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Turning human - environmental interaction into 3D landscape scenes - Visualization of landscape history in a Northern German inland dune complex

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The purpose of this paper is to describe geoarchaeological research work concerning aeolian soil erosion, and the development of landscape reconstructions and visualizations of palaeo-environmental conditions for the last 2500 years. An inland dune complex of ∼2 ha near Joldelund (Northern Germany) is used as a case study, which forms the westernmost edge of a larger inland dune field approximately 80 ha in size. In order to reconstruct the geoarchaeological landscape history, we combine pedological and geomorphologic analysis of aeolian sediments and past dune surfaces, chronology (14C, OSL-dating), detailed stratigraphy, as well as palaeo-botanical records of charcoal and pollen. A chronostratigraphy of the dune complex reveals at least five phases of intensified aeolian activity. The first phase of human-induced sand drifts and sediment deposition is dated to the Roman Iron Age. Human activities during this period such as iron ore production likely caused substantial, albeit local landscape changes. Three separate phases of wind erosion then occurred during Medieval Times, and resulted in considerable changes of the morphology of the dunes. The medieval dune development was punctuated by at least two periods of stability and soil development, which are preserved as humic horizons. The last period of activity is presumed to be deposited during Modern Times.

On the basis of the palaeo-environmental results, and the construction of detailed DEMs, different 3D visualisation techniques were used in order to visually reconstruct the ancient dune landscapes. Photorealistic landscape visualizations of Roman Iron Age and Medieval Times were created using GIS-supported software Visual Nature Studio (VNS). All scenarios of pre-historic and historic landscapes are based on digital elevation models, anthracological and pollen data as well as archaeological records and historic maps. Interactive visualizations were generated using the software a3Dc, which was developed at the Department of Geography, University of Kiel. The real-time environment a3Dc implements features such as flexible navigation (6DoF - navigation), queries of attribute data (such as pedological, sedimentological, palaeo-botanical data) as well as importing of GIS data, 3D models, billboards, and map drapes. This technique ensures the interactive exploration of surface structures and is complemented by high spatial and palaeoenvironmental landscape accuracy. This bridging of geoarchaeological and geovisualization techniques will aid researchers and educators in order to get a deeper insight into human-induced changes of landscapes in the past.