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Use of Artificial Intelligence and Two Object-Oriented Approaches (k-NN and SVM) for the Detection and Characterization of Wetlands in the Centre-Val de Loire Region, France

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Abstract : Nowadays, wetlands are the subject of contradictory debates opposing scientific, political and administrative meanings. Indeed, given their multiple services (drinking water, irrigation, hydrological regulation, mineral, plant and animal resources...), wetlands concentrate many socio-economic and biodiversity issues. In some regions, they can cover vast areas (>100 thousand ha) of the landscape, such as the Camargue area in the south of France, inside the Rhone delta. The high biological productivity of wetlands, the strong natural selection pressures and the diversity of aquatic environments have produced many species of plants and animals that are found nowhere else. These environments are tremendous carbon sinks and biodiversity reserves depending on their age, composition and surrounding environmental conditions, wetlands play an important role in global climate projections. Covering more than 3% of the earth's surface, wetlands have experienced since the beginning of the 1990s a tremendous revival of interest, which has resulted in the multiplication of inventories, scientific studies and management experiments. The geographical and physical characteristics of the wetlands of the central region conceal a large number of natural habitats that harbour a great biological diversity. These wetlands, one of the natural habitats, are still influenced by human activities, especially agriculture, which affects its layout and functioning. In this perspective, decision-makers need to delimit spatial objects (natural habitats) in a certain way to be able to take action. Thus, wetlands are no exception to this rule even if it seems to be a difficult exercise to delimit a type of environment as whose main characteristic is often to occupy the transition between aquatic and terrestrial environment. However, it is possible to map wetlands with databases, derived from the interpretation of photos and satellite images, such as the European database Corine Land cover, which allows quantifying and characterizing for each place the characteristic wetland types. Scientific studies have shown limitations when using high spatial resolution images (SPOT, Landsat, ASTER) for the identification and characterization of small wetlands (1 hectare). To address this limitation, it is important to note that these wetlands generally represent spatially complex features. Indeed, the use of very high spatial resolution images (>3m) is necessary to map small and large areas. However, with the recent evolution of artificial intelligence (AI) and deep learning methods for satellite image processing have shown a much better performance compared to traditional processing based only on pixel structures. Our research work is also based on spectral and textural analysis on THR images (Spot and IRC orthoimage) using two object-oriented approaches, the nearest neighbour approach (k-NN) and the Super Vector Machine approach (SVM). The k-NN approach gave good results for the delineation of wetlands (wet marshes and moors, ponds, artificial wetlands water body edges, ponds, mountain wetlands, river edges and brackish marshes) with a kappa index higher than 85%.

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