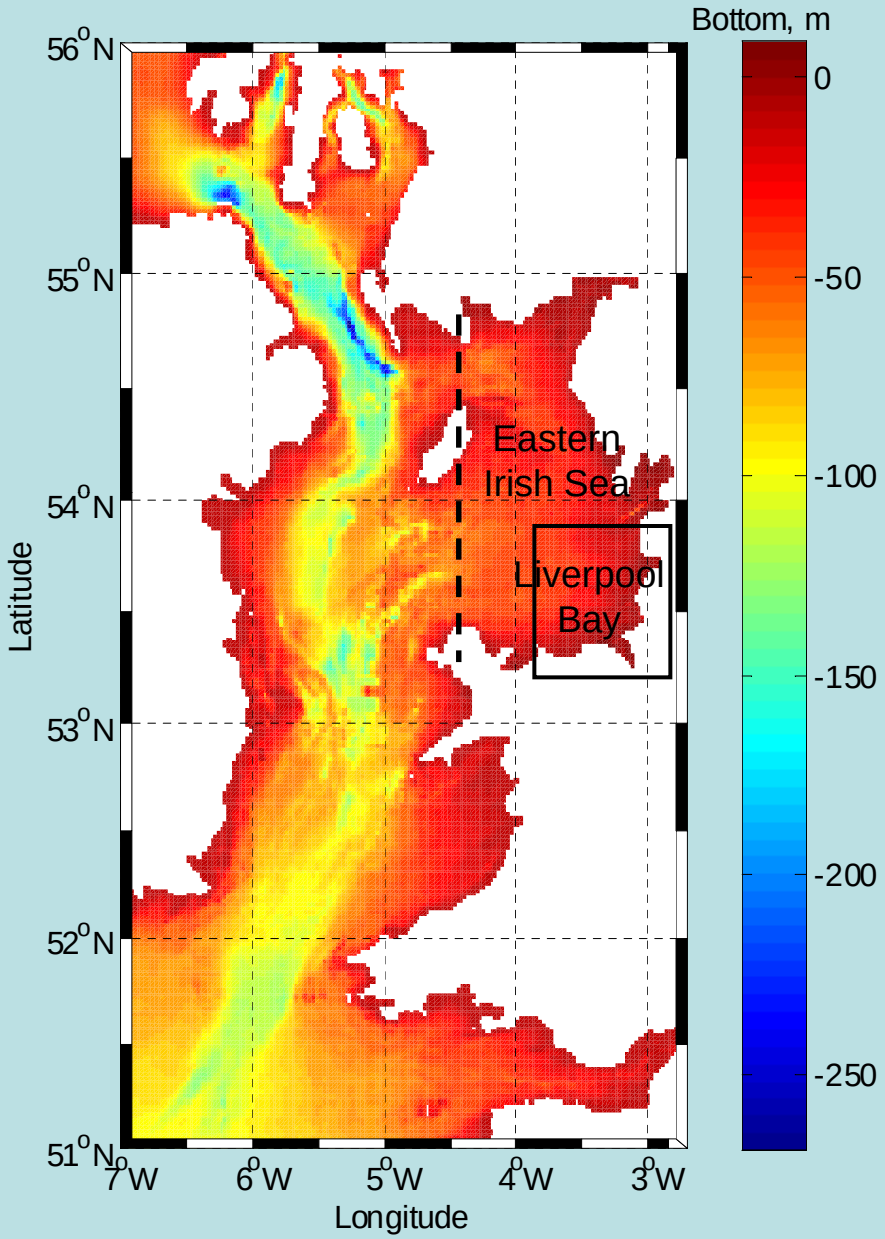


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# Project

# end users report: Potentially damaging offshore storm conditions along the Sefton Coast.

University of Plymouth

National Oceanography Centre
NATURAL ENVIRONMENT RESEARCH COUNCIL

THE UNIVERSITY of LIVERPOOL

BODC British Oceanographic Data Centre
NATURAL ENVIRONMENT RESEARCH COUNCIL

Edge Hill University

Sefton Council

By Jenny Brown

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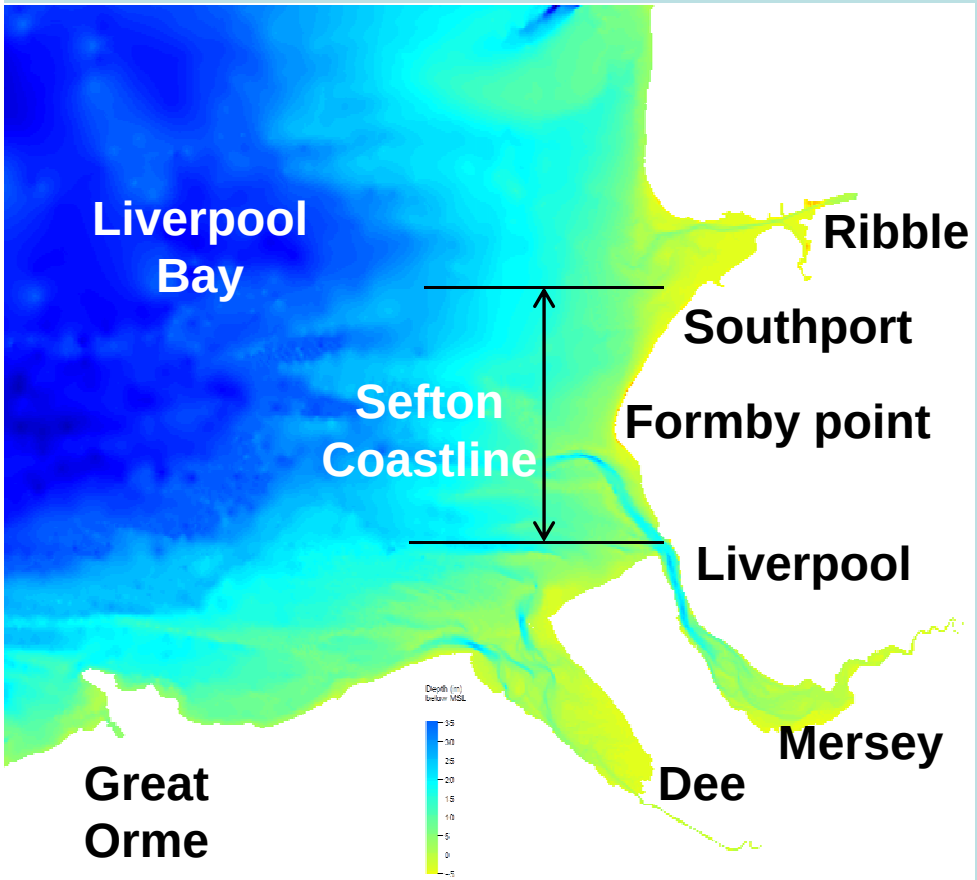
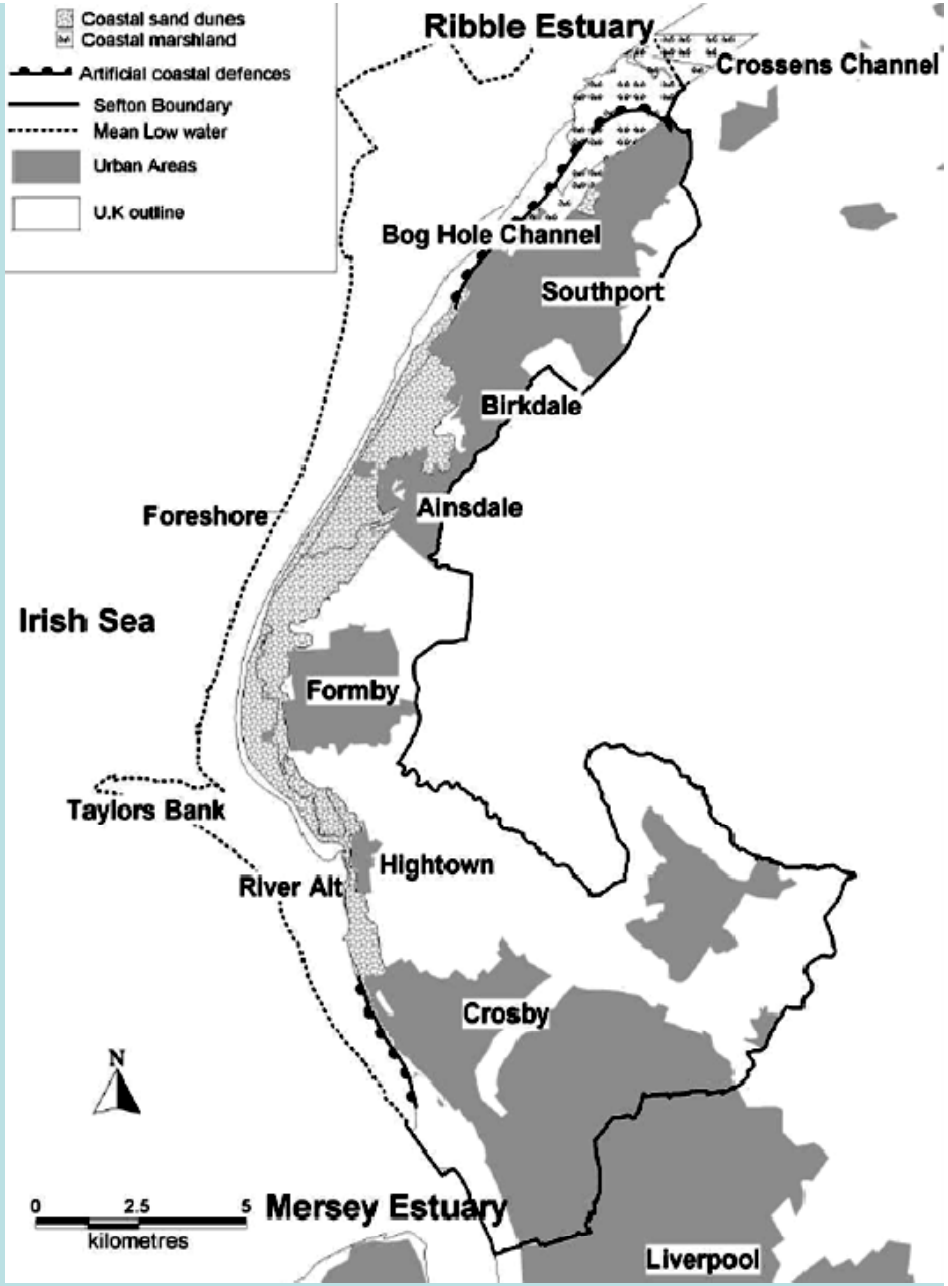
# Presentation Outline

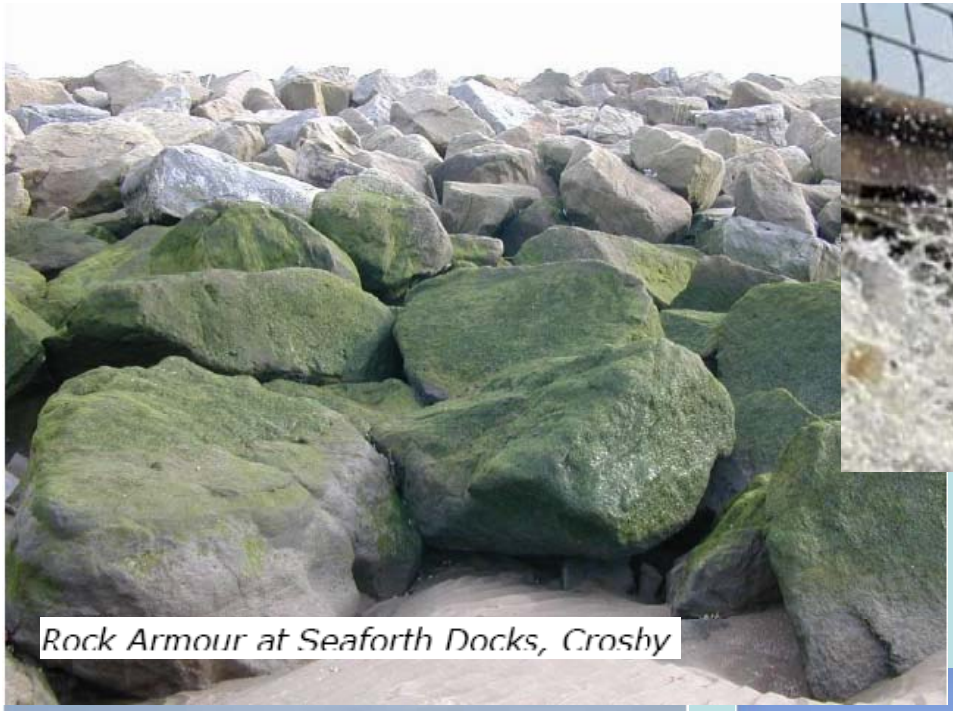
- Introduce the study area
- Modelling methods
- Show a past storm event used to validate the model setup
- Present the results from an 11year hindcast
- Historical events
- Data use / Conclusions

# The Study Area:

Sefton Coast – representative of many different UK coastlines





*Rock Armour at Seaforth Docks, Crosby*


*Sea Wall Southport*

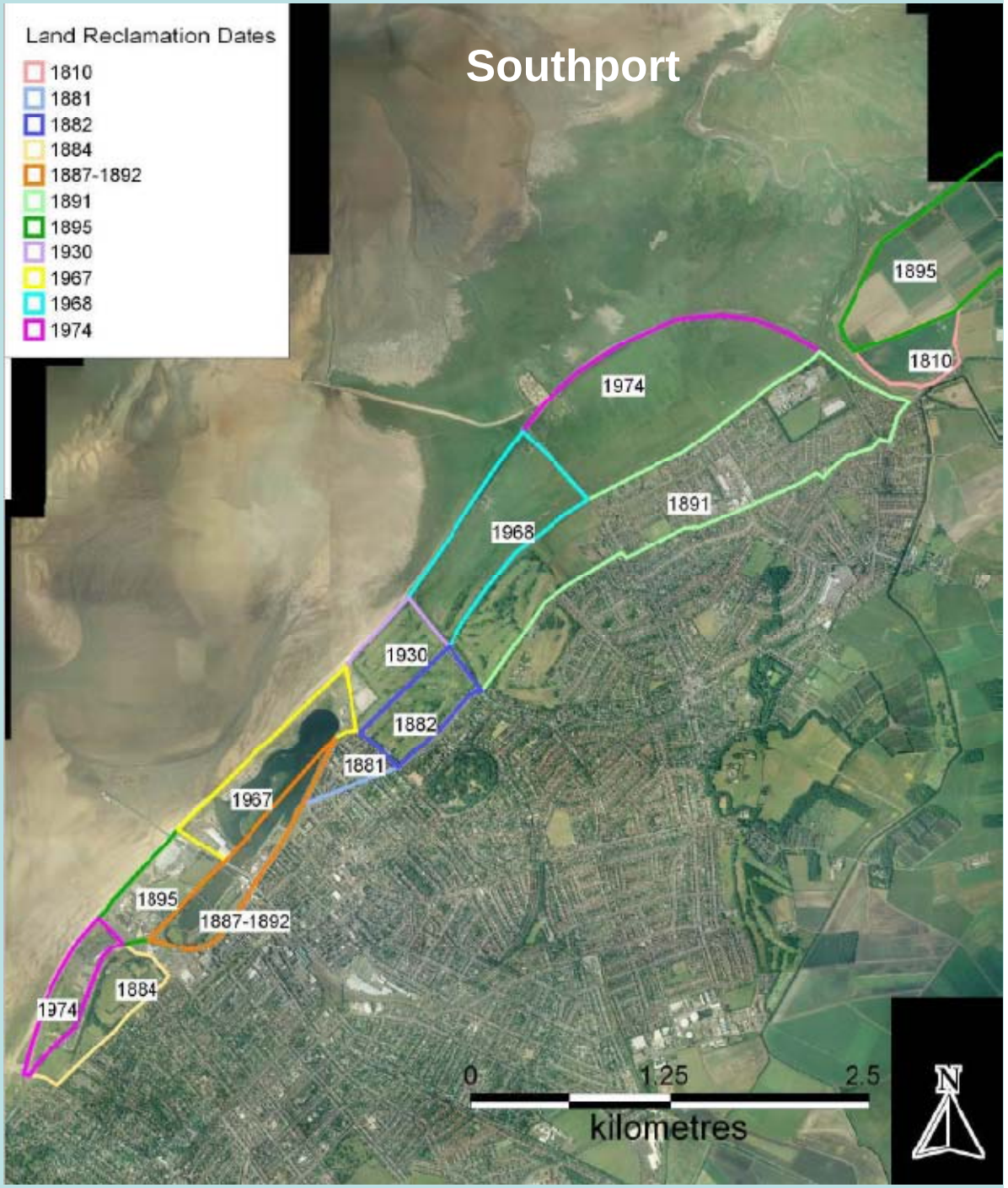
**Rubble beach North of Crosby**

*The River Alt Training Wall*

Roads susceptible to flooding

Sea wall completed 2002

**Hard defences need to withstand present & future conditions**



Saltmarsh at Fairways

Formby point

**Largest dune system UK**

Crosby

Formby storm 31st March – 1st April 2010

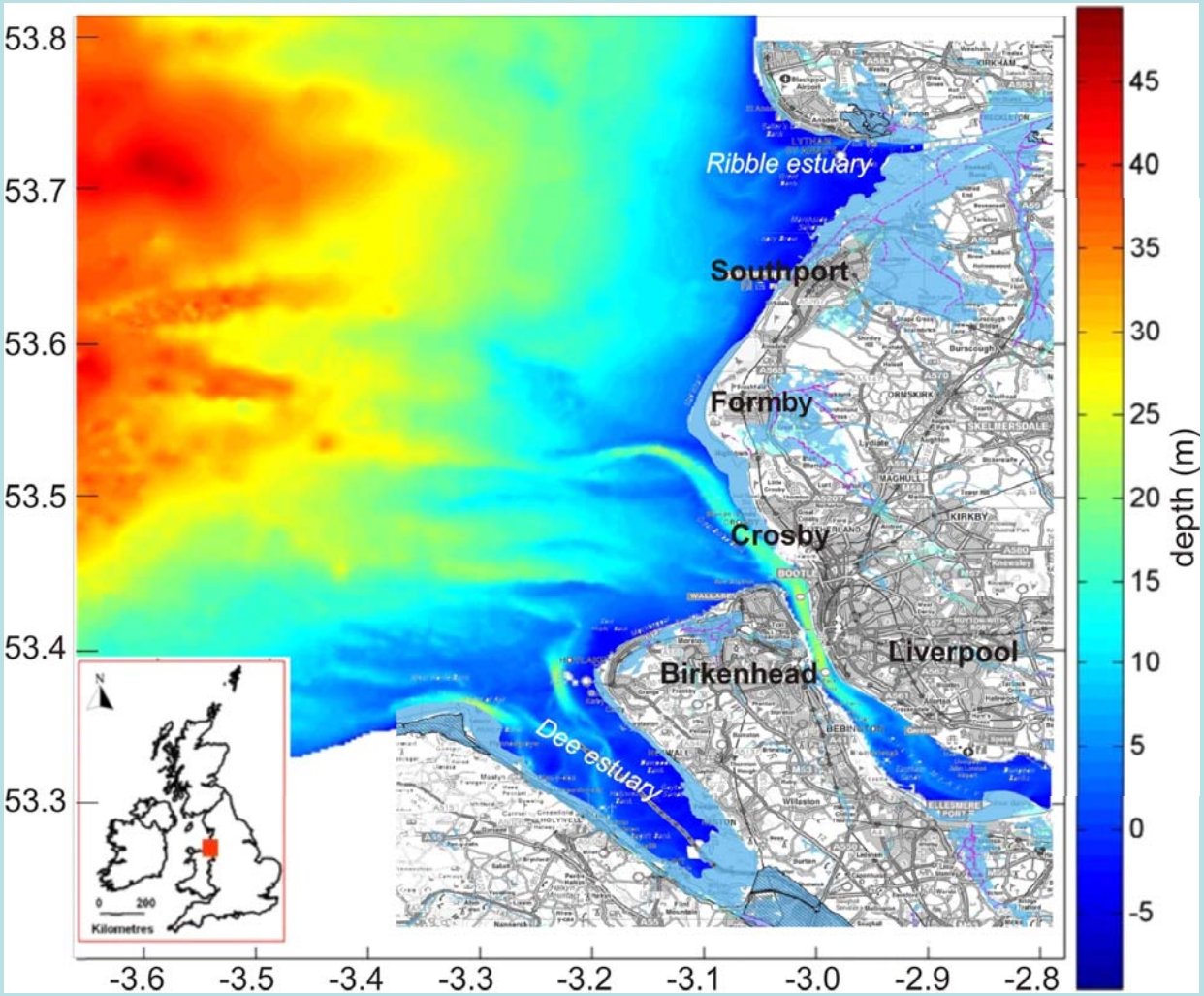
## Natural defence – risk of erosion

Formby extreme high tide Feb 2010

# Provide Important Habitats

# Economic Value


# Coastal Management requires the best knowledge of storm conditions




Develop state-of-the-art wave-tide-surge Liverpool Bay modelling system

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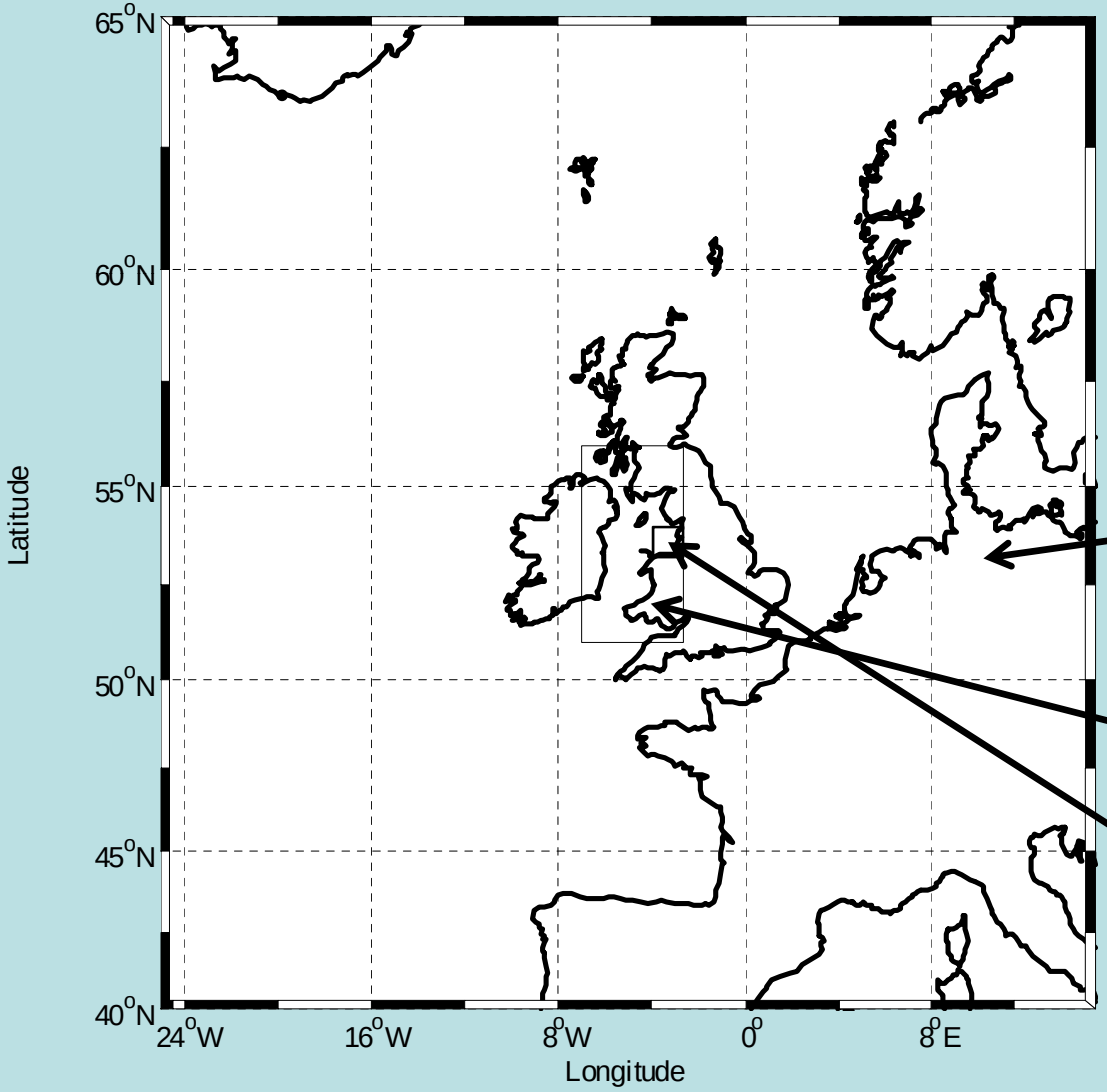
# Wave Modelling: WAveModel

**State of the art 3rd generation spectral wave model – extended for shallow water**




**One way nested model**

To provide the external wave condition Liverpool Bay

***North East Atlantic Model:***

1° resolution

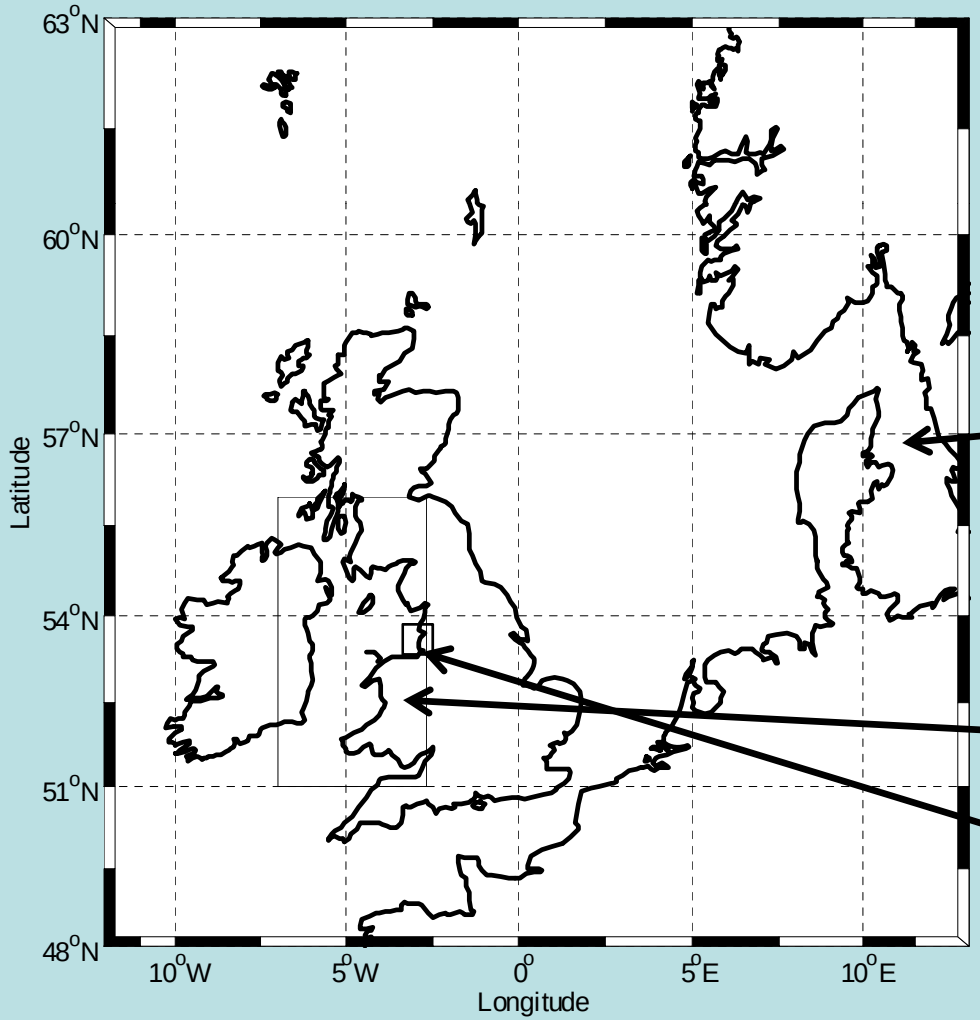
***Irish Sea Model:***
1.8km resolution

***Liverpool Bay Model:***
180m resolution

# Tide – Surge Modelling:

## **P**roudman **O**ceanographic **L**aboratory **C**oastal **O**cean **M**odelling **S**ystem

**3D hydrodynamic model – tidal, riverine and meteorological forcing**




**One way nested model**

To provide the external surge conditions to Liverpool Bay

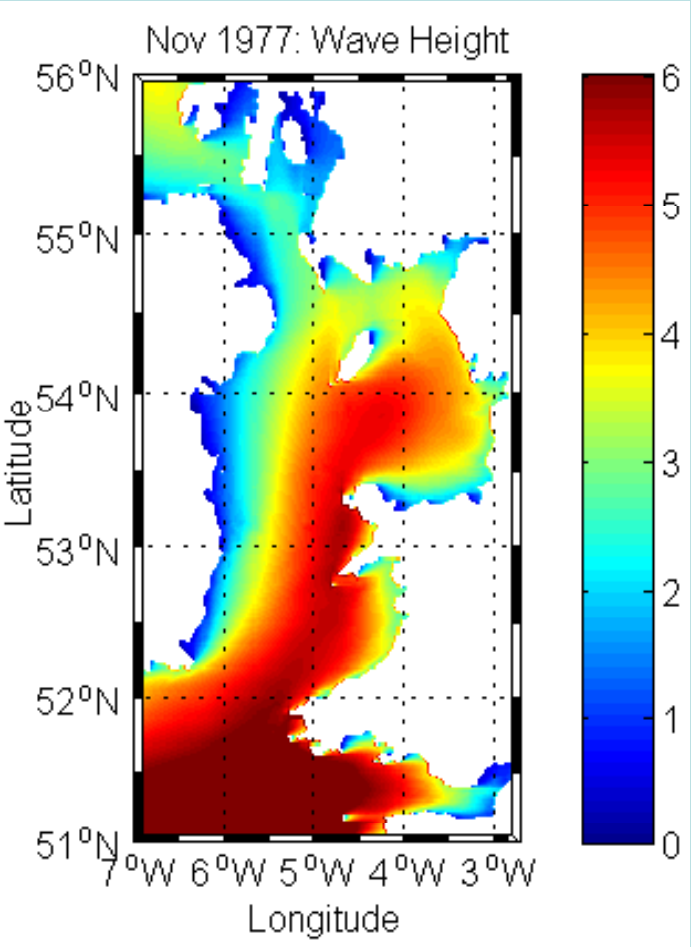
***Operational Continental Shelf Surge Model:***
Run at NOC for the UK Met. Office
12km resolution

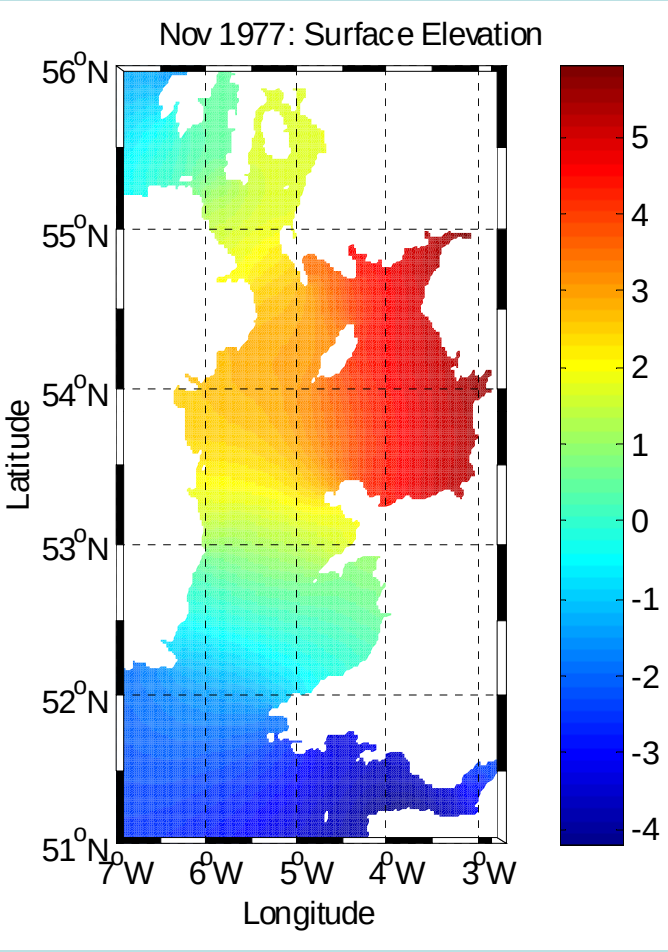
***Irish Sea Model:***
1.8km resolution

***Liverpool Bay Model:***
180m resolution

# Irish Sea: Wave-tide-surge interaction

Exchange information between surge model and wave model




Coupling involves:

(I) time varying depth and velocity fields, which refract the waves
(II) wave-current bottom boundary layer
(III) wave dependent surface roughness to generate the surge

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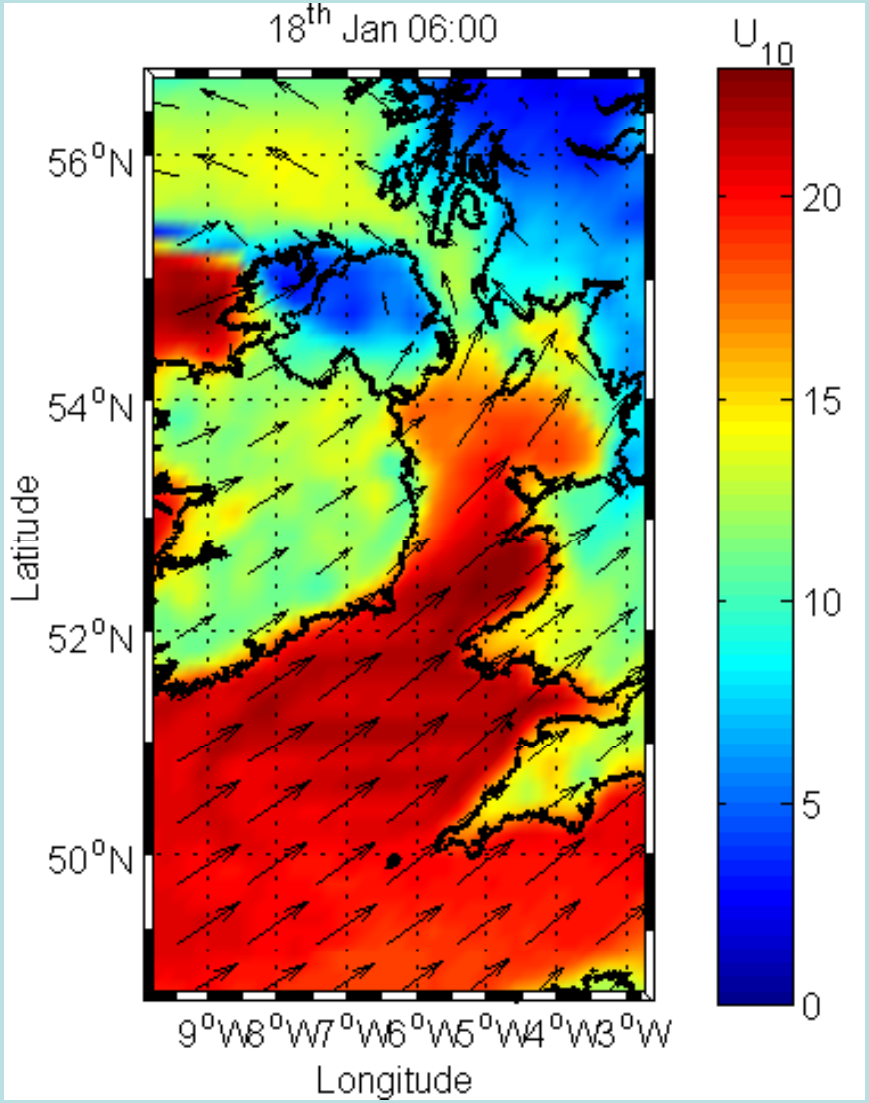
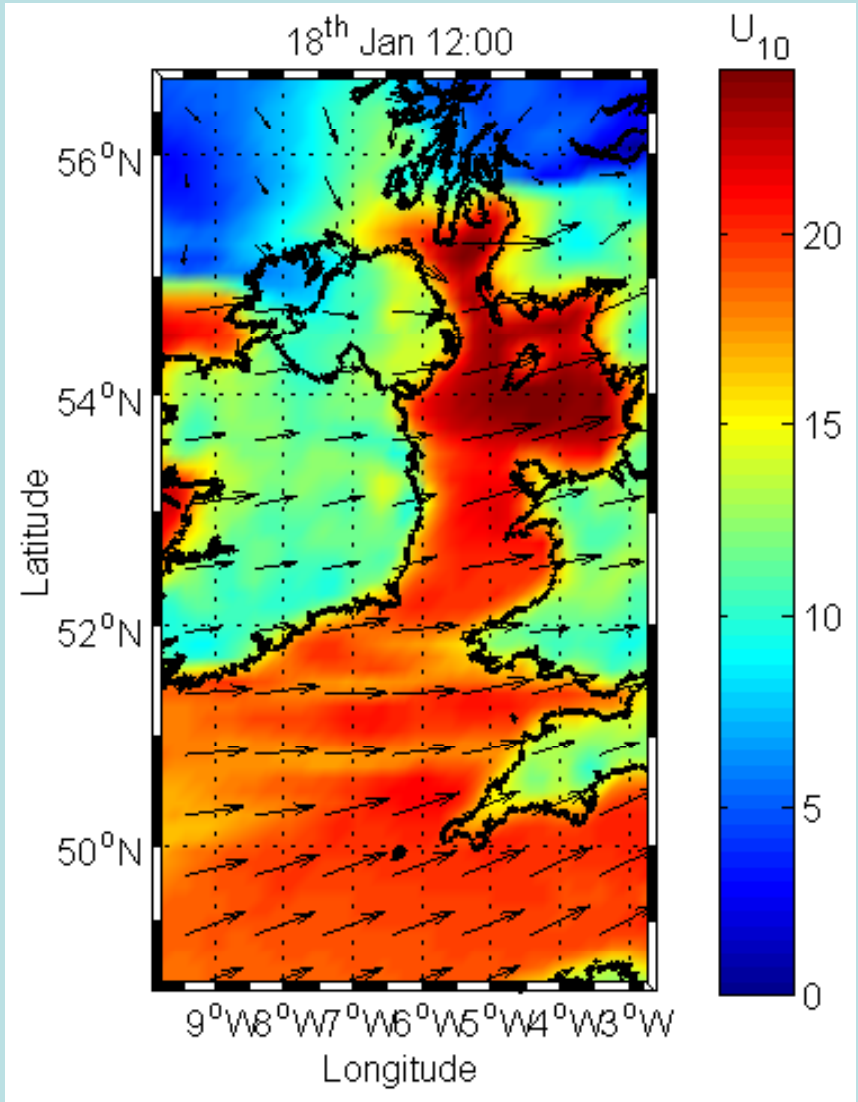
# 18th January 2007

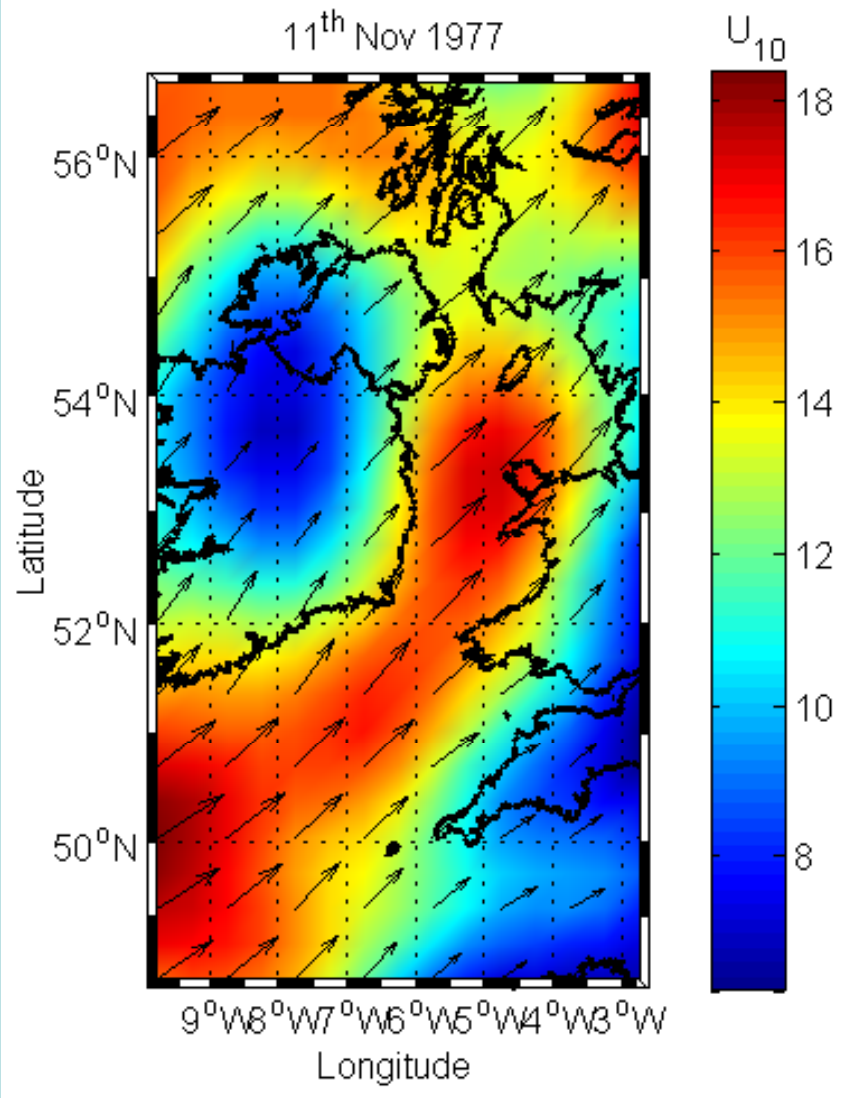
Depression travelled east to the north of Ireland and across Scotland.

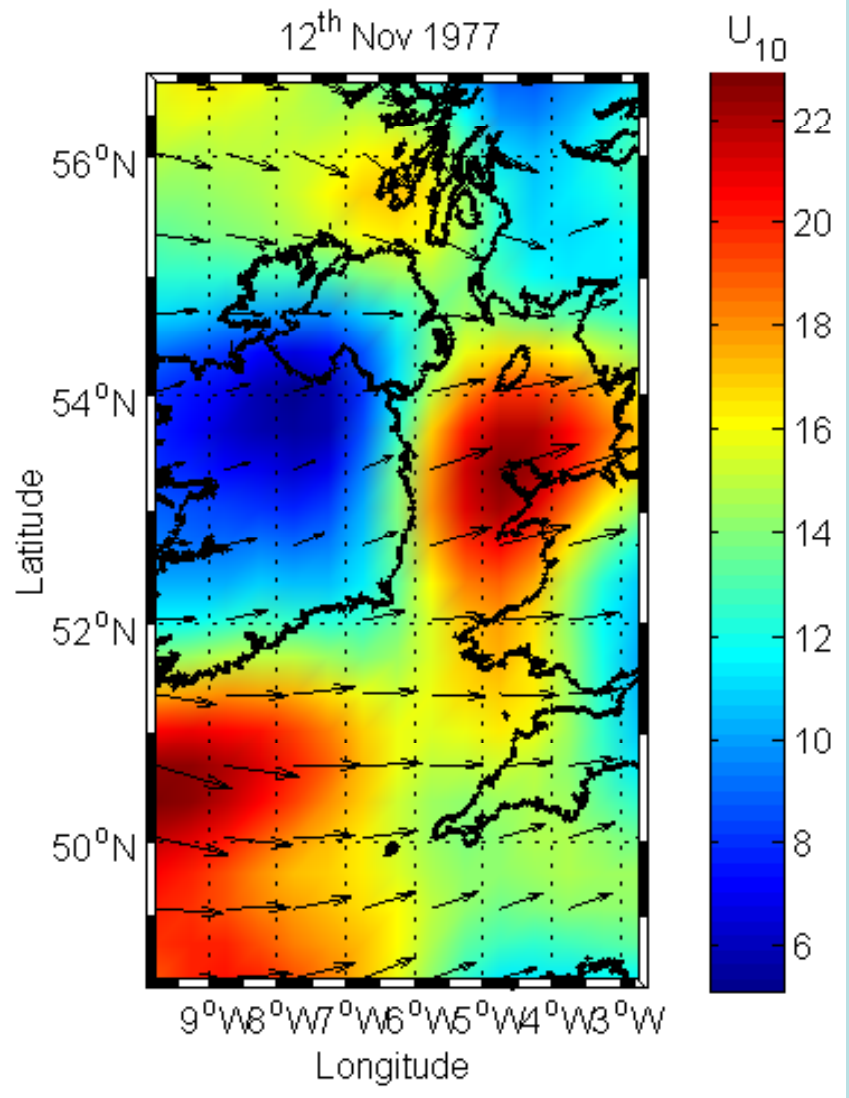


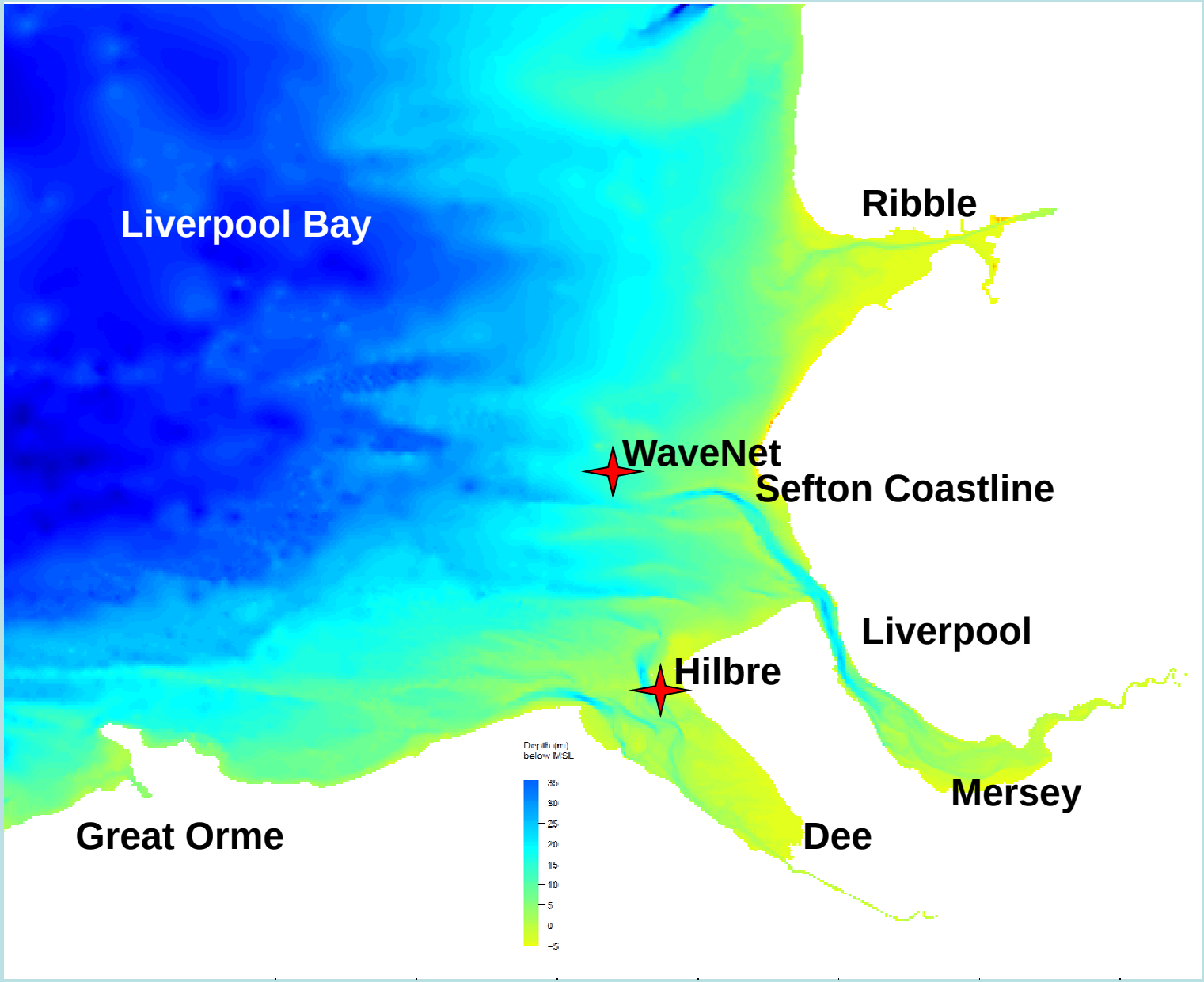
# 11-12th November 1977

Low pressure system moved from the west, easterly over the north of Scotland.

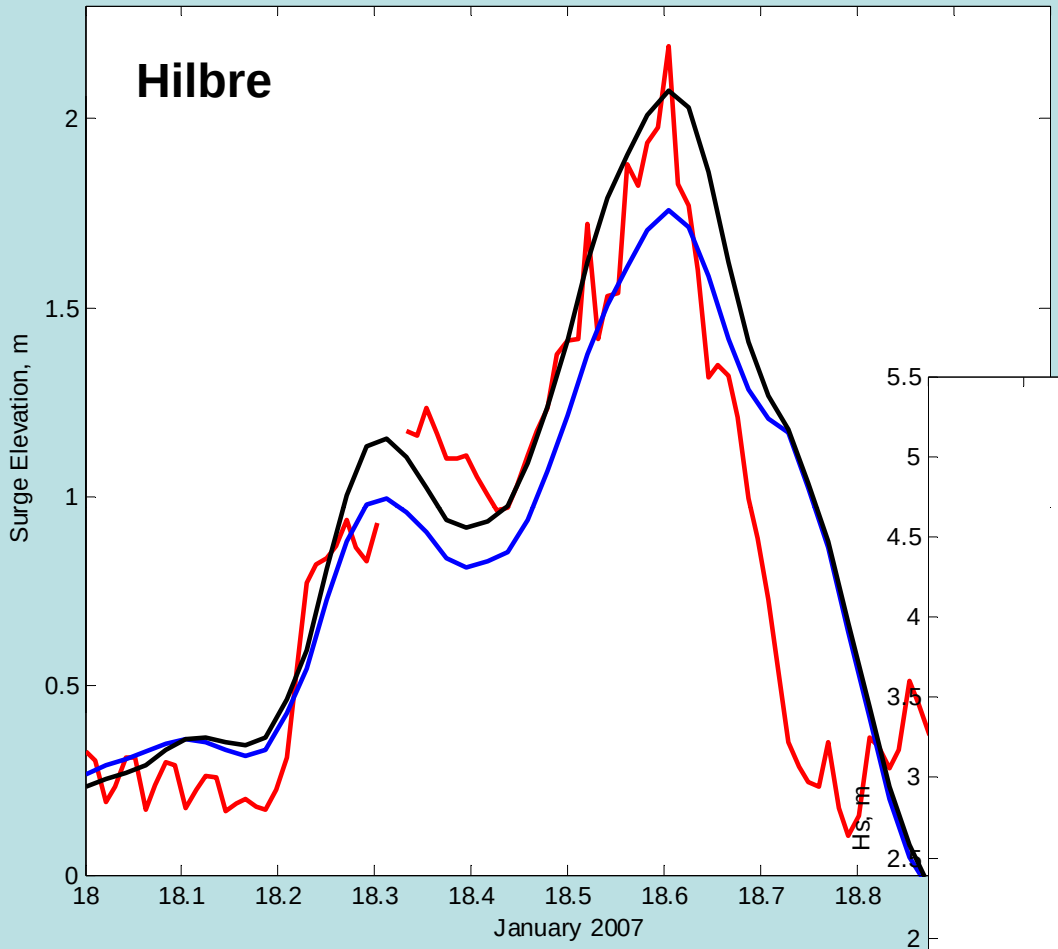


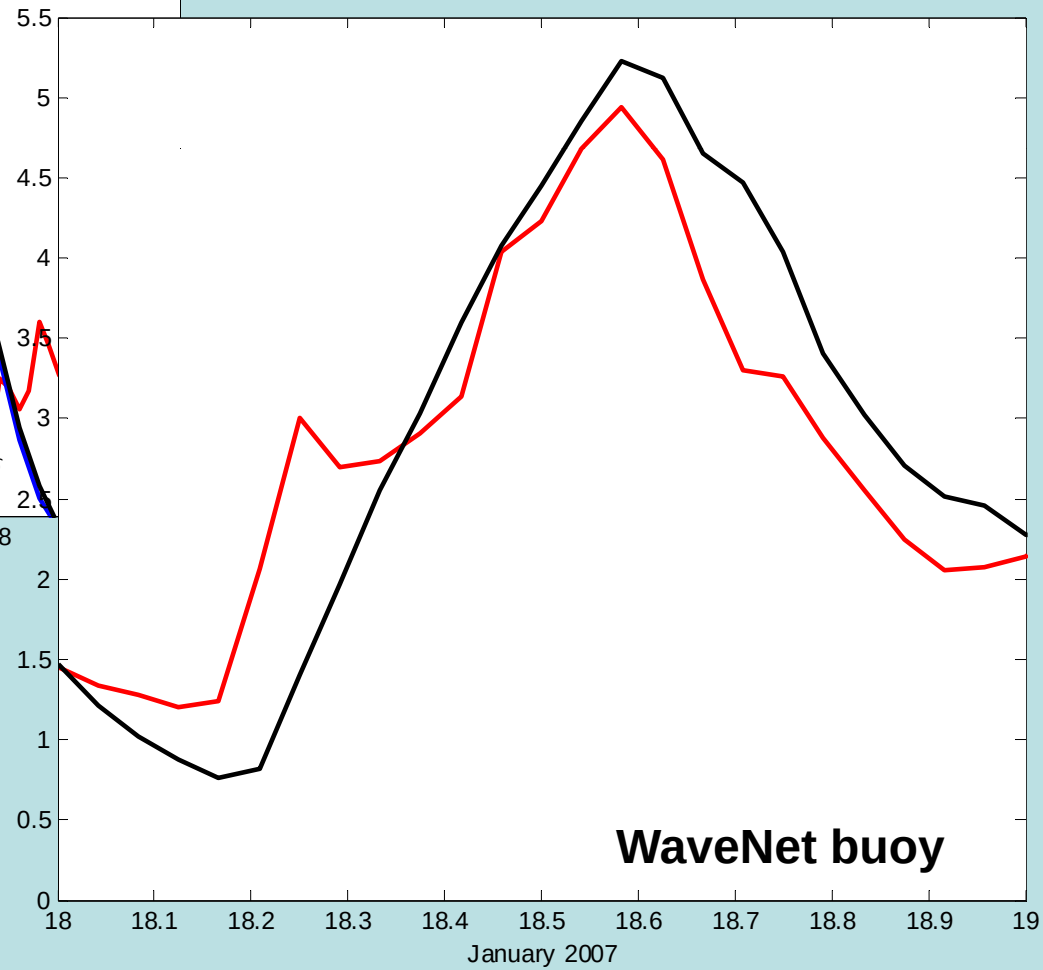



# Location Map



# Model Results 2007



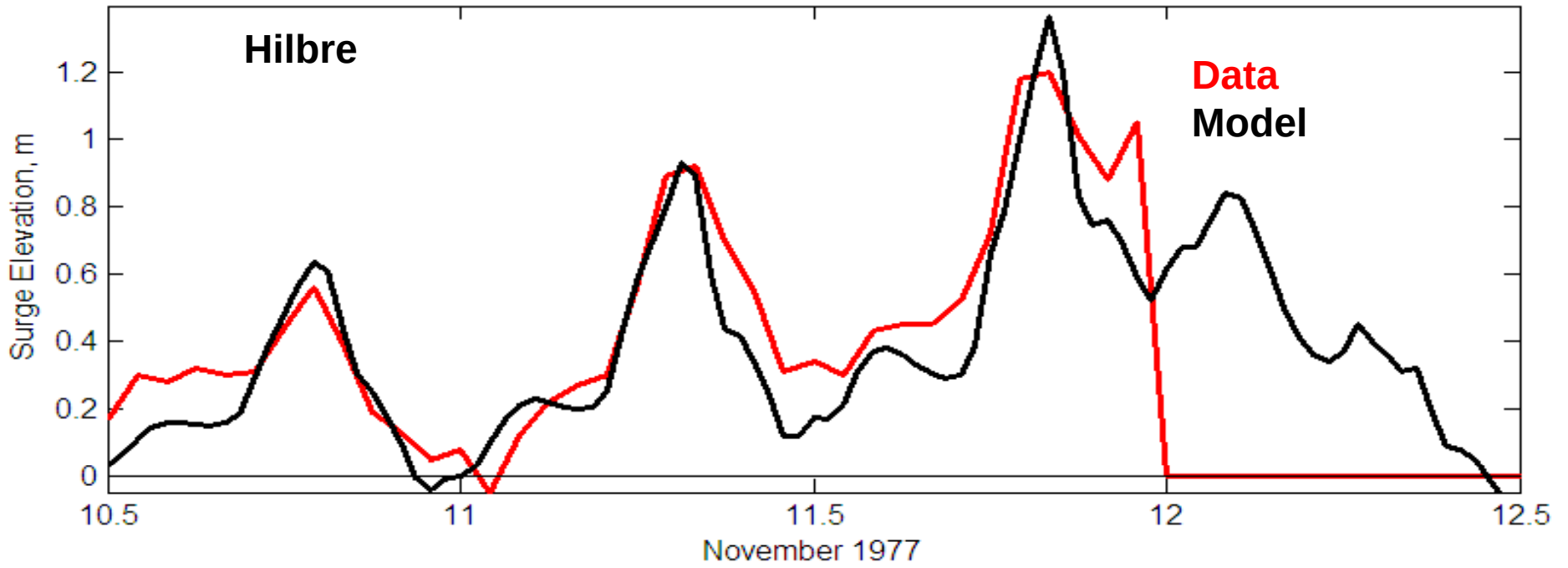




**Data**

**POLCOMS-WAM Model**

**POLCOMS Model**

# Model Surge Results 1977




**No Wave data available**

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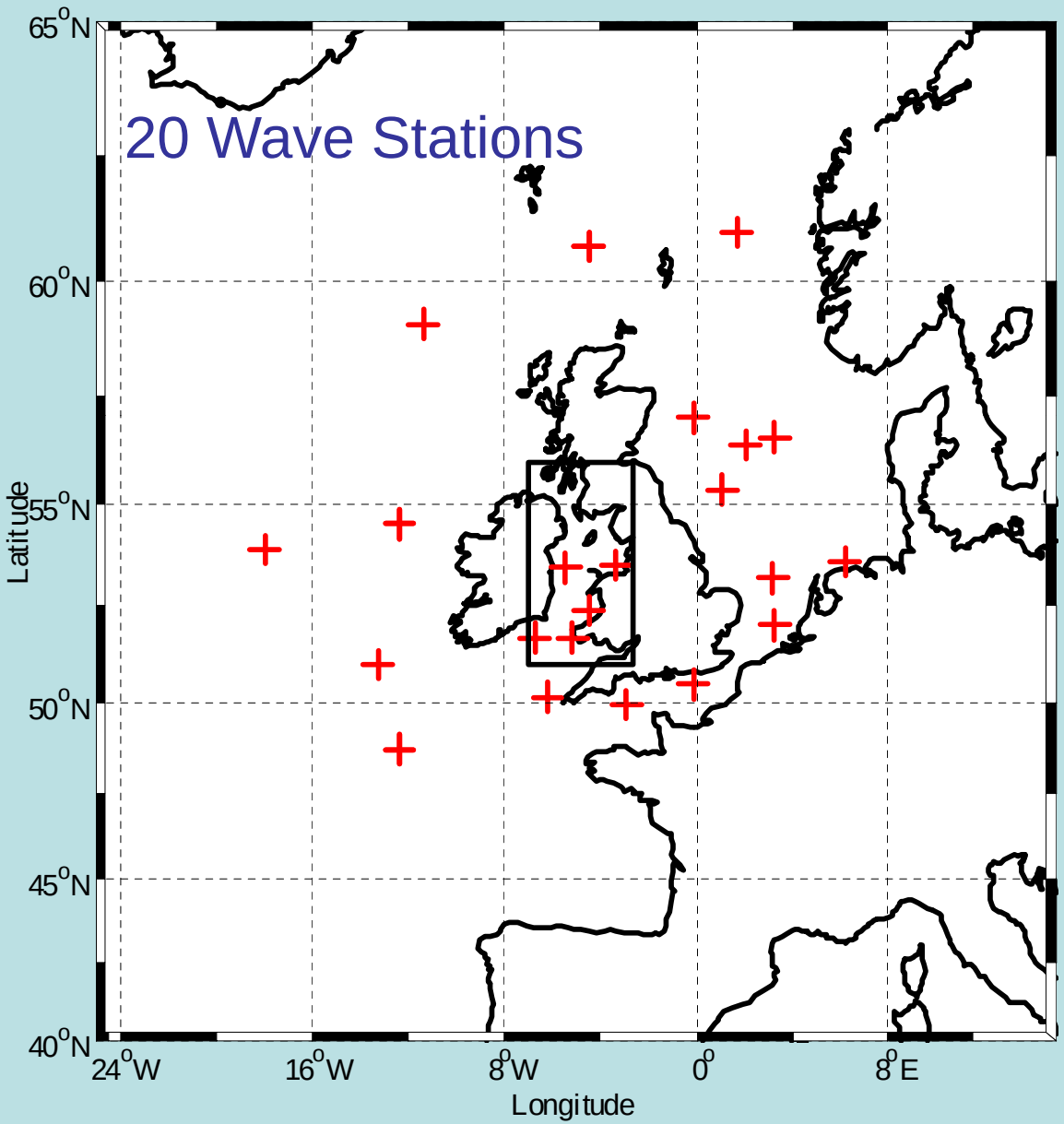
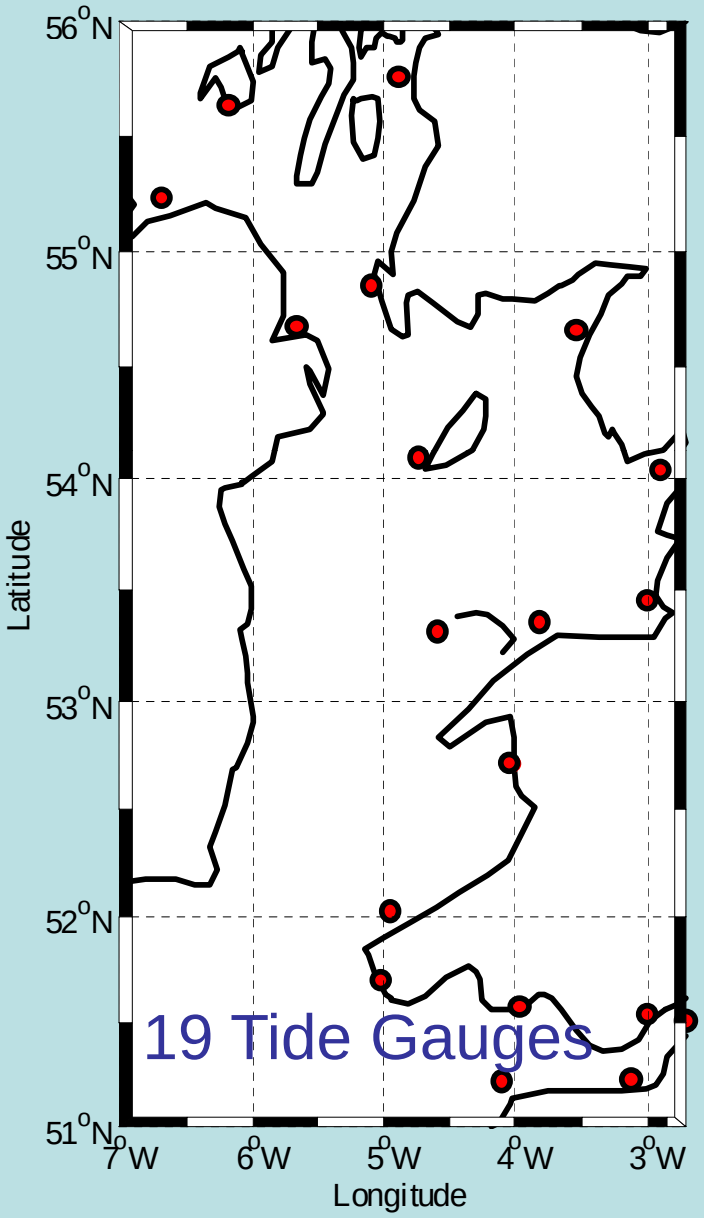
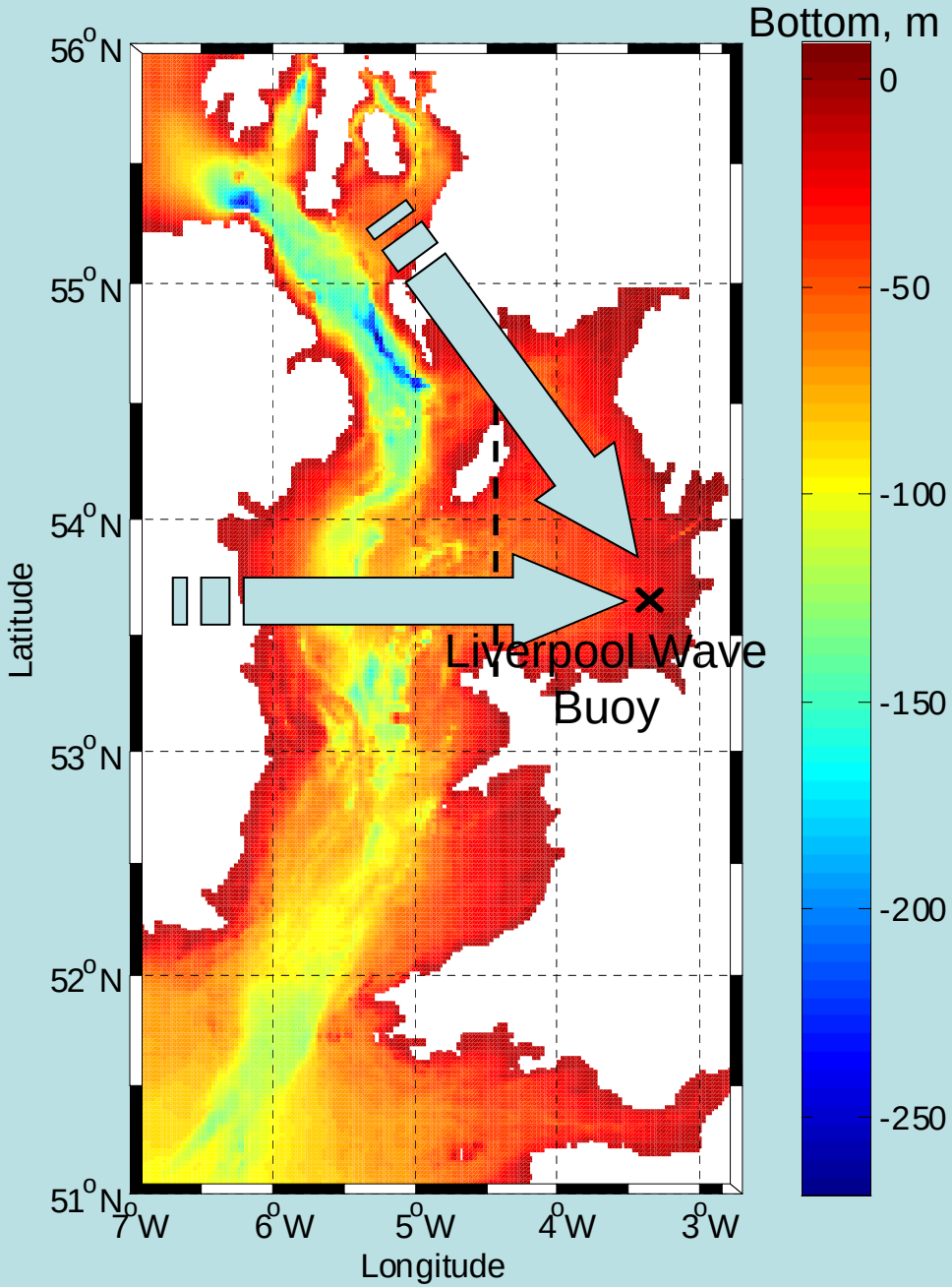
# 11-Year Simulation: Present Day (1996 – 2006)



# Extreme Waves in Liverpool Bay



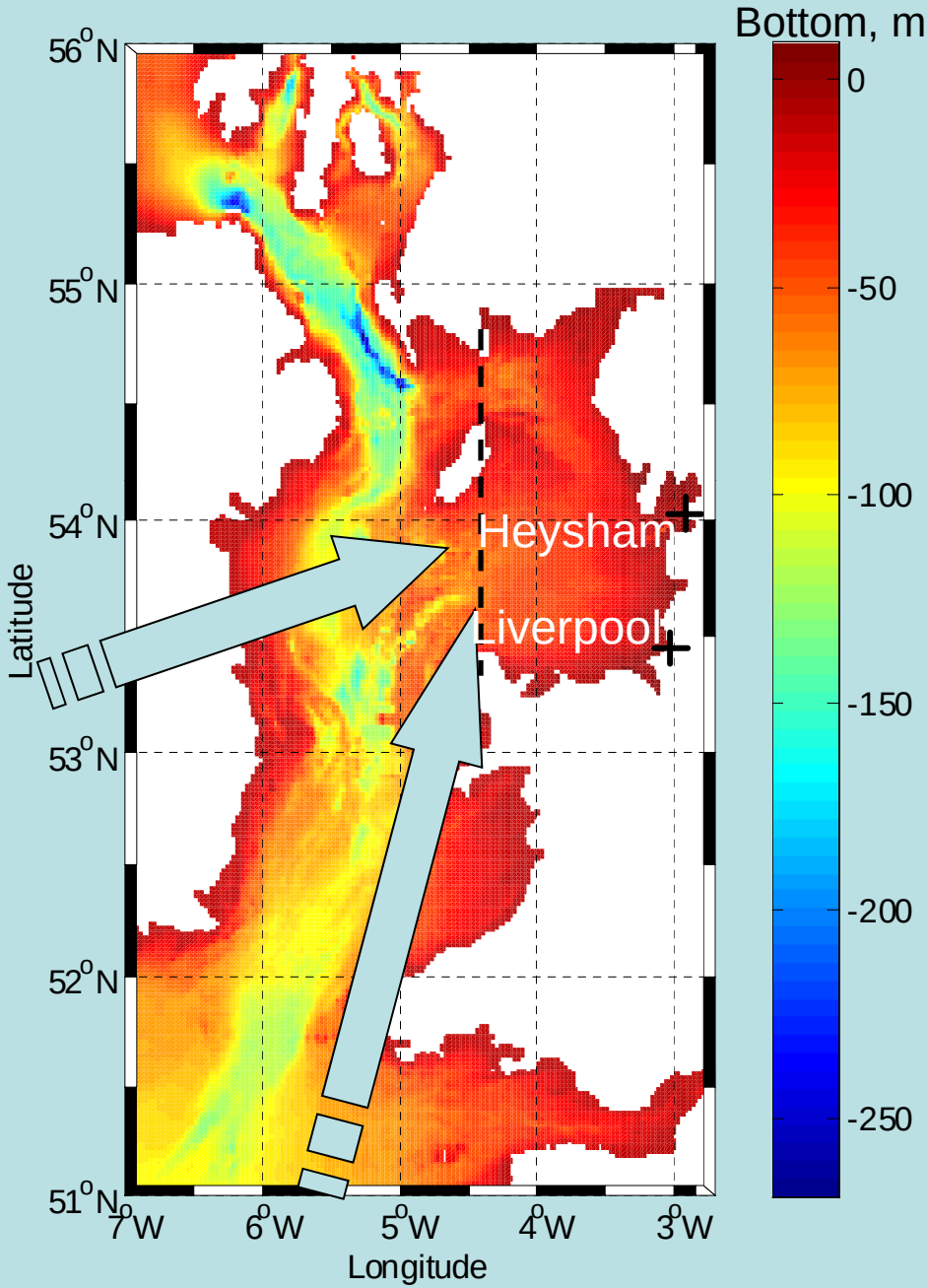

Observation + model hindcast at wave buoy location

Generated: NW – W winds (longest fetches)

Locally generated waves

**Reach: 5.6m**

# Extreme Surges along the Sefton Coast



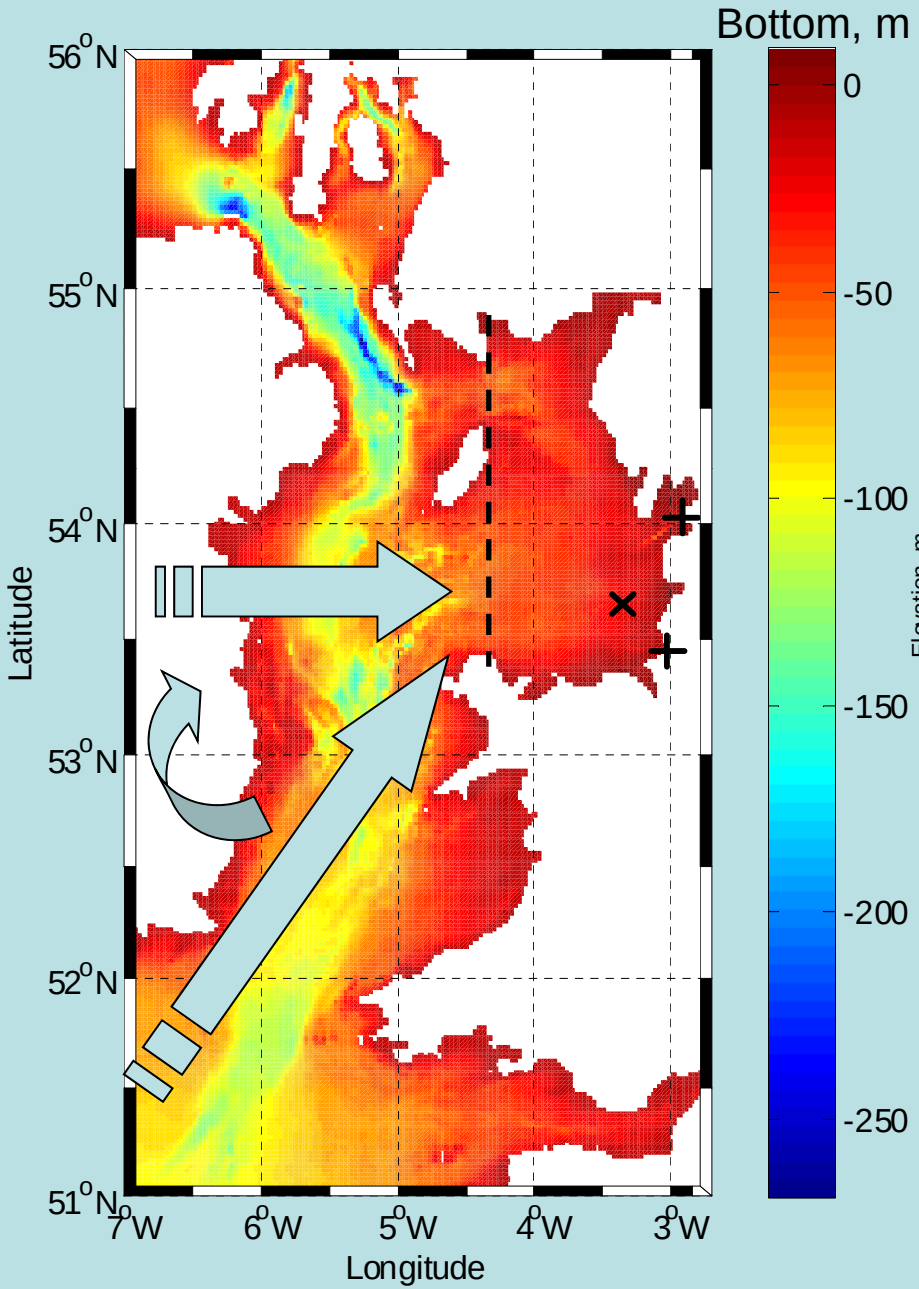

Observation + model hindcast at tide gauges either side of Sefton Coast

Generated: SSW – WSW winds (longest fetches)

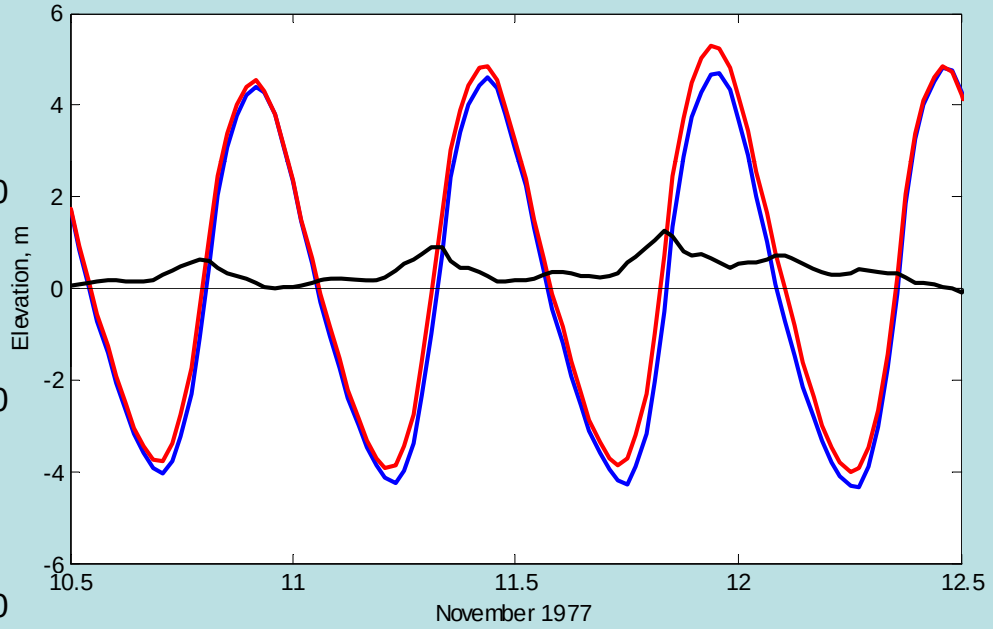
The external surge from the SW approaches/Celtic Sea dominates the surge generation.

**Reach: 2.6m**

# Flood Risk in the study area




Large 10m tidal range Liverpool Bay causes tide-surge interaction, preventing the peak surge at HW.




Greatest risk SW wind veers W during spring tides.

Extreme wave generation occurs on top of extreme high tide levels, which are increased by extreme surge conditions.


# Changes in the Dune system

Dune toe position surveyed on the 24th September 2002 and retreat following this survey until the 26th November 2002

Large changes around the point – expose (new) areas to flood risk during erosion period and during following high tide before dune recovery.

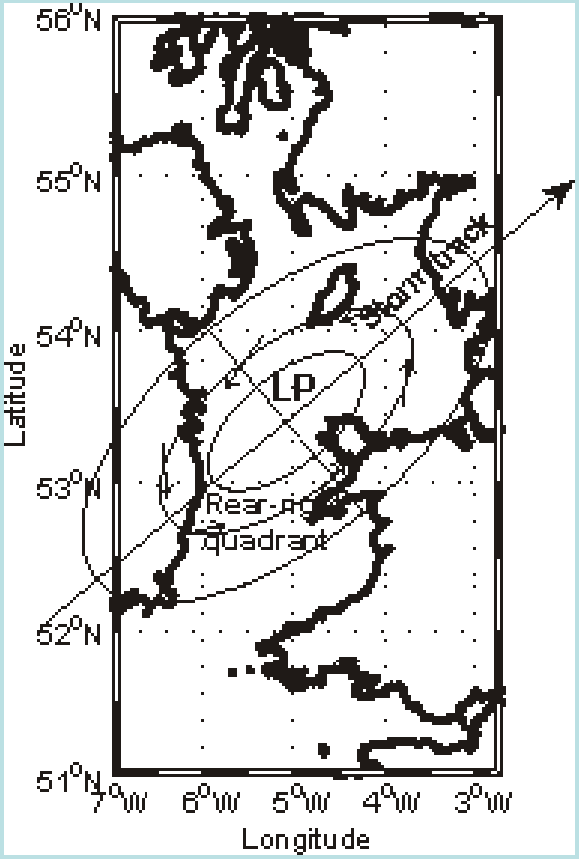
Retreat due to:

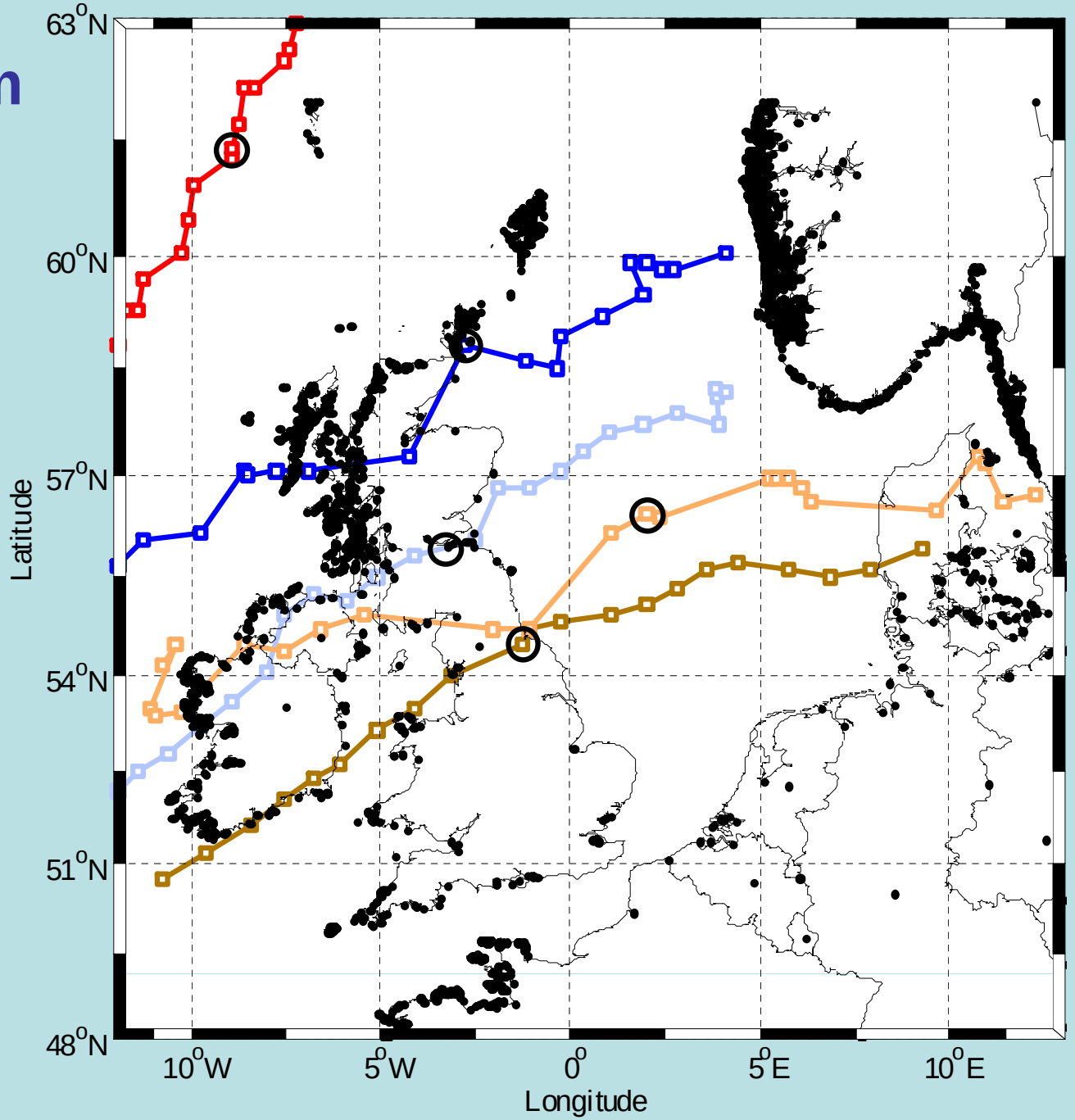
(i) storm event 25th -27th October 2002 SW-W winds, 2.3m surge, 4m waves & consecutive tides >8.7m CD.

(ii) Sequence of extreme high tidal levels during the autumn period (spring tide & any wind event SW-W).

# Liverpool storm tracks for extreme surge

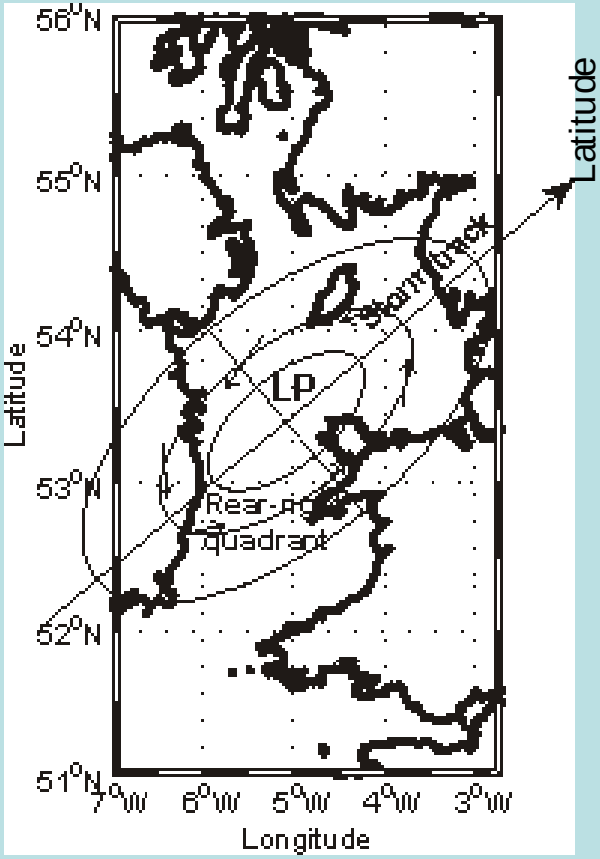
- SW-W winds

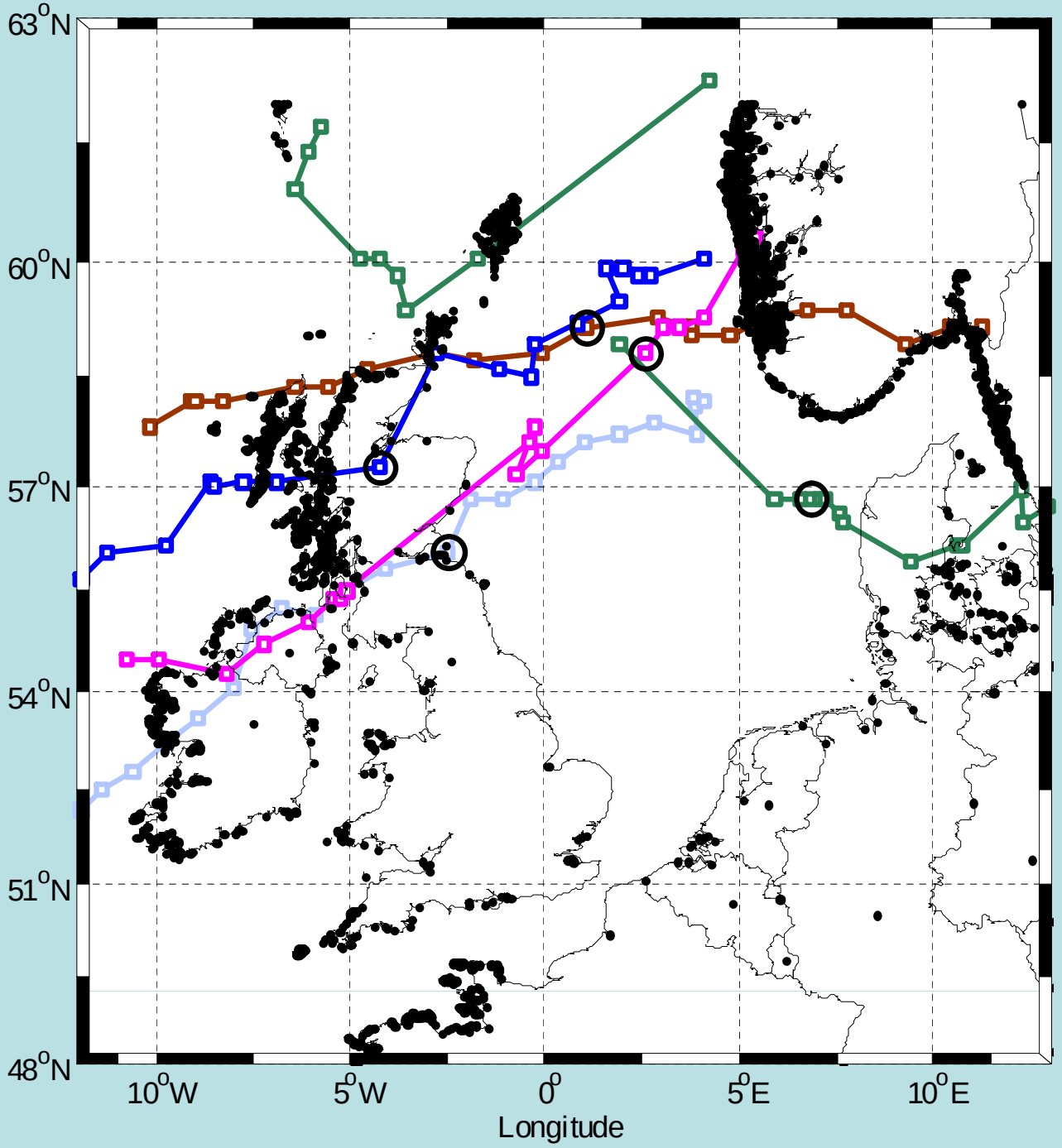


# Liverpool storm tracks for extreme waves

- W-NW winds



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Breaching of sea wall at Southport, May 1960 (Image courtesy of SMBC).

## Historical events

## Often associated with veering SW-W wind

## Past damaging storm events to the Sefton coast reported in: 1961, 1965, 1967, 1968, 1975, 1976, 1977, 1983, 1990, 1997, 2002, 2004 & 2008

Flooding at Marine Drive, Southport, November 1993 (Image courtesy of SMBC).

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# Conclusions

•POLCOMS-WAM is a valid wave-tide-surge model to apply to the Irish Sea and Liverpool Bay.

•Can now be used for future flood risk projection.

•Extreme surge levels (2.6m) along the Sefton coast occur due to SW winds.

•Extreme wave heights (5.6m offshore / 2.5m nearshore) in Liverpool Bay occur in response to NW – W winds.

•Storm tracks generating SW winds veering W lead to most severe conditions. E.g. the historical Nov 1977 event.

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# Thank You

Southport Pier

## Questions?