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# Toward High-Resolution Mapping of Desert Pavements: Field Surveys and First Results from Namibia

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Desert pavements are widespread geomorphic features in drylands, but their distribution and characteristics have not been adequately characterized. They play a critical role in the atmospheric dust cycle where they control dust emission and entrainment. Against this backdrop, the goal of this project is to map the distribution and physical characteristics of desert pavements and related stone-armored surfaces using field evidences, terrain analysis and remote sensing data, and machine-learning models. Our focus is on Namibia, where we start from an initial distribution assessment generated by GIS-based multicriteria suitability analysis.

Ground-truth data acquisition is conducted as an extensive field survey to document desert pavements across regional environmental gradients. Following zigzag transects, we record pavement characteristics including surface roughness, clast size and weathering features, and geomorphic information including micro-topography and signs of water erosion. Special emphasis is placed on the detection and characterization of vesicular horizons discriminating desert pavements against other stone-armored surfaces. We use UAV photogrammetry as well as ground-level optical and thermal surface imaging for detailed documentation and to facilitate precise local-scale analyses. These ground-truth observations will provide a representative empirical basis for analyzing pavement-forming processes and will support the development of a hybrid geospatial artificial intelligence (GeoAI) framework that integrates optical and thermal remote sensing data with terrain attributes derived from digital elevation models for digital soil mapping at a high spatial resolution.

As a preparatory step guiding the field surveys, we refine our recently proposed Desert Pavement Potential Index (DPPI) by incorporating additional environmental constraints. The updated index (DPPI v2) integrates a diurnal soil temperature range layer and a desert bloom index (DBI) into the existing index that is based on general precipitation, vegetation, soil texture, and disturbance patterns. The DBI, derived from a 26-year MODIS NDVI archive, allows stable pavements to be distinguished from surfaces that experience episodic greening and thus root development. A preliminary validation, limited to areas where the original DPPI suggested geomorphically plausible pavement conditions (DPPI ≥ 0.75) so as to avoid trivial contrasts with clearly unsuitable or vegetated surfaces and thereby enable a more meaningful assessment, indicates a considerable improvement in discrimination skill (area under the ROC curve: 0.864 for DPPI v2 vs. 0.779 with the original index). Visual comparison further shows that DPPI v2 produces a spatially

more constrained and geomorphically coherent envelope of pavement-favorable conditions.

Taken together, the combination of field observations with multi-source GeoAI models is expected to provide a scalable framework for mapping desert pavements in Namibia, which will improve the representation of surface processes in atmospheric dust modeling.