

MONITORING AND MODELING COASTAL MORPHOLOGICAL CHANGES USING VIDEO DATA AND XBEACH MODEL

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INTRODUCTION

Coastal areas are highly dynamic environments, subject to morphological changes due to the action of waves, tides, and winds. Monitoring these changes is crucial for understanding coastal evolution and planning sustainable management strategies. This study aims to analyze shoreline changes, sediment accumulation patterns, and crucial beach parameters such as width, foreshore, and swash zone slopes for sandy beaches using Xbeach Roelvink et al. (2009) numerical modeling and video data. It introduces innovative and standardized methodologies for investigating shallow water hydrodynamics and morphodynamics, including Run-up and shoreline temporal evolution. The integration of various data sources, including wave characteristics, wind patterns, tide information, bathymetric/topographic data, and video data, enables us to create precise simulations of beach behavior and morphological changes over time.

METHODS AND DATA COLLECTION

The video monitoring system implemented by the Apulian regional Basin Authority (AdBP) in collaboration with the Polytechnic University of Bari (Bari, Italy) monitor two vulnerable sites Bruno et al. (2020), Torre Canne (Fasano, Brindisi) and Torre Lapillo (Porto Cesareo, Lecce), to assess medium to long-term coastal changes. The system consists of video stations equipped with thermal and visible cameras that capture images every 30 minutes. The video camera at Torre Canne (TC) consists of one thermal (TCth) and one visible (TCvs) camera, both face NNW, while Torre Lapillo in Porto Cesareo (PC) has two visible cameras (PCvs1, PCvs2), directed NW and SE respectively. These cameras capture high-resolution images, which are subsequently uploaded to a dedicated website (<http://93.51.158.173/>) for thorough analysis. The portal consists of 5 different tabs. The Current Images tab allows the use to see the latest images from all stations (Snap, Timex, STD and geo-rectified). The Images Report allows to browse and download images from a specific period; The Shoreline Map tab shows the shoreline over the rectified geo-referenced image (Fig. 1), while the Shoreline Transect Analysis tool allow the user to analyze the shoreline over time along a user-specified transect. The Download tab allows users to download freely the output data from the portal. The resulting shoreline data from the SDM (Shoreline Detection Model) as described by Valentini et al. (2017), offers invaluable insights into the temporal dynamics of beach morphology and shoreline positioning.

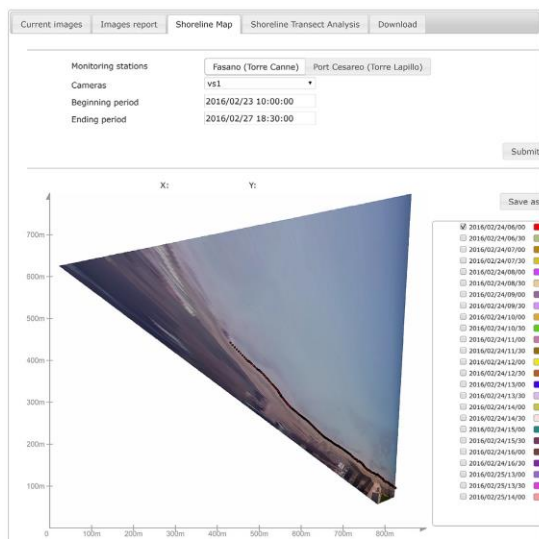


Figure 1 - Example of mapped shoreline over the georectified image using the Shoreline Detecting Model (SDM).

With the aim of validating the Xbeach model framework for predicting beach evolution on embayed sandy beaches. The measurements from a video-monitoring station, gathered during two storm events in 2016 will be used. Combining multibeam and d-RTK surveys with Unmanned Aerial Vehicle (UAV) imagery provides a high-resolution depth grid, particularly essential in shallow waters where wave hydrodynamics strongly interact with the bottom.

STUDY CASE

Torre Canne features public and private sandy beaches with a medium grain size and experiences moderate wave conditions primarily from the NNW and ESE directions. On the other hand, Torre Lapillo has low-lying shores with sandy and calcarenite rocky beaches and generally experiences a moderate to low wave climate, with the primary wave directions being SSE and SW. (Fig. 2)

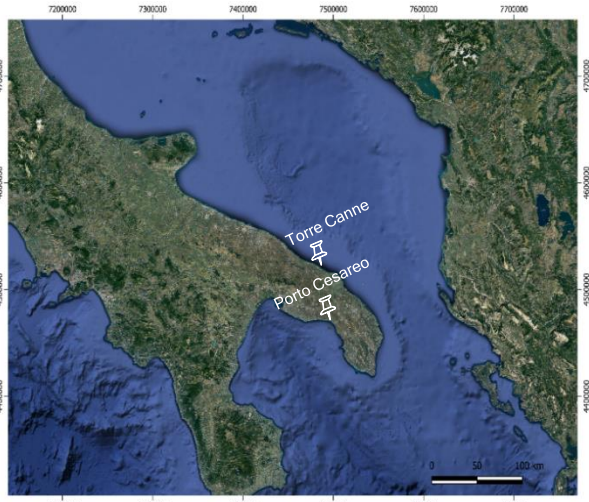


Figure 2 - Location of the video camera at 'Torre Canne', Fasano, Brindisi, Italy and 'Torre Lapillo', Porto Cesareo, Lecce, Italy (Grid coordinates: RDN2008/UTM33)

CONCLUSION

In conclusion, this comprehensive study conducted in Torre Lapillo, and Torre Canne employs a video system to capture the shoreline through the Shoreline Detection Model. Through the fusion of observed data and the numerical model, it offers valuable insights into coastal morphological changes, contributing to the sustainable management of sandy beaches and further understanding of coastal dynamics.

This research serves as a model for monitoring and modeling coastal environments. To further enhance the study's impact, the potential for using remote sensing techniques like LiDAR and satellite imagery in conjunction with the existing data sources will be explored. This multi approach promises a more comprehensive understanding of coastal dynamics and strengthens the foundation for informed decision-making in coastal management and risk mitigation.

REFERENCES

Roelvink, Reniers, van Dongeren, van Thiel de Vries, McCall, and Lescinski, (2009): Modelling storm impacts on beaches dunes and barrier islands. *Coastal Engineering*, vol. 56, no.11, pp. 1133-1152.

Bruno, Saponieri, Molfetta, and Damiani, (2020): The DPSIR Approach for Coastal Risk Assessment under Climate Change at Regional Scale: The Case of Apulian Coast (Italy). *Journal of Marine Science and Engineering*, vol.8, no.7, pp. 531.

Valentini, Saponieri, Molfetta, and Damiani (2017): New algorithms for shoreline monitoring from coastal video systems, *Earth Science Informatics*, vol. 10, no. 4, pp. 495-506.