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Supplement of

Proximate and ultimate controls on carbon and nutrient dynamics of small agricultural catchments

Zahra Thomas et al.

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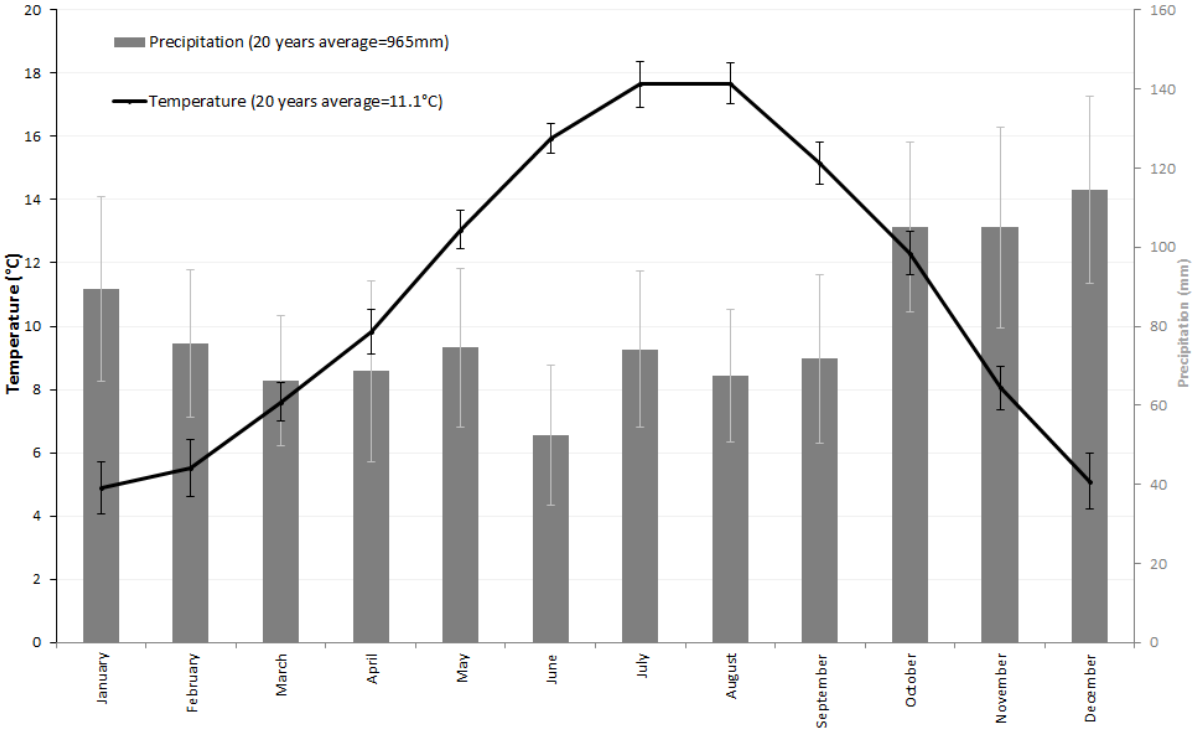


Figure S1. Ombrothermic diagram presenting 20 years data from September 1994 to august 2014.

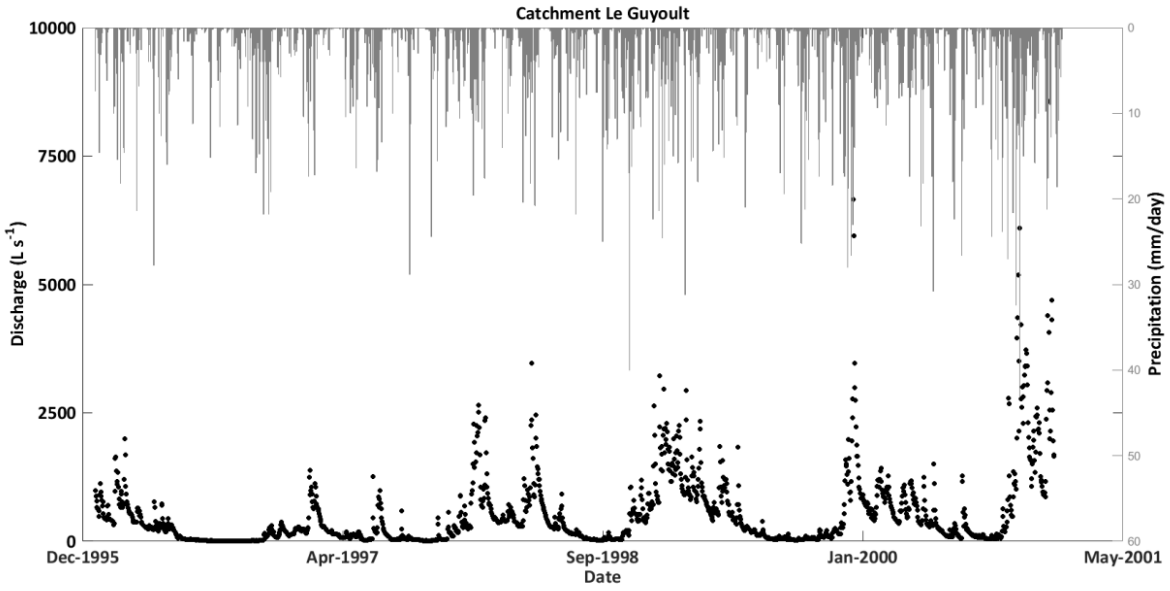


Figure S2. Discharge measured at the gaged station Le Guyoult.

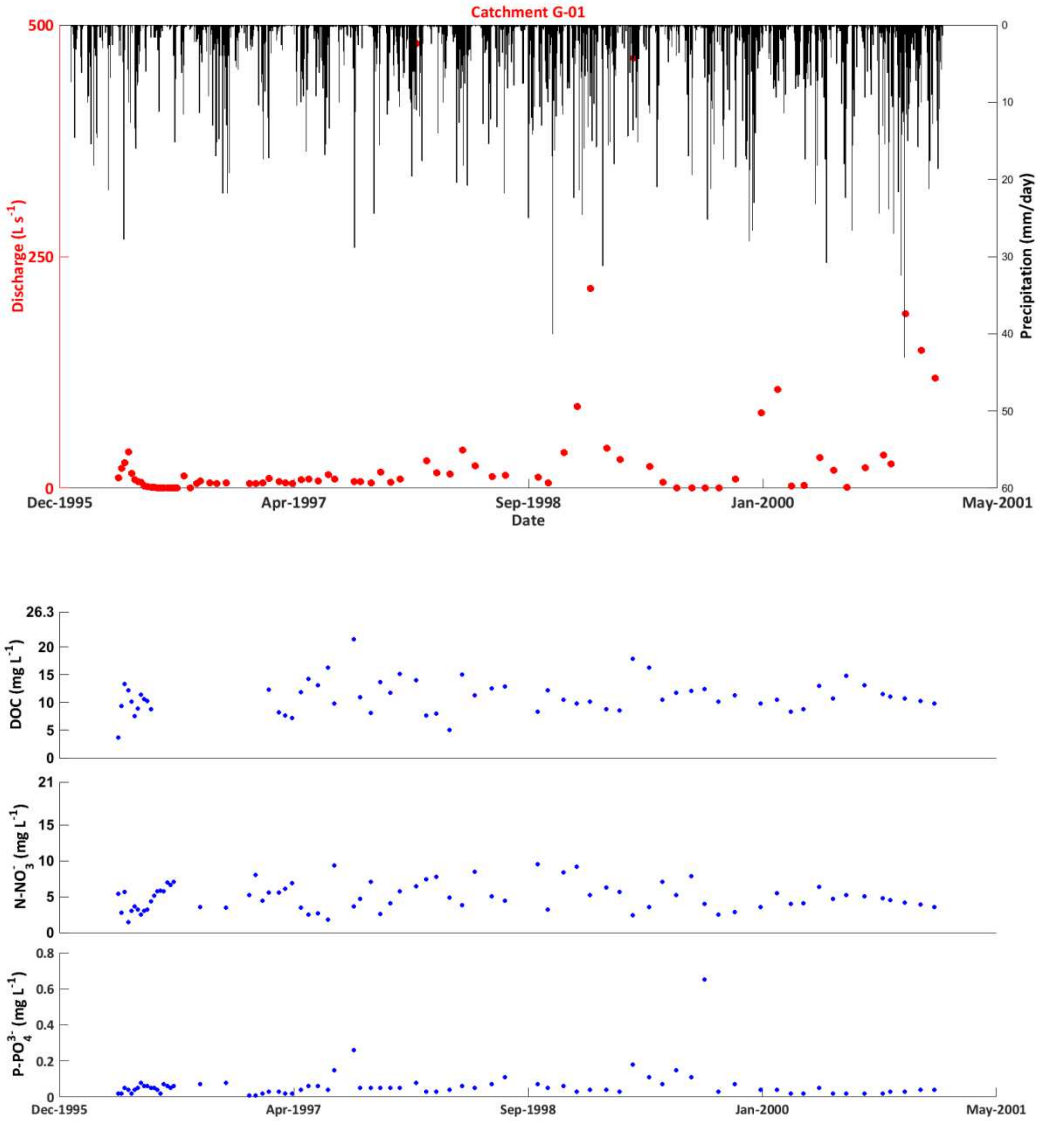


Figure S3. High and low frequency data of discharge, dissolved organic carbon, nitrate, and phosphate in stream water measured at the outlet of catchment G-01.

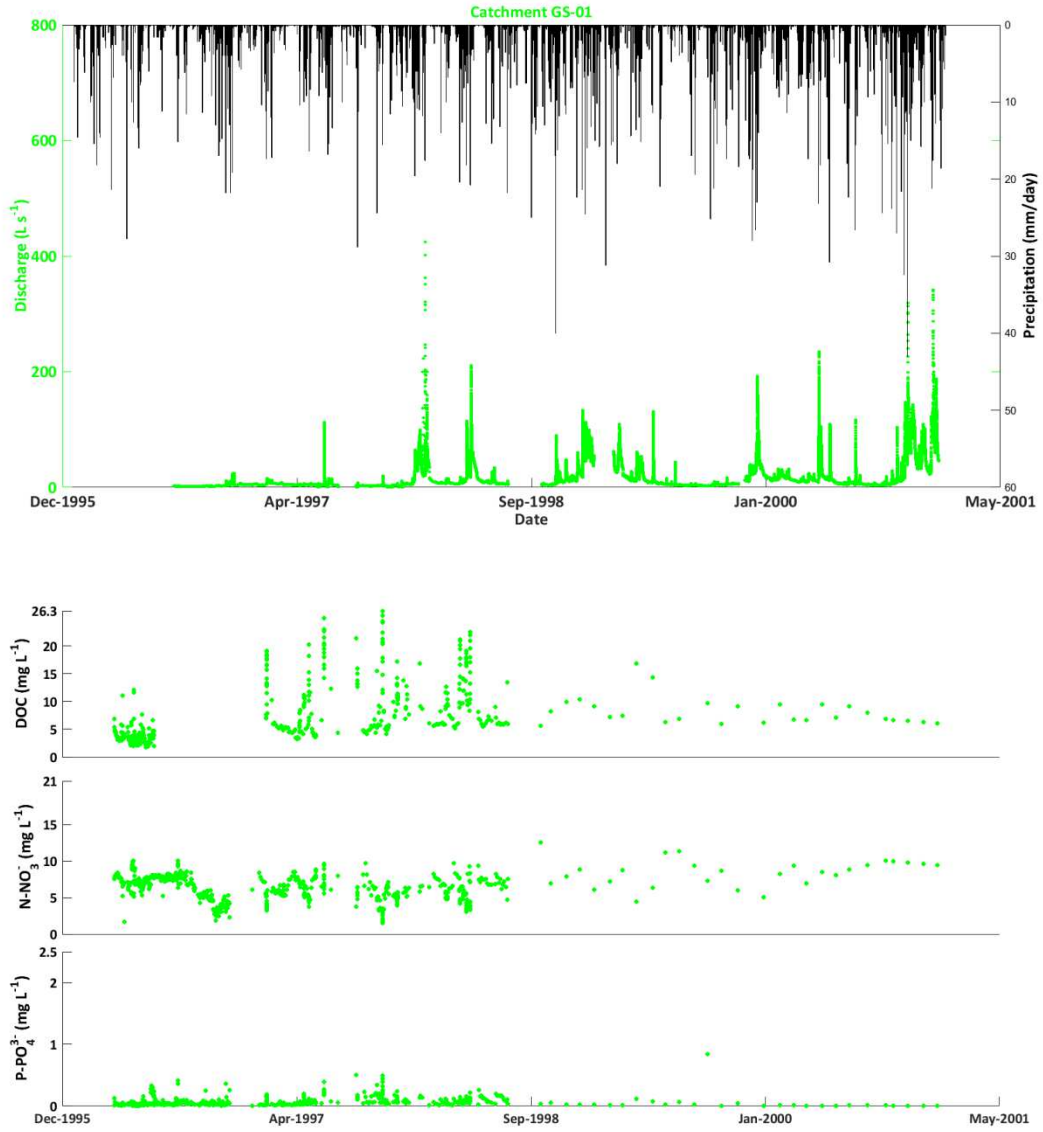


Figure S4. High and low frequency data of discharge, dissolved organic carbon, nitrate, and phosphate in stream water measured at the outlet of catchment GS-01.

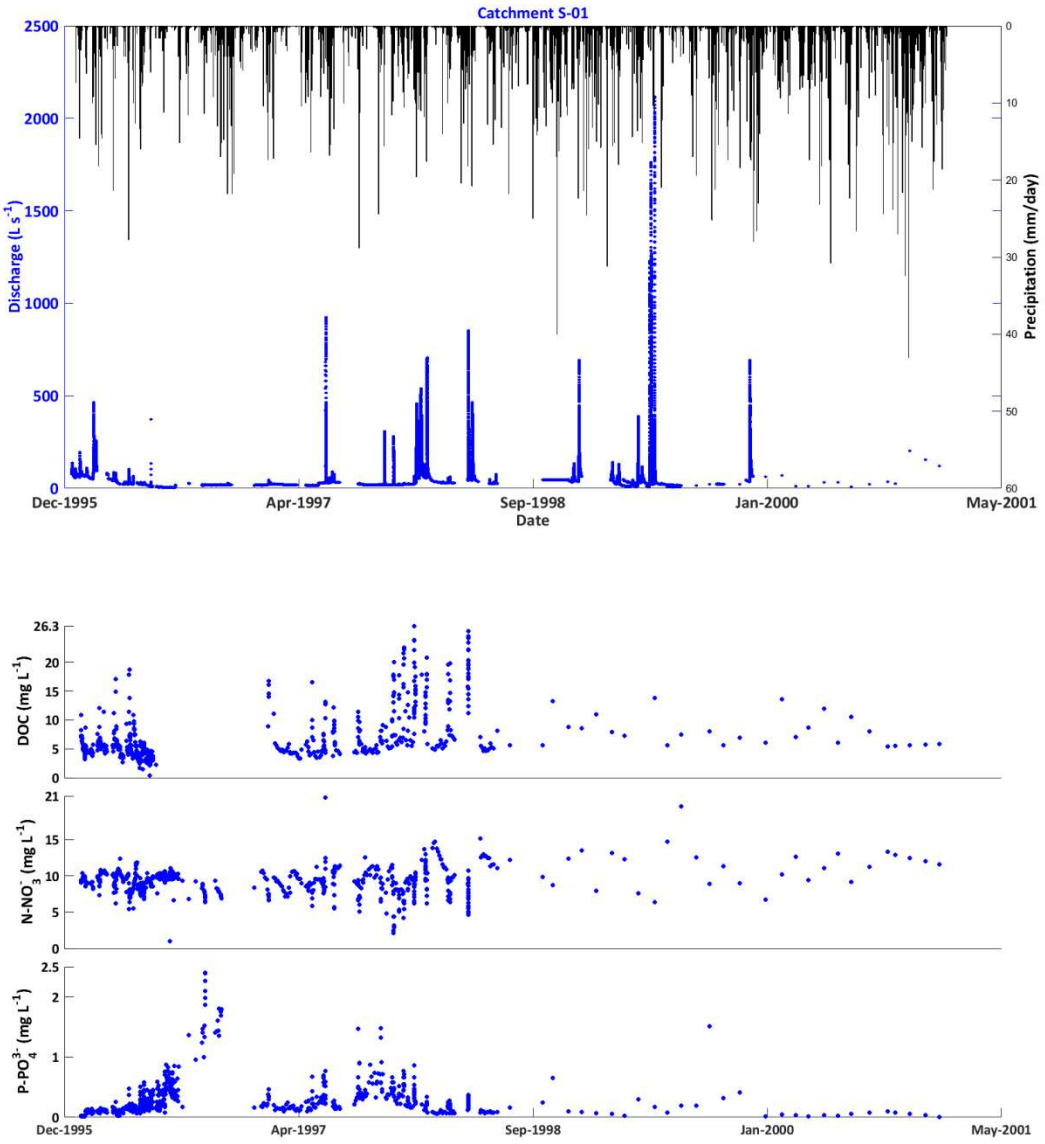
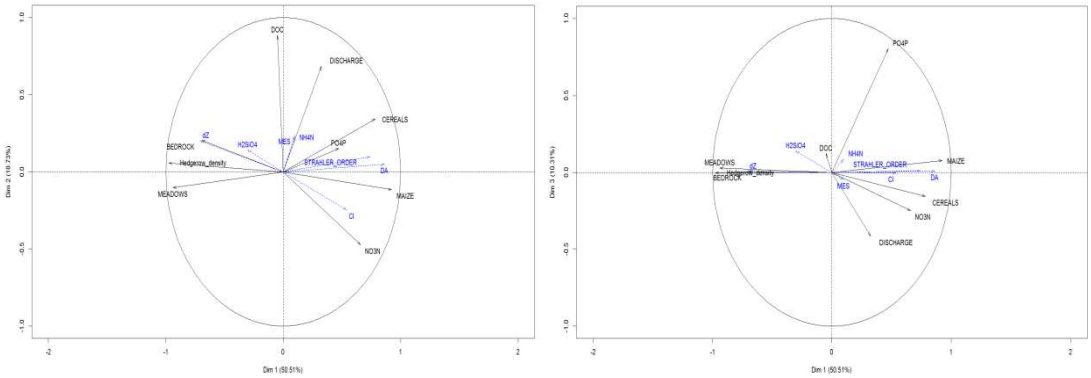


Figure S5. High and low frequency data of discharge, dissolved organic carbon, nitrate, and phosphate in stream water measured at the outlet of catchment S-01.



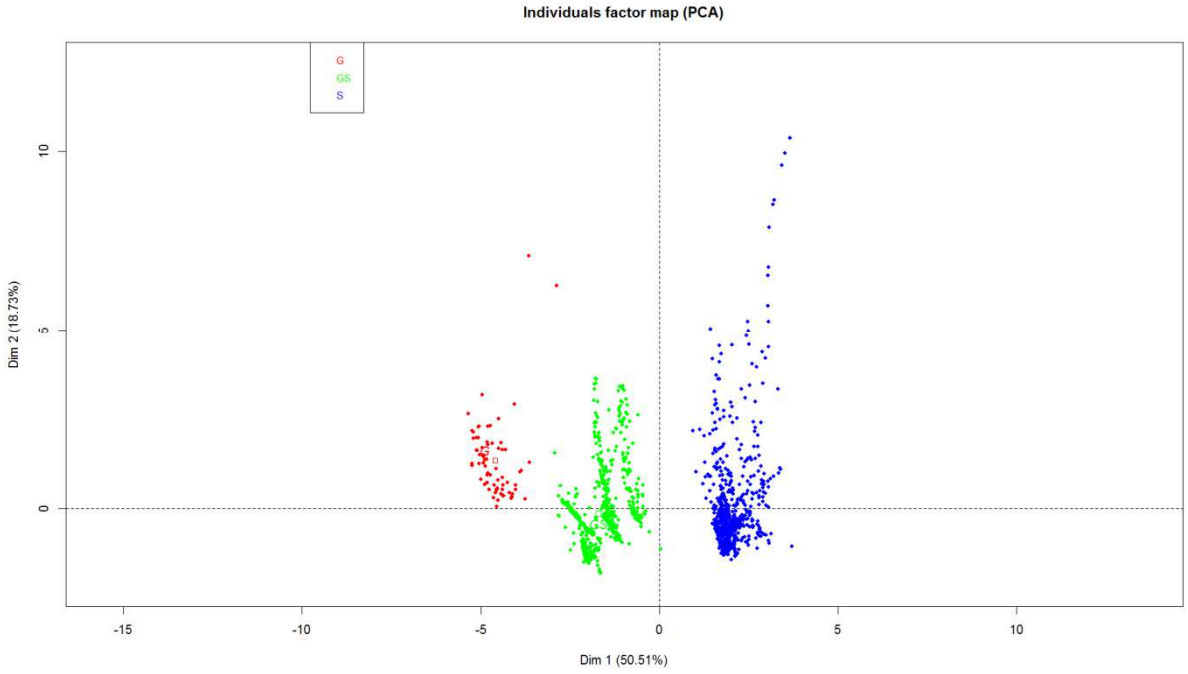


Figure S6. Principal component analysis of the major sources of variability in water chemistry for catchments G-01 (red), GS-01 (green), and S-01 (blue). Together, the first-three axes explain 80% of the total variability of the data.

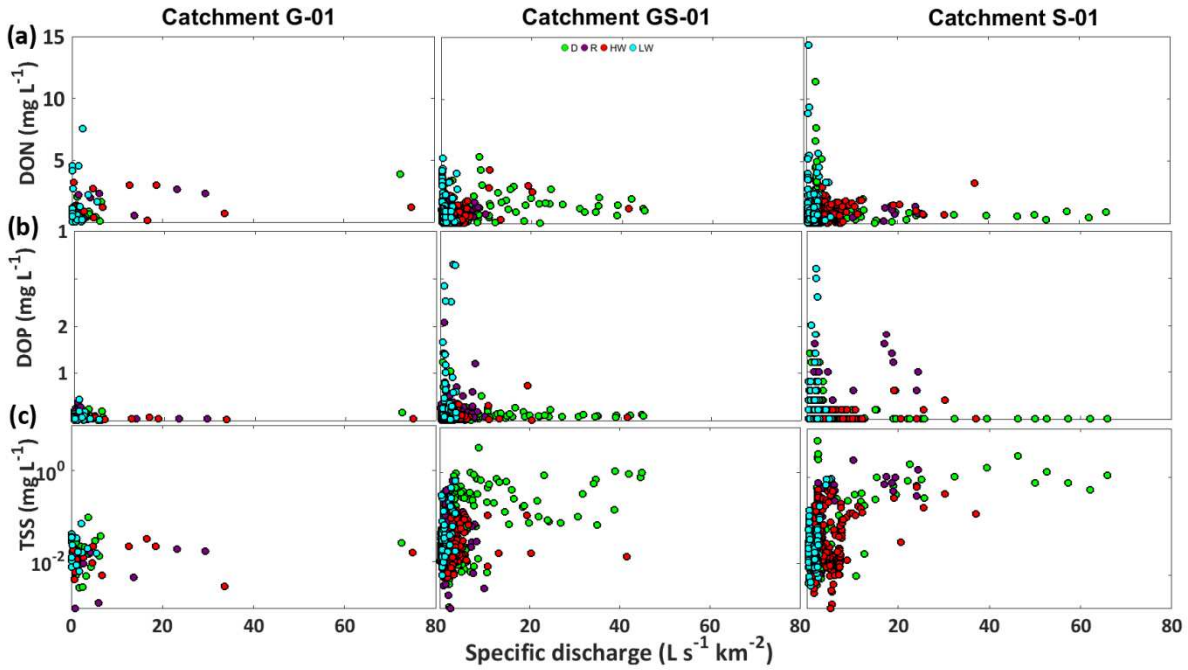


Figure S7. Relationship between specific discharge and (a) dissolved organic nitrogen, (b) dissolved organic phosphorus (c), and (d) total suspended sediment for three headwater catchments (G-01, GS-01 and S-01) in Brittany France. Chemistry data from daily automatic sampling supplemented by sub-daily sampling for catchments GS-01 and S-01 during discharge events (see methods for detailed sampling description). Note the log scale for TSS. Data are colored by hydrologic period: D=discharge (April-June), LW=low water (July-September), R=recharge (October-December), HW=high water (January-March).

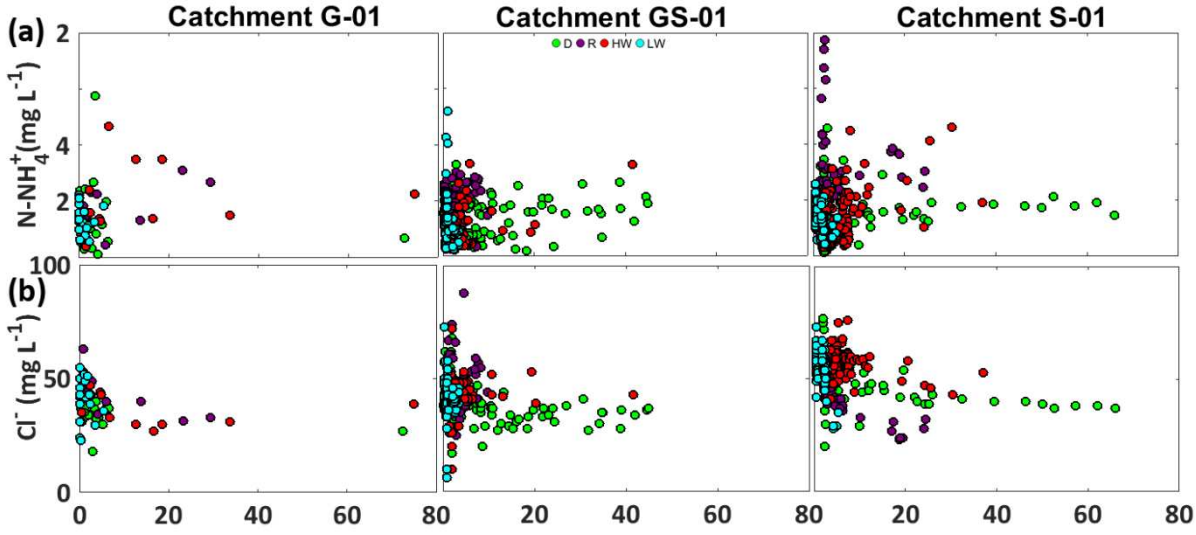


Figure S8. Relationship between specific discharge and (a) ammonium, and chloride (b) for three headwater catchments (G-01, GS-01 and S-01) in Brittany France. Chemistry data from daily automatic sampling supplemented by sub-daily sampling for catchments GS-01 and S-01 during discharge events (see methods for detailed sampling description). Data points are colored by hydrologic period (see Fig. 2 for definitions).

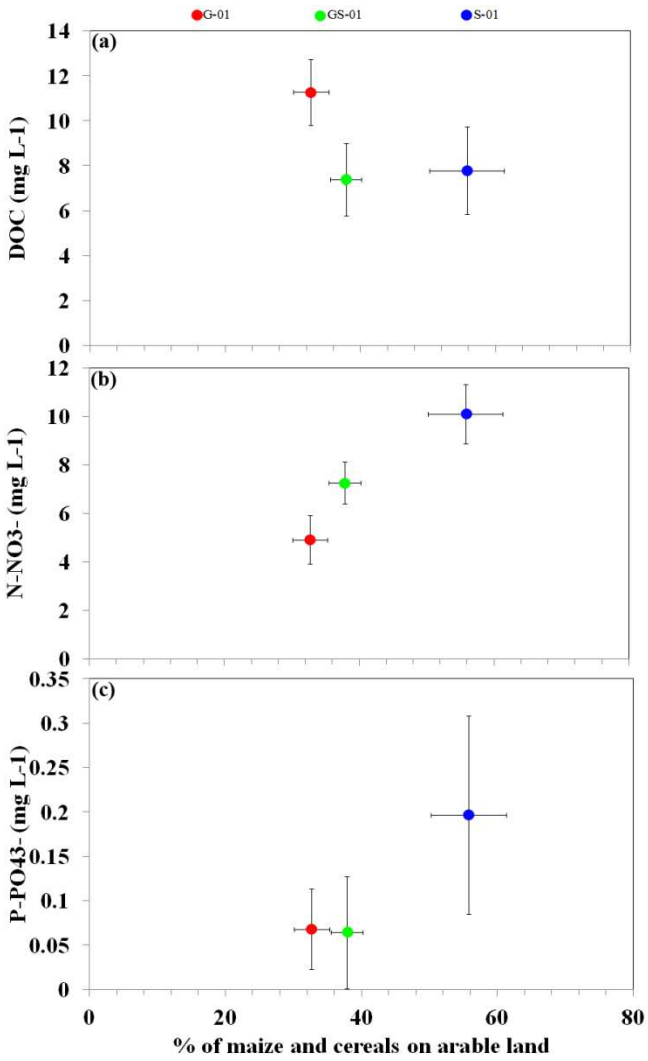


Figure S9. Relationship between (a) dissolved organic carbon, (b) nitrate, and (c) phosphate concentration and land use (% of maize and cereals on arable land) over the studied period. Error bars represent standard error of chemistry parameters and land use.

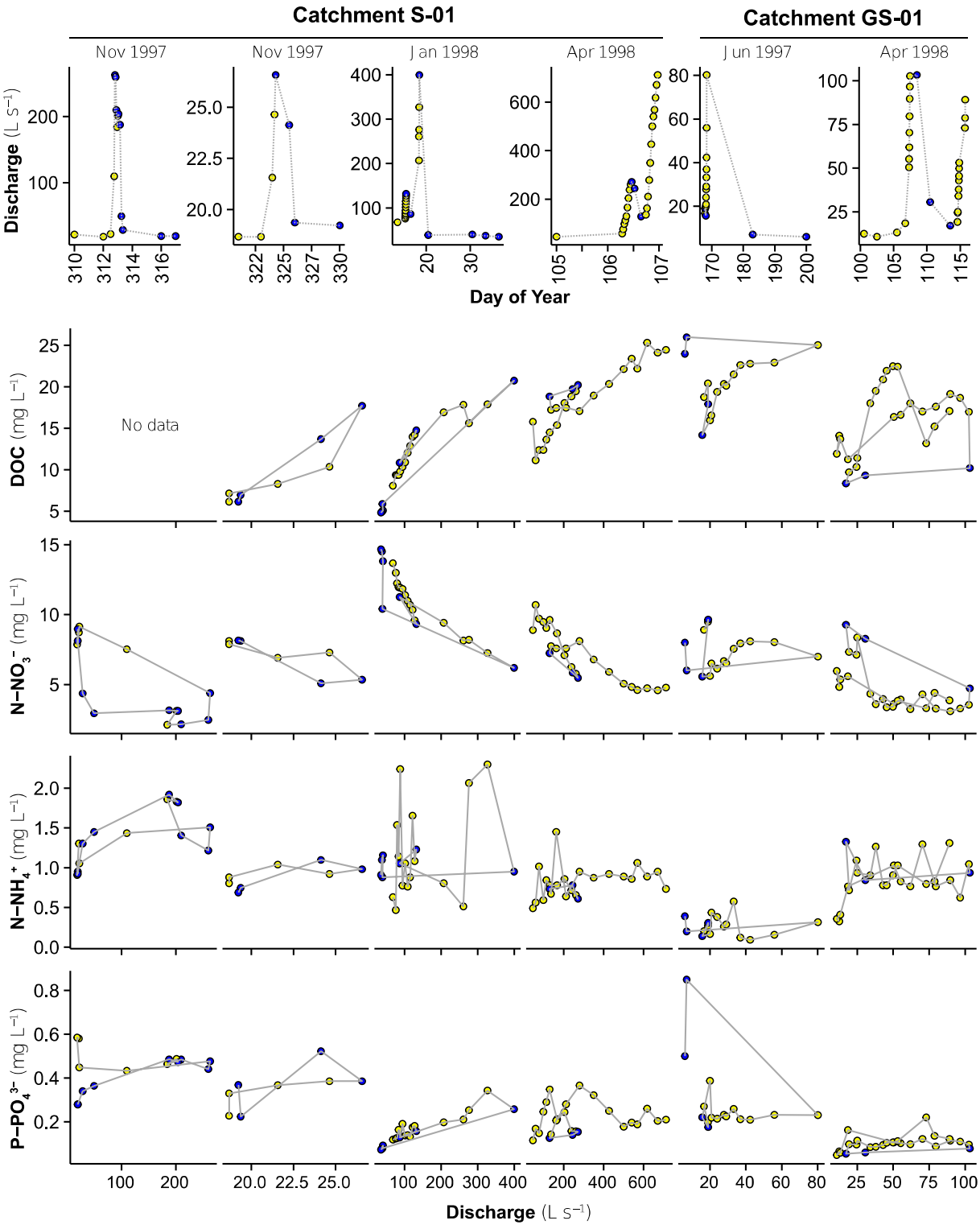


Figure S10. Response of discharge, NO_3^-, PO_4^{3-} and DOC, during storm events for catchment GS-01 and catchment S-01. Yellow points represent the rising limb and blue points represent the falling limb of the hydrograph.

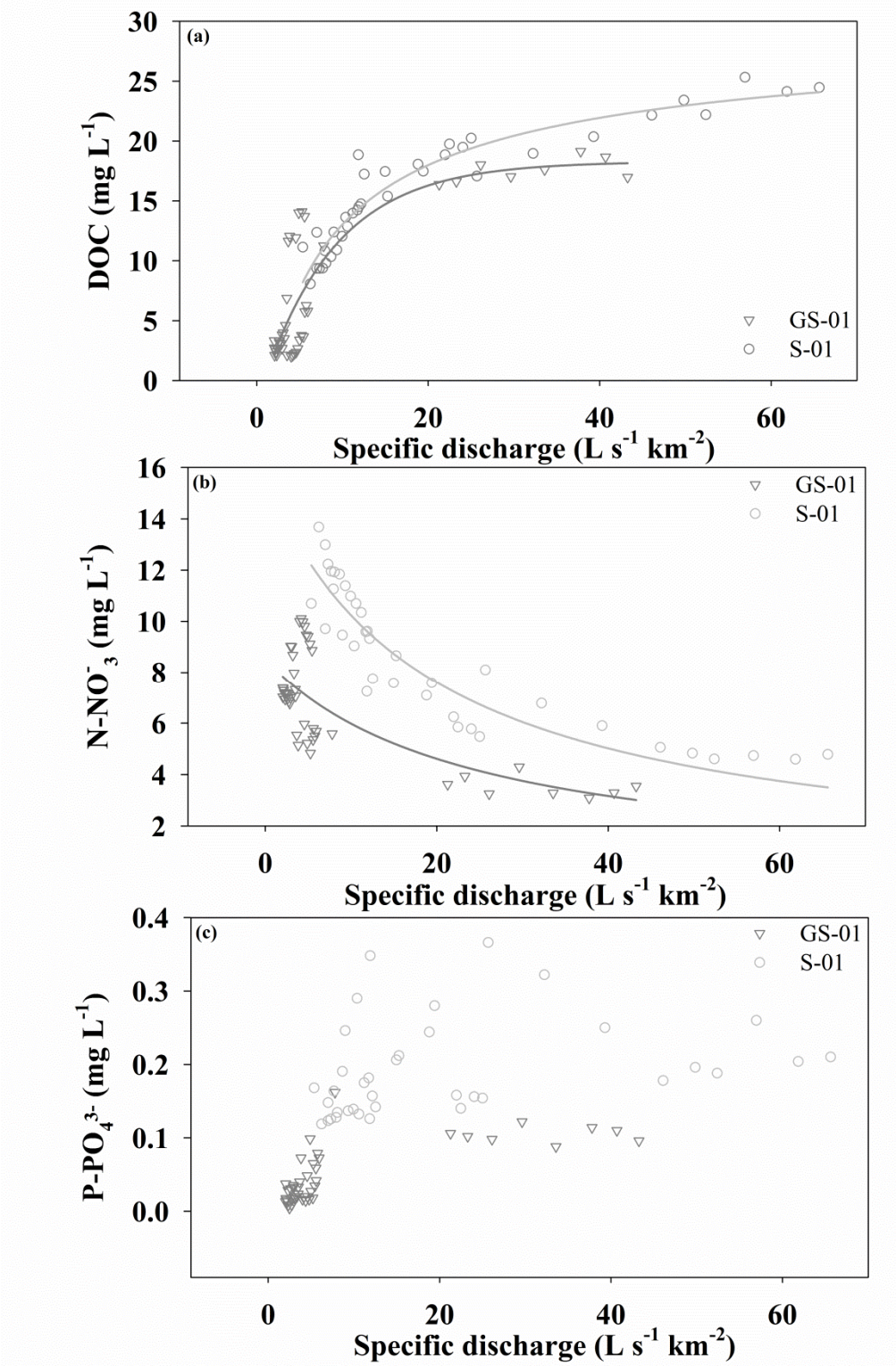


Figure S11. Relationships of specific discharge with dissolved organic carbon, nitrate, and phosphate during storm events.

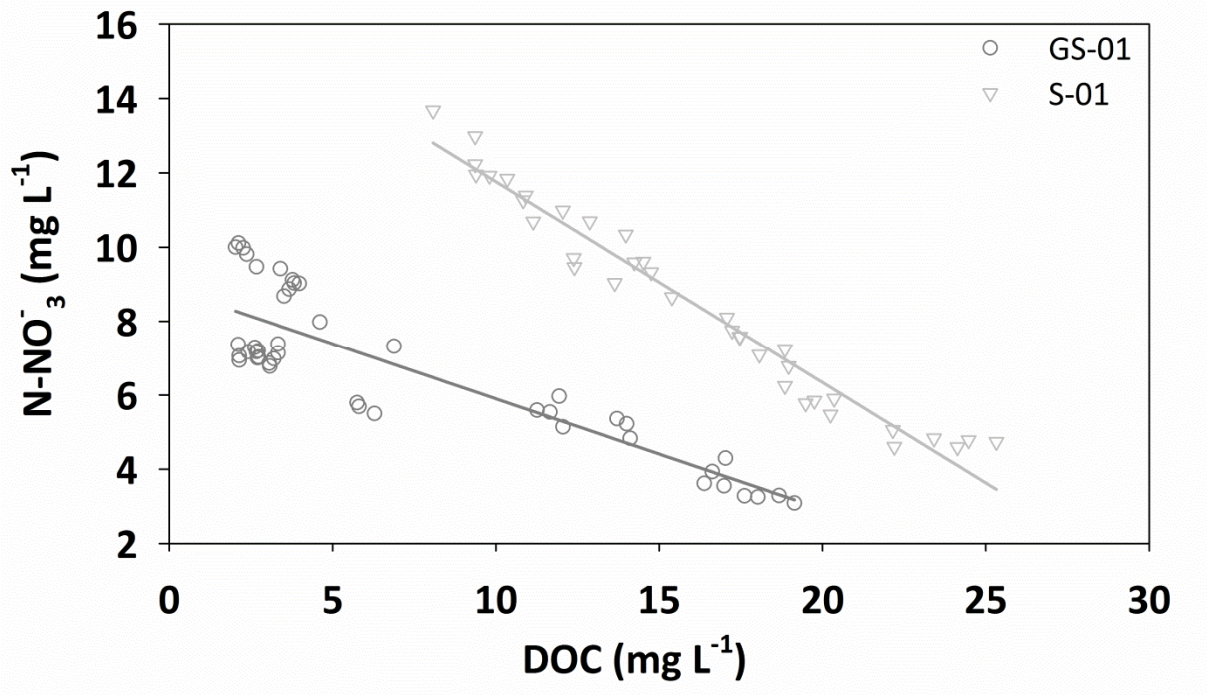


Figure S12. Relationships between DOC and NO_3^- concentrations during discharge events for the catchment GS-01 (○) and S-01 (▽).

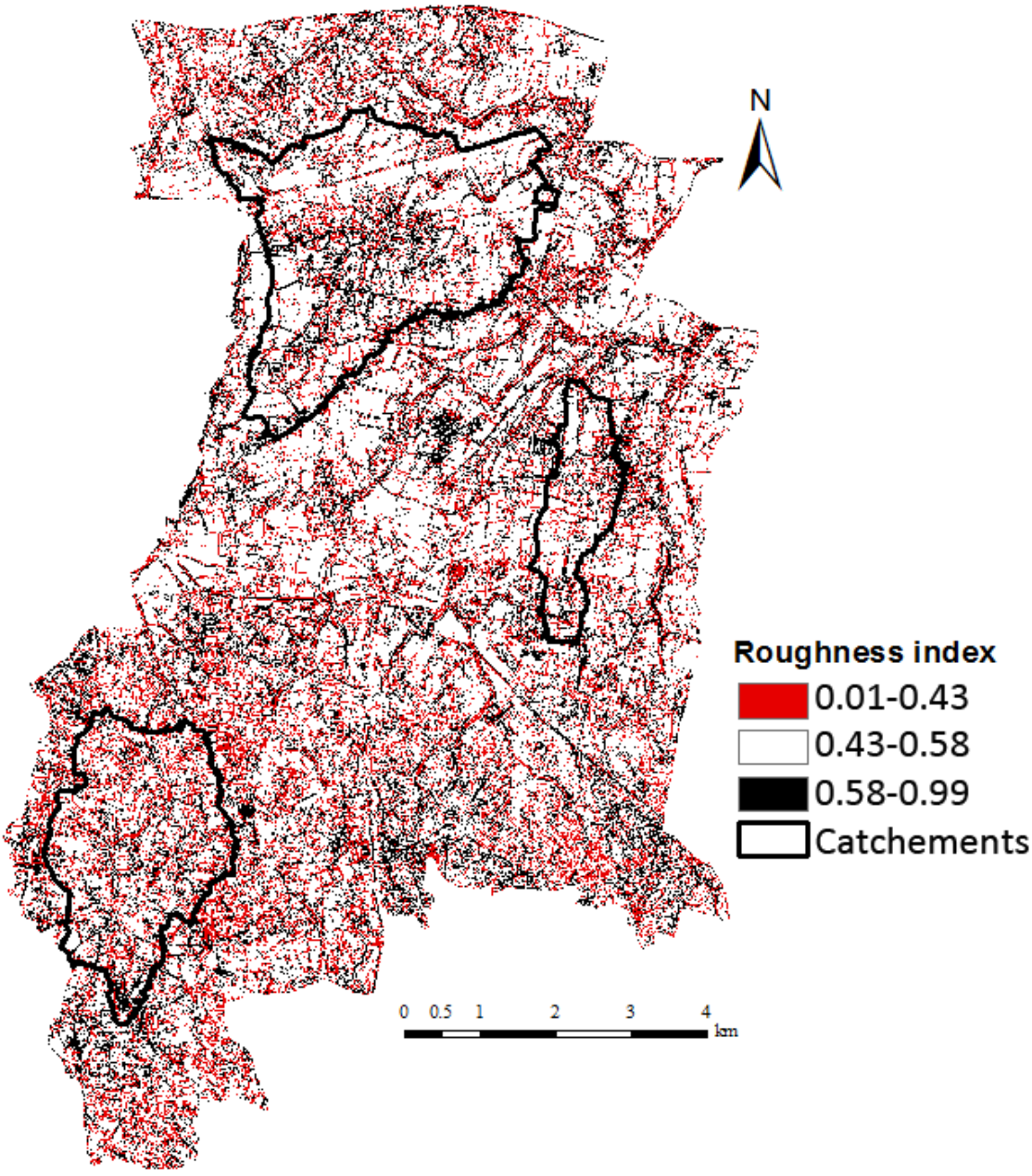


Figure S13. Roughness index calculated from 2m resolution DEM.

Hydrological years	Year 1	Year 2	Year 3	Year 4	Year 5
	Sept 95-Aug.96	**Sept 96-Aug.97**	**Sept 97-Aug.98**	**Sept 98-Aug.99**	**Sept 98-Aug.00**
Annual precipitation (mm)	786.4	794.6	819.2	1131.6	1174.4
Difference in annual precipitation with average of 20 years (mm)	-178.6	-170.4	-145.8	166.6	209.4

Table S1. Annual precipitation over the studied period compared with average conditions based on the 20 year average from 1994-2014.

	Catchments	**DOC**	**DON**	**DOP**	**Cl-**	**MES**	**N-NO_3^-**	**N-NH_4^+**	**P-PO_4**	**DSI**
Number of samples	Catchment GS	501	733	734	624	704	734	734	734	734
	Catchment S	616	783	783	709	744	781	737	781	781
	Catchment G	62	80	80	73	74	74	74	74	74
Mean (mg L^{-1})	Catchment GS	7.89	0.76	0.07	41.66	83.77	6.48	0.62	0.07	7.92
	Catchment S	7.39	0.92	0.07	54.11	150.71	9.20	0.72	0.30	6.26
	Catchment G	11.08	1.14	0.05	40.21	17.44	4.98	0.74	0.06	6.44
Standard deviation (mg L-1)	Catchment GS	5.55	0.76	0.15	6.98	199.01	1.63	0.34	0.07	1.64
	Catchment S	4.82	1.15	0.16	7.68	726.70	1.76	0.44	0.31	1.82
	Catchment G	2.96	1.32	0.05	11.41	14.32	1.88	0.48	0.08	2.19
Mean (mg L^{-1})	Catchment GS	7.89	0.76	0.07	41.66	83.77	6.48	0.62	0.07	7.92
	Catchment S	7.39	0.92	0.07	54.11	150.71	9.20	0.72	0.30	6.26
	Catchment G	11.08	1.14	0.05	40.21	17.44	4.98	0.74	0.06	6.44

Table S2. A synthetic view of the data set indicating the number of samples, the mean value and the standard deviation of the main solutes analyzed.

		Dim.1	Dim.2	Dim.3
Principal variables	**Bedrock**	**-0.69**	0.22	0.00
	Discharge	0.34	**0.68**	-0.41
	$N\text{-}NO_3^-$	**0.65**	-0.49	-0.25
	$P\text{-}PO_4^-$	0.48	0.14	**0.81**
	DOC	-0.03	**0.89**	0.12
	Corn	**0.90**	-0.14	0.08
	Cereals	**0.80**	0.32	-0.15
	Meadow	**-0.95**	-0.08	0.03
	Hedgerow_density	**-0.98**	0.06	-0.01
Supplementary variables	**Elevation**	**-0.70**	0.22	0.00
	$N\text{-}NH_4^+$	0.10	0.22	0.09
	DSI	-0.28	0.15	0.14
	TSS	0.11	0.23	-0.05
	Cl	**0.52**	-0.26	0.00

Table S3. PCA scores for the 3 principals dimensions.