Geophysical Research Abstracts
Vol. 17, EGU2015-9707, 2015
EGU General Assembly 2015

Water area variations in seasonal lagoons from the Biosphere Reserve of "La Mancha Húmeda" (Spain) determined by remote sensing classification methods and data mining techniques

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La Mancha Húmeda is a wetland-rich area located in central Spain that was designated as a Biosphere reserve in 1980. This area includes several dozens of temporal lagoons, mostly saline, whose water level fluctuates and usually become dry during the warmest season. Water inflows into these lagoons come from both runoff of very small catchment and, in some cases, from groundwater although some of them also receive wastewater from nearby towns. Most lack surface outlets and they behave as endorheic systems, with the main water withdrawal due to evaporation causing salt accumulation in the lake beds. Under several law protection coverage additional to that of Biosphere Reserve, including Ramsar and Natura 2000 sites, management plans are being developed in order to accomplish the goals enforced by the European Water Framework Directive and the Habitats Directive, which establish that all EU countries have to achieve a good ecological status and a favorable conservation status of these sites, and especially of their water bodies. A core task to carry out the management plans is the understanding of the hydrological trend of these lagoons with a sound monitoring scheme. To do so, an estimation of the temporal evolution of the flooded area for each lagoon, and its relationship with meteorological patterns, which can be achieved using remote sensing technologies, is a key procedure. The current study aims to develop a remote sensing methodology capable of estimating the changing water coverage areas in each lagoon with satellite remote sensing images and ground truth data sets. ETM+ images onboard Landsat-7 were used to fulfill this goal. These images are useful to monitor small-to-medium size water bodies due to its 30-m spatial resolution. In this work several methods were applied to estimate the wet and dry pixels, such as water and vegetation indexes, single bands, supervised classification methods and genetic programming. All of the results were compared with ground-truth data and the classification errors were evaluated by means of the kappa coefficient. Finally, the two methods that showed the best kappa values were the maximum likelihood (supervised classification) and genetic programming methods. While the former has a kappa value of 0.8 and an overall accuracy of 90%, the latter shows kappa coefficients of 0.9 and an overall accuracy of 95%.
Our approach offers a useful tool to monitor and study the water area of these lagoons which allows for the study of the hydrological trend of these seasonal water bodies.