The application of high-resolution DEMs derived from LIDAR for geoscience

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High-resolution laser altimetry (LIDAR) is applied to geological problems such as bedrock and surficial mapping and local surface processes in two different terrain types in Nova Scotia, Canada. One terrain type represents folded Paleozoic metasedimentary rocks in contact with ca. 370 Ma granite. The other type occurs in the Fundy Basin and represents a Mesozoic rift basin that has been affected by up to 4 ice sheets during the last glaciation. LIDAR data map derivatives have been interpreted for these different geological environments to demonstrate the utility of LIDAR for geoscience applications. All of the areas investigated are covered with dense vegetation that obscures the geological features on aerial photographs.

Subtle topographical differences among three flow units of the Jurassic North Mountain Basalt (NMB) are clearly visible on a LIDAR DEM for the Fundy Basin. Boundaries between flow units extracted from the DEM were verified by field mapping. Several ring structures in the lower flow unit, distinguishable only in the LIDAR data, are interpreted to be the remnants of rootless phreomagmatic cones. Two new sets of surficial landforms have been identified that indicate ice was directed northwestward into the Bay of Fundy during the late stages of glaciation depositing a blanket of till over half of the catchments draining the NMB into the bay.

Contrasting resistance to erosion of beds in folded Ordovician rocks result in subtle ridges visible on the LIDAR DEM. The contacts between the units and information on the structural deformation can be inferred directly from the LIDAR maps. A fold axis is clearly visible and a fault has been interpreted from these data. The morphology of Devonian granite in the area differs significantly from that of the folded metasedimentary rocks allowing the contact between them to be easily defined based on their topographic expression visible on the LIDAR maps. These examples demonstrate that the high-precision and resolution of LIDAR can improve bedrock and surficial mapping and our understanding of how landscapes form and evolve.