Supplement of Hydrol. Earth Syst. Sci., 26, 5185–5206, 2022
https://doi.org/10.5194/hess-26-5185-2022-supplement

Hydrology and Earth System Sciences
Open Access

Supplement of

Flood patterns in a catchment with mixed bedrock geology and a hilly landscape: identification of flashy runoff contributions during storm events

Audrey Douinot et al.

Correspondence to: Audrey Douinot (audreydouinot@gmail.com)

Supplementary materials:

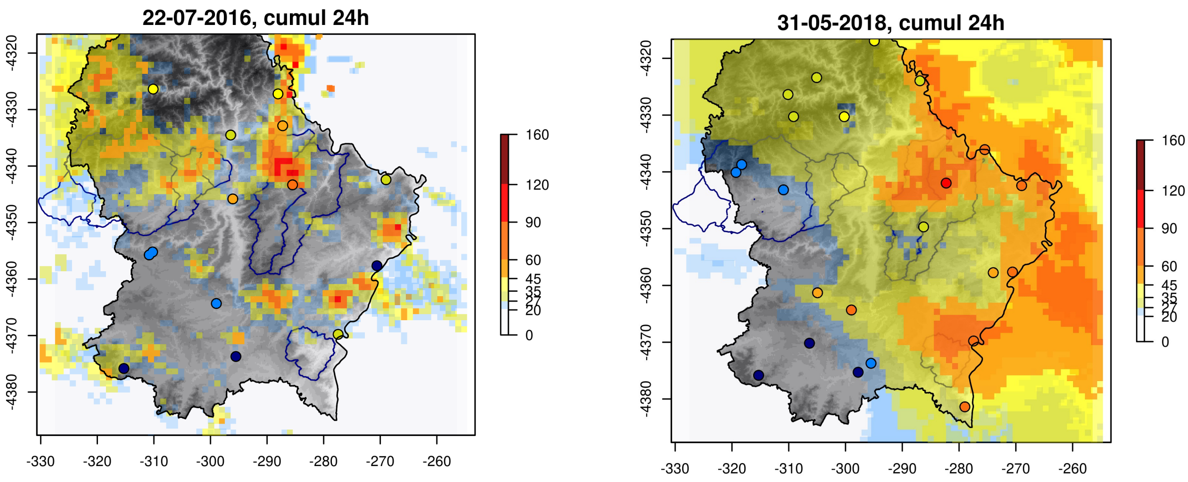

Figure S1: 24 hours rainfall amount patterns of the 2016 (left) and 2018 (right) flash flood events

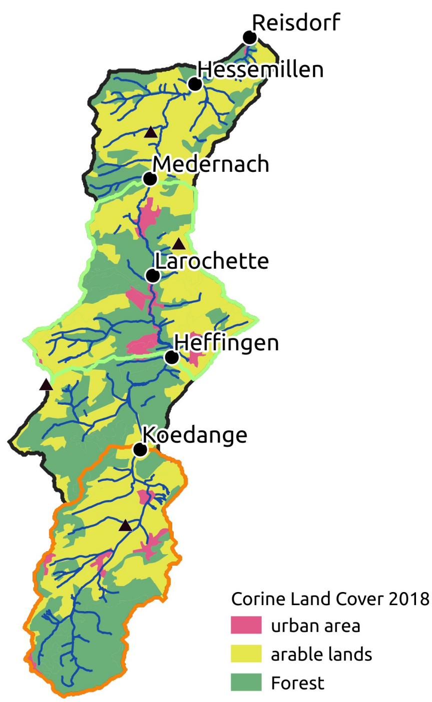

Figure S2: Land use on the Ernz Blanche catchment (Corine Land Cover 2018)

S3: Observed response times used to define the unit hydrograph and hydraulic transfer parameter ranges (table 3).

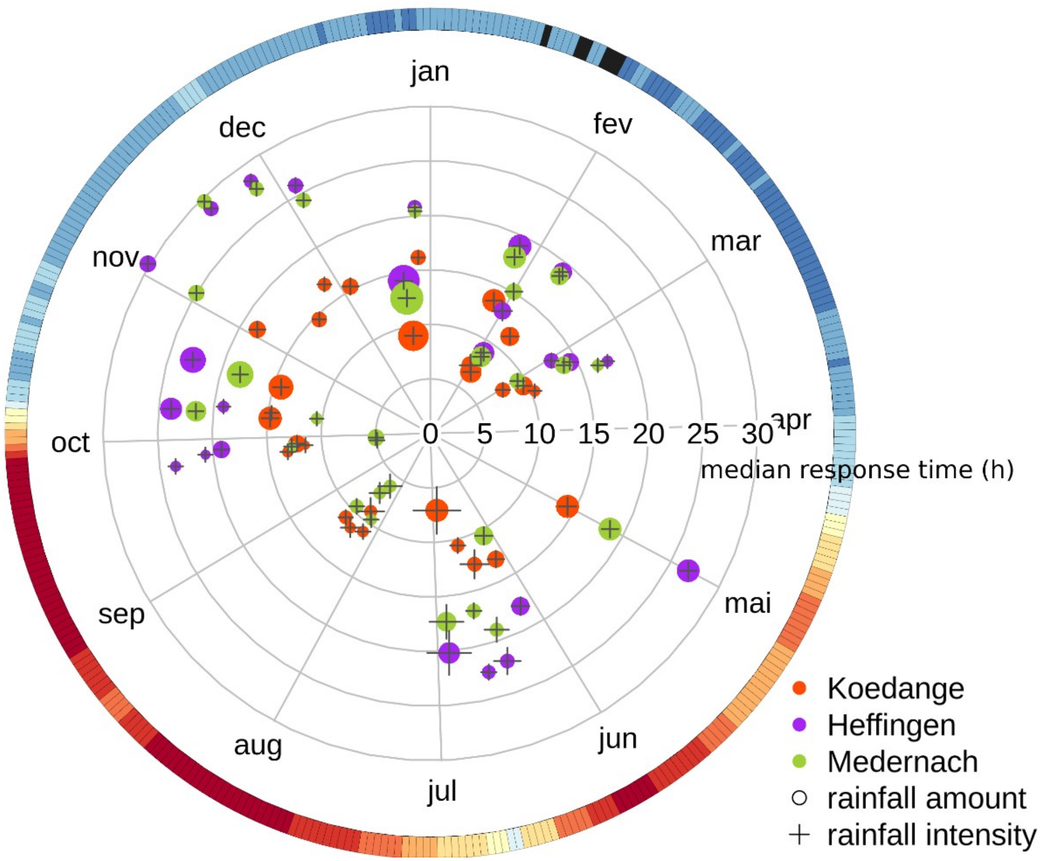

Figure S3: Time offset between the median time of the rainfall distribution and the median time of the runoff response distribution at Koedange (31.1 km^2, orange), Heffingen (48.8 km^2) and Medernach (79 km^2). The colored circle corresponds to the daily average soil moisture condition at 20 cm in depth (key color scale in figure 3).

The response times for all the events are below 20 h for the Koedange catchment and below 30 h for the Medernach catchment. This order of magnitude can be compared to the expected value of the Gamma model $E = \mu\theta$. Here we choose the parameter ranges in order that E widely covers the range [5 – 30] h.

Moreover the skewness of the Gamma function is: $S_k = 2/\sqrt{(\mu)}$. As remember, the skewness is a measure of the distance between the mode and the expected value, standardized by the variance of the distribution. Looking at the hydrograph shapes, we choose different range of variation of μ to define the Medernach-Heffingen section and the Koedange catchment. The hydrological response of this latter shows little skewness, compared to the Medernach one. Although the assessment of the skewness based on the observation is quite difficult, we assumed here that S_k is at least below 2 for Koedange, but it could significantly be higher for the Medernach catchment section.

S4: Testing a variable runoff coefficient on KOE catchment

We tested on the KOE catchment – i.e the one that seems to be more affected by the constant RC assumption – a variable RC along the event. Two Runoff Coefficients – RC^m and RC^p – have been defined: the first one characterizes the re-invigoration of the soil drainage at the beginning of the events and the second one characterizes the hydrological response in the heart of the flood respectively. Arbitrarily, the re-invigoration period is fixed to 20 h. RC^m and RC^p are calculated as indicated below:

- $$\frac{RC^m}{RC^p} = SCW\,20$$
- $$RC^m = \frac{RC \cdot V^{tot}}{V^m + SCW\,20 \cdot V^p}$$

where V^{tot} is the total rainfall amount, V^m the rainfall amount occurring during the first 20 hours, and $V^p = V^{tot} - V^m$. The impact on the FDC scores are presented in the supplementary materials, table S3. The TTD properties resulting in variable RC are compared to the TTD properties with constant RC on figure S4.

According to the FDC score (table S3), there is indeed an improvement of the results with a mean decrease of 2%. More specifically the results are significantly better with a variable RC for 11 out of the 40 events. Those events occurs during the November-May period.

Considering the TTD properties (Figure S4), TTD50 and TTDpk decreases in average by 0.5 h and 0.4 h respectively. The decrease is homogeneous on the data set. A largest difference appears during the April-Mai period, resulting in smaller range of transfer lag times uncertainties. Nevertheless, the seasonal variations of the TTD properties can be similarly observable on both unit hydrograph model simulations. The comments about TTDs properties thus based on the simulations with the constant RC hypothesis are still valid.

Table S4: Comparison of the scores of the unit hydrograph model applied on KOE catchment with constant (RC) or variable Runoff Coefficients (RC^m / RC^p). Particularly the FDC score presented here evaluates the good distributions of the low and high flood values: when the low flows are underestimated and the high flow are overestimated, or inversely, the FDC score is bad. When the overestimation or the underestimation is monotonous the FDC score is good. The rainfall-runofff event with bad FDC scores with constant RC are highlighted in shaded blue. The FDC scores are highlighted in green and red when there is an improvement or a decrease respectively of the FDC score reached with variable RC.

Event			RC	RC^m / RC^p		
	Amount [mm]	Duration [h]	FDC [% meanQ]	FDC [% meanQ]	RCm (20 first hours)	RCp
2019/08/06	11.1	14.5	11.6	11.7	0.78	1.8
2019/08/09	14.2	11.8	24.6	22.4	0.93	2.1
2019/08/12	13.5	7.9	19.2	20.0	1.18	2.65
2019/08/17	16.3	34.0	11.9	10.1	0.94	1.94
2019/09/24	11.0	27.9	14.7	23.5	1.25	2.93
2019/09/26	9.8	17.7	10.5	8.8	1.21	2.77

2019/10/07	30.3	67.1	19.3	10.4	2.38	3.47
2019/10/19	43.6	24.6	18.1	19.5	11.39	14.85
2019/11/02	21.4	74.4	31.4	28.2	10.25	13.07
2019/11/17	17.9	37.3	50.9	40.5	15.39	20.5
2019/11/26	17.3	60.5	14.3	13.2	14.90	19.9
2020/01/26	35.3	49.7	38.9	24.4	24.45	31.44
2020/01/31	21.5	35.7	16.3	13.3	29.46	37.61
2020/02/03	30.6	29.0	15.4	12.0	31.15	36.84
2020/02/09	26.2	53.6	16.2	20.1	22.48	29.67
2020/02/29	20.5	39.0	25.9	15.2	19.49	23.16
2020/03/04	24.2	45.4	7.7	6.7	29.31	36.58
2020/03/09	11.6	41.2	27.5	21.9	20.17	25.53
2020/04/29	35.2	69.8	11.8	14.5	0.90	1.9
2020/06/03	27.3	19.6	14.4	14.5	1.20	2.86
2020/06/12	16.6	16.0	15.7	12.6	2.42	4.92
2020/06/17	17.2	13.3	18.0	17.7	3.54	6.40
2020/06/26	28.4	20.3	42.6	46.7	2.48	5.05
2020/09/26	22.3	13.8	8.4	10.2	1.74	5.02
2020/12/02	17.4	43.3	12.0	14.8	14.92	19.6
2020/12/21	57.4	85.7	21.1	16.2	36.84	48.51
2020/12/27	14.0	56.3	14.6	15.4	45.65	59.98
2021/01/21	20.9	18.0	14.3	15.0	35.68	44.71
2021/01/27	43.5	129.7	9.1	13.2	37.53	49.17
2021/02/02	21.2	42.3	18.0	12.4	32.96	40.23
2021/02/06	13.0	17.4	13.2	12.6	34.24	42.46
2021/03/11	38.5	154.2	26.8	28.9	13.17	18.73
2021/04/09	36.8	46.7	82.6	64.5	11.41	17.42
2021/05/14	26.0	86.7	18.9	12.9	1.52	2.84
2021/05/24	25.9	53.6	36.7	30.7	4.41	6.98
2021/06/04	23.4	2.8	33.8	34.9	13.46	19.93
2021/06/19	15.8	6.7	26.7	19.8	2.2	4.37
2021/06/24	17.0	12.3	16.1	17.2	2.77	5.05
2021/07/13	128.9	62.1	60.4	61.0	31.06	41.68
2021/07/27	20.6	7.7	15.3	15.9	16.25	23.87

45

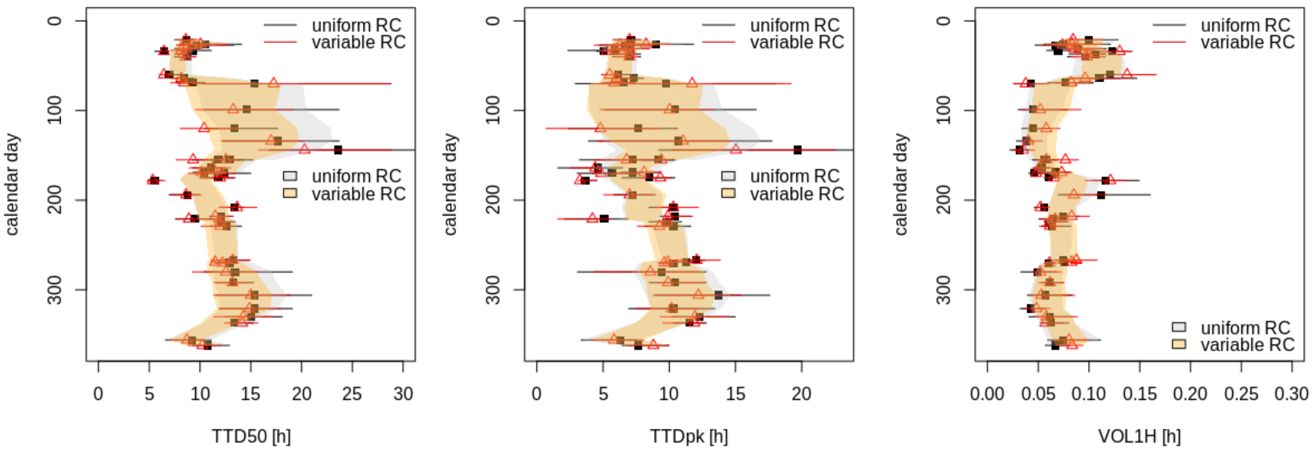

Figure S5: Comparison of the TTD propreties when calculating with the constant or variable RC on KOE catchment.