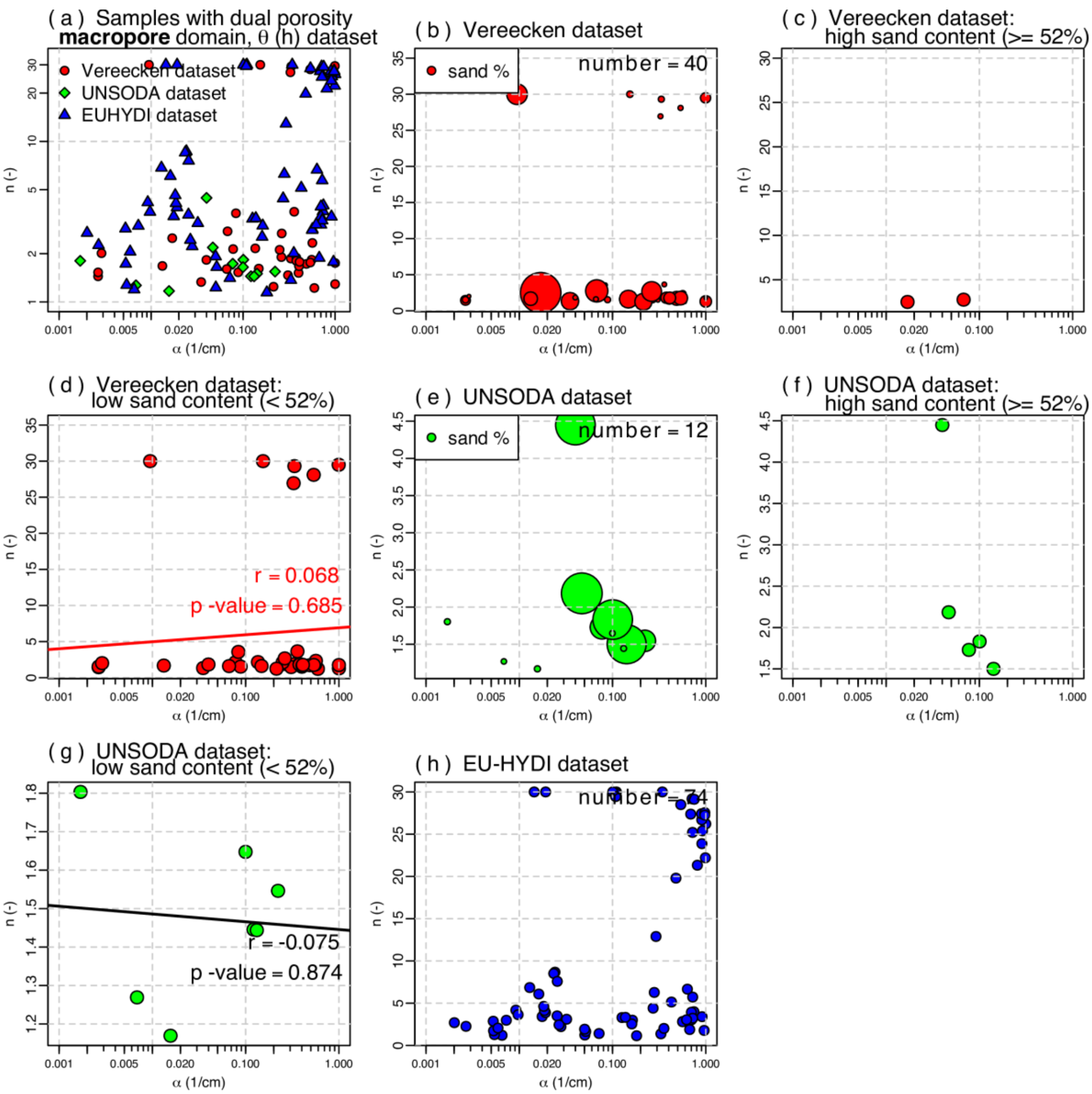

Figure A2. The relationship between van Genuchten α_1 (cm^{-1}) versus n_1 (-) of macropore domain from the bimodal fitting of soil water retention curve (Equation 3) to the retention dataset. (a) The case for samples with dual porosity for all three datasets including the Vereecken, UNSODA, and EUHYDI dataset; (b), (c), and (d) The cases for the entire, high sand (>= 52%), and low sand (<52%) content dataset from the Vereecken dataset; (e), (f) and (g) The cases for the entire, high sand (>= 52%), and low sand (<52%) content dataset from the UNSODA dataset; (h) The case from the EU-HYDI dataset.

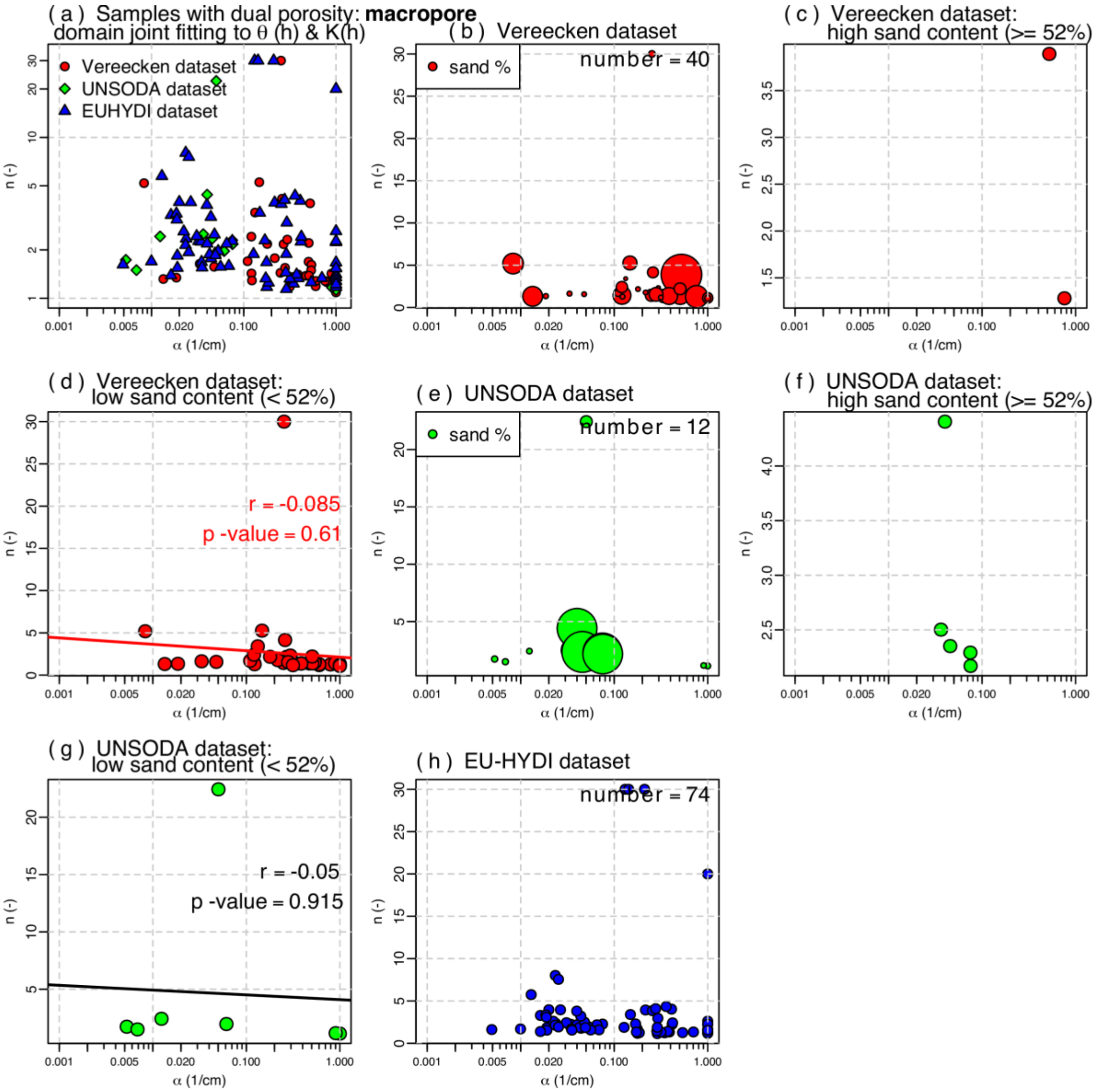

Figure A3. The relationship between van Genuchten α1 (cm-1) versus n1 (-) of macropore domain from the bimodal fitting of soil water retention curve and hydraulic conductivity curve (Equations 3 and 4) to the retention dataset and hydraulic conductivity dataset. (a) The case for all datasets including the Vereecken, UNSODA, and EUHYDI dataset; (b), (c), and (d) The cases for the entire, high sand (>= 52%), and low sand (<52%) content dataset from the Vereecken dataset; (e), (f) and (g) The cases for the entire, high sand (>= 52%), and low sand (<52%) content dataset from the UNSODA dataset; (h) The case from the EU-HYDI dataset.

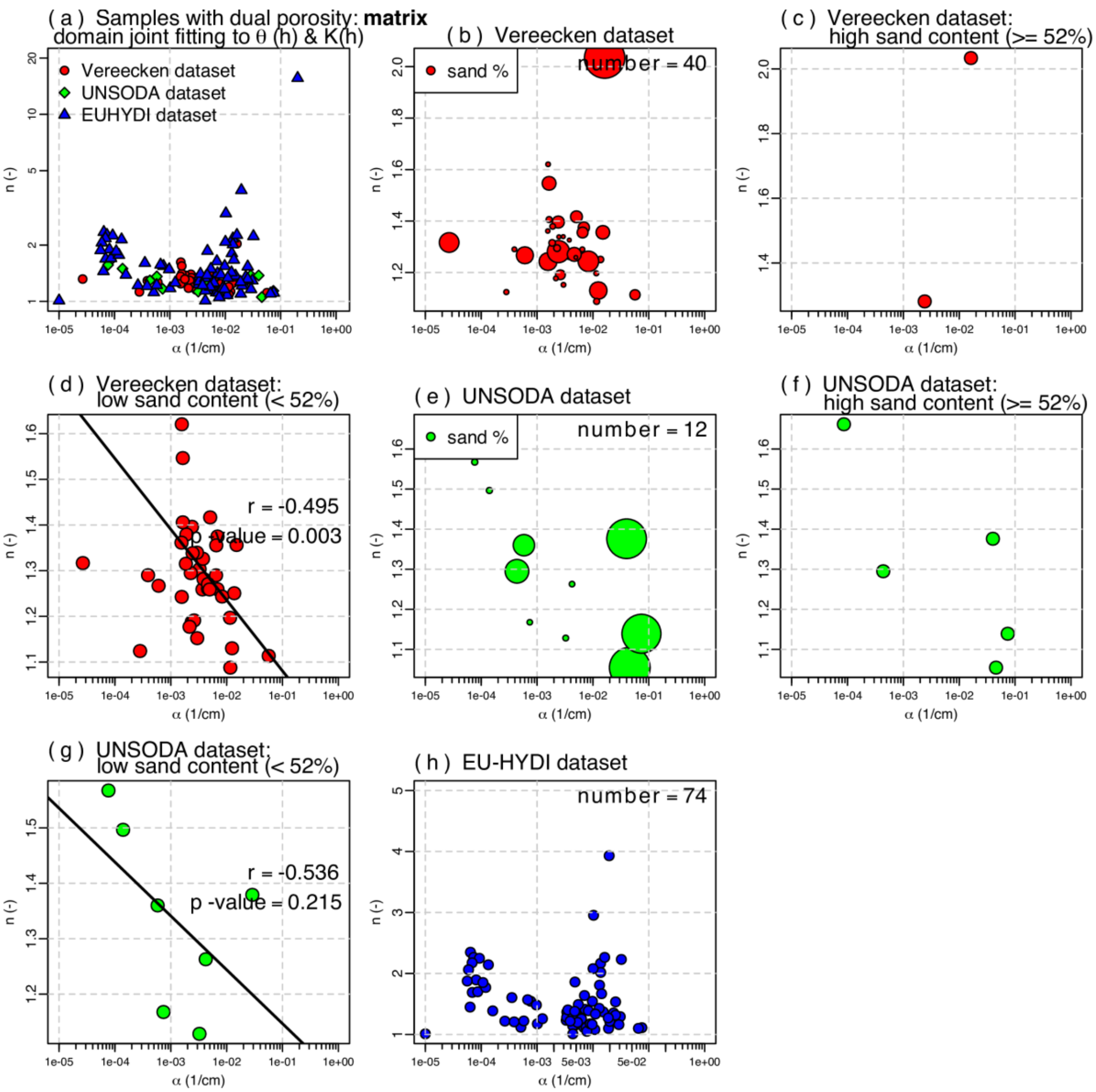

Figure A4. The relationship between van Genuchten α_2 (cm^{-1}) versus n_2 (-) of matrix domain from the bimodal fitting of soil water retention curve and hydraulic conductivity curve (Equations 3 and 4) to the retention dataset and hydraulic conductivity dataset. (a) The case for all datasets including the Vereecken, UNSODA, and EUHYDI dataset; (b), (c), and (d) The cases for the entire, high sand (>= 52%), and low sand (<52%) content dataset from the Vereecken dataset; (e), (f) and (g) The cases for the entire, high sand (>= 52%), and low sand (<52%) content dataset from the UNSODA dataset; (h) The case from the EU-HYDI dataset.

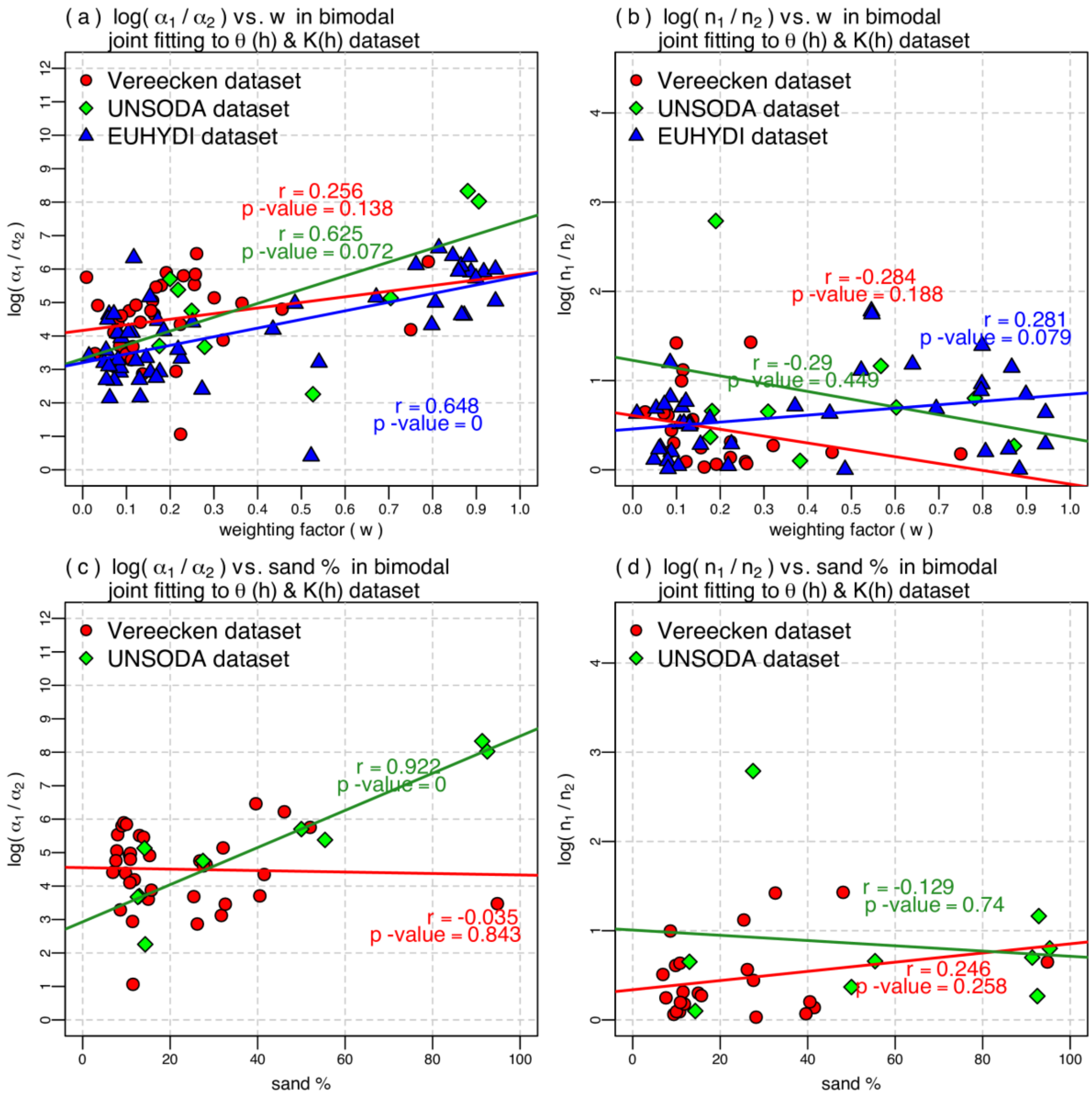

Figure A5. van Genuchten (a) α and (b) *n* in the corresponding macropore (α_1 or n_1) and matrix (α_2 or n_2) domain vs. weighting factors (*w*). (c) and (d) corresponding macropore (α_1 or n_1) and matrix (α_2 or n_2) domain vs. soil sand content. The parameters were obtained based on bimodal joint fitting of soil water retention curve and hydraulic conductivity curve (Equations 3 and 4) to the soil water retention and hydraulic conductivity dataset.