Studying Earth Surface Processes with High-Resolution Topographic Data

Objectives

The objectives of this workshop are 1) to bring together scientists who are using high-resolution topographic datasets to develop and test intellectually significant ideas regarding Earth surface processes, and 2) to provide scientists with direct, hands-on opportunities to learn about new research advances and future directions of research in Earth surface processes. In order to study many of the phenomena that continually reshape the surface of the earth, or to capture the finer details of surface motion in seismic zones, researchers need sub-meter point spacing over areas of hundreds or even thousands of square kilometers. One of the most significant, recent technological advances in the study of Earth surface processes is geodetic LASER scanning (GLS), a method that accurately determines the coordinates of hundreds of millions, or even billions, of points on the surface of the terrain, over areas hundreds of kilometers in extent, in observing periods of hours to days. GLS observations can be collected from a fixed mount, or from a moving ground-vehicle, aircraft, or spacecraft. By combining observations from more than one type of GLS, it is possible to form nested data sets that can be used to improve the point spacing over "hot spots" within larger area coverage and allow users to study the finest surface details. Airborne GLS, also referred to as airborne LASER swath mapping (ALSM), currently is the method-of-choice for the study of most geosurficial processes. To be useful for such studies, the surface coordinates derived from ALSM observations must be accurate to 5 to 10 cm vertically (height), and 20 to 30 cm horizontally (latitude and longitude), with a point spacing of a few decimeters—but some applications require accuracies and point spacing 3 to 10 times better. The proposed workshop is not limited to applications that use GLS, but GLS technology provides the highest resolution topographic data available at present, and is associated with a proliferation of state-of-the art ideas and discoveries.

In the past several years, research on Earth surface processes that uses high-resolution topographic data has spanned a broad spectrum of applications, from measuring winter snowpack, to delineating drainage patterns, to analyzing landslides, to mapping faults, scarps, and terraces, to studying a local food web over a stream through a wooded area, and many others. As one example, researchers at the University of Oregon, U.S. Forest Service - Boise, Idaho State University, and University of California at Berkeley are collaborating to document the 3-dimensional spatial pattern of landsliding along a 52-km section of the South Fork of the Eel River, northern California, and to investigate the correlation between the location of deep-seated landslides and river incision (abstract available at http://adsabs.harvard.edu/abs/2006AGUFM.H53B0619M). The researchers are using a one-meter resolution digital elevation model (DEM) based on research quality ALSM observations collected by the NSF-funded National Center for Airborne Laser Mapping (NCALM) in 2005. The results of this research demonstrate a high degree of coupling between the channel and adjacent hillslopes. In addition, the spatial distribution of instability suggests that base level has a primary role in both initiating and partially reactivating deep seated landslides. Analysis of high-resolution topographic data enabled the researchers to distinguish two different spatial patterns of landsliding, which they attribute to base level operating on different scales.

Statement of Need

New technologies that provide high-resolution topographic data have emerged relatively suddenly in the past 15 years, and only in the past five years have datasets at the scale of investigator field sites become available and affordable. The result of this newly available data has been a plethora of pioneering studies that span a broad range of applications. Scientists are studying processes and landforms in new ways that were impossible just several years ago. The rapid emergence of new technology, datasets, and ideas, although clearly an opportunity, is also a challenge to the Earth science community. The challenge is the need to find ways to maximize the dissemination and transfer of ideas, and to facilitate the sharing of public-domain databases and the tools needed to use those databases. An intensive workshop that includes ample time for close interaction among participants is an optimum solution to this challenge.