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Sediment shell-content diminishes current-driven sand ripple development and migration

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Table S1

Grain size characteristics of the sandy sediment fraction used in the experiments.

Sediment fraction	Grain size (μm)	SD
D_{10}	239	3.9
D_{50}	352	1.3
D_{90}	520	10.7

Table S2

Representative measurements of the shell valves and fragments used in the experiments.

Shell type	# samples	Length	Width	Height	Weight
Valves	200	27.5 (± 4.5)	23.6 (± 3.9)	9.5 (± 2.3)	2.3 (± 1.4)
Fragments	455	18.2 (± 7.8)	13 (± 6)	4.5 (± 2.6)	0.74 (± 0.9)

Length, width and height are in units of mm, while weight is in g. Height represents the thickness of the shell, from the umbra to the center hinge.

Table S3

Experimental settings and measurements undertaken in both experiments.

Experiment	D_{50}†	Flow (cm s^{-1})	Shell %	Duration	Measurements
ACC	352 μm	15 to 50 (increase of 0.3 min^{-1})	0, 2.5, 7.5, 10, 12.5, 15, 20, 25, 30, 40, 50	~4 hr. 26 min.	ADV†† GoPro Time-lapse‡
CF	352 μm	50	0, 5, 10, 15, 20, 50	~4 hr. 26 min.	ADV††† GoPro‡ Time-lapse

†Bare sandy sediment (control)
††Average over the 5 minutes before and after incipient motion
†††Average over the entire experiment
‡Data available but not used

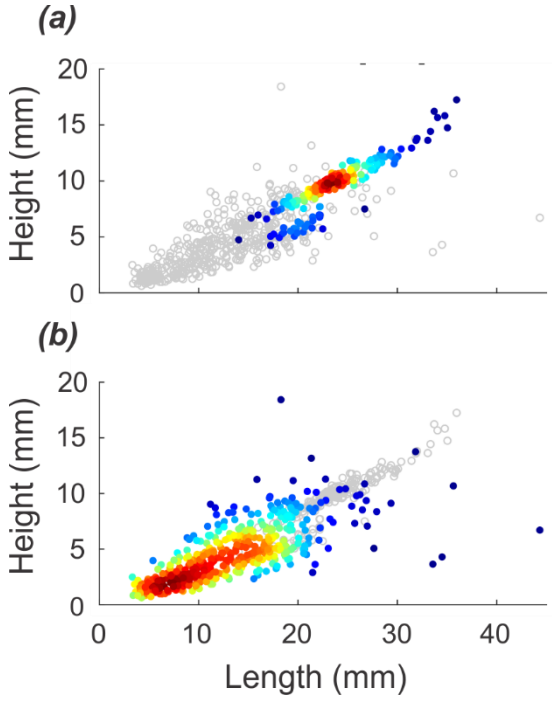

Figure S1: Measured shell Height (thickness) vs. Length for (a) whole shell valves and (b) shell fragments. Both panels contain all of the measurements, but the dataset of interest is indicated by the bright colors, while the points from the other dataset are plotted in grayscale. Colors indicate point density (e.g., how often a specific length – height ratio occurs with respect to the whole dataset) based on a kernel density estimate.

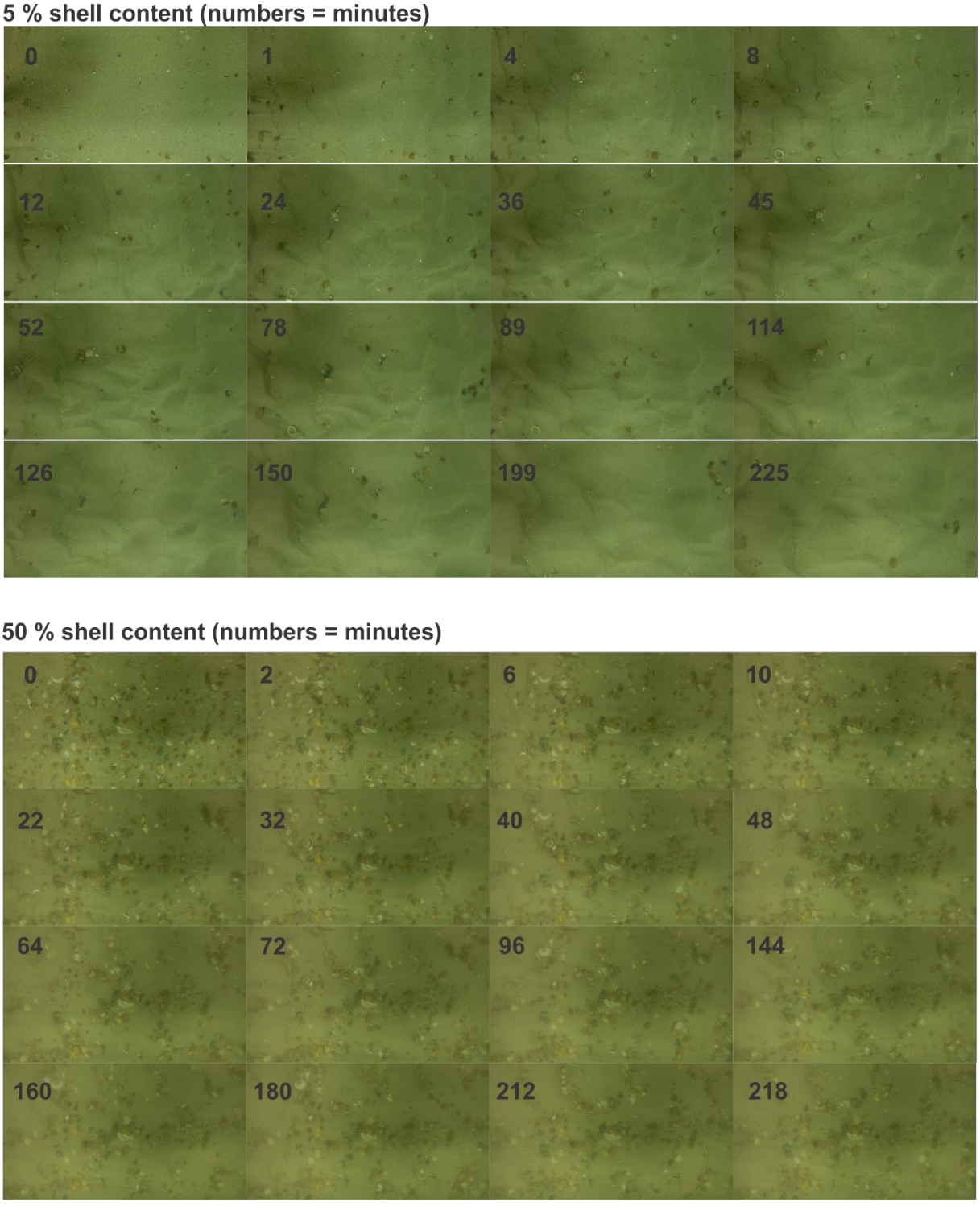

Figure S2: Snapshots extracted from the GoPro footage of the constant flow experiment to show that the majority of the shells remain in place throughout the duration of the experimental run at both the low and high shell treatments.

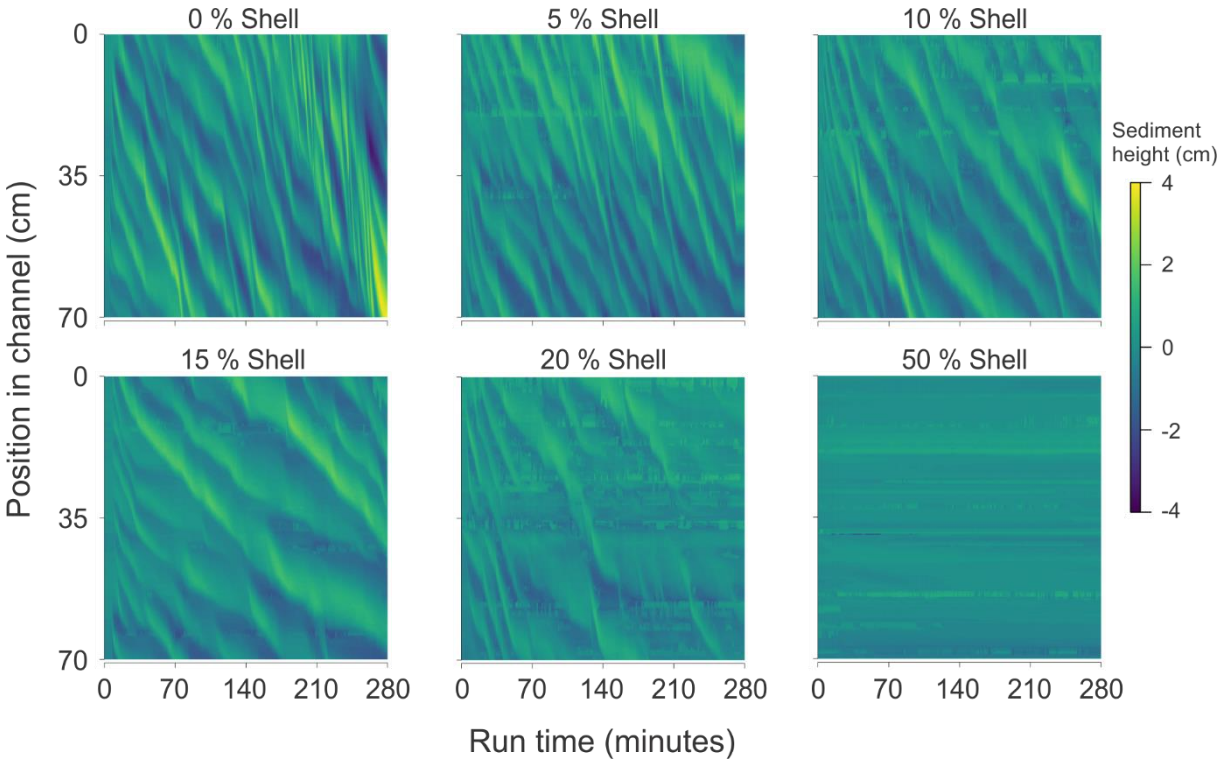

Figure S3: Raster plots of the sediment height of each constant flow experimental run to show the distance (y-axis) each ripple traveled along the flume channel over time (x-axis). These plots also show the approximate number of ripples that was present and used in the calculation of ripple height, length, asymmetry and migration rate for each run.

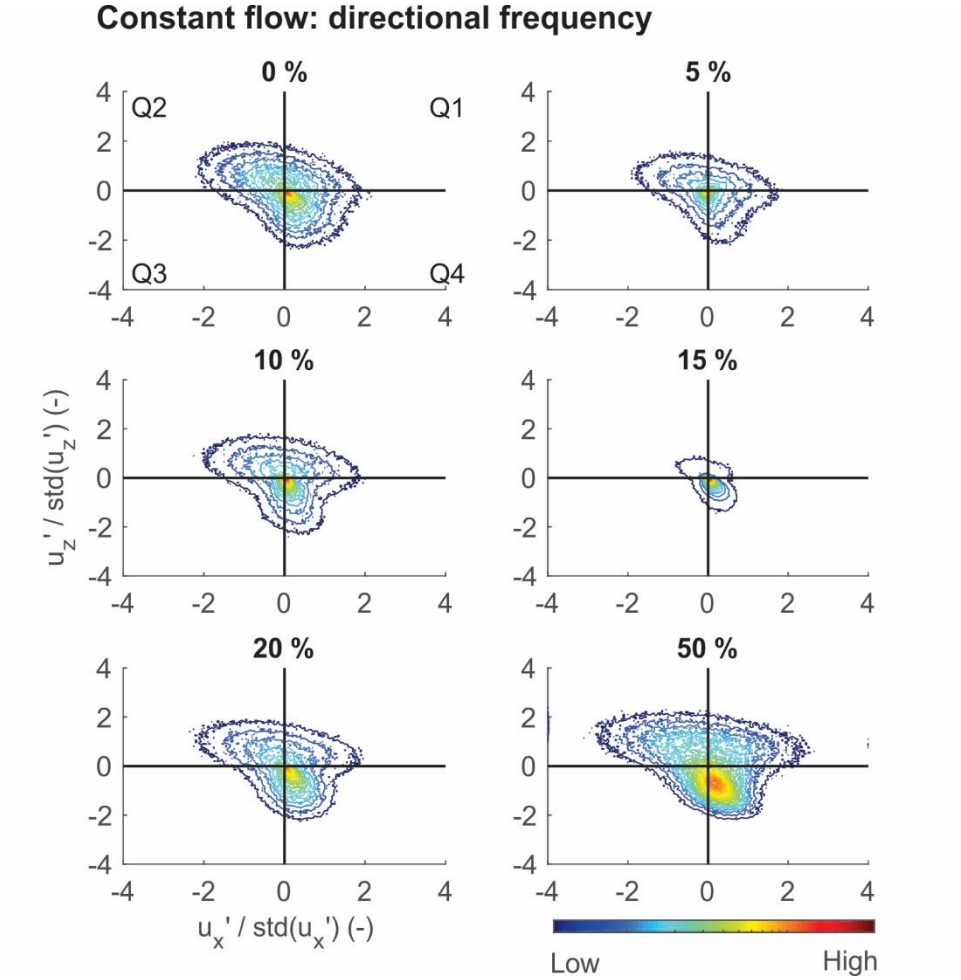

Figure S4: The quadrants of each constant flow experimental run, showing the presence of turbulent coherent structures, plotted along the streamwise and vertical planes. The contours represent the point density. Quadrant 2 (top left) represents the burst, or ejection (away from the bed) and quadrant 4 signifies the sweep events in the flow (towards the bed). Exact values are not indicated in the color scale bar as the relative turbulence frequency differs somewhat between each treatment.

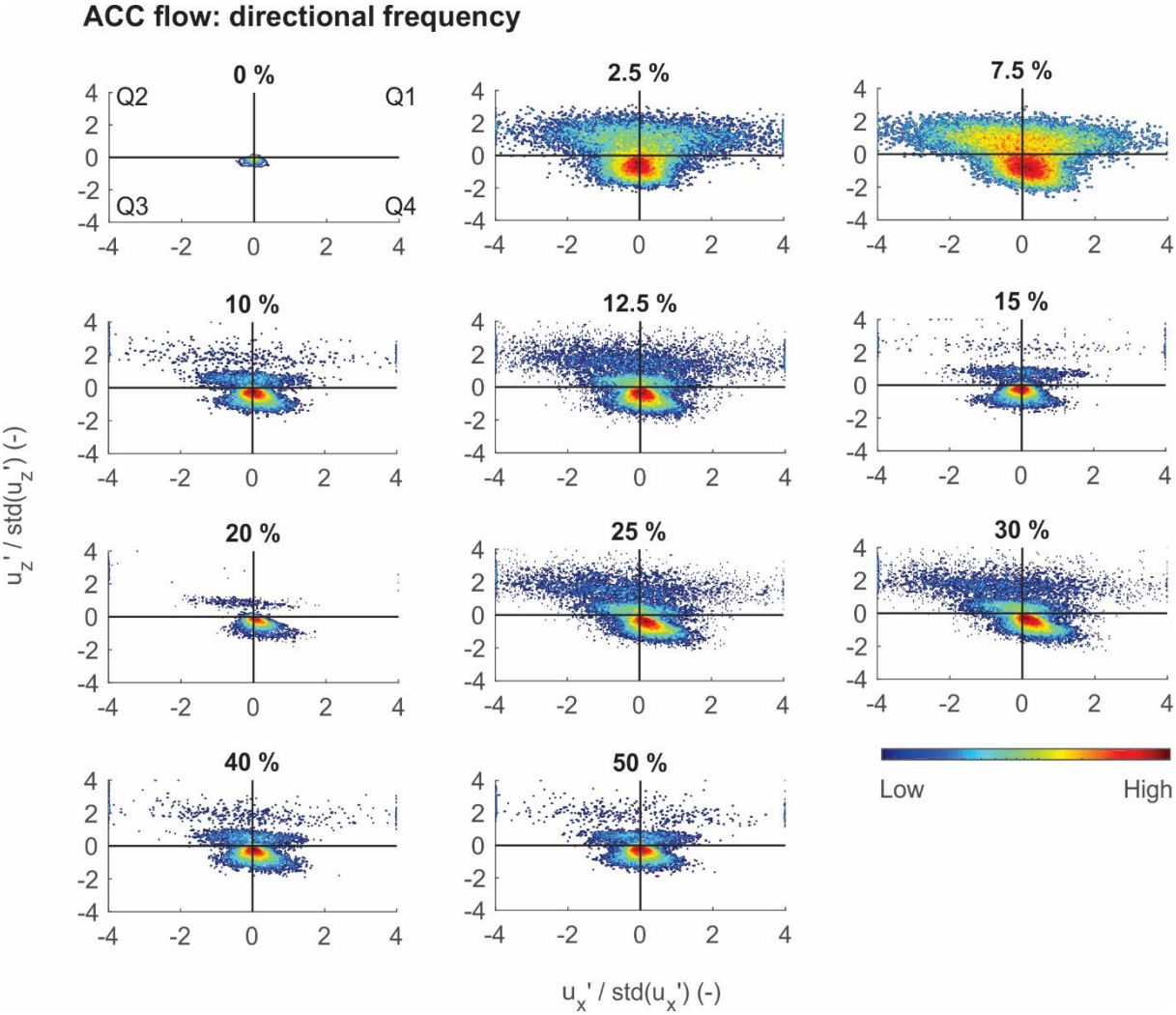

Figure S5: The quadrants of each acceleration flow experimental run, showing the presence of turbulent coherent structures, plotted along the streamwise and vertical planes. The contours represent the point density. The burst is represented by Quadrant 2 (top left) and the sweep by Quadrant 4 (bottom right). Exact values are not indicated in the color scale bar as the relative turbulence frequency differs somewhat between each treatment.