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In-situ and numerical study on tidal asymmetry in Xiangshan bay

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Xiangshan bay is a narrow tidal creek in the margin of East China Sea, the length of which is about 70 km and the width is less than 10 km. The geometry of the bay is irregular and the bottom topography is complex. The bay has an average depth of 7 m, including some deep spots reach 40 m. There are large areas of mudflat near the head, but much less along both sides of the bay.

Moored observations of current profile were carried out in Xiangshan bay during spring tide both in winter of 2010 and summer of 2011. In-situ tidal elevation and current data presented strong tidal asymmetry: The duration of flood was about 110 minutes longer than that of ebb, while the ebb velocity was faster than the flood velocity on average. Due to the effect of overtides, there were two peaks existing in flood current, but only one during ebb. Since the intertidal areas is higher than the average sea surface, maximum flood and ebb currents occur a short time before and after high water slack.

FVCOM (finite volume coastal model) is a 3-D baroclinic hydrodynamic model. It adopts unstructured grid and also the wet-dry treatment method. Therefore, FVCOM is proper to be applied for the mechanism study of tidal asymmetry. The simulated tidal levels and currents agreed well with the observed ones and the overall pattern of tidal asymmetry was qualitatively reproduced. The model results showed that overtides (M4 and MS4) were generated by the nonlinear interaction of tidal current with irregular coastline and complex bottom topography. Overtides got amplified along the bay, i.e. the amplitude of M4 increased from 0.02 m near the mouth to 0.36 m near the head, which was mainly due to quarter-wavelength resonance. By numerical experiment, it was shown that the amplitude of M4 did not change much if the areas of mudflat near the head changed. It highly depended on the location of mudflat. The ratio of amplitudes of M4 to M2 was larger when mudflat was around the mouth of the bay than near the head.