Supplement

Table S1 / S4: Correlation coefficient (ρ) between variables included in the mixed effects models, for the topsoil (top) and subsoil (bottom)

	δθpre	$\delta\theta_{post}$	θ_{pre}	θ_{post}	Δθ	$\hat{P}_{TF}$	δP_{TF}	θ_{AC}	θ_{FC}	P_g
topsoil										
δθpre	1	**0.93**	0.00	0.00	0.08	0.00	0.00	-0.23	0.15	0.00
δθpost		1	-0.02	-0.02	0.22	0.00	0.00	-0.23	0.17	0.00
θ_{post}			1	**0.89**	0.02	-0.02	0.00	0.00	0.01	0.00
θ_{post}				1	0.28	0.28	0.17	-0.02	0.02	0.30
Δθ					1	**0.66**	0.10	-0.06	0.06	**0.64**
$\hat{P}_{TF}$						1	0.01	-0.06	0.04	**0.98**
δP_{TF}							1	-0.01	0.02	0.01
θ_{AC}								1	**-0.65**	-0.06
θ_{FC}									1	0.04
P_g										1
subsoil										
δθpre	1	**0.96**	-0.01	-0.01	-0.04	0.00	0.00	-0.37	0.35	0.00
δθpost		1	-0.03	-0.03	0.02	0.00	0.00	-0.37	0.36	0.00
θ_{post}			1	**0.95**	-0.14	0.10	0.00	-0.01	0.00	0.11
θ_{post}				1	0.02	0.21	0.17	-0.02	0.00	0.22
Δθ					1	**0.50**	0.03	-0.06	0.03	**0.48**
$\hat{P}_{TF}$						1	0.02	-0.03	0.02	**0.99**
δP_{TF}							1	-0.07	0.04	0.02
θ_{AC}								1	**-0.79**	-0.03
θ_{FC}									1	0.02
P_g										1

P_g= gross precipitation; $\delta\theta_{pre}$: Spatial pattern of pre-event soil water content (see Eq. 1 and surrounding text); $\delta\theta_{post}$: spatial pattern of post-event soil water content (see Eq. 1); $\Delta\theta$: soil water content increase after rain event ($\Delta\theta = \theta_{post} - \theta_{pre}$); θ_{AC}: Air capacity; θ_{FC}: Field capacity; $\hat{P}_{TF}$: Spatial median of throughfall; δP_{TF}: Spatial pattern of throughfall (see Eq 1).

Table S2 / S1: Parameters for exploratory spatial analysis (Step 1) for throughfall and canopy density (as indicated). Listed are for the precipitation events the gross precipitation (P_G), the collection **Date**, the **even size** class, the **octile skew** of the spatial distribution, as well as the p-values of the regression testing for a spatial **trend** in the East to West (**Trend EW**) as well as in the North to South (**Trend NS**) direction. Transform indicates whether the data was transformed to remove the skew.

P_G	Date	Event size	Octile skew	Trend EW	Trend NS	transform
Throughfall						
1.6	21.07.2015	small	0.11	**0.010**	0.029	no
2.1	20.06.2015	small	0.20	0.086	0.049	no
2.8	30.05.2015	small	0.08	1.000	0.007	no
3.3	18.06.2015	medium	0.00	**<0.001**	0.082	no
3.3	13.07.2015	medium	0.06	0.050	**<0.001**	no
3.7	02.06.2015	medium	0.06	0.785	0.100	no
4.1	13.05.2015	medium	0	0.585	0.212	no
4.6	11.07.2015	medium	-0.08	0.129	0.280	no
5.7	25.07.2015	medium	0.03	0.089	0.660	no
10.5	15.07.2015	large	0.14	0.074	0.001	no
13.3	08.07.2015	large	0.04	**0.002**	0.144	no
20.1	28.07.2015	large	0.17	**0.040**	**0.001**	no
23.0	24.06.2015	large	0.11	0.334	**0.037**	no
35.2	20.07.2015	large	0.14	0.890	0.239	no
5.3	28.06.2016	medium	-0.04	**0.018**	**0.033**	no
13.7	21.06.2016	large	0.04	0.473	0.151	no
16.9	06.06.2016	large	0.03	0.422	0.114	no
19.6	02.08.2016	large	0	0.177	0.387	no
19.8	04.07.2016	large	0.03	**0.01**	0.220	no
20.8	25.05.2016	large	0.08	0.557	0.334	no
23.2	16.06.2016	large	0.02	0.344	0.019	no
24.1	14.07.2016	large	0.01	**0.012**	0.061	no
25.0	31.05.2016	large	0	0.068	0.477	no
33.5	25.07.2016	large	0.02	**0.045**	0.768	no
Canopy density			0.20	0.687	0.454	no

Table S3 / S2: Variogram model parameters for method-of-moments (MoM) variogram estimation (Step 2) for throughfall and canopy density (as indicated). Listed are for the precipitation events the collection **Date**, the **even size** class, the lower ($\boldsymbol{\theta_{low}}$) and upper bound ($\boldsymbol{\theta_{up}}$) of the confidence interval of the normalized kringing error (see Methods), the kriging errors obtained with different variogram estimators evaluated (Matheron: $\boldsymbol{\theta_{Matheron}}$; Genton: θ_{Genton}; Cressie: $\theta_{Cressie}$ and Dowd: θ_{Dowd}), the estimator chosen for step 3 and 4, as well as its shape parameters **Nugget**, **Sill**, **Partial sill**, used as intial parameters in step 4, the **effective range** in units of meters, and the underlying **Variogram model** type.

Date	Event size	θ_{low}	θ_{up}	$\theta_{Matheron}$	θ_{Genton}	$\theta_{Cressie}$	θ_{Dowd}	Estimator chosen	Nugget	Sill	Partial sill	Effective Range (m)	Variogram model
Throughfall													
21.07.2015	small	0.343	0.567	0.384	0.402	0.473	0.62	Cressie	0.009	0.099	0.09	9.2	exp
20.06.2015	small	0.343	0.567	0.474	0.706	0.644	0.411	Matheron	0.013	0.448	0.162	10.2	exp
30.05.2015	small	0.343	0.567	0.327	0.417	0.341	0.416	Genton	0.018	0.258	0.24	7.7	exp
18.06.2015	medium	0.343	0.567	0.337	0.401	0.432	0.48	Cressie	0.033	0.569	0.46	5.5	sph
13.07.2015	medium	0.340	0.57	0.42	0.517	0.498	0.42	Matheron	0.014	0.344	0.33	6.5	exp
02.06.2015	medium	0.343	0.566	0.352	0.382	0.437	0.406	Cressie	0.015	0.575	0.56	9.1	sph
13.05.2015	medium	0.342	0.568	0.397	0.501	0.497	0.521	Matheron	0.05	0.509	0.459	8.0	sph
11.07.2015	medium	0.343	0.567	0.51	0.571	0.512	0.475	Dowd	0.025	0.305	0.28	8.3	sph
25.07.2015	medium	0.343	0.567	0.382	0.477	0.482	0.534	Cressie	0.049	0.639	0.59	4.7	sph
15.07.2015	large	0.340	0.57	0.303	0.412	0.394	0.472	Dowd	0.09	3.19	3.1	4.1	sph
08.07.2015	large	0.342	0.568	0.352	0.367	0.372	0.404	Dowd	0.17	1.44	1.27	2.8	sph
28.07.2015	large	0.343	0.567	0.391	0.562	0.528	0.596	Matheron	0.324	11.054	10.73	4.4	exp
24.06.2015	large	0.343	0.567	0.319	0.375	0.408	0.432	Dowd	0.19	11.63	11.44	4.9	exp
20.07.2015	large	0.343	0.567	0.326	0.442	0.428	0.438	Genton	0.67	6.88	6.21	1.5	exp
28.06.2016	medium	0.342	0.568	0.407	0.512	0.521	0.507	Matheron	0.005	1.005	1	6.5	exp
21.06.2016	large	0.343	0.567	0.326	0.409	0.394	0.377	Genton	0.76	3.34	2.58	11.6	exp
06.06.2016	large	0.338	0.572	0.303	0.504	0.458	0.481	Cressie	0.3	4.9	4.6	2.6	sph
02.08.2016	large	0.341	0.569	0.115	0.446	0.318	0.396	Genton	0.21	6.51	6.3	4.8	sph
04.07.2016	large	0.343	0.567	0.449	0.505	0.507	0.499	Matheron	1.25	6.19	4.94	10.9	exp
25.05.2016	large	0.343	0.567	0.355	0.439	0.423	0.472	Genton	0.49	6.5	6.01	5.8	exp
16.06.2016	large	0.343	0.567	0.317	0.386	0.36	0.531	Genton	0.39	7.8	7.41	6.4	exp
14.07.2016	large	0.340	0.569	0.394	0.466	0.431	0.426	Genton	0.63	8.63	8	4.1	sph
31.05.2016	large	0.343	0.567	0.473	0.478	0.536	0.477	Matheron	1.28	10.41	9.13	4.1	exp

Date	Event size	θ_{low}	θ_{up}	$\theta_{Matheron}$	θ_{Genton}	$\theta_{Cressie}$	θ_{Dowd}	Estimator chosen	Nugget	Sill	Partial sill	Effective Range (m)	Variogram model
25.07.2016	large	0.342	0.568	0.282	0.351	0.355	0.475	Dowd	0.342	0.568	0.282	0.4	sph
Canopy density		0.343	0.567	0.325	0.559	0.533	0.346	Cressie	0.00003	3.19	3.19	3.37	exp

exp= Exponential, sph= spherical, nug= pure.nugget, for exponential model range *3

Table S4 / S3: Variogram model parameters for residual maximum likelihood (REML) variogram estimation (Step 3 and 4) for throughfall and canopy density (as indicated)

Date	Event size	θ_{REML}	Nugget	Sill	Partial sill	Nugget/Sill (%)	Effective range (m)
Throughfall							
21.07.2015	small	0.428	0.009	0.097	0.088	0.09	9.6
20.06.2015	small	0.384	0.0013	0.018	0.017	0.03	9.8
30.05.2015	small	0.418	0.014	0.254	0.240	5.83	9.2
18.06.2015	medium	0.383	0.029	0.469	0.440	0.06	5.8
13.07.2015	medium	0.294	0.015	0.365	0.350	0.04	8.6
02.06.2015	medium	0.446	0.017	0.477	0.460	3.70	8.0
13.05.2015	medium	0.439	0.037	0.468	0.431	8.58	7.6
11.07.2015	medium	0.447	0.019	0.339	0.320	0.06	8.9
25.07.2015	medium	0.442	0.049	0.669	0.620	0.07	4.6
15.07.2015	large	0.222	0.130	3.66	3.53	0.04	5.9
08.07.2015	large	0.402	0.140	1.74	1.60	0.08	4.8
28.07.2015	large	0.415	0.507	11.42	10.91	0.04	7.5
24.06.2015	large	0.391	0.320	12.88	12.56	0.02	7.0
20.07.2015	large	0.414	0.700	7.40	6.70	10.5	5.9
28.06.2016	medium	0.425	0.017	0.877	0.86	1.98	7.8
21.06.2016	large	0.357	0.57	3.4	2.83	20.14	8.9
06.06.2016	large	0.384	0.37	5.27	4.9	7.55	3.0
02.08.2016	large	0.322	0.286	6.016	5.73	4.99	5.7
04.07.2016	large	0.472	0.7	5.76	5.06	13.83	9.5
25.05.2016	large	0.439	0.54	6.21	5.67	9.52	6.5
16.06.2016	large	0.392	0.261	8.031	7.77	3.36	7.3
14.07.2016	large	0.598	0.69	10.49	9.8	7.04	5.0
31.05.2016	large	0.471	1.07	9.93	8.86	12.08	4.6
25.07.2016	large	0.434	0.16	24.41	24.25	0.66	3.5
Canopy density		0.414	0.032	3.41	3.28	0.01	7.5

Table S5: Factors driving spatial patterns of throughfall. Statistical results for the best linear mixed effects model for the for small, medium and large events (as indicated). Significant effects in bold.

	small		**medium**		**large**	
R^2 model	0.444		0.412		0.429	
R^2 fixed	0.062		0.045		0.043	
R^2 random	0.382		0.367		0.386	
Parameter	t-value	p-value	t-value	p-value	t-value	p-value
Median event throughfall, $\hat{P}_{TF}$	-1.2	0.320	0.3	0.760	0.8	0.449
Tree distance, d_{tree}	-0.3	0.749	-0.1	0.923	1.4	0.166
Number trees	-	-	-	-	-	-
Canopy density	-5.0	**<0.001**	-3.6	**<0.001**	-4.2	**<0.001**
Interactions						
$\hat{P}_{TF}$ x $d_{tree,i}$	-	-	-	-	-	-
$\hat{P}_{TF}$ x number trees	-	-	-	-	-	-
$\hat{P}_{TF}$ x number canopy layers	-1.9	*0.055*	5.4	**<0.001**	5.1	**<0.001**
$d_{tree,i}$ x number trees	-	-	-	-	-	-
$d_{tree,i}$ x number canopy layers	2.1	**0.037**	3.3	**0.001**	2.4	**0.017**
Number trees x canopy density	-	-	-	-	-	-

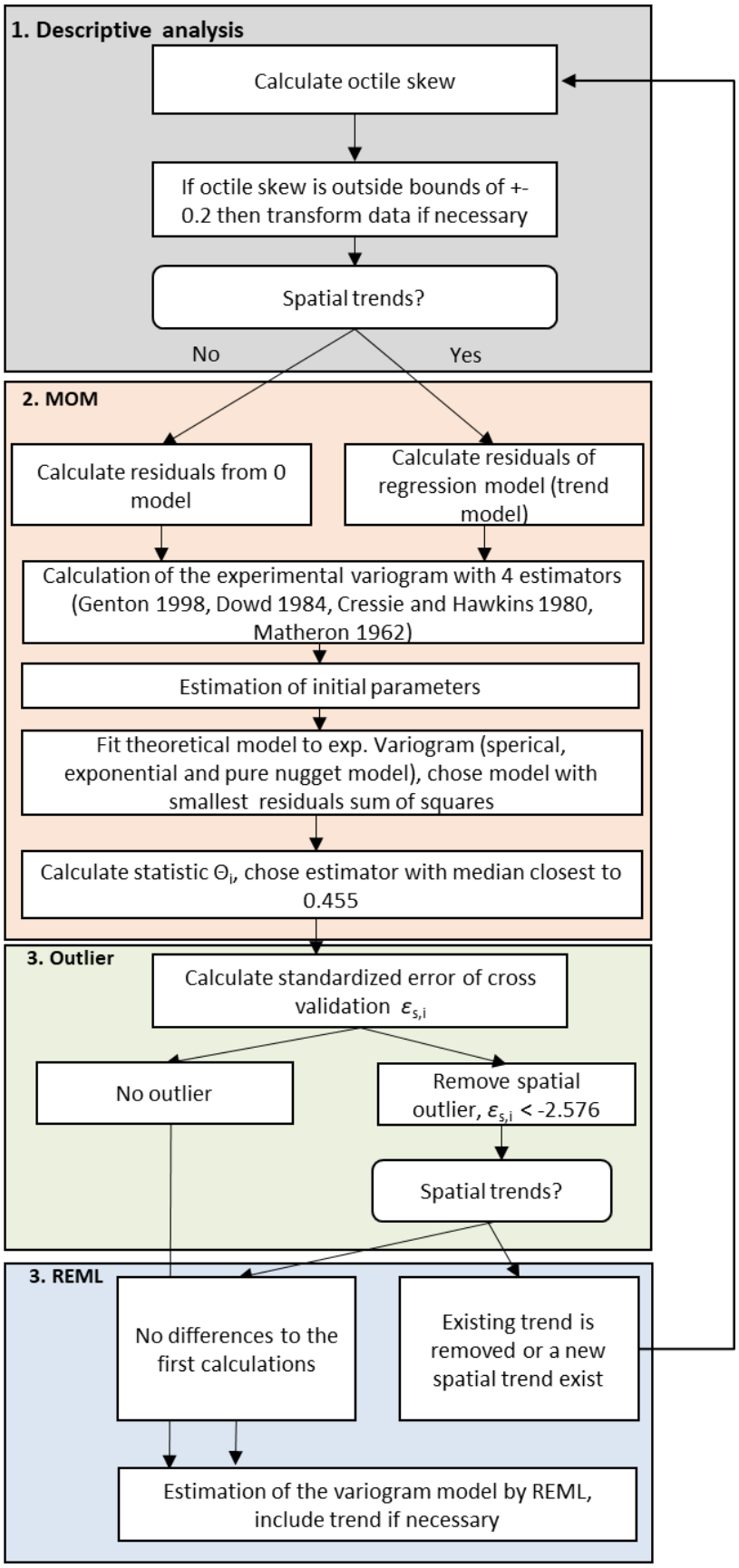

Fig. S1: Workflow for involved steps estimating the variogram parameters for throughfall, soil moisture and soil properties

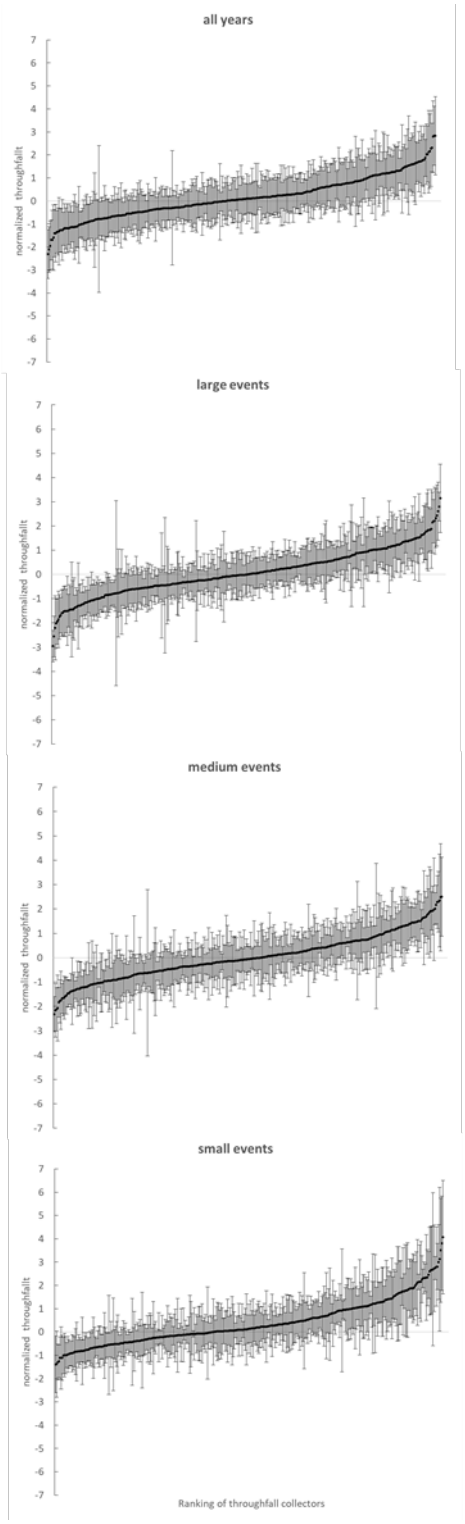

Fig. S2: Time stability plots for throughfall (δP_{TF}) separately for all, small, medium and large event sizes. Error bars indicate one standard deviation.

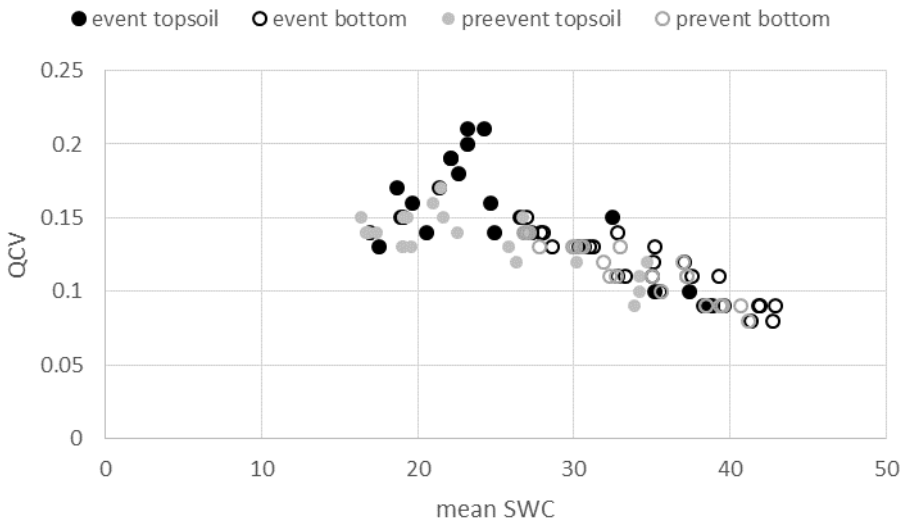

Fig. S3: Change of the spatial variation (expressed as coefficient of quartile variation) of soil water content with the spatial average soil water content for pre-event (drained) and post event (just recharged) soil water conditions.