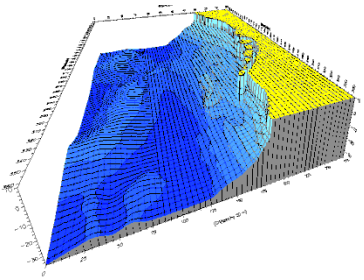
These lecture materials are for the Marine Coastal and Delta Sustainability for Southeast Asia (MARE) (Project No. 610327-EPP-1-2019-1-DE-EPPKA2-CBHE-JP).

This project has been funded with support from the European Commission. This publication reflects the views only of the authors, and the Commission cannot be made responsible for any use which may be made from the information contained herein.

Co-funded by the Erasmus+ Programme of the European Union

Meteo-marine Parameters & the Field Measurement

Overall Learning Outcomes



CLO1 **Assess the influencing environmental factors and related coastal processes, and analyze causes of coastal erosion/sedimentation**

CLO2 Develop skills and knowledge for the planning and management of coastal zone in respecting the principles of sustainability

CLO3 Evaluate application of different coastal stabilization schemes and the governing factors for their selection and impacts

PO1 **Acquire and apply engineering fundamentals to complex civil engineering problems**

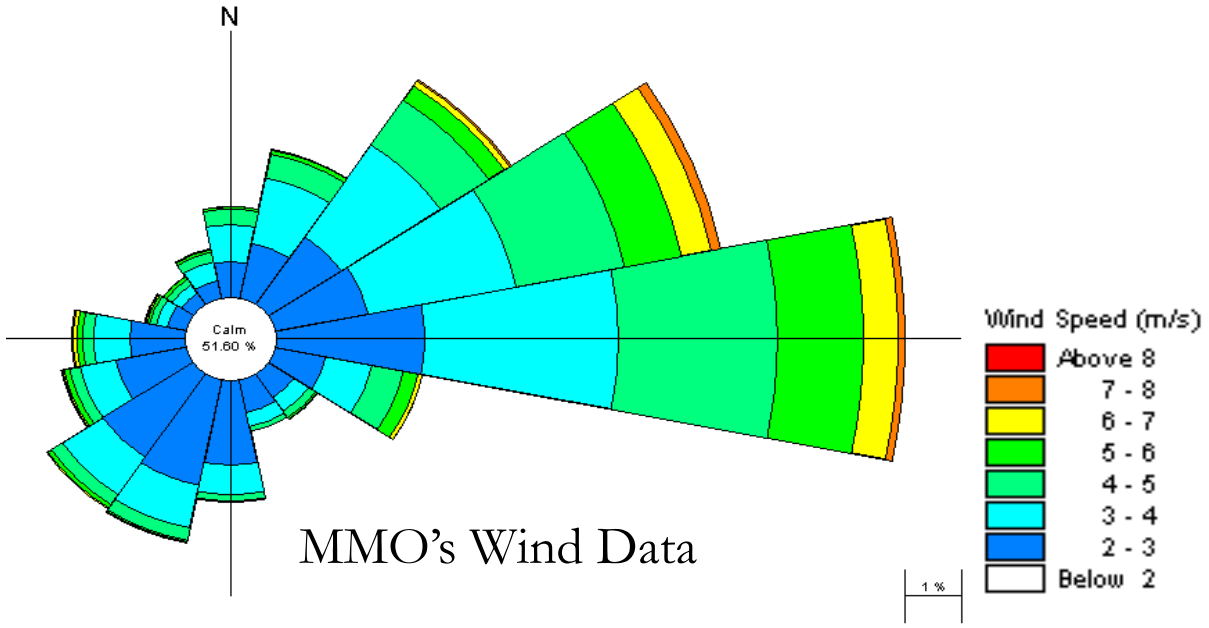
PO2 Identify, formulate and solve complex civil engineering problems using creativity and innovativeness

Topic Contents

- Bathymetry and topography survey
- **Meteo-marine parameters**
  - **Wind**
  - **Wave**
  - **Current**
  - **Water level**
  - **Sediment sampling**
  - **Water sampling**
- **Field data measurement**

Wind

- Long-term wind data for the nearest meteorological station may be procured from Malaysian Meteorological Office (MET).
- An annual wind rose can be derived to determine the dominant wind directions, the magnitude and the probability of occurrence.
- Wind data can also be used to assess wave climate at site.



MMO's Wind Data

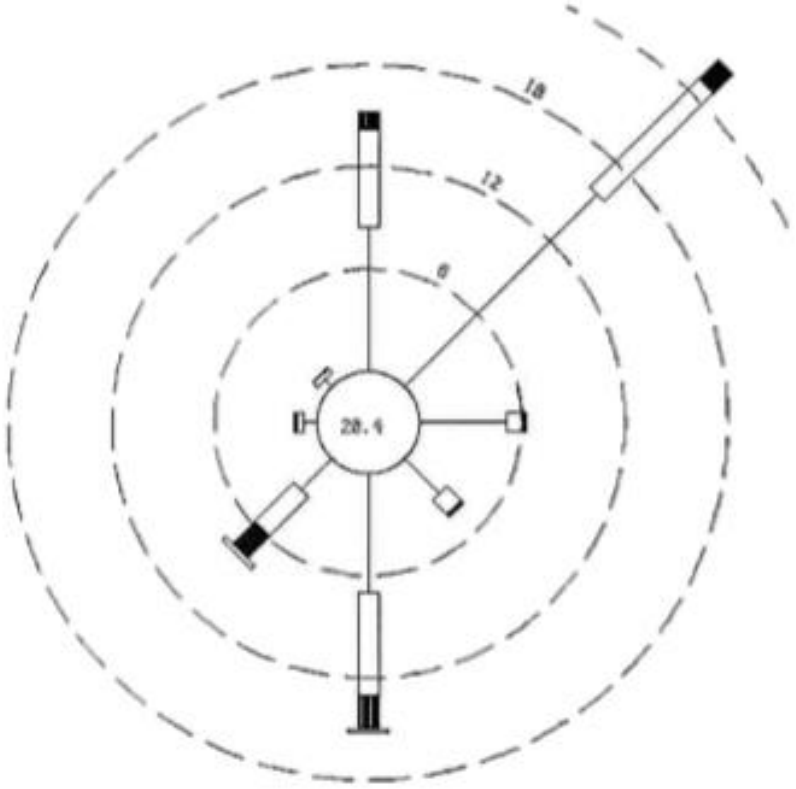
WIND ROSE SUMMARY

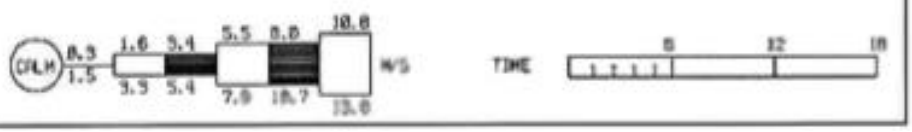
IPOH

1975 - 2005

TIME : 24-HOURS

ANNUAL





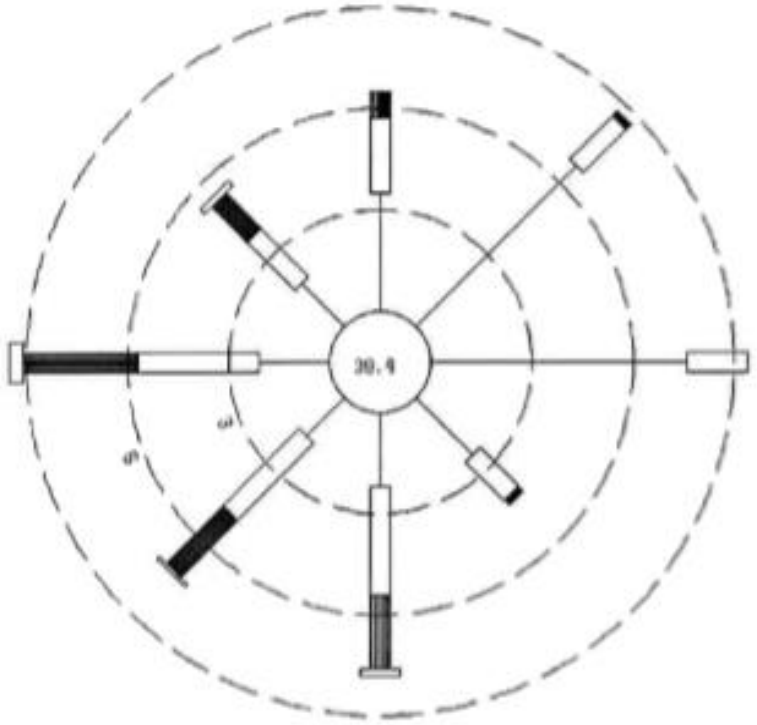
WIND ROSE SUMMARY

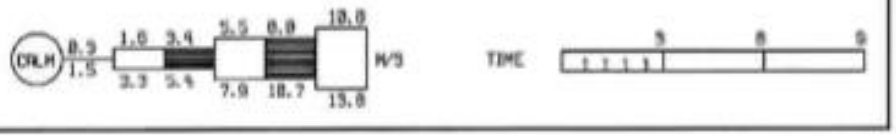
SITIAWAN

1975 - 2005

TIME : 24-HOURS

ANNUAL





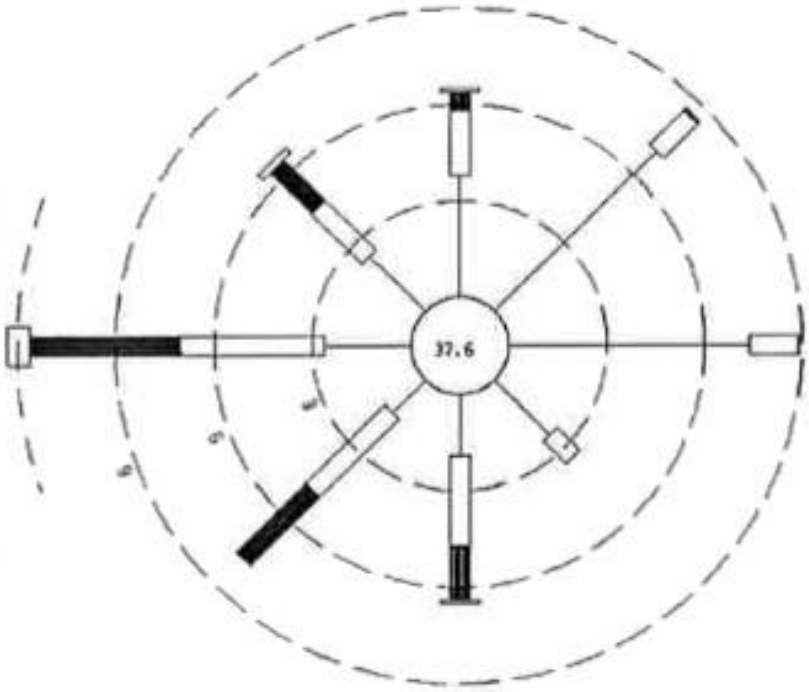
WIND ROSE SUMMARY

SITIAWAN

1975 - 2005

TIME : 24-HOURS

APRIL



WIND ROSE SUMMARY

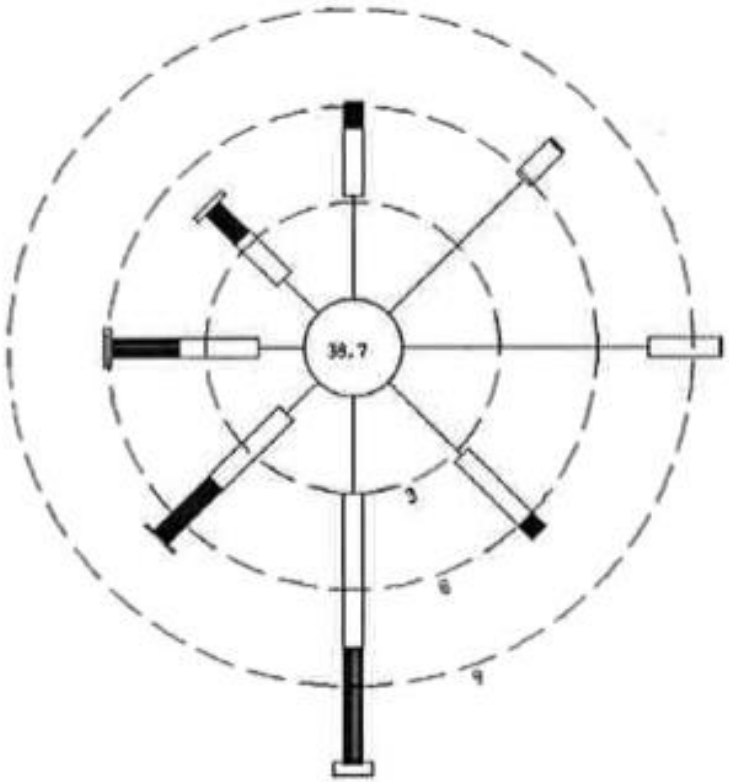
SITIAWAN

1975 - 2005

SW Monsoon

TIME : 24-HOURS

MAY - SEPTEMBER



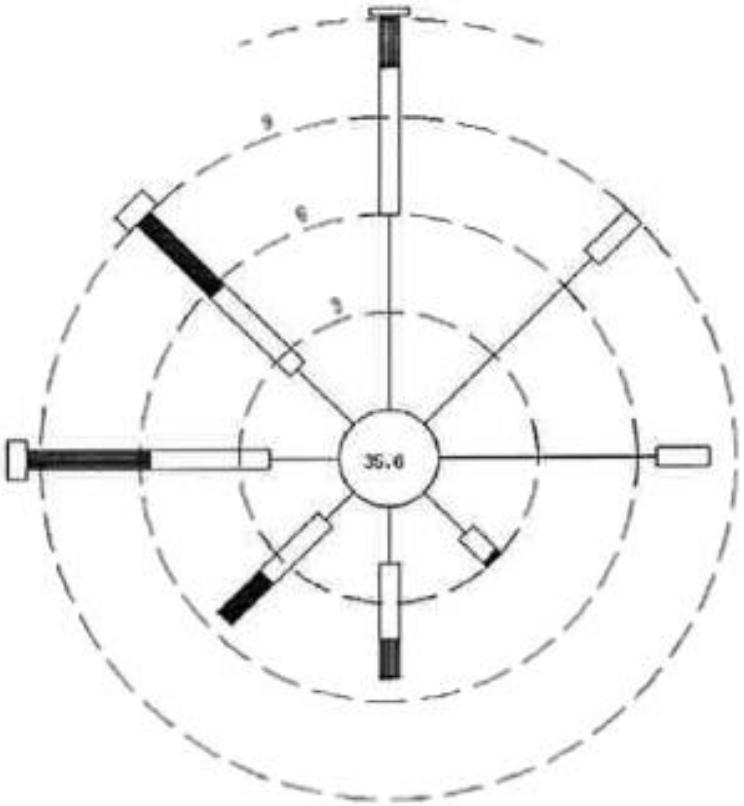
WIND ROSE SUMMARY

SITIAWAN

1975 - 2005

TIME : 24-HOURS

OCTOBER



WIND ROSE SUMMARY

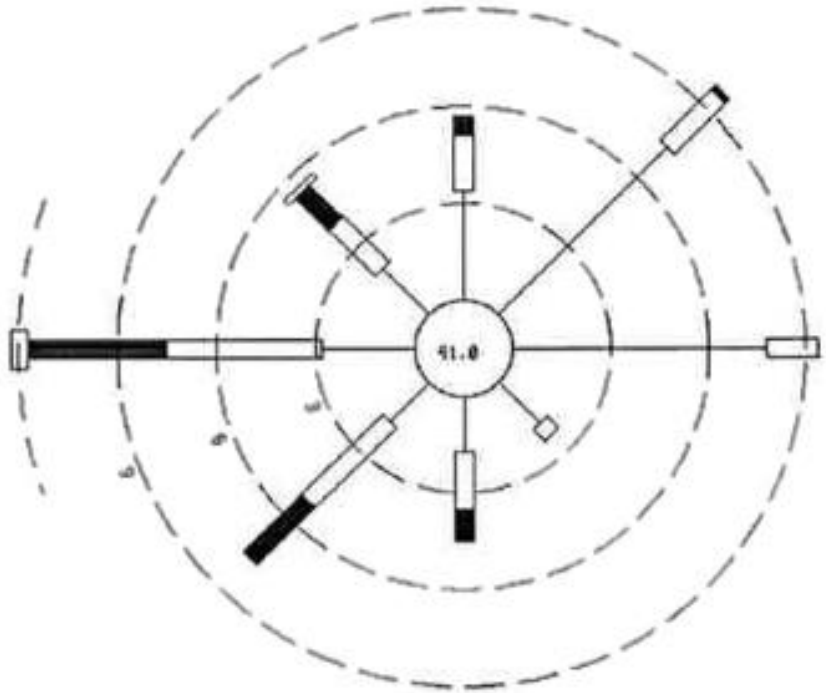
SITIAWAN

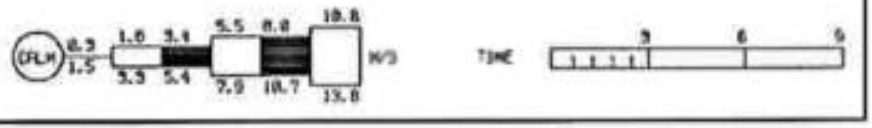
1975 - 2005

NE Monsoon

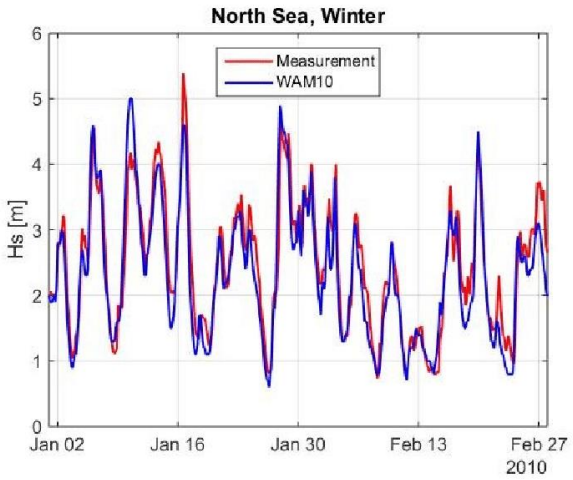
TIME : 24-HOURS

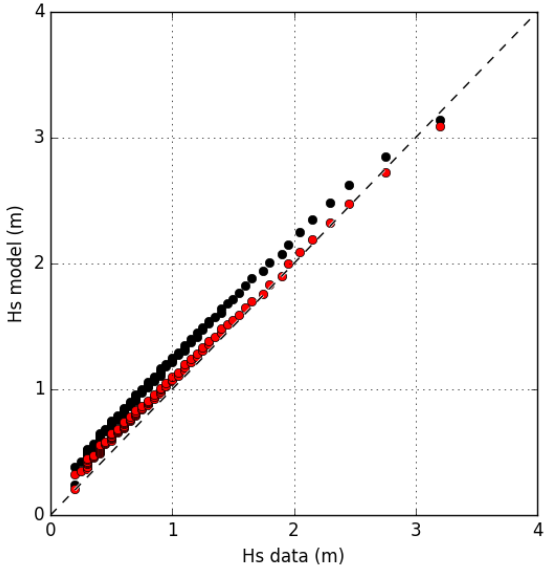
NOVEMBER - MARCH





Hindcast Approach

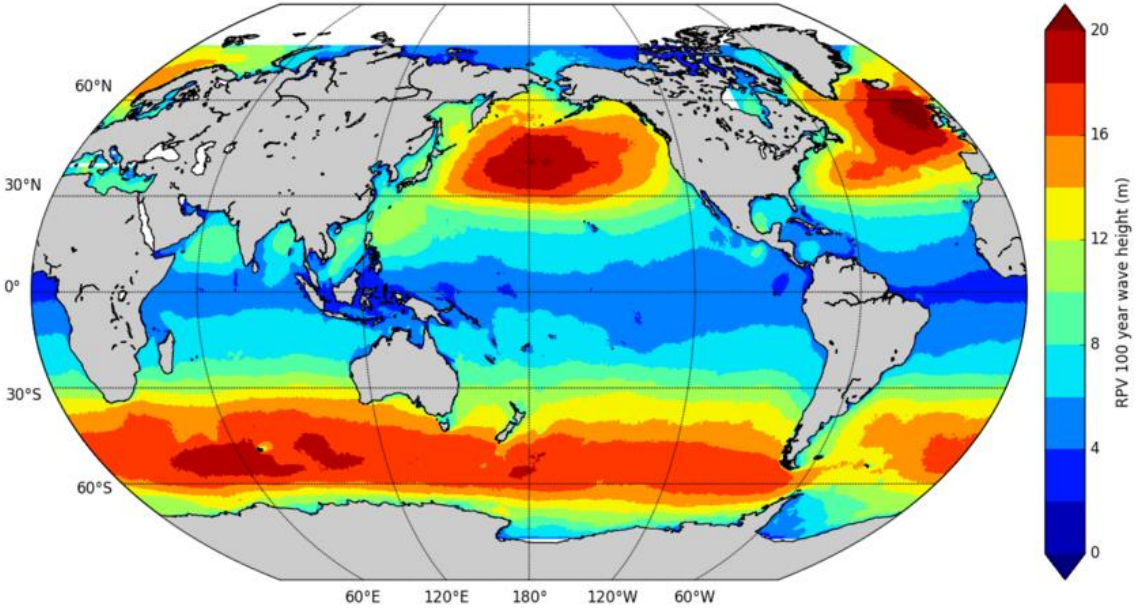




- A **hindcast** (backtesting) is a way of testing a mathematical model. Known or closely estimated inputs for past events are entered into the model to see how well they match with the simulated outputs.

- The hindcast approach entails running atmospheric and ocean response models for a historical period (typically several decades long) in order to develop the specification of climate and extremes for an application.

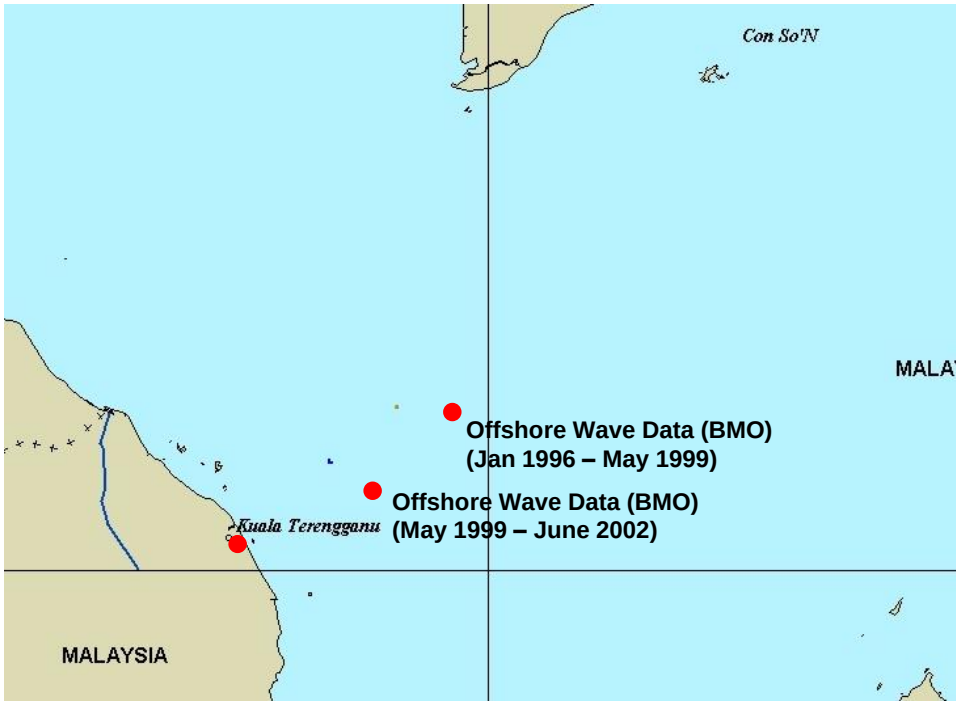
Waves



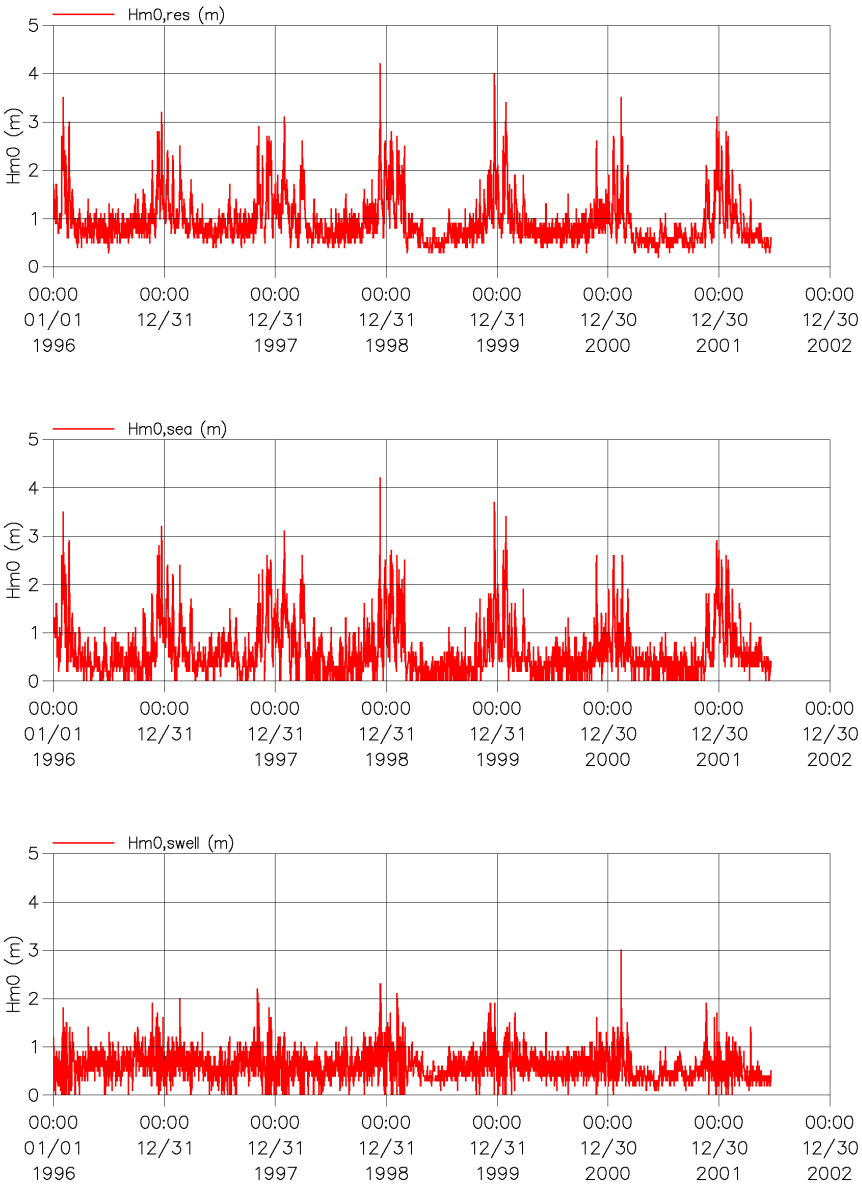
- A wind-wave hindcasting software can be used to hindcast wave data from wind records. Normally it will require hourly averaged wind data (speed & direction) covering a reasonably long period (at least 5 years) for the wave hindcasting.

- Data from various global wave models can be used to assess the wave climate e.g. UK Met Office (UKMO).

Offshore Wave Data

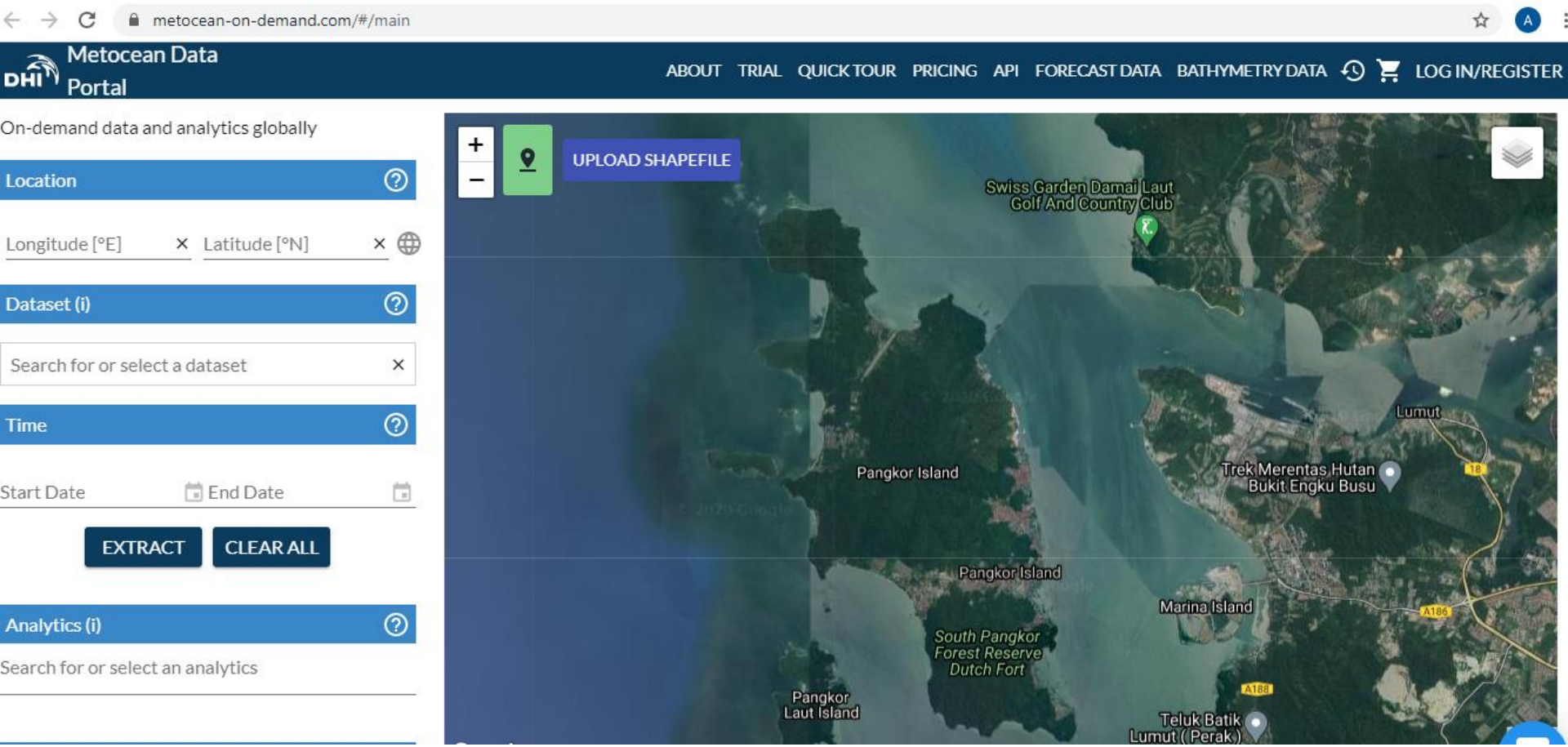


Location of Wave Data Extraction Points from UKMO Global Wave Model



Wave Height vs. Time

Wave Data



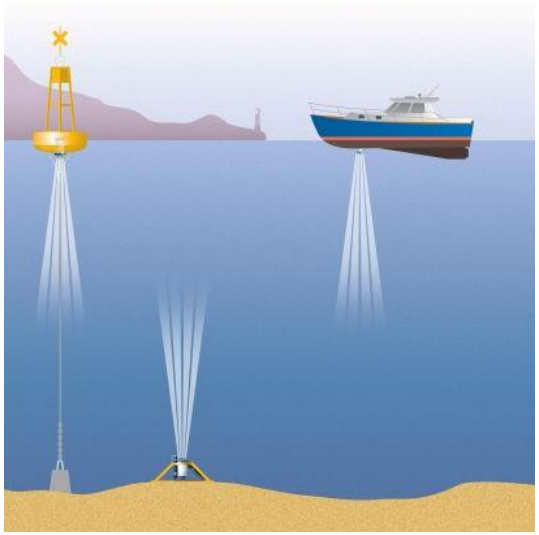
https://www.metocean-on-demand.com/#/main

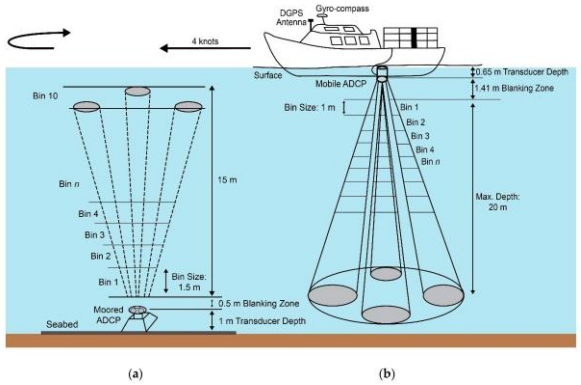
Waves

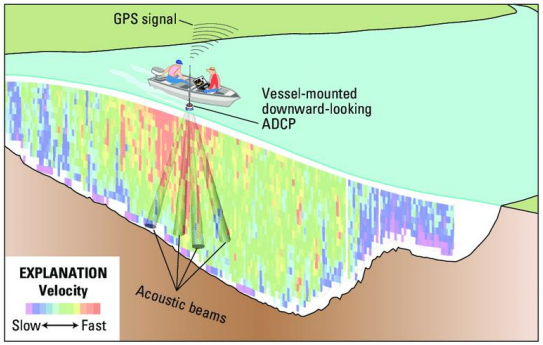
- Summary of Shipboard Meteorological Observations (SSMO) data also useful source of wave data but requires checking before use.

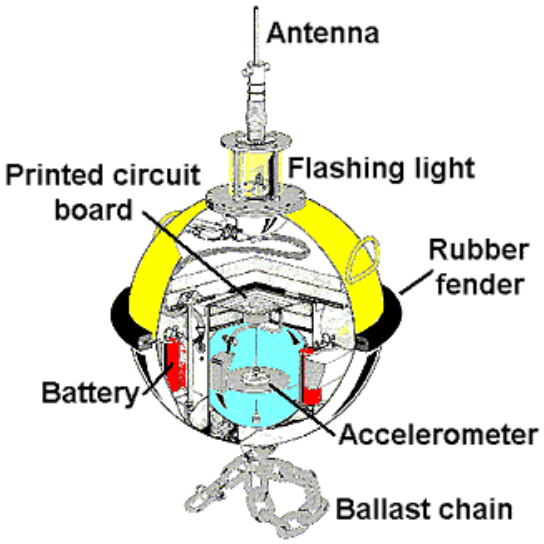
- ADCPs or wave rider buoys could also be deployed in offshore conditions to capture wave conditions within a selected time frame

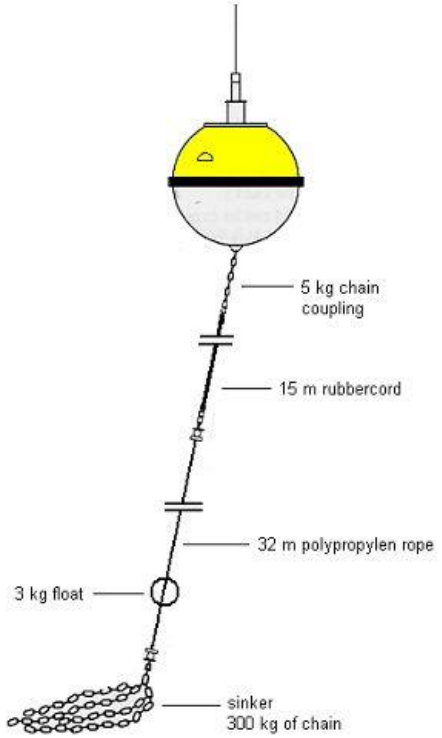
Acoustic Doppler Current Profiler





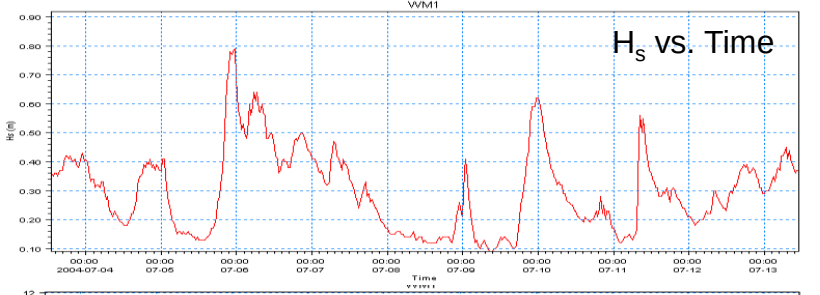


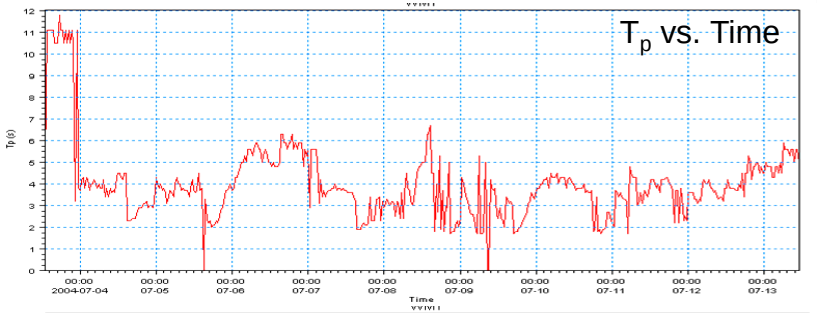


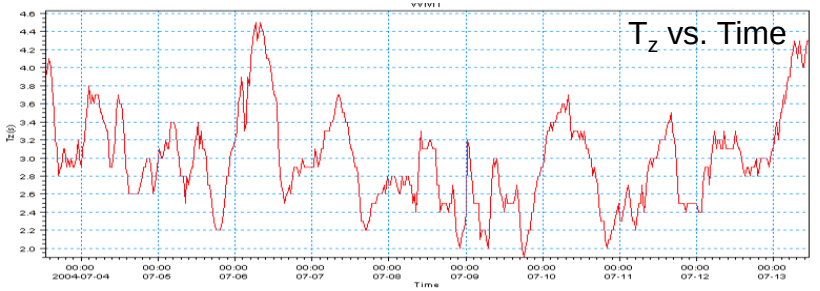


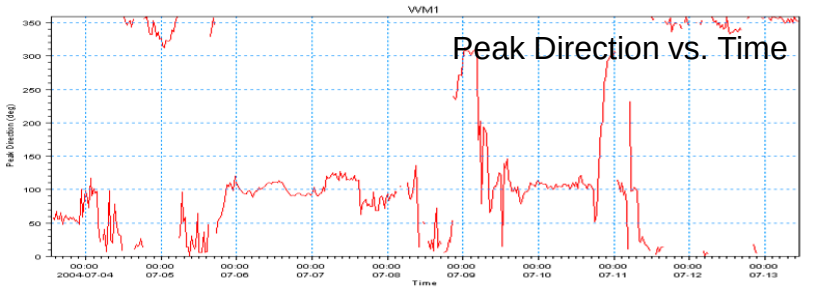
Wave Rider Buoy

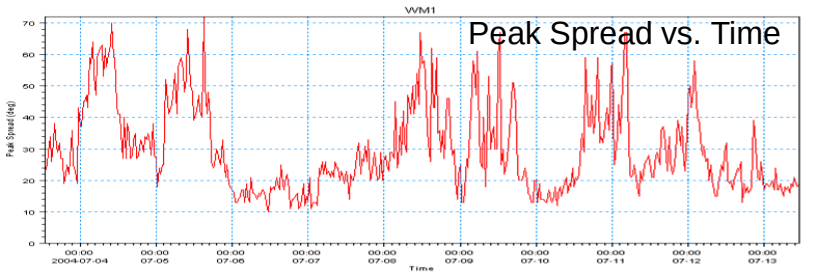
Wave Measurement



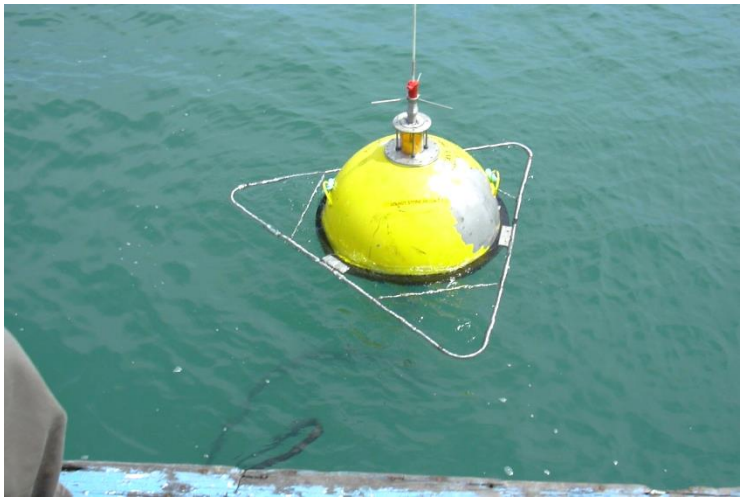






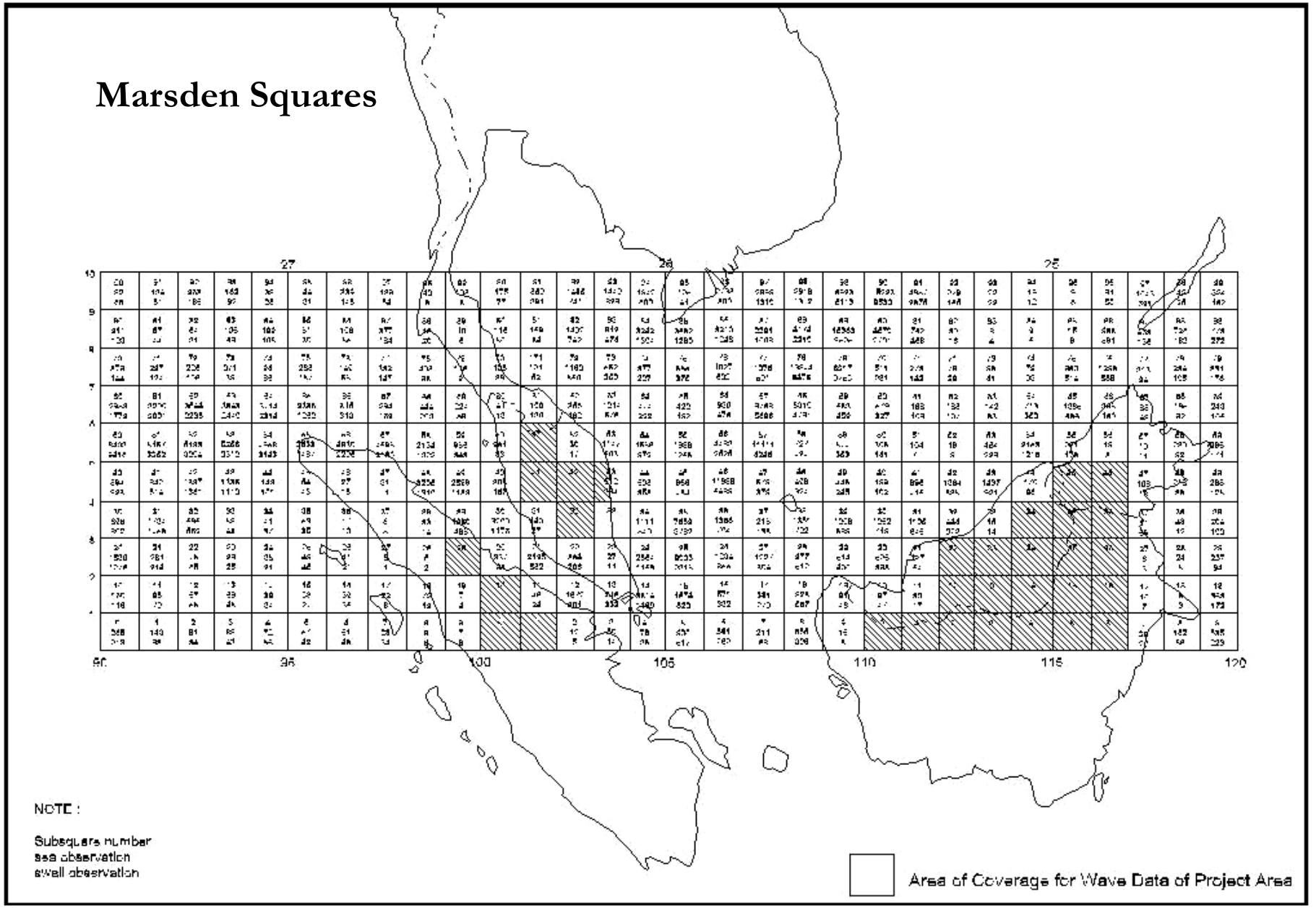


ADCP



Directional Wave Rider Buoy

Ship Observations



Shipboard Observations

BAHAGIAN KEJURUTERAAN PANTAI
JABATAN PENGAIRAN DAN SALIRAN MALAYSIA
WAVE STATISTICS SUMMARIES - WAVE & SWELL

MARSDEN SQUARE : 2663 2664 2665 2653 2654 2655 2643 2644 2645
STARTING DATE : 01-01-1949 ENDING DATE : 01-01-1983
NO. OBSERVATIONS : 7289 PERCENT CALM : 0.00%
CHOSEN MONTHS : JAN FEB MAC APR MAY JUN JUL AUG SEP OCT NOV DEC

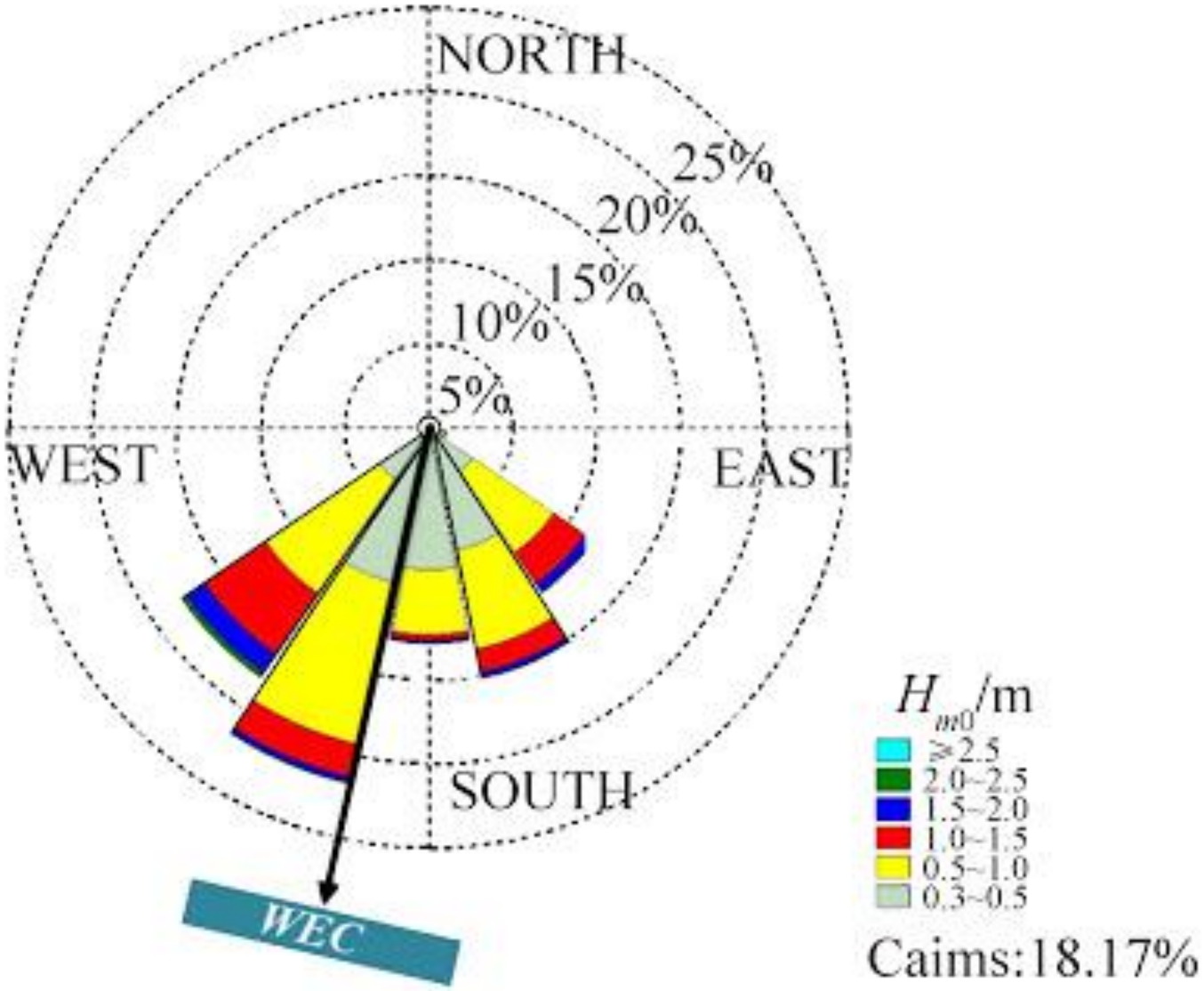
Direction : 045 - 075 DEGREES

	1	2	3	4	5	6	Total
1	3.6	0.3	0.1	0.0	0.0	0.1	4.2
2	4.7	1.5	0.4	0.1	0.1	0.6	7.4
3	1.9	2.9	0.4	0.0	0.0	0.2	5.4
4	0.5	1.6	0.5	0.1	0.0	0.0	2.7
5	0.2	0.7	0.7	0.1	0.0	0.0	1.8
6	0.1	0.2	0.6	0.1	0.0	0.0	0.9
7	0.1	0.1	0.2	0.0	0.0	0.0	0.3
8	0.0	0.1	0.1	0.0	0.0	0.0	0.2
9	0.0	0.0	0.1	0.0	0.0	0.0	0.1
Total	11.1	7.4	3.0	0.5	0.2	0.9	23.1

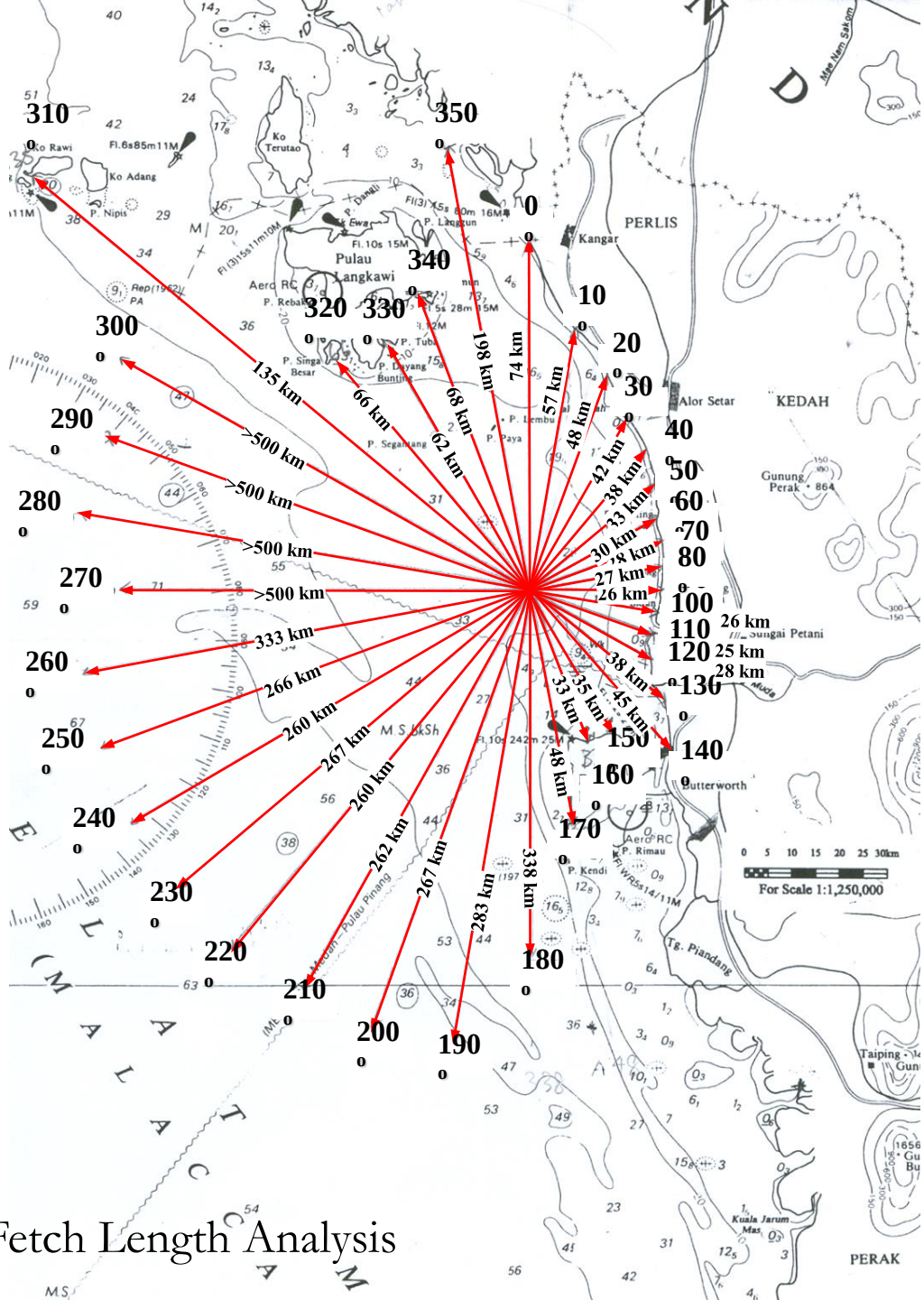
Period Code	T (s)
1	4 - 5
2	6 - 7
3	8 - 9
4	10 - 11
5	12 - 13
6	> 13

Wave Height Code	H (m)
1	< 0.75
2	0.75 - 1.25
3	1.25 - 1.75
4	1.75 - 2.25
5	2.25 - 2.75
6	2.75 - 3.25
7	3.25 - 3.75
8	3.75 - 4.25
9	> 4.25

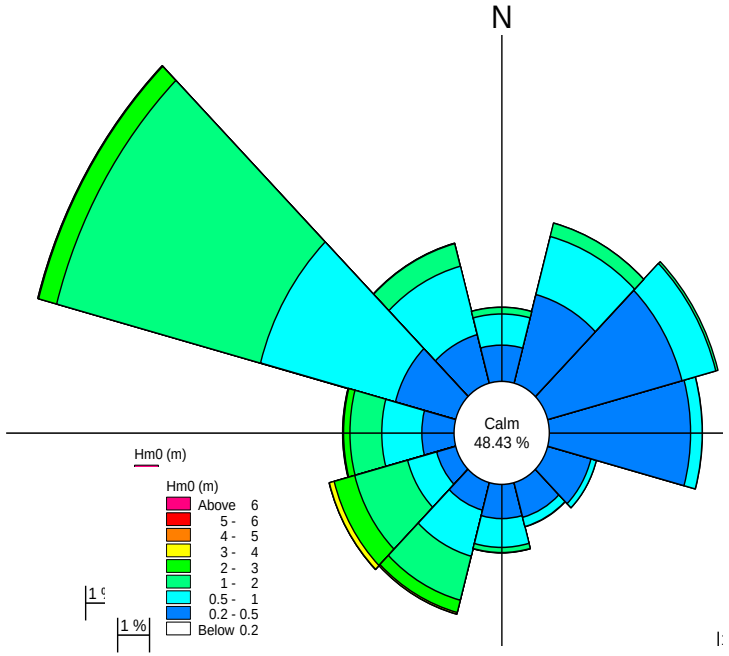
Wave Rose


NORTH
25%
20%
15%
10%
5%
WEST
EAST
SOUTH
WEC
H_{m0}/m
≥2.5
2.0~2.5
1.5~2.0
1.0~1.5
0.5~1.0
0.3~0.5
Caims:18.17%

Wave Hindcasting



Fetch Length Analysis

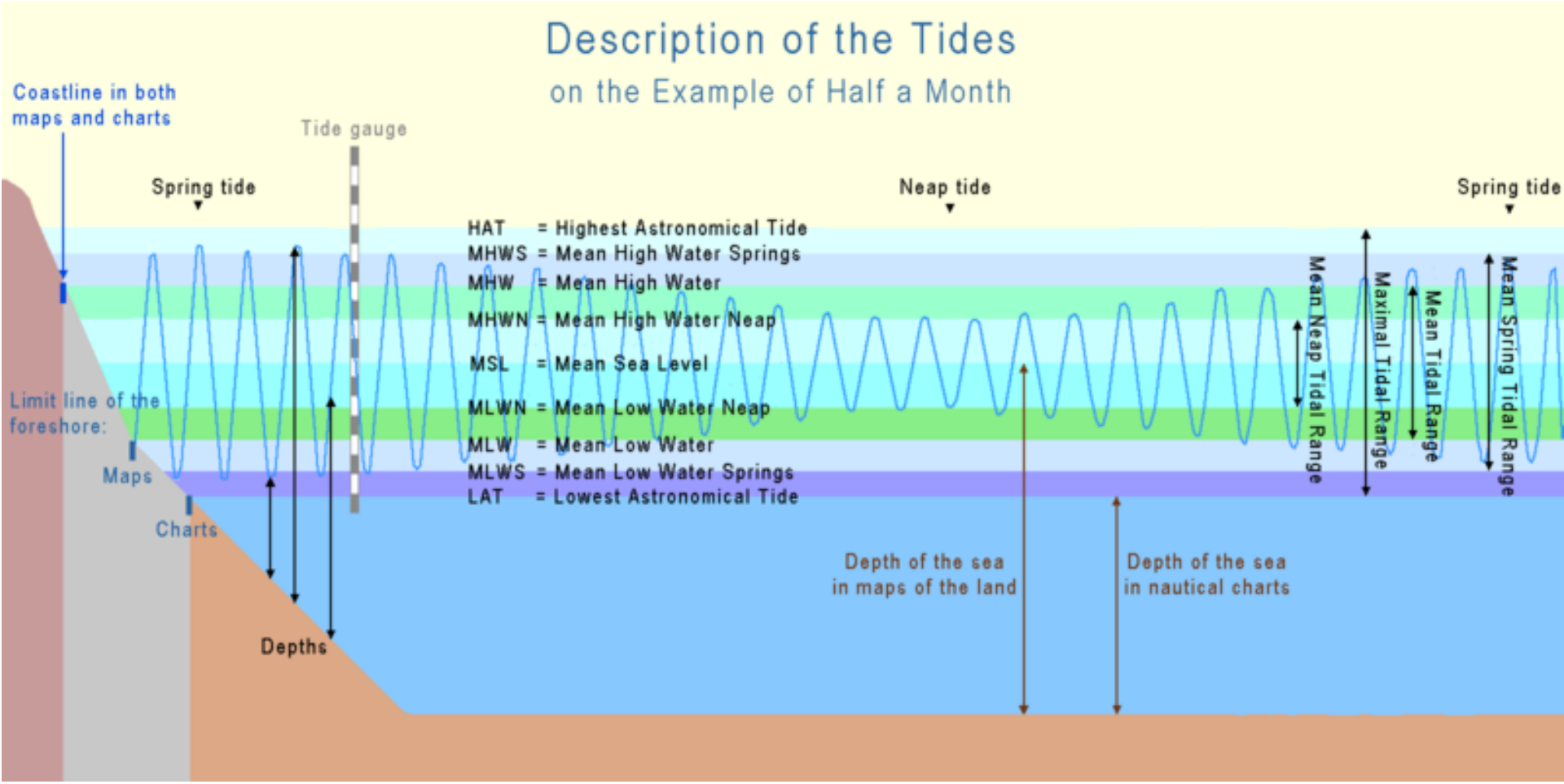


Wave Rose

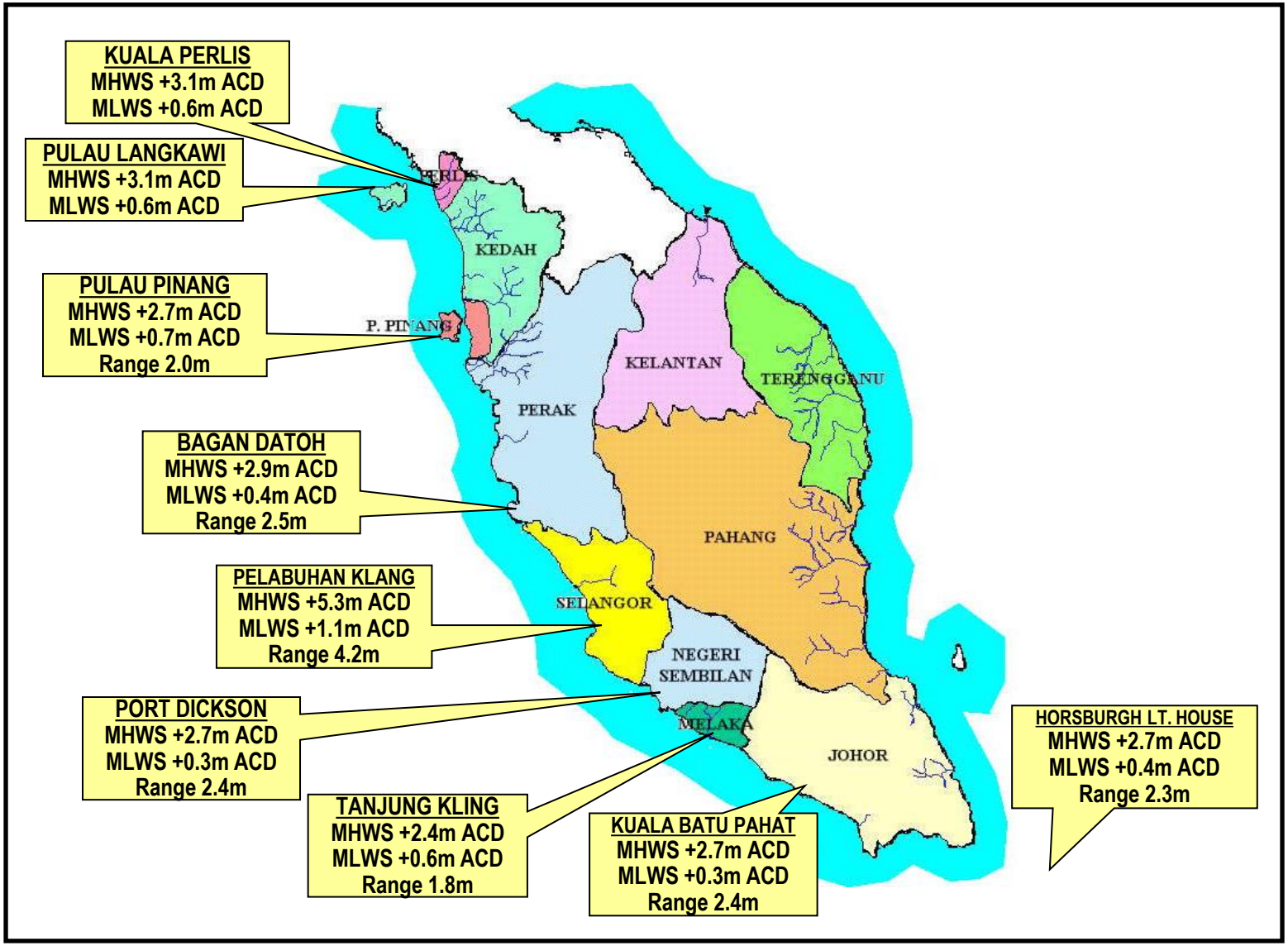
Hm0 (m)

- Above 6
- 5 - 6
- 4 - 5
- 3 - 4
- 2 - 3
- 1 - 2
- 0.5 - 1
- 0.2 - 0.5
- Below 0.2

Tidal Levels



Tidal Ranges for Peninsular Malaysia

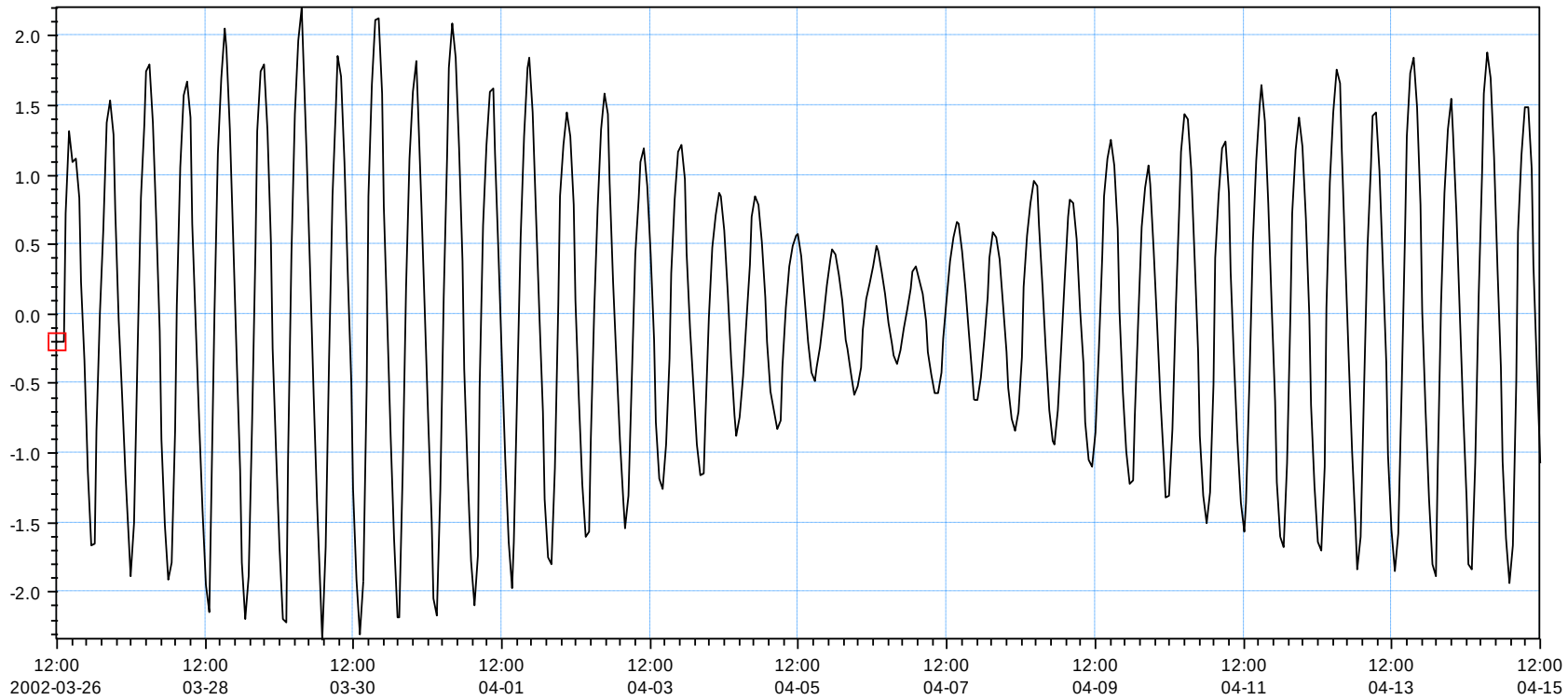


Tidal Level Variation for Penang

Highest Astronomical Tide (HAT)	3.09
Mean High Water Spring (MHWS)	2.69
Mean High Water Neap (MHWN)	1.96
Mean Sea Level (MSL)	1.71
Mean Low Water Neap (MLWN)	1.45
Mean Low Water Spring (MLWS)	0.72
Lowest Astronomical Tide (LAT)	0.00

Source: Malaysian Tide Table 2008

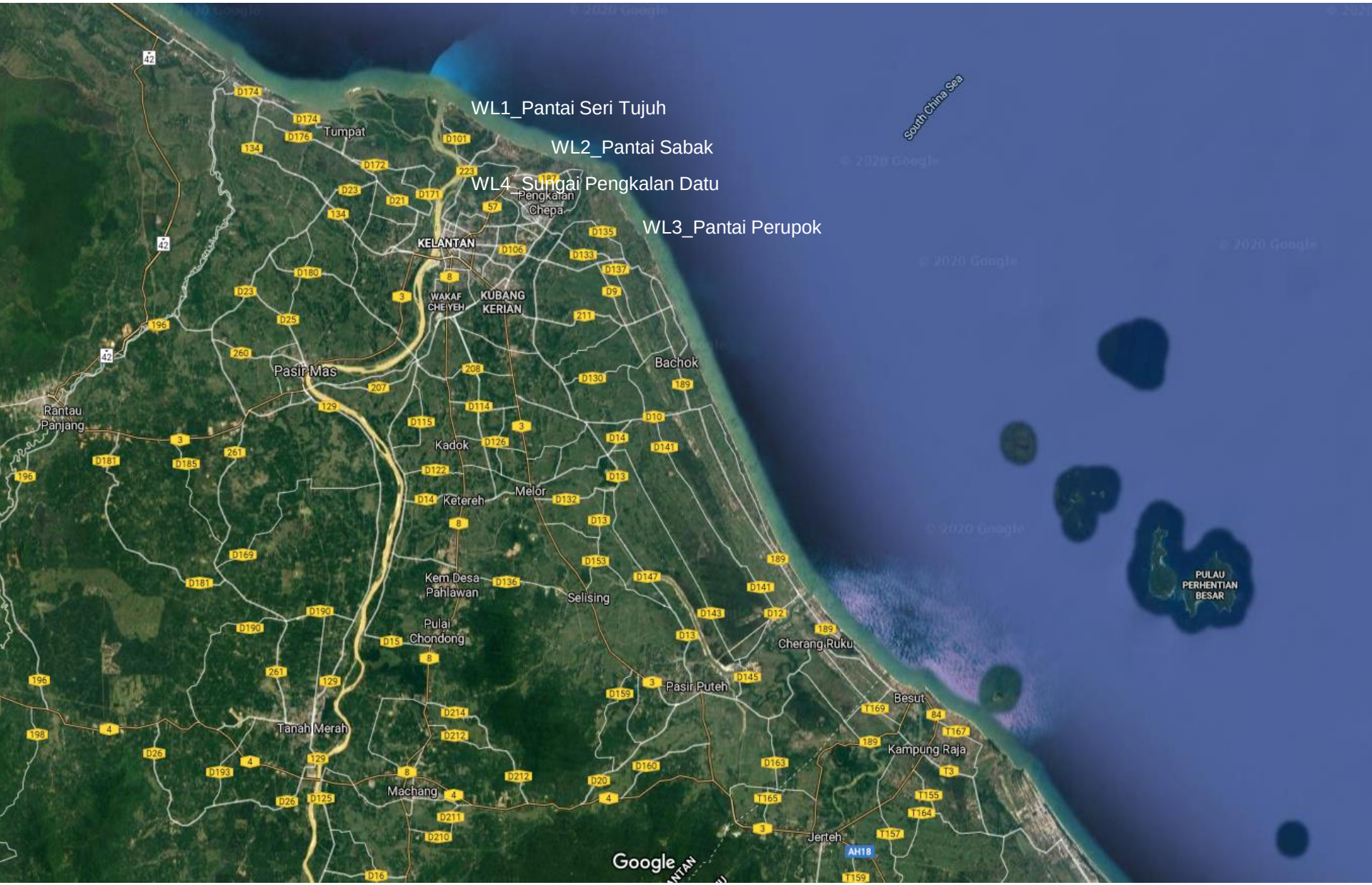
Water Level Measurement



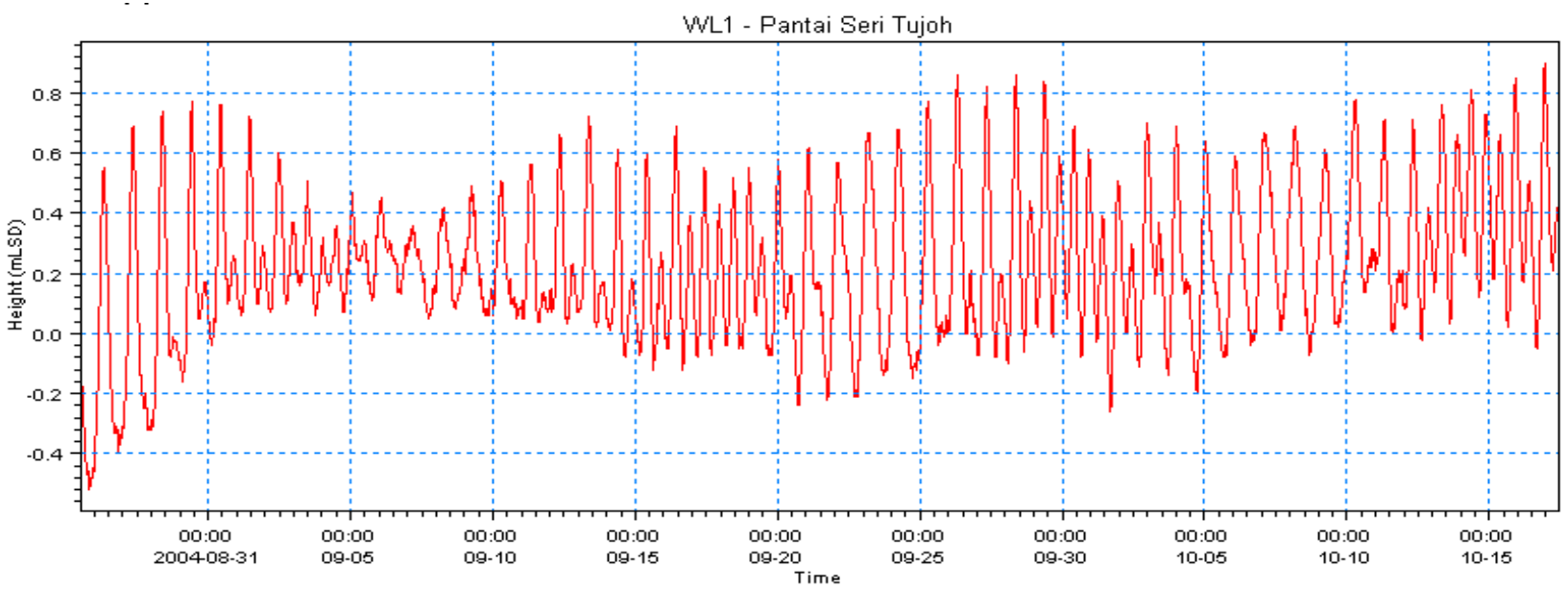
- Water level measurements usually carried out using automatic tide gauges.

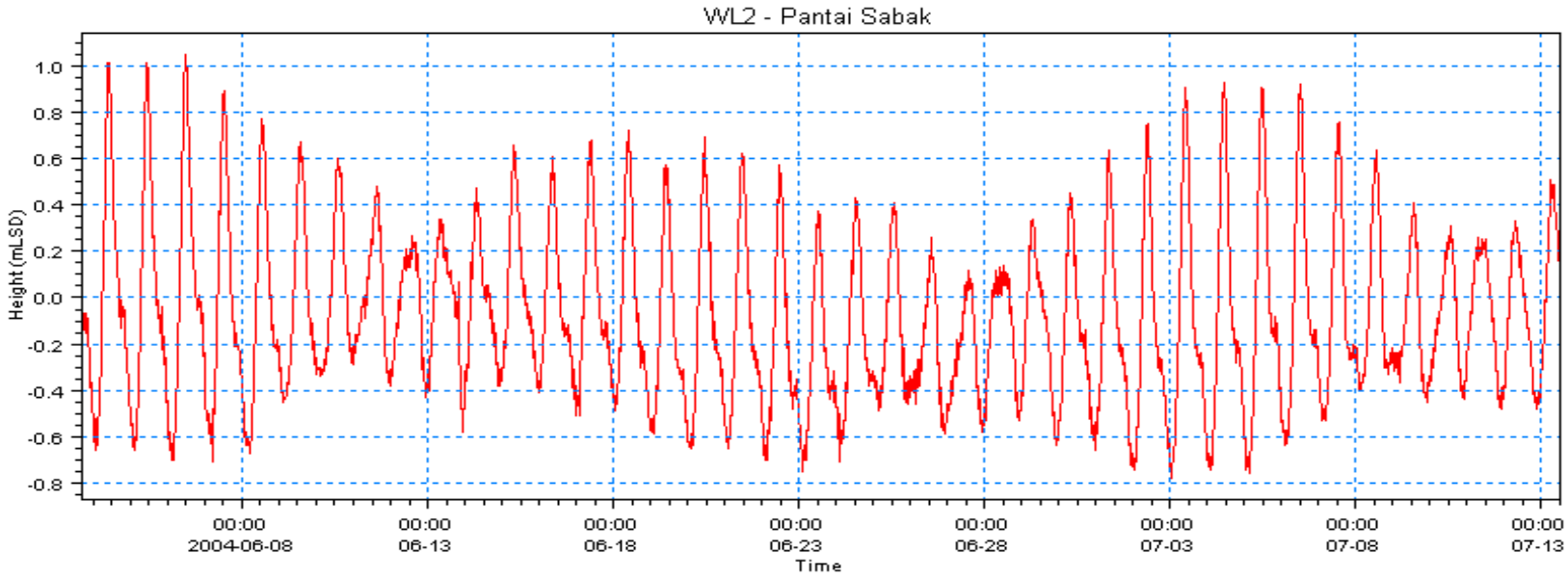
- Tide gauges are normally pressure-type.

Level Gauge Installation

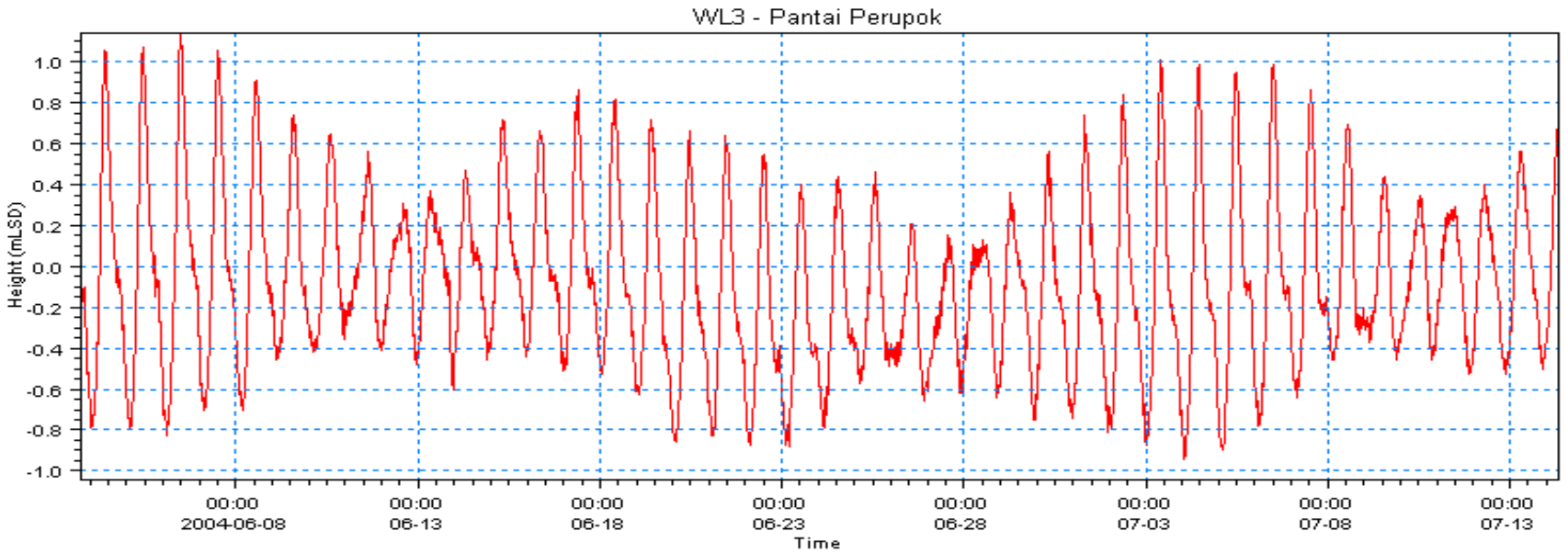

WL1_Pantai Seri Tujuh
WL2_Pantai Sabak
WL4_Sungai Pengkalan Datu
WL3_Pantai Perupok
South China Sea
Tumpat
Pengkalan Chepa
KELANTAN
WAKAF CHE YEH
KUBANG KERIAN
Pasir Mas
Bachok
Rantau Panjang
Kadok
Melor
Ketereh
Kem Desa Pahlawan
Selising
Pulai Chondong
Cherang Ruku
Pasir Puteh
Besut
Kampung Raja
Tanah Merah
Machang
Jerteh
PULAU PERHENTIAN BESAR
Google

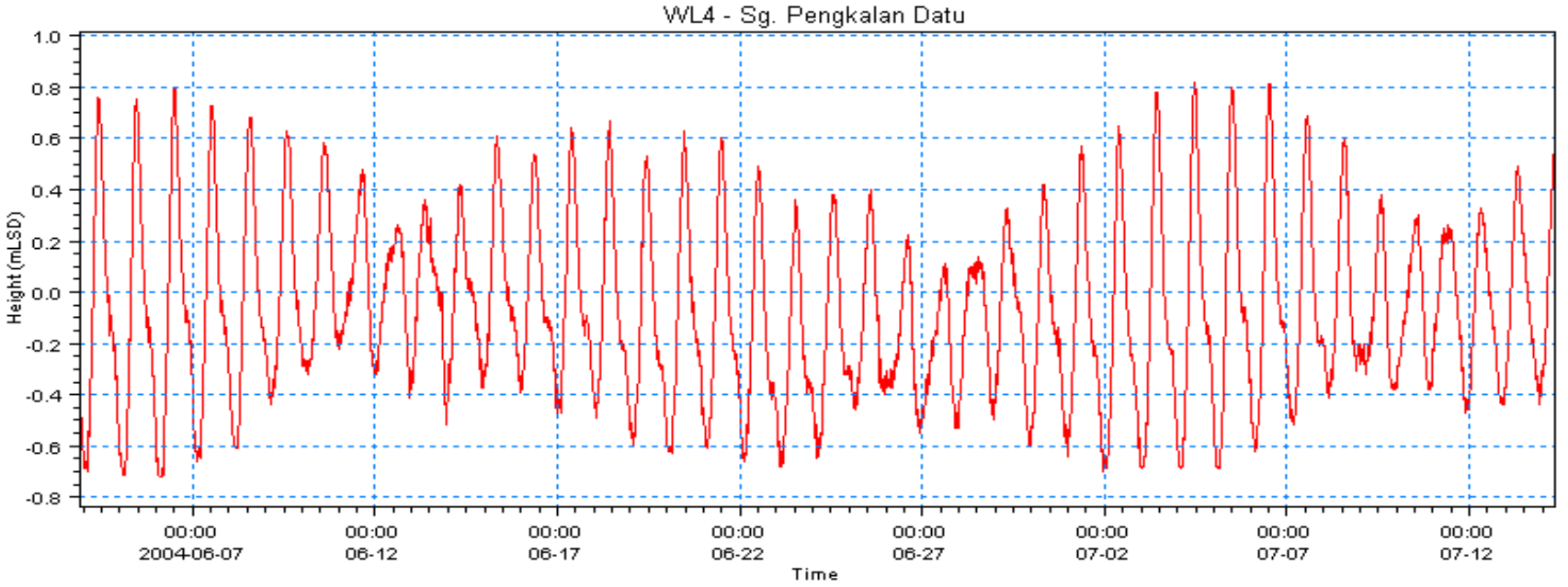
Water Level Measurement





Water Level Measurement





Currents

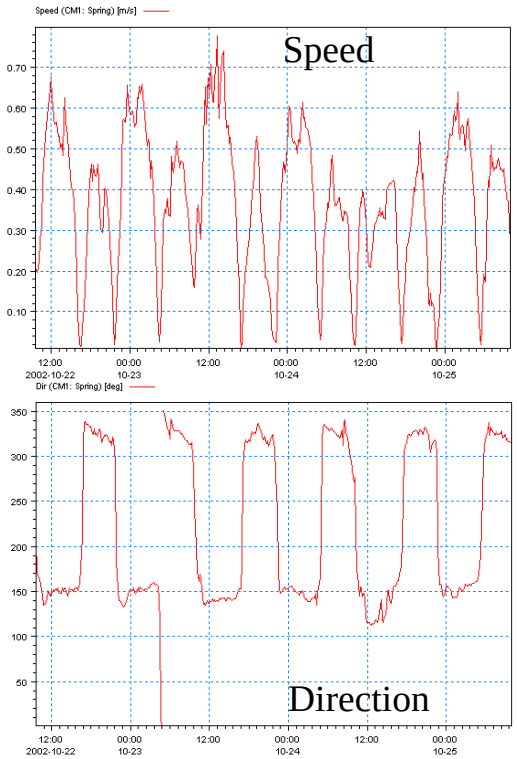
- Current measurements typically carried out using self-recording current meters and impeller-type current meters.

Currents

- Depending on the type of measuring equipment:

  Some instruments deployed at mid-depth at several locations to measure current speed & direction

  While some are bed mounted and able to measure velocity profile over water column.



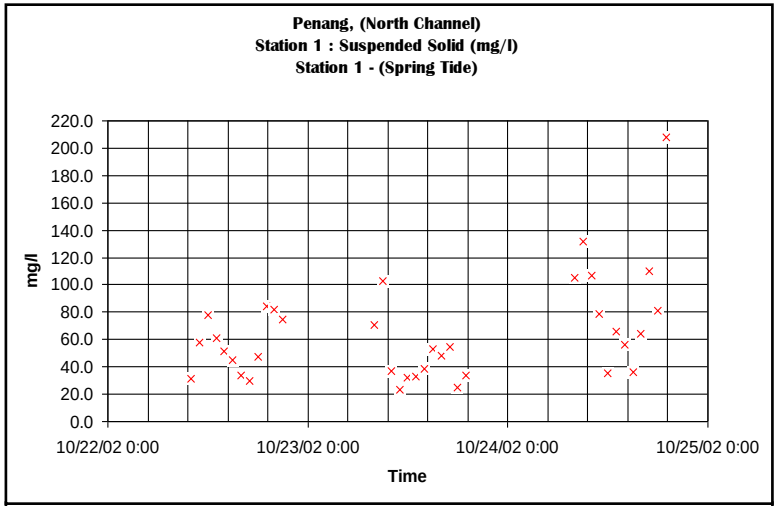
Water Sampling

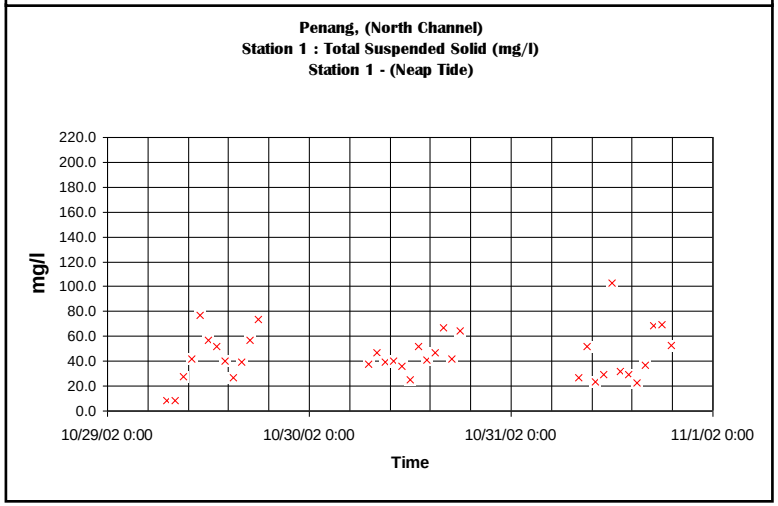
- Instrument normally used is a Van Dorn water sampler
- Water sampling done during spring & neap periods
- Water samples taken at various depths e.g. bed level, 0.2D, 0.5D and 0.8D (D is height of water column)

https://www.youtube.com/watch?v=Jn1zjm5nwMk

Water Sampling

- Samples analysed for Total Suspended Sediment (TSS) concentrations.
- Alternatively, water quality measuring instruments with sensors (normally optical in nature) capable in measuring in-situ TSS concentrations can be used. For this method, samples need not be collected and sent to a laboratory for analysis. However, instrument must be calibrated carefully before use.
- Results shall be used to calibrate & verify sediment transport numerical model.





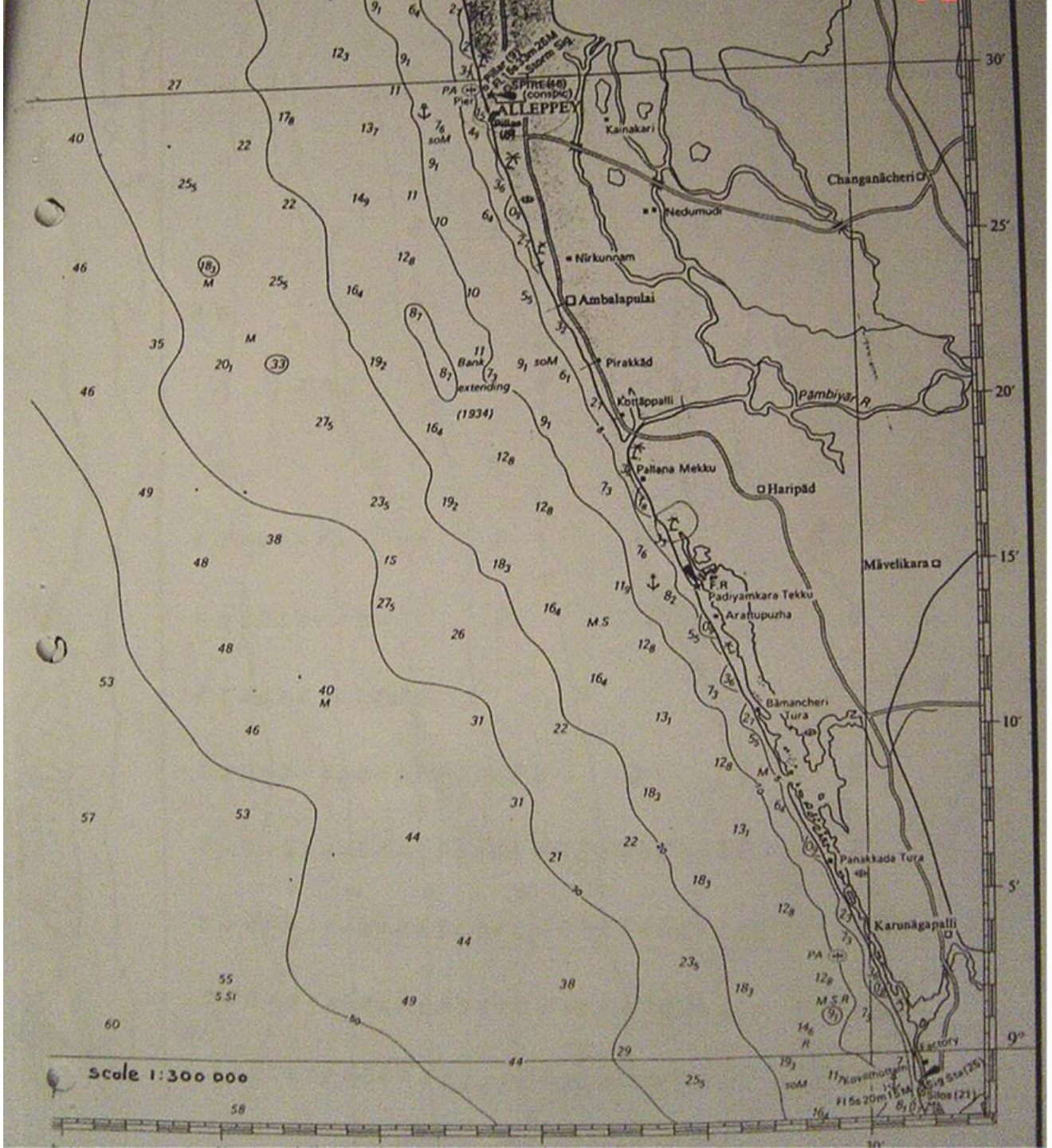
Bed Sampling

- Bed samples from bed & nearshore areas taken at various locations.
- A dedicated mechanical grab sampler is normally used.
- Samples visually classified & analysed for particle size distribution (PSD). Density of several samples shall also be determined.
- Samples taken from site will be sent to a laboratory for analysis.
- Results used to determine bed materials within the study area.

https://www.youtube.com/watch?v=FXhpAo72guI

Closing Remarks

- Appropriateness of data to any specific application dependent on context of measurement, accuracy, sensitivity & limitations of measuring instruments and/or measuring techniques.
- Recording instruments are to be calibrated regularly to ensure recording accuracy.
- Relative time scale of measurements compared with that of the phenomenon being considered together with the processing of the data recorded by the instruments are important.
- Must be willing to spend **$$$** for **quality** data.


ALLEPPEY
Pilot (48)
(conspic)
Kainakari
Changanācheri
Nedumudi
Nirkunnam
Ambalapulai
Piratkād
Kottāppalli
Pambiyār R
Paliana Mekku
Haripād
Māvelikara
F.R
Padiyamkara Tekku
Arattupuzha
Bāmancheri Tura
Panakkada Tura
Karunāgapalli
Bank extending (1934)
Scale 1:300 000

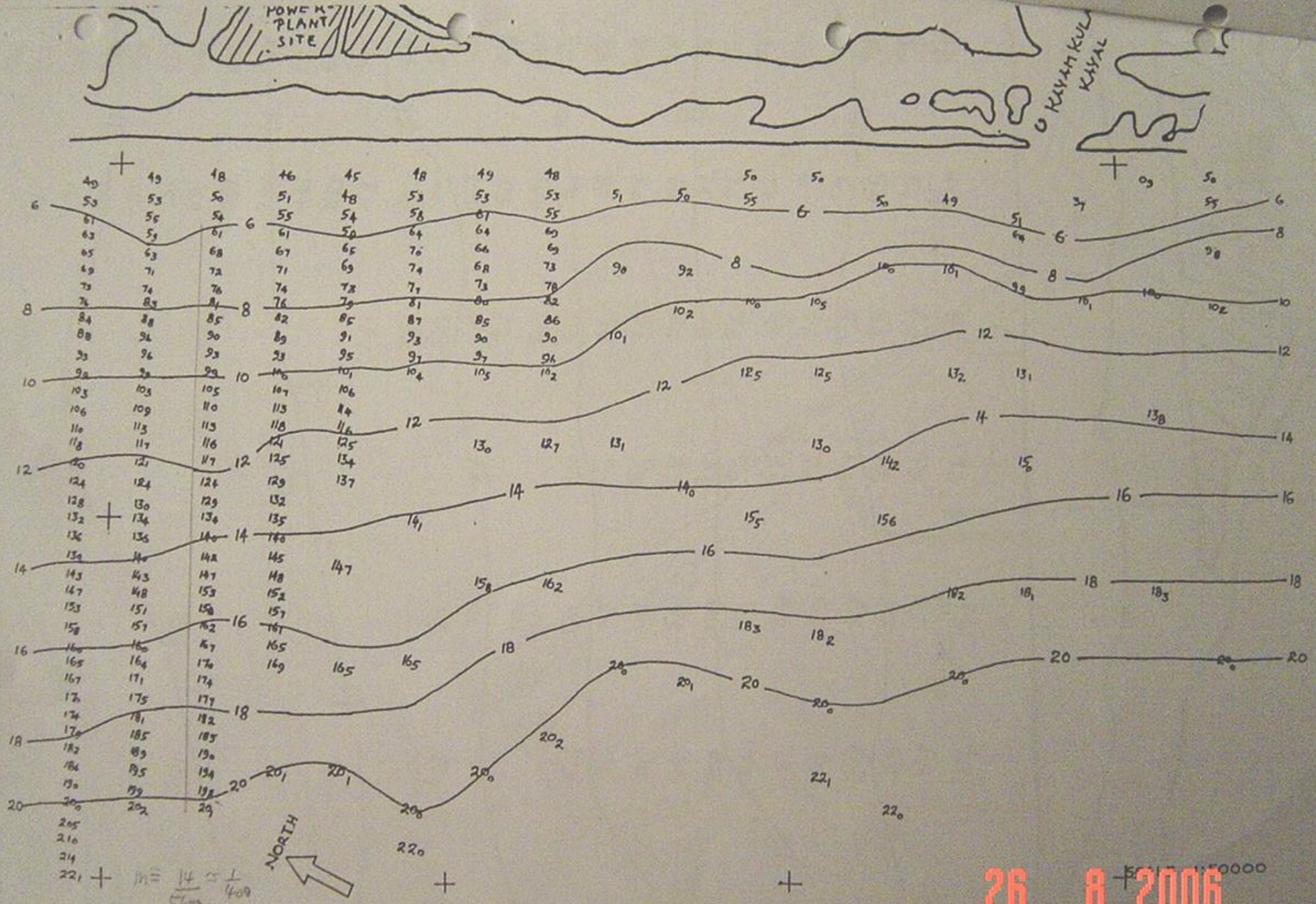


FIG. 2. BATHYMETRIC CHART KAYAMKULAM

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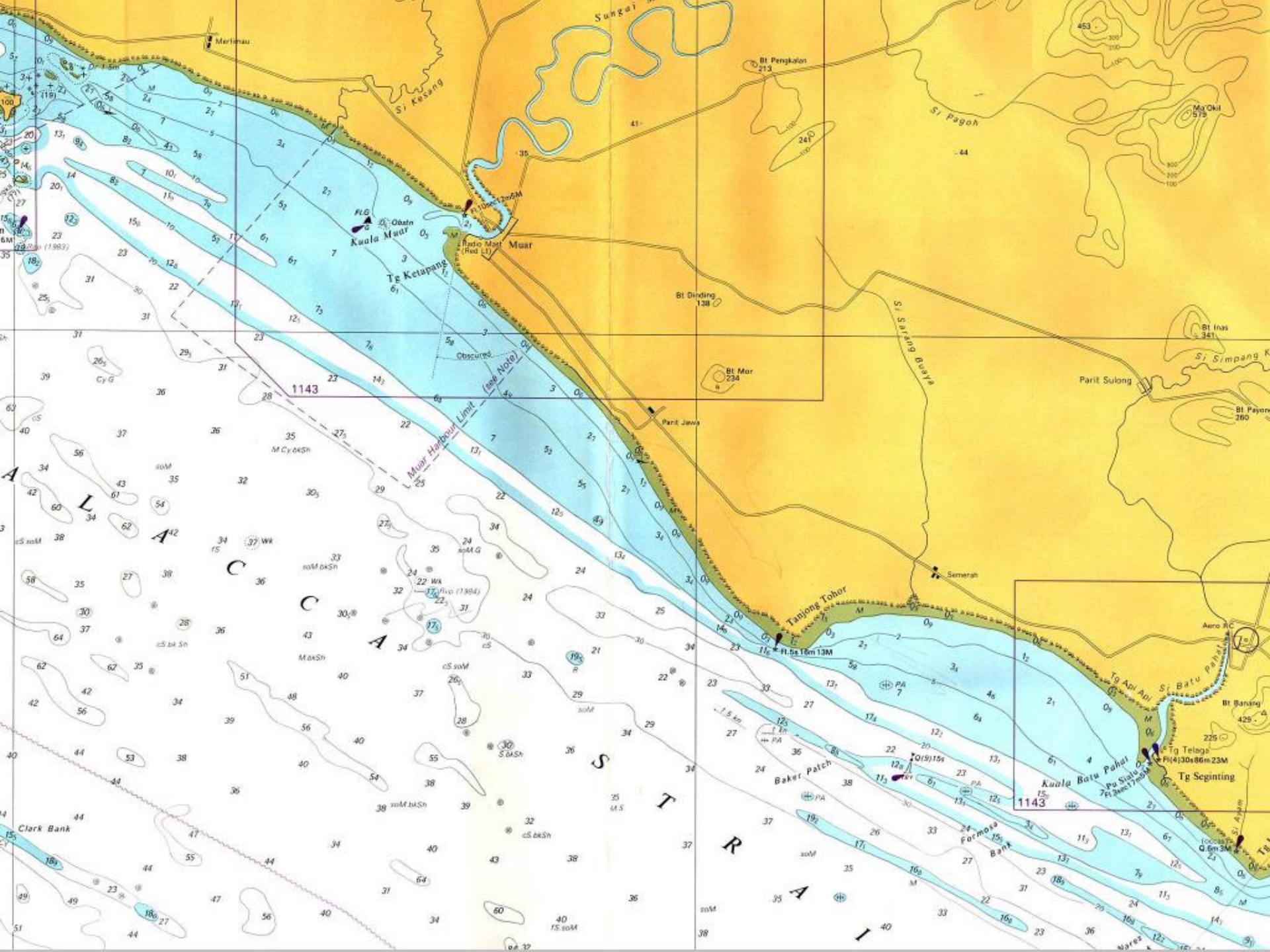
Merlenau
Si Kesang
Sungai
Bt Pengkalan 213
Si Pagoh
Ma'Okil 579
Kuala Muar
Muar
Radio Mast (Red Lt)
Tg Ketapang
Bt Dinding 138
Si Sarang Buaya
Bt Mor 234
Parit Sulong
Bt Inas 341
Si Simpang K
Bt Payon 260
Parit Jawa
Muar Harbour Limit
Obscured
1143
Semerah
Tanjong Tohor
Fl.5s16m13M
Aero RC
Tg Api Api
Si Batu Pahat
Bt Banang 429
Tg Telaga
Tg Seginting
Kuala Batu Pahat
Baker Patch
Formosa Bank
Clark Bank
STRAIT OF MALACCA

Microsoft
PowerApps

OPEN