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BEACH RESPONSE TO CLUSTERED STORM SEQUENCES

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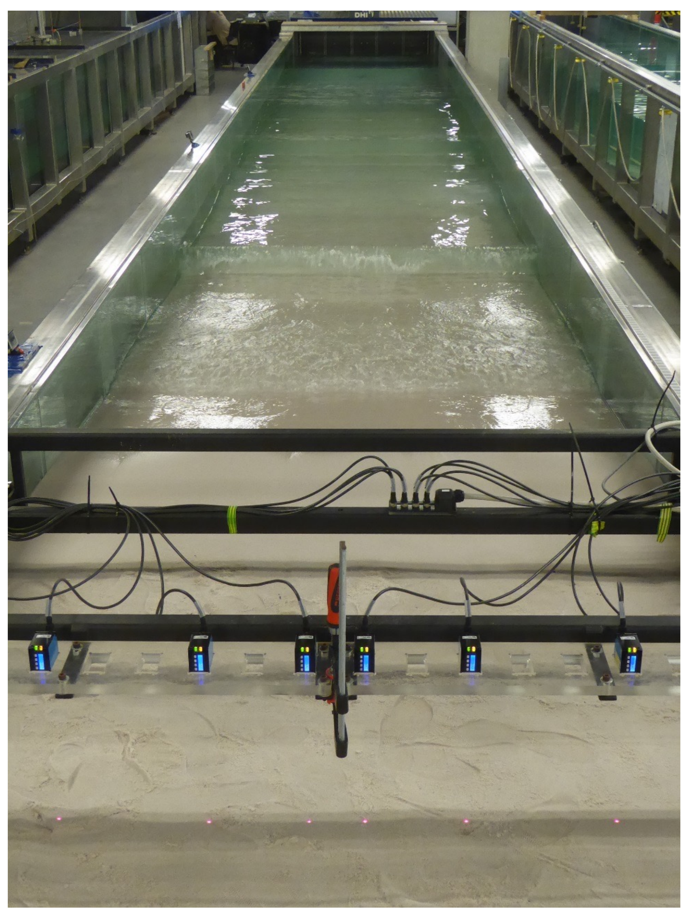
INTRODUCTION

Beaches undergo continuous cyclic evolution in the form of erosion and accretion processes. Energetic events such as storms erode the beach, while milder wave climates promote sediment recovery. Storm clustering occurs when the beach is unable to recover from a storm event before the next one commences.

A series of laboratory experiments are carried out in the wave flume at the University of Queensland to assess the influence of sequencing within storm clusters.

SCALING AND EQUIPMENT



Hydrodynamics are scaled according to Froude scaling, which ensures fluid motion similarity between nature and the model (Hughes, 1993).

Sediment transport motion is modelled via the dimensionless fall parameter (Ω), which can be thought of as the ratio between sediment fall time and wave period.

Profiles are measured using an innovative laser profiling system, which resolves bed forms to a high accuracy (Atkinson, 2015).

Sediment transport calculations are based on volume conservation principles. The integral of the transport curve over the active profile is the net sediment transport.

EXPERIMENTS

Experiments are run from an initial 1:15 planar slope. They consist of two storms (A and B), where storm A is less powerful than storm B. The storms are run in forward sequence, that is, storm A followed by storm B. The profile is then reshaped to a 1:15 planar slope and the same storms are run in reverse sequence. All storms have a duration of 4 hours in the model, which corresponds to approximately one day in nature.

Experiment 1		
Storm	A	B
$H_s\ (m)$	0.08	0.15
$T_p\ (s)$	1.5	1.5
Ω	1.37	2.56

Experiment 2		
Storm	A	B
$H_s\ (m)$	0.12	0.15
$T_p\ (s)$	1.5	1.5
Ω	2.05	2.56

Experiment 3		
Storm	A	B
$H_s\ (m)$	0.1	0.15
$T_p\ (s)$	1	1.5
Ω	2.56	2.56

A common feature observed throughout all events is the development or growth of a subaerial berm. This is most visible during the initial runs, and is caused by the difference in shape between a planar slope and an average equilibrium profile. It is therefore recommended that the initial profile is set to a beach equilibrium shape for experiments of short duration and with frequent reshaping.

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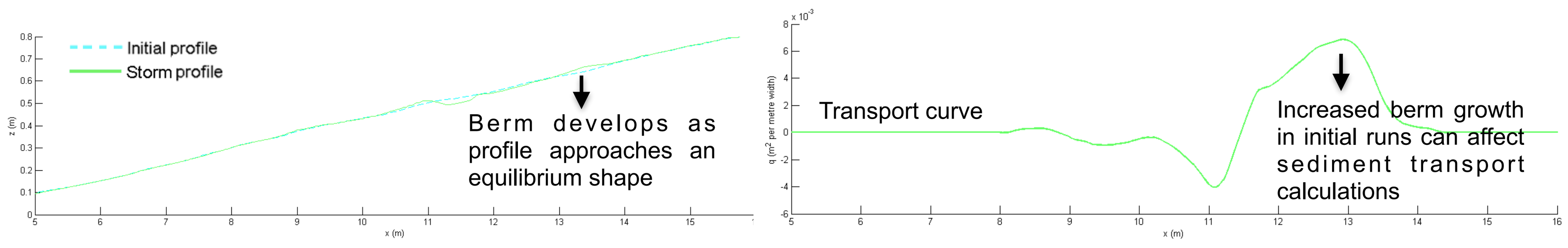
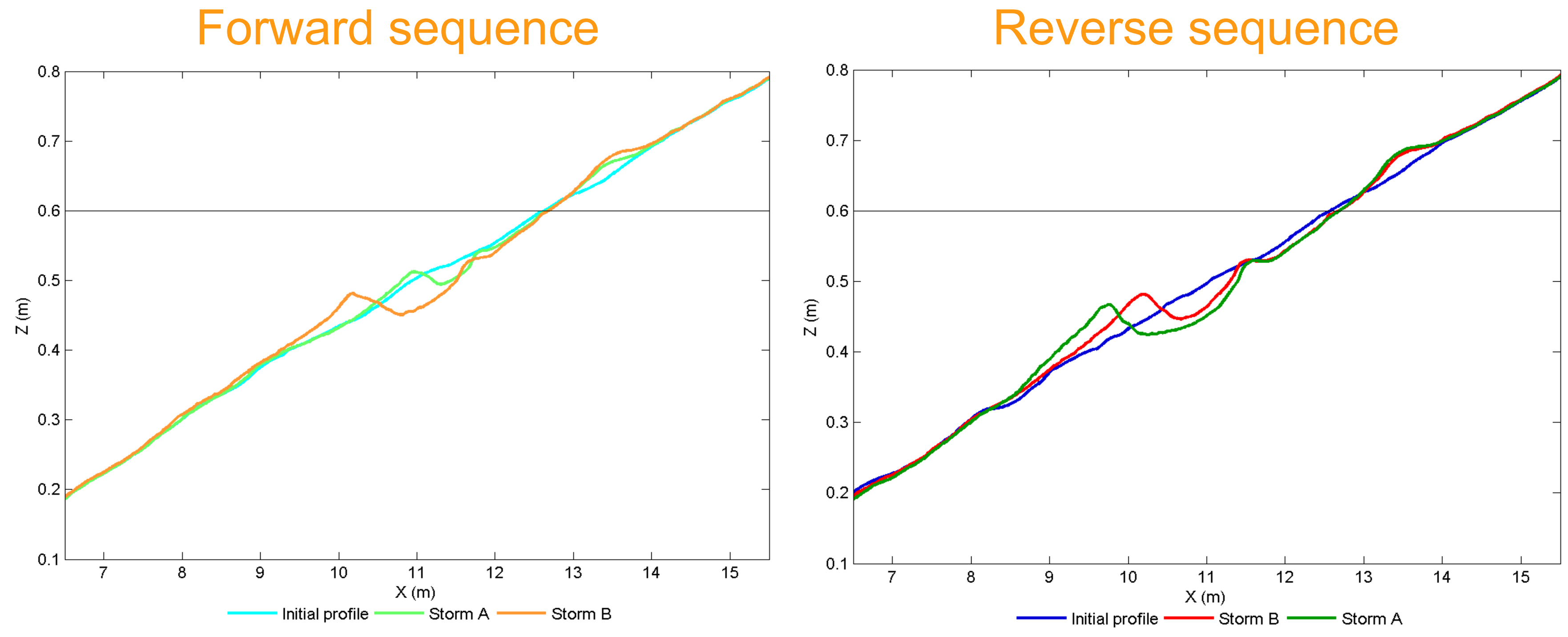
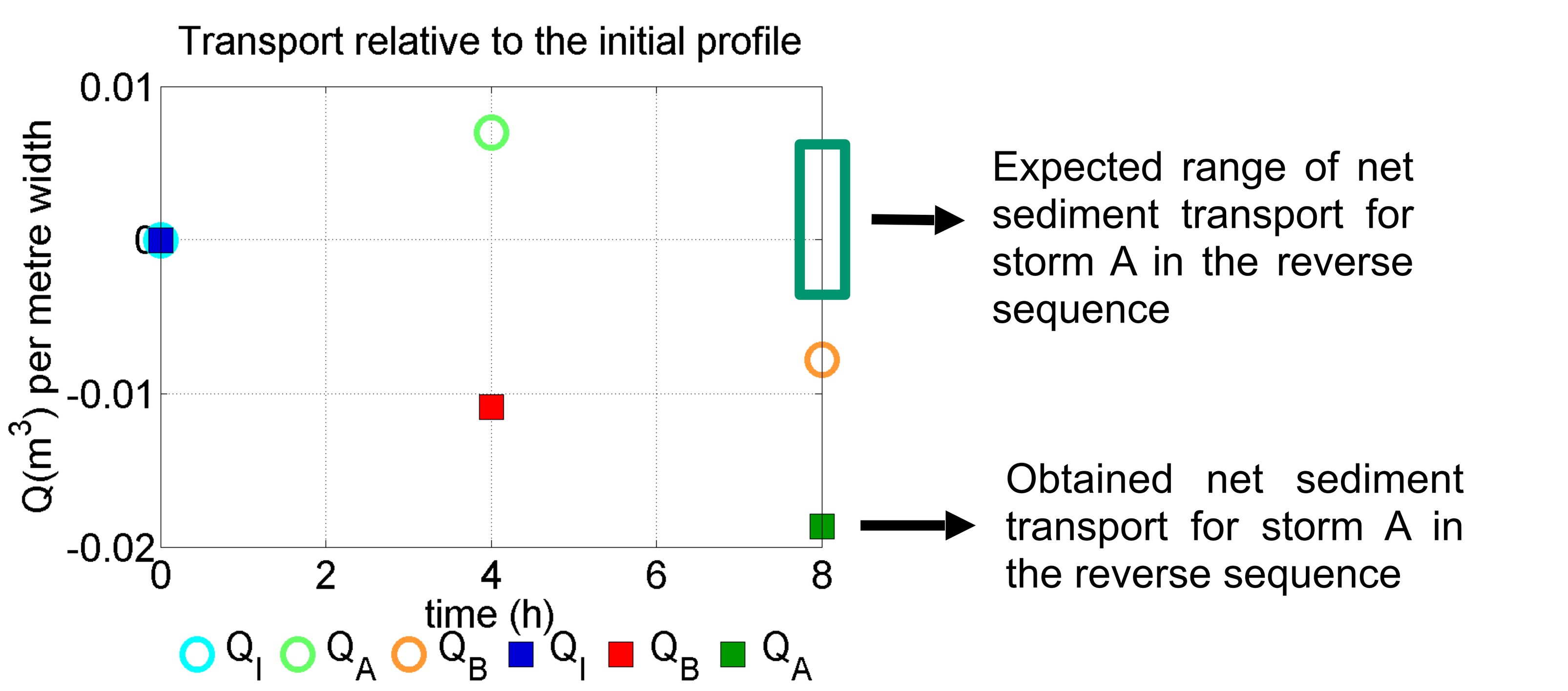


RESULTS AND DISCUSSION

The reverse sequence of Experiment 2 yields erosion volumes which exceed what would be expected from beach equilibrium theories (Wright and Short, 1984).



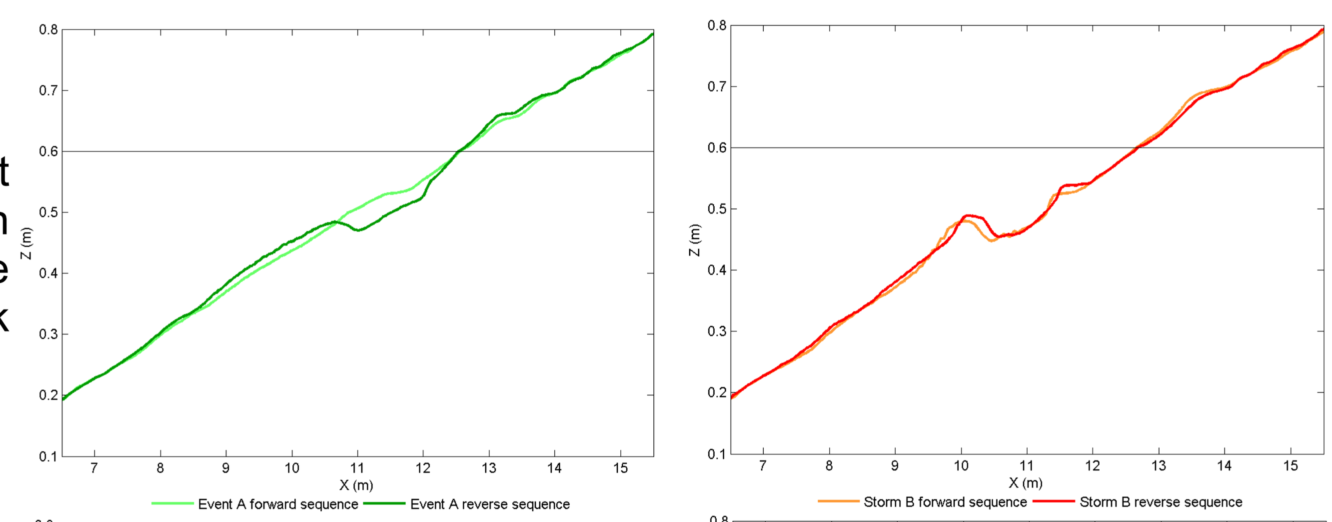
Q is the net sediment transport computed between two profiles. Negative values of Q indicate erosion, while positive values of Q indicate accretion.



Overall, profiles exhibit greater variability and sediment transport rates when a more powerful event starts the sequence. Localised erosion due to onshore transport at the lower beach face occurs when waves pass the outer bar without breaking (Experiments 1 and 3). Waves reform along the trough and break at a further onshore position.

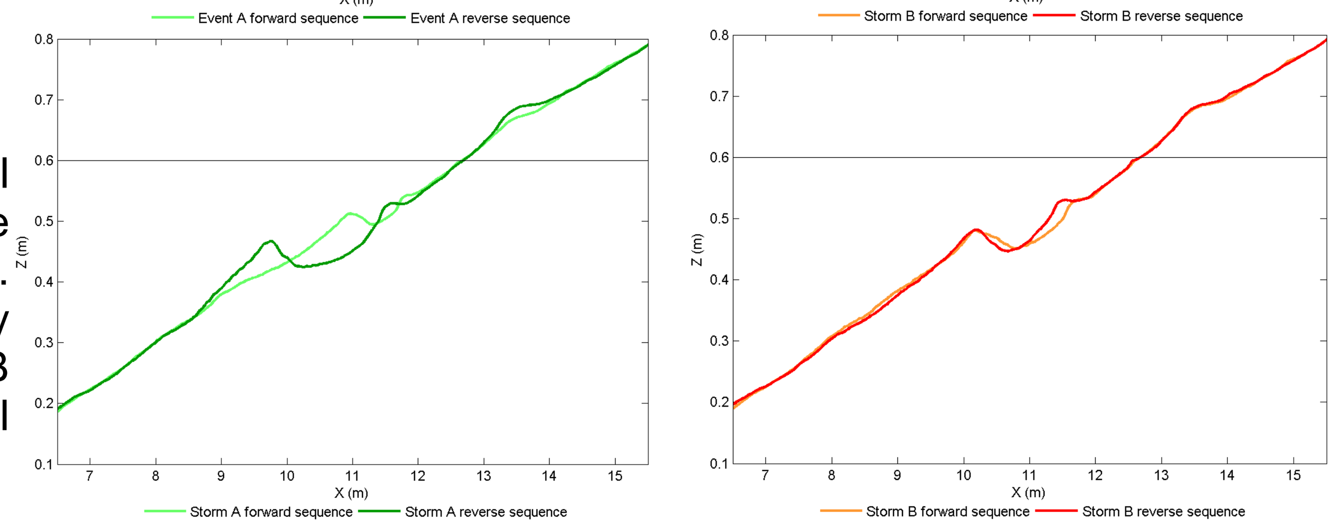
Experiment 1

Localised erosion at the lower beach face in the reverse sequence (dark green).



Experiment 2

Increased overall erosion in the reverse sequence. Almost no variability between storm B profiles in all experiments.



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