

RPAS Monitoring of the Morphological Evolution of Coastal Foredunes

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The coastal environment is in rapid and continuous evolution and it is easily affected by many natural and anthropic factors. Beaches are often backed by vegetated dunes and fulfill many different valuable ecosystem functions. They act as protective buffers against storm surge, wave attack and erosion, providing a unique habitat for flora and fauna. Coastal embryo dunes, found above mean high water, are dynamic landform being able to supply sand to the beach when needed. They may form rapidly and may be rapidly destructed due to high tides and storm waves or human interferences. The southern part (3 km long) of Rosolina (Adriatic Sea, Italy) is characterized by a wide beach bordered by a complex dune system. The geomorphological characteristics of embryo dunes have been identified by using an RPAS in order to develop a fast and low-cost surveying technique. The aircraft has flown at a 50 meters altitude, taking photos with a 12Mpix RGB camera and a GSD of about 1 cm. The images overlap of 80% in the flight direction and 60% laterally. Fourteen targets have been collocated in the area as ground control points and were surveyed using Network Real Time Kinematic (NRTK) GNSS. Images and GCPs were elaborated in Agisoft PhotoScan to generate the model. A similar NRTK survey has been performed to integrate the wrong data (due to vegetation) for the creation of a digital elevation model (DEM) in a first step and finally to validate the model obtained through UAV photogrammetry through a comparison with specially surveyed points.

The creation of a DEM from photos is one of main tasks and its accuracy is critical. A challenge in this work was to recognize the vegetation in the sand dunes area to exclude all the points not belonging to the ground. This was possible through a classification process based on slope detection. Finally, the suitable elevation accuracy has been reached and the survey has revealed a complex dune system characterized by:

- on the upper part of the beach (about 1.50 meter amsl), isolated embryo dunes (incipient foredunes) and foredunes develop along a cross-shore section of about 30 meters;
- a “depressivive” interdune of about 10 meters;
- a second field of successive well-developed dunes.

The first foredunes are of small dimensions (about 0.50 m height), and are aligned to the prevailing wind directions. The second field of dunes are higher (about 1 meter height) and form a “continuous” dune ridge parallel to the shoreline.

Another significant advantage of this method is the possibility to obtain information on the vegetation, which is an important factor driving the evolution of coastal dunes. Different blowouts and pathways have been also mapped.

The use of the orthophoto will therefore allow to collect simultaneously physical and biological data and consequently to analyze their interaction in order to improve the management of the coastal dune systems.

This study exhibits how RPAS can be successfully used in representing the spatial distribution of embryo coastal dunes and in monitoring their development.