

A Hydrological Concept including Lateral Water Flow Compatible with the Biogeochemical Model ForSAFE

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Model Availability

The model developed in this study in the visual environment Stella is available upon request.

Soil Data

In the model the transect is represented a series of soil columns (Table S1). Each soil column has a certain length and it represents the soil type within a section in the transect (e.g. C3 from 5 to 15 m from the stream). The soil texture classes are expressed as fraction of the total soil, including organic matter (OM) but excluding the coarse fraction (Gravel, fraction of total soil volume). Due to lack of data, a constant coarse fraction is assumed for all the soil columns, based on some observations along the transect. The last two columns (C6 and C7) have a different length according to the selected position of the water divide. The length ranges between 20 and 50 m when the water divide ranges between 80 and 140 m from the stream, respectively. Gray cells indicate the soil layers where measurement were available and the type of texture data collected. Where data were not available, the texture was assumed equal to the neighboring layer or column.

Texture data were used to calculate the hydraulic properties of the soil (Table S2).

Table S1. Description of the soil columns in the S-Transect model.

Column	Column Length (m)	Horizon	Depth (cm)	Clay	Silt	Sand	OM	Gravel
C1	1	1	10	0.00	0.04	0.06	0.90	0.05
C1	1	2	20	0.00	0.06	0.09	0.85	0.05
C1	1	3	40	0.00	0.15	0.25	0.60	0.05
C1	1	4	60	0.01	0.30	0.50	0.20	0.05
C1	1	5	80	0.01	0.18	0.56	0.10	0.05
C1	1	6	100	0.01	0.35	0.59	0.05	0.05
C1	1	7	150	0.01	0.37	0.61	0.01	0.05
C2	4	1	10	0.00	0.06	0.11	0.83	0.05
C2	4	2	20	0.00	0.12	0.20	0.68	0.05
C2	4	3	40	0.00	0.18	0.30	0.52	0.05
C2	4	4	60	0.01	0.34	0.57	0.08	0.05
C2	4	5	80	0.01	0.37	0.61	0.01	0.05
C2	4	6	100	0.01	0.37	0.61	0.01	0.05
C2	4	7	150	0.01	0.37	0.61	0.01	0.05
C3	10	1	10	0.03	0.19	0.67	0.11	0.05
C3	10	2	20	0.02	0.22	0.73	0.03	0.05
C3	10	3	40	0.02	0.31	0.63	0.04	0.05
C3	10	4	60	0.02	0.30	0.66	0.02	0.05
C3	10	5	80	0.01	0.19	0.79	0.01	0.05
C3	10	6	100	0.01	0.19	0.79	0.01	0.05
C3	10	7	150	0.01	0.19	0.79	0.01	0.05
C4	10	1	10	0.01	0.10	0.88	0.01	0.05
C4	10	2	20	0.03	0.10	0.85	0.02	0.05

C4	10	3	40	0.01	0.04	0.94	0.01	0.05
C4	10	4	60	0.01	0.01	0.97	0.01	0.05
C4	10	5	80	0.01	0.01	0.97	0.01	0.05
C4	10	6	100	0.01	0.01	0.97	0.01	0.05
C4	10	7	150	0.01	0.01	0.97	0.01	0.05
C5	15	1	10	0.02	0.12	0.85	0.01	0.05
C5	15	2	20	0.01	0.13	0.85	0.01	0.05
C5	15	3	40	0.02	0.01	0.96	0.01	0.05
C5	15	4	60	0.01	0.03	0.95	0.01	0.05
C5	15	5	80	0.01	0.25	0.73	0.01	0.05
C5	15	6	100	0.01	0.29	0.69	0.01	0.05
C5	15	7	150	0.01	0.29	0.69	0.01	0.05
C6	20–50	1	10	0.03	0.19	0.73	0.05	0.05
C6	20–50	2	20	0.03	0.19	0.73	0.05	0.05
C6	20–50	3	40	0.03	0.06	0.87	0.04	0.05
C6	20–50	4	60	0.01	0.11	0.87	0.01	0.05
C6	20–50	5	80	0.01	0.21	0.77	0.01	0.05
C6	20–50	6	100	0.01	0.24	0.74	0.01	0.05
C6	20–50	7	150	0.01	0.24	0.74	0.01	0.05
C7	20–50	1	10	0.03	0.17	0.78	0.02	0.05
C7	20–50	2	20	0.04	0.12	0.81	0.03	0.05
C7	20–50	3	40	0.03	0.12	0.82	0.03	0.05
C7	20–50	4	60	0.02	0.30	0.66	0.02	0.05
C7	20–50	5	80	0.01	0.27	0.71	0.01	0.05
C7	20–50	6	100	0.01	0.27	0.72	0.00	0.05
C7	20–50	7	150	0.01	0.27	0.72	0.00	0.05

Table S2. Calculated soil hydraulic properties for the modelled soil columns of the S-transect.

Column	Horizon	Dp (kg/dm ³)	Db (kg/dm ³)	Por	FC	WP	Ksat (m/d)
C1	1	1.75	0.18	0.90	0.58	0.07	0.46
C1	2	1.80	0.18	0.90	0.58	0.07	0.63
C1	3	2.05	0.27	0.87	0.56	0.06	2.60
C1	4	2.45	0.69	0.72	0.48	0.08	8.34
C1	5	2.55	1.05	0.59	0.37	0.06	4.29
C1	6	2.60	1.38	0.47	0.27	0.04	1.46
C1	7	2.64	1.79	0.32	0.15	0.03	0.18
C2	1	1.82	0.19	0.90	0.58	0.07	0.74
C2	2	1.97	0.23	0.88	0.57	0.07	1.73
C2	3	2.13	0.31	0.86	0.55	0.06	3.83
C2	4	2.57	1.10	0.57	0.35	0.06	4.10
C2	5	2.64	1.68	0.36	0.17	0.04	0.37
C2	6	2.64	1.73	0.34	0.16	0.03	0.26
C2	7	2.64	1.79	0.32	0.15	0.03	0.18
C3	1	2.54	0.74	0.71	0.46	0.10	22.96
C3	2	2.62	1.17	0.55	0.31	0.07	8.27
C3	3	2.61	1.23	0.53	0.31	0.06	3.70
C3	4	2.63	1.50	0.43	0.22	0.05	1.27
C3	5	2.64	1.68	0.36	0.16	0.03	0.93
C3	6	2.64	1.73	0.34	0.14	0.03	0.65
C3	7	2.64	1.79	0.32	0.13	0.03	0.45
C4	1	2.64	1.19	0.55	0.28	0.06	18.14
C4	2	2.63	1.24	0.53	0.28	0.07	11.76

C4	3	2.64	1.46	0.45	0.20	0.04	6.90
C4	4	2.64	1.59	0.40	0.17	0.03	3.88
C4	5	2.64	1.68	0.36	0.15	0.03	2.31
C4	6	2.64	1.73	0.34	0.13	0.03	1.61
C4	7	2.64	1.79	0.32	0.12	0.02	1.11
C5	1	2.64	1.19	0.55	0.29	0.07	15.54
C5	2	2.64	1.31	0.50	0.25	0.05	8.90
C5	3	2.64	1.46	0.45	0.21	0.05	7.51
C5	4	2.64	1.59	0.40	0.17	0.03	3.51
C5	5	2.64	1.68	0.36	0.16	0.03	0.68
C5	6	2.64	1.73	0.34	0.15	0.03	0.39
C5	7	2.64	1.79	0.32	0.14	0.03	0.27
C6	1	2.60	0.96	0.63	0.38	0.09	17.84
C6	2	2.60	1.06	0.59	0.36	0.08	12.17
C6	3	2.61	1.23	0.53	0.29	0.07	12.32
C6	4	2.64	1.59	0.40	0.17	0.04	2.34
C6	5	2.64	1.68	0.36	0.16	0.03	0.84
C6	6	2.64	1.73	0.34	0.15	0.03	0.50
C6	7	2.64	1.79	0.32	0.13	0.03	0.35
C7	1	2.63	1.12	0.57	0.32	0.08	13.75
C7	2	2.62	1.17	0.55	0.32	0.08	12.24
C7	3	2.62	1.30	0.50	0.27	0.06	7.32
C7	4	2.63	1.50	0.43	0.22	0.05	1.27
C7	5	2.64	1.68	0.36	0.16	0.03	0.62
C7	6	2.65	1.85	0.30	0.12	0.03	0.21
C7	7	2.65	1.91	0.28	0.10	0.02	0.13

Objective Functions

Table S3 presents the objective functions used in the sensitivity analysis and in the model evaluation. In the latter modelled values are compared to measurements. In the sensitivity analysis modelled values obtained when parameters are varied are compared to modelled values in the baseline scenario.

Table S3. Objective functions. Xmod:modelled value; Xobs: measured value. In the sensitivity analysis measurements are substituted with modelled values in the baseline scenario.

Function	Formula
Bias	$\frac{\sum_{i=1}^n (Xmod(i) - Xobs(i))}{n}$
NME	$\frac{\sum_{i=1}^n Xmod(i) - Xobs(i) }{Xobs} \times 100$
RMSE	$\sqrt{\frac{\sum_{i=1}^n (Xmod(i) - Xobs(i))^2}{n}}$