Mapping channel changes in glacial and legacy sediment reaches of the South River

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Abstract

The effects from both Pleistocene glaciation and historic land use change are visible throughout New England today, and continue to impact the region's watersheds. The South River in western Massachusetts is an upland setting with hillslopes mantled by glacial material. During the 18th-19th centuries, European settlement included the construction of approximately 30 mill dams along the river, coinciding with widespread regional deforestation. Sediment eroded from the landscape as a result of human activity was deposited in valley bottoms behind these mill dams, and much of this persists as legacy deposits. The banks of the South River are primarily composed of glacial and legacy sediments. I hypothesize that erosion in the watershed over the past ~100 years is primarily from legacy sediment deposits. In this study, I used aerial photographs from 1940 and 2013 to delineate channel banks and calculate changes in channel width following methods in Galster et al. (2008), in order to determine areas of widening or narrowing and changes in sinuosity, comparing reaches with banks composed of legacy and glacial sediment. Results indicate that reaches of legacy sediment have not experienced significant changes in width, where reaches of glacial sediment have been significantly narrowing. However, reaches of legacy sediment have seen an increased sinuosity (up to 12 % change) where glacial reaches have remained relatively stable, with minor increases in sinuosity (1-2% change).



Data set and Methods





Aerial photographs from 1940 and 2013 were used as the main dataset to compare changes in the channel during the second half of the 20th century. 1940s photographs were obtained from the USGS Earth Explorer and were georeferenced in ArcMap using road intersections as ground control points. Orthoimagery from 2013 was obtained from MassGIS. Channel banks were manually delineated as shapefiles for both years. Widths across the channel were measured at 80 km intervals. Areas where the channel was obscured by vegetation or too narrow to see were excluded from the analysis.

Reaches of glacial and legacy sediment were identified based off of changes in valley width. Widths across the valley were measured in ArcGIS at 100 m intervals along the channel. The average valley width is 200 m, where sections of the valley <200 m were identified as narrow reaches, and sections >200 m were identified as wide reaches.

References:

Galster, J.C., Pazzaglia, F.J., and Germanoski, D., 2008: Measuring the Impact of Urbanization on Channel Widths Using Historic Aerial Photographs and Modern Surveys.

MassGIS, 2014, USGS Color Ortho Imagery (2013/2014), http://www.mass.gov/anf/research-and-tech/it-serv-and-support/application-serv/officeof-geographic-information-massgis/datalayers/colororthos2013.html. USGS Earth Explorer, 2017, https://earthexplorer.usgs.gov/.

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Overall, sections of the channel constricted by glacial material indicate a significant trend toward narrowing (p < 0.05). The legacy sediment sections do not indicate any significant changes in width (p= 0.4526). However, the reaches of legacy sediment generally display an increase of sinuosity (up to 12%), indicating dynamic change, as opposed to the glacial reaches, which have remained relatively stable and have only experienced minor increases in sinuosity (1-2%).

BC GIS Contest 2017

Channel Mapping

Reach	Sediment type	1940 Sinuosity	2013 Sinuosity	Percent change	T-test p valu
1	Glacial	1.39	1.40	1%	0.7322
2	Legacy	1.43	1.43	0%	0.6854
3	Glacial	1.51	1.54	2%	0.8936
4	Legacy	1.08	1.21	12%	0.9338
5	Glacial	1.52	1.53	1%	< 0.05
6	Legacy	1.29	1.45	12%	< 0.05