

Epilithic biofilms diversity and assembly in island tropical rivers (Guadeloupe) submitted to chlordecone contamination pressure

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IMPORTANT POINTS

- Microbial biofilms provide a useful model for investigating fundamental aspects of community interactions and ecosystem function.

- Few knowledge on diversity of epilithic biofilms. Data on tropical biofilms are particularly lacking.

- Banana plantations have been submitted to chlordecone treatment to prevent attacks by *Cosmopolites sordidus*, a weevil that destroys the banana plants.

- Intensive treatment during more than 20 years lead to river contamination due to pesticide run-off across agricultural soils that potentially affect epilithic biofilms.

HIGHLIGHTS

- Chlordecone contamination measured in the rivers reflected predictions

- Bacterial epilithic biofilms community structure is well explained by a set of environmental parameters including CLD contamination.

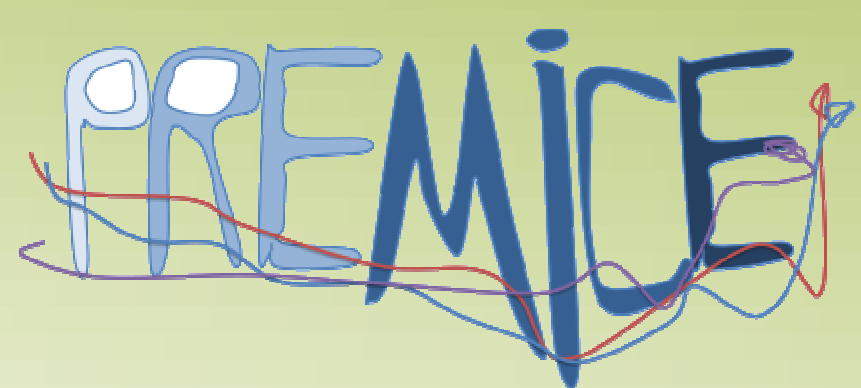
- Upstream and downstream sites were clearly differentiated indicating that local parameters contribute to shape the community along the river.

REFERENCES

Schloss PD et al. (2009) *Introducing mothur: open-source, platform-independent, community-supported software for describing and comparing microbial communities*. *Appl Environ Microbiol* **75**, 7537-7541.

R Core Team (2013). *R: A language and environment for statistical computing*. R Foundation for Statistical Computing, Vienna, Austria. ISBN 3-900051-07-0, URL <http://www.R-project.org/>

TECHNICAL SUPPORT



Regional Platform of Environmental Microbiology
<http://iprem-eem.univ-pau.fr/live/PREMICE>

FINANCIAL SUPPORT



PARTNERS



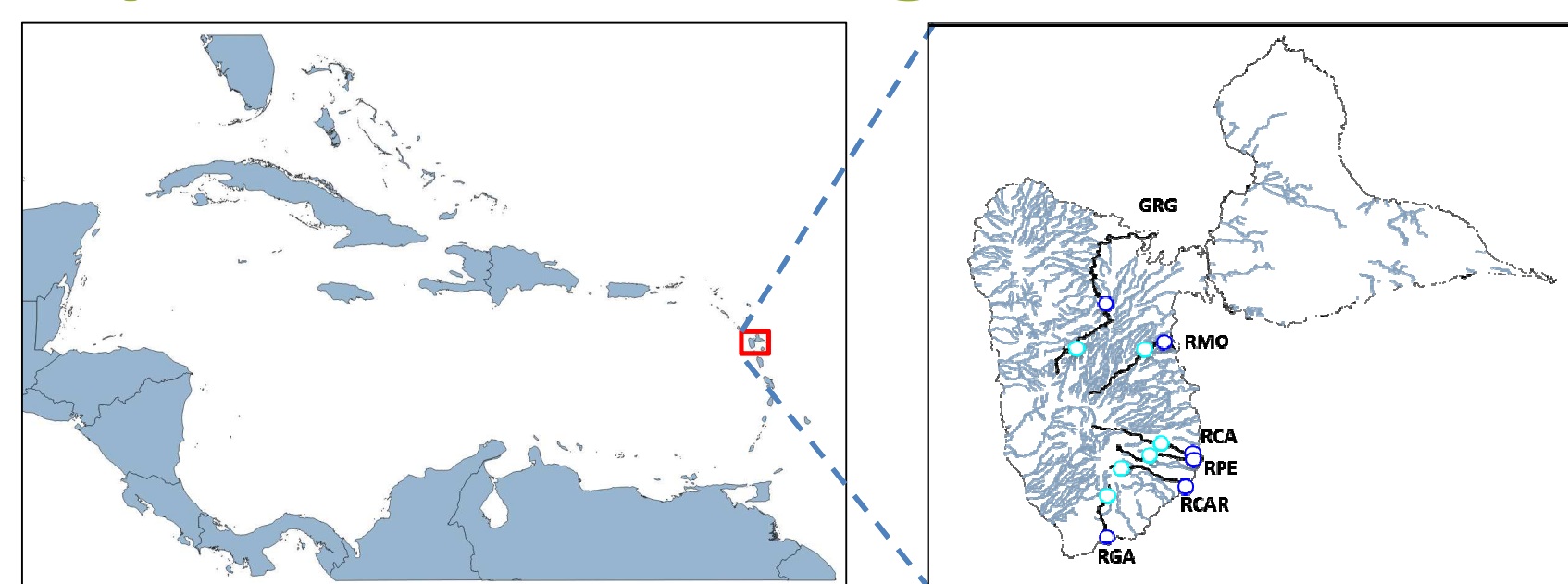
The context

Rivers and streams are **open ecosystems** dominated by a continuous **unidirectional flow** from headwaters to the mouth and in constant interaction with surrounding areas. Numerous species thrive in these lotic ecosystems but the communities of biofilm microbial play there a pivotal role driving **key ecosystems processes** and sustaining **biogeochemical fluxes**.

Several studies investigated epilithic biofilm biology in temperate or boreal continental areas including community composition and assembly, origin of microorganisms, impact of contaminants, etc... Surprisingly however it seems that no attention has been paid to island epilithic biofilms whereas they provide ideal model to study community assembly in microbial community. Additionally few reports investigated the biological diversity of tropical biofilms that may substantially differ from temperate or boreal lotic hydrosystems. The study presented here is a first step to apprehend some of these topics in the context of tropical island and contamination pressure.



Experimental design



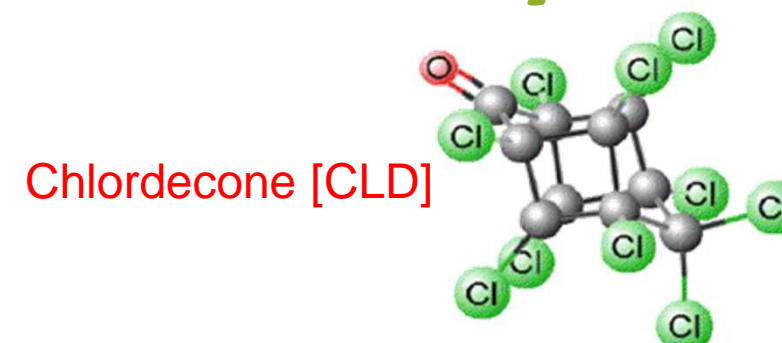
The archipelago of the Antilles and the Guadeloupe island (red square)

Rivers (6) and sites (upstream and downstream) investigated in Basse-Terre region



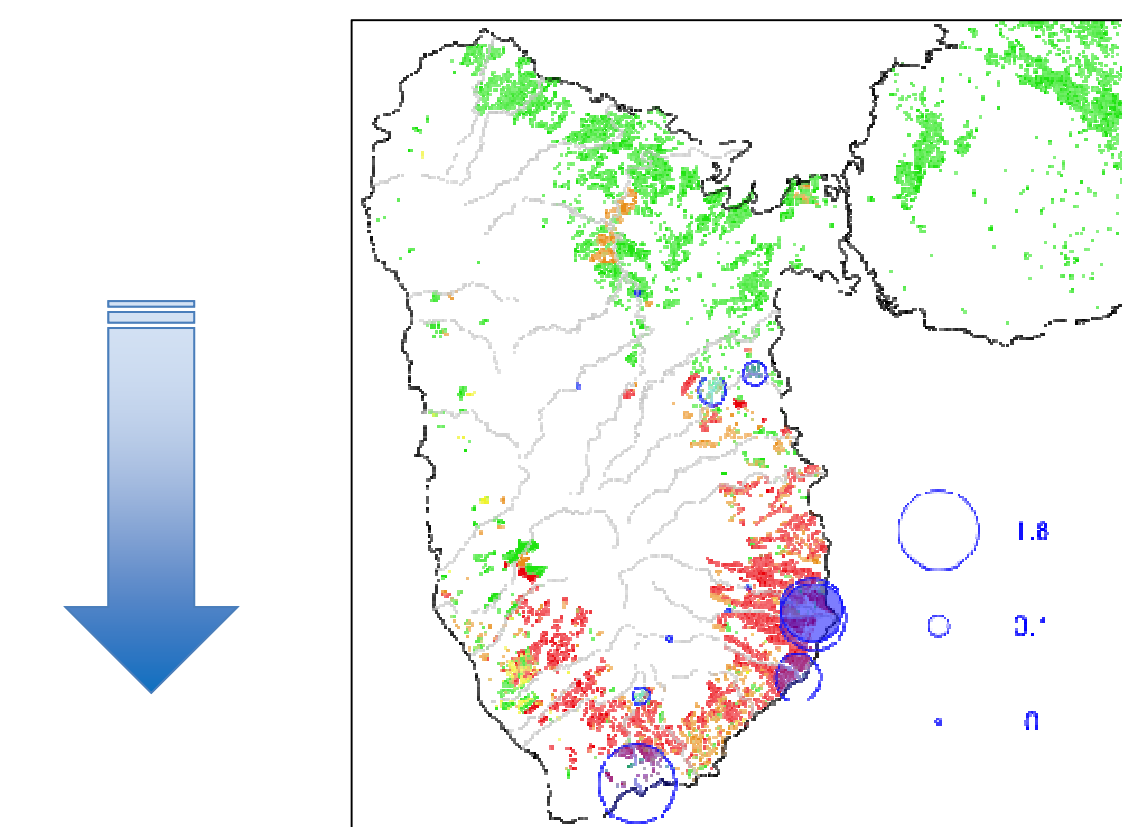
Epilithic biofilm grew on glass slide immersed in a net during 21 days

Chemistry



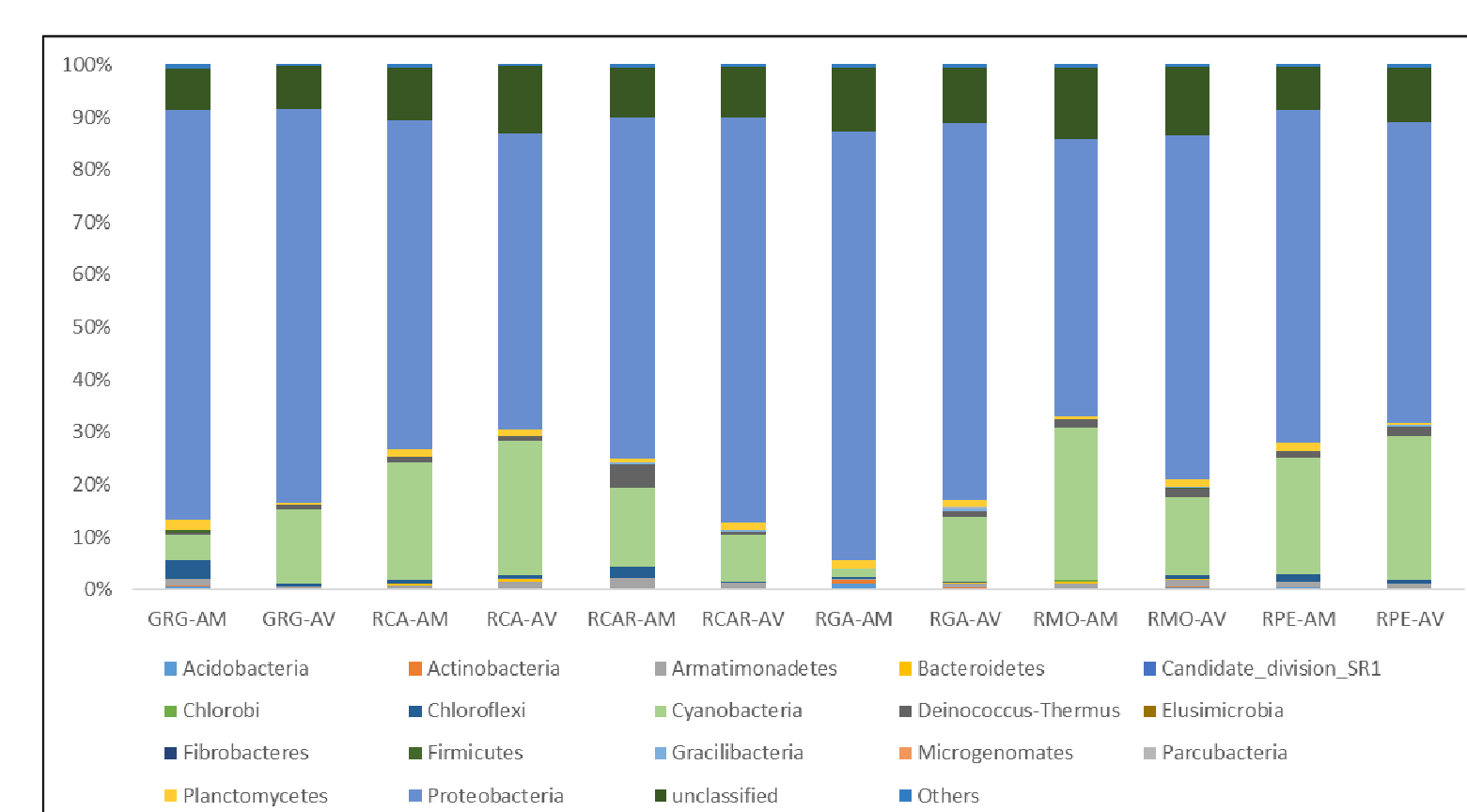
Chlordecone was analyzed by HPLC-ESI-MS-MS (UPLC-Quattro premier Waters)

A gradient of chlordecone Contamination



Chlordecone distribution. The size of the circles is proportional to CLD concentration in the river (µg/L) and potential chlordecone pollution according to the French DAAF réglementation (background)

Proteobacteria and cyanobacteria as main contributors to tropical biofilms communities



Relative abundance of bacteria phyla in the biofilm after 21 days. Interestingly among Proteobacteria, Rhizobiales dominated along with Sphingomonadales and Rhodobacterales. Around 10% of OTU were not classified

Molecular analysis

- Inventories of microorganisms composing the epilithic biofilm communities was performed by targeting the small subunit of ribosomal genes
- The V1-V3 hypervariable region was PCR amplified and sequenced using MiSeq high throughput sequencing (PREMICE platform).
- Data treatment was performed using MOTHUR to obtain OTU table (Schloss et al, 2009)

Statistical analyses

- Log-transformation of OTU abundances to lower the weight of rare and possibly "erratic" OTUs
- Pairwise dissimilarities among samples calculated using the relative abundance-based distance Bray-Curtis (BC).
- Relationship between the 10 predictors and the BC dissimilarity matrix tested using Constrained Analysis of Principal Coordinates (CAPSCALE) with automatic stepwise variable selection based on AIC (excludes longitude)
- Analyses of variance using Monte Carlo test of significance (9999 iterations) to test the effect of each predictor and the first CAPSCALE axis. All statistical analyses implemented within the R statistical programming environment (R Core Team 2014).

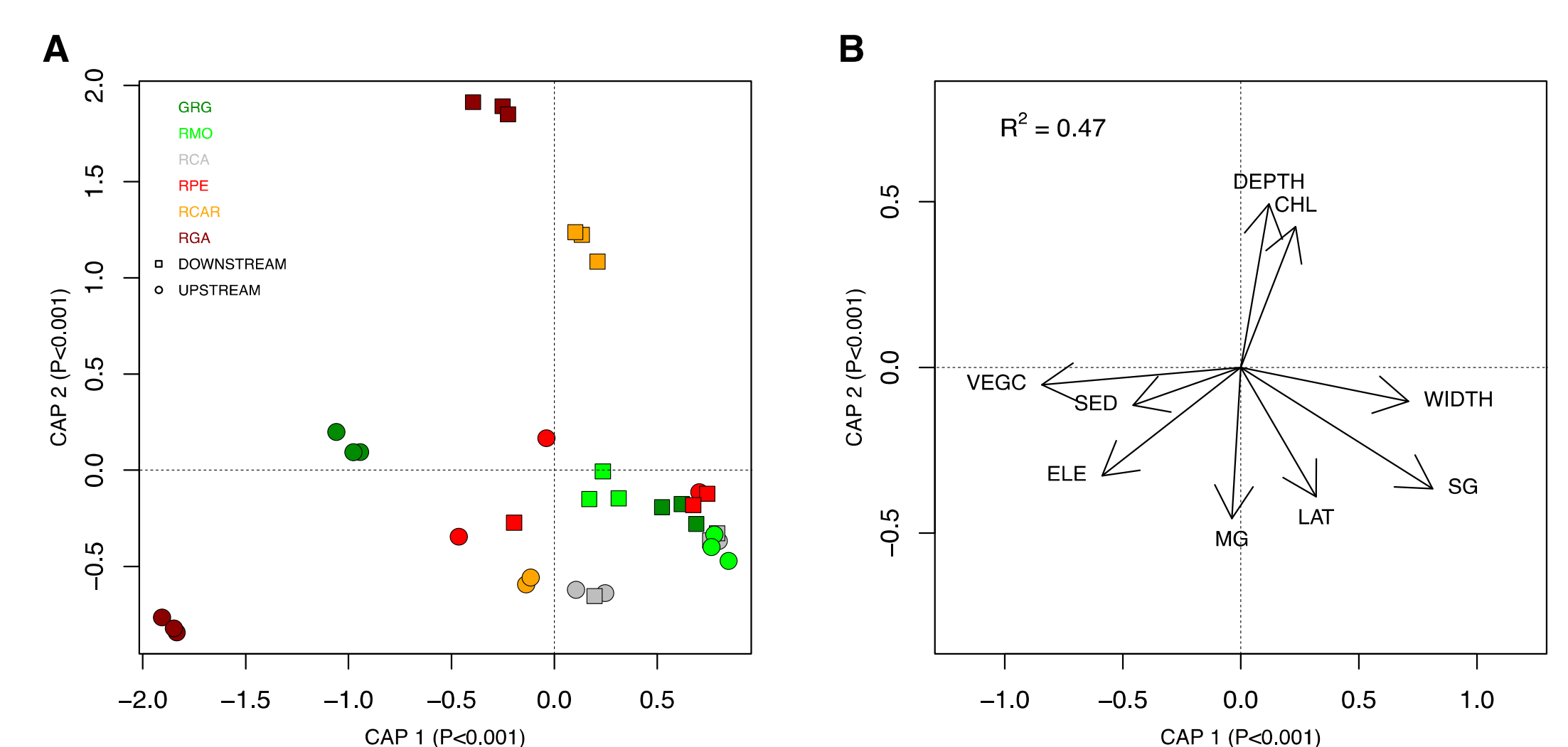
A set of predictors that contributed to explain bacterial community structure in the biofilms

Abbreviations	Variables	Ecological relevance
VEGC	Vegetal cover	Affect the amount of light necessary for photosynthesis
MG	Granulometry (main)	Reflect current velocity - Provide habitats for biofilm's grazers (zooplankton, meiofauna, fishes, ...)
SG	Granulometry (secondary)	
SED	Type of sediment	
ELE	Elevation	Affect irradiance - Indicative of the amount of nutrients
WIDTH	Width of the river	Indicative of river size
DEPTH	Average depth	Determine river pattern
LONG	Longitude	
LAT	Latitude	
CHL	Chlordecone concentration	Contamination pressure ?

Variables	DF	SS	F	P
VEGC	1,25	1.0799	4.9293	0.001
LAT	1,25	0.6445	2.9417	0.002
MG	1,25	0.6564	2.9961	0.001
SG	1,25	0.4449	2.0307	0.001
CHL	1,25	0.4937	2.2535	0.002
WIDTH	1,25	0.4551	2.0771	0.003
ELE	1,25	0.4114	1.8780	0.004
SED	1,25	0.3395	1.5496	0.031
DEPTH	1,25	0.3166	1.4450	0.054

Results of the analysis of variance using Monte Carlo test of significance (9999 iterations) testing the effect of each predictor (on the left table) The degree of freedom (DF), the sum of squares (SS), the F-ratio (F) with its associated P-values (P) are given. Significant results are marked in bold.

Chlordecone among others predictors explained epilithic biofilms composition



Constrained analysis of principal coordinates (CAPSCALE) testing the relationship between Bray-Curtis (BC) dissimilarity matrix and the 9 predictors retained by the variable selection procedure.