

# MECHANISMS OF SEDIMENT TRANSPORT AND SEAWATER EXCHANGE IN THE KARAVASTA LAGOON, ALBANIA

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## INTRODUCTION

Karavasta Lagoon is located at the coastal extending between Shkumbini and Semani Rivers, in the center part of the Albanian Adriatic coast in Republic of Albania (see Figure 1). The lagoon is one of the Ramsar sites and the largest area (4300 ha) with the largest fishing catch in the country. The environments around the lagoon have been significantly changed after the 1950s due to increased needs for agricultural land. The reclamation network was built with drainage in two large canals: Terbuf and Myzeqe. Moreover, the mining activities upstream of Shkumbini River, deforestation and freshwater extraction in east of the Karavasta etc. could affect the delta environment. The Karavasta has three channels connected with the Godulla Lagoon, the west side of Karavasta. Although the northern channel was directly connected to the Adriatic Sea in the past, the channel was blocked due to sedimentation. The only one channel of Godulla lagoon, which location is changing, is directly connected to the sea. In this situation, local fishermen concerned that the degradation of the lagoon eco-system was causing a decline in fishery resources. The sediment transport in this area is relatively drastic and might affect the seawater exchange to diverse ecosystem in the lagoon. This study aims at understanding the mechanisms of sediment transport and seawater exchange in the Karavasta Lagoon to conserve this natural landscape.

## NATURAL CONDITIONS

This study examined the characteristics of natural conditions such as wave, tide, rainfall, river environment. Firstly, this study used the reanalysis data from ERA5 since there is no wave observation data in this area. Figure 2 shows the wave roses of the ERA5 reanalysis wave data in the west side of the lagoons with four seasons of the 2021 year. There are two dominant waves from NW-NNW and SSE-S-SSE. In summer, northern waves are predominant, while two dominant waves are found in other seasons. Secondly, the tidal amplitude in this area is very small according to the previous studies such as Pano (2015); the average of the tidal amplitude is 0.09 to 0.19 m, while the maximum is about 0.5 m. Thirdly, the sand sources here are highly affected by the converted locations of the two river mouths; Semani river moved to the south in 1962, from just south of Godulla lagoon, while Shkumbini river to the north in 1996.

## MECHANISM OF SEDIMENT TRANSPORT

To understand the long-term shoreline change, several satellite images were collected from 1991 to 2021 (see Figure 3). As mentioned above, the northern channel from the Karavasta lagoon to sea was blocked due to huge sedimentation deposit; the shoreline has been

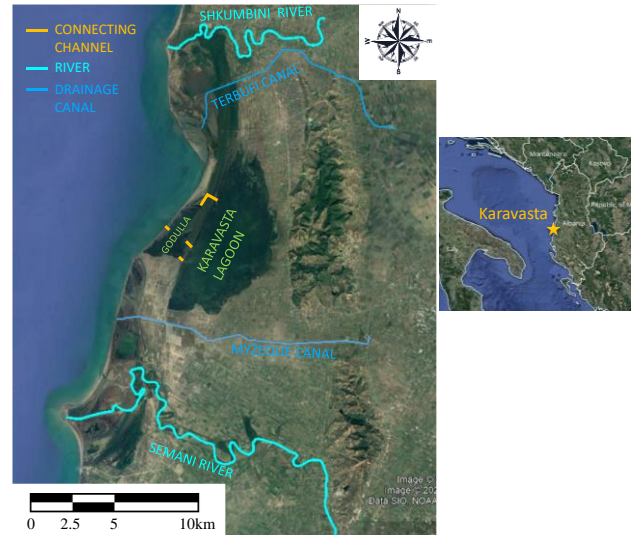


Figure 1 - Location of Karavasta Lagoon

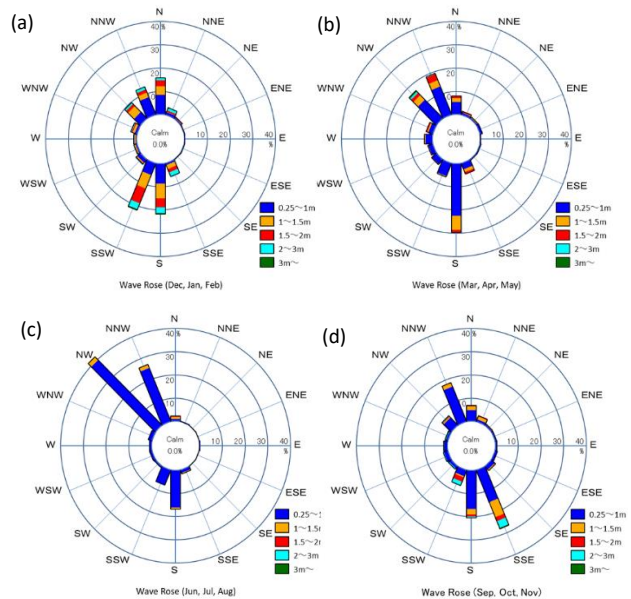


Figure 2 - Seasonal Wave Roses from ERA5 Reanalysis Data: (a) Winter, (b) Spring, (c) Summer, (d) Autumn

changed by about 500 m in 27 years. Meanwhile, 500 m of severe shoreline retreat occurred in the south part of the Godulla lagoon during the same period. It is also found that extreme accumulation in the current locations of both river mouths due to their sediment discharge. On the other hand, severe coastal erosions have been identified in the areas where the two river mouths were in the past.

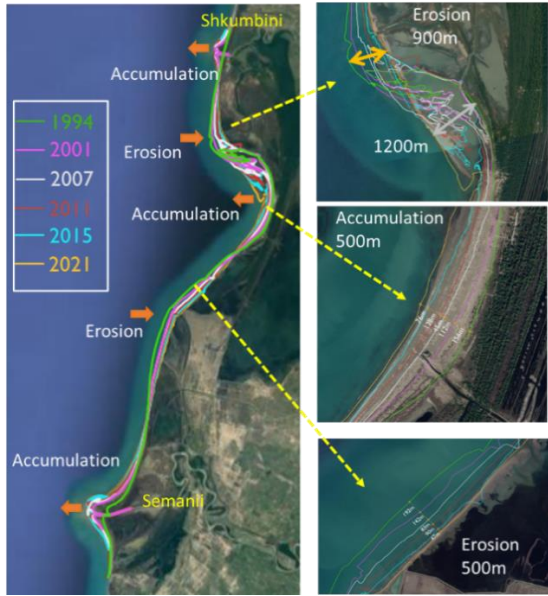


Figure 3 -Shoreline Analysis of Karavasta Lagoon by Satellite Images from 1994 to 2021

The mechanism of sediment transport in this area is summarized; The sediment source is the huge sand supply from the two rivers and sand deposit in the old river mouths. Two dominant waves in the north and south direction transfer such sand towards both ways.

#### MECHANISM OF SEAWATER EXCHANGE

To grasp the mechanism of seawater exchange in the two lagoons, this study conducted environmental field measurement and numerical simulations by MIKE 21. Firstly, according to the measurement results from October to December 2021, the water levels in the two lagoons have a very small difference and the current velocities in the three channels were very slow, 0.1 - 0.8 m/s at maximum. Furthermore, the water depth in the two lagoons were no significant change between 1984 and present, as well as the salinities in the two lagoons. This means that the water quality measured in this study is similar to the past one, not getting worse. The results of field measurement indicated that the seawater exchange occurs through one channel to Godulla and three channels to Karavasta lagoon from sea. Because the amplitude of astronomical tide is about 30 to 40 cm per day, the water level change in the Karavasta lagoon is about 1 to 3 cm per day. Therefore, the regular seawater exchange between Karavasta and sea would be very small, and the blockage of the northern channel might not affect the water quality in the Karavasta Lagoon.

Next, this study executed the numerical simulations by using MIKE21 to understand the effect of these channels on the water circulation and salinity levels in Karavasta and Godulla Lagoons. Before main calculation, the calibration was conducted with the water level and salinity values that have been measured on site and confirmed the validity to compare with these results. The calculation cases include several natural conditions and interventions such as opening the blocked northern channel and widening the channel of sea and Godulla.

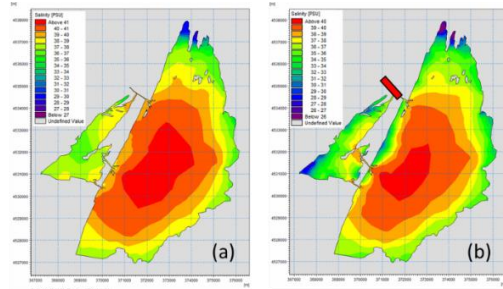


Figure 4 - Simulation Results of Salinity with (a) Current Condition and (b) Opening the Northern Channel

Figure 4 shows sample results of salinity in the intervention of opening the northern channel compared with the current condition. The results clarified that there is no significant improvement in salinity with opening the northern channel, which certifies the above mechanism of seawater exchange in the Karavasta Lagoon.

#### CONCLUSION

This study revealed that the blockage of the northern channel didn't significantly affect the seawater exchange and salinity in Karavasta lagoon compared with the situation studied in 1996 and 2015, although the only channel connecting with Godulla lagoon and sea is critically affected by drastic sediment transport. Therefore, the ecosystem degradation of the lagoon can be caused by the area development before 1990s such as the Shkumbini River delta deviation further north and Semani River further south, intensive river gravel exploitation, the loss of the floodplain (separation by canals and dikes), water extraction for irrigation, deforestation. Reviewing comprehensive development plan and ecosystem restoration project is necessary to restore the ecosystem.

Such lagoon eco-systems with substantial sediment transport are very common not only in Albania, but also on the continuous Adriatic coast. The findings of this study expect to be applied to such coasts and contribute to coastal management in this region.

#### ACKNOWLEDGEMENT

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#### REFERENCES

- Ciavola, Mantovani, Simeoni, Tessari (1999): Relation between river dynamics and coastal changes in Albania: An assessment integrating satellite imagery with historical data, *International J. of Remote Sensing* 20(3)
- Pano (2015): Albania Water Resource, Albania academy of sciences.
- Copernicus Climate Change Service (C3S) (2017): ERA5: Fifth generation of ECMWF atmospheric reanalyses of the global climate. Copernicus Climate Change Service Climate Data Store (CDS), February 9, 2023. <https://cds.climate.copernicus.eu/cdsapp#!/home>