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MONITORING THE WADDEN SEA: A MULTI-SENSOR AND MULTI-TEMPORAL APPROACH FOR HIGH RESOLUTION CLASSIFICATION AND MONITORING OF THE NORTH SEA'S TIDAL FLATS

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THEME: Monitoring the Wadden Sea: A multi-sensor and multi-temporal approach for high resolution classification and monitoring of the North Sea's tidal flats

KEY WORDS: Wadden Sea monitoring, Hierarchal classification, tidal flats, multi-sensor, multi-temporal, RapidEye, Terra SAR-X

ABSTRACT:

The German tidal flats are a part of the trilateral Wadden Sea located in the southeastern part of the North Sea. The Wadden Sea is characterized by a large intertidal transition zone between land and sea with barrier islands, channels, gullies, salt marshes and tidal flats. The multitude of transitions between land and sea, salt- and freshwater are the basis for a highly adapted, partly endemic flora and fauna and relative species richness. It is a vulnerable ecosystem which is highly influenced by climate changes and the anthropogenic usage of the North Sea. Changes in temperature and variety of species, harmful algal blooms and reduction of fish population as well as changes of the morphology in the Wadden Sea are examples for the effects of global climate change and anthropogenic pressure. The changes in the environment and the long-term developments caused by these factors cannot be monitored by the standard measurement methods alone. Large-area surveys of the intertidal flats are often difficult due to tides, tidal channels and unstable underground. For this reason, remote sensing offers effective tools for monitoring the changes of the flora and fauna. This advantage, however, has so far been impeded by the fact that data of the intertidal flats can only be obtained at low tide. For a long time satellites could not guarantee an image during low tide due to their repetition cycle of several days. The chances for low-tide imaging at cloud free weather conditions have been significantly improved due to the high temporal accuracy (one day) of the German 5-satellite constellation RapidEye (RE). In addition to the optical system of RE we are using the radar system Terra SAR-X (TSX) to bypass the negative effect of clouds on optical images. Both systems have a high spatial resolution of 5m (RE) and 1m (TSX), respectively. In this study a multi-sensor and multi-temporal concept for an automated and semi-automated hierarchical classification of the German tidal flats is presented. Basis for this hierarchical method is a combined analysis of RE and TSX satellite data coupled with ancillary vector data about the distribution of vegetation, mussel beds and sediments. A decision tree based and hierarchically structured algorithm to combine the multi-sensor data sets was developed integrating object and texture-based analysis methods. The results showed that we are able to semi-automatically classify the classes of interest mussel beds and salt marshes with high accuracy. Although some progress in the classification of vegetation and sediments in the tidal flats is achieved, it still remains as a challenge.

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