HISTORICAL LANDSCAPE CHANGE IN POCATELLO, IDAHO USING 'STRUCTURE-FROM-MOTION' PHOTOGRAMMETRY

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Introduction

Historical aerial imagery of the Pocatello, Idaho region ranging from 1959 to 1994 were collected and compiled into georeferenced orthomosaics. Using 'Structure-from-Motion' photogrammetry, digital surface models (DSMs) are also derived from spatially accurate point cloud data. DSMs can be used to detect both natural and anthropogenic spatiotemporal change. Together with feature extraction, these may be used as input for visualizations and predictive modeling used to aid in land management decision-making and land use and landscape change mapping over time.

Question 1

How has the landscape and landuse in Pocatello changed over time?

Question 2

How can visualization of future scenarios contribute to the land use planning process for the Portneuf Watershed?

Study Area

The study area is situated in urban and rural portions of Pocatello, with particular emphasize on the Portneuf River which has gone through a considerable amount of change especially with measures to enact flood control in the mid 1960s.

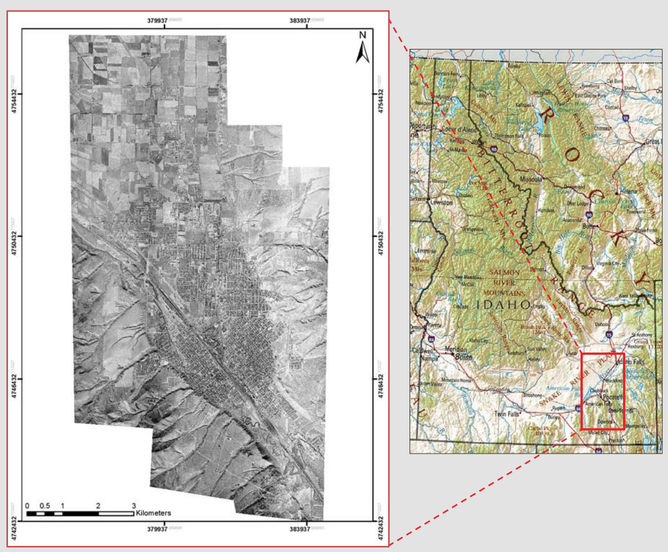

Figure 1. Orthomosaic of Pocatello , Idaho circa 1959

Methods

To analyze landscape change over time in Pocatello, DSMs used in this analysis were interpolated from point clouds (Below) using a structure-from-motion photogrammetry technique to produce 1-meter scale rasters. Additionally, aerial imagery on a roughly decadal scale from the early 1950's to 1994 were derived and georeferenced as well as orthorectified.

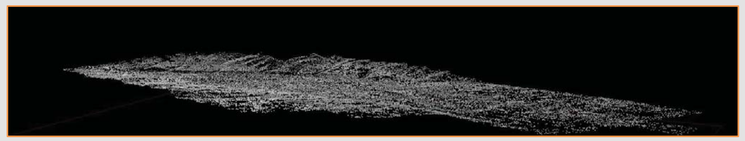

Figure 2. Structure from motion-generated point cloud of 1959 imagery

Difference images were created using ArcGIS 10.2 and converted into absolute values to assess the gross landscape change. These rasters were then cropped to a simple bounding box to exclude edge-effect areas where there are too few stereo-matched image tiles to generate a highly accurate point cloud. Statistics from the resulting surfaces were extracted and compared between decadal sets.

Results

The image analysis of the DSMs presented here suggests that growth, development, and change in the Pocatello area has varied throughout the period studied, with the greatest amount of change occurring from 1975 to 1984. The mean change from this time period is 5.2 m^3 compared to 1.2 m^3 for 1959 to 1968, 1.2 m^3 from 1968 to 1975, and 1.7 m^3 from 1985 to 1994. The maximum change for a single meter pixel averaged 37.38. The resulting imagery is used to visualize change over time.

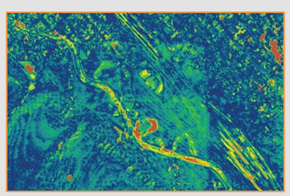

Figure 3. Difference raster from 1959 to 1968

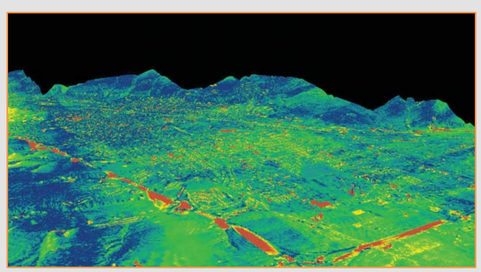

Figure 4. 3D model of difference raster highlighting construction of the interstate highway system, draped over 1968 DSM

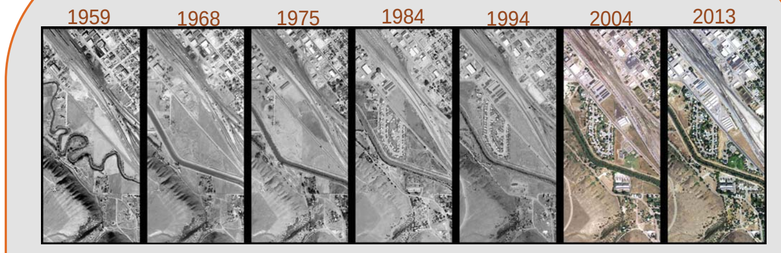

Figure 5. Time series from 1959 to 2013

Figure 6. Feature extraction example

Figure 7. Procedural modeling in CityEngine

Orthomosaics derived from structure from motion photogrammetry will be analyzed on a decadal scale using object oriented feature extraction. These extracted features include building footprints, vegetation, roads, and other land cover types. In addition to topography from DSM models, these data can then be used to measure change over time and as inputs for visualization in 3D environments; specifically, in procedural modeling software such as ESRI CityEngine. The resulting models and analysis will be produced at a spatial resolution typically not available for local-scale analysis.

Discussion

Images of the past, present, and future Pocatello valley produced in this research will be provided to the Portneuf River Management group to assist. Land surface change detection can be used to further knowledge of human ecology, landscape change and ecosystem services in Pocatello, Idaho. Modeling and visualization in a 3D environment will enable decision makers to better understand the interactions of ecosystem services and the Pocatello regional economy. These analyses can reveal trends over time and improve visualizations that help stakeholders in the planning process.

References

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- Fig. 6: http://www.textronsystems.com/products/geospatial/feature-analyst, Fig. 7: http://www.smarterbettercities.ch/wp-content/uploads/2014/01/Japan_view_07CE.jpg

Acknowledgements

Idaho State University