Back-Silting Causes under Normal Environments of the Upper Section of Deep-Water Channel in Yangtze Estuary, China

Xiaoxiao Li, Xiaodong Zhao and Xiping Dou

Nanjing Hydraulic Research Institute

State Key Laboratory of Hydrology-Water Resource and Hydraulic Engineering

Introduction

Yangtze Estuary (YE)

- A basic regime characterized as three-stage bi-furcation shape and four-outlets: (see the lower-left corner of Figure 1)

The first-stage bifurcations are the South Branch (S-B) and North Branch (N-B);

The S-B is divided into South Channel (S-C) and North Channel (N-C);

Finally, the S-C is divided into South Passage (S-P) and North Passage (N-P).

The deep-water channel

- The deep-water channel (see Figure 1) with a depth of 12.5m in YE was completed in 2010. It is divided into four sections from upstream to down: S-C section (W0-W1), Yuanyuansha (Yys) section (W1-W2), N-P section (W2-W4) and offshore section (W4-W5).

- The upper section refers to the S-C section and the Yys section.

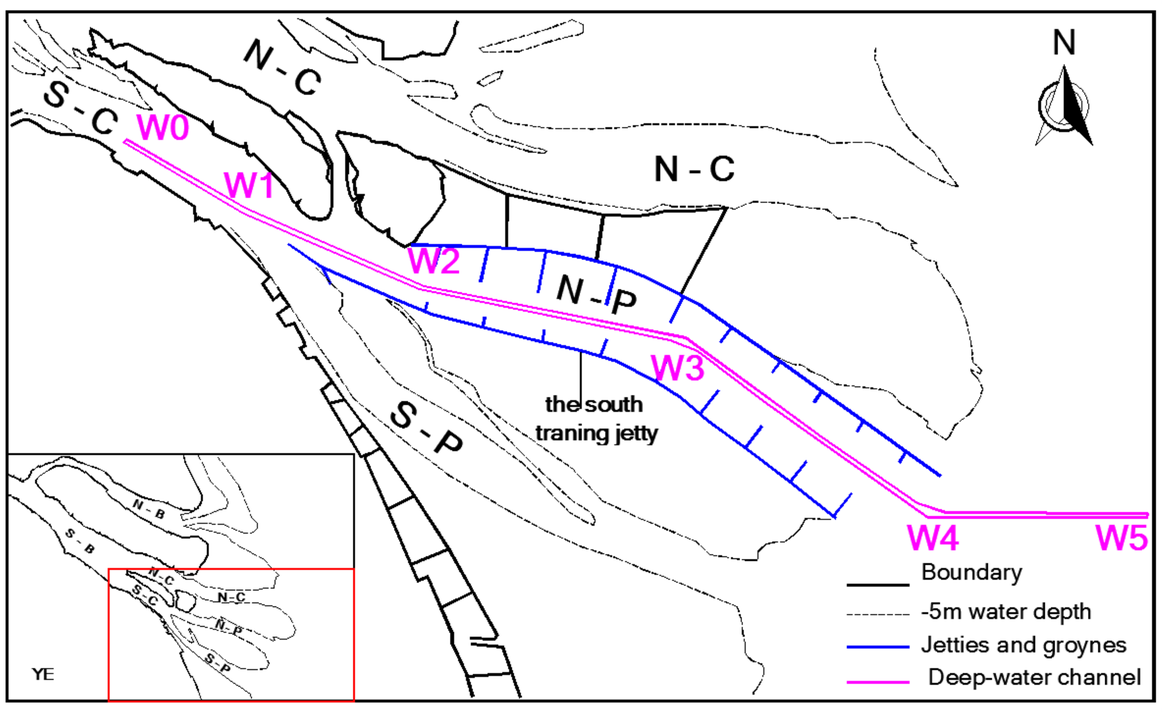

Figure 1 – Sketch of the deep-water channel in Yangtze Estuary

Objective

While bringing huge social and economic benefits, the navigation channel was back-silted seriously under normal environments during 2010 to 2012. It must be maintained by trail suction dredger with a large dredging cost. Thus, seeking back-silting causes and posing solutions is imperative.

Time-space distribution of back-silting

Concentrative in space with large amount

- The total amount of back-silting under normal environments is very large with an average of about 80 million m^3/a, which mainly concentrates in two peak sections along the channel.

- The upper section is the sub-peak section with a proportion of 25%.

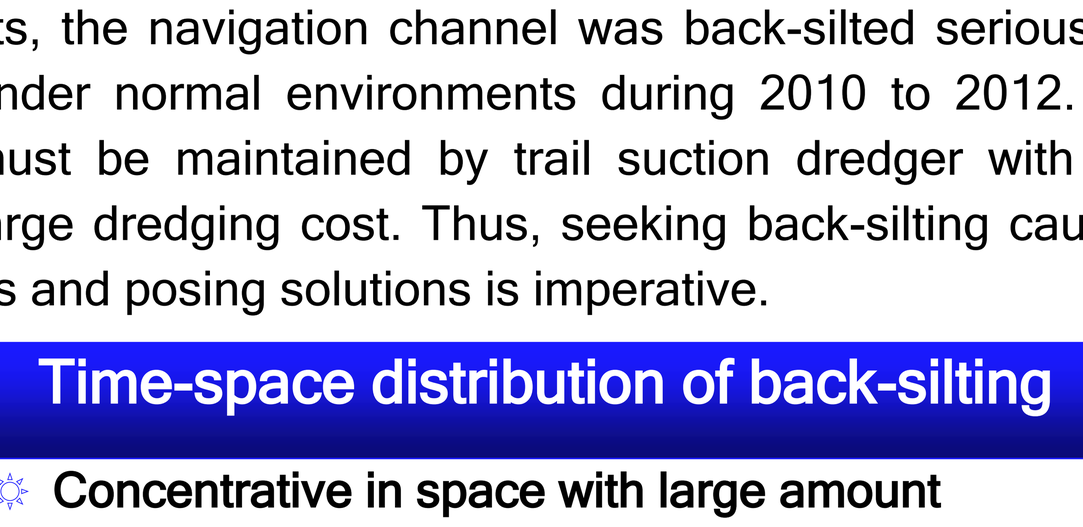

Figure 2 – Average amount of back-silting along the deep-water channel during 2010-2012

The silting characteristics, particle size of back-silt and the flow and sediment environment in the two peak-sections are distinctively different, so it is better to study respectively.

Seasonal difference

- In the S-C section, the silting amount in the flood and dry season are almost equal with an average of 6.8 million m^3/a;

- In the Yys section, the silting amount in flood season is two times of the amount in dry season with a larger average amount of 16 million m^3/a.

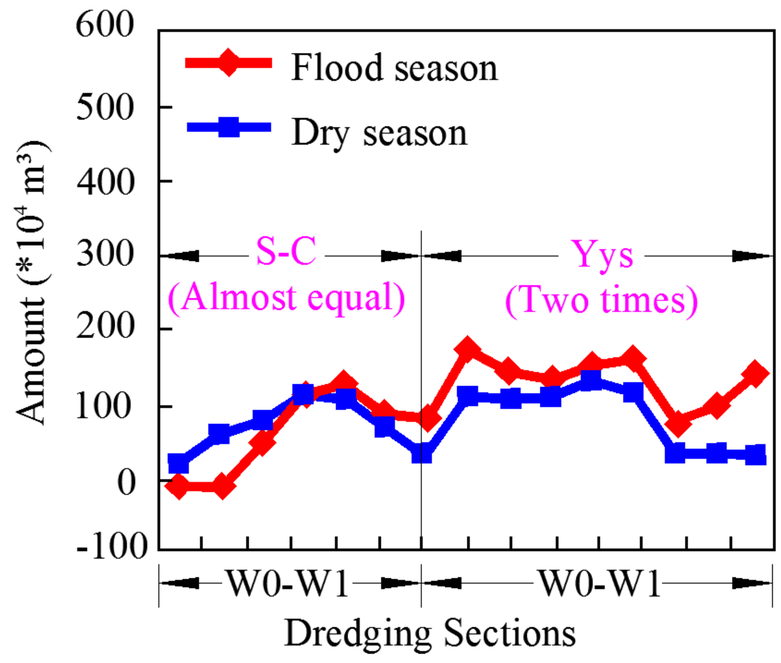

Figure 3 – Average amount of back-silting along the deep-water channel in flood and dry season

Research perspectives and approaches

Table 1 – Research breakthrough points and approaches

Breakthrough point	Approach
Composition analysis of back-silt to seek silting sources	Field sampling, sediment characteristic test
Effect of human activities and changes of flow and sediment supply from river basin	Hydrographic and sediment data analysis
Effect of riverbed adjustment and waterway deepening in YE	Bathymetric data analysis, numerical modelling
Sediment transport features in the upper section	Physical modelling, sediment characteristic test

Results and conclusions

The particle sizes of back-silt in S-C section are comparable to that of bed-load in S-C, while the back-silt in Yys section source from both bed-load and suspended sediment.

The decrease of sediment supply from river basin doesn't response directly to the silting amount in the upper section.

The back-silting causes under normal environments are as followings:

1) The main cause is that sediment transport capacity decreased in the upper section after waterway deepened;

2) Silting duration in Yys section increased;

3) Higher sediment-concentration water, flowing from S-P at high tide over the south training jetty, offered parts of suspended sediment sources for the Yys section;

4) Bed-loads supplied from the S-B and S-C to the upper section increased.

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