Temporal and Spatial Prediction of Lignite Mining Waste Rock Pile Stability in Northern Lusatia by Using Artificial Neural Networks

**Andreas Barth (*), Enrico Kallmeier (*),
Robert Böhnke (**), Beate Lucke (**)**

(*) Beak Consultants GmbH,
(**) Lausitzer und Mitteldeutsche Bergbauverwaltungsgesellschaft mbH (LMBV)

Presented at the Symposium: 17th Geokinematischer Tag (12th May, 2016) of the University of Mining and technology, Freiberg, Germany.

ABSTRACT

Geotechnical events of terrain deformation due to soil liquefaction (example see Figure 1) in lignite mining waste rock piles of the Northern Lausatia area (opencast pits Schlabendorf and Seese), have been modeled as time series for the years 2009 – 2013 by using artificial neural networks.

Figure 1: Example of a surface deformation (Photo; LMBV)

The model has clearly recognized the influences of various lithological and non-lithological controlled parameters on the occurrence of geotechnical events, and these have been quantified and weighted in terms of their importance. The model is able to predict the temporal evolution and the exact spatial location of the events occurring in the dumps as a function of changing groundwater

levels and surface morphology. The model shows dynamically the emergence of new risk areas in hitherto seemingly stable areas (Figure 2).

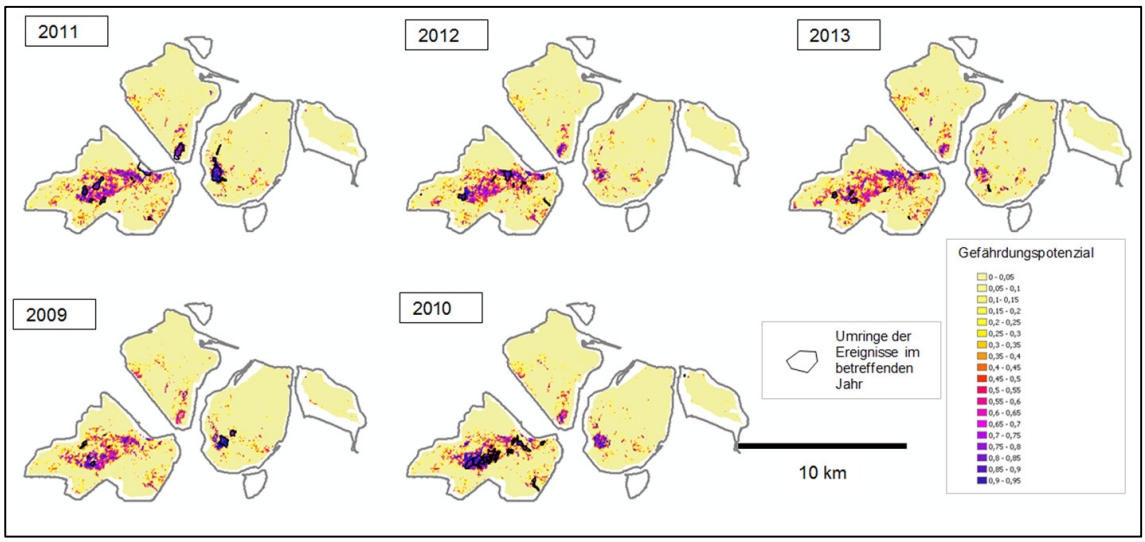

Figure 2: Modeling the hazard potential for the years 2009 – 2013 and known geotechnical events

The correctness of the model was confirmed by means of various tests and its predictive success was demonstrated through forecasting of events for the years 2014 and 2015 and their comparison with the observed events of those years (Figure 3).

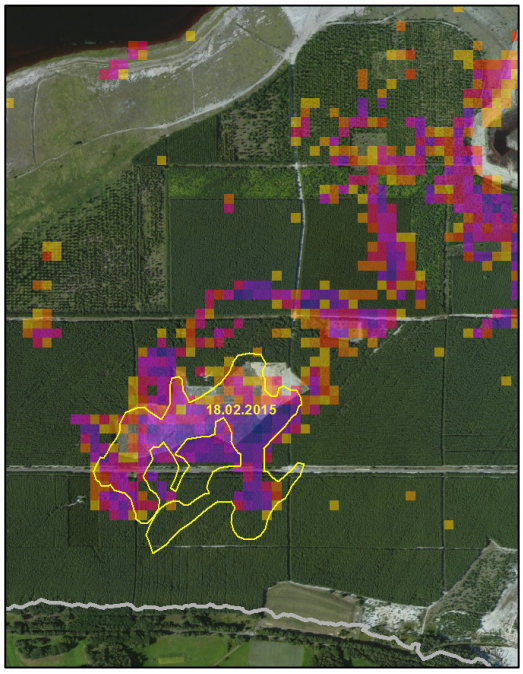

Figure 3: Comparison of the predicted hazard potential (year 2014) with the location of a geotechnical event of February 2015 (Grid size: 25 m)

The following main risk factors were identified:

Important destabilizing factors are a monotonous lithology with the following composition: 31% fine sand, 34% medium sand, 31% coarse sand, 3% silt, <1% gravel, <1% lime, <1% clay, <1% coal, k_f-values between 10^{-4} and $10^{-4.5}$ m/s, a surface to groundwater distance of 3.45 meters (median value), high gradients of non-lithological controlled parameters: waste dump surface, groundwater level, depth to groundwater and thickness of saturated dump.

Important stabilizing factors are a high heterogeneity of lithology (high gradients of the lithological controlled parameters: e.g. gravel content, sand content, clay content, carbon content), a low proportion of sand in the dump composition, high proportions of gravel, silt, clay, lime, or coal, a high depth to groundwater, low gradients of non-lithological controlled parameters: open pit surface, groundwater surface, depth to groundwater, thickness of saturated dump, strongly changing k_f values between 10^{-7} and 10^{-2} m/s.

The model can be used as a dynamic tool for risk management before and during the rehabilitation of lignite waste dumps, and for constructing stable waste dumps. By means of varying the model parameters (e.g. design of the dump surface, composition of dumped rocks, rising groundwater) the geotechnical effects of dump design and remediation scenarios can be predicted.