



**The Hong Kong University of Science and Technology**

**Department of Mathematics**

**MPhil THESIS EXAMINATION**

***Numerical Modelling of Submesoscale Processes in  
an Idealized Coupled Estuary-Shelf System off  
Hong Kong***

*By*

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**ABSTRACT**

We conduct a numerical simulation on an idealized estuary-shelf system to investigate submesoscale processes under multiple forcing of winds and buoyancy from river runoff. The system is analogue to physical settings of the Pearl River Estuary (PRE) and adjacent shelf off Hong Kong. Based on Regional Ocean Modeling Systems (ROMS) of primitive equations with turbulent closure scheme, the numerical model is implemented by a high horizontal resolution of  $100\text{m}\times 100\text{m}$  grid with open boundaries in a limited-area computational domain. The model is forced by prevailing monsoon wind stress and buoyancy from river discharge. By utilizing various combinations of physical forcing and numerical implementations, we successfully simulate the submesoscale flow structures characterized by horizontal length scale of  $O(100)\text{m}$  and examine the response of estuarine and shelf circulation to the multiple forcing. In particular, we study the freshwater bulge, frontal formation and estuary-shelf exchange under the influence of active submesoscale processes in the system. The instability associated with submesoscale fronts induced by river plume is closely bounded to the interaction between wind-driven currents and buoyancy effects. We found that submesoscale processes develop at the edge of the river plume and they spread and intensify with time. This is because of underlying nonlinear effects and unbalanced motions. This study develops a submesoscale-resolving numerical model and improves our understanding of the ocean circulation around the PRE by identifying the underlying submesoscale processes unmentioned before.

**Date** : **22 Aug 2019, Thursday**  
**Time** : **11:00 a.m.**  
**Venue** : **Room 3494 (near lifts 25-26)**  
**Thesis Examination Committee** : **Prof. Chi Hung Jimmy FUNG (Chairman)**  
: **Prof. Jianping GAN (Supervisor)**  
: **Prof. Tiezhen QIAN**

*(Open to all faculty and students)*

The student's thesis is now being displayed on the reception counter in the General Administration Office (Room 3461).