Imperial College London

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DETERMINING WAVE-HEIGHT STATISTICS AND LIMITING SEA-STATES BY ANALYSING SHALLOW WATER FIELD MEASUREMENTS

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1. OBJECTIVES

- To determine the limiting wave height and limiting sea-state
- To understand the influence of bed slope, effective depth, wave steepness and Ursell number (measure of wave non-linearity) on the wave height and crest elevation distributions
- To determine potential design distributions for wave heights and crest elevations

2. WHY DO WE NEED THEM?

- Design of rate of wave overtopping of seawalls, sliding of concrete caissons of vertical breakwaters and wave run-up, calculations of dynamic loading

3. METHODOLOGY

Pre-processing of raw data

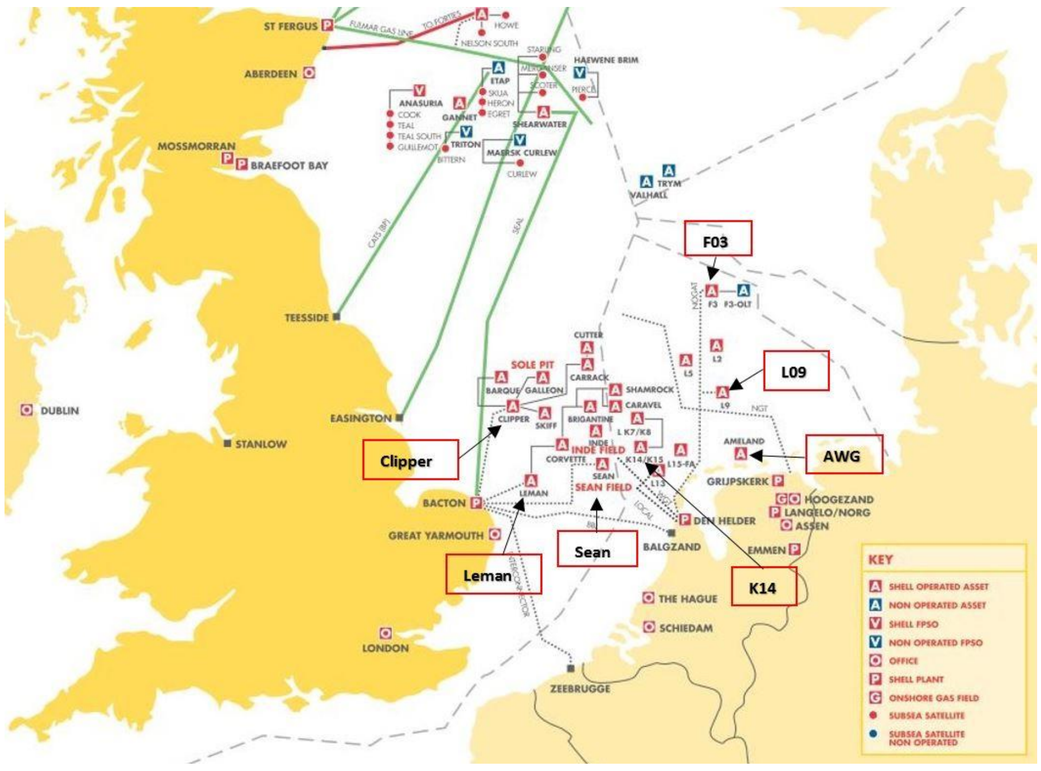
Quality Control

Analysis and storage

Steps:

- Removal of tides
- Division into 20-min samples
- Quality control
- Analysis to find wave parameters
- Storage of results in SQLite database

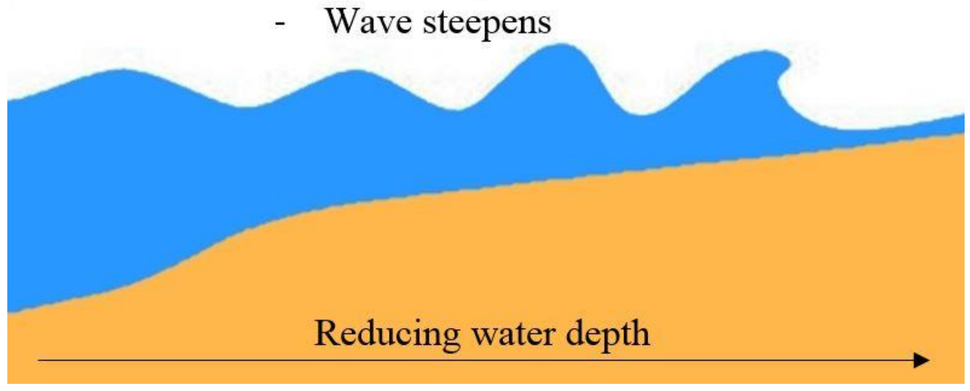
4. SOURCES OF FIELD DATA



5. WAVE TRANSFORMATION

From deep to shallow water:

- Period unchanged
- Wave length decreases
- Wave height increases
- Wave steepens



6. FACTORS INFLUENCING WAVE HEIGHT AND CREST ELEVATION DISTRIBUTIONS

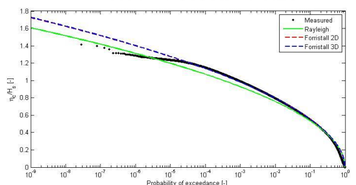
It was found that the wave height and crest elevation distributions are primarily dependent on the effective water depth, the wave steepness and the wave non-linearity. For mild bed slopes (<1/500), the wave height and crest elevation distributions are found to be independent of the local bed slope.

7. LIMITING WAVE HEIGHTS AND SEA-STATES

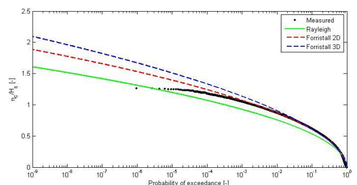
Installations	Mean Water Level [m]	Local bed slope [-]	Maximum normalised significant wave height, H_s/d [-]	Maximum normalised crest elevation, η_c/d [-]	Maximum normalised down-crossing wave height, H_{dc}/d [-]	Maximum normalised up-crossing wave height, H_{uc}/d [-]
AWG1	7.70	1:500	0.52	0.56	0.78	0.73
Clipper	23.30	1:1000	0.25	0.27	0.43	0.44
L09	24.98	1:1000	0.27	0.28	0.43	0.41
K14	27.36	1:1000	0.29	0.30	0.47	0.50
Sean	32.26	1:1000	0.19	0.22	0.32	0.32
Leman	35.76	1:1000	0.14	0.14	0.23	0.23
F03	42.35	1:1000	0.23	0.25	0.40	0.37

8. POTENTIAL DESIGN DISTRIBUTIONS

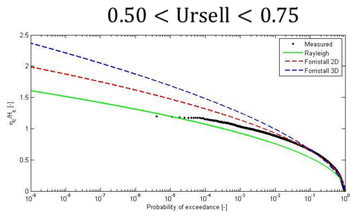
0.00 < Ursell < 0.25



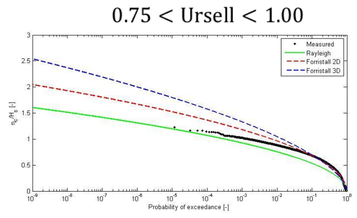
0.25 < Ursell < 0.50



0.50 < Ursell < 0.75



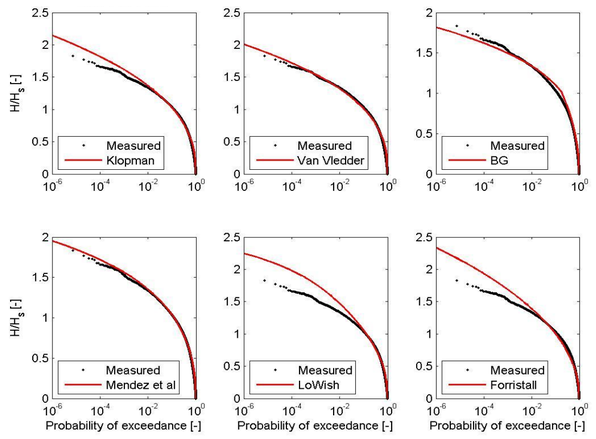
0.75 < Ursell < 1.00



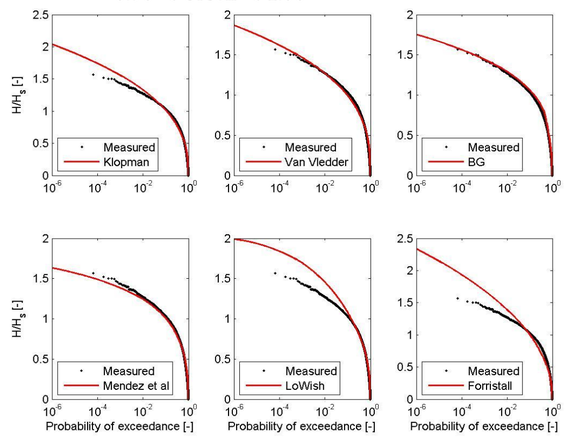
Best fit crest elevation distributions:

- Ursell number:
  - < 0.25: Forristall 2D
  - > 0.25: none

0.50 < Ursell < 0.60



0.90 < Ursell < 1.00



Best fit wave height distributions:

- Ursell number between 0.5 and 0.6: Mendez et al. (2004)
- Ursell number between 0.9 and 1.0: Battjes & Groenendijk (2000)
- Overall (Ursell number between 0.0 and 1.0): van Vledder (1991)

9. ACKNOWLEDGEMENTS

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10. REFERENCES

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