XI Giornata dei Giovani Geomorfologi AIGeo
"The role of early-career geomorphologists in natural hazard assessment and risk reduction"
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Morphological Quality Index of surface water bodies in Western Sicily

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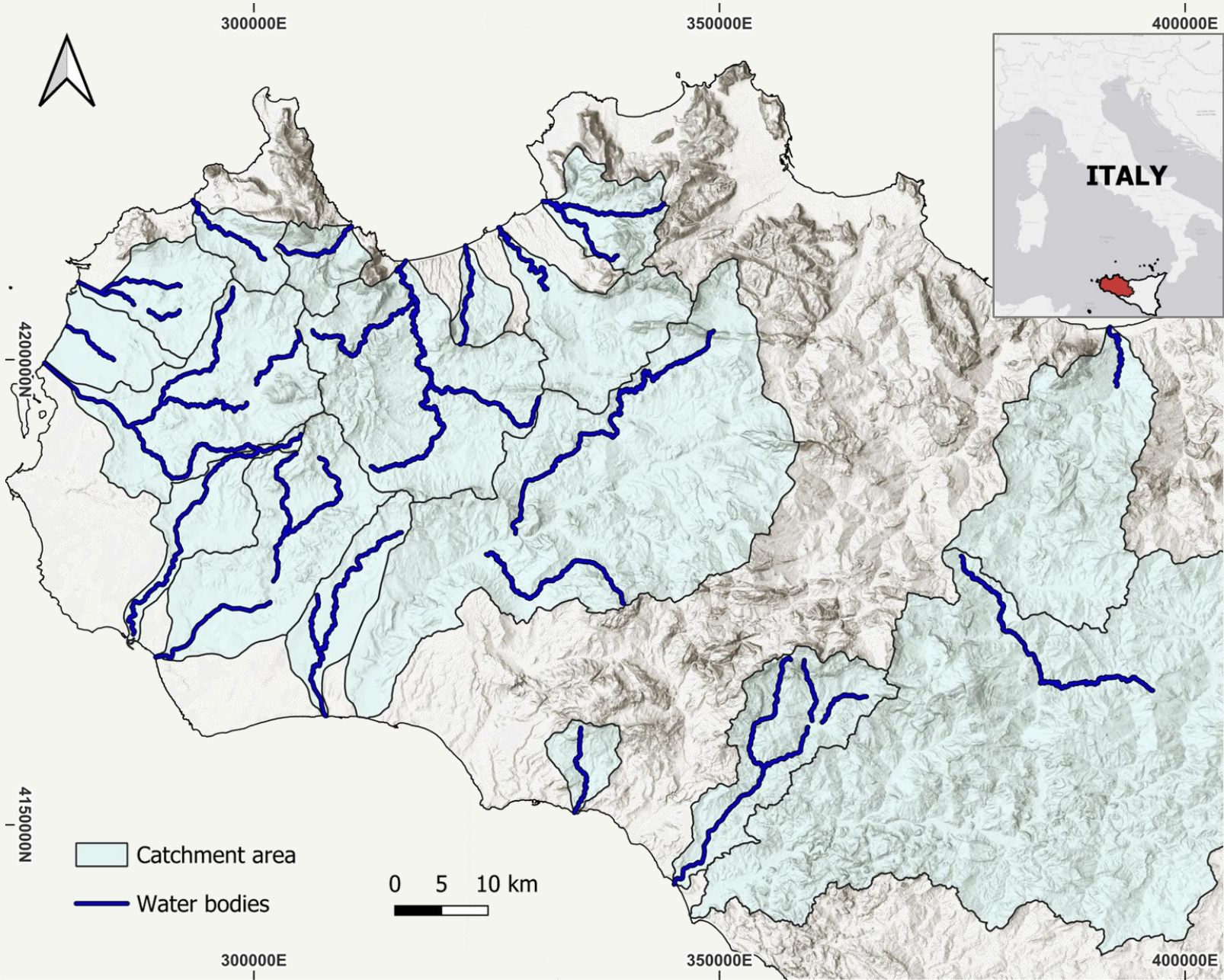
MINISTERO DELLA TRANSIZIONE ECOLOGICA
REGIONE SICILIA
Autorità di bacino
Università degli Studi di Palermo
DiSTeM Dipartimento di Scienze della Terra e del Mare
GIGA LAB LABORATORIO DI GEOMORFOLOGIA, IDROGEOLOGIA E GEOLOGIA APPLICATA

Study area

BASIN	WATER BODY
Torto	F. Torto
Nocella	F. Nocella
	Fosso Raccuglia
Jato	F. Jato
Finocchio	T. Finocchio Molinello
S. Bartolomeo	F. Freddo
	F. Sirignano
	F. Freddo
	F. Caldo
	S. Bartolomeo
Guidaloca	T. Guidaloca
Forgia	T. Forgia
Lenzi	Canale di Xitta (Lenzi)
	Canale di Baiata
	F. cod. 319
BM fra Lenzi e Birgi	F. cod. 302
Birgi	Torrente Fastaia
	F. della Cuddìa
	F. Bordino
	Fiumara Pellegrino
	F. Birgi
Mazarò	T. Judeo
	F. Mazarò

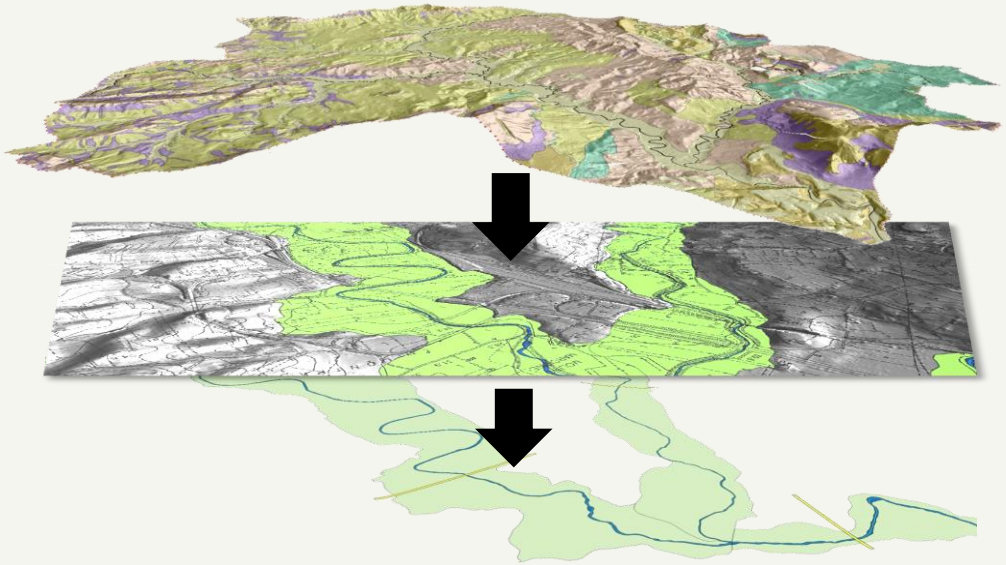
BASIN	WATER BODY
Arena	F. Delia
	Canale della Mokarta
	F. Delia
	F. Delia
Modione	F. Modione
	Canale Ricamino
	F. Modione
Belice	F. Belice Destro
	Torrente Senore
Carabollace	V. Portolana
Magazzolo	F. Magazzolo
	Vallone Acque Bianche
	T. Gebbia
	F. Magazzolo
	F. Magazzolo
Platani	Vallone Morello
	Vallone Tumarrano



IDRAIM methodology

SPATIAL SCALE

- Definition of the catchment area and physiographic units
- Mapping of major river morphologies
- Subdivision into reaches



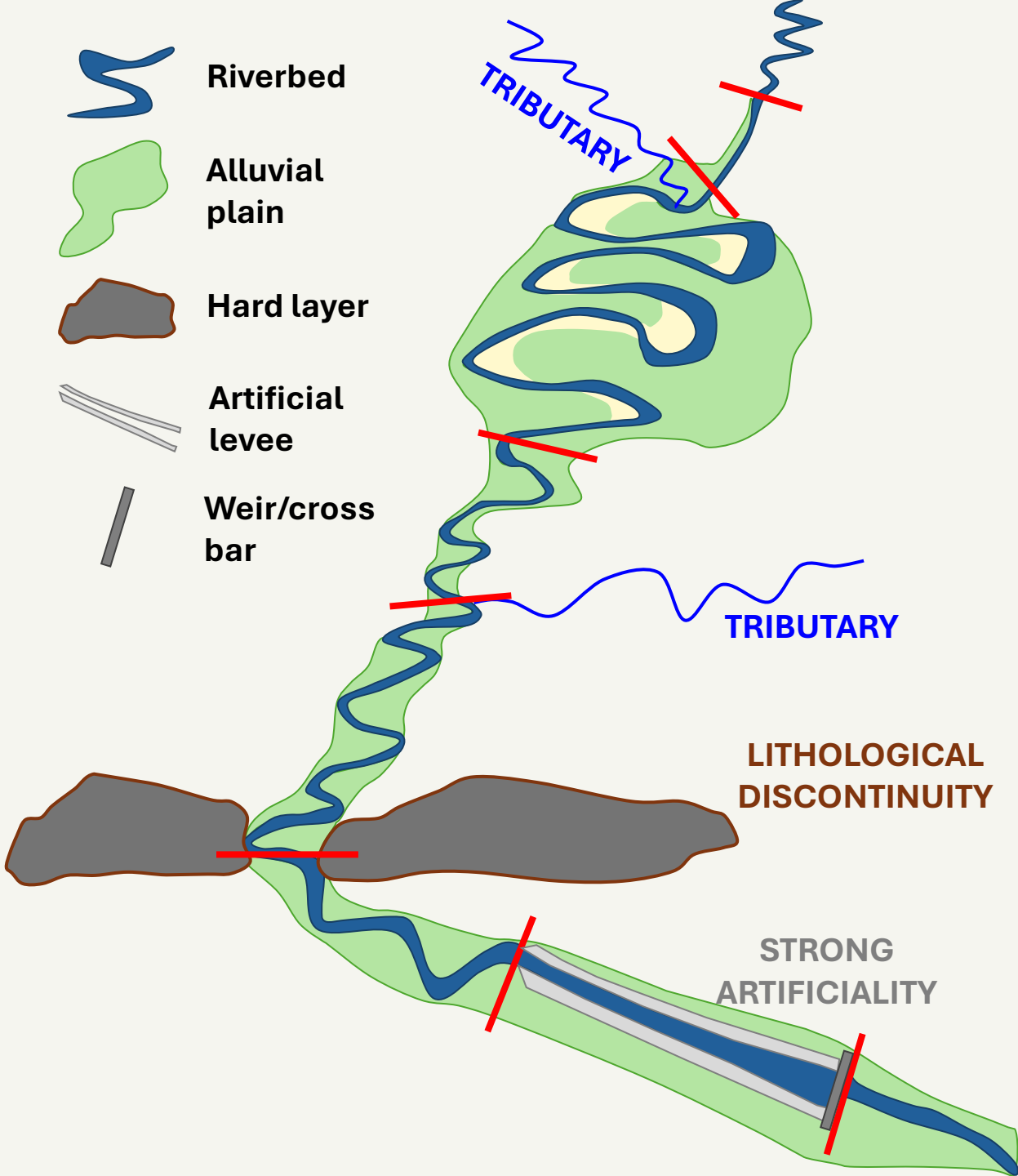
TIME SCALE

- Reconstruction of the past evolution of the water body
- Assessment of current conditions using the Morphological Quality Index (MQI)

Torto river

Subdivision into reaches

- **Sinuosity**
  - Sinuosity Index (SI)
  - Braiding Index (BI)
  - Anastomosing Index (AI)
- **Confinement**
  - Confinement Degree (CD)
  - Confinement Index (CI)
- **Other elements**
  - Lithological discontinuities
  - Discontinuity of the slope of the bottom
  - Variations in the plain size
  - Hydrological discontinuities
  - Variations in sediment size
  - Variations in morphological units
  - Strong artificialization



GEOMORPHOLOGICAL FUNCTIONALITY		A	B	C	
Longitudinal continuity					
F1	Longitudinal continuity in sediment and wood flux	0	3	5	
Lateral continuity					
F2	Presence of a modern floodplain	0	3	5	
F3	Hillslope - river corridor connectivity	0	3	5	
F4	Processes of bank retreat	0	2	3	
F5	Presence of a potentially erodible corridor	0	2	3	
Channel pattern					
F6	Bed configuration - valley slope	0	3	5	
F7	Forms and processes typical of the channel pattern	0	3	5	
F8	Presence of typical fluvial forms in the alluvial plain	0	2	3	
Cross-section configuration					
F9	Variability of the cross-section	0	3	5	
Bed structure and substrate					
F10	Structure of the channel bed	0	2	5	6
F11	Presence of in-channel large wood	0		3	
Vegetation					
F12	Width of functional vegetation	0	2	3	
F13	Linear extension of functional vegetation	0	3	5	

ARTIFICIALITY		A	B	C		
Upstream alteration of longitudinal continuity						
A1	Upstream alteration of flows	0	3	6		
A2	Upstream alteration of sediment discharges	0	3	6	9	12
Alteration of longitudinal continuity in the reach						
A3	Alteration of flows in the reach	0	3	6		
A4	Alteration of sediment discharge in the reach	0	4	6		
A5	Crossing structures	0	2	3		
Alteration of lateral continuity						
A6	Bank protections	0	3	6		
A7	Artificial levees	0	3	6		
Alteration of channel morphology and/or substrate						
A8	Artificial changes of river course	0	2	3		
A9	Other bed stabilization structures	0	3	6	8	
Interventions of maintenance and removal						
A10	Sediment removal	0	3	6		
A11	Wood removal	0	2	5		
A12	Vegetation menagement	0	2	5		

CHANNEL ADJUSTMENTS		A	B	C	
CA1	Adjustments in channel pattern	0	3	6	
CA2	Adjustments in channel width	0	3	6	
CA3	Bed-level adjustments	0	4	8	12

Morphological Quality Index (MQI)

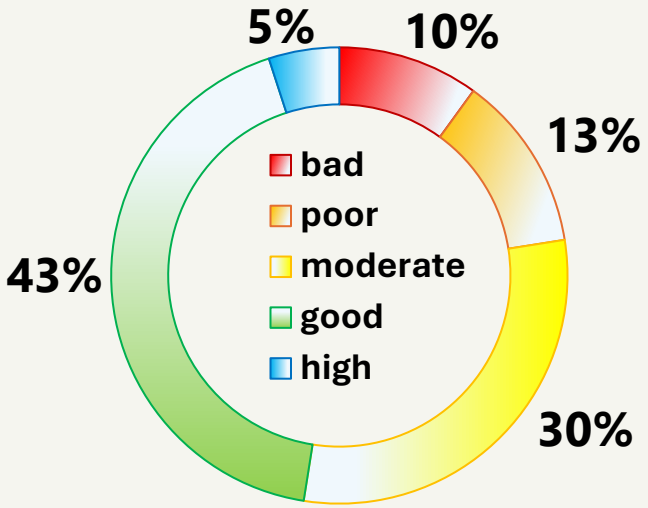
The Morphological Quality Index (MQI) is an index derived from expert judgment applied to three groups of indicators such as Geomorphological Functionality (F), Artificiality (A) and Channel Adjustments (CA).

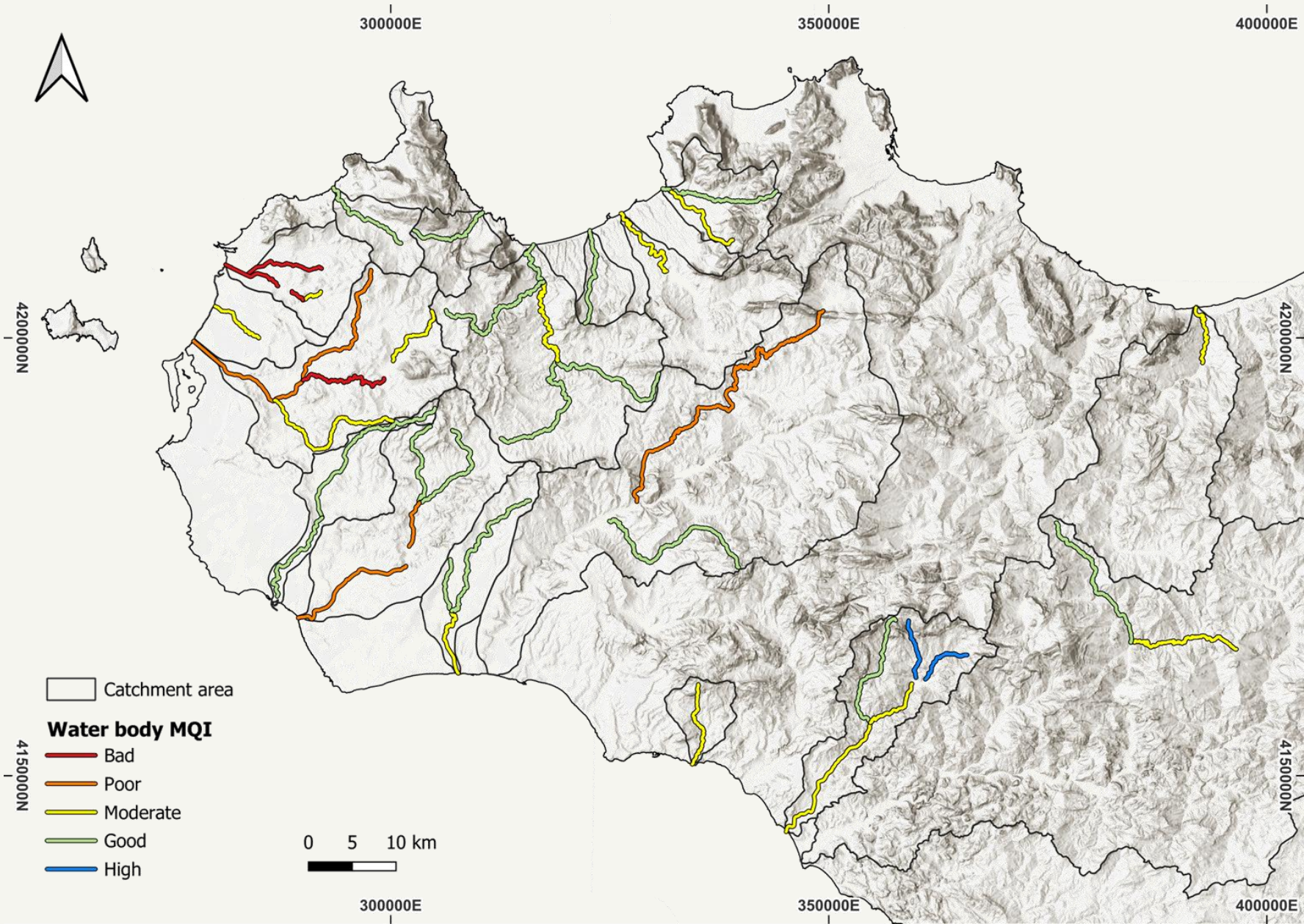
Each indicator is assigned a class to which a score corresponds. From the sum of the scores, we obtain the MAI (Morphological Alteration Index).

$$1 - MAI = MQI$$

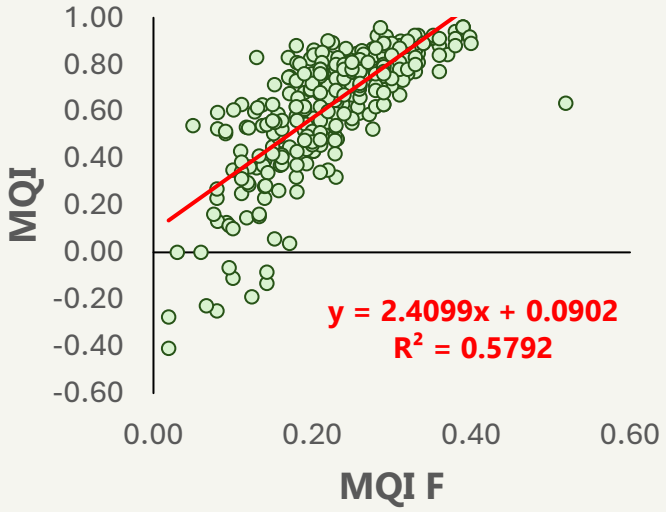
MQI	Quality classes
$0.0 \leq MQI < 0.3$	*Very poor or bad*
$0.3 \leq MQI < 0.5$	*Poor*
$0.5 \leq MQI < 0.7$	*Moderate*
$0.7 \leq MQI < 0.85$	*Good*
$0.85 \leq MQI \leq 1.0$	*Very good or high*

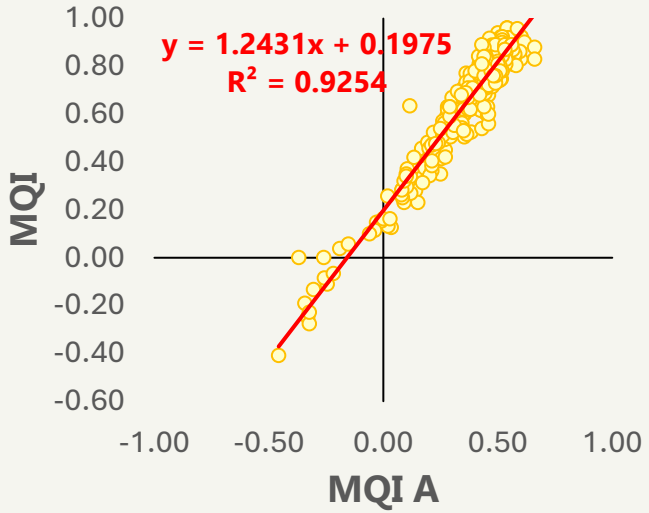
Water bodies MQI

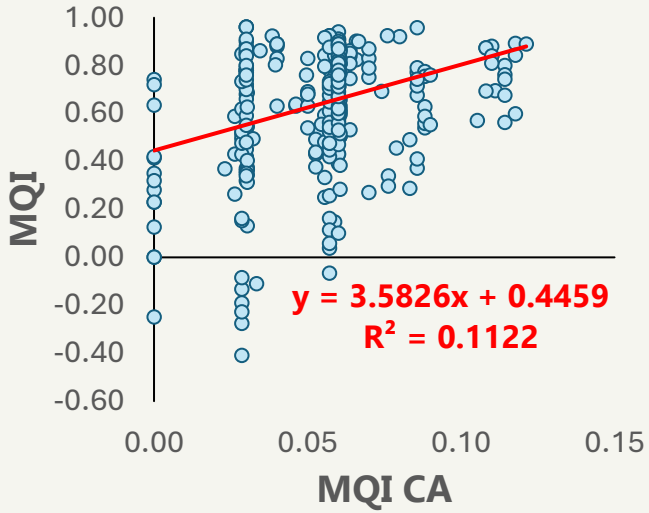




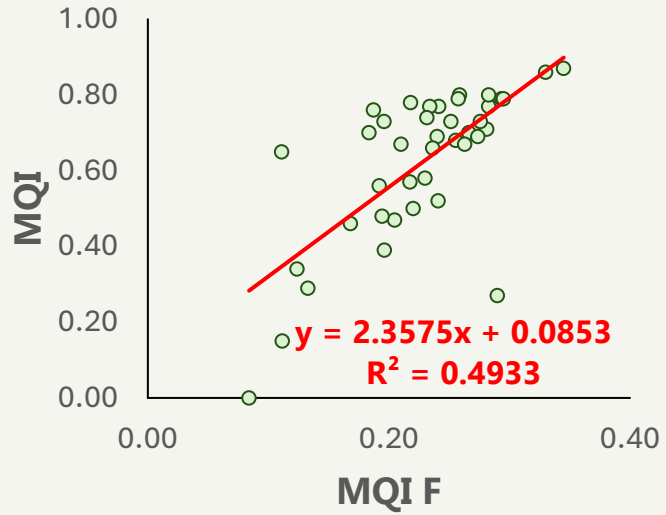
MQI vs indicators F, A and CA

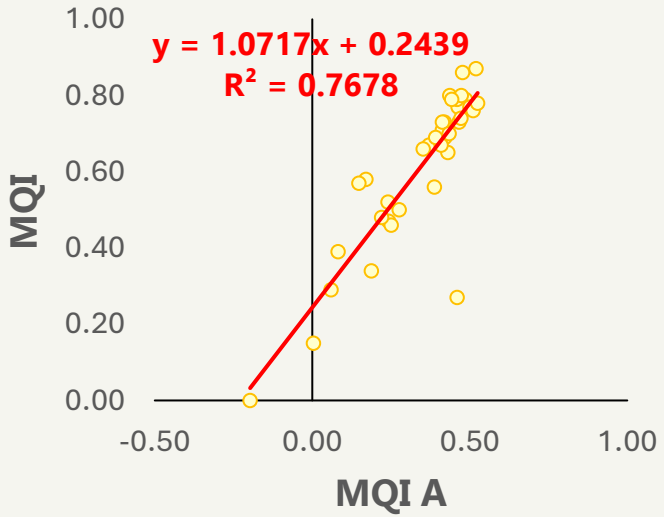


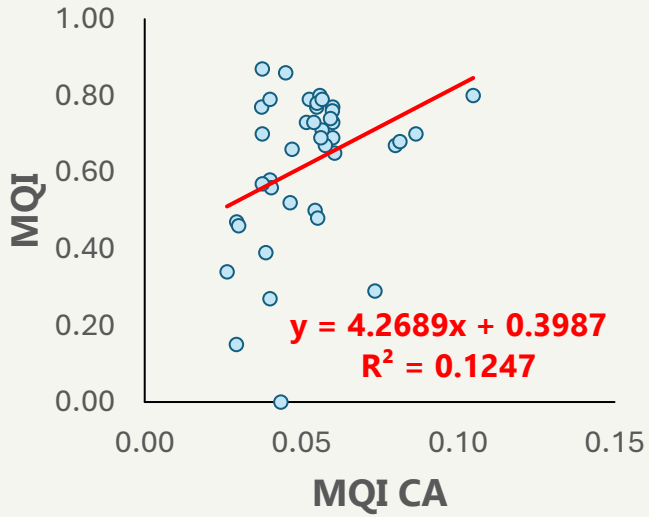




Reach scale







Water body scale

Sensitivity Analysis

To evaluate the response of a reach to a class variation of each indicator, a sensitivity analysis was performed.

Two sheets have been created, one for confined reaches and one for semi- and unconfined reaches, with which all possible class variations of MQI can be calculated starting from the original MQI.

FUNCTIONALITY					
F1	pt	scelta	SF	na	Max
A	0	x	0	0	5
B	3				
C	5				
F2	pt	scelta	SF	na	Max
A	0	x	0	0	5
B	3				
C	5				
F4	pt	scelta	SF	na	Max
A	0		3	0	3
B	2				
C	3	x			
F5	pt	scelta	SF	na	Max
A	0	x	0	0	3
B	2				
C	3				
F7	pt	scelta	SF	na	Max
A	0		3	0	5
B	3	x			
C	5				
F8	pt	scelta	SF	na	Max
A	0		0	3	3
B	2				
C	3				
F9	pt	scelta	SF	na	Max
A	0		3	0	5
B	3	x			
C	5				
F10	pt	scelta	SF	na	Max
A	0		2	0	6
B	2	x			
C1	5				
C2	6				
F11	pt	scelta	SF	na	Max
A	0		3	0	3
C	3	x			
F12	pt	scelta	SF	na	Max
A	0		2	0	3
B	2	x			
C	3				
F13	pt	scelta	SF	na	Max
A	0		3	0	5
B	3	x			
C	5				

ARTIFICIALITY					
A1	pt	scelta	SF	na	Max
A	0	x	0	0	6
B	3				
C	6				
A2	pt	scelta	SF	na	Max
A	0		6	0	12
B1	3				
B2	6	x			
C1	9				
C2	12				
A3	pt	scelta	SF	na	Max
A	0	x	0	0	6
B	3				
C	6				
A4	pt	scelta	SF	na	Max
A	0		6	0	6
B	4				
C	6	x			
A5	pt	scelta	SF	na	Max
A	0		3	0	3
B	2				
C	3	x			
A6	pt	scelta	SF	na	Max
A	0		3	0	6
B	3	x			
C	6				
A7	pt	scelta	SF	na	Max
A	0	x	0	0	6
B	3				
C	6				
A8	pt	scelta	SF	na	Max
A	0		3	0	3
B	2				
C	3	x			
A9	pt	scelta	SF	na	Max
A	0	x	0	0	8
B	3				
C1	6				
C2	8				
A10	pt	scelta	SF	na	Max
A	0		0	6	6
B	3				
C	6				
A11	pt	scelta	SF	na	Max
A	0		0	5	5
B	2				
C	5				
A12	pt	scelta	SF	na	Max
A	0		0	5	5
B	2				
C	5				

CHANNEL ADJUSTMENTS					
V1	pt	scelta	SF	na	Max
A	0		3	0	6
B	3	x			
C	6				
V2	pt	scelta	SF	na	Max
A	0		0	6	6
B	3				
C	6				
V3	pt	scelta	SF	na	Max
A	0		0	12	12
B	4				
C1	8				
C2	12				

F1 - A

	F	A	V	Stot	Max(Stot)	Sna	Smax	IAM	IQM
SF tot	19	21	3	43	142	37	105	0.41	0.59

F1 - B

	F	A	V	Stot	Max(Stot)	Sna	Smax	IAM	IQM
SF tot	22	21	3	46	142	37	105	0.44	0.56

F1 - C

	F	A	V	Stot	Max(Stot)	Sna	Smax	IAM	IQM
SF tot	24	21	3	48	142	37	105	0.46	0.54

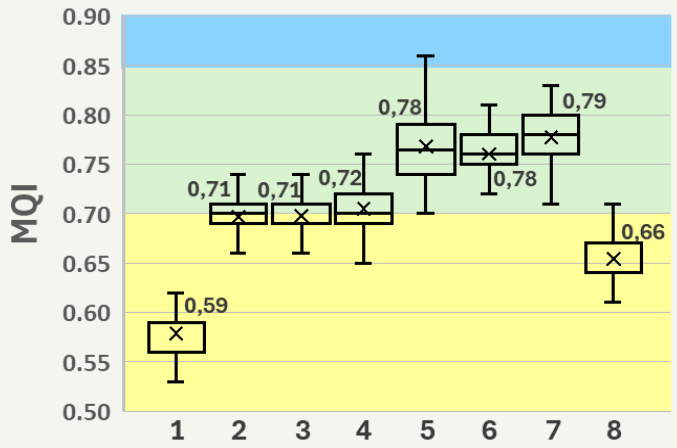
Sensitivity Analysis

Water body MQI = 0,70

Water body	Reach	Type reach	Lenght [m]	MQI	F1			F2			F3			F4			F5			F6			F7			F8	F9			F10				F11		F12			F13		
					A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A B C	A	B	C	A	B	C1	C2	A	C	A	B	C	A	B	C
4801	1	S-NC	1925	**0.59**	0.59	0.56	0.54	0.59	0.56	0.54				0.62	0.60	0.59	0.59	0.57	0.56				0.62	0.59	0.57		0.62	0.59	0.57	0.61	0.59	0.56	0.55	0.62	0.59	0.61	0.59	0.58	0.62	0.59	0.57
4801	2	S-NC	2300	**0.71**	0.74	0.71	0.69	0.71	0.69	0.67				0.74	0.72	0.71	0.71	0.69	0.69				0.74	0.71	0.69		0.71	0.69	0.67	0.71	0.69	0.67	0.66	0.74	0.71	0.73	0.71	0.70	0.76	0.73	0.71
4801	3	R-NC	900	**0.71**	0.71	0.69	0.67	0.71	0.69	0.67				0.74	0.72	0.71	0.71	0.69	0.69				0.71	0.69	0.67		0.71	0.69	0.67	0.71	0.69	0.67	0.66	0.74	0.71	0.73	0.71	0.70	0.76	0.73	0.71
4801	4	S-NC	3850	**0.72**	0.75	0.72	0.70	0.72	0.69	0.68				0.74	0.72	0.71	0.72	0.70	0.69				0.75	0.72	0.70		0.72	0.69	0.68	0.74	0.72	0.69	0.69	0.75	0.72	0.74	0.72	0.71	0.75	0.72	0.70
4801	5	S-C	1100	**0.78**	0.79	0.76	0.73				0.79	0.76	0.73							0.79	0.76	0.73					0.79	0.76	0.76	0.81	0.79	0.76	0.74	0.82	0.79	0.82	0.80	0.79	0.82	0.79	0.77
4801	6	S-SC	700	**0.78**	0.78	0.75	0.73	0.78	0.75	0.73				0.81	0.79	0.78	0.78	0.76	0.75				0.81	0.78	0.76		0.78	0.75	0.73	0.78	0.76	0.73	0.72	0.81	0.78	0.80	0.78	0.77	0.81	0.78	0.76
4801	7	S-C	700	**0.79**	0.80	0.77	0.74				0.83	0.80	0.78							0.80	0.77	0.74					0.80	0.77	0.77	0.80	0.78	0.74	0.73	0.83	0.80	0.83	0.81	0.80	0.83	0.80	0.78
4801	8	S-NC	1225	**0.66**	0.67	0.64	0.62	0.67	0.64	0.62				0.69	0.68	0.67	0.67	0.65	0.64				0.67	0.64	0.62		0.69	0.67	0.65	0.67	0.65	0.62	0.61	0.69	0.67	0.69	0.67	0.66	0.71	0.69	0.67

Water body	Reach	Type reach	Lenght [m]	MQI	A1			A2					A3			A4			A5			A6			A7			A8			A9				A10			A11			A12		
					A	B	C	A	B1	B2	C1	C2	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C1	C2	A	B	C	A	B	C	A	B	C
4801	1	S-NC	1925	**0.59**	0.59	0.56	0.53	0.65	0.62	0.59	0.56	0.53	0.59	0.56	0.53	0.65	0.61	0.59	0.62	0.60	0.59	0.62	0.59	0.56	0.59	0.56	0.59	0.62	0.60	0.59	0.59	0.56	0.53	0.53	0.59	0.56	0.53	0.59	0.57	0.54	0.59	0.56	0.53
4801	2	S-NC	2300	**0.71**	0.71	0.69	0.66	0.74	0.71	0.69	0.66	0.63	0.71	0.69	0.66	0.75	0.71	0.69	0.73	0.71	0.70	0.71	0.69	0.66	0.71	0.69	0.69	0.71	0.69	0.69	0.71	0.69	0.66	0.66	0.71	0.69	0.66	0.71	0.69	0.67	0.71	0.69	0.66
4801	3	R-NC	900	**0.71**	0.71	0.69	0.66	0.77	0.74	0.71	0.69	0.66	0.71	0.69	0.66	0.77	0.73	0.71	0.71	0.69	0.69	0.71	0.69	0.66	0.71	0.69	0.71	0.74	0.72	0.71	0.71	0.69	0.66	0.66	0.71	0.69	0.66	0.71	0.69	0.67	0.71	0.69	0.66
4801	4	S-NC	3850	**0.72**	0.72	0.69	0.67	0.78	0.75	0.72	0.69	0.67	0.72	0.69	0.67	0.76	0.72	0.70	0.74	0.72	0.71	0.72	0.69	0.67	0.72	0.69	0.69	0.72	0.70	0.69	0.72	0.69	0.67	0.67	0.72	0.69	0.67	0.72	0.70	0.68	0.72	0.69	0.67
4801	5	S-C	1100	**0.78**	0.79	0.76	0.72	0.86	0.82	0.79	0.76	0.72	0.79	0.76	0.72	0.79	0.74	0.72	0.81	0.79	0.78	0.79	0.76	0.72							0.76	0.72	0.72	0.70	0.79	0.76	0.76	0.79	0.77	0.73	0.79	0.77	0.73
4801	6	S-SC	700	**0.78**	0.78	0.75	0.72	0.83	0.81	0.78	0.75	0.72	0.78	0.75	0.72	0.81	0.78	0.76	0.78	0.76	0.75	0.78	0.75	0.72	0.78	0.75	0.75	0.78	0.76	0.75	0.78	0.75	0.72	0.72	0.78	0.75	0.72	0.78	0.76	0.73	0.78	0.75	0.72
4801	7	S-C	700	**0.79**	0.80	0.77	0.73	0.87	0.83	0.80	0.77	0.73	0.80	0.77	0.73	0.80	0.76	0.73	0.80	0.78	0.77	0.80	0.77	0.73							0.77	0.73	0.73	0.71	0.80	0.77	0.77	0.80	0.78	0.74	0.80	0.78	0.74
4801	8	S-NC	1225	**0.66**	0.67	0.64	0.61	0.72	0.69	0.67	0.64	0.61	0.67	0.64	0.61	0.67	0.63	0.61	0.69	0.67	0.66	0.67	0.64	0.61	0.69	0.67	0.67	0.69	0.68	0.67	0.69	0.67	0.64	0.64	0.67	0.64	0.61	0.67	0.65	0.62	0.67	0.64	0.61

Water body	Reach	Type reach	Lenght [m]	MQI	V1			V2			V3			
					A	B	C	A	B	C	A	B	C1	C2
4801	1	S-NC	1925	**0.59**	0.62	0.59	0.59	0.59	0.56	0.53	0.59	0.55	0.51	0.48
4801	2	S-NC	2300	**0.71**	0.74	0.71	0.71	0.71	0.69	0.66	0.71	0.68	0.64	0.60
4801	3	R-NC	900	**0.71**	0.74	0.71	0.71	0.71	0.69	0.66	0.71	0.68	0.64	0.60
4801	4	S-NC	3850	**0.72**	0.72	0.69	0.69	0.72	0.69	0.67	0.72	0.69	0.65	0.61
4801	5	S-C	1100	**0.78**	0.79	0.76		0.79	0.76		0.79	0.74	0.70	
4801	6	S-SC	700	**0.78**	0.78	0.75	0.75	0.78	0.75	0.72	0.78	0.74	0.70	0.67
4801	7	S-C	700	**0.79**	0.80	0.77		0.80	0.77		0.80	0.76	0.71	
4801	8	S-NC	1225	**0.66**	0.69	0.67	0.67	0.67	0.64	0.61	0.67	0.63	0.59	0.56



Sensitivity Analysis

Water body	Reach	Type reach	Lenght [m]	MQI	F1		
					A	B	C
4801	1	S-NC	1925	0.59	0.59	0.56	0.54
4801	2	S-NC	2300	0.71	0.74	0.71	0.69
4801	3	R-NC	900	0.71	0.71	0.69	0.67
4801	4	S-NC	3850	0.72	0.75	0.72	0.70
4801	5	S-C	1100	0.78	0.79	0.76	0.73
4801	6	S-SC	700	0.78	0.78	0.75	0.73
4801	7	S-C	700	0.79	0.80	0.77	0.74
4801	8	S-NC	1225	0.66	0.67	0.64	0.62
			12700				

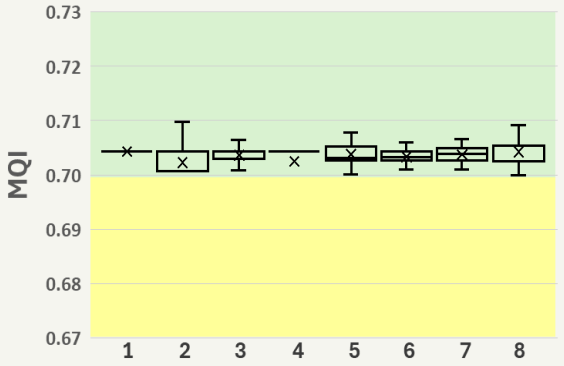
$$MQI_{WB} = \frac{MQI' * l'}{L} + \frac{MQI'' * l''}{L} + \cdots + \frac{MQI^n * l^n}{L}$$

Water body MQI = 0,70

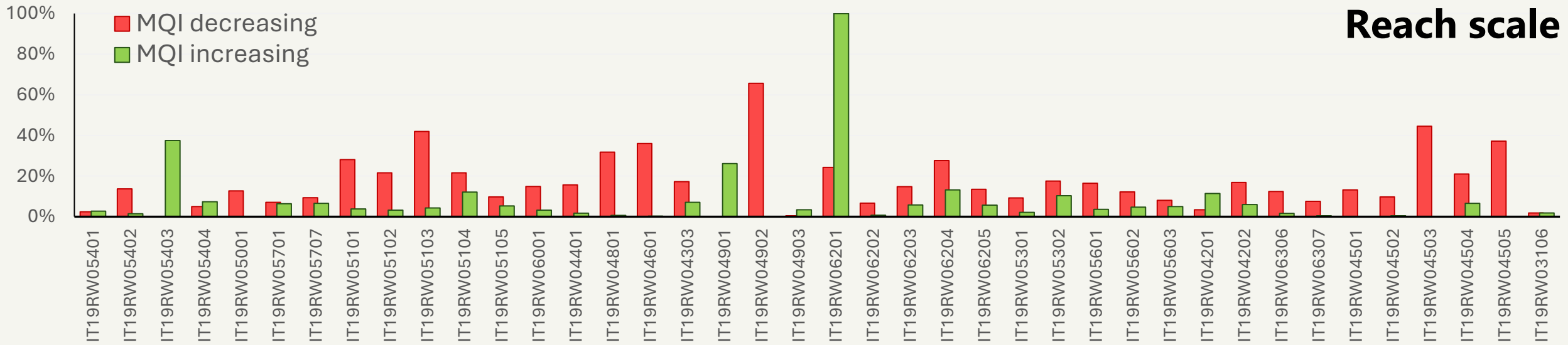
Water body	Reach	Type reach	Lenght [m]	MQI	F1			F2			F3			F4			F5			F6			F7			F8	F9			F10				F11		F12			F13		
					A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A B C	A	B	C	A	B	C1	C2	A	C	A	B	C	A	B	C
4801	1	S-NC	1925	0.59	0.70	0.70	0.70	0.70	0.70	0.70				0.71	0.71	0.70	0.70	0.70	0.70				0.71	0.70	0.70		0.71	0.70	0.70	0.71	0.70	0.70	0.70	0.71	0.70	0.71	0.70	0.70	0.71	0.70	0.70
4801	2	S-NC	2300	0.71	0.71	0.70	0.70	0.70	0.70	0.70				0.71	0.71	0.70	0.70	0.70	0.70				0.71	0.70	0.70		0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.71	0.70	0.71	0.70	0.70	0.71	0.71	0.70
4801	3	R-NC	900	0.71	0.70	0.70	0.70	0.70	0.70	0.70				0.71	0.71	0.70	0.70	0.70	0.70				0.70	0.70	0.70		0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.71	0.70	0.71	0.70	0.70	0.71	0.71	0.70
4801	4	S-NC	3850	0.72	0.71	0.70	0.70	0.70	0.70	0.69				0.71	0.70	0.70	0.70	0.70	0.70				0.71	0.70	0.70		0.70	0.70	0.69	0.71	0.70	0.70	0.70	0.71	0.70	0.71	0.70	0.70	0.71	0.70	0.70
4801	5	S-C	1100	0.78	0.71	0.70	0.70				0.71	0.70	0.70							0.71	0.70	0.70					0.71	0.70	0.70	0.71	0.71	0.70	0.70	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.70
4801	6	S-SC	700	0.78	0.70	0.70	0.70	0.70	0.70	0.70				0.71	0.70	0.70	0.70	0.70	0.70				0.71	0.70	0.70		0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.71	0.70	0.71	0.70	0.70	0.71	0.70	0.70
4801	7	S-C	700	0.79	0.70	0.70	0.70				0.71	0.70	0.70							0.70	0.70	0.70					0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.71	0.70	0.71	0.71	0.70	0.71	0.70	0.70
4801	8	S-NC	1225	0.66	0.71	0.70	0.70	0.71	0.70	0.70				0.71	0.71	0.71	0.71	0.70	0.70				0.71	0.70	0.70		0.71	0.71	0.70	0.71	0.70	0.70	0.70	0.71	0.71	0.71	0.71	0.70	0.71	0.71	0.71

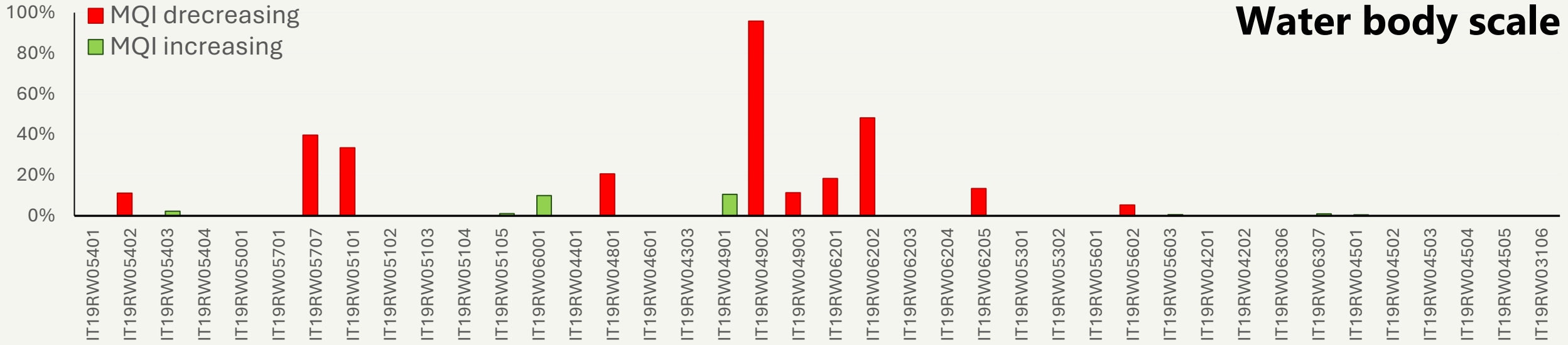
Water body	Reach	Type reach	Lenght [m]	MQI	A1			A2					A3			A4			A5			A6			A7			A8			A9				A10			A11			A12		
					A	B	C	A	B1	B2	C1	C2	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C1	C2	A	B	C	A	B	C	A	B	C
4801	1	S-NC	1925	0.59	0.70	0.70	0.70	0.71	0.71	0.70	0.70	0.70	0.70	0.70	0.70	0.71	0.71	0.70	0.71	0.71	0.70	0.71	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70
4801	2	S-NC	2300	0.71	0.70	0.70	0.70	0.71	0.70	0.70	0.70	0.69	0.70	0.70	0.70	0.71	0.70	0.70	0.71	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70
4801	3	R-NC	900	0.71	0.70	0.70	0.70	0.71	0.71	0.70	0.70	0.70	0.70	0.70	0.70	0.71	0.71	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.71	0.71	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70
4801	4	S-NC	3850	0.72	0.70	0.70	0.69	0.72	0.71	0.70	0.70	0.69	0.70	0.70	0.69	0.72	0.70	0.70	0.71	0.70	0.70	0.70	0.70	0.69	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.69	0.69	0.70	0.70	0.69	0.70	0.70	0.69	0.70	0.70	0.69
4801	5	S-C	1100	0.78	0.71	0.70	0.70	0.71	0.71	0.71	0.70	0.70	0.71	0.70	0.70	0.71	0.70	0.70	0.71	0.71	0.70	0.71	0.70	0.70							0.70	0.70	0.70	0.70	0.71	0.70	0.70	0.71	0.70	0.70	0.71	0.70	0.70
4801	6	S-SC	700	0.78	0.70	0.70	0.70	0.71	0.71	0.70	0.70	0.70	0.70	0.70	0.70	0.71	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70
4801	7	S-C	700	0.79	0.70	0.70	0.70	0.71	0.71	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70							0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70
4801	8	S-NC	1225	0.66	0.71	0.70	0.70	0.71	0.71	0.71	0.70	0.70	0.71	0.70	0.70	0.71	0.70	0.70	0.71	0.71	0.70	0.71	0.70	0.70	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.70	0.70	0.71	0.70	0.70	0.71	0.70	0.70	0.71	0.70	0.70

Water body	Reach	Type reach	Lenght [m]	MQI	V1			V2			V3			
					A	B	C	A	B	C	A	B	C1	C2
4801	1	S-NC	1925	0.59	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.69	0.69
4801	2	S-NC	2300	0.71	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.69	0.68
4801	3	R-NC	900	0.71	0.71	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70
4801	4	S-NC	3850	0.72	0.70	0.70	0.70	0.70	0.70	0.69	0.70	0.70	0.68	0.67
4801	5	S-C	1100	0.78	0.71	0.70		0.71	0.70		0.71	0.70	0.70	
4801	6	S-SC	700	0.78	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70
4801	7	S-C	700	0.79	0.70	0.70		0.70	0.70		0.70	0.70	0.70	
4801	8	S-NC	1225	0.66	0.71	0.71	0.71	0.71	0.70	0.70	0.71	0.70	0.70	0.70



Sensitivity Analysis





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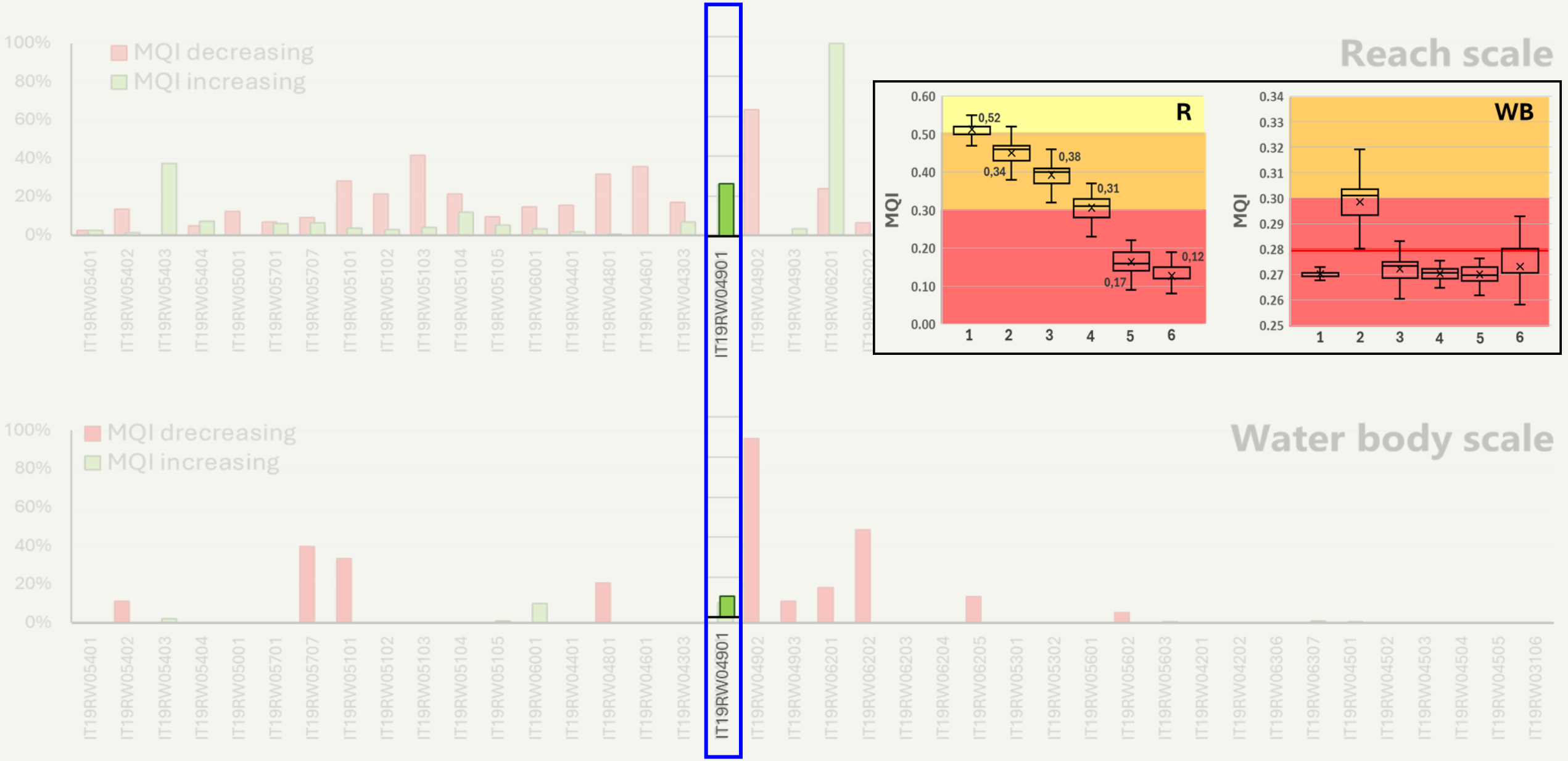

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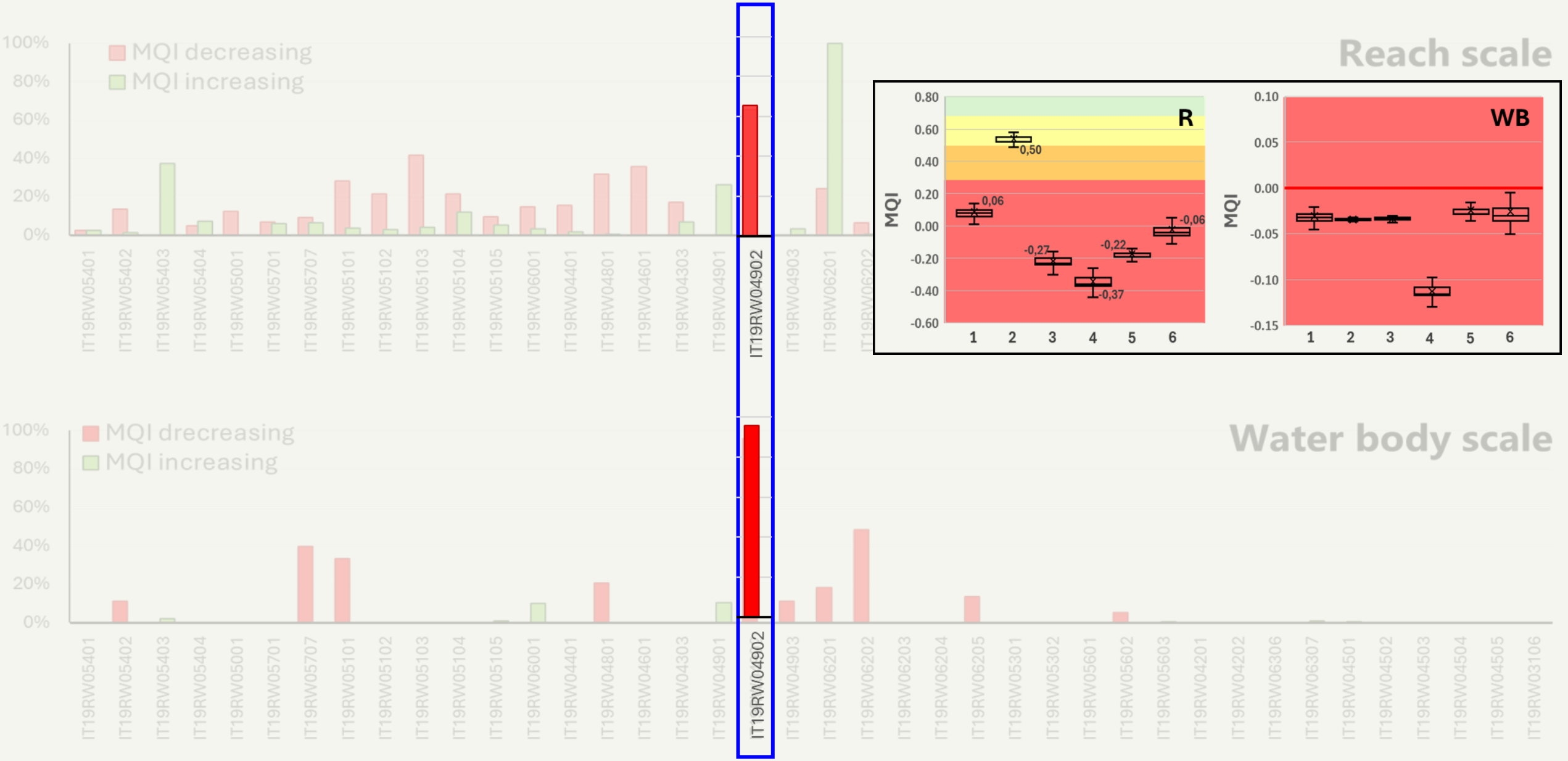
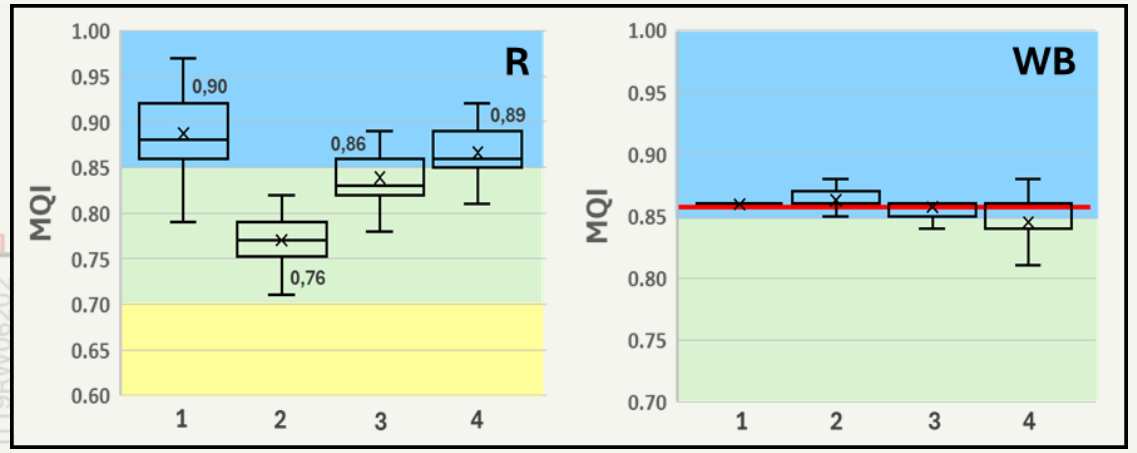


Sensitivity Analysis

Reach scale

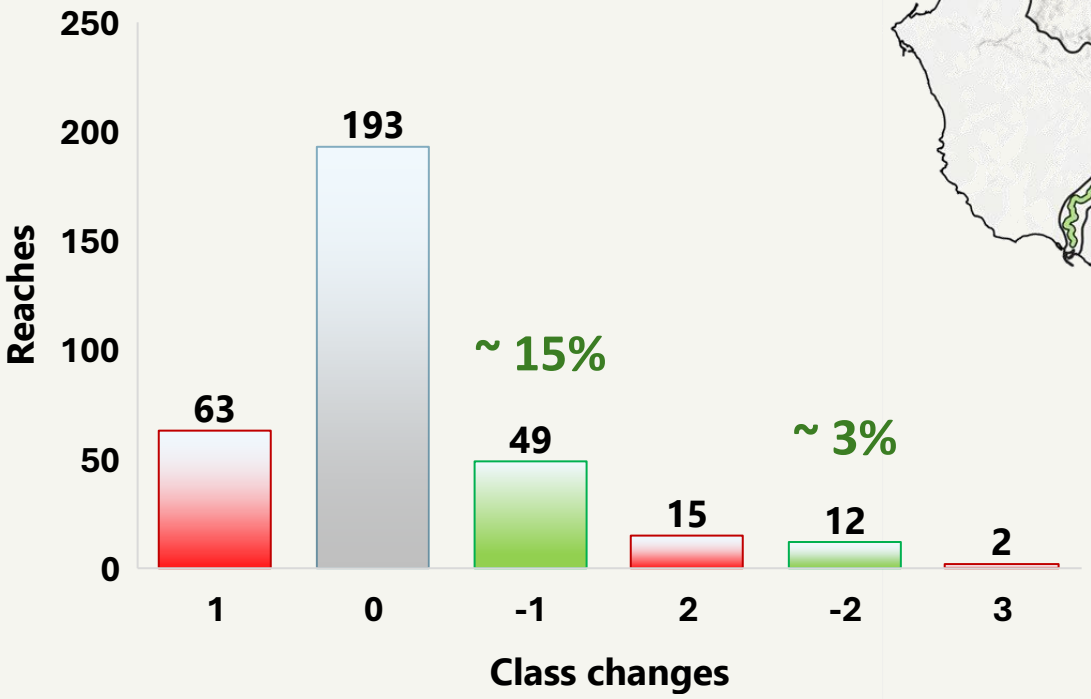


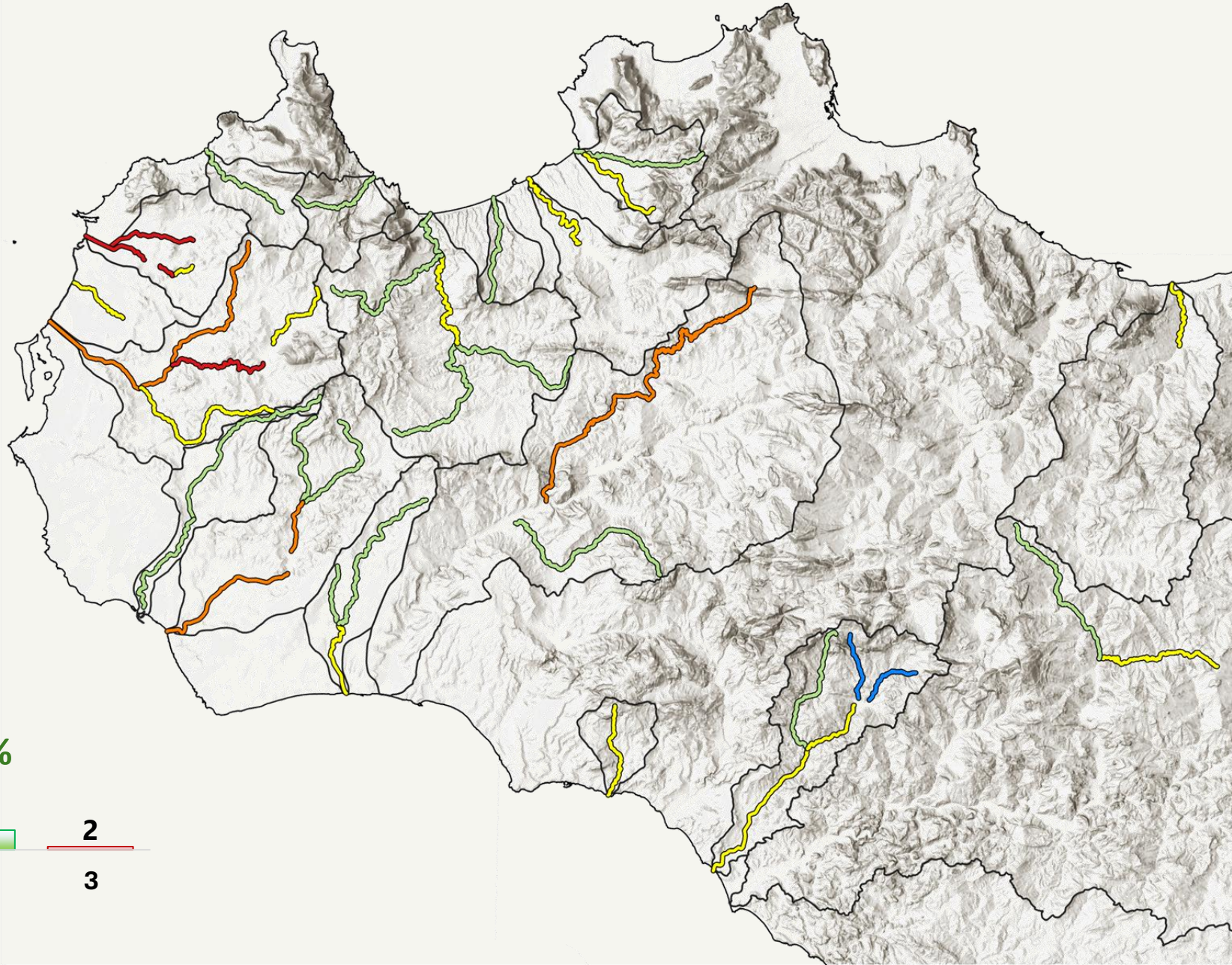
Water body scale

Sensitivity Analysis

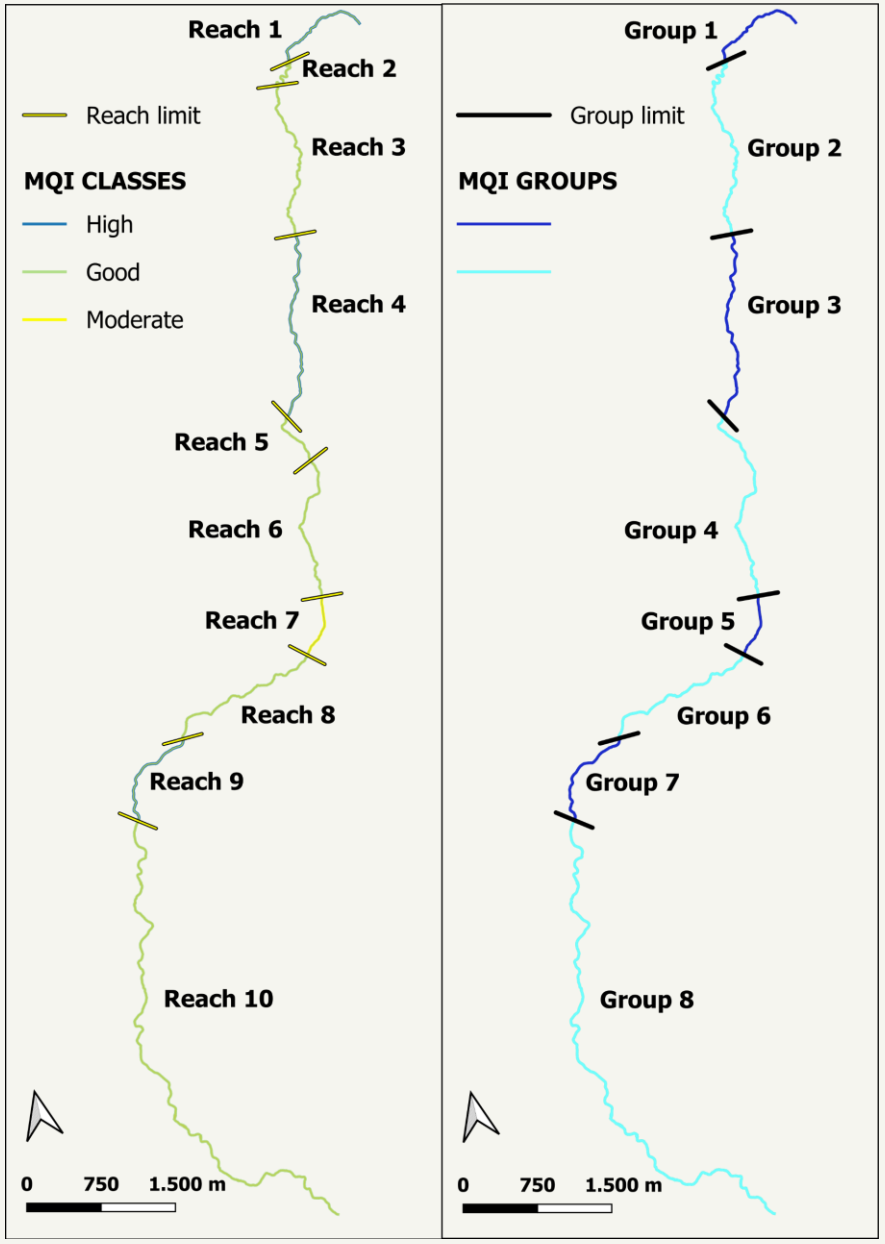
Sensitivity Analysis

The analysis of the variations revealed that, out of a total of 334 reaches, 80 reaches underwent a worsening of morphological quality class (columns in red), 61 reaches underwent an improvement of morphological quality class (columns in green), and 193 reaches maintained the original quality class (column in grey).





Morphological Quality Fragmentation Index



The **Morphological Quality Fragmentation Index (MQFI)** indicates the variability of the MQI class along the water body.

To derive the MQFI, the first step is to find consecutive reaches with the same MQI class and merge them into a single group.

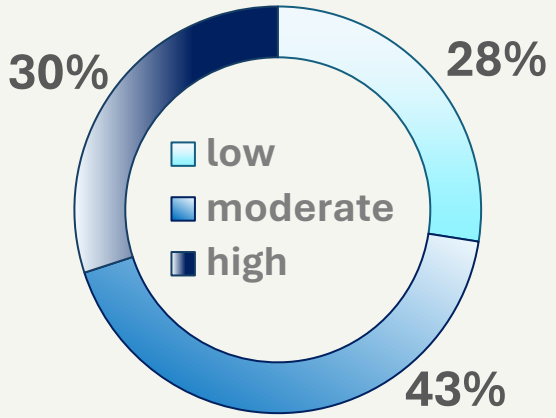
Each time the MQI class changes, a new group is generated.

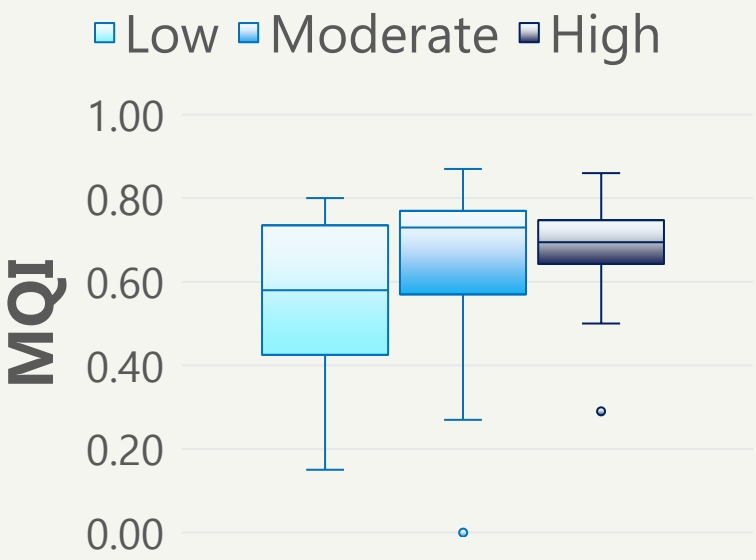
$$MQFI = \frac{\sum MQI\ groups}{\sum reaches - 1}$$

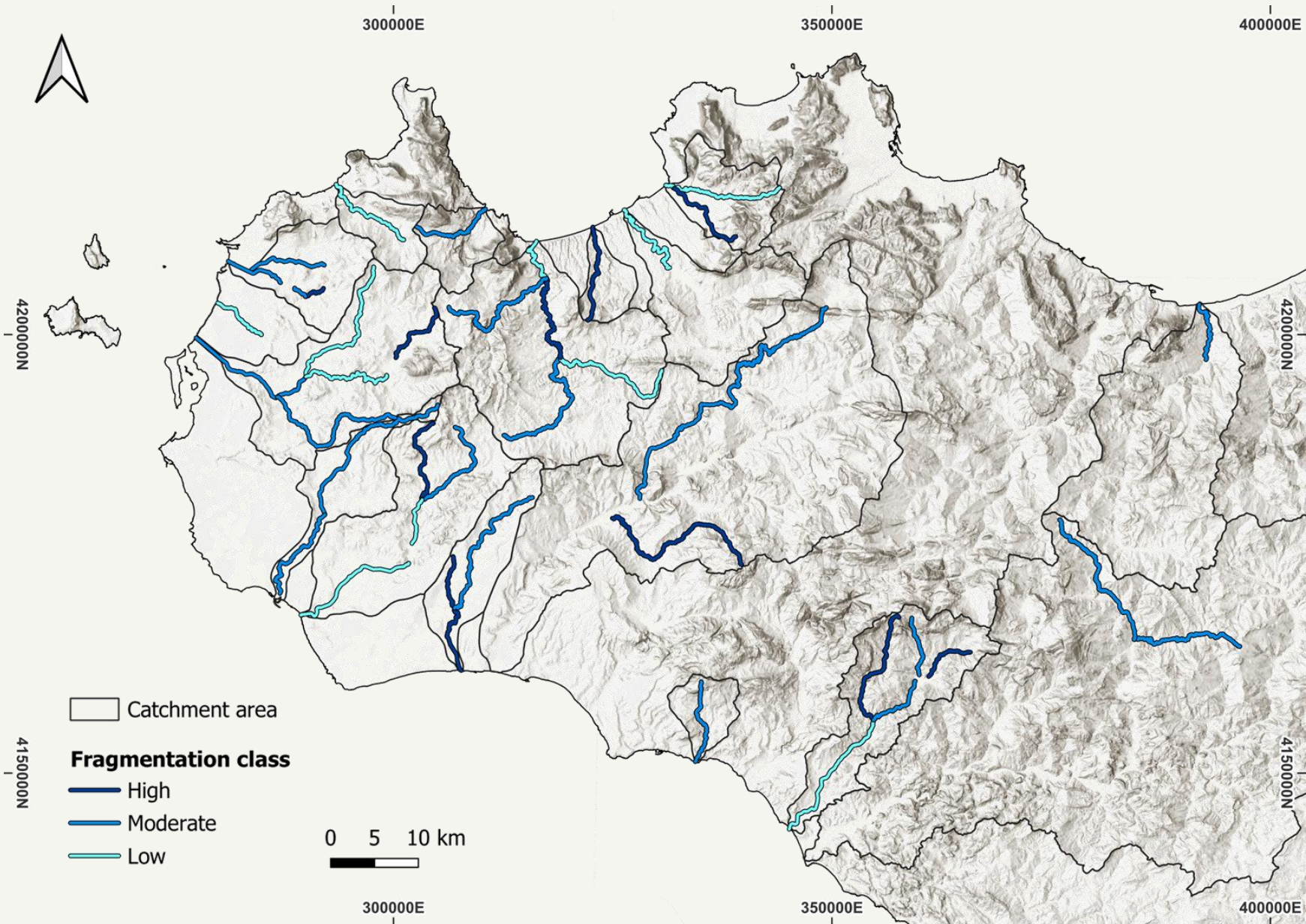
The MQFI is dimensionless and ranges from 0 to 1. MQFI values tending to 0 indicate water bodies that are poorly fragmented and have good longitudinal continuity, MQFI values tending to 1 indicate water bodies that are highly fragmented and have poor longitudinal continuity.

MQI groups = merge of reaches with the same MQI class

Water bodies MQFI







Conclusions

1. 78% of the water bodies studied have an Excellent, Good or Sufficient morphological quality. Only 22% have a Poor or Bad morphological quality.

2. The application of IDRAIM highlights that the assessment of morphological quality at the water body scale can mask well-recognizable local criticalities at the reach scale.

3. Sensitivity analysis allows us to go beyond the IQM value, showing that:

    - small variations in indicators can produce significant reach class changes;
    - intervening on certain indicators can improve or worsen the morphological quality of the reach;
    - the effects of reach quality variations on the water body MQI are controlled by an incidence of the specific reach length.

Conclusions

4. The Morphological Quality Fragmentation Index (MQFI) represents a useful screening tool to distinguish water bodies with specific problems from those with widespread alterations.

5. The IQM assessment, sensitivity analysis and MQFI provide administrations with useful operational support for water bodies management.


Thanks for your attention