SWOS
Satellite-based Wetland Observation Service

Determination of wetland ecosystem boundaries and validation of habitat classifications using remote sensing: Fuente de Piedra (Spain)

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SWOS project partner — 6 user organisations/NGOs | 3 universities | 4 companies

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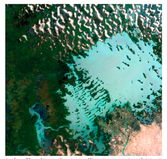
Lake Chad Landsat satellite image April 2015

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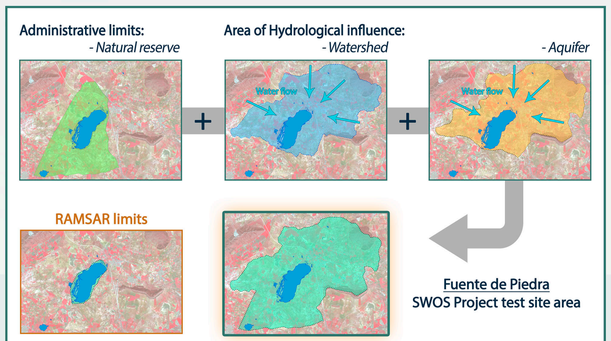
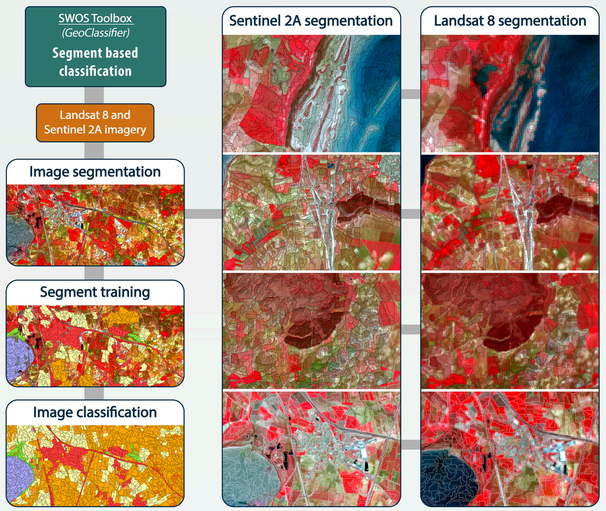
Remote sensing techniques (SRS) are valid tools for wetland detection and monitoring that could support wetland managers in their assessments. These techniques support the analysis of spatial and temporal changes in wetland ecosystems allowing a better understanding of their condition and their capacity to provide ecosystem services.

This research develops comprehensive guidelines to determine the boundaries of the Fuente de Piedra wetland ecosystem located in Andalusia, Spain. It defines the main MAES classes covering this ecosystem using Landsat 8 (L8) and Sentinel 2A (S2A) images for the period 2015-2016.

The MAES framework (Mapping and Assessment of Ecosystems and their Services) uses the EUNIS habitat classification system in Europe. The accuracy of the SRS results delivered is tested using the regional inventory of land use produced by the regional government of Andalusia in 2011.

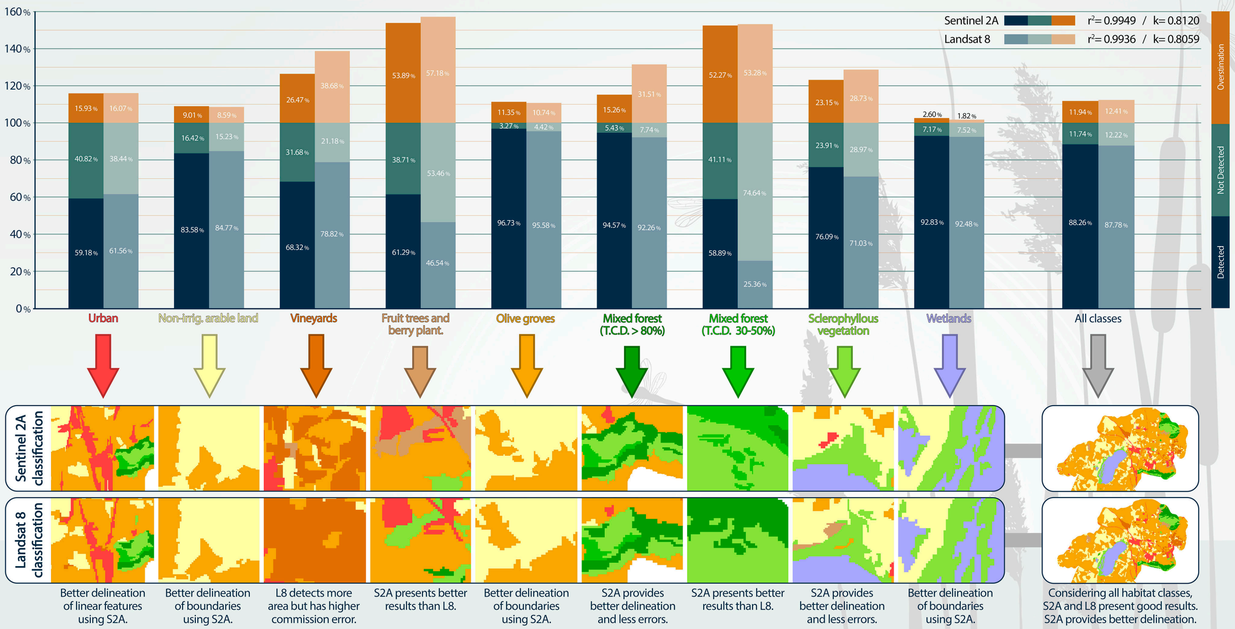
By using the ecological and hydrological settings of the area, the boundaries of the ecosystem are determined using a hydroecological approach that considers the socio-economic activities causing the major pressures on the wetland ecosystem.

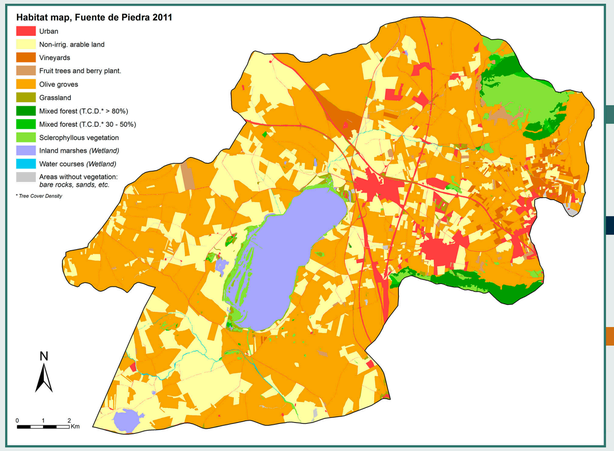




The segment based classifications of the satellite imagery made with the newly developed SWOS toolbox (under the Horizon 2020 SWOS project), provide reliable and accurate results in both cases (r^2= 0.99). Image segmentation shows more accurate results using S2A, specially in the case of linear features, due to its higher spatial resolution. The accuracy test against the regional inventory shows that the habitat classifications have an overall accuracy, considering all habitat classes together, of 87.8% and 88.3% using L8 and S2A respectively.

Habitat classification results *(Sentinel 2A and Landsat 8 , 2015-2016)*





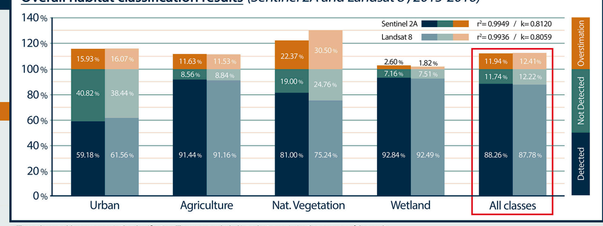
Habitat regional inventory *(Junta de Andalucía, 2011)*

Habitat - *MAES nomenclature*		Area (km²)	%
U	Urban	10.46	5.36
A	Non-irrig. arable land	50.17	25.71
A	Vineyards	3.91	2.00
A	Fruit trees and berry plant.	1.75	0.90
A	Olive groves	101.35	51.93
X	Grassland	1.51	0.78
	Total inventory area	195.17	

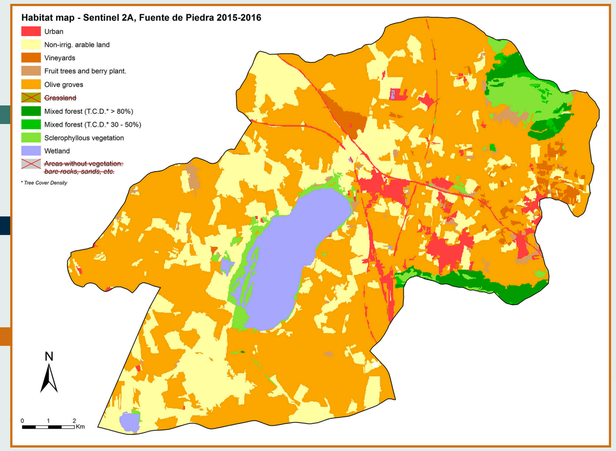
Habitat - *MAES nomenclature*		Area (km²)	%
N	Mixed forest (T.C.D. > 80%)	3.92	2.01
N	Mixed forest (T.C.D. 30 - 50%)	0.68	0.35
N	Sclerophyllous vegetation	7.78	3.98
W	Inland marshes *(Wetlands)*	12.82	6.57
W	Water courses *(Wetlands)*	0.21	0.11
X	Areas without vegetation	0.62	0.32

U - Urban
A - Agriculture
N - Natural vegetation
W - Wetland
X - Not included in classification*

Overall habitat classification results *(Sentinel 2A and Landsat 8 , 2015-2016)*



*These classes add many errors in the classification. They were excluded in order to maximize the accuracy of the results.



Conclusions

- Protected areas whose limits are based on ecological and hydrological settings of the ecosystem allow managers greater control of environmental issues affecting the area.
- Image segmentation and definition of feature boundaries is better using Sentinel 2A due to its higher spatial resolution, especially in the case of linear features.
- In terms of area detected both satellites provide very similar results with high accuracy for most classes. Therefore, it seems that both satellites can coexist and be used together for general LULC classifications.
- S2A seems to identify habitats more accurately than L8, but difficulties in distinguishing different types of natural vegetation in Mediterranean ecosystems are still present (Houborg et al., 2015). This difference is probably due to its higher spectral scale especially in the largest number of bands in the infrared spectral range (Frampton et al., 2013). Based on this research, S2A shows to improve the results of Landsat when conducting studies of vegetation/habitat detection.
- In terms of habitat mapping, though some limitations still exist in the segregation of some functional/ contextual classes, some classes seem to be feasible to be detected using SRS, namely olive groves and arable land. The limitations seem to be present mainly whenever ancillary data are not available. Nevertheless, ongoing research on phenological changes within habitats/plant communities would make possible more detailed segregation of some habitat types as well as some further indications on their condition/ health and pressures they are subjected to (J.S. Rawat and M. Kumar, 2015).

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