Figure S1: Picture, illustrating the differences in peat colour for the different plots and sub-plots. Lower row, trays 1-4: plot 12, trays 5-8: plot 13. Top row, trays 1-4: plot 19, trays 5-8: plot 22

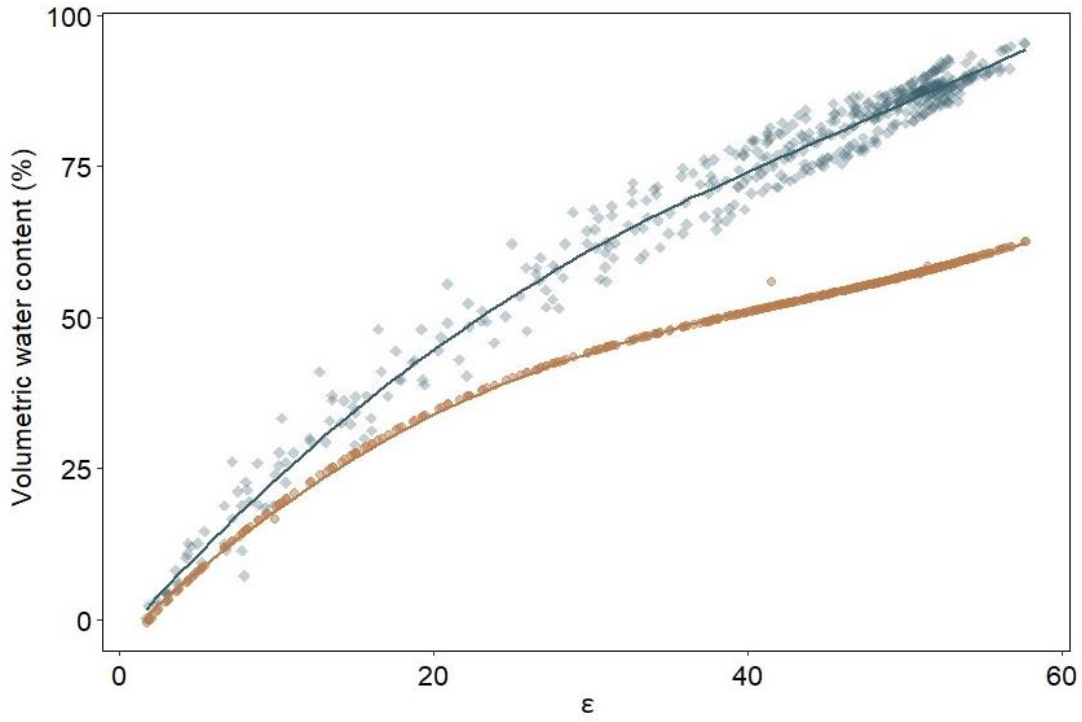

Figure S2: Difference between measured (brown) and corrected (blue) water contents in dependence to ε (K) across plots

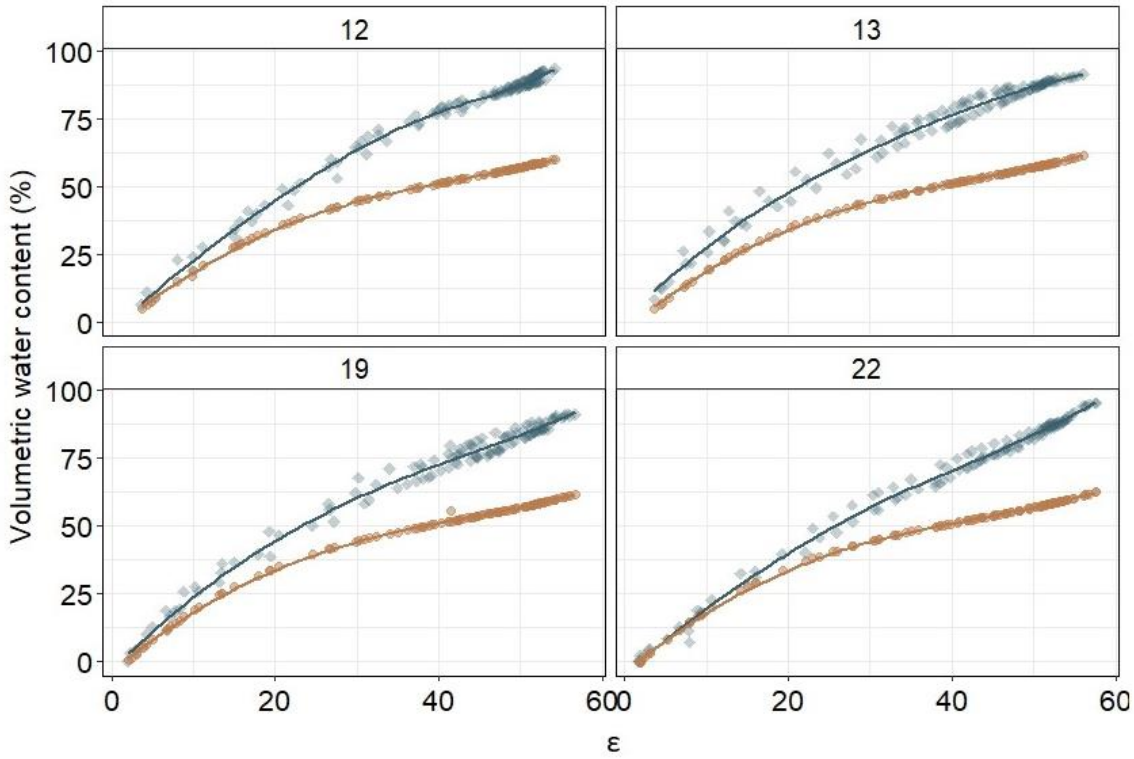

Figure S3: Difference between measured (brown) and corrected (blue) water contents in dependence to ε (K) for each plot

Table S1: Outcomes regarding the modelled contents of organic carbon derived by the generalized additive models (GAM) as described in Table 1 for all plots and subplots as indicated by annual number of cuts. OC (%) in green indicates actual measured values. Standard error (n = between 29 and 31) is given in brackets

Plot	OC (%)	WK	WKV	WKD	WKS	WKC	WKCV	WKvP	WKBD
12	44.6 (±0.2)	31.1 (±0.5)	46.1 (±0.9)	41.3 (±0.7)	46.1 (±0.9)	45.1 (±0.5)	45.1 (±0.5)	45.1 (±0.5)	34.8 (±0.8)
13	26.5 (±0.2)	31.1 (±0.3)	28.6 (±0.7)	26.5 (±0.5)	28.6 (±0.7)	25.8 (±0.3)	25.8 (±0.3)	25.8 (±0.3)	27.7 (±0.6)
19	23.3 (±0.1)	31.3 (±0.3)	29.9 (±0.8)	34.0 (±0.6)	29.9 (±0.8)	26.3 (±0.4)	26.3 (±0.4)	26.3 (±0.4)	29.1 (±0.7)
22	36.9 (±0.4)	31.3 (±0.4)	29.8 (±0.7)	30.5 (±0.6)	29.8 (±0.7)	37.8 (±0.4)	37.8 (±0.4)	37.8 (±0.4)	35.2 (±0.9)

Table S2: Outcomes regarding the modelled contents of organic carbon derived by the generalized additive models (GAM) as described in Table 2 for all plots and subplots as indicated by annual number of cuts. OC (%) in green indicates actual measured values. Standard error (n = 32) is given in brackets.

Plot	OC (%)	WKI	WKVI	WKDI	WKSI	WKCI	WKCVI	WKvPI	WKBDI
12	44.6 (±0.2)	38.2 (±0.4)	44.7 (±0.2)	42.6 (±0.2)	44.7 (±0.2)	44.7 (<0.1)	44.7 (±0.2)	44.7 (<0.1)	40.3 (±0.3)
13	26.5 (±0.2)	31.3 (±0.3)	27.4 (±0.1)	26.8 (±0.2)	27.4 (±0.1)	25.6 (<0.1)	27.4 (±0.1)	25.6 (<0.1)	27.9 (±0.3)
19	23.3 (±0.1)	29.3 (±0.3)	28.3 (±0.2)	30.7 (±0.3)	28.3 (±0.2)	25.1 (<0.1)	28.3 (±0.2)	25.1 (<0.1)	27.8 (±0.5)
22	36.9 (±0.4)	33.3 (±0.4)	31.8 (±0.3)	32.1 (±0.3)	31.8 (±0.3)	36.8 (±0.1)	31.8 (±0.3)	36.8 (±0.1)	36.2 (±0.5)

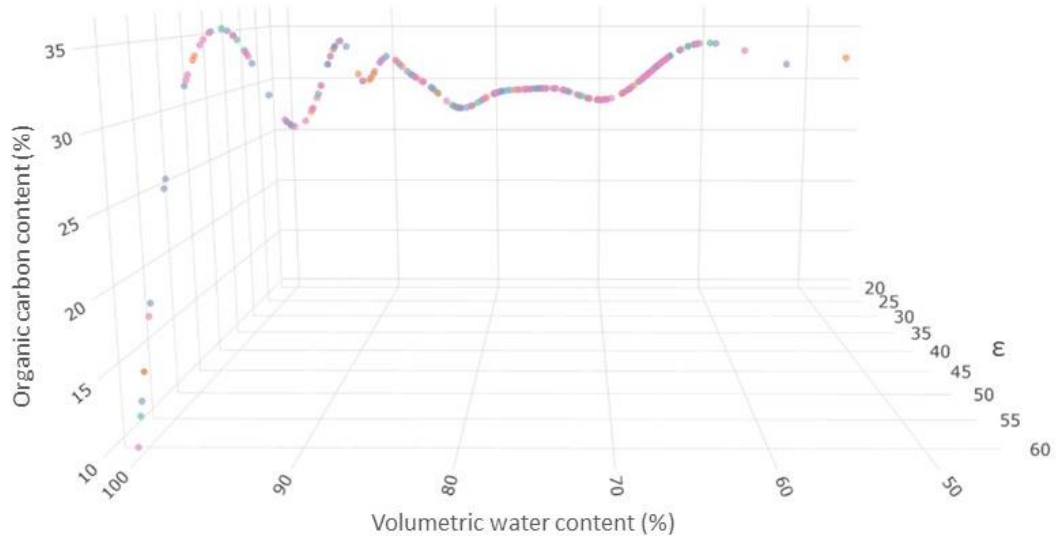

Figure S4: Available online as interactive html version under: https://github.com/ClaudiNielsen/Supplementary-material-TDR-paper/blob/main/3dplot%20Vejr%20WK.html

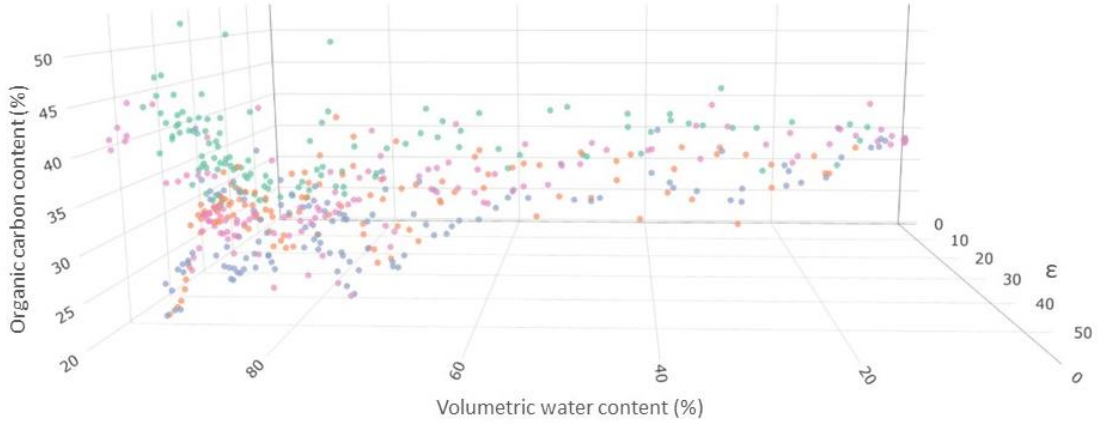

Figure S5: Available online as interactive html version under: https://github.com/ClaudiNielsen/Supplementary-material-TDR-paper/blob/main/3dplot%20IMP%20WKI.html

All 3D interactive models are available online under the github repository:

https://github.com/ClaudiNielsen/Supplementary-material-TDR-paper

Figures 4a and 3b are explicitly found under:

4a: https://github.com/ClaudiNielsen/Supplementary-material-TDR-paper/blob/main/3dplot%20Vejr%20WKvP.html

4b: https://github.com/ClaudiNielsen/Supplementary-material-TDR-paper/blob/main/3dplot%20IMP%20WKvPI.html

By downloading the html content – the plots can be moved and viewed in any html viewer by copy & paste the code.

Table S3: Extended table showing the general additive models (GAM) used for modelling of organic carbon (OC) by TDR measurements (continuous variables) and peat substrate bioindices (categorical variables), showing the code formula applied in the statistical platform R in the mgcv package.

Model name	**Continuous variables included (Smooth terms, f_1)**	**Categorical variables included (Parametric coefficients, $\beta_{1,2}$)**	**Model formula (R code)**
WK	θ_{cor} (W), ε (K)	-	OC ~ ti(W, K, k = 10) + 0
WKV	θ_{cor} (W), ε (K)	Vegetation (V)	OC ~ ti(W, K, k = 10) + Veg + 0
WKD	θ_{cor} (W), ε (K)	Distance to river and ditch (D)	OC ~ ti(W, K, k = 10) + Distance2 + Distance + 0
WKS	θ_{cor} (W), ε (K)	Silt content (S)	OC ~ ti(W, K, k = 10) + Silt + 0
WKC	θ_{cor} (W), ε (K)	Peat colour (C)	OC ~ ti(W, K, k = 10) + Colour + 0
WKCV	θ_{cor} (W), ε (K)	Peat colour + Vegetation (CV)	OC ~ ti(W, K, k = 10) + Colour + Veg + 0
WKvP	θ_{cor} (W), ε (K)	Von Post scale of humification (vP)	OC ~ ti(W, K, k = 10) + vP + 0
WKBD	θ_{cor} (W), ε (K)	Bulk density (BD)	OC ~ ti(W, K, k = 10) + BD + 0
WKI	θ_{cor} (W), ε (K), Z (I)	-	OC ~ ti(W, K, IMP, k = 5) + 0
WKVI	θ_{cor} (W), ε (K), Z (I)	Vegetation (V)	OC ~ ti(W, K, IMP, k = 5) + Veg + 0
WKDI	θ_{cor} (W), ε (K), Z (I)	Distance to river and ditch (D)	OC ~ ti(W, K, IMP, k = 5) + Distance2 + Distance + 0
WKSI	θ_{cor} (W), ε (K), Z (I)	Silt content (S)	OC ~ ti(W, K, IMP, k = 5) + Silt + 0
WKCI	θ_{cor} (W), ε (K), Z (I)	Peat colour (C)	OC ~ ti(W, K, IMP, k = 5) + Colour + 0
WKCVI	θ_{cor} (W), ε (K), Z (I)	Peat colour + Vegetation (CV)	OC ~ ti(W, K, IMP, k = 5) + Colour + Veg + 0
WKvPI	θ_{cor} (W), ε (K), Z (I)	Von Post scale of humification (vP)	OC ~ ti(W, K, IMP, k = 5) + vP + 0
WKBDI	θ_{cor} (W), ε (K), Z (I)	Bulk density (BD)	OC ~ ti(W, K, IMP, k = 5) + BD + 0

Following, the graphical model outputs are presented, where K is the dielectric permittivity, Wat_cal2 is the by TDR measured and by the polynomial regression corrected volumetric water content. The seven figures represent the generalized additive model (GAM) outputs for the models without impedance (IMP). Due to three continuous variables in the GAMs including IMP, no such figures can be printed. Figure captions give the model abbreviation, which details can be found in Table S3 and Table 2.

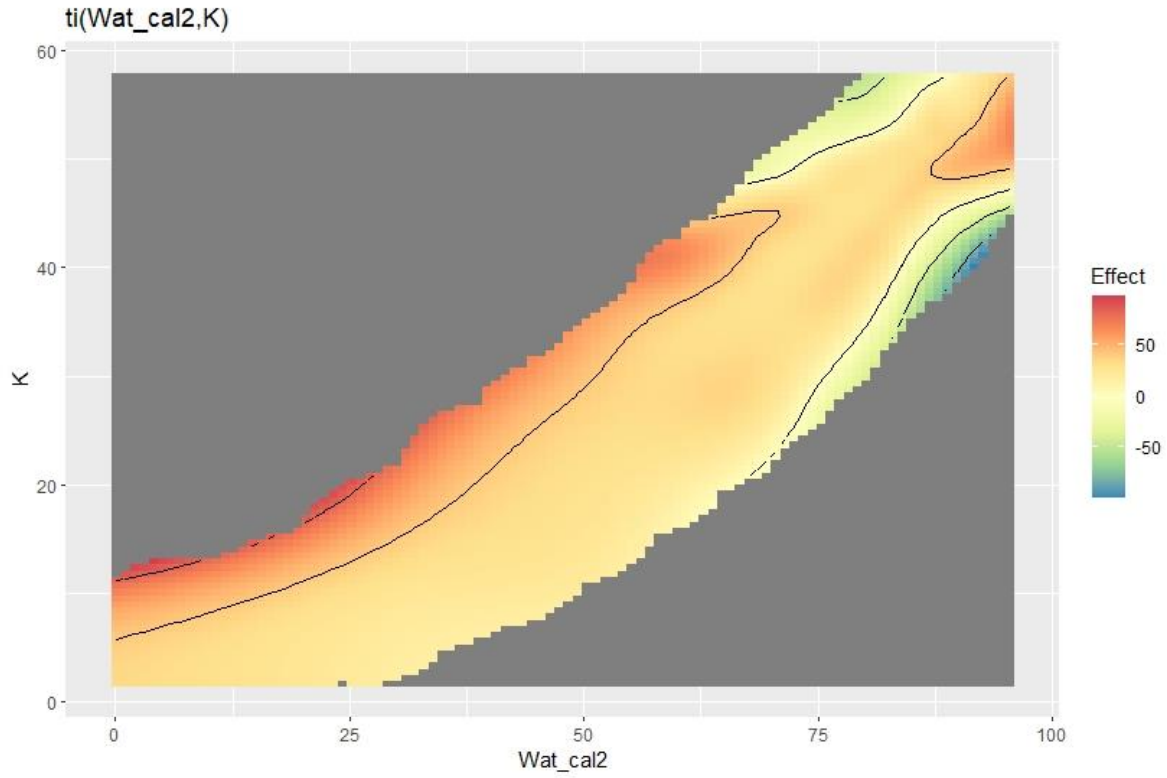

Figure S6: Model WK

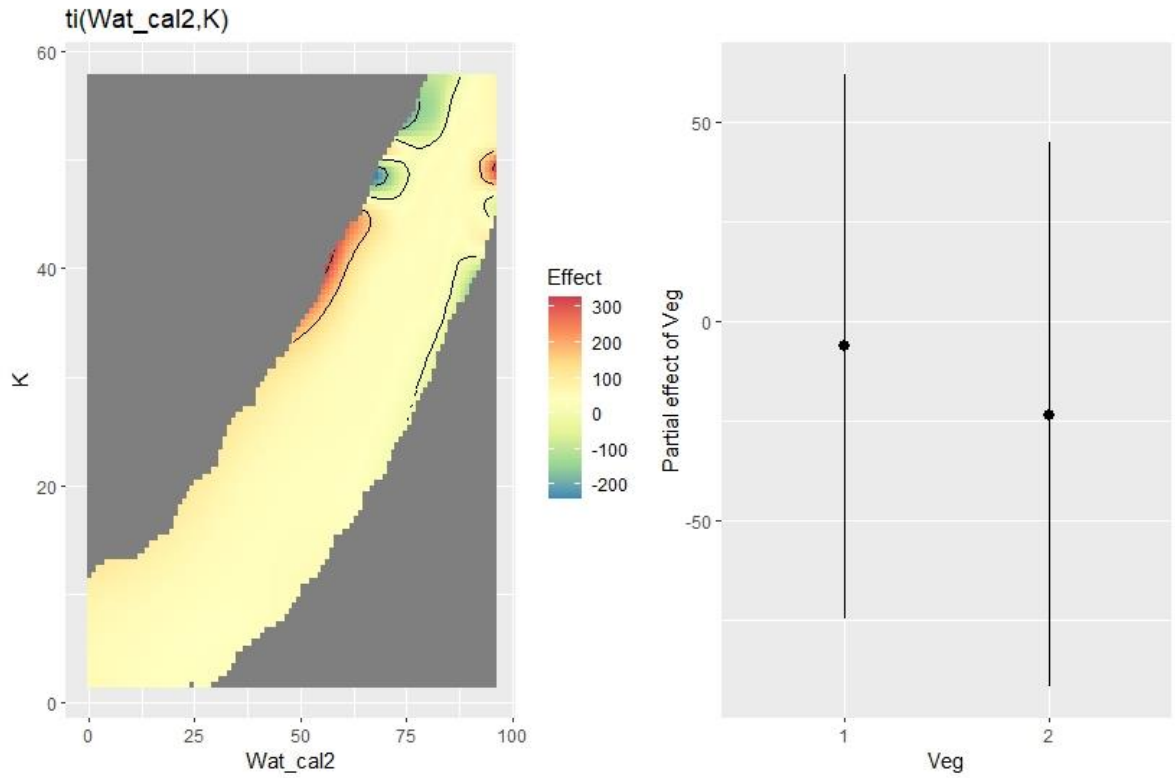

Figure S7: Model WKV

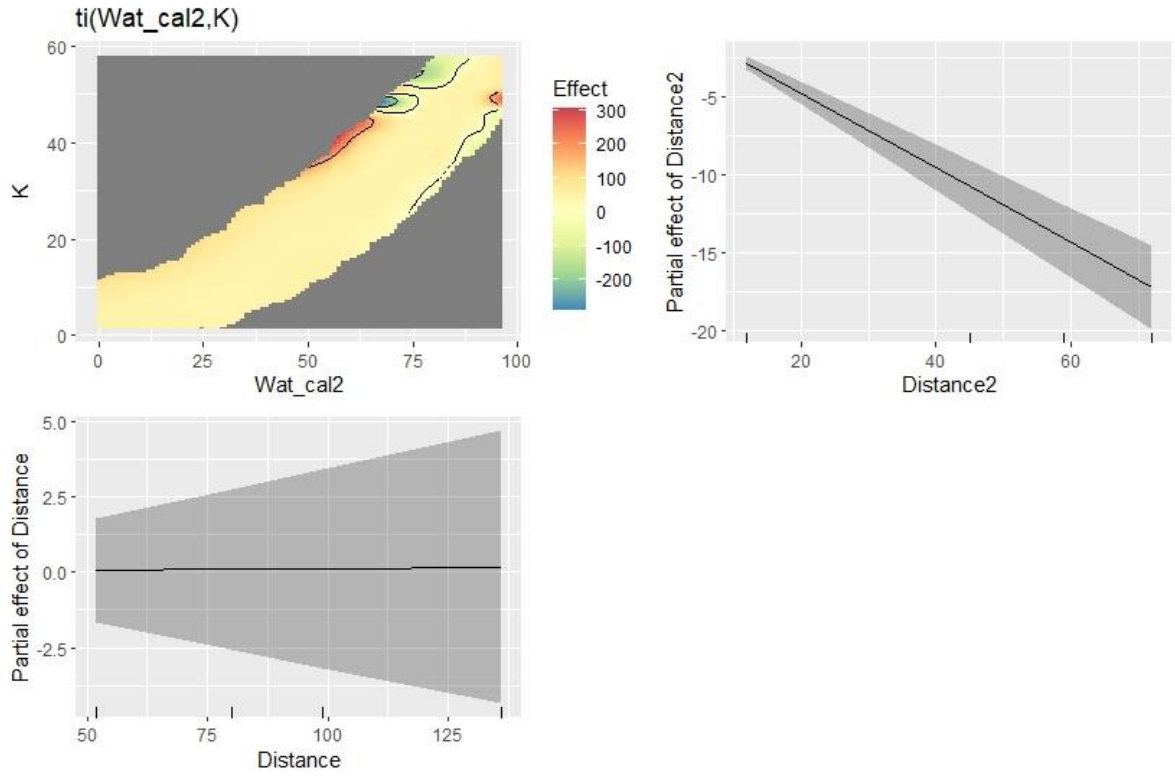

Figure S8: Model WKD

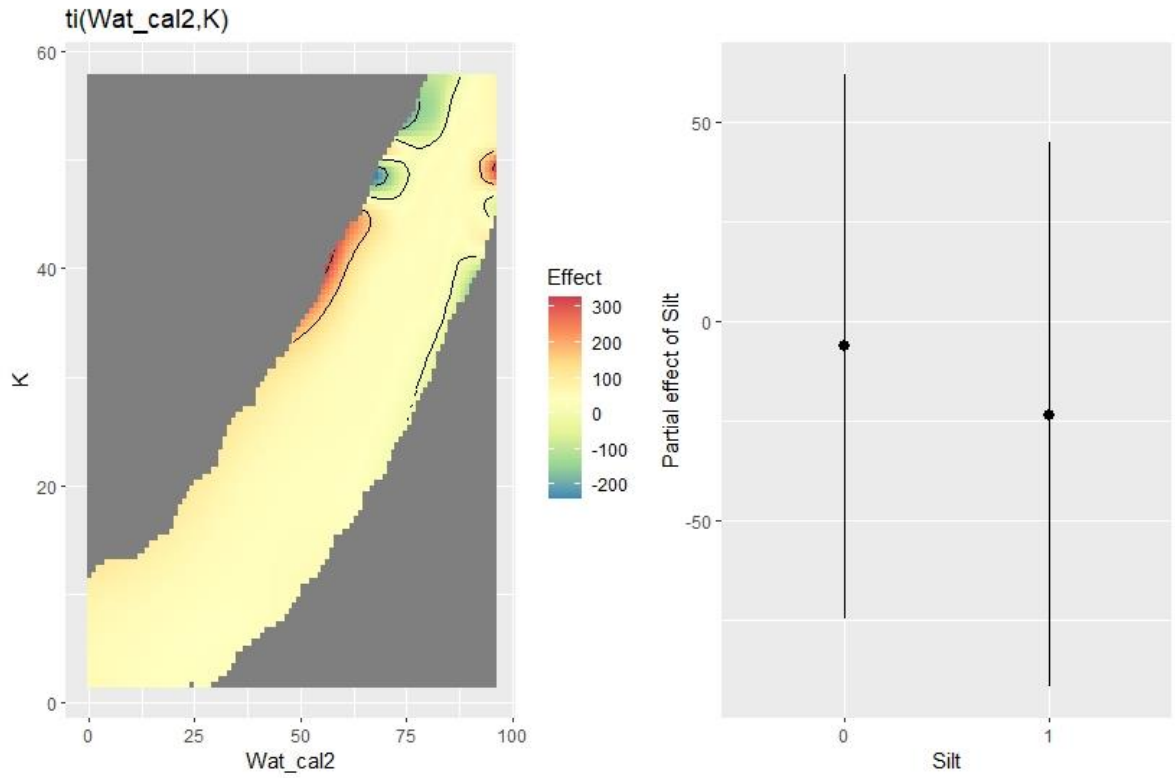

Figure S9: Model WKS

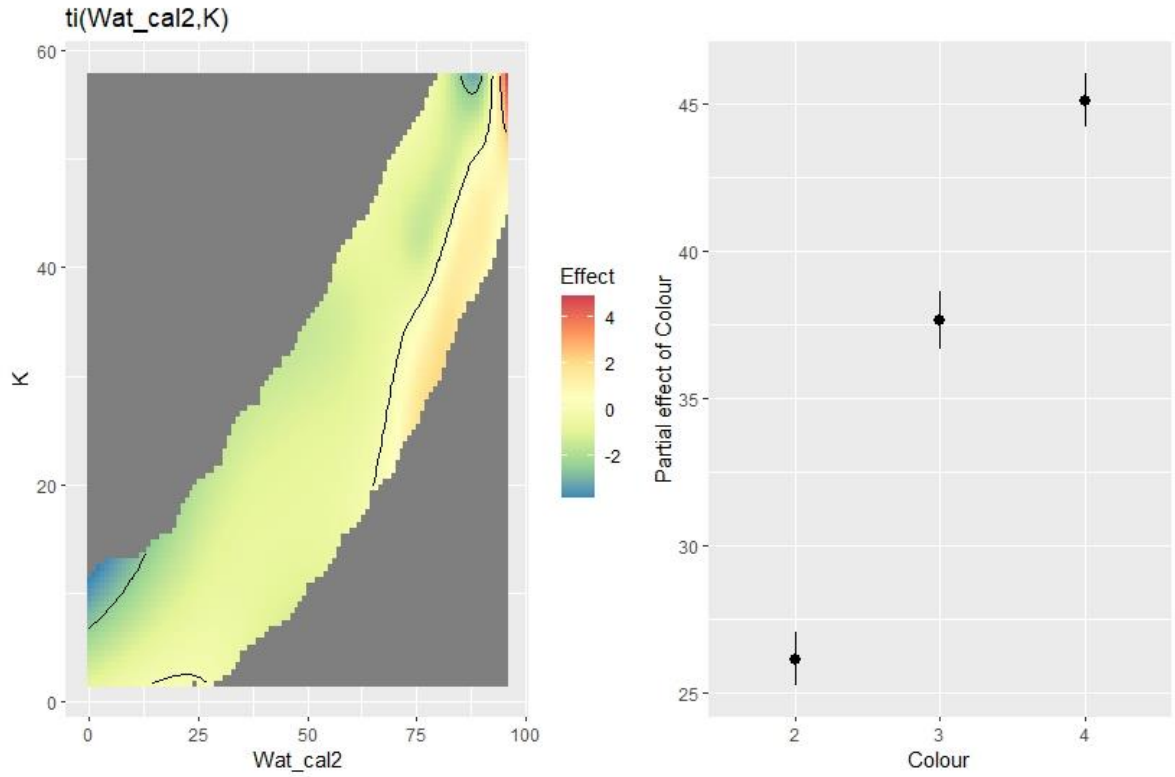

Figure S10: Model WKC

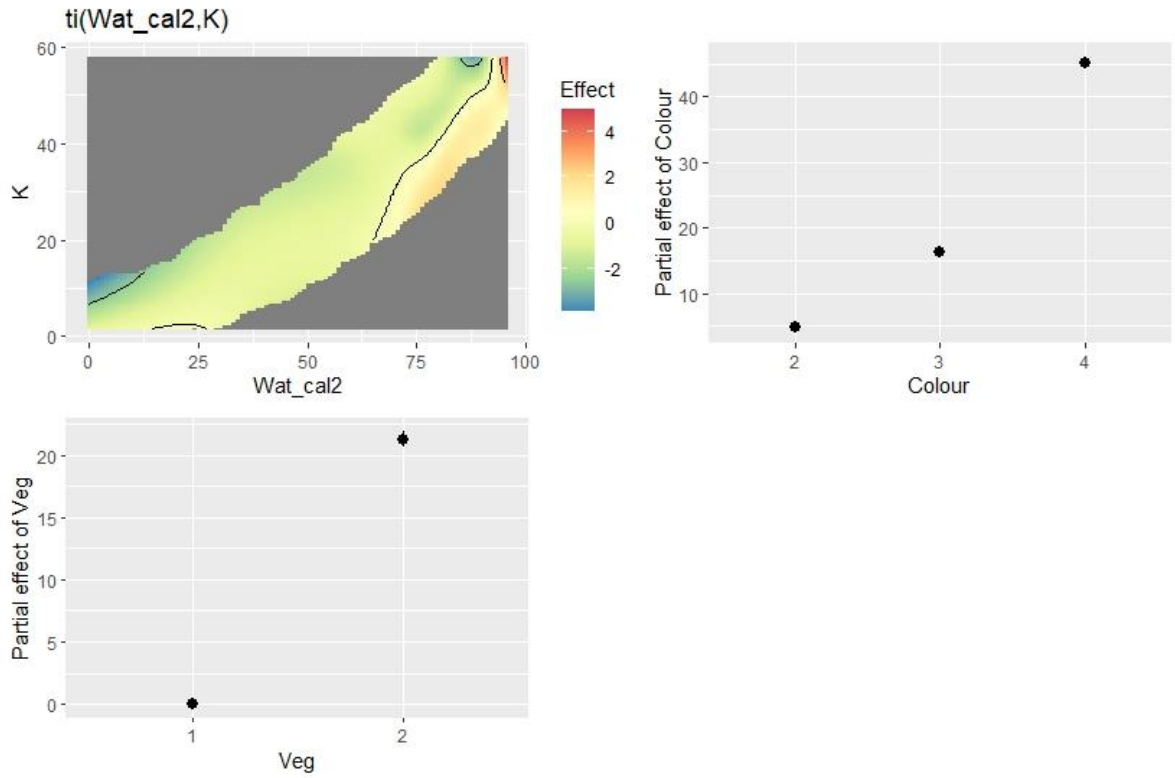

Figure S11: Model WKCV

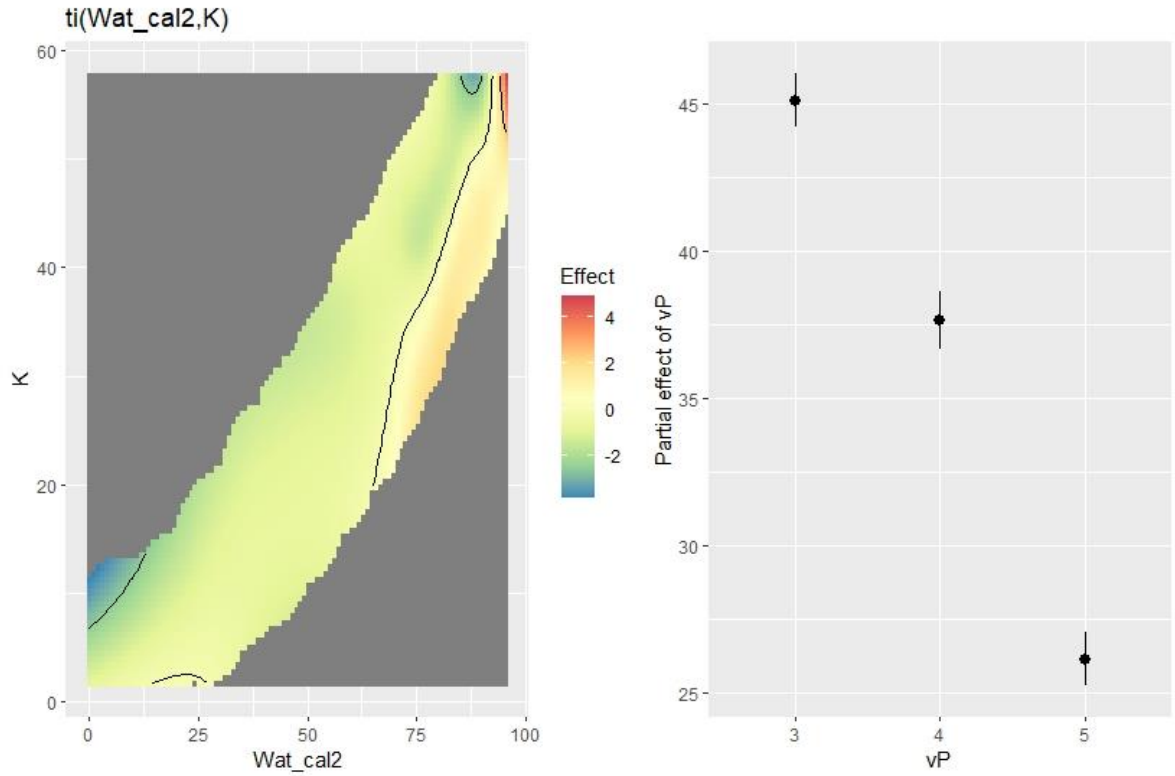

Figure S12: Model WKvP

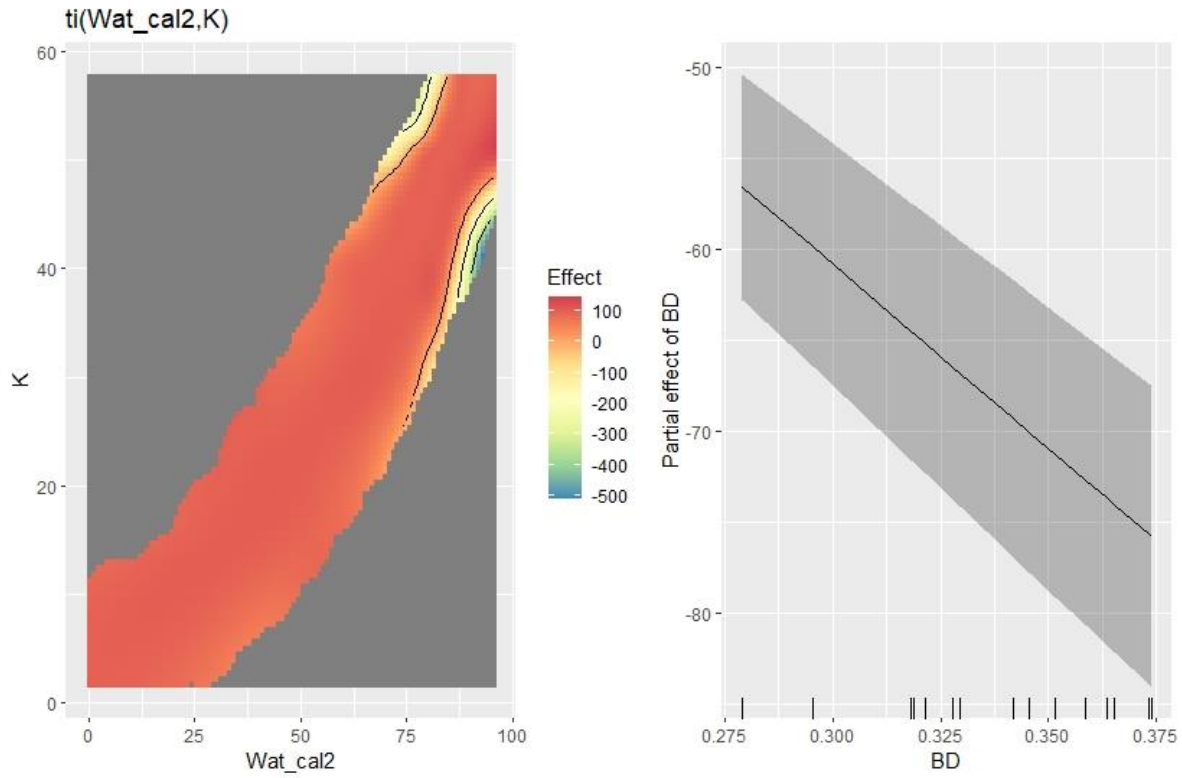

Figure S13: Model WKBD