Continental Shelf Research 147 (2017) 1–6

Contents lists available at ScienceDirect

Continental Shelf Research

journal homepage: www.elsevier.com/locate/csr

Editorial

Sediment- and hydro-dynamics of the Mekong Delta: From tidal river to continental shelf

ARTICLE INFO

Keywords:
Mekong River
Mekong Delta
Tidal river
Estuary
Sediment transport
Mangroves
Morphology
Sediment accumulation
Clinoform

ABSTRACT

This introduction to the special issue entitled, "Sediment- and hydro-dynamics of the Mekong Delta: from tidal river to continental shelf", describes the setting and program design of collaborative studies with integrated field and modeling experiments in 2014–2015, along with associated research in the region. The Mekong River is among the largest on Earth in terms of water discharge, and much of the sediment delivered from the Tibetan Plateau has accumulated in the subaerial and subaqueous components of the Mekong Delta. As a group, the papers in this special issue describe the portion of the system where the sediment source signal is altered along the tidally influenced river and is delivered to the shorelines and continental shelf. The linked studies provide a holistic view of the system, and emphasize the interactions between hydrodynamics and sediment transport processes in sub-environments as sediment makes its way along the path from source to sink.

1. Introduction

Large tropical deltas act as the repositories for much of the global sediment input to the ocean. Sedimentary processes form them and shape their surfaces, and thus control their resilience. These regions host unique physical processes as they lie between fluvial and marine environments, and this combination of drivers creates interactions and feedbacks that are a function of the relative magnitude of fluvial to marine forcing. The subaerial surfaces of deltas are some of the most productive and populated on the globe, and the subaqueous surfaces support a myriad of aquatic communities and resources. Understanding the sediment dynamics and hydrodynamics on these vast surfaces that lie near sea level is critical to our ability to predict, manage and conserve the resources and ecosystems existing there today and in the future.

This special issue, "Sediment- and hydro-dynamics of the Mekong Delta: from tidal river to continental shelf", contains research on these topics using the case study of the Mekong Delta (Fig. 1). Many of the papers presented herein are based on research as part of a multi-investigator project with integrated field experiments in 2014–2015 and coupled numerical modeling. This research effort, referred to as the Mekong Tropical Delta Study, is described below. Other papers supplement the results from this focused research project and add breadth to the special issue. In addition to the primary research papers presented here, synthesizing articles can be found in an *Oceanography* issue (see Nittrouer et al., 2017, for an introduction to the volume).

1.1. The Mekong Tropical Delta Study 2014–2015

Rivers are the largest suppliers of particulate material to the world ocean, and at present, they are estimated to deliver ~13 GT/y of sediment globally (Syvitski and Kettner, 2011). In general, discharge values are determined from gauging stations that are upstream of tidal influence. For the major rivers of the world, the freshwater tidal reach can extend for hundreds of kilometers above the coastal ocean, and this unidirectional source signal is often assumed to be directly transferable as the input to the oceanic sink. Yet the signal is transferred through zones of complex hydro- and sediment-dynamics, i.e., the tidal river, the zone of estuarine processes, the river mouth/shoreline system, and the inner shelf. Falling between the realms of fluvial and oceanic research, the hydrodynamic and sedimentary processes within this continuum are poorly understood. Investigating the processes, their impacts on mass budgets, and the most appropriate means to model and remotely observe them requires integrated research programs and interactions among researchers of broad backgrounds. This collection of studies on the Mekong Delta provides a unique opportunity to focus our efforts on linkages between processes that are active in discrete sub-environments of the tidal river and estuary, shoreline, and inner continental shelf, and to evaluate the terrestrial to marine gateway as a continuum. This gateway within the overall source-to-sink system exerts strong controls on the magnitude and timing of sediment as it transits between the catchment and the oceans.

The Mekong Tropical Delta Study in 2014–2015 brought together researchers from the United States, Vietnam, New Zealand, and the Netherlands to work on different aspects of the Mekong sediment dispersal system. The focus region was on: the Sông Hậu distributary of the Mekong River, which carries the largest component of the freshwater discharge (~40% of the total; Nguyen et al., 2008); the mangrove forests at the

http://dx.doi.org/10.1016/j.csr.2017.08.022

Available online 11 September 2017

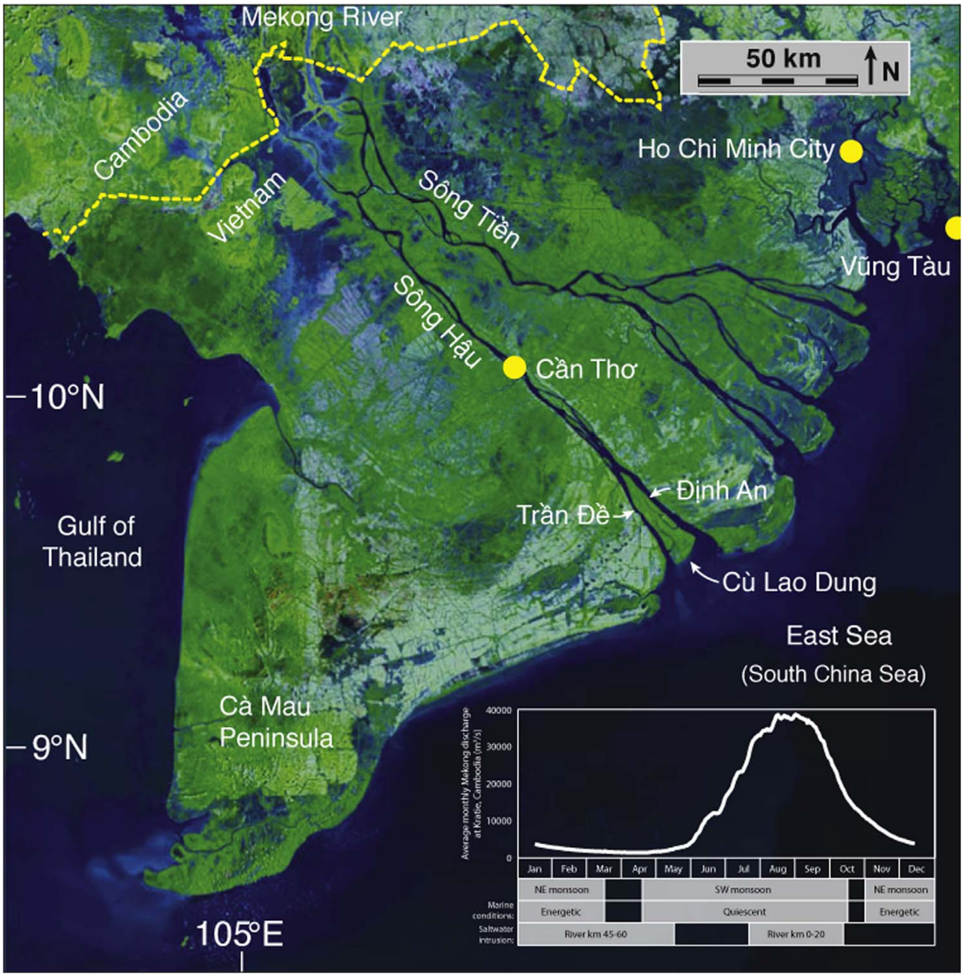

Fig. 1. Mekong Delta and its distributary channels. The Sông Hậu distributary channel was the focus of tidal river and estuarine studies. The mangrove fringe at the seaward end of the Cù Lao Dung was the focus of shoreline studies on tidal flats colonized by mangroves. Seaward of the channel and shoreline focus sites lies the subaqueous delta, at which sediment from the river mouths has formed an alongshelf clinoform seaward of the channels and extending southward along the Cà Mau Peninsula. Mekong River discharge varies seasonally with peak discharge during the SW monsoon season (inset). At this time, only a slight penetration of saline water into the distributaries occurs, and offshore waves are generally quiescent. During the NE monsoon, saline water penetrates into the distributaries ~ 45–60 km, and winds and waves offshore are more energetic.

shoreline of the river-mouth island, Cù Lao Dung; and the inner shelf extending along the Cà Mau Peninsula (Fig. 1). The underlying objectives of the overall study were to:

1. *explore the controls on sediment delivery to the coastal ocean along the tidally influenced distributary channels*. The tidal Mekong River has been a largely understudied reach; however, the sedimentary dynamics there control the magnitude and routing of particles to the coastal ocean. Sediment takes mutually exclusive pathways on flood and ebb tides, which influence the deposition of sediment onto distributary islands, impacts the storage and release of sediment in both the mainstem and floodplain areas, alters the deposition and erosion of channel-bed sediments, and regulates export of sediment to the shorelines and continental shelf, thereby placing a control on its fate.
2. *evaluate the role of vegetation on currents, waves, and sedimentation within the intertidal shoreline*. Vegetation is present along the shoreline and mainstem Mekong tidal river (mangroves at the seaward tidal flat and other brackish-water vegetation along the river). The ultimate source of sediment to these vegetated environments is clearly the river, yet the pathway of sediment delivery is not direct. Asymmetric progradation of mangrove forests allows us to study the controlling source and delivery processes in one localized site, and to contrast processes to previous studies in unvegetated intertidal regions (e.g., Willapa Bay, WA; Nittrouer et al., 2013).
3. *link the tidal river and shoreline processes with the longer-term evolution of the delta*. Mekong River sediment discharged to the continental shelf is actively building a clinoform deposit seaward of the subaerial delta and along the Cà Mau Peninsula. The transport dynamics constrain the prograding feature near the shore and may also promote shoreline outbuilding or erosion. Controls within the tidal river and at the distributary mouths influence the signal propagation of sediment discharged to the shelf environment. Where subaqueous deltaic deposits are formed on the continental shelf, these controls should be detectable in the mechanisms and signatures of sediment flux and deposition. The Mekong delta fits in a category with other river deltas (e.g., Yangtze and Columbia Rivers) that have distinct seasonal differences in coastal processes. In these deltas, sediment is supplied during conditions when delivery and advection of sediment in the surface plume is not synchronous with energetic waves and alongshelf currents. The resulting seasonal alternation between surface-plume delivery and bottom-boundary-layer resuspension processes in the Mekong study area have allowed the formation of an alongshelf-oriented clinoform structure with a relatively shallow rollover depth.

Through collaborations among scientists with a broad range of expertise, the research contained in this issue provides a valuable contribution to the holistic view of material flux through linked sub-environments. It adds to our understanding of "source-to-sink" sediment dispersal in a tropical river-delta-coastal-shelf system. The research contained here provides a new view of how sediment fluxes (e.g., sizes, amounts) are linked in time and space. This knowledge enables better interpretation of remotely sensed signatures throughout this type of region, and the ability to formulate well-constrained numerical models that expand our understanding of the physical processes today, and allows us to project into future anthropogenically and climate-influenced scenarios.