GCMRC Updates:

Water Quality and Sediment,

2008 High Flow Experiment, and

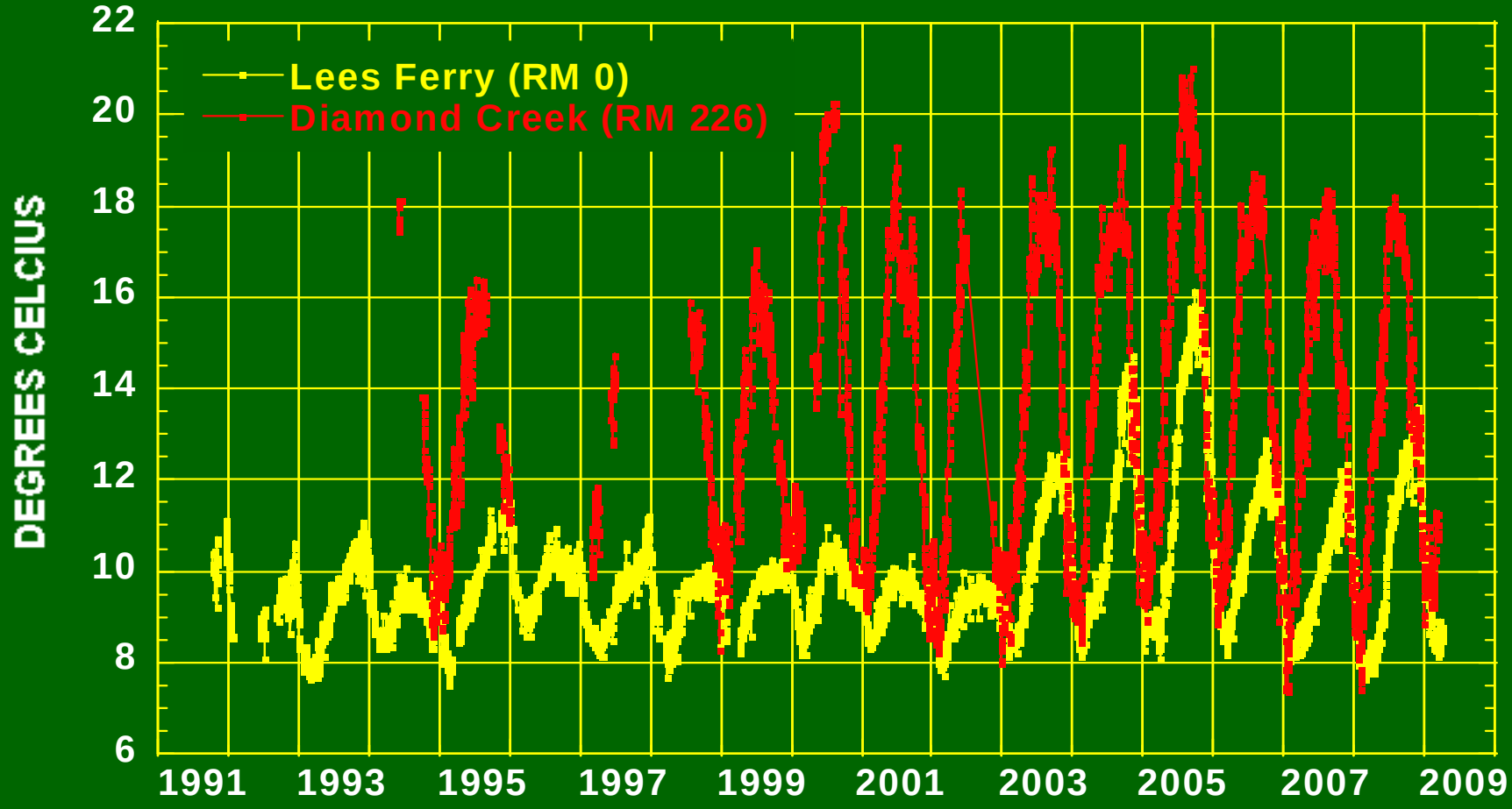
Integrated Flow, Temperature, and Sediment Modeling

April 29, 2009

GCDAMP AMWG Meeting, Phoenix

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

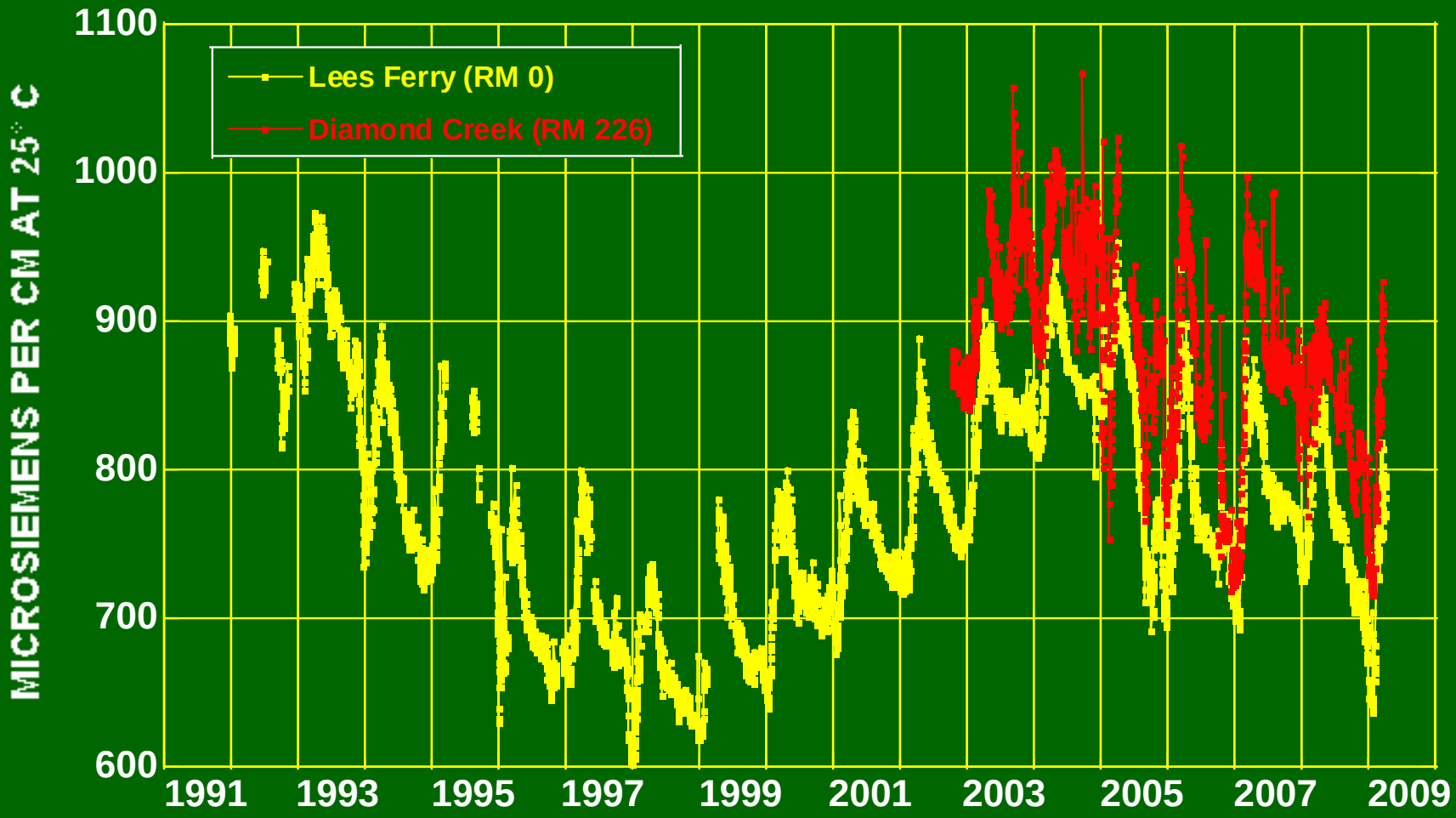
Water Quality Update:
Colorado River mainstem temperature: 1991-2009



USGS

Preliminary results – subject to review and revision

Water Quality Update:
Specific conductivity (salinity): 1991-2009



USGS

Preliminary results – subject to review and revision

2008 High Flow Experiment Update

- All projects progressing on schedule
  - Preliminary reporting ongoing
  - Final reporting on individual projects by December 2009
  - Synthesis of 2008 HFE with past high flows scheduled for 2010

USGS

HFE Project 1A. – Sediment Inputs, Main Channel Transport, and Sediment Mass Balance

- All but 10 samples (of thousands) from mainstem sites have been processed
- Have now reached the point of calculating fluxes and the mass balance
  - Grand Canyon gage
  - Rest will follow soon
- Available on-line
- More details to be presented

at June TWG meeting

USGS

http://www.gcmrc.gov/products/other_data/gcmrc.aspx

Sand inputs since 2008 HFE have been minimal

- Paria River supplied between 250,000 and 370,000 metric tons of sand

- Little Colorado River supplied between 260,000 and 490,000 metric tons of sand

Furthermore, sand export exceeded sand input during this period…

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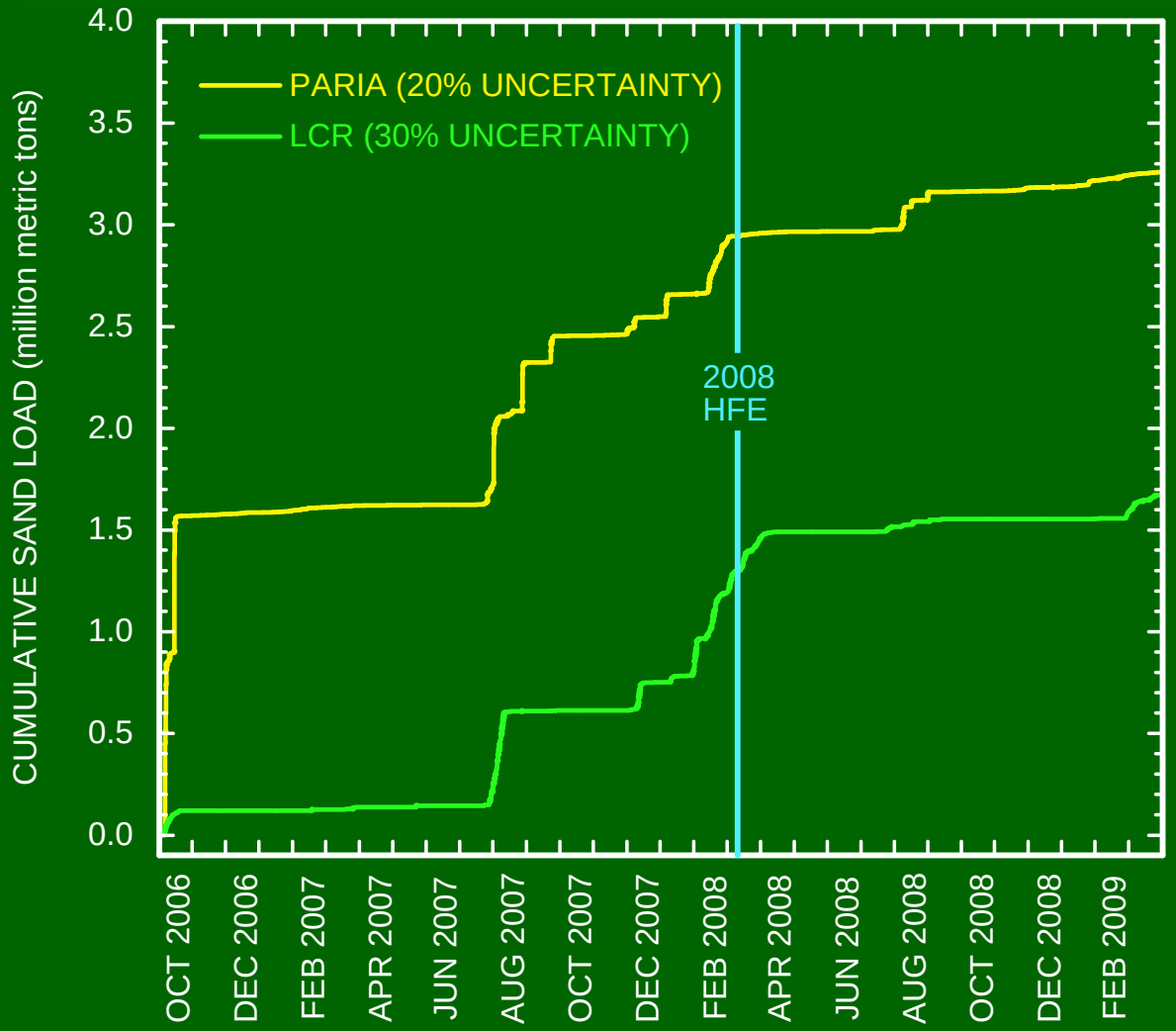
Preliminary results – subject to review and revision

Tributary Sand Inputs Between Lees Ferry and Grand Canyon Gages During Past 30 Months



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Preliminary results – subject to review and revision

Preliminary HFE Sand Transport Results

- Sand mass-balance upstream from the Grand Canyon gage was still positive on recession of 2008 HFE (relative to October 1, 2006)
  - At least 280,000 metric tons of the sand supplied since October 1, 2006, was retained upstream from the Grand Canyon gage
  - Most of this retained sand was likely stored in the sandbars deposited during the 2008 HFE

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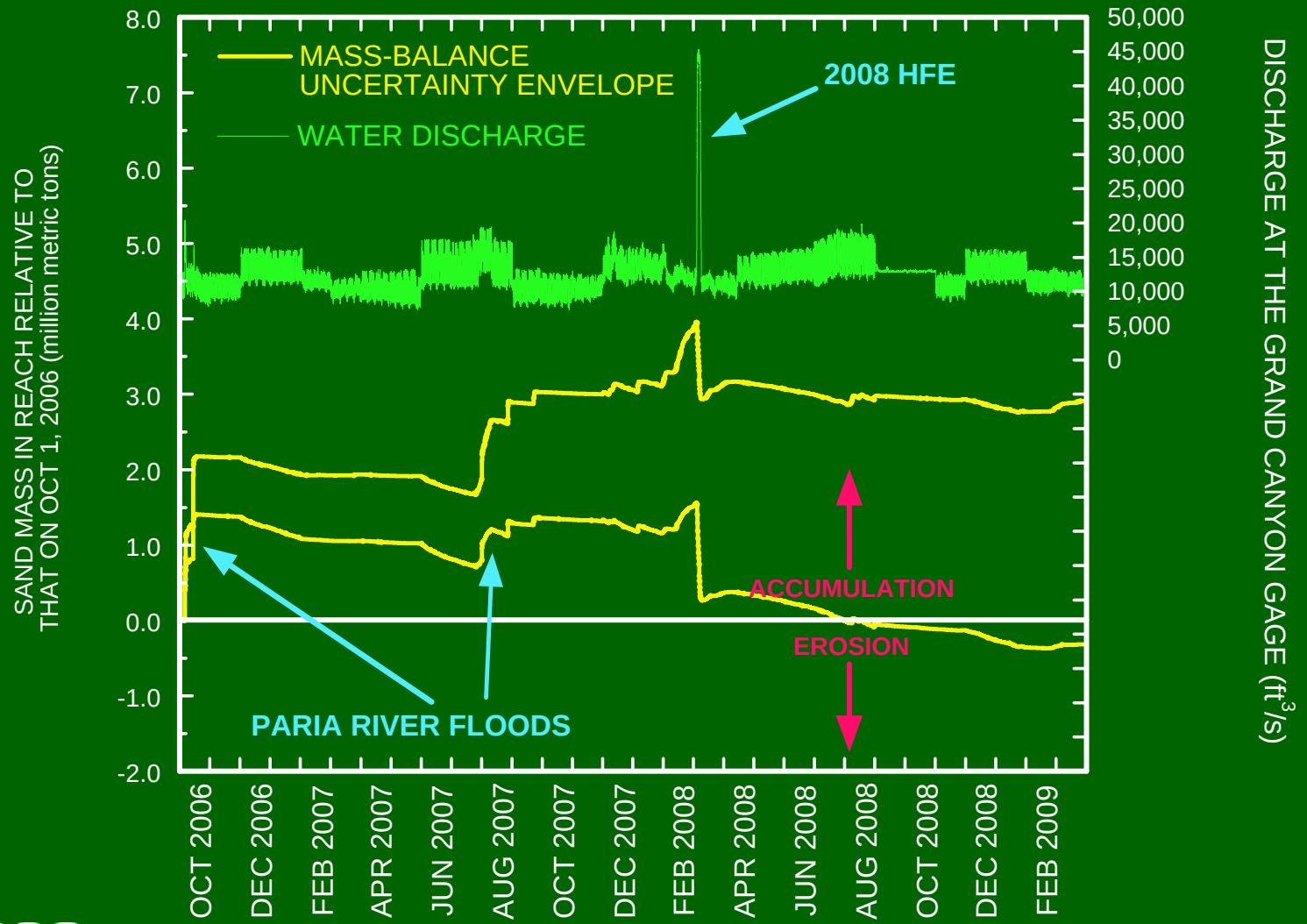
Preliminary results – subject to review and revision

Mass Balance Sand Budget Between the Lees Ferry and Grand Canyon Gages, Oct. 2006 – Mar. 2009



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Preliminary results – subject to review and revision

Preliminary Observations on Suspended Sand Transport During the 2008 HFE

- Sand concentrations during the 2008 HFE were…
  - much higher than during the 1996 controlled-flood experiment at all measurement locations
  - much higher than during the 2004 controlled-flood at two locations (61-mile to 225-mile)
  - as high as the 2004 controlled-flood at one location (30-mile)

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Preliminary results – subject to review and revision

Negative sand mass-balance following 2008 HFE

- Export past the Grand Canyon gage exceeded tributary supply by at least 25,000 metric tons and as much as 590,000 metric tons
- Erosion of sand from this reach occurred during all operations, including the 12,000 cfs steady flows released from the dam during September-October 2008

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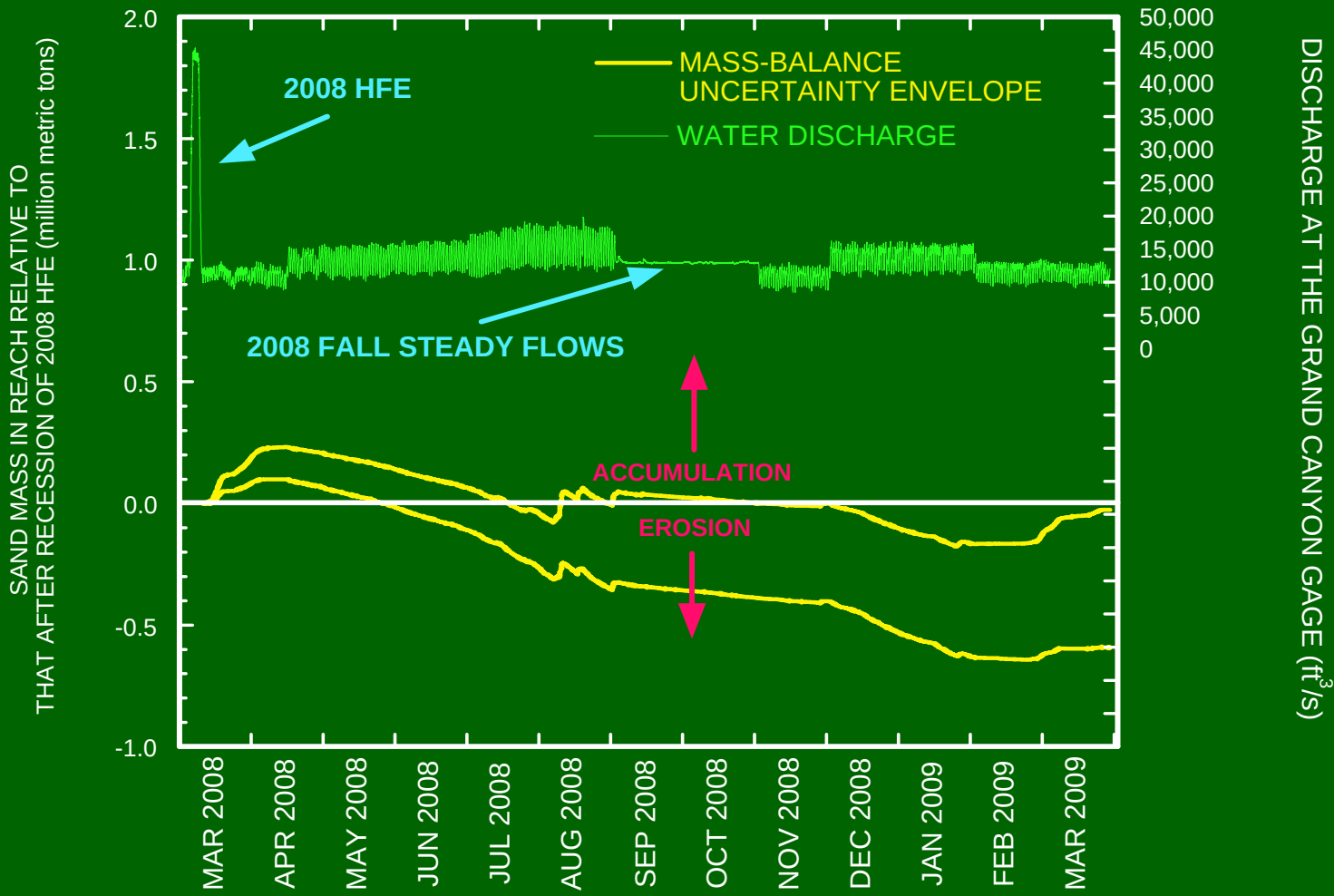
Preliminary results – subject to review and revision

Mass Balance Sand Budget Between the Lees Ferry and Grand Canyon Gages, Mar. 2008 – Mar. 2009



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Preliminary results – subject to review and revision

HFE Project 1B. – Detailed measurements for modeling studies

- Data are all processed
- Flow velocity and sediment data being used in calibrating and testing 3d model.
- On schedule for draft report by July and final report by December, 2009

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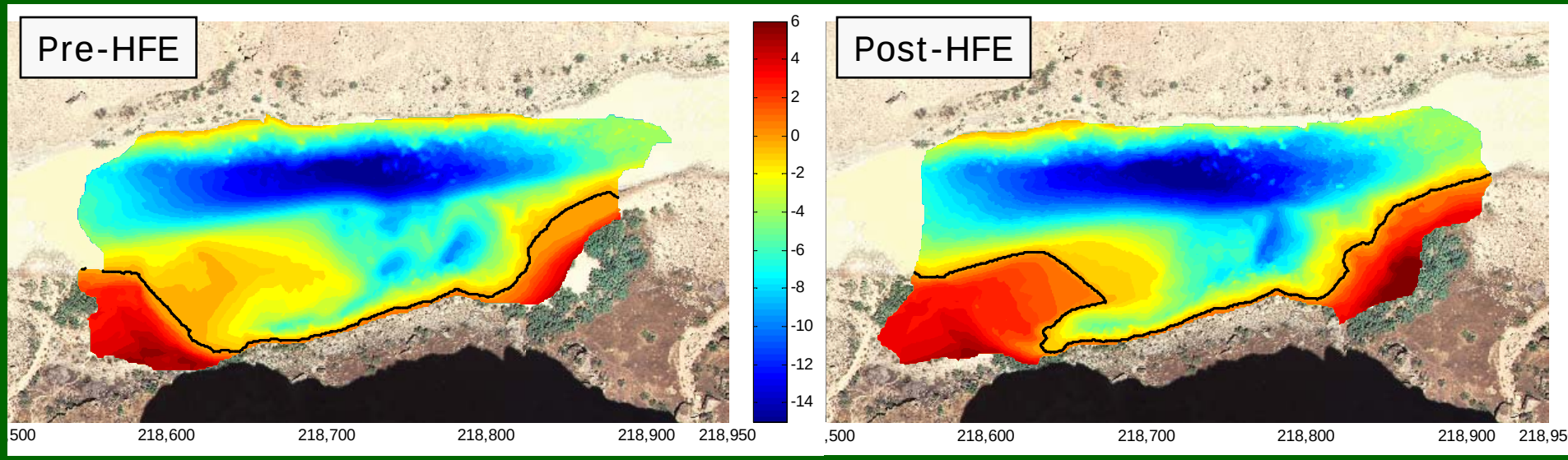
Cooperators: Scott Wright (USGS CA), Northern Arizona University, Arizona State University

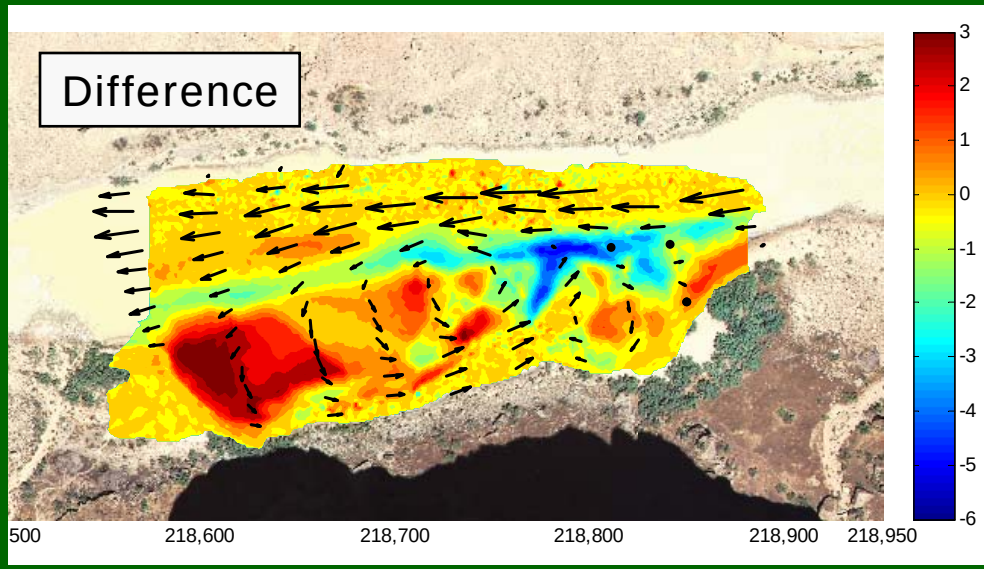
Willie Taylor eddy (RM 45.3)



Primary deposition on the reattachment bar

Erosion in the return current channel and along eddy "fence"

Overall net deposition



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Preliminary results – subject to review and revision

HFE Project 1C. – Monitoring of sandbars, campsites, and Aeolian transport

- **Ground surveys and bathymetric data processed for X sites**
- **On schedule for draft report by September and final report by December, 2009**
- **Results from study on Aeolian transport near archeology sites were reported at the 2008 Science Symposium and will be published in the proceedings volume**

Cooperators: Northern Arizona University, Utah State University, USGS Coastal and Marine Geology

USGS

19 Mile Wash RM 19.41L: 1985-2008 comparison

1985 (~4,100 ft^3/s)

2008 (~7,700 ft^3/s)

USGS

http://www.gcmrc.gov/research/high_flow/2008/science.aspx

Preliminary results – subject to review and revision

HFE Project 1D. – Evaluating the effect of the HFE on sandbar-created backwaters

- All data processed
- Final trip to establish survey control was just completed
- On schedule for draft report by September and final report by December, 2009

USGS

Cooperators: Shepard Wesnitzer Inc., Northern Arizona University, Utah State University

Progress on HFE Projects 2 - 4

Project:

2. Evaluating the effect of the HFE on native and non-native vegetation
3. Evaluating the effect of the HFE on the aquatic food web
4. Evaluating the effect of the HFE on Rainbow Trout Survival and Movement

- All data processed
- Partial results presented at 2008 Science Symposium
- On schedule for draft reports this fall and final reports by December, 2009

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Integrated Flow, Temperature, and Sediment Modeling Research

April 29, 2009

GCDAMP AMWG Meeting, Phoenix

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

Goals of the integrated modeling project

- Evaluate planned operations and “what if” scenarios for dam operations
- Provide input to ecological models

  - Develop and apply predictive models of
    - stage and discharge
    - mainstem and nearshore temperature dynamics
    - mainstem sediment transport
    - sandbar dynamics and stability

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Integrated Flow, Temperature and Sediment Modeling Research Program: 2009

- Workshop held in September, 2008
  - Modeling team received input from stakeholders and discussed the 2009 work plan
  - Comments were received on:
    - scenarios to be modeled
    - spatial scope
    - specific processes
  - Modeling team developed a proposal following the stakeholder input

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Four Flow & Sediment Modeling approaches to be developed during 2009-2010 project

Modeling approach	Time scale	Spatial scale	Primary questions addressed
1) Eddy scale models	Days to weeks	short reaches	How do eddy sandbars evolve? What is the "optimal" high flow hydrograph shape (peak and duration)? How is water temperature distributed along shorelines?
2) Bar stability models	Days	individual sandbars	How do various ramping rates affect the stability of sandbars?

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Four Modeling approaches to be developed during 2009-2010 project

Modeling approach	Time scale	Spatial scale	Primary questions addressed
3) Reach scale models	Months to years	Long reaches resolved at widely spaced (~0.1-1 km) cross-sections	How are tributary sediments transported through the mainstem? At what rate does downstream warming occur in the mainstem?
4) Decadal scale models	Years to decades	Long reaches resolved at the resolution of the monitoring sites	How do various dam operations compare with respect to the long-term sand budget? Addresses evaluation of the operations "scenarios" with respect to sand transport.

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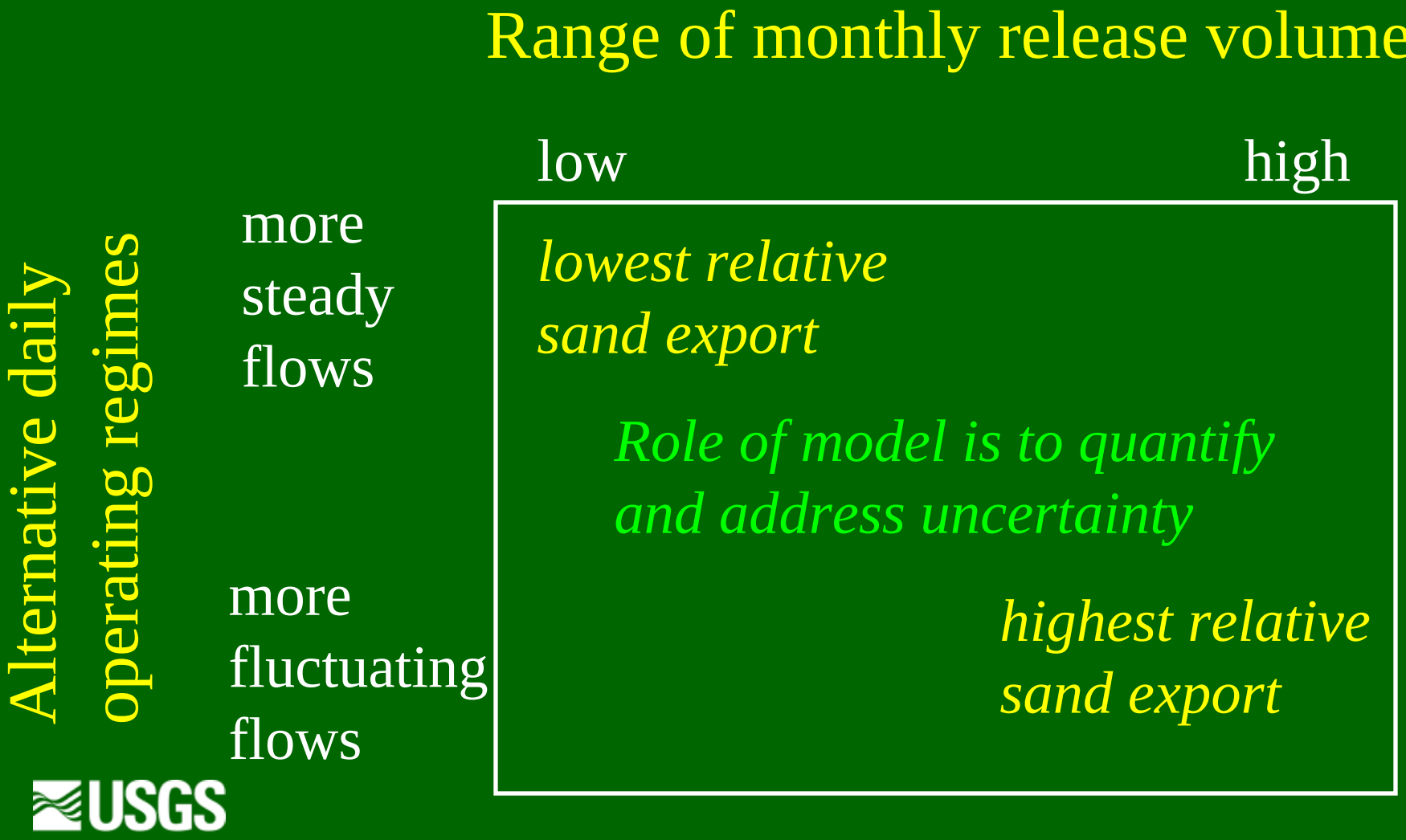
Generalized matrix of scenarios that may be evaluated with decadal scale sediment model



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Generalized matrix of scenarios that may be evaluated with decadal scale sediment model

Range of monthly release volumes

low

high

Alternative daily operating regimes

more steady flows

more fluctuating flows

Subject of "Is There Enough Sand?"

Need more sophisticated models to evaluate other flow regimes and make comparisons

USGS

Schedule for Integrated Modeling Program: 2009 – 2010

- Commence work in May or June, once proposal review process is complete
- Provide final proposal and opportunity for discussion and additional stakeholder input at summer TWG meeting
  - Are there additional scenarios of specific interest?
  - Types of downstream temperature simulations desired?
- Hold second workshop in Fall 2009 to discuss progress and preliminary results
  - Focus on reach-average routing model and scenario testing
- Hold third workshop in Summer or Fall 2010
  - Likely focus on eddy-scale models of near-shore flow, sediment, and temperature dynamics
  - Integration of sandbar dynamics and nearshore water temperature

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