Abstract

Light Detection and Ranging (LiDAR) technology combined with high-resolution differential Global Positioning Systems (dGPS) provide the ability to measure coastal elevation with high precision. This study investigates the use of LiDAR data and GIS to conduct time-series analyses of coastal sediment volume shifts during the 2006-2007 El Niño winter, Summer of 2007 and following 2007-2008 La Niña winter in the Oceanside Littoral Cell (OLC). The OLC, located in Southern California, spans from Dana Point to La Jolla and includes over 84 km of coastline. The ability to quantify sediment volume changes contributes to the scientific understanding of the role El Niño storms play in the OLC sand budget. This study provides a method to analyze LiDAR data to evaluate coastal geomorphologic changes over time. Additionally, identifying specific areas of coastal beach erosion associated with historical El Niño events can aid beach managers, planners, and scientists in protecting the valuable coastline. LiDAR datasets were prepared and formatted which included ground classifying millions of elevation points. Formatted datasets were inputted into an Empirical Bayesian Kriging (EBK) model, creating high-resolution, 1-meter grid cell, Digital Elevation Models (DEMs). The EBK model also incorporated uncertainty into the workflow by producing prediction error surfaces. LiDAR-derived DEMs were used to calculate sediment volume changes through a technique called DEM differencing. Results were visualized through a series of maps and tables. Overall results show that there was a higher rate of beach sediment erosion during the 2006-2007 El Niño winter than the 2007-2008 La Niña winter. Sediment accretion was evident during the intermediary Summer of 2007. Future applications of this study include incorporating bathymetric datasets to understand near-shore sediment transport, evaluating sediment contribution through cliff erosion, and conducting decadal scale studies to evaluate long-term trends with sea level rise scenarios.