HEC-RAS Sediment Transport

US Army Corps of Engineers
Engineer Research and Development Center

Need   Sediment processes pose one of the primary failure modes of flood damage reduction projects. Deposition can make sponser maintenece costs prohibative and incision can undermine infrastructure. USACE PDTs need to analyze these critical failure modes that could change the TSP with efficient tools.

Approach   HEC is adding sediment transport capabilities to 1D and 2D HEC-RAS. Nearly all flood risk management (FRM) studies develop 1D (and, increasingly 2D) HEC-RAS hydraulic models. By adding sediment transport to these models that the districts are already using for their FRM feasibility studies, we are making it more cost effective to analyze these critical failure modes.

Outcomes   Several new 1D sediment features (e.g. unsteady sediment transport, bank failure computations, stochastic connection to HEC-WAT) are available in the current version of HEC-RAS. USACE districts are currently applying these new capabilities to analyze sediment failure modes of FRM, navigation, reservoir management, and environmental studies. Future versions of HEC-RAS will include new 1D and 2D sediment features. These features (including 2D sediment and non-Newtonian physics) are available to USACE users and their partners for alpha and beta testing.
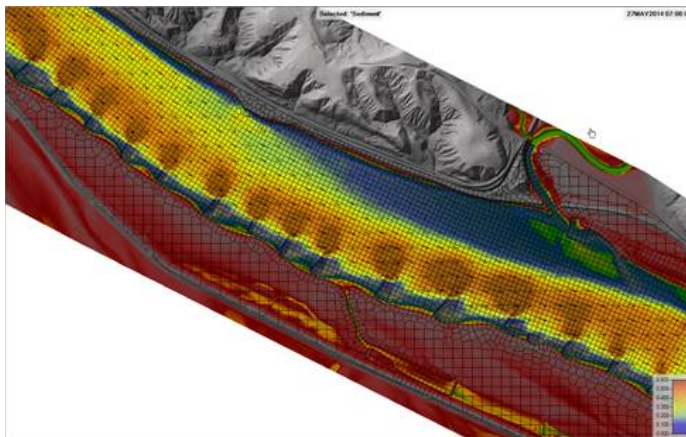
HEC-RAS 2D Sediment Simulation of the Chester reach of the Mississippi (Concentration Plot)
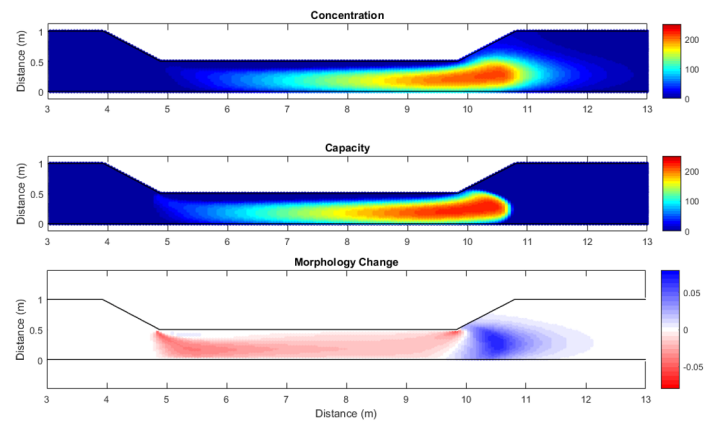
Laboratory Validation of HEC-RAS 2D Sediment Transport

More Information   For more information or alpha/beta software contact Stanford Gibson (stanford.gibson@usace.army.mil) or Alex Sánchez (Alejandro.Sanchez@usace.army.mil).

New release versions of HEC-RAS are available at HEC's website:
http://www.hec.usace.army.mil/software/hec-ras/

For more information on FRM R&D, see the ERDC FRM wiki:
https://wiki.erdc.dren.mil/Flood_and_Coastal_Storm_Damage_Reduction_Research_Program

Documentation

Several documents and project reports are available that describe the new sediment features in HEC-RAS and demonstrate how to use them, including:

Gibson, S., Osorio, A., Creech, C., Amorim, R., Dircksen, M., Dahl, T., Koohafkan, M. (2019) Two pool-to-pool spacing periods on large sand-bed rivers: Mega-pools on the Madeira and Mississippi, Geomorphology, 328, 196-210.

Gibson, S., B. Comport, and Z. Corum. (2017) "Calibrating a Sediment Transport Model through a Gravel-Sand Transition: Avoiding Equifinality Errors in HEC-RAS Models of the Puyallup and White Rivers," Proceedings, ASCE EWRI World Environmental & Water Resource Congress.

Gibson, S., A. Sánchez, S. Piper, and G. Brunner, (2017) "New One-Dimensional Sediment Features in HEC-RAS 5.0 and 5.1," Proceedings, ASCE EWRI World Environmental & Water Resource Congress.

Creech, C., Castañon, A., Amorim, R., and Gibson, S. (2018) "Sediment Transport Model of the Madeira River Using HEC-RAS for Waterway Design,"*Hydrossedimenology in the Nexus Context for a Sustaiable Society*, XIII Brazilian Meeting of Sediment Engineiring: Particles in the Americas, Brazil.

Gibson, S. and Cai, C. (2017) "Flow Dependence of Suspended Sediment Gradations," *Water Resources Research,* 53(11), 9546-9563, doi.org/10.1002/2016WR020135

Dahl, T., Gibson, S., Heath, R., Nygaard, C. (2018) *HEC-RAS Unsteady Flow and Sediment Model of the Mississippi River: Tarbert Landing to the Gulf*, Mississippi River Geomorphology and Potomology Technical Report.

Gibson, S. and Crain, J. (2018 – Draft in Review) Modeling Sediment Concentrations During a Drawdown Reservoir Flush: Simulating the Fall Creek Operations with HEC-RAS, Regional Sediment Management Tech Note, 10p.

Gibson, S. and Boyd, P. (2016) "Monitoring, Measuring, and Modeling a Reservoir Flush on the Niobrara River in the Sandhills of Nebraska," Proceedings, River Flow 2016, ed Constantinescu *et al*., 1448-1455.

Gibson, S. and Nelson, A. (2016) "Modeling Differential Lateral Bed Change with a Simple Veneer Method in a One-Dimensional Sediment Transport Model," Proceedings, River Flow 2016.

Gibson, S. and Pridal, D. (2015) "Negotiating Hydraulic Uncertainty in Long Term Reservoir Sediment Models:Simulating Argandab Reservoir Deposition with HEC-RAS," Federal Interagency Sediment Conference, SedHyd Proceedings.

Gibson, S., Simon, A., Langendoen, E., Bankhead, N., and Shelley, J. (2015) "A Physically-Based Channel-Modeling Framework Integrating HEC-RAS Sediment Transport Capabilities and the USDA-ARS Bank-Stability and Toe-Erosion Model (BSTEM)," Federal Interagency Sediment Conference, SedHyd Proceedings.

Shelley, J. and Gibson, S. (2015) "Modeling Bed Degradation of a Large, Sand-Bed River with In-Channel Mining with HEC-RAS," Federal Interagency Sediment Conference, SedHyd Proceedings.
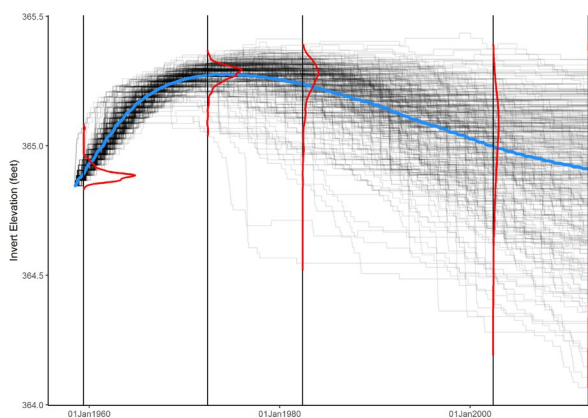
HEC-RAS bed elevation results from five hundred different 50-year hydrologic futures (from HEC-WAT)
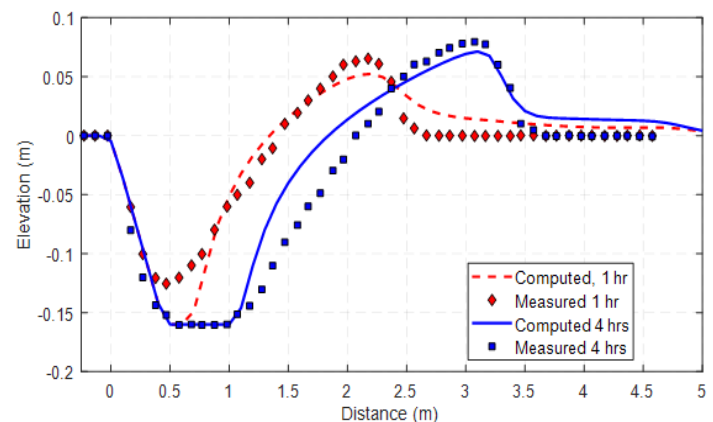
2D Sediment Jet Scour Model Validation