MIAS

Natural Environment Research Council

Institute of Oceanographic Sciences
Crossway, Taunton, Somerset. TA1 2DW

PROVISIONAL CRUISE REPORT

VESSEL: RV Frederick Russell

CRUISE PERIOD: 6 October-14 October 1981 presumably cruise 81/14 first leg.

PERSONNEL:

R L Soulsby	SSO	(Principal Scientist)	6-11 October
R H Wilkinson	HSO	(Principal Scientist, 11-14 Oct)	6-14 October
G P Le Good	HSO		6-14 October
R A Haine	HSO		6-14 October
Mrs B L S A Wainwright	ASO		6-14 October
J S Chappell	Student		6-14 October
A P Salkield	SSO		10-11 and 13-14 October
P D Thorne	HSO		10-14 October

ITINERARY:

6 Oct Travelled to Plymouth, unloaded and set up equipment. Sailed 2000 for Start Bay and anchored overnight.

7 Oct Three-point anchored at Stn M. Tested raising and lowering of rig supported on electric cable. Fitted instruments to rig and tested them with rig at midwater.

8 Oct Made improvements to rig handling and instruments. Commenced profiling experiment at 1400, and continued through night.

9 Oct Continued profiling experiment until 1600. Weather too bad to continue working (SW9), so sailed to Dartmouth and moored to buoy overnight.

10 Oct Attempted to anchor bow and stern at Stn 8 in R Dart to obtain turbulence profiles with no ship motion, but position unsuitable for anchoring. Anchored off Pilchard Cove while instruments were got ready for ripple shadow experiment. APS and PDT came out on MV Devonian to join Frederick Russell at 1200. Three-point anchored at Stn 1 at 1800 and commenced ripple shadow experiment, which continued overnight.

11 Oct Ripple shadow experiment (RSE) continued until 0800. APS and PDT conducted trials of the Sand Transport Probe (STP) during daytime. MV Devonian came alongside at 1700 and took APS and RLS to Dartmouth, and thence to Taunton. RSE recommenced at 1830 and continued throughout the night.

12 Oct RSE finished at 0730 and recommenced at 1800. STP trials during day.

13 Oct RSE finished at 0730 and recommenced at 1830. STP trials during day. APS returned to ship via MV Devonian at 1000.

14 Oct RSE finished at 0530. Grab sample taken at Stn 1. Anchor weighed at 0545. Echo sounder survey over Stn 1 and M, with grab sample at M prior to returning to Plymouth. Docked at 1015 hours. RHW, BSLAW, JSC and APS returned to Taunton.

OBJECTIVES: The cruise was made as part of the DoE funded programme of research into the processes of sand movement by tidal currents. The aims were:

(a) To make measurements of the tidal variation in the vertical profile of turbulent kinetic energy, in order to elucidate the dynamics of the tidal boundary layer.

OBJECTIVES: (Contd)

(b) To measure the tidal variation in the shape of sea bed sand ripples, and the simultaneous variation in the near bottom velocity profile. This will help determine whether previously noted temporal variation in the sea bed roughness length is caused by the changing ripple asymmetry.

(c) Field trials of the Sand Transport Probe for measuring suspended sediment concentration.

PROCEDURE AND METHODS:

Objective (a)
Measurements of turbulent kinetic energy profiles have not been made previously, so this experiment was largely concerned with trying out techniques and obtaining a limited data set for developing the analysis methods. Two 5 cm diameter electromagnetic current meter (EMCM) heads were mounted orthogonally on a rig so as to measure all 3 components of the fluctuating current velocity. The rig was hung over the ship's side suspended from an electric strain cable and profiled up and down through the water column. A cycle of measurements was taken every hour, consisting of a 10 min measurement with the rig on the bed followed by consecutive 6 min measurements at each of six heights above the bed. An echosounder mounted on the rig gave its height above the bed, and the water depth was periodically read from the ship's echosounder. Because the rig is moving due to ship motion relative to a fixed coordinate frame, it was necessary to measure its own motion so that this can besubtracted from the EMCM outputs. Three out of the six degrees of freedom were measured, namely heave velocity obtained from an accelerometer, pitch and roll. These, together with the EMCM data, were recorded every 0.2s on a microprocessor controlled digital data logger, and also on a back-up analogue tape recorder. The rig also carried a rigidly mounted Braystoke Direct Reading Current Meter and two Ott current meters, and these, together with a Braystoke DRCM hung separately at a constant 7 m below the water surface, were recorded every minute on the data logger. A method of raising and lowering the rig without requiring a break in the electric cable was used. This involved winding the cable onto the dredge winch with the load taken at the cable's midpoint, so that two ends of cable came off the drum, one leading to the rig and the other to the lab. A specially fabricated wooden jacket was fitted over the wire on the winch drum to protect and guide the electric cable.

Objective (b)
The shape of the sand ripple was monitored optically by obliquely casting the shadow of a horizontal rod (pointing into the flow) onto the sea bed. The shape of the shadow was recorded photographically using a remotely triggered Hasselblad 550 EL/M. An U/W television camera was directed at approximately the same field of view and was used as a viewfinder to detect when significant change in the ripple shape had occurred, and thus the photographs could be taken at the optimum moments.

The mean velocity profile was measured using 6 Ott propellor current meters mounted at approximately logarithmic spacing above the bed. The counts from these were recorded every minute on the data logger.

Objective (c)
Measurements of suspended load were conducted using the STP, which was calibrated on site against pumped samples. The analogue signal was digitised using a threshold detector and recorded on a digital data logger.

EQUIPMENT PERFORMANCE:

Objective (a)
The system of lowering the rig proved successful and allowed rapid changes to be made in its height above the bed. All the instruments on the rig worked well, except for one of the Ott current meters which was subsequently dismantled and repaired. The digital data logger, which had not previously been tested in the field, worked well and gave no problems. The TV camera suffered from a faulty plug, but it was not essential for experiment (a), so it was removed and repaired in readiness for the ripple shadow experiment.

Objective (b)
The operation of the Hasselblad 500 EL/M with the 70 exposure magazine proved intermittently unreliable but thorough deck testing of both the camera and the remote triggering system failed to locate the fault. The use of 12 exposure magazines with the original timer box was finally resorted to, even though this necessitated raising the frame every hour to change films.

Four out of six Ott current meters could be seen on the television, so any fouling by weed etc could be noted. Apart from the fouling their reliability seemed better than 95%, with occasional stickiness caused by sand in their bearings. Provided that only one meter was affected in this way at a time, the rotor was overhauled the next time the rig was on deck.

A two pump system had been arranged for the pumped sampling, which alleviated the previous priming difficulties. It transpired, however, that the flow rate obtained was sufficient to collapse the valve tube in the manifold box, whereas a smaller flow rate was insufficient from the sampling point of view. The manifold was abandoned, and samples just taken from one level.

Objective (c)
Damage to the STP on 12 Oct caused a decrease in operational performance and this seriously impeded the investigation with the STP.

RESULTS:

(a) The main purpose of the experiment was achieved, namely to test out the feasibility of making turbulence profiles from an anchored ship. The system of handling the rig and the hourly sequence of operations proved to be workable. The heave velocities due to ship motion could be seen qualitatively to be mirrored in the EMCM traces, but surprisingly the pitch and roll were both steady to within ±0.1° at all times, and rapid logging of them could be dispensed with in the future. It is still not known how important yaw, surge and sway are, as these were not measured. Although the weather was poor during the experiment so that there was both appreciable ship motion and wave orbital motion superimposed on the velocities, a useful data set was obtained, and analysis of

this will show how successfully the motion can be removed, as well as giving a first impression of the behaviour of the turbulent kinetic energy in an oscillatory tidal boundary layer.

Because of the weather, data could only be obtained at Stn M (shallow water, fast currents) and not at Stn 7 (deeper water, slower currents). Nor could they be obtained at Stn 8 where it was hoped that ship motion would be negligible, because of the anchoring difficulties.

Future experiments must be planned at sites and dates where wave activity can be expected to be minimal, but granted this they should be capable of yielding valuable results.

(b) The intermittent malfunction of the Hasselblad prevented us obtaining full sets of ripple and velocity profiles during the first three nights, but some data was obtained during this period which together with 'guesstimates' of the shadow shape on the TV screen copied on acetate sheet should progress the investigation considerably. A full set of both types of profile was obtained on the last night (equinoctial spring). Sediment concentrations at 10 cm above the bed and mean velocity profiles were obtained on all four nights, totalling about 35 hours of data in all.

(c) Initial measurements with the STP appeared satisfactory up to the time of its damage.

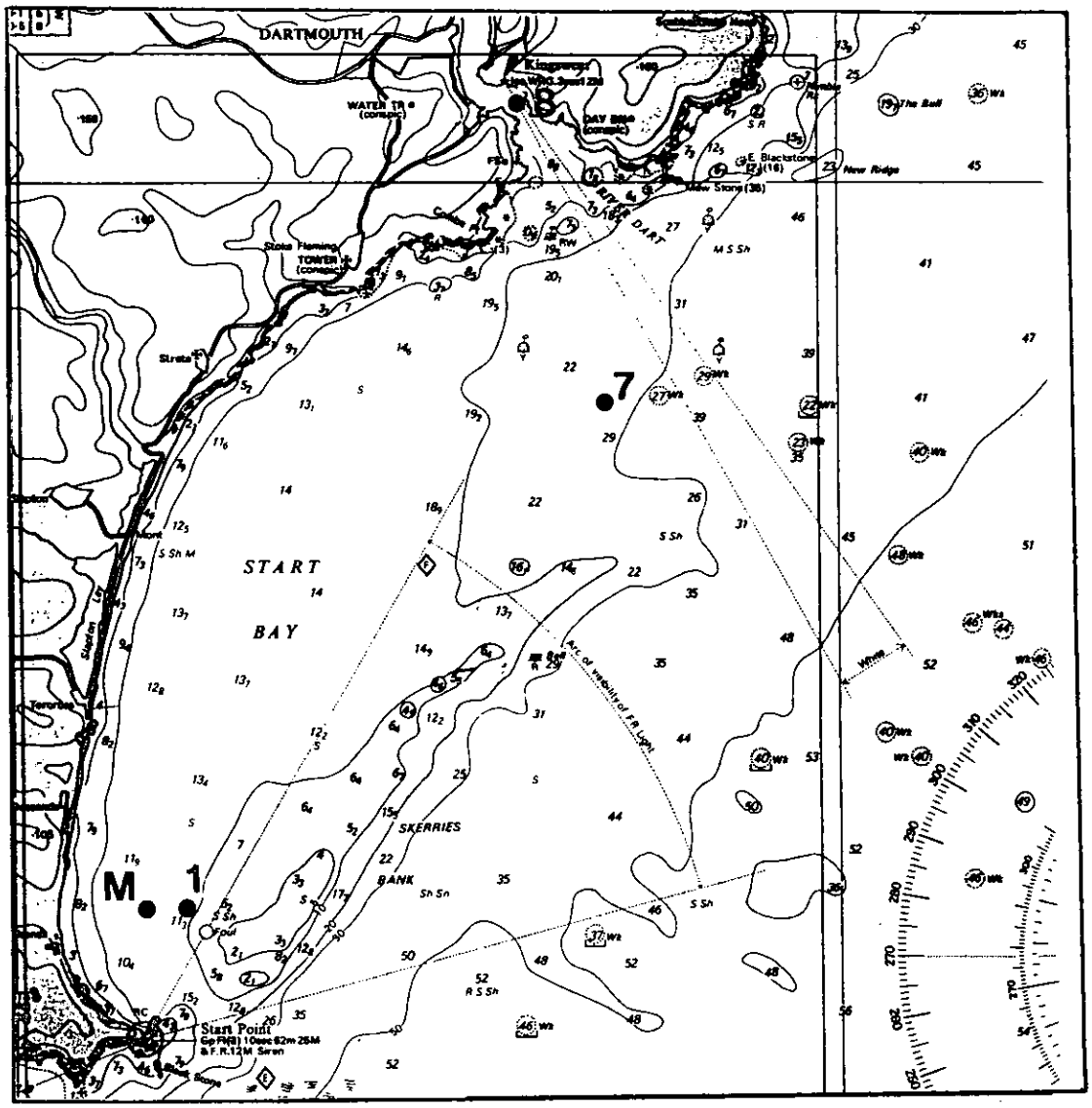
STATION LIST:

1	50° 14.3'N	3° 37.9'W
7	50° 18.2'N	3° 32.8'W
8	River Dart off One Gun Point	
M	50° 14.4'N	3° 38.2'W

PREPARED BY: R L SOULSBY
R H WILKINSON

APPROVED BY: A P CARR

DATE: 6 November 1981.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