**A GPU-based Parallelization Approach to conduct Spatially-Explicit Uncertainty and Sensitivity Analysis in the Application Domain of Landscape Assessment**

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**Abstract**

This paper illustrates a CUDA GPU-based concept to accelerate the computationally intensive calculations of performing spatially-explicit uncertainty and sensitivity analysis in multi-criteria decision-making models. Uncertainty and sensitivity analysis is a two-step approach to validating the robustness of spatial- and non-spatial model solutions. The uncertainty analysis quantifies the variability of model outcomes while the sensitivity analysis accounts for the contributions of model inputs to the overall model output variability. The proposed solution is applicable for large-scale spatial problems that incorporate millions of alternatives and hundreds of thousands of simulation runs. Furthermore, this GPU-based concept represents a low-cost approach in comparison to high-performance computing that incorporates super computers. Additionally, the concept allows the integration of different decision rules (e.g. simple additive weighting, ideal point, ordered weighting averaging, or analytical hierarchy process) in order to evaluate the performance of the alternatives involved. The proposed approach was tested on a landscape assessment example in order to identify the variability of the model outcomes with respect to the criteria “Compactness”, “Mean Patch Area”, “Relief Energy” and “Variety” that define landscape diversity.