

# Modelling the coasts of North Wales



PRIFYSGOL  
BANGOR  
UNIVERSITY



Peter Robins ([p.robins@bangor.ac.uk](mailto:p.robins@bangor.ac.uk))

Centre for Applied Marine Sciences, Bangor University

## NW Anglesey

Tidal energy extraction  
Sediment transport

## Menai Strait

Tidal asymmetry  
Sediment transport

## Conwy Estuary

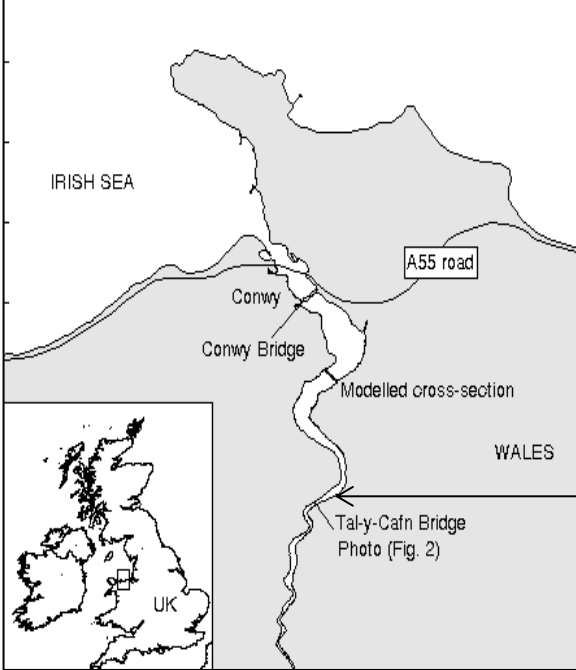
Biophysical modelling  
Nutrient transport

## Mawddach Estuary

Flooding  
Sea-level rise  
Coastal management

## Dyfi Estuary

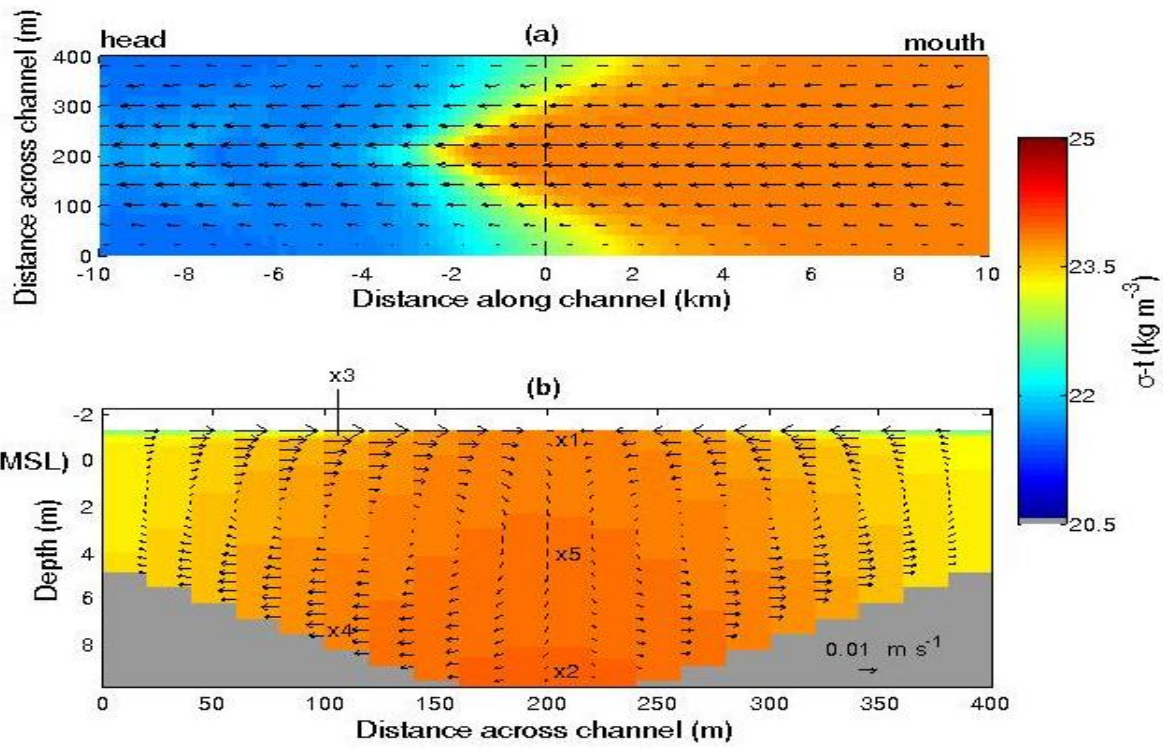
Flooding  
Sea-level rise  
Coastal Management

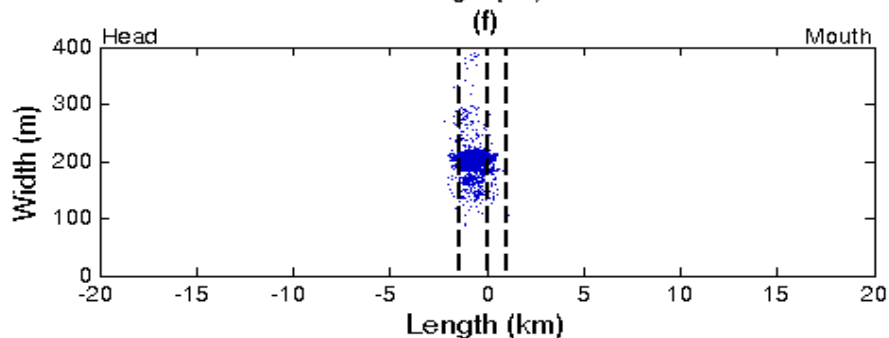
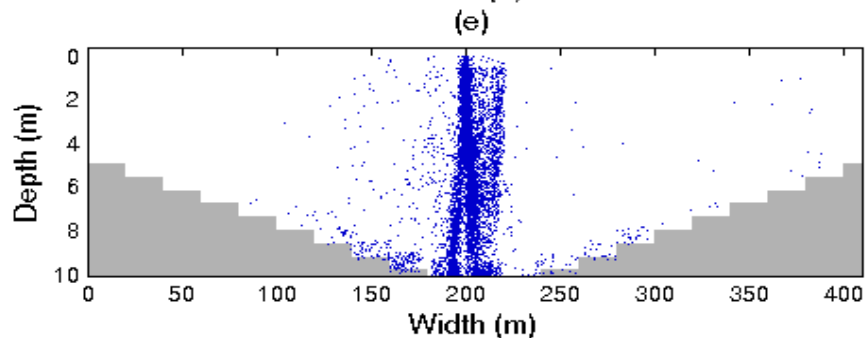
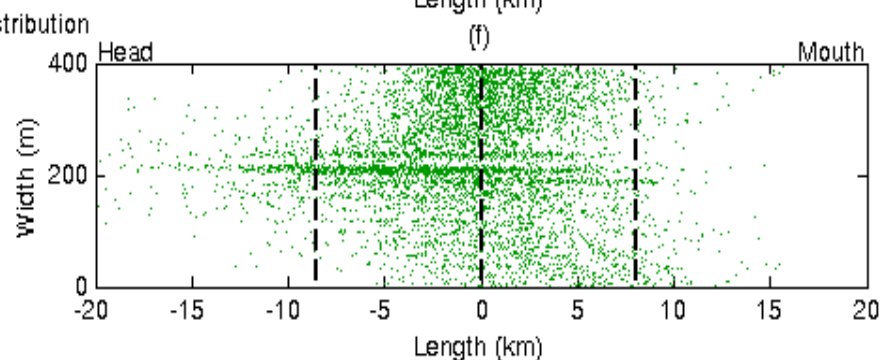
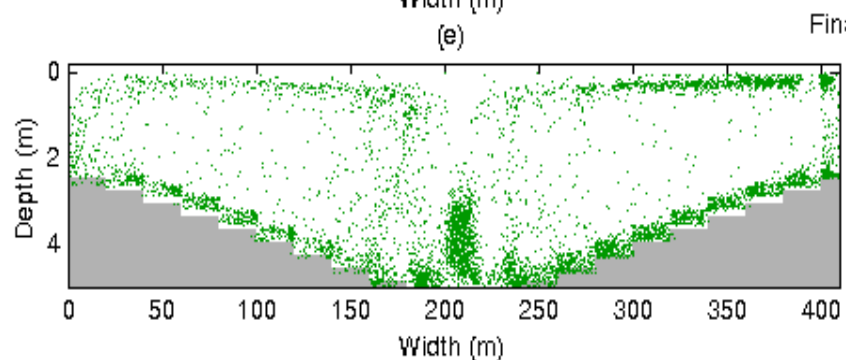
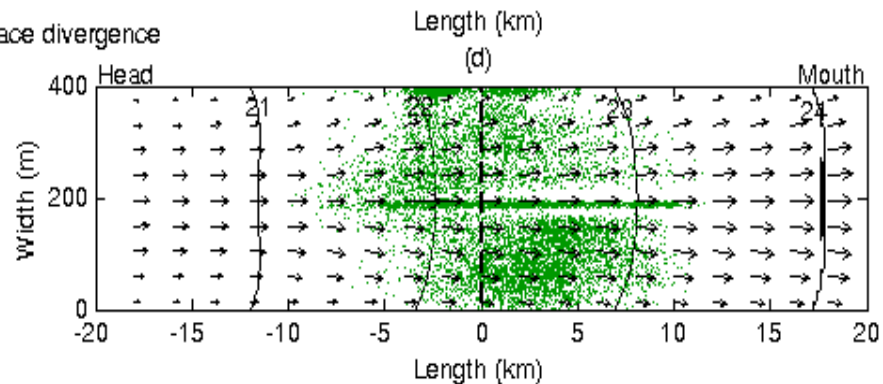
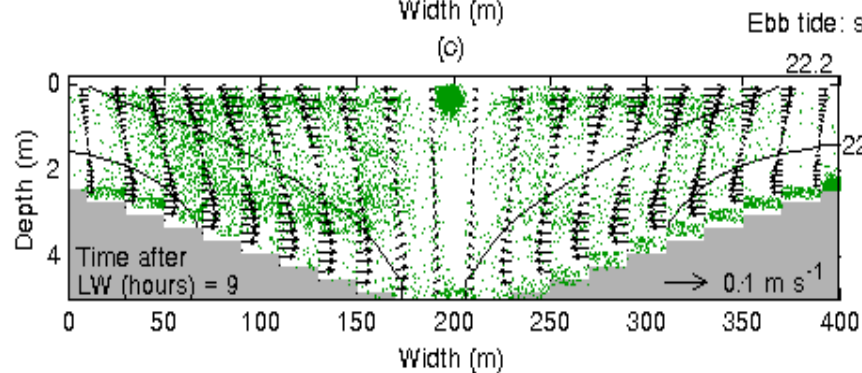
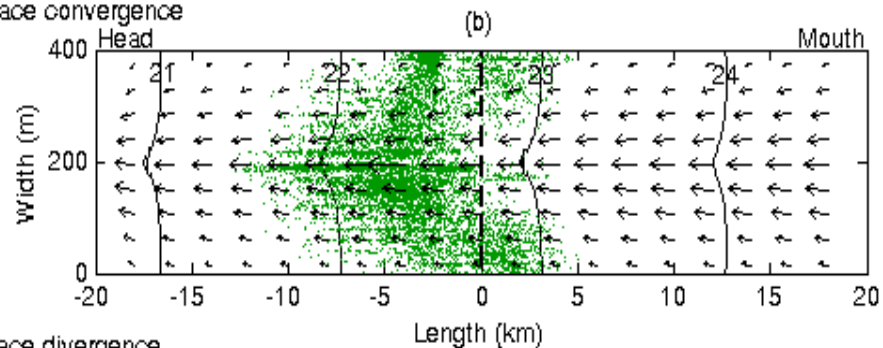
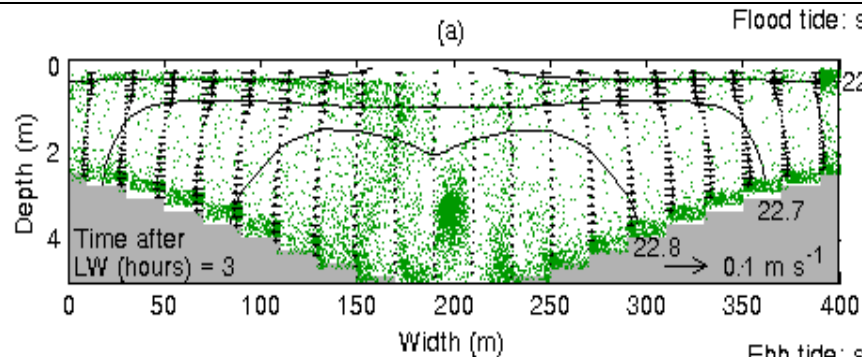


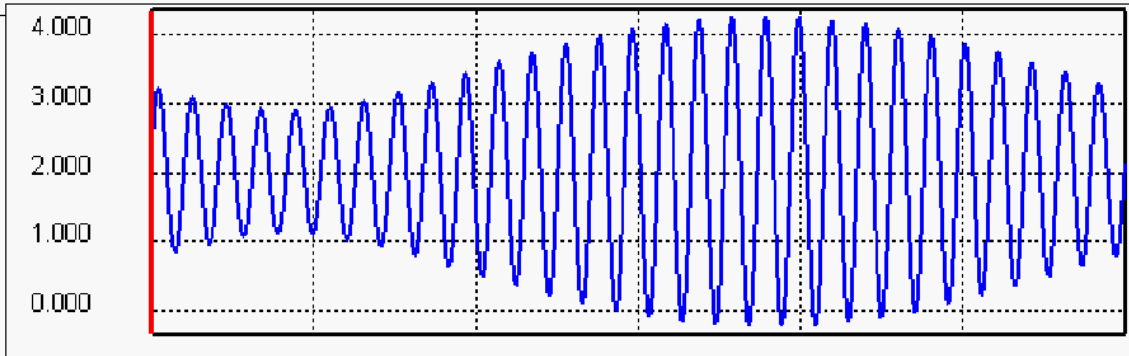
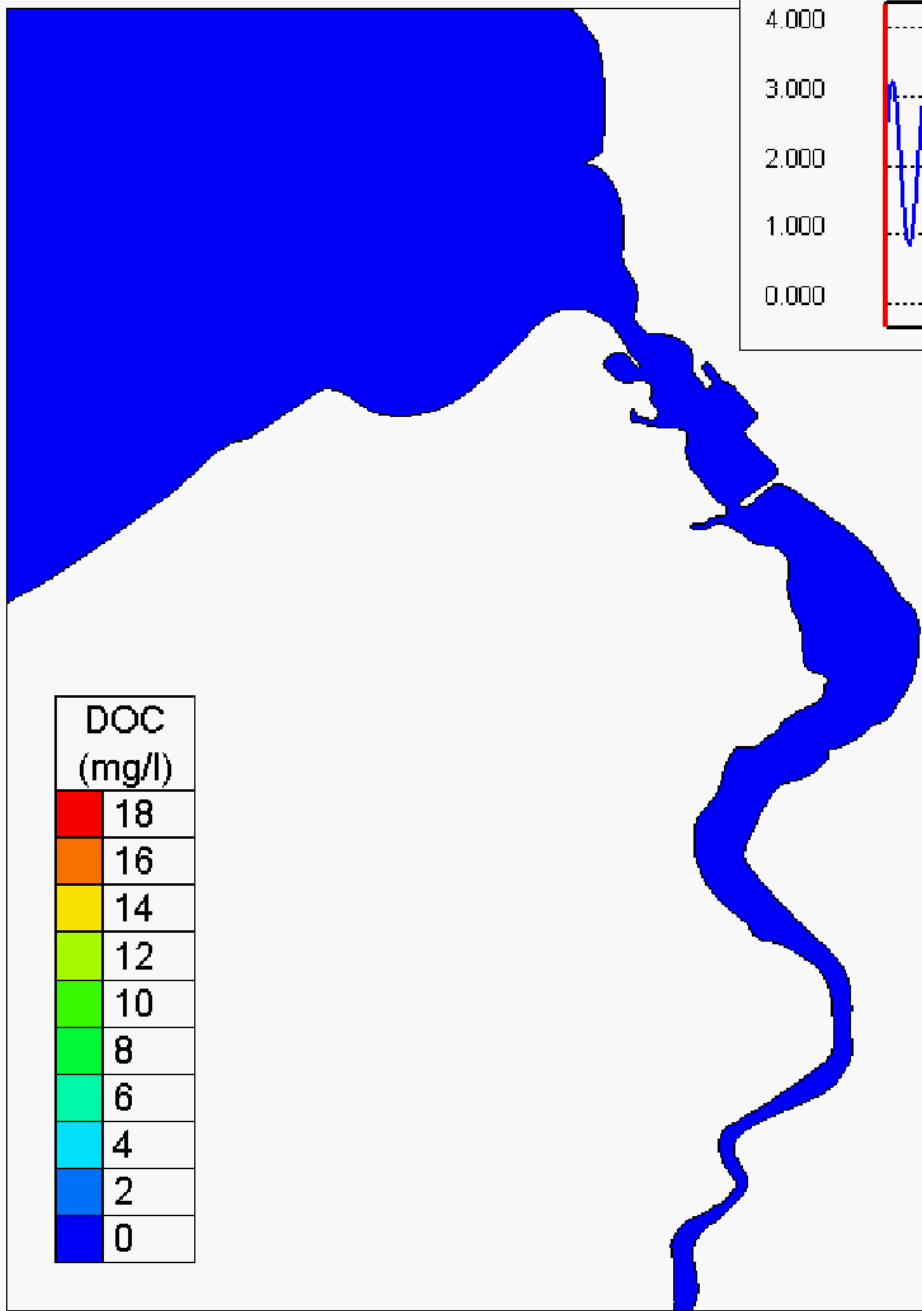
# Conwy Estuary

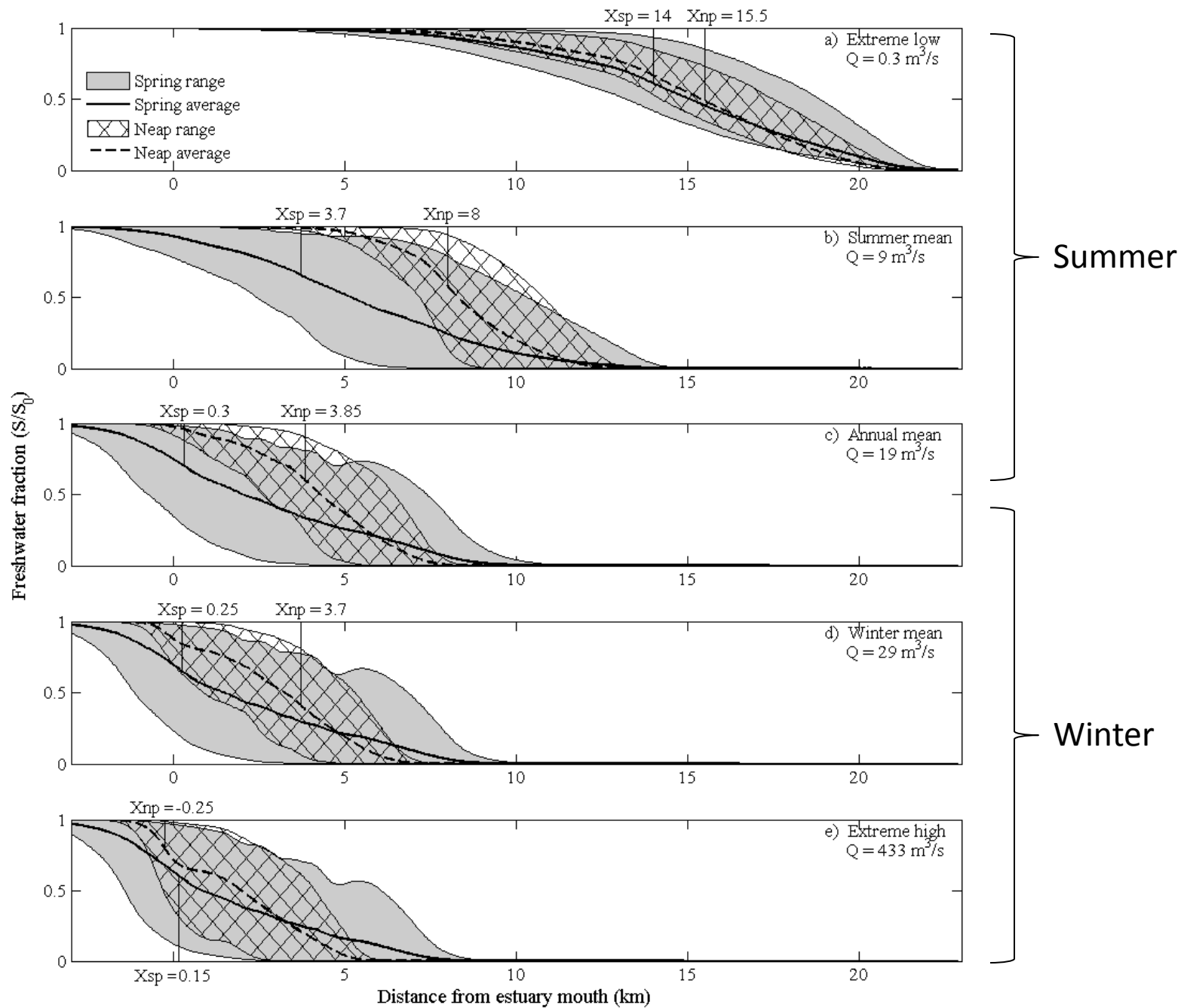


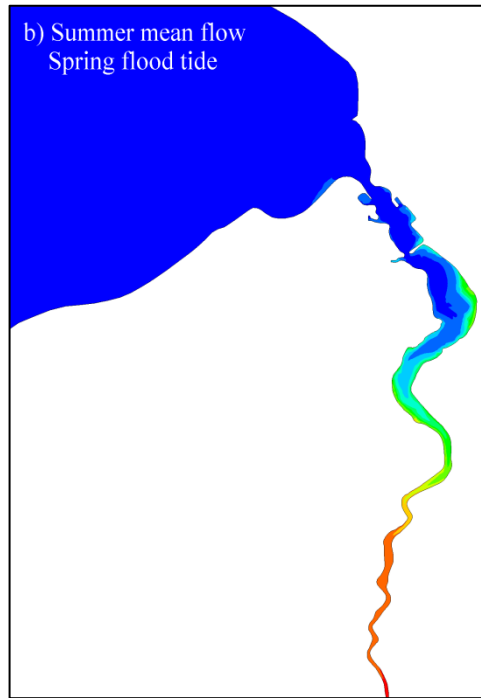
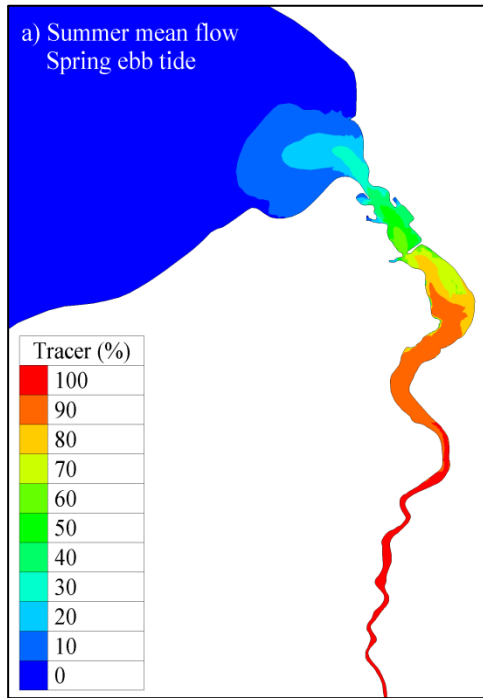
**Simulating an axial convergence front and larvae tracking**  
(Robins et al. 2012)



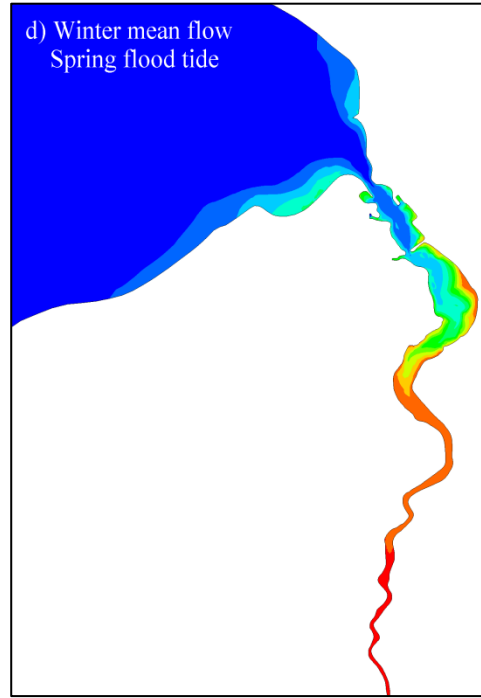
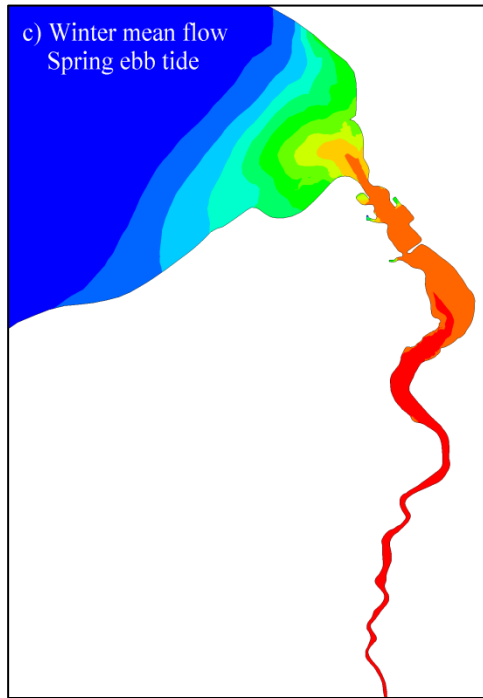




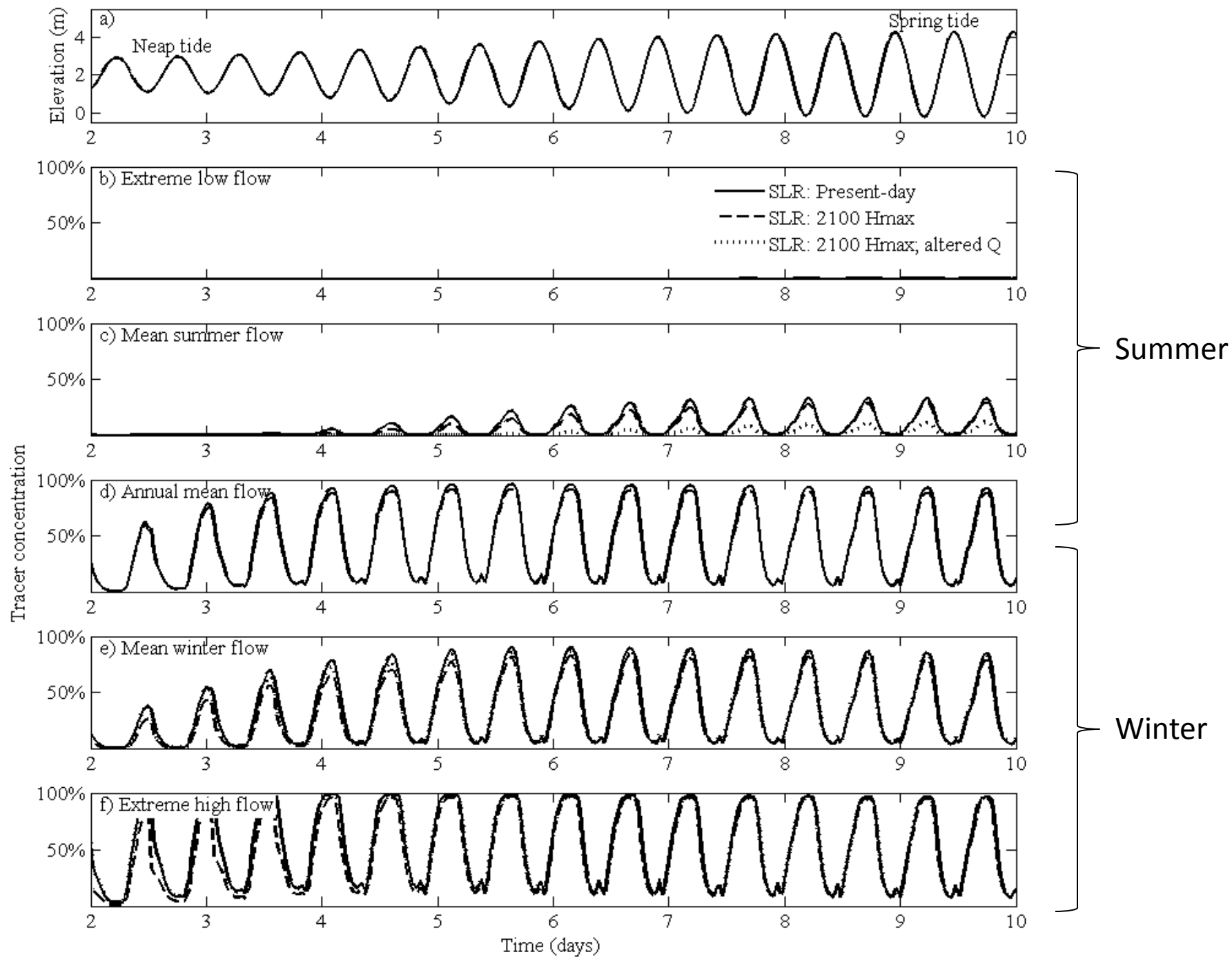




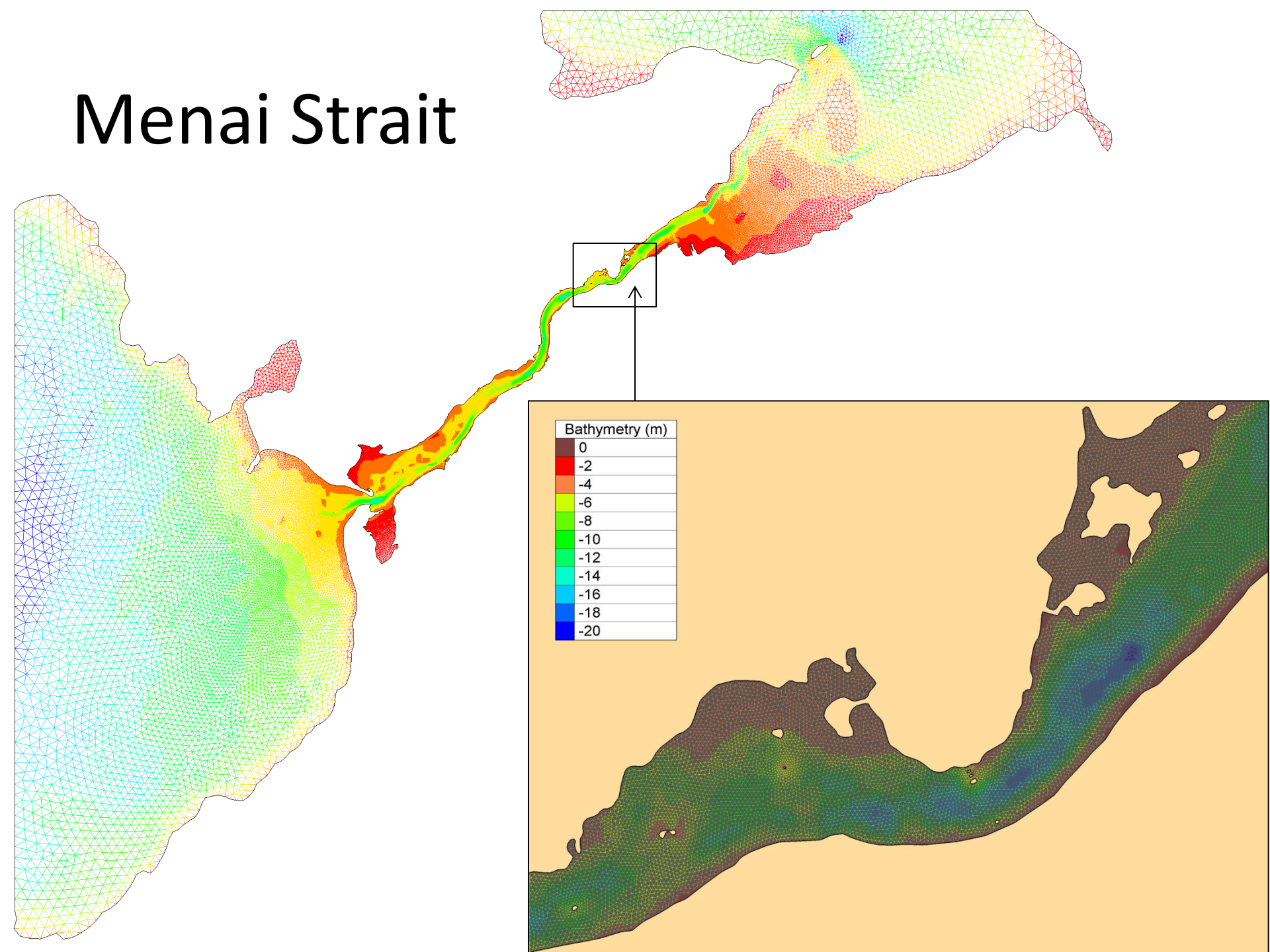
Summer



Winter



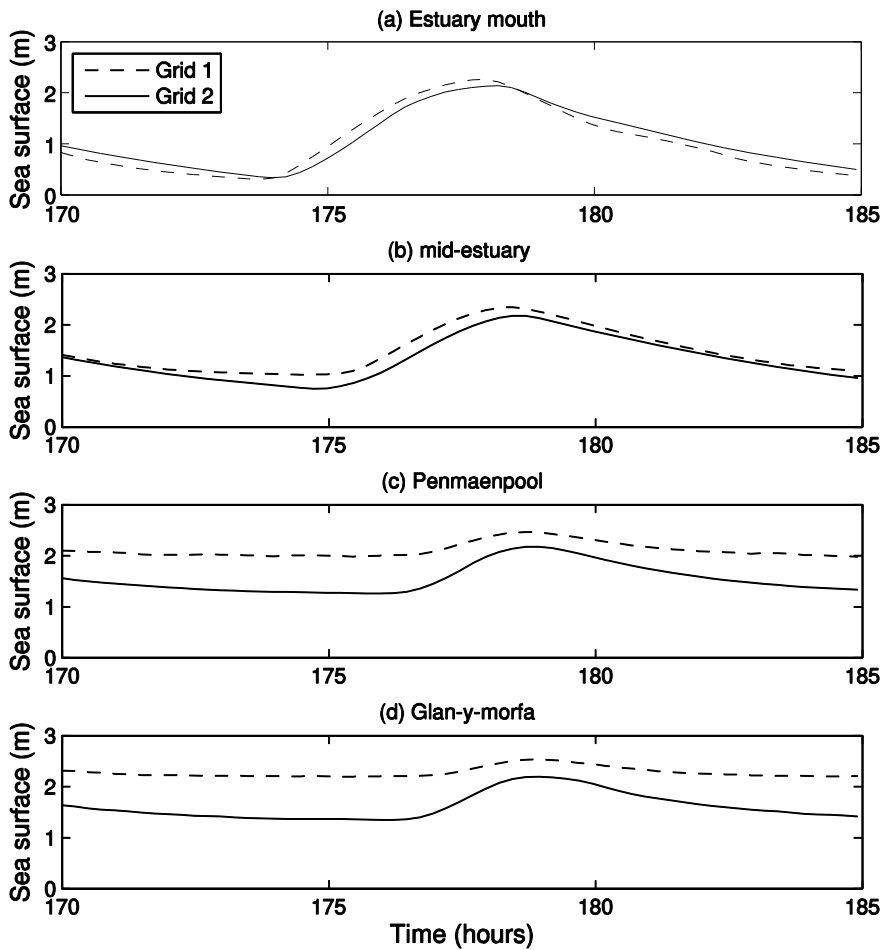
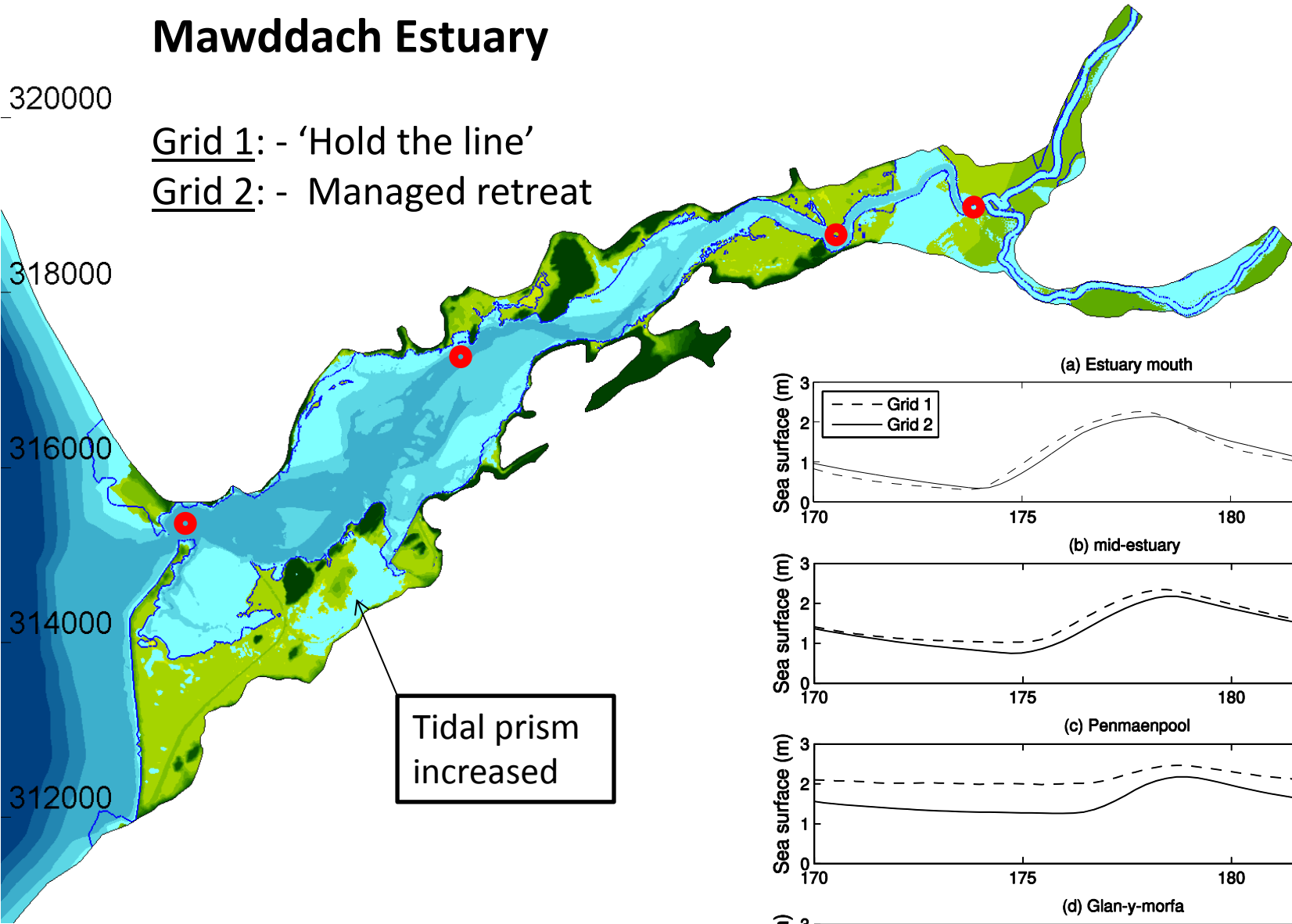
# Menai Strait



# Mawddach Estuary

Grid 1: - 'Hold the line'  
Grid 2: - Managed retreat

320000  
318000  
316000  
314000  
312000



296000

295000

294000

293000

292000

291000

**Bad data!**



259000

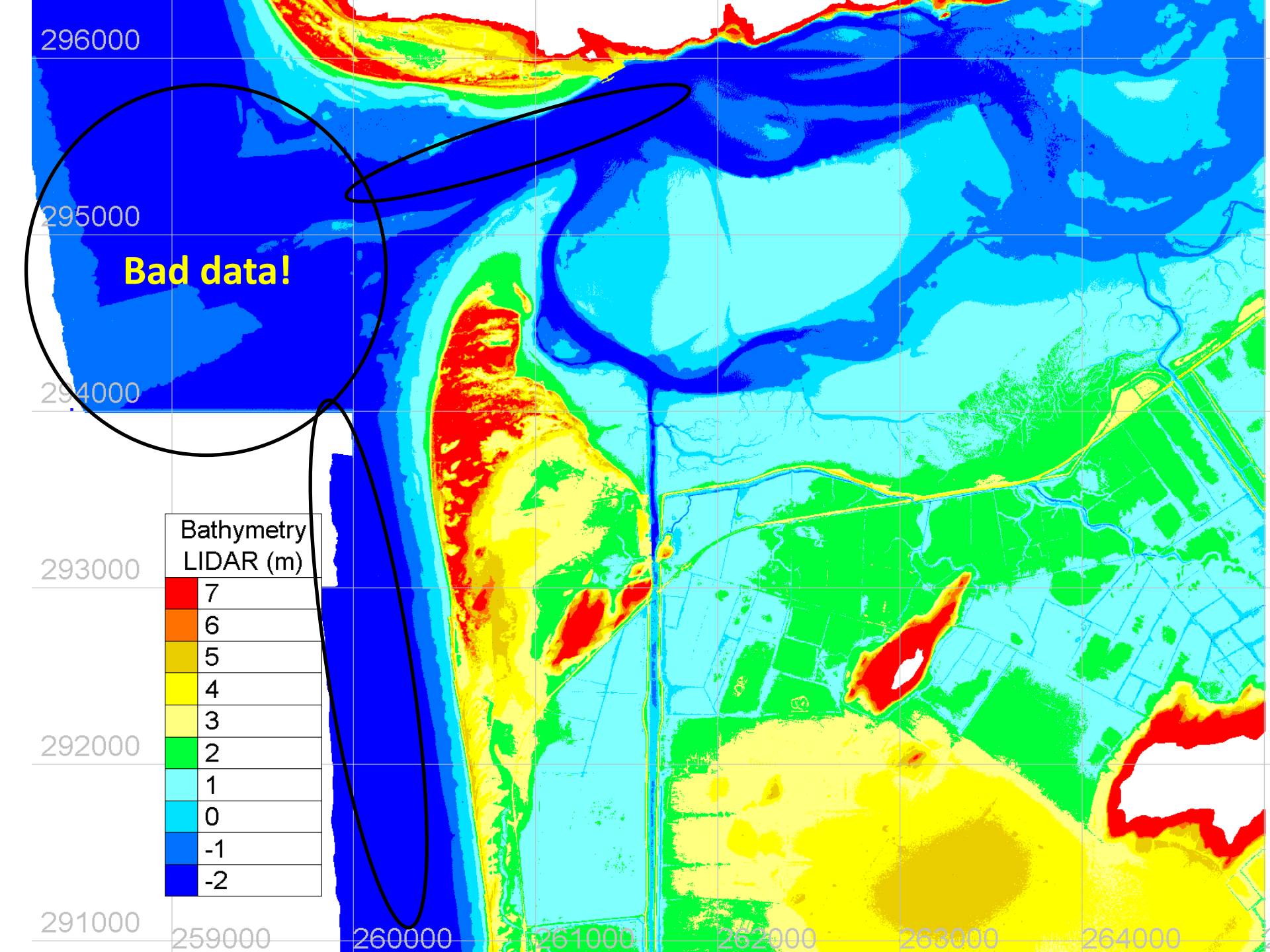
260000

261000

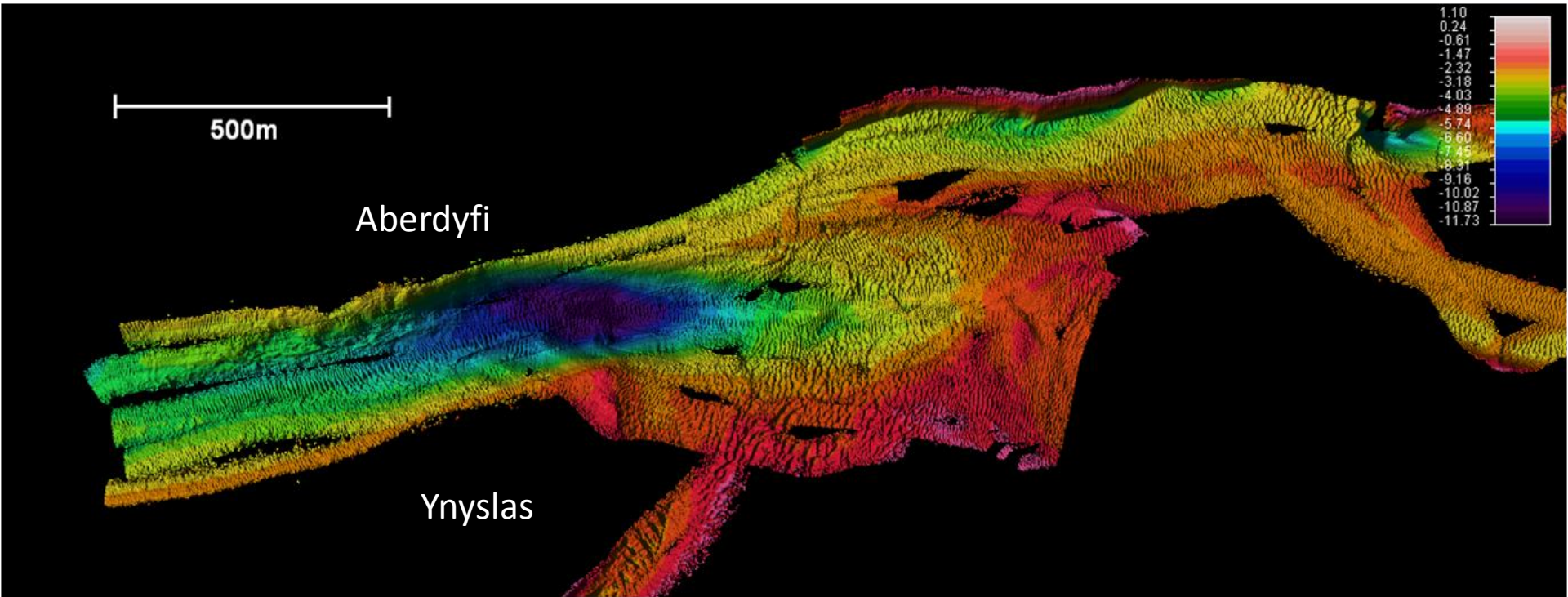
262000

263000

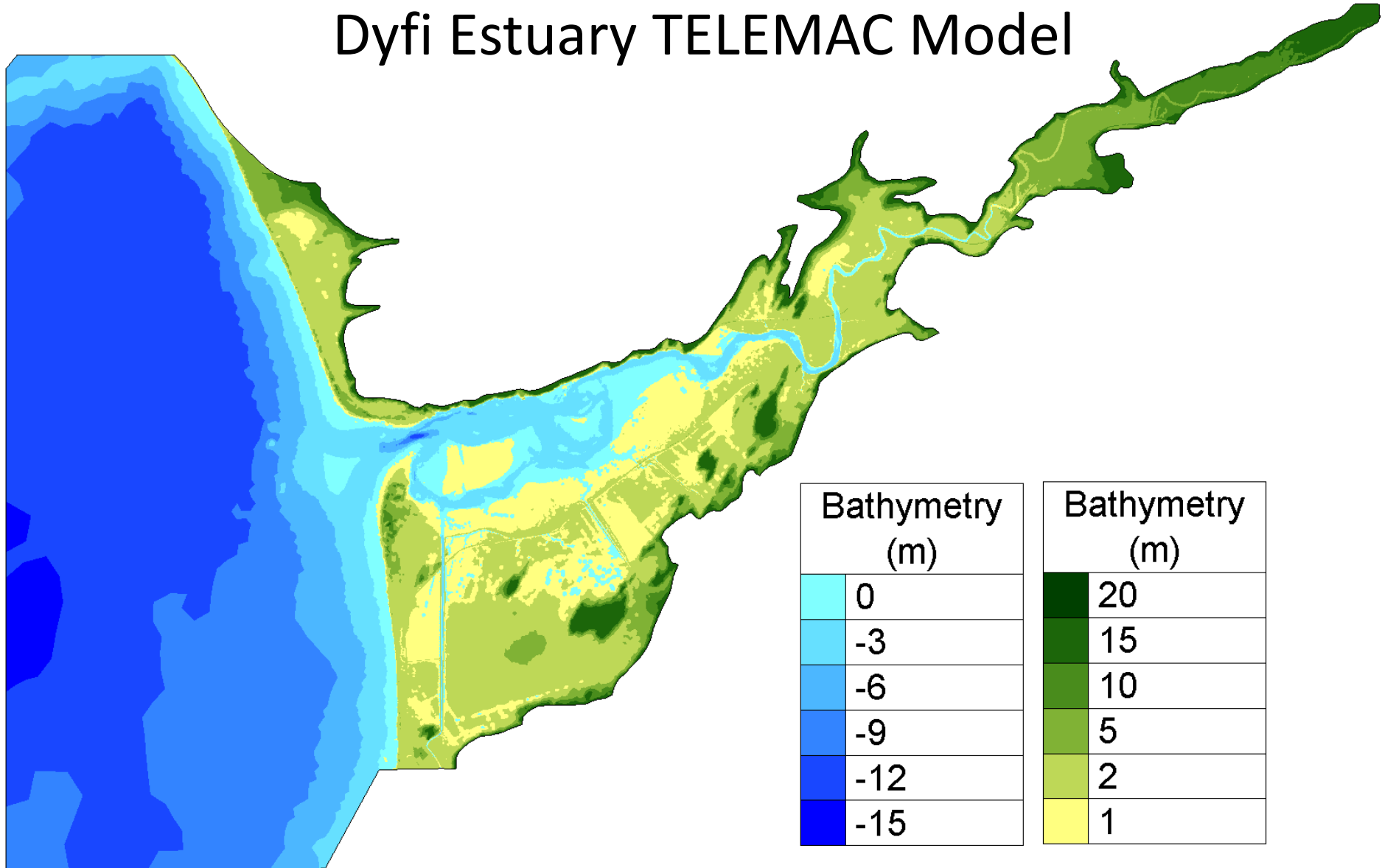
264000



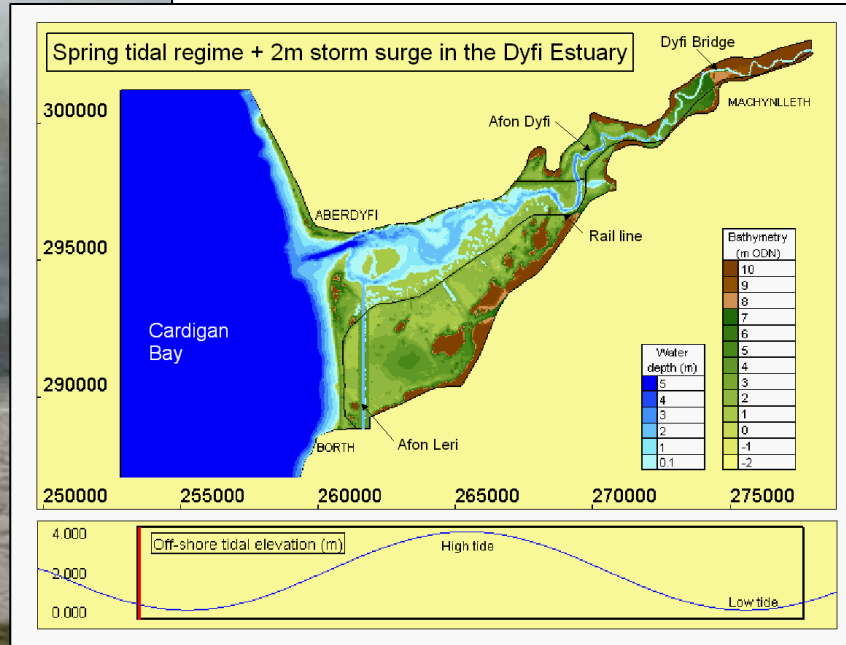
# 2007 Multibeam bathymetry data



# Dyfi Estuary TELEMAC Model



# Dyfi Estuary: January 2014 storms



[Home](#) ▶ [Data](#) ▶ [Real-time data – UK National Tide Gauge Network](#) ▶

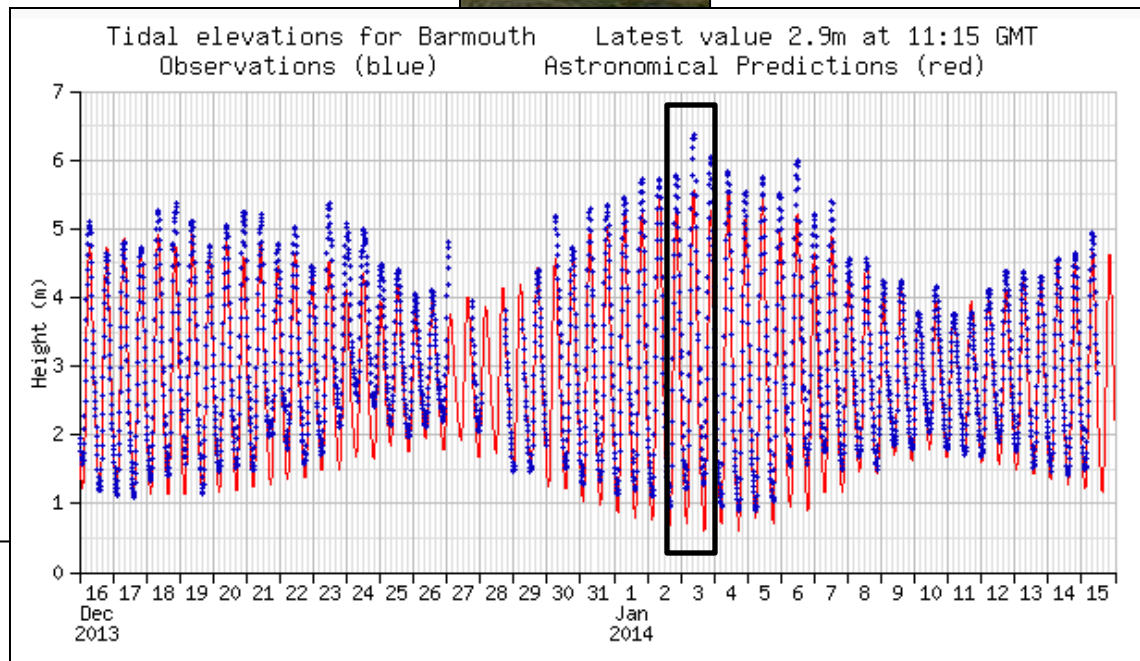
## Highest & lowest surges for Barmouth

Sea level networks

### Barmouth, up to March 2008

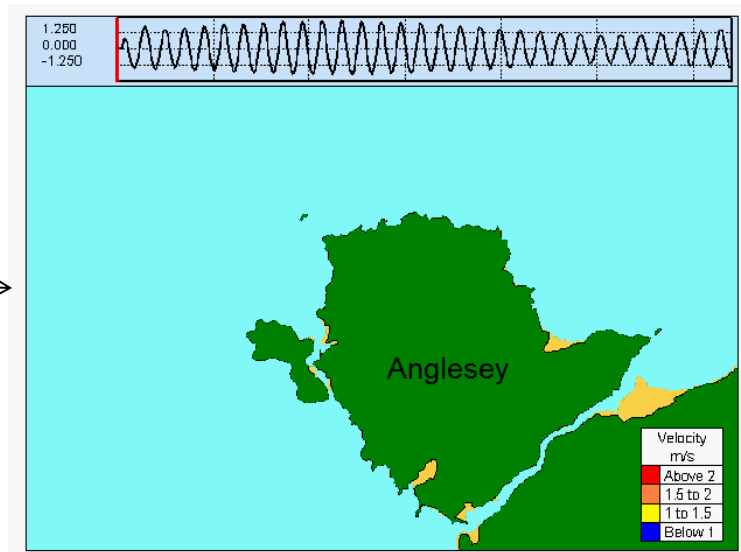
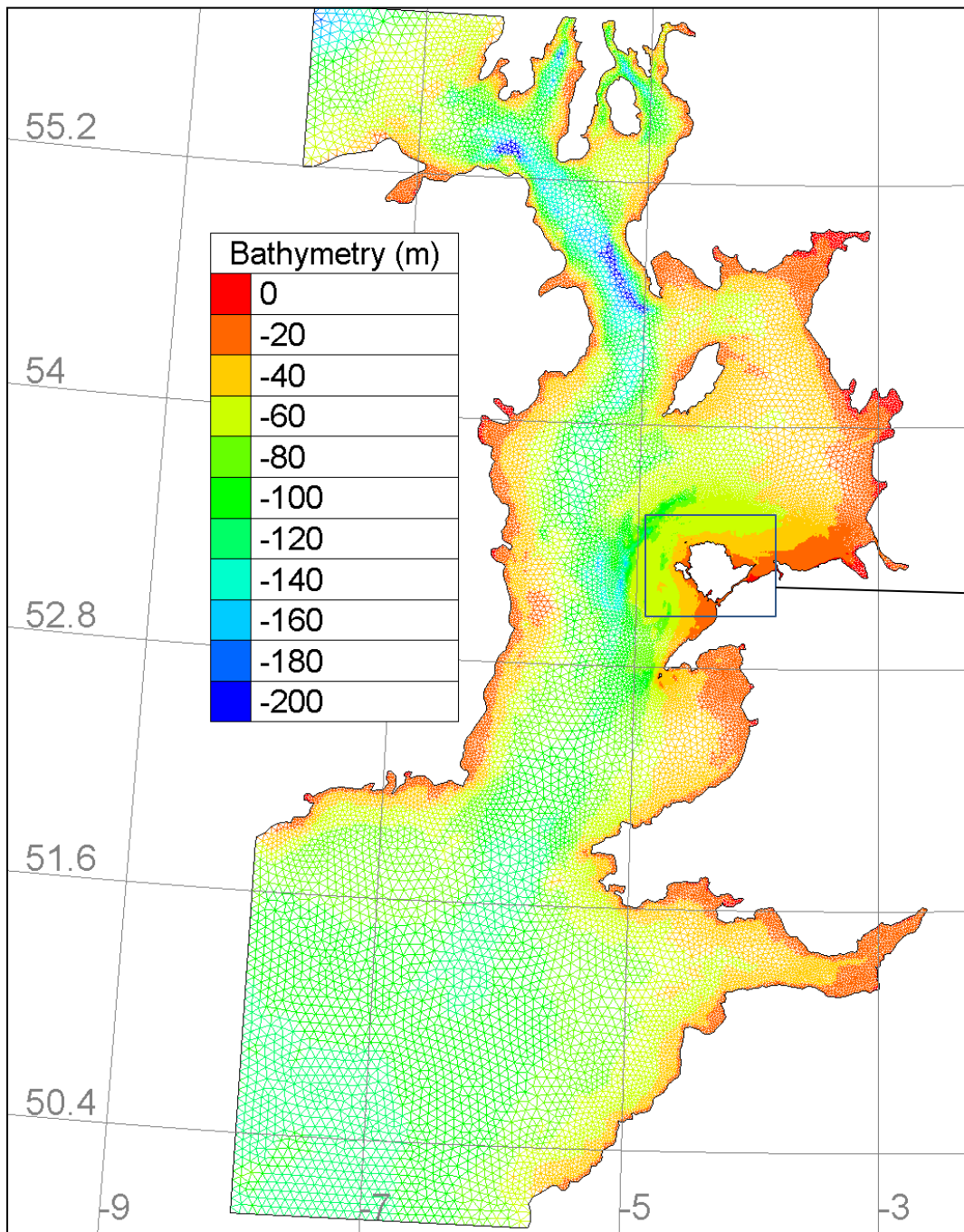
#### Top 10 positive surges

2.18m	04:00	26 Feb 2002
2.09m	00:00	13 Dec 2000
1.95m	06:45	27 Oct 2002
1.95m	18:15	24 Dec 1997
1.86m	06:15	8 Dec 1994
1.63m	06:00	11 Jan 2007
1.50m	14:00	21 Jan 1995
1.50m	19:00	24 Oct 1998
1.46m	19:45	8 Dec 1993
1.42m	03:30	3 Dec 2006



# Northwest Anglesey: tidal energy

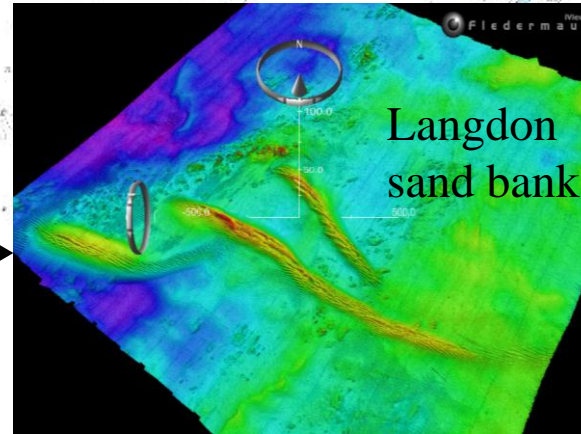




Multibeam data: May 2012

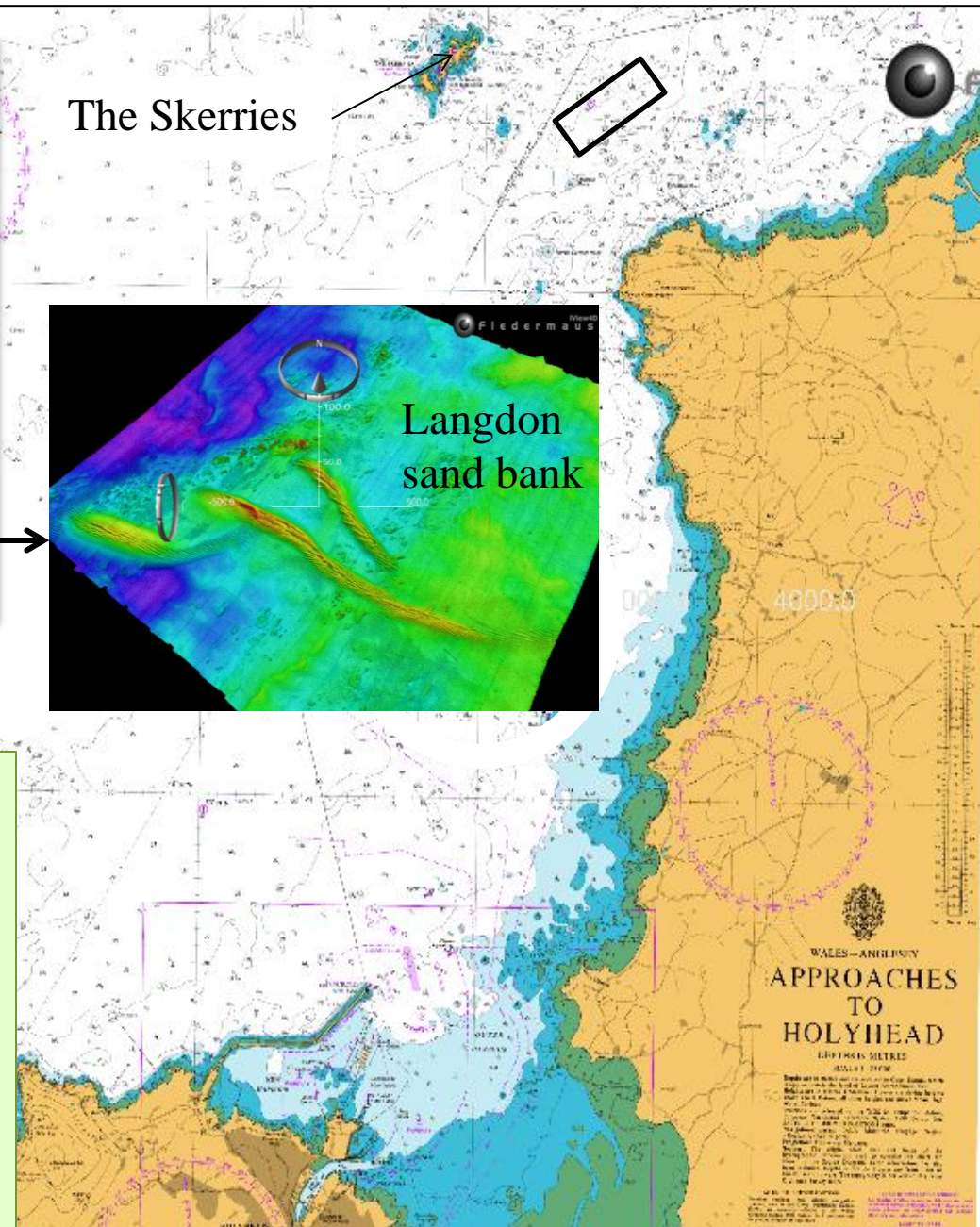


The Skerries



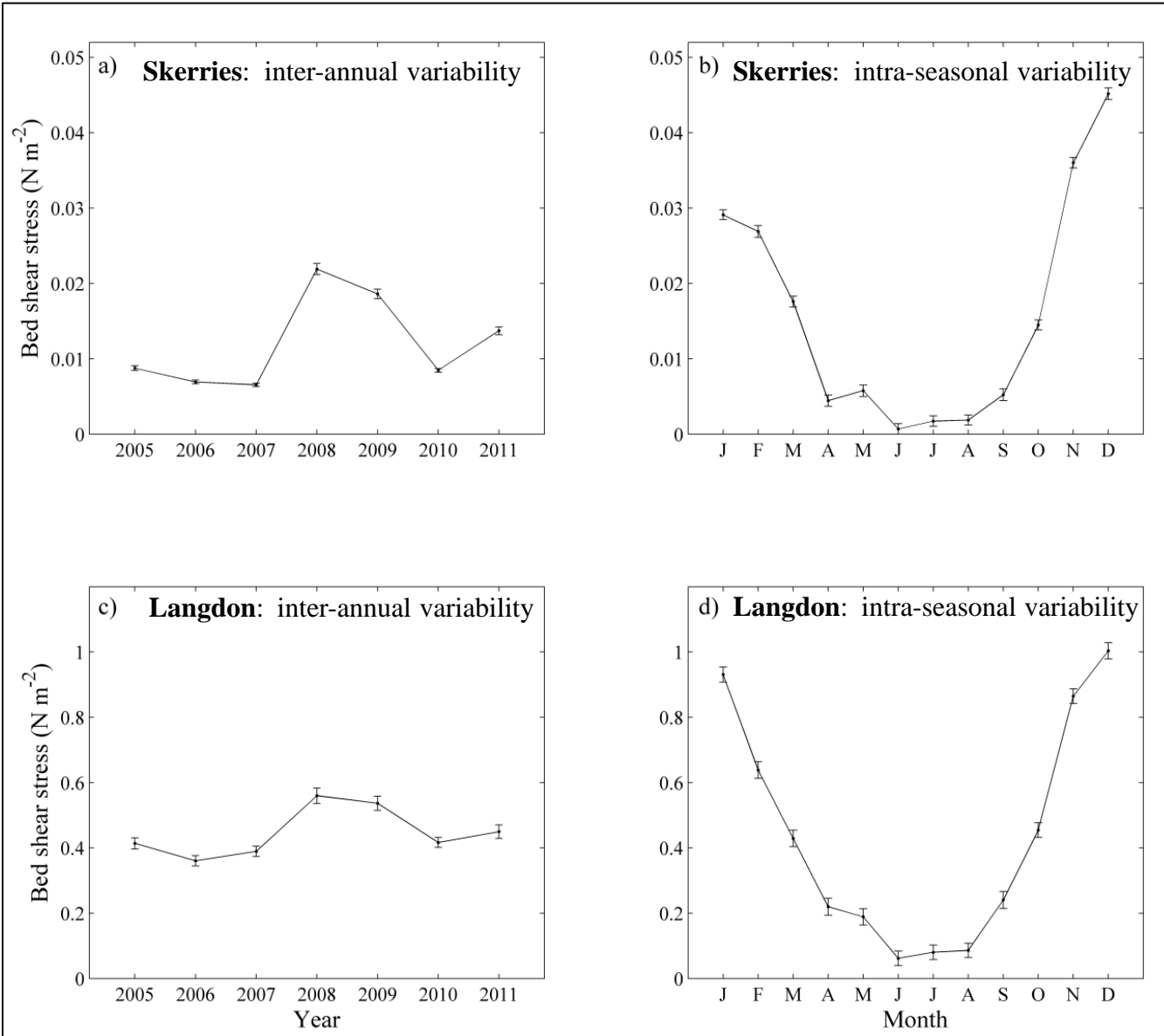
## 2) Sand bank formations

- form in the lee of islands and headlands
- Important for natural coastal protection, particularly during storms, as they refract and dissipate wave energy



# Natural variability: wave-induced bed shear stress

$$\tau_{wave} = \frac{1}{2} \rho f_w U W_{RMS}^2$$



# Tidal-stream energy extraction

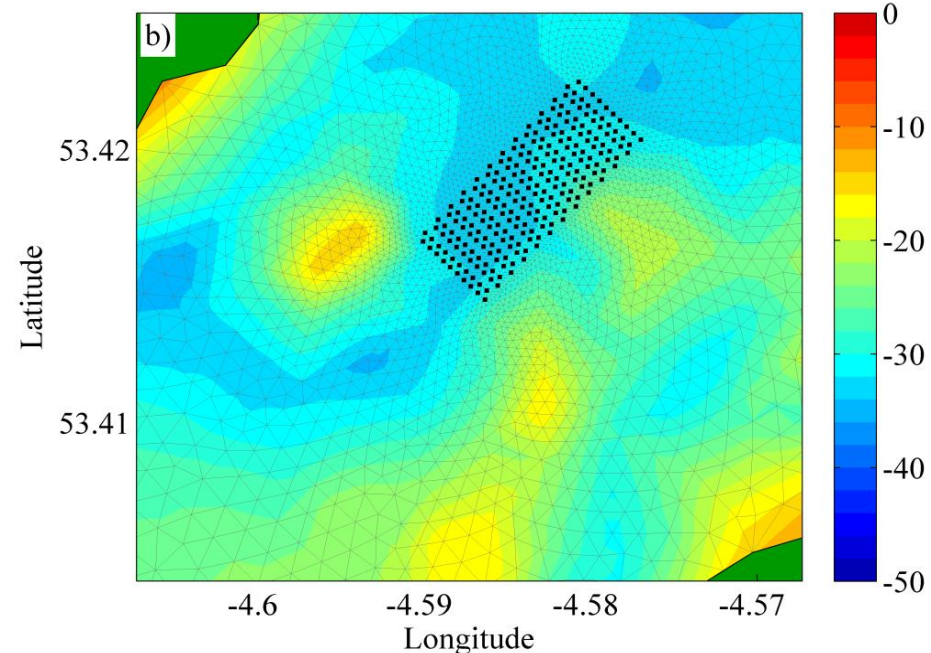
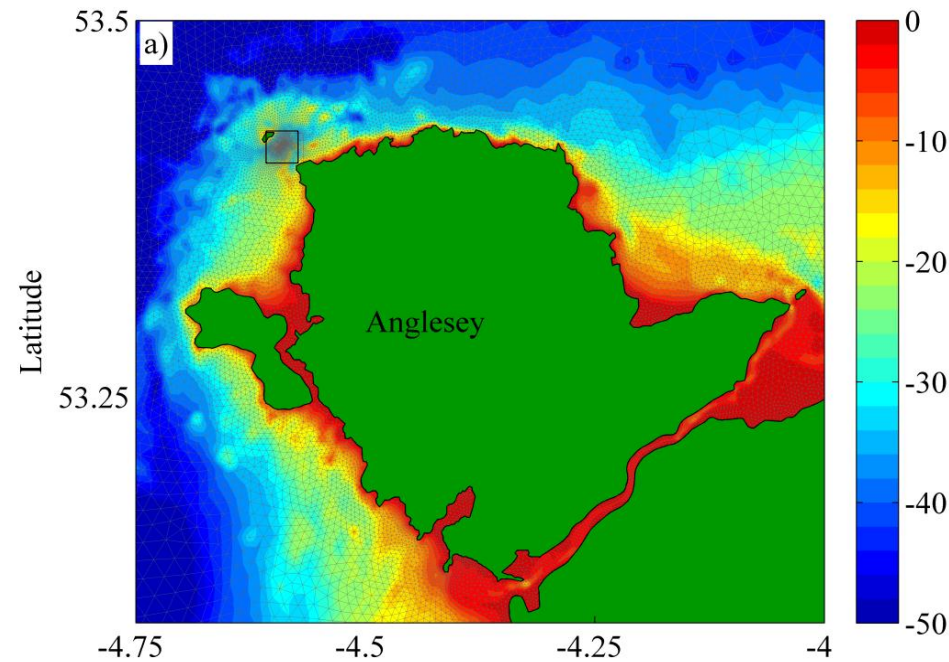
- How do TEC arrays affect:
  - Suspended sediment?
  - Formation of sand banks?
  - Net sediment fluxes?
- Is the impact significant relative to natural intra-seasonal and inter-annual variations?

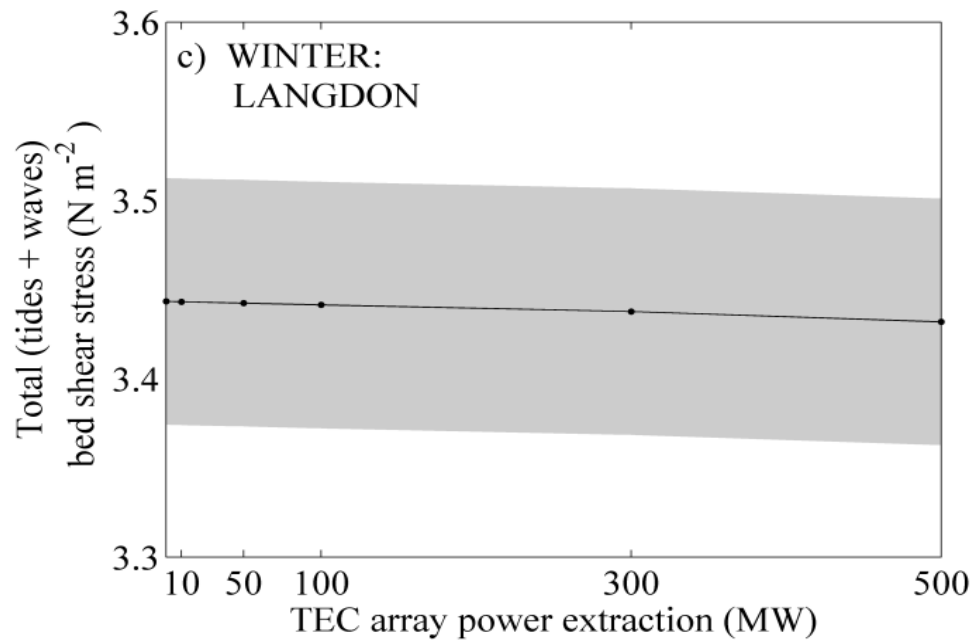
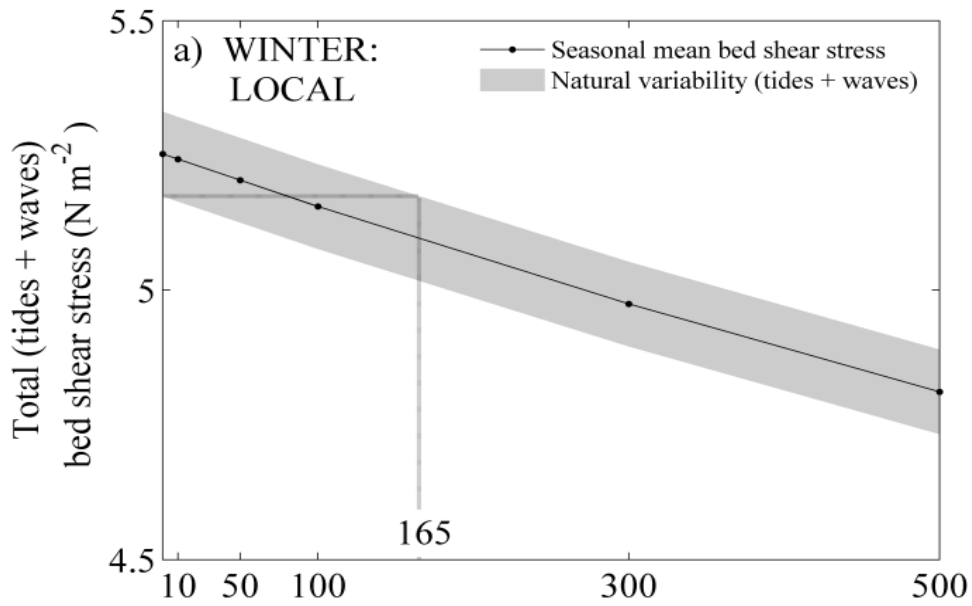
## TEC array simulations:

- 2 MW turbines induce drag force on flow

$$F_x = -C_p \frac{P}{\rho U A D} \cos(\theta)$$

- 10, 50, 100, 300, 500 MW TEC arrays
- Staggered turbines





Reference: Robins et al. 2014  
(Renewable Energy)