Field Observations of Step Dynamics on a Macrotidal Gravel Beach

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C-CoDE

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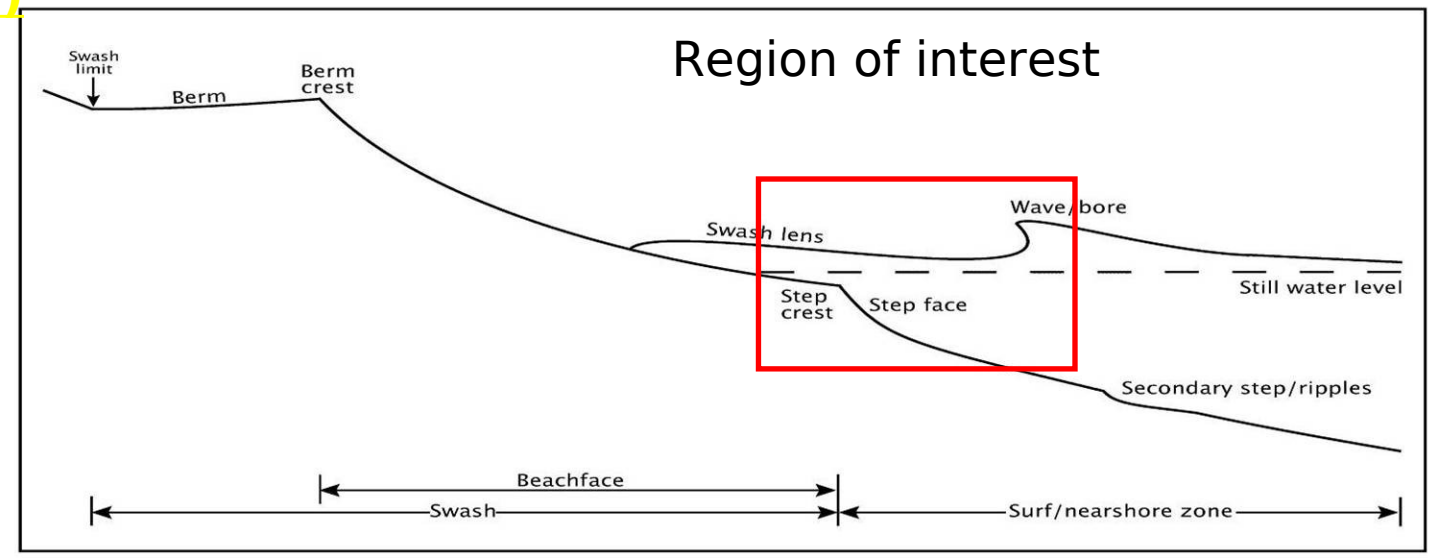
he beach step (1)



- Protective feature – maintains reflectivity during storms
- Common feature on steep (coarse-grained) sand and gravel beaches
- Steep hydrodynamic gradient
- Because of the step, the beachface is more hazardous at high tide

he beach step (2)

1) ... migrates with the tide? [Strahler, 1966; Nordstrom and Jackson, 1993]

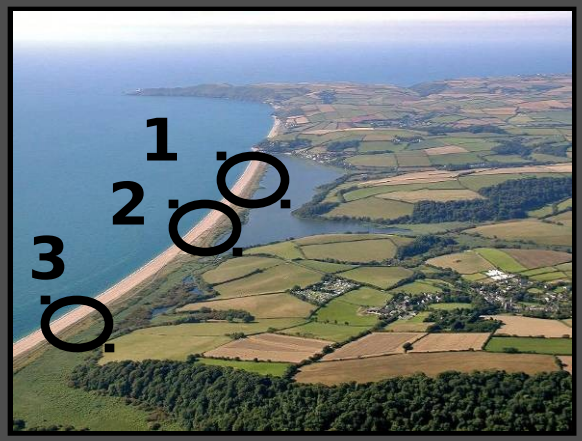
2) ... is sensitive to variations in wave breaker type? [Larson and Sunamura, 1993]

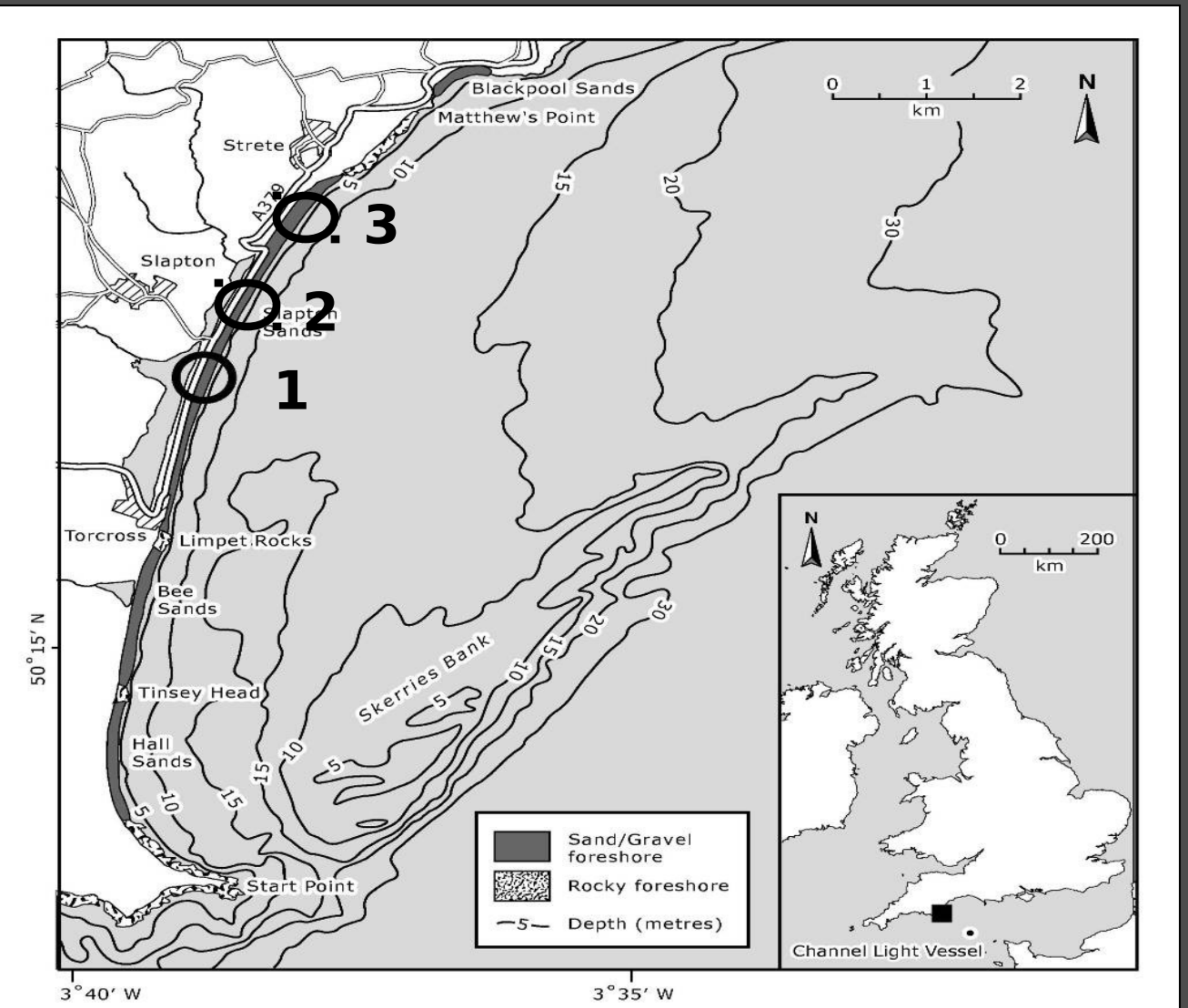
3) ... increases in height with wave height? [Sunamura, 1984; Hughes and Cowell, 1987]

4) ... concentrate the coarsest sediments found on the beach face? [Short, 1984; Bauer and Allen, 1995]

5) ... is a sediment convergence point – analogous to a breakpoint bar? [Miller and Ziegler, 1958]

ld Site: Slapton, Start Bay, Devon, UK





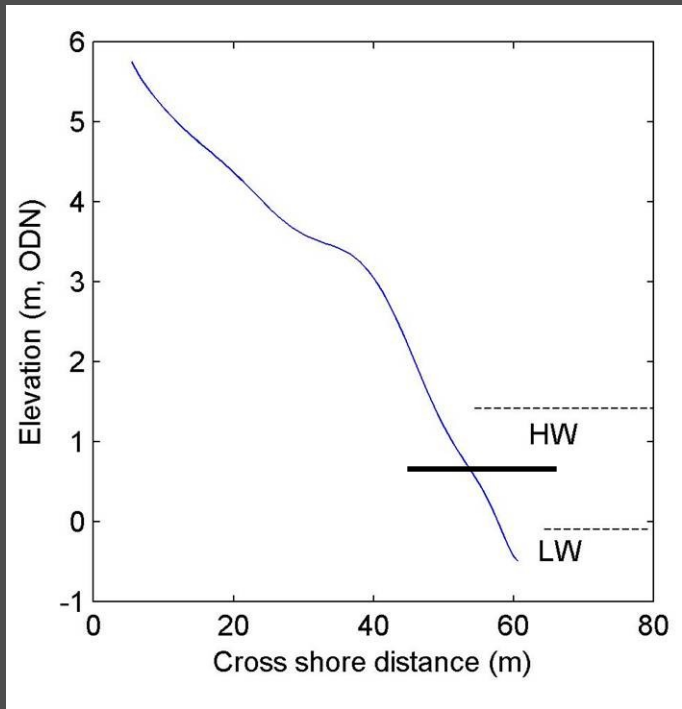
Macrotidal (4-4.5m springs)

Very 2-D, swash aligned

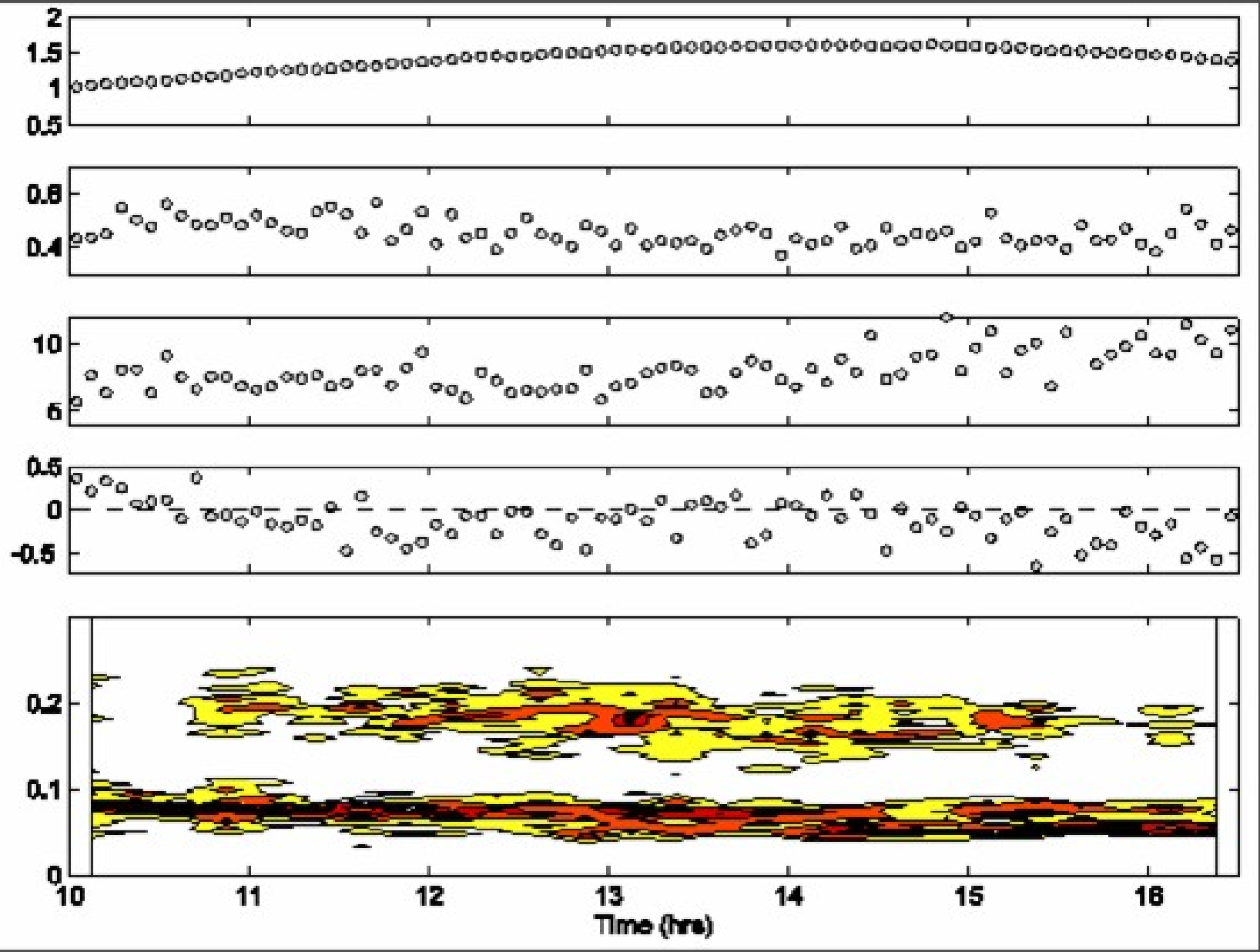
D_{50} ~ 6mm

tanβ = 0.1 – 0.2

periment 27th September 2005



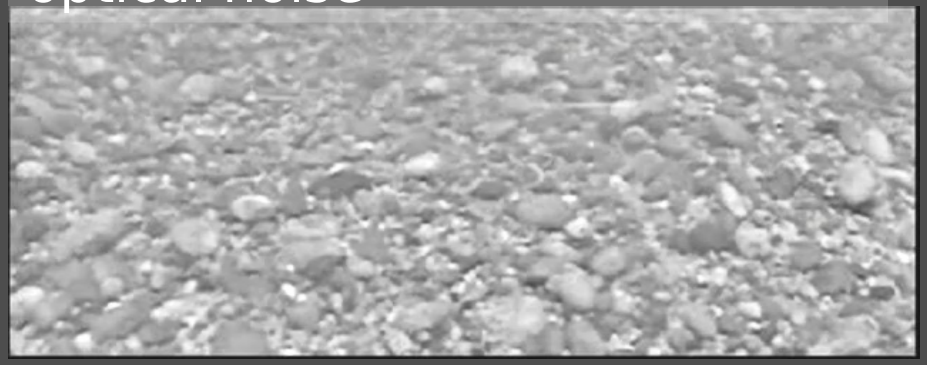
Hydrodynamics



ediment Transport (1)

~4.5 hours of video de-compiled into 402370 high res. frames

variety of adaptive filtering techniques to remove several sources of electrical and optical noise

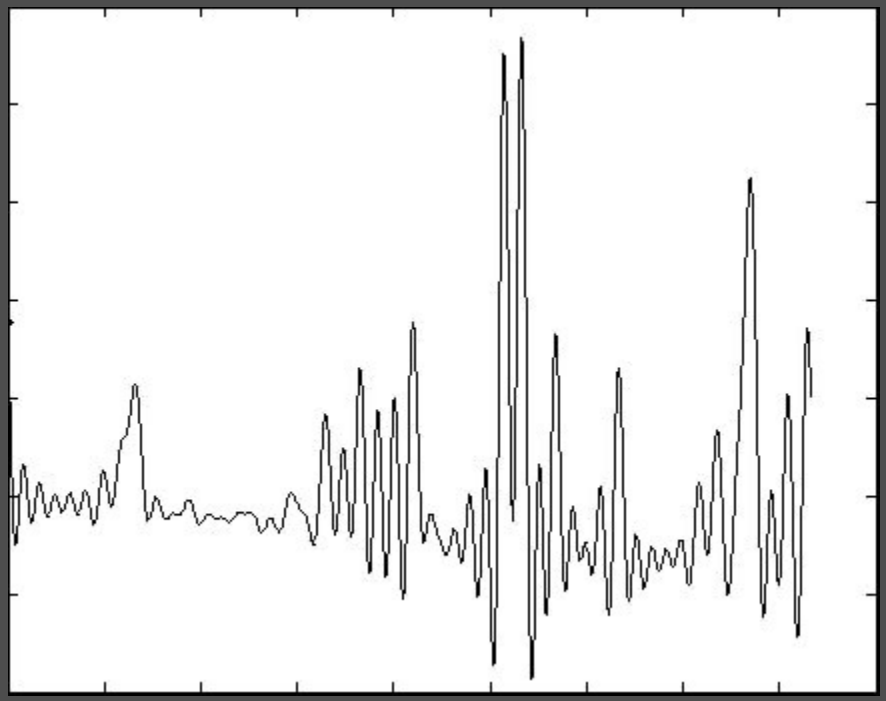


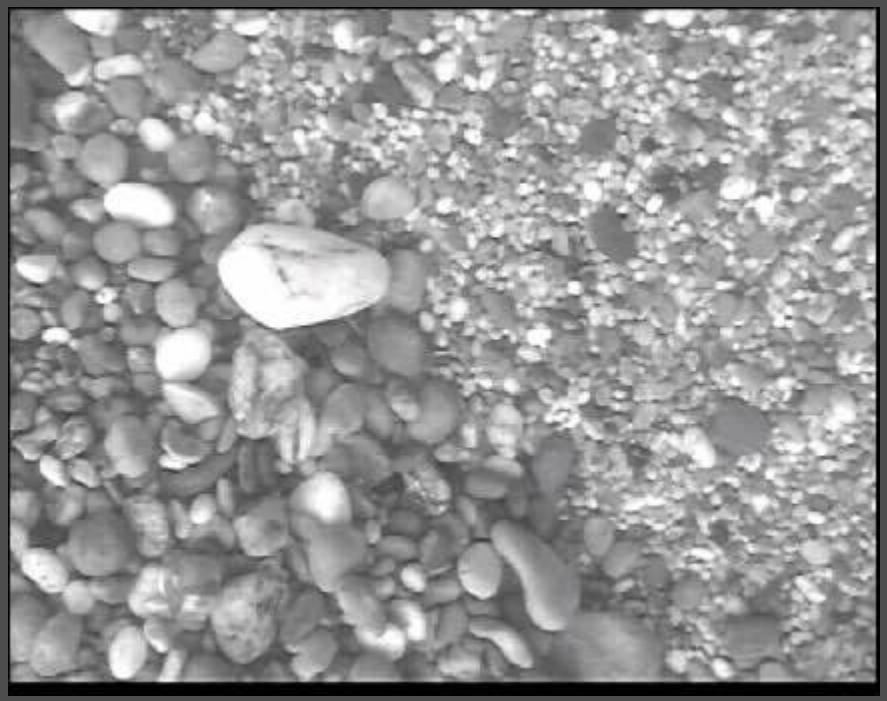
2D correlation between each successive frame provided a dimensionless (and scalar) 'bed motion coefficient'

$$\Omega = \frac{\sum_m \sum_n \alpha\beta}{\left[\sum_m \sum_n \alpha^2\right] - \left[\sum_m \sum_n \beta^2\right]}$$

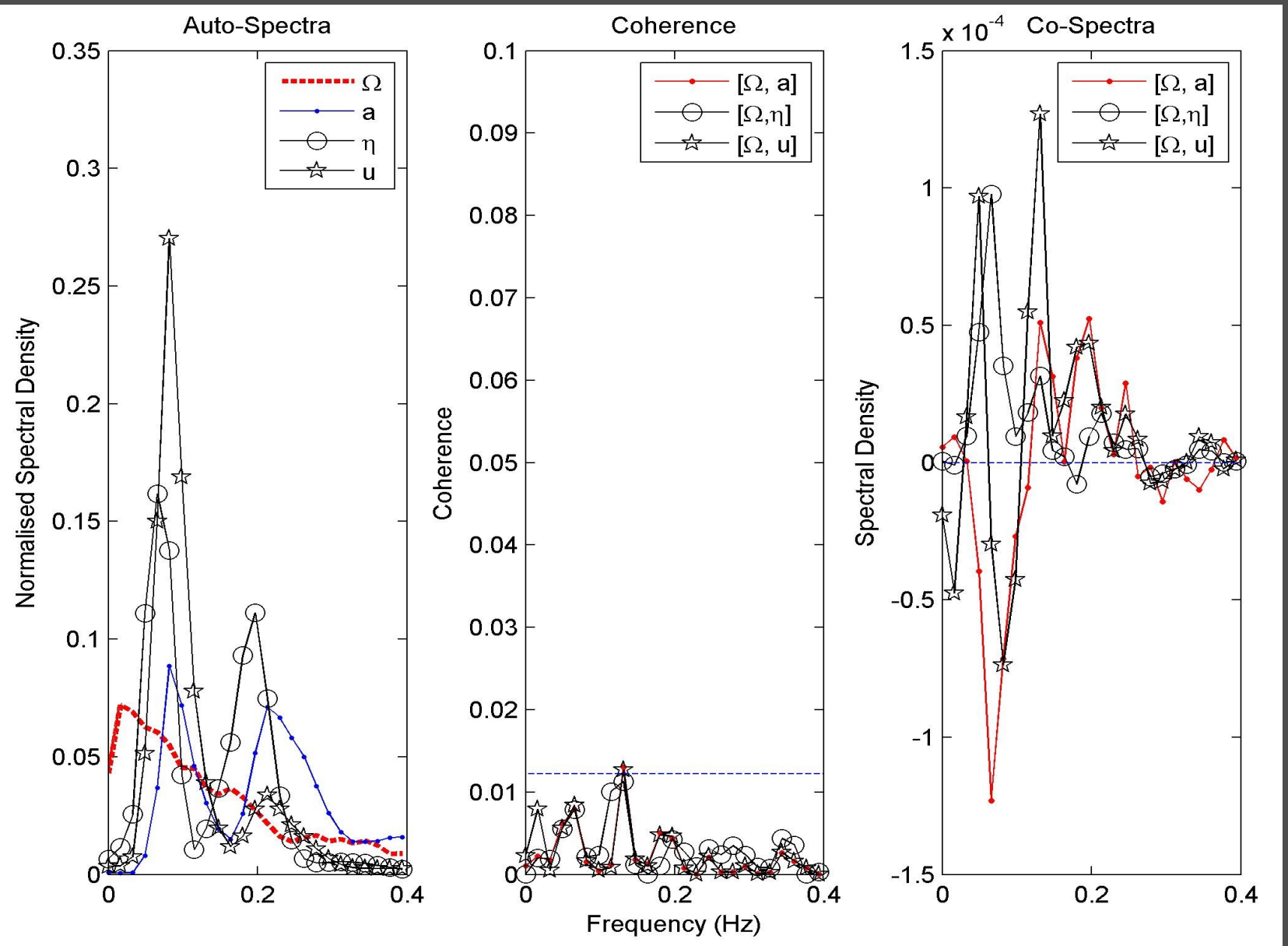
$$\alpha = I^t{}_{mn} - \bar{I}^t$$

$$\beta = I^{t+1}{}_{mn} - \bar{I}^{t+1}$$

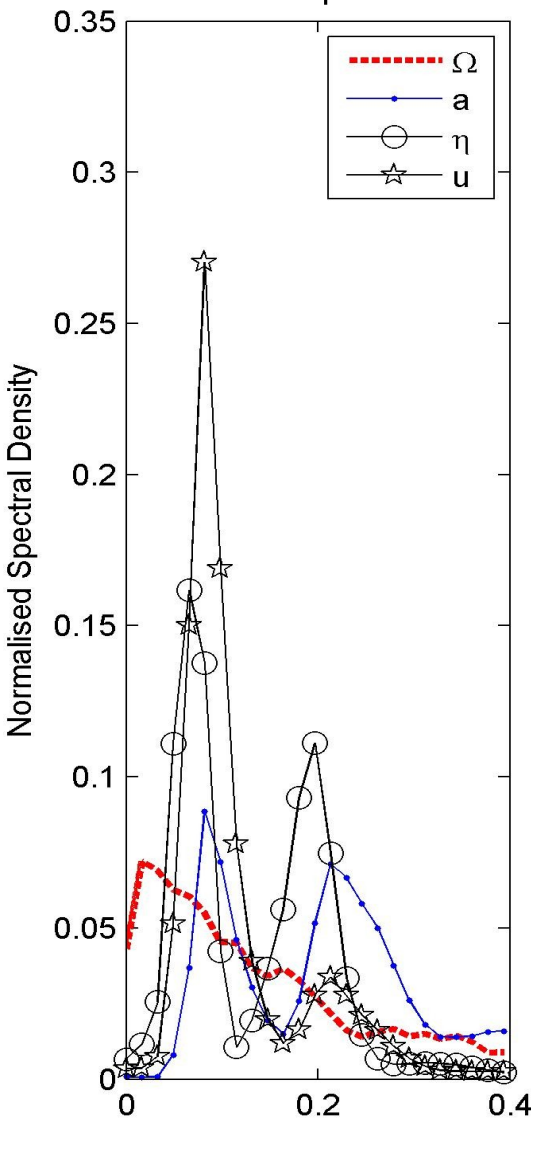


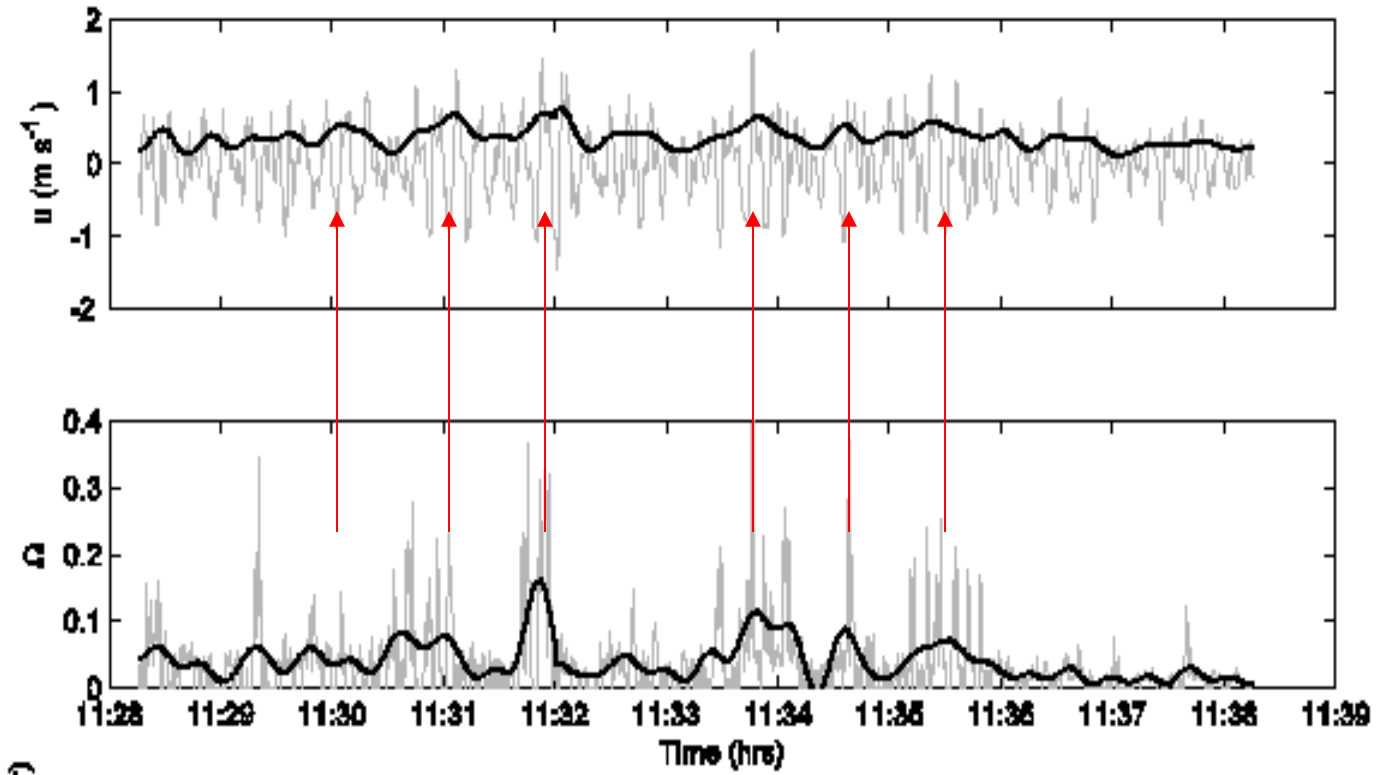


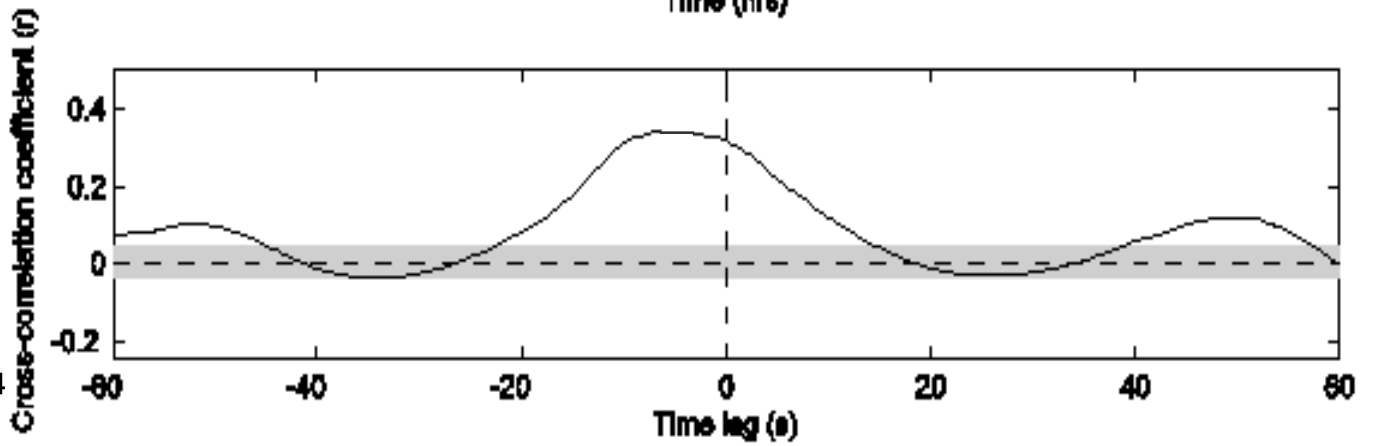
ediment Transport (2)



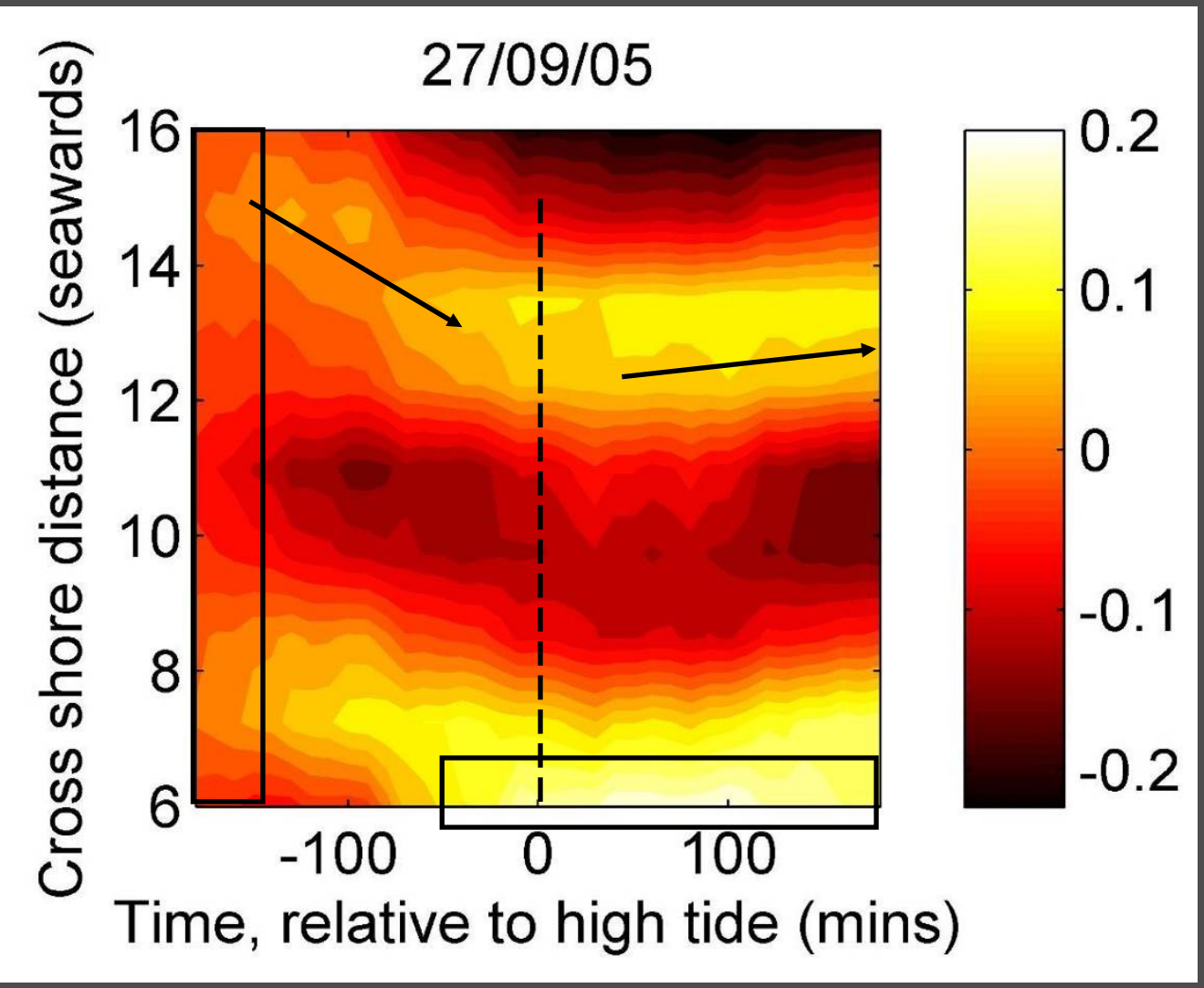
ediment Transport (2)







Morphological Change

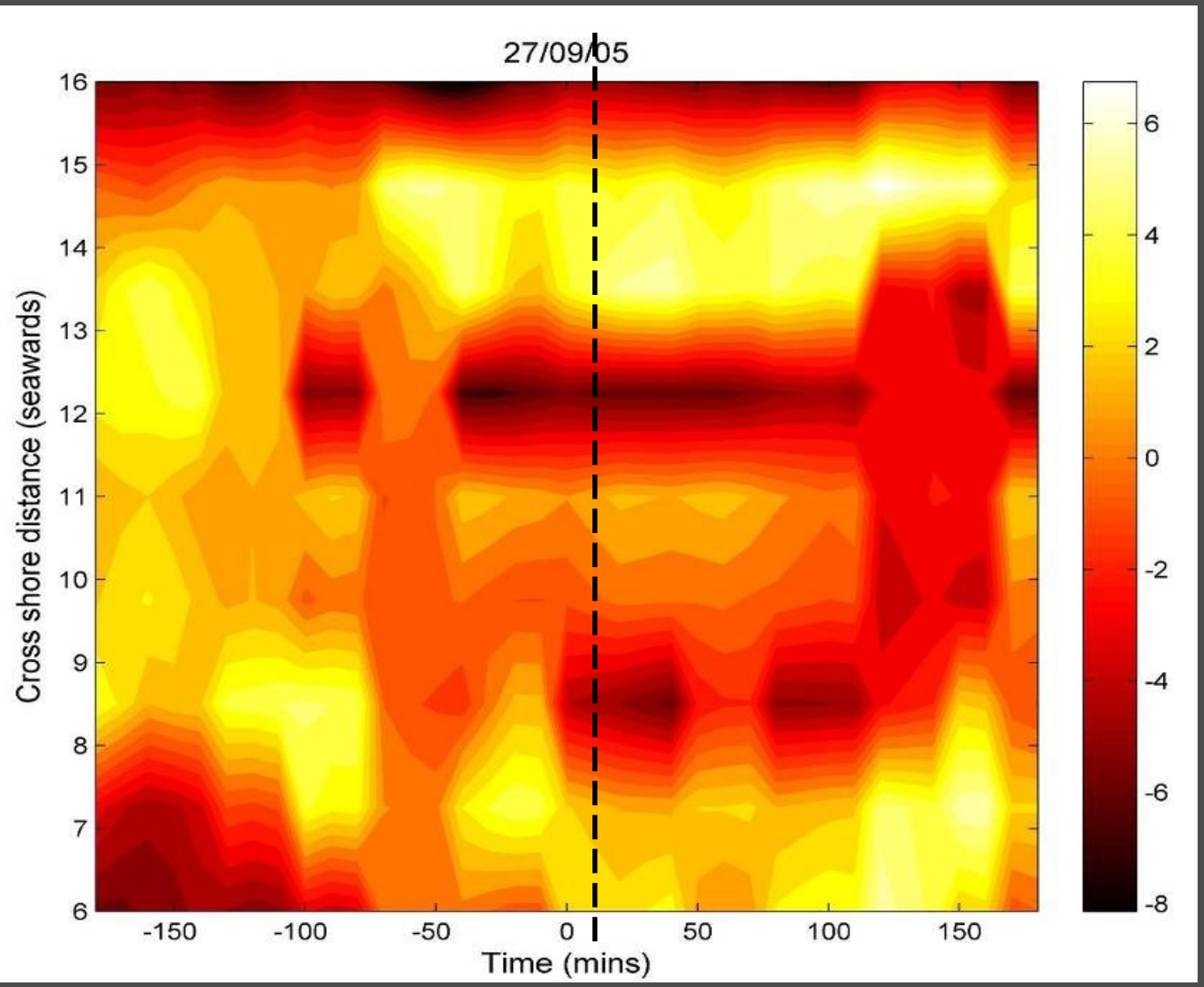


Both step and berm are accretionary but have different relaxation times

Volumetric discrepancy between nearshore/ step and berm

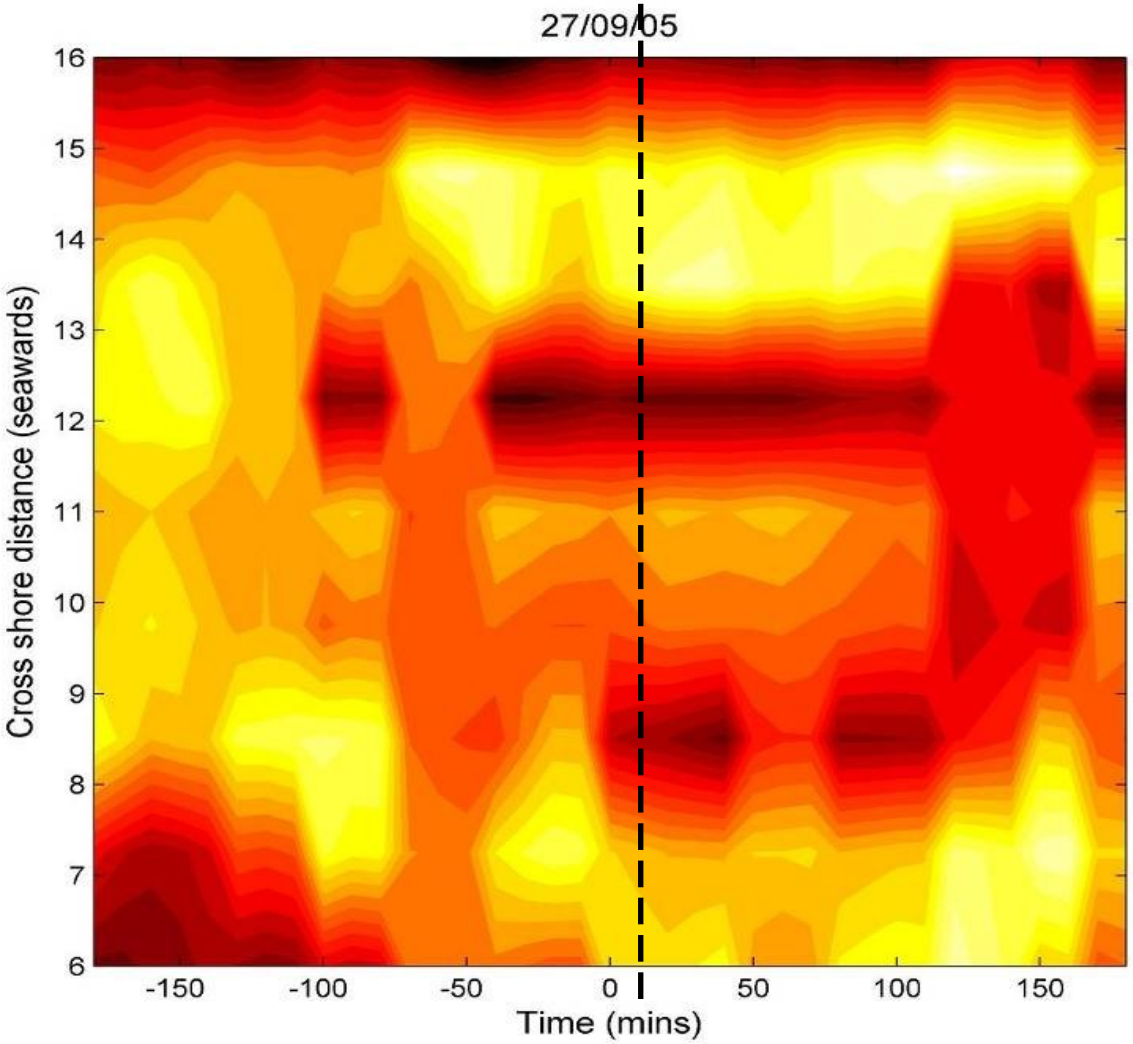
Figure (above): Morphological change relative to initial profile (m)

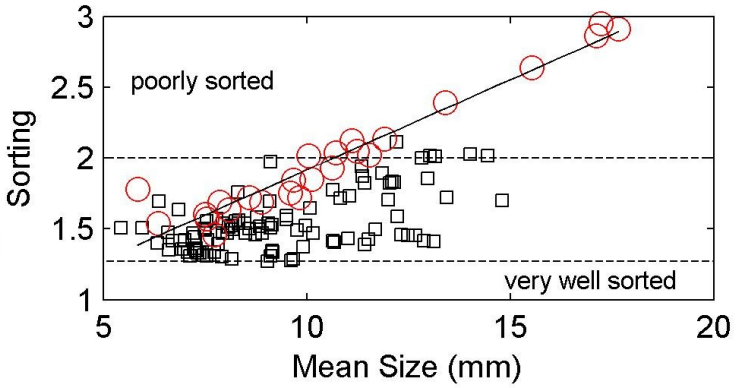
Sedimentological Change

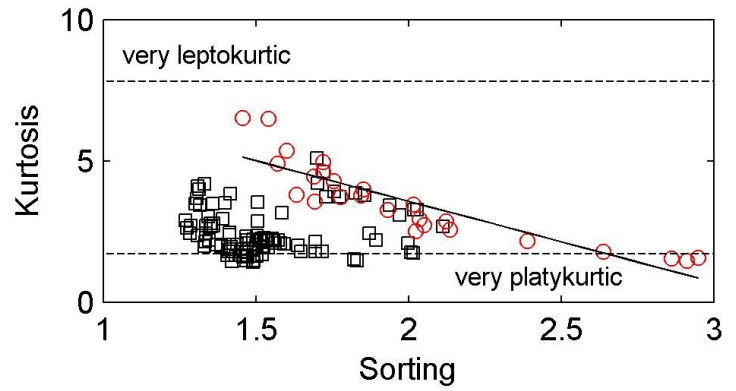


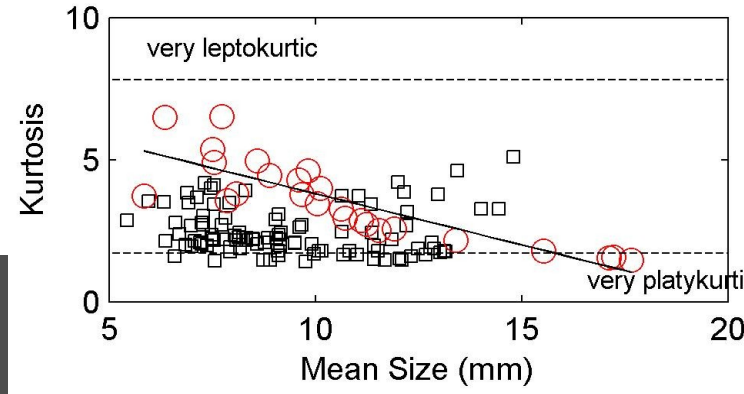
Change in sediment size relative to mean cross shore sediment size (mm)

Sedimentological Change





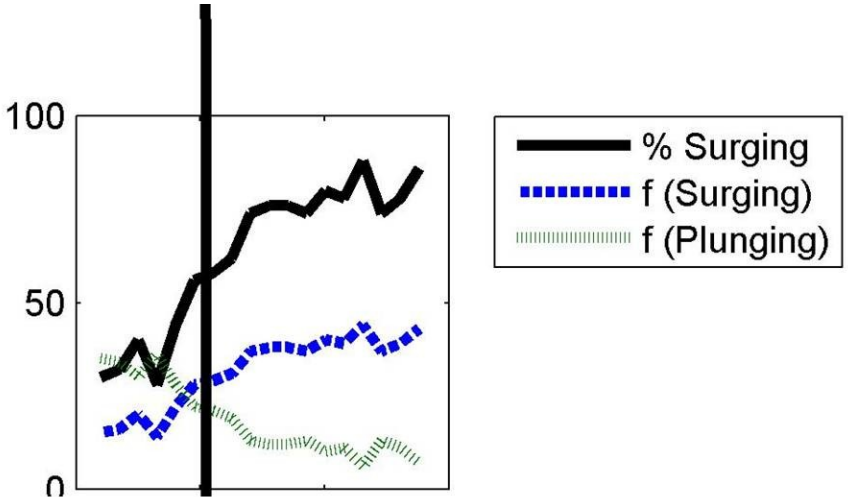


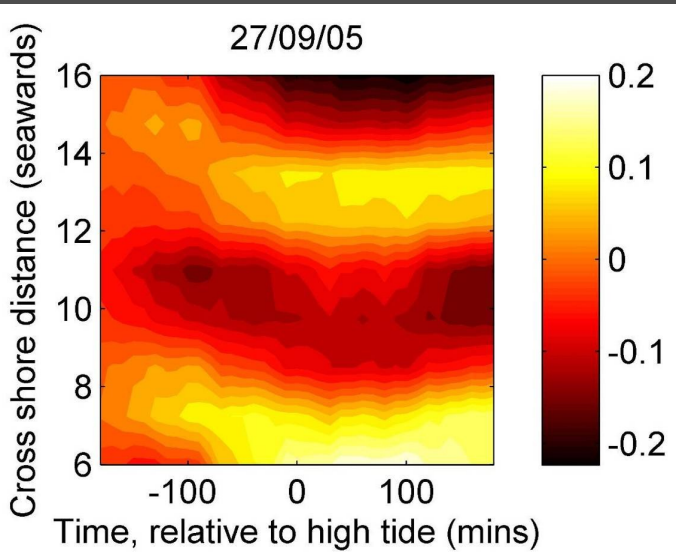


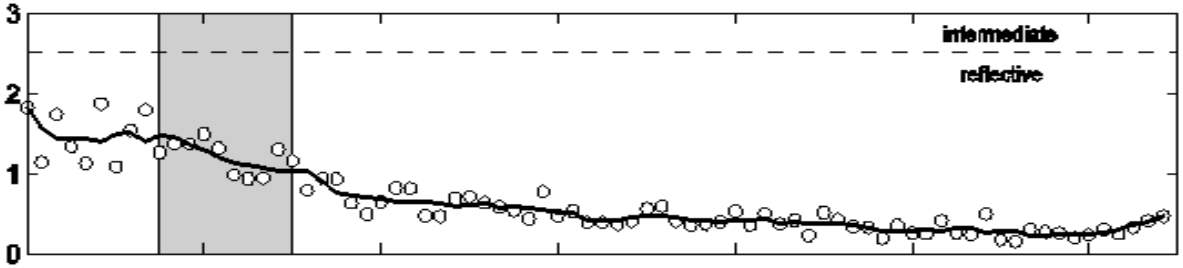
Red dots = step sediments;
black stars = swash sediments

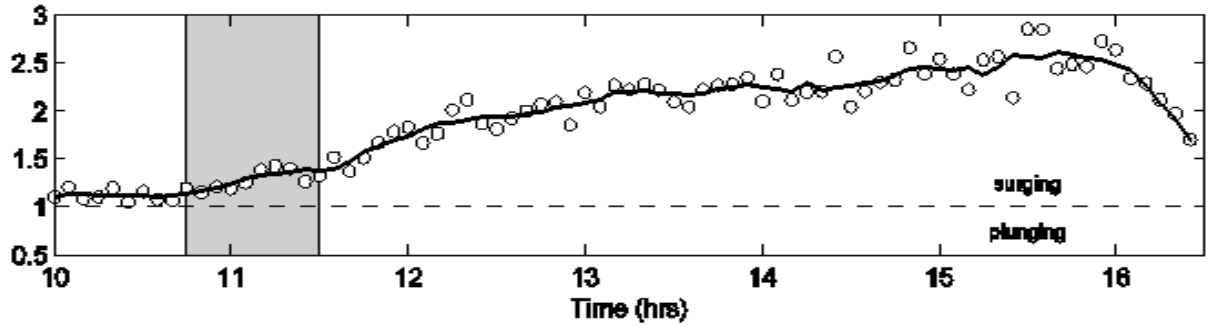
Morphodynamics

video observations of wave breaker



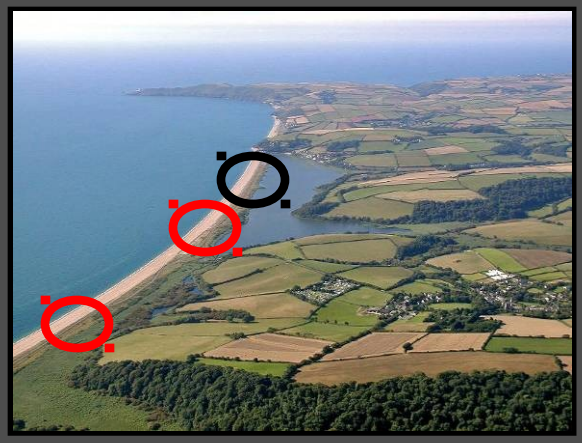


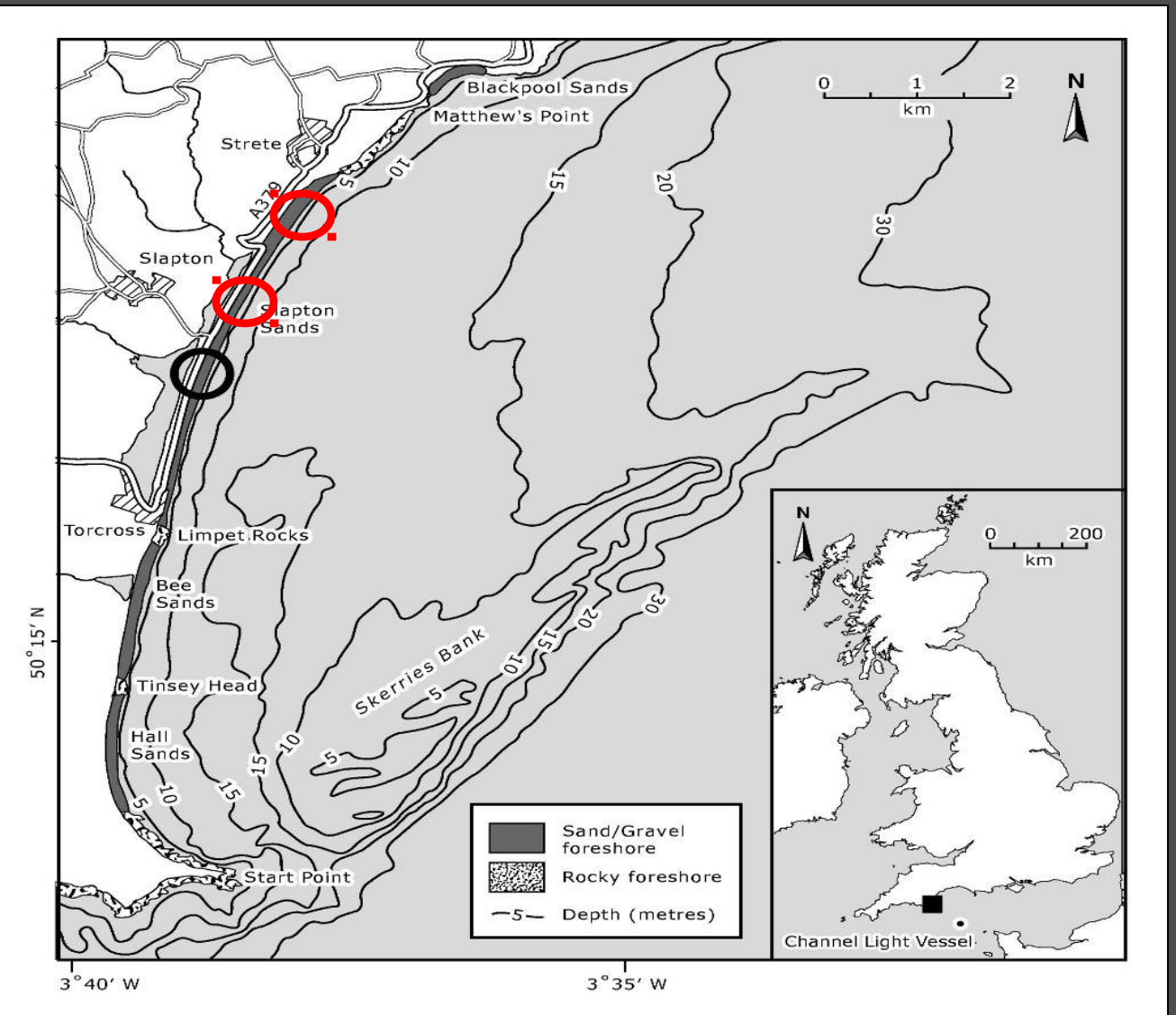




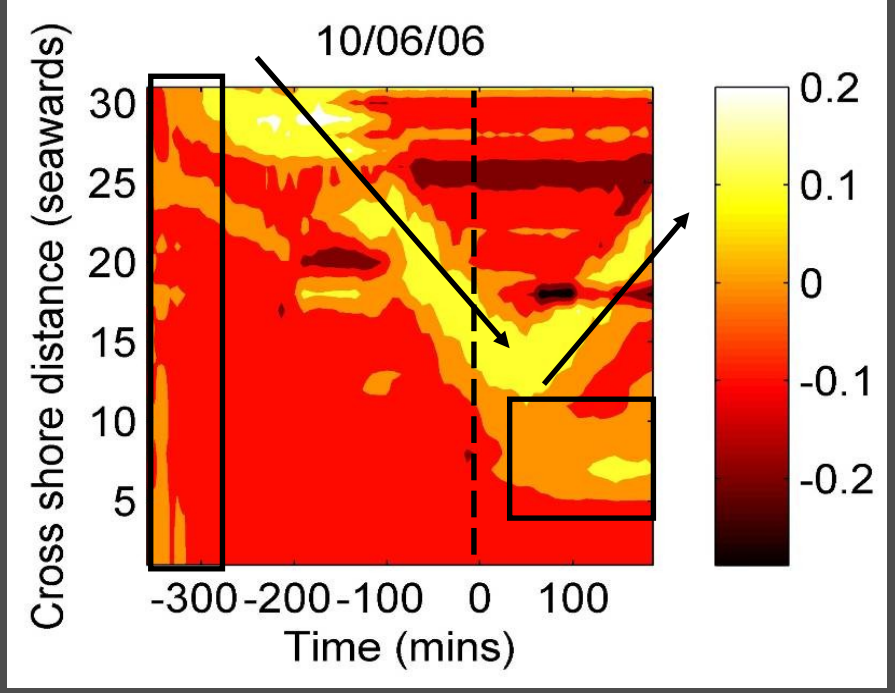
surf scaling

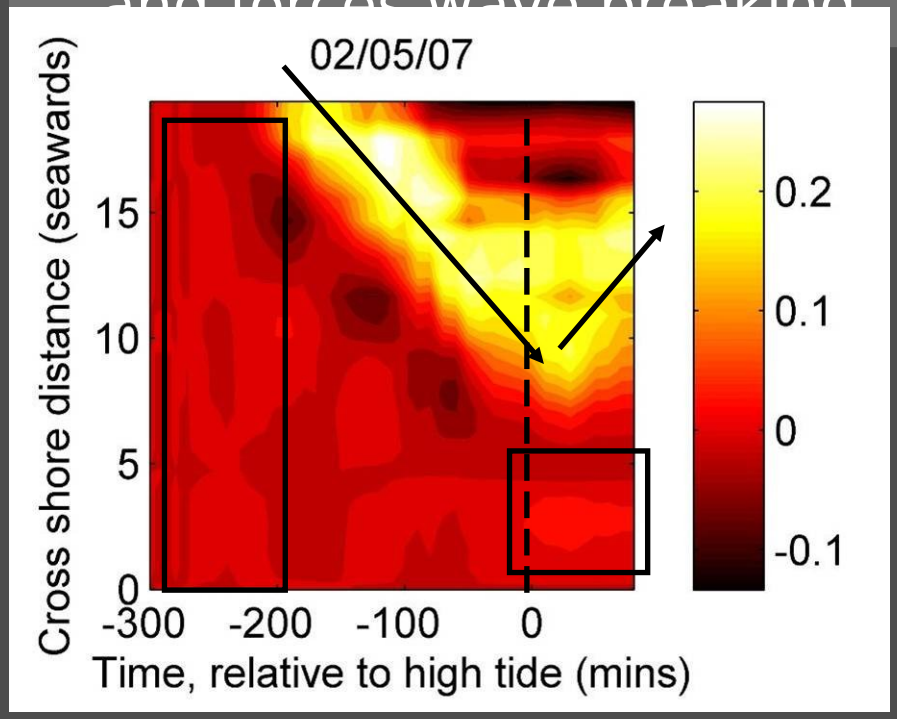
surf similarity

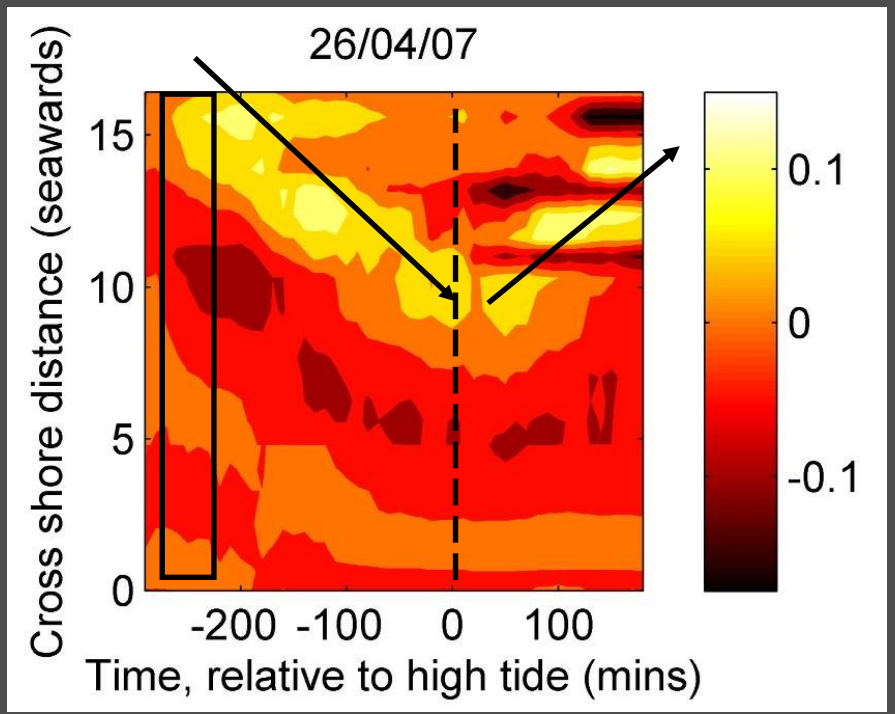


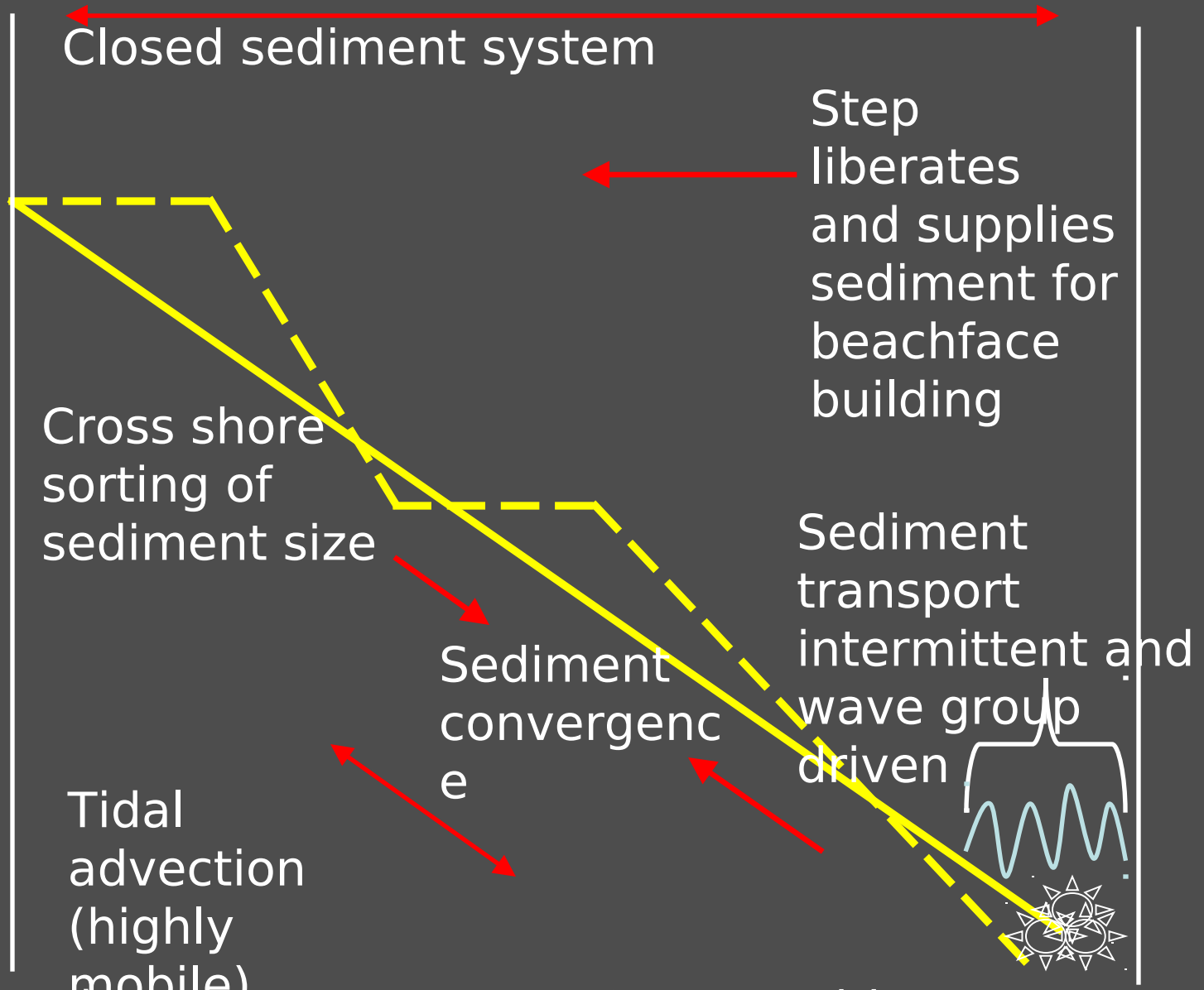

Blackpool Sands
Matthew's Point
Strete
A379
Slapton
Slapton Sands
Torcross
Limpet Rocks
Bee Sands
Tinsey Head
Skerries Bank
Hall Sands
Start Point
0 1 2
km
N
5
10
15
20
30
Sand/Gravel foreshore
Rocky foreshore
5 Depth (metres)
0 200
km
Channel Light Vessel
50°15′ N
3°40′ W
3°35′ W

- The step migrates with the rising and falling tide
- The step is more pronounced at high tide and is often absent at low tide (subtidal ripples)
- The step remains submerged and forces wave breaking








Closed sediment system
Step liberates and supplies sediment for beachface building
Cross shore sorting of sediment size
Sediment convergenc e
Sediment transport intermittent and wave group driven
Tidal advection (highly mobile)
Step dimensions tidally modulated
Step sensitive to breaker

Thanks

Thanks for listening

Field Assistants:

Dave Dawson
Rich Hartley
Jon Tinker
George Graham
Ben Allured
Tamsin Watt
Richard Charman
Josh Gibson
Iain Fairley
Tim Scott
Amaia Alegria
Isabelle Emmanuelle
Tom Deacon
Ian Ball