

***Comparison of the performance of the
Met office UK-waters wave model with a
network of shallow water moored buoy data***



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Seaford



Hurst Spit



Weymouth



Hythe



Eastbourne



Bulverhythe



Herne Bay



Pevensey



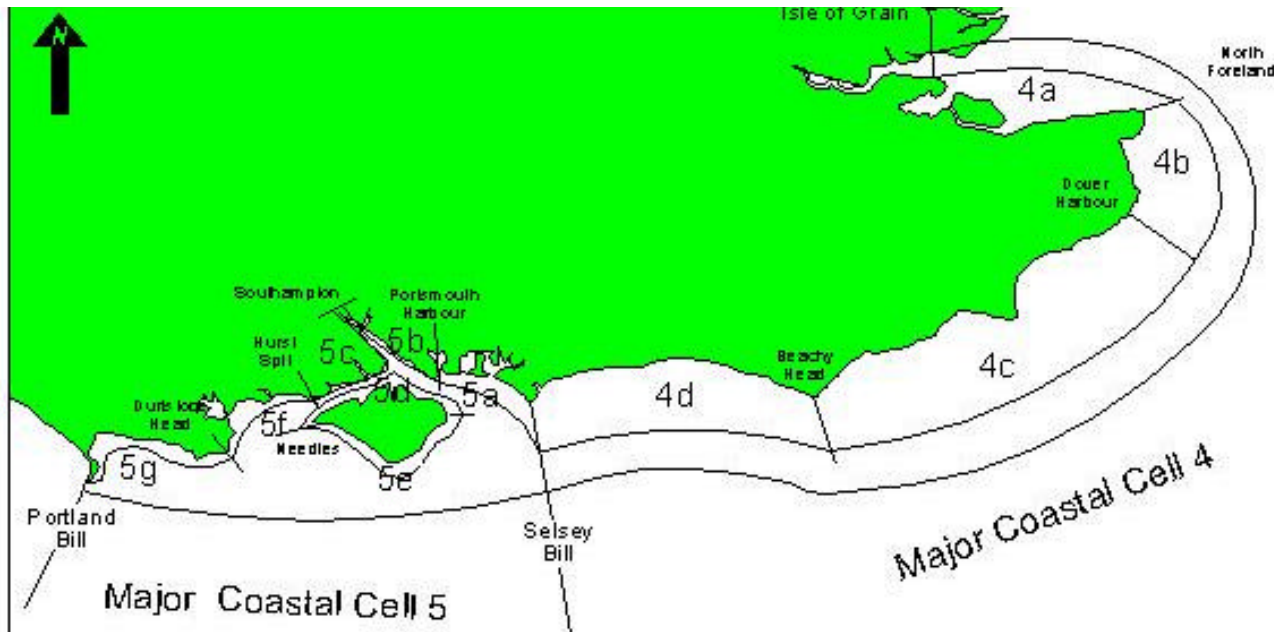
Bournemouth

Complex risk scenarios

- ***High quality data required for beach management***
 - ***Strategic planning***
 - ***Operational management***
 - ***Planning new schemes***
 - ***Performance evaluation***



Vision



- Promote, inform and integrate the operational monitoring requirements of: regional overview; shoreline management plans; coastal strategies, and individual schemes, between the limits of the boundaries of regional cells 4 and 5*



Wave climate for flood and coastal defence in the UK

- ***Design conditions***
 - ***Shallow water sites***
 - ***Hs, Tz, q, spectral shape***
 - ***Time series***
 - ***Probability distributions***
 - ***Extreme events***
 - ***Joint probability waves and tides***





Time series

- ***Beach plan shape models***
- ***Longshore transport rates***



Time series

- *Coastal flood forecasting*
- *Event analysis*



Herne Bay 1953, (c) J.Hawkins



Structure design

- *Rock structures - stability*
 - *Extreme events*
 - *Hs, Tz,*



Overtopping

- ***Extreme events***
 - ***Period***
 - ***Steepness***
 - ***Water level***



Beach recharge design

- *Extreme conditions*
 - *Cross shore*
(H_s , T_z ,
spectral shape)
- *Wave climate*
 - *Morphological evolution*
 - *Longshore transport*
(H_s , T_z , q)



Wave climate UK

- *Offshore*
 - *HINDWAVE*
 - *Wind wave hindcast*
 - *Met office wave models (since 1986)*
 - *Second-generation global and regional wave models*
 - *Measured wave data (supplementary)*
- *Nearshore*
 - *Transformation models*
 - *Measured wave data (supplementary)*



Objectives

- ***Identify differences between the Met office hindcast and measured buoy data***
- ***Are the differences significant in shoreline management terms?***
- ***Feedback to Met Office model developers for model improvement***



Met Office Wave Models

- **Second-generation global and regional wave models**

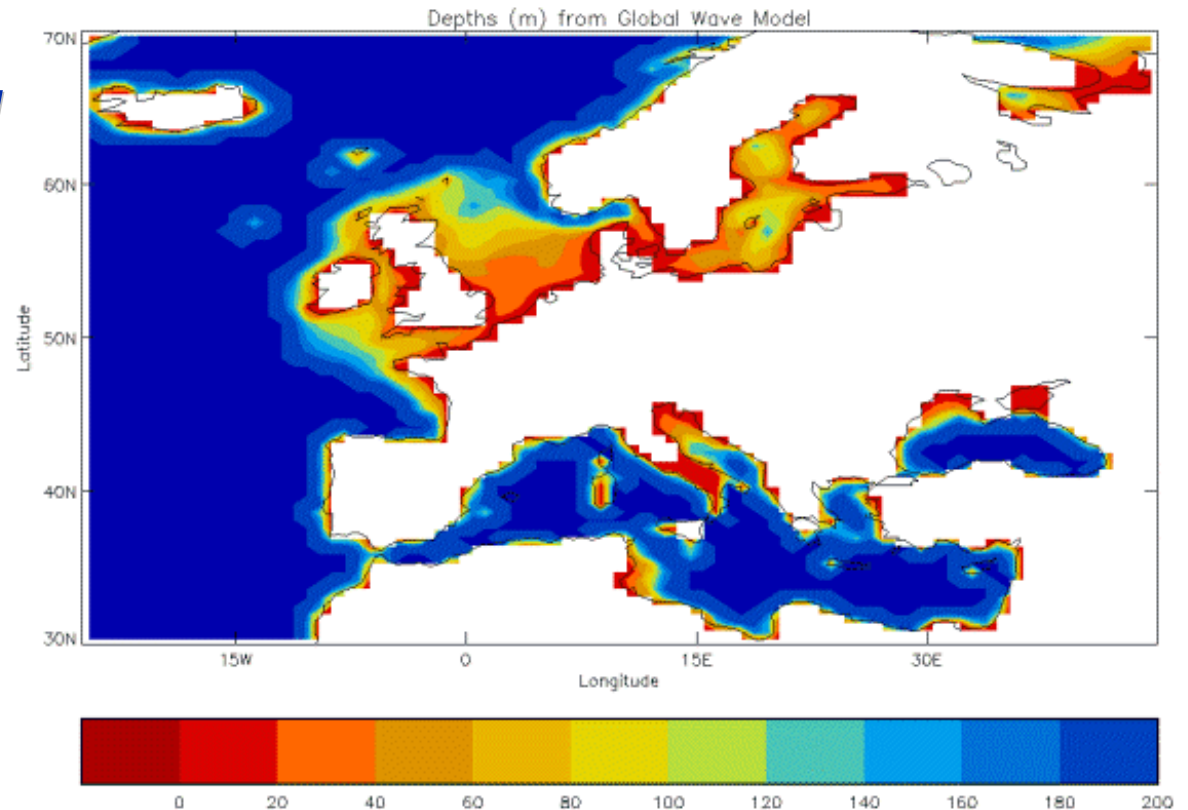
- **Global**

- 5/9° longitude
 - 5/6° latitude

- **European 35km**

- **UK waters**

- 12km
 - 1/9° longitude
 - 1/6° latitude

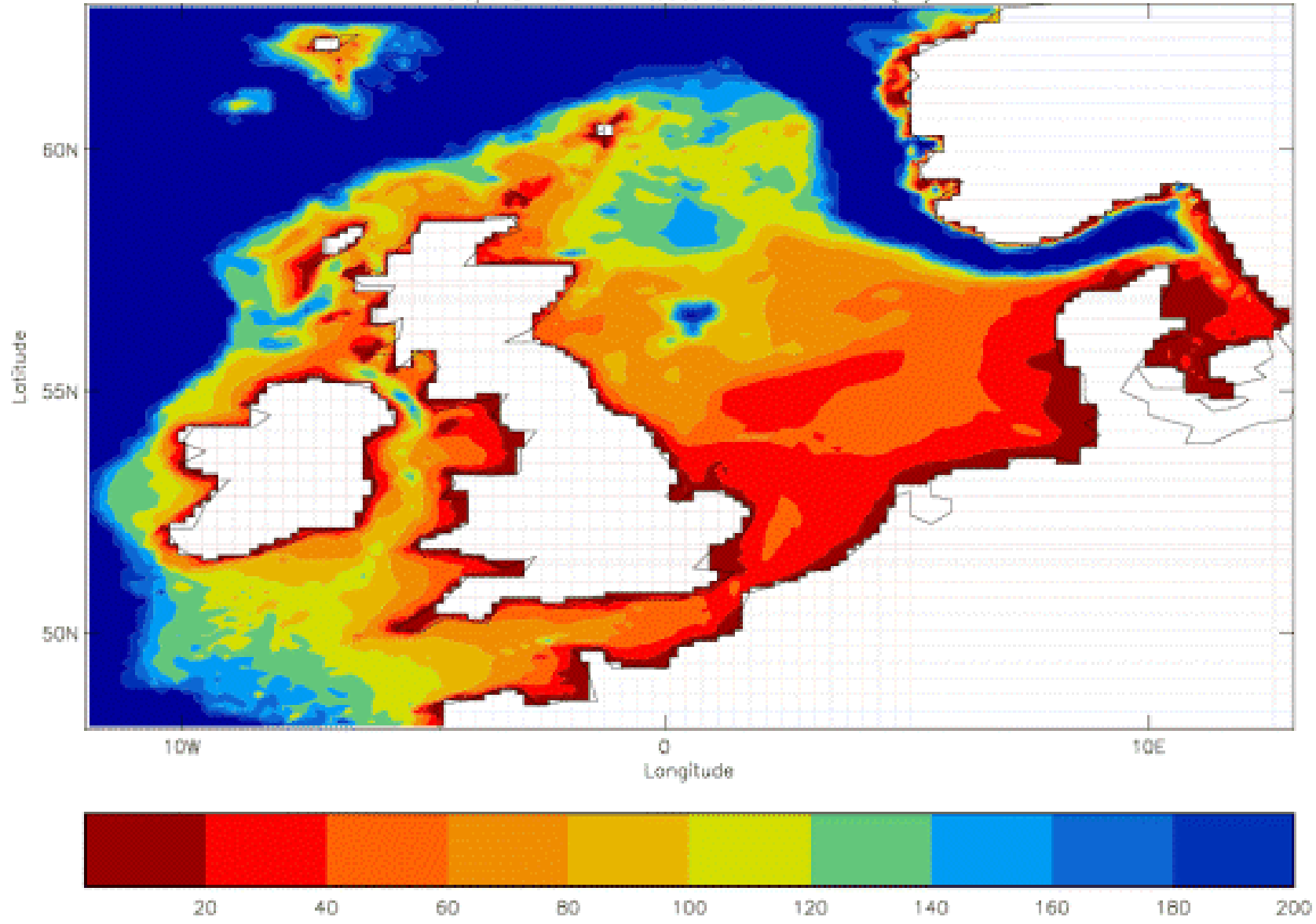


European wave model

- ***boundary data from the global wave model at the open boundaries***
- ***hourly surface winds from global and mesoscale numerical weather prediction (NWP) models***
- ***region wide hindcast at selected grid points since 1986***

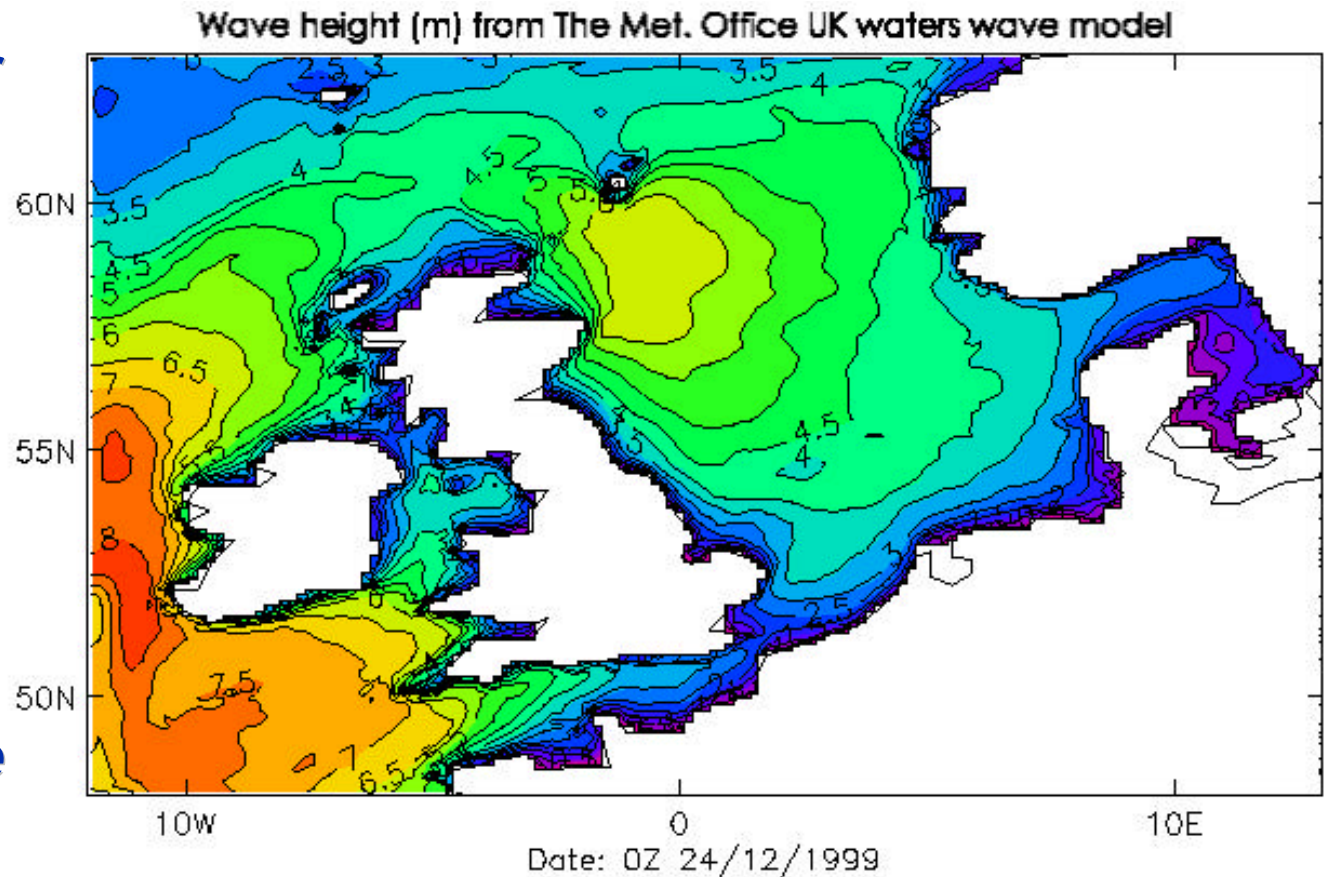


Depths from UK Waters Wave model (m)



UK Waters model

- *shallow-water physics,*
 - *bottom friction,*
 - *refraction*
 - *shoaling*
- *time-varying currents on the waves*
- *Regional hindcast since 2000*



Data sources

- ***Synthetic data***
 - ***Time series data for Met-office UK model at selected sites***
 - ***Shallow water transformations using time series***
- ***Field measurements***
 - ***Existing wave recorders***
 - ***New wave recorders***
 - ***Primarily high risk locations***







Pevensey Bay



Channel Coastal Observatory - Wave data - Microsoft Internet Explorer

Address: http://www.channelcoast.org/data_management/real_time_data/?link=waves.html

Channel Coastal Observatory

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Main areas

- Programme Background
- Programme aims
- Programme design
- Survey techniques
- Analysis programme
- Data Management
- Survey programme schedule
- Project administration

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> Data management > Real Time Data > Wave data

Wave data

Wave data is already collected at several sites within the region. Data from these sites will be integrated within the programme during 2003. Real time data trials will take place using the Milford-on-Sea site during March 2003.

Wave recorder

- existing
- unavailable

Existing sites	Instrument	Owner
Boscombe	Directional waverider buoy	
Milford on Sea	Datawell Waverider buoy	New Forest DC
Lyminster	Pressure recorder	June 2003
Sandown Bay	Directional waverider buoy	
Chichester Bar	Pressure recorder	Havant BC
Hayling Island	Directional waverider buoy	
Rustington	Directional waverider buoy	
Pevensey	Directional waverider buoy	
Folkestone	Directional waverider buoy	
Arun	Pressure recorder	Arun DC
Deal Pier	Pressure recorder	Dover DC
Heme Bay	Etrometa step gauge	Canterbury CC

Updated 19th August 2003

Buoy locations

www.Channelcoast.org

Inter-
active map
on website

Buoy locations



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> Data management > Wave Charts > Rustington Buoy

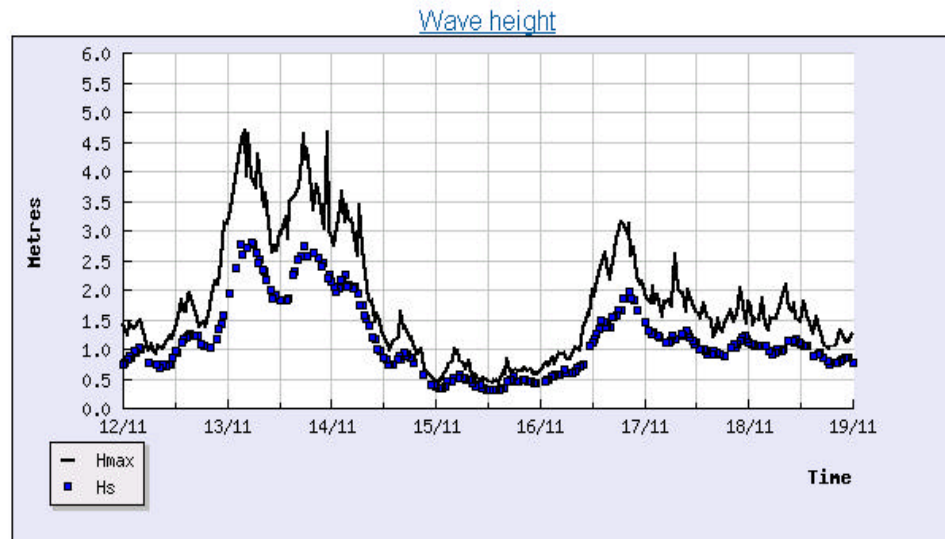
Rustington Buoy

[Graphs](#) | [Table](#) | [Additional information](#)

Display to date:

Latest Data:

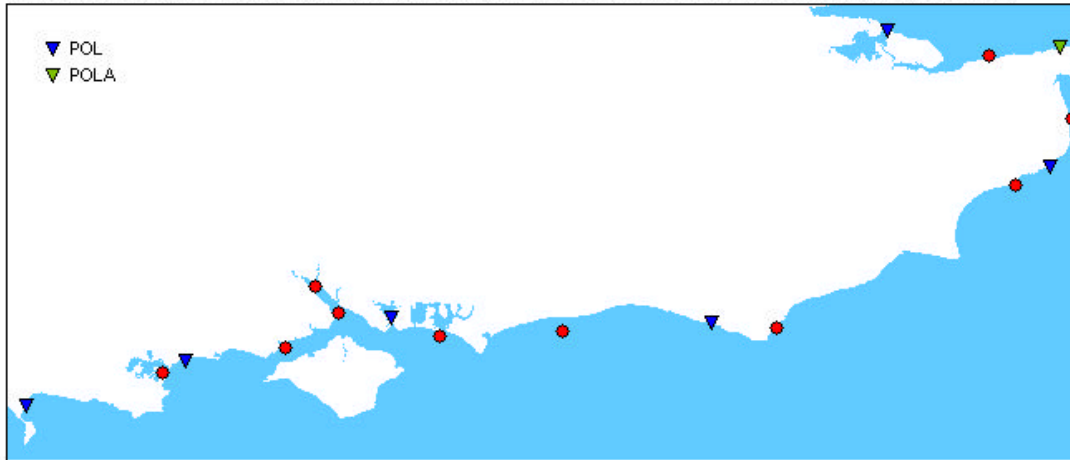
Time (GMT)	Latitude	Longitude	Wave Height (m)	Max Wave Height (m)	Tpeak (s)	Tm (s)	Mean Direction (°)	Spread (°)	Sea Temp (°C)
19-11-2003 21:30	50.73386	-0.49503	0.8	1.25	6.7	4.6	257	30	12.6



[Data Issues](#)

Tide data

Tide data is already collected at several sites within the region. Data from these sites will be integrated within the programme during 2003. Real time data trials will take place using the Lymington site during March 2003.

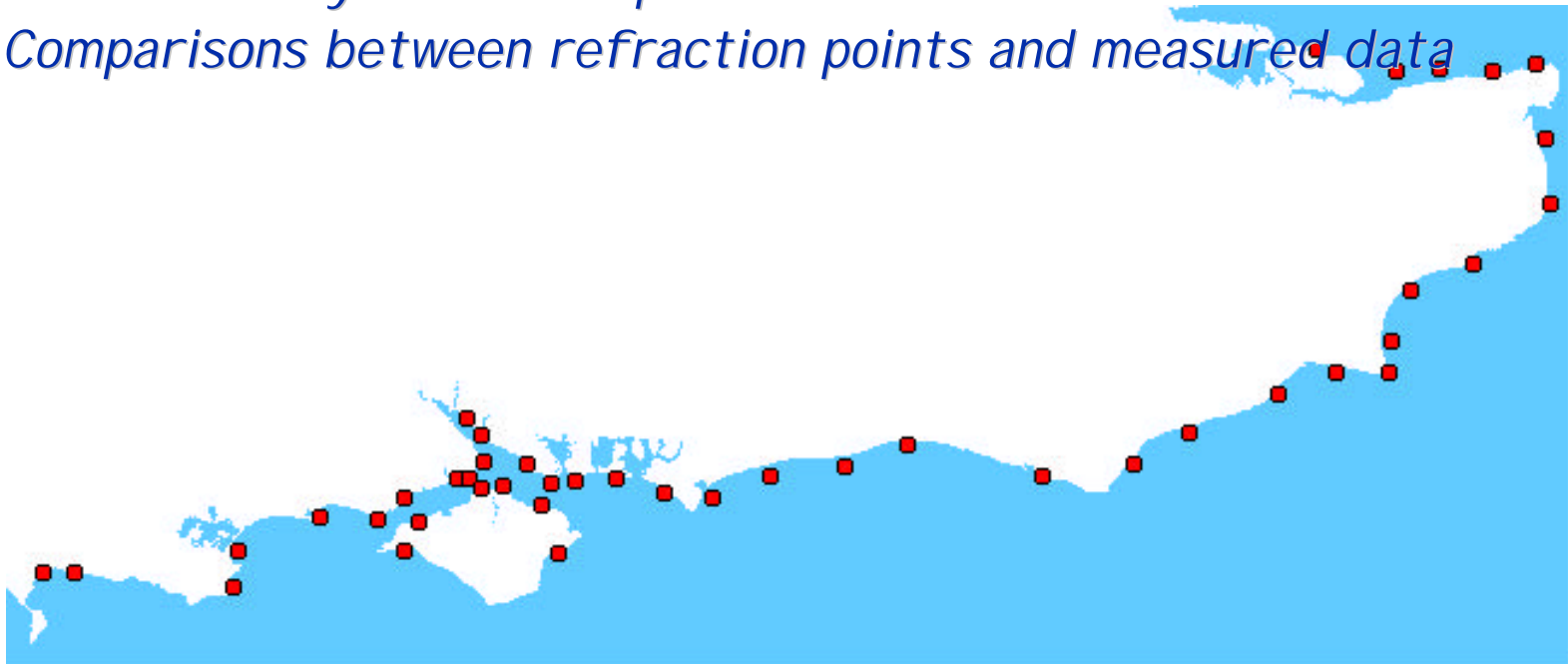


- Existing tide gauges quality checked, and upgraded
- Selected new sites added
- National tide gauge network station used
- Real time links to existing stations,
- Long term statistics updated annually

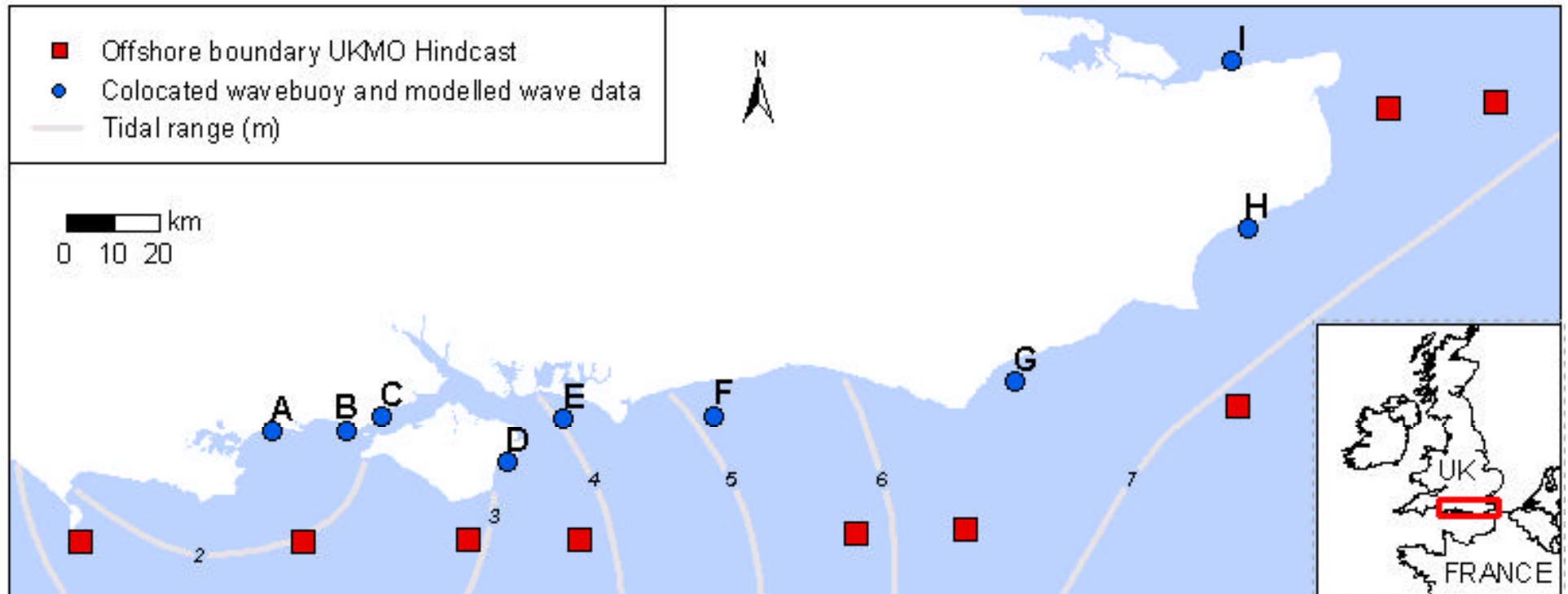
Existing sites	Instrument	Owner
Lymington	Pressure recorder	New Forest DC
Chichester Bar	Pressure recorder	Havant BC
Arun	Pressure recorder	Arun DC
Eastbourne	Pressure recorder	EA
Deal Pier	Pressure recorder	Dover DC
Herne Bay	Etrometa step gauge	Canterbury CC
Folkestone	Pressure recorder	Shepway DC
Poole harbour	Pressure recorder	Poole Harbour Commissioners
Southampton	Pressure recorder	ABP
Calshot	Pressure recorder	ABP
Archive only		
Newhaven	UK permanent network	POL
Bournemouth	UK permanent network	POL
Portsmouth	UK permanent network	POL
Dover	UK permanent network	POL
Weymouth	UK permanent network	POL

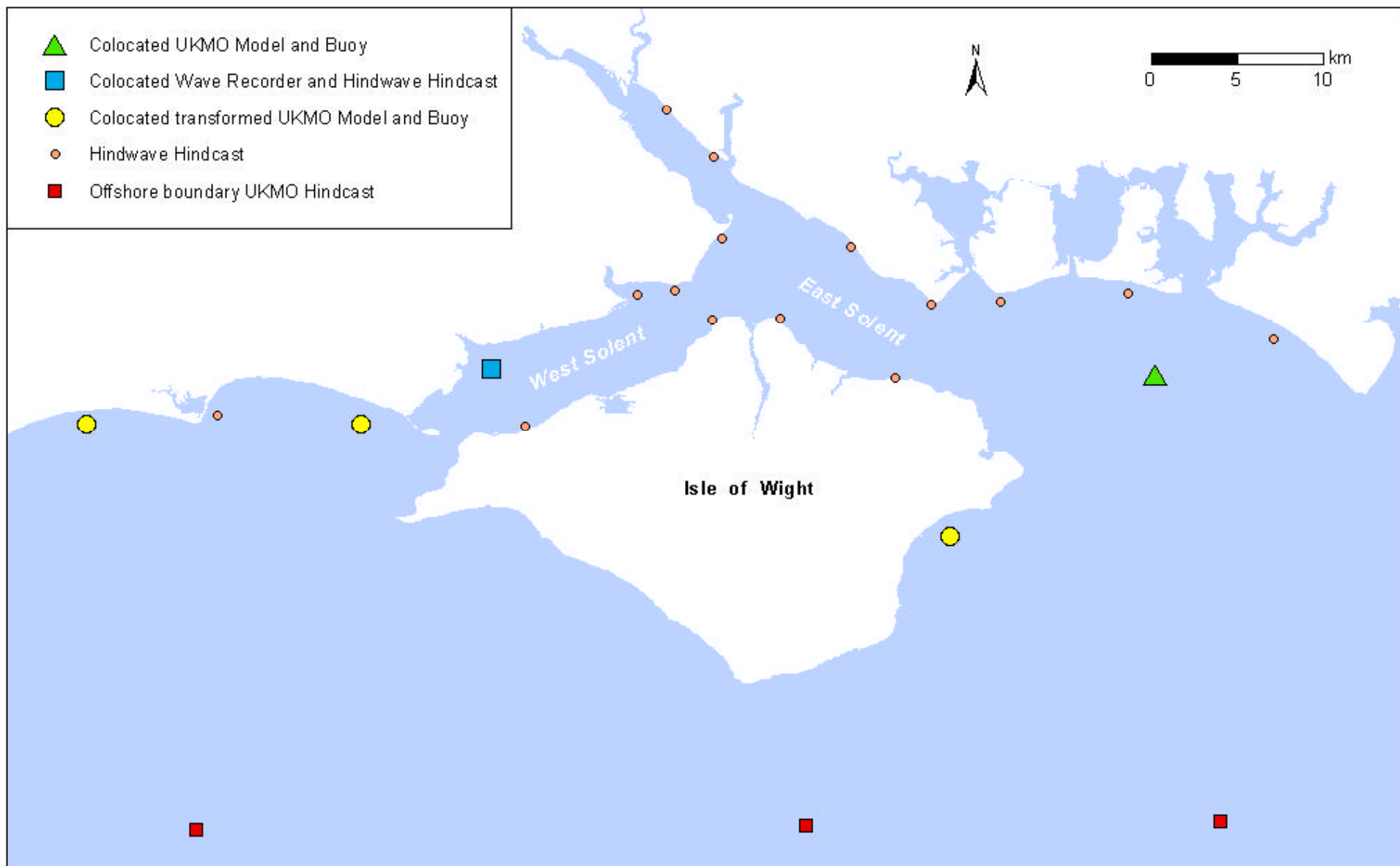
Near shore synthetic wave data

- *42 near-shore wave prediction points established*
- *Time series since 1986 all stations*
- *Probability distributions H_s , T_z , direction each site*
 - *Offshore wave data UKMO*
 - *Monthly updates and annual model re runs*
- *Extreme analysis annual updates*
- *Comparisons between refraction points and measured data*



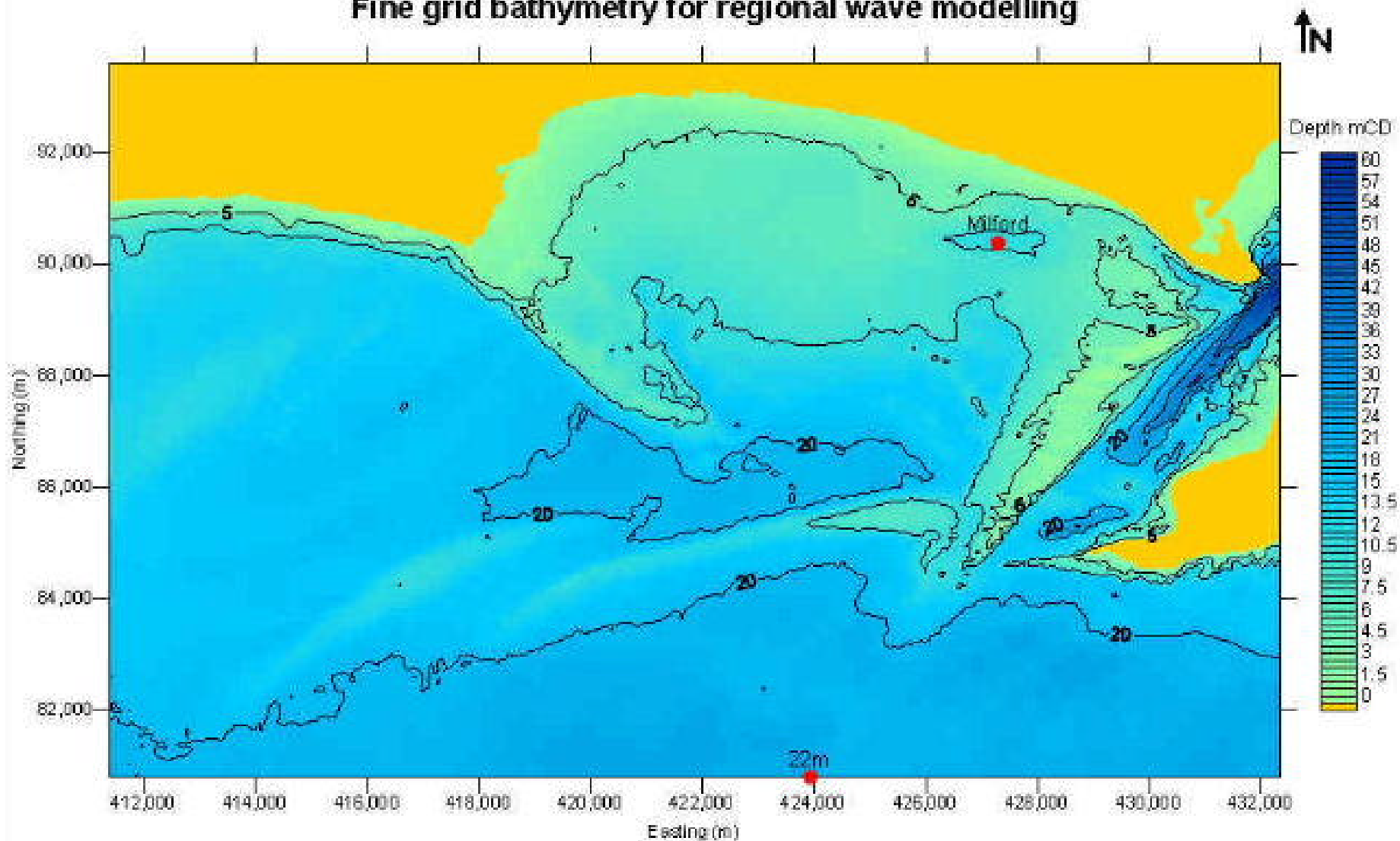
Location of wave measurement sites in Southeast England



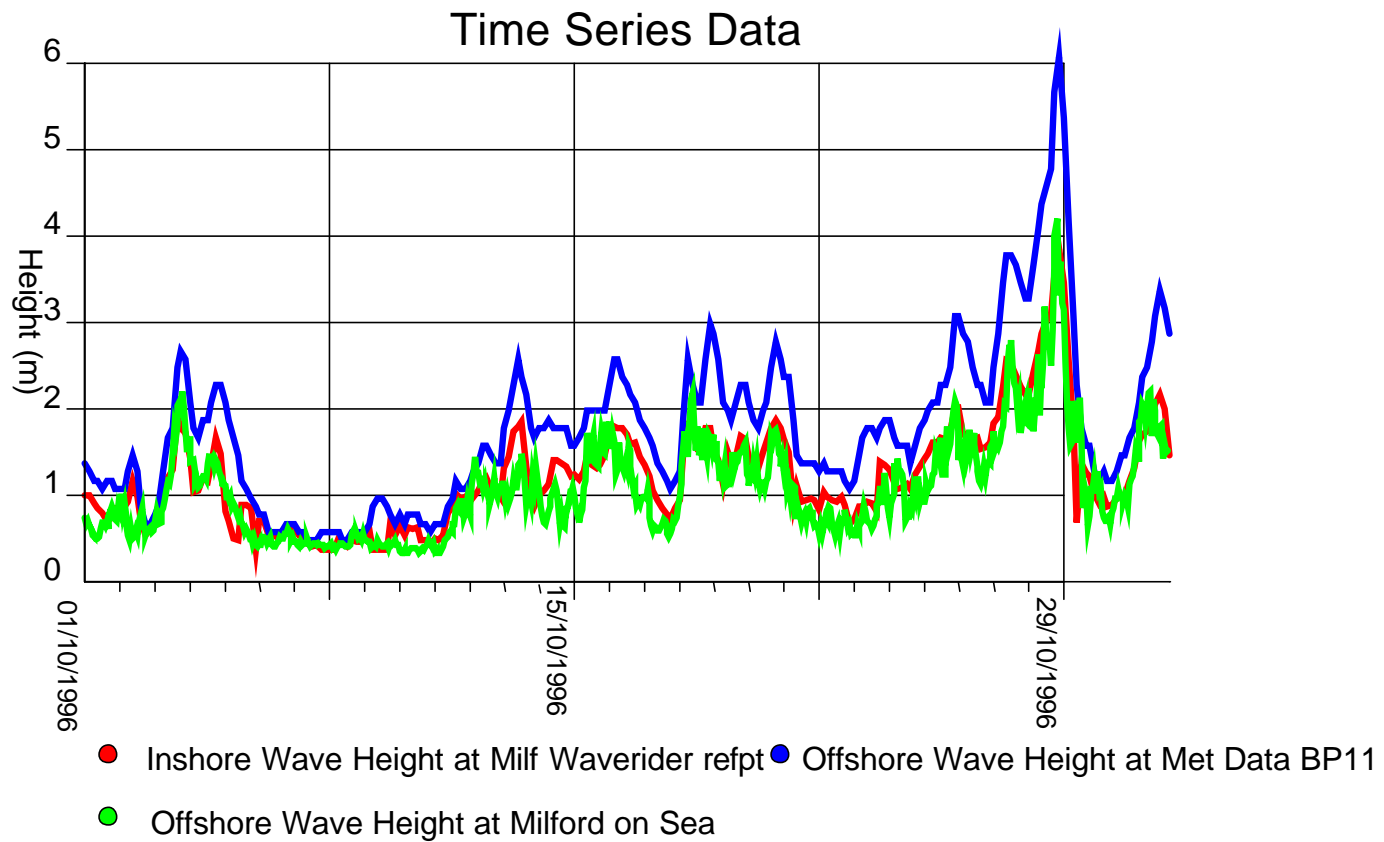


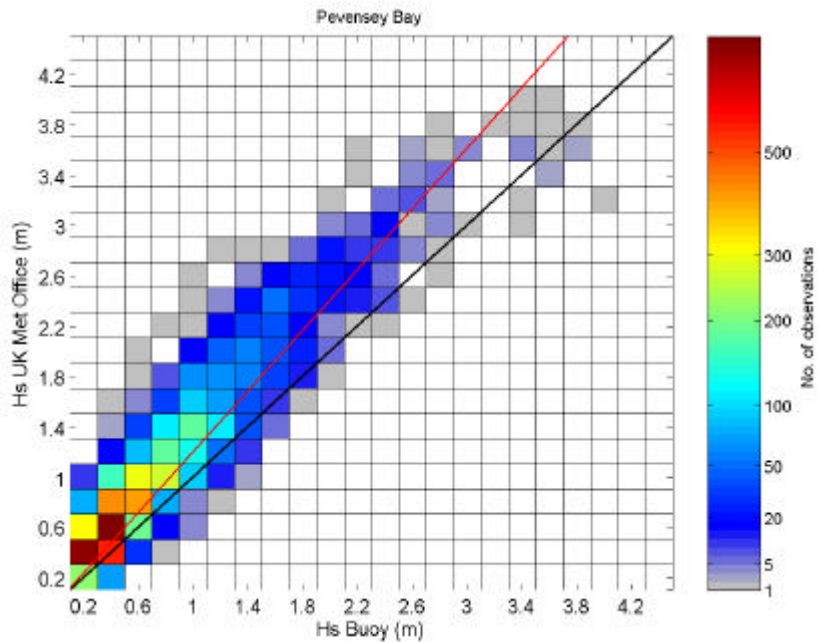
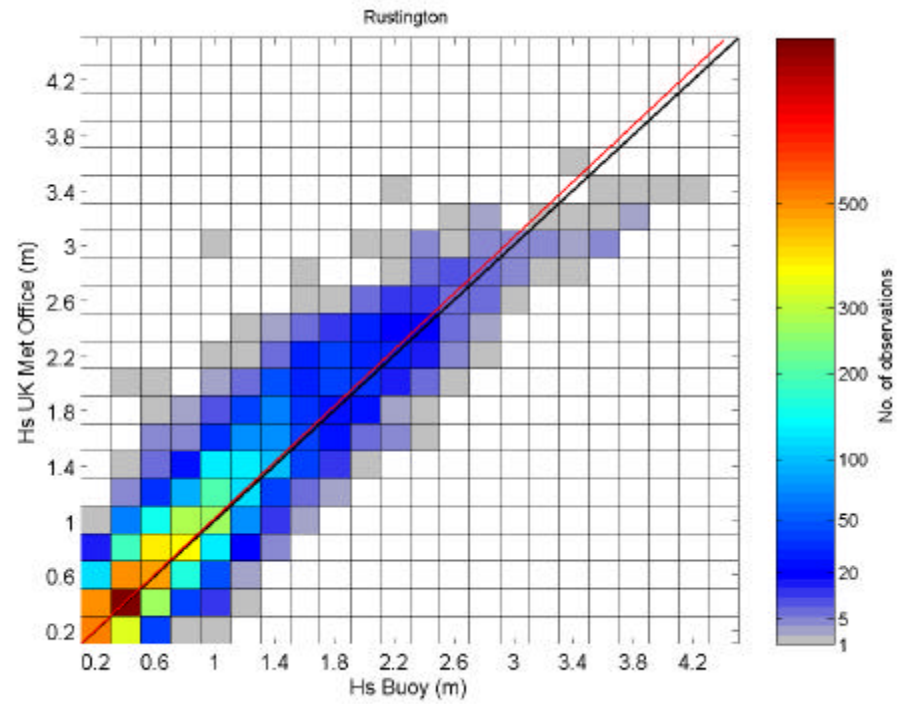
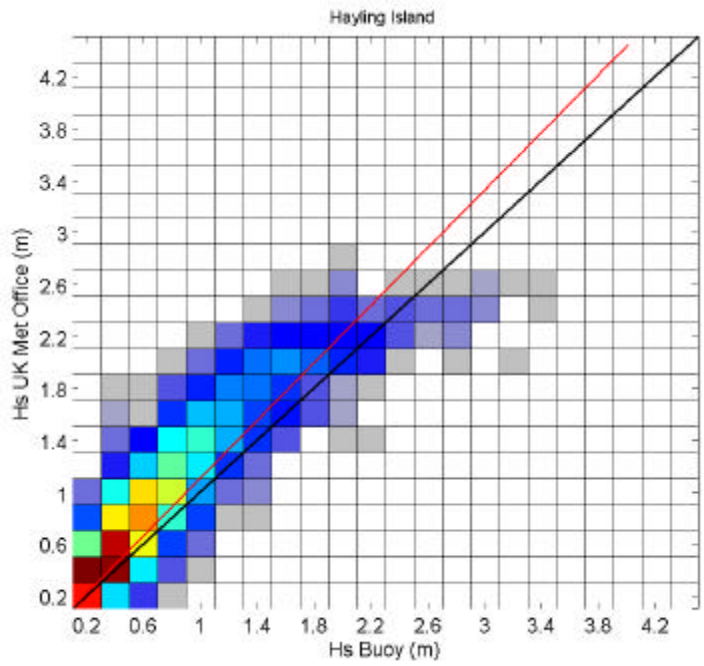
CHRISTCHURCH BAY MODELLING

Fine grid bathymetry for regional wave modelling



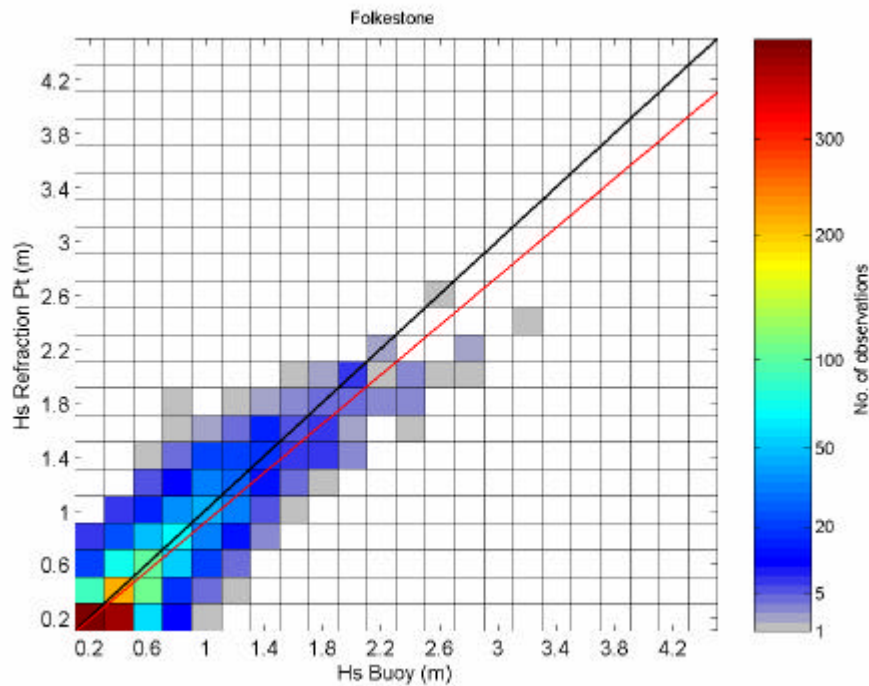
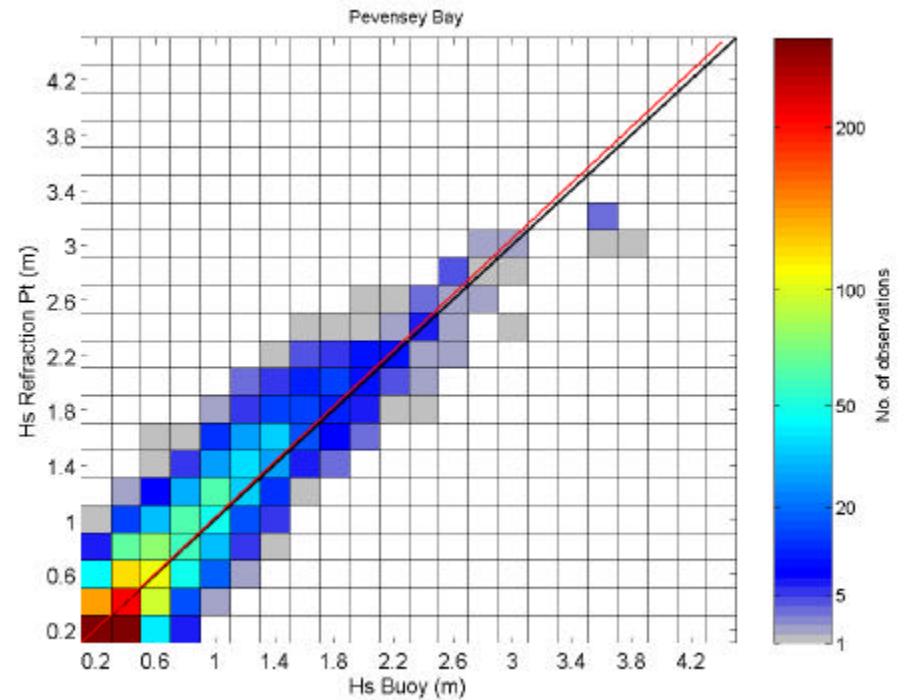
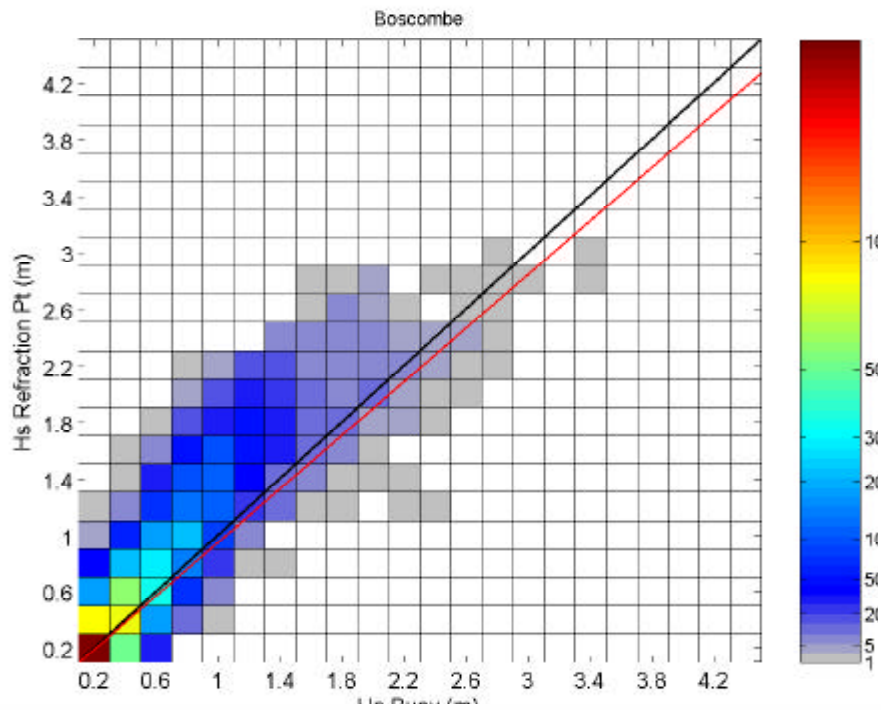
Time series comparison





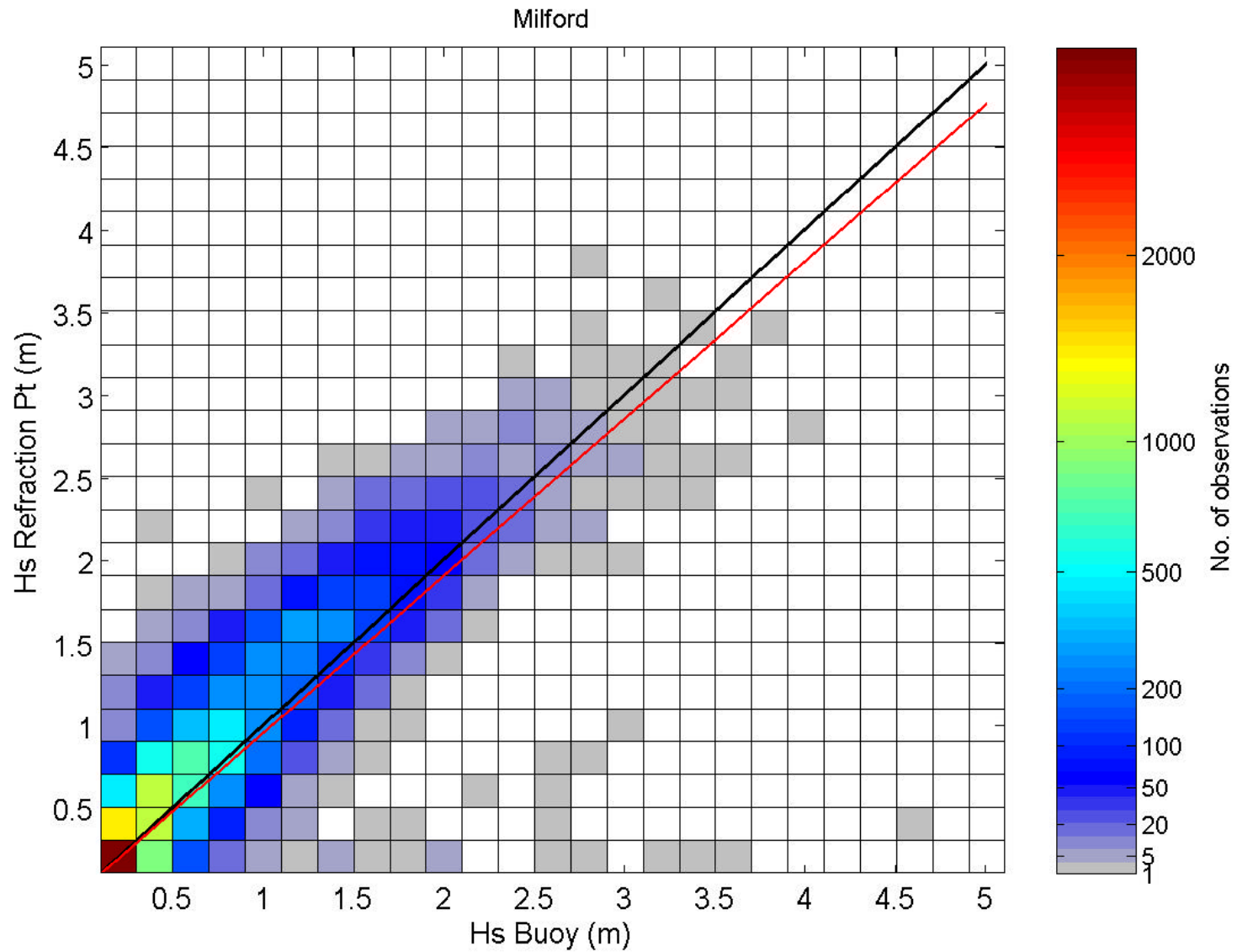
*Direct Hindcast to
buoy site
(H_s)*





*Transformation
modelling from hindcast
at offshore boundary to
buoy locations*



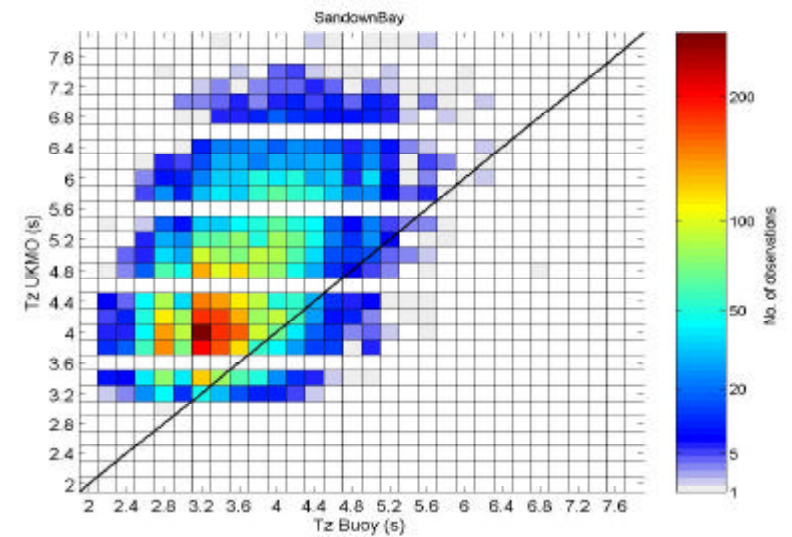
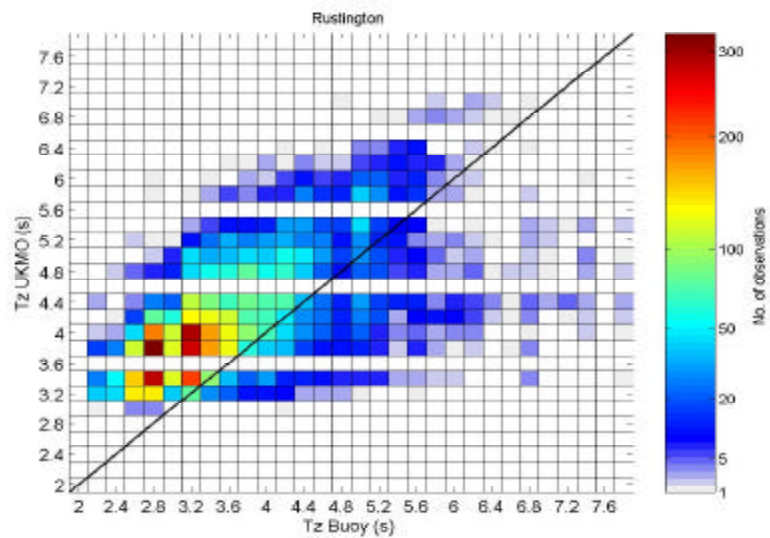
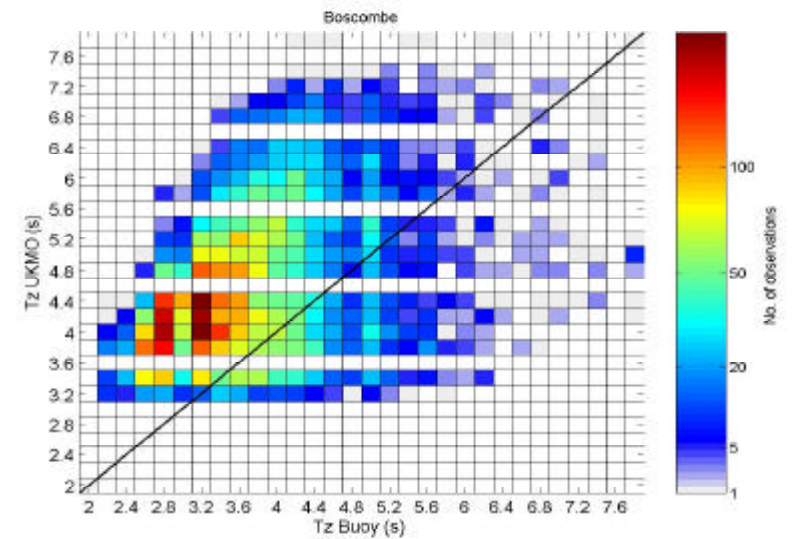
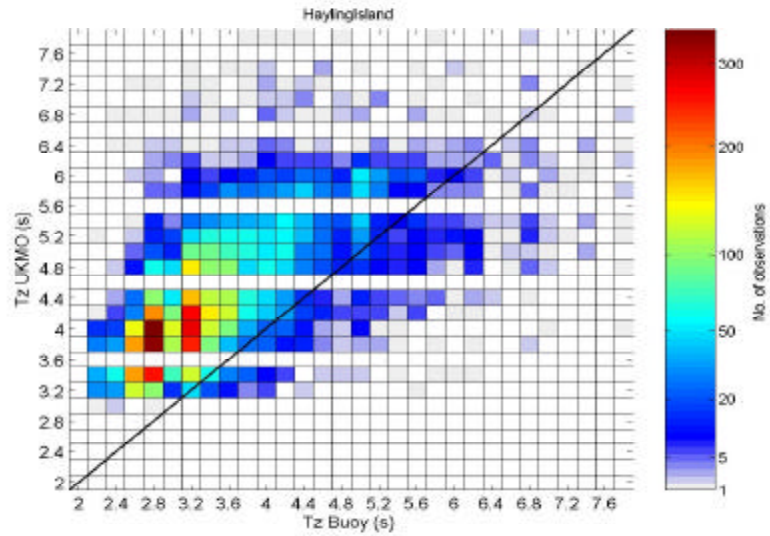


Long term records of H_s at Milford buoy

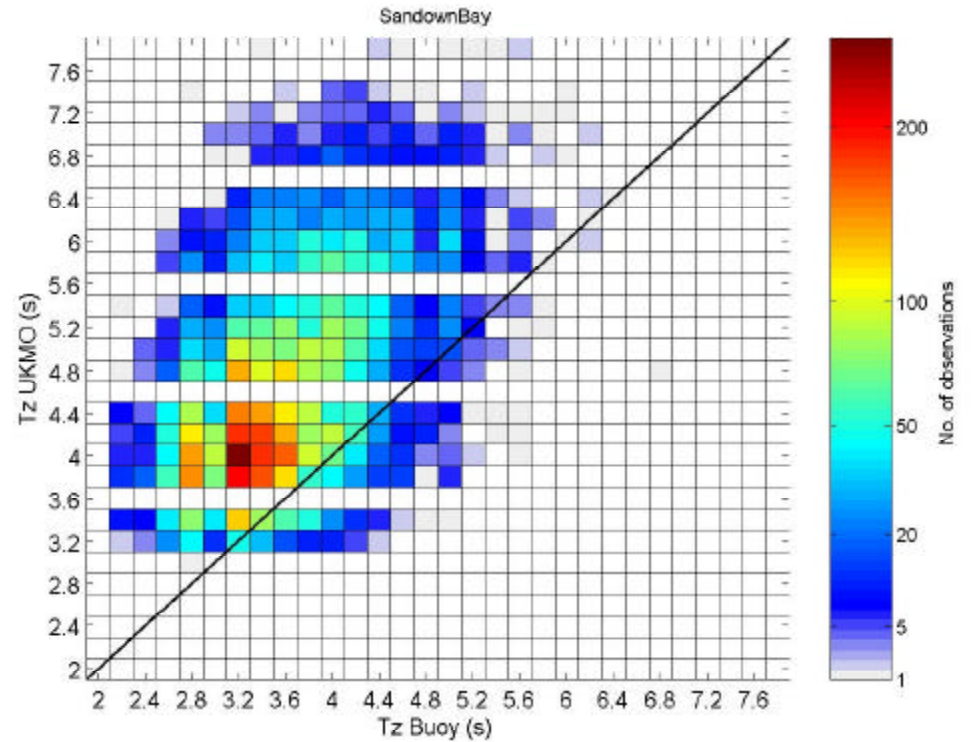
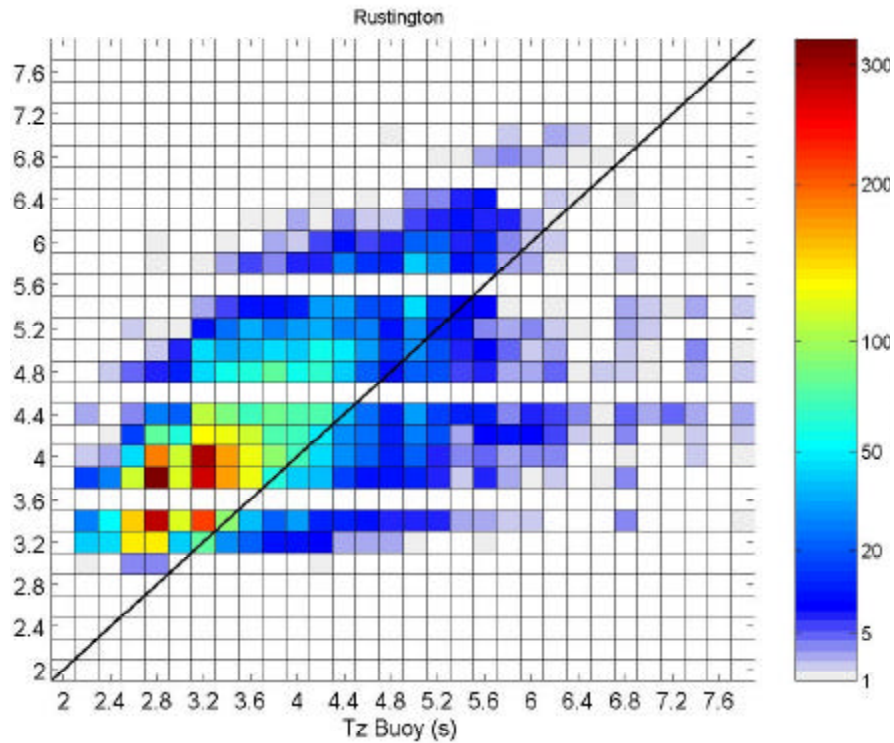


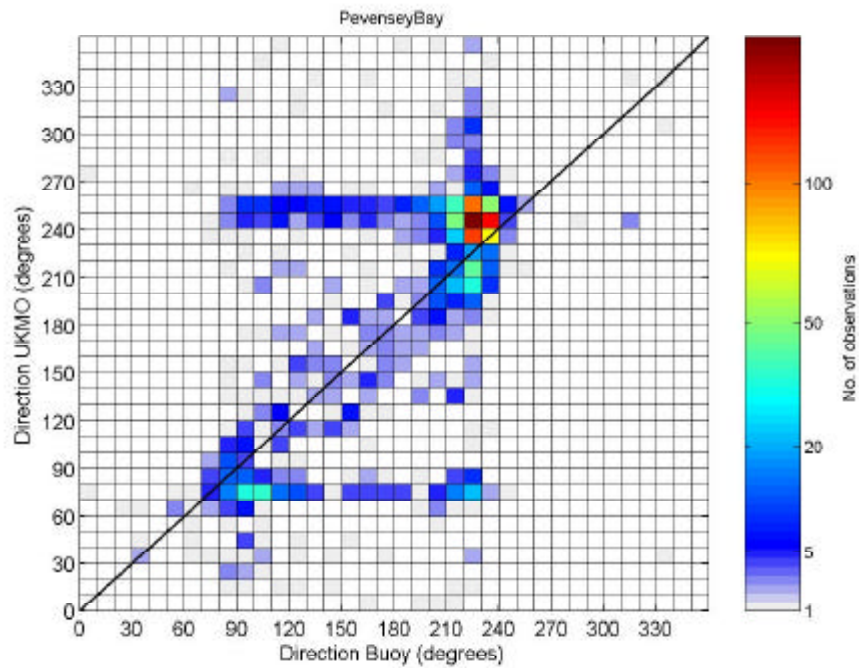
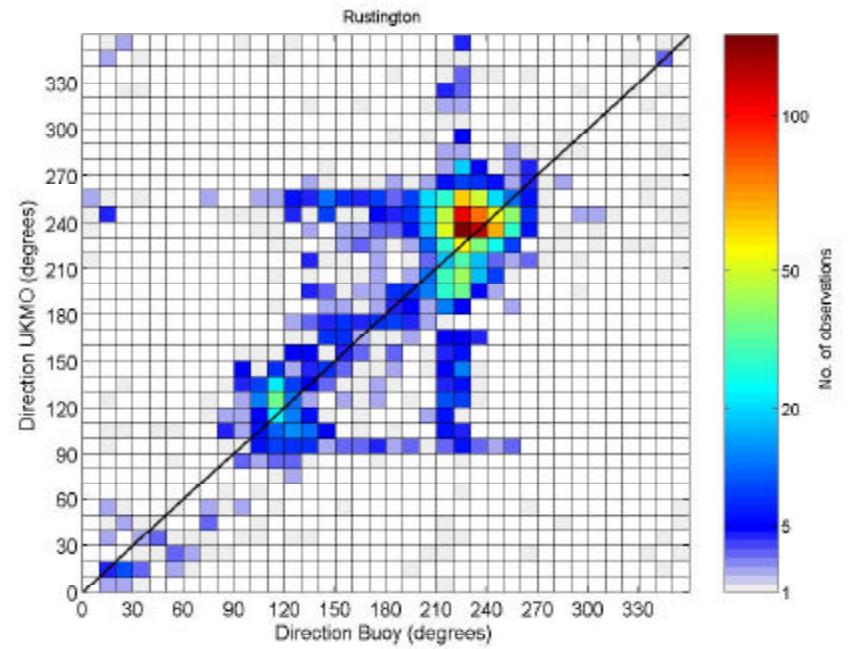
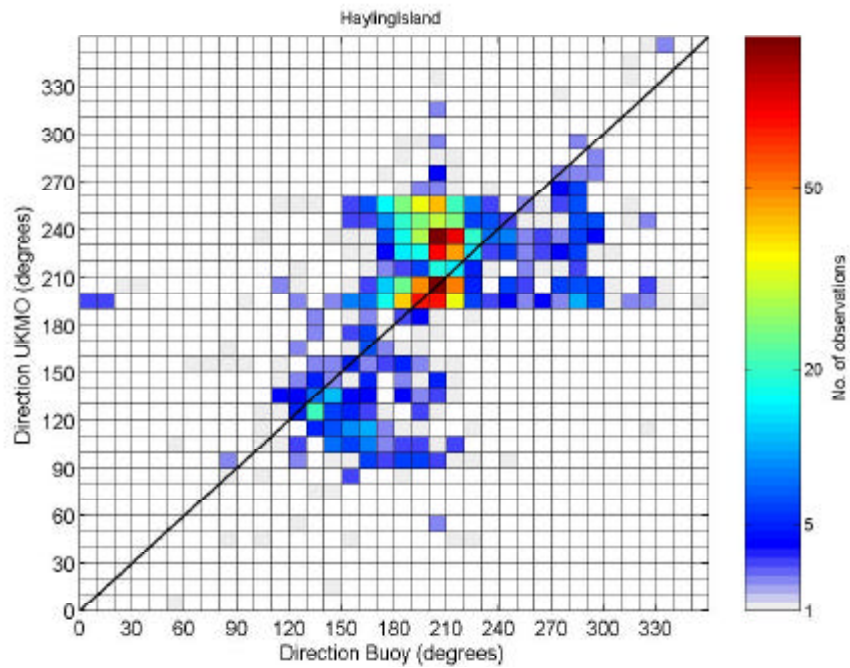
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Wave period



Wave period

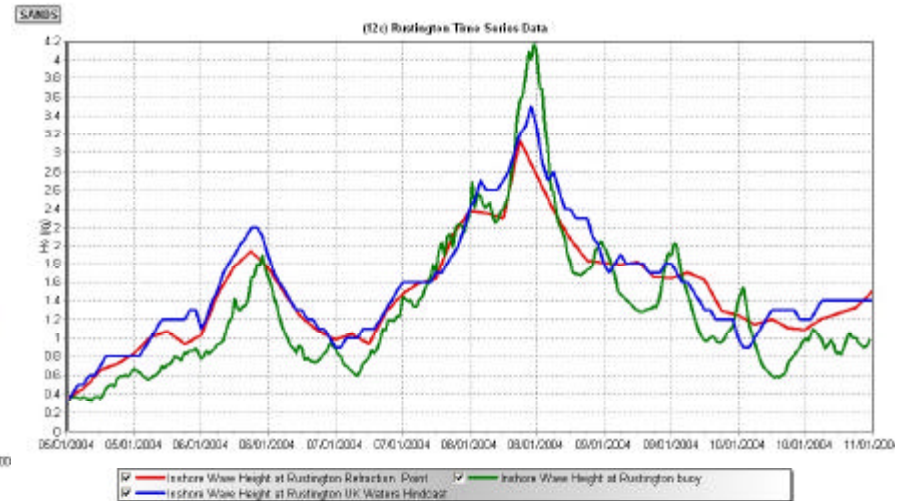
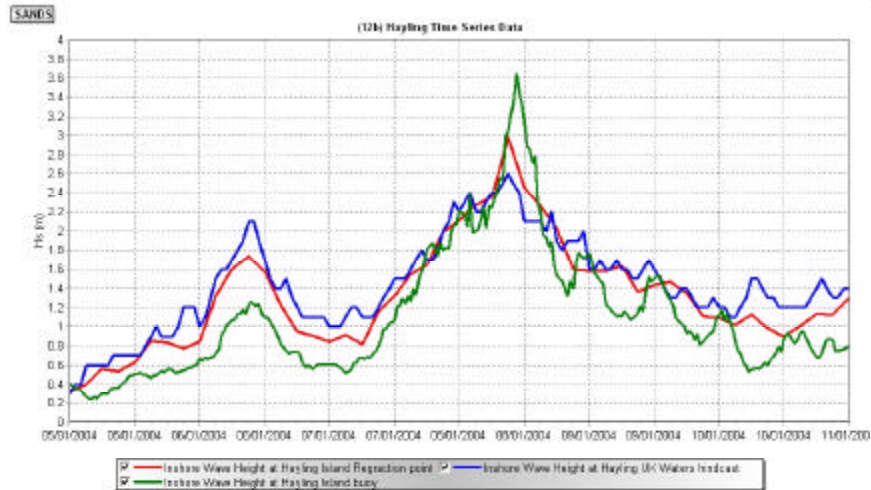
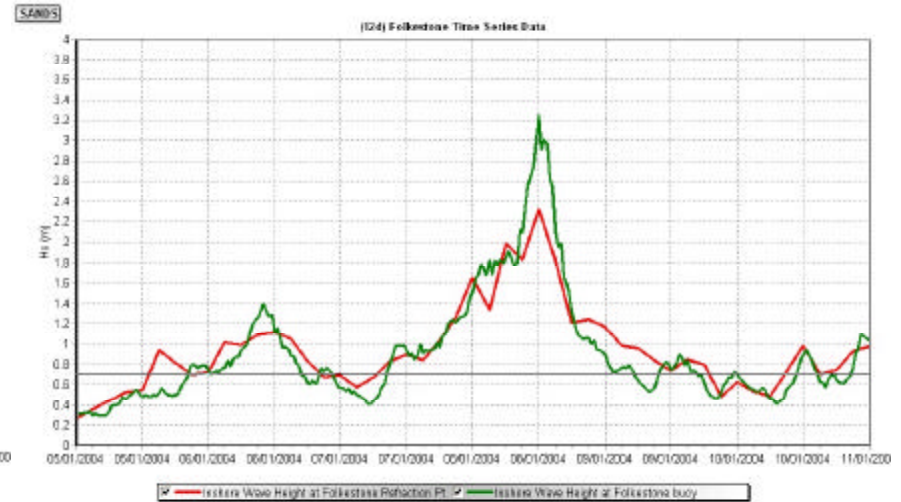
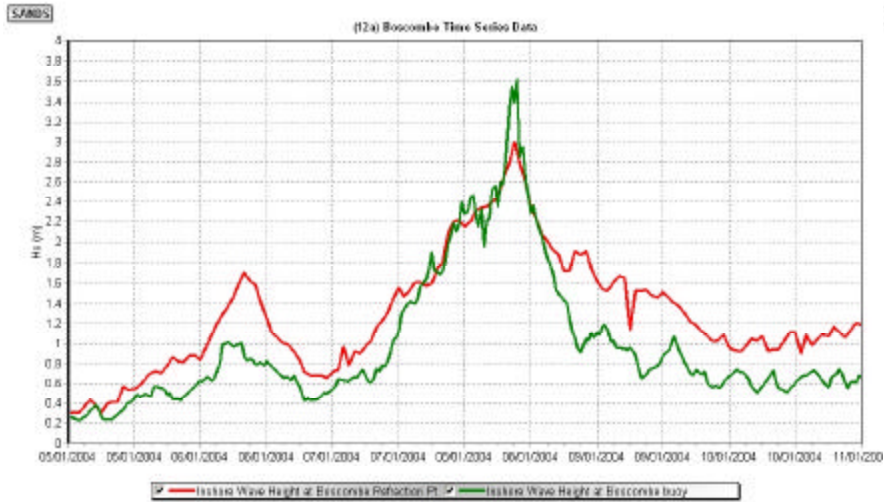




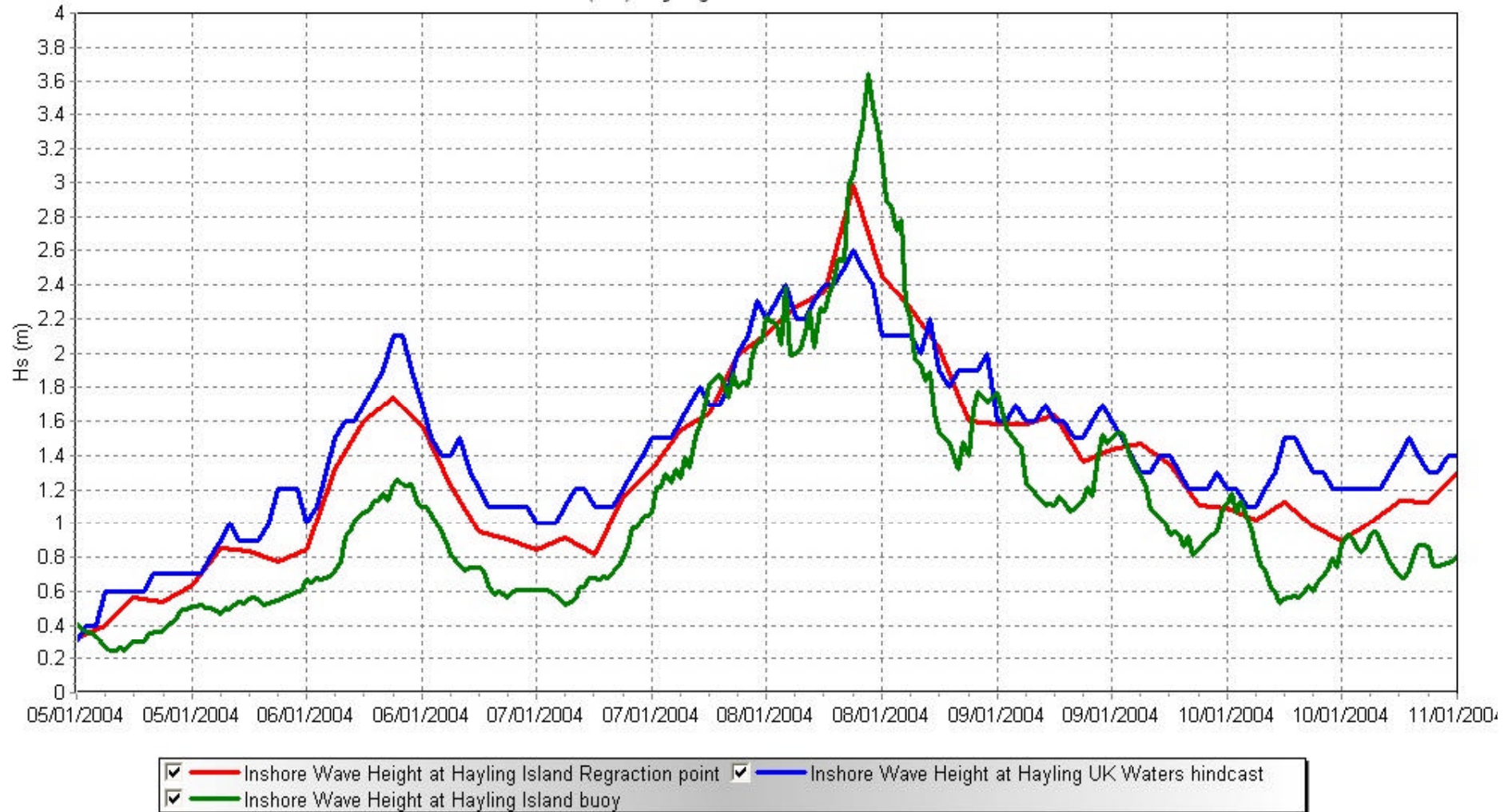
Direction



Event analysis



(12b) Hayling Time Series Data



- *Better description of time series at buoy*
- *Co-located and transformed data follow similar patterns*



SANDS

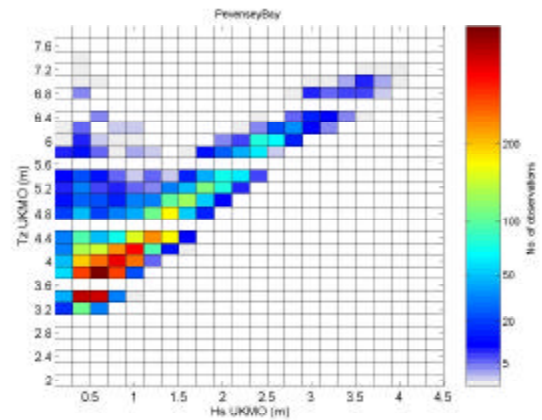
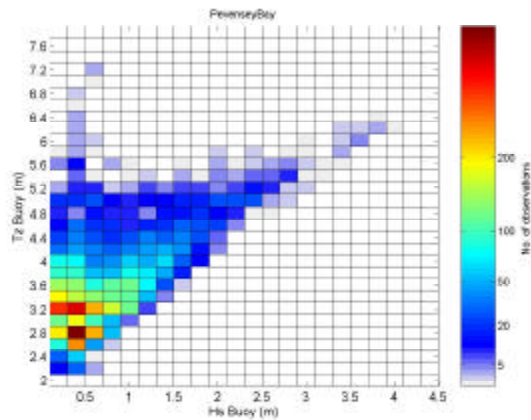
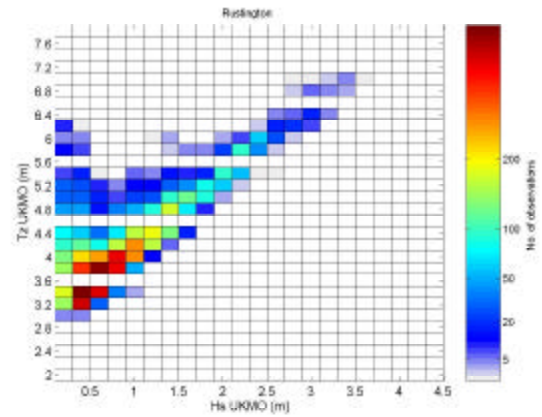
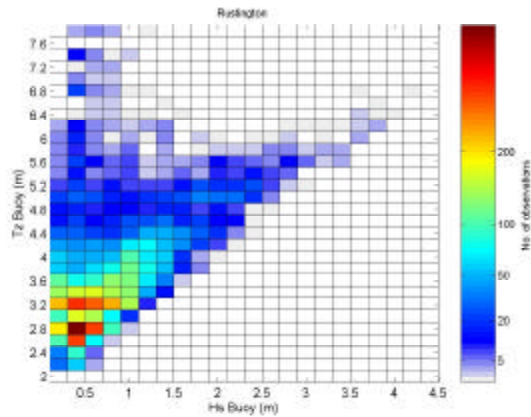
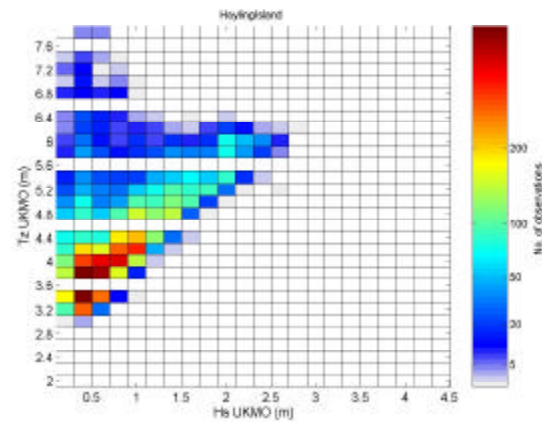
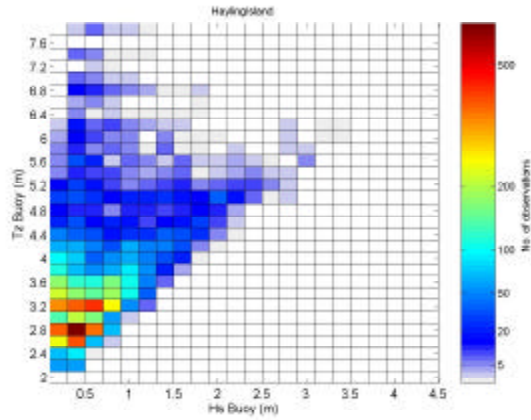
(12a) Boscombe Time Series Data

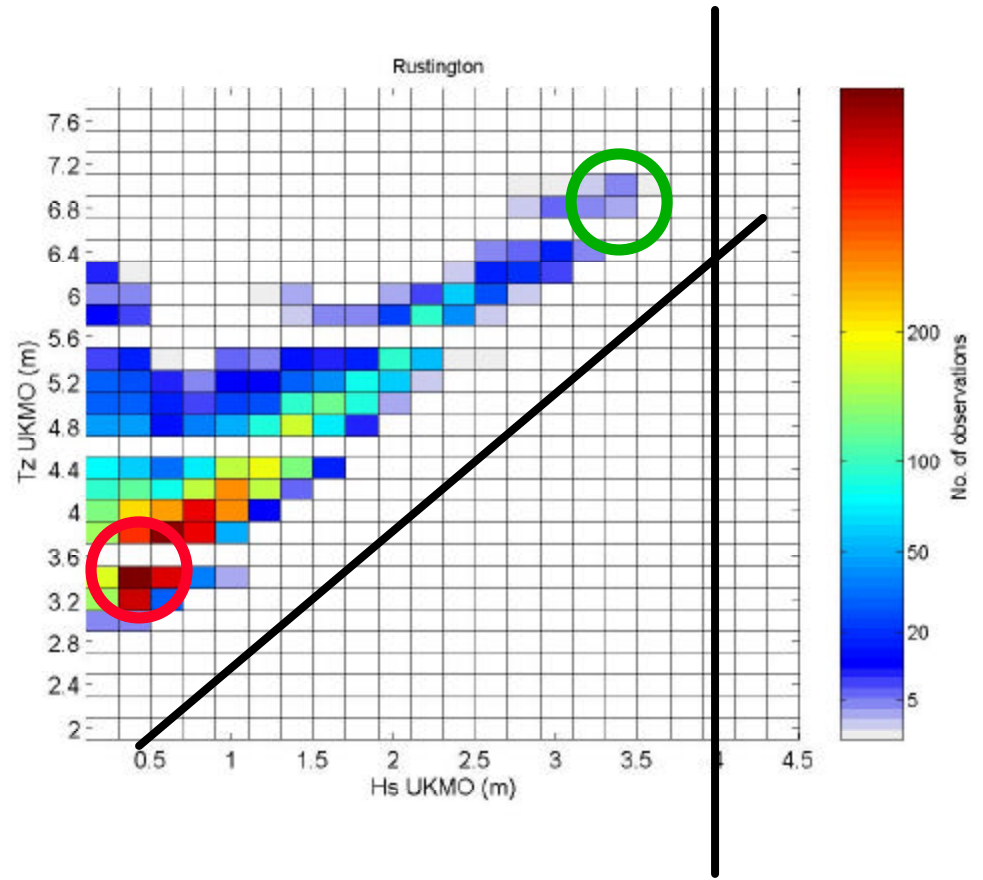
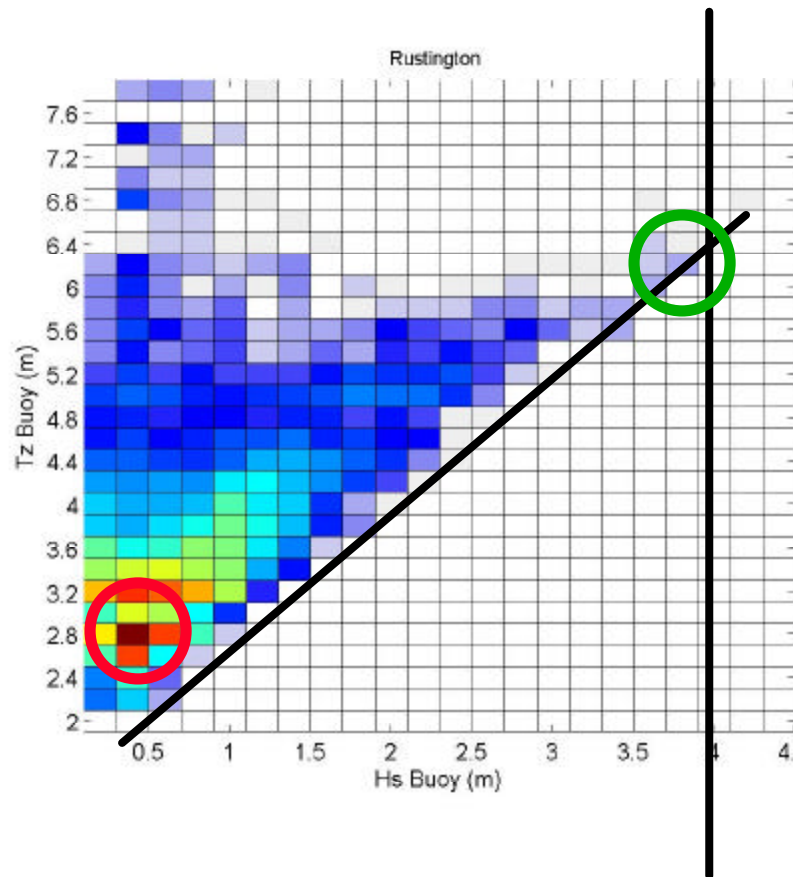


- *Under prediction of extremes*
- *Over estimation of $H_s < 2m$*
- *Good timing of peaks*



Wave steepness





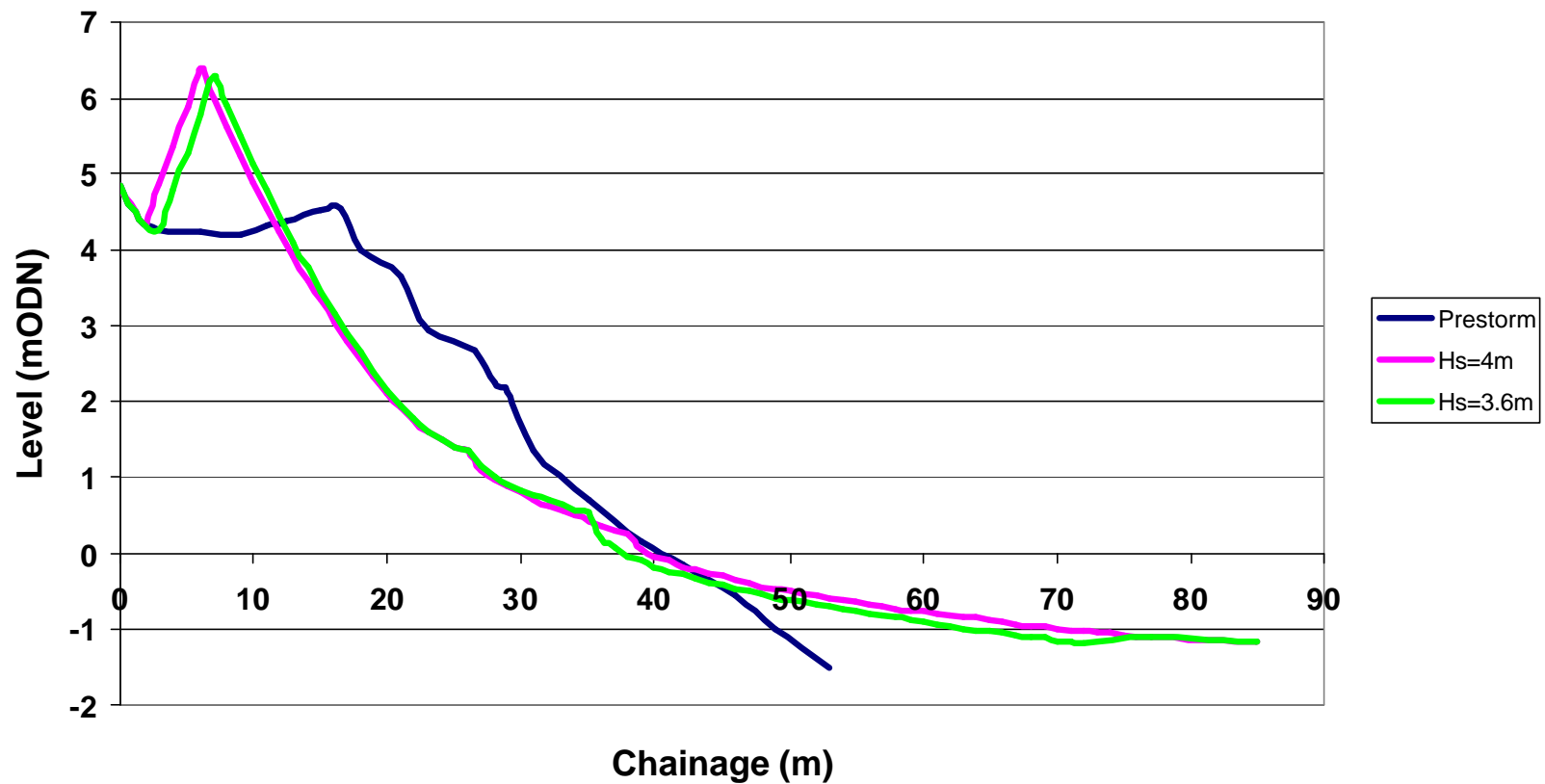
Impact on wave run-up and profile response



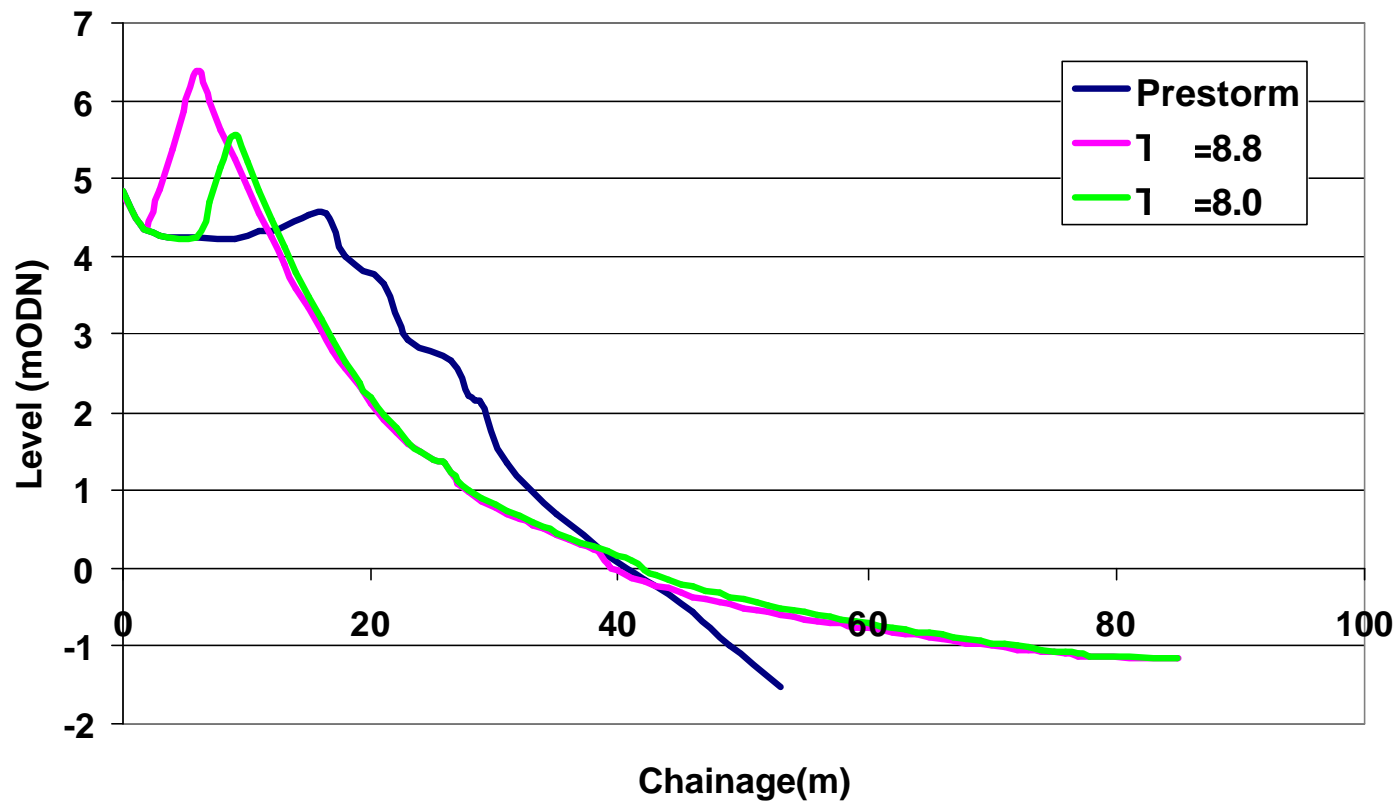
- ***Variation in H_s***
- ***Variation in T_z***



Empirical profile response modelling - impact of 10% change in H_s



Empirical profile response modelling - impact of 10% change in T_z



Impact on armour stability

Plunging waves

$$H_s/D D_{n50} = 6.2 P^{0.18} (S/\ddot{O}N_z)^{0.2} X_m^{-0.5}$$

$$H_s = 3.6m \quad W_{50} = 4.6t$$

$$H_s = 4.0m \quad W_{50} = 6.2t$$

Constants

$$T_z = 9.5s, P = 0.3, \text{cota} = 3$$

P = notional permeability

S = design damage A_c/D_{n50}^2

A_c = erosion area from profile

N_z = number waves

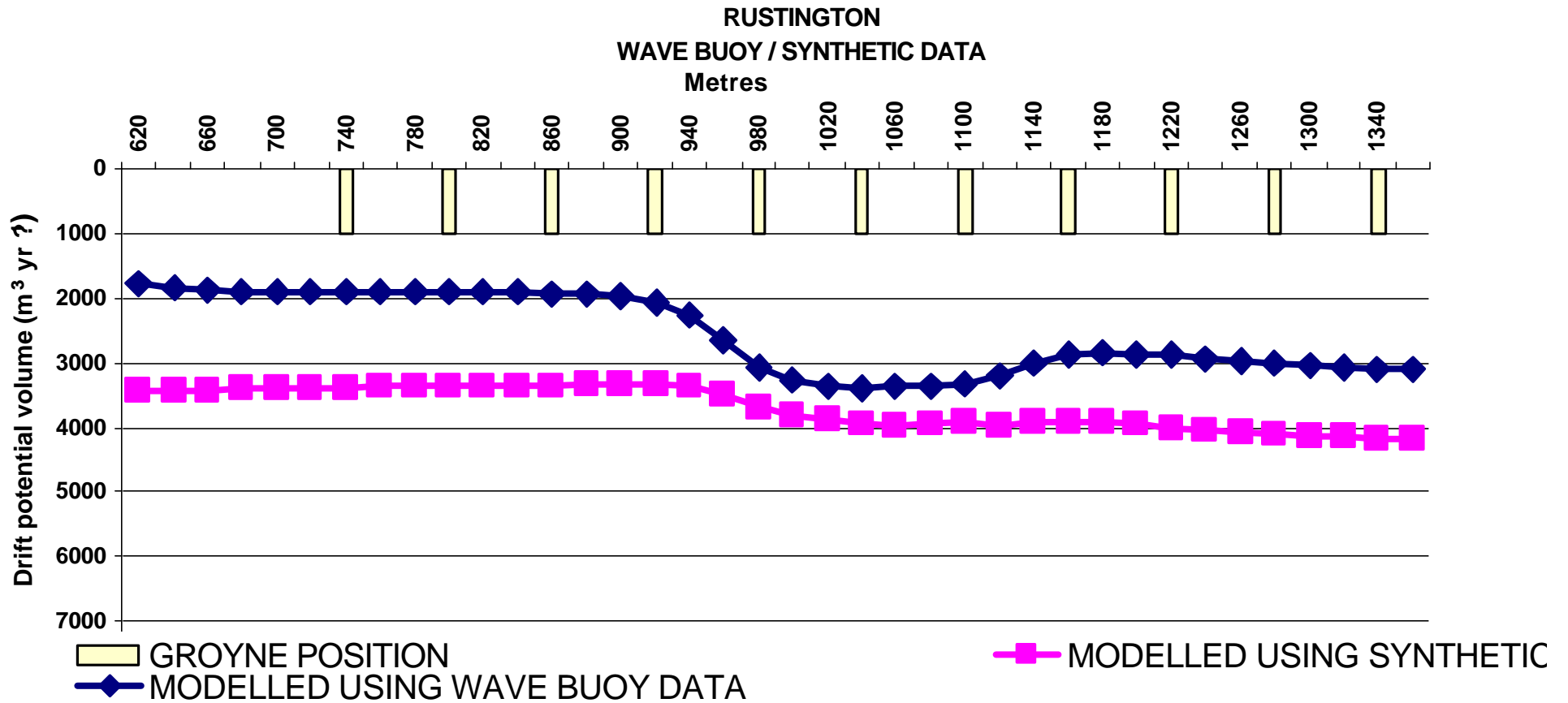
X_m = surf similarity parameter

Surging waves

$$H_s/D D_{n50} = 1.0 P^{-0.13} (S/\ddot{O}N_z)^{0.2} / \text{cot} \alpha X_m^P$$



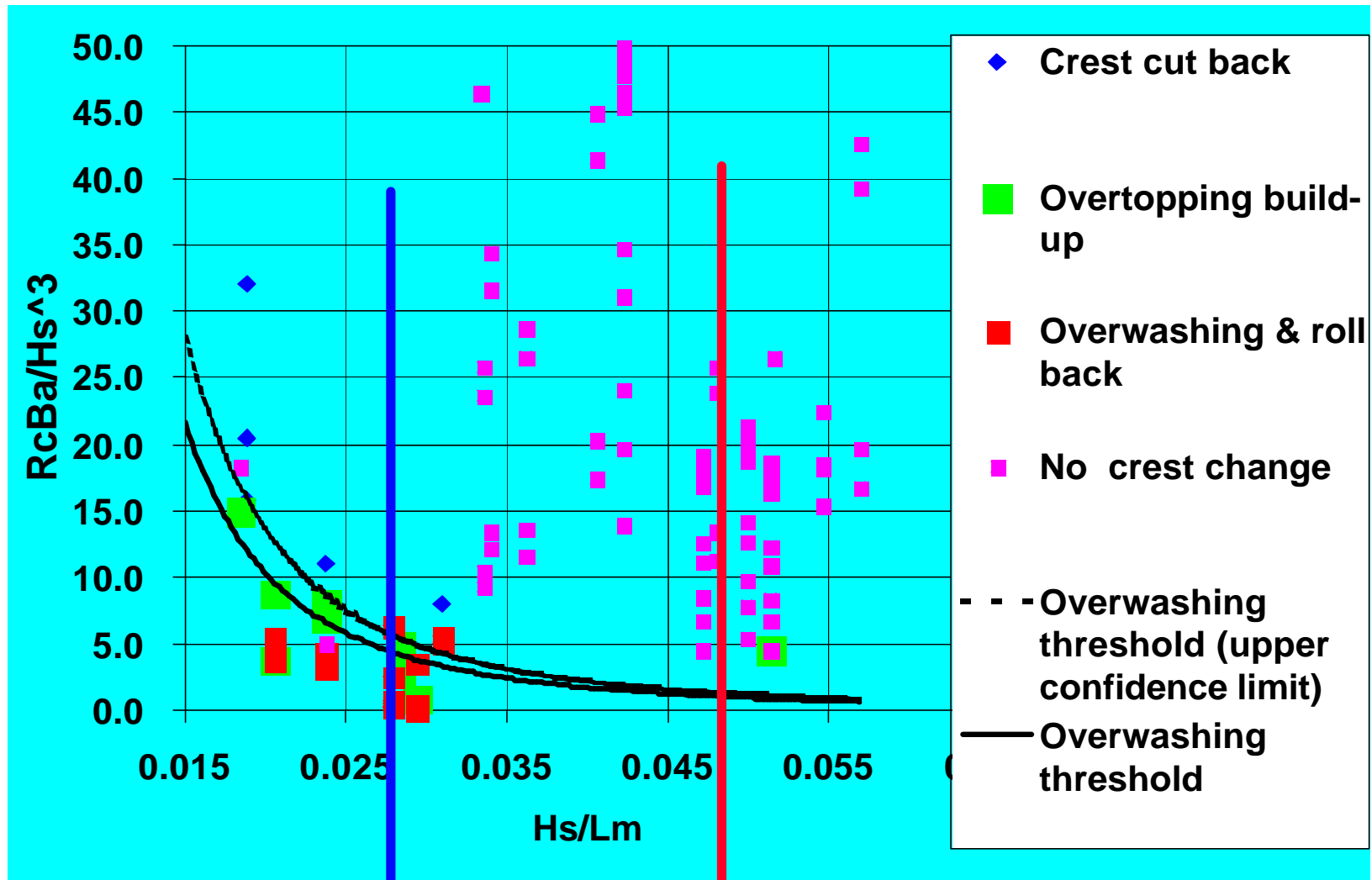
Sediment transport



*Identification of critical conditions to
prevent barrier breaching*



Wave steepness



Impacts of period on runup and profile response





Concluding observations

- ***Hs over-predicted for $H_s < 2m$***
- ***Hs for extremes under-predicted***
- ***Tz typically over-predicted***
- ***Direction scattered - possibly related to buoy or phasing***
- ***Significant shoreline management impacts***

Future development

- ***Conduct systematic statistical analysis***
- ***Refine analysis to include longer clean data sets***
- ***Analyse spectral data sets***
- ***Proposals to improve Met Office model***
 - ***Standardise output to 1hour***
 - ***Improve extreme conditions***
 - ***Examine wind input from NWP models***
 - ***Improve frequency resolution***





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