

# INTEGRATING ASTER REMOTE SENSING AND ELECTRIC RESISTIVITY TOMOGRAPHY FOR POST-FIRE HYDROLOGICAL ASSESSMENT

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## INTRODUCTION

Wildfires burn vegetation, which exposes the underlying geology and directly alters runoff, infiltration, and subsurface flow. Accurately identifying near-surface rock masses is essential for modeling post-fire hydrological responses. The 2022 wildfire in Bohemian Switzerland National Park in the Czech Republic exposed extensive bedrock, which allowed for geological characterization through remote sensing and geophysics.



Fig. 1 High-resolution unmanned aerial vehicle (UAV) orthophoto of burned vegetation in Bohemian Switzerland National Park.

## METHODS AND MATERIALS

ASTER L1T imagery, filtered for cloud cover below 10%, was collected from June to September and composited. The images were then atmospherically corrected using the Dark Object Subtraction (DOS) method in Google Earth Engine. Sixteen lithological band-ratio indices were computed and an NDVI threshold of 0.3 was applied to identify bare surfaces with maximized spectral contrast.

- Mineral mapping: The Spectral Angle Mapper (SAM) algorithm, which uses a reference spectral library, identified the dominant mineral phases, including quartz, silica, iron oxide, clay, carbonate, and kaolinite.
- ERT Calibration: Field resistivity measurements classified values above 5,000 ohm.m as solid sandstone and values between 3,000 and 5,000 ohm.m as weathered sandstone.
- Classification: A random forest classifier with 200 trees was trained using ERT-labeled samples, spectral indices, digital elevation model (DEM), slope, and gray-level co-occurrence matrix (GLCM) texture homogeneity as input features.

## RESULTS

ERT data classified measurement points into three resistivity categories: solid sandstone (>5,000 ohm.m), weathered sandstone (3,000–5,000 ohm.m), and non-sandstone (<3,000 ohm.m). Three-dimensional ERT profiles confirmed the spatial extent and depth of high-resistivity rock masses.

Three Random Forest models were iteratively developed with progressively enriched input features (Table 1).

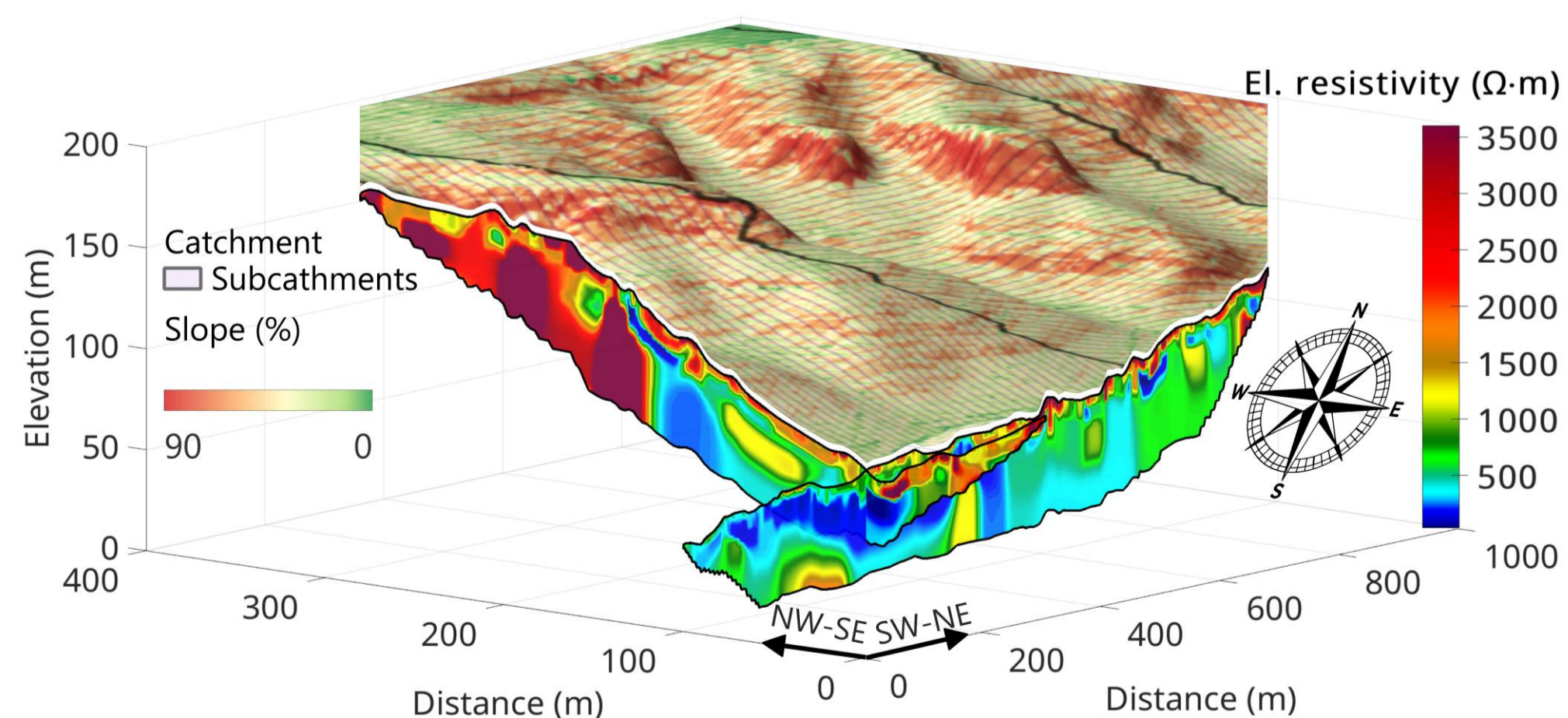


Fig. 2 3D electrical resistivity tomography (ERT) of two survey profiles.

## DISCUSSION

Progressive model improvement confirms that spectral indices alone are insufficient for reliable sandstone mapping. Topographic and textural variables are essential for reducing false positives. A comparison of pre-fire and post-fire CN demonstrates that exposed, impermeable sandstone surfaces significantly increase runoff coefficients. In areas where the rock mask indicates shallow and hard bedrock, the watershed response is expected to intensify further.

Tab. 1 Sandstone classification accuracy across model iterations.

	Baseline	VNIR(balanced)	VNIR-NDVI-DEM
<b>Overall Accuracy</b>	76.3%	78.2	83.3
<b>Kappa Coefficient</b>	0.34	0.56	0.61
<b>Recall (Sandstone)%</b>	33	76	87
<b>Precision (Sandstone)%</b>	76	84	76
<b>F1-Score</b>	0.46	0.80	0.81
<b>Training Points</b>	186	817	817

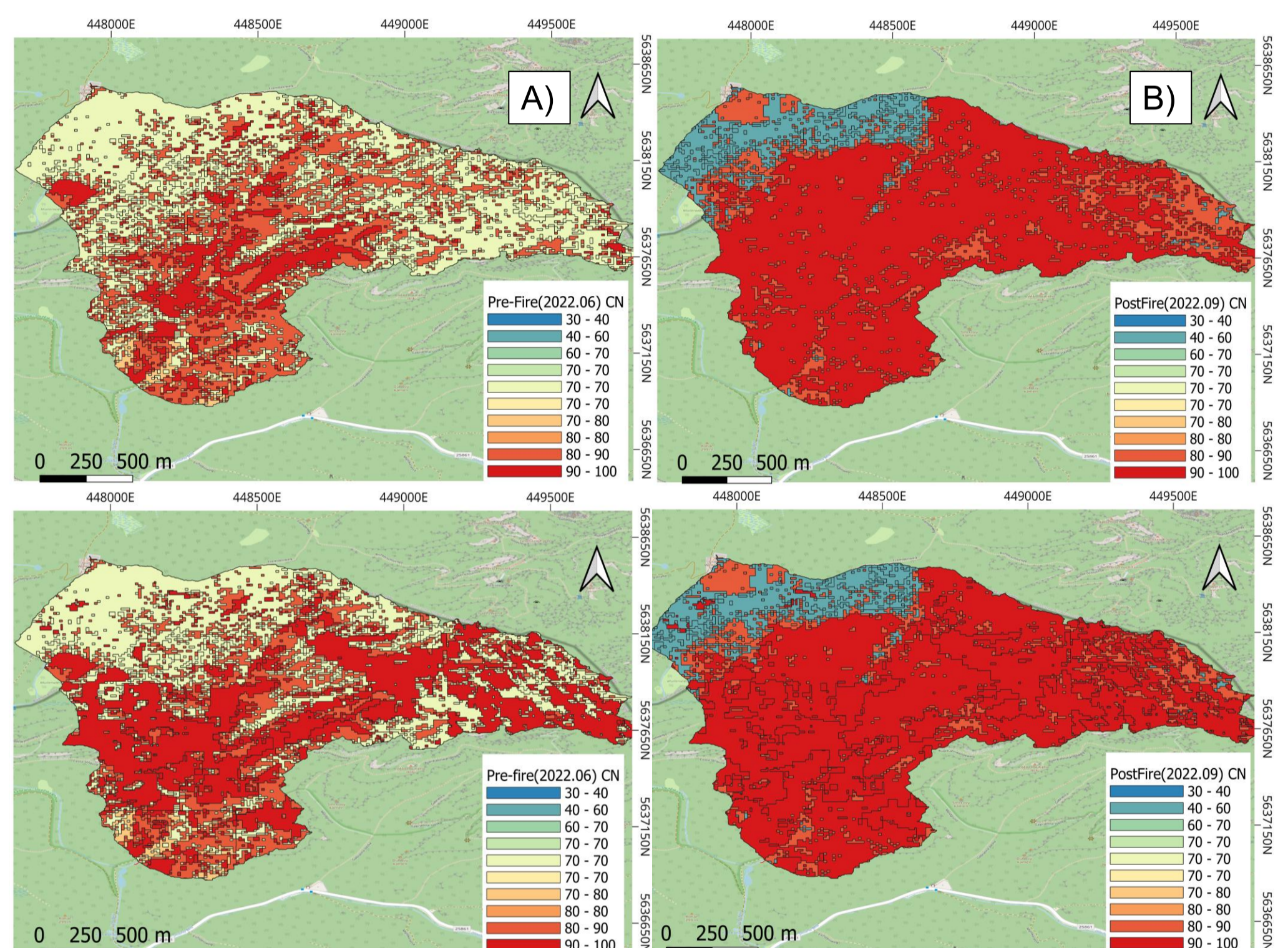


Fig. 3 Curve Number (CN) maps for study area in NP without (top) and with (bottom) rock mask for pre-fire (A, C) and post-fire (B, D) conditions.

## CONCLUSION

This study demonstrated the effectiveness of integrating ASTER multispectral remote sensing with ERT ground-truth data in identifying and delineating near-surface solid sandstone bodies in post-fire environments. This integration provides critical geological information for hydrological modeling.

- The ASTER-ERT integration provides a reliable framework for mapping these bodies, achieving 80.3% overall accuracy and a Kappa coefficient of 0.61 through Random Forest classification.
- Post-fire vegetation removal enhances spectral contrast, improving the detection of exposed rock surfaces and mineralogical transition zones that are obscured by an intact forest canopy.
- The validated sandstone mask modifies Curve Number (CN) values of impermeable rock surfaces. These adjusted CN maps going to be integrated into distributed hydrological models to improve runoff prediction and flow path delineation in post-fire catchments.

## ACKNOWLEDGMENTS

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