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Digital mapping of loess in Northwest Germany based on satellite images

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Loess maps of various scales are important input data for advanced investigations of spatial loess properties such as variation in grain size, thickness and facies or study of loess provenance. Many representations of loess distribution in Northwest Germany are based on geological maps. Mostly these maps were created at the beginning of the last century. During this time especially thin loess covers were not incorporated in favour of underlying hard rocks or other Quaternary deposits. Due to the change in mapping policy at the end of the last century much more of the unconsolidated rocks, particularly with regard to loess, were displayed on the revised or updated maps.
In this study the analysis of optical remote sensing data, ranging from visible light to the infrared, was tested to create a more realistic map of the loess distribution in Northwest Germany. The investigation area includes the loess along the northern loess boundary between Helmstedt and Minden and extends to Kassel and Goettingen in the South. Here, in southern Lower Saxony, northern Hesse and eastern North Rhine-Westphalia, loess and loess derivates are widely distributed apart from river beds, valley flanks, steep slopes and higher mountain ranges. The thickness of the loess cover, that is of Weichselian, sporadic of Saalian or Elsterian age, varies between few centimetres and about 20 m. The hard rocks of the study area were influenced by tectonic and halokinetic processes resulting in a complex and small-scale pattern of folds, depressions, horsts and grabens.
Satellite images of the Landsat TM and ETM+ sensors, recorded between 1985 and 2008, were used for this study. After radiometric calibration and atmospheric and geometric correction of every dataset, coniferous forest, water and areas of high urbanization were masked. Then a synthetic file was made up of all remaining pixels, preferring the pixel, displaying the purest soil or bare rock.
Various digital mapping techniques e.g.
band rationing, PCA, supervised and unsupervised classification were compared to delineate loess and loess soils from other rocks or soils. Due to the different spectral signature of the underlying reddish sand-, clay- and siltstone or white to grey limestone and marls of Triassic, Cretaceous and Jurassic age loess can be separated clearly. To discriminate the loess from younger displaced loess or flood plain deposits the classification results were combined with elevation data of the ASTER DEM.