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Evaluating the Compressibility of Elevation Data using Space-Filling Curves

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Two of the typical points of interest with elevation data, or Geographic Information Systems (GIS) data in general, are storage and query costs. The former is typically addressed by integrating standard compression schemes into already existing storage mechanisms, such as GZIP in HDF5. Space-Filling Curves (SFCs) have already been used to reduce access time for spatial operations on point and polygon data. In this research, we evaluate the effect of using SFCs as a pre-processing step for standard compression schemes on elevation data. We break up common compression tools into their base algorithms and identify canonical SFCs from the literature (for example, the Hilbert curve).

We use 1-arcsecond resolution elevation maps from the Shuttle Radio Topographic Mission (SRTM) as the comparative data-set upon which we apply all combinations of SFCs and compression schemes. The SFCs, in most cases, neither significantly improve nor worsen compression ratios when compared to non-preprocessed results. However, we show that certain pre-processing steps improve the compression performance of otherwise ineffective compression techniques. This research shows the potential for future work on compression schemes which allow for in-place search and modifications without the loss of compression performance. Another application is to apply these techniques to astronomical data from the Square-Kilometre Array, a major scientific and engineering project in South Africa, for which some preliminary results have been attained.

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