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Recovery of a coastal dune system at Punta Marina (Italy) following dune preservation schemes and reintroduction of vegetation

Edoardo Grottoli, Paolo Ciavola, Enrico Duo, and Andrea Ninfo
University of Ferrara, Department of Physics and Earth Sciences, Ferrara, Italy (grtdrd@unife.it)

In the current scenarios of sea level rise and increasing coastal erosion processes, dune conservation is one of the potentially more efficient solutions for Disaster Risk Reduction policies. Coastal dunes represent a natural defence barrier from flooding and can protect strategic infrastructures and populated urban areas located behind them.
The abstract reports the results of a yearly monitoring programme (March 2017 April 2018), performed using UAV surveys to describe the geomorphic evolution of a coastal dune system, recently subjected (2015) to a preservation scheme by local authorities, which included re-vegetation with pioneering plants (2016). The project mainly consisted in the construction of wood walk-boards and a fence to prevent trampling by beach-goers. A total of 5500 local dune plants were planted to accelerate sedimentation and growth of the incipient dune that developed at the shortly after the construction of the protection scheme. The entire dune area is 600x150 m (90000 m2) while the area of interest (incipient dune) is 4700 m2.
The estimation of sand transport over time on the incipient dune was monitored comparing the DoDs (Dem of Difference) of the four UAV surveys. Surveys were performed flying at 80 m with a Phantom DJI 3 professional equipped with a digital camera of 12 megapixels. Automatic flight plans with 72% of sidelap and frontlap were realized after the deployment and measurement of 20 GCPs (Ground Control Points) with an RTK-GNSS. A ground resolution of 3.2-3.3 cm/pix was achieved for each survey. GCPs returned an error always below 10 cm and a validation of elevation values between RTK-GNSS field measured and drone derived ones was done, with a resulting RMSE of 7-9 cm.
During the monitoring period, the incipient dune showed the ability to withstand storms and to grow under strong wind action in a few months. The buffering role played by the wooden fence and the planted vegetation resulted to be important for the generation and growth of this incipient dune that locally reached and exceeded 0.5 m of vertical growth. The vegetation contribution by the reintroduced plants in overestimating the volume growth of the dune was estimated to be 11%. , The incipient dune currently represents a small deposit of loose sand potentially able to feed the facing beach after big storms or to enlarge the portion of stabilized dune at its rear. The latter process has already started since the crest of the incipient dune, after its most important vertical growth, showed also a landward migration that locally joined the stable foredune located behind.
Since the evaluation of extreme storm impacts is often site-dependent, the observed geomorphic change can be functional to determine local coastal vulnerability to erosion and inundation hazards. The lifetime of this kind of coastal protection scheme will be also determined relatively to the occurrence of more energetic storms which may occur in the future.