INTERNAL DOCUMENT

I.O.S.

NATURAL ENVIRONMENT RESEARCH COUNCIL
INSTITUTE OF OCEANOGRAPHIC SCIENCES

Institute of Oceanographic Sciences

Internal Document 82

February 1980

RRS JOHN MURRAY CRUISE 20/79

5th-17th December 1979

NEAR-SURFACE CURRENT AND WAVE INTERCOMPARISONS NEAR THE UK DATA BUOY (POSITION 48°43'N, 08°58'W)

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JOHN MURRAY CRUISE 20/79

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SCIENTIFIC OBJECTIVES

The aims of the experiment were:

(a) to test the assertion that mean currents in the uppermost few metres of the wave field can be measured adequately using vector-averaging current sensors mounted on a moored surface following buoy,

(b) to test an experimental mooring designed for this purpose, and to investigate its suitability for mooring arrays of pitch/roll wave buoys,

(c) to see whether the technique provides sufficient accuracy for shear to be detected in the near surface region,

(d) to provide further testing for the vector averaging electromagnetic current meter recently developed at IOS,

(e) to provide independent measurements in the open sea against which the performance of the UK data buoy wave and current sensors can be assessed.

The intention of the present experiment was to make observations in an area on the Continental Shelf where surface currents (<50 cm/s) are generally much less than wave orbital speeds. Two moorings were laid with as small a separation as was practicable, each consisting of anchor, acoustic release, subsurface buoyancy, compliant tether, and surface following annular float containing two vector averaging electromagnetic current meters (VAECMs). Comparisons were to be made between the outputs from the current sensors and the displacement rates of drifting surface floats, tracked acoustically. Drogues attached to the floats cause them to respond to local water movement at the depths of the moored current sensors. Determination of the float positions was to be made in a similar manner to that adopted in the JASIN 1978 experiment (IOS Cruise Report No. 74): measurement of the ranges from the ship to a float and from a moored remote interrogator to the float. Directional reference for the baseline is obtained by taking radar fixes on a surface buoy attached to the remote interrogator mooring.

The first of the VAECM-equipped buoys measured current at two depths (0.5, 1.5 metres, averaging interval 112.5 sec) with a view to detecting any shear in this depth range. One of these instruments sampled more frequently (3.5 sec interval) for 3 hours each day so as to extend the frequency response to include wave frequencies. The second instrument carried identical heads at the same depth, 50 cm, thus allowing a test to be made for the near unity coherence which should be obtained between the two outputs.

The performance of surface following floats on a compliant single point mooring was of wider interest in view of a proposed experiment using an array of moored pitch/roll buoys to obtain improved wave directional resolution.

The opportunity was also taken to include two different types of rotor vane current meters (Geodyne type Vector Averaging Current Meter and Aanderaa Current Meter) on each mooring at a depth of approximately 40 m. This was partly to enable comparison to be made with the wind related component of near surface currents, partly to afford a comparison between vector-averaging and non vector-averaging sampling schemes.

The experiment was to take place in the vicinity of the UK Data Buoy, DB1. This offered advantages in that DB1 measures current at 3 m depth, thus making a valuable contribution to shear determination. Equally, the attachment of drogues to some floats at 3 m mean depth was planned, so as to facilitate comparison with the DB1 current sensor and so validate its output.

Furthermore, it was planned to make directional wave measurements, deploying the IOS pitch/roll buoy system from the ship, and to take regular meteorological observations, for later comparison with DB1 data. The aim of the pitch/roll measurements was to provide information on the high frequency slope following performance of the UK Data Buoy, DB1, as well as comparisons of wave height. Pitch/roll buoy slope following performance is near perfect up to wave frequencies in excess of 0.3 Hz whereas the pitch and roll response of DB1 cuts off at about this frequency. By comparison of pitch/roll buoy and DB1 slope spectra it was hoped that it would be possible to derive the transfer function of DB1 in pitch and roll, under a range of tidal conditions, thereby enabling corrections to be made to DB1 data.

NARRATIVE

RRS John Murray sailed from Barry at 19.30 hrs on Wednesday 5th December, following some slight delay occasioned by repairs to the forward deck windlass motor. On 6th December, steady progress was made down the Bristol Channel through appreciable swell, a stop being made near 49°37'N, 07°09'W in order to test two acoustic command releases at 100 m depth using the hydrographic winch. During the night of the 6th, deteriorating weather conditions forced a reduction of speed and delayed arrival at the buoy site until approximately 22.00 hrs on 7th December. A brief seabed survey was then made around the buoy to ascertain whether the site was clear of obstructions, and to establish sounding depths. From this point onwards until the ship left the DB1 site (Fig. 1), the frequency of meteorological observations (normally made and reported every six hours) was increased to include hourly values of wind speed, wind direction and barometric pressure.

By first light on the 8th, conditions had improved sufficiently to permit overside work and the first current meter mooring (Fig. 2) was laid at a point from which the data buoy, DB1, had a radar range and true bearing of 0.45 m, 353°. Before leaving the mooring observation was maintained on the surface buoy containing the current meters to check for proper surface following, since the float apparently had less buoyancy than expected. Within a few minutes of deployment the buoy was observed to tow under. It was decided to leave the first mooring until the second had been laid, but to add surface buoyancy to the second mooring at the end of the short stiffened strop as a precaution. The laying of the second mooring at a point 0.42 nm distant from DB1 (true bearing 326°) commenced at 13.30 hrs, proceeded more smoothly and was completed by 14.32 hrs. In this case, the wave following characteristics of the surface float appeared entirely satisfactory.

On returning to the first mooring, the surface buoy was found to have capsized. In the attempt to recover it, prior to providing additional buoyancy, both current sensor heads were damaged by the rubbing strake on the ship's hull when coming alongside. The entire buoy was therefore lifted sufficiently to replace it with a small marker float; the buoy was inboard by 15.05 hrs.

The acoustic remote interrogator was now positioned at a point NNE of DB1 (0.38 nm, 204°) attached below a streamlined surface dhan buoy carrying a radar reflector (Fig. 3). This was to serve as a reference marker for float position fixing. A subsequent check made at 2.1 miles range showed that the dhan buoy could be detected through the sea clutter on the ship's radar, although not without difficulty. On rigging the towed interrogator fish (16.50 hrs), acoustic interrogation of the dhan buoy mooring provided acceptable return signals. The system was now ready for the first float to be deployed. However, given the surface conditions, it was decided to heave to until daylight.

During the night of the 9th/10th, weather conditions worsened; at daybreak it was clearly not possible to deploy either floats or the pitch/roll buoy although met. observations continued and recordings were made with the shipboard wave recorder. By mid afternoon gusts of up to 70 knots were reported: recorded maximum wave height was 38 feet (shipboard wave recorder). Forecasts of further deterioration in the weather led to a decision to seek shelter in Falmouth Bay, which was reached at 18.30 hrs on 10th December.

RRS John Murray remained in shelter until 09.00 hrs on 13th December, when a course was again set for DB1 with the promise of better weather conditions. The forecast proved over optimistic and on arrival in the area, shortly after noon on the 14th, conditions were again poor. Location by radar of DB1 in such heavy sea conditions proved difficult: the most certain identification was provided by the navigation light after dusk. Visual identification was also made of the flashing light attached to the surface current mooring; this was in the correct position. No signals were received, however, from the dhan buoy mooring when interrogated.

A further deterioration in weather now forced John Murray to head into wind for the next eighteen hours. Gusts exceeding 90 knots were recorded during the night of the 14th. By 1500 hrs on the 15th conditions had improved sufficiently for the ship to return to the buoy site, reached during the evening. The presence of the two current meter moorings was again confirmed although no trace of the dhan buoy could be found. With no prospect of an improvement in the weather, which would permit retrieval of the moorings, a course was set for Barry, reached at 07.30 hrs on 17th December.

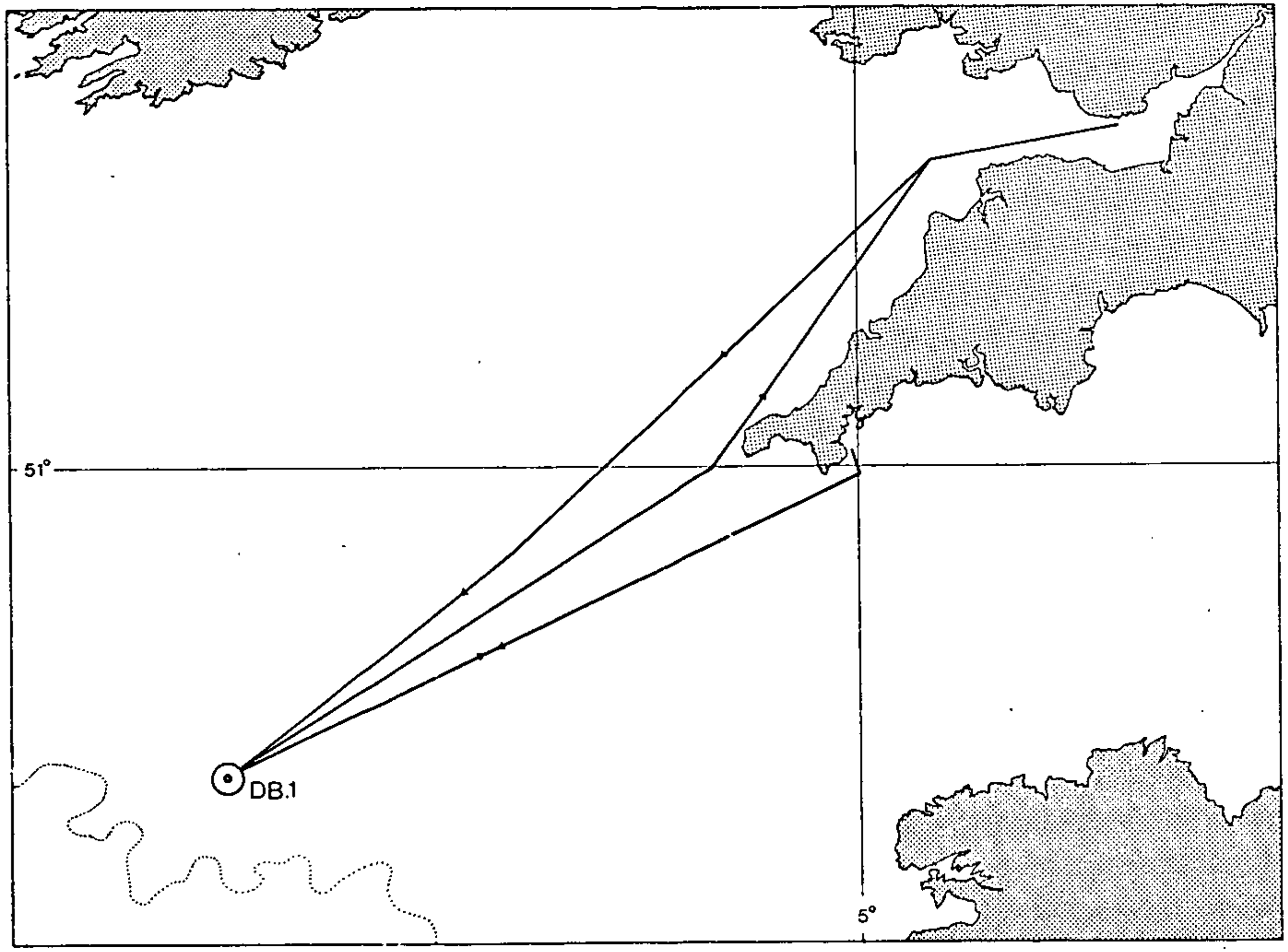

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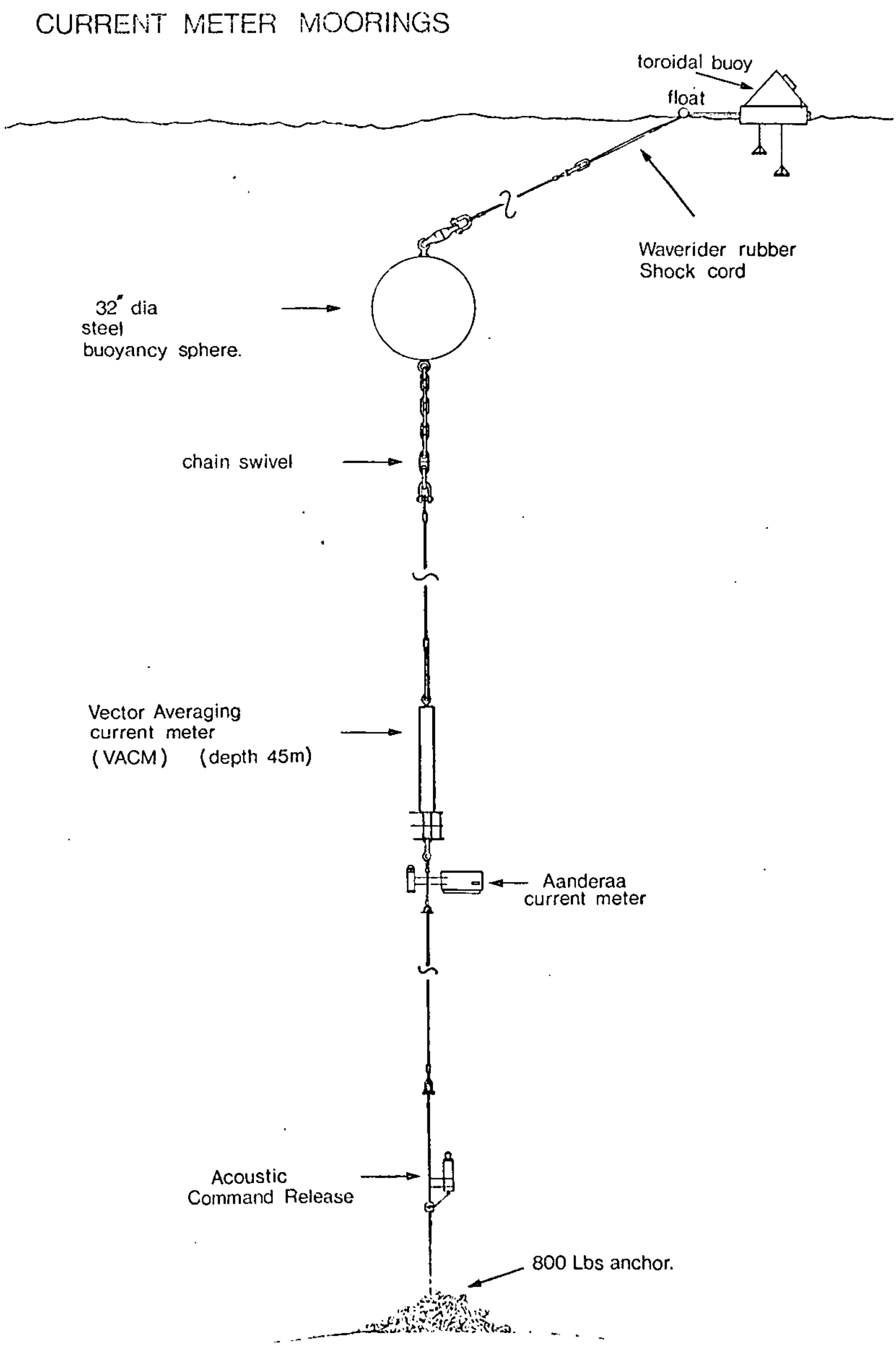
FIG. 1



CURRENT METER MOORINGS
toroidal buoy
float
Waverider rubber
Shock cord
32" dia
steel
buoyancy sphere.
chain swivel
Vector Averaging
current meter
(VACM) (depth 45m)
Aanderaa
current meter
Acoustic
Command Release
800 Lbs anchor.

FIGURE 2

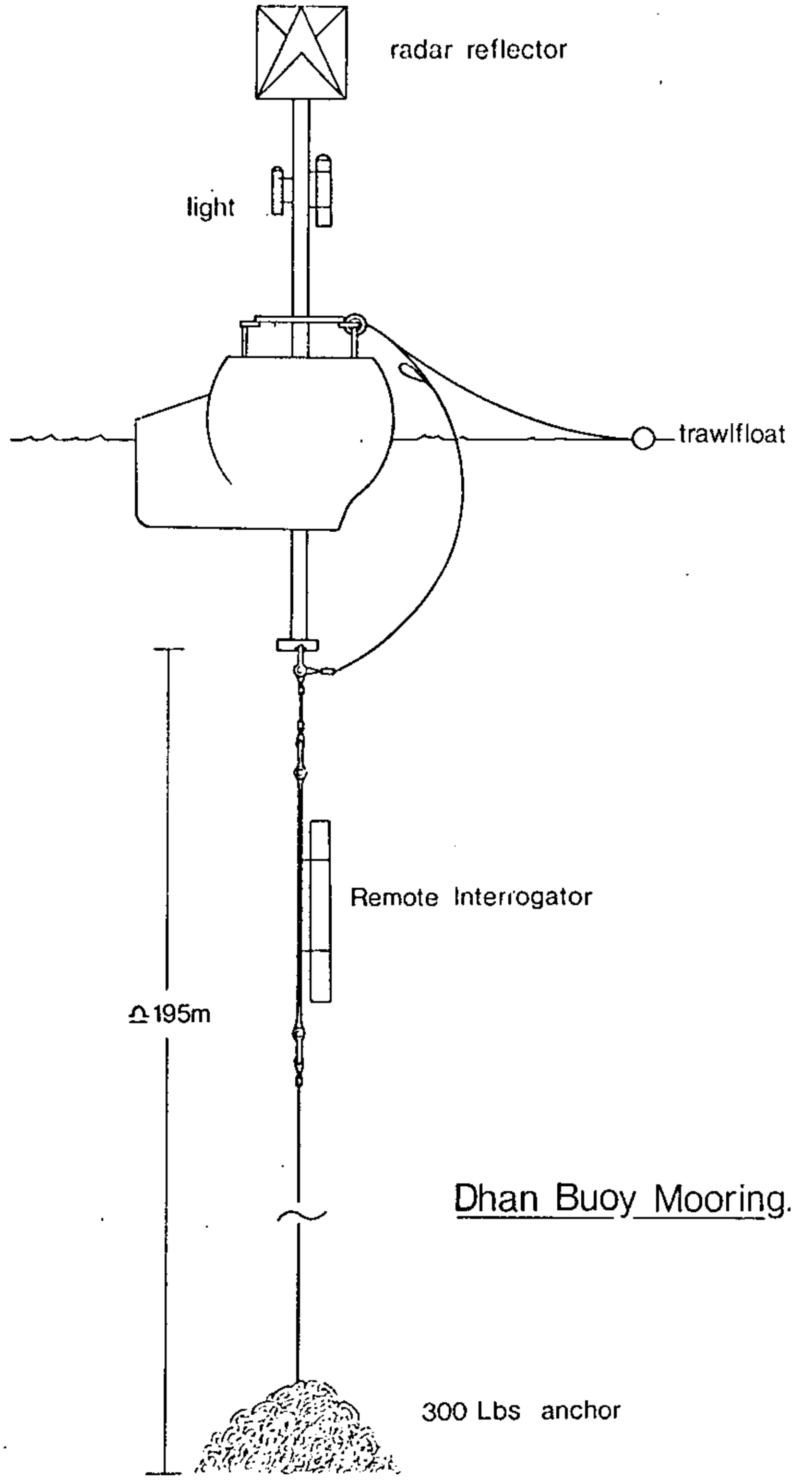

radar reflector
light
trawlfloat
Remote Interrogator
⩍195m
Dhan Buoy Mooring.
300 Lbs anchor

FIGURE 3