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Artificial intelligence for discrimination of sediment facies based on high-resolution elemental and colour data from coastal sediments of the East Frisian Wadden Sea, Germany

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Sediment facies provide vital information for the reconstruction of past environmental variability. Due to rising interest for paleoclimate data, sediment surveys are continually growing in importance as well as the amount of sediments to be discriminated into different facies. The conventional approach is to macroscopically determine sediment structure and colour and combine them with physical and chemical information - a time-consuming task heavily relying on the experience of the scientist in charge. Today, rapidly generated and high-resolution multiproxy sediment parameters are readily available from down-core scanning techniques and provide qualitative or even quantitative physical and chemical sediment properties. In 2016, an interdisciplinary research project WASA (Wadden Sea Archive) was launched to investigate palaeolandscapes and environments of the Wadden Sea. The project has recovered 92 up to 5 m long sediment cores from the tidal flats, channels and off-shore around the island of Norderney (East Frisian Wadden Sea, Germany). Their facies were described by the conventional approach into glaciofluvial sands, moraine, peat, tidal deposits, shoreface sediments, etc. In this study, those sediments were scanned by a micro X-ray fluorescence (μ -XRF) core scanner to obtain high-resolution records of multi-elemental data (2000 μ m) and optical images (47 μ m). Here we propose a supervised machine-learning application for the discrimination of sediment facies using these scanning data. Thus, the invested time and the potential bias common for the conventional approach can be reduced considerably. We expect that our approach will contribute to developing a more comprehensive and time-efficient automatic sediment facies discrimination.

Keywords: the Wadden Sea, μ -XRF core scanning, machine-learning, sediment facies discrimination