Measurements for Seabed Characterization Experiment

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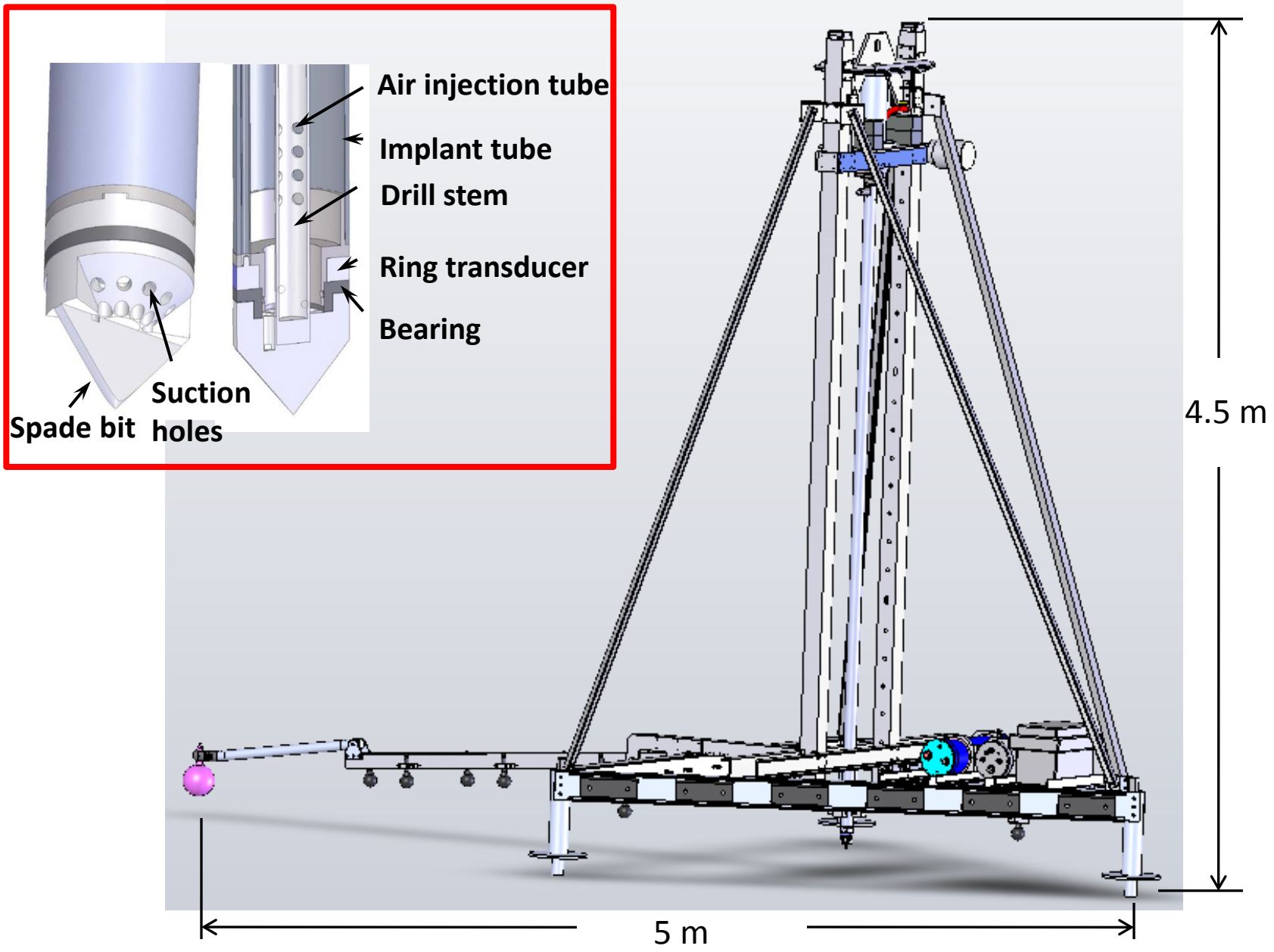
Outline

- Proposed measurements for Seabed Characterization Experiment

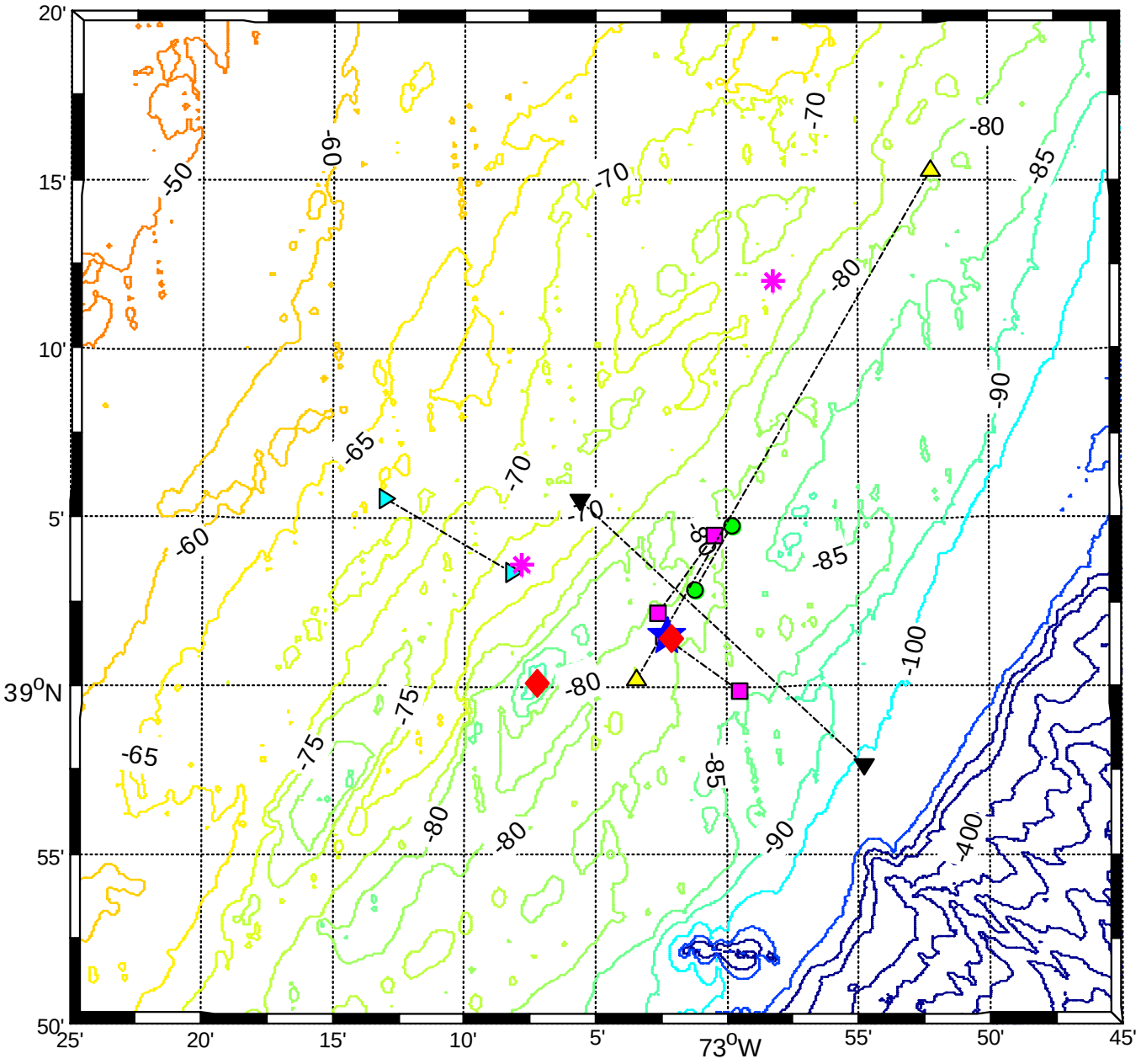
- Equipment

Direct measurement of sediment sound speed and attenuation using SAMS (Sediment Acoustic-speed Measurement System)


Air injection tube
Implant tube
Drill stem
Ring transducer
Bearing
Suction holes
Spade bit
4.5 m
5 m

Dimensions	Vertical: 4.5 m Horizontal: 5 m (including extension arm)
System working depth	100 m
Maximum sediment penetration	3 m
Acoustics	
Sources	Total 10 sources: 1 low-frequency source (ITC1007); 9 mid- to high-frequency sources (ITC1032)
Receiver	ITC5510 (customized ring transducer)
Frequency coverage	700 Hz – 10 kHz & 1.5 – 35 kHz
Deployment	
Ship requirement	Crane or A-frame, 20’ clearance; 12’x12’ deck size for the frame, 5’x12’ for air compressor; dynamic positioning
No of personnel required	4 – 5
Time for deployment	0.5 – 1 hour
Time for acoustic transmission	2 – 3 hours

Direct measurement and inversion results of sediment sound speed during SW06

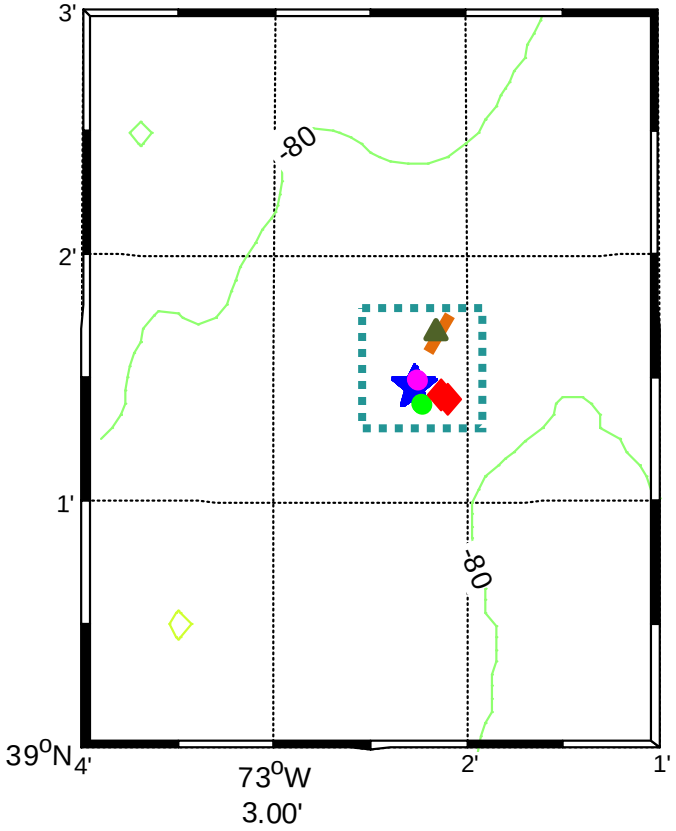


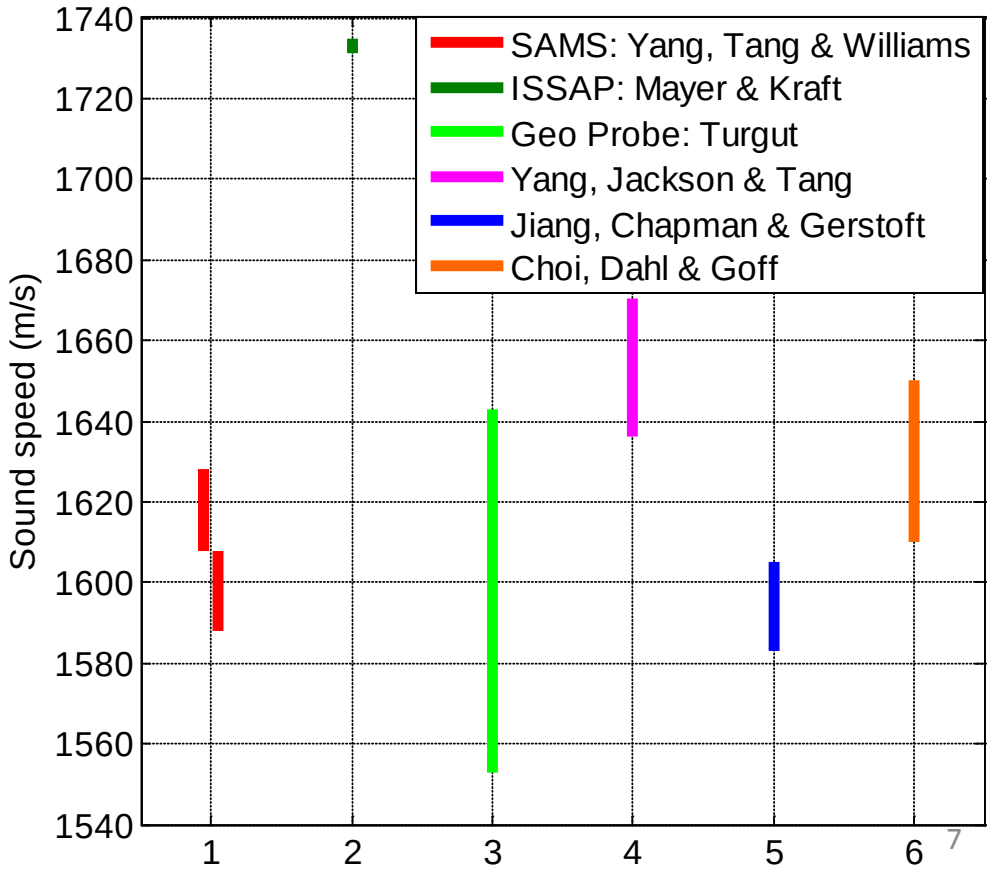
- SAMS (direct measurement):
  1618 ± 11
  1598 ± 10
  1600 ± 20
- Zhou:
  1591.5 ± 18.2
- Hodgkiss, Gerstoft & Huang:
  1596 ± 11
- Potty & Miller:
  1610 - 1595
- Dahl & Choi:
  1630 ± 20
- Chapman & Jiang:
  1636 ± 16
- Knobles:
  1650, 1708
- Ballard & Becker:
  1615 - 1730
- Hines & Pecknold:
  1687
- Lin, Lynch & Newhall:
  1710 ± 10

Direct measurement and geoacoustic inversion of sediment sound speed in SW06

2 km boxed area:

- **SAMS (direct, APL-UW):** 1618 ± 11; 1598 ± 10
- **ISSAP (direct, Mayer & Kraft):** 1733 ± 2 (1 station); 1721 ± 25 (6 stations, 5km range)
- **Geo Probe (direct, Turgut):** 1636
- **Yang, Jackson & Tang:** 1650 ± 15
- **Jiang, Chapman & Gerstoft:** 1594 ± 11
- **Choi, Dahl & Goff:** 1630 ± 20





How to compare direct measurement and inversion results

- Frequency band:

  1 – 10 kHz VS below a few kHz

- Penetration depth

  3 m VS equivalent penetration depth of 2 wavelengths (3 m → 1 kHz)

- Point measurement VS an averaged result along the acoustic track

Benefits and collaboration

- Benefits

  1. provide statistics of bottom properties (2 – 3 hours for 1 deployment)
  2. can be compared with other direct measurement techniques and inversion results

- Cross check again other direct measurements such as vibrocore (Goff), geo phone (Potty and Miller) and Geo Probe (Turgut, NRL).

Equipment

Laser Line Scanner

- Measure bottom roughness
- Resolution: 1mm covering a 0.3 m x 3.5 m area
- Weight: 300 kg
- Time required for measurement: 30 min
- Dimension: 5 m x 2 m x 3 m

Towed SBE-CTD Chain (TOWSBE)

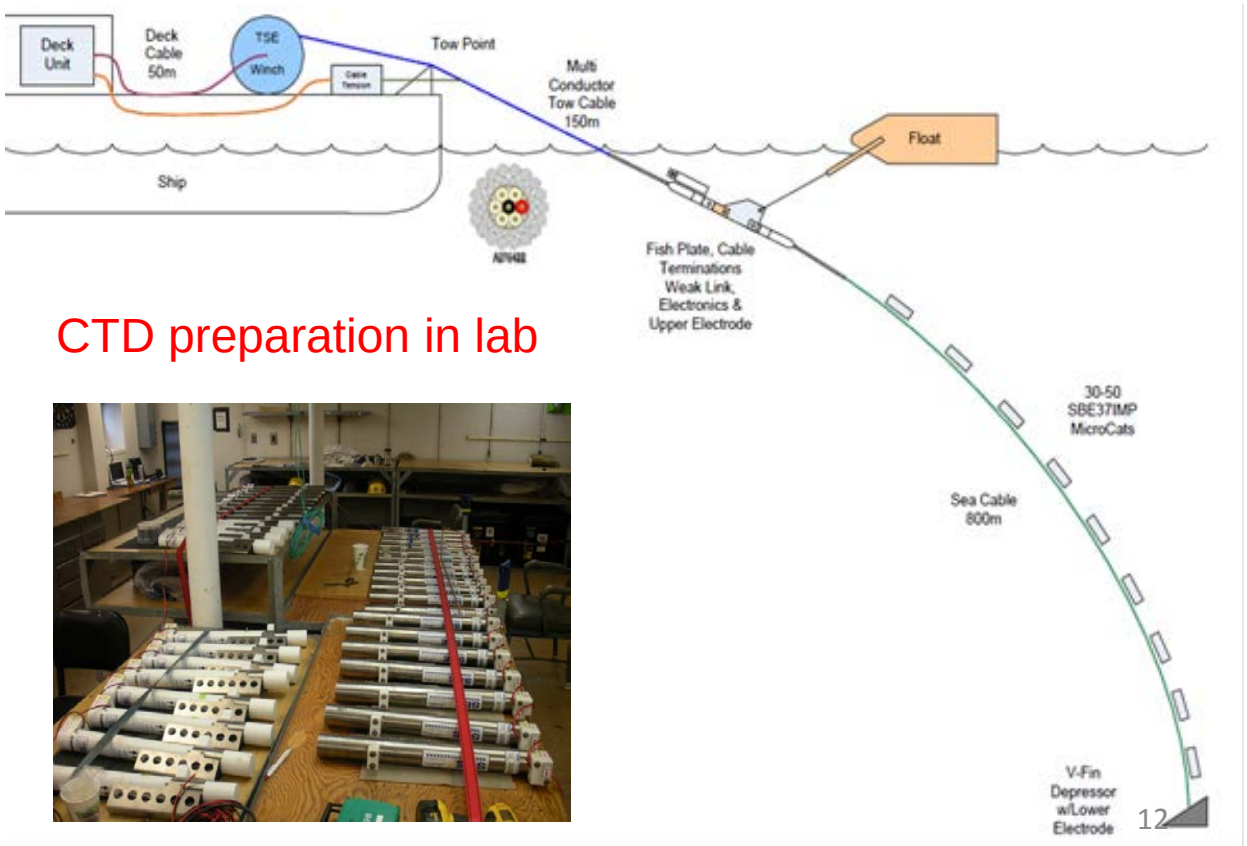
Lien APL/UW

- 800-m armored cable
- Flexible mounting depths, 40+ SeaBird CTD sensors available
- 10-s sampling time interval
- Typical towed speed 4 kt; maximum speed 8 kt.

Operation requirements

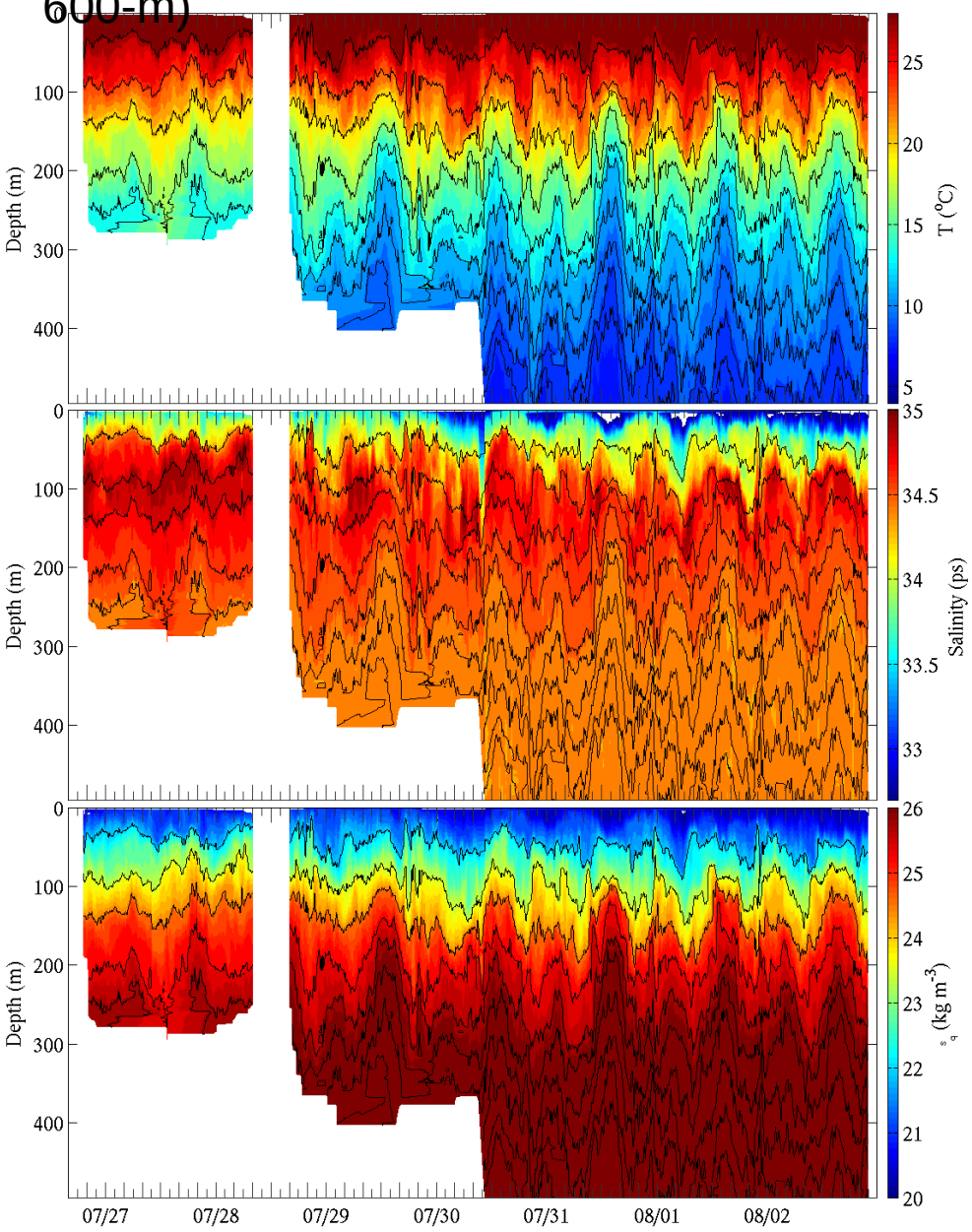
- Lab space: 12’x6’ bench
- Deck space: 7’x2’x4’, one reel of armored cable
- Operation: A-frame/crane and TSE winch; 4 persons + one ship staff required.
- Total weight: 0.5 ton
- Deployment and recovery of 800 m chain might take 5 hrs each, depending on the sea state
- Loading and offloading < 1hr
- TOWSBE can be operated continuously for at least 1 week

Sketch of TOWBE



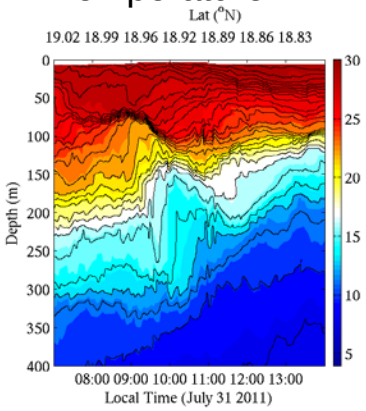
CTD preparation in lab

TOWSBE in Luzon Strait in 2011 with varying cable lengths (300-m, 400m, and 600-m)

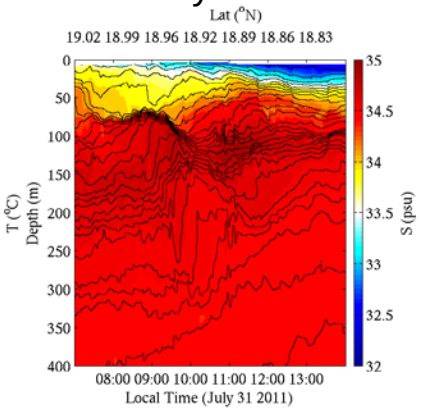


TOWSBE captured the details of one hydraulic event. Salinity anomaly of 0.2 psu was found within the hydraulic jump. The realtime data transmission allowed detection of energetic events and improved the observational plan.

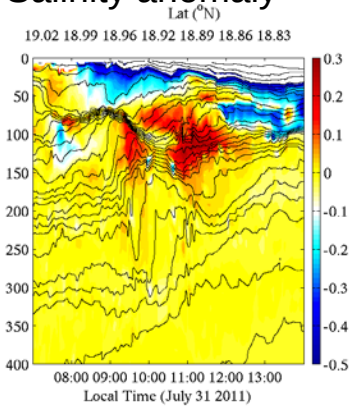
Temperature



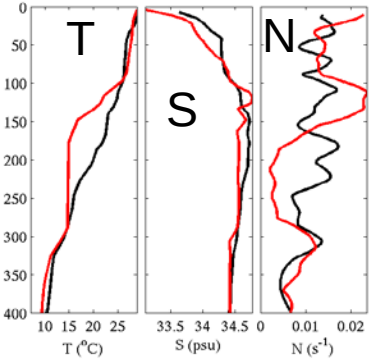
Salinity



Salinity anomaly



T, S, N before (black) and during hydraulic jump (red)



32-element HAARI line array

- length: 6.2 m
- Weight: 100 kg
- Dry lab space: 1 bench area

Sources

- ITC 2015
- ITC 2010x
- ITC 1007
- ITC-5485/ITC-5490 Source Frame