Continuing Projects

Title: Identifying primary and secondary controls on turbidity and sediment yield in Oregon's paired watershed studies

Investigators:
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Project duration:
24 months (Dec. 1, 2015-Nov. 30, 2017)

Objectives:
The Watersheds Research Cooperative (WRC), consists of three paired watershed studies (Trask [TWS], Hinkle Creek [HCWS], and Alsea [AWS]). Turbidity and suspended sediment data have been collected at all of these watershed studies; however, there has been no attempt to integrate the results across studies to provide broader insights that may not be possible otherwise. The overall objectives of the proposed research are to:

I. Synthesize the turbidity and suspended sediment data from the watershed studies in Oregon.
II. Model the relationship between turbidity and sediment yield and morphometric, soils, geologic, and climatic variables at the catchment scale to identify primary and secondary controls.
III. Provide a process-based framework to classify watersheds in terms of resilience and vulnerability to sedimentation, to be used to assess contemporary forest practices.
IV. Develop testable hypotheses for identifying 'hot spots' for turbidity and sediment production within forested watersheds.

Summary of accomplishments toward objectives over past year:

I. Considerable efforts were required to conduct an assessment of data usability from the three WRC study sites. Despite previous QA/QC efforts, the data sets for discharge, turbidity, sediment, and spatial information were incomplete or unusable for the objectives of the planned study. After this assessment, it was determined that the TWS data was the only site that could be analyzed immediately (see "Problems, barriers, proposed changes to objectives" for more details). As a result, we used the TWS to develop an initial framework for analysis and testable hypotheses that could be validated at other locations.
II. The analysis investigated trends in suspended sediment yields in reference and harvested catchments of the TWS. Trends were related catchment morphometry, soils, geology, and climate to identify primary and secondary controls.
III. It was determined that catchment geology, morphometry, and soils were correlated, and collectively provided a model to predict the observed differences in sediment yields and vulnerability to contemporary forest practices among sites. Within the framework of contemporary forest practices, the suspended sediment yield response to land management was determined to be secondary or dependent on catchment characteristics (i.e., primary control).

IV. A testable hypothesis for 'hot spots' in increased yields was proposed, by which catchment characteristics (geology and morphometric variables) can be used to predict resilience and vulnerability to sedimentation.
V. This preliminary analysis and framework were summarized in a manuscript that was submitted to the Journal of Hydrology for publication. It is currently under peer review.

Problems, barriers, proposed changes to objectives:

I. Initial assessment of data quality, indicated quality issues with the turbidity data at all sites due to lack of calibration of the instruments that were deployed in the field. Lack of calibration lead to poor and unreliable relationships between with other variables, including discharge, suspended sediment concentration, and lab turbidity. As such, the turbidity data is likely not usable for any robust analyses.
II. The AWS discharge and climate data have been undergoing a rigorous quality assessment. As such, this data is still not usable to undertake rigorous analyses.
III. Suspended sediment data at the TWS was collected by different methods at different spatial scales, which created substantial challenges for comparisons.
IV. Data quality/accessibly issues have resulted in a decision by Bywater-Reyes (postdoctoral scholar) and mentors (Bladon and Segura) to investigate the usage of other existing data sets in the Pacific Northwest to achieve the overall objectives of the originally proposed work. It is important to reiterate that the overall objectives of the originally proposed work have not changed—only the approach to achieve those objectives has been amended.

Planned work:

I. Compile suspended sediment data from additional sources (USGS, USFS, NP, DEQ) for sites within the western Pacific Northwest region (underway).
II. Analyze trends in suspended sediment yields at sites through time and space in relation to their morphometric, soils, geologic, and climatic setting and land use history.
III. Test and compare results obtained through TWS analysis to develop a process-based framework to classify watersheds in terms of resilience and vulnerability to sedimentation, which may be used to assess contemporary forest practices.
IV. Test and compare results obtained through TWS analysis for identifying 'hot spots' for turbidity and sediment production within forested watersheds.

List of names and brief overview of graduate and/or undergraduate engagement in project [e.g., thesis, research experience for UG, etc.]:

I. Dr. Nicholas Cook (Postdoctoral Scholar), Casey Steadman (PhD candidate), Ryan Cole (undergraduate; honors thesis student), Joey Tinker (undergraduate student).
    - Cook, Steadman, Cole, and Tinker aided the project in quality assurance/quality control of data sets from the TWS, HCWS, and AWS. They have also assisted in standardization of data set presentation across studies to prepare the data for analyses. Additionally, Dr. Cook was integral in preparation of the spatial (GIS) layers across studies, which he used in his OFIC funded research project that is closely aligned to this FWHMF project. We believe this graduate and undergraduate engagement will aid in achieving the project objectives while also providing excellent educational opportunities.

List of presentations, posters, etc.:

Bywater-Reyes, S., Segura, C., and Bladon, K.D. 2016. Influence of Geology and Basin Characteristics on Suspended Sediment Yield in Harvested Western Oregon Headwater Streams. American Geophysical Union Fall Meeting. Dec. 12-16, 2016. San Francisco, CA.

List of publications, thesis citations:

Bywater-Reyes, S., Segura, C., and Bladon, K.D. Geology and geomorphology control suspended sediment yield and modulate increases following timber harvest in Oregon headwater streams. *In review*: Journal of Hydrology.