Supporting Information for "Characterizing the Composition of Sand and Mud Suspensions in Estuarine Environments using Combined Optical and Acoustic Measurements"

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Contents of this file

1. Data Availability

Data archiving for this study is currently underway, with some data already publicly available at 4TU Centre for Research Data at https://doi.org/10.4121/collection:seawad (Delft University of Technology et al., 2019). Details of this dataset can be found in Van Prooijen et al. (2020) and van der Werf et al. (2019).

Hydrodynamic data from the Acoustic Doppler Current Profiler (ADCP-HR) can be accessed as netcdf files via this link:

`https://data.4tu.nl/articles/dataset/KUSTGENESE2_0_SEAWAD_Frame-Mounted_High_Resolution_`

However, the unprocessed ADV SNR (signal-to-noise ratio) used in this study was not included in that dataset, and will be uploaded separately. Laboratory results are also not yet included in the public archive. These data files have been temporarily included here as supporting information for the review process: `https://surfdrive.surf.nl/files/index.php/s/q1slh1EqhRkUhl1` `ADCP-HR_azg201709_f4_processed.nc` contains additional processed hydrodynamic data from the Acoustic Doppler Current Profiler (ADCP-HR), and `SCI_azg201709_f4_processed.nc` contains the optical and acoustic backscatter data plus derived values of the Sediment Composition Index (SCI) and fraction of sand in suspension (f_{sand}). `SCI_LabExperiments.nc` contains the data from the laboratory experiments summarized in Figures 3 and 4 of the manuscript.

The data under consideration will be stored openly in compliance with FAIR Data standards on the 4TU data repository (https://data.4tu.nl/), upon acceptance of the manuscript.

2. Experiment 1 (E1) Protocol

In this section, we elaborate on the experimental protocol for Experiment 1 (E1). A complete record of the sediment concentrations and sand fractions measured in E1 is provided in Table 1 of the appendix of the main manuscript.

The following measurement protocol was used in Experiment 1:

1. Tank was filled with fresh water and left overnight to reach room temperature.

2. Fine sediment, i.e., Bentonite powder (if required for the tested condition) was stabilized in suspension for 30 min in a 5 l beaker with a mixer before being introduced into DEXMES.

3. Tank was mixed for 30 mins to provide enough time for fine sediment to reach equilibrium.

4. Sand was added to the DEXMES tank 5 mins before data collection in order to reach the target total concentration.

5. At the end of the 10 min recording interval, a 1 l sample is collected using nozzle at sensor depth, i.e., 25 cm below the water surface and 12 cm away from the wall.

6. This procedure is repeated for both sand classes ($d_{50} = 100$ and $200\mu m$) and the 6 total concentration levels, from $15mg/l$ to $200mg/l$.

The water samples from mixed sand/fine experiments then were filtered with Grade GF/F Glass Microfibre filters filters and dried to estimate mass concentration. Based on preliminary experiments, we made an assumption that fine sediment is always fully suspended, and the deficiency of total concentration, if any, is the outcome of the deposition of sand. Hence, we did not separate sand/fine sediment in quantifying total concentration. For pure sand experiments, the water samples were sieved with a $40\mu m$ sieve before dried and weighted for mass concentration.

3. Experiment 2 (E2) Protocol

In this section, we elaborate on the experimental protocol for Experiment 2 (E2). A complete record of the sediment concentrations and sand fractions measured in E1 is provided in Table 2 of the appendix of the main manuscript.

The following measurement protocol was used in Experiment 2, beginning with the $d_{50} = 100\mu m$ sand:

1. Tank was manually cleaned and instruments were mounted.

2. Tank was slowly filled with fresh water.

3. Propeller turned on to a constant rate of shear.

4. After 10 mins, mud sample added to tank to provide a consistent background composition.

5. Every 15 mins after that, sand was added to increase the sand concentration and meet the target values in Table **??**.

6. Every 10 mins after new sediment was added, we took a pumped sample ($\sim$ 30 cm beneath surface).

7. Once tests were complete, tank was flushed and manually cleaned.

8. After the $d_{50} = 100\mu m$ sand test, procedure was repeated for $d_{50} = 200\mu m$ test.

Pumped water samples were passed through a $63\mu m$ sieve to separate sand ($> 63\mu m$) from fine sediment ($< 63\mu m$). The fine sediment was additionally filtered, then the two fractions were separately dried, and weighed as per Aminot and Kérouel (2004) to yield baseline estimates of true suspended sediment concentrations.

The median and standard deviation of optical and acoustic backscatter for each sediment loading condition were computed for the period 3-14 mins after sediment load was added to ensure complete mixing. As samples were added every 15 minutes, this corresponded to approximately 660 samples per sediment loading condition for the OBS (1 Hz sample rate) and 5280 samples per sediment loading condition for the ADV (8 Hz sample rate).

References

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