Artificial neural network based geohazard potential mapping for sustainable land use planning: approaches and examples from Germany and Namibia

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Natural hazards such as soil liquefaction, landslides, mud flows, soil creeping and many others cause serious damages to existing infrastructure, urban and rural environments. Their consideration is of even higher importance for creation of sustainable solutions in the context of fast growing urban centres, economic and agricultural utilization of new areas and landscapes, rehabilitation of mining and industrial areas.

In order to understand and rank risks, predictive models are essential to know both the locations of expected hazardous events and the date of their appearance. Because of the complexity of the cause-effect relationships and the common lack of reliable data, a mathematical-analytical modelling of geohazards in many cases is not applicable. Instead, artificial intellect based predictive methods offer reliable alternatives. In this paper, approaches of geohazard predictive modelling by using artificial neural networks (ANN) are described and their applicability in real life use cases is demonstrated. Modelling and consideration of geohazards is described within the workflow of spatial land use planning, conflict analysis and conflict solution.

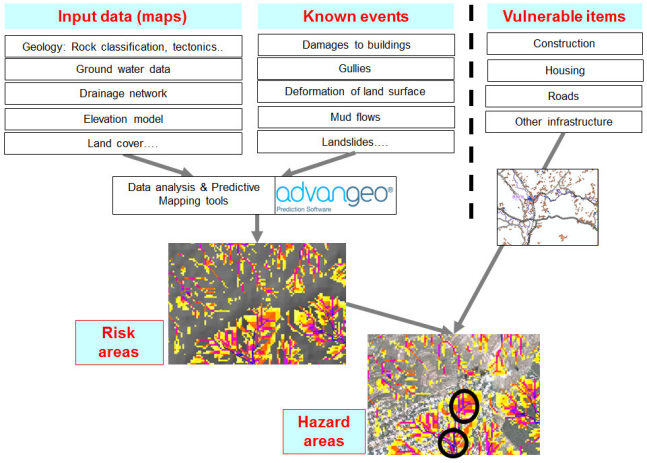

Figure 1: Geohazard potential in land use planning

In the first example, ANN and other approaches were used to model and predict fault related ground instabilities, rainfall and gravity related risks in the area of the city of Windhoek (Namibia). Hazard maps have been created by overlaying risk maps with maps of existing and planned land use structures. Satellite images have been used to consider informal settlements. Maps of recommended land use were created in order to support the city of Windhoek in its administrative activities.

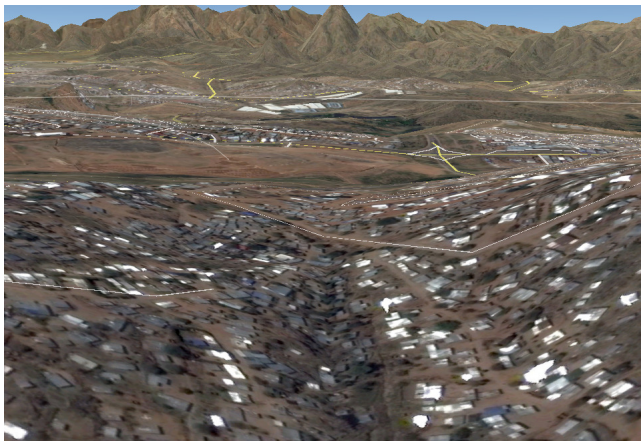

Figure 2: Informal settlement in Windhoek: houses are built in dry river beds (Source: Google Earth)

In the second example, ANN were used to analyse the appearance of ground liquefaction processes in post mining landscapes in Germany. These events create heavy damages to re-cultivated lands causing big economic losses. The models are able to predict both the location and dates of events depending on the ground water level, surface morphology, and lithology of waste rock material. Predictive models are used to manage the rehabilitation process, construct safe post-mining landscapes and define appropriate post-mining land use.