Cascading Scales of Beach Analysis Within a Regional Coastal Monitoring Programme

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www.Channelcoast.org

Decades				
Years				
Seasons				
Days				
Hours				
Real-time				
	100’s metres	Kilometres	10’s Km	100’s Km

Regional Overview

Coastal Strategy

Shoreline Management Plans

Engineering schemes and Beach Management Plans

Storm Events

Flood Forecasting Operational Planning

Spatial scale

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Complex risk scenarios

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

Developing management techniques

- Accuracy of nearshore wave climate prediction
- Managed realignment opportunities
- Sediment transport modelling calibration
- Inadequate field data to provide calibration or validation of models

Historical approach

- Undefended stretches of shoreline infrequently monitored, despite potential for local interaction with managed sites.

- Existing data generally localised at "beach management" sites.

- Inconsistent approach regionally

An approach to regional programme design

- Risk based
- Cost effective
- Coordinated
  - Local authority / EA partnership
  - 48 local authorities
- Strategic and Operational benefits
- Expandable / transferable

Risk based design framework

- Geomorphology / geology
- Defence type
- Exposure / flood risk
- Strategic management option

Programme structure

- Range of levels of monitoring
  - High level on areas with beach management plans that require intervention eg recycle, recharge
  - Comprehensive programme in actively managed high risk areas
  - Lower levels in do nothing areas

Regional distribution of beach management sites

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Baseline surveys

- Accessible beaches

  Land survey (RTK) spot height and ground model

- Inaccessible beaches, cliffs, tidal inlets

  Combination LIDAR and aerial survey

- Baseline orthophoto survey whole region
- Baseline bathymetric survey across whole region

Regular surveys

Topographic

- Land survey (beaches) profiles
  - Over 8000 profile locations regularly surveyed
  - frequency varies 1-2 times per year
    - additional provision for post storm surveys
  - spacing varies from 100m-500m

Post storm surveys

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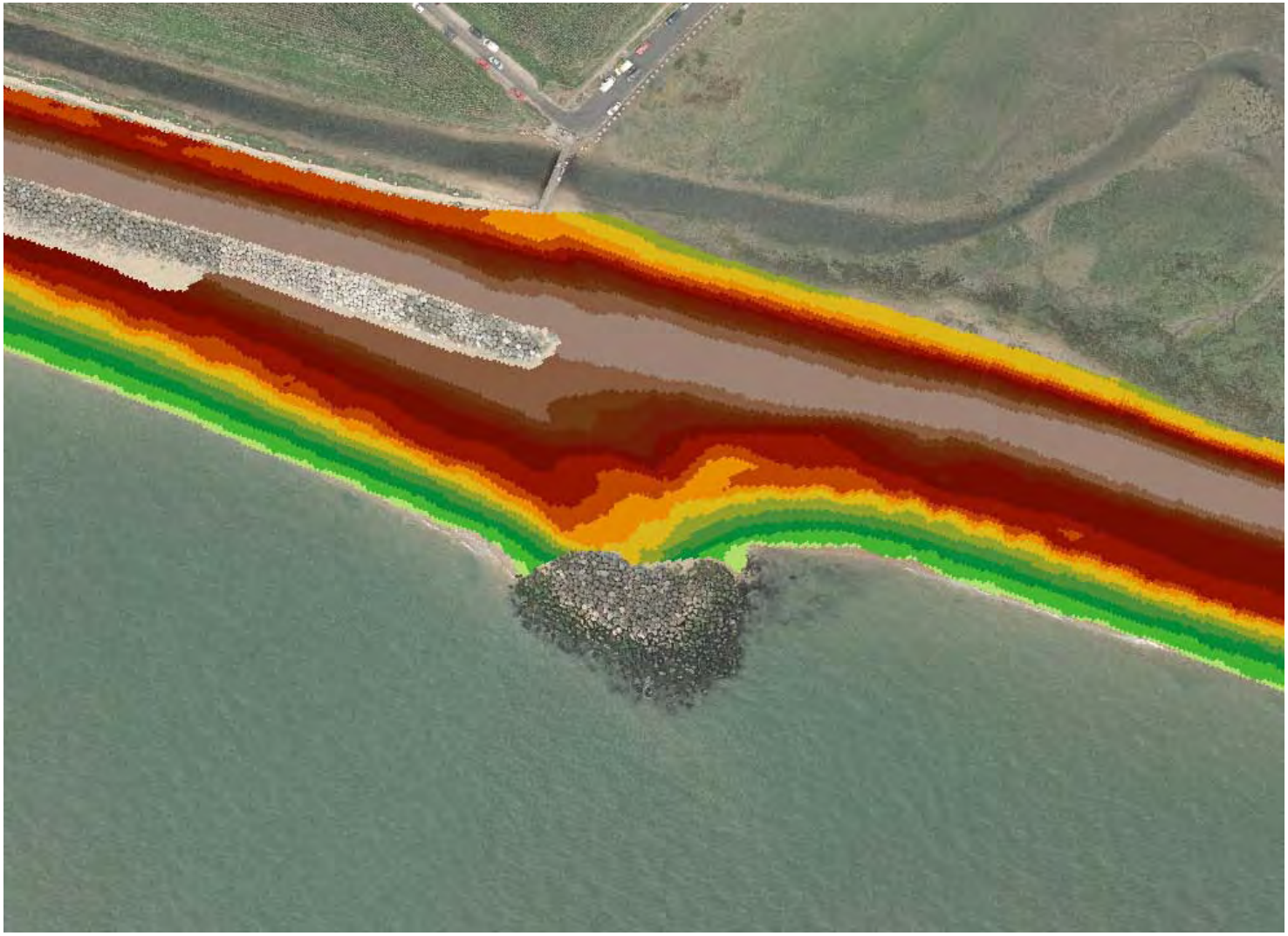
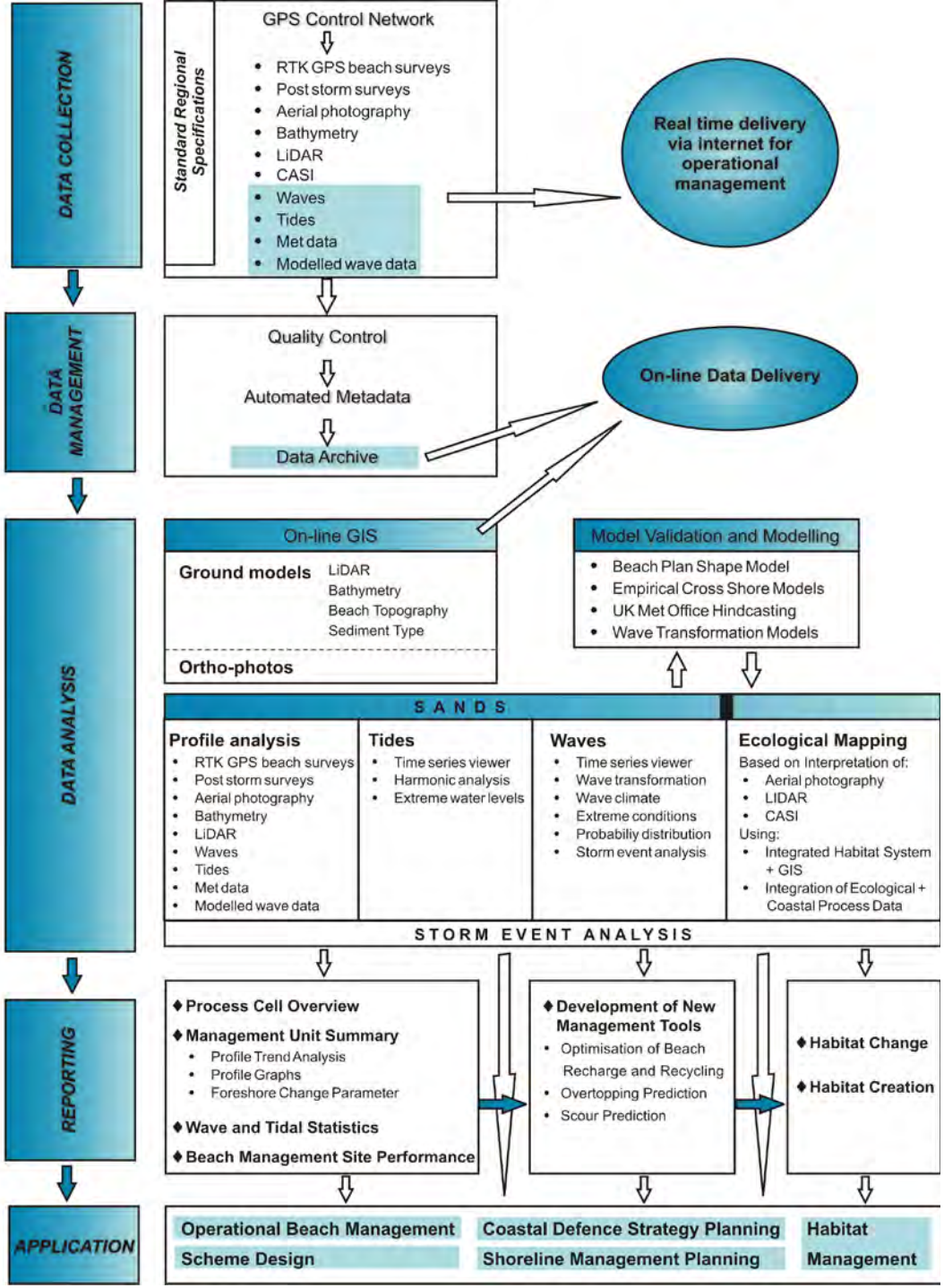
Beach management plan sites



Dense spot height surveys
and ground models



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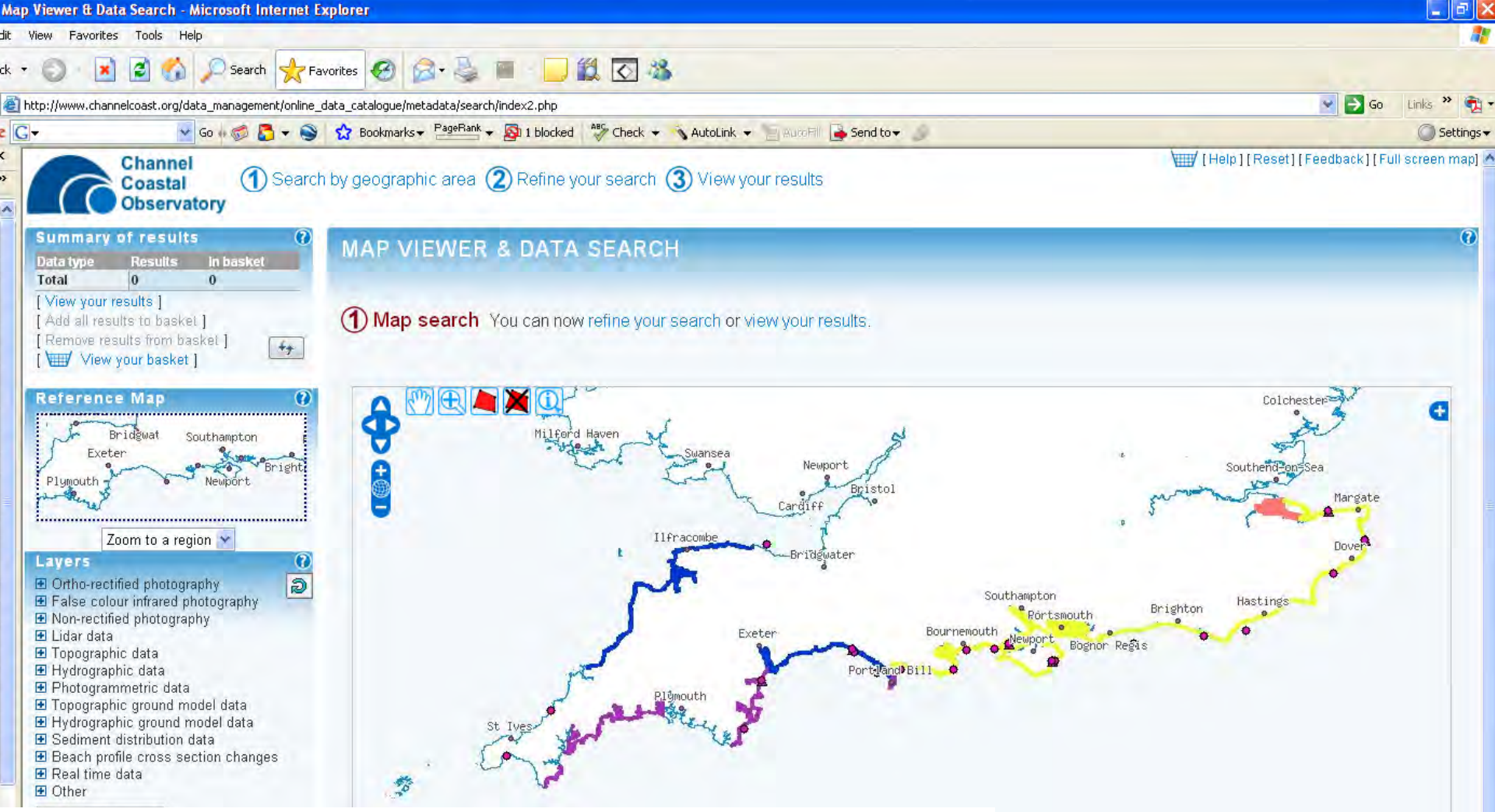

- *Online GIS data viewer*
  - *Real time wave and tide data*
  - *High resolution data*
    - *orthophotos (0.1m)*
    - *on the fly ground models (0.5m LIDAR)*
    - *Multibeam bathy – coming soon*
  - *Multiple data sets*
  - *FGDC metadata*
  - *All data available for download*

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DUAL MAP VIEWER

Zoom to a region

- Photogrammetric data
- Topographic ground model data
- Hydrographic ground model data
- Sediment distribution data
- Beach profile cross section changes
- Real time data
  - *Wave buoys*
  - *Tide gauges*
- Other

- Ortho-rectified photography
  - *2007*
  - *2006*
  - *2005*
  - *2003*
  - *2002*
  - *2001*
- False colour infrared photography
- Non-rectified photography
- Lidar data

- Photogrammetric data
- Topographic ground model data
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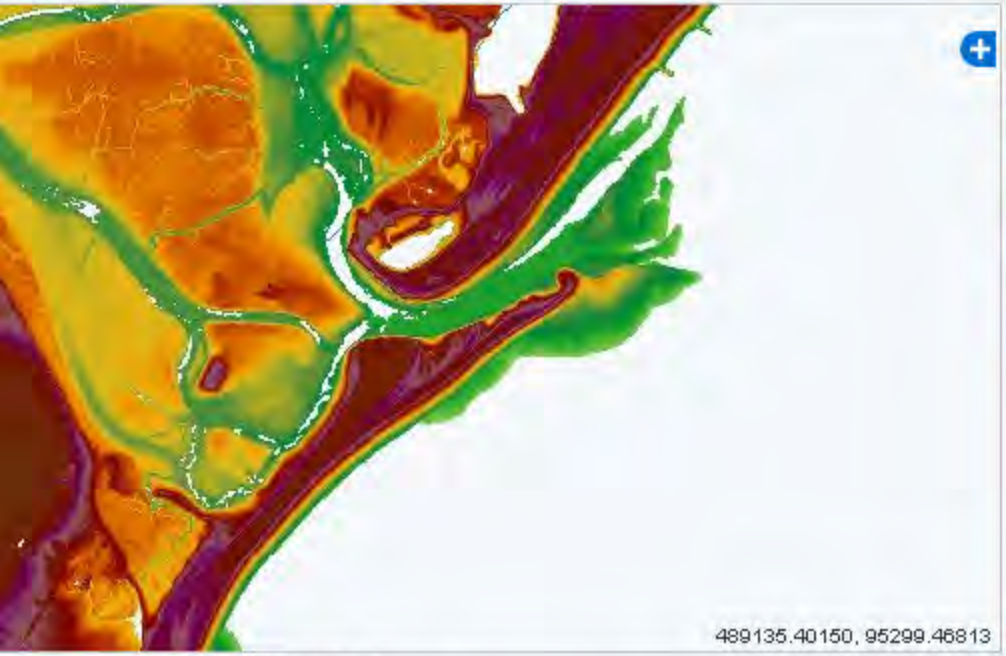
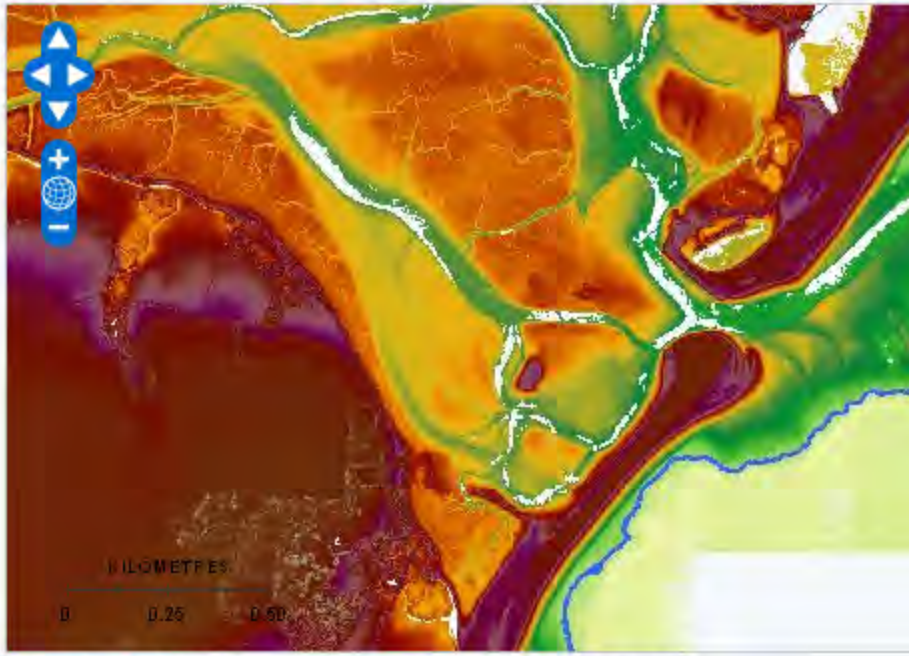
DUAL MAP VIEWER

Zoom to a region





- Photogrammetric data
- Topographic ground model data
- Hydrographic ground model data
- Sediment distribution data
- Beach profile cross section changes
- Real time data
  - *Wave buoys*
  - *Tide gauges*
- Other

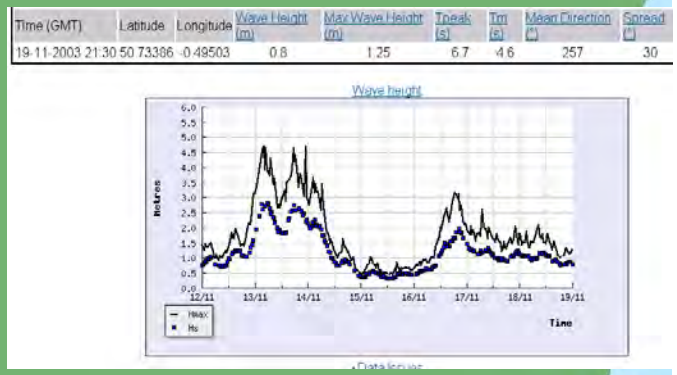
- Ortho-rectified photography
- False colour infrared photography
- Non-rectified photography
- Lidar data
  - *2008*
  - *2007*
  - *2006*
  - *2005*
  - *2004*

Elevation (meters OD)

75.0+

- Photogrammetric data
- Topographic ground model data
- Hydrographic ground model data
- Sediment distribution data
- Beach profile cross section changes
- Real time data
  - *Wave buoys*
  - *Tide gauges*
- Other

- *Low spatial resolution*
  - *Point data*
- *High frequency*
  - *Real time*



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

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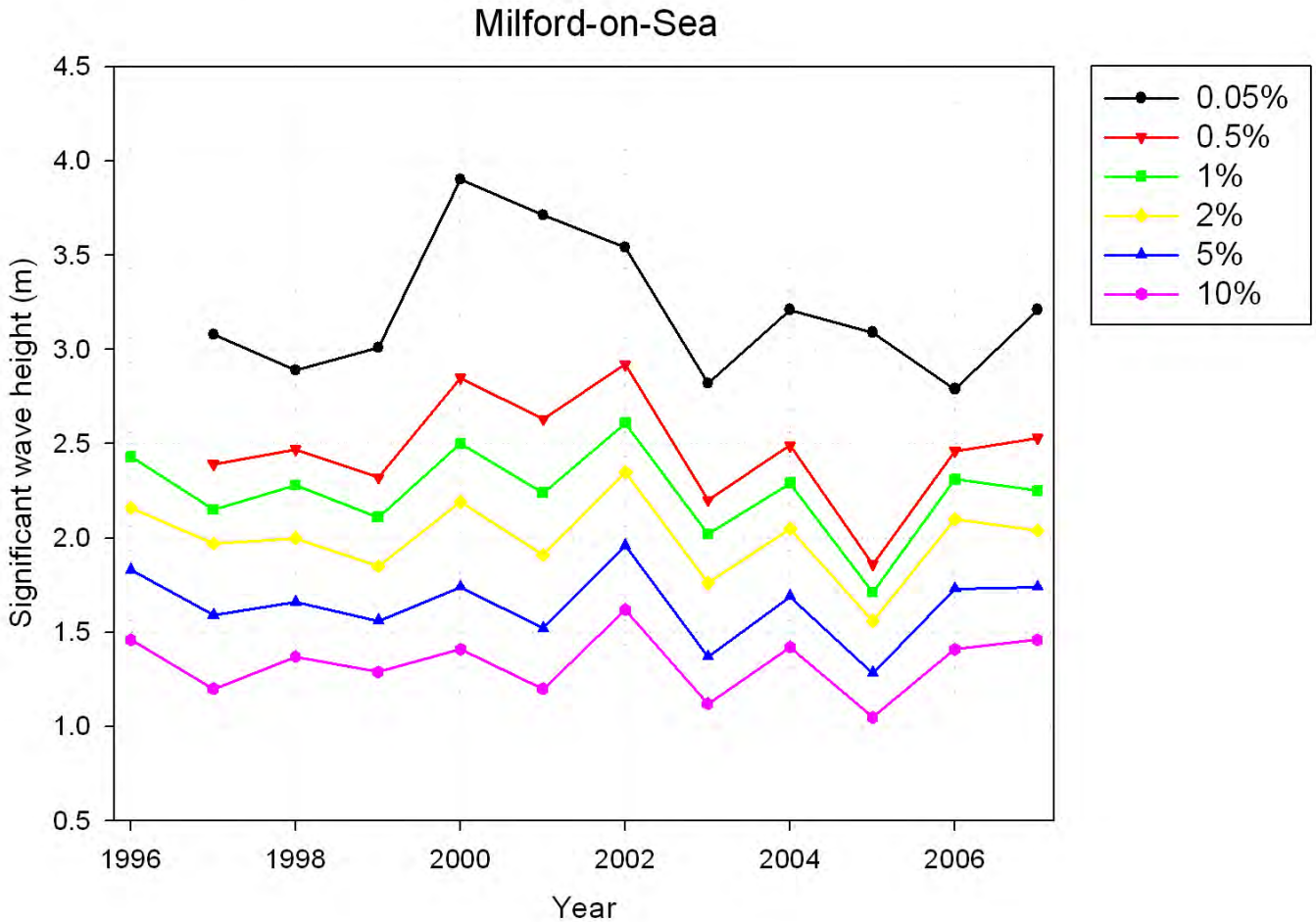
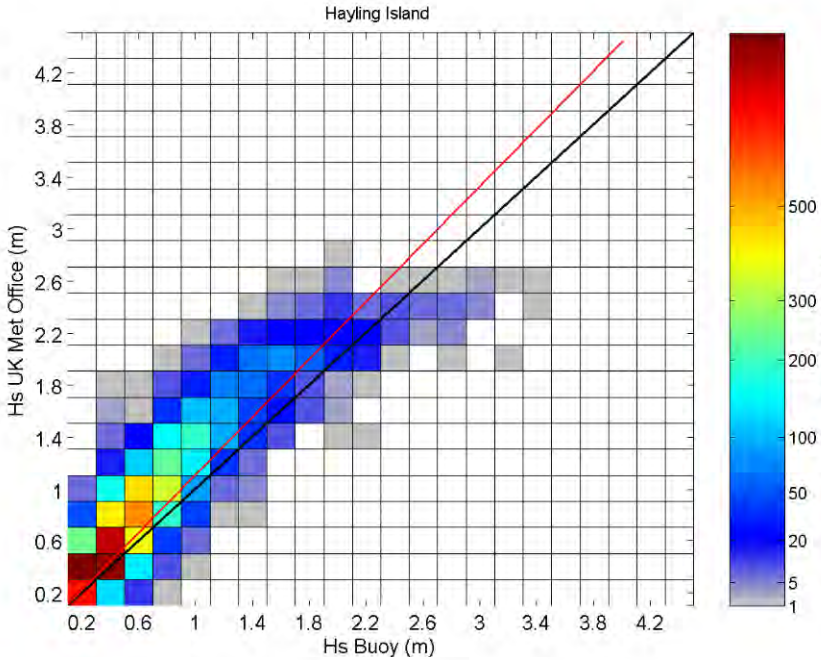
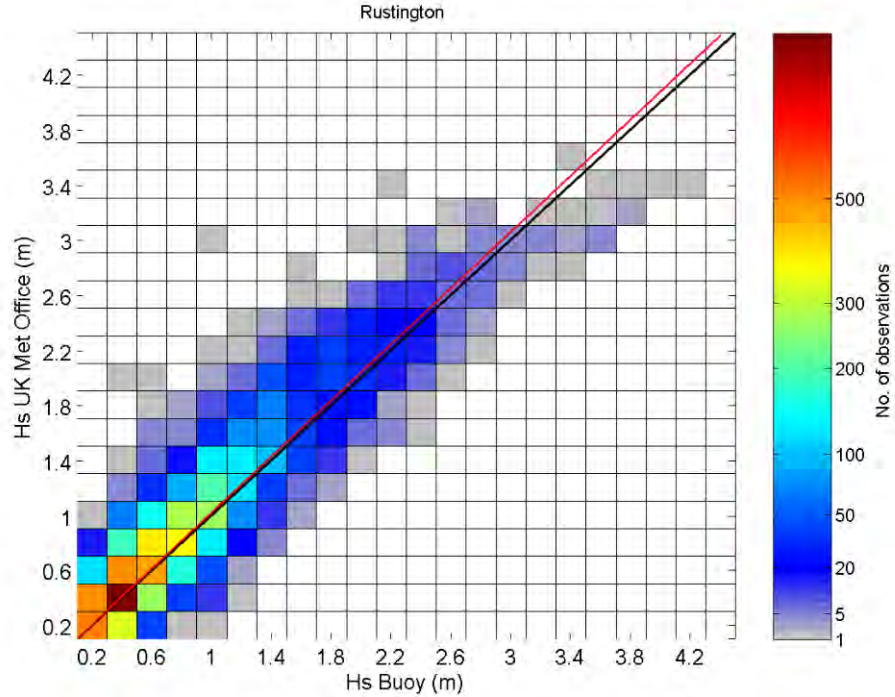
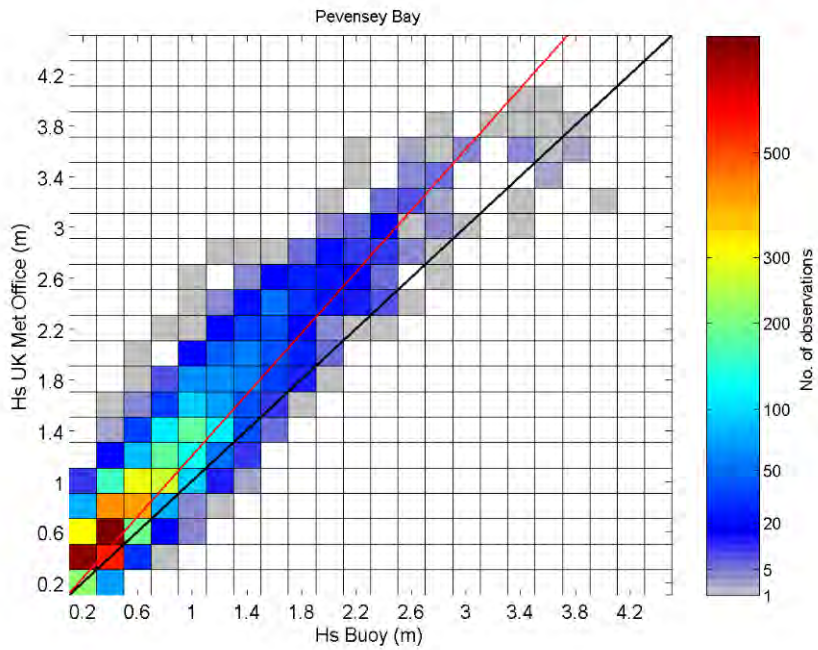
- *Long time series*
- *Probability distributions*
- *Extreme events*









Direct Hindcast to buoy site

(H_s)

Regional trends

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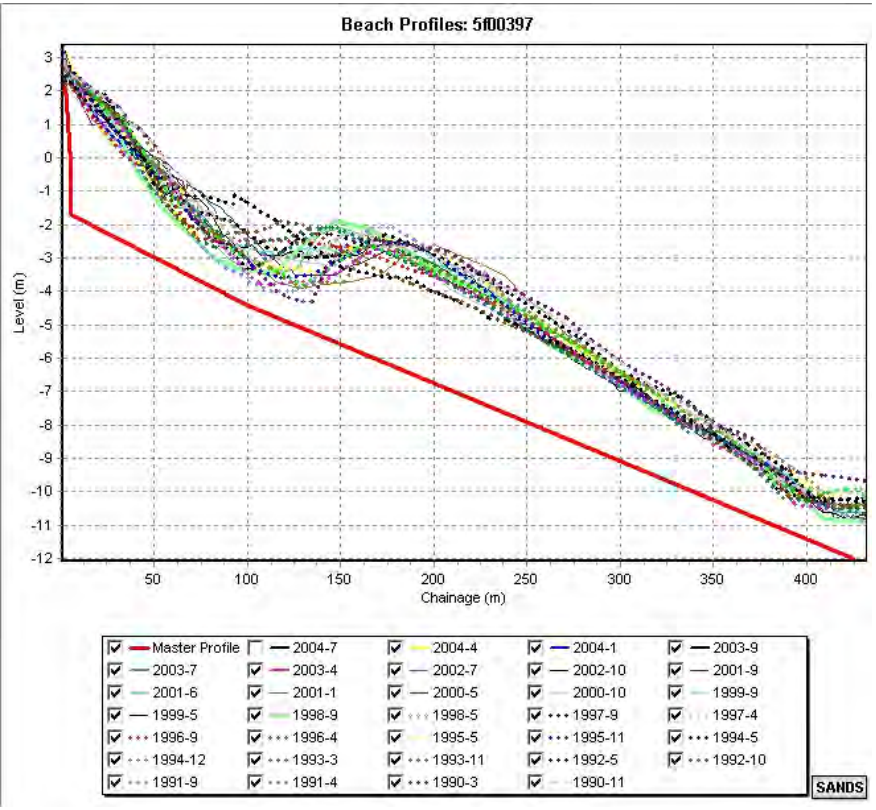
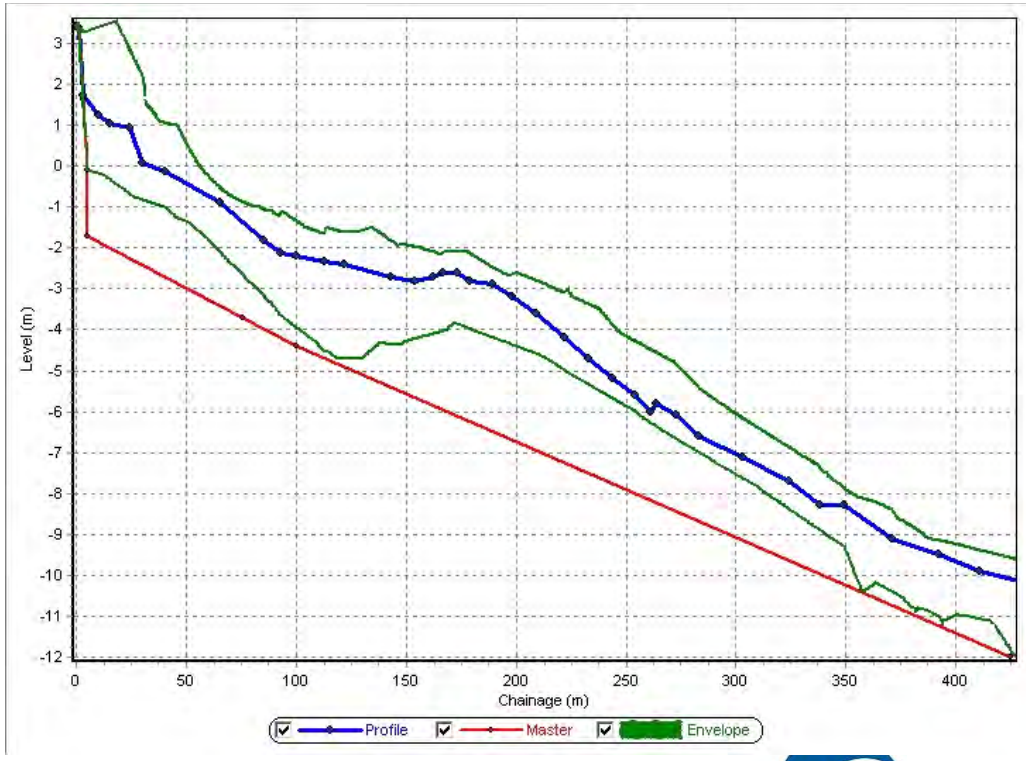
Individual profile scale

master profiles, mean profiles and envelope





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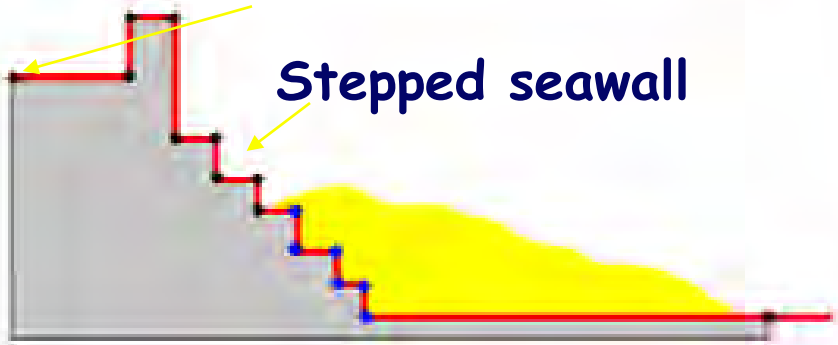
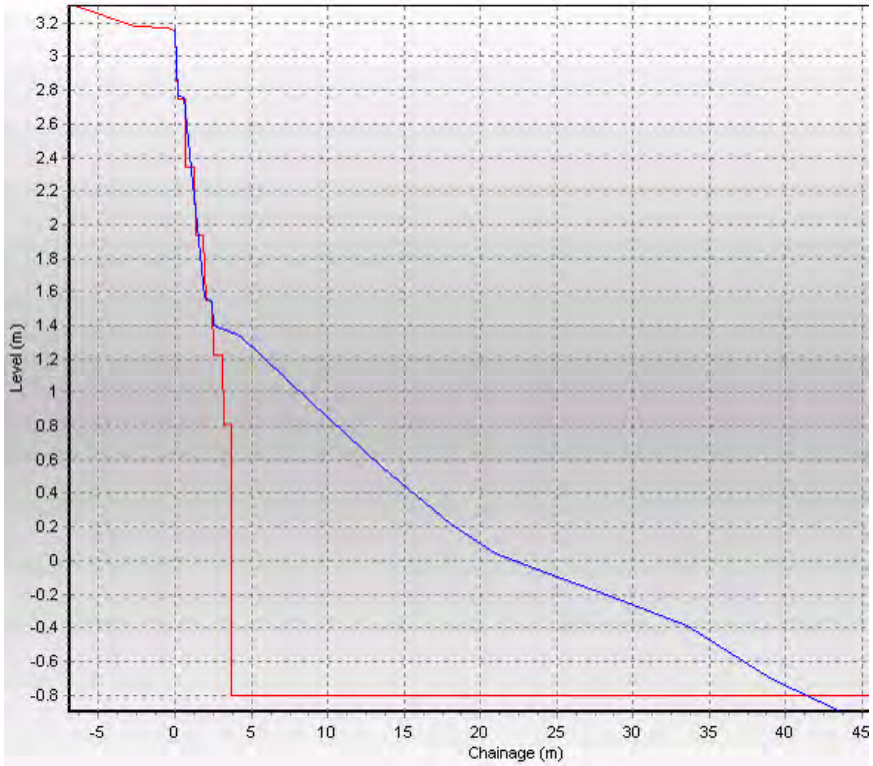
Many complex situations encountered on profiles and approx 8,000 profile locations in programme

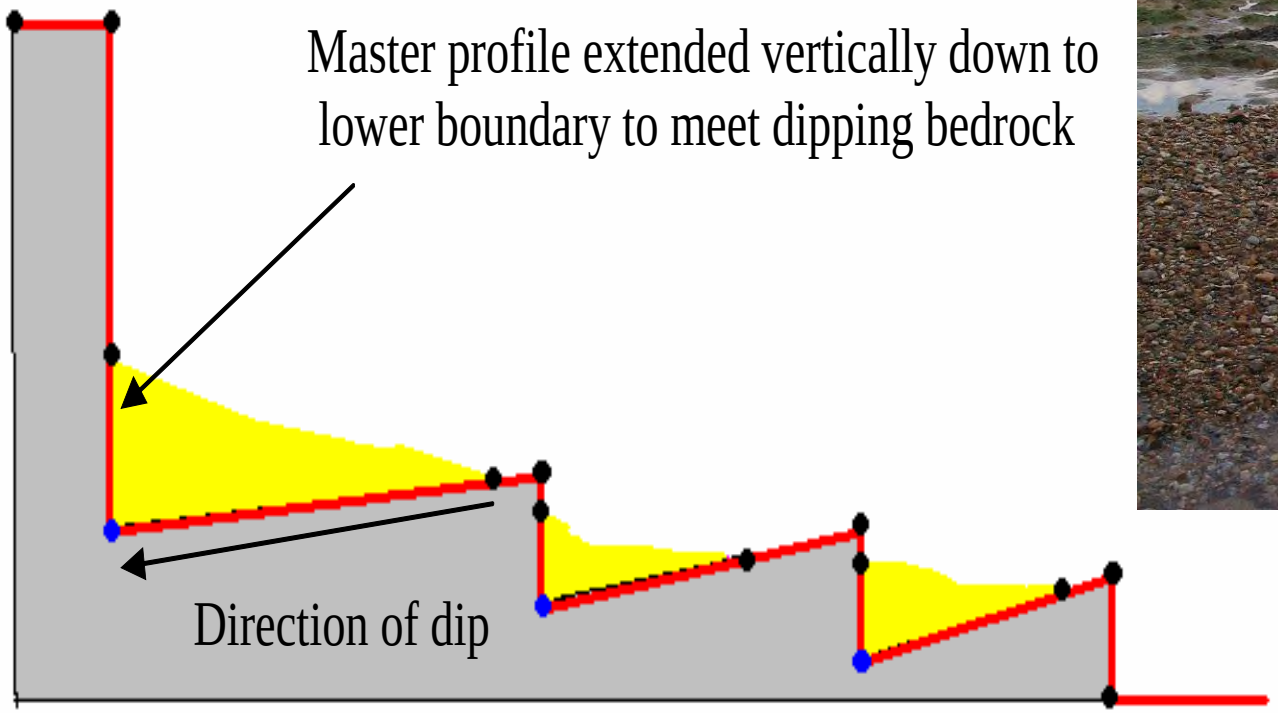
Designing master profiles

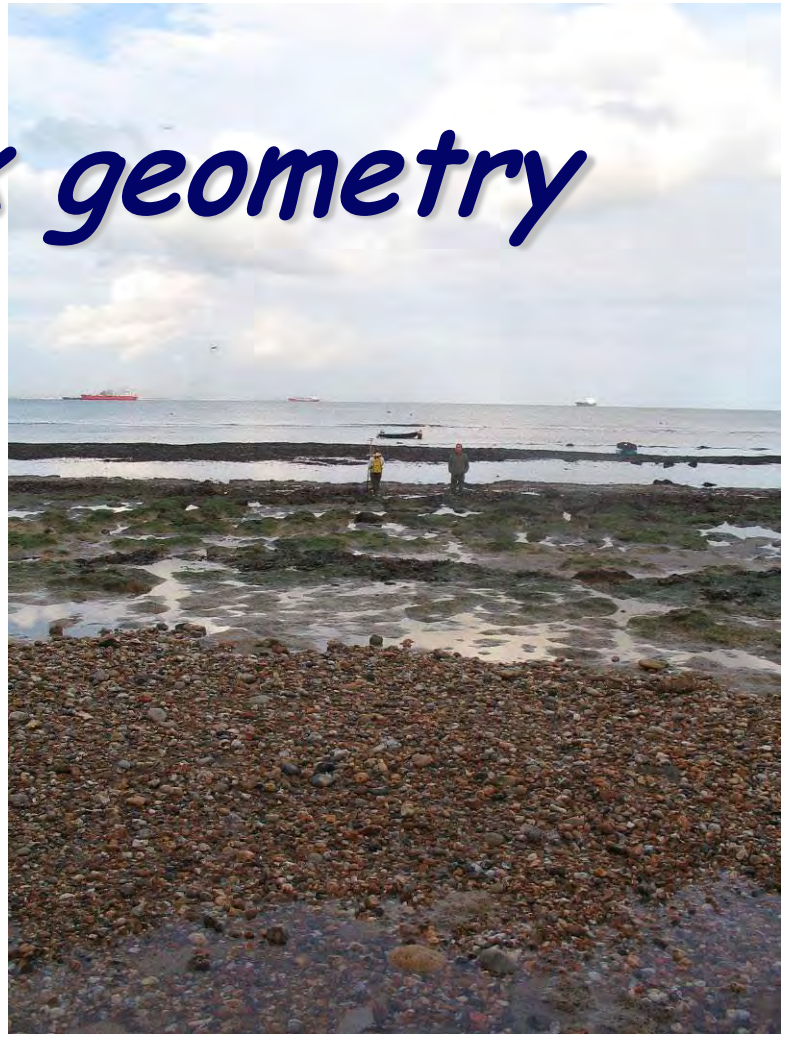
Constrained profiles





Varied bed rock geometry





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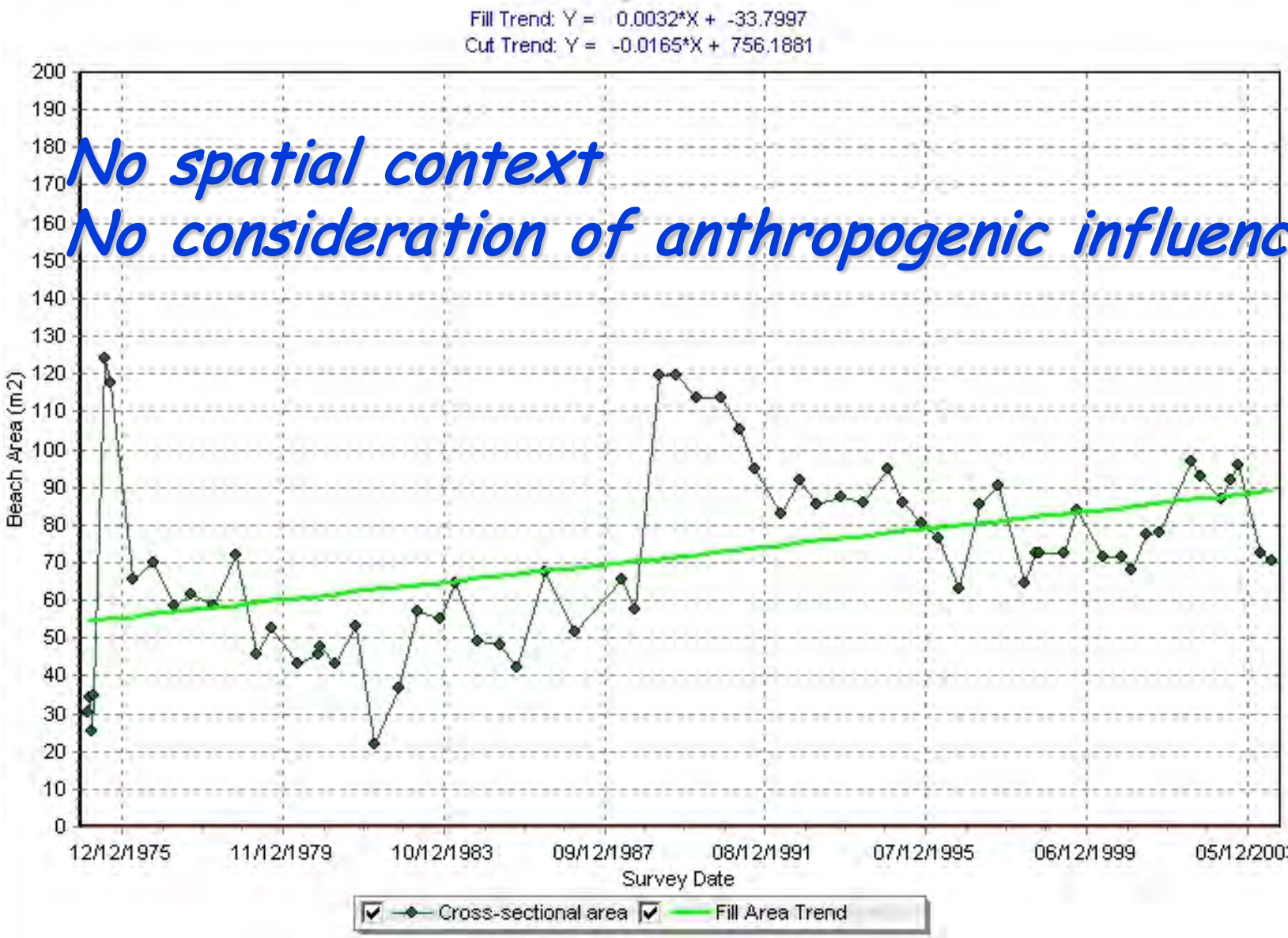
Individual profile scale

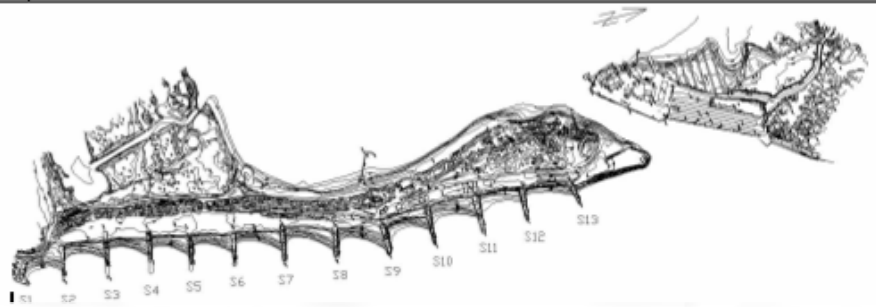


No spatial context

No consideration of anthropogenic influence

Beach management impacts

Form Code:	RECYCLING LOG – Deposition Site



DATE:	LOGGED BY:	WORKS CODE: Mudeford Sandbank Beach Nourishment
10th March 2004	Martin Ruffle, Raymond Brown Plant Hire	

NOTES: *e.g. Weather conditions, post emergency works, date of storm, scheme maintenance etc.*
Annual beach nourishment work carried out as part of the Beach Nourishment Plan for Mudeford Sandbank. Barometric pressure 1035 bar, extraction took place approx 150m east of the distal end.

FRONTAGE DESCRIPTION BEFORE MATERIAL PLACEMENT:
i.e. Seawall Exposed, Berm Width = 2m etc.
Beach volumes reduced within inter-tidal zone leaving a vertical face between 0.5m and 1.0m up to crest level.

FRONTAGE DESCRIPTION AFTER MATERIAL PLACEMENT:
i.e. Material Profiled; crest height, berm width, profile gradient, Back Tipped etc
Material back tipped and graded off to gradual beach profile. Crest levels maintained.

MATERIAL PLACED BETWEEN		QUANTITY OF MATERIAL		MATERIAL DESCRIPTION *e.g Shingle/Sand/Mixed*
Profile/Groyne Number *	To Profile/Groyne	Lorry Capacity (tonnes or m³)	Number of Lorry Loads	
S1	S2	Average 10cum	7	Mixed shingle and sand
S2	S3	"	28	" " " "

** Areas can be defined using ABMS Profile numbers (see map), Groyne numbers, descriptions, and/or drawn on the map*

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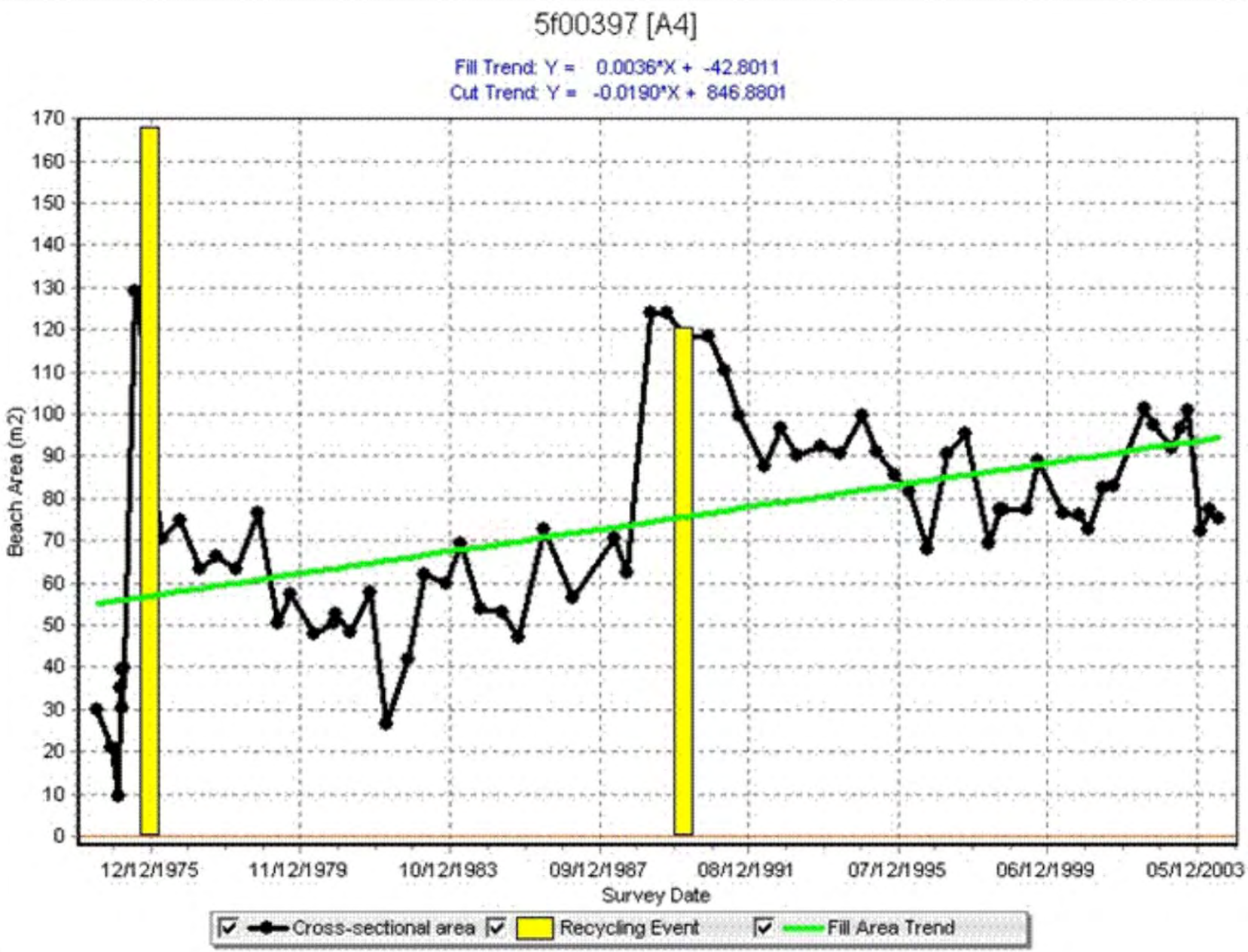
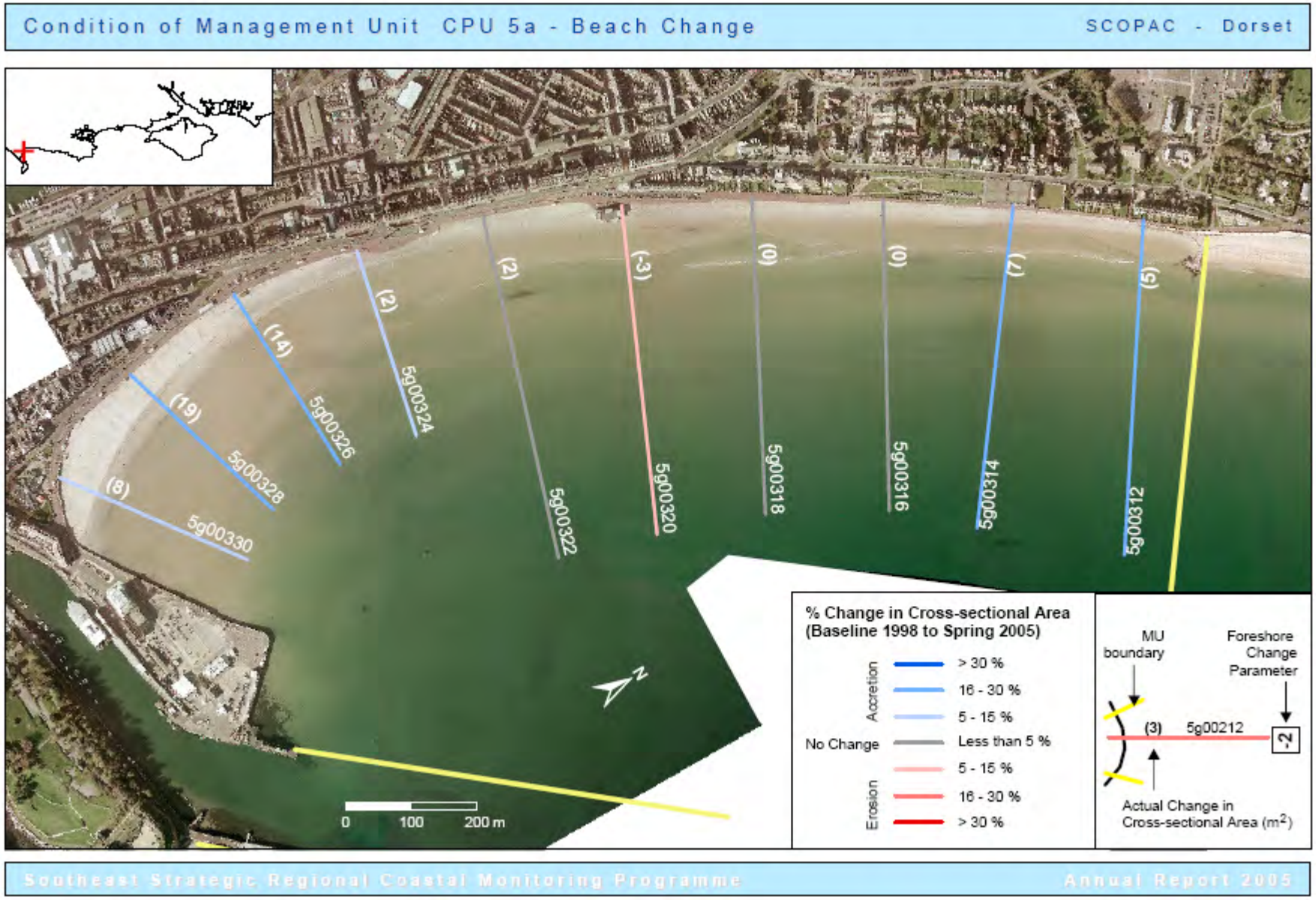
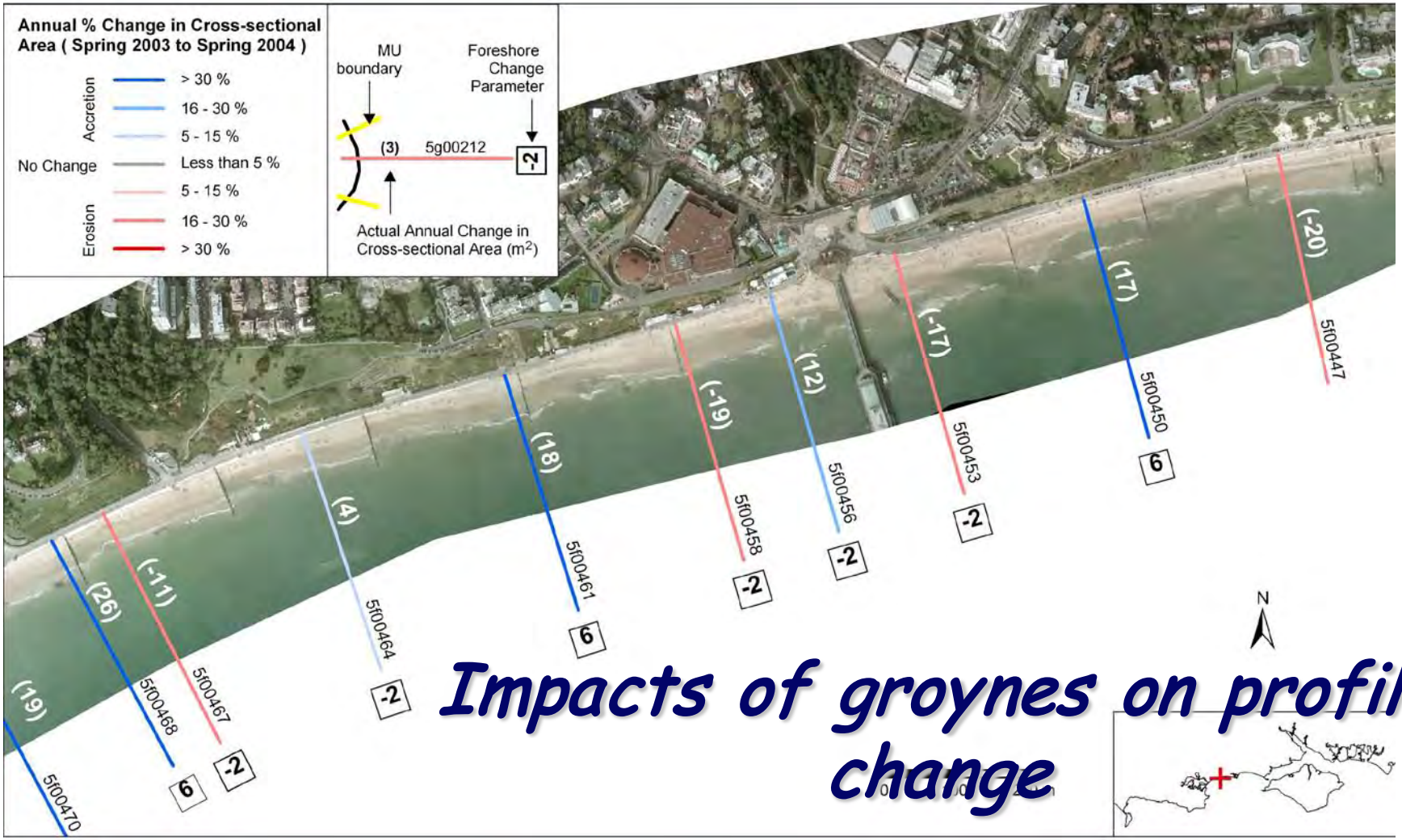
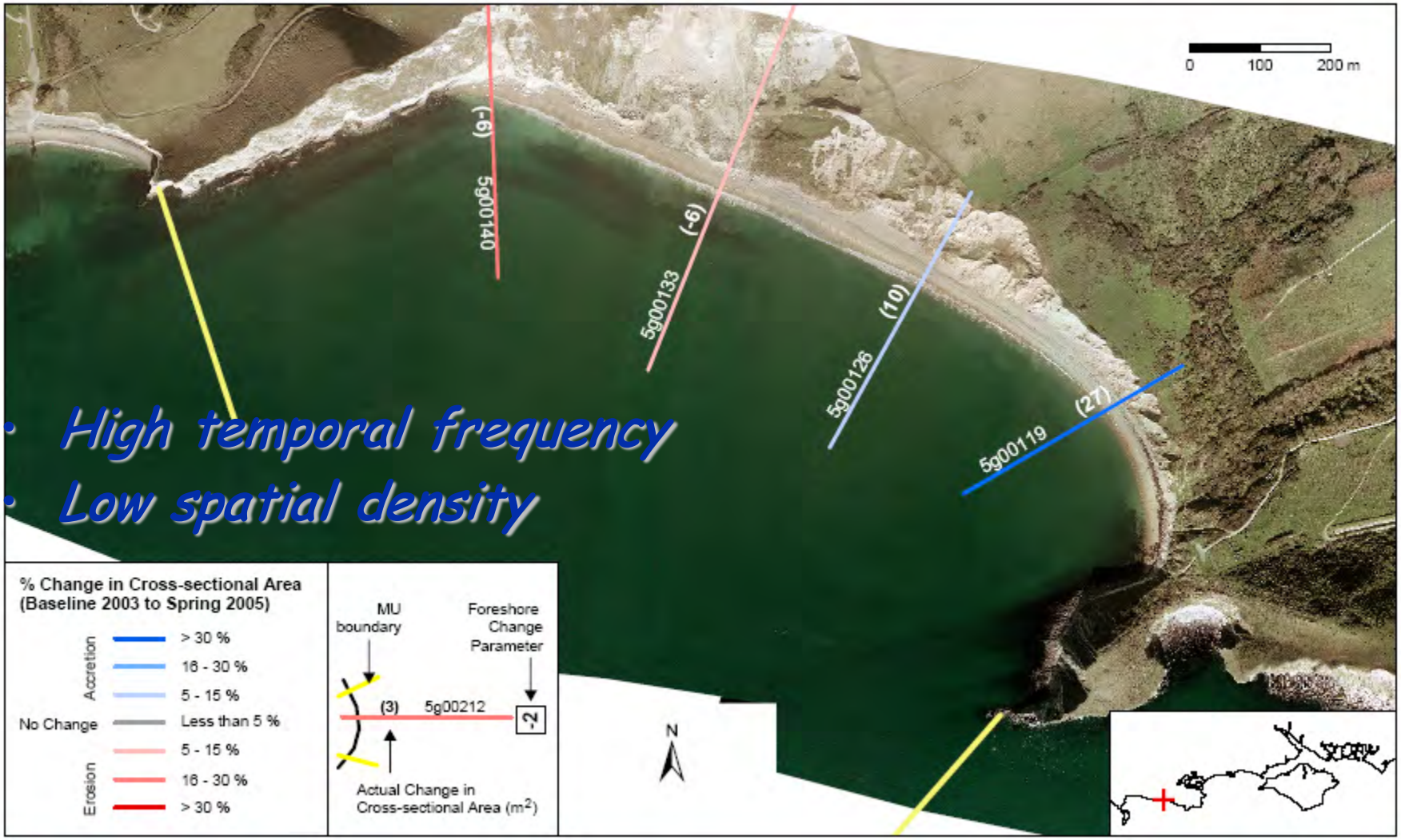

5f00397 [A4]
Fill Trend: Y = 0.0036*X + -42.8011
Cut Trend: Y = -0.0190*X + 846.8801
Beach Area (m2)
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
12/12/1975
11/12/1979
10/12/1983
09/12/1987
08/12/1991
07/12/1995
06/12/1999
05/12/2003
Survey Date
Cross-sectional area
Recycling Event
Fill Area Trend



- *Aggregation to management unit scale*

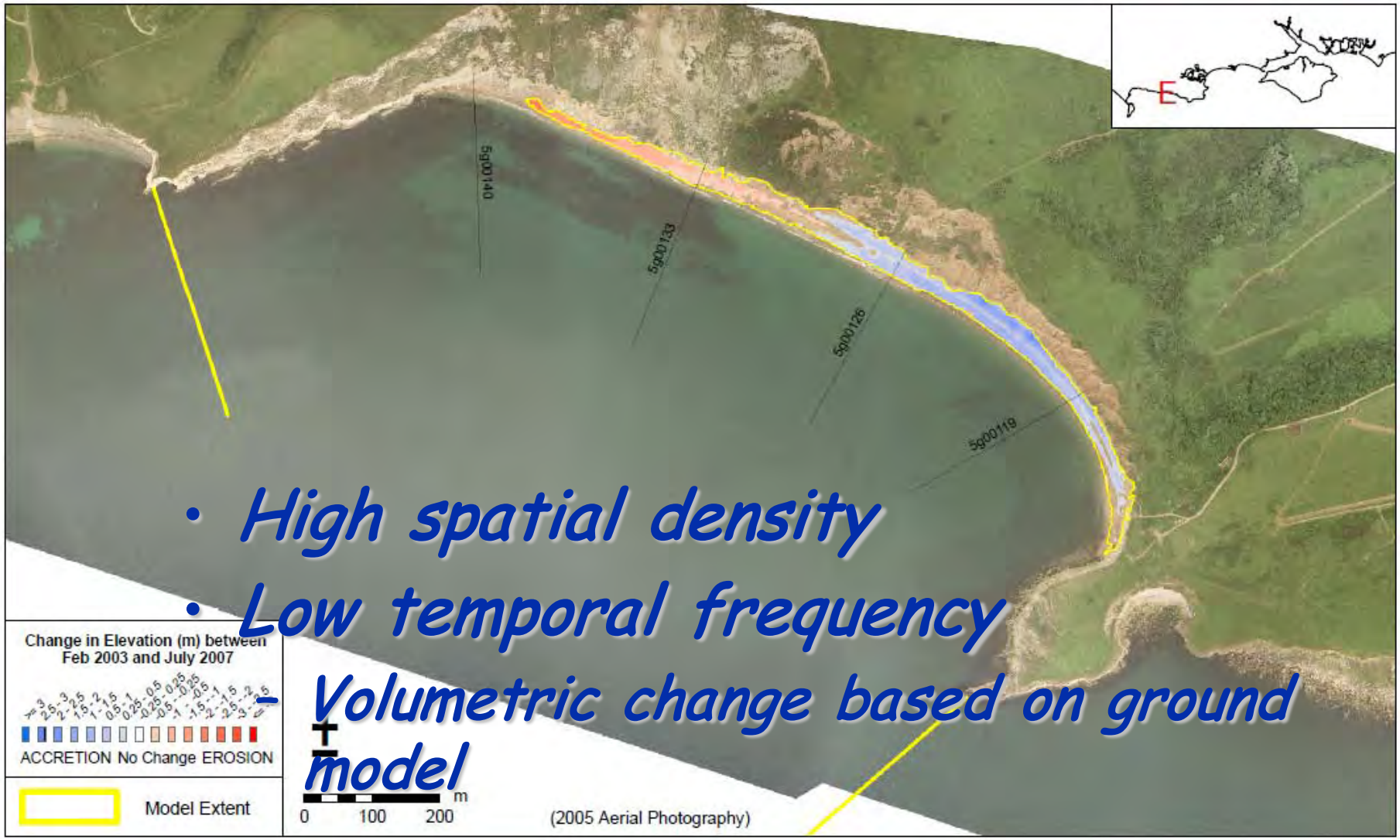


Impacts of groynes on profile change

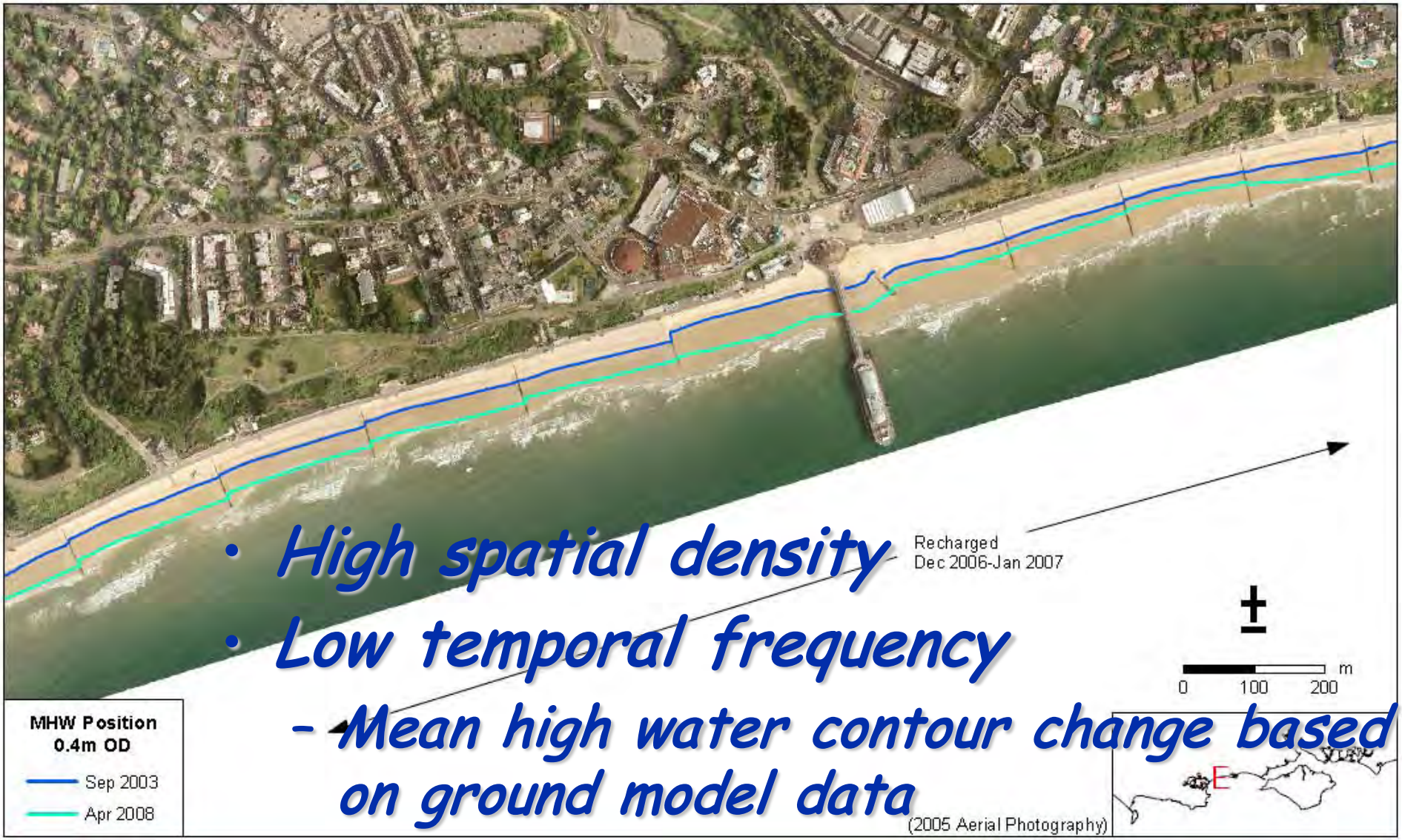


- *High temporal frequency*
- *Low spatial density*

Management unit scale



- *High spatial density*
- *Low temporal frequency*
- *Volumetric change based on ground model*



- *High spatial density*
- *Low temporal frequency*
  - *Mean high water contour change based on ground model data*

- *Aggregation to management unit scale*
- *Annual temporal scale*

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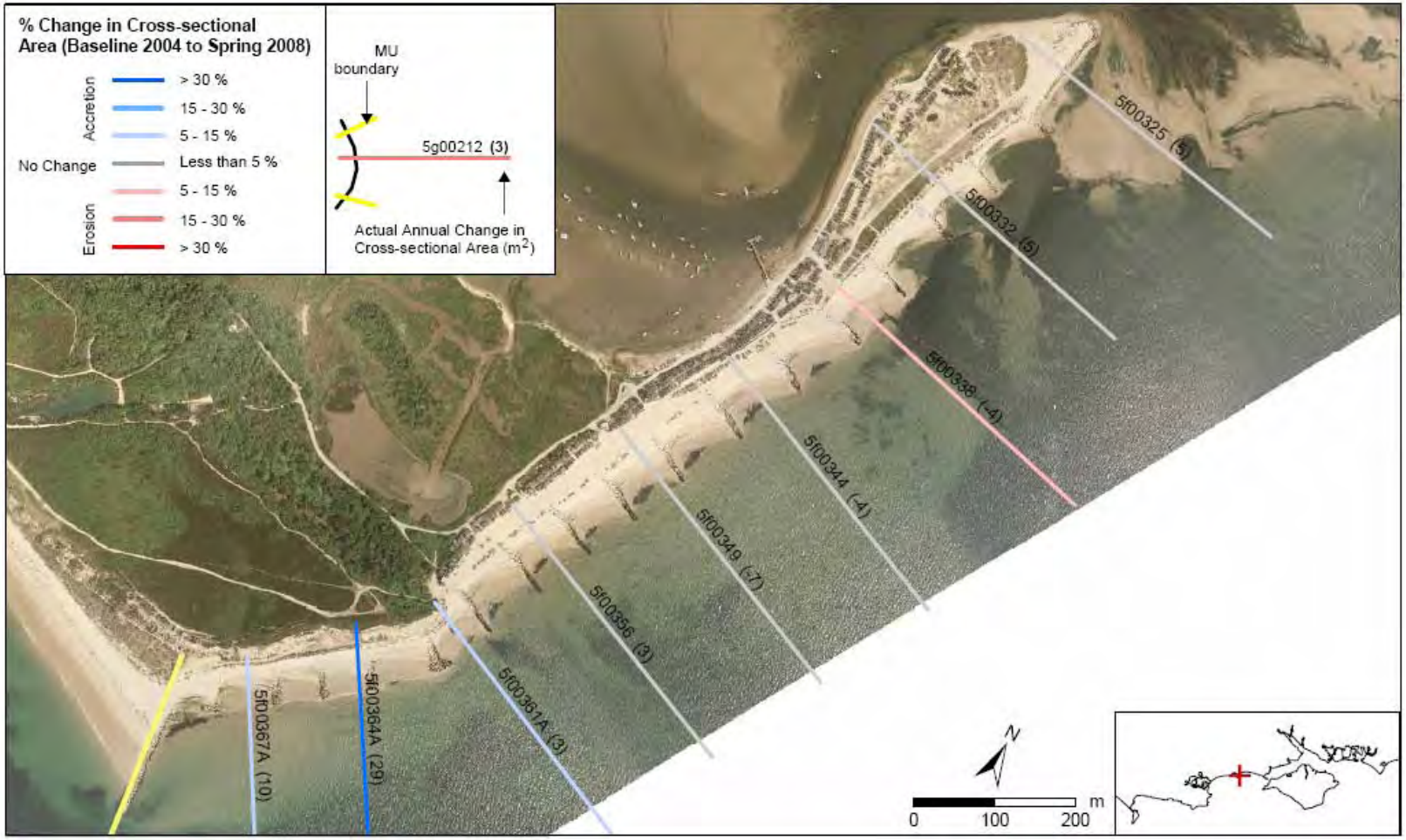
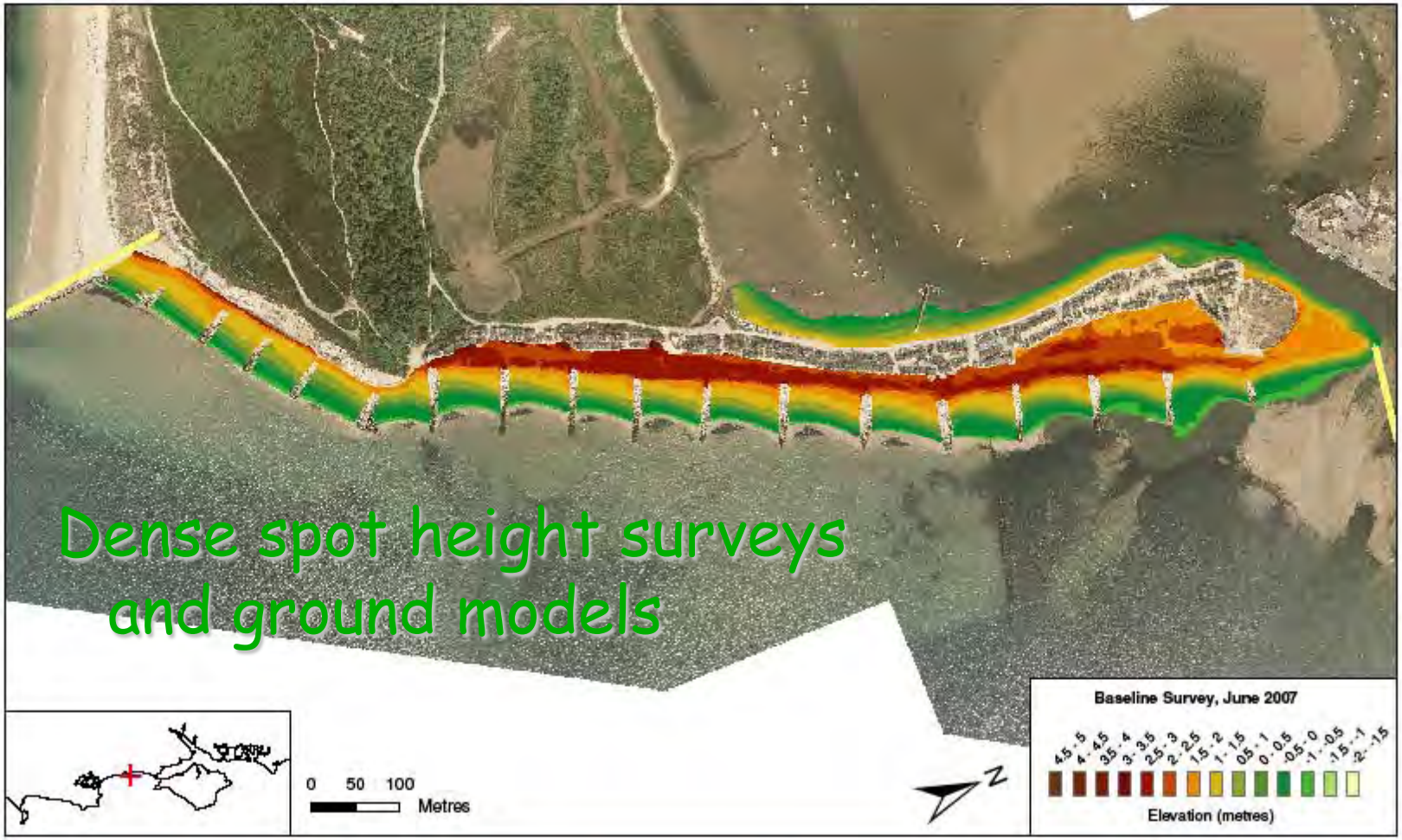


- *Aggregation to management unit scale*
- *Cumulative temporal scale*

Beach management plan sites

Figure 4.5 - Digital Terrain Model of Topographic Baseline Survey SCOPAC - Mudeford Sandbank



Southeast Strategic Regional Coastal Monitoring Programme BMP Site Maps

Annual change analysis based on DEM

- *Annual change analysis based on DEM*

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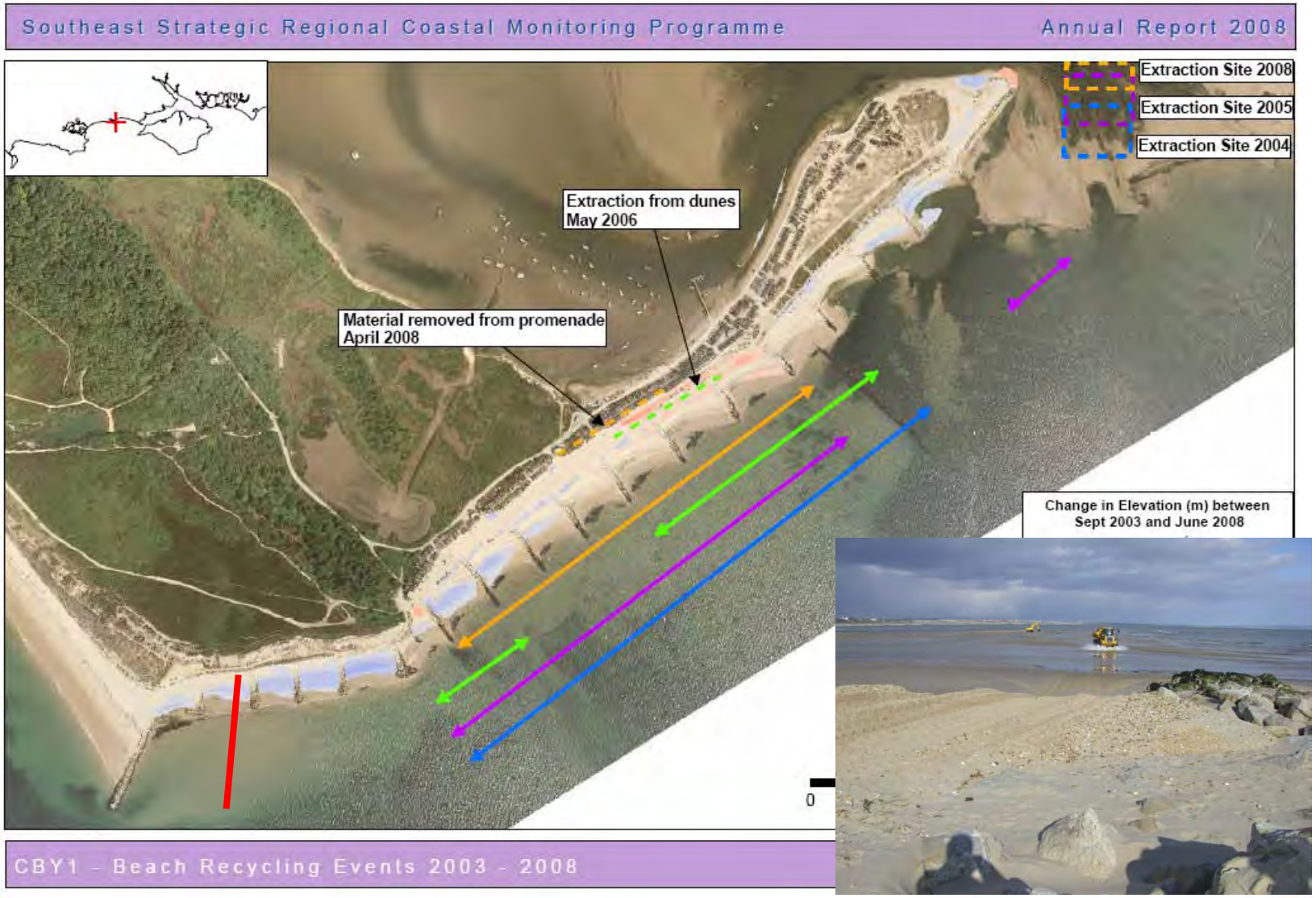
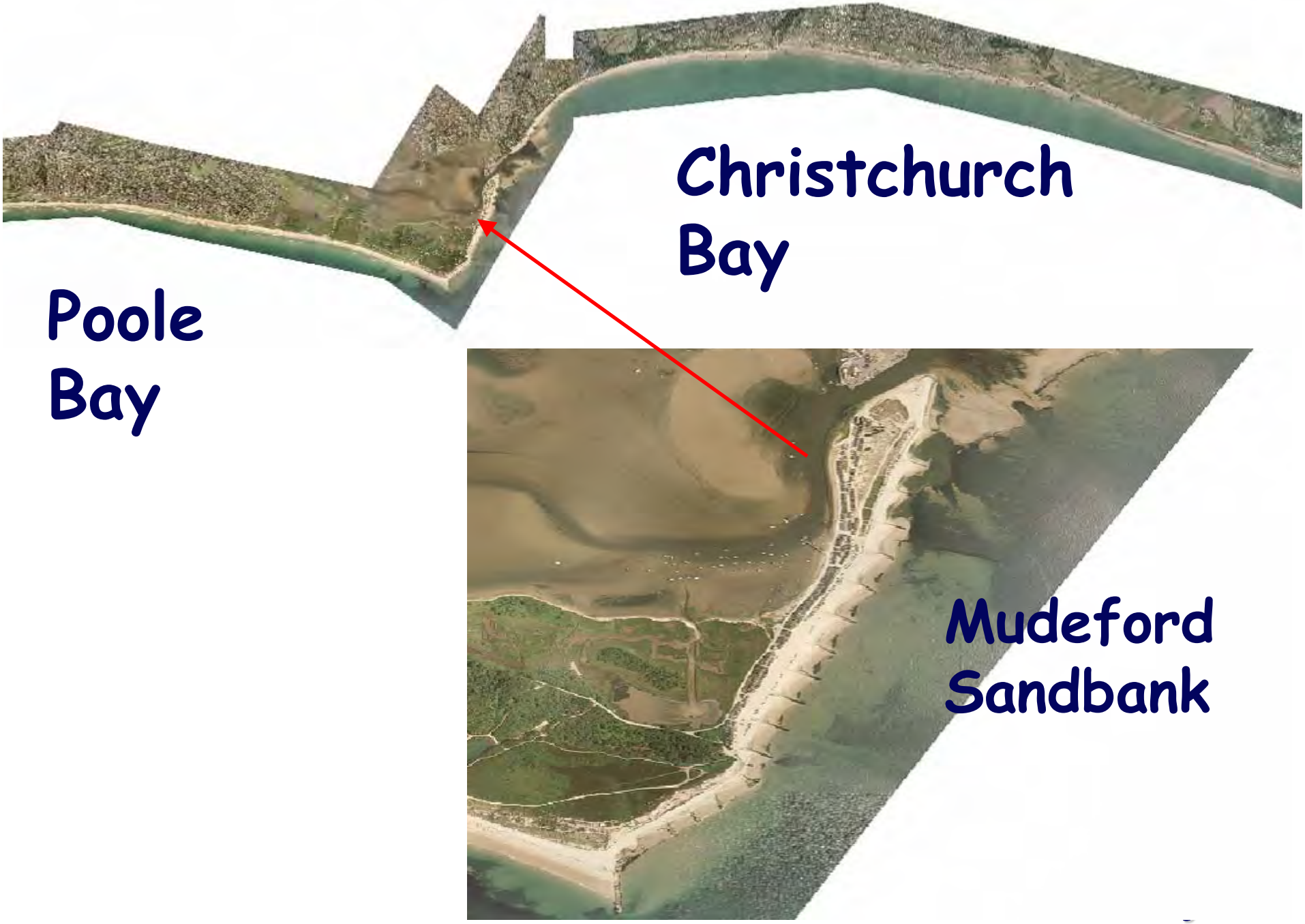
- *Annual change analysis based on DEM*

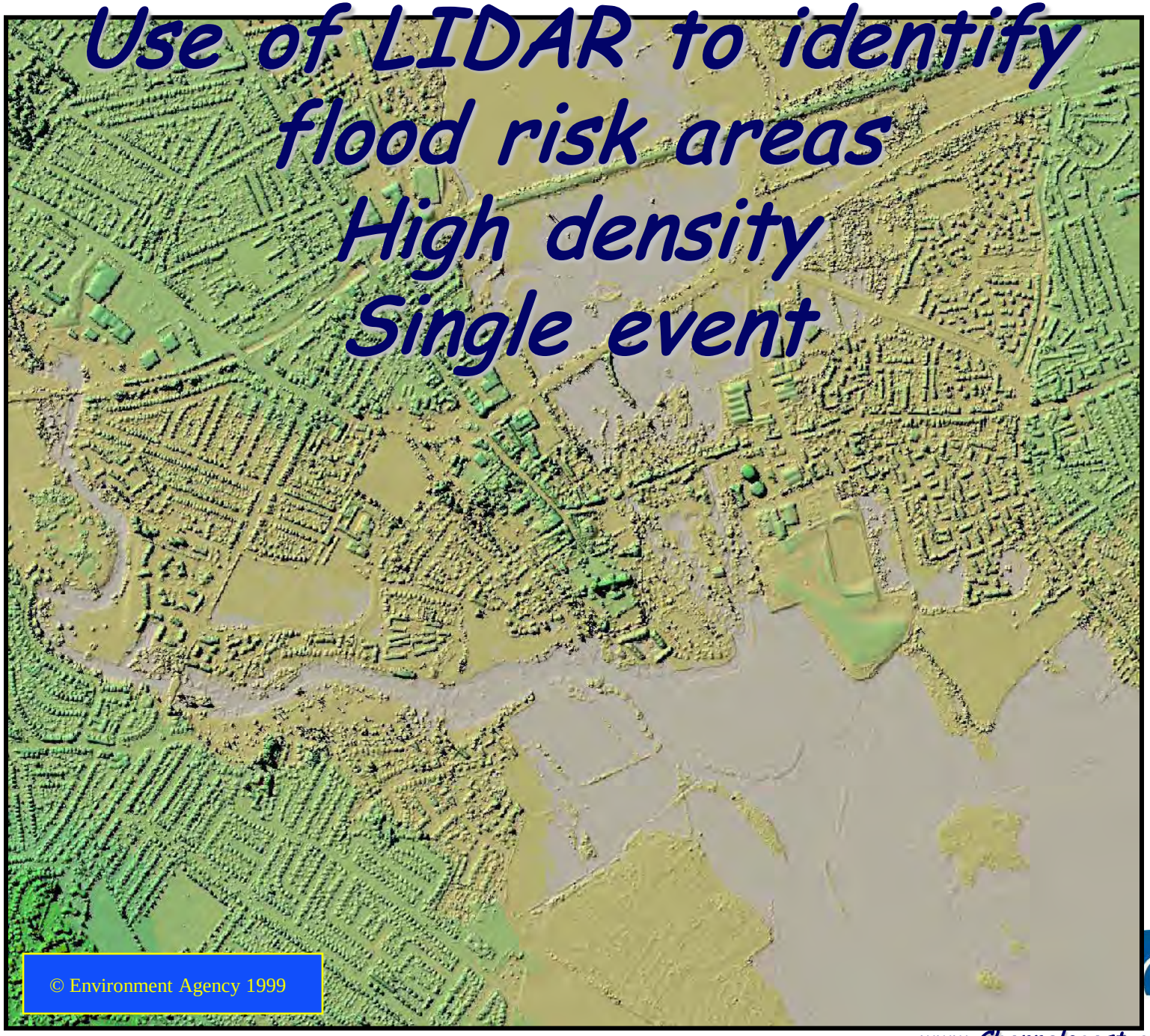


- ***Management activity log***

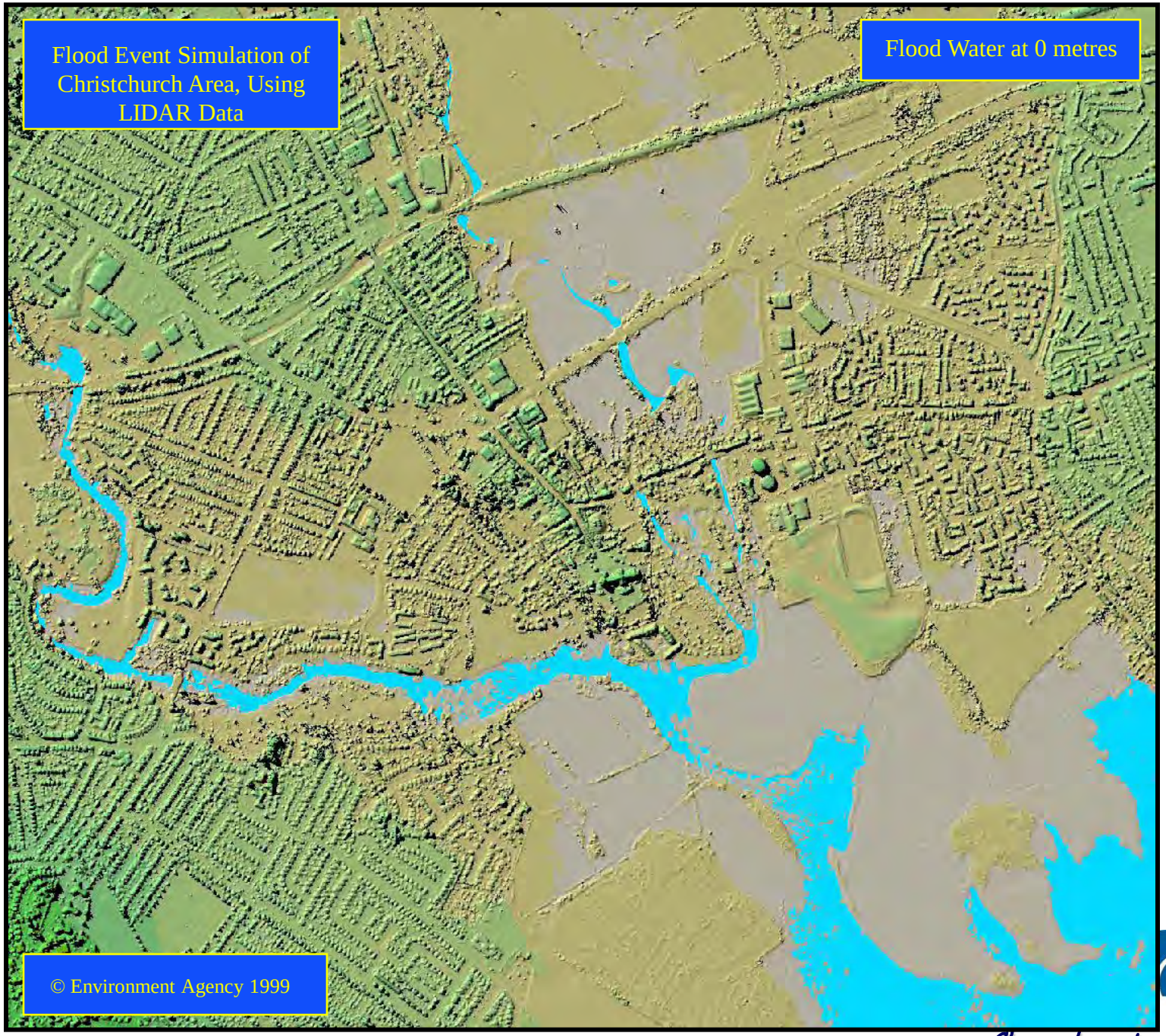

Christchurch
Bay
Poole
Bay
Mudeford
Sandbank

- *Impacts adjacent frontage*

Use of LIDAR to identify flood risk areas
High density
Single event



© Environment Agency 1999



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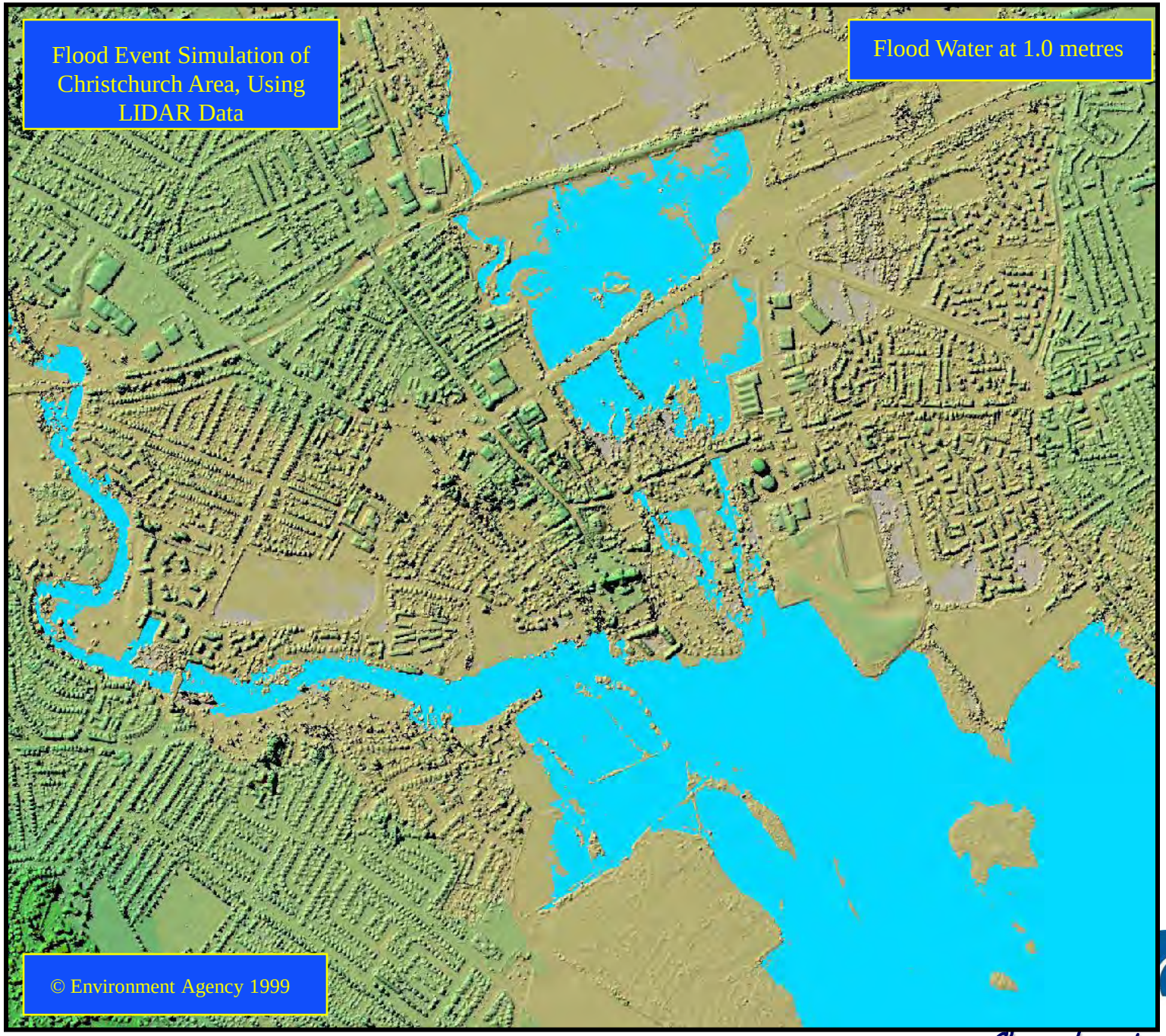

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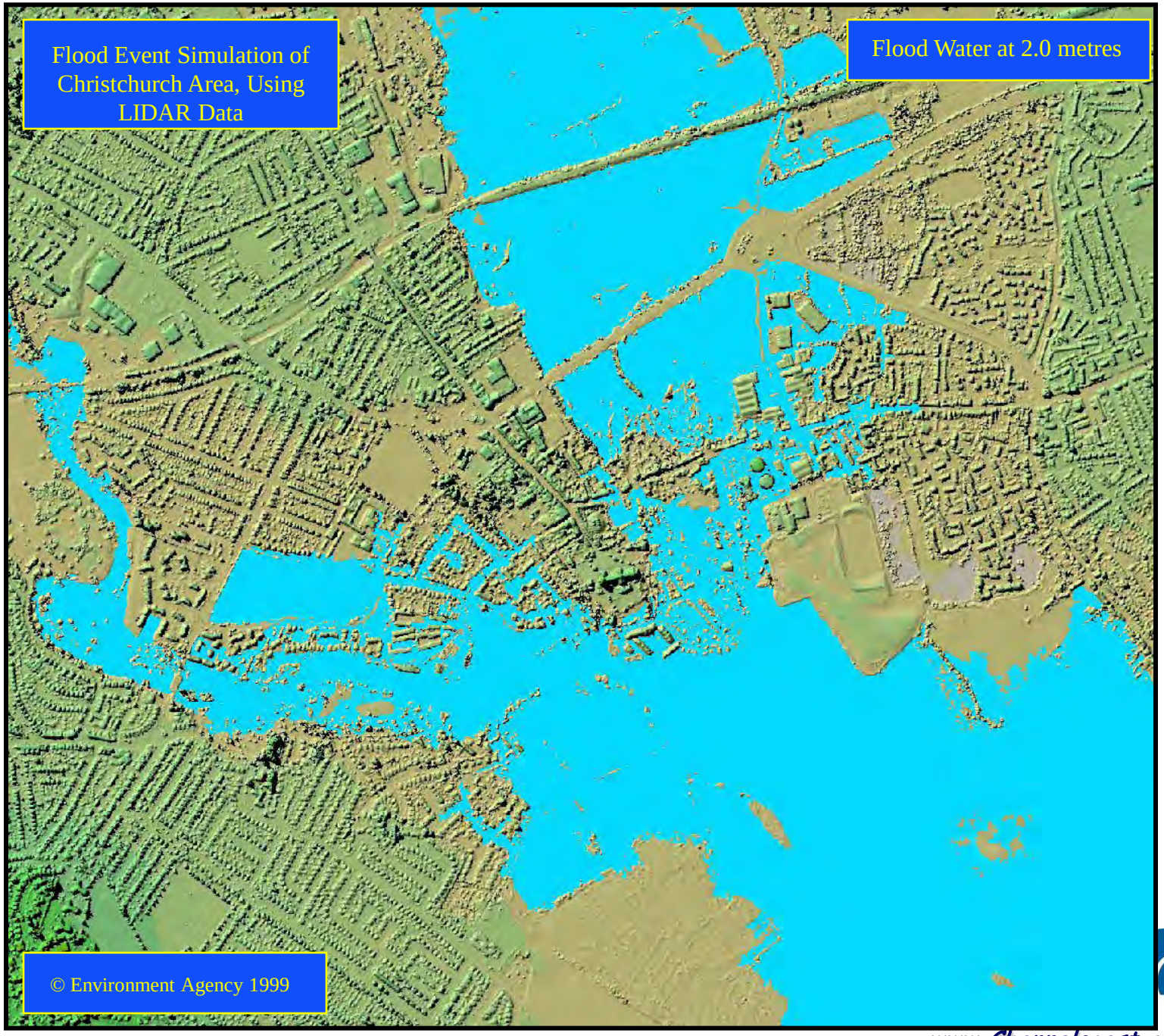

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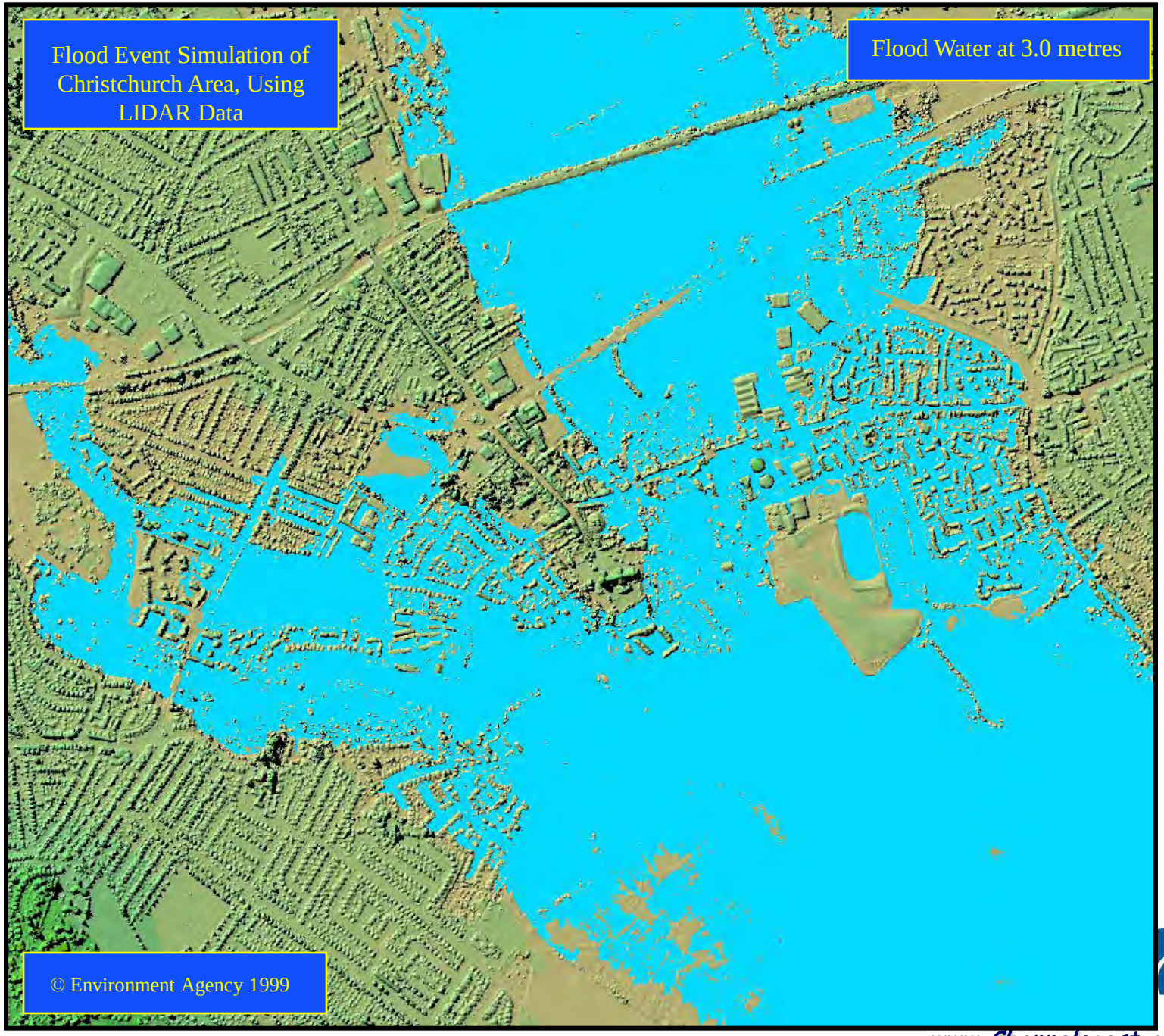

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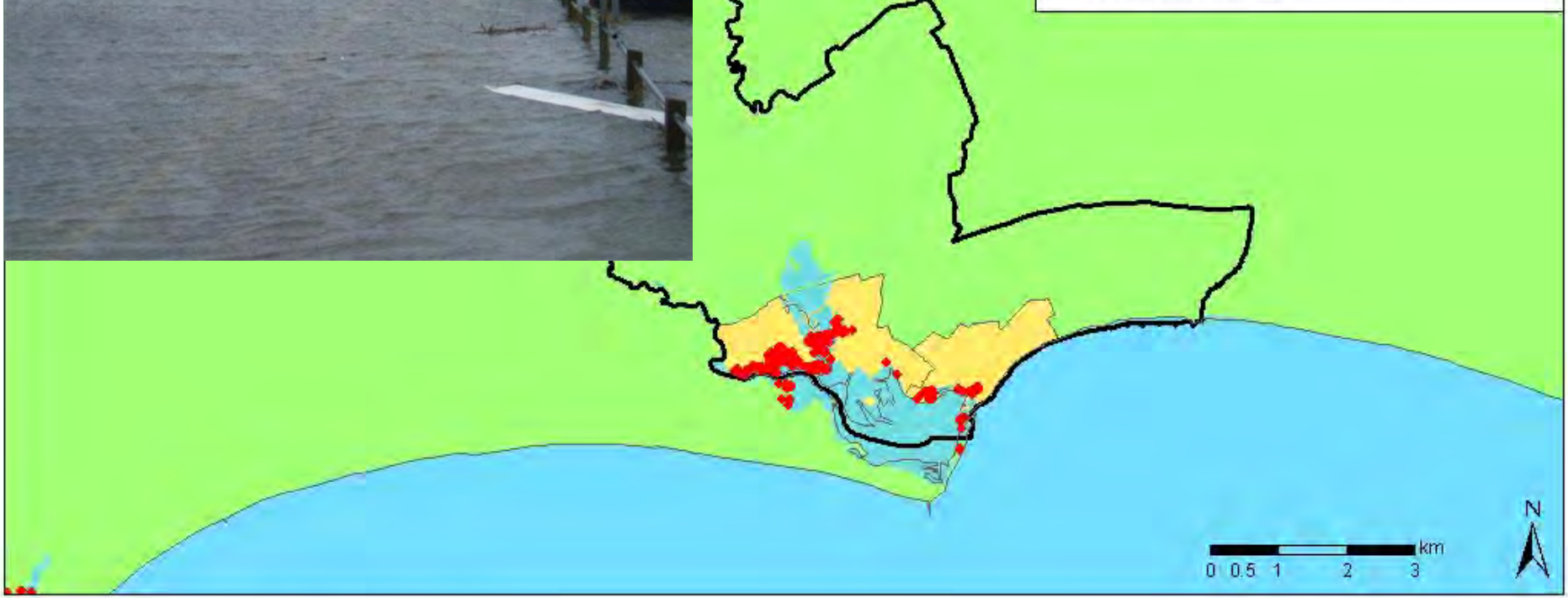
Data provided courtesy of the Environment Agency, Hampshire and West Sussex County Councils

- Properties in Tidal Floodplain
- Christchurch District Council
- Flood Zone 3 (1:200 yr) 2008
- Wards Affected By Tidal Flooding

Local Authority	Number of Properties in Tidal Floodplain
Christchurch District Council	545



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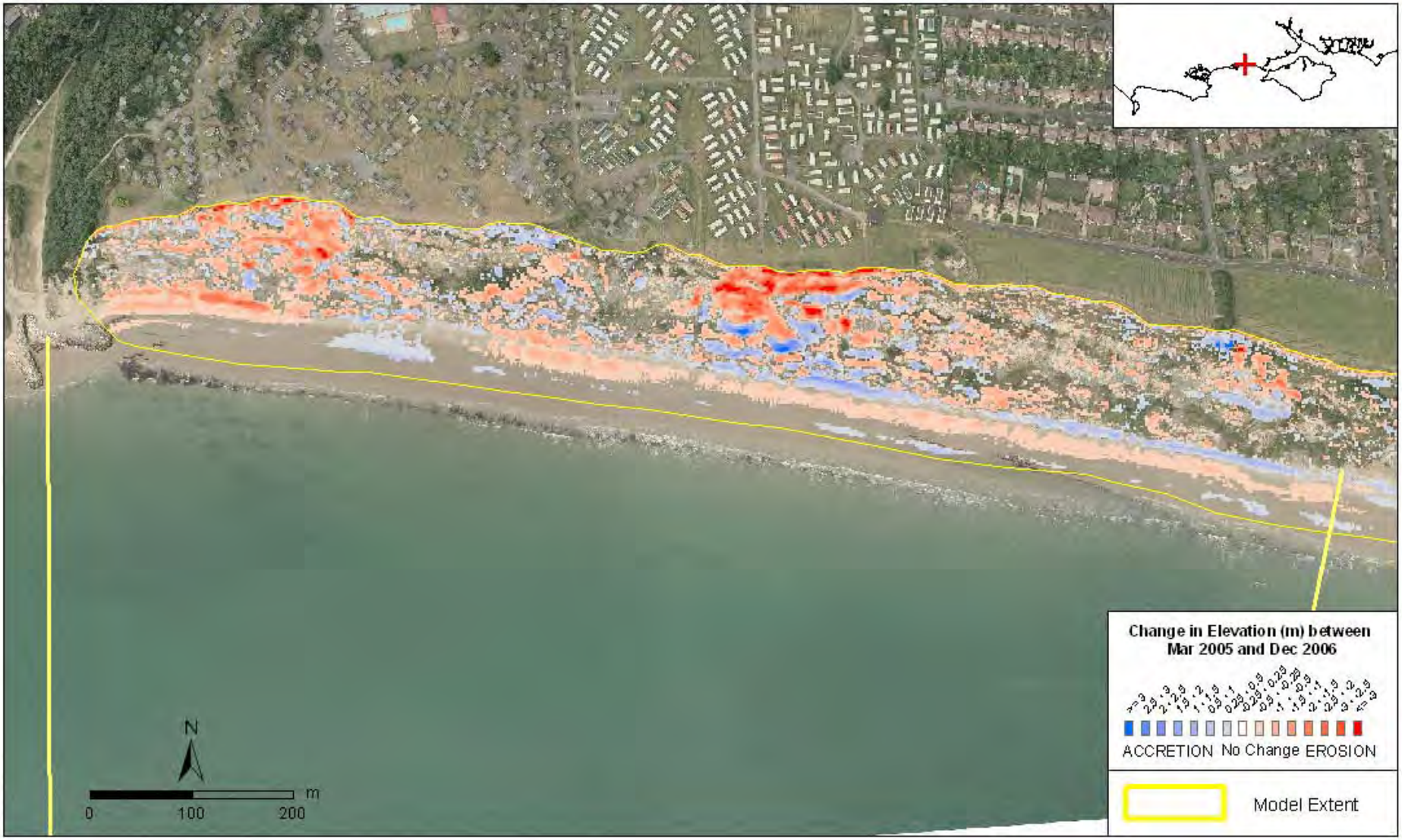

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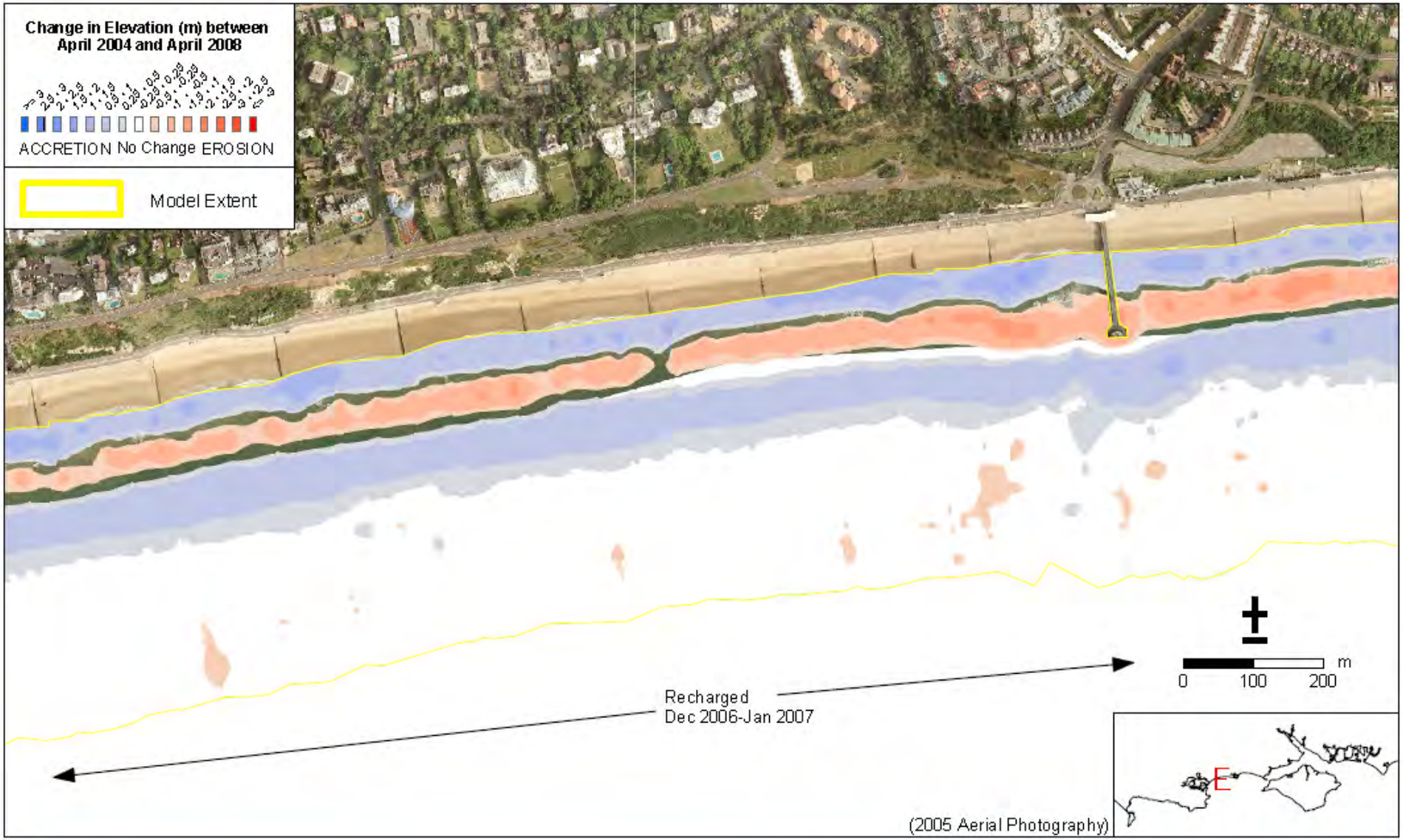

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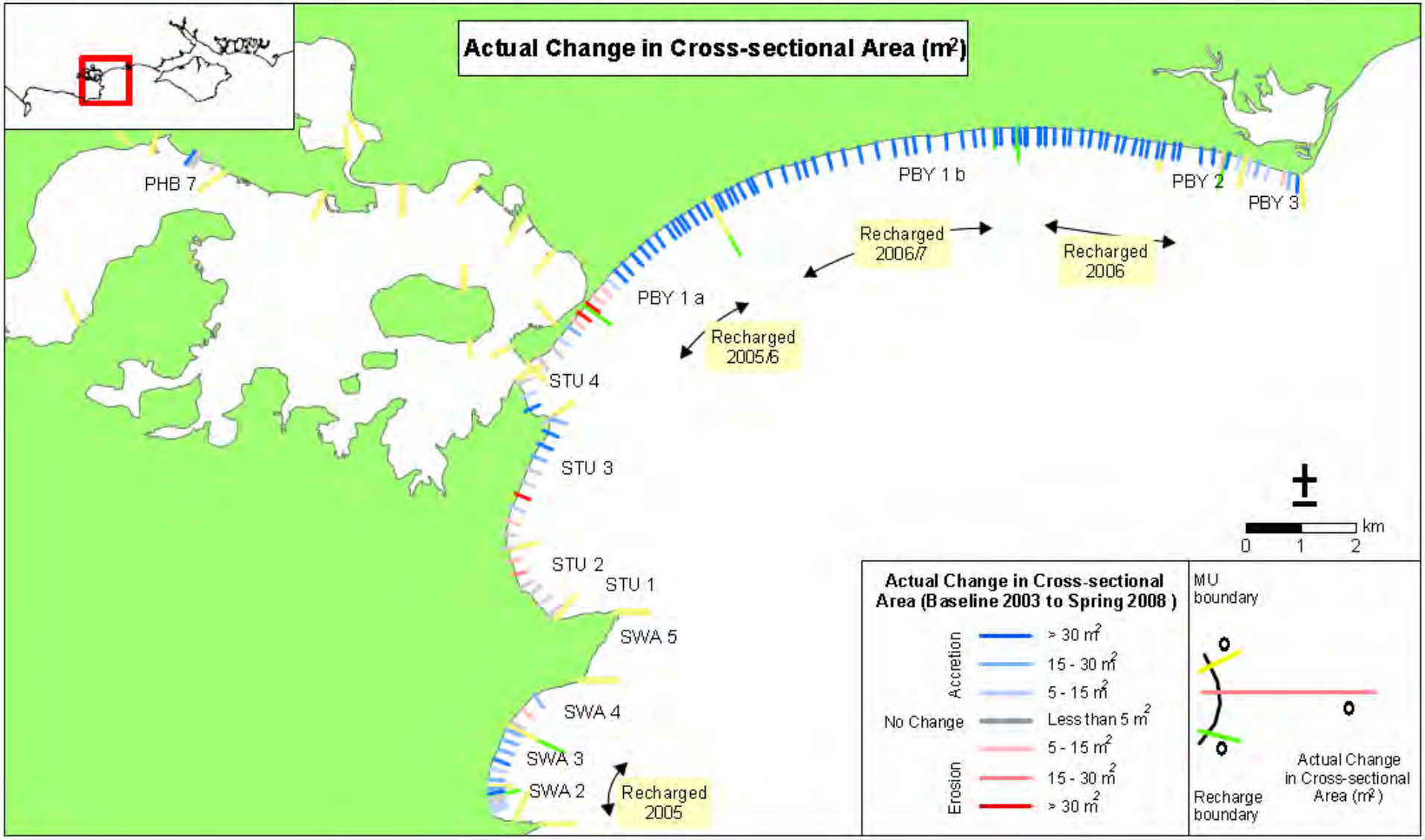
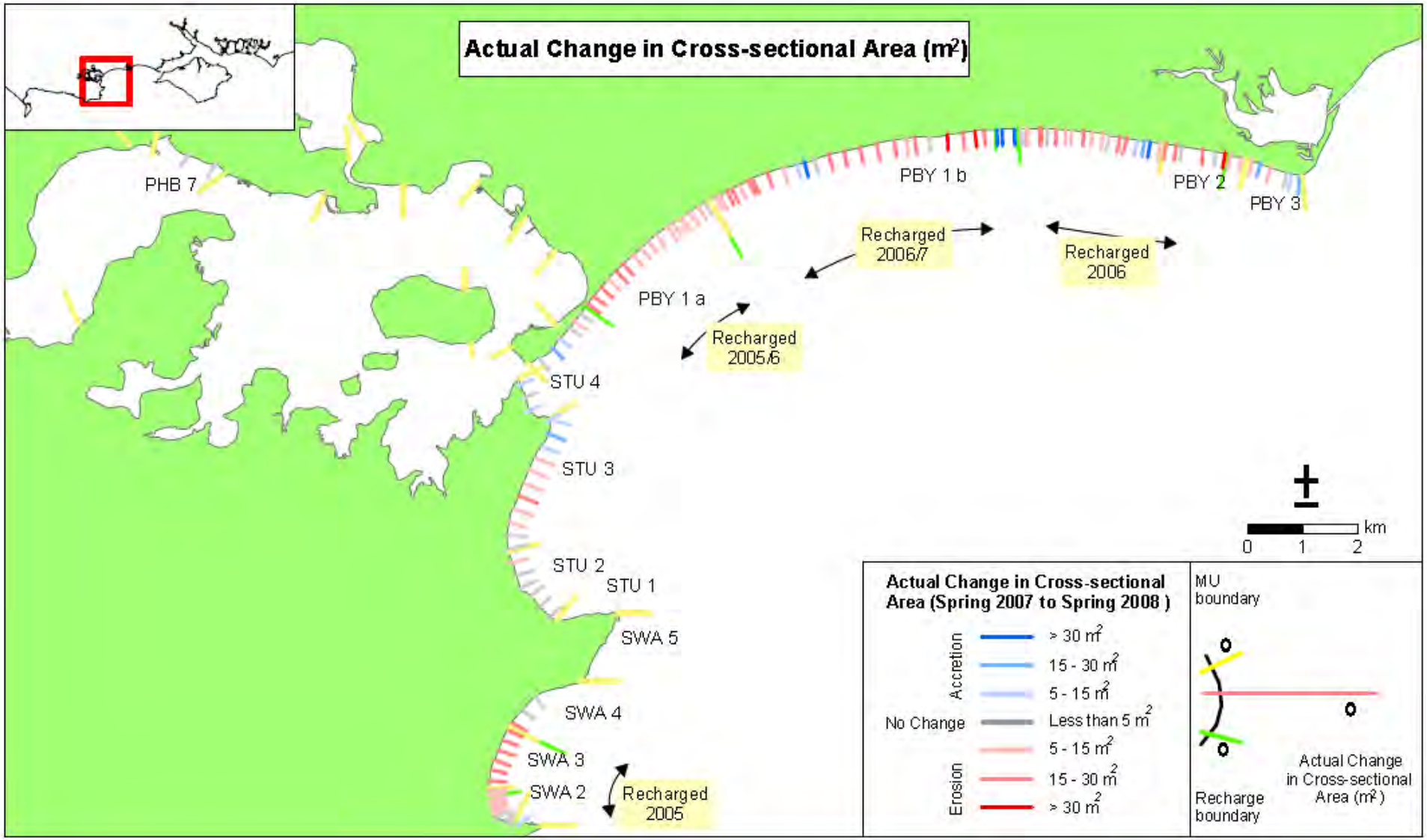
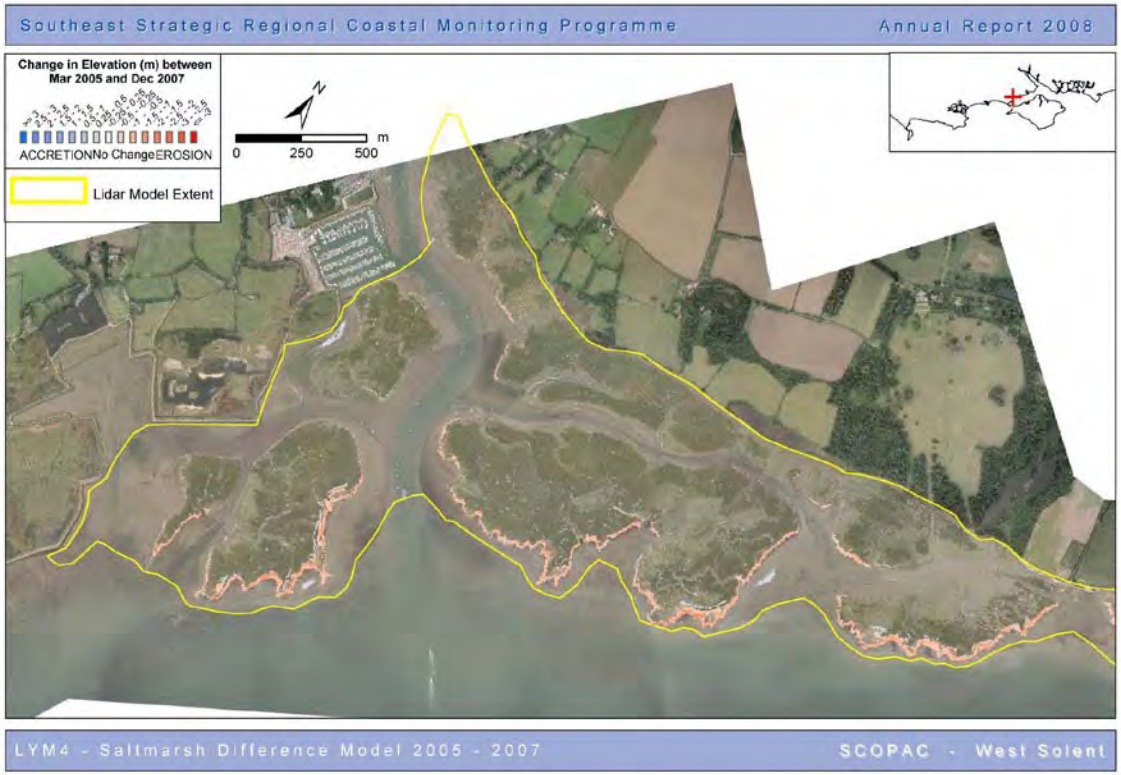

Actual Change in Cross-sectional Area (m²)
PHB 7
PBY 1 b
PBY 2
PBY 3
Recharged 2006/7
Recharged 2006
PBY 1 a
Recharged 2005/6
STU 4
STU 3
STU 2
STU 1
SWA 5
SWA 4
SWA 3
SWA 2
Recharged 2005
km
0 1 2
Actual Change in Cross-sectional Area (Baseline 2003 to Spring 2008)
Accretion
> 30 m²
15 - 30 m²
5 - 15 m²
No Change
Less than 5 m²
Erosion
5 - 15 m²
15 - 30 m²
> 30 m²
MU boundary
Recharge boundary
Actual Change in Cross-sectional Area (m²)


Actual Change in Cross-sectional Area (m²)
PHB 7
PBY 1 b
PBY 2
PBY 3
Recharged 2006/7
Recharged 2006
PBY 1 a
Recharged 2005/6
STU 4
STU 3
STU 2
STU 1
SWA 5
SWA 4
SWA 3
SWA 2
Recharged 2005
km
0 1 2
Actual Change in Cross-sectional Area (Spring 2007 to Spring 2008)
Accretion
> 30 m²
15 - 30 m²
5 - 15 m²
No Change
Less than 5 m²
Erosion
5 - 15 m²
15 - 30 m²
> 30 m²
MU boundary
Recharge boundary
Actual Change in Cross-sectional Area (m²)

Systematic regional trends

- Saltmarsh evolution
- 60 year data set
- Systematic regionwide loss 1-1.5% per year



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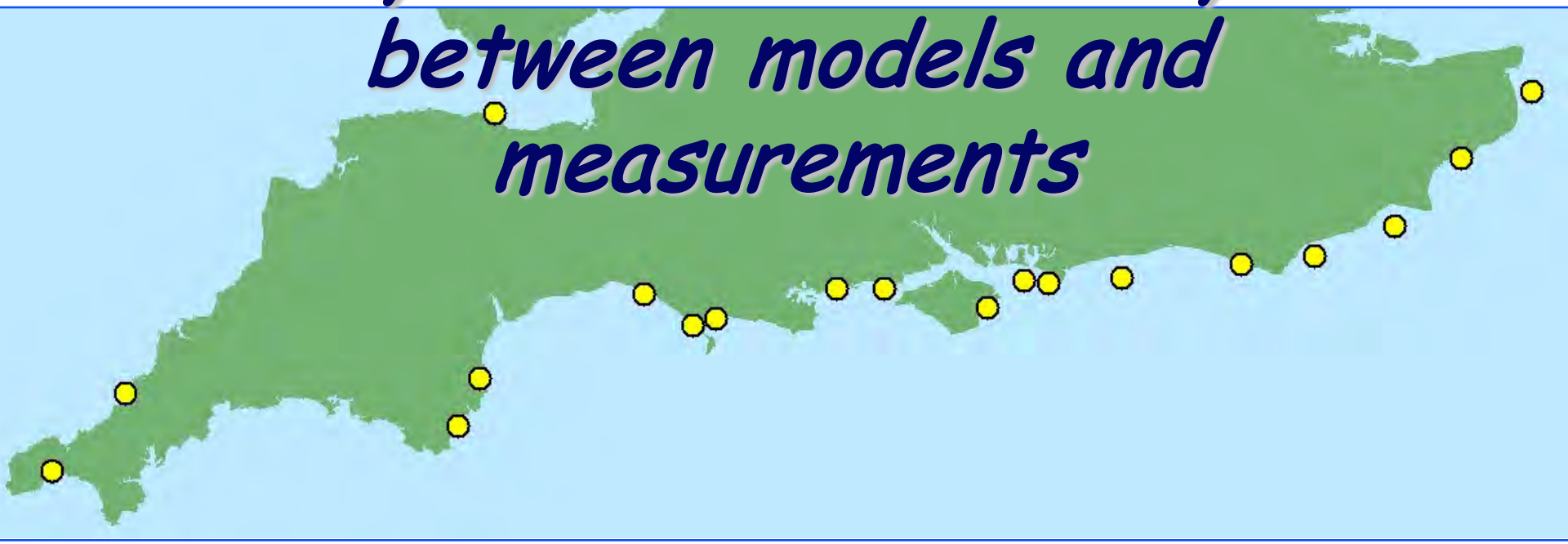
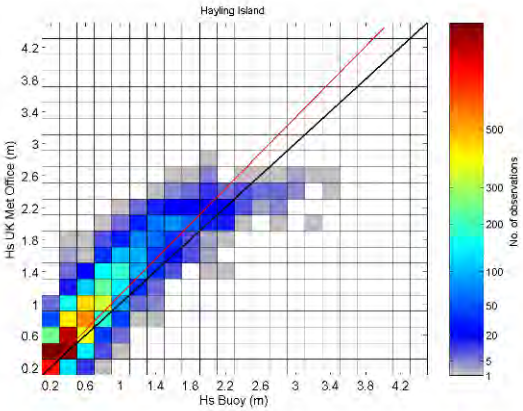
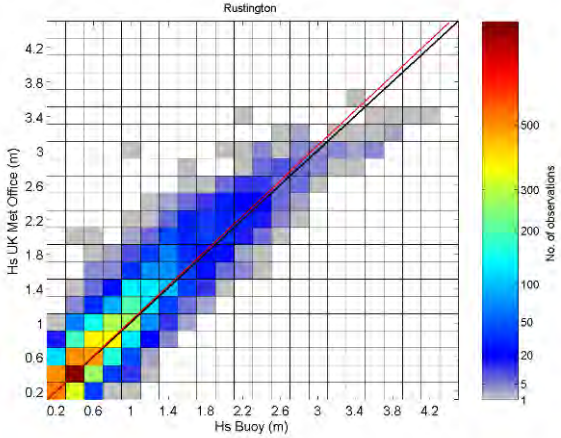
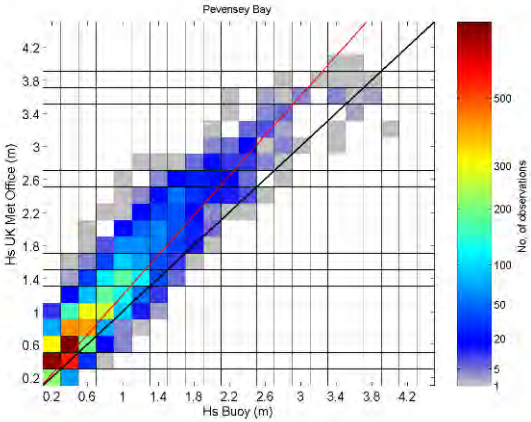
Systematic variability between models and measurements









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Systematic regional trends

- Regionwide volumetric changes
- Balanced with management activities

- Based on consistent approach to measurement
- Long term programme

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Concluding remarks

- Large scale long term data collection and management programme developed for coastal hazard management
- Data collected and analysed to consistent standards for all tiers of management
- GIS presentation and data aggregation styles developed for each management level
- Successful approach within shoreline management community in the UK