ANALYSIS OF ASAR/ENVISAT POLARIMETRIC BACKSCATTERING CHARACTERISTICS OF DOÑANA NATIONAL PARK WETLANDS

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Doñana National Park marshes, in South West Spain, extents over 27,000 ha of the Gualdalquivir River estuary, on the Atlantic Ocean coast. The site undergoes a yearly cycle of inundation in autumn and drying out during the spring season. While flooded, Doñana wetlands create a crucial passage, breeding and wintering site for more than half million waterfowl each year, including about 150 bird species. The park is also home to endangered species of flora and fauna. Doñana National Park was recognised as a Biosphere Reserve under UNESCO's Man and the Biosphere Programme in 1980 and inscribed on the World Heritage List in 1994.

The FLUMEN Research Group at the Technical University of Catalonia (UPC), Spain, is currently acquiring ASAR/EnviSat images of Doñana's marshes to monitor the flood extent evolution during the inundation and dry-out processes. The objectives are to further the understanding of the wetland hydrodynamics and to calibrate the existing hydraulic model of the marshes, which will serve as a management tool for the National Park authorities.

Detailed observation of the flooding process is of particular interest for the calibration of the hydraulic model. This process is rapid and coincides with overcast conditions. These two characteristics, rapid land cover change and overcast weather, pointed at the ASAR instrument, on board of the EnviSat satellite, as the most suitable sensor for monitoring Doñana's inundation. Radar microwave radiation can penetrate most meteors, so ASAR is able to collect data under almost all weather conditions. Additionally, ASAR's multiple incidence angle capability enables up to 15 image acquisitions of Doñana per 35-day orbit cycle. Thus, ASAR may potentially provide the required frequent observations of Doñana's marshes during the flooding process.

To date, FLUMEN has acquired 155 ASAR images of Doñana's marshes, 79 of them during the hydrological years 2006/07 and 2007/08, in swaths IS1 to IS7 and in Alternating Polarization mode (HH/VV and HH/HV polarizations). These last images have been georeferenced and calibrated to radar backscattering coefficient (σ^0).

The analysis and interpretation of the ASAR scenes is aided by complementary data sources as follows: a precise digital elevation model of the site; a network of five hydrometeorological gauging stations which take continuous measurements of water level, wind direction and velocity,

and other meteors; ground truth data collected during ASAR image acquisitions over Doñana; concurrent Landsat images; several vegetation thematic maps.

Average backscattering coefficients, in the HH/VV and HH/HV polarimetric modes, of the main class cover types identifiable on the ASAR images have been extracted for the seven swaths within cells of sizes from 9x9 to 30x30 pixels. The aim was to determine the minimum cell size (i.e. better spatial resolution) for the classification of the cover types, while avoiding excessive dispersion of the cell average backscattering and consequent confusion among classes. The found optimal cell size is class and swath dependant.

Average backscattering coefficient within several optimal size cells have been extracted for each land cover class. These values, when obtained from Alternating Polarization mode images, were plotted for each swath in 2D scatter charts, the x and y axes representing the backscattering in the two polarizations of the image. Such plots will allow an easy assessment of the classes separability in each ASAR swath. Conclusions about best swaths and polarizations for flood and vegetation monitoring in Doñana National Park, depending on the inundation and phenological stages will be drawn.

Beautiful concordance between backscattering coefficients and other measured physical parameters have been found. Examples are: backscatter form wind-roughened water surface and wind speed, backscatter from emerged vegetation and soil humidity, density and height of flooded vegetation and backscattering from it. Such correlations will hopefully be exploited in the course of coming projects with the objective of a better monitoring and management of Doñana National Park.