High-Resolution Digital Elevation Models: Analysis Tools and Applications

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The recent availability of high-resolution digital elevation models (DEMs) has opened up new areas of investigation and has resulted in the development of new data analysis tools. Many of the new investigations center on the study of landforms that are created and modified by climatic, tectonic, and volcanic processes. These studies may be approached through measurements of 1) profiles, 2) slopes, 3) 3-dimensional shapes, and 4) volumes.

Profiles of streams give information on their approach to "grade", departures from which yield information on tectonic and climatic perturbations along their length. I'refiles taken parallel to and on each side of a fault have also been used to determine the amount of slip on the fault, through measurement of offsets of major ridges and valleys. Profiles across volcanoes have also been used to study their constructional and erosional history. Measurement of slopes in a region gives significant information on the tectonic and erosional history of the area. Steep slopes at high elevations are characteristic of uplifted glaciated terrain, moderate slopes of fluvial activity, and flat slopes of depositional basins. The three-dimensional shapes of landforms contain information on their formation and modification. For example, conical shapes are representative of surfaces of transport at the feet of mountains, while convex hillslopes are formed by slower "creep" processes. Finally, volumes of landforms such as lava flows, glaciers, and landslides allow rates of formation and transport to be derived.

Because of their importance to inversion models that also incorporate multisensory data, new techniques are being developed for use with high-resolution topographic data that include derivation of slope and azimuth maps. Slope and azimuth maps allow correction of illumination geometry effects on visible-near infrared and thermal infrared data and derivation of local incidence angles for inversion of radar images. In addition, high-resolution DEMs allow rectification of distortions inherent in radar images, allowing more quantitative interpretation and integration with other data.

* his work was carried out by the Jet Propulsion Laboratory, California Institute of Technology, under contract with NASA.