

Interpretation

The indicator describes the self-purification performance of a river floodplain section with regard to the retention of introduced phosphorus. It indicates the extent to which the P load of the water is reduced within a river floodplain section under consideration. Different turnover rates in different compartments (e.g. river, active floodplain) can be considered in the indicator. If hydrological data on flood duration and phosphorus concentrations are available, they can be integrated into the models/proxies to supplement the calculations for retention in the floodplain.

References

BfG (2012). QSim - das Gewässergütemodell der BfG. Ein Instrument zur Simulation und Prognose des Stoffhaushalts und der Planktodynamik in Fließgewässern.

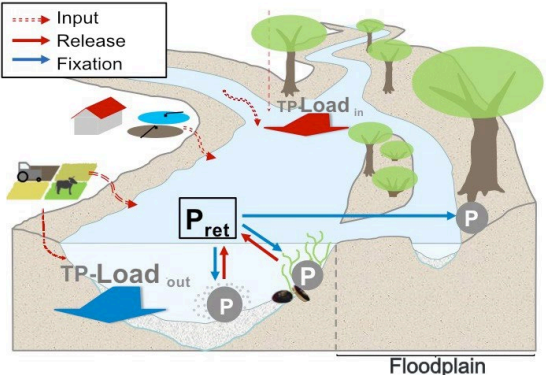
Venohr, M., Hirt, U., Hofmann, J., Opitz, D., Gericke, A., Wetzig, A., Natho, S., Neumann, F., Hürdler, J., Matrangola, M. (2011). Modelling of nutrient emissions in river systems – MONERIS – methods and background. *International Review of Hydrobiology*, 96, 435 - 483.

Schulz-Zunkel, C., Scholz, M., Kasperidus, H.D., Krüger, F., Natho, S. & M. Venohr (2012). Nährstoffrückhalt. In: Scholz, M., Mehl, D., Schulz-Zunkel, C., Kasperidus, H.D., Born, W. & K. Henle: Ökosystemfunktionen von Flussauen. *Naturschutz und Biologische Vielfalt* 124, 48-72.

Schulz-Zunkel, C., Baborowski, M., Ehlert, T., Kasperidus, H. D., Krüger, F., Horschler, P., ... & Natho, S. (2021). Simple modelling for a large-scale assessment of total phosphorus retention in the floodplains of large rivers. *Wetlands*, 41(6), 1-15.

■ Original approach according to River Ecosystem Service Index (RESI) (Podschun et al., 2018)

Class	Abbr.	Description		Spatial reference	
Regulating	P _{ret}	Temporary retention of phosphorus (P) by incorporation into stationary biomass (e.g. bivalves, macrophytes, floodplain vegetation) or by uptake into sediments (deposition, sorption)		Floodplain segment or compartment <input type="checkbox"/> former floodplain <input checked="" type="checkbox"/> active floodplain <input checked="" type="checkbox"/> river	
Variable	Abbr.	Unit	Variable description	Data basis	Comment
P-Load	P _{load}	t a ⁻¹ at the inlet of the 1 km river section	Annual mean of the P-load entering the river section	Modelling (QSim (BfG 2012) and/or MONERIS (Venohr et al. 2011)) or calculations from monitoring data.	
Retention/Release (+/-) of P in the river	RetR	t a ⁻¹ per 1 km river section	Annual P retention in the river section by uptake into stationary biomass or into sediments	Modelling (QSim and/or MONERIS) or direct measurements	(+) in case of retention (-) in case of release
Retention of P in the active floodplain	RetFP	t a ⁻¹ per 1 km floodplain section	Annual P retention in the floodplain section by deposition during floods	Modelling (Schulz-Zunkel et al. 2012)	(+) No release is modeled in floodplains

Calculation						
Pathways of P in river and floodplain				Indicator		
				$P_{ret} = \frac{\Sigma(RetR, RetFP)}{P_{load}} * 1000$		
Scaling <input checked="" type="checkbox"/> national <input type="checkbox"/> local	Ind _{Pret} [‰]	> 0.05	> 0.02 – 0.05	> 0.005 – 0.02	> 0 – 0.005	≤ 0
Evaluation Class (Scale for discharges between 100 and 1000 m³s⁻¹)		5	4	3	2	1
Qualitative Evaluation		Very high Retention	High Retention	Moderate Retention	Low Retention	Release or no Retention

■ Adaption for Danube-wide application

Class	Abbr.	Description			Spatial reference
Regulating	P _{ret}	Temporary retention of phosphorus (P) using semiempirical models and deposition potential in floodplains			Floodplain segment or compartment <input type="checkbox"/> former floodplain <input checked="" type="checkbox"/> active floodplain <input checked="" type="checkbox"/> river
Variable	Abbr.	Unit	Variable description	Data basis	Comment
P-Load	P _{load}	t a ⁻¹ at the inlet of the 10 km river section	Annual mean of the P-load entering the river section	Modelling (MON-ERIS (Venohr et al. 2011)) or calculations from monitoring data.	https://doi.org/10.1002/iroh.201111331
Retention of P in the river	RetR	t a ⁻¹ per 10 km river section	Annual P retention in the river section by uptake into stationary biomass or into sediments	Modelling (MON-ERIS)	
Retention of P in the active floodplain	RetFP	t a ⁻¹ per 10 km floodplain section	Annual P retention in the floodplain section by deposition during floods	Modelling (Schulz-Zunkel et al. 2021) considering flooding frequency (Schleuter 2016)	https://doi.org/10.1007/s13157-021-01458-x https://asnevents.s3.amazonaws.com/Abstrakt-Full-Paper/25266/56778058d89c3-1046-564e91e004326-schleuter-25266_REV2overREV1-RE-WORK5.pdf
Calculation					
Pathways of P in river and floodplain				Indicator	
				$P_{ret} = \frac{\sum (RetR, RetFP)}{P_{load}} * 1000$	

Scaling <input checked="" type="checkbox"/> national <input type="checkbox"/> local	Quintiles of Ind _{Pret}	0.8 - 1	0.6 - 0.8	0.4 - 0.6	0.2 - 0.4	0 - 0.2
Evaluation Class		5	4	3	2	1
Qualitative Evaluation		Very high Retention	High Retention	Moderate Retention	Low Retention	low or no Retention

■ Data sources

Data set	Data type	Spatial reference	Spatial resolution	Source	Creation date	Comments
Pload Output table from MONERIS	Table	International / rivers	Analytical units (AU)		2021	Intersection of AU (MONERIS) with river-floodplain segments
RetR MONERIS: Discharge, slope, water surface area	Table	International / rivers	AU	water surface area: https://land.copernicus.eu/local/riparian-zones/land-cover-land-use-lclu-image	2021	
RetFP Copernicus riparian zones LCLU (MAES_1)	Polygon	International / Active FP	Minimum Mapping Unit: 0.5 ha Minimum Mapping Width: 10 m	https://land.copernicus.eu/local/riparian-zones/land-cover-land-use-lclu-image	2012	
RetFP Corine land cover (CLC 2018)	Polygon	International / Active FP	Minimum Mapping Unit (MMU): 25 ha	https://land.copernicus.eu/pan-european/corine-land-cover/clc2018	2018	
RetFP Flooding frequency	Raster	International / Active FP	30 m	EU DTM: https://doi.org/10.5281/zenodo.4057883	2020	https://asnevents.s3.amazonaws.com/Abstrakt-FullPaper/25266/56778058d89c3-1046-564e91e004326-schleuter-25266_REV2overREV1-REWORK5.pdf