



Determination of wetland ecosystem boundaries and validation of land use maps using remote sensing: Fuente de Piedra case study (Spain)

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Remote sensing techniques (SRS) are valid tools for wetland monitoring that could support wetland managers in assessing the spatial and temporal changes in wetland ecosystems as well as in understanding their condition and the ecosystem services they provide. This study focuses on the one hand, on drawing hydro-ecological guidelines for the delimitation of wetland ecosystems; and on the other hand, to assess the reliability of widely available satellite images (Landsat) in estimating the land use/ land cover types covering wetlands.

This research develops comprehensive guidelines to determine the boundaries of the Fuente de Piedra wetland ecosystem located in Andalusia, Spain and defines the main land use/ land cover classes covering this ecosystem using Landsat 8 images. An accuracy of the SRS results delivered is tested using the regional inventory of land use produced by the regional government of Andalusia in 2011.

By using the ecological and hydrological settings of the area, the boundaries of the Fuente de Piedra wetland ecosystem are determined as an alternative to improve the current delimitations methodology (the Ramsar and Natura 2000 delineations), used by the local authorities so far and based mainly on administrative reasoning. In terms of the land use land cover definition in the area, Fuente de Piedra wetland ecosystem shows to cover a total area of 195 km² composed mainly by agricultural areas (81.46%): olive groves, non-irrigated arable land and pastures, being 54.82%, 25.71% and 0.93% of the surface respectively. Wetland related land covers (water surface, wetland vegetation) represent 6.85% while natural vegetation is distributed in forest, 1.67%, and shrub areas, 4.14%, being 5.81% in total. 4.58% of the area corresponds to urban and other artificial surfaces. The rest, 1.30%, is composed of different areas without vegetation (sands, bare rock, dumps, etc.).

The classification of the Landsat images made with the newly developed SWOS toolbox (under the Horizon 2020 SWOS project) provides reliable results ($r^2 = 0.98$). The image segmentation corresponds very closely with the plots of land observed in the satellite image, and the allocation of land use coverages corresponds in 82% of the segments. Forest and olive groves are the best identified coverages with an accuracy of 93% in both cases. Wetlands are correctly classified by 87%, where linear features (narrow streams, etc.) are not detected by the methodology used due to the limitations of Landsat resolution.

Arable lands are classified with an accuracy of 85.5%; where the methodology seems to confuse this land use with sparse olive grove. In the case of shrubs, accuracy round the 72%, with confusions with this land use are related with arable land, sparse forests in wetland areas.

In the case of urban areas, only 60.5% of the segments are correctly classified as the distinction between urban fabric and industrial areas does not seem to be possible and linear features are not detected (highways, secondary roads, ...).