In situ survey campaigns for bathymetry, hydrodynamics, and sediment concentration in LMDCZ

October 2016 and February-March 2017

1. Introduction

The project is designed to have two in-situ survey campaigns. The first campaign is in October when the sediment plume was extended the farthest offshore in the East sea and present the southwest monsoon when the West sea coasts are severely eroded. The second campaign is in February at the peak of northeast monsoon which causes severe coastal erosion in the East sea. Thus, October 2016 and February 2017 were chosen for survey campaigns in the frame of the project.

The survey includes the following river and coastal stations:

- Two fixed river stations at the Mekong river (My Thuan) and Bassac river (Can Tho). These stations are also located at the National Hydrology Stations and installed for measuring discharges (Q) and suspended sediment concentration (SSC) by ADCP (see Figure 0-4);
- Two fixed coastal stations at Go Cong and U-Minh (see Figure 0-);
- Marine sampling stations from 2 mobile ships cruising along the East and West seas (see Figure 0-).

At the coastal stations, the following parameters are measured:

- Water level (hourly at the 2 fixed stations)
- Vertical distribution of velocity
- Vertical distribution of salinity (5 points for each vertical line)
- Vertical distribution of sediments (5 points for each vertical line)
- Waves (height, period and direction)

In addition, bathymetry is surveyed at the two study sites during each campaign: the alongshore extension at Go-Cong is 21 km and at U-Minh 25 km; the cross-shore extension is about 8 km at both sites with a sampling resolution of 1.25 km on average. The purpose of the bathymetry survey is to validate the morphological models.

The results of in-situ survey campaigns are uploaded on the project website (http://lmdcz.siwrr.org.vn/) for sharing among project members.

2. Bathymetry Survey

The scope of bathymetry survey includes three coastal sites: Go Cong (Tien Giang province) in the East sea; and two sites in the West sea, including U Minh and stretch of the coast between Song Doc River and Bay Hap River (Ca Mau province).

a. Site 1: Go Cong district, Tien Giang province (the East Sea)

- Survey alongshore extension of 21 km from the Soai Rap river mouth to Tieu river mouth (Figure 0-1);
- Survey periods: 24 - 31/8/2016 and
- Survey lines: 20 cross-sections of about 8.5 km length each cross section. The distance between consecutive cross sections is about 1 - 1.5 km. Total section length is 20*8.5 km = 170km.

Figure 0-1 Plan view of bathymetry survey at site 1 - Go Cong, Tien Giang province in the East sea

b. Sites 2: U Minh and Site 3: Phu Tan (stretch of the coast between Song Doc River and Bay Hap River)

- Survey alongshore extension of about 25 km at site 2 (Figure 0-2);
- Survey alongshore extension of about 31 km at site 3 (Figure 0-2);
- Survey period: From 28/9/2016 - 12/10/2016
- Survey lines:
  - At site 2: 10 cross-sections of about 9 km length for each cross section. The distance between cross sections is about 2.5 km. Total section length is 10*9 km= 90km;
  - At site 3: 21 cross-sections of about 9 km length for each cross section. The distance between cross sections is about 1.5 km. Total section length is 21*9 km= 210 km.

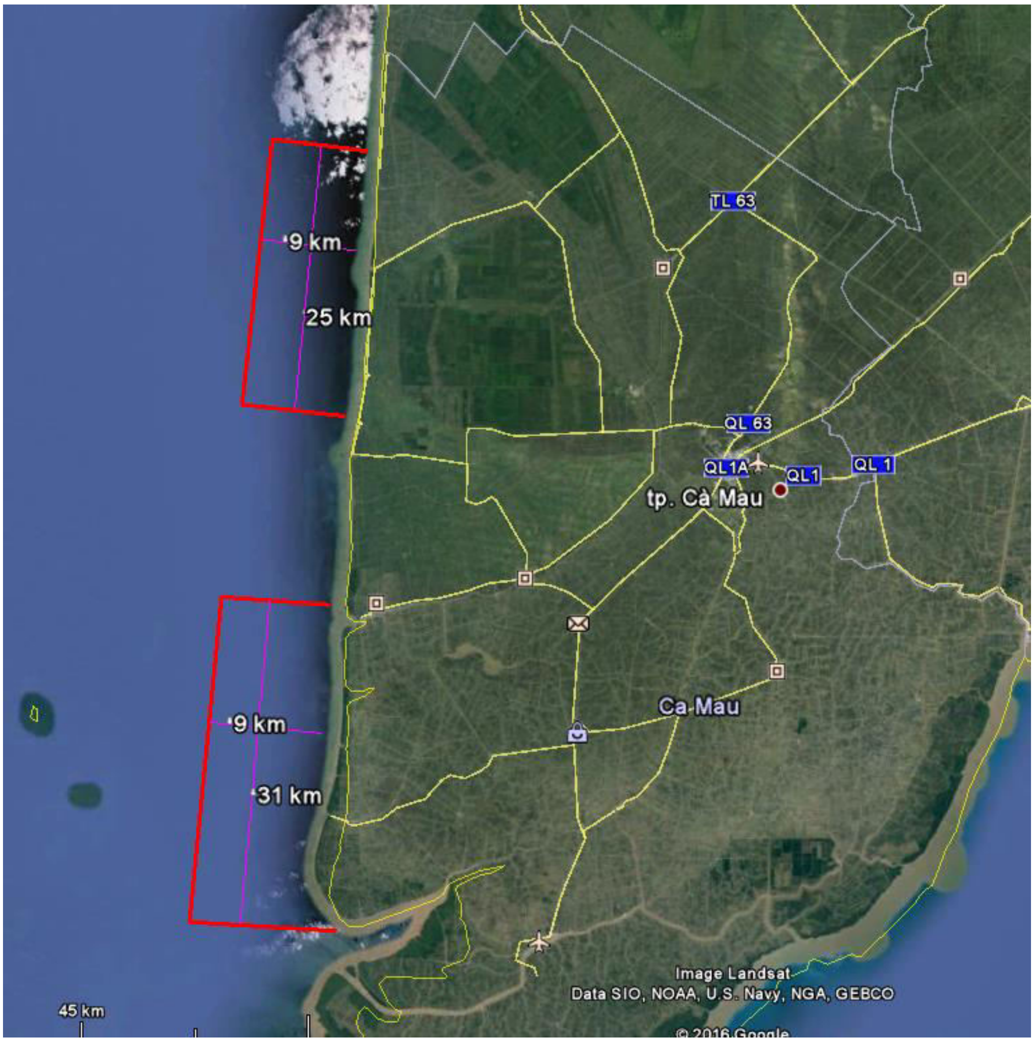
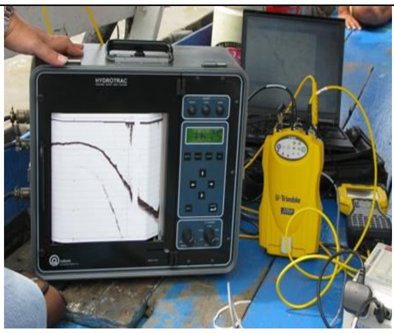


Figure 0-2 Plan view of bathymetry survey in the West sea at site 2 (U Minh) and site 3 (Phu Tan)

c. Human resources and survey equipment

- Human resources: 4 persons, including 1 captain, 1 crew member, 2 survey technicians operating the equipment;
- Survey method: Combination of Echo sounder and GPS systems;
- Equipment: Echo sounder ODOM, GPS Trimble, laptop, ship and accessories such as batteries, transformer, power generator, etc.



Echo Sounder, GPS Trimble

Laptop connected to survey equipment

Echo sounder mounted on the boat

cables & connectors

Figure 0-3 Survey equipment and connection in the field

Results of the survey are presented in Appendix C. They are also compared with previous surveys to explore shoreline change at the study sites.

3. Hydrology survey

There are two major campaigns undertaken during project implementation. The first campaign is in October 2016 for the southwest monsoon and the second campaign February-March 2017 for the northeast monsoon. Each campaign lasted for 15 days.

- 1st survey campaign: 16.10.2016 – 01.11.2016
- 2nd survey campaign: 24.02.2017 – 12.03.2017

The campaigns covered the whole LMDCZ with two fixed station at two local studies site (Go Cong and U Minh) and several mobiles stations.

3.1 Discharge stations in the Mekong river

Discharges and velocities in the Mekong river system are measured at two fixed stations: My Thuan in the Mekong River and Can Tho in the Bassac River (Figure 0-4).

- Coordinates of My Thuan station: X= 599009.21; Y=1135943.72
- Coordinates of Can Tho station: X= 589519.87; Y=1107292.21

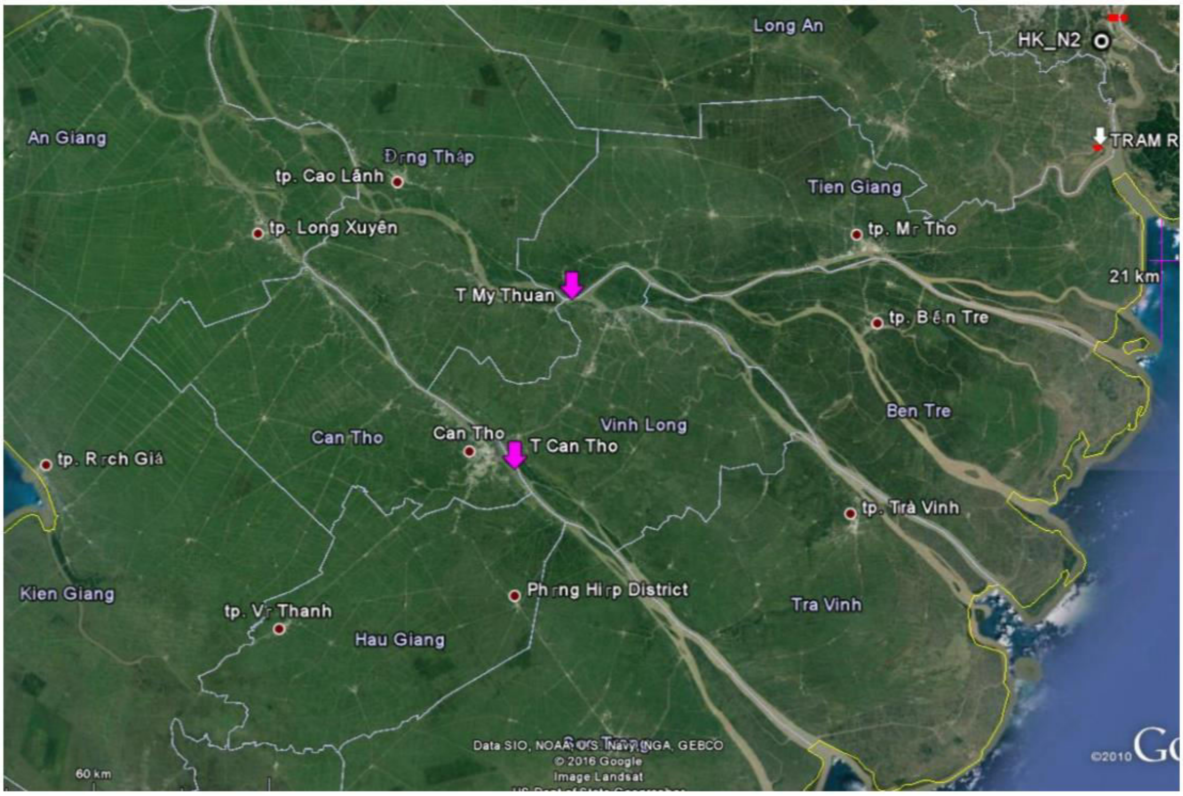


Figure 0-4 My Thuan and Can Tho stations in the Mekong and Bassac rivers

a. Sample rate and survey duration for discharge

- Survey period:
  - the 1st survey of 15 days 16 - 31/10/2016 and
  - the second survey of 15 days 24/02/2017 – 11/03/2017
- Sample rate: hourly

15 days * 24 times/day * 2 stations = 720 records

- Survey parameters:
  - Discharge and velocity;
  - Water samples for SSC at the centre line of river; at 3 depths of 0.2H, 0.4H, 0.8H where H is depth in metre; at 9:00 and 15:00 every day.

15 days * 6 samples * 2 stations = 180 samples

b. Human resources and survey equipment

- Human resources: 5 persons were deployed at each station, including 1 captain, 1 crew member, 3 survey technicians;
- Survey equipment: Acoustic Doppler Current Profilers (ADCP) with frequency 600Khz of Workhorse Rio (USA) for discharge measurement, including laptop, boat and accessories (batteries, water sampler, etc.) and connectors (Figure 0-5).

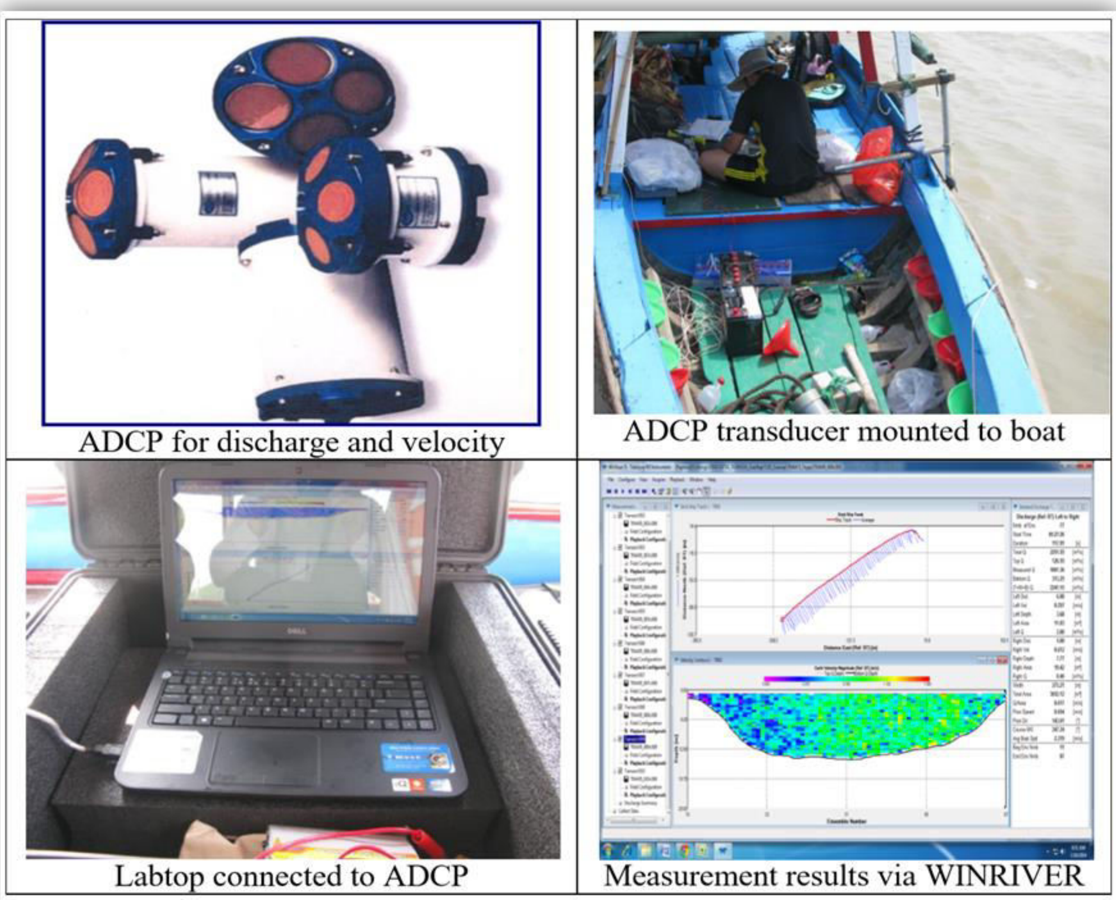


Figure 0-5 Survey equipment and cables/connectors to measure discharge

3.2 Fixed coastal stations

The project set up two fixed coastal stations to survey wind, waves, currents and salinity at Go Cong, Tien Giang province in the East sea, and U Minh, Ca Mau province in the West sea (Figure 0-3).

- Coordinates of Go Cong station: X=705,910.85; Y=1,135,667.81
- Coordinates of U Minh station : X=464,620.47; Y=1,029,689.91

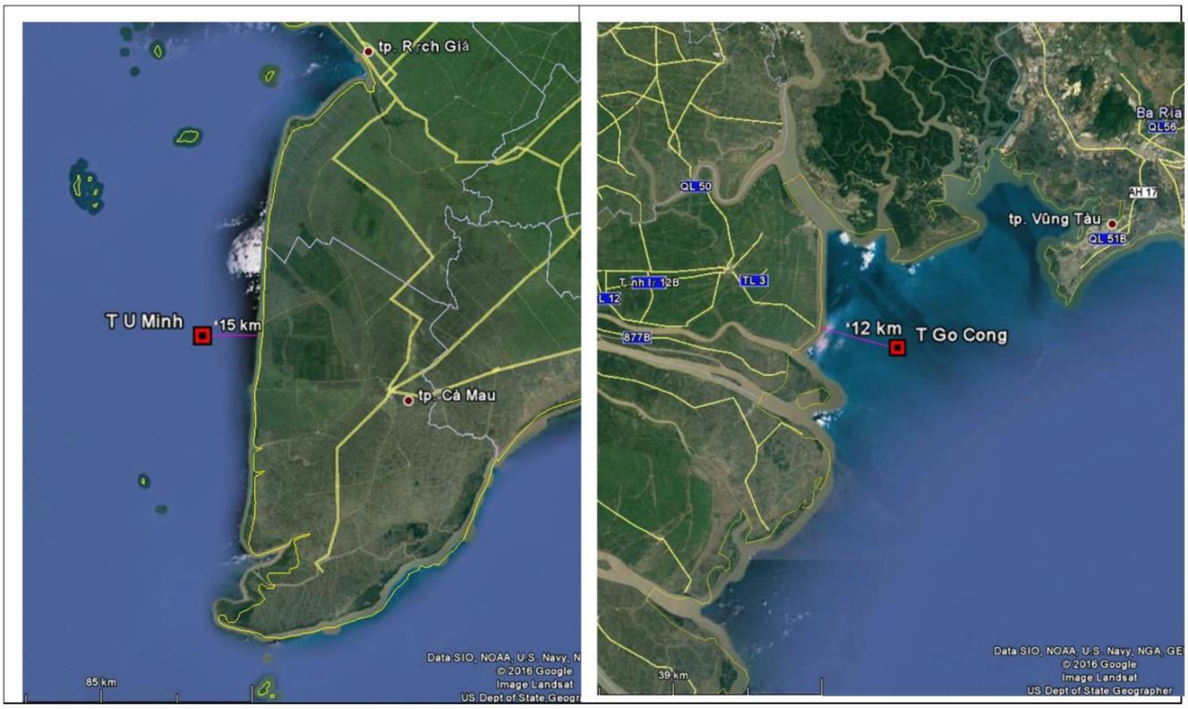


Figure 0-3 Locations of U Minh and Go Cong wind, waves, currents and salinity measurement stations

a. Sample rate and survey duration for wind, waves, currents, and salinity

- Survey period:15 days
  - The 1st survey campaign: from 16/10/2016 to 31/10/2016 at Go Cong station and from 17/10/2016 to 01/11/2016 at U Minh station
  - The 2nd survey campaign: from 24/02/2017 to 11/03/2017 at Go Cong station and from 25/02/2017 to 02/03/2017 at U Minh station
- Sample rate
  - for waves and currents: 15 minutes
  - for SSC and salinity: 2 hours, i.e. 12 times per day, at depths of 0.2H, 0.4H, 0.6H, 0.8H and shelfbed;

    15 days *12 times/day* 5 samples * 2 stations =1,800 records
  - for wind: 2 hours

    15 days *12 times/day * 2 stations = 360 records

b. Human resources and survey equipment

- Human resources: 5 persons were deployed at each station, including 1 captain, 1 crew member, 3 survey technicians.
- Survey equipment: FLowQuest for waves and currents measurement, and Testo 410-1 and NEDA 1604 for wind survey, including laptop, boat and accessories (batteries, water sampler...) and connectors (Figure 0-4).

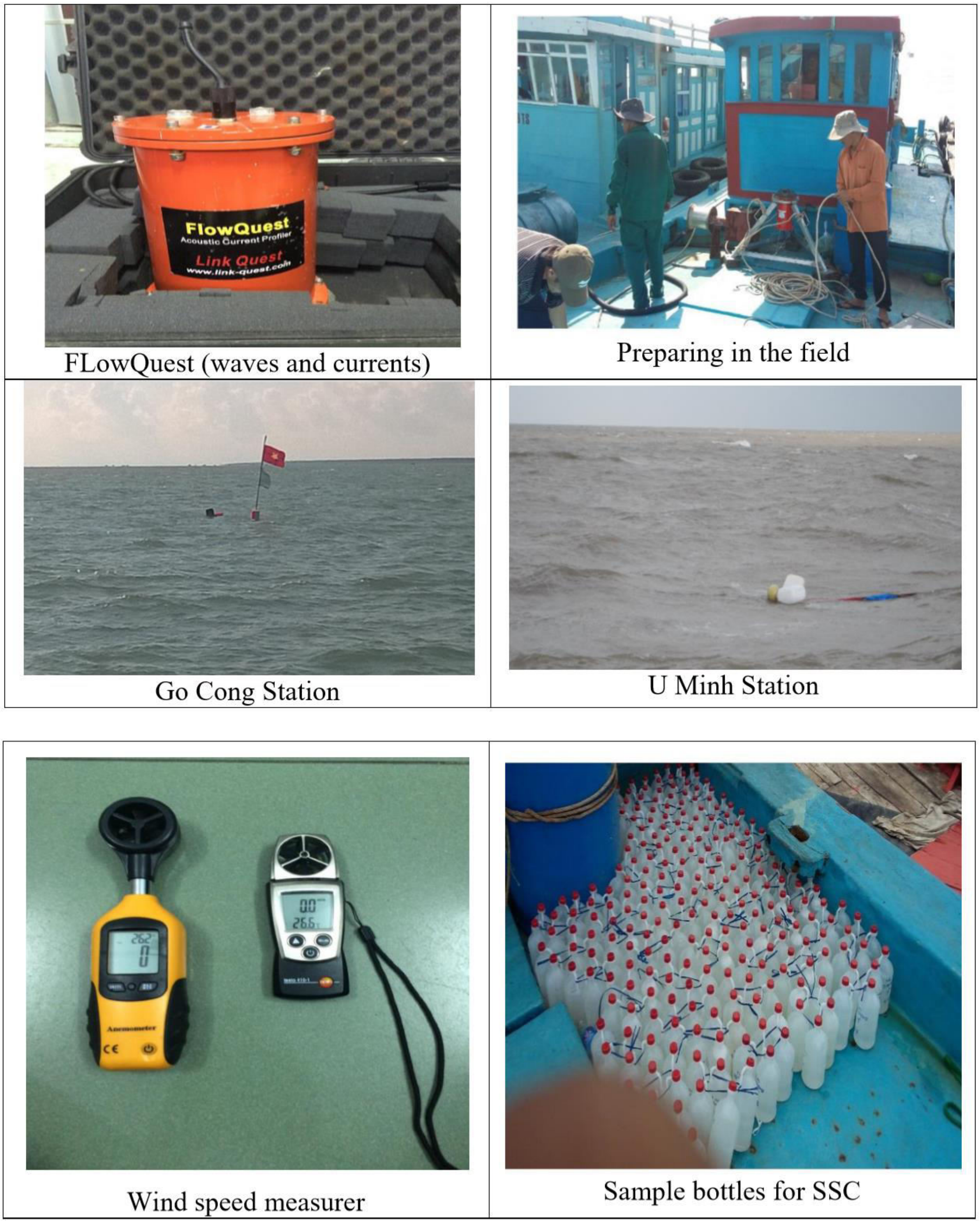


Figure 0-4 Equipment for 2 fixed coastal stations

3.3 Mobile stations

Two mobile ships went along the coast to sample waters and survey other parameters at 183 stations in the East and West seas as shown in Figure 0-5.

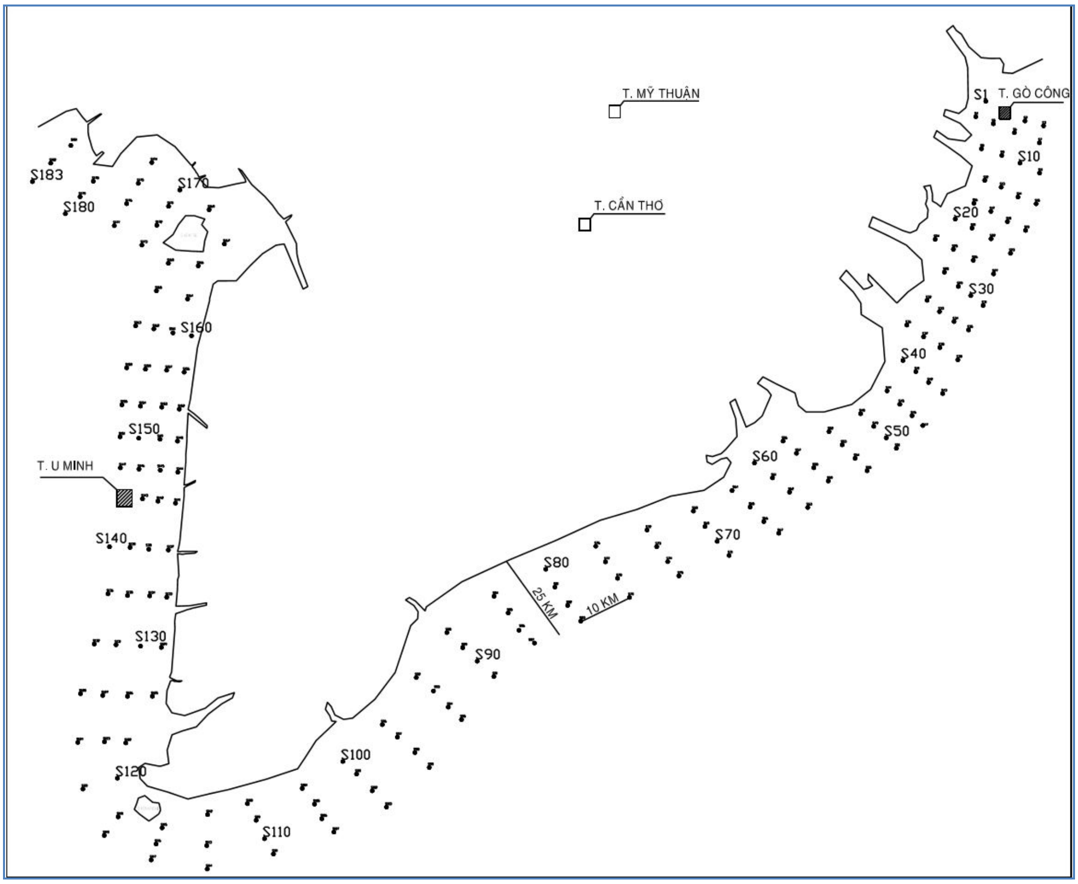


Figure 0-5 Location of 183 measure points in the East and West seas

a. Sample rate and survey duration for wind, waves, currents, salinity and SSC

- Survey period: 18 days from 16/10/2016 to 02/11/2016
- Sample rate: 30 minutes for wind, waves and currents
- Water samples for SSC and salinity at 5 depth levels at each site: 0.2H, 0.4H 0.6H, 0.8H and on the shelf bed (H is water depth at each station)

  183 stations*5 samples = 195 samples

- Bed material was also sampled at each station for grain size analyses

b. Human resources and survey equipment

There are two ships moving from Tien Giang province (the East sea) and Kien Giang province (the West sea) to the Ca Mau cape.

- Human resources: 6 persons were deployed at each mobile station, including1 captain, 1 crew member, 4survey technicians;
- Survey equipment: AWAC and WSHW600-I-UG137 for wave and current measurement, including laptop, boat and accessories (batteries, water sampler...); and CTD instrument for salinity (Figure 0-6).

WSHW600-I-UG137

AWAC

Water sample bottle

CTD equipment (West sea)

Figure 0-6 Survey equipment and field activities

4. Laboratory test

Samples contained in plastic bottles of about 1 litter were sent to the SIWRR Laboratory in Binh Duong province. They were then divided into 2 parts for the independent testing.

a. Salinity test

The salinity sample was analysed using JENCO-3107 tool kit (USA) in the lab. The JENCO Model 3107 bench type Conductivity, Salinity, Temperature System is a rugged, microprocessor based instrument designed for use in field laboratories and process control applications, using a four electrode cell, it is an essential tool for precise measurements of conductivity, salinity and temperature [JENCO Electronics Ltd., Operational manual].

b. SSC test

Laboratory equipment

Equipment for SSC test in the lab includes:

- Oven (temperature adjustability)
- Non-ash filter paper (made in Europe) with the following properties:
    - Size (60 x 60) cm
    - Pore diameter: 15-20 micrometer
- Filter kits, including: funnel and cylinder
- Laboratory scale/Scientific balance

Test procedure

The following procedure was applied to analyse SCC samples.

- Non-ash filter paper is dried to a constant weight and the mass (m_0) was measured before the filter experiment;
- Water sample bottle was shaken thoroughly and divided into two parts. Each part had a volume of V_0 (≥ 500 ml) and filtered through non-ash filter paper by filter kits.
- After filtered, the filter paper with sediment was heated to a constant mass at 106 ± 10^{o}C and then weighed (m_1);
- Experiment was conducted twice for each sample. Laboratory results are interpreted as the average of two experiments.
- Suspended sediment concentration (SSC in mg/l) is calculated using the following formula:

$$\frac{m_1 - m_0}{V_0} x10^6$$

Results from these tests are presented in Appendix A and B.

APPENDIX A

Results of the first survey campaign

16.10.2016 - 01.11.2016

1. *Go Cong* station: Water level, current and wave parameters at the mooring station during wet season

Water level fluctuations, current velocities and wave parameters at the mooring station of Go Cong were measured during 15 days in October 2016 and presented in Fig 3.3 in the main report. The water level fluctuations indicate for a mixed, dominant semi-diurnal tide, which is typical of two high waters (higher high water and lower high water) and two low waters (lower low water and higher low water) each day (Fig 1a). Tidal ranges (the different in height between higher high water and lower low water) vary between 3.7 m (on October 22, 2016) and 1.9 m (October 24, 2016). Tidal ranges of ebb phases (the different in height between the consecutive high water and low water) are not significant different from tidal range of flood phases (the different in height between the consecutive high water and low water). However, the durations of ebb phases are generally longer than the durations of flood phases with the different of about 40 minutes (Tab. 1).

Tab. 1: Tidal parameters at mooring station of Go Cong in wet season 2016

Tidal parameters	Max	Min	Average
Tidal range (m)	3.69	1.89	2.58
Tidal range of ebb phase (m)	3.47	0.53	1.93
Tidal range of flood phase (m)	3.46	0.09	1.90
Duration of ebb phase (hour)	8.50	5.00	6.53
Duration of flood phase (hour)	7.50	4.25	5.87

The current velocities at the mooring station of Go Cong are mostly controlled by tide and are dominated by ebb current (Fig. 1, Fig. 2). Current directions are mainly coastal parallel with ebb current directions ranging from SSE to SSW and inversely flood directions from NW and N (Fig. 1f). At near the sea bed, directions of ebb and flood dominate in S and N directions, respectively; while at near the surface, ebb and flood directions are mainly in SSE and NNE (Fig. 2). Current directions at near the surface under lower water level fluctuation conditions are strongly affected by wave (Fig. 2, Fig 4). However, these effects are mainly in during ebb tide under low velocities conditions.

Except at near the sea bed, maximum values of ebb current are usually higher than the maximum values of flood current (Fig. 1 and Fig. 2). The current asymmetry is more significant during spring tide under high water level fluctuation with the values of the ebb velocities are almost two times higher the flood velocities. During 15 days, maximum velocities of ebb and flood currents respectively are about 1.89 m/s and 1.62 m/s at near the surface, about 1.68 m/s and 1.46 m/s at near the sea bed. The maximum of depth averaged ebb and flood velocities are about 1.68 m/s and 148 m/s.

Current velocities also show that ebb current velocities at sub-surface layers are usually higher compared to flood current velocities at near the surface or at near the sea bed (Fig. 1c and Fig. 2, Fig. 3). These higher ebb velocities at sub-surface layers occur mainly during spring tide at even lower water level variation conditions (lower tidal range of ebb phase) (Fig. 3a, b). Maximum current velocity of about 2.3 m/s over 15 days period is observed during ebb phase on 22 October 2014 at about 5 m from the sea bed (Fig. 3c).

Wind data at the mooring station of Go Cong were measured using an anemometer from the anchored fishing boat. Wind speeds during from 16-31 Oct. 2016 are generally gentle with maximum speed of about 4.3 m/s and averaged speed about 1.2 m/s (Fig. 1e). Wind directions are scattered but the wind flows dominantly between WSW-WNW over the period from 16-26 Oct. 2016 and from ENE-E direction from 27-31 Oct. 2016.

Wave directions are almost controlled by the wind. The wave directions are also separated in two periods with the directions mainly from SSW-SW (account for 53% of all observed directions) during the first period from 16-25 Oct. 2016 and dominantly in the directions between SE-SSE (accounting for 28%) during the second from 26-31 Oct. 2017 (Fig. 1d). Correspondently to the dominated directions of wind and wave, wave heights during the first period (spring tide), the wave height variations are commonly small and not correlated with the fluctuations of wind speeds. The significant and maximum wave heights (H_s and H_{max}) during the first period are less than 0.5 m (0.3 m on average) and 0.7 m (0.45 m) (Fig. 1a, b, c). Compared to the first period, during the second period (neap tide), wave height values are higher with more fluctuations. Daily peaks of H_s and H_{max}, which mainly occur during low tides at the times between 6 PM to 9 PM, are mostly reaching 1 m and 1.5 m respectively. In contrast to these peaks of wave height, relatively camp wave conditions occur mainly in the morning from 6 AM to 11 AM with H_s of about 0.5 m. The maximum values of H_s and H_{max} during the second period are about 1.5 m and 2.1m. The differences between the successive max and min H_s are ranging from about 0.5 m up to 1 m (Fig. b). The variations of wave heights are more or less coincidence with the wind speeds. However, the differences between the consecutive max and min wind speeds are smaller compared to those values of wave heights. This information suggests that onshore wind (Fig. 1e) associated with ebb currents might generate relative high waves during this second period.

Suspended sediment concentrations (SSC) at the mooring station Go Cong show that both wave and tide are controlling the suspended matters. The minimum values of SSC usually occur at round slack tides (Fig. 5a, c). Peaks of SSC at near the seabed usually concise with peaks of tidal current or-and-peaks of wave height (Fig. 5a, b, c, d). The peaks of SSC during ebb and flood tides are not significantly different. From 16 – 25 Oct, during generally low wave condition and strong current velocity in spring tide, the SSC is mostly driven by tidal current (Fig. 5e, f). During neap tide from 25-30 Oct, the variations of SSC are controlled by wave actions. The SSC values during the wet season vary about 2 mg/l to 200 mg/l (not fully shown in Fig. 5). There is a strongly increase of SSC values from near the surface (from the relative depth of 04H) to near the seabed (1H); however, the SSC values at near the surface (02H) are higher than those values in the sub-surface layer at the depths of 04H and 06H (see supplement excel data from the LMDCZ website). The results from of 72-hour moving average of SSC show that the SSC value at near the seabed is about 1. 5 times higher than the mean SSC values of 5 depths (Fig. 5e). On average of 15 days, the SSC values at 5 relative depths are about 64 mg/l (at 02H), 55 mg/l (04H), 61 mg/l (06H), 82 mg/l (08H) and 120 mg/l (1H). The mean SSC value over the 5 depths and 15 day is about 75 mg/l.

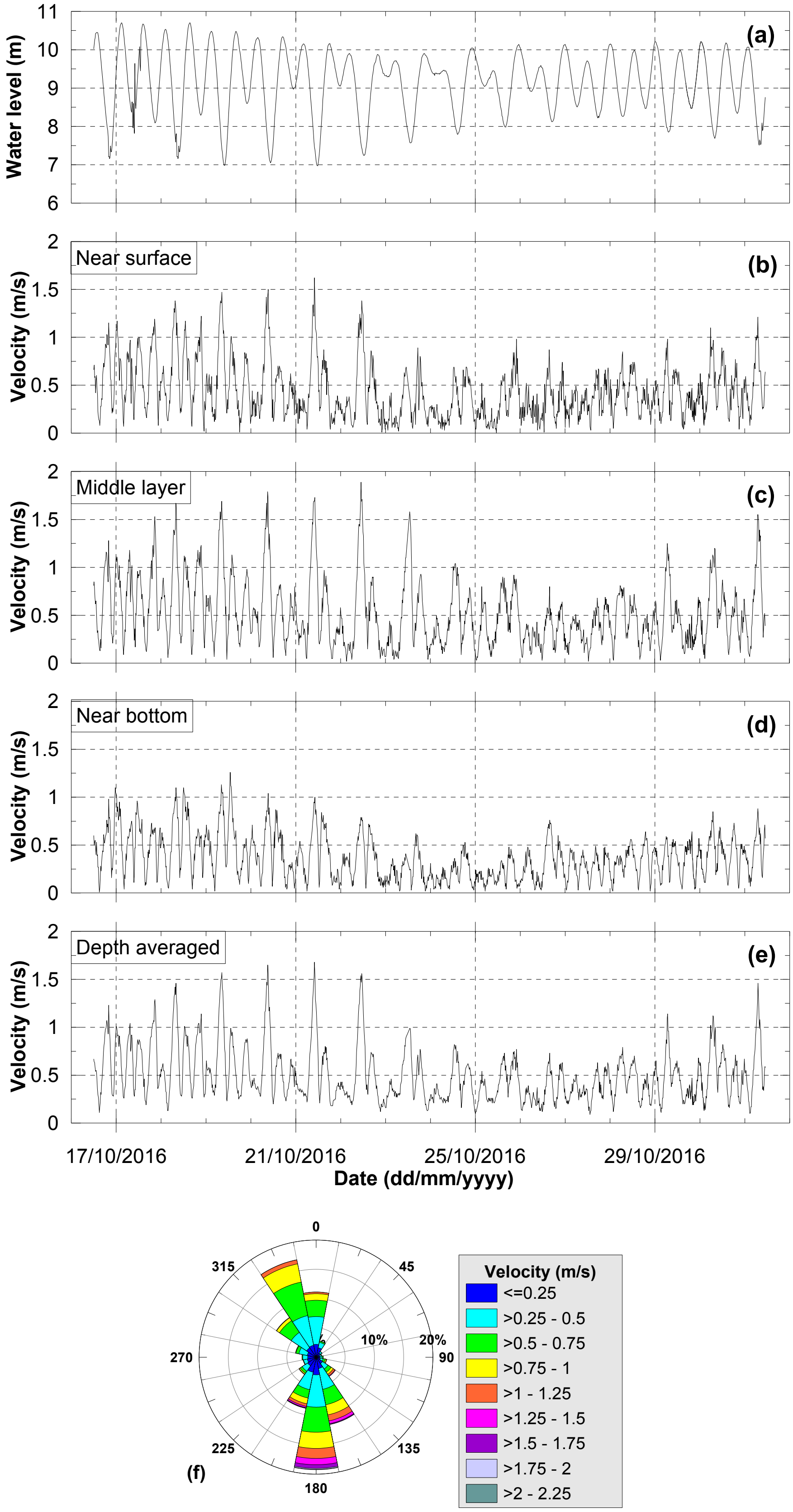


Fig. 1: Time series plots of (a) water level relatively to the sea bed and current velocities of (b) near surface, (c) middle layer, (d) near bottom and (e) depth averaged and (f) directional distribution of current velocity at the mooring station of Go Cong in wet season 2016.

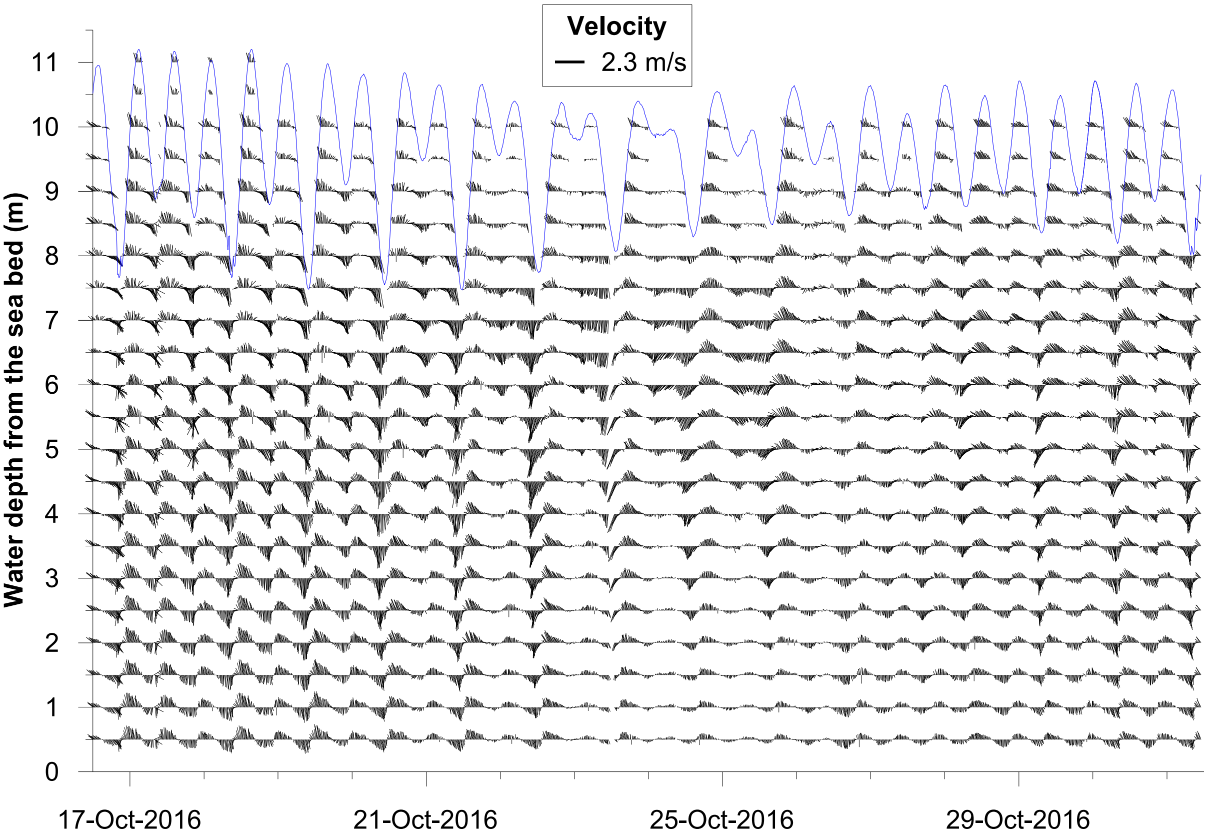


Fig. 2: Time series plots of vectors of current velocity profiles and water level (blue line) at the mooring station of Go Cong in wet season. Zero water depth is referred at the sea bed.

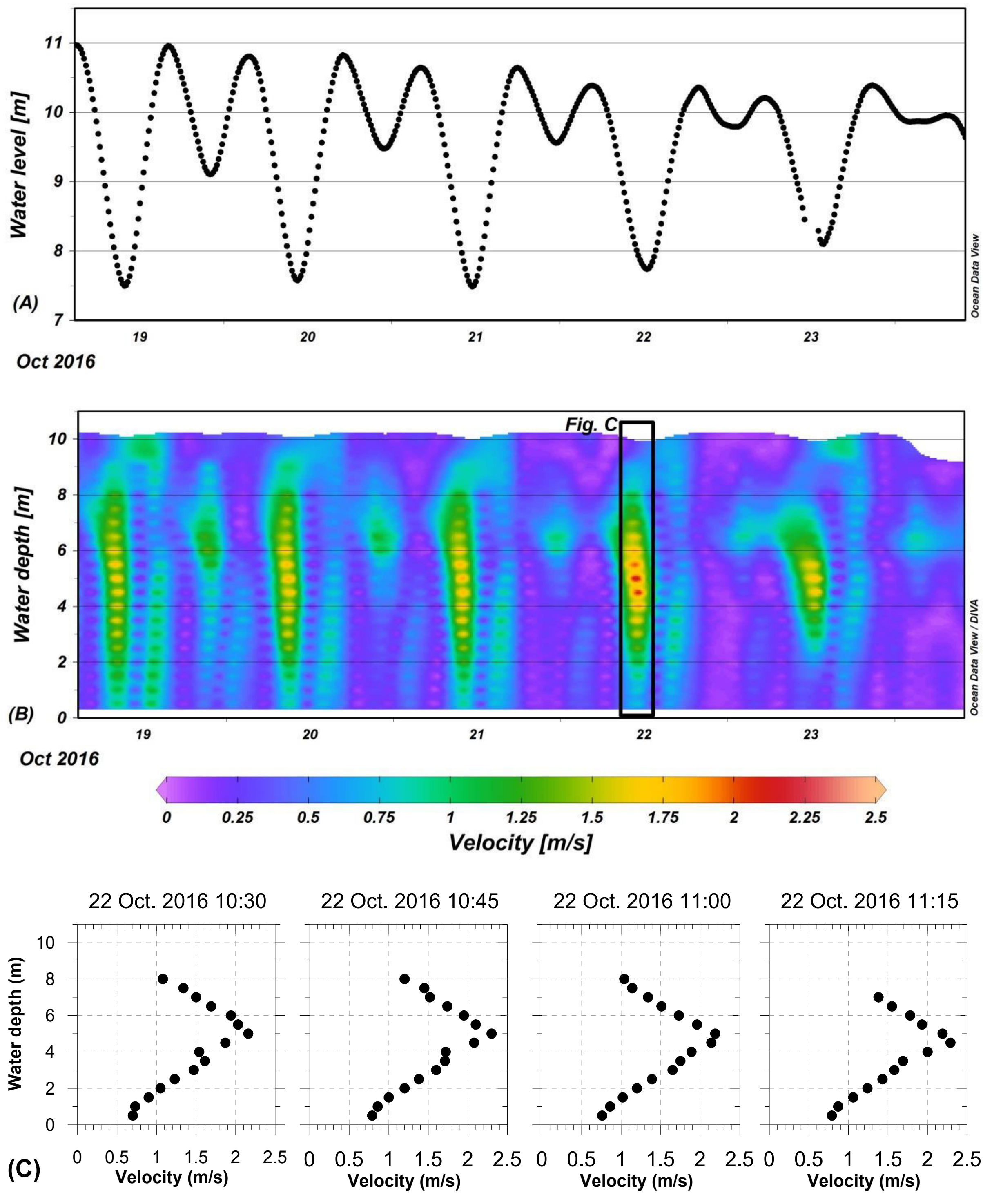


Fig. 3: Examples of current velocity profiles at Go Cong in wet season which indicates that ebb current is dominated and velocities of a sub-surface layer are faster compared to the velocities at near the surface and near bottom.

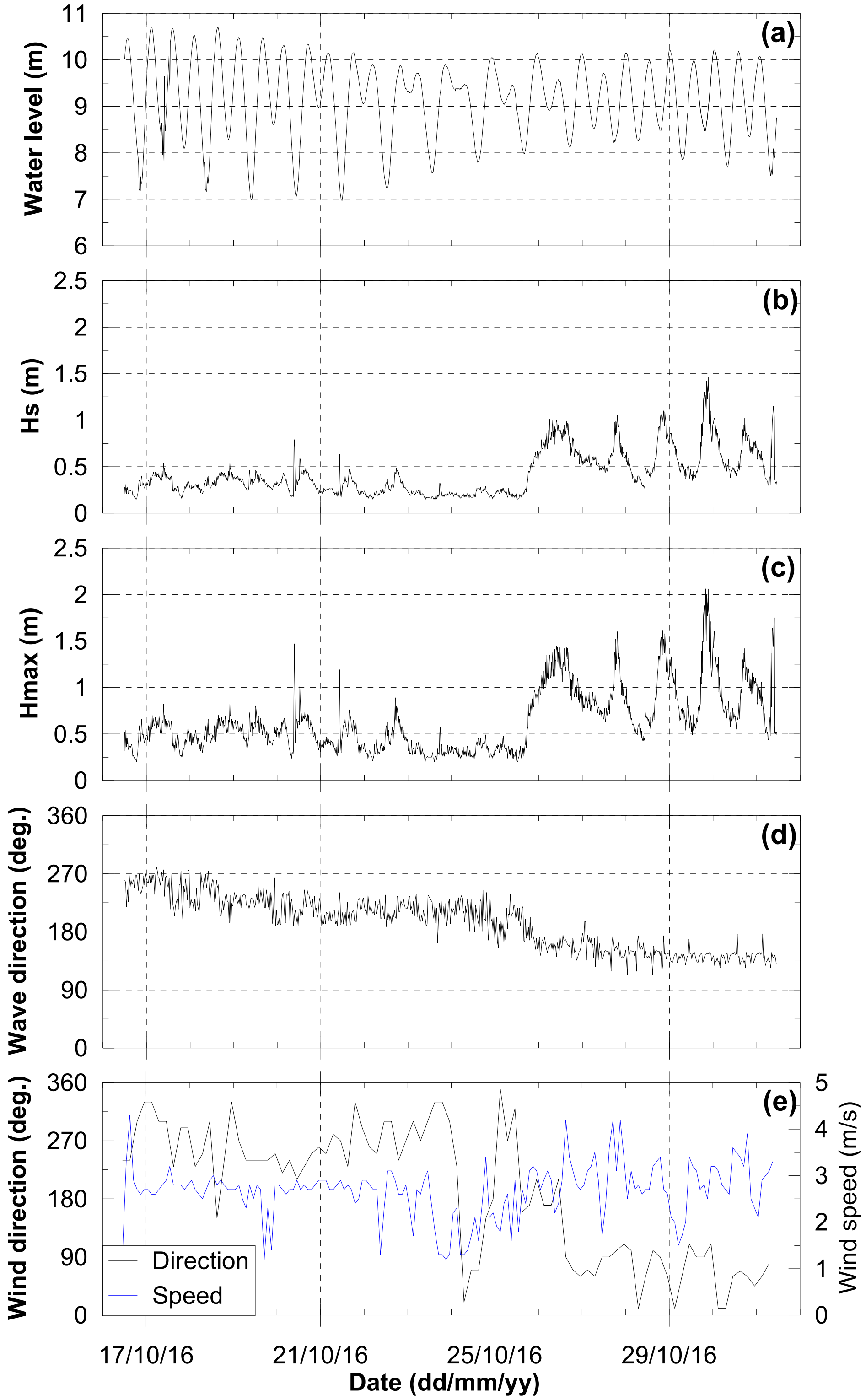


Fig. 4: Time series plots of (a) water level, (b) significant wave height (Hs), (c) maximum wave height (Hmax), (d) wave direction and (e) wind direction and speed at the mooring station of Go Cong in wet season 2016.

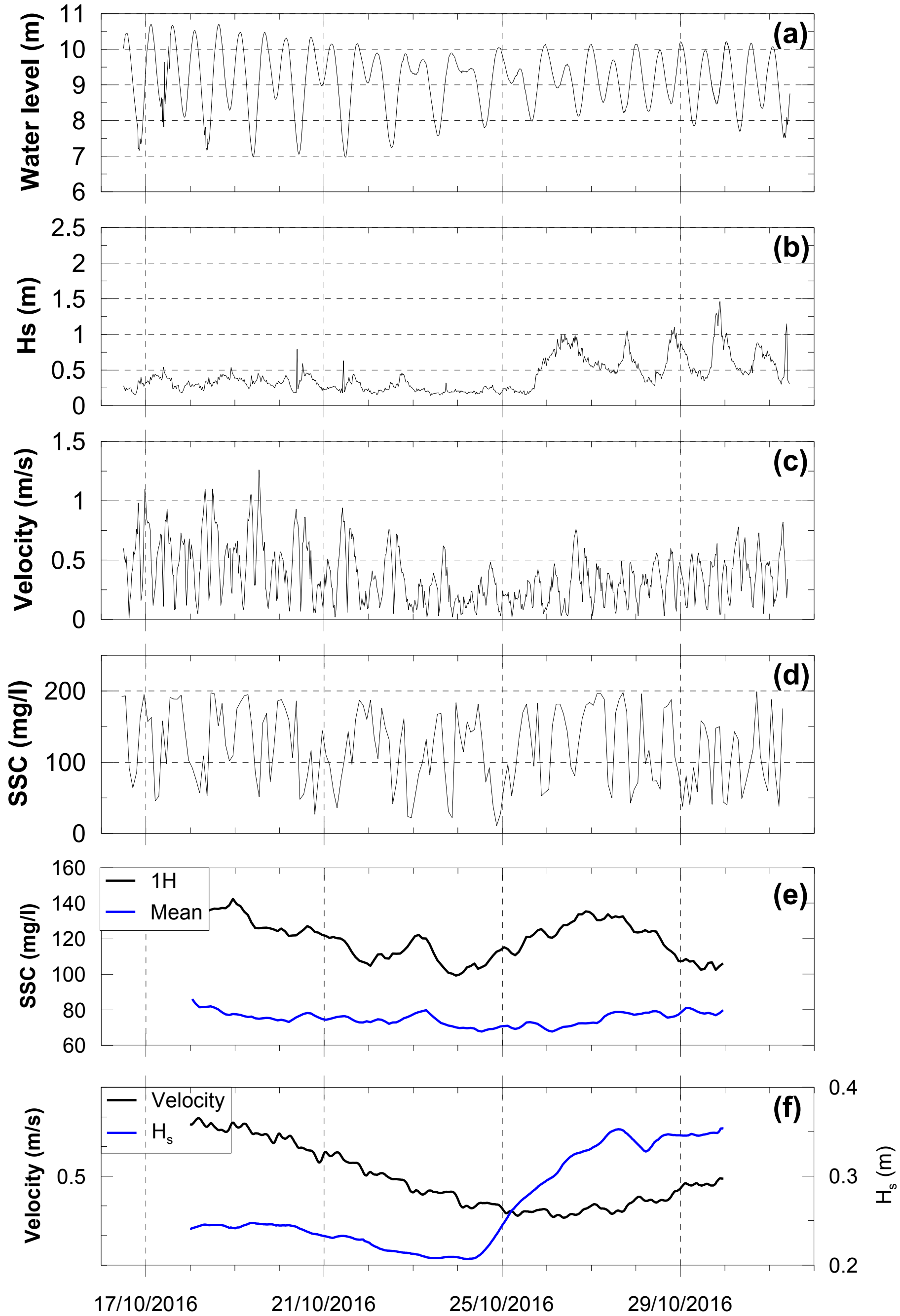


Fig. 5: Time series plot of (a) water level, (b) significant wave height, (c) current velocity at near the sea bed and (d) suspended sediment concentration at near the sea bed and (e) the 72-hour moving average of SSC at near the seabed and the mean SSC over the water column and (f) velocity near the seabed and H_s which was measured at the mooring station of Go Cong during wet season.

2. *U Minh* station: Water level, current and wave parameters at the mooring station during wet season

Water level data at the mooring station of U Minh during 15 days from 17 Oct – 1 Nov. 2016 in wet season show a typical type of mixed, mainly semi-diurnal tide (Fig. 5 - Fig7). However, the water level fluctuation is generally low. Max tidal range of about 0.8 m was observed during spring tide while min tidal range is about 0.4 m in neap tide. Mean tidal range over 15 days period is about 0.6 m. There are not significant differences between tidal ranges of flood and tidal ranges of ebb (Tab. 2). The average tidal ranges of ebb and flood are both about 0.4 m. However, the duration of ebb (on average 6.35 hours) is typically longer than the duration of flood (6 hours).

Tab. 2: Tidal parameters at mooring station of U Minh in wet season 2016

Tidal parameters	Max	Min	Average
Tidal range (m)	0.83	0.42	0.61
Tidal range of ebb phase (m)	0.83	0.12	0.43
Tidal range of flood phase (m)	0.65	0.23	0.43
Duration of ebb phase (hour)	7.0	5.5	6.35
Duration of flood phase (hour)	7.5	4.25	6.09

Current velocities at the mooring station of U Minh are generally low with current directions are very scattered and not clearly showing dominating flood and ebb directions (Fig. 6e). Current velocities at near surface can reach about 0.8 m/s at middle stages of the measurements. Current velocities at near sea bed are mainly less than 0.25 m/s with max value only about 0.5 m/s. The very scatter directions can be caused by strong wave actions in this area. However, vertical profiles of current velocities (Fig. 6) show ebb current directions mainly range from SE – S and dominated in SSE direction whereas flood directions are from N-NE and dominated in NNE. During spring tide with generally camp wave condition, from 17-22 Oct. 2016, ebb and flood and ebb current directions are clearer observed. However, since 21 Oct, in the layer from 3 m to 13.5 m from the sea bed, only ebb current in directions of SE-S are seen. This dominated ebb currents indicate for the strongly wave influence on the current regime in this area.

The asymmetry between ebb and flood current is also observed with ebb current dominated. Although this asymmetry is not obviously seen in the Fig. 5, Fig. 6 shows ebb currents are faster than flood currents, especially during the period from 22-24 Oct. For all data over the vertical profiles during 15 days, maximum velocities are about 0.94 m/s for ebb and 0.87 m/s for flood. However, depth averaged velocities show strongly ebb current dominated with maximum velocities of ebb and flood currents are about 0.64 m/s and 0.32 m/s, respectively.

Wind velocities measured from the anchored boat show the changes in wind directions from SW monsoon (ranging from WSW – SSW) during the period from 17 – 27 Oct and NE monsoon with mainly in NE direction from 28 Oct – 2 Nov (Fig 7). Wind velocities are about 2 - 8 m/s with dominated speed of about 4 m/s.

Wave directions are also variations mostly similar the changes in wind directions indicating for the type of wind-induced wave. However, wave directions range mainly from W-SW with highest frequency in WSW. There are also seen some directions from SSE and S which occur around 27 Oct when the wind changing in the directions from SW to NE (Fig. 7).

During this period, the area was suffered a wavy condition with significant wave heights (Hs) are always greater than 0.5 m. During the action of SW wind directions, Hs and maximum wave heights (Hmax) reach 1.6 m and 2.7 m. respectively. These values are also the highest wave heights observed in this field survey. Maximum Hs from the directions S and SSE is about 1.5m. The values of Hs range from about 0.5 m– 1.6 m (about 0.9 m on average of 15 days period).

The SSC data at the mooring station of U Minh in the wet season show that both wave and current actions are also caused sediment re-suspensions (Fig. 8). The SSC values usually decline to minimum values at around slack tides. Peaks of SSC are mainly seen after the peaks of current velocity or wave height. During spring tide, tidal current and wave control the variations of SSC. While during neap tide, the changes of SSC are mainly caused by wave (Fig. 8e, f). The SSC data show as well the high turbidity values during the wet season with the SSC values range between 0-170 mg/l (Fig. 8d). A strongly increase of SSC amounts from near the surface to near the seabed was also observed with the mean SSC at near the seabed is about twice higher than the SSC at near the surface. On average of 15-day periods, the SSC values at 5 relative depths are about 33 mg/l (at near the surface, 02H), 45 mg/l (04H), 45 mg/l (at 06H), 67 mg/l (08H) and 74 mg/l (near the seabed, 1H). The mean and maximum SSC values over 5 depths and 15-day period are about 53 mg/l and 98 mg/l, respectively.

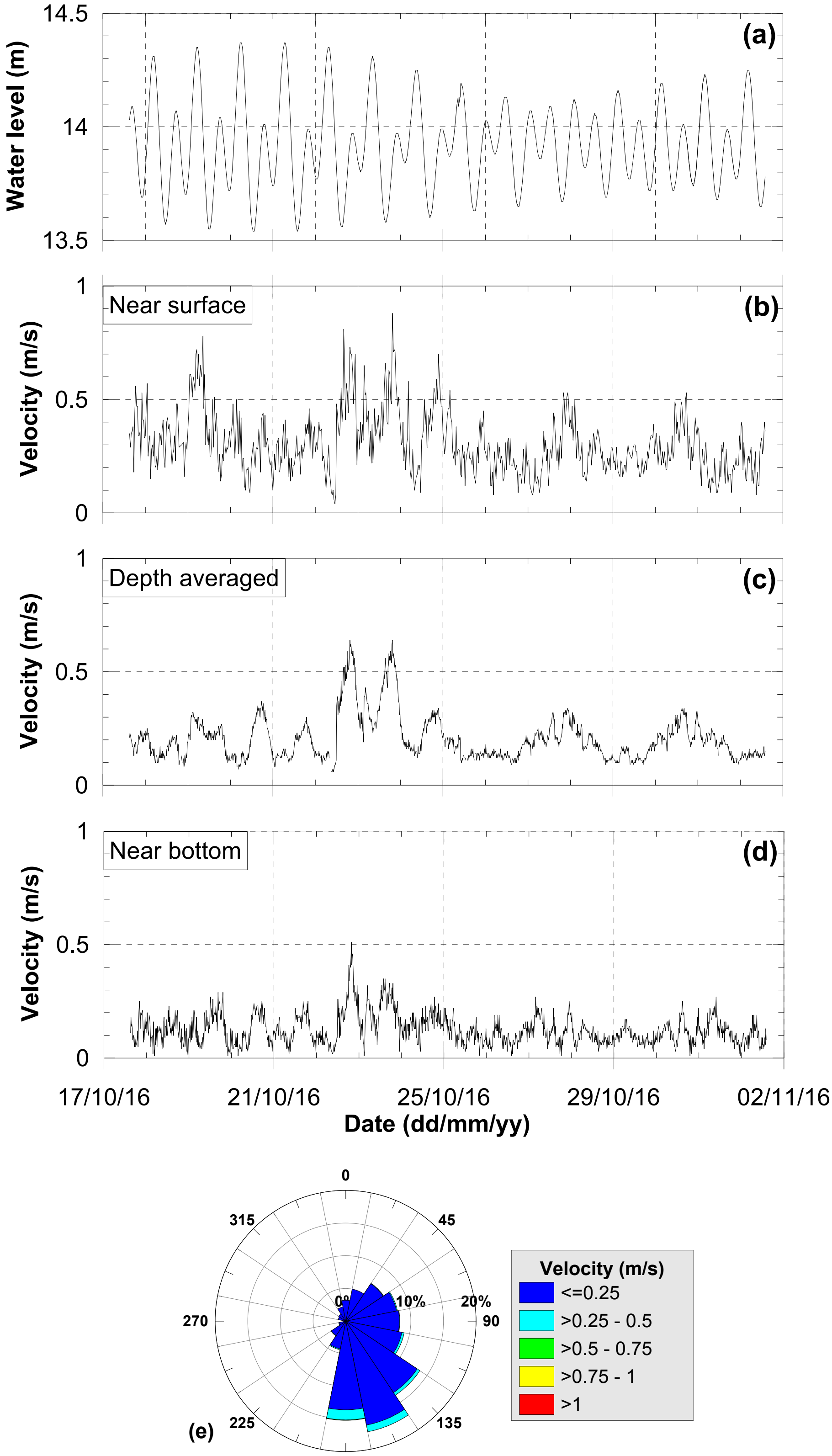


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Fig. 5: Time series plots of (a) water level relatively to the sea bed and current velocities of (b) near surface, (c) depth averaged and (d) near bottom and (e) directional distribution of current velocity at the mooring station of U Minh in wet season 2016.

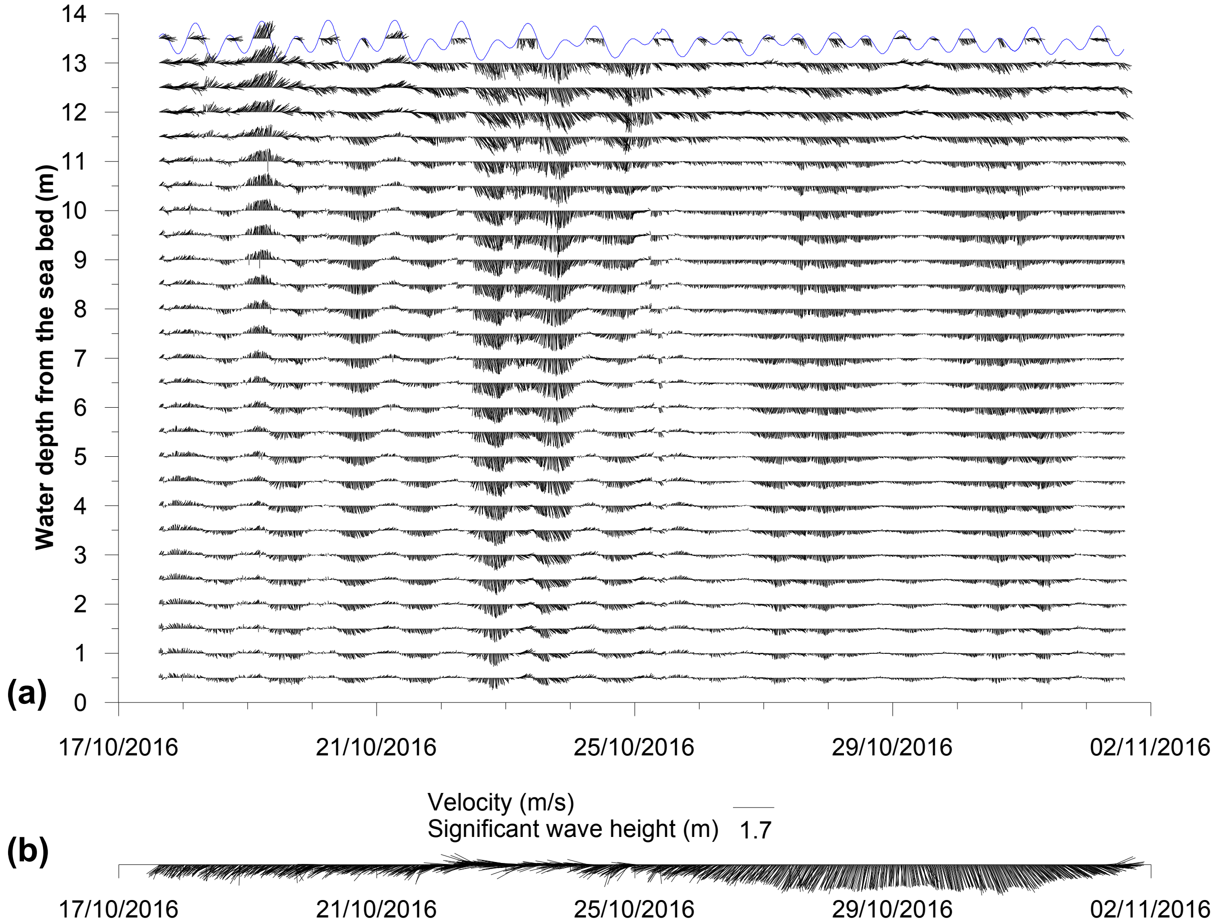
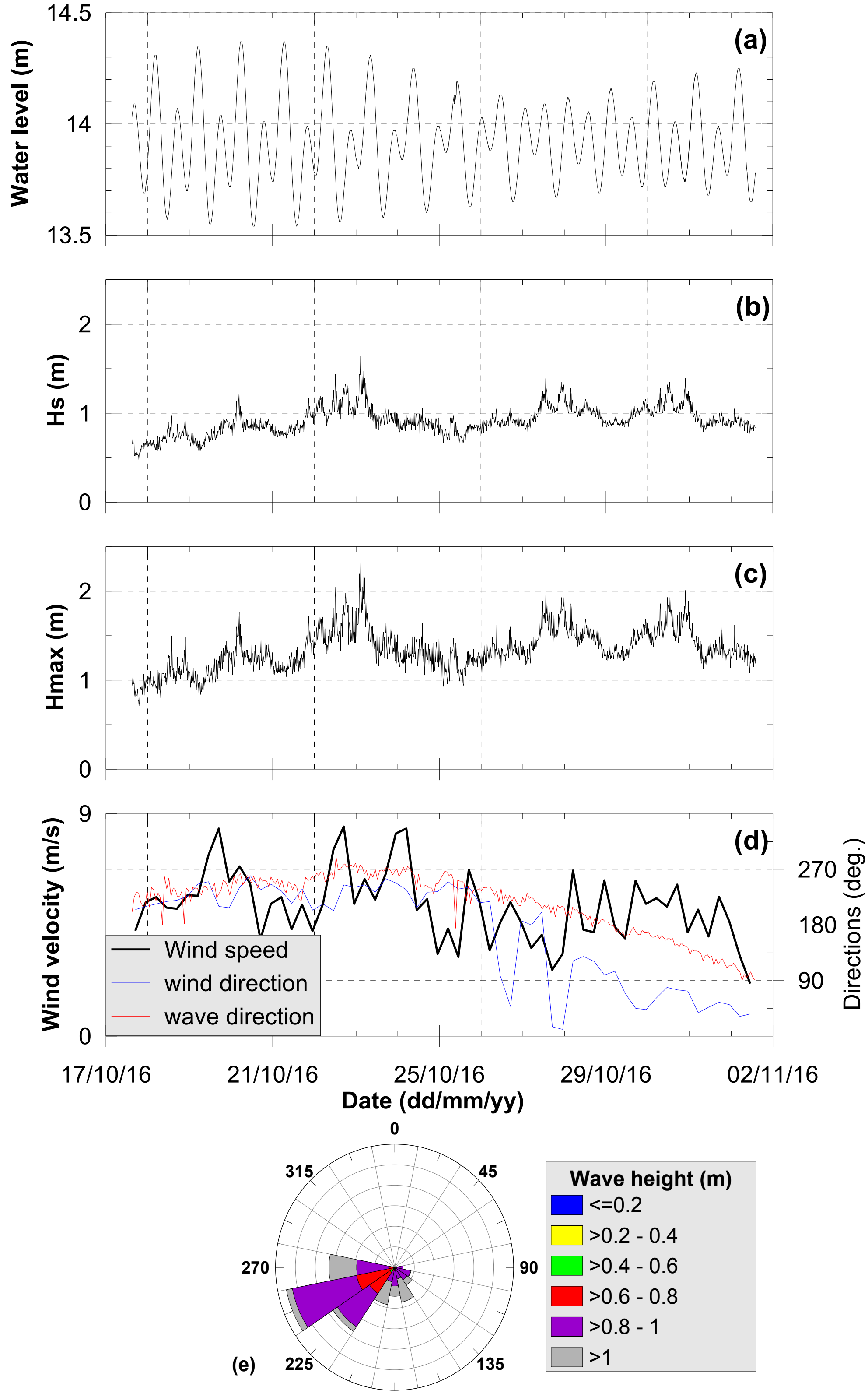


Fig. 6: Time series plots of vectors of (a) current velocity profiles and water level (blue line) and (b) significant wave height at the mooring station of U Minh in wet season. Zero water depth is referred at the sea bed.



4.

Fig 7: Time series plots of (a) water level fluctuations, (b) significant wave height (H_s), (c) maximum wave height, (d) wind speed and direction (blue line) and wave direction (red line), and (e) directional distribution of significant wave height which were measured at the mooring station of U Minh in wet season from 17 Oct to 2 Nov 2016. Water level is referred at the sea bed.

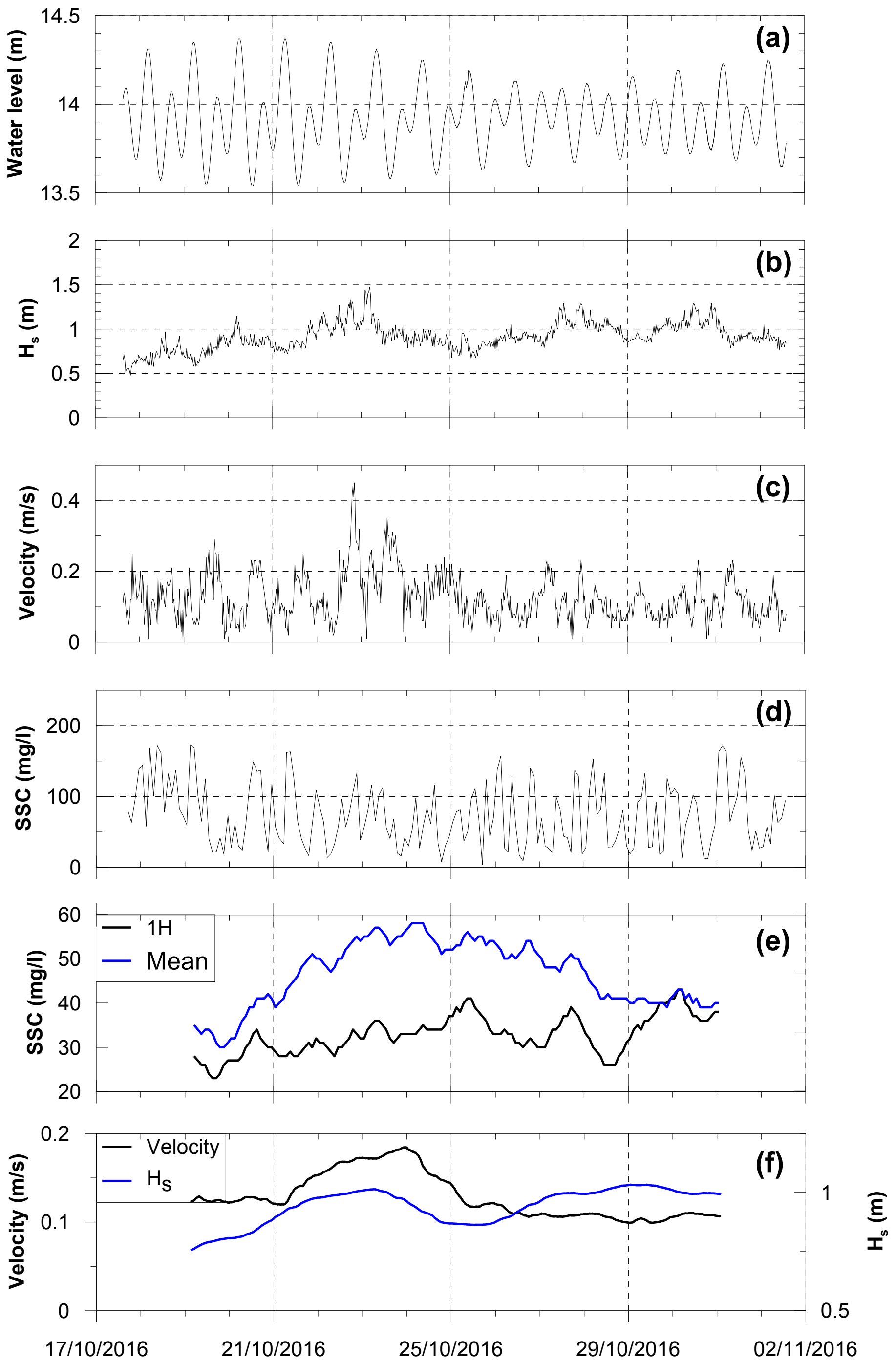


Fig. 8: Time series plot of (a) water level, (b) significant wave height, (c) current velocity at near the sea bed, (d) suspended sediment concentration at near the sea bed and (e) the 72-hour moving average of SSC at near the seabed and mean SSC over the water column and (f) velocity near the seabed and H_s which was measured at the mooring station of U Minh during wet season.

3. Mobile stations: Current velocity, wave parameter, Suspended Sediment Concentration (SSC) and Salinity during wet season

Current velocity, wave parameter, suspended sediment concentrations (SSC) and salinity along coast of the Mekong Delta are presented at different relative depths from the near surface to the sea bed (Fig. 9-12) and the grain size distribution of sea bed sediment is shown in Fig. 13. These data were acquired at mobile stations (Fig. 0-5) from 16 Oct – 01 Nov 2016. The measurements of current and wave data were carried out during only 30 min each station. Salinity data were collected from 16 Oct-26 Oct using two methods: CTD instrument and water samples for lab analysis. Fig. 12 shows the similarity between two sets of data. However, salinity data measured by the CTD are generally higher than those values measured from the water samples. At near the surface, the both salinity data are mostly similar with a slightly difference at the locations near the Song Doc. At near the seabed, the salinity data measured from the CTD are higher than the salinity measured from water samples. However, the tendencies of regional distribution of salinities collected by the in-situ CTD and laboratory measurement are not significant different. This difference is perhaps due to the offset between the CTD instrument used in the field and the salinity sensor in the laboratory. In addition, the data collection procedure may also contribute to the slightly different in the data measured by the two methods.

Due to the very short-time measurements and the data at these stations collected in different tidal situations, current velocities at mobile stations are hard to interpret. There were two cruising boat. The first one started from 16 Oct-01 Nov at Go Cong (station S1) to the cape of Ca Mau (S111) and the second boat began from 17 Oct -25 Oct from Song Doc (station S140) to Rach Gia (S183) and then from 26 Oct-31 Oct from Song Doc to the cape of Ca Mau (S112). In general, in the East Sea the current measured during spring tide at Go Cong to neap tide at the cape of Ca Mau. While in the West Sea from Song Doc to Rach Gia, current data were measured during mainly in spring tide and from Song Doc to the cap of Ca Mau, the current were collected from spring tide to neap tide.

The current velocities show that the velocities in the East Sea are higher than those in the West Sea (Fig. 9). The current directions in the East Sea are mainly coastal parallel with clearly ebb and flood directions; whereas the current directions are dominantly in S direction. Maximum depth averaged velocity in the East Sea and the West Sea is about 1 m/s and 0.4 m/s respectively. During neap tide depth averaged current velocity around the cape of Ca Mau is about 0.5 m/s.

Wave data in wet season at the mobile stations show that the western side of the Mekong is stronger affected by the prevailing SW waves than the eastern side (Fig. 10). In the West Sea, the wave directions at the locations off the coast from Song Doc to Rach Gia are mostly perpendicular to the coast. Wave directions in south of Song Doc to the cape of Ca Mau are almost parallel to the coast. While in the East Sea, the wave directions are very scattered. Wave heights in the West Sea are also higher compared the wave heights in the east sea. Averaged values of significant and maximum wave heights are about 0.7 m and 1.2 m for West Sea and 0.5 m and 1.4 for East Sea.

Suspended sediment concentrations (SSC) at 5 relative depths are presented in Fig. 15. The SSC data show that the suspended matter values in the East Sea are generally higher those values in the West Sea. Most of the SSC data are less than 200 mg/l. There is a gradient of increasing SSC values from near the surface to seabed. The sediment flume from the Mekong river mouth was also recognized The higher SSC values are located near the mouths and extended about 10 km offshore. Low suspended sediment concentrations region was found along the coast from south of Bassac to Bo De. In this region, SSC data are usually lower than 100 mg/l. Higher SSC data are seen at the shallower bathymetry locations near the cap of Ca Mau with the values of 120 mg/l at near the surface up to 200 mg/l at near the seabed. In the West Sea, most of SSC data are below 100 mg/l, especially at off coast stations the SSC values are mostly less than 10 mg/l. There is a small are near the bay of Rach Gia which shows the SSC value can reach from about 60 mg at near the surface to 140 mg/l at near the seabed. The high SSC values during the wet season along the Mekong Delta were confirmed as well from the SSC values at both mooring stations Go Cong (Fig. 5) and U Minh (Fig. 8).

River flumes are also obviously observed from the salinity distribution along the Mekong Delta. Low salinity values at the Mekong river mouths range from 10-24 PSU (Fig. 12). The low salinity region are seen close to the coast along the south of Bassac to the tip of Ca Mau with salinity values vary about 10-20 PSU. This indicates as well the picture of along shore transport of river flume along the Mekong Delta. There is also a low salinity area near the coast from Song Doc to Rach Gia. This perhaps is due to the fresh water discharge from the channels in the western side of the Mekong Delta.

Supplement to the these SSC and salinity data along the Mekong Delta during SW monsoon, the detailed pictures of suspended matter and salinity distributions at some typical cross-section profiles are shown in Fig. 14-20. These data are also putting in regarding to tidal fluctuations.

Sediment grain-size distribution along the Mekong Delta is shown in Fig. 13. During the wet season (Oct 2016), the clinoform in the estuary zone, from Cua Tieu to Dinh An, was influenced by strong river runoff and fine sediment discharge. Silt was found near the river mouths and on the lower fore set of the estuary zone. Off Dinh An and Bassac river mouths, a range of mixed sediment from fine silt to very fine sand were found, with prevailing coarse silt sediment. Elsewhere in this area, sediments were composed of sand mixture ranging from very fine to medium sand, with fine sand being dominant. Along the East coast and West coast, south of the Bassac river mouth to Rach Gia, most seabed sediments had fine silt grain-size. There were small areas with fine sand near the cape of Ca Mau in front of Bo De mouth and near Ha Tien.

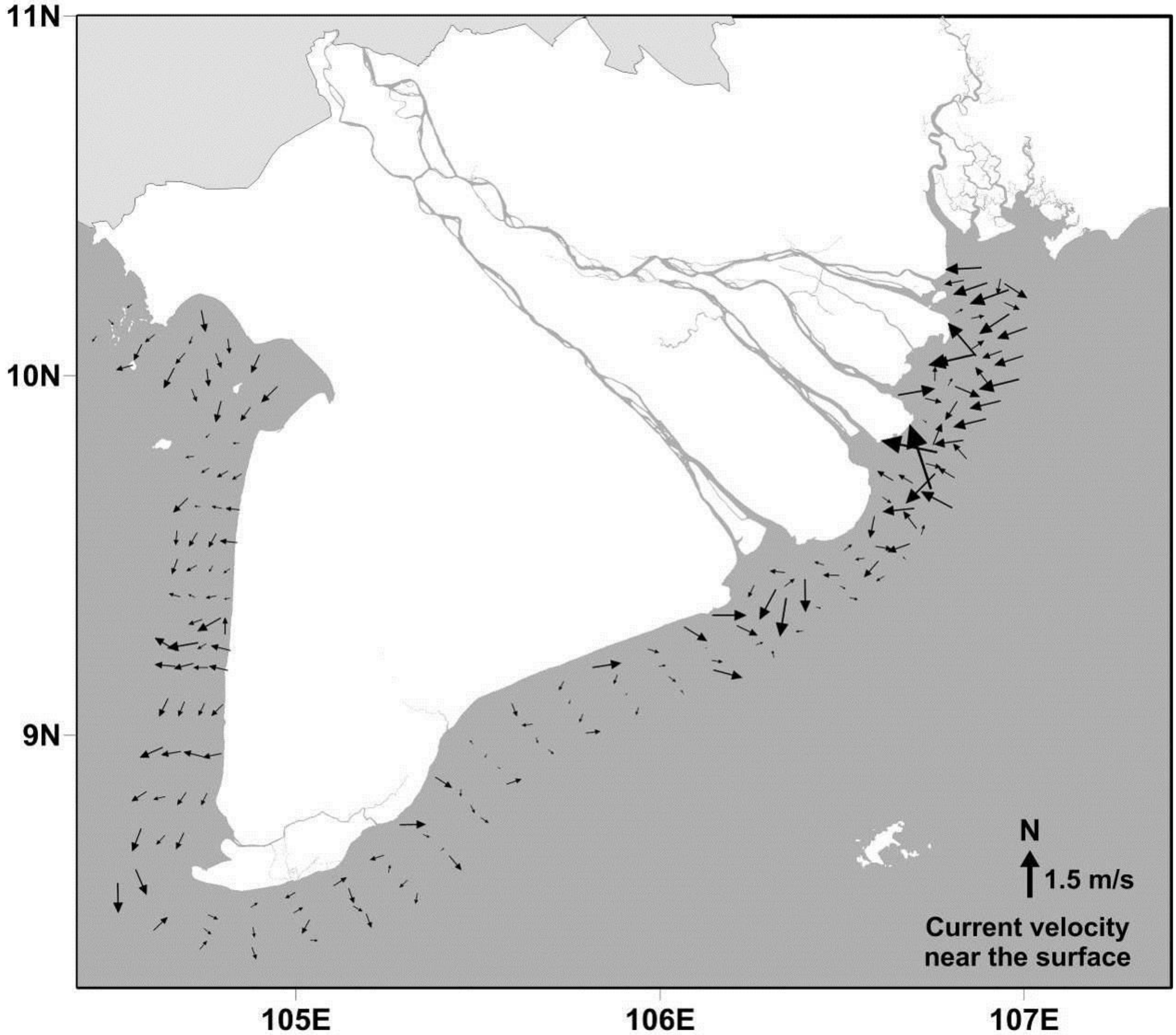


Fig. 9a: Vectors of current velocity at near the surface of short-term stations along the Mekong Delta coast. These data were measured at each station for 45 minutes with the time interval of 15 minutes and were collected from 16 October to 1 November 2016.

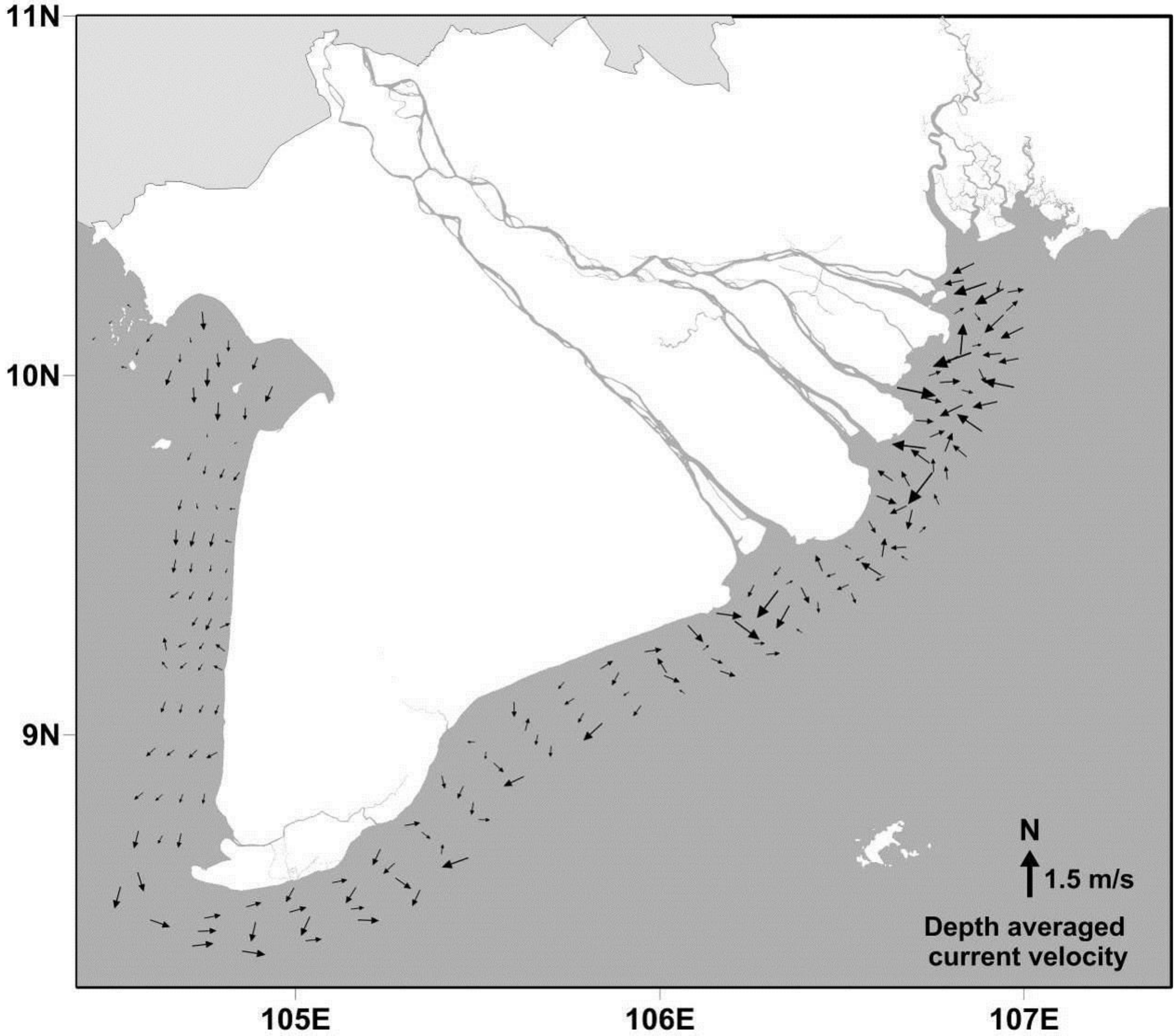


Fig. 9b: Vectors of depth averaged current velocity of short-term stations along the Mekong Delta coast. These data were measured at each station for 45 minutes with the time interval of 15 minutes and were collected from 16 October to 1 November 2016.

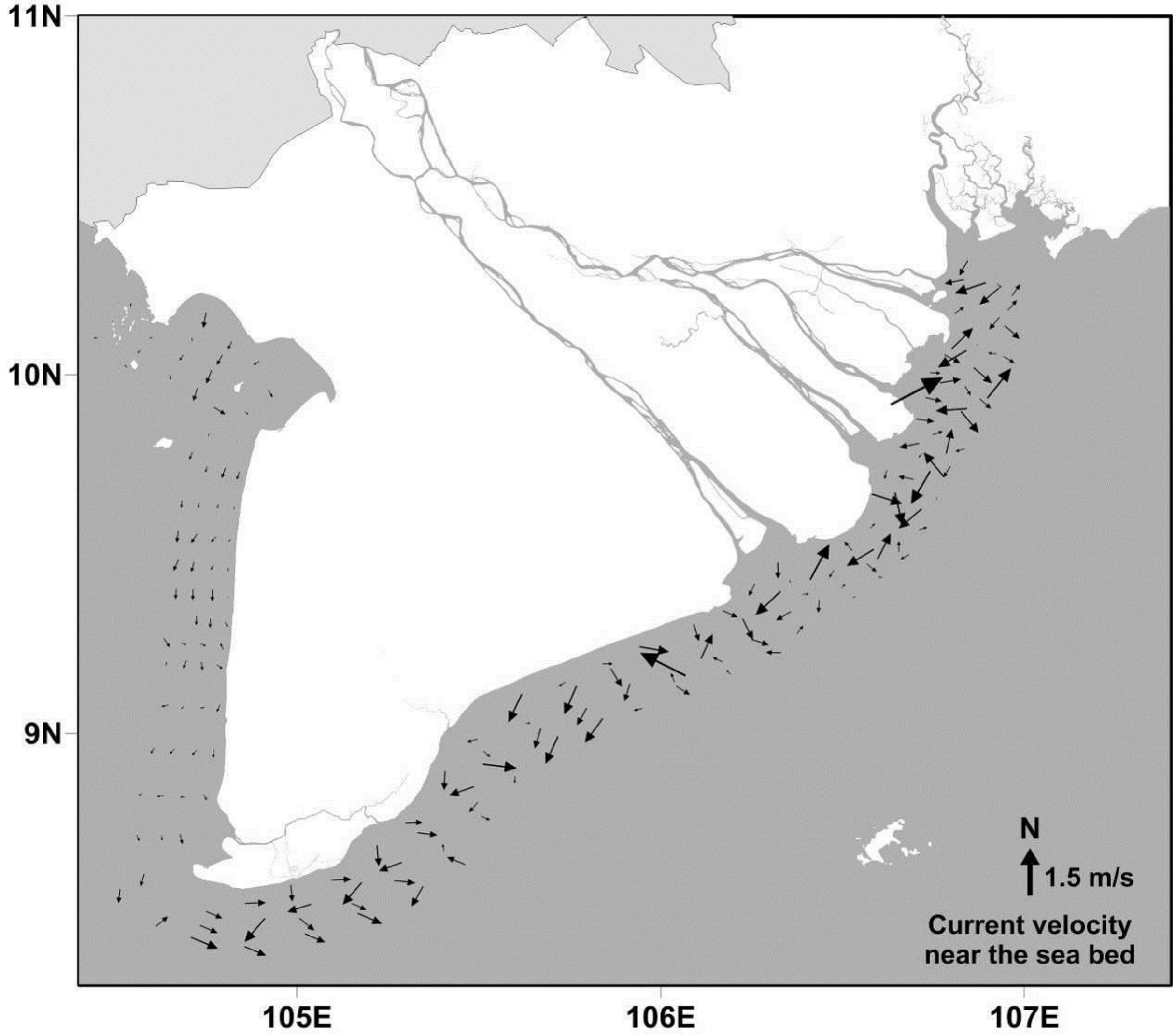


Fig. 9c: Vectors of current velocity at near the sea bed of short-term stations along the Mekong Delta coast. These data were measured at each station for 45 minutes with the time interval of 15 minutes and were collected from 16 October to 1 November 2016.

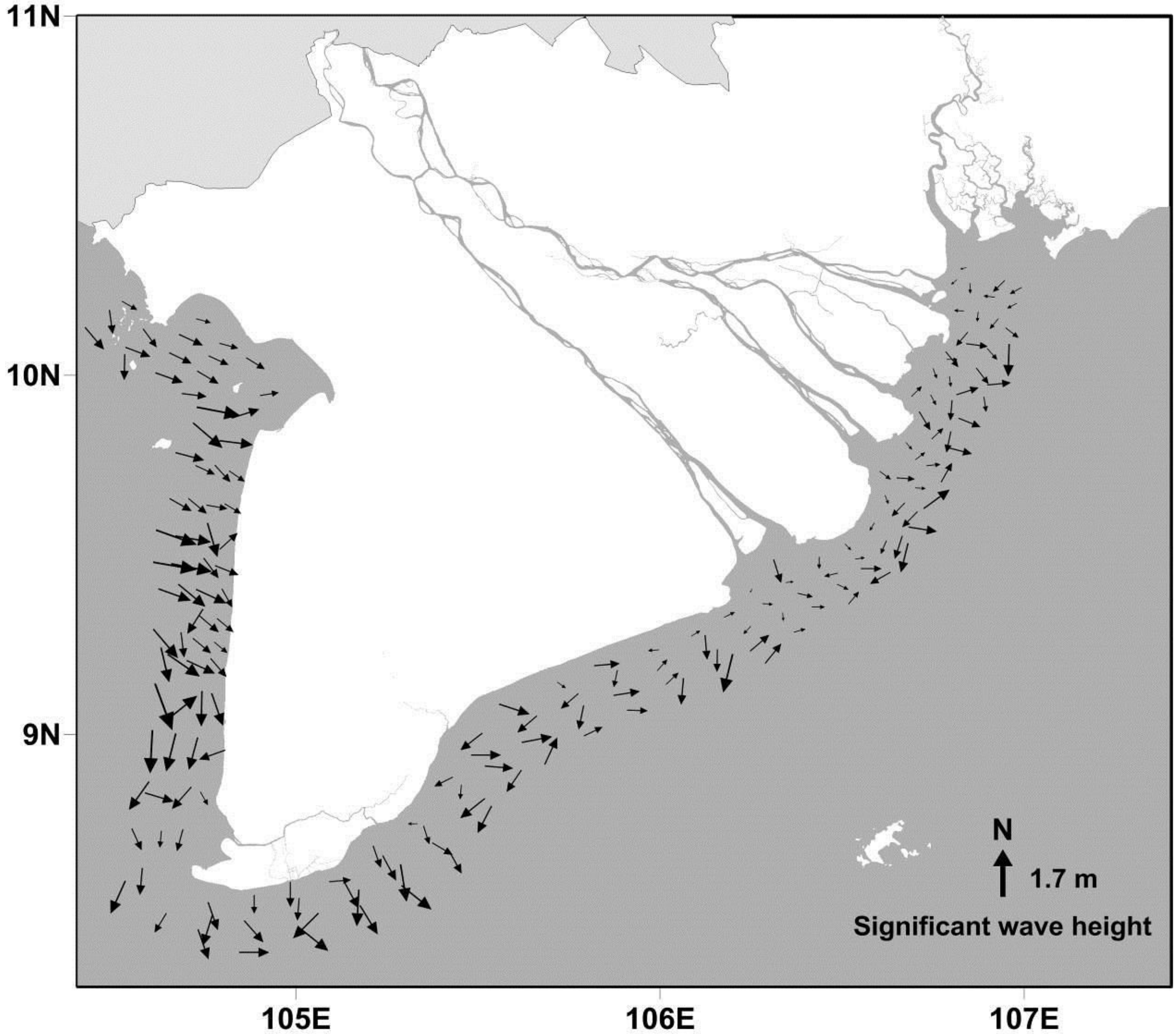


Fig. 10a: Vectors of significant wave height of short-term stations along the Mekong Delta coast. These data were measured at each station for 45 minutes with the time interval of 15 minutes and were collected from 16 October to 1 November 2016.

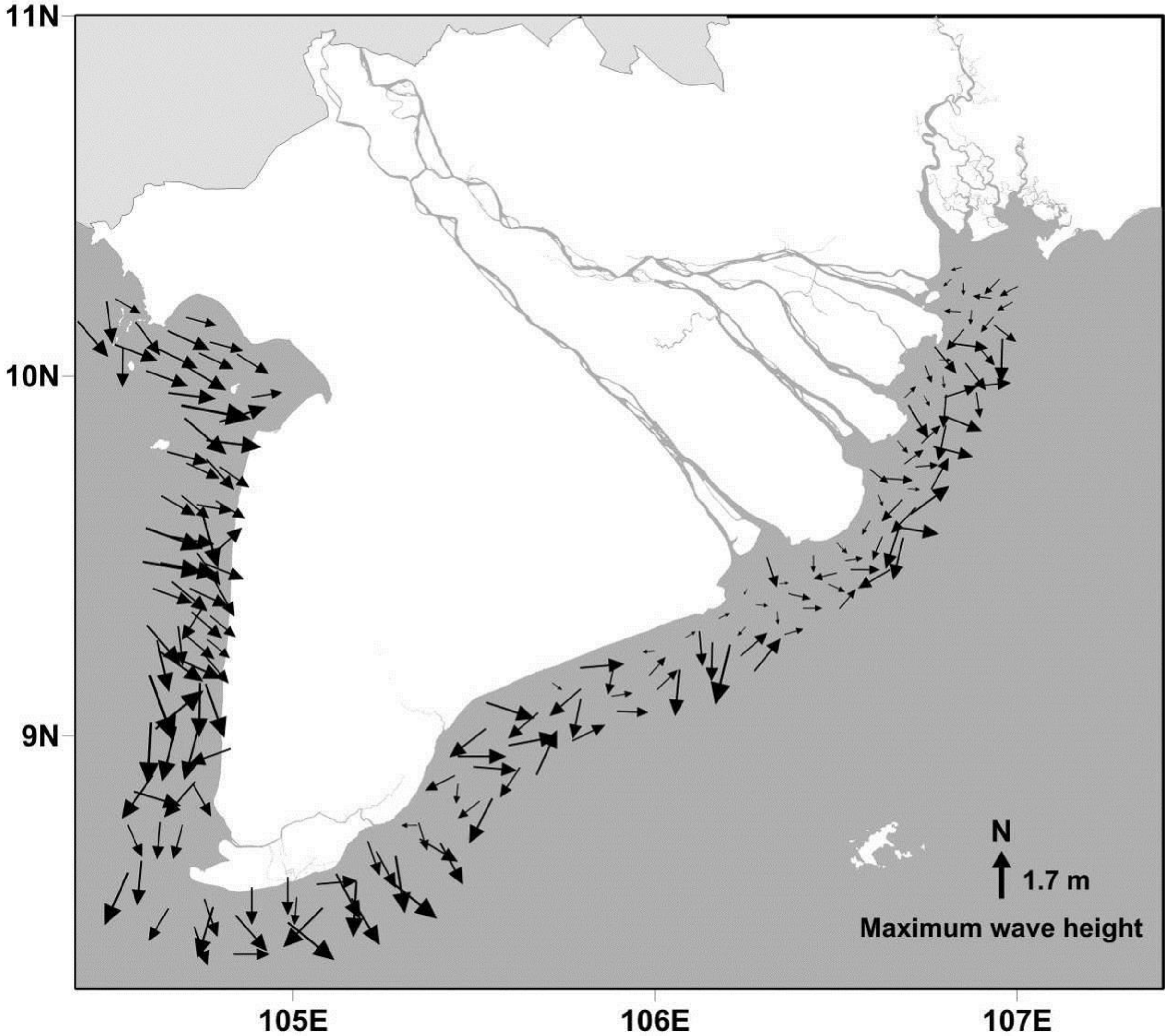


Fig. 10b: Vectors of maximum wave height of short-term stations along the Mekong Delta coast. These data were measured at each station for 45 minutes with the time interval of 15 minutes and were collected from 16-26 October 2016.

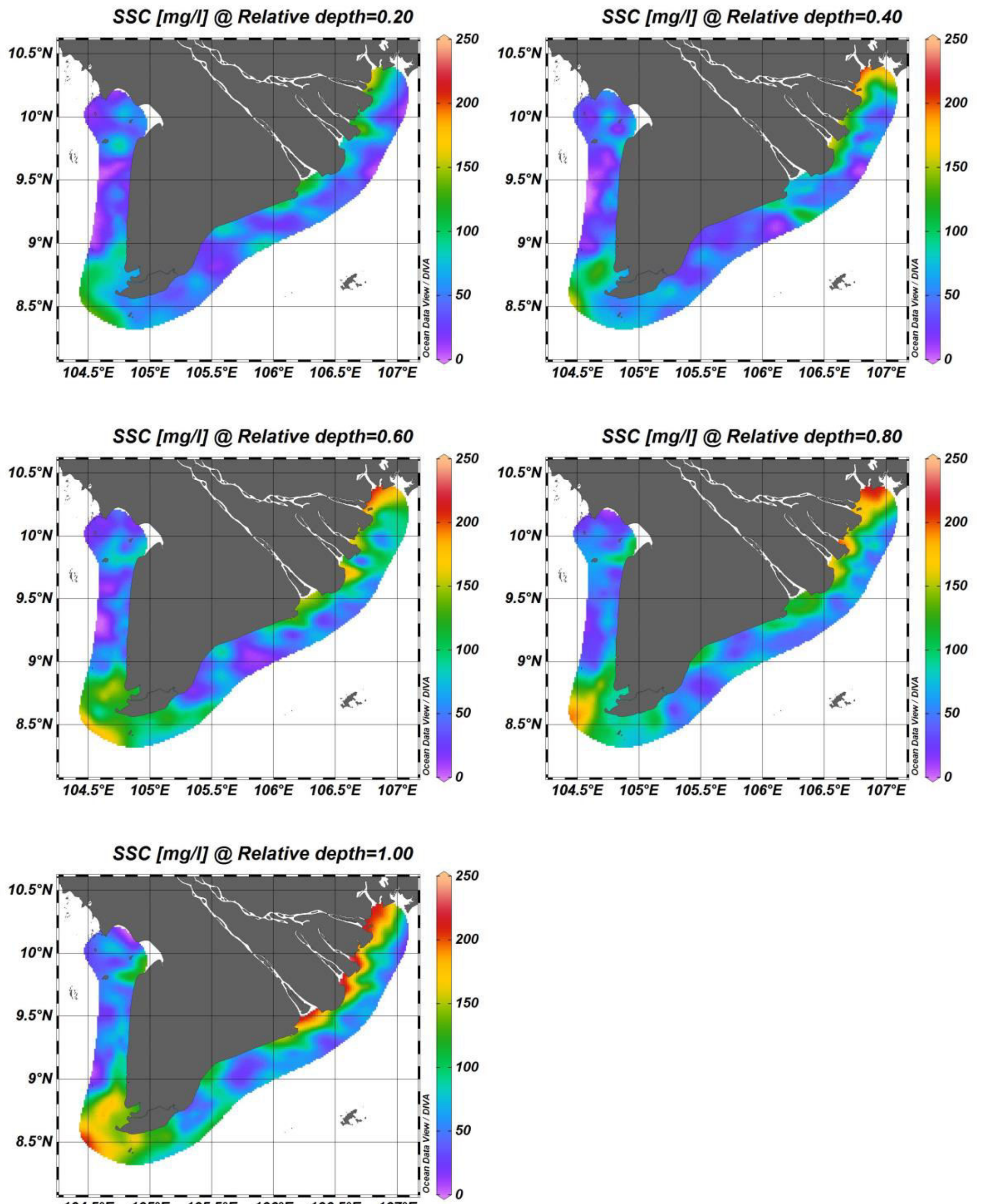


Fig. 11. Suspended sediment concentrations (SSC) along coast of the Mekong Delta at five relative depths from the near the surface (Depth=0.2) to near the sea bed (Depth=1.00). These data were sampled from 16 Oct. to 26 Oct. 2016 and measured in the laboratory.

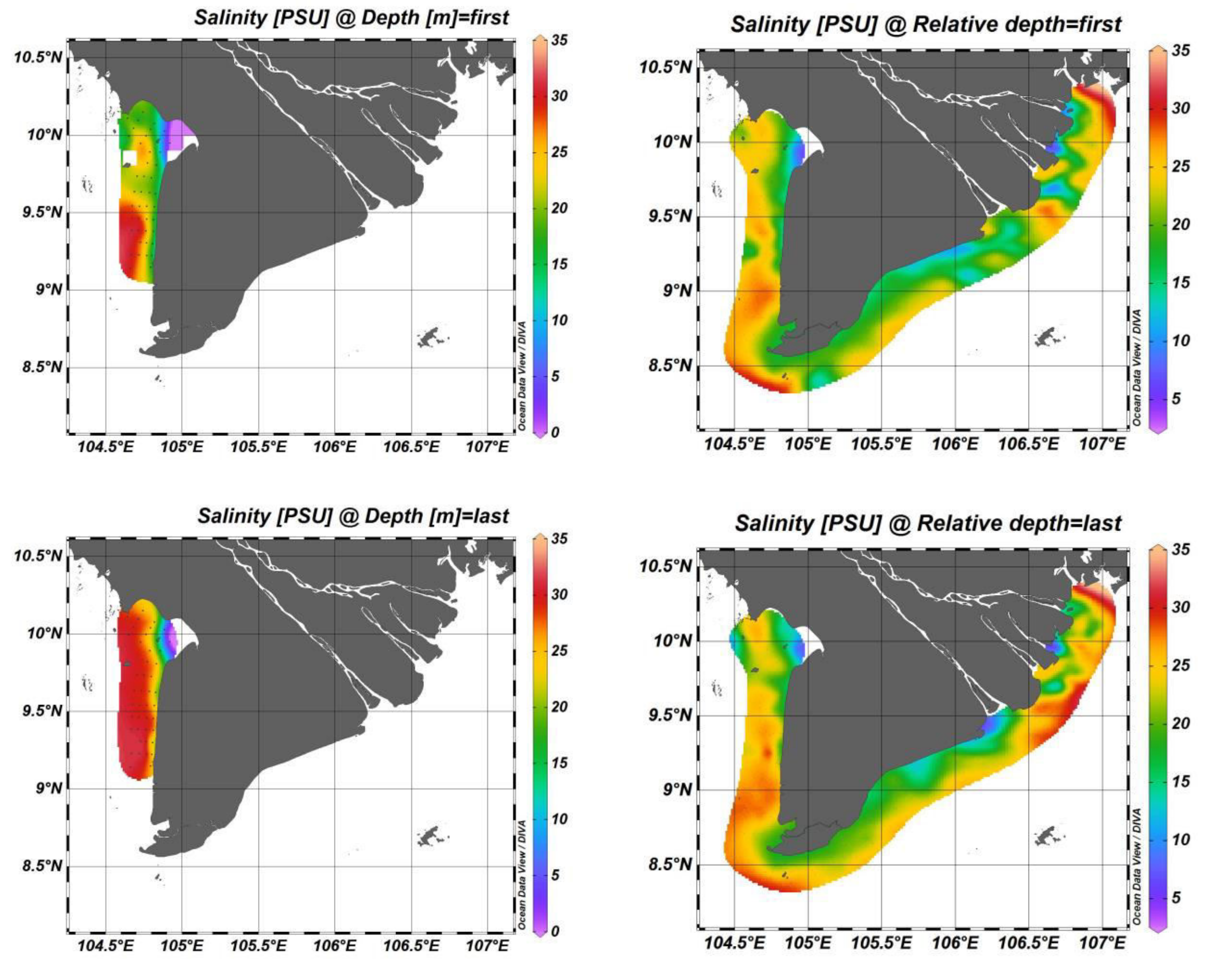


Fig 12: Comparison of salinity data, which were collected in 16 Oct. – 26 Oct. 2016, between the two measuring methods from the CTD instrument (left figures) and from the water samples (right figures). The salinity data in top figures are collected at near the surface and the data in bottom figures are selected at near the sea bed. These data show that the salinity data measured in-situ using the CTD probe are very similar to the data measured from the water samples. This indicates that the salinity data measured from the water samples were reliable.

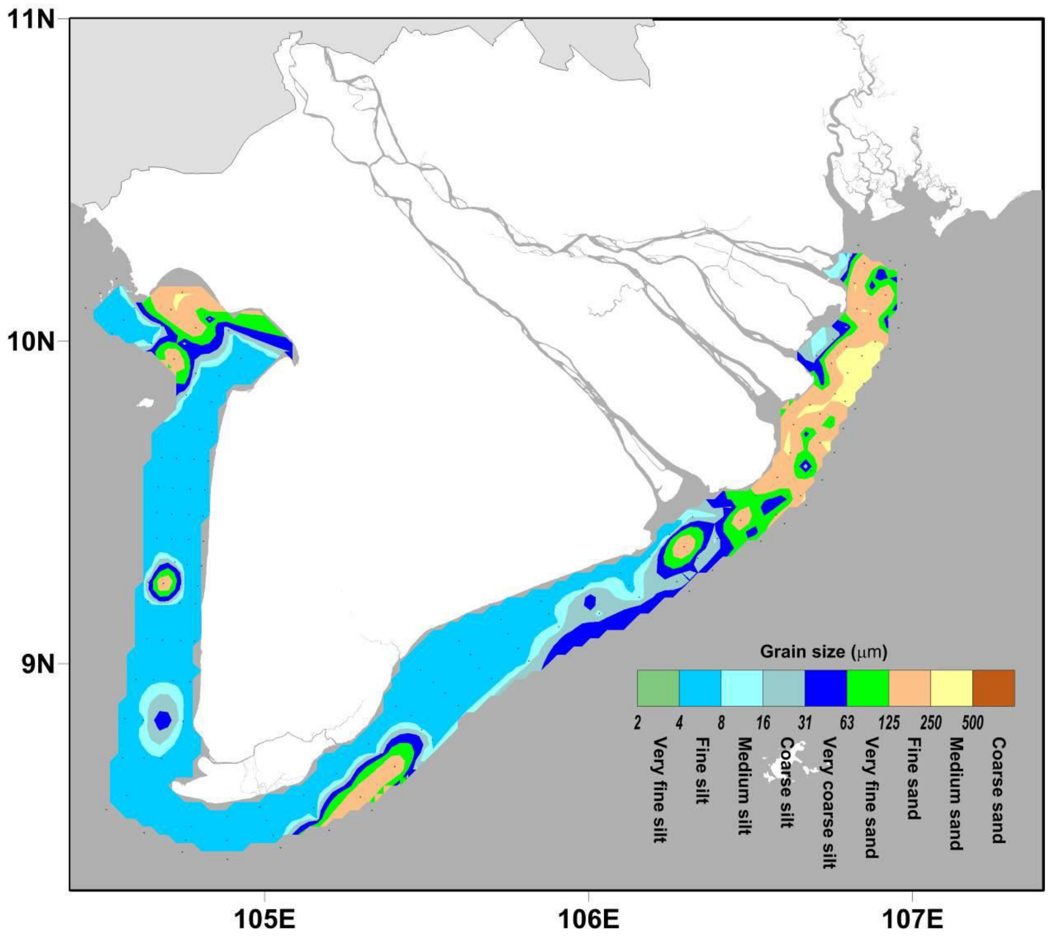


Fig. 13: Grain size distributions of sea bed sediment along the Mekong Delta coast. These values are the dominant modes from the results of grain size analysis using GRADISTAT (Blott, 2010). These sediment samples were collected from 16-26 October 2016.

4. Analysis of typical transects in LMDCZ during wet season 16.10.2016 – 01.11.2016

Salinity and suspended sediment concentrations at some typical transects, e.g. Cua Dai, Ham Luong, Cung Hau, Bassac, Ganh Hao, song Doc, Rach Gia, were analysed in correlation with water level fluctuations from predicted tide for the national tide gauges. The results are presented from Fig. 15 to Fig. 21.

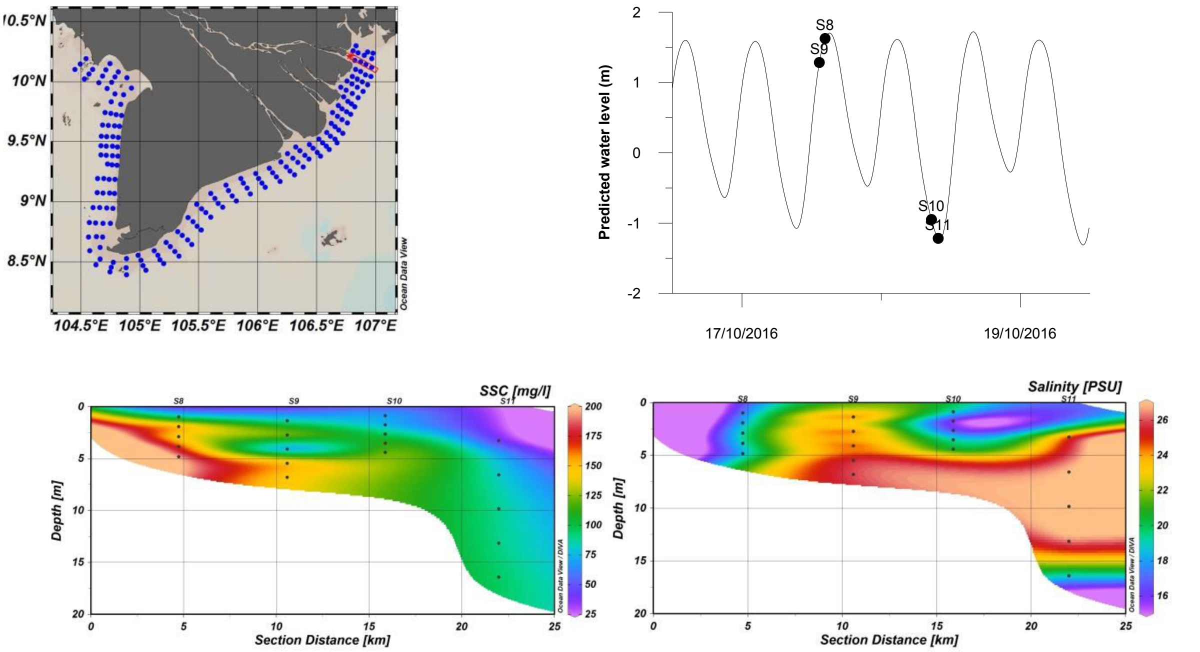


Fig. 14: Salinity and suspended sediment concentration on Cua Dai transect (4 stations from S8-S11) in correlation with water level fluctuations from predicted tide for the national tide gauge, Binh Dai station which is located near the mouth of Cua Tieu River, Oct 2016

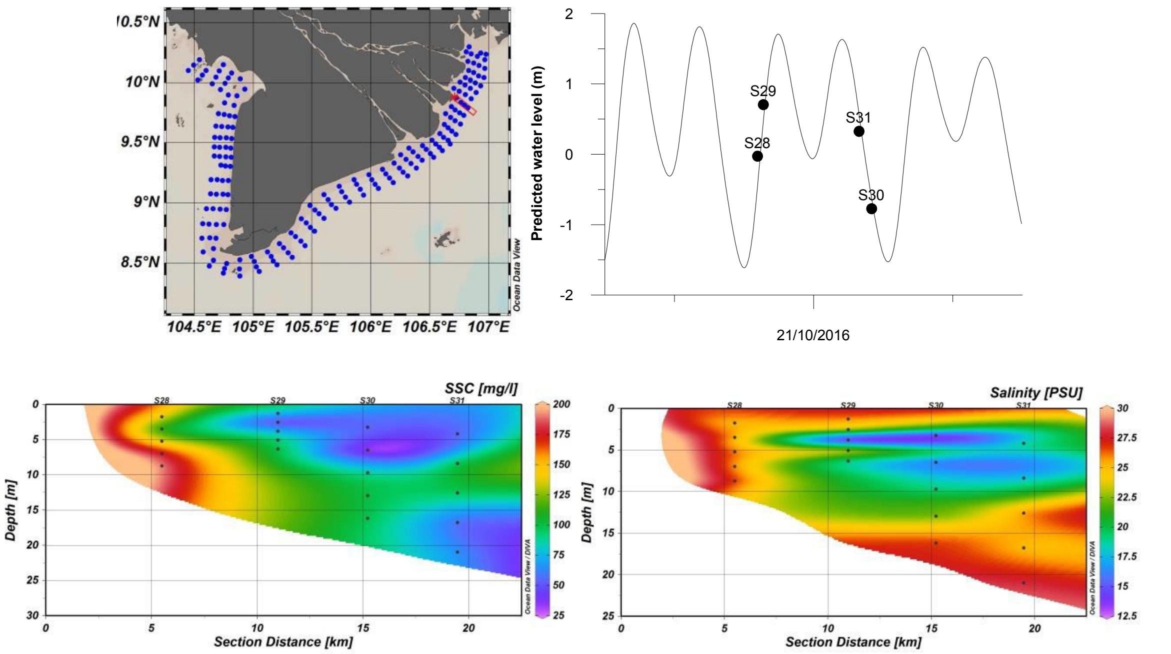


Fig. 15: Salinity and suspended sediment concentration on Ham Luong transect (4 stations from S28-S31) in correlation with water level fluctuations from predicted tide for the An Thuan station which is located near the mouth of Ham Luong River, Oct 2016

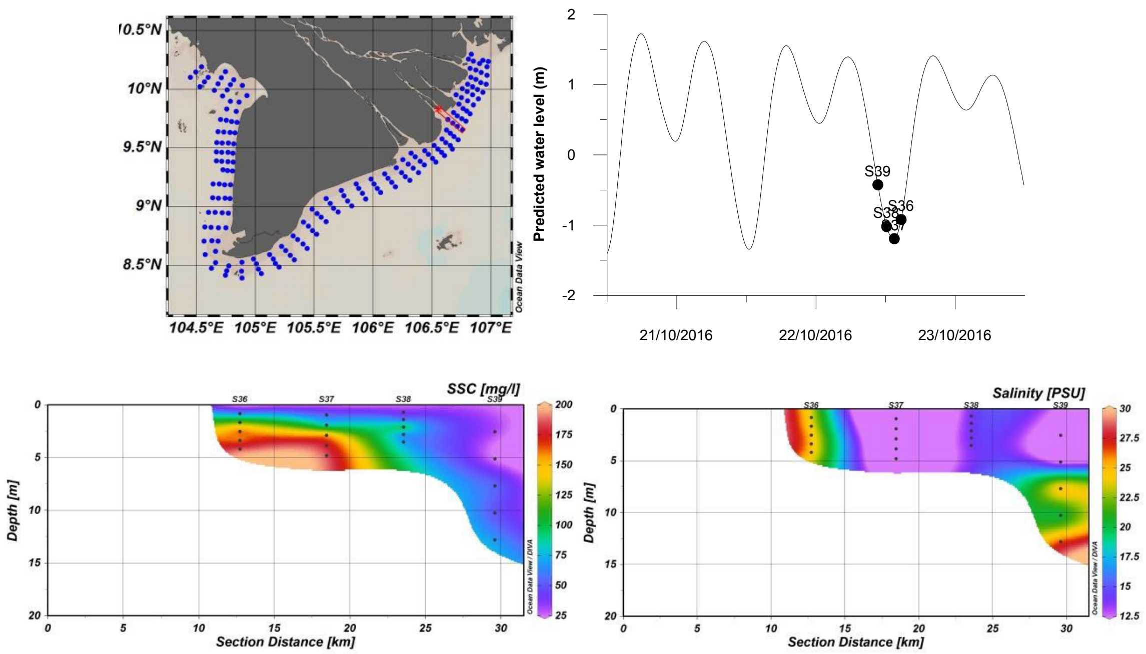


Fig. 16: Salinity and suspended sediment concentration on Cung Hau transect (4 stations from S36-S39) in correlation with water level fluctuations from predicted tide for the Ben Trai station which is located near the mouth of Cung Hau River, Oct 2016

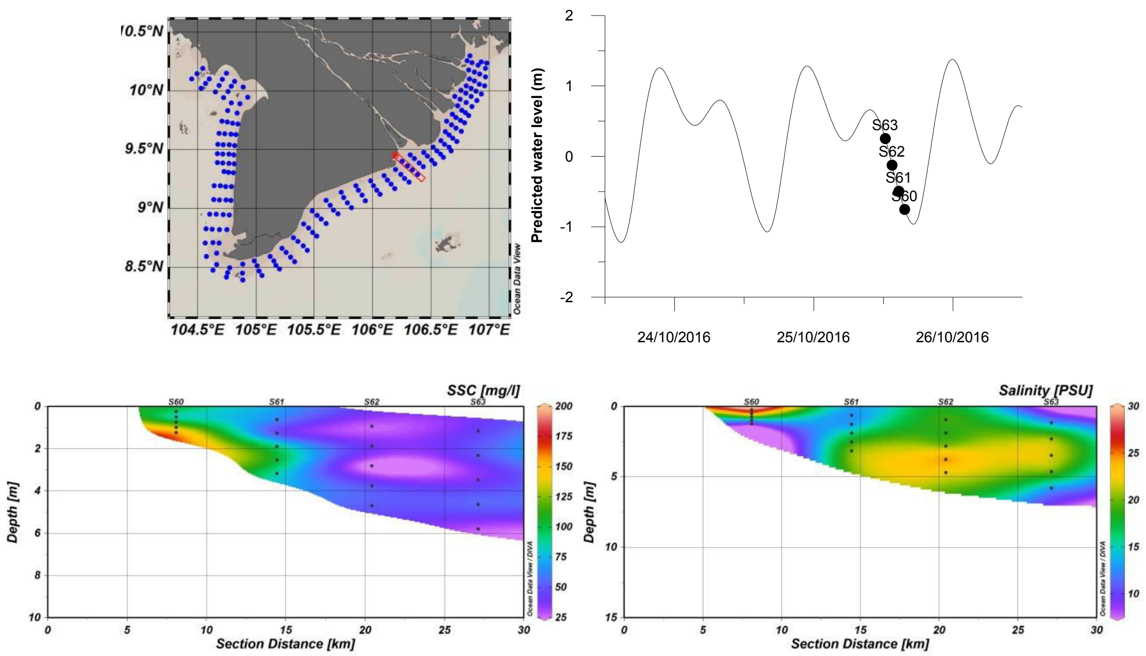


Fig. 17: Salinity and suspended sediment concentration on Bassac transect (4 stations from S60-S63) in correlation with water level fluctuations from predicted tide for the national tide gauge, My Thanh station which is located near the mouth of Bassac River, Oct 2016

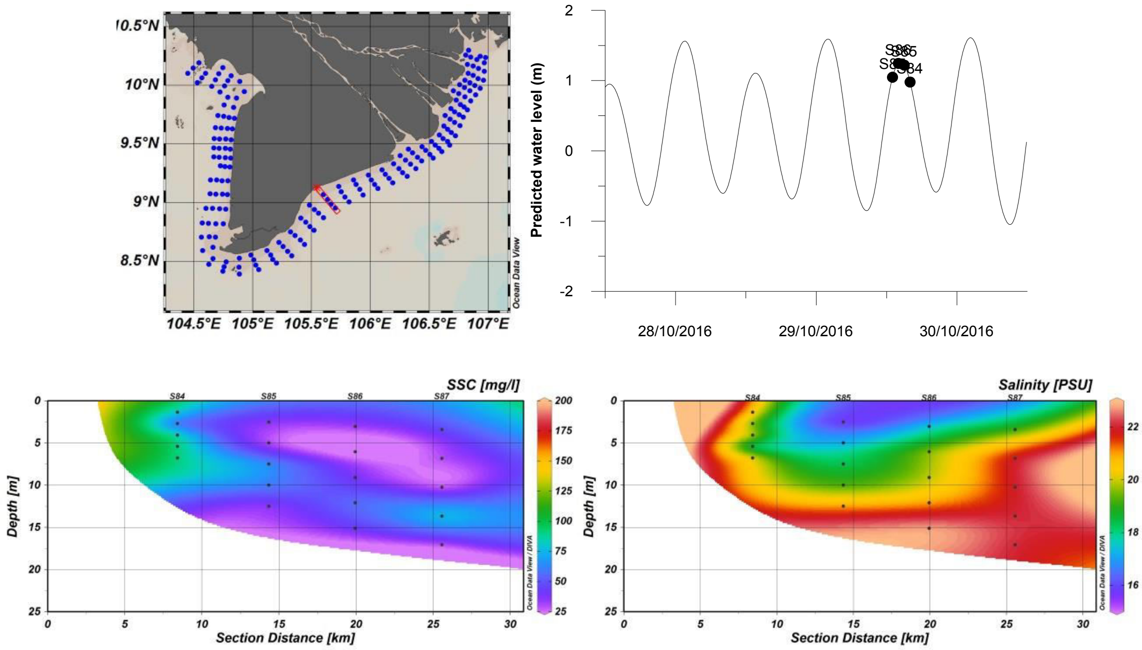


Fig. 18: Salinity and suspended sediment concentration on Ganh Hao transect (4 stations from S84-S87) in correlation with water level fluctuations from predicted tide for the Ganh Hao station which is located near the mouth of the Ganh Hao tidal channel, Oct 2016

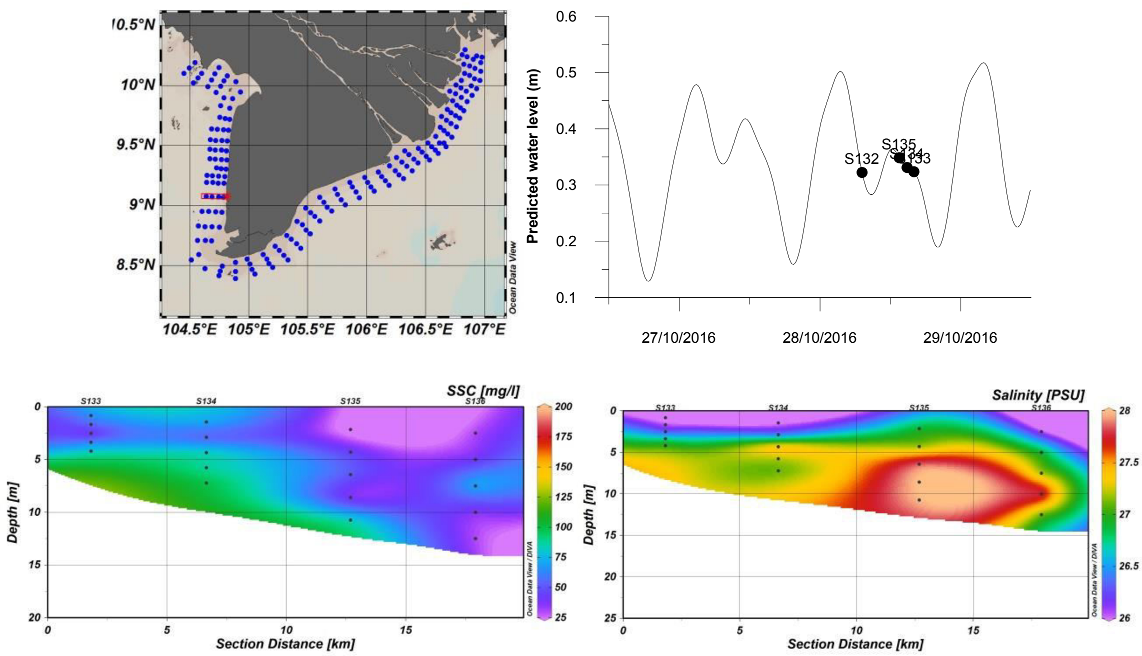


Fig. 19: Salinity and suspended sediment concentration on Song Doc transect (4 stations from S132-S135) in correlation with water level fluctuations from predicted tide for Song Doc station which is located near the mouth of the Song Doc tidal channel, Oct 2016

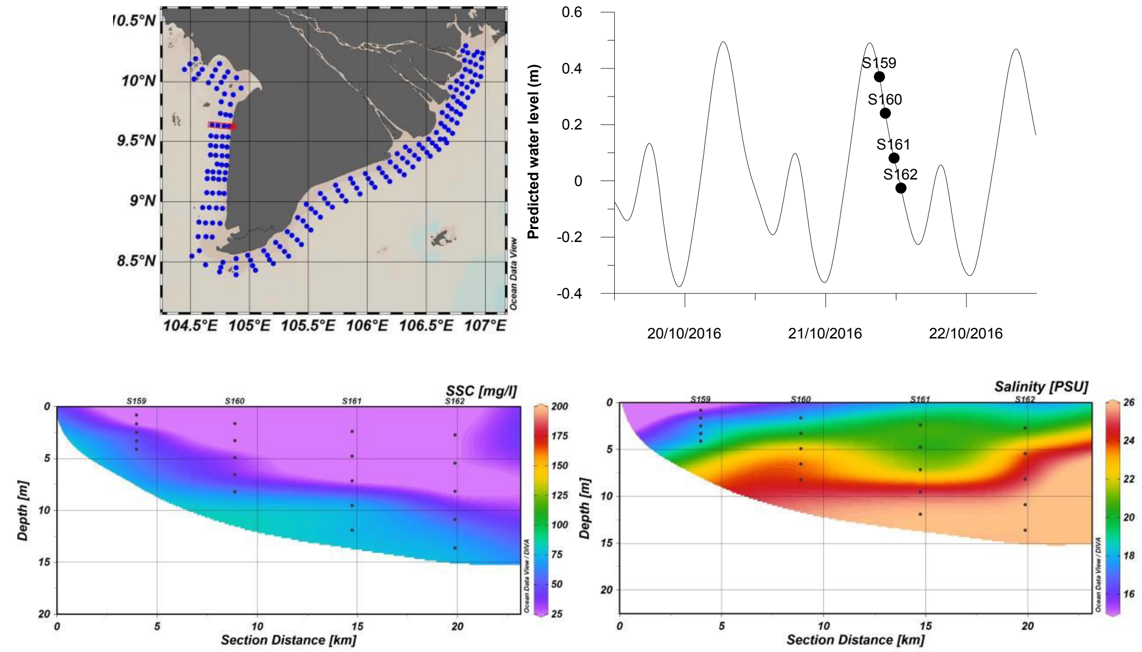


Fig. 20: Salinity and suspended sediment concentration on south of Rach Gia transect (4 stations from S159-S162) in correlation with water level fluctuations from predicted tide for Song Doc station which is located near the mouth of the Rach Gia River, Oct 2016

APPENDIX B

Results of the second survey campaign

24.02.2017 - 12.03.2017

1. *Go Cong* station: Water level, current and wave parameters at the mooring station during dry season

Water level fluctuations, current velocities and wave parameter at the mooring station of Go Cong were measured during 15 days in 24 Feb to 12 Mar 2017 (Fig. 1-4). Tidal ranges vary from 2.11 m (on 3 Mar 2017) to 2.84 m (28 Feb 2017). It is not significant difference between the tidal ranges of ebb phases and the tidal ranges of flood phase. The durations of ebb and flood phases are almost the same with the difference in mean duration between ebb and flood is about 8 minutes (Tab. 1). The maximum value of tidal range of flood or ebb is about 2.84 m. On average during 15 day, mean tidal range is about 2.6 m and mean tidal ranges of ebb or flood phases are both about 1.84 m.

Tab. 1: Tidal parameters at mooring station of Go Cong in dry season 2017

Tidal parameters	Max	Min	Average
Tidal range (m)	2.84	2.11	2.46
Tidal range of ebb phase (m)	2.84	0.46	1.84
Tidal range of flood phase (m)	2.86	0.52	1.84
Duration of ebb phase (hour)	7.50	5.00	6.29
Duration of flood phase (hour)	7.75	4.75	6.16

About time series current velocities of vertical profiles, measured values are almost less than 1 m/s during 15 days. There is not significant difference between ebb and flood currents. However ebb currents are slightly faster than flood currents (Fig. 1). The maximum values of current velocity are about 0.72 m/s (for flood) and 0.92 m/s (for ebb) at near the surface, about 0.70 m/s (flood) and 0.77 (flood) at near the sea bed and about 0.71 m/s (flood) and 0.84 m/s of depth averaged.

Current directions show relatively uniform directions over the water column. Flood currents flow dominantly in NW directions; reversely ebb currents are mainly in SE (Fig. 1e). Current velocities are also not considerable variation in depth. From the surface to the bottom, current velocities are slightly deceasing (Fig. 2). At the times of highest observed velocity (1.18 m/s) (27 Feb 2017), in the layer from the depth of 6.5 m to near the surface, current velocities are more fluctuations; whereas from depth of 6.0 m to near the sea bed, velocities are slightly deceasing with a gently gradients (Fig. 3). This indicates for a strong influence of wave on currents in this near surface layer.

Wind and wave parameters at Go Cong illustrate for a strongly NE monsoon condition. Wind directions range from E-SE and dominated in SE. Wave directions are dominated in ESE (accounting for 67% of all directions measured in 15 days) and SE (accounting for 33%) and significant wave heights are almost higher than 0.5 m (Fig. 4). The variations of wave heights are not related very well to wind velocities measured from the anchored fishing boat. This indicates that locally measured wind data are not fully explained for wave height fluctuations in this area. From 24 Feb to 3 Mar 2017 (spring tide), wave heights reach the highest values. After that, wave heights tend to decease to the minimum values from 3-6 Mar 2017 (neap tide). Then, wave heights show an increasing trend again from 6-12 Mar 2017 (spring tide). The periods of peaks or troughs of wave height during the first and the last periods are almost 1 day. The ranges between the consecutive peak and trough of wave heights can reach up to 1.5 m for significant wave height (H_s) and 2 m for maximum wave height (H_{max}). The maximum of H_s and H_{max} are about 1.6 and 2.3 m, respectively. The mean value of H_s and H_{max} are 0.8 m and 1.2 m.

The SSC data at the mooring station of Go Cong is presented in Fig. 5. During the dry season, the vertical distribution of SSC is mostly lower than 100 mg/l (Fig. 5d). It is hard to figure out the predominant factor between wave and current in driving suspended sediments. The variations of the suspended sediments are well fitted with the fluctuations of both wave and current actions (Fig. 5e, f). Peaks of SSC are mainly observed after the peaks of wave height or peaks of current velocity (Fig. 5b, c, d). Although big wave conditions happen most of the times, the SSC values periodically fall to zero values. However, these zero values are mostly occurring around high tides (Fig. 5a, d). The vertical distribution of SSC values shows no significant difference of SSC at near the surface or near the bottom. Average SSC values of during 15-day period are about 13 mg/l at near the surface (02H), 14 mg/l (04H), 16 mg/l (06H), 19 mg/l (08H) and 26 mg/l (near seabed, 1H). The maximum SSC values range from 80 mg/l (at 02H) to 107 mg/l (at 1H). The average SSC from 5 depths in 15 days is about 18 mg/l.

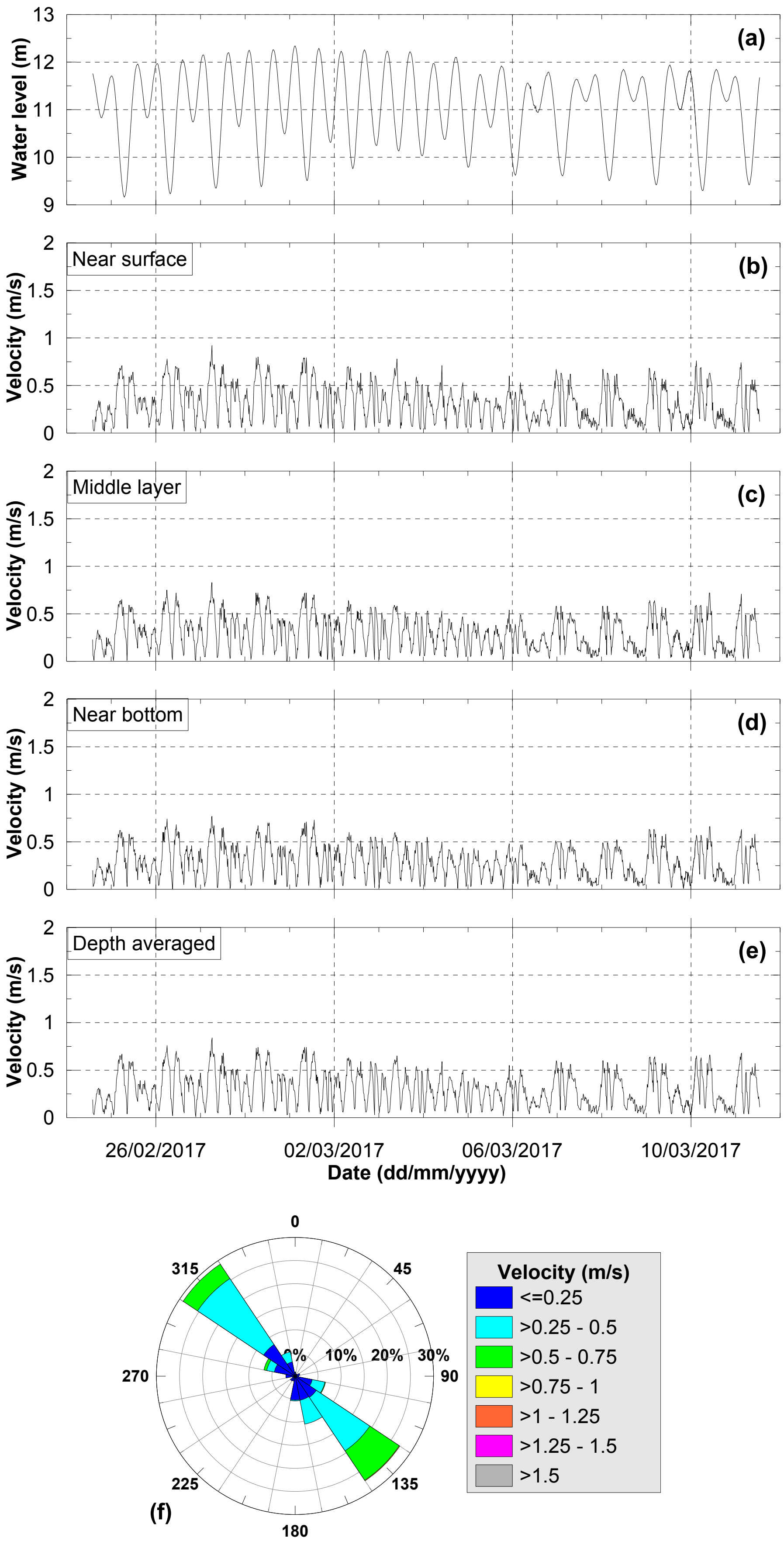

Water level (m)
(a)
Near surface
(b)
Middle layer
(c)
Near bottom
(d)
Depth averaged
(e)
Velocity (m/s)
26/02/2017
02/03/2017
06/03/2017
10/03/2017
Date (dd/mm/yyyy)
(f)
Velocity (m/s)
<=0.25
>0.25 - 0.5
>0.5 - 0.75
>0.75 - 1
>1 - 1.25
>1.25 - 1.5
>1.5

Fig. 1: Time series plots of (a) water level relatively to the sea bed and current velocities of (b) near surface, (c) middle layer, (d) near bottom and (e) depth averaged and (f) directional distribution of current velocity at the mooring station of Go Cong in dry season 2017.

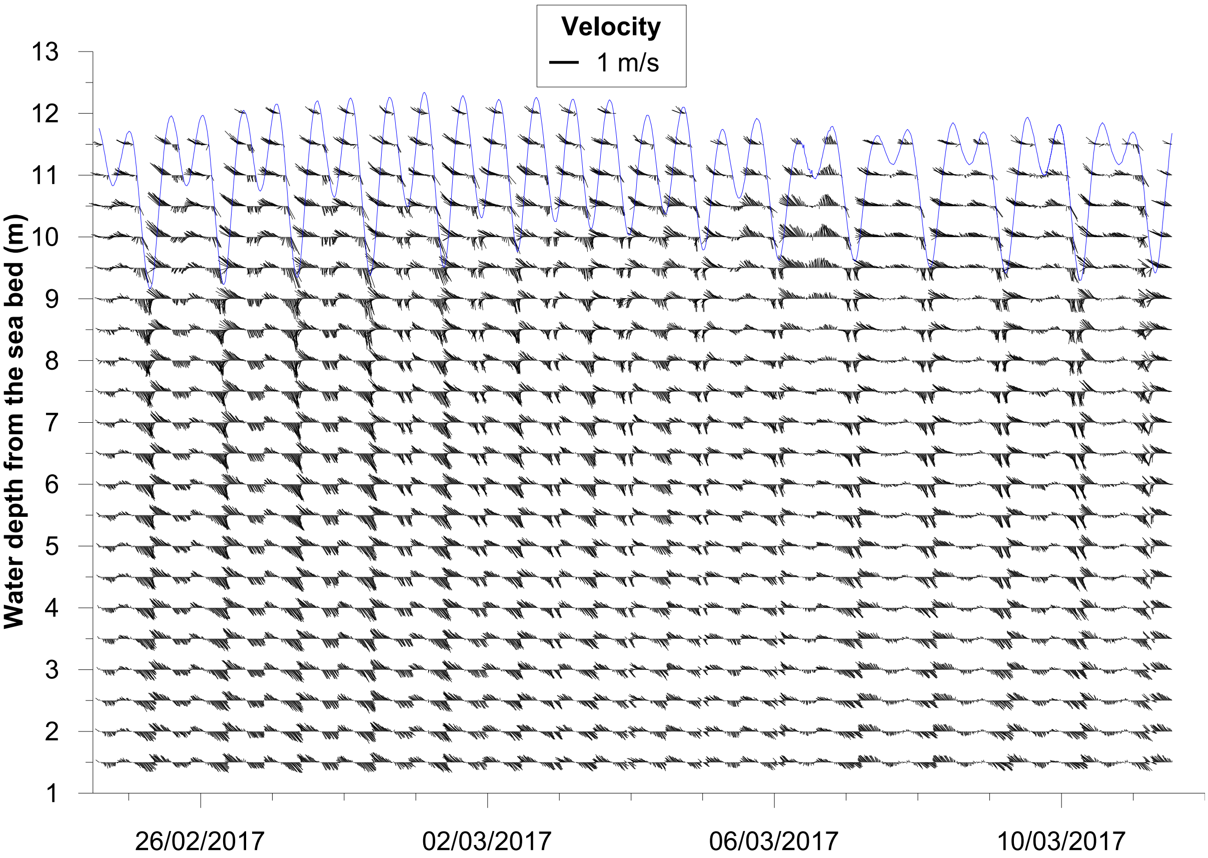


Fig. 2: Time series plots of vectors of current velocity profiles and water level (blue line) at the mooring station of Go Cong in dry season 2017. Zero water depth is referred at the sea bed.

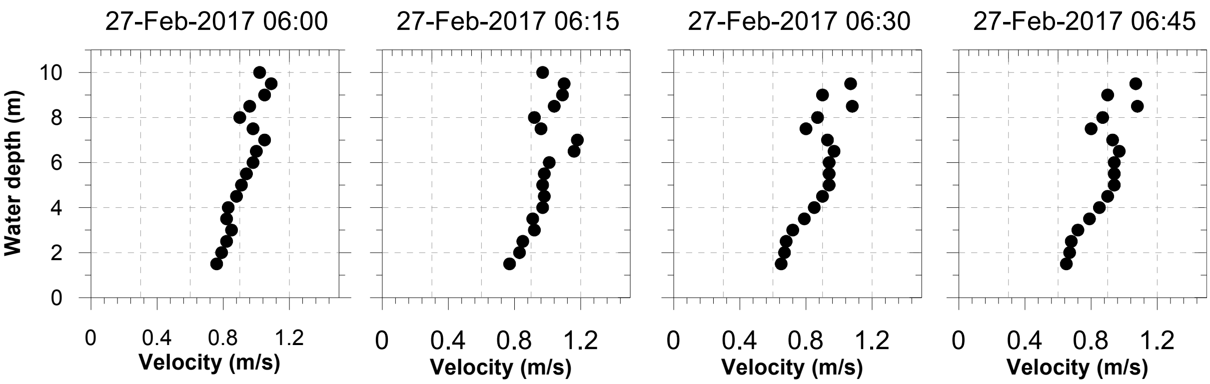


Fig. 3: Examples of current velocity profiles during ebb phase at Go Cong in dry season which indicates that velocities of a sub-surface layer are faster compared to the velocities near surface and near bottom.

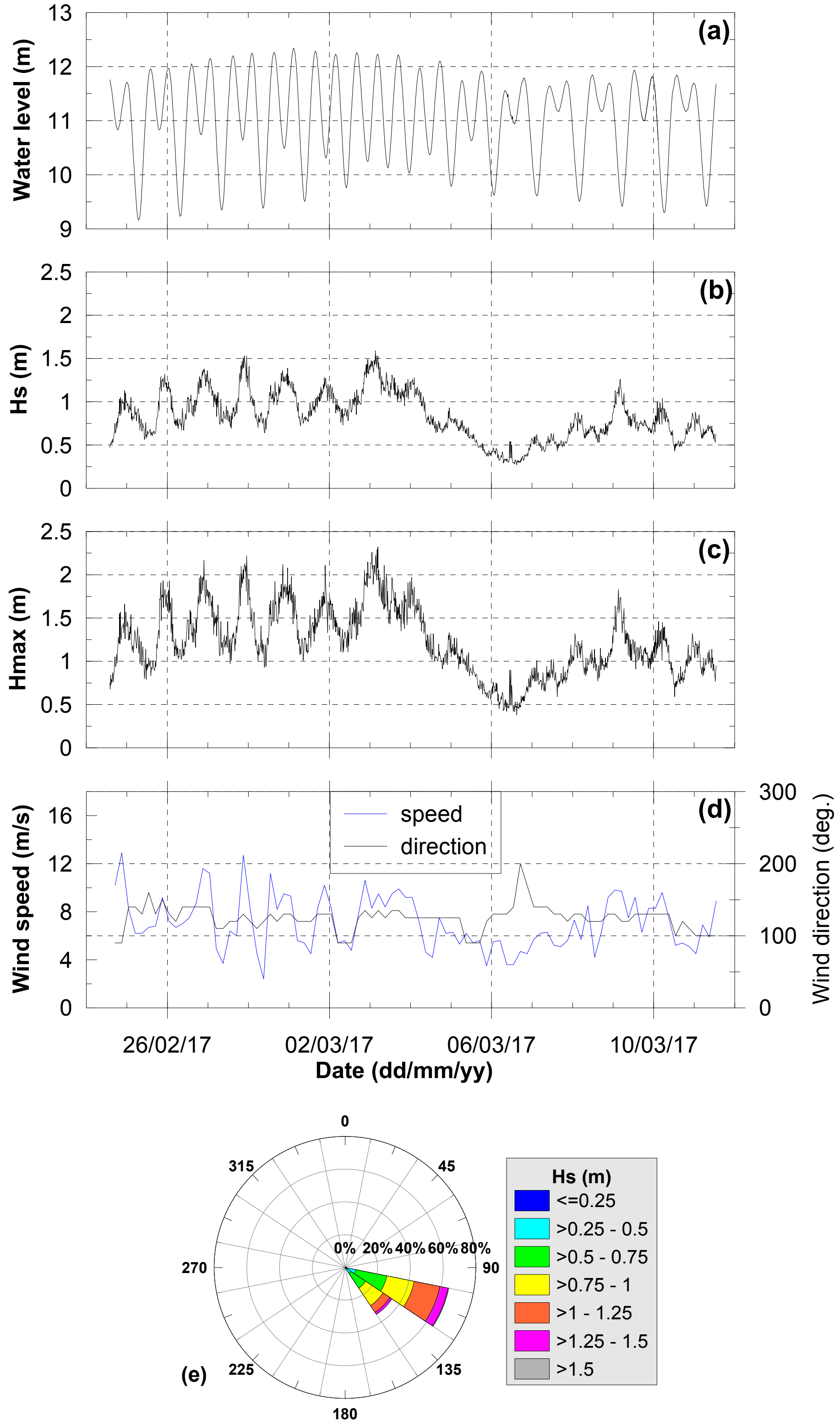


Fig. 4: Time series plots of (a) water level, (b) significant wave height (Hs), (c) maximum wave height (Hmax) and (d) wave period and (e) directional distribution of significant wave height at the mooring station of Go Cong in dry season 2017.

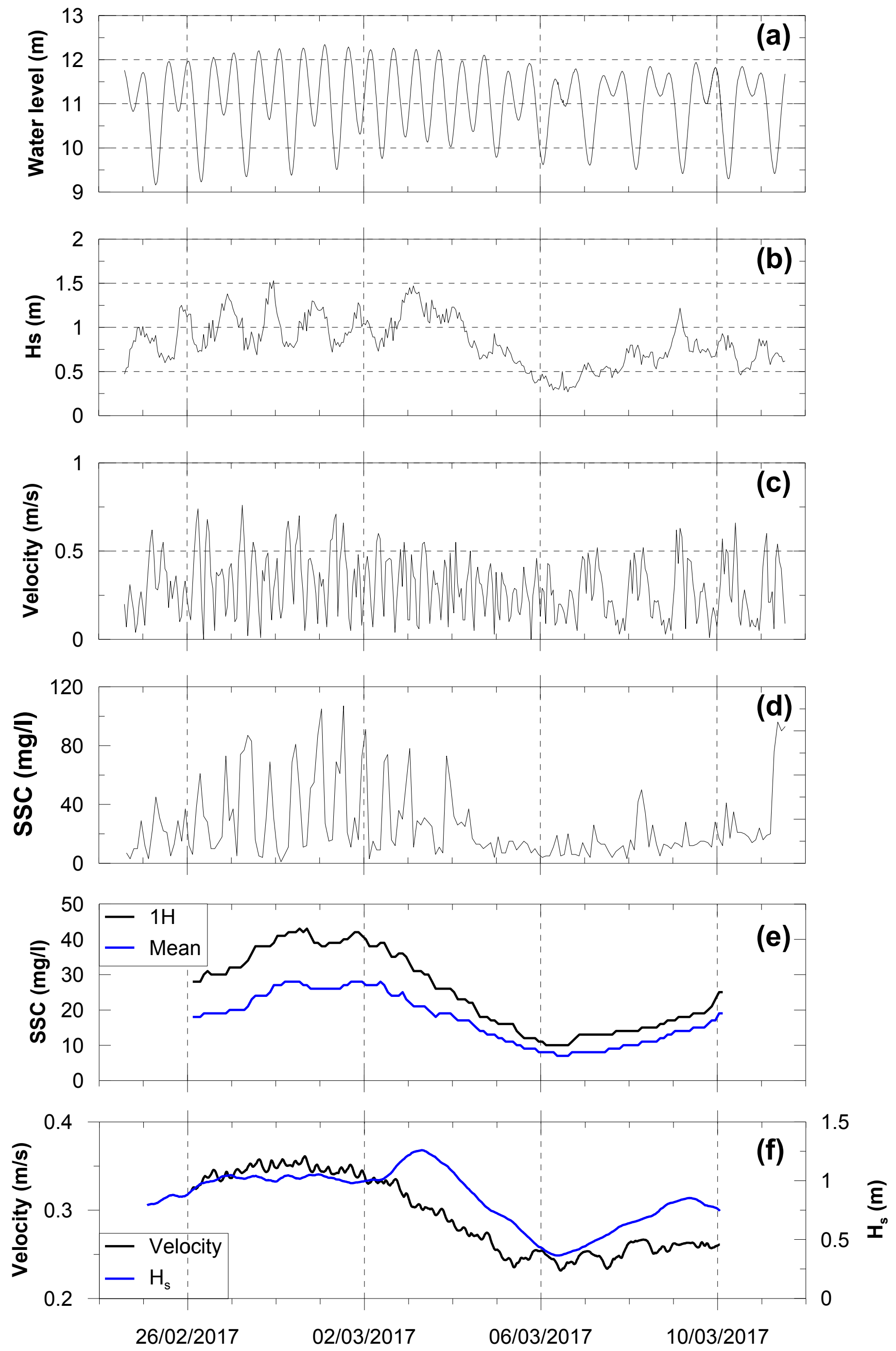


Fig. 5: Time series plot of (a) water level, (b) significant wave height, (c) current velocity at near the sea bed, (d) suspended sediment concentration at near the sea bed and (e) the 72-hour moving average of SSC at near the seabed and mean SSC over the water column and (f) velocity near the seabed and H_s which was measured at the mooring station of Go Cong during dry season.

2. *U Minh* station: Water level, current and wave parameters at the mooring station during dry season

The variations of water level, current velocity and wave parameter at the mooring station of U Minh were measured during Feb-Mar 2017 and are depicted in Fig. 5-7. The water level fluctuations indicate that the tide is mixed, mainly diurnal. This tidal regime is changing compared to the tide measured at this location during the field survey in Sep-Oct 2016 (Fig. 5). The levels of two consecutive high tides are significantly different during spring tide with a maximum range of 0.6 m. Although the diurnal component is obviously dominant, two high tides and two low tides each tidal day are often observed. Tidal ranges vary from about 0.4 m to 0.77 m (0.6 m on average).

Current directions are much dispersed and the dominant ebb and flood directions are not clearly identify in the directional distribution of current velocity (Fig. 5f). However, vector plot of current velocities (Fig. 6) on vertical profiles show flood (N) and ebb (S) current directions are flowing parallel to the coast. There are strongly delay in phase between ebb or flood currents and falling or rising tides. Ebb currents usually begin at about middle stage of low tide up to the beginning of high tide (Fig. 6). This situation also happens for flood current. Peaks of flood current usually occur at high tide; whereas peaks of ebb currents occur at the next high tide (Fig. 6).

Current velocities are generally lower than 0.5 m except at near the surface with max current velocities occasionally reach 0.7 m/s. Although the asymmetry between ebb and flood velocities is not significant, max ebb currents are usually higher than flood current (Fig. 5 and Fig. 6). Near the sea bed, max ebb and flood currents are about 0.40 m/s and 0.32 m/s, respectively. For depth averaged velocities, max ebb and flood currents are about 0.37 m/s and 0.3 m/s.

During NE moon soon, wind and wave directions at U Minh are very scatter with (Fig. 7). Wave directions from E-ESE are slightly more dominant than the remaining directions, which are also observed included SW (Fig 7.e). Significant wave heights (Hs) are mainly less than 0.5 m (Fig. 7b). While maximum wave heights (Hmax) are usually below 1 m (Fig. 7c). Camp wave conditions are often seen with wave heights about 0.1 m for Hs and 0.15 m for Hmax. Maximum Hs and Hmax during 15 days are app. 0.58 m and 1.08 m. On average, mean Hs is about 0.3 m and mean Hmax is app. 0.5 m.

Suspended matters at the mooring station of U Minh in dry season are surprisingly very low, although it is checked carefully the calibration procedures. Most of the SSC values are less than 5 mg/l (Fig. 8). These data need to be revised again to indentify is there any incorrect laboratory procedures to obtain the SSC data from the water samples.

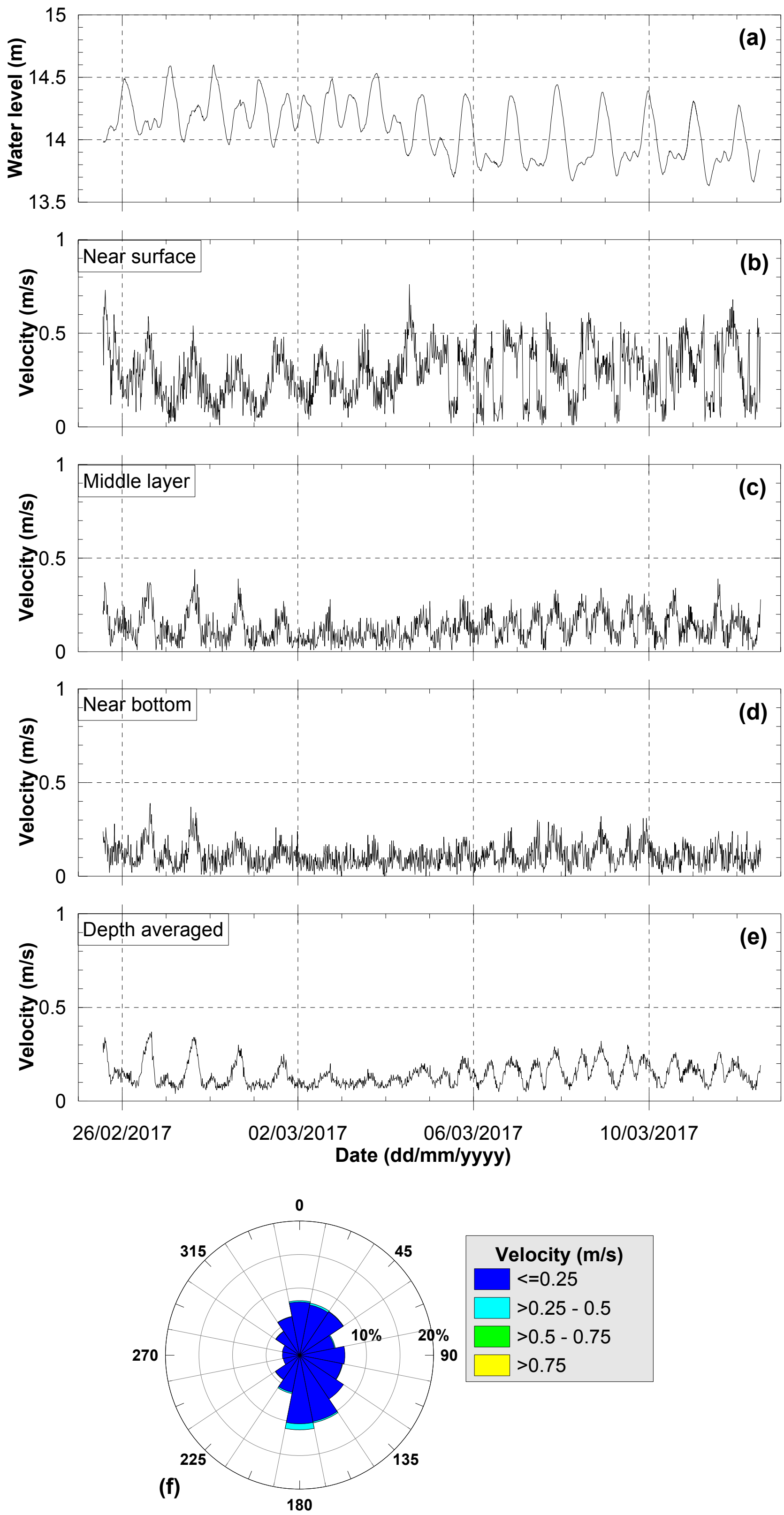


Fig. 5: Time series plots of (a) water level relatively to the sea bed and current velocities of (b) near surface, (c) middle layer, (d) near bottom and (e) depth averaged and (f) directional distribution of current velocity at the mooring station of U Minh in dry season 2017.

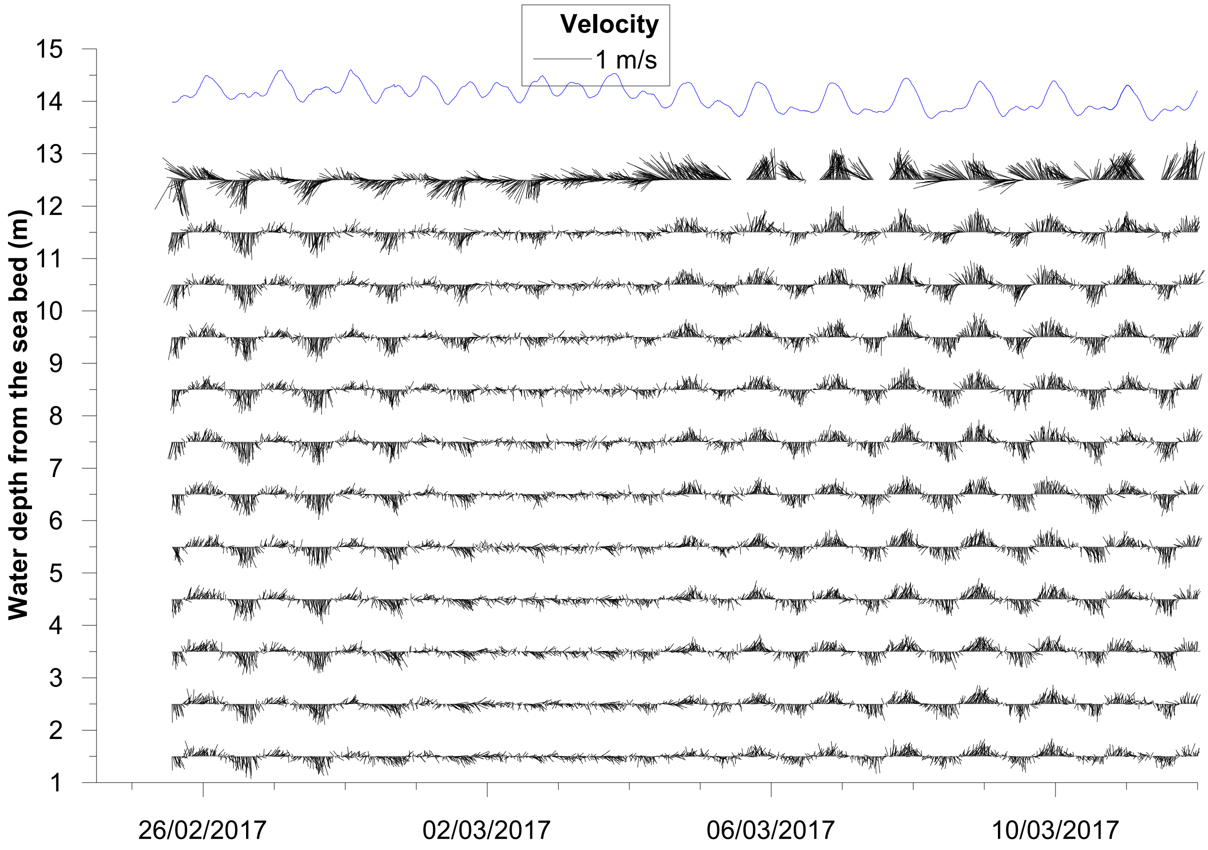


Fig. 6: Time series plots of vectors of current velocity profiles and water level (blue line) at the mooring station of U Minh in dry season 2017. Zero water depth is referred at the sea bed.

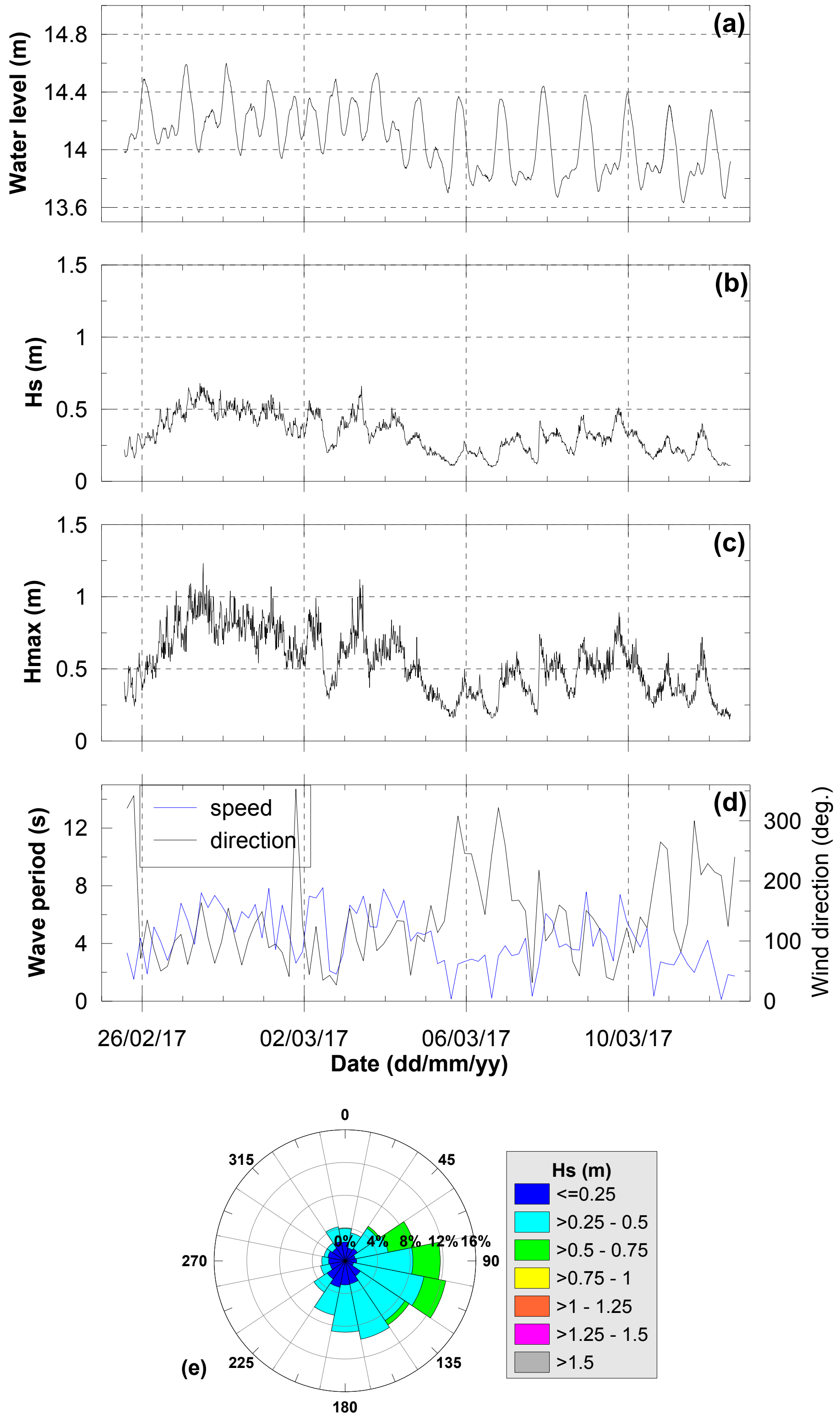


Fig. 7: Time series plots of (a) water level, (b) significant wave height (Hs), (c) maximum wave height (Hmax) and (d) wave period and (e) directional distribution of significant wave height at the mooring station of U Minh in dry season 2017.

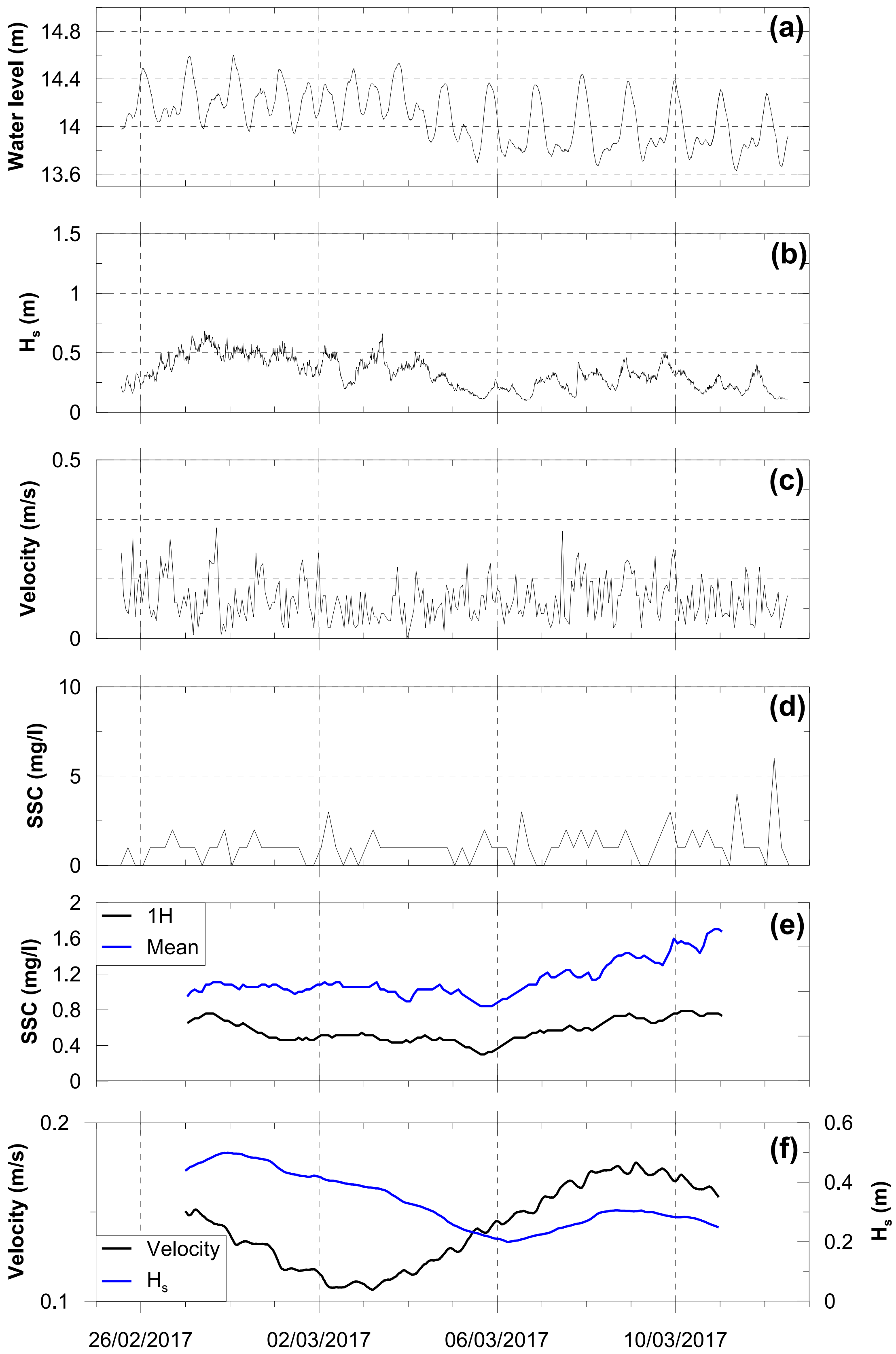


Fig. 8: Time series plot of (a) water level, (b) significant wave height, (c) current velocity at near the sea bed, (d) suspended sediment concentration at near the sea bed and (e) the 72-hour moving average of SSC at near the seabed and mean SSC over the water column and (f) velocity near the seabed and H_s which was measured at the mooring station of U Minh during dry season

3. Mobile stations: Current velocity, wave parameter, Suspended Sediment Concentration (SSC) and Salinity during dry season

Current velocity, wave parameter, suspended sediment concentrations (SSC) and salinity along coast of the Mekong Delta during dry season are presented at different relative depths from the near surface to the sea bed (Fig. 9-11) and the grain size distribution of seabed sediment is shown in Fig. 12. These data were acquired at short-term mobile stations (Fig. 0-5) from 25 Feb – 14 Mar 2017. The measurements of current and wave data were carried out during only 30 min each station using two cruising boats. The first boat started from Go Cong (S14) on 25 Feb 2017 to the cap of Ca Mau (S103) on 14 Mar 2017. The second boat began from Ha Tien (S181) on as well 25 Feb 20167 to the cap of Ca Mau on about 12 Mar 2017. The Salinity data were collected in the East Sea from 25 Feb – 12 Mar 2017 using two methods: CTD instrument and water samples for lab analysis. Fig. 13 shows the similarity between two sets of data. This indicates that the data derived by both methods are reliable.

It is stricky to present the current data at 183 stations along the Mekong which were collected in differerent time and tide situations. However, current velocities are also show that velocities in the West Sea are lower than the velocities in the East Sea. In the West Sea, current directions from Rach Gia to Ha Tien indicates clearly both ebb and flood current directions. While in the area from south of Rach Gia to near the cape of Ca Mau, current directions are dominantly in S. This indicates as well the southward current dominated in the West Sea. In the East Sea current directions are very scattered which indicates the coastal paralel current patterns. The current velocities around the cape of Ca Mau is suprisely stronger compared to the velocities in the West Sea.

Wave paramenters show a strong NE monsoon condition with significant and maximum wave heights could reach 3.1 m and 3.4 m respecitvely (Fig.10ab). The highest wave heights were observed at the beginning of the field survey with wave directions are mostly perpendicular to the easten coast of the Mekong Delta (see Fig. 10 with wave height vectors off the Ba Lai and Ham Luong River mouths). Along the Ham Luong river mouth to the Bassac, the generally high wave contions were observed but wave directions are mainly parallel to the coast. Off the Bassac mouth to the cap of Ca Mau, a relative camp wave situation was seen with wave directions are almost coastall parallel. This coastl parallel direction might due to the interactions between strong ebb current direction (Fig. 10) and wave diction. Wave directions in the West Sea are domninantly in offshore directions. This wave pattern along the Mekong Delta indicates that during NE monsoon the eastern coast is more affected by wave actions than the western side. Average and maximum significant wave heights were about 0.7 m and 1.2 m for the West Sea and 0.5 m and 1.4 m for the East Sea.

The SSC data along the Mekong Delta during NE monsoon show relatively low suspended matters in the water column except at round the cape of Ca Mau (Fig. 11). Most of the SSC values are below 10 mg/l. About 60% of the measured data in the total of 914 data points have the SSC values less than 5 mg/l. Only 12% of SSC data are about 10 mg/l. There were almost no suspended matters in the water column along the south of Bassac to Bo De in the eastern side and in the northern part of the Bay Hap river mouth to Rach Gia in western side. These low SSC values are related to small wave height and low current velocity condition during the data collections (Fig. 10). However, the river flume was observed with a relative high SSC values at all of the Mekong river mouths, especially off the Ba Lai-Ham Luong mouths and the Bassac mouth. Together with the salinity distribution (Fig. 12), the high

SSC value in front of the Bassac could possible from river discharge and the re-suspended sediment due to wave; while the high amount of SSC facing to the Ba Lai-Ham Luong mouth could be driven by wave action (Fig. 10). Around the cape of Ca Mau, highest values of SSC during this field survey were recognized with the maximum of SSC reaches about 150 mg/l. In the region from northern part of the cape of Ca Mau to Ha Tien (from stations S125-S183), about 75% of the SSC values is below 5 mg/l. This low SSC during this time is also observed at the mooring station of U Minh (Fig 8d).

The salinity data during this NE monsoon shows that the marine environment is dominated along the Mekong Delta (Fig. 12). The salinity values are mostly higher than 30 PSU, which accounts for about 90% of the total measured data (915 samples). However, the river discharge was also observed at the mouth of the Bassac River where the salinity values range from about 11 - 24 PSU. There is also a small area with low salinity of about 26 PSU around Ganh Hao. This low salinity here perhaps is due to the along shore transport of fresh water from the Bassac River. In the West Sea, it is not found such a low salinity region, which indicates for the minor fresh water discharge to this region during NE monsoon. The detailed pictures of SSC and salinity distribution along the Mekong Delta in some typical cross-sections are illustrated in the Fig. 14-20.

During the winter monsoon (dry season) in Feb-Mar 2017, the distribution of surface sediments along the LMDCZ changed significantly, especially along the Estuary zone and East coast (Fig. 13). Along the estuary zone, the fine silt observed in front of the river mouths during the wet season was no longer found during the dry season. In the estuary zone also, coarser sand was observed with grain-size ranging from fine to medium. Along the East coast, a large part of fine-grained sediments (mainly fine silt) detected in the wet season were gone and replaced by coarser sediment. Two small patches of very fine sand were found in front of Bo De mouth and in the cape of Ca Mau. Along the West coast, fine silt remained in the dry season but coarse sand was found at some offshore locations. The origin of this sand patch is unclear but shell fragments in these samples may possibly have affected the grain-size analysis.

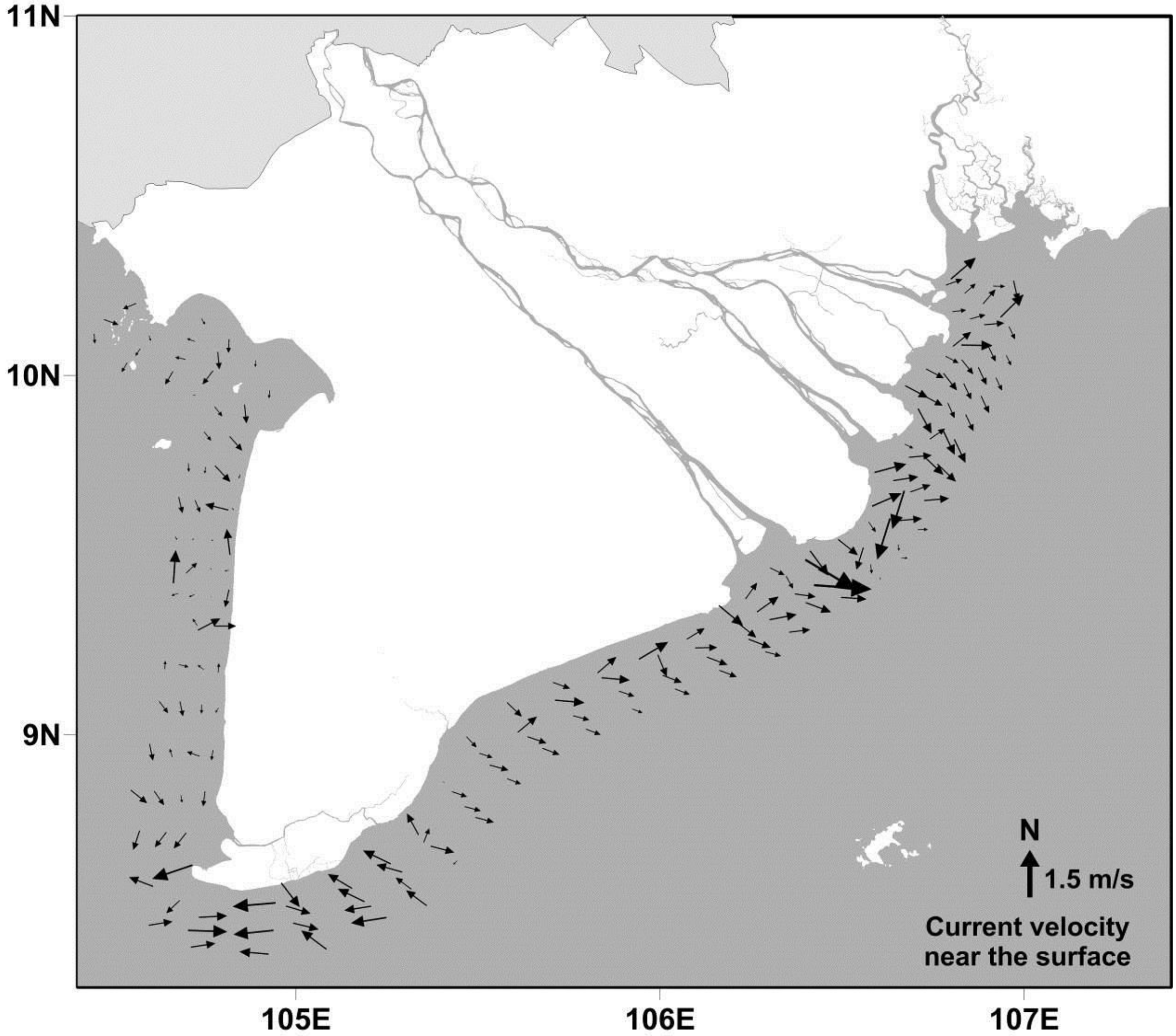


Fig. 9a: Vectors of current velocity at near the surface of short-term stations along the Mekong Delta coast. These data were measured at each station for 45 minutes with the time interval of 15 minutes and were collected from 25 February to 14 March 2017.

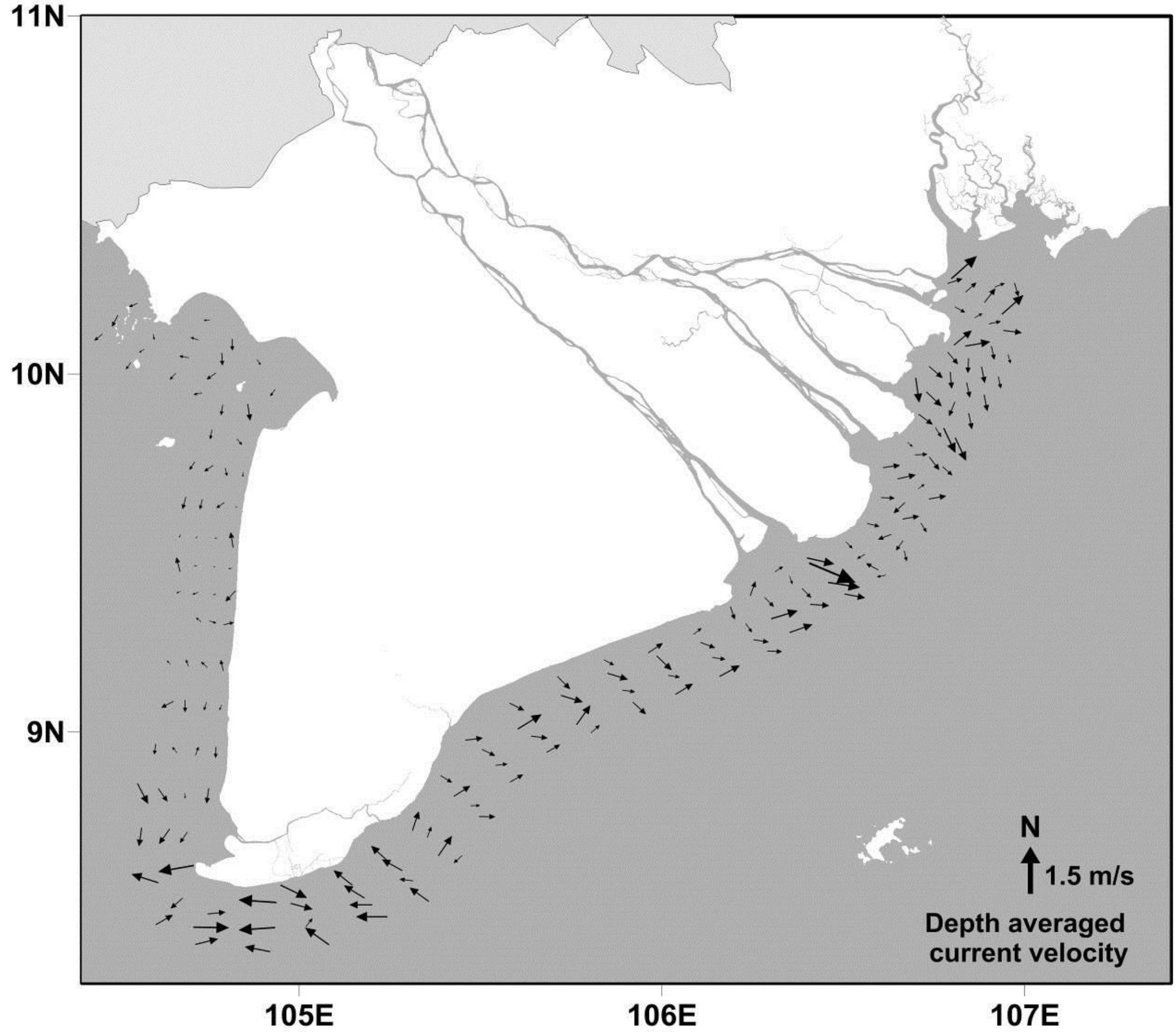


Fig. 9b: Vectors of depth averaged current velocity of short-term stations along the Mekong Delta coast. These data were measured at each station for 45 minutes with the time interval of 15 minutes and were collected from 25 February to 14 March 2017.

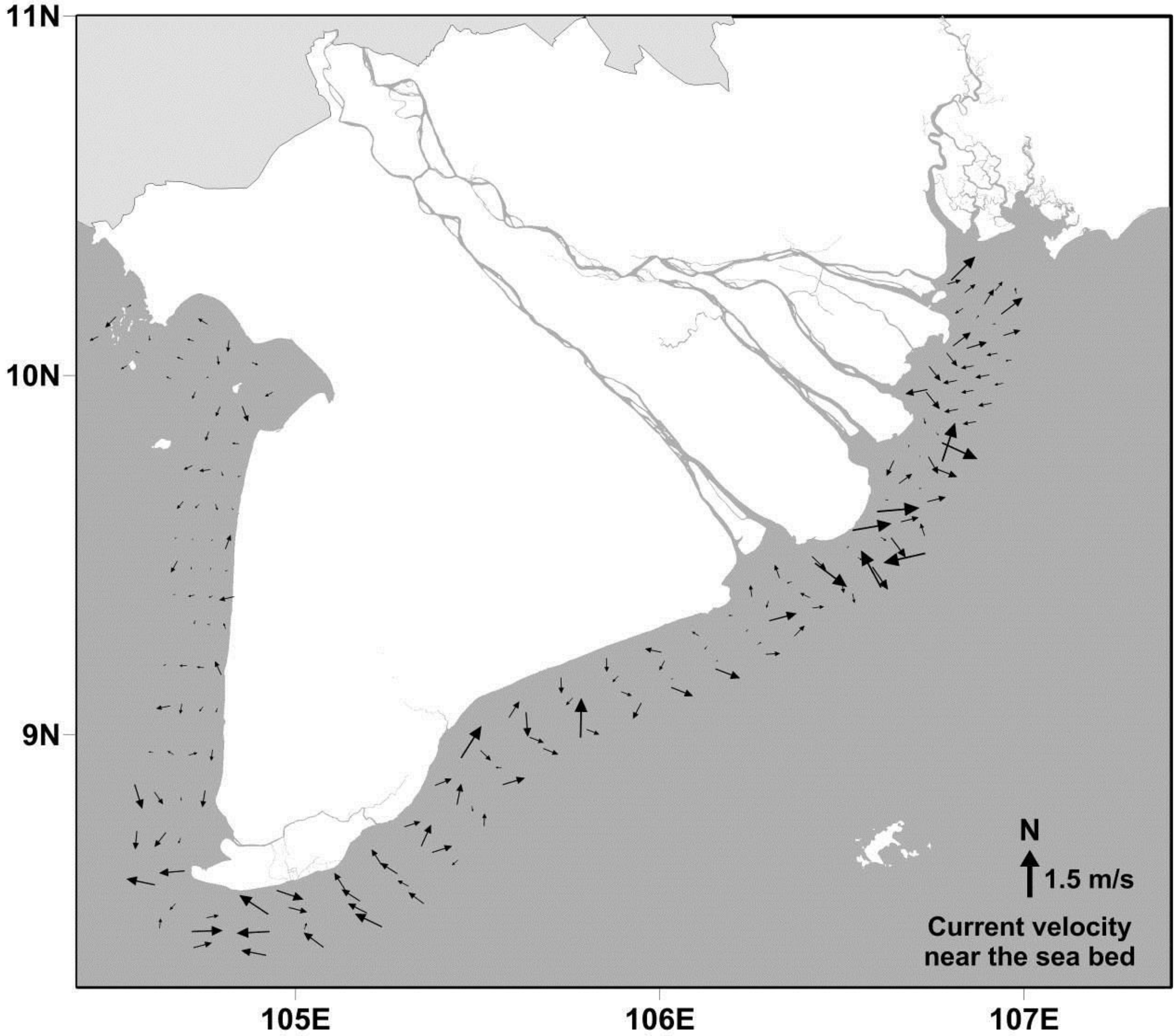


Fig. 9c Vectors of current velocity at near the sea bed of short-term stations along the Mekong Delta coast. These data were measured at each station for 45 minutes with the time interval of 15 minutes and were collected from 25 February to 14 March 2017.

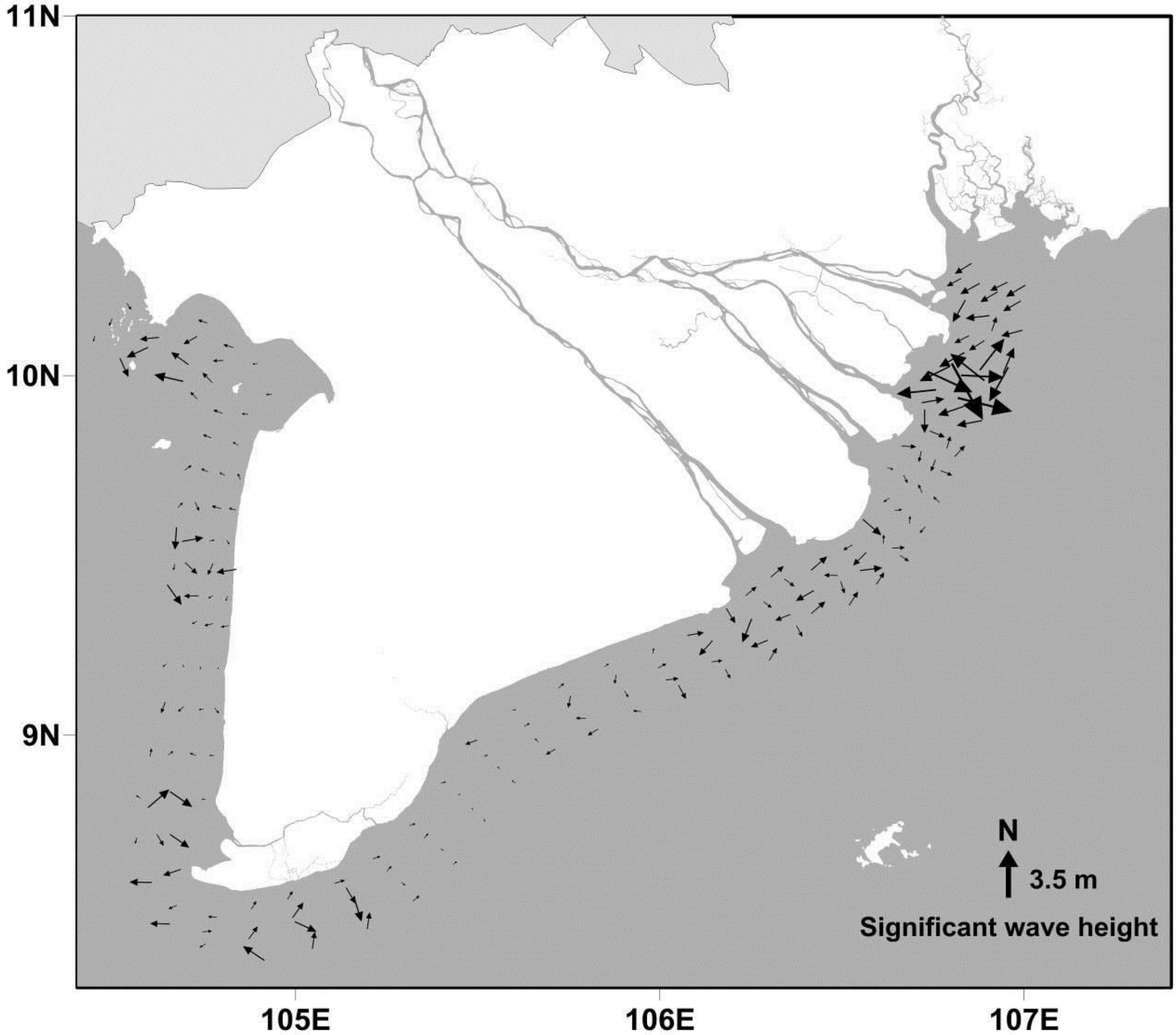


Fig. 10a: Vectors of significant wave height of short-term stations along the Mekong Delta coast. These data were measured at each station for 45 minutes with the time interval of 15 minutes and were collected from 25 February to 14 March 2016.

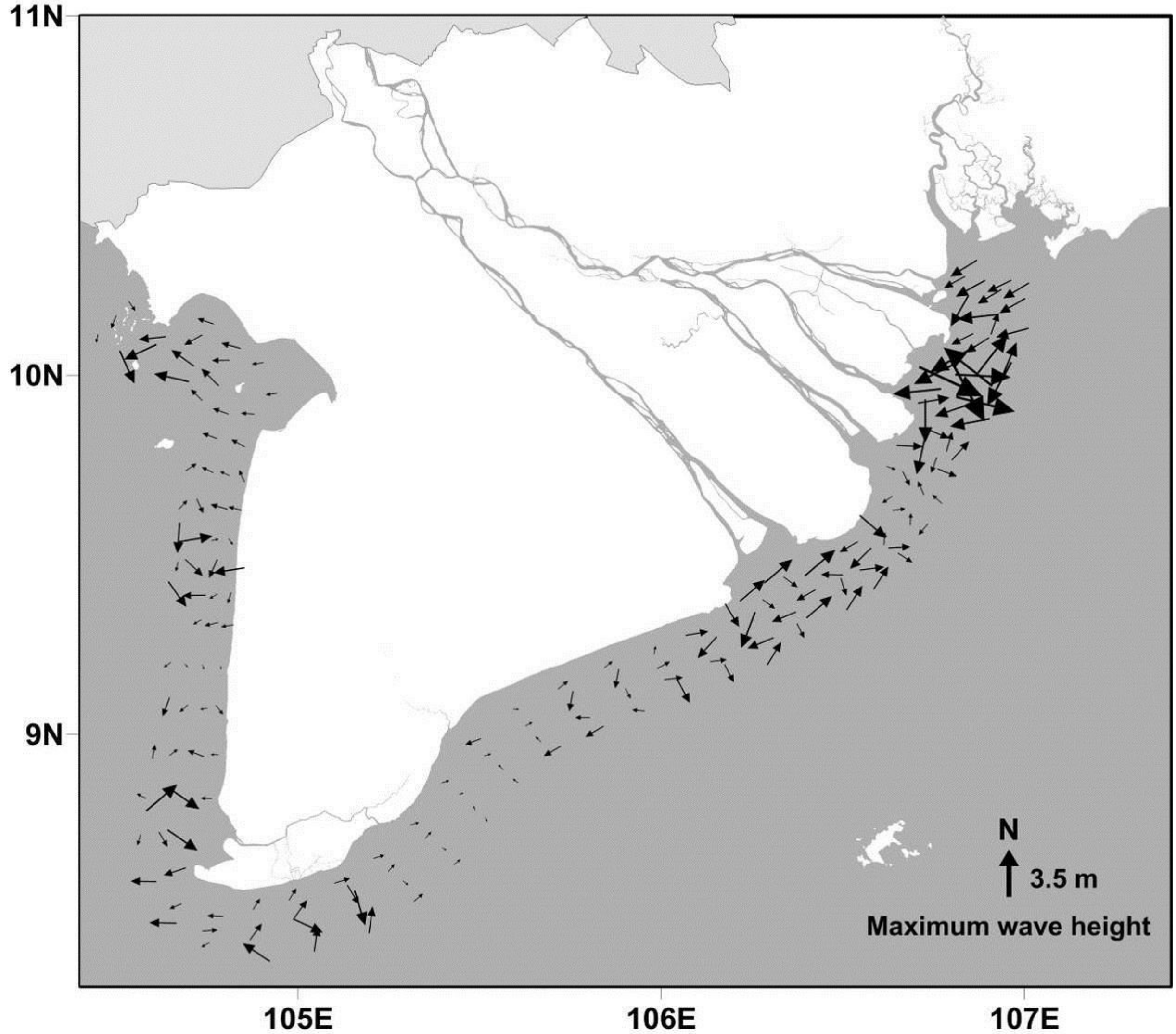


Fig.10b: Vectors of maximum wave height of short-term stations along the Mekong Delta coast. These data were measured at each station for 45 minutes with the time interval of 15 minutes and were collected from 25 February to 14 March 2017.

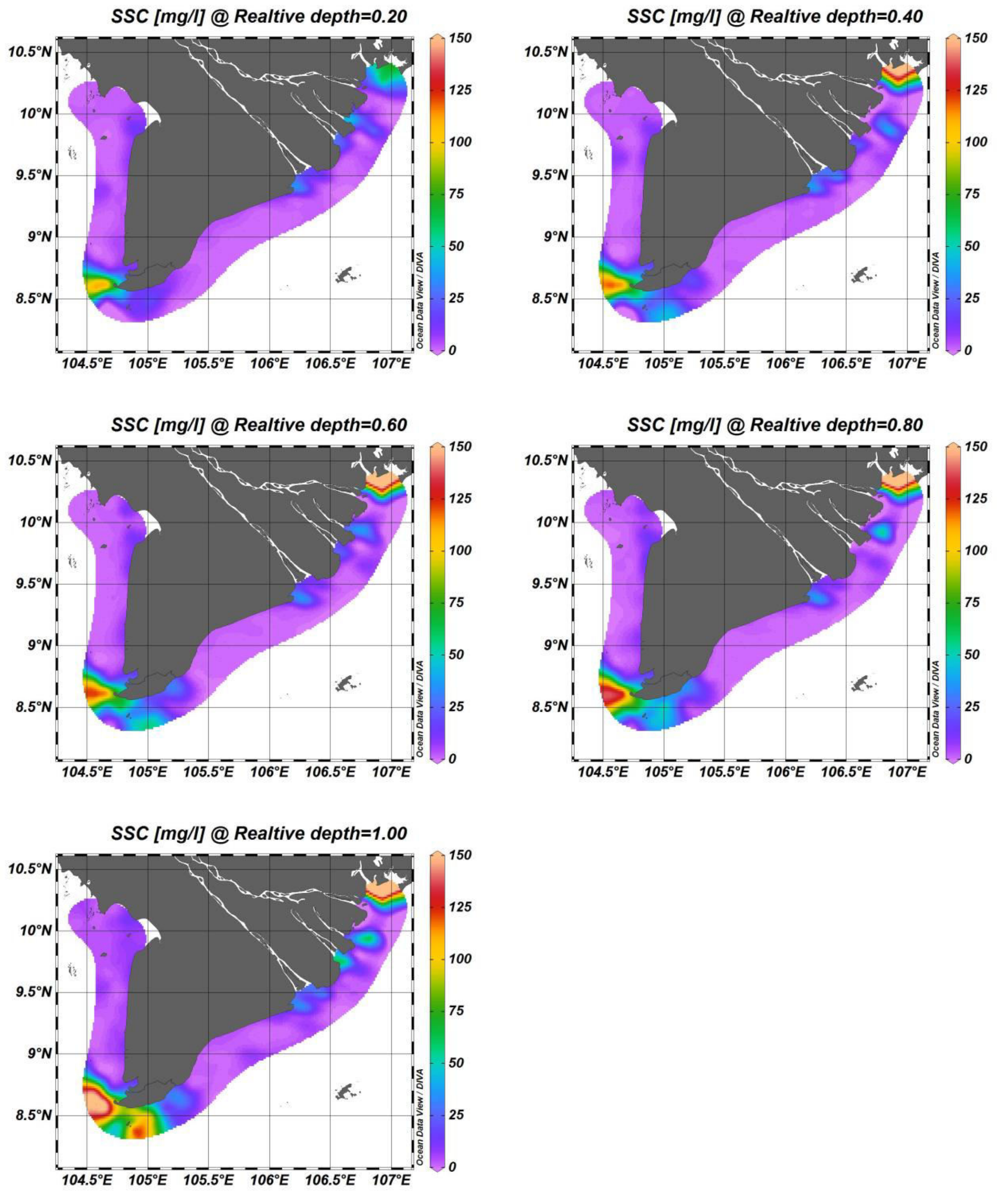


Fig. 11: Suspended sediment concentrations (SSC) along coast of the Mekong Delta at five relative depths from the near the surface (Depth=0.2) to near the sea bed (Depth=1.00). These data were sampled from 25 Feb. to 14 Mar. 2017 and measured in the laboratory.

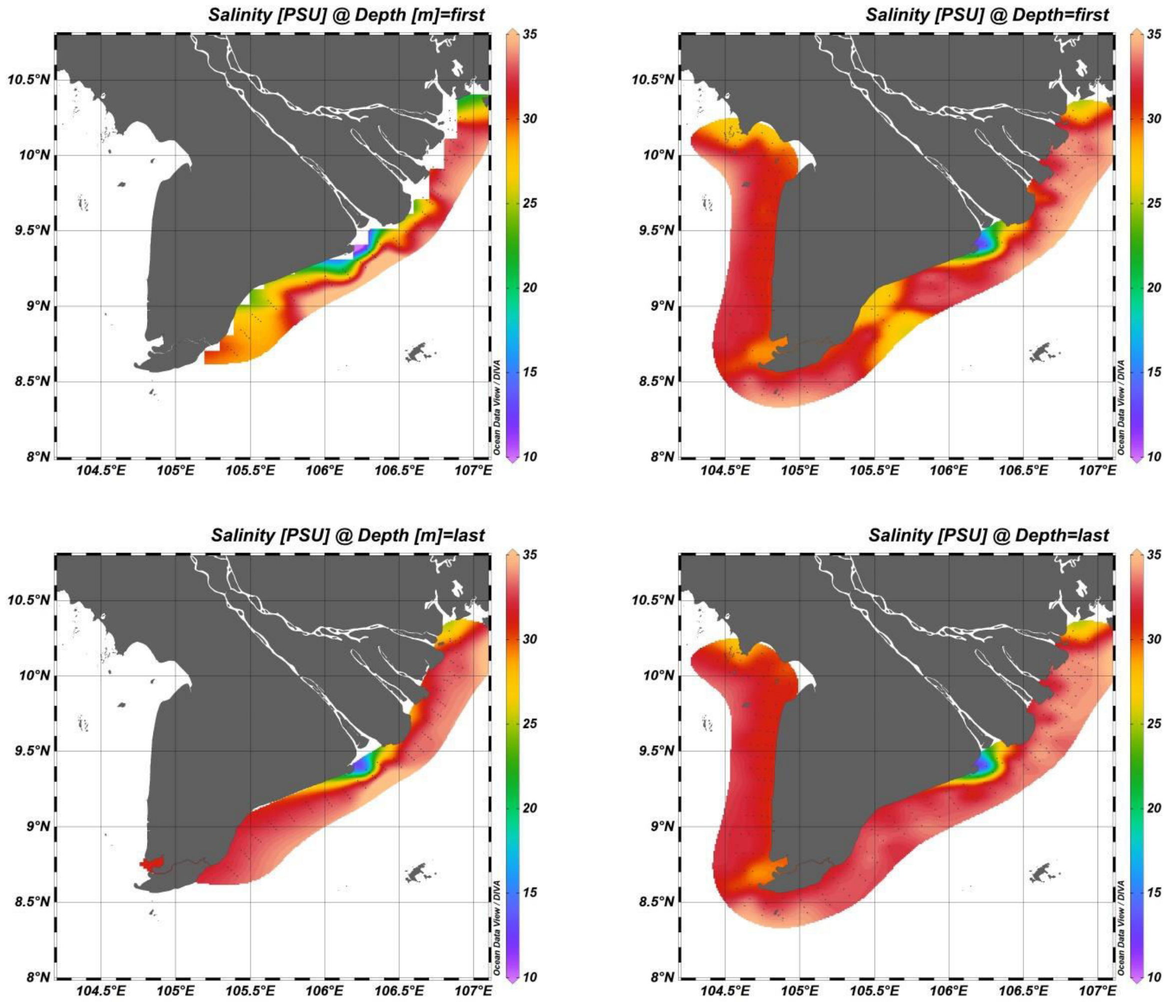


Fig. 12: Comparison of salinity data, which were collected in 25 Feb. – 14 Mar. 2017, between the two measuring methods from the CTD instrument (left fig.) and from the water samples (right fig.).

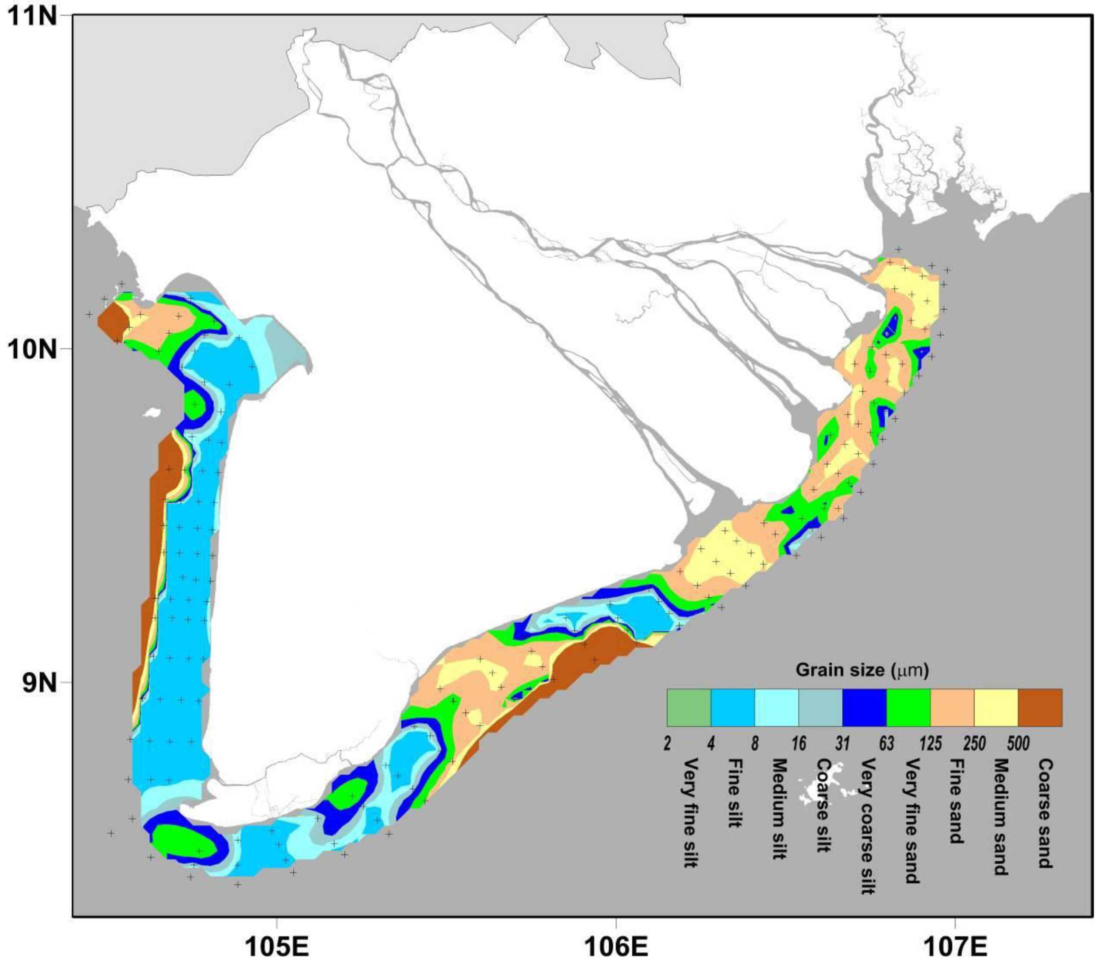


Fig. 13: Grain size distributions of sea bed sediment along the Mekong Delta coast. These values are the dominant modes from the results of grain size analysis using GRADISTAT (Blott, 2010). These sediment samples were collected from 25 February-14 March 2017

4. Analysis of typical transects in LMDCZ during wet season 24.02.2017 – 12.03.2017

Supplement to the salinity and SSC data along the Mekong, these data at some typical transects, e.g. Cua Dai, Ham Luong, Cung Hau, Bassac, Ganh Hao, Song Doc, Rach Gia, were analysed and plotted in correlation with water level fluctuations from predicted tide for the national tide gauges. The results are presented from Fig. 15 to Fig. 20.

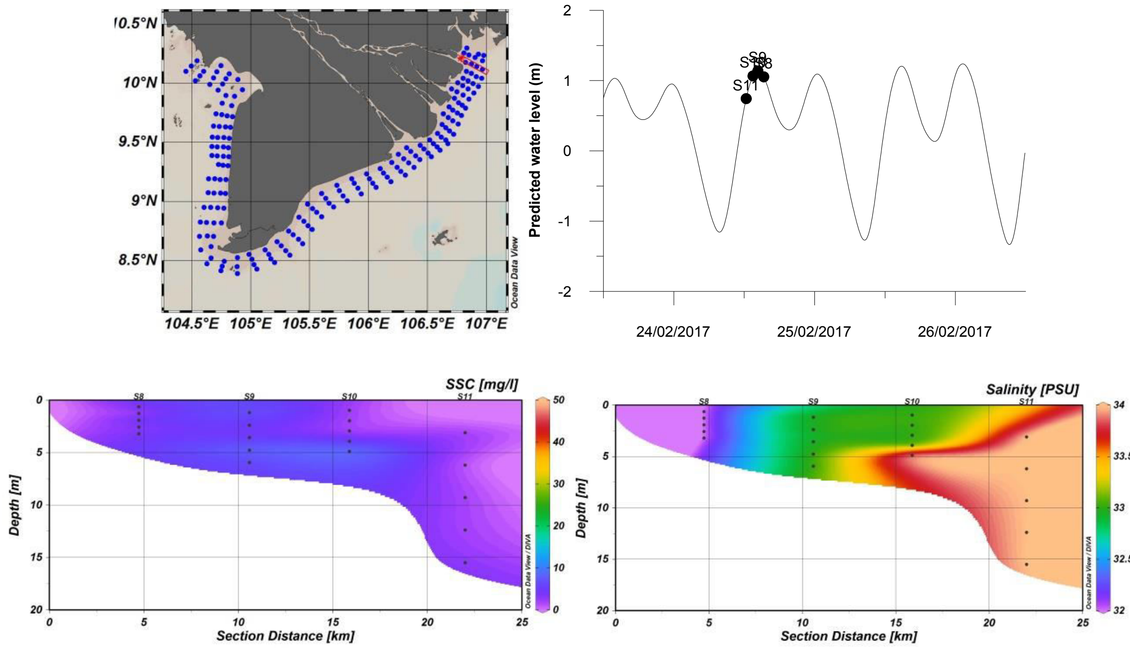


Fig. 14: Salinity and suspended sediment concentration on Cua Dai transect (from S8-S11) in correlation with water level fluctuations from predicted tide for the national tide gauge, Binh Dai station which is located near the mouth of Cua Tieu River, Feb-Mar 2017

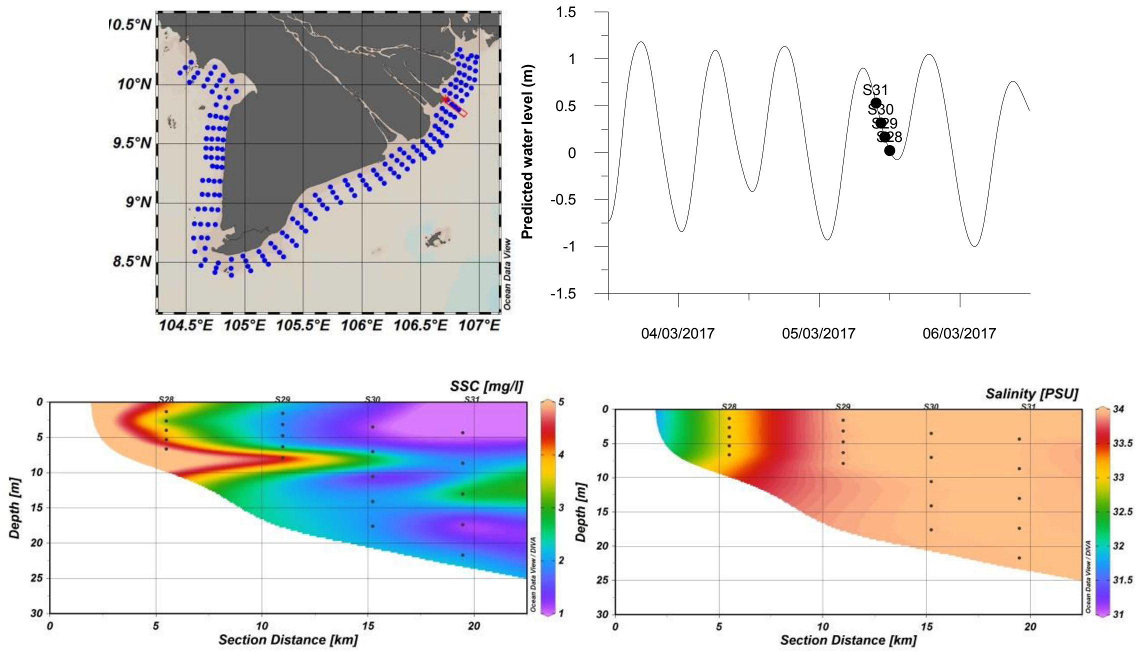


Fig. 15: Salinity and suspended sediment concentration on Ham Luong transect (from S28-S31) in correlation with water level fluctuations from predicted tide for the An Thuan station which is located near the mouth of Ham Luong River, Feb-Mar 2017

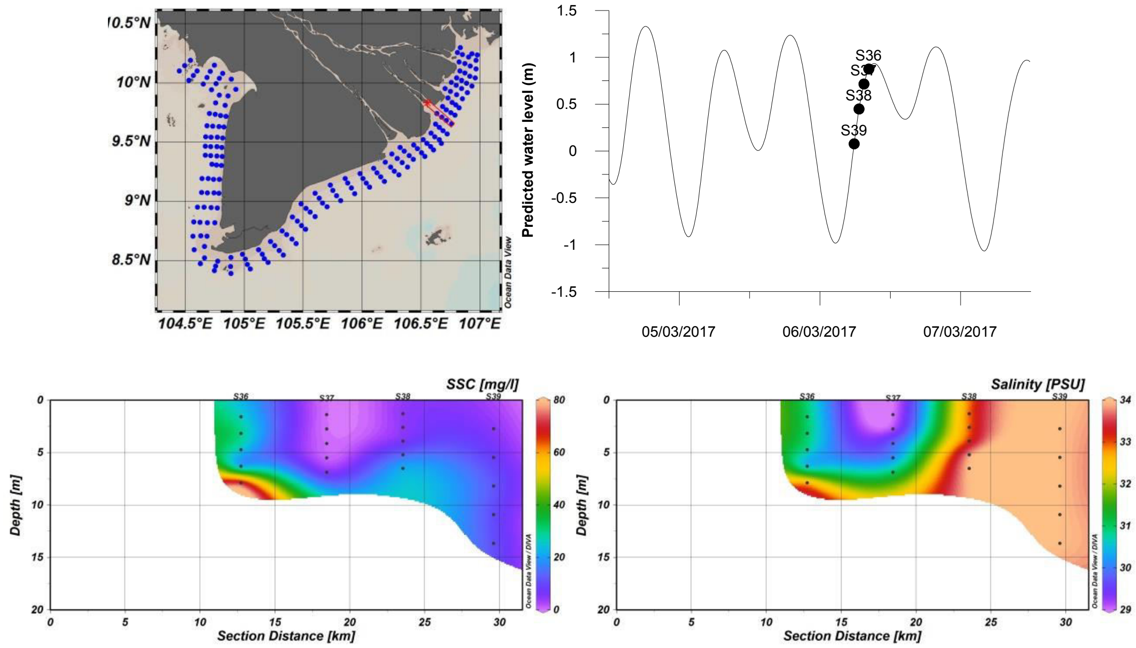


Fig. 16: Salinity and suspended sediment concentration on Cung Hau transect (from S36-S39) in correlation with water level fluctuations from predicted tide for the Ben Trai station which is located near the mouth of Cung Hau River, Feb-Mar 2017

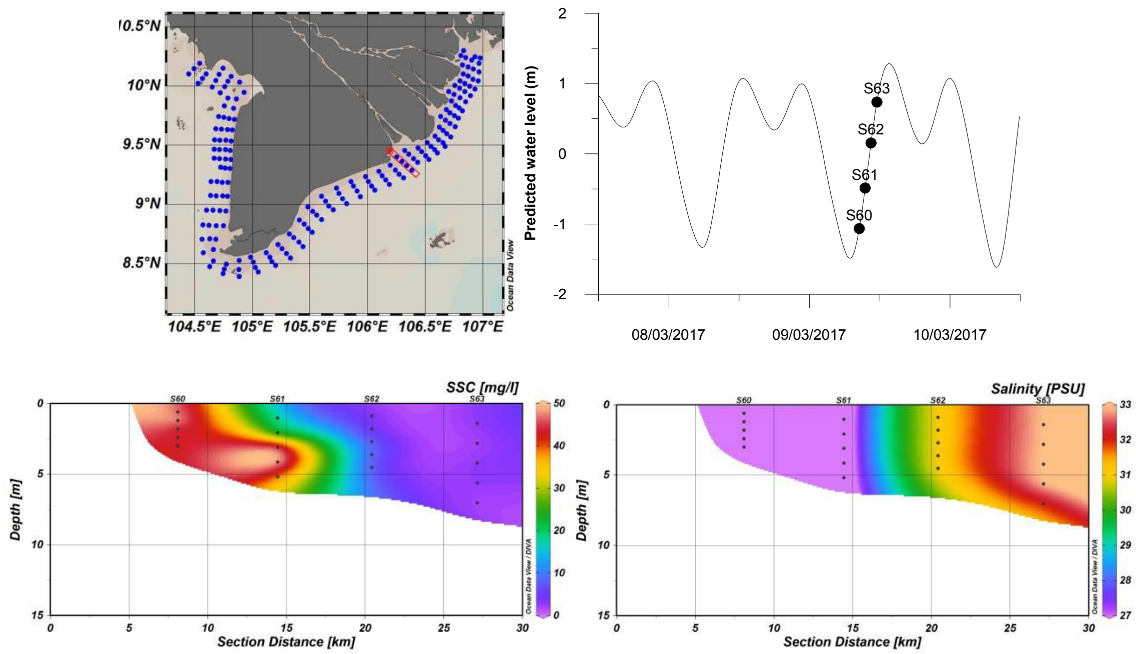


Fig. 17: Salinity and suspended sediment concentration on Bassac transect (from S60-S63) in correlation with water level fluctuations from predicted tide for the national tide gauge, My Thanh station which is located near the mouth of Bassac River, Feb-Mar 2017

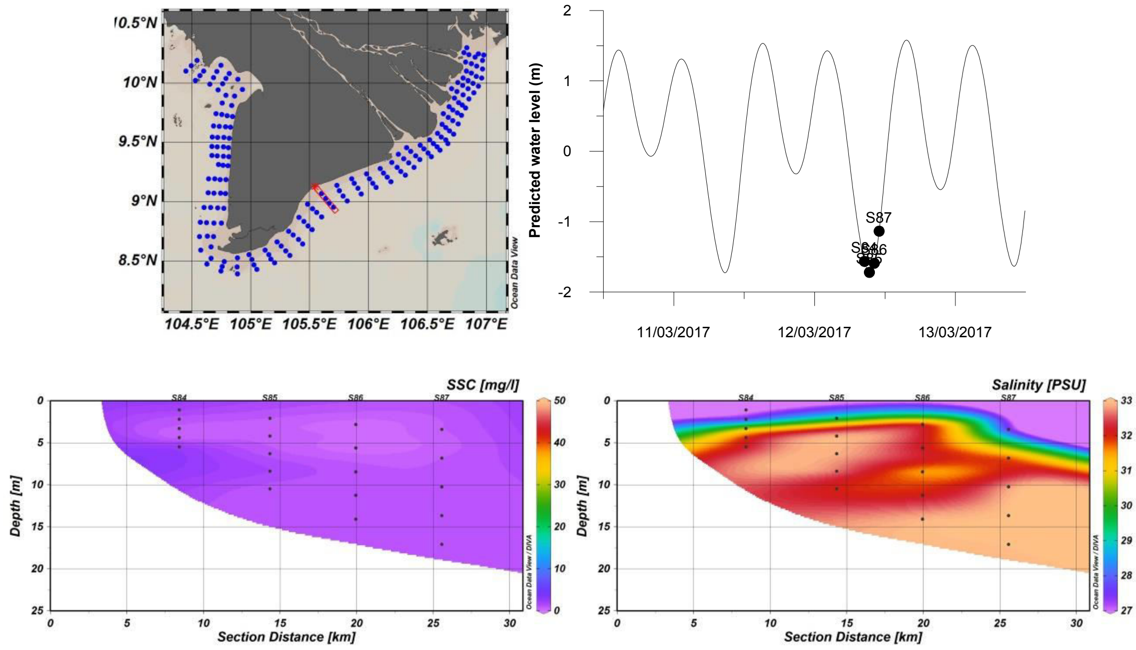


Fig. 18: Salinity and suspended sediment concentration on Ganh Hao transect (from S84-S87) in correlation with water level fluctuations from predicted tide for the Ganh Hao station which is located near the mouth of the Ganh Hao tidal channel, Feb-Mar 2017

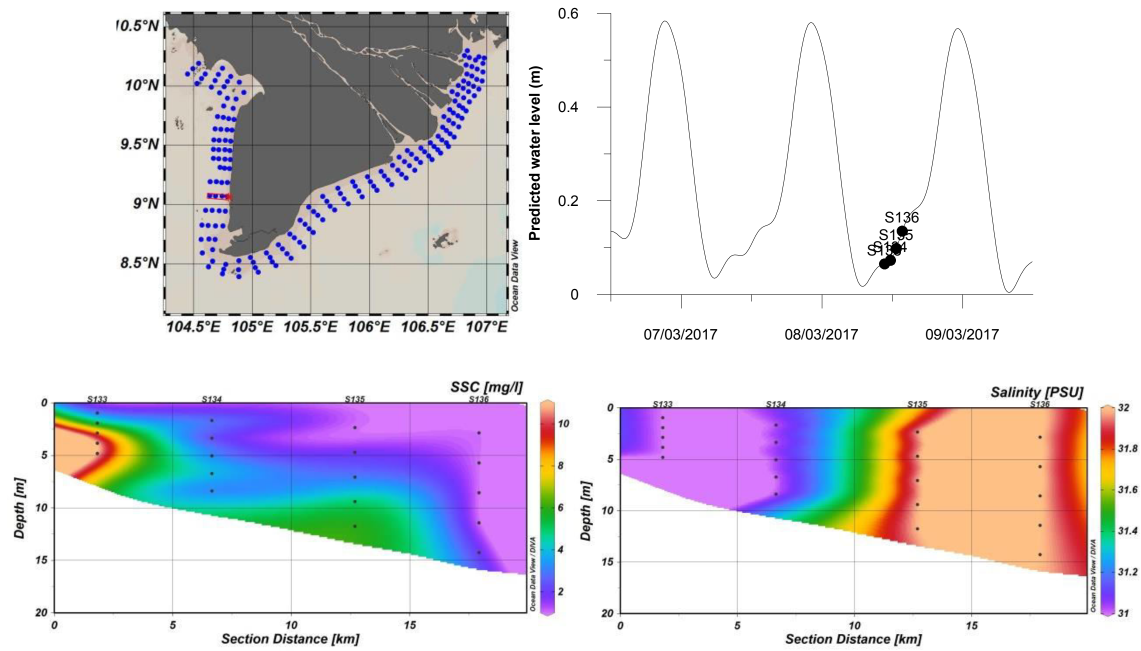


Fig. 19: Salinity and suspended sediment concentration on Song Doc transect (from S133-S136) in correlation with water level fluctuations from predicted tide for Song Doc station which is located near the mouth of the Song Doc tidal channel, Feb-Mar 2017

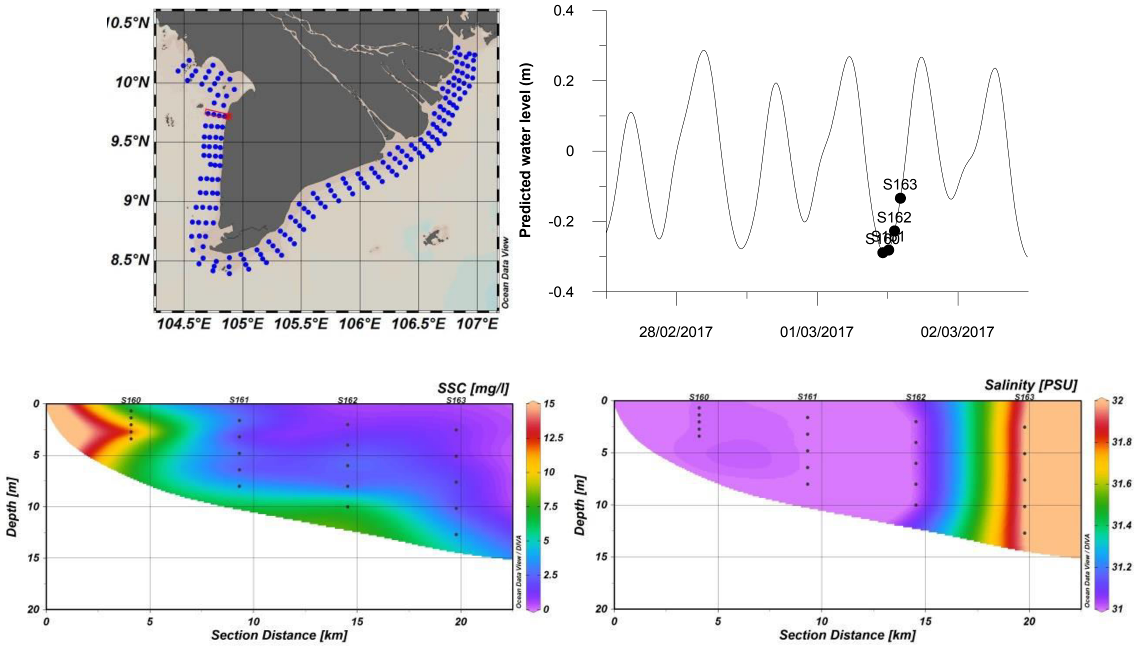


Fig. 20: Salinity and suspended sediment concentration on south of Rach Gia transect (from S160-S163) in correlation with water level fluctuations from predicted tide for the Song Doc station which is located near the mouth of the Rach Gia River Feb-Mar 2017

APPENDIX C

Results of bathymetry survey campaign

Bathymetry maps were presented for 3 sites (see Figure 0-6) with xyz coordinates presented in Figure 0-7, Figure 0-8 and Figure 0-9. The data were tabulated and uploaded to LMDCZ website to share among the project members (http://lmdcz.siwrr.org.vn/).

Bathymetry survey is also compared to other surveys from previous studies which can be found in the report of shoreline change in the fame of this project.

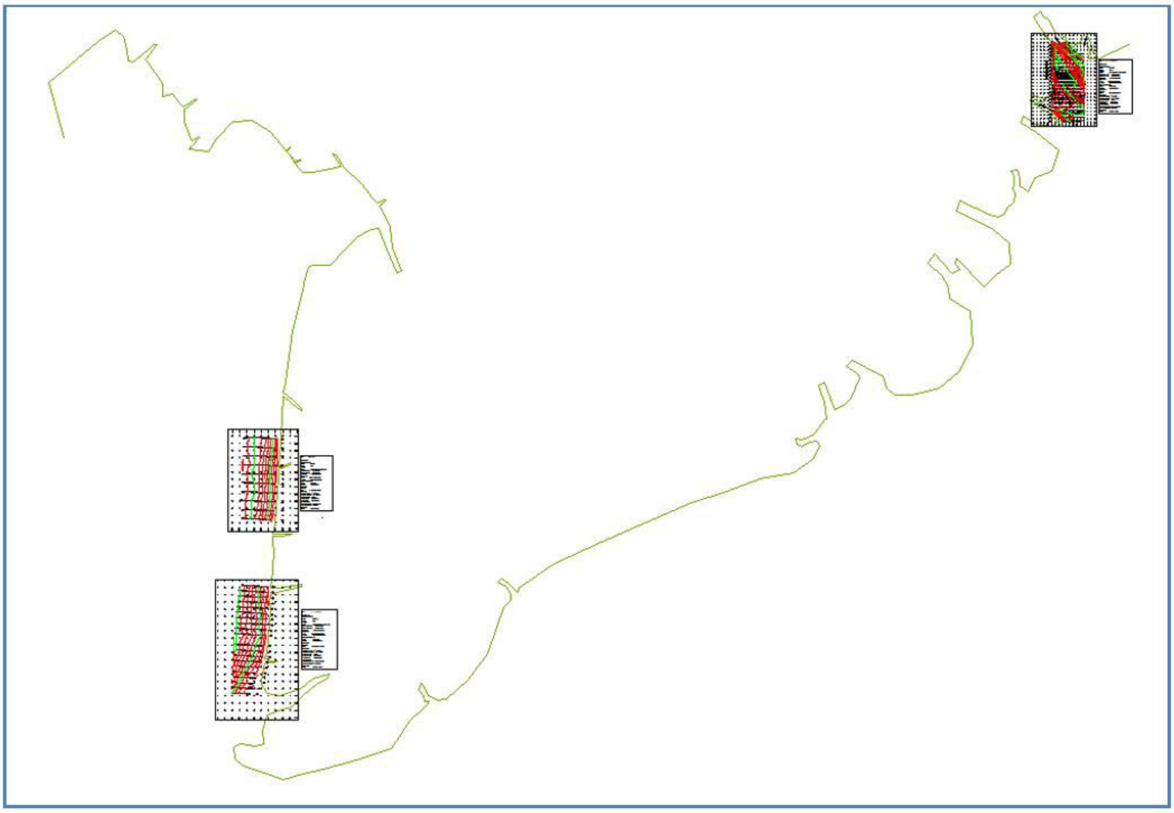


Figure 0-6 Location of the three survey sites in the LMDCZ

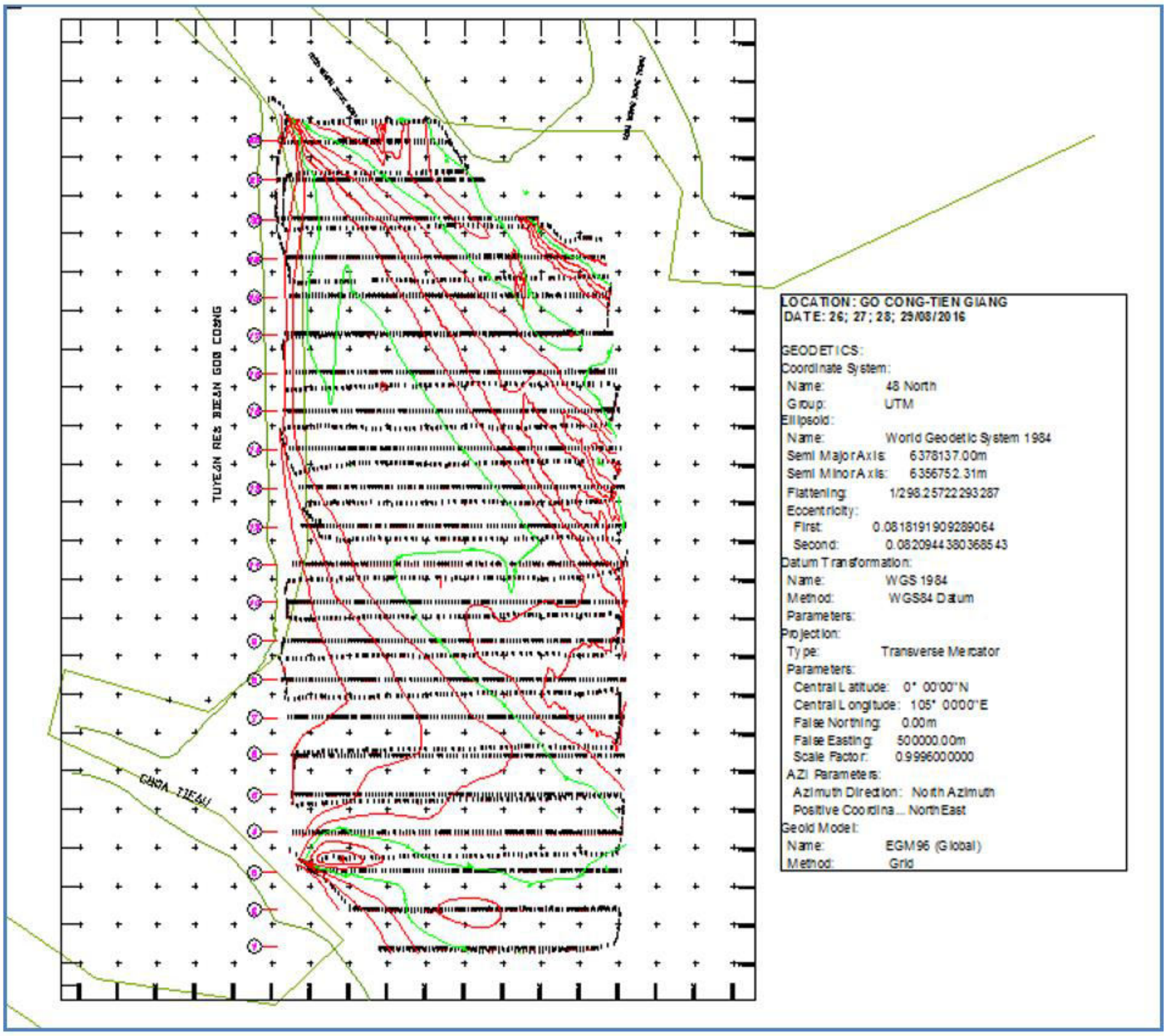


Figure 0-7 Bathymetry at Go Cong in the East sea 24 - 31/8/2016

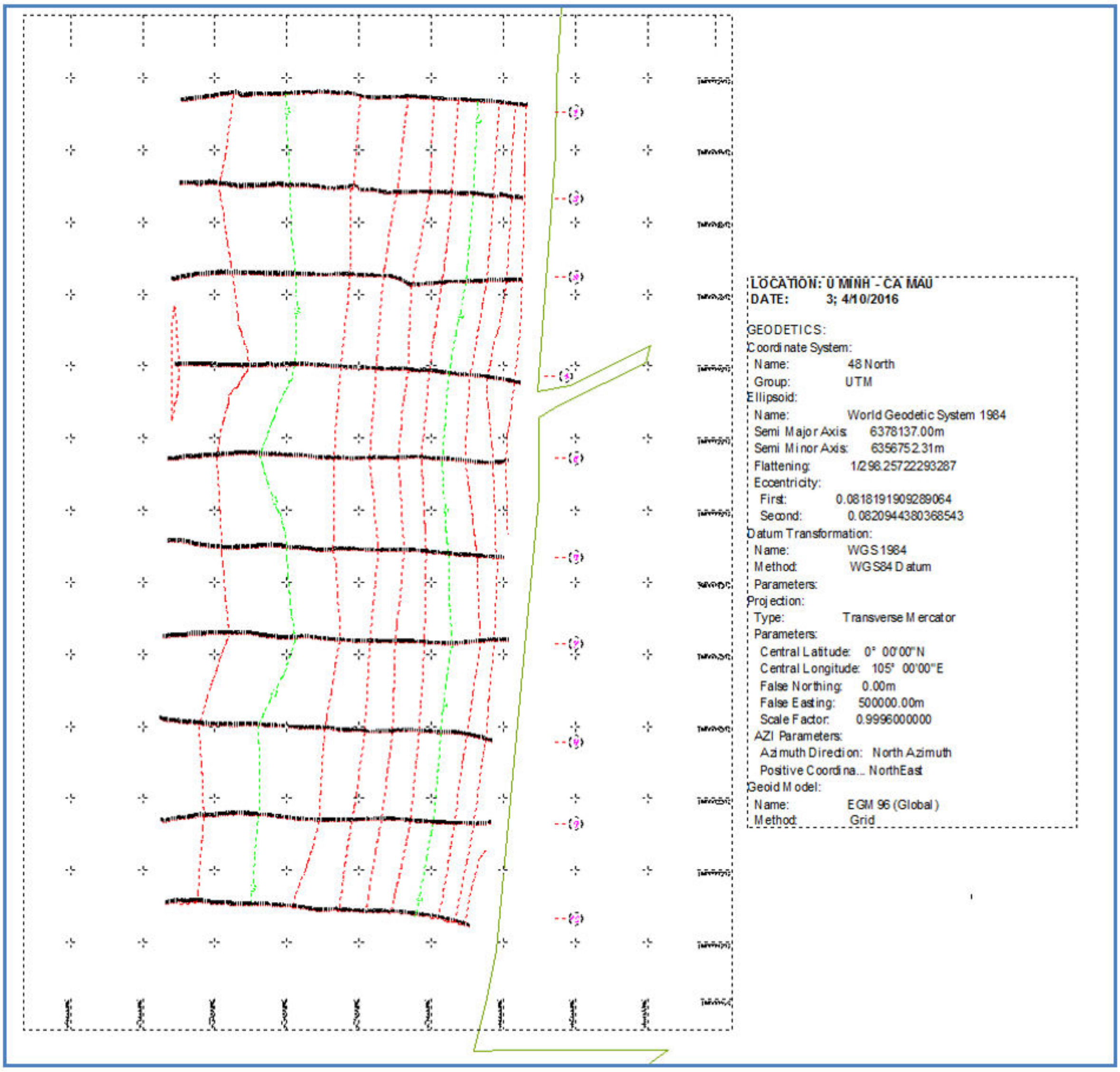


Figure 0-8 Bathymetry at U Minh, Ca Mau Province in the West sea, 28/9/2016 - 12/10/2016

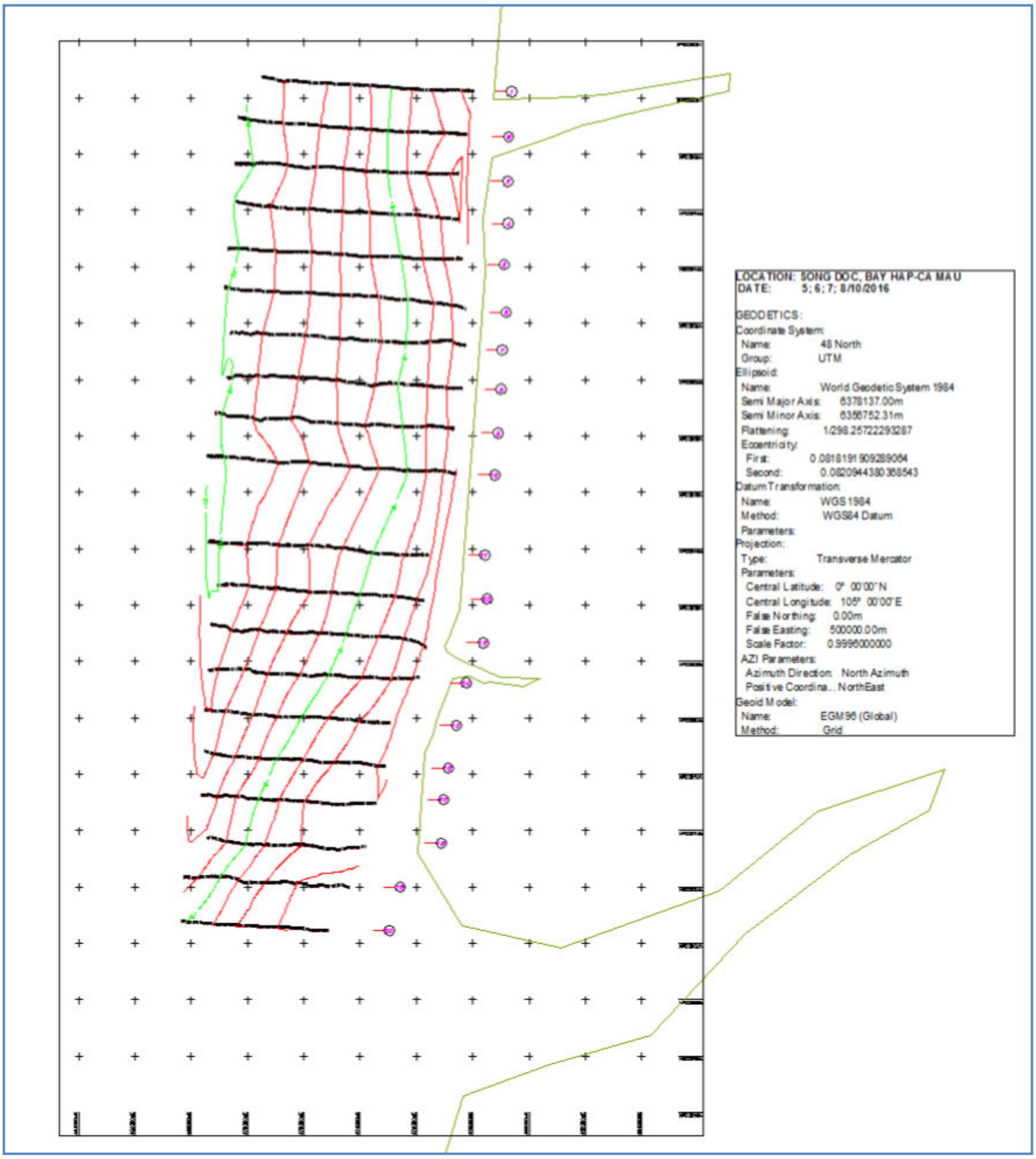


Figure 0-9 Bathymetry at site 3 from Song Doc to Bay Hap rivers, Ca Mau Province in West sea, 28/9/2016 - 12/10/2016