HYDROGRAPHIC SURVEY

Hydrographic Survey

- “The branch of applied science which deals with the measurement and description of the physical features of sea and adjoining coastal areas”
- **Hydrographic survey** is the science of measurement and description of features which affect navigation, marine construction, dredging, offshore oil exploration/drilling and related activities.
- **Hydrographic surveying “looks” into the ocean to see what the sea floor looks like.**
- Hydrographic Survey are used to define the shoreline and underwater features.

Why do we need ?

- Offshore Drilling
- Harbor Construction
- Containerization
- Determining Water Depth and location of rocks
- Evaluating area of Sedimentation and erosion
- Providing recreational facilities such as beaches and marine
- Determining pollution sources
- Determining river channel profiles

Introduction:

- The results from a hydrographic survey are normally plotted to produce a bathymetric contour map, which is a plan of the depth of the sea bed arranged in such a manner as to show lines of equal depth from the coastline.

- In a hydrographic survey, the actual measurement of the water depth is the easy part. The main problem is not knowing how far the survey boat is from the coastline when the depth is recorded.

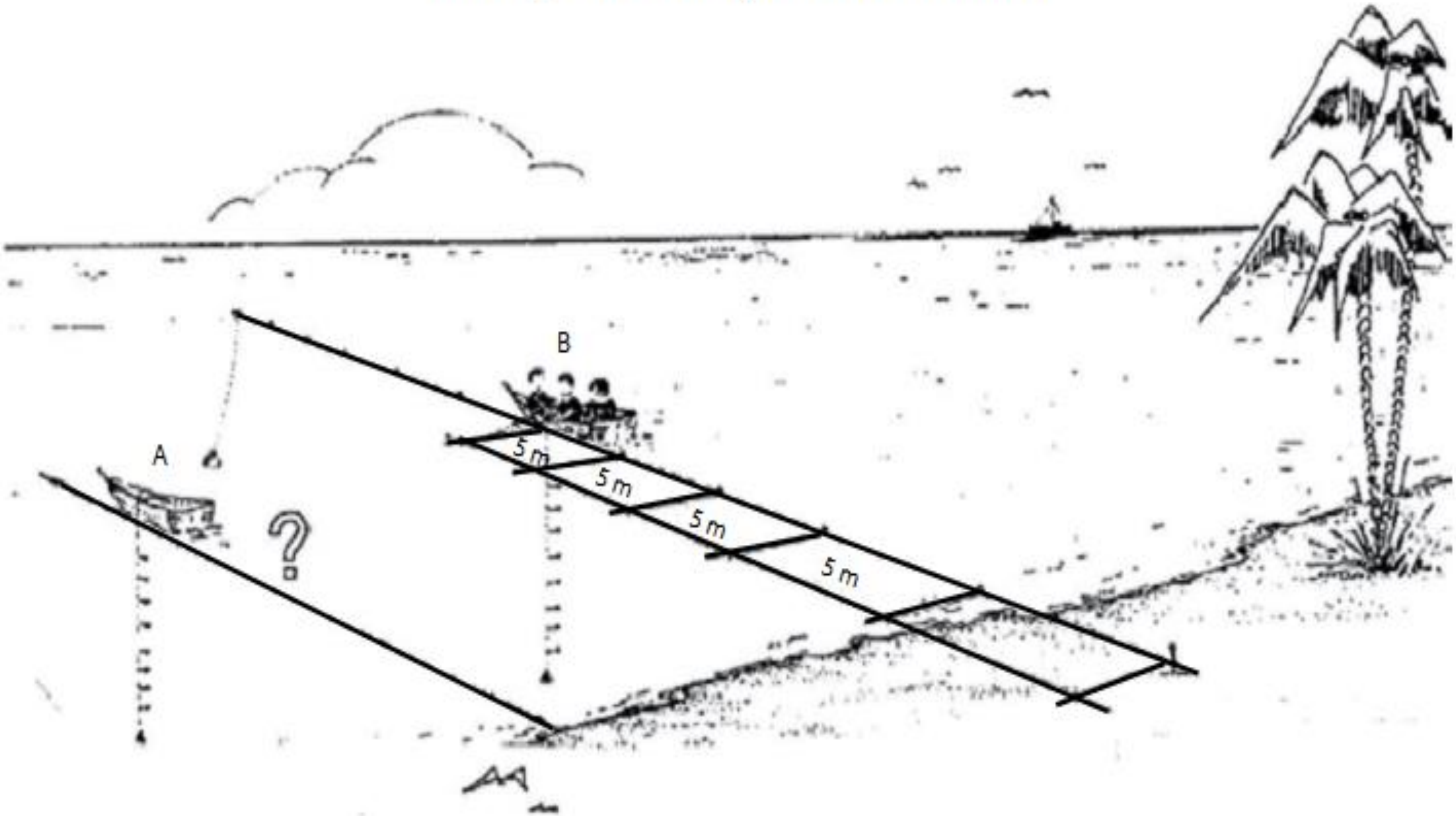
Introduction

- Boat A in Figure 1, for example, has no point of reference in relation to the coast. Boat B, on the other hand, is using a calibrated float line to obtain a “FIX” or position with respect to the coastline; in this case, 20 metres away on the straight line between the peg and the buoy.
- Hence, for each vertical depth recording, a horizontal position “FIX” is also required.
- Both vertical depth measurements and horizontal position measurements may be carried out either manually (low tech, low cost) or using sophisticated depth and position fixing equipment (high tech, high cost), depending on the end use of the survey.

Introduction

FIGURE 1

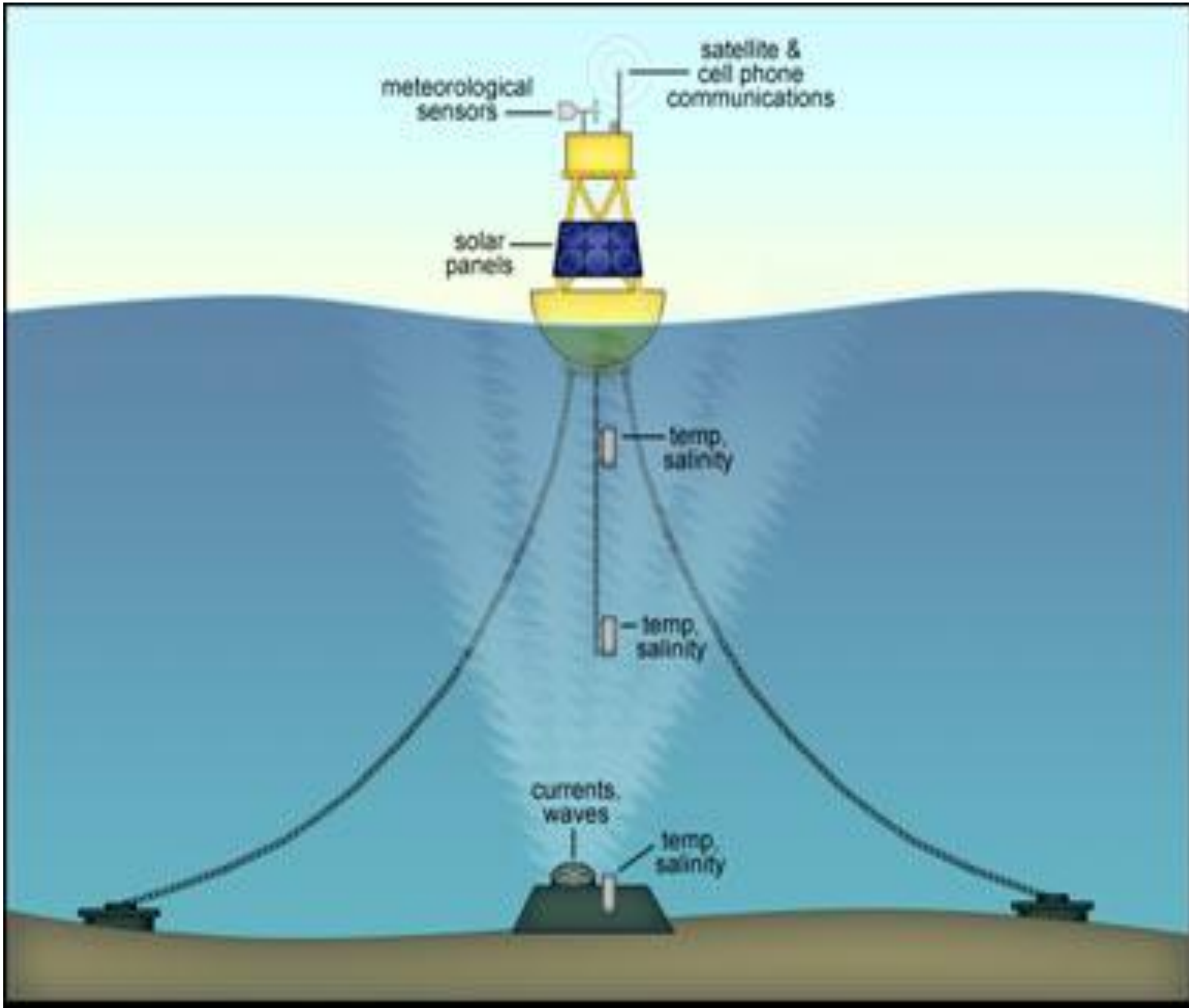
Fixing a vessel's position offshore



Buoy:


NOAA


EATH BUOY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sensors
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Hydrographic Survey Vessel

Hydrographic survey vessel:

- Hull: Aluminum
- Survey Speed: 3-8 knots
- Transit Speed: > 15 knots
- Range: 250 nautical miles
- Propulsion: 2 Diesel Engines
- Drives: 2 propellers

Classification:

- Hydrographic surveys are required for a wide variety of purposes, ranging from simple reconnaissance (at project formulation, for instance) to payment for work carried out underwater, such as dredging. The size of the area to be surveyed also influences the methodology to be used and hence the equipment required. In ascending order of accuracy, hydrographic surveys may be broadly classified as:

• Reconnaissance	Class 3
• Project condition or design	Class 2
• Contract payment	Class 1

Maximum allowable errors in hydrographic surveys

Type of survey	Class 3	Class 2	Class 1
Vertical accuracy	500 mm	300 mm	150 mm
Horizontal positioning	100 metres	12 metres	6 metres

Methodologies:

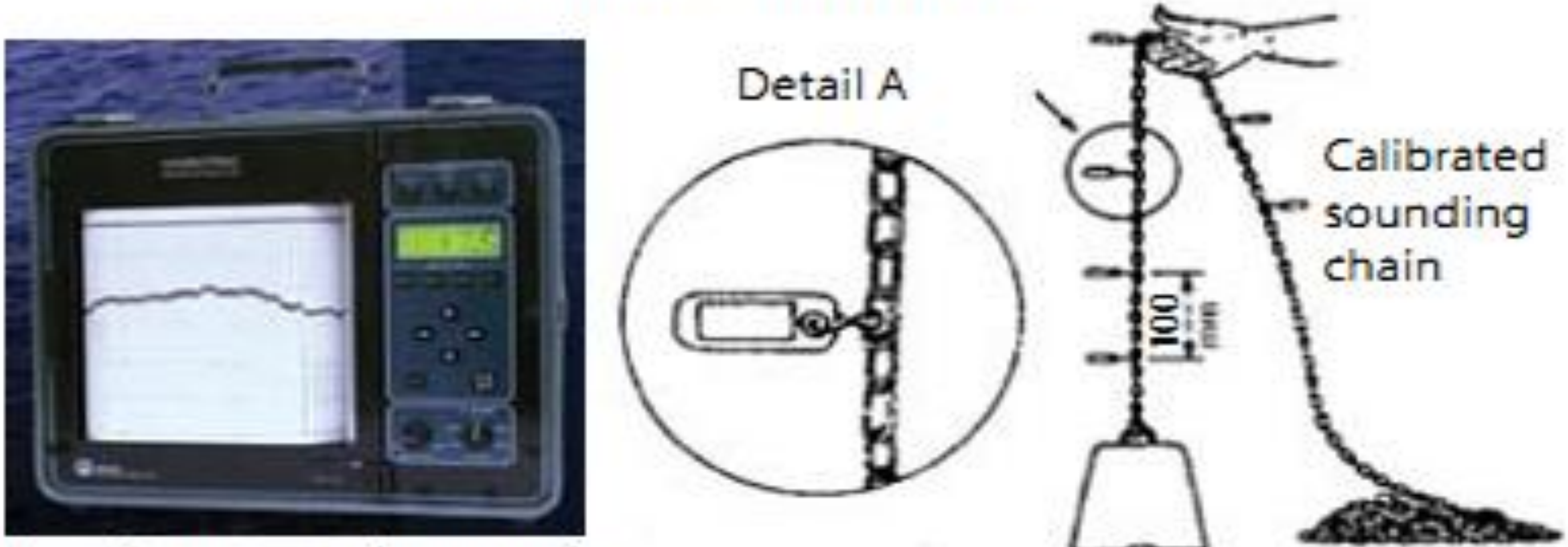
- There are various methodologies in use nowadays to carry out a hydrographic survey, depending on the end use of the survey and the size of the area to be surveyed. Vertical depth measurements may be carried out using:

1. Hand-held calibrated lead sounding line.
2. Simple engineering echosounder recording on paper.
3. Advanced engineering echosounder recording on a data logger and linked to position fixer via integrated software (fully automated).

Vertical Depth Measurement:

- Figure 2 illustrates the hand-held calibrated lead sounding line, right, and on the left, the simple engineering echosounder.

FIGURE 2
Echosounder and lead line



Engineering-type echosounder

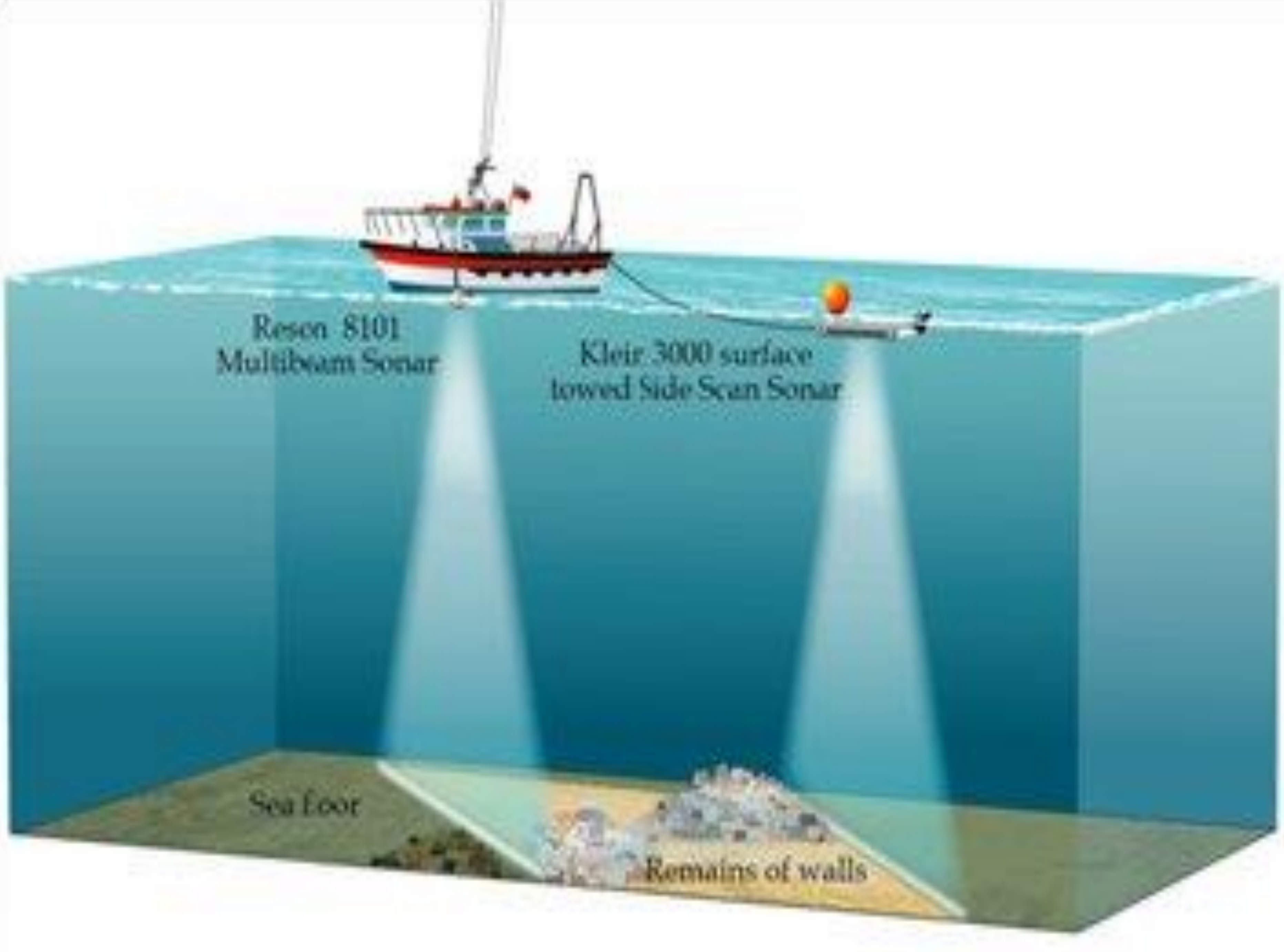
Vertical Depth Measurement

- Figure 3 illustrates an advanced echosounder of the type used in modern Class 1 surveys. The echosounder is linked to a software package and yields electronic contour maps directly. This type of echosounder is also used for real-time monitoring of dredging works.

FIGURE 3
Advanced echosounder integrated with survey software (www.reson.com)

Methodologies

- Horizontal position fixing measurements may be carried out using:
  1. Hand-held optical square in conjunction with a float line;
  2. Single theodolite in conjunction with a float line or twin theodolites;
  3. Constant range tracking electronic positioning system (EPS); and
  4. Differential Global Positioning System (GPS).

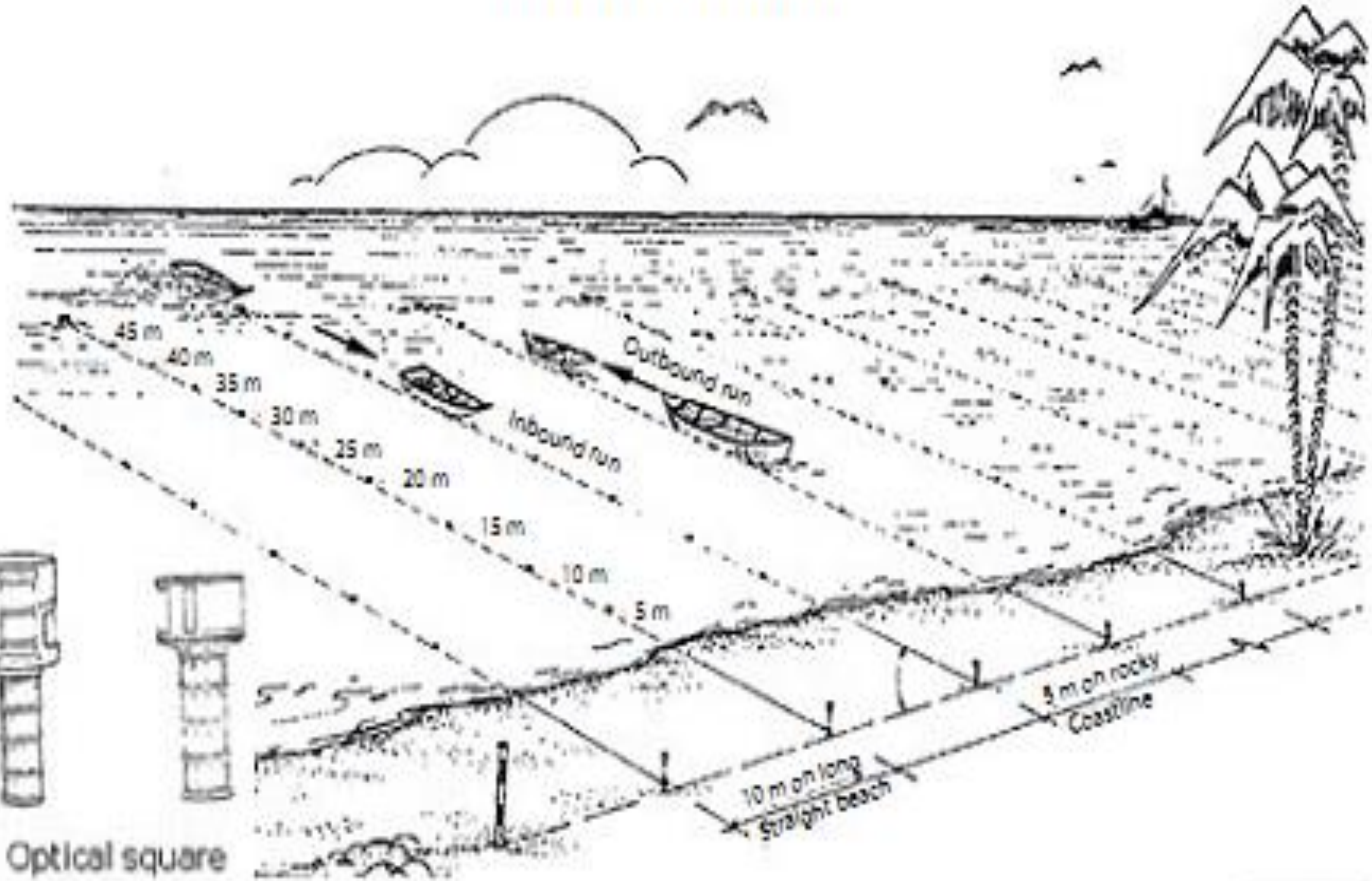


Reson 8101
Multibsam Sonar
Kleir 3000 surface
towed Side Scan Sonar
Sea floor
Remains of walls

Horizontal Position Fixing:

- **Method-1:**
- **The hand-held optical square in conjunction with a float line method**, also known as the parallel line method (Figure 4), is the most basic method in setting out a straight baseline along the beach, say 100 metres long or more, depending on the extent of the hydrographic survey, with a ranging rod placed at either end.
- At every 5 or10 metres from either end (5 metres for irregular terrain and 10 metres for flat beach), a steel peg is driven into the ground and, by means of an optical square (or theodolite), a buoy is dropped offshore at right angles to each peg.
- One end of the float line is anchored to the steel peg and the other to its corresponding buoy offshore. By tying in the baseline to the topographic survey, the depth readings may be plotted on paper in the right place.
- It is always a good practice to extend the survey about 100 metres on either side of the proposed shelter or landing.

FIGURE 4
Parallel line method



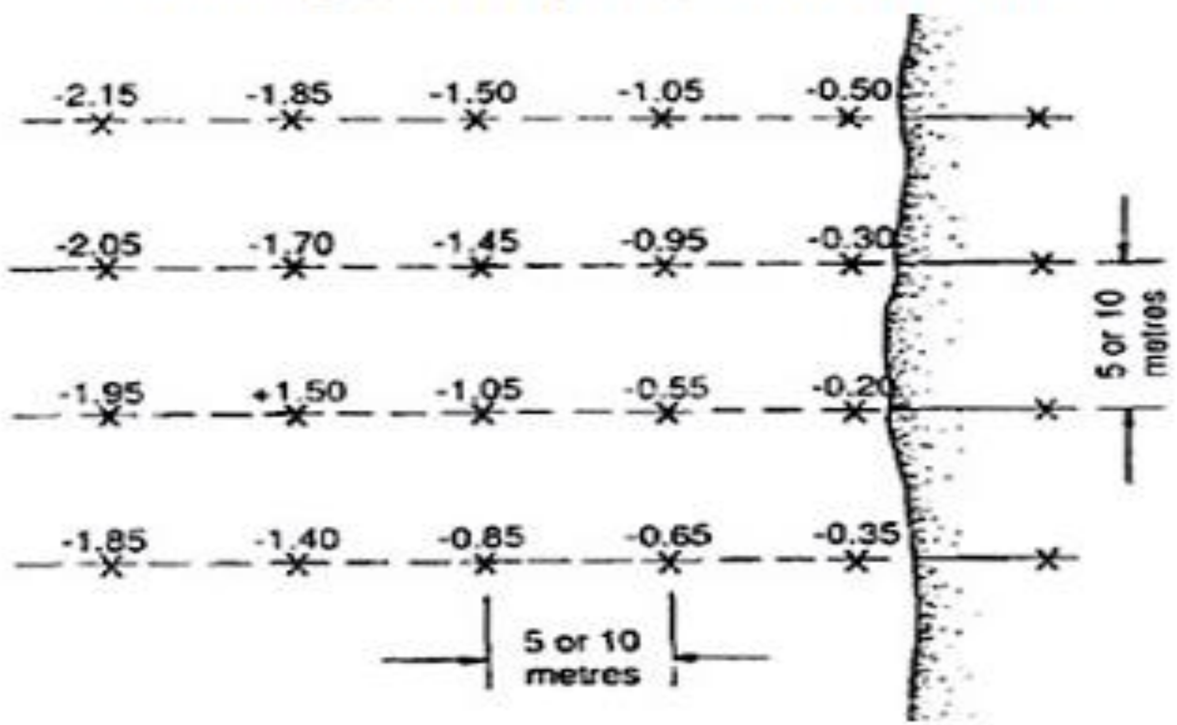
Method-1

- The actual depth of the water may be read by simply lowering the calibrated sounding chain every 5 or 10 metres and the person using the chain calls out the readings to another person in the boat who records the figures on paper in the correct order.
- This type of recording yields a grid with spot levels only. If an engineering echosounder is available with an experienced operator, the actual soundings may be recorded on the special thermal paper roll by the instrument itself.
- A continuous bottom profile is thus obtained on a continuous strip chart and sounding levels scaled off the chart.

Method-1

- Figure 5 illustrates the type of plotted soundings derived by this method of survey. This method is considered acceptable for all three classes of surveys with a maximum offshore distance of 200 meters.

FIGURE 5
A soundings plot using the parallel line method



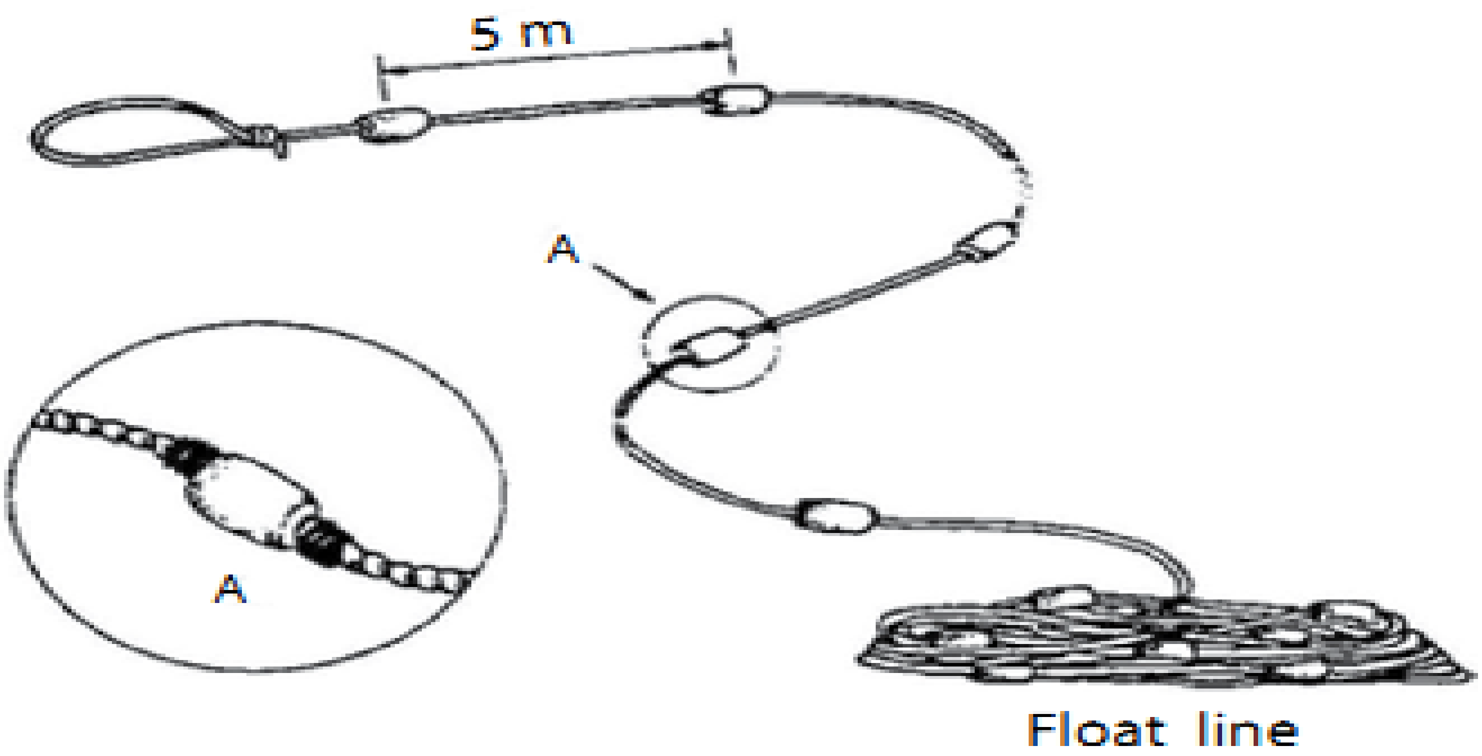
Method-1

- The calibrated float line, illustrated in Figure 6, should be made up from a length of 12 mm diameter polypropylene rope with coloured floats at 5 and 10 metre intervals. One large spherical red float should be installed every 50 meters to ease chain readings from the survey vessel.
- The float line is rather difficult to keep stretched in a perfect line in the presence of wind, waves or current. It is therefore recommended that survey work involving float lines be carried out when the sea is perfectly calm (Figure 7).

Method-1

FIGURE 6

The calibrated float line – maximum length 200 metres

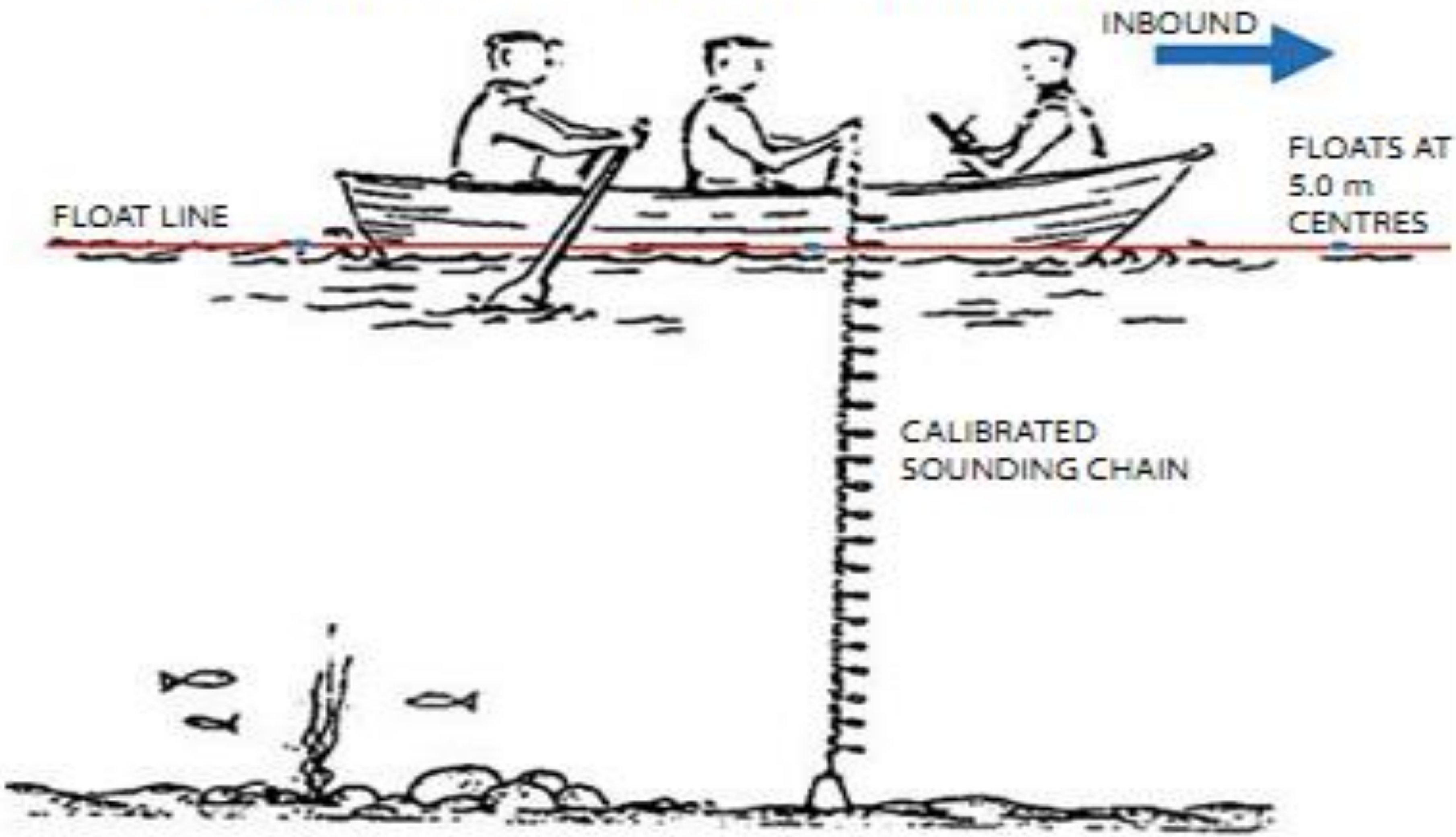


Material	Nylon	Polyethylene	Polypropylene
Stretch (elasticity)	High elongation	Low elongation	Low elongation
Weight of 200 m	20.6 kg	16.0 kg	14.5 kg
	Not suitable	Suitable	Most suitable

Method-1

FIGURE 7

Recording the soundings manually at 5 m centres



Method-2

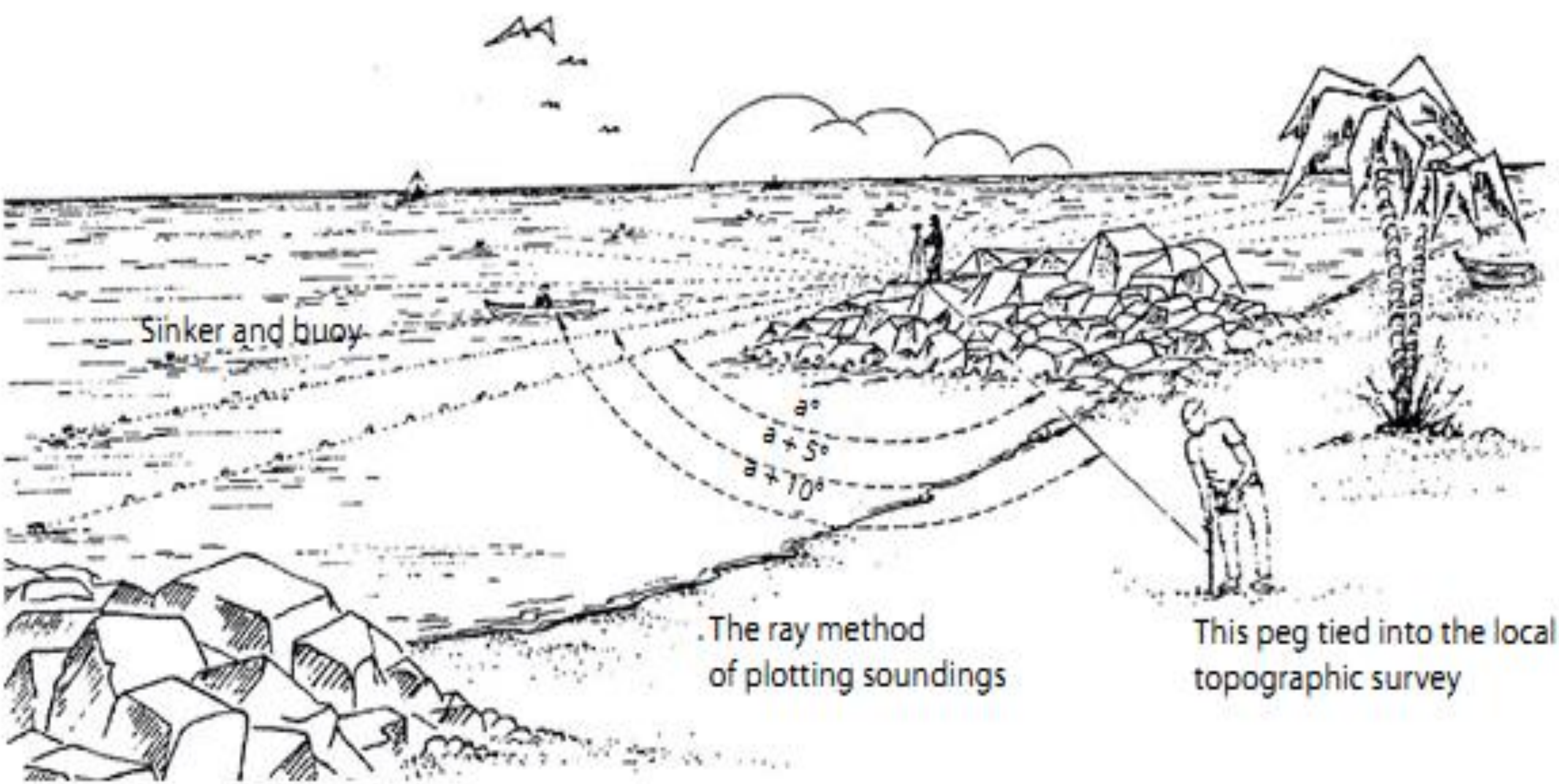
Method-2:

- The single theodolite, in conjunction with a float line (ray method) or twin theodolite intersection (triangulation method), is the second most basic method of fixing positions offshore.

- In the past, positioning by these methods from baseline points onshore was often used to position vessels on near-shore projects.

Method-2

FIGURE 8
The ray method



Method-3

Method-3:

- The constant range tracking EPS (Electromagnetic Position System) used to be the most commonly employed positioning method.

- This method replaced the triangulation theodolites with electronic microwave ranging EPS which utilize range-range positioning techniques.

- This method has now been superseded by GPS techniques.

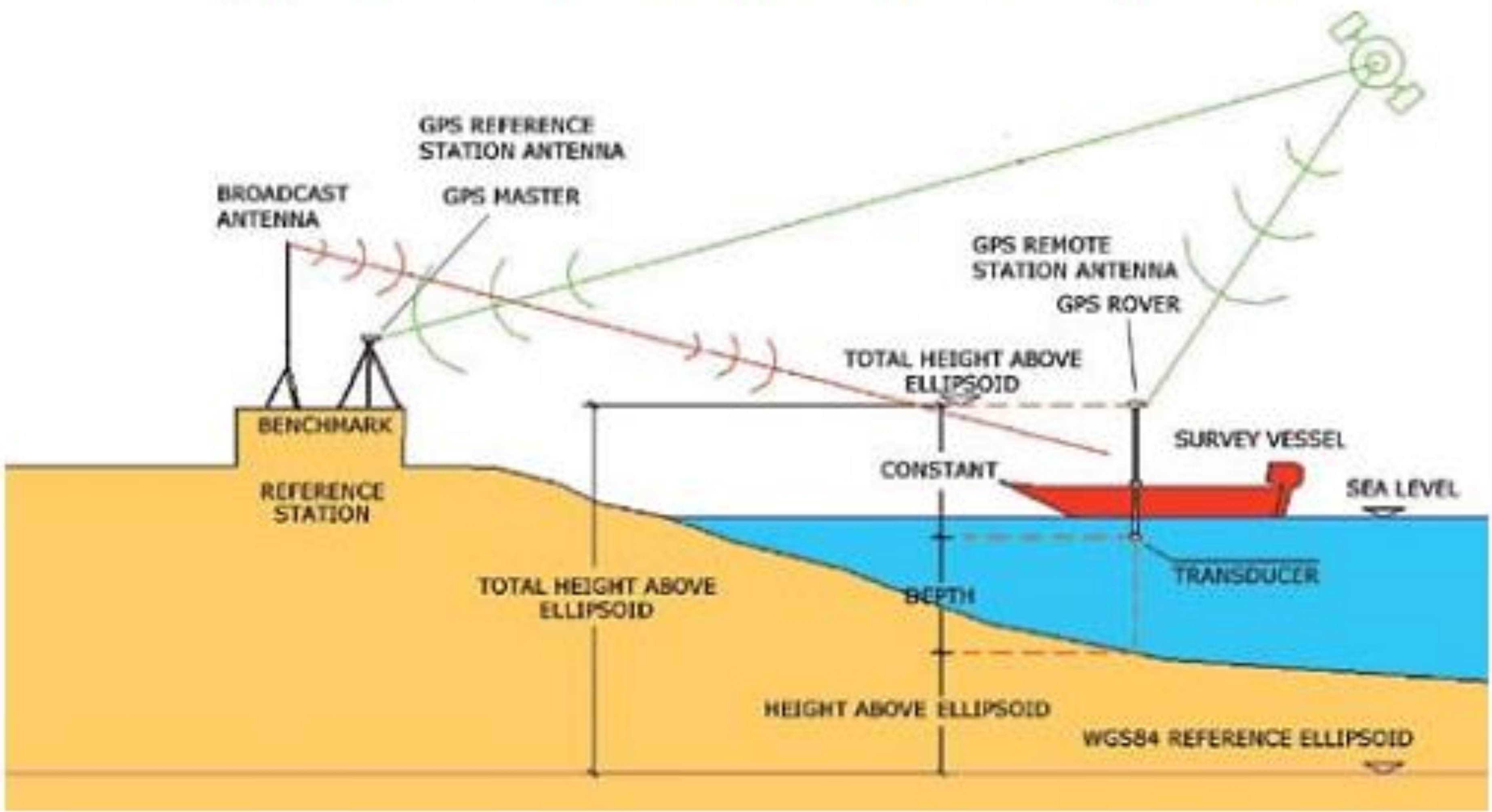
Method-4

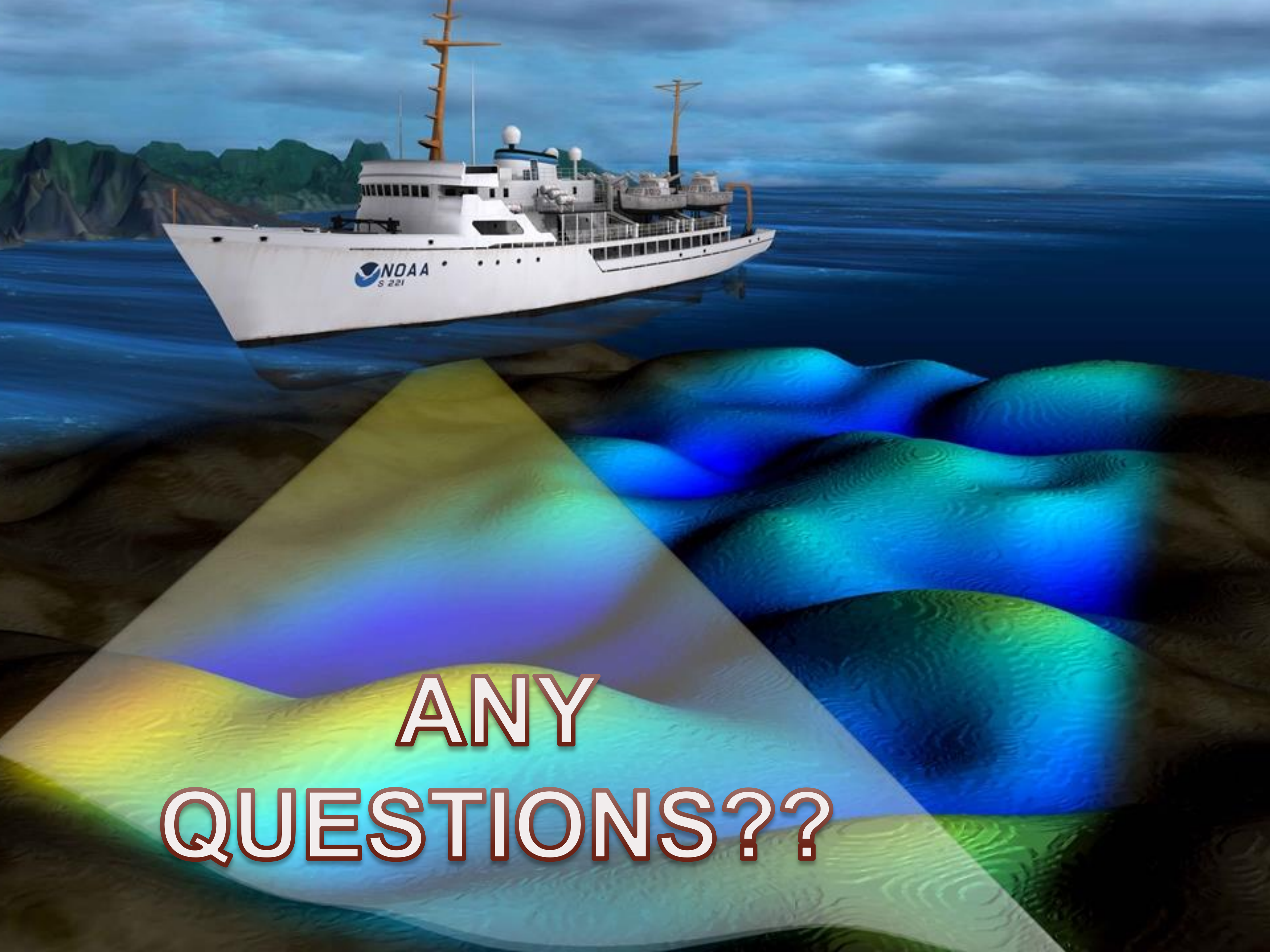
- **Method-4:**
- Differential GPS is the primary survey reference for all types of present-day engineering and construction activities. GPS is a continuous, all-weather, worldwide, satellite-based electronic positioning system.
- It is available to the general public and is known as a standard positioning service. Over the past several years, a technique has been developed to process signals from two GPS receivers operating simultaneously to determine the 3-D line vector between the two receivers.
- This technique is known as “differential positioning” (DGPS) and can produce real-time positions of a moving vessel, Figure 9.

Method-4

FIGURE 9

Differential GPS real-time measurement of position of survey vessel

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