# Dynamic and geomorphic process in a transition zone of salt marsh and mudflat

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## Introduction

During the current situation of sea-level rise and increasing storminess, it is widely recognized that salt marshes is of growing importance for the sustainable coastal protection as potential buffers to waves and tidal flows, in addition to their global importance in ecosystem services (Perillo et al.,2009; Barbier et al., 2011; Moller, 2012; Moller et al.,2014). The primary aim of this study is to investigate how the presence of *Spartina alterniflora* affects sediment settling and intratidal erosion and accretion processes in an intertidal flat, based on integrated field measurements of waves, near-bed boundary turbulent velocities, intratidal bed-level changes, sediment properties. Such multi-disciplinary studies will bring an illuminating insight into the causes and consequences of changes in sediment property and processes of erosion and accretion with influence of saltmarsh plant, and it also is a requirement for improved quantification, understanding and modelling of the role of biological as well as physical processes in sediment dynamics and suspended sediment transport.

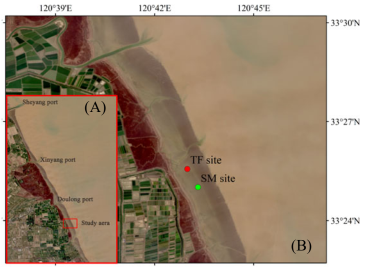


Fig. 1 (A) location map of study area (B) enlargement showing the observation site. Red point denotes tidal flat site and green point denotes saltmarsh observation

## Method

The field measurements were conducted from November 29th to December 7th, 2017. Using custom-made "Door" frame with two stainless steel legs (Fig.2), which were pushed into the sediment at least 1.5 m to maintain the stability of this frame during the flooding period. All the instruments used in this study were installed on this frame to measure a series of parameters of water depth, wave height, near-bed boundary velocities and intratidal bed-level changes (Fig.2).

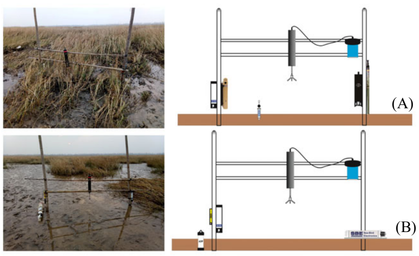


Fig. 2 Schematic figure of instruments used in This study and their deployment height located at the surface sediment. (A) Saltmarsh station (B) Tidal flat station

## Acknowledgements

Financial supports for this study were provided by Natural Science Foundation of China (Grant number: 41576090 and 41625021). We thank Jieping Tang, Tingfei Lan, and Hao Wu who participated in the fieldwork for assisting field experiments on the Doulong port intertidal flat, Jiangsu Coast, China.

## Results

### 3.1 Hydrodynamic forces

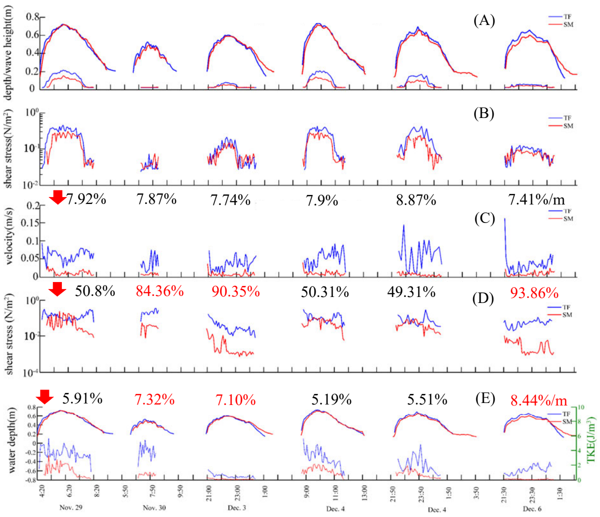


Fig. 3. Time series of (A) water depth and significant wave heigh, (B) bed shear stresses due to waves ($\tau_w$), (C) near bed current velocity, (D) bed shear stresses due to currents ($\tau_c$) (E)TKE density

① During field measurement, although on average hydrodynamic at Tidalflat station is stronger than that at Saltmarsh station(Fig.3), the *Spartina alterniflora* shows considerable flow and turbulent energy reduction and wave attunation ability, the high TKE dissipation efficiency maybe the reason how new saltmarshes can be established under relatively rough hydrodynamic conditions.

② Bed-level changes and rates of erosion and accretion at saltmarsh station are all smaller than corresponding those at TF station (Fig.4). , It influences the erosion and accretion processes within a tide cycle and the SM station tends to be accumulated while the TF station is more likely to be eroded

③Such circumstances is caused by saltmarsh plant which can result in changes of bottom sediment propriety, the plant greatly changed its underlying surface properties

### 3.2 Bed shear stress (BBS)

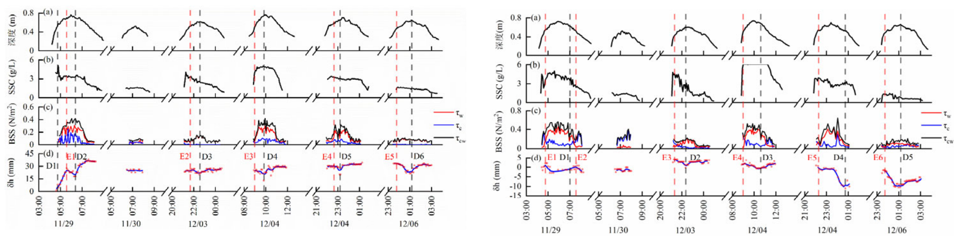


Fig. 4 . Data summaries at Saltmarsh station (A) and Tidalflat station (B) for a) Bed shear stress estimates due to combined currents and waves ($\tau_{cw}$); b) Suspended Sediment Concentration (SSC); c) The Bed Level Changes (BLC) obtained from the Velocimeter, with an increased value denoting a deposition and a decreased value denoting erosion. Individual circles are the values for each burst and the solid lines c) are 3-point moving averages. Vertical red dotted lines show the location of critical shear stress for erosion during each tide cycle, while vertical black dashed lines indicate the location of critical shear stress for deposition. D1~D6 in c) indicate deposition phase and E1~E6 indicate erosion phase.

### 3.3 Sediment grain-size parameters

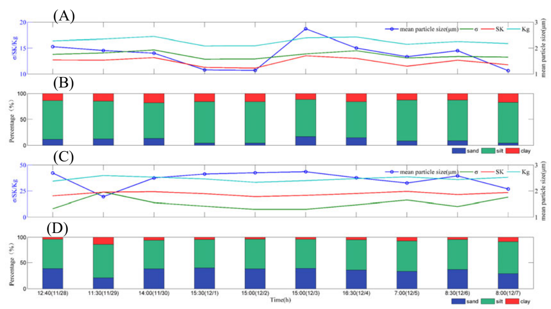


Fig. 5. Time series of sediment grain size parameters (A,,B, saltmarsh station; C, D, tidalflat station)

| Erison Phase | $\tau_{ce}$ (N/m²) | | Deposition Phase | $\tau_{cd}$ (N/m²) | |
|---|---|---|---|---|---|
| | TF | SM | | TF | SM |
| E1 | 0.29 | 0.38 | D1 | 0.22 | 0.32 |
| E2 | 0.17 | 0.09 | D2 | 0.17 | 0.18 |
| E3 | 0.15 | 0.17 | D3 | 0.22 | 0.08 |
| E4 | 0.19 | 0.32 | D4 | 0.08 | 0.21 |
| E5 | 0.20 | 0.12 | D5 | 0.13 | 0.19 |
| E6 | 0.16 | - | D6 | - | 0.07 |
| Mean | 0.19 | 0.22 | Mean | 0.16 | 0.18 |

Table 2 Erosion thresholds of erosion phase ($\tau_{ce}$, N/m²) and deposition thresholds of deposition phase ($\tau_{cd}$, N/m²) from Tide 1~6.

## Conclusion

1. The magnitude of erosion at TF station is greater than that at SM station while the accretion shows an opposite trend, The reasons are that saltmarsh plants can stabilise the sediment and decrease hydrodynamic, further leading to lower erosion rate, whereas saltmarsh plants also probably cause abundance of biodeposition, thus inducing higher deposition rate, compared to tidal flat.

2. During field measurement, tide-averaged $\tau_{cw}$ at SM station is smaller than that of corresponding tide at TF station. This circumstance is presumably caused by saltmarsh plants which can increase bed friction drag, further decreasing hydrodynamic.

3..The value $\tau_{ce}$ (=0.22 N/m²) at SM station was a little higher of that (=0.19 N/m²) at TF station while the $\tau_{cd}$ (=0.16 N/m²) at SM station was a little lower of that (=0.18 N/m²), which means the sediment is easier to settling but harder to move, it results in the accumulation of saltmarsh.