



Modeling Updates

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2 April 2007 Technical Work Group Meeting

U.S. Department of the Interior
U.S. Geological Survey

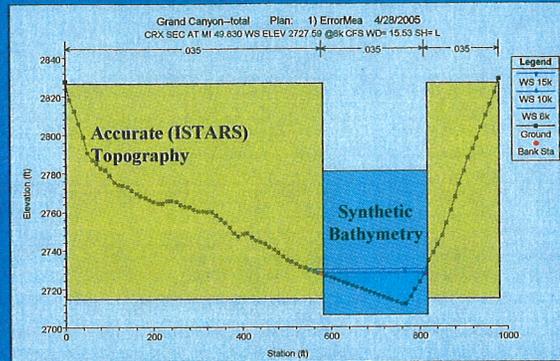
Outline

- Update on HEC-RAS model (developer: Chris Magirl, USGS Tucson AZ)
- Update on sand routing model (developers: Steve Wiele, USGS Tucson, Peter Wilcock, JHU, and Paul Grams, USU)
- Summary of outcomes from modeling review meeting held Feb 15-16, Santa Cruz CA



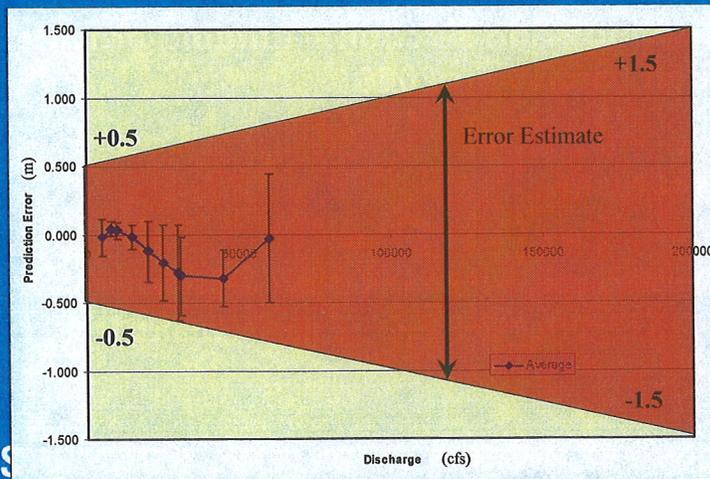
HEC-RAS Model

Bathymetry is estimated, used to calibrate



HEC-RAS Model

Modeled WSE predictions compared to 18 NAU monitoring site locations; measured water profiles up to 60k cfs (Joe Hazel)



HEC-RAS Summary

- New 1-D hydraulic model (with GUI) to replace STARS
- Uses 2002 DEMs with modern water-surface profile
- Predict water-surface elevations and virtual shorelines in Grand Canyon for any flow up to 200k
- Error of new model ranges from ± 0.5 m to ± 1.5 m
- Report documentation expected this fiscal year



Sand Routing Model

- Project initiated in 2002 through competitive solicitation and selection – funding provided through fiscal year 2006
- Project team:
 - Steve Wiele – USGS Tucson
 - Peter Wilcock – Johns Hopkins University
 - Jack Schmidt and Paul Grams – Utah State University



Sand Routing Model

■ Approach

- Reach-averaged one-dimensional description of the main channel
- Sand exchange with eddies through “look-up” functions based on 2D model runs
- Additional main channel storage through inclusion of pools – determined from longitudinal profile
- New formulation for sand entrainment over a coarse immobile bed (Grams Ph.D. dissertation)



Sand Routing Model

Final report:

Wiele, S. M., P. R. Wilcock, and P. E. Grams (2007), Reach-averaged sediment routing model of a canyon river, *Water Resour. Res.*, 43, W02425, doi:10.1029/2005WR004824.

- The paper contains a description of the model formulation and application of the model for July 2004 – March 2005
- The results can be considered a mixed bag: good agreement with observations for some things, not so good for others
- Model was not calibrated, i.e. no tuning of model parameters was attempted to improve model performance (some work has occurred on this front since publication of this paper)



Sand Routing Model

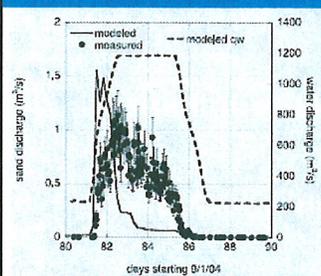


Figure 16. Model-predicted and measured sand discharge during the November 2004 experimental release at river mile 30. Error bars represent an estimated 20% error in the measurements.

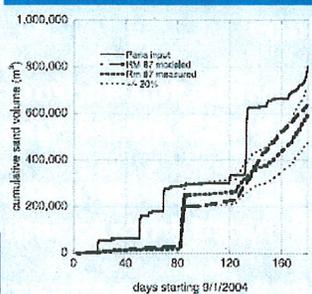


Figure 28. Model-predicted and measured cumulative sand volume at river mile 87 between 1 September 2004 and 1 March 2005. Error bounds represent an estimated 20% error in the measurements.

Not so good

Good

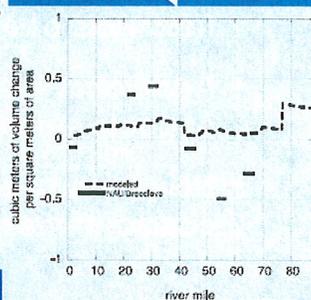


Figure 29. Model-predicted and measured change in total eddy sand volume. Both model and measurements show small changes in sand deposit thickness compared to changes that occurred during the 1996 high flow.



Modeling Review Meeting

- Recommended by the Sediment PEP (Wohl et al., 2006, p. 8):** "There was insufficient time to get into the detailed problems associated with the current model during the PEP, but the panel remains concerned about the condition of the model. The panel recommends that the current one-dimensional Colorado River model be critically reviewed by a small group that will be tasked with making recommendations to guide further development or re-development of the model"
- Review meeting Feb 15-16, 2007 in Santa Cruz CA.** Focused primarily on Wiele et al. model but also covered other sediment transport modeling activities (e.g. coarse sediment). Final report will be available next month.



Modeling Review Meeting

Panel findings related to sand routing model:

- Present version of the model is a “proof of concept” for the approach
- Because of the simplified approach, the model in its current formulation will not have predictive capability beyond the range of calibration (the WRR paper presented no calibration)
- Future efforts should be directed toward evaluating and improving the model



Modeling Review Meeting

Panel recommendations for future efforts:

- Calibrate and test the existing model to determine its immediate applicability to situations of interest – evaluate model uncertainty
- Gradually improve the formulation, starting with refining the reach-averaged discretization
- Evaluate the algorithms for pool and eddy storage using available data and multi-dimensional models. Evaluate available multi-dimensional models for this purpose.
- Collect additional field data and/or conduct laboratory experiments to improve understanding and models of channel-eddy exchange processes



Modeling Review Meeting

Summary

- The modeling program needs better integration internally and with the data program (major emphasis of PEP) – need a flexible framework capable of incorporating future needs
- Sand routing model is a step forward but more work is necessary to evaluate its predictive capabilities – program should continue to improve upon the model in the future
- More effort is needed to understand the complex hydrodynamic and sediment transport processes in and around eddies – modeling and field/laboratory data

