我院硕士研究生在国际权威期刊《Coastal Engineering》发表高水平论文

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近日，我院硕士研究生曹煜（已毕业，全国首届高等学校水利类优秀研究生学位论文获得者）与其导师张蔚教授（通讯作者）在中信所一区，海岸工程类排名第一的国际学术期刊《Coastal Engineering》上发表高质量学术论文：“Impact of trends in river discharge and ocean tides on water level dynamics in the Pearl River Delta”。近年来，我院加大硕士研究生的培养力度，包括学院支持硕士研究生短期访学和国际交流，极大的促进了高水平成果的产出。

河口三角洲的研究以往多关注陆相水沙的改变对三角洲内动力过程的影响，而海相潮动力变化对三角洲内动力过程作用的认识还相对较少，尤其在径潮非线性的相互作用方面是比较欠缺，目前这方面也正是世界范围内的研究热点。该论文深入研究了径潮相互作用的演化过程对三角洲内水位分布的影响，并证明了高强度人类活动能让一个三角洲的属性发改变的趋势：河床的快速下切使得珠江三角洲正从一个涨潮占优型三角洲有往落潮占优型三角洲演变的趋势。研究成果为三角洲的防洪和通航等工程问题提供了科学支撑。

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Impact of trends in river discharge and ocean tides on water level dynamics in the Pearl River Delta

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ABSTRACT

The spectrum of tidal and subtidal water level variations in river deltas responds to river discharge variation, ocean tides, and human activities of many kinds. It remains a contemporary challenge to identify the main sources of changes in tidal dynamics in deltas, because of nonlinear interactions between tides and the river discharge in a changing setting. Understanding the main forcing factors controlling the evolution of mean water levels and the associated amplitudes and phases of tidal constituents can help to understand the causes of floods and the occurrence of low flows hindering navigation. Here, a nonstationary harmonic analysis tool (NS_TIDE) is applied to hydrological data from 14 stations in the Pearl River Delta (PRD) spanning the period 1961–2012. The water levels and main tidal constituent properties are decomposed into contributions of external forcing by river discharges and ocean tides, providing insight into the nonstationary tidal-fluvial processes. Significant temporal trends in mean water levels and tidal properties are observed in the PRD. Results indicate that there is spatial variability in the response of mean water levels and tidal properties to river discharge variation in the delta. The abrupt changes in bathymetry in the delta due to intensive sand excavation are likely responsible for the observed spatial variations in tidal response, which reduce the flood-dominant tidal asymmetry in this area.

1. Introduction

Deltas are the most densely populated areas of the world subject to fast economic development (Syvitski et al., 2009). Located where the river flows enter the ocean, many deltas face the combined risk of sea level rise, land subsidence, and storm surges (Hoitink et al., 2017), which may increase the risk of flood hazards worldwide (Syvitski et al., 2009). In some deltas, human interventions have a stronger influence on tidal river environments than sea level rise and land subsidence, and may overwhelm the gradual changes caused by the latter two factors (Vellinga et al., 2014). Intensive human activities during a short time period, such as sand mining (Templeton and Jay, 2013), dredging (Jewell et al., 2012), reservoir construction (Jay et al., 2011), channel deepening (Guo et al., 2014) and closure of a channel (Vellinga et al., 2014), cause significant variations of water levels and tidal properties in terms of constituent amplitudes and phases, which may exacerbate the problem of flooding and navigational safety (Hoitink and Jay, 2016).

Numerous studies on river tides in deltas are available (Jay et al., 2008; Buschman et al., 2009; Arns et al., 2013; Dean and Houston, 2013; Weisse et al., 2014). Water level dynamics within deltas are subject to variations of many factors, such as wind, ice cover, channel deepening, river discharge and oceanic tidal forcing, making the tidal river environments highly nonstationary (Sassi et al., 2012; Buschman et al., 2013; Guo et al., 2016; Hoitink and Jay, 2016). Since ample data and basic theory of river tides are readily available, the response of low frequency and higher frequency (quarterdiurnal, semidiurnal, diurnal etc.) tides to changing of external forcing by river discharges and ocean tidal ranges are frequently addressed (Jay and Flinchem, 1997; Godin, 1999; Kukulka and Jay, 2003; Guo et al., 2016). In river deltas and estuaries where the river discharge is strong and exhibits evident seasonal patterns (e.g., the Yangtze Estuary, the Amazon Estuary, the Pearl River Delta), the modulation of tidal propagation by the river discharge is

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