

Discussions on radar remote sensing techniques and sediment process studies

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LONG-TERM GOALS

To develop and advance techniques for the remote sensing of waves, together with the algorithms needed to extract shallow water bathymetric maps and currents from the data. In parallel, we are also aiming to use advanced acoustic techniques to improve understanding and parameterisation of the interaction between sediments and hydrodynamics.

OBJECTIVES

- 1) To foster collaborative links between US (NRL) and UK (POL) researchers in these areas.
- 2) The aim of the meeting was to discuss the potential for collaboration with the framework of the mixed sediments programme to be started by NRL-Stennis in September 2003.
- 1) To explore possibilities for a future NICOP proposal related to the radar work in particular.

APPROACH

- 1) POL has been experimenting with radar remote sensing systems since the early 1970s. Some progress has been made in the extraction of directional wave spectra from the recorded radar images (Judith Wolf), and techniques have also been developed to map the wave wavelengths of the waves within the area viewed by the radar (Paul Bell). These data have then been used in a bathymetric inversion based on linear theory to infer water depths with considerable success. Further developments are in progress to improve the bathymetric inversion using non-linear wave theories (Paul Bell).
- 2) Okey Nwogu has received ONR funding under the Coastal Dynamics programme to apply BOUSS2D (a Boussinesq model) to the problem of better determining the imaging mechanisms and transfer functions between radar images of the sea surface and the sea surface itself. *This funding covered only work by the US partner with no funding for POL effort.*
- 3) POL is currently installing a new marine radar system on a remote island in the Dee Estuary between the Wirral peninsular and North Wales (Paul Bell). This will supply a long record of radar data in an

area characterised by constantly changing sand banks and channels and a variety of sediments from sand to mud. This installation will be part of the larger POL Coastal Observatory which will include a high level of measurement and modelling infrastructure, including LIDAR and interferometric multibeam echosounder surveys, a WERA HF radar operating at 16MHz giving surface currents and wave spectra, several tide gauges, wave buoys, water quality measurements, met stations, regular benthic frame deployments and CTD surveys using the Research Vessel Price Madog and operational POLCOMS model runs.

4) Sediment processes have also been studied for many years at POL (Jon Williams, Peter Thorne, Paul Bell), and we have a number of high resolution acoustic systems suitable for both field and large scale flume studies, many of which were used in the recent Deltaflume 2001 experiment which generated a high quality dataset relating suspended sediments, sea bed ripples and wave action at field scale.

The combination of these interrelated projects provide a considerable strength in this area, and several possibilities for collaboration with US partners. In particular, the POL Coastal Observatory site may be a suitable choice for a second field site for the NRL Mixed Sediments Programme.

TRAVEL COMPLETED

Person Visited	Position	Institution	Location	Scientific/Technical Purpose	Dates
Todd Holland	Scientist	NRL	Stennis Space Centre	Radar remote sensing, Coastal Observatory, Sediment dynamics, Mixed sediments Programme	27 th May 2003
Okey Nwogu	Scientist	U. Michigan	Stennis Space Centre	Radar remote sensing, Coastal Observatory, Sediment dynamics, Mixed sediments Programme	27 th May 2003

RESULTS

- (a) Mutual exchange of information on current projects and plans at respective laboratories.
- (b) Identification of a number of areas of potential collaboration particularly in the forthcoming field campaigns for the mixed sediments program, bringing P.O.L expertise in radar and acoustics into the project, and in the algorithms used of for bathymetric inversions of remotely sensed data.
- (c) Todd Holland agreed to investigate possible funding strategies with ONR/NRL, particularly in light of the ONR contract already obtained by Okey Nwogu under the Coastal Dynamics funding stream of ONR.
- (d) The meeting also provided an ideal opportunity for discussions between Paul Bell and Okey Nwogu, allowing progress on the radar work in both US and UK to be communicated.
- (e) An open invitation was extended to Todd Holland to visit the field site at his convenience.

IMPACT/APPLICATIONS

- (a) Marine radars can be found in many coastal sites and on most ships. The ability to add accurate shallow water mapping and wave measurement capability to such systems has implications for navigation, hydrography and safety.
- (b) The possibility of regular updates to bathymetric charts in highly dynamic or difficult to survey areas will enable more accurate predictions from ocean models.
- (c) Potential participation in the Mixed Sediments Programme could provide an opportunity to study the response of mixed sediments to a range of hydrodynamic conditions and bring POL expertise and instrumentation with acoustics and radar into the project.

RELATED PROJECTS

POL Coastal Observatory – A suite of instruments to be installed for a minimum of 5 years in the Liverpool Bay area of the UK. The aim is have real time/near real time data telemetry from all instruments back to the Proudman Lab and accessible via the web. Some systems are already in place and others are ready to be installed this year (2003). (<http://cobs.pol.ac.uk>)

POL Sediment Dynamics programme – focusing on mobile sediment patch off the Dee Estuary in the Irish Sea, and planning to integrate real time measurements with POLCOMS model framework. (<http://www.pol.ac.uk>)

COAST3D EU funded project – now completed. Radar data and other in-situ measurements were recorded in Egmond in The Netherlands and Teignmouth in the UK. This is providing a valuable dataset for the development of the bathymetry extraction algorithms used by the radar. (http://www.hrwallingford.co.uk/projects/COAST3D/COAST3D/index_new.html)