

Supplementary S2

Acoustic Backscatter & Sediment Mobility Analyses

This document contains details regarding how the downward-facing Aquadopp HR Profiler acoustic velocities were used to determine sediment mobility using dimensionless Shields parameters. Full water column acoustic backscatter data were used for hazardous event identification ground-truthing and cluster interval length analysis. Select portions of the available data are used for visualization purposes while results in the manuscript are based on the entire available dataset.

An example time series of sediment mobility for March 2018 is presented below Figure S2.1 as a time series of the instantaneous dimensionless Shields parameter. Threshold exceedance events based on critical thresholds of motion for sediment grain sizes and event types are labeled with text and shading to denote the type of hazardous event. Grain size values for d_{50} ranged from 0.06 - 0.53 mm with corresponding θ_{cr} from 0.03 - 0.12.

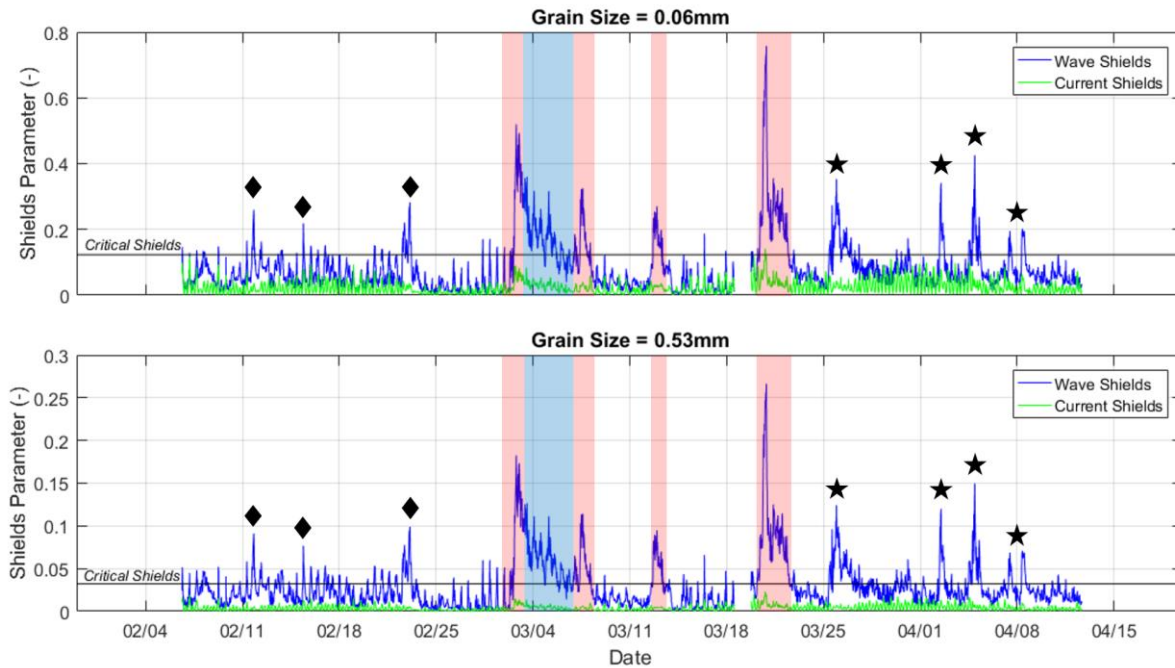


Figure S2.1: Instantaneous dimensionless Shields values from Feb-Apr 2018 derived from the downward-facing Aquadopp HR Profiler for the smallest (top) and largest (bottom) grain diameters. Black lines are critical thresholds of BLAH (top) and BLAH (bottom). The blue lines denote wave-domination conditions while the green dashed lines represent current-domination conditions. Shaded regions highlight hazardous events that were defined in the Methods section of the main manuscript with blue being a ‘Sunny’ event and red being a ‘Storm’ event. Black diamonds denote frontal passage while black five-pointed stars denote troughs over the site. The events created threshold exceedance for Shields parameters but did not meet criteria for hazardous event categories.

From Figure S2.1, areas of mobility threshold exceedance that occurred between hazardous events were caused by stationary troughs over the study site. Troughs are similar to fronts but

lack all the attributes of a fully defined front. Low-pressure, higher winds, precipitation, high vorticity, and clouds may be present. The periods of March 8-13 and 25-31 had higher U_{10} and H_s values but were not high enough to denote a 95% exceedance. While sediment was mobilized during these periods, it was not classified as a hazardous event.

Turbidity values were measured during one deployment for comparison to the Aquadopp HR Profiler backscatter values at 0.5 m off the seabed (Figure S2.2). This comparison supports the use of the backscatter values as a qualitative representation of sediment mobility in the water column.

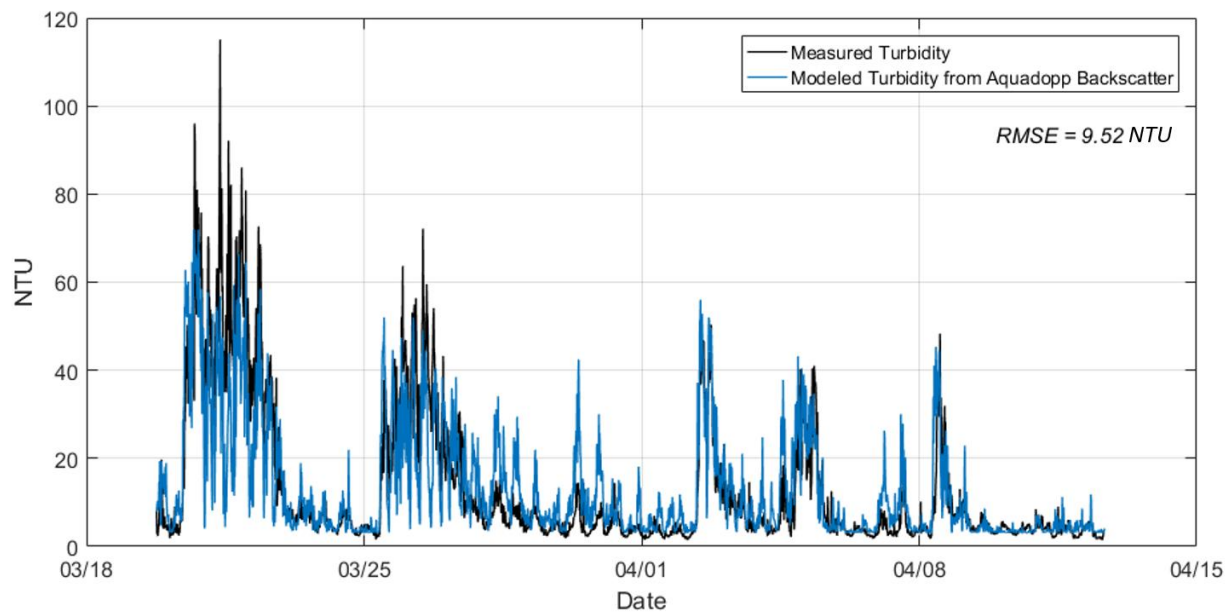


Figure S2.2: Turbidity values from the AML CTD (black) compared to the modeled turbidity values using the Aquadopp HR Profiler backscatter values (blue). The dates shown represent XC Toby (March 20-22, 2018) followed by sediment events which were not categorized as hazardous events based on the criteria presented in the methods section. Root Mean Square Error (RSME) was 9.52 NTU, approximately 8% error based on the AML CTD measurement sensitivity.

Backscatter Residuals

Full water column acoustic backscatter (Figure S2.3 top) was demeaned by calculating a rolling average using a 25-hour window width to remove tidal signals (Figure S2.3 middle) and retain backscatter residuals (Figure S2.3 bottom).

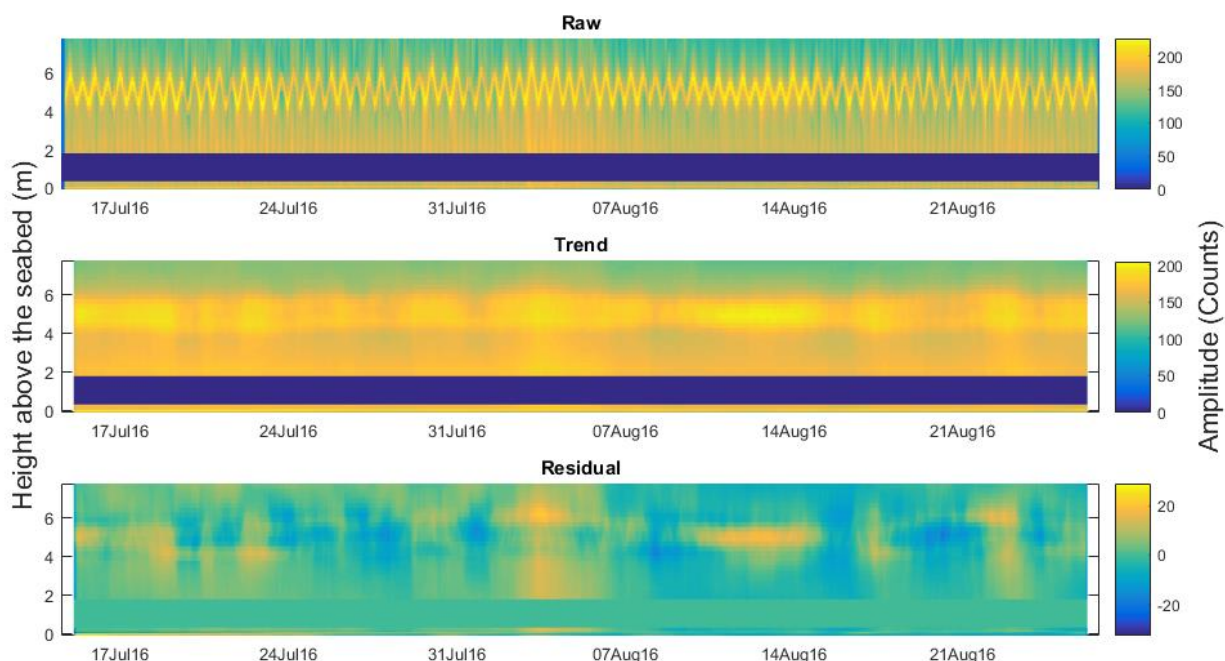


Figure S2.3: Processing steps for demeaning the raw acoustic backscatter values (top) using a 25-hour moving window (middle) to reach the non-tidal or residual backscatter (bottom). The solid dark blue line in each plot represents the blanking distance of each instrument on the frame as well as the frame itself.

The 95th percentile for backscatter residuals was then calculated and presented in the results section as a hazardous event identifier. All available deployments are shown in Figure S2.4 below for two heights above the seabed. These heights represent bedload and suspended sediment flux, respectively. This served as ground-truthing for hazardous events through a sediment mobilization perspective. It is important to note the exceedance values for the backscatter are inherent to the systems used during these field deployments. The exact values are not transferrable to other instruments or sites.

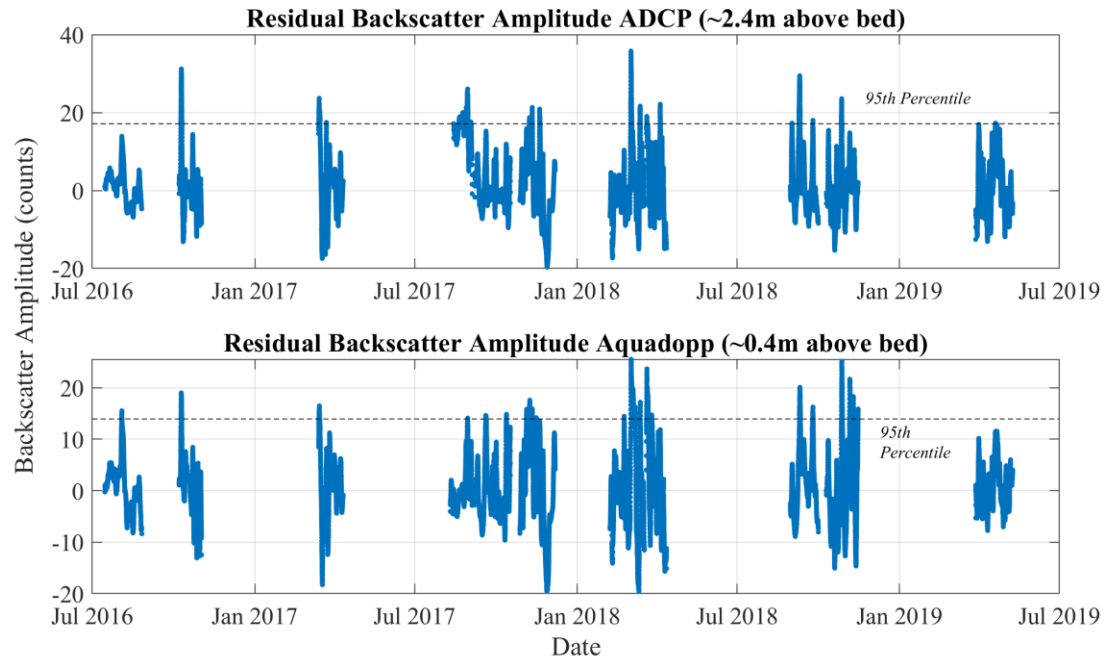


Figure S2.4: Examples for 95th percentile exceedance events from 2016-2019 (dashed black lines). The top plot displays the upward-facing ADCP at 2.4m above the seabed. The bottom plot shows the downward-facing Aquadopp HR Profiler residuals at 0.4m above the seabed. The exceedance values are 17.1 and 13.9, respectively.