International Cartographic Association
Association Cartographique Internationale

3D-Terrain Mapping and Mixed Reality Cartography supporting Edutainment in Landscape Genesis – The Saarschleife Geoptope Application

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Keywords: 3D-Mapping, Geotopes, Landscape Genesis, Edutainment, Mixed Reality

Abstract:

The Saarschleife geotope (SE-Germany) represents one of the most prominent geotopes of the SaarLorLux region and is known far beyond the borders of the Greater Region. Surprisingly, there is no visual representation of the relief history and genesis of this river meander, which is unique for Central Europe - as is common at places with comparable outstanding phenomena, such as e.g. the Rocher Saint-Michel d'Aiguilhe[1] (France) or some national parks in the U.S.(e.g. Grand Canyon[2]). The Saarschleife geotope therefore was choosen as a pilot object for the envisaged analysis of the landscape genesis but also regarding the 3D mapping and visualization. The visualisation presents the relief history and geological evolution of the last 300 million years in selected geological epochs, which are of fundamental importance for the understanding of today's geomorphological relief conditions, and is compiled into a summarized chronology.

For this purpose, based on the processus of geological map interpretation and additional field work, the area around the Saarschleife was divided into 22 transects on an area of 11 x 11 km, where at each crosspoint of the transects the todays geological and geomorphological conditions are mapped and overlayed on top of the terrain model in a first step. In addition, published information concerning the geological and geomorphological history of the area has been analysed.

In a second step, the thickness of the different geological layers was estimated for each of the crosspoints. Faults, heavings and depressions were determined and transferred together with the geological layers into a digital 3D landscape model. In the discussed case-study, the multipoint feature concept of the ArcGIS Pro – Software was choosen to map the subterranean features in a digital model. In order to finally arrive at an area-wide data set, the point information had to be extrapolated into the area in a further step. Here, we applied the nearest-neighbour approach to the datasets.

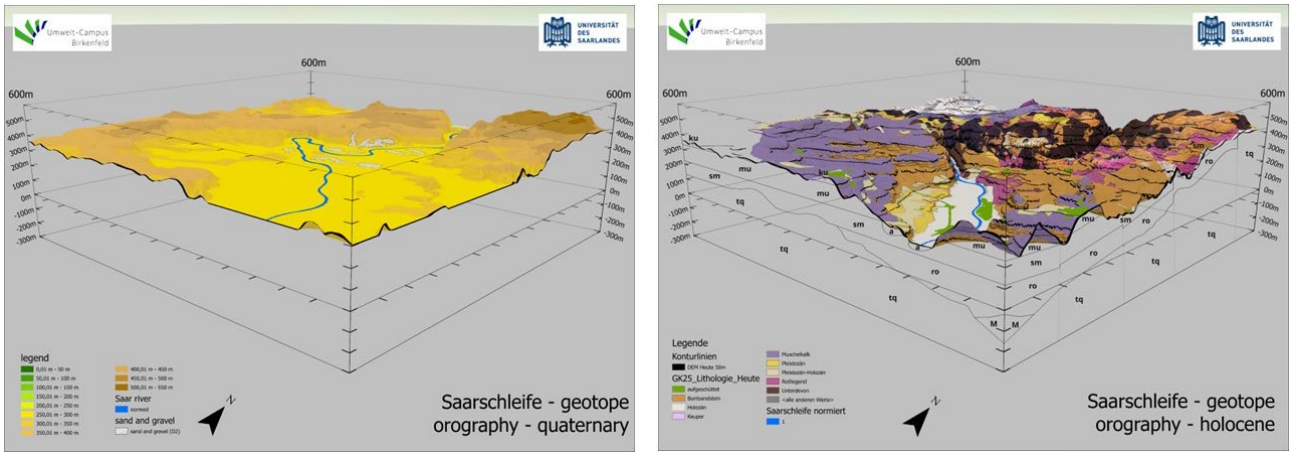

Figure 1. Modeled surface form of the Saarschleife landscape of two selected geological epochs (quaternary, holocene)

[1] https://en.wikipedia.org/wiki/Saint_Michel_d%27Aiguilhe; last access: 06.05.2023
[2] https://www.tandfonline.com/doi/abs/10.5408/informal_geoscience_education_; last access: 06.05.2023

Abstracts of the International Cartographic Association, 6, 128, 2023.
31st International Cartographic Conference (ICC 2023), 13–18 August 2023, Cape Town, South Africa.
https://doi.org/10.5194/ica-abs-6-128-2023

To keep the orography of the landscape of the different epochs readable and comparable, for each of the time slices the same height color ramp was choosen (traditional: dark green (low) to brown colours (mountainous)). Figure 1 gives the reader an impression of the orography of two selected epochs (quaternary and holocen).

In order to move from a static representation to the desired dynamic presentation of landscape evolution in space and time, a simple multiGIF was generated from the data of the different geological epochs in a first approach. Even with this unsophisticated technique, the landscape genesis appears much more comprehensible to the viewer than is possible, for example, with static map works or haptic printouts of the landscape of the respective epoch.

One step ahead, Mixed Reality refers to a technology that makes it possible to expand the real environment of the user (the landscape models in our case) by inserting digital content. Especially within a learning context, mixed reality applications are linked with a high benefit to education, as mentionend e.g. by Bonali et al. (2022), Gaol and Prasovla-Forland (2022), or Janiszewski et al. (2020). Conceptually, extensions for all human senses are conceivable: everything from text modules, perfume, vibrations, audio, and video to complex 3D models is possible. Ideally, it appears to the user as if the real and digital objects exist in the same room. While the user immerses himself in a completely virtual world with Virtual Reality (VR), with Augmented Reality the real environment of the user remains present, e.g. through the image in the smartphone camera. However, this real existing environment is expanded by the integration of digital content.

Next and final step within our work therefore is the integration of the mapped epochs of the Saarschleife landscape in a mixed reality (MR) context (work in progress). The type of presentation in which the digital content is made available to the user is particularly important for the construction of a MR system. Ongoing discussions in the working group are preferring an Augmented Reality (AR) application with an enrichment of the single timeslices with epoch typical content as vegetation, climate simulations and/or historical benchmarks. This work we will perform the next months to be able to present and install the Saarschleife geotope application by the end of the year 2023 in a regional museum but also at the tourist centre of the Saarschleife.

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