

# **The use of UAV data to observe post-mining processes and the formation of subsidence lakes in the former mining area of Prosper-Haniel mine**

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The utilization of drone flights for geo-monitoring post-mining processes is experiencing a rapid surge in popularity. Modern unmanned aerial vehicles (UAVs) are becoming increasingly accessible to a wide range of users. This paper focuses on the application of drone flights. Our proposed solution involves employing various sensors, including multispectral cameras and thermal cameras, to monitor the mining areas environment.

The former Prosper-Haniel mine is located in the north-western part of the Ruhr area (Germany) (Fig.1). The main mining exploitation in the research area started in the 1990s and lasted until 2014 [1-3].

The data captured by multispectral UAVs can be utilized, for instance, to generate orthophotos and calculate remote sensing indicators (Fig.2), thereby enabling environmental monitoring. Moreover, the use of a thermal camera facilitates observation of soil and water temperatures (Fig.3).

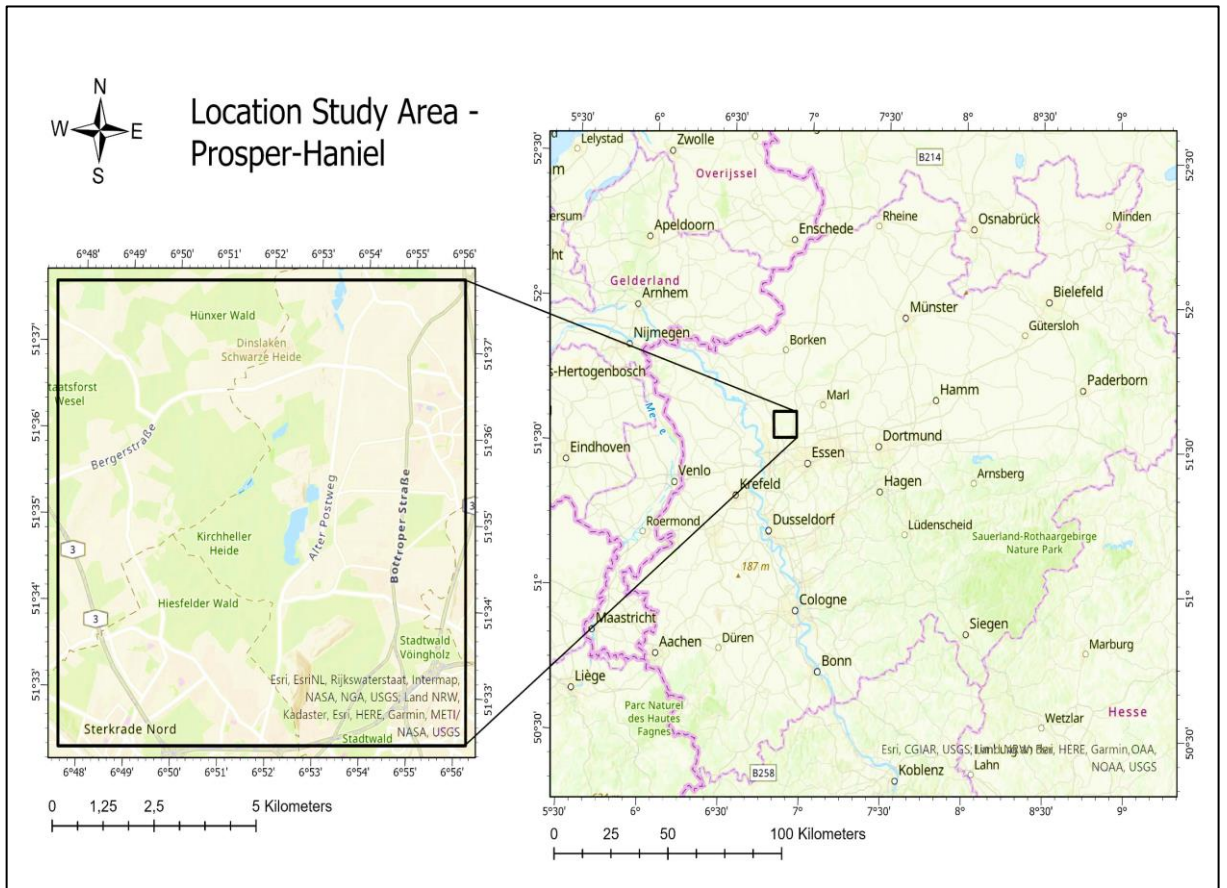
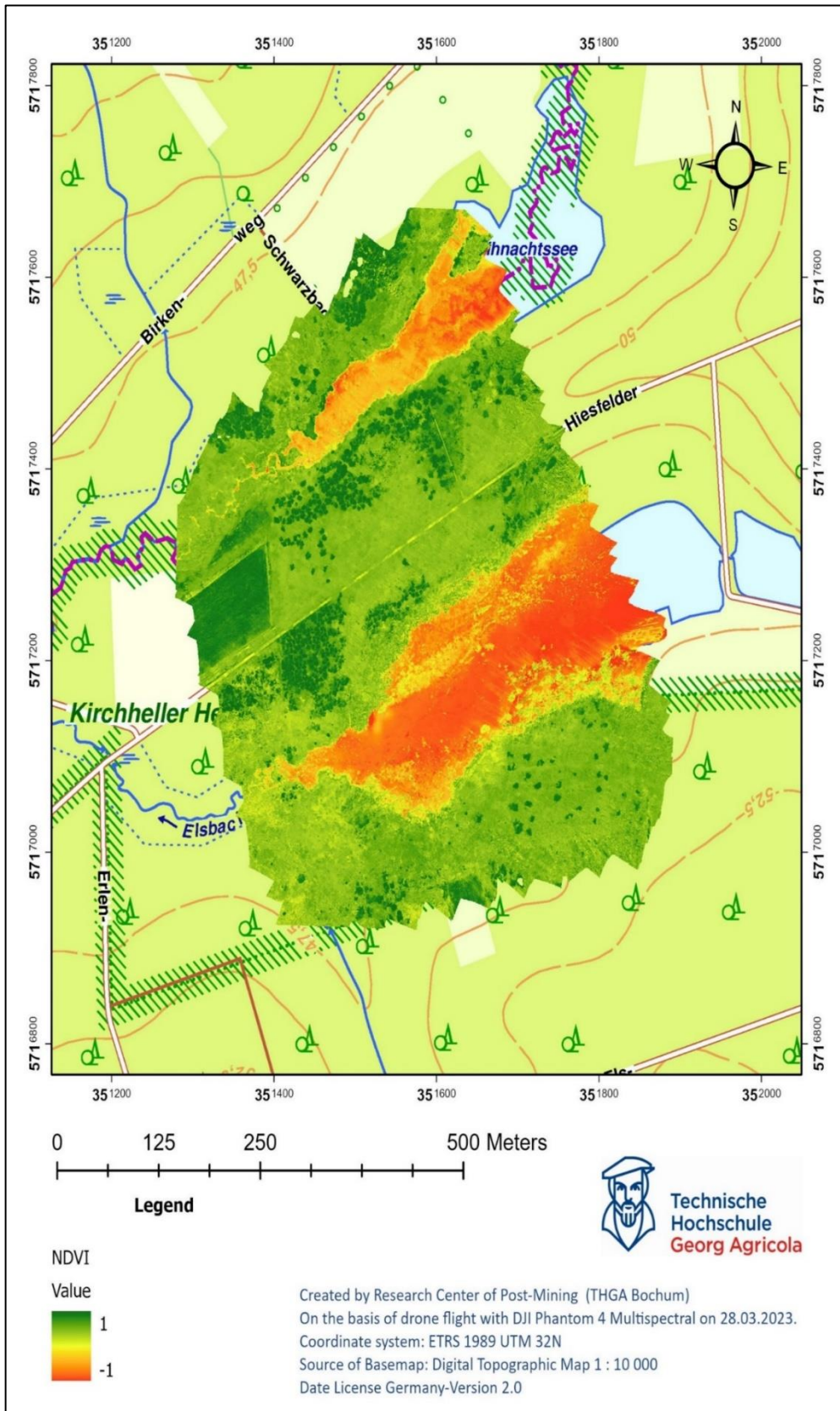
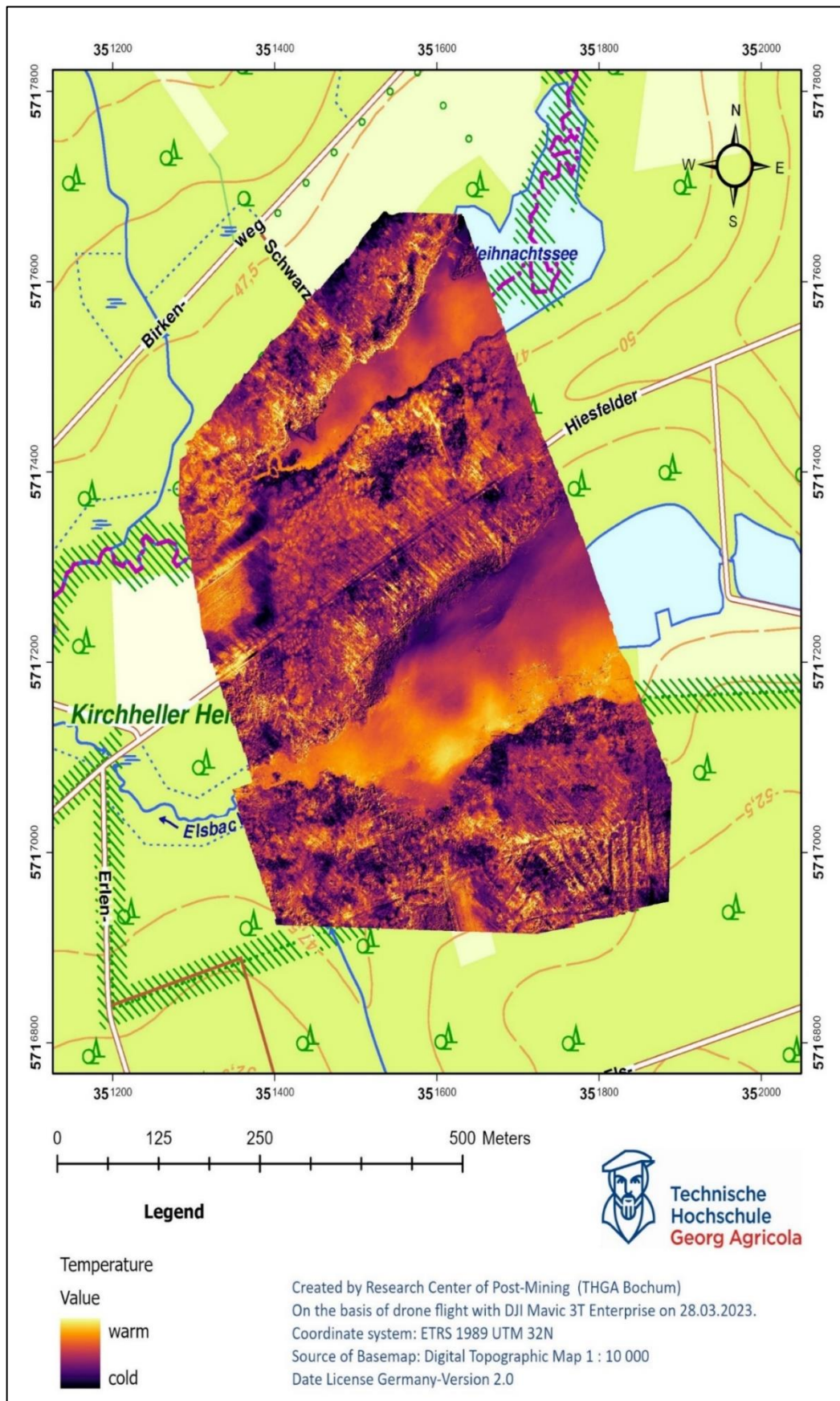


Figure 1. Location of the study area in the north-western Ruhr area in Germany [4].



**Figure 2.** Normalized Difference Vegetation Index (NDVI) derived from the multispectral data.



**Figure 3.** Thermal orthophoto calculated from the captured thermal infrared data.

By integrating and fusing data from different drone flights with high precision georeferencing, we can achieve improved visualization and, most importantly, a deeper understanding of the ongoing processes in the environment.

The use of a multispectral camera during drone flights allows for the creation of high resolution, multispectral orthophotos, enabling detailed vegetation analysis. Derived remote-sensing indices (Fig.2) from the captured spectral channels provide accurate assessment of vegetation conditions and cover changes.

Drone flights equipped with a thermal camera can identify water currents in bodies of water (Fig.3). The results represent a preliminary phase for further long-term geo-monitoring of the post-mining processes at the closed Prosper-Haniel mine.

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