Article, Published Version

Guillot, Benoît

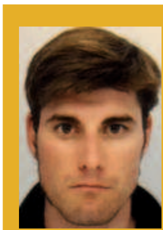
Gautrelle Dike analysis at Oleron island

Hydrolink

GAUTRELLE DIKE ANALYSIS AT OLERON ISLAND

BY BENOÎT GUILLOT

The Oleron island is located along the French Atlantic coast less than 30 kilometers north of the Gironde estuary. Artelia was commissioned in 2017 by the Charente-Maritime Departement Council to analyze the consequences of a removal scenario of *Gautrelle* dike in the north of the island. This dike was built in the 1990's to protect a large low elevation area which includes a camping site.



Benoît Guillot is the manager of ARTEDRONES, the field data acquisition team of Artelia specialized in drone operation. He obtained a master and PHD degree in developing protocols to acquire topographic data of groins and dikes in shoreline environments by using drones.

The study was performed between the spring of 2017 and the winter of 2018. To understand the morphodynamics of the area, we used diachronic aerial photography and a small Unmanned Aerial Vehicle (UAV), to achieve precise topographic and ortho-image data. These data were combined with GIS computations and analysis.

Material and methods

Old aerial photographs were obtained using the database of the French National Geographical Institute (IGN) for the years 1950, 1964, 1973, 1984, 1991 and 2000. Between years 2000 and 2014 we used reference ortho-images, called "BD Ortho", provided also by IGN. These images are mainly black and white and were mosaiked for each date, using a stereo-photogrammetric protocol. After this mosaiking, they were georeferenced using remarkable georeferencing points picked-out from a 2014 reference image. After a technical check, each resulting orthophoto was visually photo-interpreted to identify the shoreline position (dune toe, dike or groin toe). Then, each diachronic shoreline was analyzed with GIS software using the *Digital Shoreline Analysis System* (DSAS) [1] to get evolution dynamics.

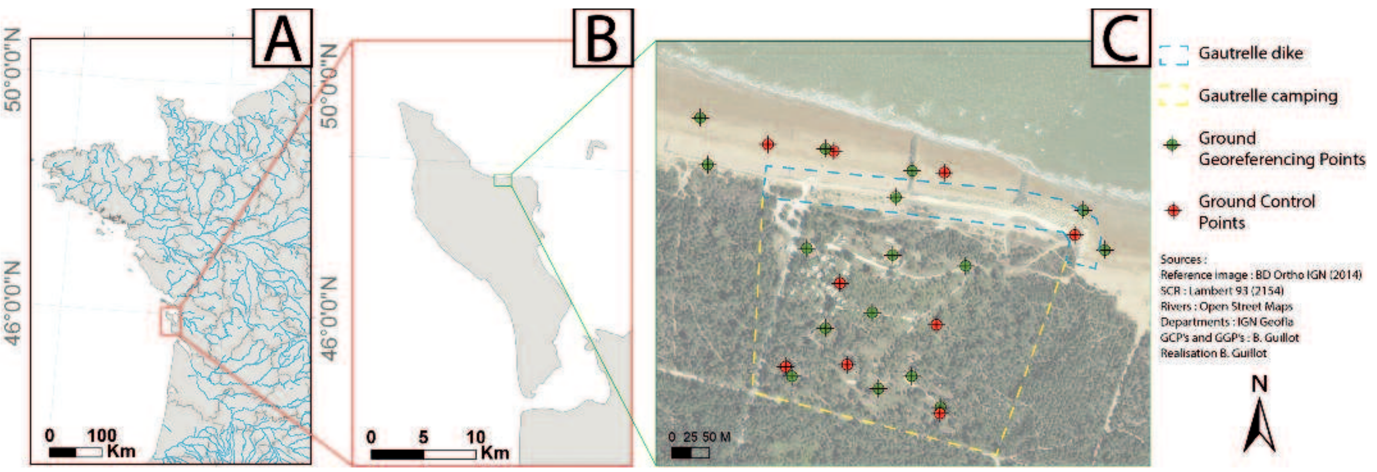
The high-resolution survey was conducted in the spring of 2017, to actualize the last topographic data acquired in 2010, and the last orthophoto acquired in 2014. For this survey, we used a local stereo-photogrammetric protocol [2]. This is based on the use of Ground Georeferencing Protocol (GGP) and Ground Control Points (GCP). Those points were georeferenced with a centimetric *Trimble Geo 6000* Global Navigation Satellite System (GNSS), with a Post-Processing Kinematic (PPK) protocol. Aerial data were obtained deploying an UAV equipped with a 3 axis brushless gimbal and 20 Mp camera (*DJI Phantom 4 Pro*). During the stereo-photogrammetric assembly, low precision UAV GNSS positions were not used. The entire model was georeferenced, using GGP's and GCP's. The data produced were a 1-cm cell-size orthophoto and a 4-cm cell-size Digital Surface Model. Vertical accuracy of the data is less than 6 cm and horizontal accuracy is less than 3 cm. Vegetation was classified and filtered above the camping surface, to produce a Digital Terrestrial Model.

Those data were then computed with a GIS (*Arcgis*) software. Several analyses were deployed. The first involved the extraction of contour lines, hillshades and slopes.
The second focused on computing cut and fill to identify topographic differences and to document the evolution of the topography between 2010 and 2017. The third set of analysis dealt with the conversion of the topographic differences into volumetric differences using each DSM cell surface and elevation difference.

Results

Results obtained by this survey allowed analyzing precisely the topographical and morphological evolution of the shoreline (figure 4). The data showed significant morphological evolution of the beach, specifically

Figure 1. Study site localization: In A: Study site located in South-West French littoral. In B: Study site located at Oleron Island. In C: overview of the study site



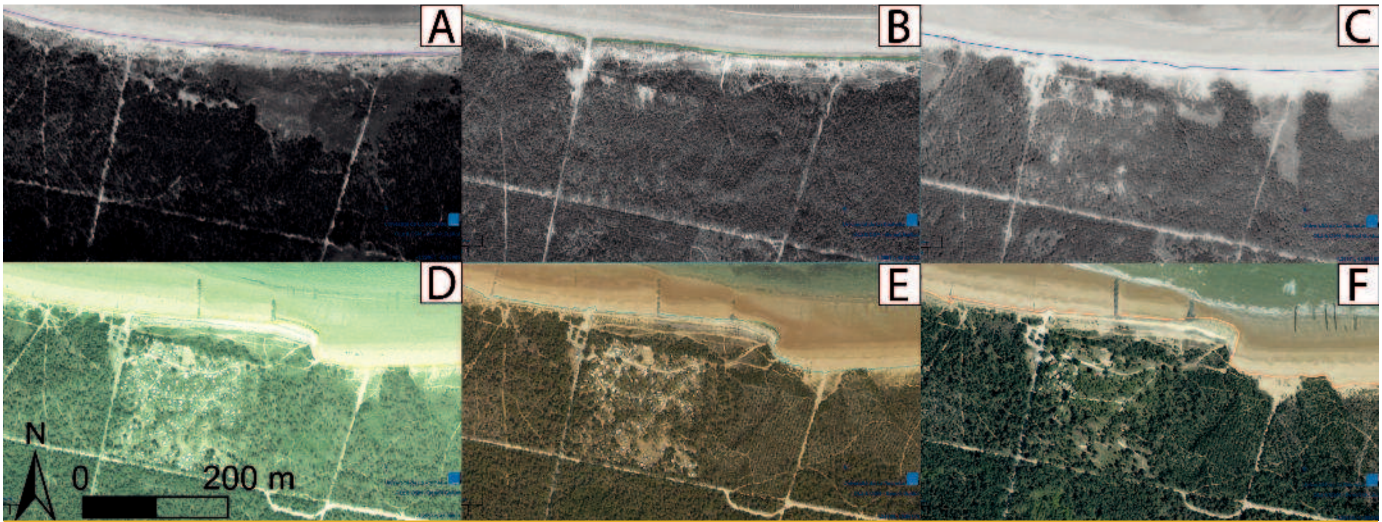


Figure 2. Diachronic images of the study site: 1950 (A), 1973 (B), 1984 (C), 2000 (D), 2010 (E), 2014 (F)

around groins and dike. The adjacent field appears to be relatively stable.

Conclusion

New technologies such as photogrammetric drones or UAS appear to be very interesting for analyzing littoral environments. The possibility to implement automated flight plans offers new perspectives for deploying this type of equipment easily. Combined with a robust protocol using ground control points, this technology can be deployed on demand after every meteorological event such as storms or severe winds. For coastal studies, the accuracy of data, the very high resolution and the flexibility of the protocol are highly valuable in support of traditional studies such as 2D or 3D modeling. Future improvements to this protocol are expected by optimizing the number of ground control points (to be decreased) and by working on the classification of vegetation points. ■

References

[1] USGS, U.S.G.S., 2016. Department of The Interior, DSAS 4.0, Installation, Instructions and User Guide, updated for Version 4.3 (only compatible with Arcgis 10).
[2] Guillot, B., Musereau, J., Dalaine, B., Morel, J., 2018. Coastal Dunes Mobility Integration and Characterization: Developing of a Flexible Volume Computing Method. Journal of Geographic Information System 10, 503–520. https://doi.org/10.4236/jgis.2018.105027

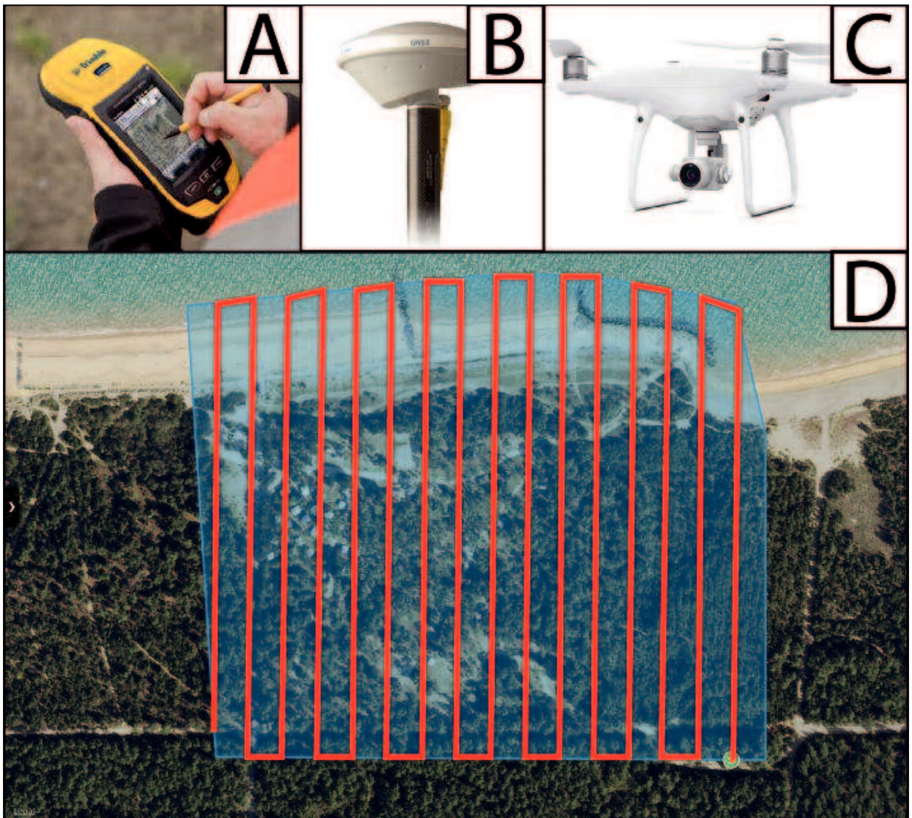


Figure 3. Geo6000 GNSS (A) with Trimble Zephyr model 2 antenna (B), the UAV used for the survey (C), the flight plan deployed (D)

Figure 4. Topographic data (A), contours (B), and topographic differential (C)