How, bedform migration rates and sedinent transport in a tidal inlet

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Abstract

Work reported here forms part of the EU MAST3 INDIA[1] project (Inlet Dynamics Initiative: Algarve), studying the dynamics of a small, highly dynamic tidal inlet in the Ria Formosa, Algarve, Portugal, O'Connor et al., 1999, Figure l. Using the multi-sensor PIP (POL Instrument Package) deployed at various positions in the Barra Nova inlet from a small jack-up barge, Figure 2, detailed contemporaneous measurements of hydrodynamic conditions, bedforms and suspended sediments have been obtained. The primary focus of this paper concerns in situ measurements of suspended sediment concentration profiles and the wavelength, amplitude and migration rates of bedforms measured using the SSS and ARP instruments.

l-Instruments

Instrumentation on the PIP consisted of: a pressure sensor to measure waves; two sets of electromagnetic current meters, ECM's, a 3D high resolution coherent Doppler (HRCD) system, and two acoustic Doppler velocimeters, ADU, to measure wave-current flows; an acoustic ripple profiler (ARP) and a sector scanning sonar (SSS) device to measure, bedforms; and three acoustic backscatter, ABS, instruments and a vertical array of 8 pump sampling nozzles to measure the concentration of suspended sediment, (Williams et al.,1999), Figure 3. The PIP was deployed through the barge moon pool and was positioned at known height above the bed by means of a hydraulic carriage. This permitted instruments to be raised and lowered relative to the local bed elevation as ripples migrated. Measurements were obtained at three locations in the inlet, Figure 4.

2-Results

During periods of strong tidal flows when depth-mean flow exceeded 3 m/s, individual mega-rippes/dunes were observed to migrates a distance of approximately 4 m in 2.5 hours. On other occasions, when waves penetrated the inlet, complex bedform assemblages were observed. Results indicate a complex feedback between evolving bed morphology, local hydrodynamic conditions and rates of sediment transport, Bed shear stresses and apparent bed roughness values have been calculated at locations over the surface of migrating bedforms using log-profile, eddy correlation and TKE methodologies, Figure 5 and Figure 6. In particular, use of HRDC data has permitted examination of detailed flow structure over bedforms at a spatial and temporal resolution which until recently has only possible in the laboratory. The temporal characteristic of the u, v and w turbulent flow components have been used to investigate turbulence structure over migrating bedforms in current-only and wave-current flow conditions. Results compare favourably with existing models of flow over irregular surfaces. Temporal and spatial patterns of suspended sediment transport over bed forms have been examined using ABS data. These analyses have permitted the testing of models to predict C-profiles and sediment transport, Figure 7.

Acknowledgements

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References

O'CONNOR B. A. et al. (1999) Tidal inlet monitoring & modelling project INDIA). Proceedings Oceanology International, Singapore, 12pp.

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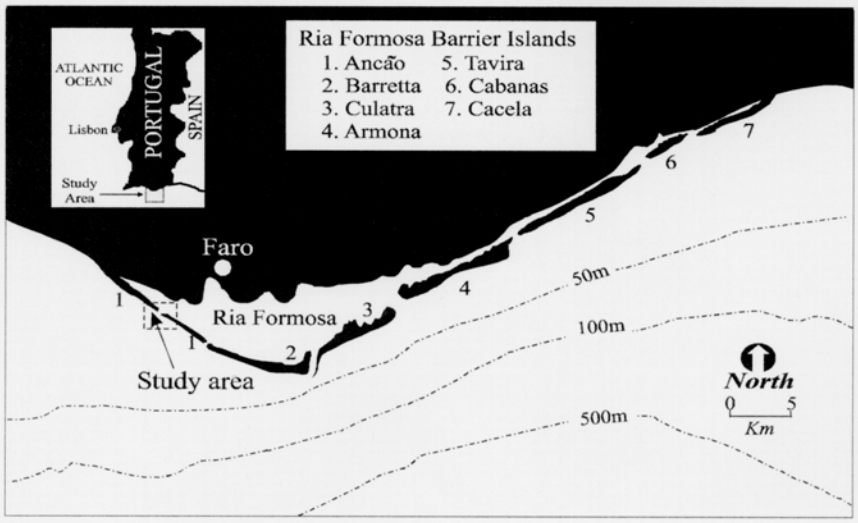
http ://www.pol.ac.uk/INDIA.html

a)



b)

Figure 1 a) Location of the Barra Nova inlet, Ria Formosa, Algarve, Portugal; b) aerial view of the Barra Nova approximately 12 months before the start of the field campaign

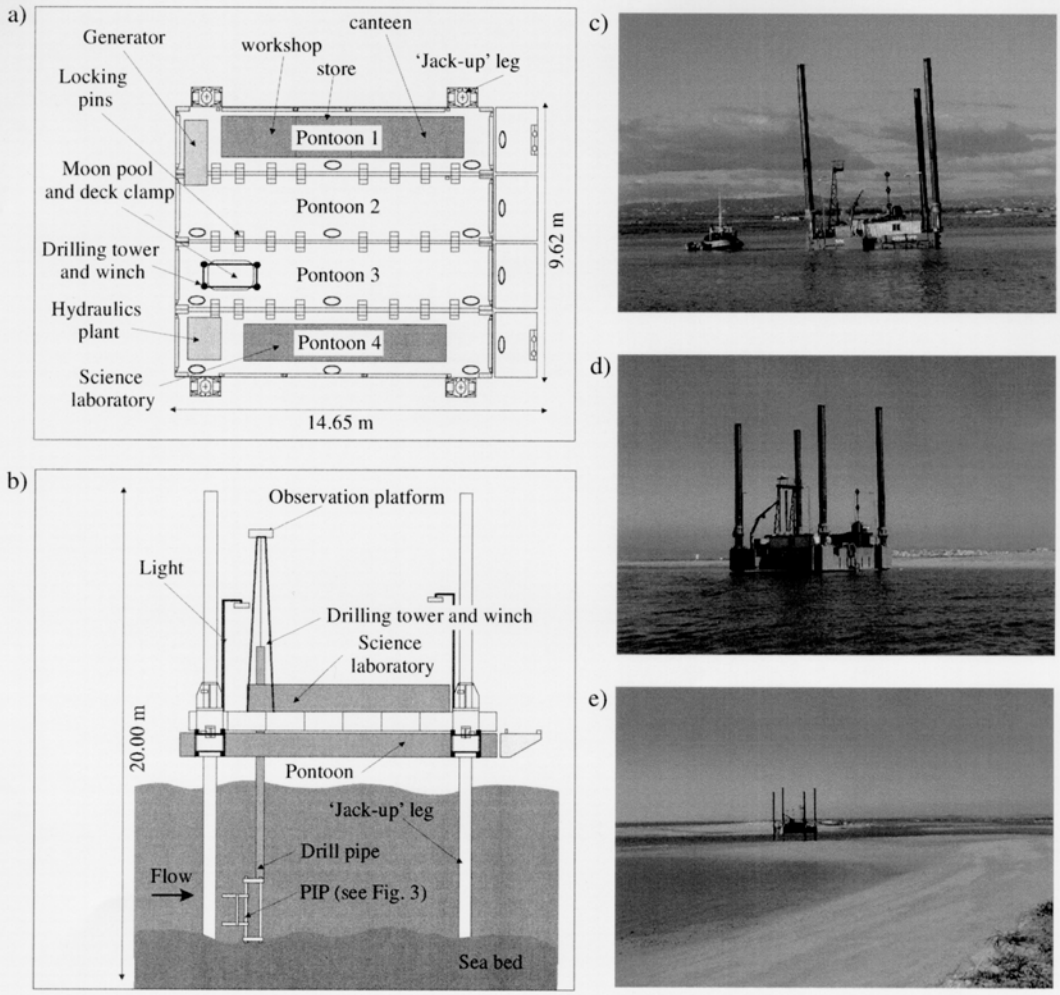


Figure 2 Seacore 'jack-up' barge: a) plan view ; b) side elevation; c) towage to the Barra Nova; d) barge at location 2 at high water looking north-east; and e) barge at location 2 at low water looking west.

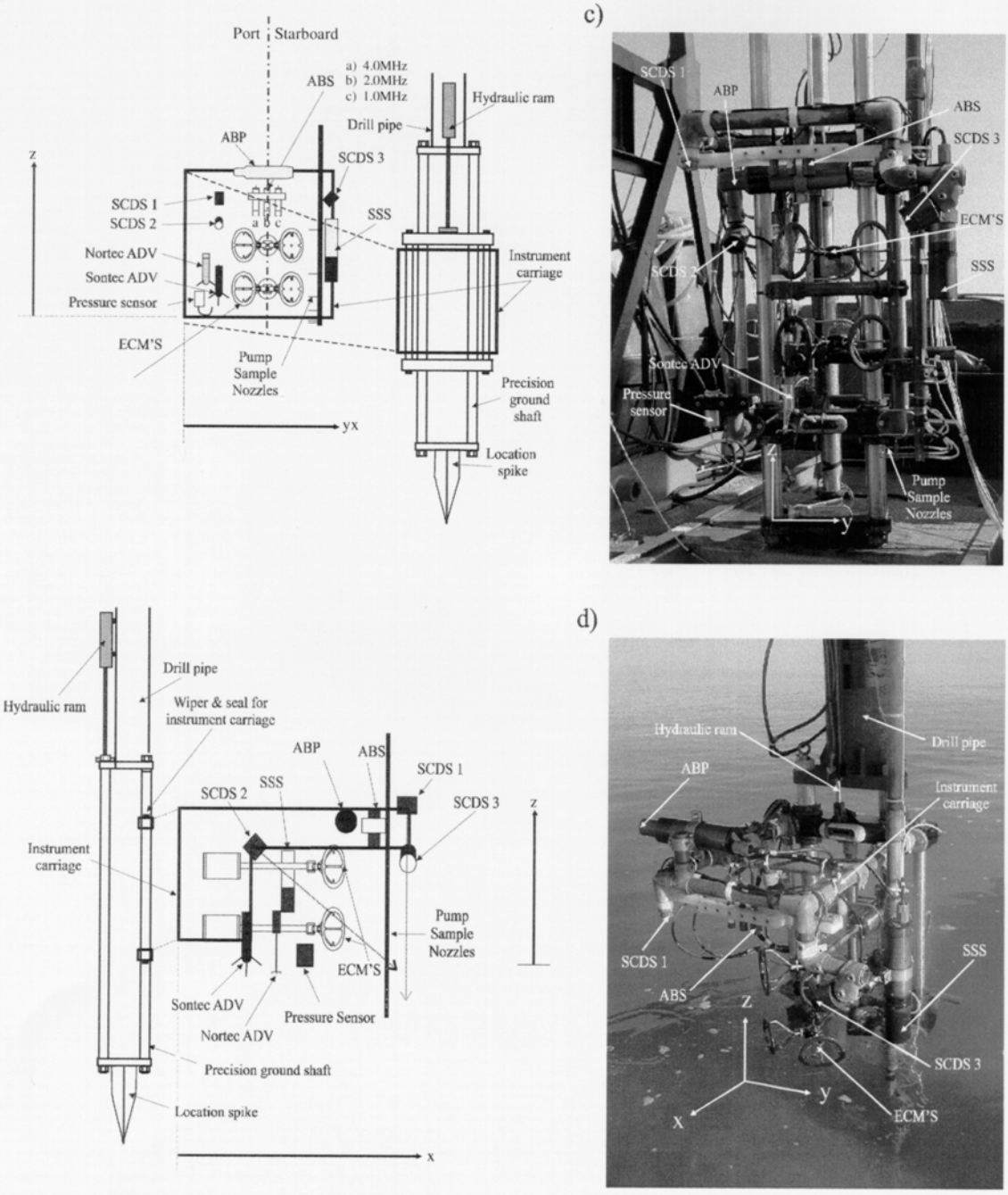


Figure 3 PIP schematic a) front elevation; and b) side elevation. c) PIP on deck of the barge and d) PIP deployment at low slack water, 27 January, 1999.

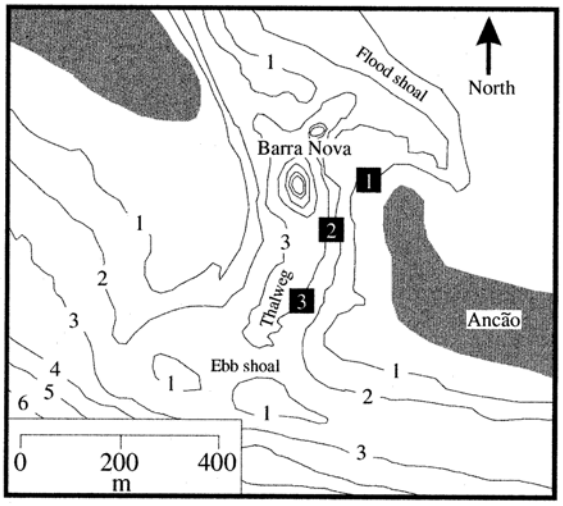


Figure 4 Locations of PIP measurements in the Barra Nova from DGPS: 1) 36° 59.29943'N, 7° 57.86543'W; 2) 36° 59.29400'N, 7° 57.91242'W; and 3) 36° 59.28532'N, 7° 57.90937'W (Depth contours in metres below low water).

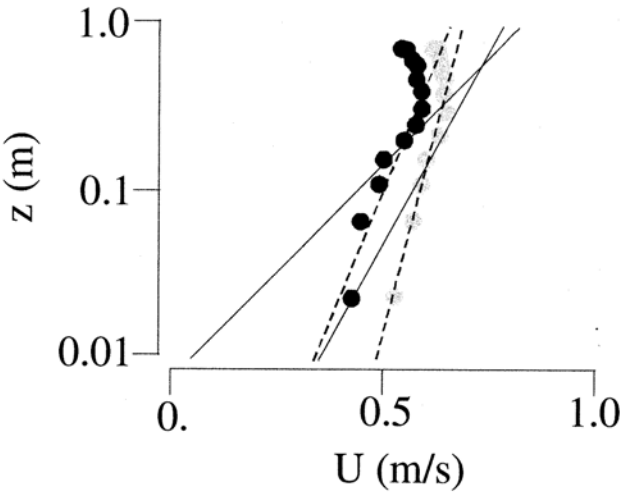


Figure 5 Measured average velocity profiles above ripples

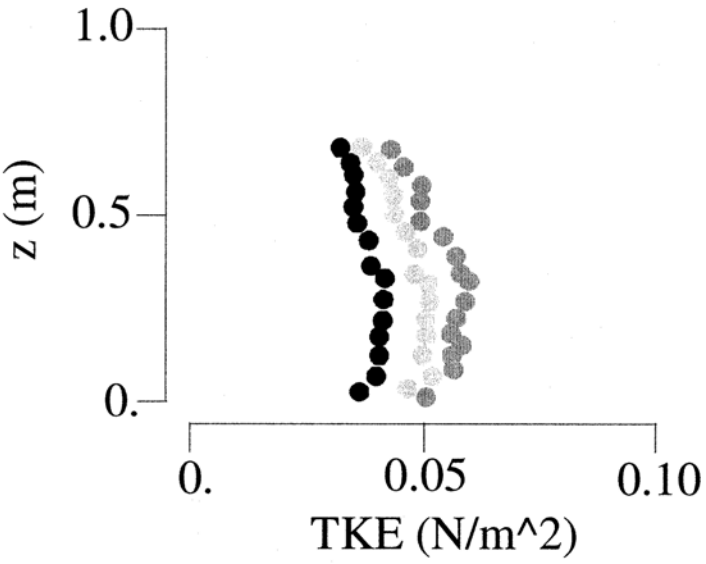


Figure 6 Measured TKE profiles above ripples

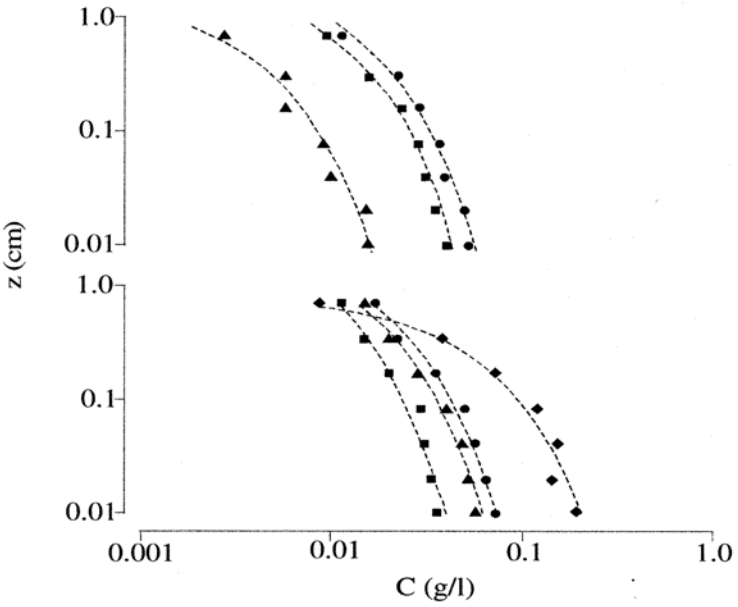


Figure 7 Measured suspended sediment concentration profiles above ripples

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