Arab Academy
for Science , Technology and Maritime Transport

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The International Maritime Transport and Logistics Conference

# "MARLOG 13"

# Towards Smart Green Blue Infrastructure

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# The Impacts of Differences Between Tide Gauge and RTK Tide Data on Dredging Calculations in Hydrographic Survey Operations

# Outline

- Introduction
- Case Study on Tide Data Variations
- Methodology
- Results
- Discussion and Recommendations

# Smart Blue Infrastructure

# Introduction

## 1.1 What is Dredging?

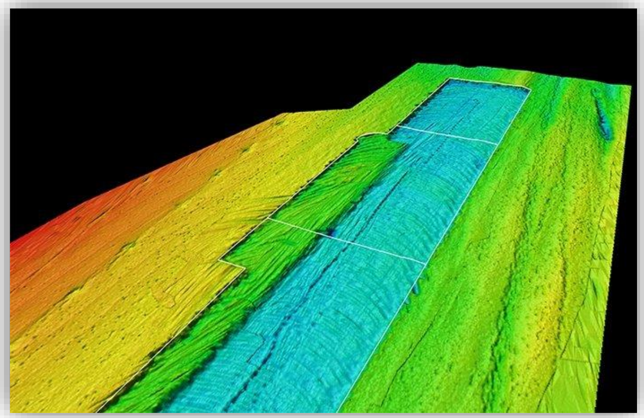
### Dredging Operations

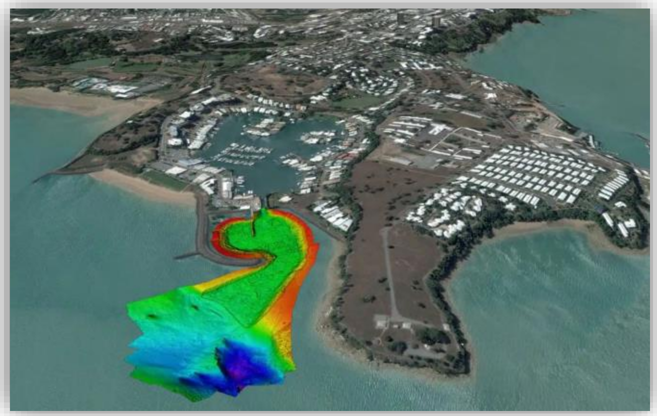
Capital Dredging

Maintenance Dredging

Introduction

## 1.2 Hydrographic Surveying



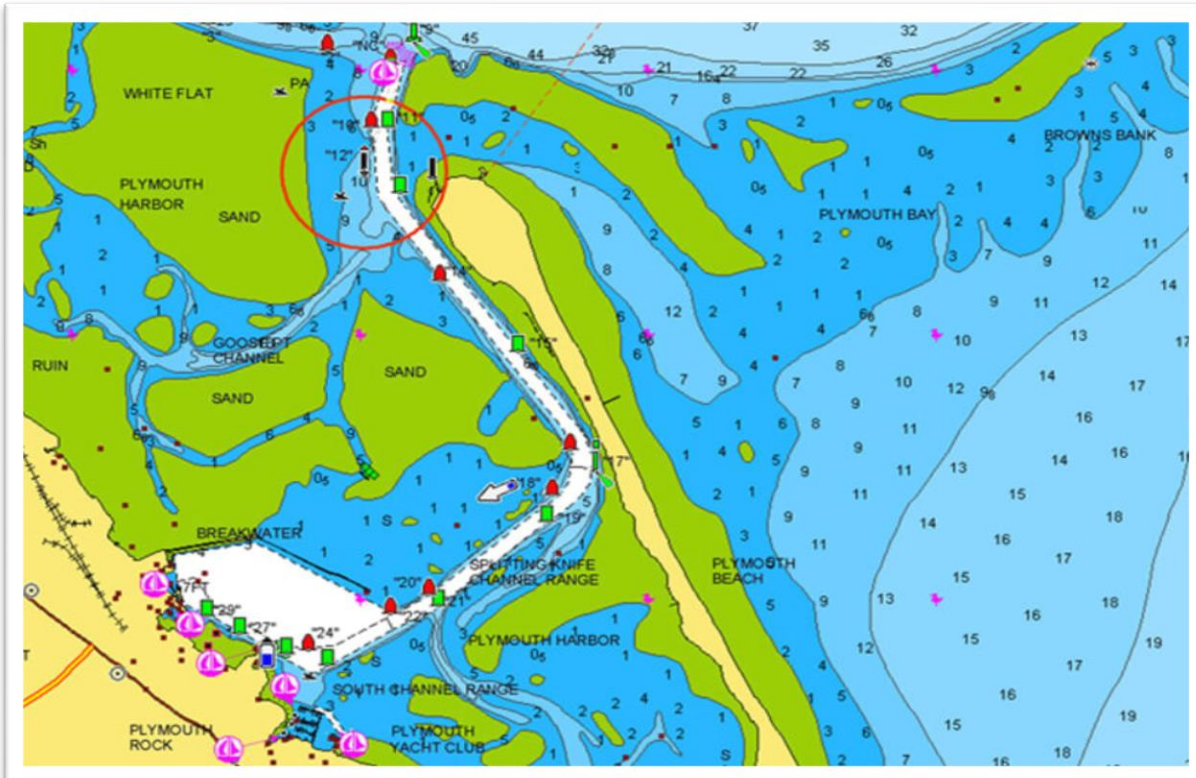


Dredging and Reclamation Process

Navigational safety in ports and access channels

# Introduction

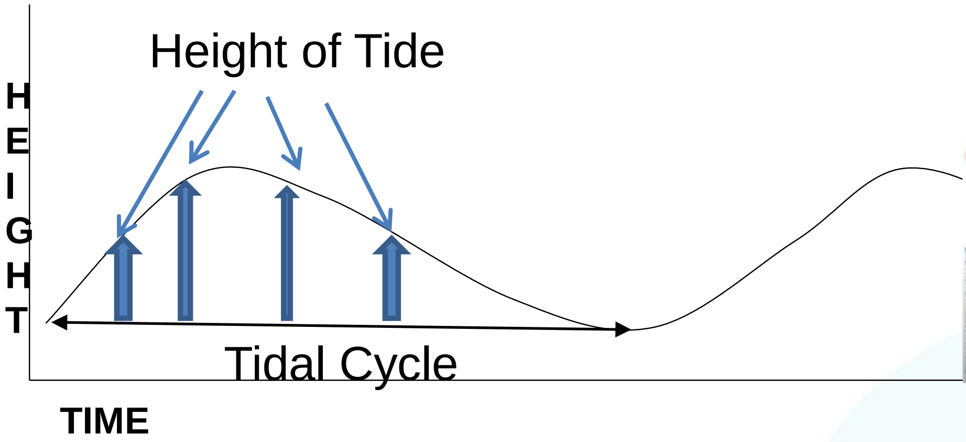
## 1.3 Charted Depth

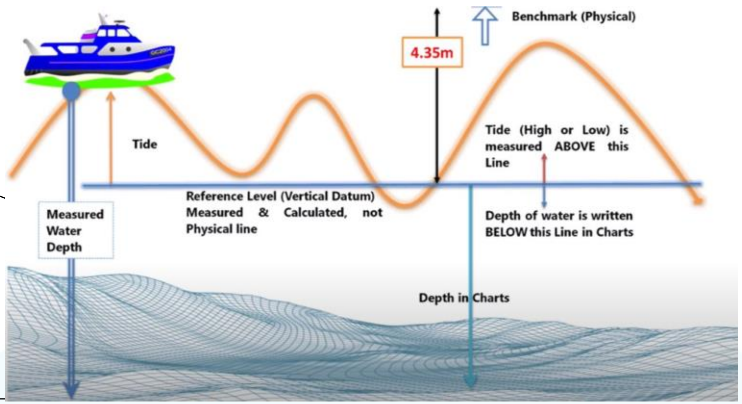


Introduction

1.4 Tides

**<u>Height of Tide</u>** The vertical distance from the chart datum to the level of the water at any time.

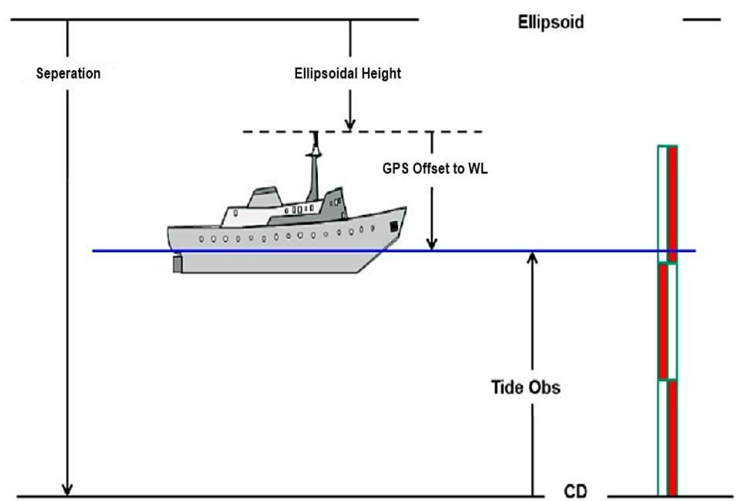


Introduction

1.5 How to measure Tide?

Tide Gauge




RTK GPS

# Introduction

## 1.6 Problem Definition

The study evaluates the effectiveness of the Real-Time Kinematic (RTK) tide method in hydrographic surveys for dredging operations.

## 1.7 Importance of the Study.

Accurate dredging quantity calculations depend mainly on pre and post-hydrographic surveying operations which need precise tide data applied in depth reductions. This study will determine the best method for getting tidal data for depth reduction, which will consequently affect Volume calculation for dredging operation and financial project cost.

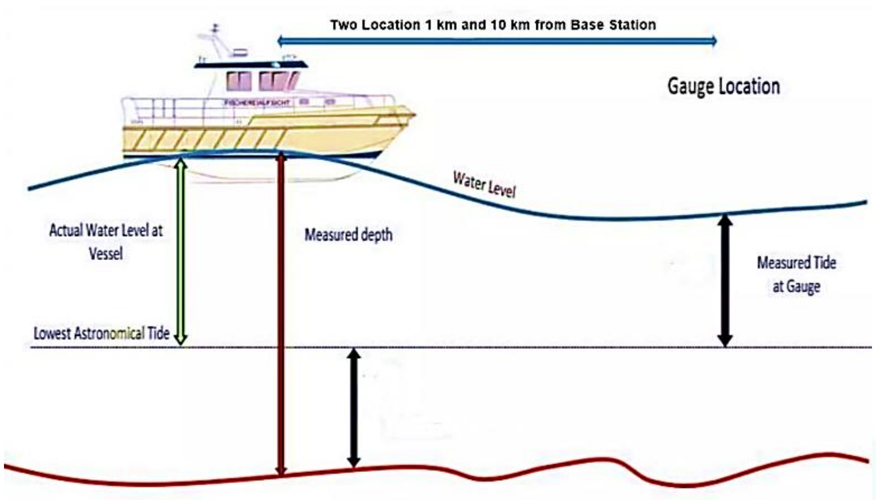
## Introduction

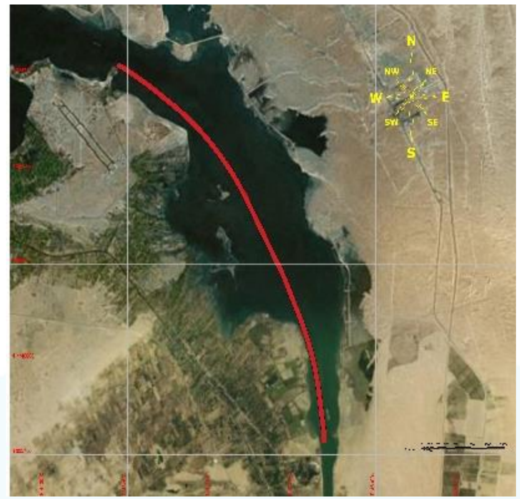
### 1.8 Paper Objective

This paper aims to precisely define the difference between the two methods used in hydrographic surveying for applying tidal data for depth reduction, besides examining the most appropriate method used for dredging quantity calculations.

## 2. Case Study on Tide Data Variations

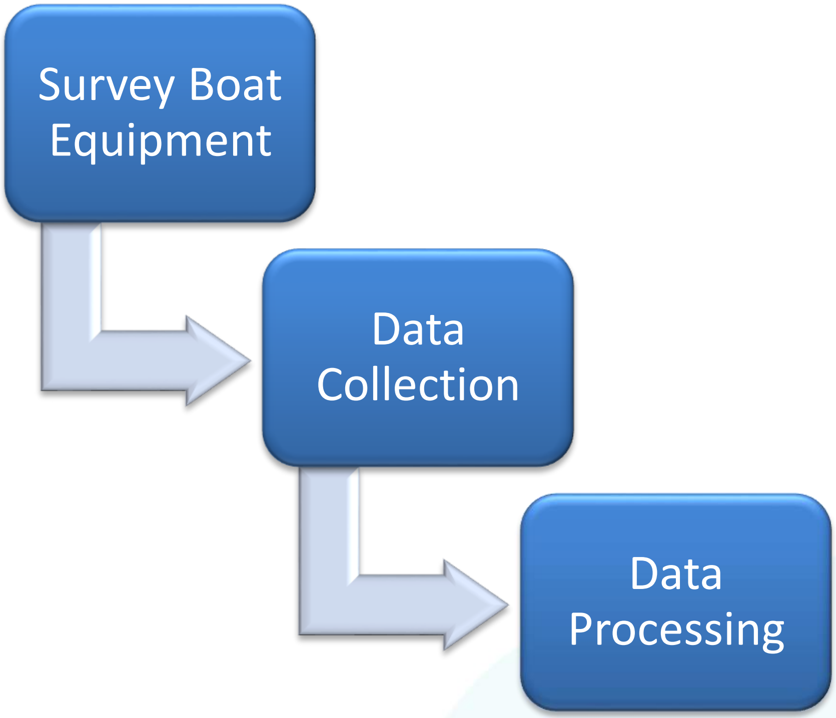
- *Area of Study*



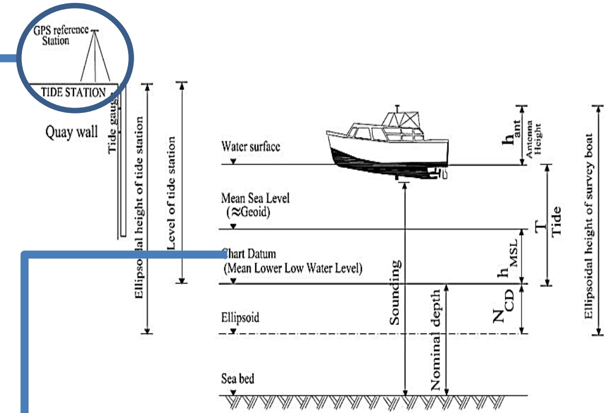

Displays exactly where the study is located in Suez Canal from KP 122 to KP 132, Egypt, Google Earth.

## 3. Data Collection and research Methodology



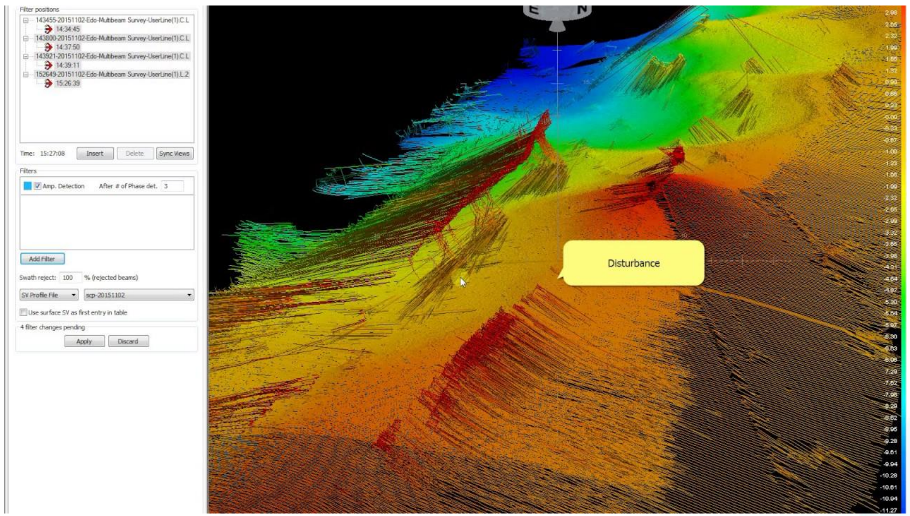
## 3.1 Survey Boat Equipment

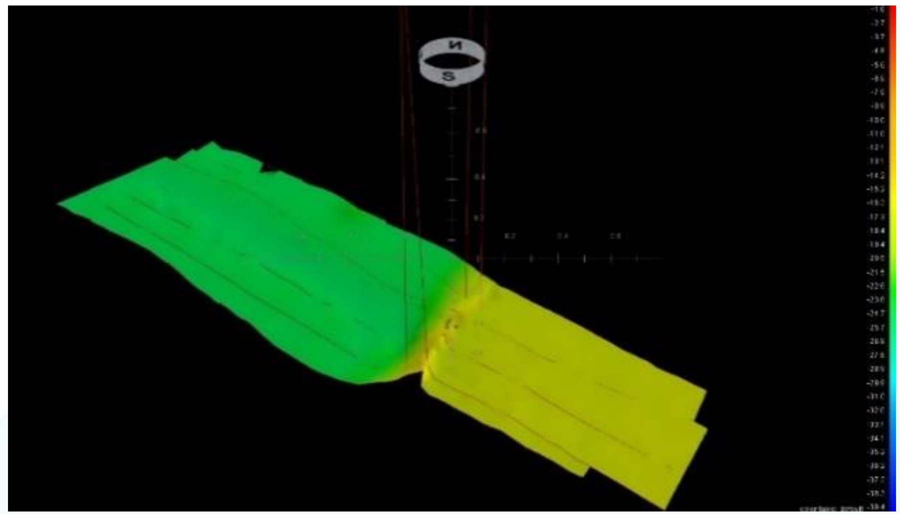
- Survey Equipment
  - GPS Reference Station — Provide correction data
  - Multibeam T20 — Depths
  - POSMV
    - Position
    - Heading
    - Motion
  - Tide
    - RTK Tide
    - Tide Gauge




### 3.1 *Data collection and Processing*

The Multibeam data obtained were collected and processed using the PDS Teledyne software.



# 4. RESULTS



**Comparaison between RTK and tide gauge data distance about 1 km from the base station**

Comparison between RTK and tide gauge data distance about 10 km from the base station

## *4.1 Reduced Depth and Quantity Computation in the Area of Study*

| East | North | RTK TIDE(m) | ATG(m) | Diff(m) |
|---|---|---|---|---|
| 452802.50 | 3347642.50 | 22.99 | 22.94 | -0.05 |
| 452803.50 | 3347642.50 | 23.00 | 22.94 | -0.06 |
| 452804.50 | 3347642.50 | 22.98 | 22.93 | -0.05 |
| 452800.50 | 3347643.50 | 23.00 | 22.97 | -0.03 |
| 452801.50 | 3347643.50 | 23.02 | 22.98 | -0.04 |
| 452802.50 | 3347643.50 | 23.02 | 22.98 | -0.04 |

Average differences ±3

Compares depths for the first experiment to 1km

| East | North | RTK TIDE (m) | ATG(m) | Diff(m) |
|---|---|---|---|---|
| 457984.5 | 3341632.5 | 24.22 | 24.32 | -0.10 |
| 457985.5 | 3341632.5 | 24.30 | 24.40 | -0.10 |
| 457986.5 | 3341632.5 | 24.46 | 24.56 | -0.10 |
| 457987.5 | 3341632.5 | 24.62 | 24.73 | -0.11 |
| 457988.5 | 3341632.5 | 24.81 | 24.91 | -0.10 |
| 457989.5 | 3341632.5 | 24.93 | 25.03 | -0.10 |

Average differences ±15

Compares the depths of the survey are far from the reference station about 10 km


The first experiment is done based on using RTK tide and ATG data for depth reduction, •
while the study area was near to reference station. DTM of data processed by ATG will be a reference surface for volume calculation as it’s more suitable than RTK data. The data in Figure 8 shows that there are about 1,473 m³, as the green color in the legend shows the differences between the two data sets from zero to 0.10 cm

The second trial involved employing RTK tide and ATG data for depth reduction, with the study area positioned approximately 10 km away from the reference station. The computation of dredged quantities was carried out based on the existing tide correction. The Digital Terrain Model (DTM) derived from data processed by ATG serves as a more suitable reference surface for volume calculation compared to RTK data. Figure 9 illustrates the color-coded disparities ranging between 0.10 cm and 0.20 cm, revealing a substantial difference of approximately 36,991 m³ between the dataset processed using RTK tide values and the one processed using ATG tide values.

## 5. DISCUSSION

If you have unreliable tide data with an average error of 0.03 cm and you're calculating the volume of an area with a length of 1000 m and a width of 300 m, this could indeed lead to inaccuracies in your volume calculation. The error in tide data can propagate when calculating volumes, especially for areas where small changes in elevation, like tides, can significantly impact the result.

Let's break down the potential impact on volume calculation:

**1.Area Calculation:**

1. Length = 1000 m
2. Width = 300 m
3. Area = Length x Width = 1000 m x 300 m = 300,000 $m^2$

**2.Tide Height Impact:**

1. Average tide error = 0.03 cm
2. Volume error = Area x Tide Height Error = 300,000 $m^2$ x 0.03 m = 9000 $m^3$

# 5. DISCUSSION

Another breakdown for the potential impact on volume calculation with the same area

**1.Area Calculation:**

1. Length = 1000 m
2. Width = 300 m
3. Area = Length x Width = 1000 m x 300 m = 300,000 $m^2$

**2.Tide Height Impact:**

1. Average tide error = 0.15 cm
2. Volume error = Area x Tide Height Error = 300,000 $m^2$ x 0.15 m = 45000 $m^3$

If the project involves activities such as dredging, construction, or land reclamation, accurate volume calculations are essential. Errors in tide data could lead to incorrect estimations of the materials needed, affecting resource planning and costs.

## 6. RECOMMENDATIONS

1- If the project involves activities such as dredging, construction, or land reclamation, accurate volume calculations are essential. Errors in tide data could lead to incorrect estimations of the materials needed, affecting resource planning and costs.

2- Projects such as the construction of waterfront structures may be sensitive to tide levels. Inaccurate tide data could influence the design and construction requirements, potentially leading to additional costs if adjustments are needed

3- In projects involving navigation channels or ports, inaccurate tide predictions can affect vessel access, potentially leading to delays and increased operational costs

4- It’s advisable to invest in more accurate tide data or implement corrective measures. This may involve incorporating technology, such as reliable tide gauges or sensors, and working closely with experts in hydrography or marine surveying to ensure the data used in the project is as precise as possible

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*Thank You*