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HERMES-3rd Open Workshop

COASTAL ZONE MANAGEMENT AND CLIMATE CHANGE AT LOCAL SCALE: THE HERMES PROJECT APPROACH

ΔΗΜΟΚΡΙΤΕΙΟ ΠΑΝΕΠΙΣΤΗΜΙΟ ΘΡΑΚΗΣ
DEMOCRITUS UNIVERSITY OF THRACE

Wednesday, July 3, 2019
IGEWE Main Building, Don Bosko nr.60, Tirana

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Application of GiS to monitor the impact of development on the coastal zone: Buna river delta to Mat delta river, Albania

Ervis Krymbi PhD

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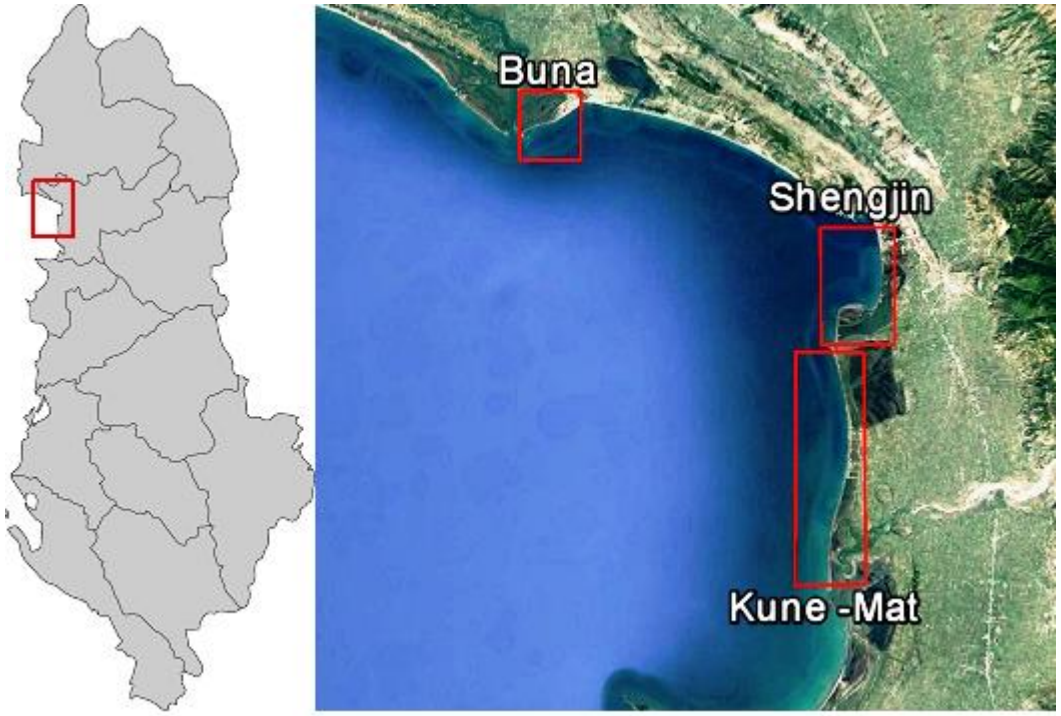
The Albanian pilot sites



Site Name	Length (km)	Minimum Latitude	Minimum Longitude	Maximum Latitude	Maximum Longitude
Buna (AL)	3	41°50'52.2"N	19°22'40.6"E	41°51'41.0"N	19°24'54.9"E
Shëngjin (AL)	6.5	41°48'20.5"N	19°35'55.3"E	41°45'07.8"N	19°34'28.1"E
Kune-Mat (AL)	10	41°44'55.2"N	19°34'19.4"E	41°38'29.8"N	19°34'17.4"E

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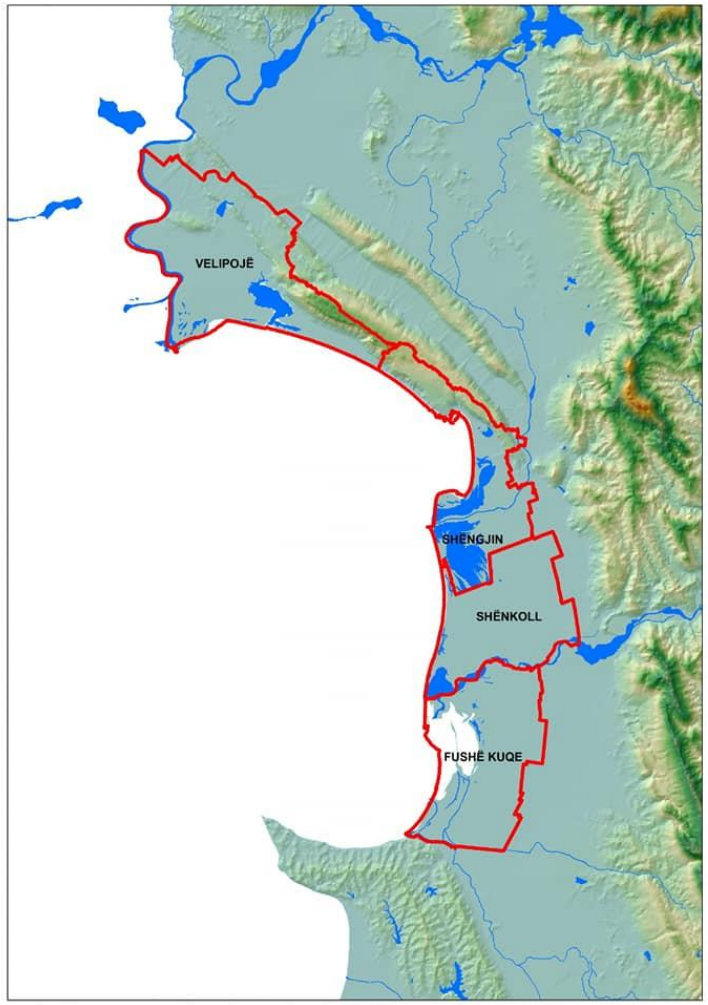

The stability of the Buna-Drini-Mati River Deltas depends on the physical character of its coastline which, in turn, is determined by its geology, geomorphology and the actions through time of wind, waves and tides. The physical attributes influence its conservation value, its development potential, and its vulnerability to erosion or flooding.

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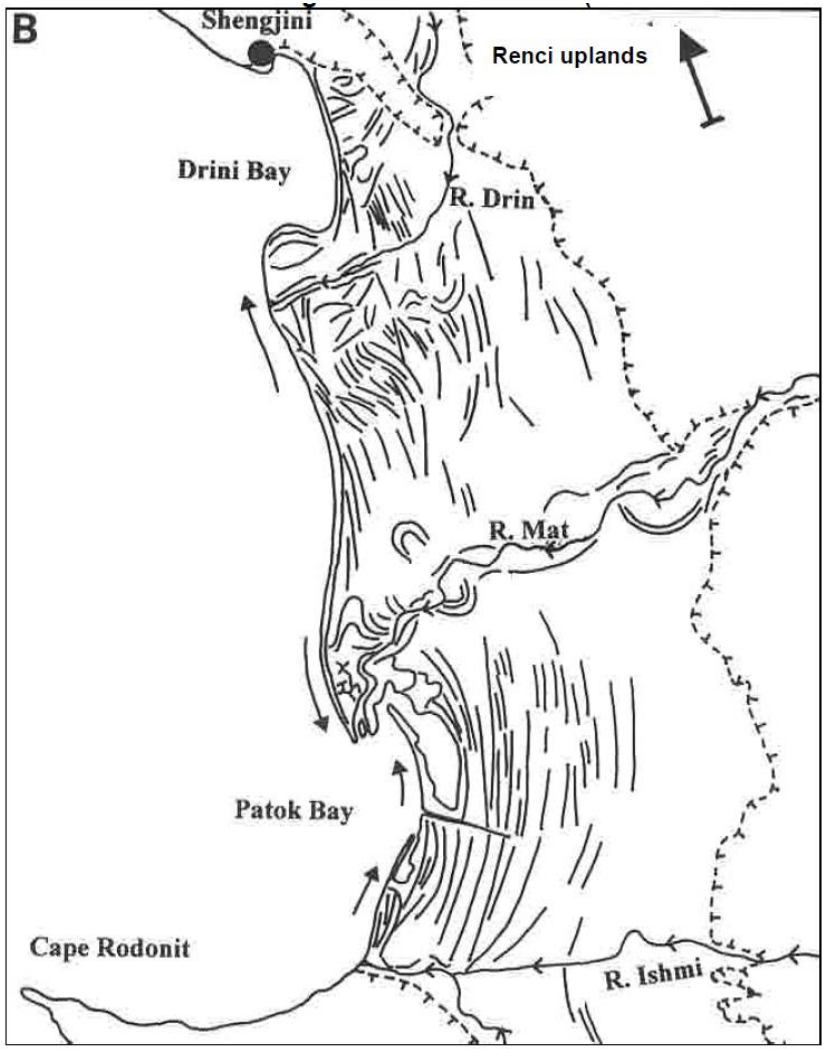
GEOLOGICAL EVOLUTION

The coastal plain of the area is underlain by Holocene (last 10,000 years) deposits reaching a maximum width of about 11 km. The Holocene sediments are the latest deposits in a sedimentary basin that has persisted in this area since the early Neogene (Mathers et al., 1999). The main structural trend is aligned north-northwest to south-southeast and Neogene sedimentary rocks with this orientation provide the boundaries.



Holocene beach ridges across the area of study (from Mathers et al., 1999)

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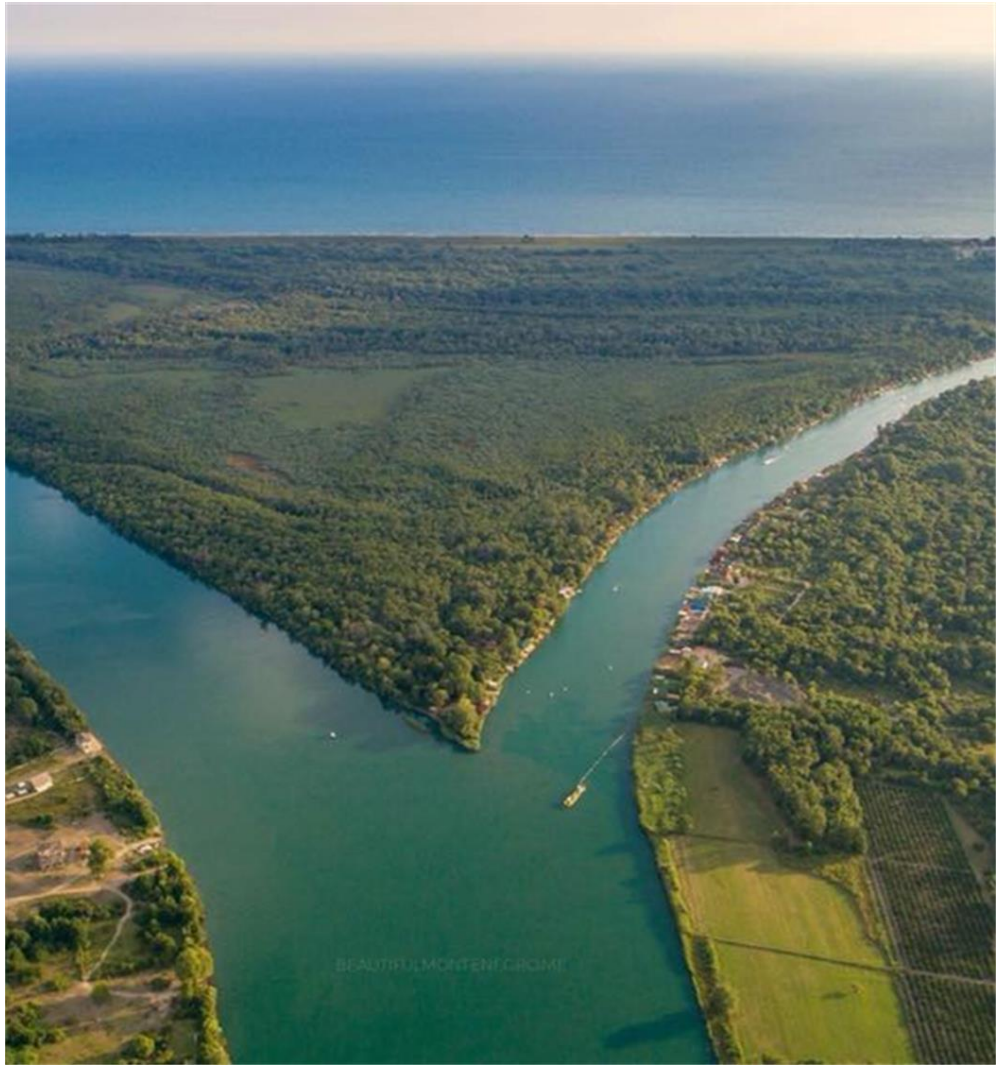
Physical characteristics

The Buna River is the outflow of Lake Shkoder and receives the waters of the Drin Basin.

Its catchment, with a total area of 20,585 km2, comprises the catchments of Lakes Prespa, Ohrid and Drin River to the south, the White Drin River to the east, and Lake Shkoder to the north and north-east



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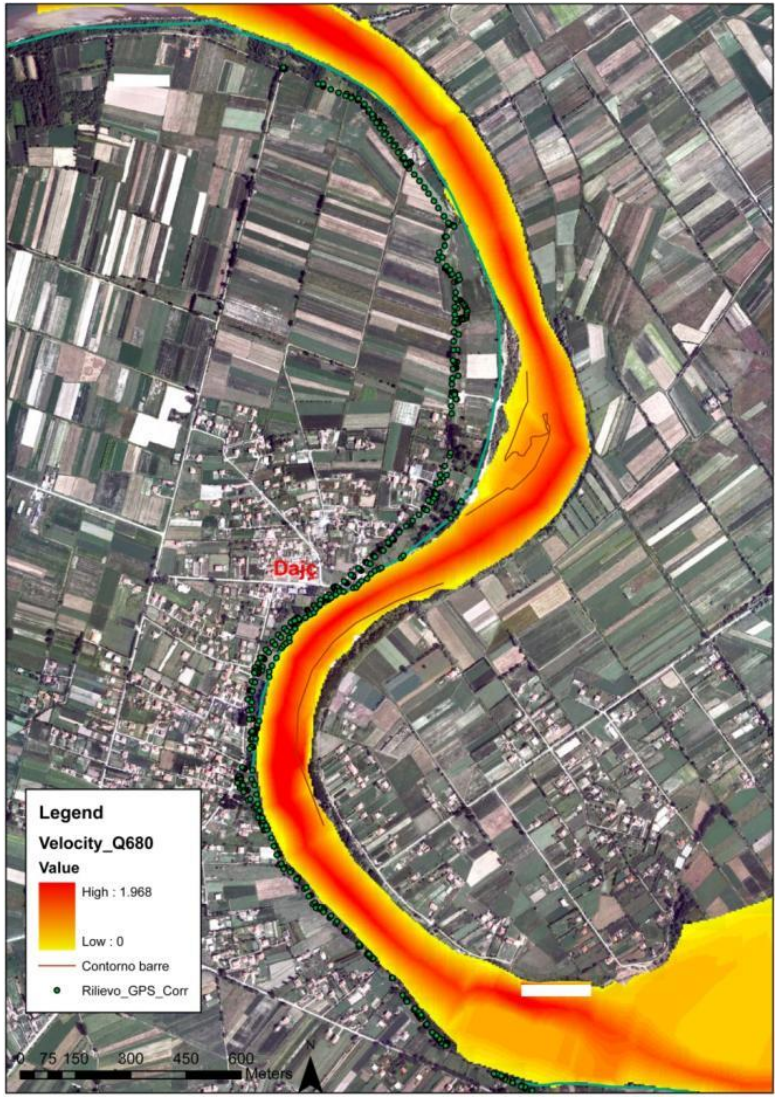
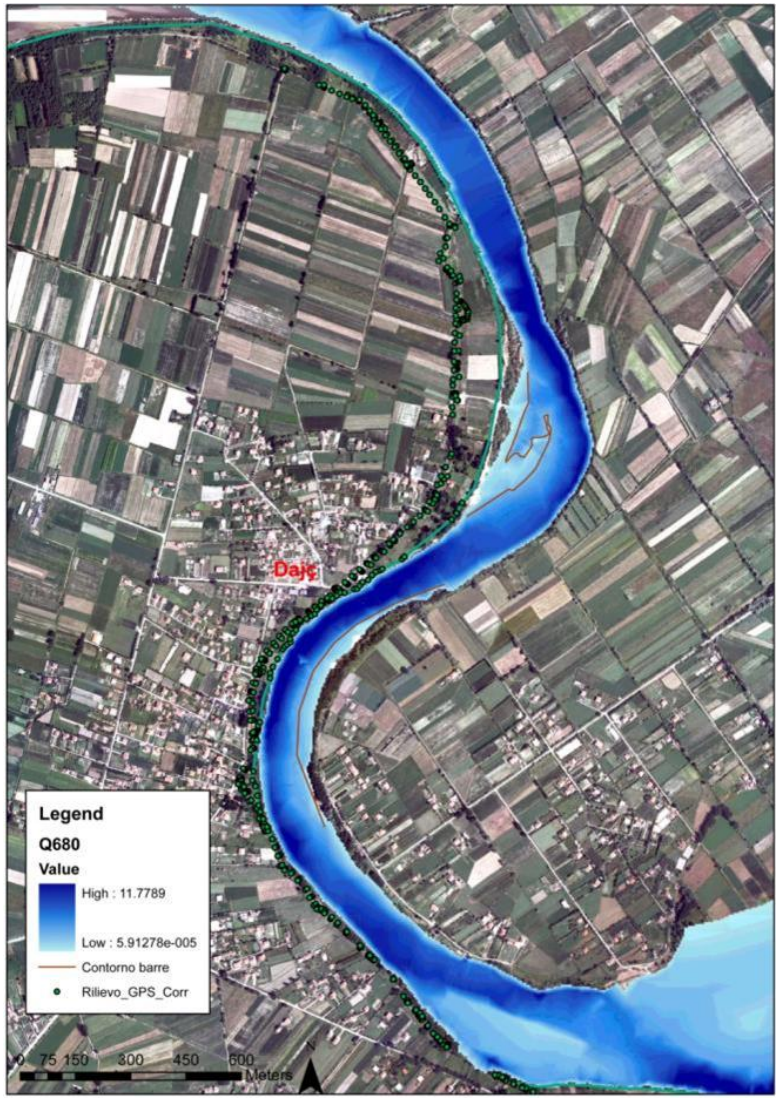
The Buna starts as the southern outflow of Lake Shkoder situated close to the city of Shkodra (less than 3 km downstream from the old Shkoder fort). From this source the river meanders in a south-westerly direction to the Adriatic (a direct distance of only 25 km), dividing into channels to form a marshy delta and the island of Ada Bojana where it enters the sea.





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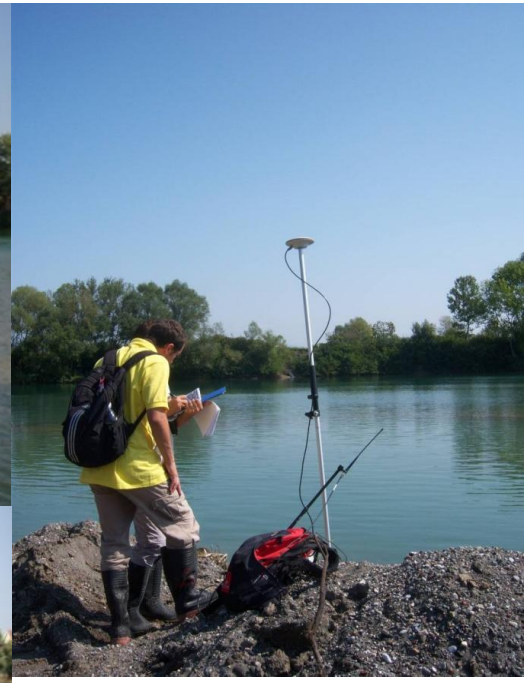
The river basin is composed of limestone, sandstone, shales and recent deposits. The Buna riverbed curves and meanders over long distances through three limestone cliffs.

The first occurs at Shkoder in the Tarabosh–Rozafa reef in the main structure of Rumija, the second at Fraskanjel in the ridge of Shas Hill, and the third at Rečka Gora. With these exceptions, the bed of the Buna River cuts through alluvial, mainly loamy, deposits.



The marine zone in front of the Buna/Bojana delta is characterized by a generally extended continental shelf that reaches its maximum extension at about 60-80 km from the coastline. Although outside the plan area, the furthest of these (80 km) is also the deepest point in the Adriatic, at 1,223 m.

The Buna Delta lies astride the Albania-Montenegro border in the extreme north-west of the country. Its sediment supply has been reworked bi-directionally. Three stages of Holocene wave-dominated delta formation, each clearly defined by sub-parallel clusters of beach ridges,

Delta formation

The formation of deltas is attributed to three forcing factors:

- eustatic variations (sea level), which control the available volume for sedimentation and the position of the general base level (shelf).
- sediment transport to the delta, which depends on the climatic variability and on human activities in the catchment basin, as well as on the capacity of transfer of the river channel.
- tides and coastal currents.

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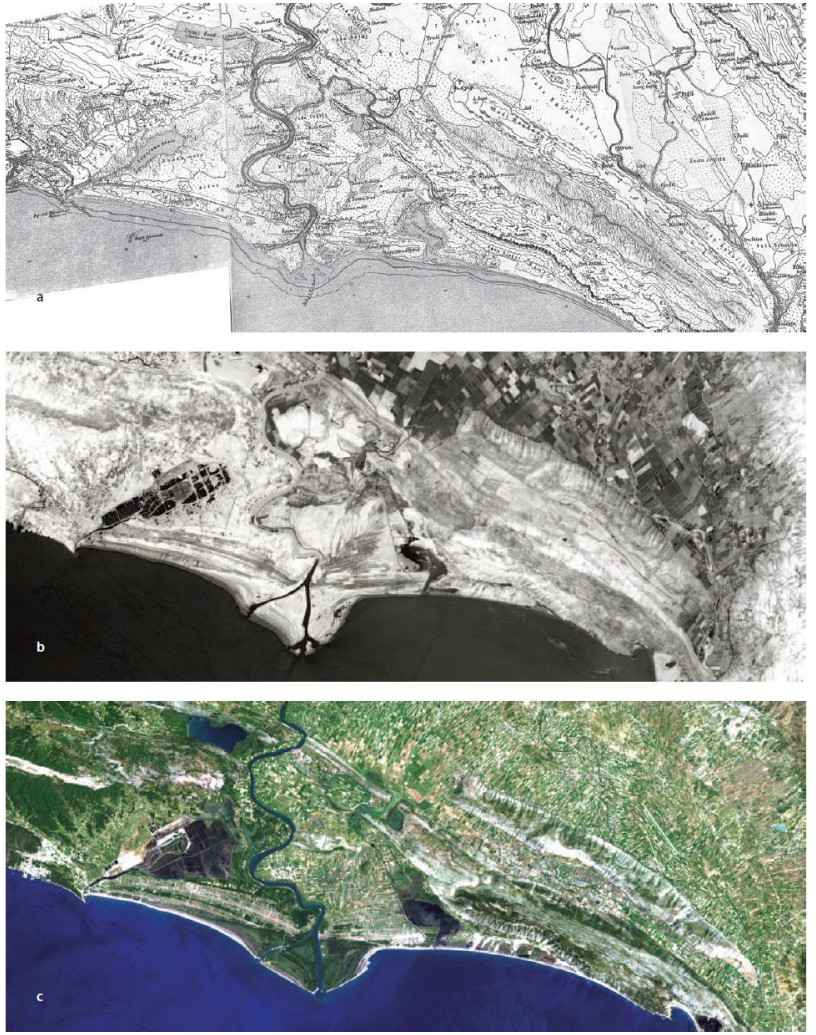
As indicated in the map the whole delta complex can be divided into several morphological units:

- The active Buna delta. Between 1910 and 1980 the delta grew by 1 to 1,5 km, especially in the eastern part, which is explained by the main discharge through the eastern branch of the river. Since the 1980s, following construction of the Drin reservoir, the sediment load has decreased, and the delta front is being partly destroyed.



Changes in Buna Delta: 1900 (a), 1972 (b) and 2002 (c).

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Buna Delta

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Buna Delta and the Reservat of Velipoja

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The disappearance of the island Franz Jozef

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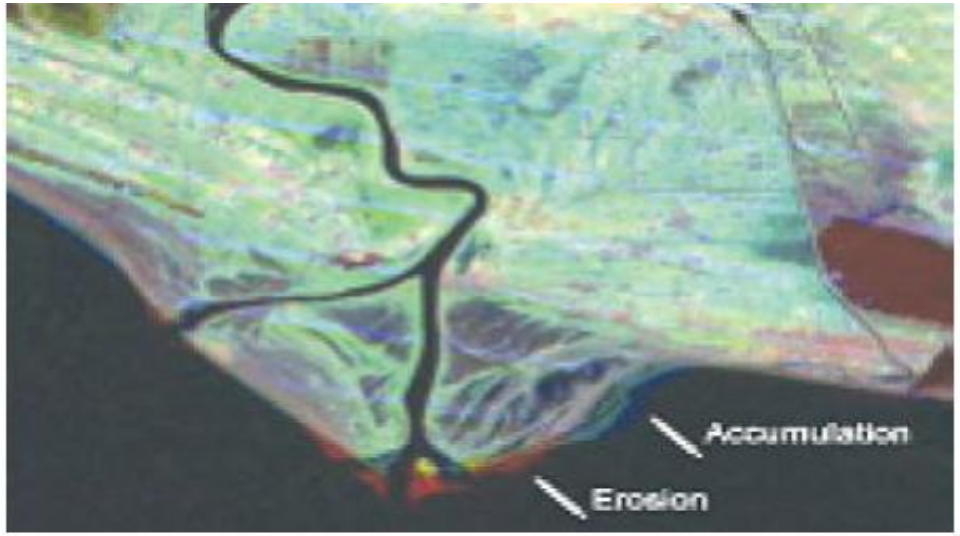
Buna Delta-Montenegrin part



Left: changes of Adriatic shoreline in the delta of Buna River, combination of Landsat NIr bands for years 1975 (Red) and 2009 (Blue-Green). Right: aerial view of Buna River delta.

The delineation of the erosion of delta of Buna River and with the accumulations in Velipoja beach obtained due to the combinations of Landsat NIr images from 1975 and 2009 (Frashëri et al., 2011; Frashëri et al., 2014).

General characteristics of the Buna delta - Shëngjin coastline

This coast represents the northwestern part of the Albanian coast. It is extended for a total of 22 km, while the length of the segments is different. From delta of Buna - Vilun 8 km.
Vilun-Rana e Hedhun 8 km.
Rana e Hedhun-Shengjin 6 km.

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In terms of natural development of Velipoja's coastline is subject to three main activities:

a.The accumulative charge of the Buna River
b.marine wave
c.wind activity (eolic activity)

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In this coastal part the two main types of coastal reliefs appear:
The type of low-cost coastal lowland and the high rock type with abrasive activity and form.
The type of low-altitude seaside accumulative that occupies most of the length of the coastline, starting from the Rana e Hedhur beach in the south to the Buna River in the north.

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Vilun Lagoon is located 2 km east of the beach of Velipoja, has an area of about 300 ha and a depth generally 1-3 m.

Once this lagoon is called the lagoon of the brook, because there were many boats, an interesting mammal that feeds on fish.

This lagoon is surrounded by wetlands, communicates with the sea through a natural canal, in which due to tidal and reflux water changes direction every 6 hours. There are saline water at an average temperature of 20-22 C.

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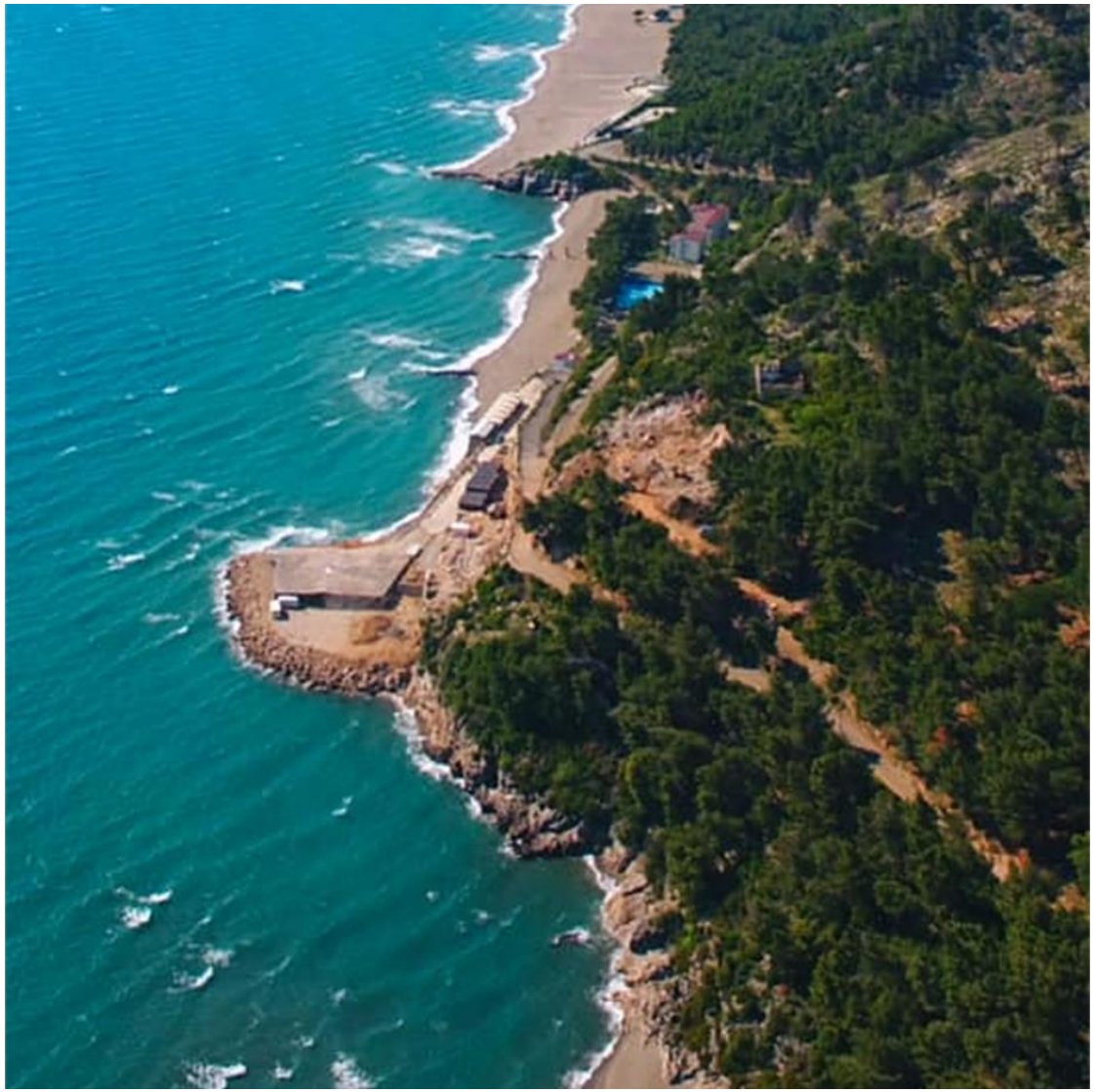

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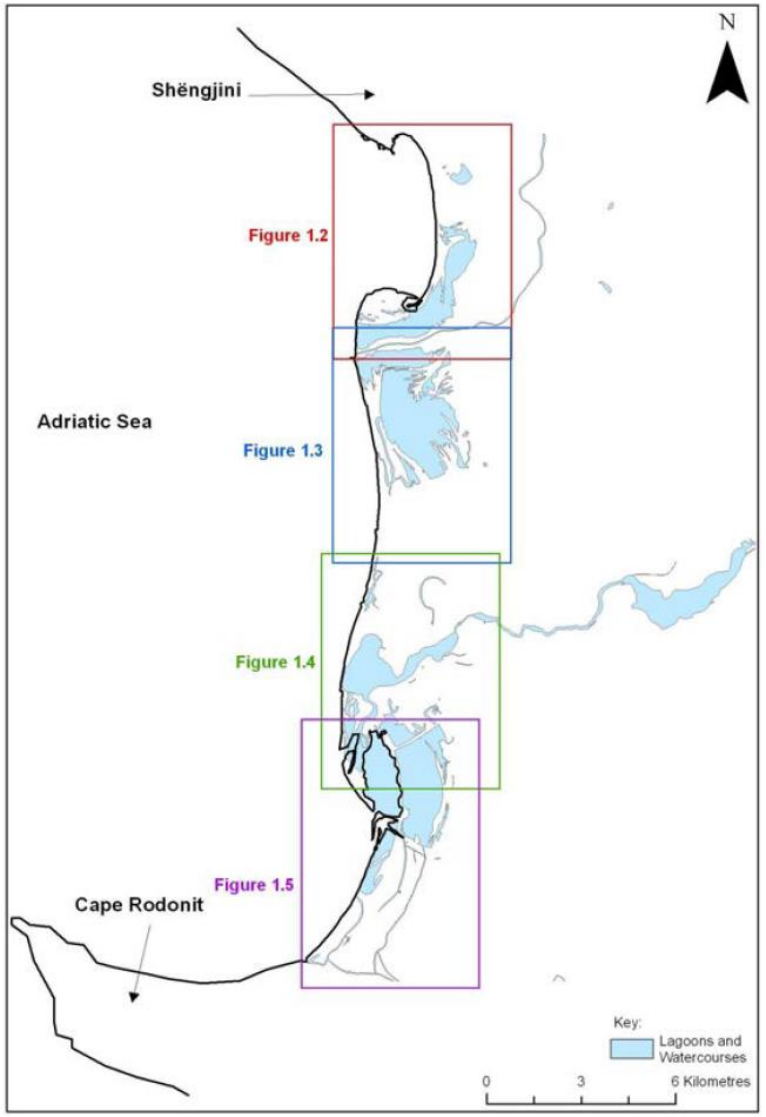

The low-lying coastal region of the Drini-Mati River Deltas is situated in northern Albania between the rock headlands of Shëngjini in the north and Cape Rodonit in the south.

The lowland area is approximately 25km long and up to 3km wide (average 2km) and comprises a complex of habitats, including beaches, dunes and wetlands (predominantly saltmarshes and lagoons)

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The stability of the Drini-Mati River Deltas depends on the physical character of its coastline which, in turn, is determined by its geology, geomorphology and the actions through time of wind, waves and tides. The physical attributes influence its conservation value, its development potential, and its vulnerability to erosion or flooding. Hence, an appreciation of the various physical shoreline types and their geomorphology lies at the heart of effective coastal planning in the area.

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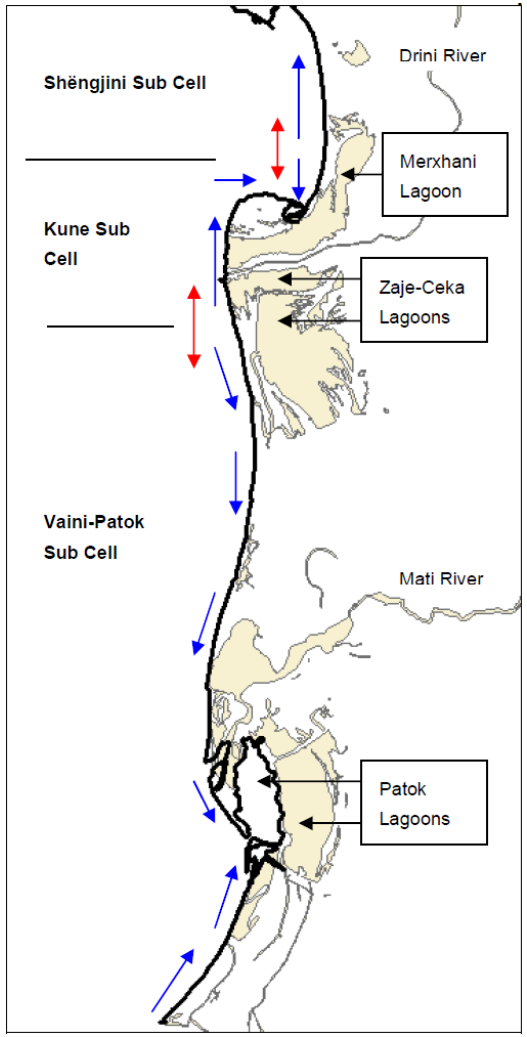
Littoral Cell and Sub-Cells

The Drini-Mati River Deltas can be divided based on the concept of littoral cells and sub-cells.

Littoral cells are defined lengths of shoreline within which the cycle of bedload sediment erosion, transport and deposition is essentially self-contained. The boundaries of a littoral cell are typically headlands or sinks such that transport of sediment into the cell from the adjacent compartments is restricted.



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Sediment transport along the area coast is driven by waves approaching predominantly from the west and northwest. The longshore sediment transport along Shëngjini Beach is opposite to this direction because this beach is located in the lee of Shëngjini headland which provides shelter from waves approaching from the northwest. Hence, sediment transport is reversed as the predominant waves approach from more southerly sector. The partial submergence of military bunkers originally built in the early 1980s on the dunes indicates that most of Shëngjini Beach (the southern 2,000m to the northern shore of Merxhani Lagoon) is eroding.

Partially submerged military bunkers along Shëngjini Beach

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Coastal Erosion along the Kune and northern Vaini-Patok Sub-Cells

The key factor causing coastal erosion along the Kune and northern Vaini-Patok littoral
cell is low sediment supply, manifested in three main ways:
1.reduced sediment input to the coast from the Drini River due to upstream diversion;
2.changing location of the Drini River mouth as a result of anthropogenic effects; and
3.alteration of longshore sediment transport rates due to construction of a breakwater south of the Drini River mouth.

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The main coastal erosion issues of the area are confined to the sediment starved Shëngjini, Kune and northern Vaini-Patok littoral cells.

The southern Vaini-Patok littoral sub cell is healthier because sufficient sediment enters the coastal zone from the Mati River despite the extraction of gravels (and sands) from the river bed. No coastal erosion adaptation measures are considered to be necessary along the southern Vaini-Patok littoral sub cell.

The morphology of Kune Spit indicates that longshore sediment transport along the spit is to the south driven by the predominant waves. Given that longshore sediment transport is to the north along Shëngjini Beach means that there is a zone of sediment transport divergence between the two (sediment moves bi-directionally, but eventually is transported away from this location in opposite directions). Longitudinal beach widths suggest that the divergence is located in a zone centred on the northern shore of Merxhani Lagoon

Most of Kune Spit is eroding and placing Merxhani Lagoon at threat from marine inundation. Evidence for this erosion is the partial submergence of the pine woodland that used to stand on the low-lying dunes and the development of a small cliff along the back of the beach towards the lagoon entrance. The highest erosion rates are estimated to be 2-3myr.

Partially submerged pine trees along Kune Spit

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Kune Island is a ‘peninsula’ fronting the southwest portion of Merxhani Lagoon to the west of the lagoon entrance. The peninsula is approximately 1,000m wide from the beach to the shore of Merxhani Lagoon. It is composed of a series of beach ridges and dunes accreted as recurves at the end of a spit that has grown from the south.

Small eroding cliff at the back of Kune Spit beach

The southern part of the Patok littoral cell is part of the sedimentary system of the Mati River and has a positive sediment budget. Even though sand and gravel extraction has taken place from the Mati River bed, the regime at the coast is depositional. However, the extraction has caused environmental problems along the banks of the river. The Patok Lagoon area is very mobile due to changes in the Mati River flow where it enters the sea. Currently, deposition of a new spit has created a new Outer Lagoon seaward of the initial Inner Lagoon, providing an additional buffer to incoming waves.

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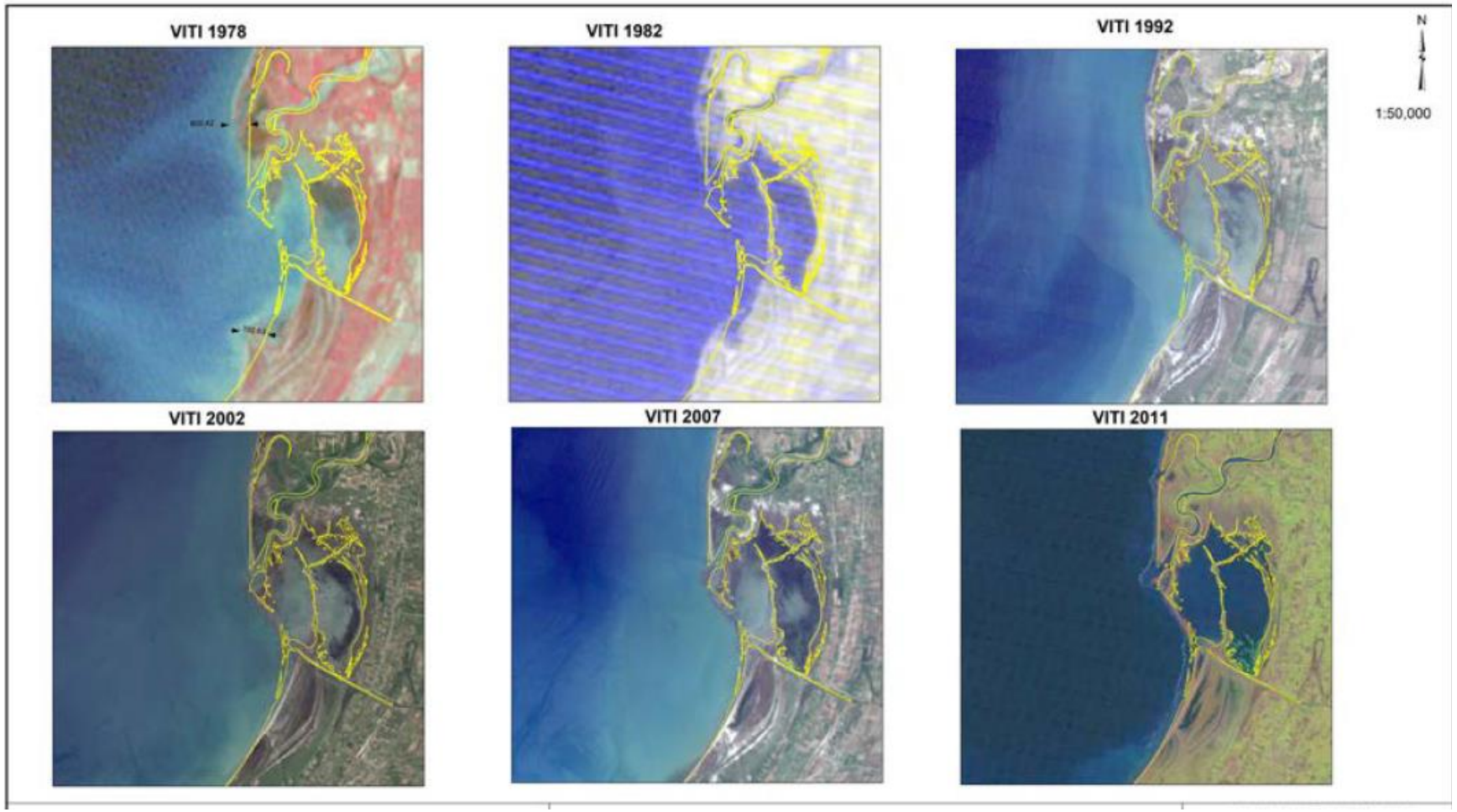

Morphological changes of the Mat River estuary area

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Conclusions

Different interventions implemented in years on coastal areas or along main Albanian rivers have significantly influenced the shrinking of the area or loss of functions of several important coastal ecosystems, the existing knowledge and analysis of these activities, their extent and impacts on natural resources are insufficient to allow for an appropriate plan of measures to minimize and or avoid these adverse impacts. So, it is necessary to conduct this study to identify measures to be taken for properly addressing these impacts.

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