

Article

The First Video Witness of Coastal Boulder Displacements Recorded during the Impact of Medicane “Zorbas” on Southeastern Sicily

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Abstract: Over the last few years, several authors have presented contrasting models to describe the response of boulders to extreme waves, but the absence of direct observation of movements has hindered the evaluation of these models. The recent development of online video-sharing platforms in coastal settings has provided the opportunity to monitor the evolution of rocky coastlines during storm events. In September 2018, a surveillance camera of the Marine Protected Area of Plemmirio recorded the movement of several boulders along the coast of Maddalena Peninsula (Siracusa, Southeastern Sicily) during the landfall of the Mediterranean tropical-like cyclone (Medicane) Zorbas. Unmanned autonomous vehicle (UAV) photogrammetric and terrestrial laser scanner (TLS) surveys were performed to reconstruct immersive virtual scenarios to geometrically analyze the boulder displacements recorded in the video. Analyses highlighted that the displacements occurred when the boulders were submerged as a result of the impact of multiple small waves rather than due to a single large wave. Comparison between flow velocities obtained by videos and calculated through relationships showed a strong overestimation of the models, suggesting that values of flow density and lift coefficient used in literature are underestimated.

Keywords: boulders; Medicane; flow; UAV; waves

1. Introduction

Mediterranean hurricanes, also called Mediterranean Tropical Like Cyclones (TLCs) or medicanes, are warm-core cyclones that develop over the Mediterranean Sea [1–3] with characteristics similar to tropical cyclones. Such storms are constituted by rotating cloud systems characterized by gale force winds, severe precipitation, and a low pressure center, accompanied by a spiral pattern of thunderstorms [4–7]. Two specific areas appear to be the favored locations for medicane genesis: the western Mediterranean [2,8] and the central Mediterranean–Ionian Sea [9,10]. During the last decades, the impacts of medicanes along the coasts of Mediterranean basin have strongly influenced the human settlements, causing a lot of damage and casualties [6,11]. Moreover, several authors predict that, in the next future, climate changes could modify medicanes, decreasing the frequency of their occurrence but increasing the strength of their impacts [4,12,13]. In the last