Spatial-scale Considerations When Evaluating Sediment Transport Model Performance

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Introduction: A primary method for evaluating the performance and reliability of a sediment transport model is to compare predicted and observed changes in bed elevation. Estimates of net sedimentation rate (NSR) based on geochronology analysis of radioisotope cores have been used in many studies to calibrate a sediment transport model. Typically, five to ten NSR data points are available for calibration purposes at a particular site. One limitation of this approach is that NSR data to evaluate model performance are generally collected in areas that are net erosional over multi-year periods. This paper discusses the use of alternative data, which provides a more reliable method for characterizing changes in fluvial and estuarine morphology within the model domain.

Methods: Over the last few years, multi-beam bathymetry (MBB) data have become available for model calibration at several contaminated sediment sites in the United States. This type of data has made it possible to generate bed elevation change data over large portions of the model domain (e.g., data point in every grid cell). With the emergence of large datasets for bed elevation change, the relevance of spatial scale, which ranges from a single grid cell to large areas of the model domain, needs to be considered when evaluating the performance of a sediment transport model in estuarine and fluvial environments.

Results: The presentation will be focused on various approaches for using MBB data to evaluate model performance for a range of sites, rather than focusing on a particular site. Methods for analyzing and interpreting comparisons of MBB data and model predictions of bed elevation change over spatial scales ranging from a single grid cell (e.g., less than 0.5 hectare) to the entire study area (e.g., more than 100 hectares) will be discussed. The objectives of these analyses are to: 1) qualitatively and quantitatively evaluate model performance over a range of spatial scales; and 2) develop insights about model reliability that can be used to assist decision-makers during evaluation of remedial alternatives.

The mass balance shown on Fig. 1 provides an example of a model-data comparison at the largest spatial scale (i.e., entire study area) for a modeling study conducted in a tidal freshwater river.

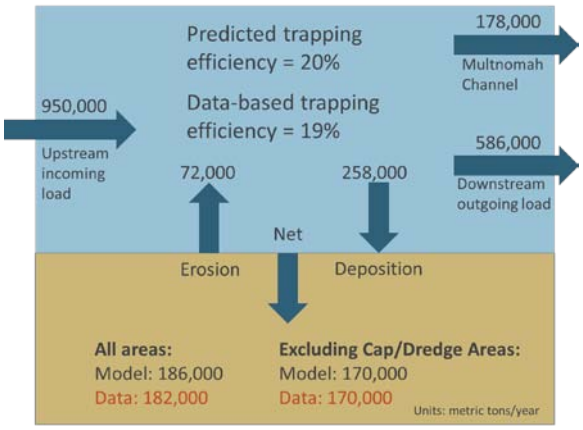

Fig. 1: *Sediment mass balance for 18-km reach of a tidal freshwater river for 6-year simulation period.*

Discussion: Evaluation of model performance over a wide range of spatial scales using MBB data at several contaminated sediment sites in the United States has shown that this approach helps to: 1) increase confidence in model predictions; and 2) inform the conceptual site model. The results of spatial scale analyses from several modeling studies have demonstrated the following:

- Variability in model predictive capability tends to increase as spatial scale decreases, which is typical behavior for a high-resolution numerical model.
- Generally, model bias is relatively consistent over the range of spatial scales (i.e., single grid cell to entire study area).