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Synergy between LIDAR and RADARSAT-2 images for the recognition of vegetation structures in the coastal wetlands of the Danube Delta

Simona Niculescu, Cédric Lardeux, Ion Grigoras, Jenica Hanganu, and Laurence David
Institut Universitaire de la Mer, Laboratory Géomer, Plouzané, France (simona.niculescu@univ-brest.fr)

Wetlands are among the most productive environments in the world and are characterized by exceptional biological diversity. Despite their indisputable importance, these environments remain among the most endangered ecosystems in the world due to drainage, drying out, pollution or overexploitation of resources. The Danube Delta, a coastal wetland of the Black Sea, cannot escape these dangers and, to preserve its resources, it has been declared a Biosphere Reserve (in 1993). The biodiversity of this area is remarkable and it possesses one of the largest reed in the world (a continuous 2,700 km^2 reed cover).

The main goal of this project is to determine, characterize and derive functional descriptors of the vegetation structures, Phragmites australis species of the Danube Delta being the most prevalent. For this purpose, this project aims, on the one hand, at interpreting LIDAR measurements (acquired in May 2011) in conjunction with RADARSAT-2 satellite observations (acquired in early June 2011) and, on the other hand, at validating the results obtained by the introduction of the spectral measurements of the main vegetation classes into a Spectral Angle Mapper algorithm applied to a SPOT-5 image (May 2011). The LIDAR data allow the assessment of vegetation height with an accuracy of a few centimeters. Hence, the various vegetation layers can be accurately mapped. However, the differentiation of the various vegetation formations within a same layer requires the contribution of complementary data sources such as RADARSAT-2 data. The radar measurements are derived using the C band (λ wavelength = 5.3 cm) providing additional information on the vegetation cover structure with regard to roughness, moisture and biomass. The simultaneous acquisition of HH, HV and VV polarizations allows the differentiation of the areas according to their response to different polarizations by establishing their polarimetric signatures. Based on these raw data, we were able to derive other indices such as, for instance, the intensity of the four polarizations, the span and the polarimetric entropy. Entropy is very sensitive to vegetation density; the thicker the vegetation, the higher the entropy becomes. The approach allowed us to obtain valuable information regarding different types of exploitation of the reed (cut or burned reed). Moreover, the exploitation of the SPOT 5 spectral information was made possible due to the calibration carried out using spectrometers to perform spectral measurements in the areas previously identified on the images.