

Agent-based and object-oriented image analyses of irrigated areas

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Irrigation is a major consumer in the global water cycle. Hence, water resource management depends often on the knowledge of trends in irrigated agriculture. However, spatial data on irrigation is sparse. Therefore, specific remote sensing applications are needed to gather information on irrigation especially for remote regions with sparse data. Today, remote sensing applications in hydrology rely typically on a pixel-based classification. Water management on the other hand requires objects more complex than pixels (political units, sub-basins, coverage areas). In the past decade, the pixel-based classification approach was extended by GEOBIA, the Geographical Object-Based Image Analysis. GEOBIA groups similar pixels into objects, hereby creating a network of linked objects with a spatial reference. The resulting shapes are more similar to the shape of real world occurrences like irrigated plots or deforested areas. However, the application of GEOBIA in hydrology or water resource management is sparse.

In this study we introduce the concept of Agent-Based Image Analysis (ABIA) as an extension to GEOBIA to hydrological remote sensing applications. This extension of the GEOBIA approach allows a more flexible application of object-based image classification through image object agents. Image object agents are encapsulated software objects that perceive and interact with their environment. We define rule-sets of interaction between agents and their environment to improve the results from GEOBIA, creating a transferable application for the delineation of irrigated plots.

In our case study, we set up an ABIA classification framework to detect irrigated agriculture in Nebraska, US. Auxiliary data like temperature and precipitation is used to set up the GEOBIA ontology for a fuzzy classification scheme. Results show that GEOBIA and the ABIA extension provide valuable tools for the detection of irrigated areas. In the outlook we specify new challenges like the choice of pre-segmentation and the increased demand for computation we are faced with.