Status of Sediment Resources – August 2016

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USGS Grand Canyon Monitoring and Research Center with cooperation from Northern Arizona University, Arizona Water Science Center, Grand Canyon National Park, and Grand Canyon River Guides

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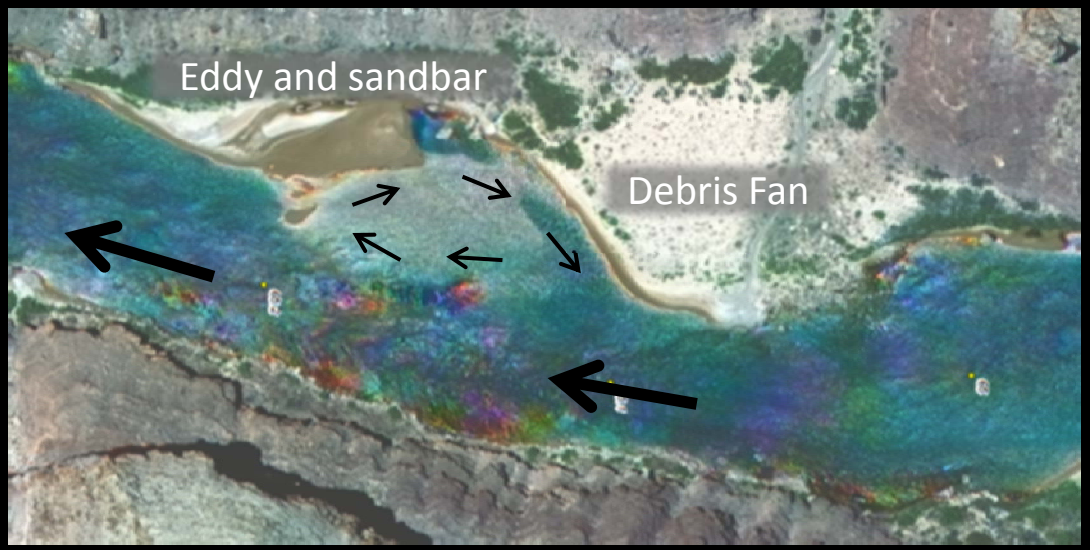
Eddy-deposited sandbars and High-flow Experiments

- During low flows, sand supplied by tributaries (like Paria River) accumulates on bed and in eddies
- High flows redistribute sand to build sandbars (beaches)
- Following high flows, sand erodes from beaches



Status of sandbars depends on sand supply (mostly from Paria River), redistribution of that sand downstream, and flows that build and erode the sandbars.

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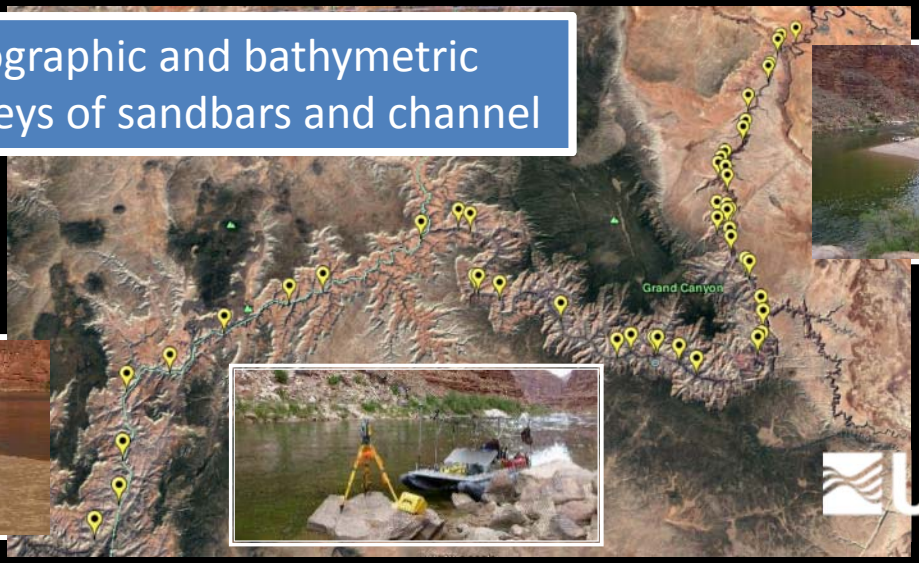
Sediment and Geomorphology Programs Overview

- Streamflow and sand flux (Project 2)

Measurements at gages to track sand inputs and movement downstream

- Sandbars, campsites, and sand storage (Project 3)

Topographic and bathymetric surveys of sandbars and channel



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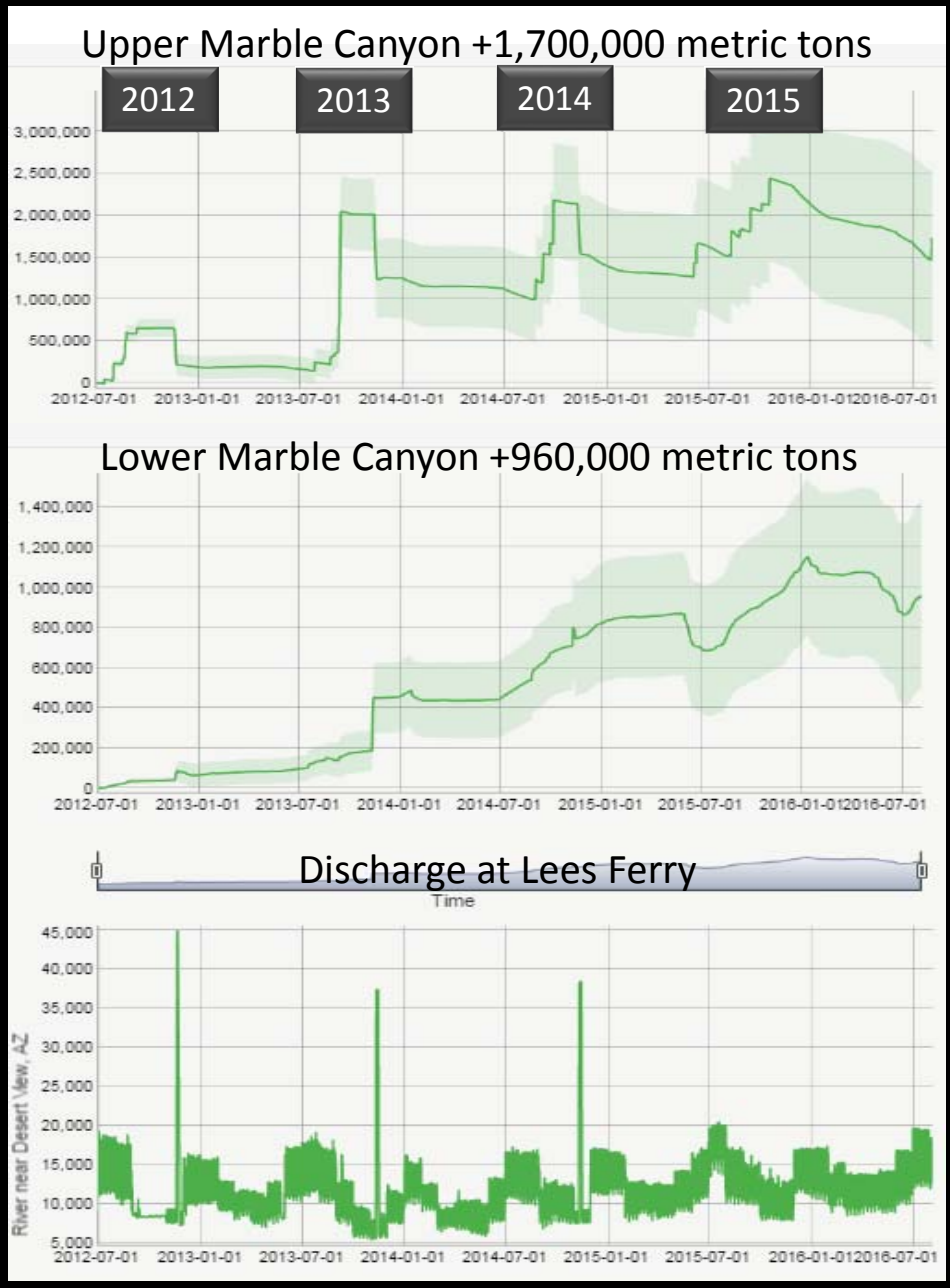
HFE Protocol:

- There were relatively large inputs of sand from the Paria River in each of the years of the HFE Protocol from 2012 to 2015

Sand budgets July 2012 to Aug 2015



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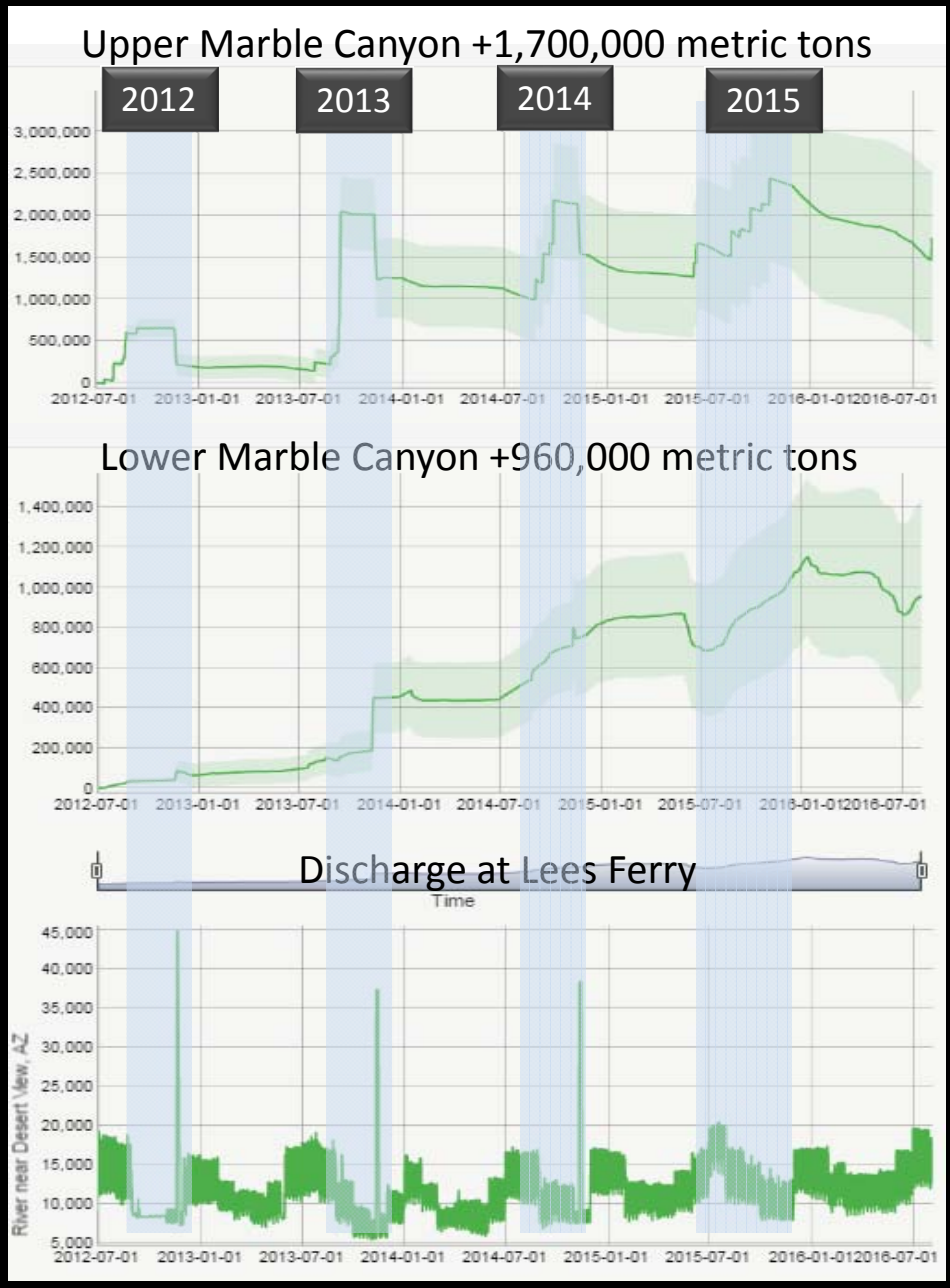
Preliminary data, do not cite

HFE Protocol:

- There were relatively large inputs of sand from the Paria River in each of the years of the HFE Protocol from 2012 to 2015
- The HFEs in 2012, 2013 and 2014 built sandbars AND sand accumulated in the channel

Sand budgets July 2012 to Aug 2015



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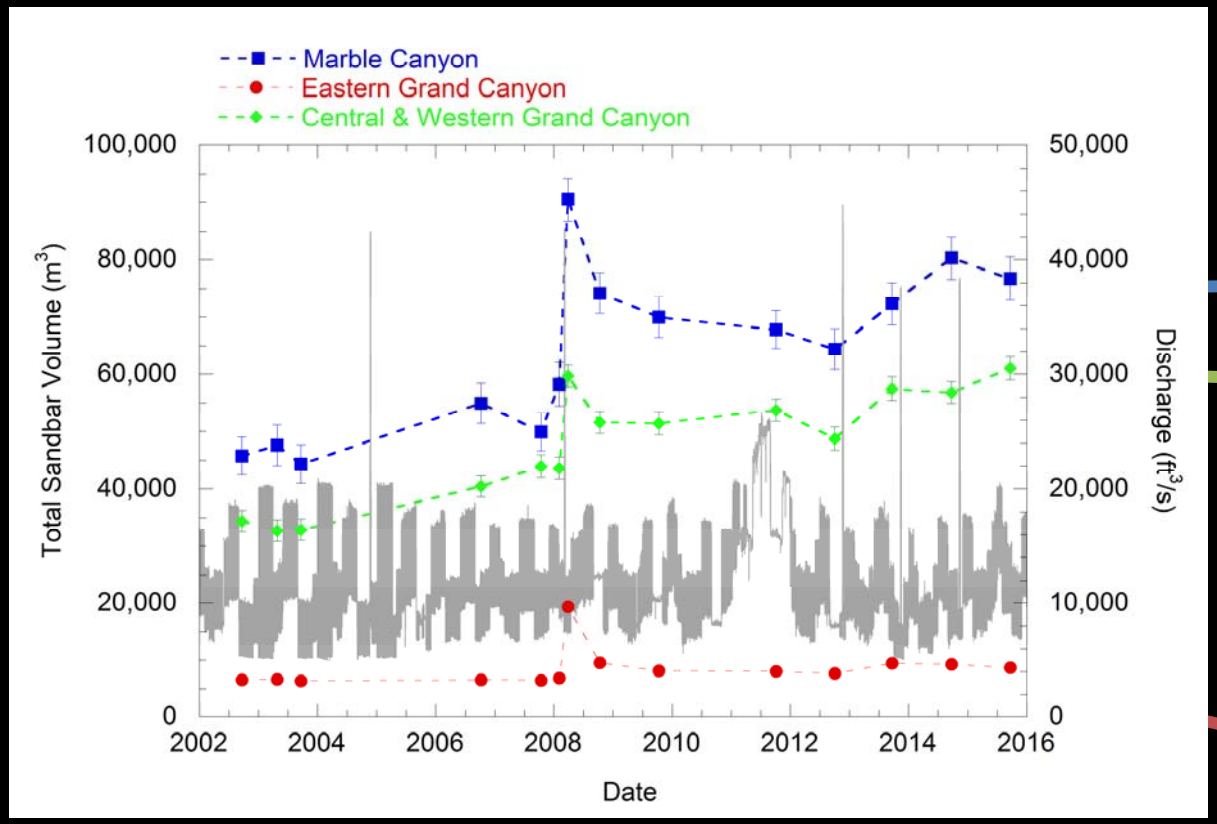
Sandbars: 2008-present



Marble Canyon: larger than 2012 and slightly larger than Oct. 2008

Grand Canyon (below RM 87): large relative to 2012 and Oct. 2008

Grand Canyon (RM60-87): same relative to 2012 and Oct. 2008

- 50 individual sandbars with data 2008-present
  - 25 in Marble Canyon
  - 7 in Grand Canyon (RM 60-87)
  - 18 in Grand Canyon (below RM 87)
- With October 2008 as reference (8-month post-HFE)
  - Increase in Marble Canyon and Grand Canyon (below RM 87)
  - No change in Grand Canyon (RM60-87)

Preliminary data, do not cite

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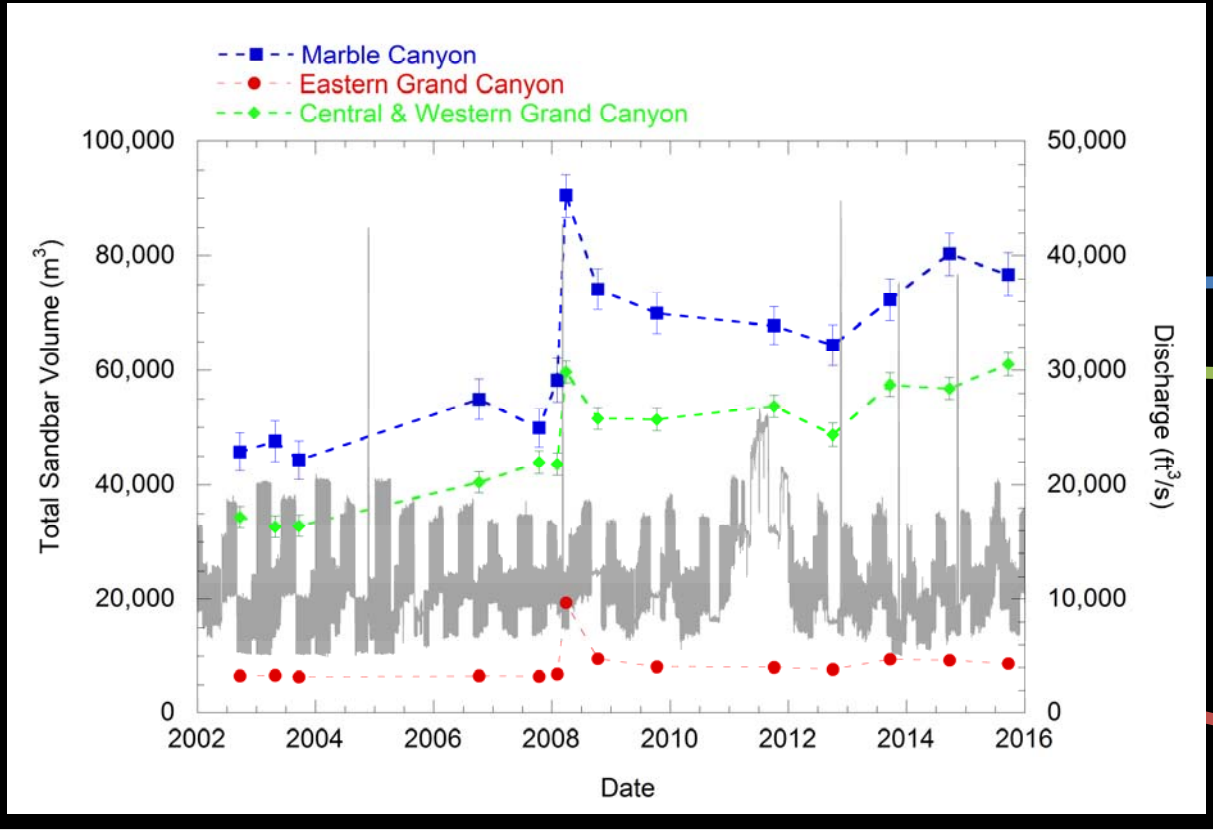
Sandbars: 2008-present



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Next Monitoring Trip Launches October 1

- Photos from remote cameras analyzed and available by late October.
- Data from surveys in January 2017.
- If fall 2016 HFE occurs, photos and analysis in January 2017.

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Mass-balance Sand Budgets since 2012

Period of budget	Upper Marble Canyon (RM 0-30)	Lower Marble Canyon (RM 30-61)	Eastern Grand Canyon (RM 61-87)	East Central Grand Canyon (RM 87-166)	West Central Grand Canyon (RM 166-225)
July 1, 2016 – Aug. 5 2016	57,000 ± 75,000	85,000 ± 24,500	-77,000 ± 30,500	Not yet available	Not yet available
July 1, 2012 – Aug. 5 2016*	1,700,000 ± 1,150,000	960,000 ± 455,000	-990,000 ± 725,000	2,400,000 ± 1,425,000	-440,000 ± 765,000

**To March 2, 2016 for East Central and West Central Grand Canyon*

What do these different amounts of accumulation/evacuation in different segments mean?

Preliminary data, do not cite

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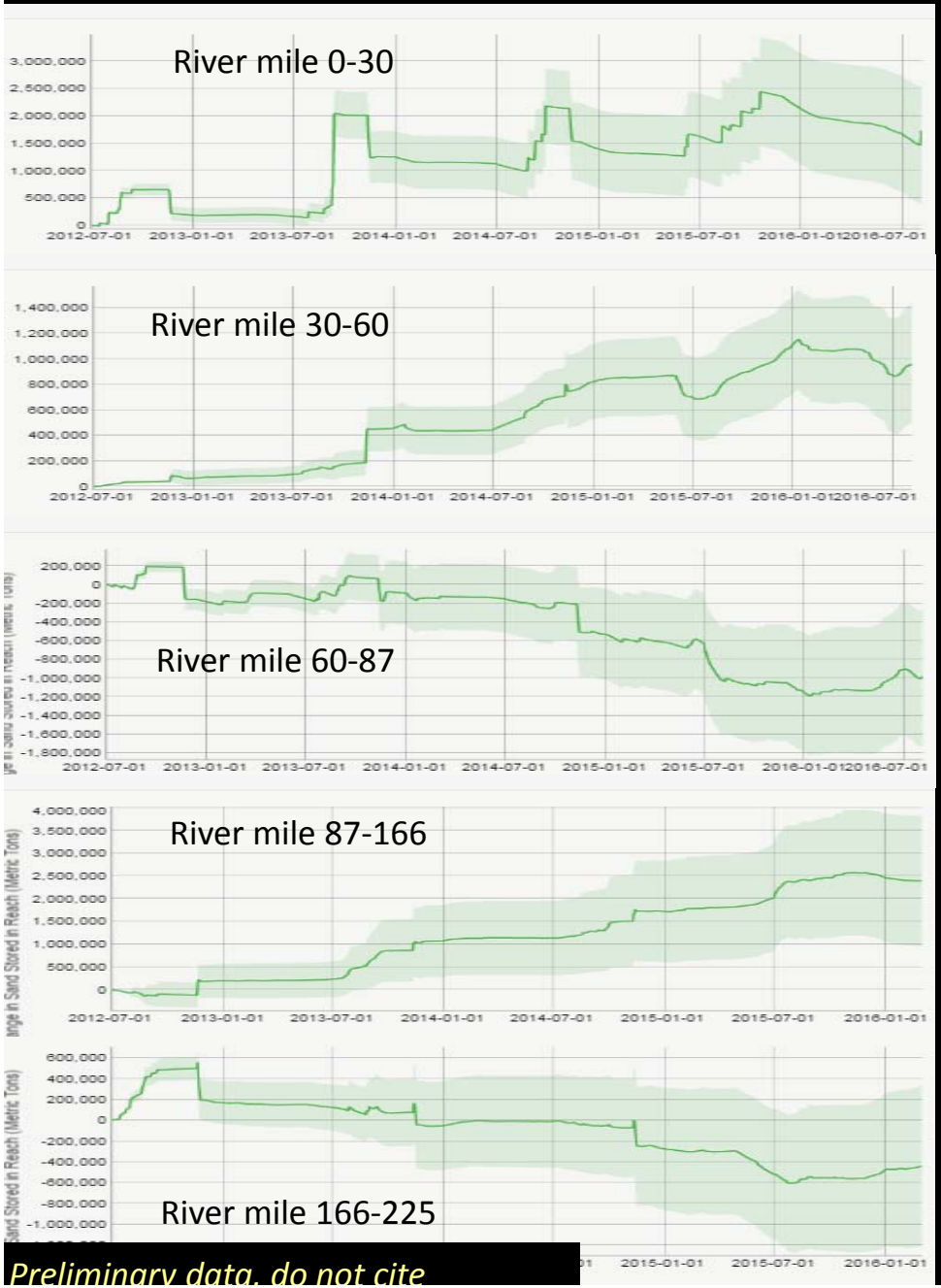
Patterns of Sand Distribution Since 2012



Preliminary data, do not cite

Upper Marble Canyon
- Accumulation following Paria floods
- HFE's push accumulation downstream.

Lower Marble Canyon
- No accumulation preceding HFEs
- Accumulation DURING HFEs

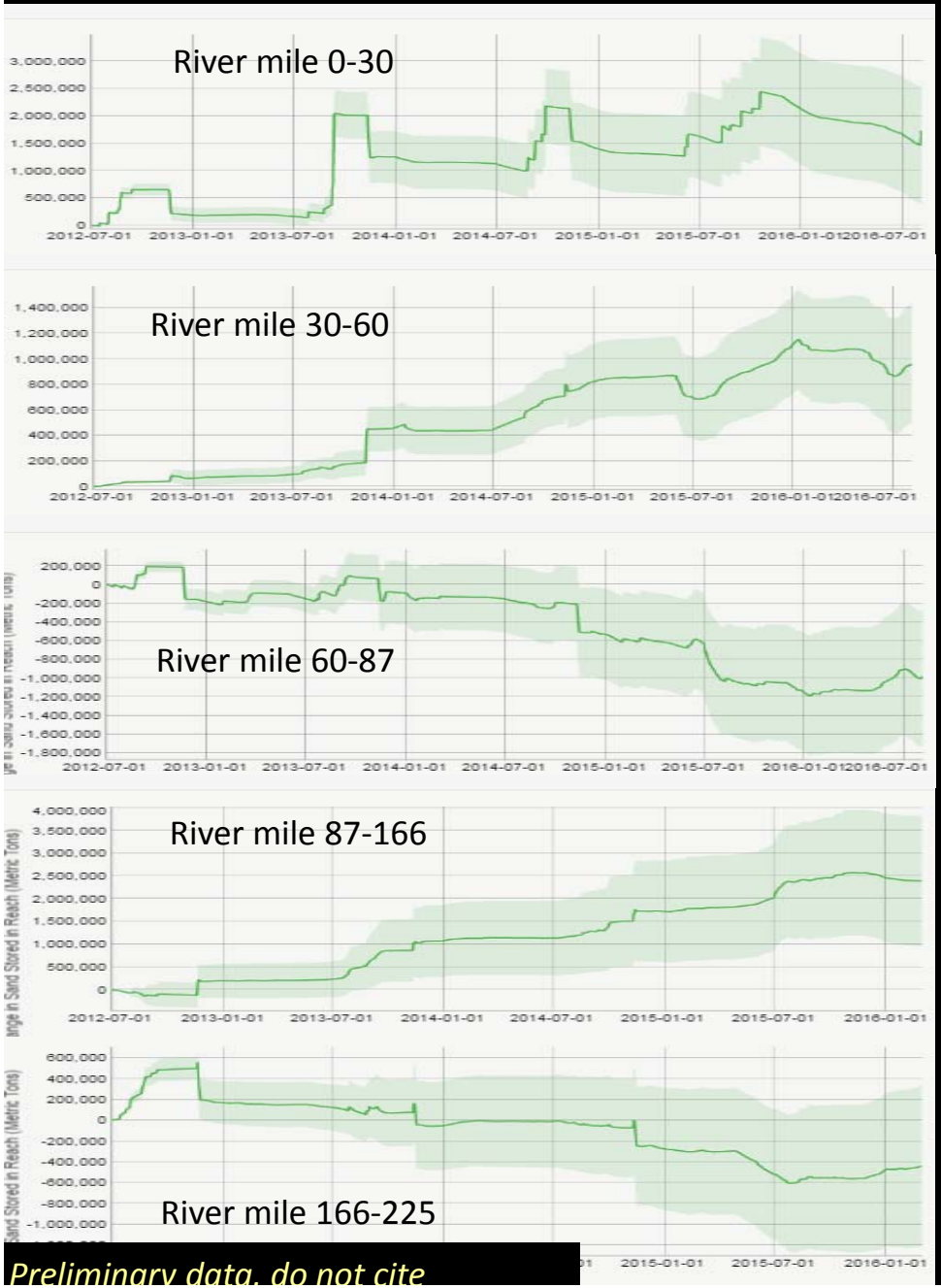
Eastern Grand Canyon
- Not much input from Little Colorado
- HFEs and high fluctuating flows move sand out.

East Central Grand Canyon
- No accumulation preceding HFEs
- But accumulation during HFEs

West Central Grand Canyon
- Not much accumulation preceding HFEs
- HFEs and high fluctuating flows move sand out.

USGS

Patterns of Sand Distribution Since 2012



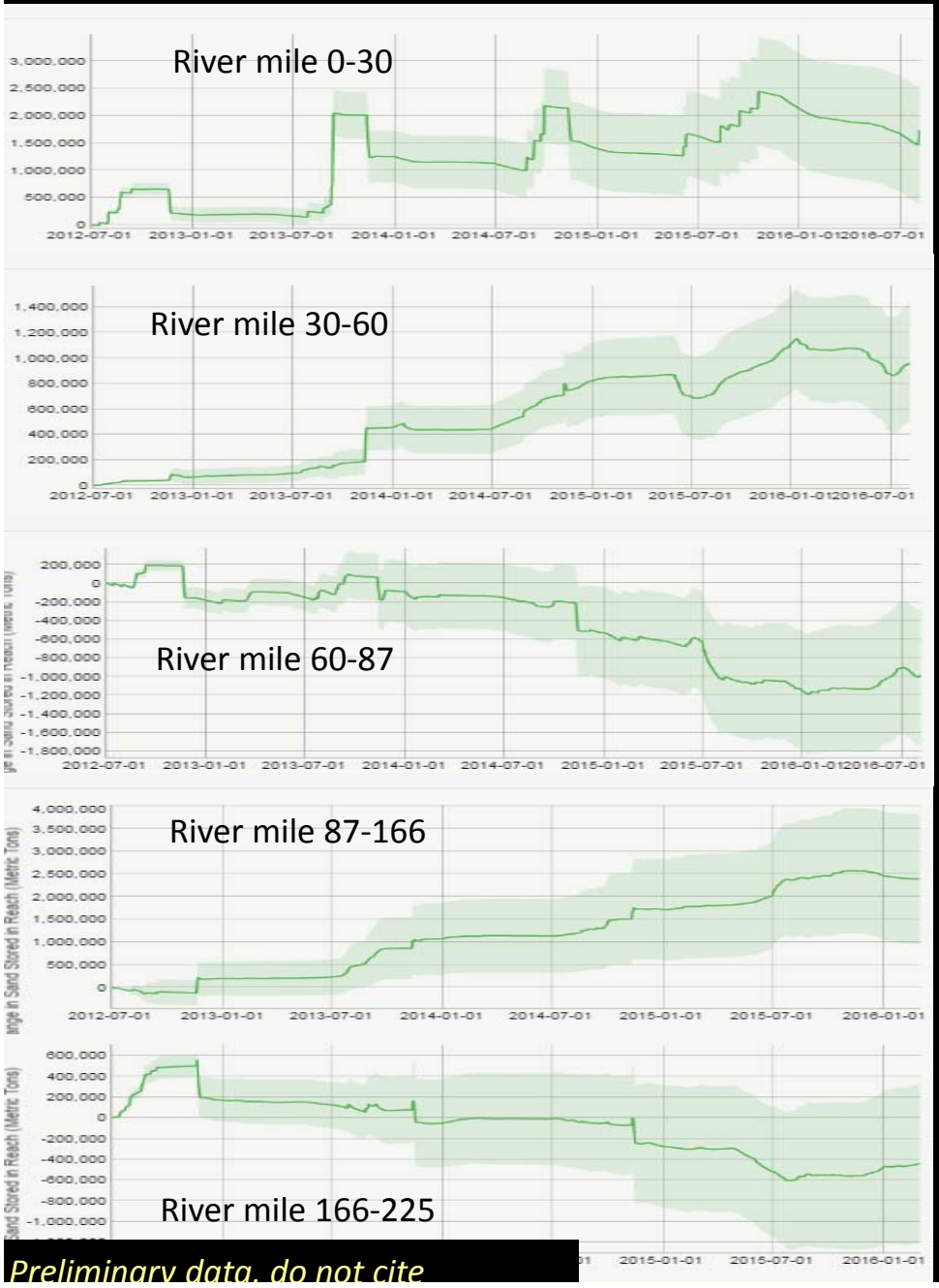
Preliminary data, do not cite

What do changes of these magnitudes mean?

- The changes (positive or negative) equal about 1 to a few years of Paria River sand inputs
- Based on our preliminary analysis of channel mapping data, changes occur in the eddies and channel next to eddies over a small (10 to 20%) of each segment.

USGS

Patterns of Sand Distribution Since 2012



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Possible Explanations for Different Response Among the Long Segments:

- Each segment is adjusting to combination of inputs and flow regime. (e.g. low inputs from Little Colorado River)
- Slow propagation through canyon of large slow-moving sediment “waves.”

USGS

Mass-balance Sand Budgets

Period of budget	Upper Marble Canyon (RM 0-30)	Lower Marble Canyon (RM 30-61)	Eastern Grand Canyon (RM 61-87)	East Central Grand Canyon (RM 87-166)	West Central Grand Canyon (RM 166-225)
Sand Budgets for Past 4 years:					
July 1, 2012 – Aug. 5 2016*	**1,700,000 ± 1,150,000**	**960,000 ± 455,000**	**-990,000 ± 725,000**	**2,400,000 ± 1,425,000**	**-440,000 ± 765,000**
Sand Budgets for Past 9 years:					
2007 – 2016	**420,000 ± 1,800,000**	**330,000 ± 970,000**	**-1,800,000 ± 1,773,000**	**650,000 ± 3,350,000**	**2,000,000 ± 1,936,000**

The uncertainty in sand budgets becomes larger than the signal for long time periods.

- Most of the 4-year budgets show significant changes.
- The 9-year budgets are all inconclusive.

Preliminary data, do not cite

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