ACOUSTIC DOPPLER VELOCIMETRY (ADV) IN A SMALL ESTUARINE SYSTEM. FIELD EXPERIENCE AND "DESPIKING"

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Estuarine mixing and dispersion are turbulent processes. Present understanding of estuary turbulence remains however limited, partly because long-duration studies of turbulent properties are difficult and rare. Herein, some long-duration turbulence data recorded at high-frequency using acoustic Doppler velocimetry (ADV) are analysed. The data sets were collected in a small sub-tropical estuary (Fig. 1). The data analysis shows conclusively that turbulence properties cannot be derived from unprocessed ADV signals and that even "classical" despiking methods are not directly applicable to unsteady estuary flows. Instead a detailed post-processing technique is developed and applied.

A new three-stages post-processing method is presented. The technique includes (1) an initial velocity signal check, (2) some "pre-filtering" and (3) some despiking, while each stage includes velocity error detection and data replacement. The method is applied to two long-duration field studies. Optimum coefficients are derived for a small subtropical estuary. Comparative analyses of un-processed, "despiked-only", and post-processed velocity data highlight the necessity for an advanced post-processing method (Fig. 2, Table 1)). While the acoustic Doppler velocimetry is a relatively simple technique, present results demonstrate that unprocessed ADV data should not be used, even for a study of time-averaged velocity components.

Importantly, further field data are necessary to validate the post-processing technique, by comparing post-processed data with independent data acquired simultaneously at the same location in the natural system. At present, the selection of more appropriate techniques is intricate since no independent data set (i.e. 'true data set") is available. Comparisons between post-processing techniques are basically limited to an assessment of the number of removed spikes, and some subjective evaluation of differences in turbulent velocity properties.

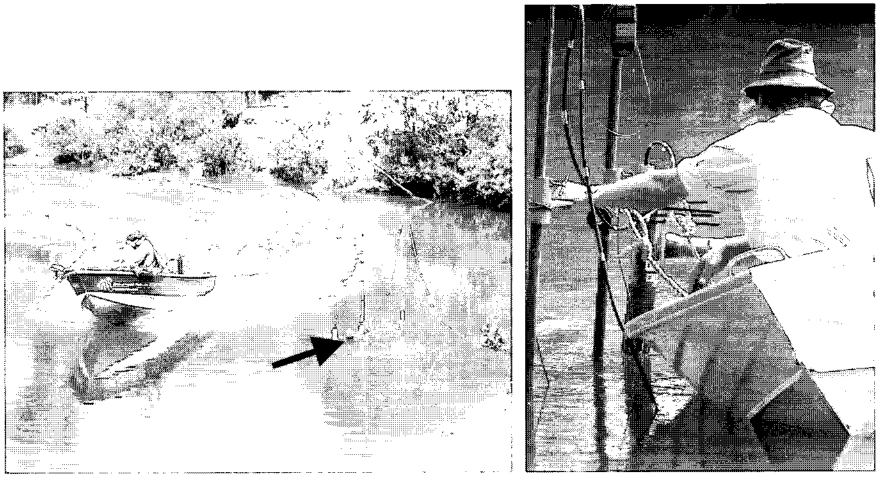

Fig. 1 Acoustic Doppler velocimetry in Eprapah Creek estuary
(A) Boat passing next to ADV probe during ebb tide.
(B) (B) Vertical probe adjustment during floodtide.

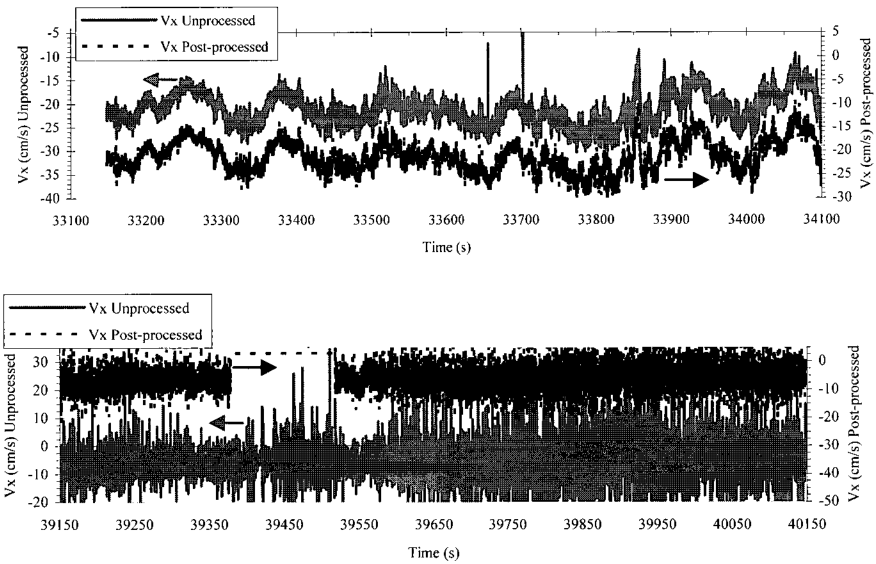

Fig. 2 Comparison of original and post-processed velocity signals - Field study E2, V_X velocity component - Time is expressed in seconds since midnight (GPS time)

Table 1. Turbulent velocity statistics for three time intervals (Fig. 2): (1) t = 28,148 to 29,148 s; (2) t = 33,148 to 34,148 s; (3) t = 39,148 to 40,148 s (expressed since midnight, GPS time)

	Un- processed			Post- processed			Remarks
	V_x	V_y	V_z	V_x	V_y	V_z	
(A) Average (cm/s)	-5.203	0.322	-0.254	-5.210	0.321	-0.255	t = 28148 to 29148 s
(A) Std dev. (cm/s)	1.388	0.610	0.142	1.374	0.607	0.140	1.1% of data errors
(A) Skewness	-0.909	0.0214	-0.306	-0.965	0.020	-0.342	
(A) Kurtosis	0.856	-0.476	0.710	0.809	-0.501	0.620	Excess kurtosis
(B) Average (cm/s)	-21.21	3.566	-1.499	-21.21	3.567	-1.500	t = 33148 to 34148 s
(B) Std dev. (cm/s)	3.293	2.234	1.608	3.276	2.220	1.586	2.0% of data errors
(B) Skewness	0.241	0.0853	-0.191	0.234	0.080	-0.209	
(B) Kurtosis	-0.196	-0.0431	1.389	-0.270	-0.109	1.151	Excess kurtosis
(C) Average (cm/s)	-6.066	0.675	-0.982	-4.858	1.191	-0.995	t = 39148 to 40148 s
(C) Std dev. (cm/s)	4.99	3.20	1.36	4.729	2.410	0.683	18.4% of data errors, but
(C) Skewness	0.421	-4.34	0.423	0.328	-0.341	0.031	99.9% data error on V_x
(C) Kurtosis	10.37	162.7	80.2	-0.269	0.104	1.368	Excess kurtosis