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New insights from DEM's into form, process and causality in Distributive Fluvial Systems

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Recent developments in platforms and sensors, as well as advances in our ability to access these rich data sources in near real time presents geoscientists with both opportunities and problems. We currently record raster and point cloud data about the physical world at unprecedented rates with extremely high spatial and spectral resolution. Yet the ability to extract scientifically useful knowledge from such immense data sets has lagged considerably. The interrelated fields of database creation, data mining and modern geostatistics all focus on such interdisciplinary data analysis problems. In recent years these fields have made great advances in analyzing the complex real-world data such as that captured in Digital Elevation Models (DEM's) and satellite imagery and by LIDAR and other geospatially referenced data sets. However, even considering the vast increase in the use of these data sets in the past decade these methods have enjoyed only a relatively modest penetration into the geosciences when compared to data analysis in other scientific disciplines. In part, a great deal of the current research weakness is due to the lack of a unifying conceptual approach and the failure to appreciate the value of highly structured and synthesized compilations of data, organized in user-friendly formats. We report on the application of these new technologies and database approaches to global scale parameterization of Distributive Fluvial Systems (DFS) within continental sedimentary basins and illustrate the value of well-constructed databases and tool-rich analysis environments for understanding form, process and causality in these systems. We analyzed the characteristics of aggradational fluvial systems in more than 700 modern continental sedimentary basins and the links between DFS within these systems and their contributing drainage basins. Our studies show that in sedimentary basins, distributive fluvial and alluvial systems dominate the depositional environment. Consequently, we have found that studies of modern tributary drainage systems in degradational settings are likely insufficient for understanding the geomorphology expressed within these basins and ultimately for understanding the basin-scale architecture of dominantly distributive fluvial deposits preserved in the rock record.