Supplementary material

Mechanisms of consistently disconnected soil water pools over (pore)space and time

Matthias Sprenger[1,2], Pilar Llorens[1], Carles Cayuela[1], Francesc Gallart[1], Jérôme Latron[1]

[1]Institute of Environmental Assessment and Water Research (IDAEA-CSIC), Calle Jordi Girona, 18-26, 08034 Barcelona, Spain

[2]Department of Forestry and Environmental Resources, North Carolina State University, 2720 Faucette Dr, Raleigh, NC 27606, USA

Correspondence to: Matthias Sprenger (mspreng@ncsu.edu)

This file includes:

- Supplementary Figures S1
- Supplementary Figures S2
- Supplementary Table S1
- Supplementary Table S2
- Supplementary Table S3

Supplementary Figures

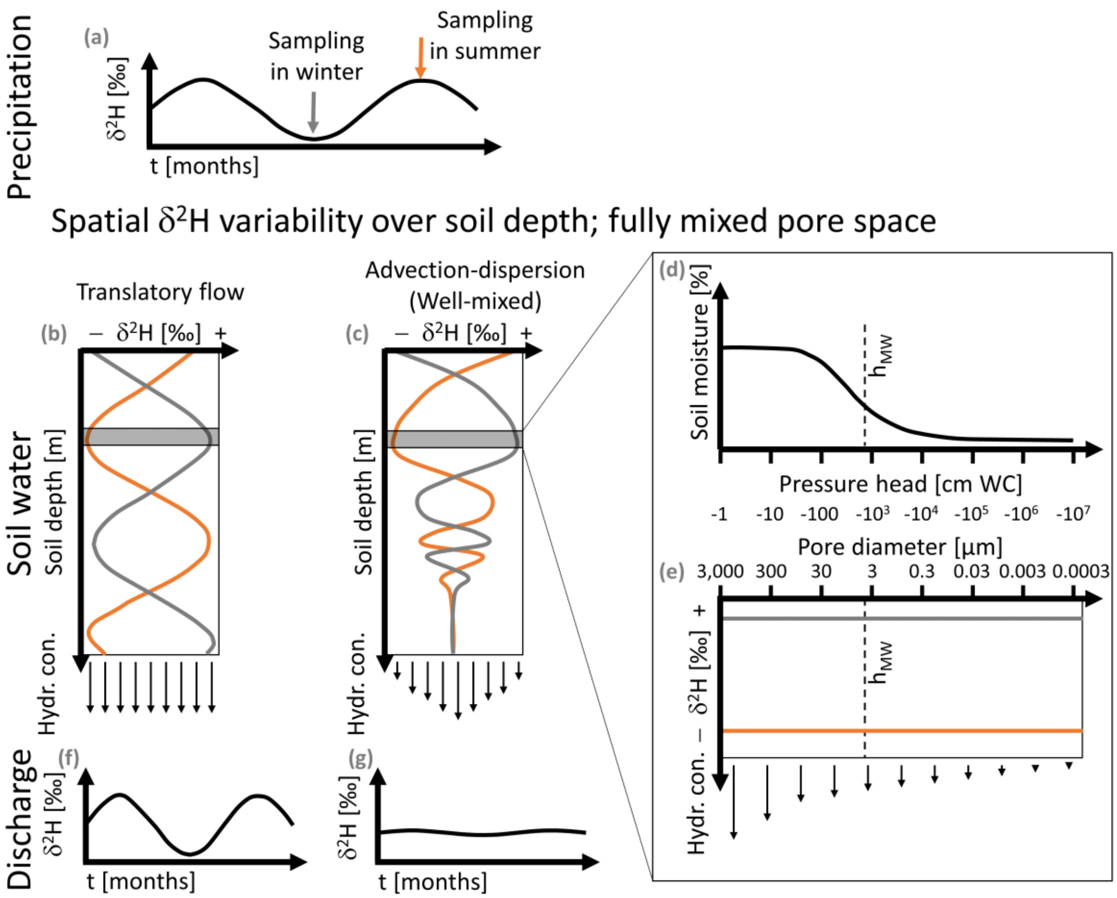

Figure S 1 Water flow and transport according to uniform flow (water in soil pores is fully mixed). a, Seasonal variation of the isotopic composition in the rainfall. Arrows indicate soil sampling days. b, Isotope depth profile under translatory flow. for the sampling during winter (grey) and summer (orange). The arrows below the profile represent the uniform hydraulic conductivity. c, Same as (b), but with dispersion leading to loss of seasonality over the depth. d, Water retention curve with h_{MW} indicating the threshold for suction of lysimeter sampling. e, isotopic compositions across the pore space at a specific depth. f, Isotopic composition of the discharge under translatory flow. g, Same as (f), but for advection-dispersion flow. Note that (d) and (e) represent the water retention and isotope values for the depth indicated with a grey bar in (b) and (c).

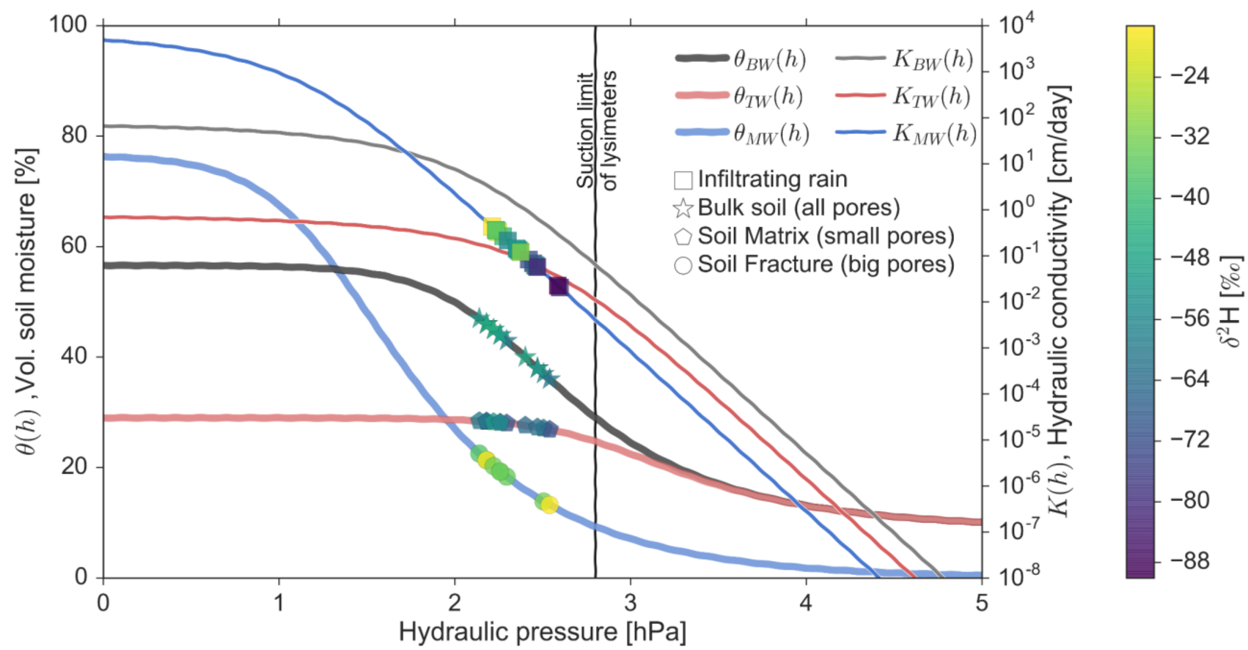

Figure S 2 Water retention curves (θ(h), thick lines) and hydraulic conductivity (K(h), thin lines) for bulk soil (grey), small soil pores holding tightly bound water (Soil matrix, red), and big pores routing mobile water (Soil Fracture, blue). The color code of squares represent monthly weighted averages of rainfall stable isotopic composition (same as squares in Figure 3b), colors of stars and circles show observed isotopic compositions for each day of sampling of bulk and mobile soil waters, respectively (same as BW and MW in Figure 1 and 2), and colors of the pentagons are derived isotopic compositions of tightly bound water (TW in Figure 2). The distinction of the water retention and hydraulic conductivity curves between soil matrix and fractures were made based on the dual-porosity approach proposed by Gerke & van Genuchten (Gerke and van Genuchten, 1993) and the values for the van Genuchten parameter (van Genuchten, 1980) were based on pedotransfer functions (Schaap et al., 2001) (values shown in Table S3).

Supplementary Tables

Table S 1 Median and standard deviation of δ^2H and lc-excess values of bulk and mobile soil water and piezometer samples over the study period.

Sample	Depth [cm]	n	Median δ^2H [‰]	Stdev δ^2H [‰]	Median lc-excess [‰]	Stdev lc-excess [‰]
Bulk water	-10	15	-47.75	5.14	-7.83	2.36
	-20	15	-50.77	6.50	-3.83	1.16
	-30	15	-52.4	5.04	-4.50	1.36
	-50	15	-52.5	4.31	-3.65	1.84
	-100	15	-53.52	1.81	-3.50	1.27
Mobile water	-20	11	-32.85	6.84	-3.45	3.82
	-50	14	-36.22	4.69	-2.11	1.40
	-100	15	-40.58	1.95	-1.95	0.73
Piezometer	var	15	-44.40	1.80	-1.48	1.18

Table S 2 Weighted average isotopic compositions [‰] of rainfall samples between May 2011 and May 2013.

Period	δ^2H	δ^{18}O
Winter (DJF)	-59.37	-9.09
Spring (MAM)	-45.06	-7.38
Summer (JJA)	-29.67	-5.40
Autumn (SON)	-44.05	-7.36
Year	-41.44	-6.94

Table S 3 Soil hydraulic parameters describing the water retention and hydraulic conductivity as shown in Figure S 2 based on the dual-permeability concept by Gerke and van Genuchten (1993).

	θ_r [$cm^3\ cm^{-3}$]	θ_s [$cm^3\ cm^{-3}$]	α [cm^{-1}]	n [-]	K_s [cm day^{-1}]
Bulk soil	0.0907	0.5662	0.0065	1.5893	73.96
Soil matrix	0.0907	0.29009	0.00249	1.5893	0.7396
Soil fractures	0	0.7662	0.0565	1.5893	7395.9

References

Gerke, H. H. and van Genuchten, M. T.: A dual-porosity model for simulating the preferential movement of water and solutes in structured porous media, Water Resour. Res., 29, 305–319, doi:10.1029/92WR02339, 1993.

Schaap, M. G., Leij, F. J., and van Genuchten, M. T.: ROSETTA: a computer program for estimating soil hydraulic parameters with hierarchical pedotransfer functions, J. Hydrol., 251, 163–176, doi:10.1016/S0022-1694(01)00466-8, 2001.

van Genuchten, M. T.: A closed-form equation for predicting the hydraulic conductivity of unsaturated soils, Soil Sci. Soc. Am. J., 44, 892–898, 1980.