Hyporheic Exchange 2012 Dataset Read Me

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Introduction

The dataset describes concentration-time data recorded in an EROSIMESS system (erosimeter).

This dataset provides the data used in the journal article:

> Chandler, I. D., I. Guymer, J. M. Pearson, and R. van Egmond (2016), Vertical variation of mixing within porous sediment beds below turbulent flows, *Water Resour. Res.*, 52, doi:10.1002/ 2015WR018274.

Please visit www.doi.org/10.1002/2015WR018274 for more information.

The data was collected by Dr Ian Chandler at the University of Warwick, under the supervision of Prof. Ian Guymer, as part of his PhD thesis.

> Chandler, I. D. (2012), Vertical variation in diffusion coefficient within sediments, *PhD Thesis*, *University of Warwick*.

Please visit http://wrap.warwick.ac.uk/49612/ for more information.

This archive was prepared by Prof. Ian Guymer, with assistance from Dr Fred Sonnenwald, at the University of Sheffield.

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File naming and data format

This dataset consists of two files, this read me file and a Microsoft Excel .xlsx format workbook. The workbook file contains 27 sheets, one summary sheet outlining the experimental configurations, and 26 data sheets containing concentration time-records for each experimental configuration.

Each data sheet is named by a unique experiment identifier. Each sheet contains 8 or 9 columns of data. The first column provides the time since the start of the experiment in seconds. The final column records water temperature in degrees Celsius, with the penultimate column giving the calibrated Rhodamine concentration in the water column in parts per billion by a Cyclops fluorometer. Columns in between provide the calibrated Rhodamine concentrations in parts per billion measured by the fibre optic fluorometers. Note that the columns may not be in order.

For example, the first part of the 20110330 sheet contains:

Time	FOF1	FOF2	FOF4	FOF5	FOF6	Cyclops	Temp
(s)	(ppb)	(ppb)	(ppb)	(ppb)	(ppb)	(ppb)	(°C)
0	31.5	100.0	100.0	100.0	100.0	2.3	20.5
10	69.9	102.9	99.7	99.7	100.0	2.2	20.5
20	88.1	106.7	99.5	99.4	100.0	2.6	20.5

In this instance, 20 seconds after the start of the experiment the concentration at fibre optic fluorometer six (FOF6) is 100.0 parts per billion. The data for 20110330 is plotted in Figure 1.

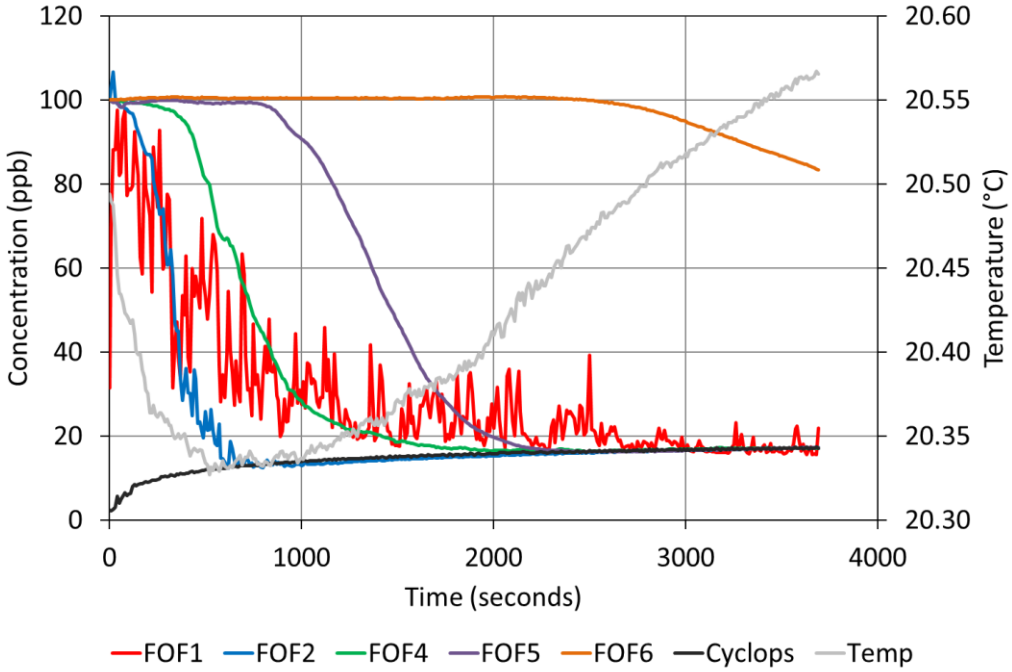

Figure 1 Example plot of the 20110330 data

Experimental setup

An EROSIMESS system was modified with a flanged connection between the main section and base at the sediment-water interface to improve the placement of sediment, to provide side access for instrumentation in the base section and to incorporate an in-situ permeability test, as shown in Figure 2.

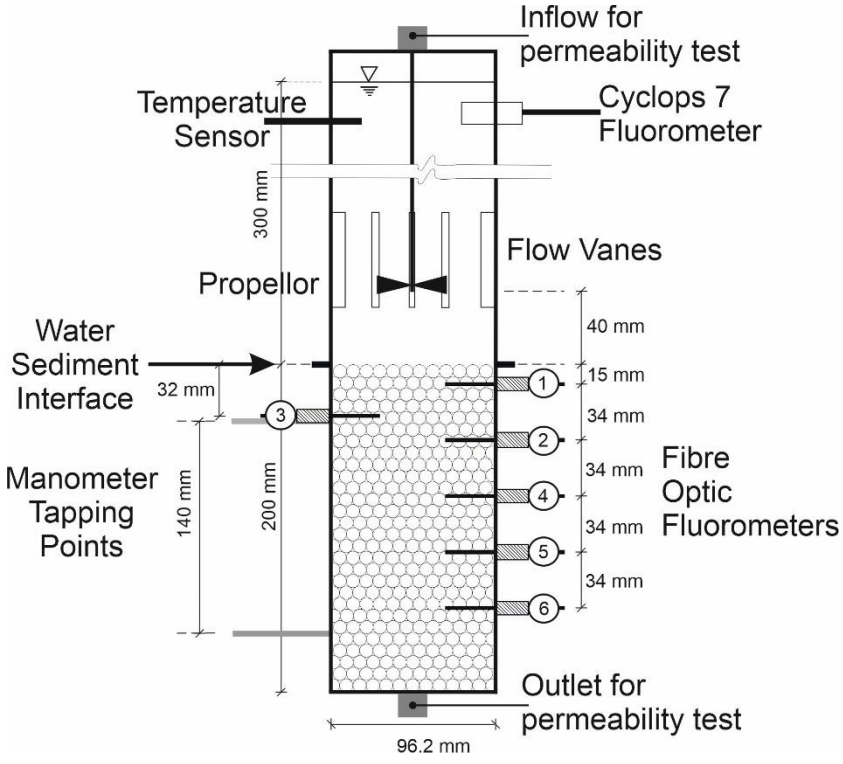

Figure 2 Schematic of erosimeter

The upper section was 300 mm high with an internal diameter of 96.2 mm. A motor (not shown) was positioned on top of the main section with a shaft bringing the 20 mm diameter tri-blade propeller to 40 mm above the sediment-water interface. As in the original design, six flow vanes were located around the circumference at the height of the propeller. The 200 mm tall base section had the same diameter as the main section.

Each test consisted of five main stages. The first stage was to place a homogeneous concentration of Rhodamine throughout the bed into the base section and take a calibration reading for the fibre optic fluorometers. Next, the main section was placed and filled with clean de-aired water. The motor was then installed, switched on and the tracer experiment allowed to run. Once the tracer experiment was complete the motor was stopped and replaced by the constant head permeability test apparatus. The permeability test was then conducted on the in-situ bed sediment.

The test series consisted of five different bed shear velocities (0.01, 0.015, 0.02, 0.03, and 0.04 m/s) and five different sediment diameters (0.15, 0.35, 0.0625, 1.85, and 5.0 mm) in various combinations. Some combinations could not be tested without causing sediment motion, and therefore were not tested. The sediment consisted of single size solid soda glass spheres with a quoted density of 2530 kg/m^3. The solute tracer used was Rhodamine WT (US patent 3,367,946).

A Turner Designs Cyclops 7 fluorometer and a temperature sensor were positioned on opposite sides 240 mm above the sediment water interface to take concentration measurements in the water column. Five fibre optic fluorometers (FOF), instrument numbers 1, 2, 4, 5 & 6, were aligned vertically at -15, -49, -83, -117 and -151 mm below the top of the base section (the sediment-water interface), to take in-bed concentration measurements. For a few tests an additional Fibre Optic Fluorimeter, number 3, was positioned 32 mm below the sediment water interface from the opposite side. All the fluorometers had an accuracy of 1 ppb or better. The fibre-optic fluorometers had a head diameter of 4 mm. A mesh cover (30 mm long by 4 mm) was positioned over the end of the fibre to create a measurement volume of approximately 0.23 ml. The excitation source was a green laser diode and the emissions detector was a photomultiplier tube (PMT) with appropriate cut-off optical filters for Rhodamine WT. The signal from the PMT was passed through a low pass filter, with a cut-off frequency of 30 Hz, to reduce noise from the mains power supply, whilst still capturing the expected rate of concentration change.

The base section of the erosimeter included a drain so that a constant head permeability test could be conducted (British Standard 1377-5, 1990), in-situ, after solute trace experiments had been undertaken. A cap, connected to the constant head source, was placed on top of the main section, replacing the motor and housing. Manometer gland points, 140 mm apart in the base, were used to measure the hydraulic gradient within the sediment bed.