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C3A CENTRO AGRICOLTURA ALIMENTI AMBIENTE
UNESCO Chair in Engineering for Human and Sustainable Development
Department of Environmental, Civil and Mechanichal Engineering
University of Trento
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MORPHOLOGICAL TRAJECTORIES OF THE NEAR-NATURAL VJOSA RIVER

Marta Crivellaro
University of Trento
12th October 2022, Tirana

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Current status of the Vjosa River

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Morphological Quality (WFD 2000/60) Index (MQI)
The official index to assess hydromorphological quality in Italy

REACH SCALE!

(1) Geomorphological functionality
Assessment of forms and processes functionality.

(2) **Artificiality**
Assessment about existing infrastructures and interventions.

(3) **Morphological variations**
Assessment of morphological variations of the last decades (with particular reference to rapid economic growth period as for planimetric variations)

>> SET OF INDICATORS >> MQI

MQI range
1 >> **completely unaltered watercourse**
(coinciding with the *reference condition*)
0 >> **completely altered watercourse**

Class of quality	MQI
High	$0.85 \leq MQI \leq 1.0$
Good	$0.7 \leq MQI < 0.85$
Moderate	$0.5 \leq MQI < 0.7$
Poor	$0.3 \leq MQI < 0.5$
Bad	$0.0 \leq MQI < 0.3$

MORPHOLOGICAL QUALITY INDEX

An application on the Vjosa River main course

MSc thesis

Multi scale hydro-morphological characterisation of the Vjosa river in Albania

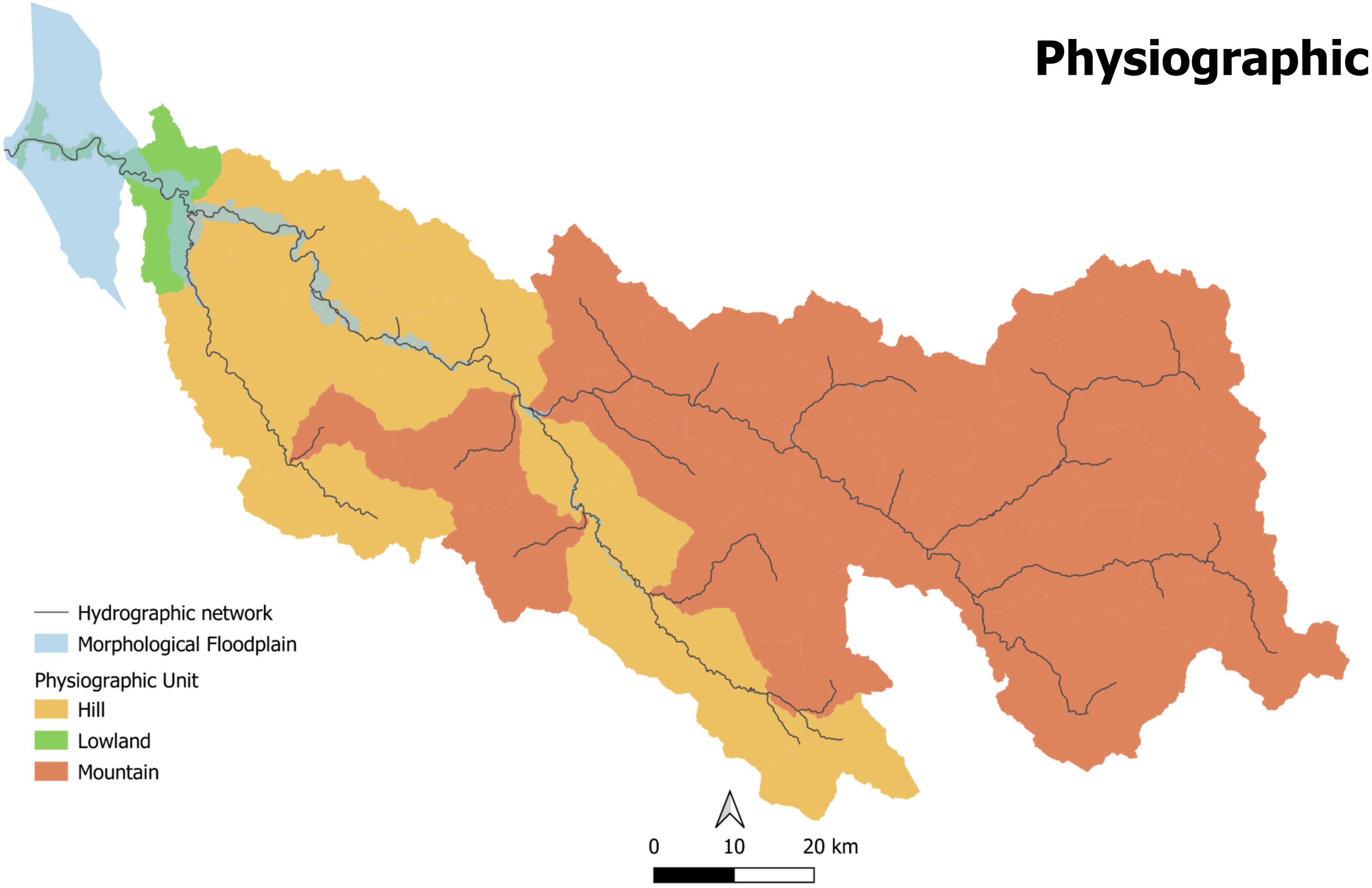
Giacomo Laghetto

University of Trento – Department of Civil, Environmental and Mechanical Engineering

A.Y 2018/2019

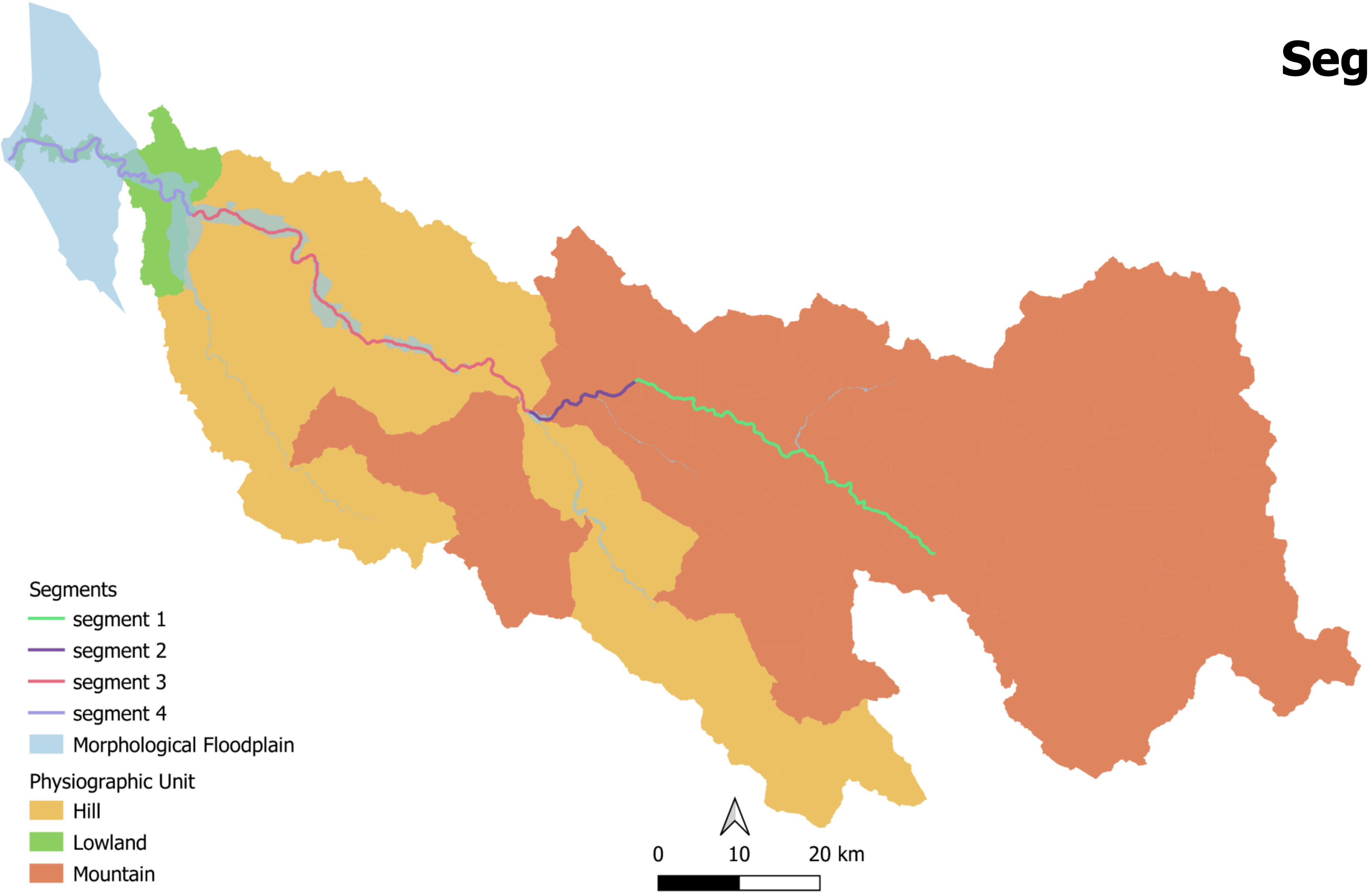
Adapted from
Eng. Giacomo Laghetto MSc thesis

Physiographic Units



Adapted from
Eng. Giacomo Laghetto MSc thesis

Segments



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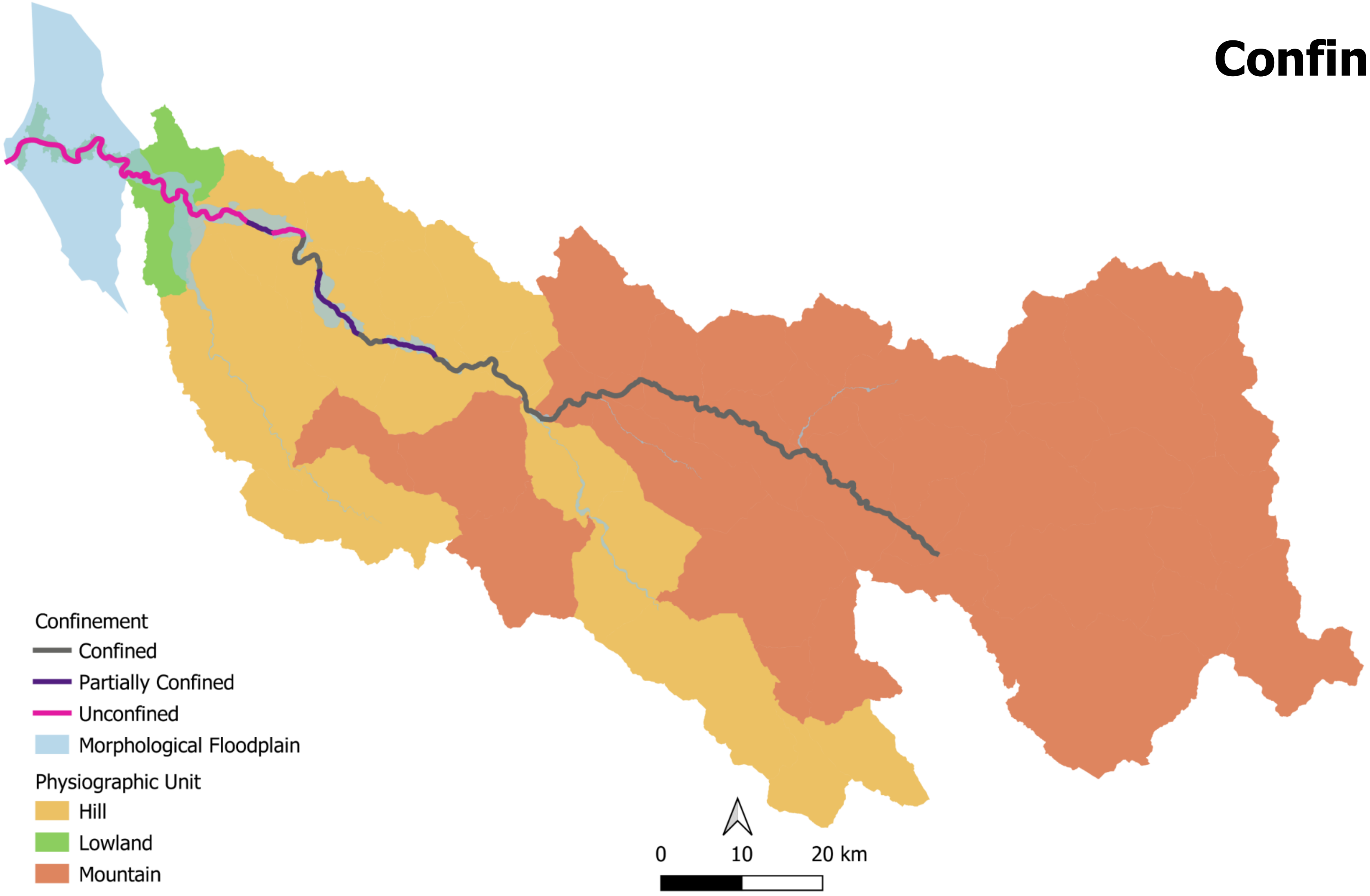
Confinement



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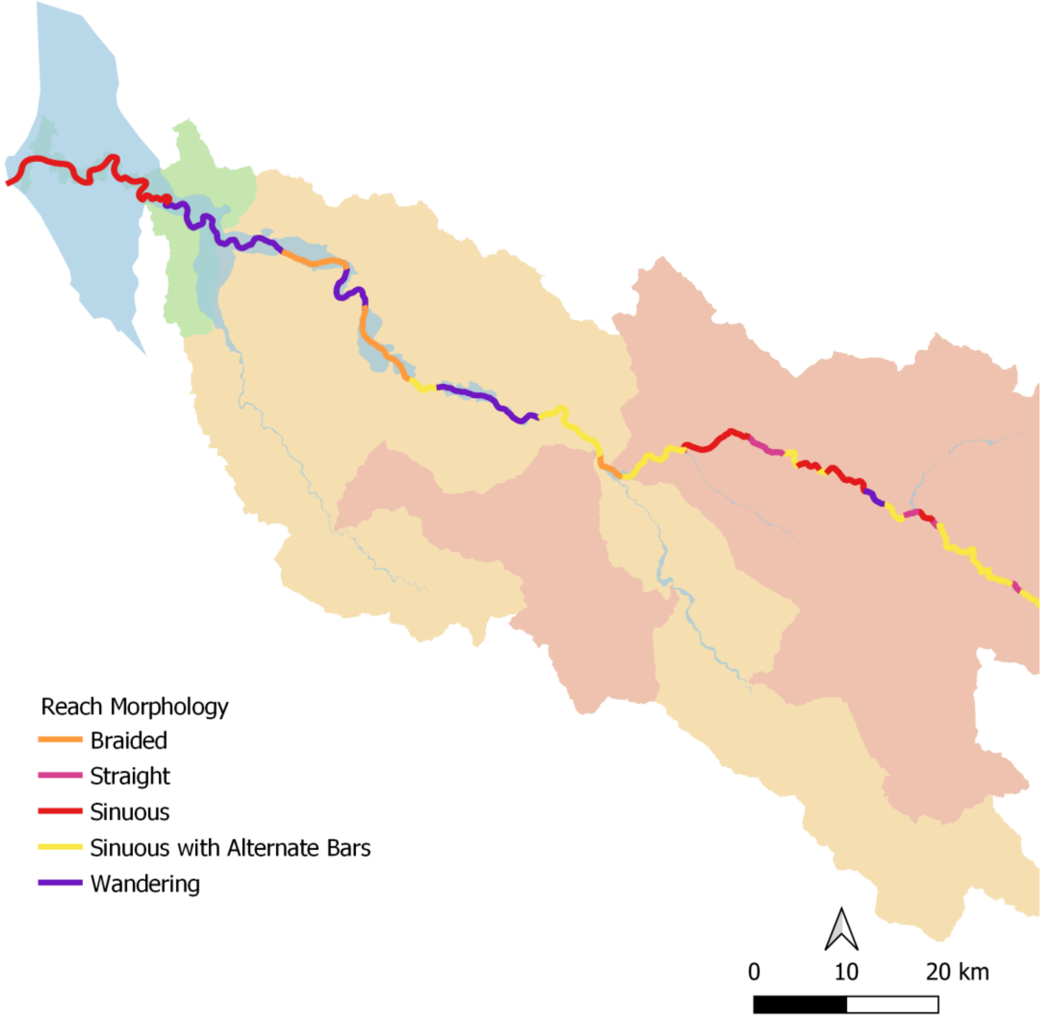
Reaches



n.	cod.	Lanscape unit	Segment	Length [m]	i_F [%]	C_d	C_i	Conf.	S_i	B_i	Morphology
1	1.1	Mountain	1	1551	0.35%	100%	1	C	1.06	1	S
2	1.2	Mountain	1	5547	0.24%	98%	1	C	1.11	1	S
3	1.3	Mountain	1	1900	0.30%	100%	1	C	1.02	1	ST
4	1.4	Mountain	1	5007	0.37%	100%	1	C	1.21	1	S
5	1.5	Mountain	1	6559	0.27%	100%	1	C	1.12	1	S
6	1.6	Mountain	1	1572	0.60%	100%	1	C	1.07	1	S
7	1.7	Mountain	1	1315	0.22%	100%	1	C	1.03	1	ST
8	1.8	Mountain	1	2033	0.32%	100%	1	C	1.09	1	S
9	1.9	Mountain	1	1104	0.43%	100%	1	C	1.02	1	ST
10	1.10	Mountain	1	3809	0.31%	100%	1	C	1.11	1	S
11	1.11	Mountain	1	2320	0.33%	100%	1	C	1.09	1.2	W
12	1.12	Mountain	1	3206	0.31%	90%	1.2	C	1.13	1	S
13	1.13	Mountain	1	2718	0.32%	100%	1	C	1.17	1	S
14	1.14	Mountain	1	1591	0.29%	100%	1	C	1.33	1	S
15	1.15	Mountain	1	2379	0.35%	100%	1	C	1.17	1	S
16	1.16	Mountain	1	3346	0.27%	100%	1	C	1.08	1	S
17	1.17	Mountain	1	1837	0.18%	100%	1	C	1.03	1	ST
18	1.18	Mountain	1	2643	0.19%	100%	1	C	1.04	1	ST
19	1.19	Mountain	1	2171	0.24%	100%	1	C	1.06	1	S
20	2.1	Mountain	2	6176	0.21%	100%	1	C	1.12	1	S
21	2.2	Mountain	2	1728	0.24%	100%	1	C	1.05	1	S
22	2.3	Mountain	2	7587	0.27%	90%	1.1	C	1.16	1	S
23	3.1	Hill	3	3749	0.32%	65%	1.3	C	1.04	2	B
24	3.2	Hill	3	10031	0.17%	100%	1	C	1.06	1.1	S
25	3.3	Hill	3	3640	0.16%	75%	1.5	C	1.09	1.1	W
26	3.4	Hill	3	2434	0.17%	70%	1.5	C	1.06	1.1	W
27	3.5	Hill	3	6663	0.17%	10%	1.8	PC	1.04	1.3	W
28	3.6	Hill	3	3530	0.18%	100%	1	C	1.03	1	S
29	3.7	Hill	3	10717	0.18%	20%	3	PC	1.04	2.2	B
30	3.8	Hill	3	8748	0.11%	60%	1,3	C	1.09	1.1	W
31	3.9	Hill	3	3948	0.21%	5%	>2	U	1.06	1.5	B
32	3.10	Hill	3	3440	0.07%	50%	>2	PC	1.02	2	B
33	3.11	Hill	3	9903	0.07%	5%	>2	U	1.12	1.3	W
34	4.1	Plain	4	10460	0.05%	10%	>2	U	1.20	1.4	W
35	4.2	Plain	4	27459	0.02%	0%	>5	U	1.14	1	S/M

Adapted from
Eng. Giacomo Laghetto MSc thesis

MQI

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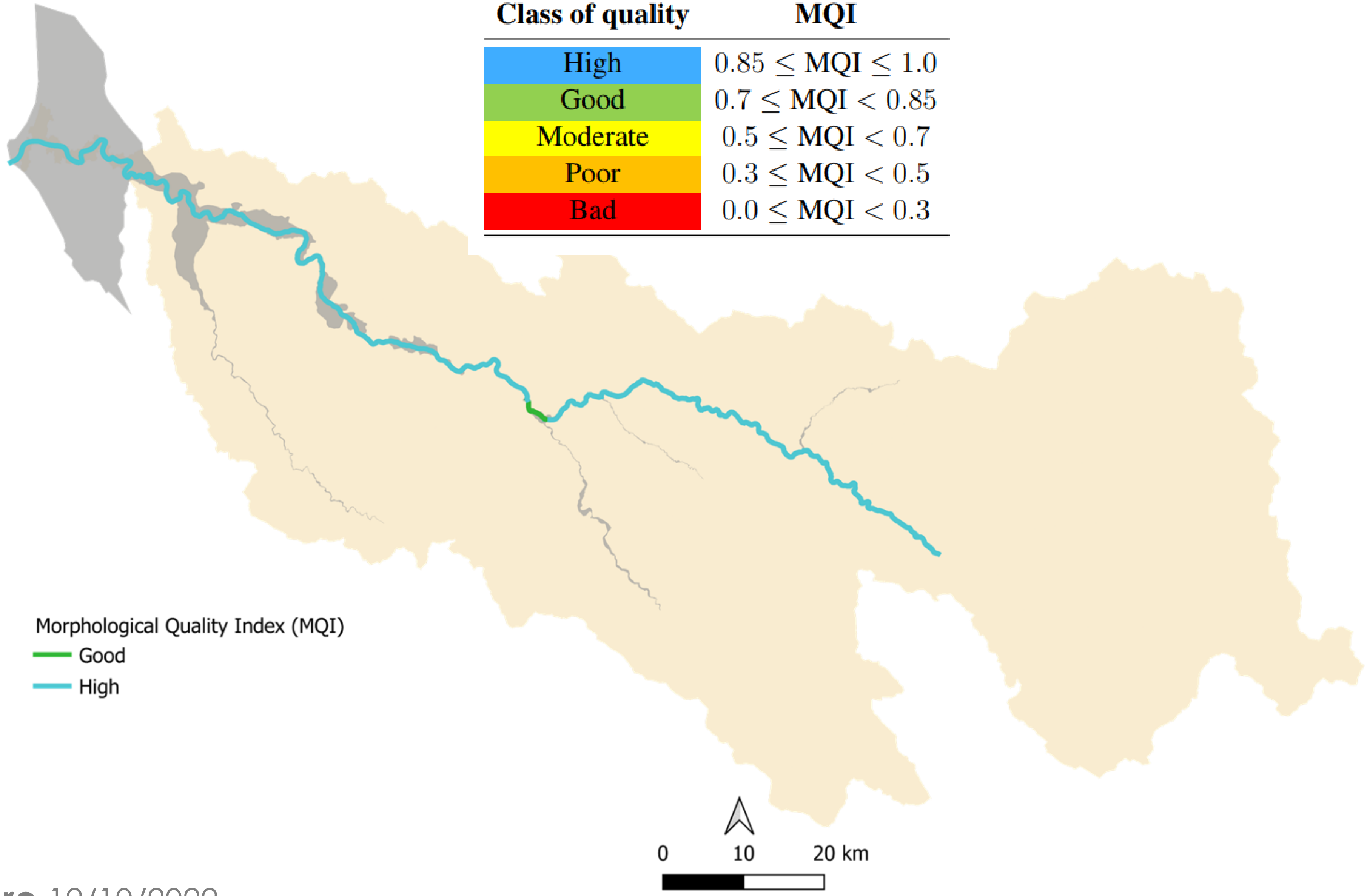

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What about the past?

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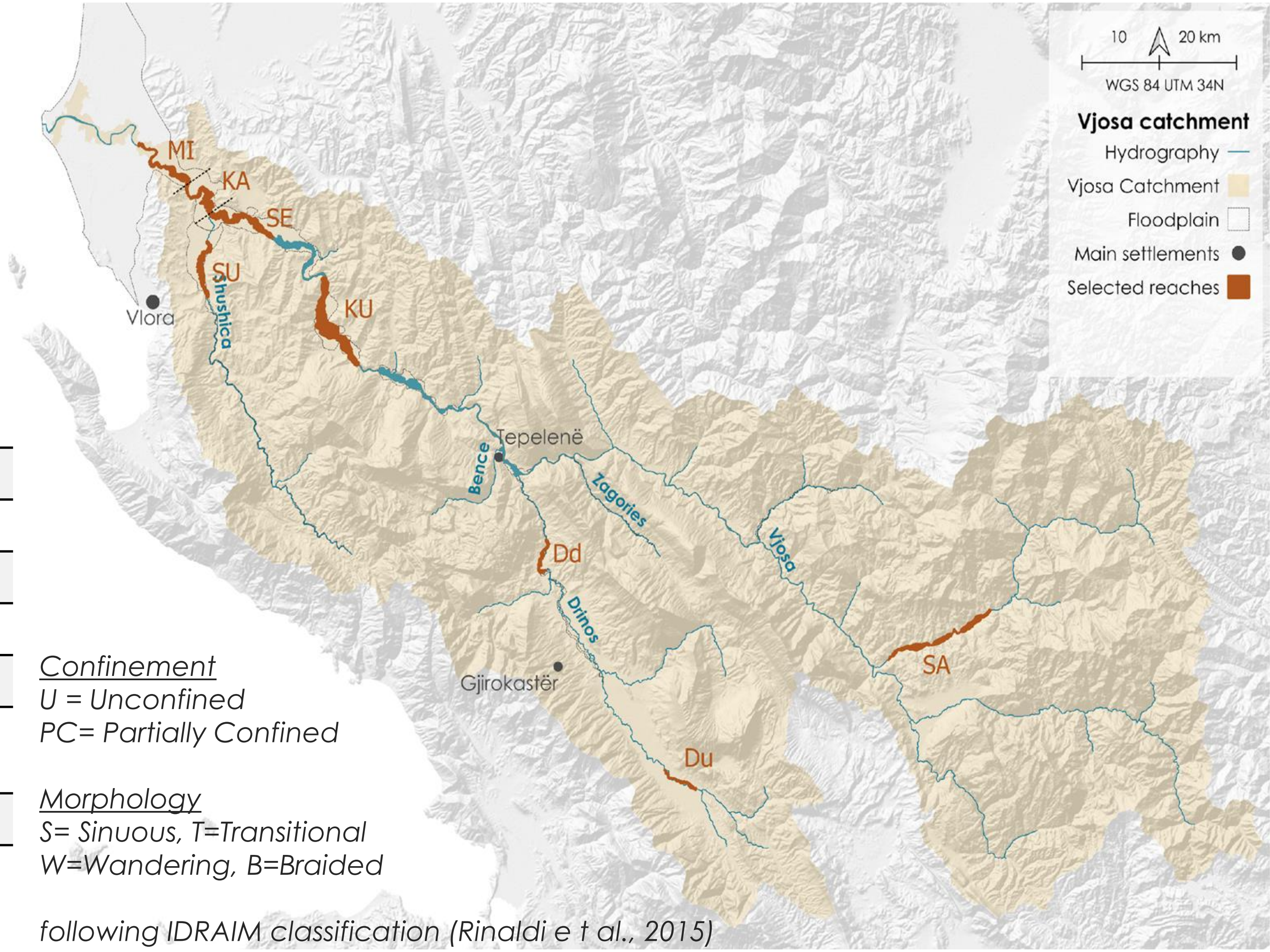
The Vjosa River

Catchment and reach scale approach

8 selected river reaches

Reach Name	*m.a.s.l.*	*length (km)*	*Slope (m/km)*	*Conf.*	*Morpho*
Mifol (MI)	2	10.5	0.2	U	S
Kashisht (KA)	5	12	0.5	U	S/T
Selenizza (SE)	12	12.3	0.5	U	W
Shushica (SU)	35	8.1	2.5	PC	W
Kuta (KU)	53	13.5	1.8	PC	B
Drinos down (Dd)	165	5.8	3.8	C	W
Drinos up (Du)	205	6.3	1.8	PC	T
Sarandaporo (SA)	605	16.4	3.3	C	B



Confinement
U = Unconfined
PC= Partially Confined

Morphology
S= Sinuous, T=Transitional
W=Wandering, B=Braided

following IDRAIM classification (Rinaldi e t al., 2015)

Recent channel adjustments

USGS 1968 Declassified Corona images

Landsat images 1985-2020

REMOTE SENSING
Planform classes procedure

Active channel widths over time 1968-2020

Analysis of drivers of change

Recent channel adjustments

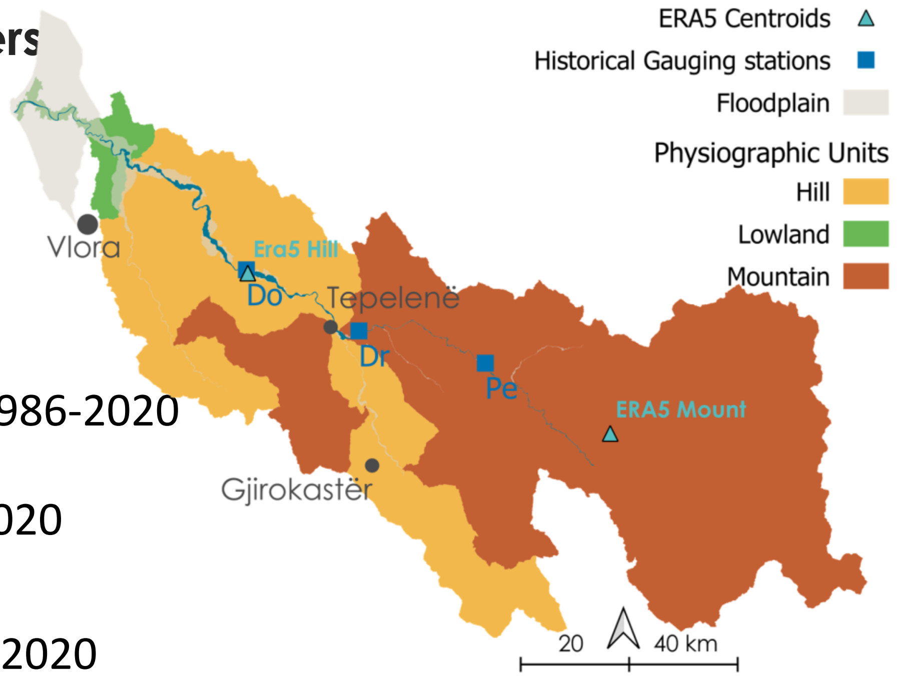
USGS 1968 Declassified Corona images

Landsat images 1985-2020

REMOTE SENSING
Planform classes procedure

Active channel widths over time
1968-2020

Analysis of drivers of change



Forest cover dynamics 1986-2020

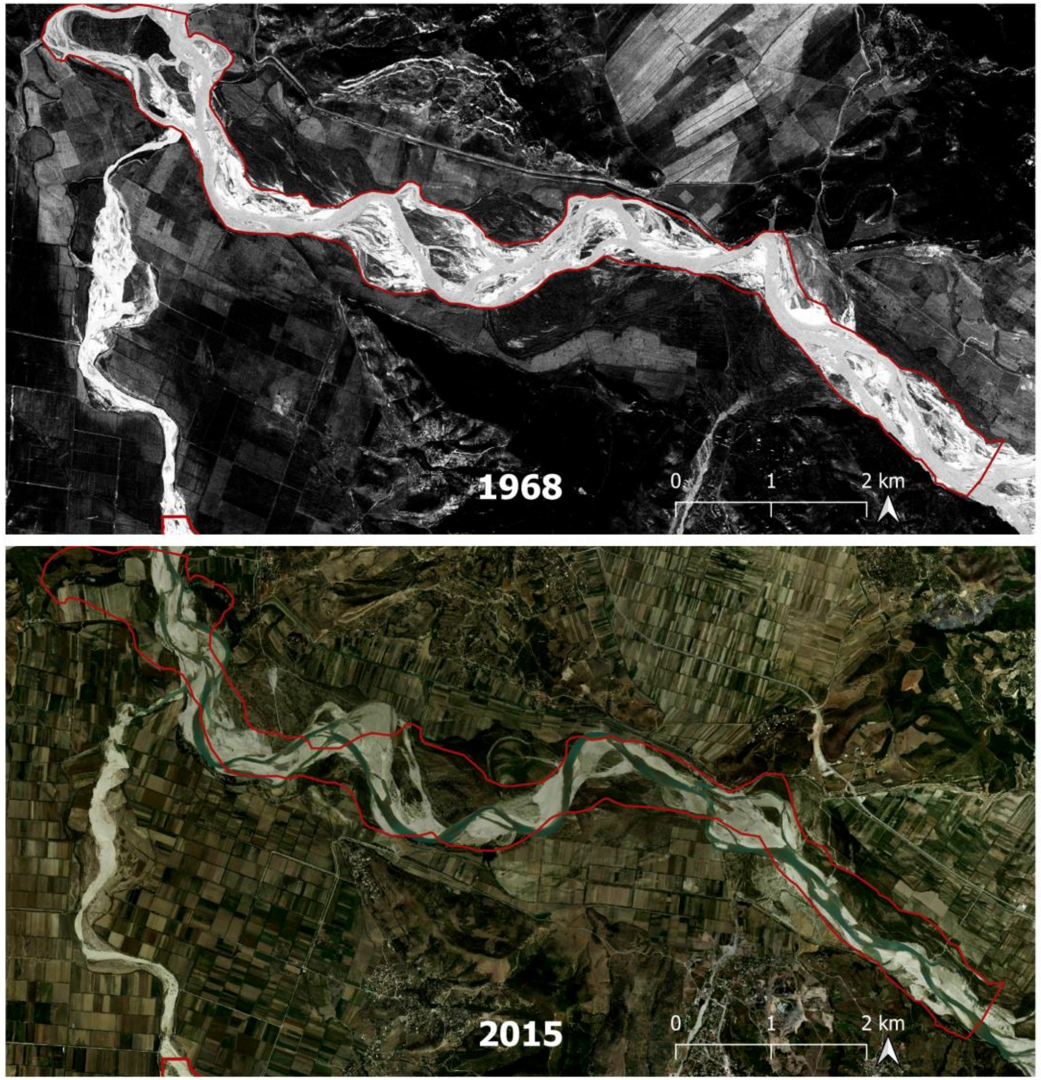
Sediment Mining 2004-2020

HPPs & Riverbanks 2004-2020

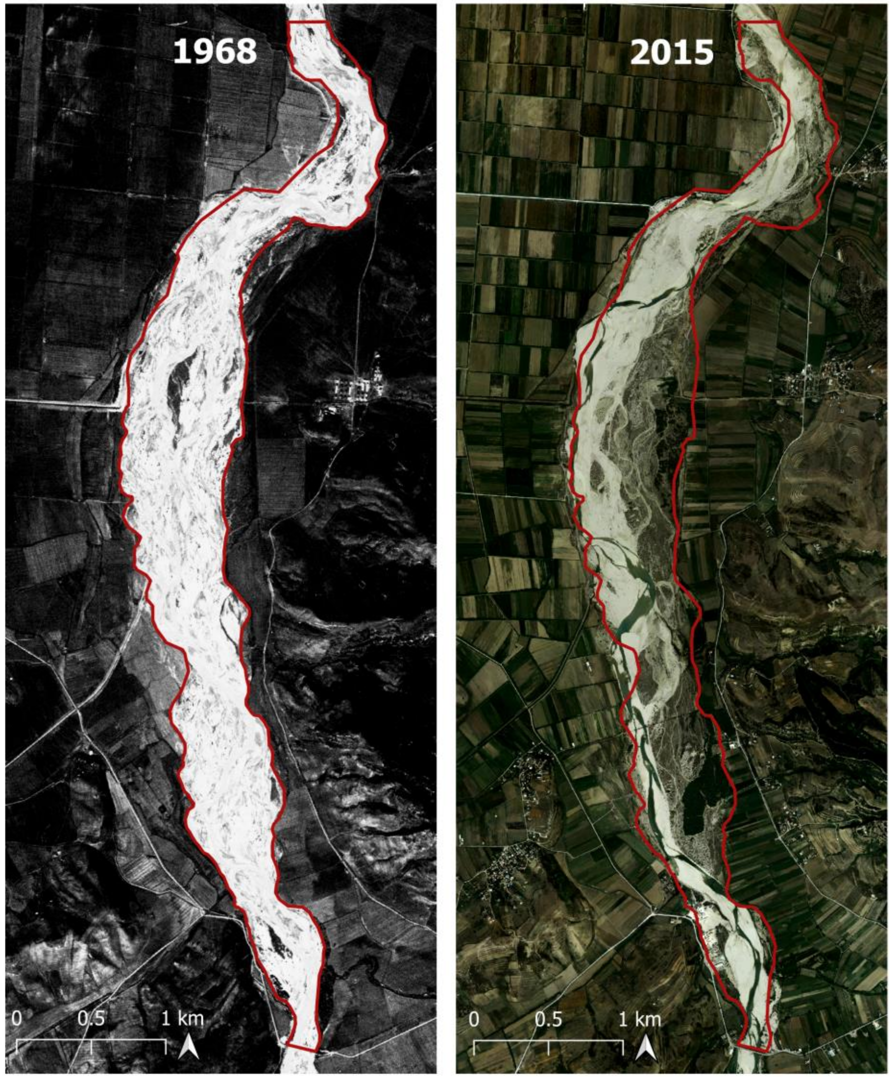
Flow regime analysis

- **Q and P comparison**
- **Events over thresholds analysis**

Selenizza reach

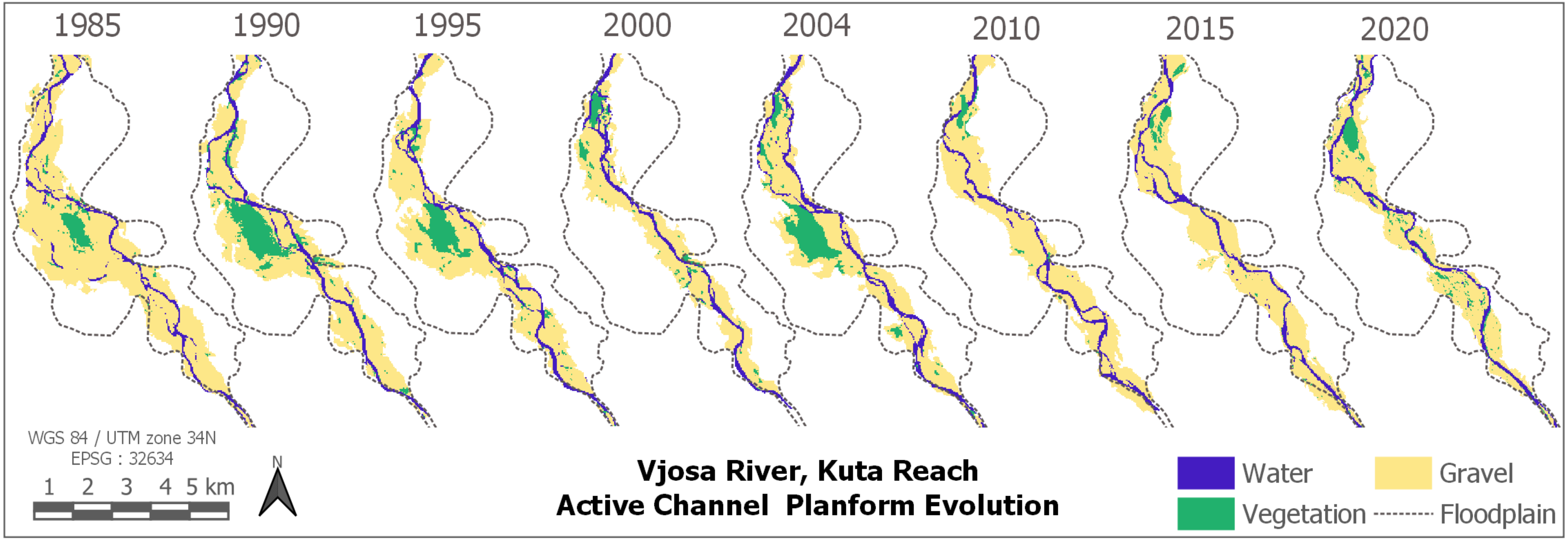


Shushica reach



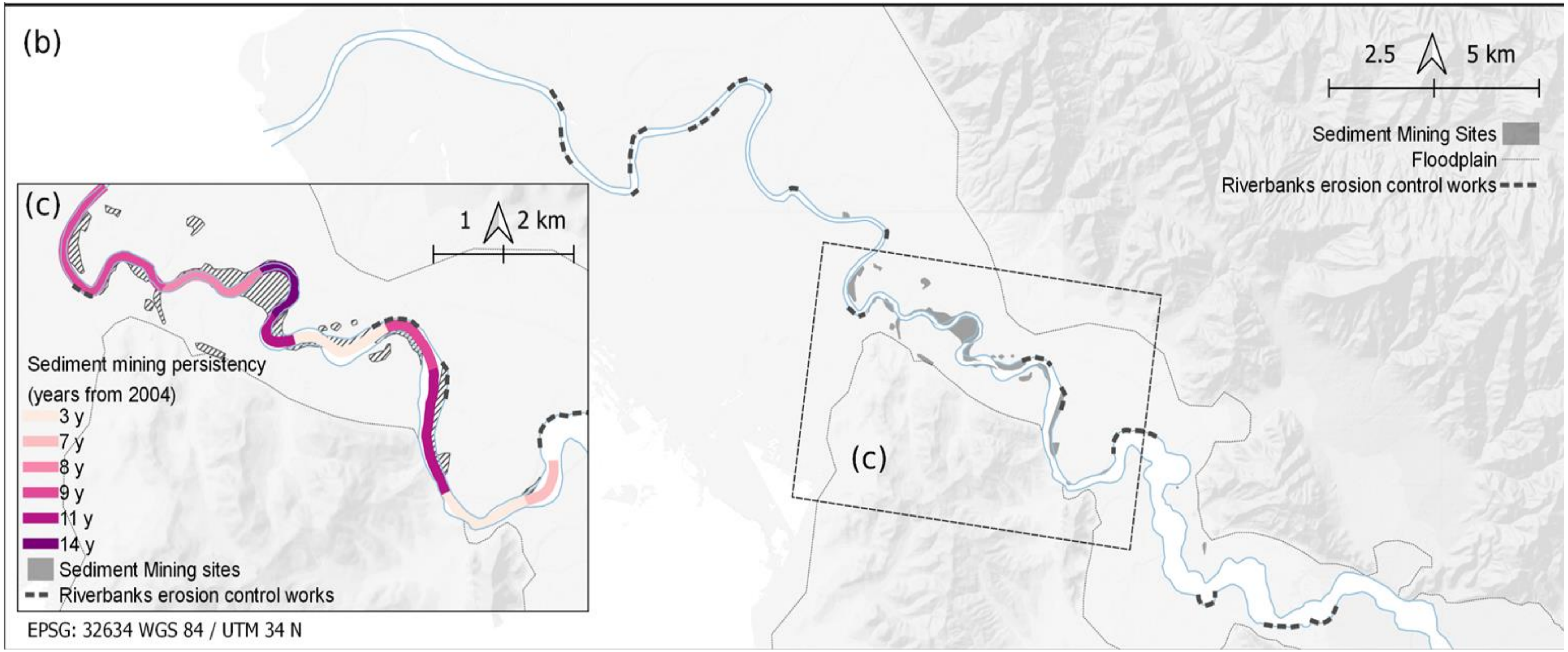
Active width ↓
Sinuosity ↑

Kuta reach



Active channel narrowing

Anthropic Pressures
Sediment mining activities in the lowland reaches



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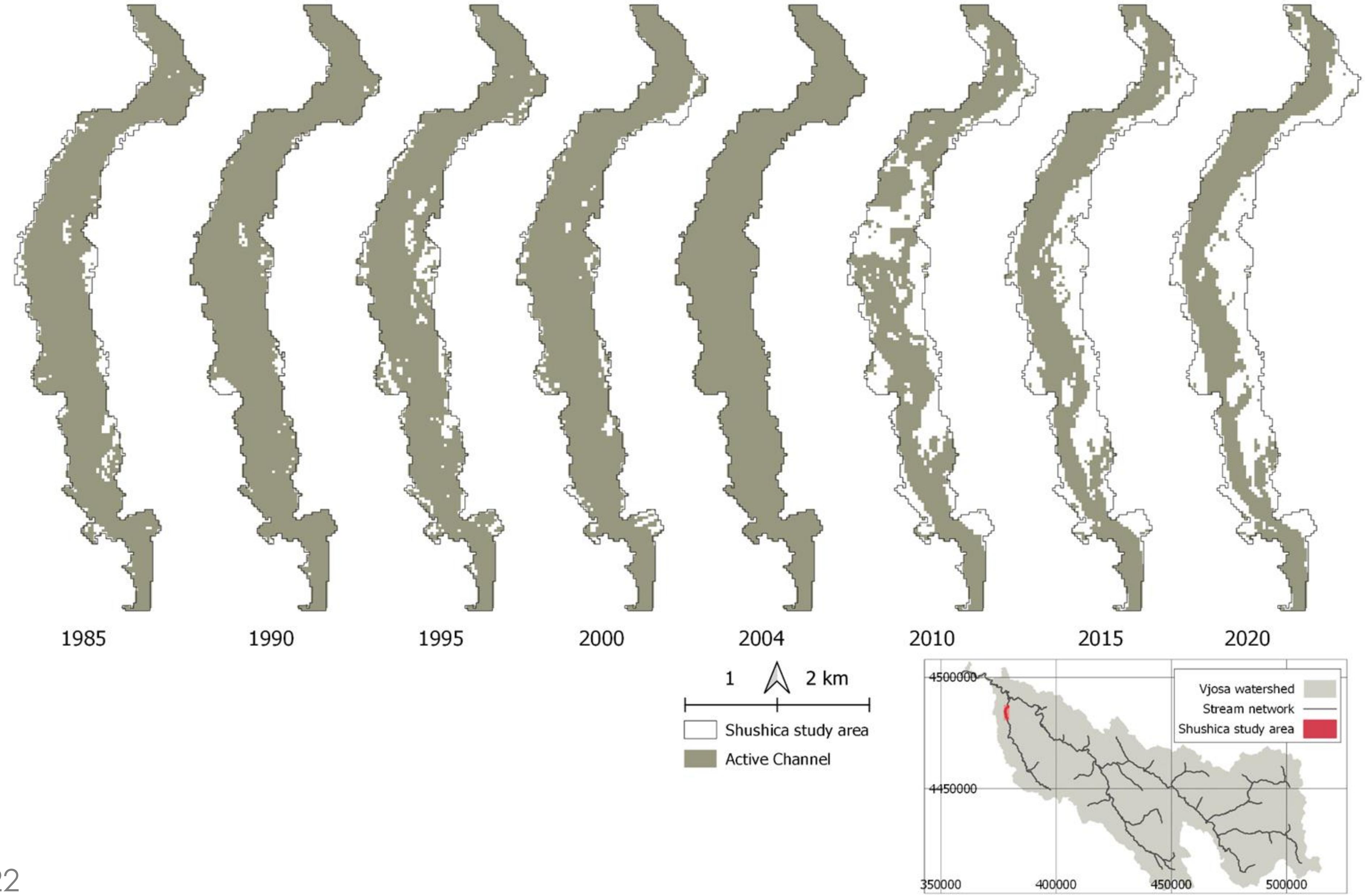
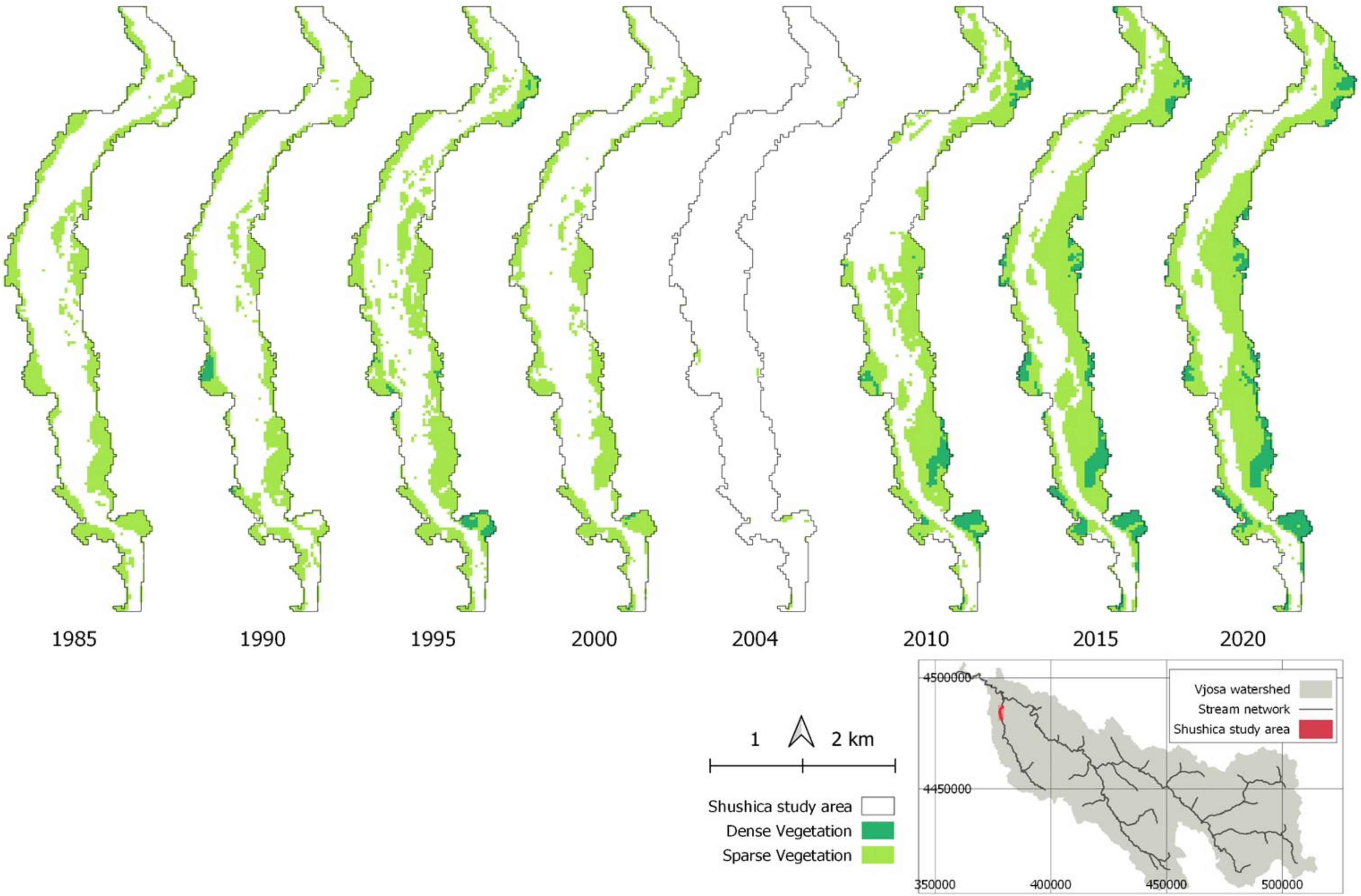
Shushica reach

Active channel narrowing

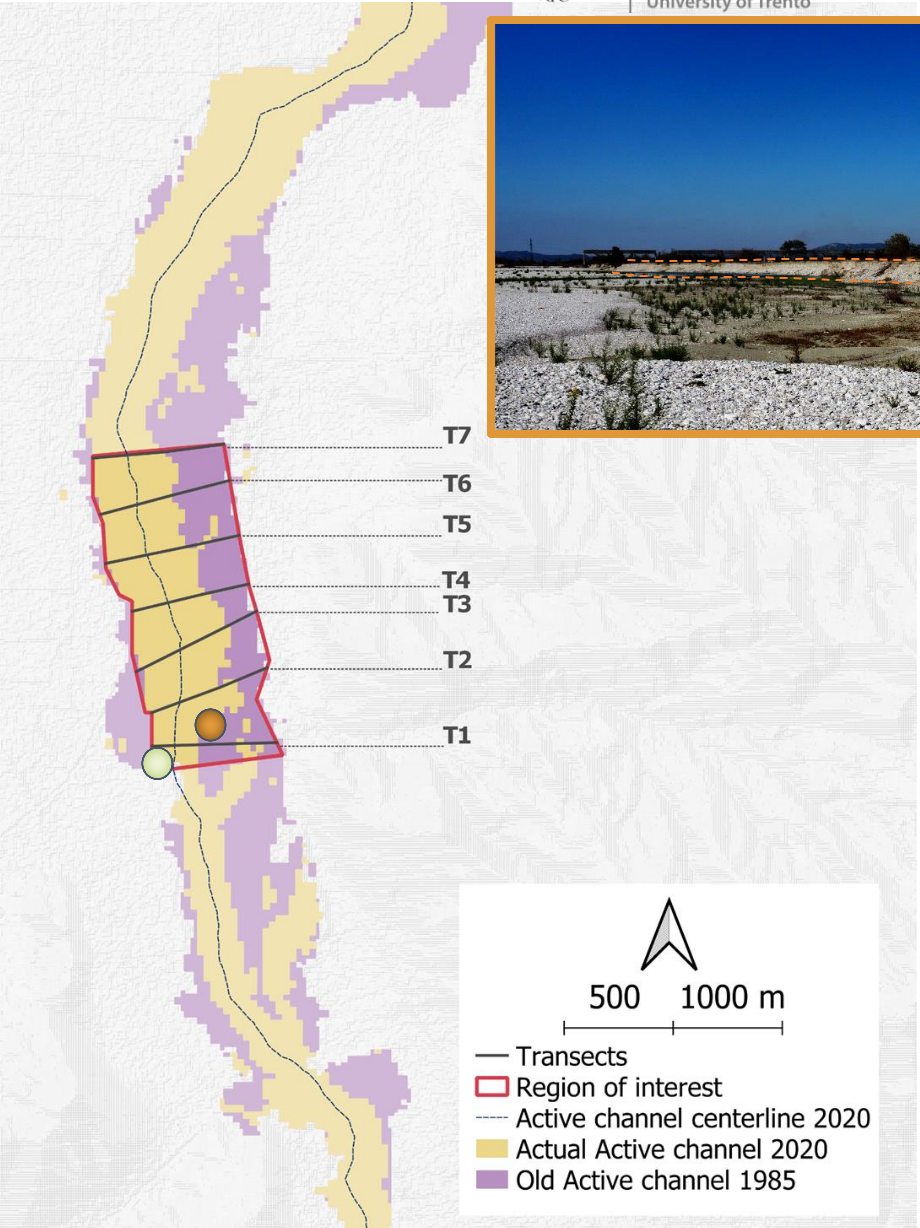


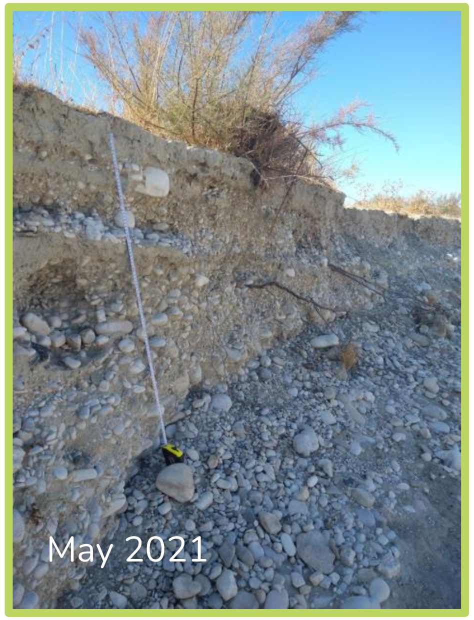
Shushica reach

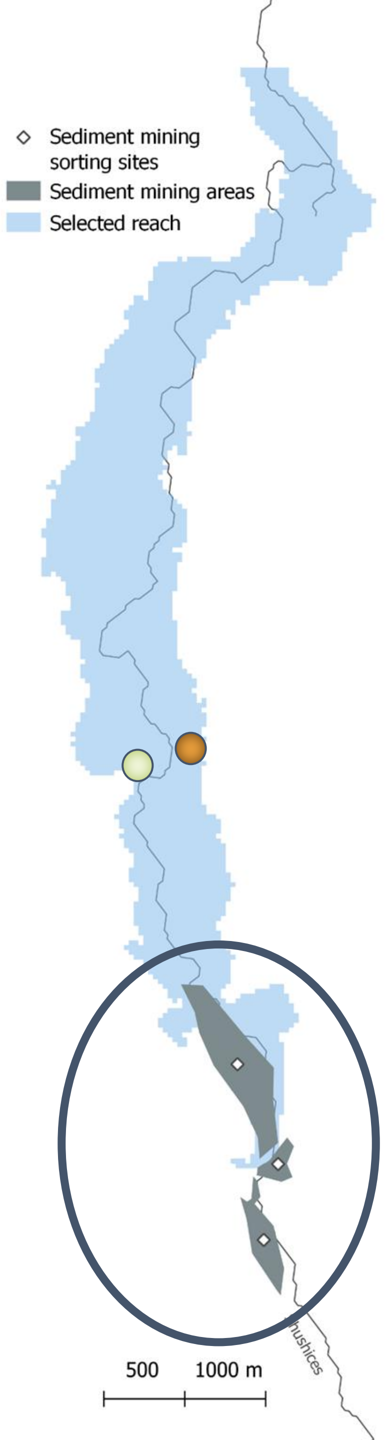
In channel vegetation growth



Marta Crivellaro 12/10/2022







Sediment Mining sites

already present in 2004 google earth ortophoto

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Vjosa River recent morphological trajectories

Morphological trajectories

Flow regime analysis

Forest cover dynamics

Sediment Mining

HPPs & Riverbanks

Time

Active channel width narrowing

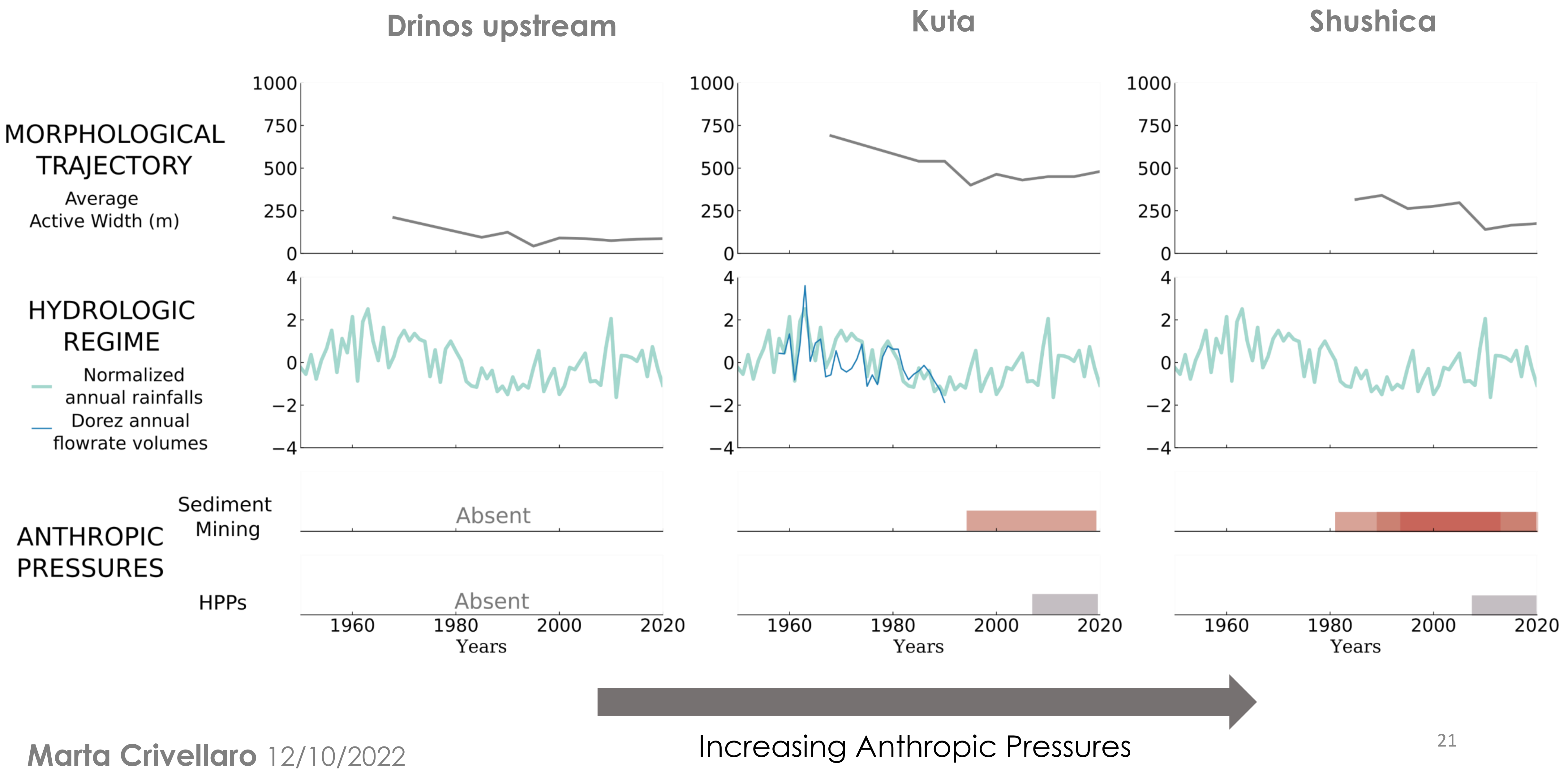
Decreasing narrowing rates over time

Decreasing trend in duration and frequency of formative events

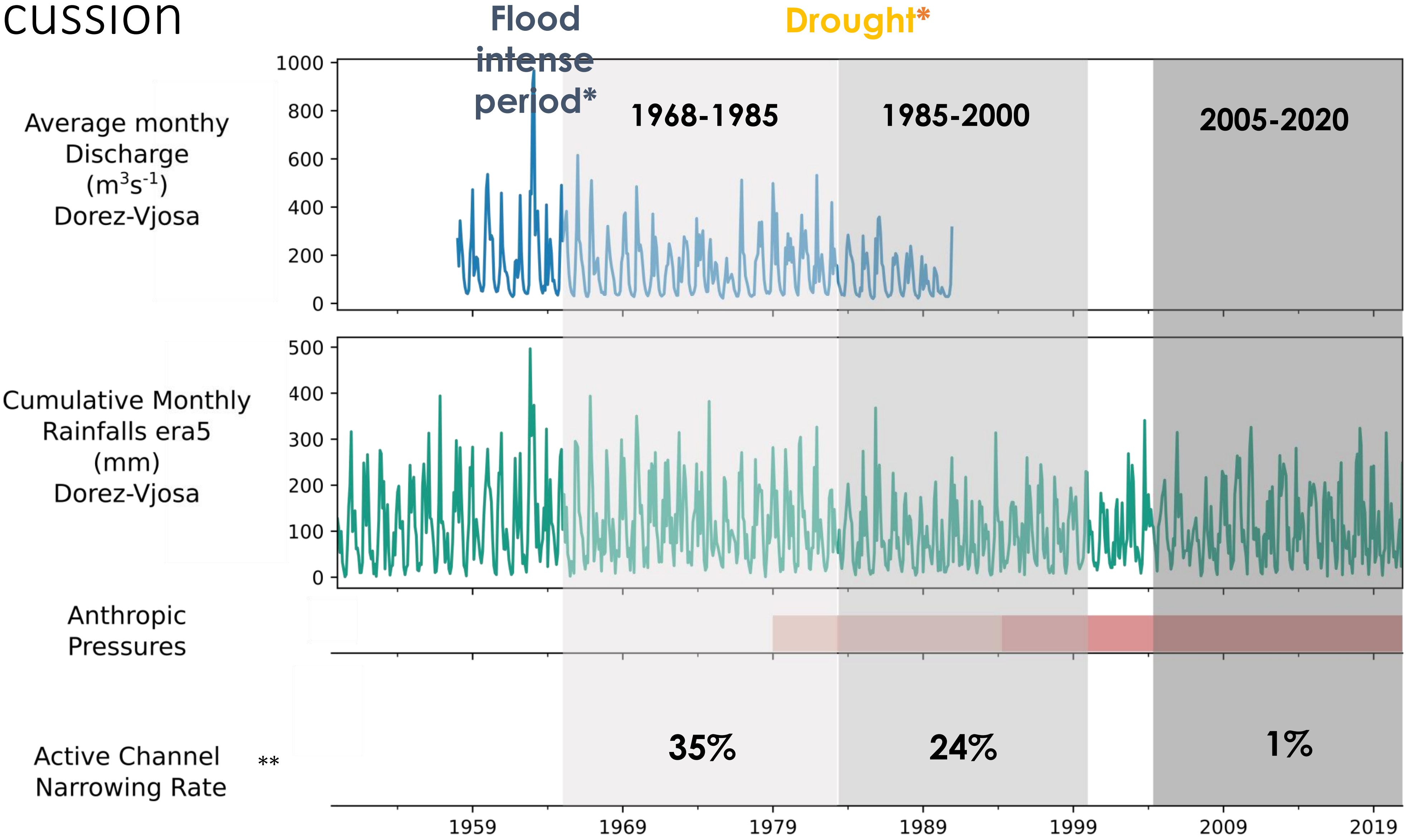
No significant forest cover change 39 km² (-21%)

22 sediment mining areas
Lowland segments

Bank protection structures in the lowland part of the river
No significant alteration due to HPPs


Drinos upstream
Kuta
Shushica
MORPHOLOGICAL TRAJECTORY
Average Active Width (m)
HYDROLOGIC REGIME
Normalized annual rainfalls
Dorez annual flowrate volumes
ANTHROPIC PRESSURES
Sediment Mining
HPPs
Absent
Absent
1000
750
500
250
0
4
2
0
−2
−4
1960
1980
2000
2020
Years
Increasing Anthropic Pressures

Discussion



**Average with respect to the 8 reaches

Take Home Messages

1. Catchment scale

- **Impact of climatic fluctuations on river morphology >>** System's attainment to a characteristic state after 1960s intense hydrological period
- The **Vjosa system's active width is controlled by medium to large floods**

2. Reach scale

- Shushica reach: **Sediment mining** caused a **30% reduction of the active width** in the last **37 years.**

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Thank you for your attention!

Faleminderit!

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12th October 2022, Tirana
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