Geophysical Research Abstracts
Vol. 19, EGU2017-7435, 2017
EGU General Assembly 2017

Numerical model calibration with the use of an observed sediment mobility mapping technique.

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Two-dimensional numerical models' use and accuracy has greatly increased over the last decade partially due ease of topographic data access and acquisition. This is largely due to the surge in survey technologies such as GPS, LiDAR, terrestrial laser scanners (TLS), and Structure-from-Motion (SfM). As many studies have shown, topography is often the greatest influence on a model's predictive accuracy. Recently, studies have shown the use of accurate topographic datasets for numerical modeling yields appreciable accuracies in both depth and inundation patterns when compared to observed data, even in highly complicated planforms such as shallow braided rivers.

Model calibration is typically limited by data availability, data quality, and the user's experience. Hydraulic calibrations with a fixed bed mode often focuses purely on depth predictions using gauge data and more rarely spatial depth data, velocity data, and inundation patterns. Morphological models with bed updating and erosion are often calibrated using erosion and deposition patterns and more rarely consider sediment transport acquired field data. Transitioning from a hydraulic to morphological calibration includes a considerable increase in complicated processes, model parameters, assumptions, and sources of errors. With morphological observed data limited to documented topographic changes, a model's 'performance' is merely based on replicating results instead of processes, and thus it is difficult to fully evaluate the model's true ability.

With the increase in data acquisition and model usage, there is a need to push numerical model testing beyond traditional performance metrics and toward process evaluations. To address this need, instantaneous morphology processes must be evaluated. Flume experiments of a 24 m x 1.6 m wide channel with 1 mm sediment and a 1% slope were ran to develop a braided river and fully documented with: i) highly accurate Structure-from-Motion derived topography (average errors 2 mm) and ii) a novel time-lapse imagery technique used to identify areas of incipient motion. Using the numerical model Delft3D Flow, the experiments were simulated and observed incipient motion and modeled shear stress were compared to evaluate the model's ability to accurately predict sediment transport. Observed and model results were evaluated and compared, which identified a motion threshold and the ability to evaluate the model's performance. To quantify model performance, the ratios of correctly predicted areas divided by total area were calculated and produced a 75% inundation accuracy with a 71% incipient motion accuracy.

Inundation accuracies are comparable to reported field studies of braided rivers with highly accurate topographic acquisition. Nevertheless, 75% inundation accuracy is less than ideal, and likely suffers from the complicated topography, shallow water depth (average 1 cm), and the corresponding model's inaccuracies that could derive from even subtle 2 mm elevation errors. As shear stress calculations are dependent upon inundation and depth, the sediment transport accuracies likely suffer from the same issues. Regardless, the sediment transport accuracies are very comparable to inundation accuracies, which is an encouraging result.

Marie Sklodowska-Curie Individual Fellowship: River-HMV, 656917