USING LIDAR DATA HAS HELPED IMPROVE THE UNDERSTANDING AND INTERPRETATION OF RESOURCES AT GREAT SAND DUNES NATIONAL PARK AND PRESERVE, COLORADO, U.S.A.

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Introduction: Great Sand Dunes National Park & Preserve was mapped using lidar (Light Detection and Ranging) in the fall of 2011 as part of a U.S. Geological Survey project [1] that conducted a lidar survey of southern Colorado's San Luis Valley. The project design required a sampling interval of one return per square meter and a vertical accuracy of 15 cm. This is the most accurate topographic mapping of Great Sand Dunes to date and has been used by the National Park Service (NPS) to quantify and visualize the resources it is charged with protecting and interpretation of these resources.

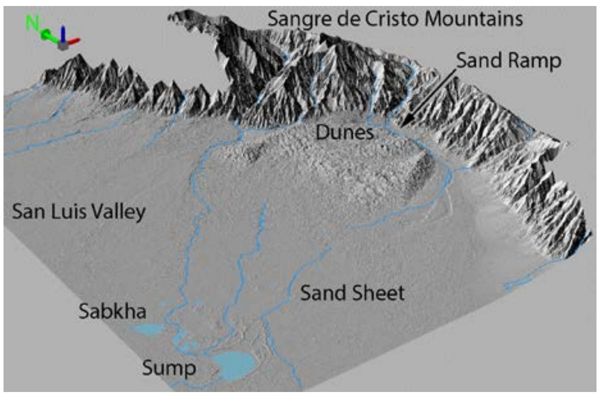

Figure 1: Hillshade of digital elevation model for Great Sand Dunes National Park & Preserve created from the lidar dataset. Vertical exaggeration = 2.

Discussion: Great Sand Dunes is a dynamic landscape where sabkha, sand sheet, dune, and sand ramp deposits have developed along a topographic gradient [2]. Figure 1. The lowest deposit is found in a depression, described as a sump that is the terminus of an internally drained region where playa lakes form [3]. This sump is believed to be the immediate source of sand for the Great Sand Dunes aeolian system [4].

Having a lidar dataset allows the NPS to better understand the relationship between topography, sand deposits, and hydrology. For example, what is the extent of the sump in relation to the distribution of sand? How large would playas become before they overflow the sump and become tributary to the Rio Grande? At what depth to ground water does the sabkha transition to sand sheet?

Accurate topographic data also allows the NPS to make more precise measurements in areas such as determining the sand volume of the dunefield. It also has been used to help develop a systematic method to measure dune height. Great Sand Dunes contains mega-dunes. The summit of the dune is straight forward, but defining the base of such a complex dune form is more complicated. Using elevations at the perimeter of the dunefield, a generalized valley floor can be projected beneath the dunefield. This serves as a base elevation for the dune forms above it. Then the elevation of the dune crest can be subtracted from the elevation of the projected base to give the dune height, making it possible to know the elevation of all dunes in the dunefield. Previously, only a few index dune heights were known as they were surveyed using traditional techniques.

Lidar can give a bare earth perspective, removing vegetation so that landforms stand out. Changing vertical exaggeration and lighting angles can also improve landform identification. In many ways manipulating lidar data can give a better view than seeing an area first hand. In 2010, the Second Planetary Dunes Workshop fieldtrip went to Great Sand Dunes and viewed a crater of unknown origin [5]. Thanks to lidar, the NPS now knows that there is one, possibly more very similar features in that area.

Digital elevation modeled created from lidar data can also be used as a visualization tool. The XYZ data can be projected as 3 dimensional models which are very useful for visualizing landforms, such as dunes, to a non-scientific audience. To enhance this effect it can be presented in stereo 3D. The NPS uses this with positive public response.

References: [1] Giffin C. L. (2011) *USGS Lidar Point Cloud (LPC) CO_San-Luis-Valley_2011*. [2] Valdez A. V. (2007) *Quaternary geology of Great Sand Dunes National Park and Preserve, southern Colorado (Chapter A.)* U.S. Geological Survey, Open-File Report 2007-1193, 3-51. [3] Emery P. A. (1971) *Hydrology of the San Luis Valley, south-central Colorado*. U.S. Geological Survey Hydrologic Investigations Atlas HA-381. [4] Madole R. F. and Romig J. H. (2008) *On the origin and age of Great Sand Dunes, Colorado*. Geomorphology 99, 99–119. [5] Marvin U. B. (1966) *A re-examination of the crater near Crestone, Colorado*. Meteorics, 3(1) 1-10

Additional Information: Lidar and other geographical data sets can be obtained from the USGS at: http://earthexplorer.usgs.gov/