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CESU Final Report Summary for A Water and Sediment Budget for the Lower Mississippi-Atchafalaya River in Flood Years 2008-2010: Implications for Sediment Discharge to the Oceans and Coastal Restoration in Louisiana
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Purpose: The challenges of studying the Mississippi River are due to its complex sediment-water dynamics and the multiple (and often competing) uses of its resources. Flood control and navigation are primary factors that control how the river is managed. A third factor is the use of the river resources, namely water and sediment, for nourishing the degrading coastal wetlands of the states of Louisiana and Mississippi. As such, these factors must be fully considered and coordinated while developing techniques to harness the sediment resources of the River for coastal restoration. This study utilizes data from USGS/USACE monitoring stations and site specific studies to develop a detailed suspended sediment budget for the lowermost Mississippi and Atchafalaya River systems for the flood years of 2008, 2009, and 2010.
Location: Lower Mississippi River - Mississippi-Atchafalaya LDE reach
Methods: Focused on creating water and sediment budgets only for flood years (FY) 2008-2010 to minimize this systemic source of variability (although some comparison with historic data is presented as well). A flood year begins on October 1st, as this is typically close to minimum water discharge in the Mississippi River. Hence, the study period extends from October 1, 2007 to September 30, 2010. Stations are divided into two types: USGS/USACE monitoring stations where a year or more of continuous data are available about water or suspended sediment discharge, and project studies, which were conducted to address a specific scientific or management issue, or which relate to a specific exit point (natural or man-made) from the river. The USGS strategy in the lowermost Mississippi is to collect samples 12-15 times/year across the entire flood year but with denser sampling during periods of peak discharge.
Results: The Mississippi River reach below Old River Control (ORC) is a highly efficient trap for sand. Approximately 47-67% of fine (<62.5 microns) sediment in suspension at ORC leaves the channel above Head of Passes. This is a result of the loss through channel exits mentioned above and by overbank flow into the batture at higher discharges. Approximately 30% of the fines and 49% of the sand in suspension in the upper Atchafalaya station at Simmesport, LA is trapped in the basin upriver of the exits into Atchafalaya Bay. The widening of the guide levees away from the channel in the lower Atchafalaya Basin allows for significant overbank sediment storage during floods. The division of suspended sediment at ORC differs from the 70:30 water split of Mississippi + Red River discharge due to the distinct Red River suspended sediment load. Sand is apportioned between the lower Mississippi and Atchafalaya pathways at an 83:17 ratio, and fines at a 60:40 ratio. Total (fines + sand) suspended sediment loads can increase by a

factor of four on timescales of a few days in the Baton Rouge to Head of Passes reach (and decrease at a similar rate) during rising discharge conditions. These —spikes in suspended load are caused by a sediment pulse in the early phase of overbank flooding in the reaches of the river above ORC (basin hysteresis), and the remobilization of fines stored for several months on the bed in low river discharge conditions below Baton Rouge. It is clear from the channel aggradation response to large water withdrawal observed at ORC and at the exits below Belle Chasse, as well as from the results of a recent study for the LCA Program of channel aggradation associated with the 2011 opening of the Bonnet Carre Spillway, that large (>1% of total water discharge) water diversions have a significant downstream impact on suspended sand transport capacity. Significant land-building is not taking place in the Barataria and Breton Sound basins downriver of Pt. a la Hache, LA in spite of receiving significant sediment from multiple exits (26% of the fines and 8% of the suspended sand available at ORC or 34% and 25% available at Belle Chasse). One possibility to explain this is that subsidence-induced relative sea level rise is offsetting this large sediment contribution. Water suspended sediment ratios of individual water exits downriver of Belle Chasse indicates that there is a progressive downstream reduction in the efficiency of these channels in passing sediment per unit water discharge. This is likely a response to the progressive loss of sand by channel bed aggradation, and to a reduction in hydraulic head in the tidal and estuarine reach. A comparison in this report of the impact of bedload processes for transporting sand suggests that the downstream variability in bedload rates and in exchange rates of sand between bed and water column creates a complex and interactive set of processes that hinders our ability to predict whether (and on what timescale) observed bed sequestration will have any effect on dredging rates required at Southwest Pass and other areas near Head of Passes.

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