

TDVS2016ACT Dataset Read Me

(Transverse Dispersion in Vegetation across a Shear-layer 2016: Artificial, *Carex*, *Typha*)

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1 Introduction

This dataset describes concentration and velocity profiles recorded in a flume fitted with partial width emergent vegetation. It accompanies the journal article submissions entitled "A CFD-based mixing model for vegetated flows". This dataset was collected by Dr Patrick West under EPSRC Doctoral Training grant EP/K503204/1 and Dr James Hart at the University of Warwick. Special thanks to Ian Baylis for his expert technical support. This archive was uploaded by Dr Fred Sonnenwald at the University of Sheffield. Their work was completed under EPSRC grants EP/K024442/1 and EP/K025589/1.

Please visit <http://vpond.group.shef.ac.uk> for more information.

2 File naming and data format

This dataset consists of one ZIP file containing six folders. The first five folders contain CSV data and are named after one of the five types of vegetation tested, e.g. '4_Winter_Typha' (see Section 3 for more information on the experimental setup). The sixth folder contains JPG photographs, and is named '6_Photos'. Each vegetation folder contains at least one sub-folder, '1_Concentration', that contains concentration profiles. Some vegetation folders contain an additional folder, '2_Velocity', that contains velocity profiles.

2.1 Concentration profiles

Each 1_Concentration folder contains ten CSV files, two for each of five flow rates. Each pair of CSV files is the upstream and downstream record for that configuration (flow rate).

File naming reflects the experimental configuration. For example, take the file '2_High-Density_AV/1_Concentration/HDAV_52_2DS.csv'. This is data collected from the High-Density Artificial Vegetation (HDAV) at a flow rate of $0.0052 \text{ m}^3\text{s}^{-1}$ at the downstream (2DS) measurement location. The filename contains the flow rate in $\text{ls}^{-1} \times 10$, in this case 52. This file is paired with the file '2_High-Density_AV/1_Concentration/HDAV_52_1US.csv', data collected at the upstream (1US) measurement location (the measurement locations are separated longitudinally by 1 m).

Each CSV file contains the calibrated temporally averaged mean transverse concentration profile of Rhodamine 6G dye in parts per billion (ppb) above mean background concentration. The first column

contains the transverse position in the channel in metres and the second column the calibrated mean concentration. Both the channel and vegetation start at 0 m.

For example, the first part of `HDAV_52_2DS.csv` contains:

```
0, 0.48172
0.00085106, -0.011433
0.0017021, -0.016279
0.0025532, -0.040427
```

In this instance, row 3 indicates that at 1.7 mm into the vegetation and across the channel, the mean recorded concentration was -0.016279 ppb (slightly below mean background concentration). This data is plotted in Figure 1.

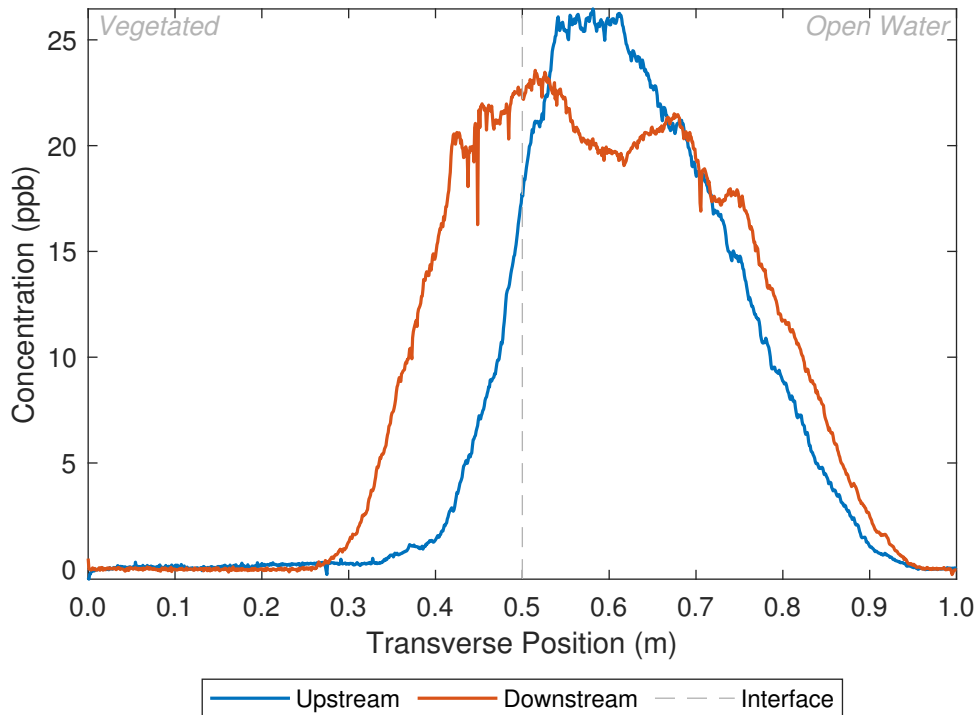


Figure 1: Example plot of the High-Density Artificial Vegetation $0.0052 \text{ m}^3 \text{ s}^{-1}$ configuration, generated using Matlab, 'demoplot.m', and the data files:

`2_High-Density_AV/1_Concentration/HDAV_52_2DS.csv`; and
`2_High-Density_AV/1_Concentration/HDAV_52_1US.csv`.

2.2 Velocity data

Each `2_Velocity` folder contains five CSV files, one for each of five flow rates. These files are named in a similar fashion to the concentration profiles. For example, take the file '`1_Low-Density_AV/2_Velocity/LDAV_42_3VEL.csv`'. This file is data collected from the Low-Density Artificial Vegetation (LDAV) at a flow rate of $0.0042 \text{ m}^3 \text{ s}^{-1}$ (42) and describes velocity (3VEL) data. The first column of a velocity CSV file contains the transverse position in the channel in metres and the second column the mean stream-wise velocity in ms^{-1} .

3 Experimental setup

A 1 m wide flume was fitted with vegetation along one side to form a partially vegetated channel. Real vegetation had a width of 0.5 m and artificial vegetation a width of 0.6 m. Flow depth was fixed at 0.15 m. Vertical line source dye injections were carried at the vegetation-water interface. Calibrated measurements of dye concentration were made 1 m and 2 m downstream from the injection point using laser induced fluorescence. The lasers used were line lasers fitted at mid-depth. Concentration was recorded across the width of the flume as pixel intensity using cameras located beneath the flume. 10 minute continuous injections were made at 5 different flow rates of $Q \approx 3.3, 4.3, 5.2, 6.4$ and 7.5 ls^{-1} . A schematic of the experimental configuration is shown in Figure 2.

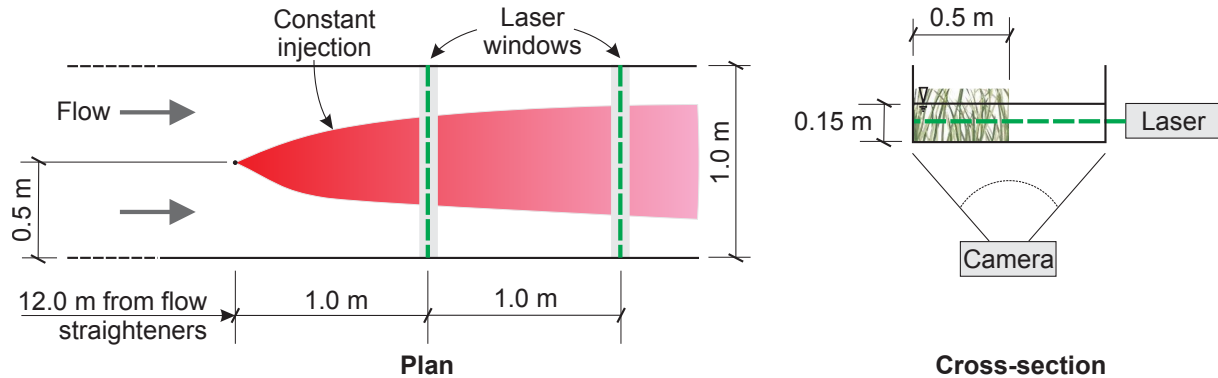


Figure 2: Experimental configuration (real vegetation pictured with interface at 0.5 m)

Velocity measurements were taken using Acoustic Doppler Velocimetry (ADV) mid-channel depth at the laser windows. Either a Nortek Vectrino II or Metflow UVP probes were used. Due to experimental limitations, only best-fit mean stream-wise velocity profiles are available. These have been fit to the individual measured data points. More information is available in West (2016). Additional details on the experimental setup are also available in Sonnenwald *et al.* (2017).

4 Vegetation characterisation

Measurements were made in 5 types of emergent vegetation, two artificial vegetation and three real vegetation. The vegetation characteristics and interface location are given in Table 1. The photographs included in this archive that show the vegetation are reproduced in Figure 3.

References

- Sonnenwald, F., Hart, J., West, P., Stovin, V., & Guymer, I. (2017). Transverse and longitudinal mixing in real emergent vegetation at low velocities. *Water Resources Research*, 53(1), 961–978. <https://doi.org/10.1002/2016WR019937>
- West, P. (2016). *Quantifying solute mixing and flow fields in low velocity emergent real vegetation*. PhD thesis, University of Warwick. <http://wrap.warwick.ac.uk/81815/>

Type	Stem Density N (stems/m ²)	Stem Diameter d (m)	Frontal Facing Area a (m ⁻¹)	Solid Volume Fraction ϕ [-]	Interface Location (m)
Low-Density Artificial Vegetation	398	0.004	1.592	0.005	0.6
High-Density Artificial Vegetation	1594	0.004	6.376	0.020	0.6
Summer <i>Carex Acutiformis</i>	3388±819	0.005±0.001	18.3±5.9	0.077±0.029	0.5
Winter <i>Typha Latifolia</i>	161±72	0.010±0.007	1.6±1.4	0.013±0.014	0.5
Summer <i>Typha Latifolia</i>	171±42	0.019±0.010	3.2±1.8	0.047±0.036	0.5

Table 1: Vegetation characteristics

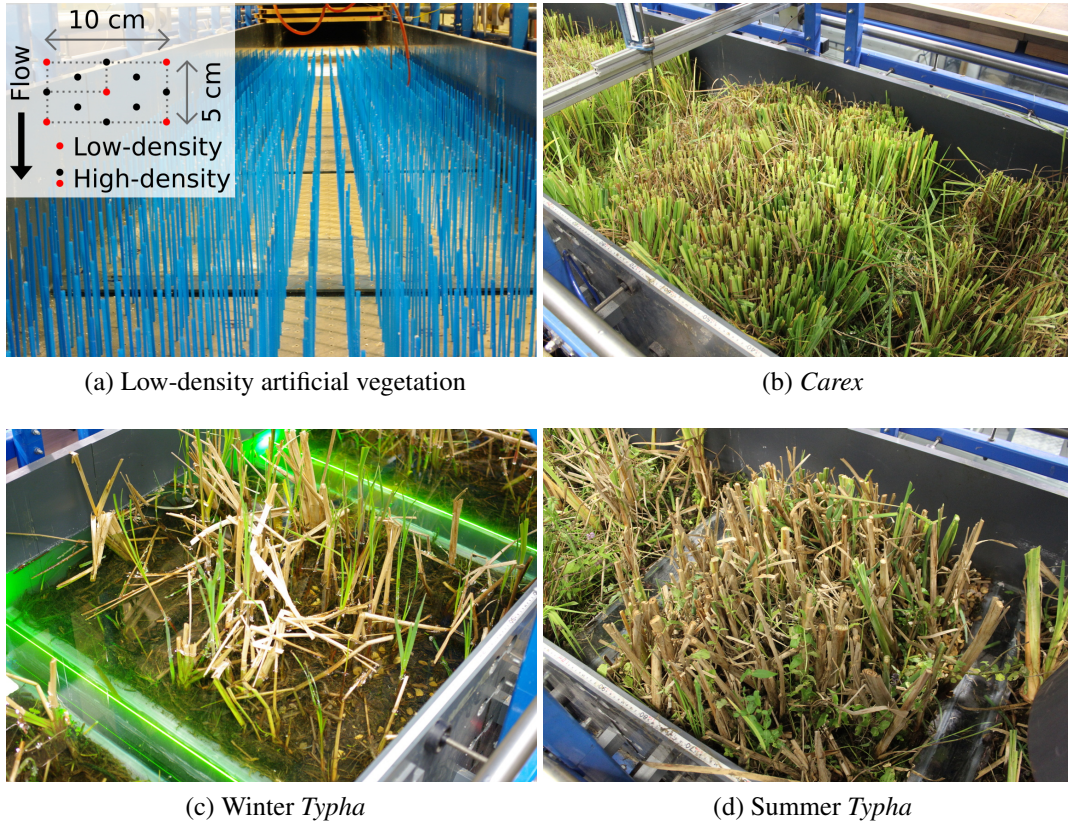


Figure 3: Photos of vegetation