EGU24-7821, updated on 14 Jan 2025
https://doi.org/10.5194/egusphere-egu24-7821
EGU General Assembly 2024

AI-aided Assessment of Mass Movement Potentials Along the Coast of Mecklenburg-Western Pomerania – Project Introduction and Outlook

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Coastal areas are dynamic zones where geological, marine, and atmospheric processes interact. The coastal shapes constantly evolve due to both natural factors and human activity. Gravitational mass movements, commonly called landslides, are prominent indicators of coastal dynamics. With the current climate projections indicating increasing stormy weather and extreme water levels, coastal communities face an escalating hazard of more frequent and severe landslides on steep coastlines. Mecklenburg-Western Pomerania exhibits a cliff coast of approximately 140 km, which is assessed to be actively receding in most parts.

The project, titled “AI-aided Assessment of Mass Movement Potentials Along the Coast of Mecklenburg-Western Pomerania,” focuses on developing advanced methods for quantitatively evaluating the hazard potential of mass movements in these ever-changing environments. This approach should enhance the efficiency and effectiveness of hazard assessment routines. The project covers five small study areas exhibiting different cliff types composed of chalk, glacial till sediments, and sand.

The exposition of the complex geological conditions through the coastal retreat may change. Therefore, one of the most significant challenges is the accurate mapping of current geological conditions controlling, among other factors, the occurrence of landslides. In some parts, the average coastal retreat is about 0.5 m annually. At the same time, detailed geological mappings conducted years or even decades ago do not adequately represent the current geological conditions that could be fed into models to conduct a landslide susceptibility assessment since some mapped features no longer exist.

Because traditional detailed field mapping by experts is time-consuming and costly, we seek options to enhance the mapping by employing uncrewed aerial vehicles (UAVs) equipped with multispectral sensors. These UAVs, through repetitive surveying missions, gather detailed data that enable precise change detection in photogrammetric point clouds. This data is essential for accurately calculating coastal retreat, mass balancing, and structural analysis. Employed AI

algorithms interpret the UAV imagery, performing semantic segmentation to classify the surface into meaningful categories for further modeling. Given the need for extensive labeled datasets to train AI algorithms, we also explore data augmentation strategies. These strategies aim to generate extensive artificial datasets based on real-world data, which are crucial for effectively training the desired models.

Overall, we try to design a workflow to streamline the analysis steps, starting with UAV flight campaigns and classical photogrammetric processing paired with AI components to derive geological information. The derived parameters provide input in data-driven landslide susceptibility models. Furthermore, the generated spatio-temporal time series should be used for pre-failure pattern analysis with advanced AI for the long-term outlook.