

Field Measurements and Nearshore Modelling at Sandyduck

Ib A. Svendsen
Center for Applied Coastal Research, University of Delaware, Newark, DE 19716
(302) 831-2449, FAX (302) 831-1228
e-mail: ias@udel.edu

William G. Grosskopf, P.E.
Vice President and Principal Coastal Engineer
Offshore & Coastal Technologies, Inc.- East Coast, 500 Spencer Road, Avondale, PA 19311
610-268-0410, FAX 610-268-0421,
e-mail: WGGAVONDALE@delphi.com

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LONG TERM GOAL

The long-term goal of this research is to increase our understanding and capabilities of predictive modeling of short wave-averaged nearshore circulation patterns (shoreline to nominally 15m depth), through use of a combination of numerical modeling and data analysis from field and laboratory experiments.

OBJECTIVES

The project objective is to measure cross shore variations in waves and currents along the northern (incident) boundary of a highly-instrumented measurement area at the Field Research Facility during SandyDuck (1997) experiment.

APPROACH

In order to define wave and current boundary conditions perpendicular to the shoreline at the northern boundary of the SandyDuck experiment four self-recording pressure gage/current meters (PUV) were deployed at the Field Research Facility (FRF), Duck, North Carolina. Two types of gages were used which employ different current measurement technologies so that instrument-related effects on measurements could be better understood. One pair consisted of SeaPac 2100 directional wave gages manufactured by Woods Hole Instrument Systems. The SeaPac employs a Paroscientific Digiquartz pressure transducer and an electromagnetic current meter. The second pair of gages consisted of Acoustic Doppler Velocimeter Ocean (ADVO) directional wave gages manufactured by SonTek, Incorporated. The ADVO consisted of a Paroscientific Digiquartz pressure transducer and a three-dimensional acoustic doppler current meter. Both types of instrument packages measured absolute pressure, water temperature, and two components of horizontal current at 1Hz throughout the 6-week deployment period. The gages were deployed (as described later) at three locations across the surf zone. At the middle location, one SeaPac and one ADVO were co-located to provide an opportunity to

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directly compare the data from both instrument types and to quantify the effect of method on the experimental results.

WORK COMPLETED

The experimental design and deployment of the instruments were completed in Fiscal Year 1997 (FY97). In FY98, the instruments were retrieved and the data were archived. Analysis and dissemination of the data and numerical modeling of the SandyDuck time period are planned when funding becomes available.

The field deployment of the instruments took place 18 September 1997 to 3 November 1997. Prior to the deployment, all instruments were carefully calibrated and field-checked. The locations chosen for deployment of the instruments were selected as shown in Figure 1 at longshore station 1107. This station was approximately 100 meters north of the Field Research Facility (FRF) property line. Although this location was slightly more southerly than originally desired, it was selected to satisfy the scientific requirement for measuring the experiment's far- field boundary condition while placating local residents who did not want the gages too far from the FRF property. All gages had adequate memory and battery capacity to collect data throughout the 45-day data collection period at a sampling frequency of 1 Hz.

The gages were affixed to pipe mounts that were 6 meters long. Figure 2 illustrates this mounting system. The pipe mounts were jetted into the seafloor at locations selected from beach profile plots of conditions surveyed the day before. The FRF's Coastal Research Amphibious Buggy (CRAB) was used as the transport vehicle and jet pumping platform for installing the instruments. Instrument locations were chosen with the objective of capturing the longshore current variation across the surf zone during storm events, including the flow within the nearshore trough. Beach profiles surveyed during prior storms at the FRF were studied to estimate the evolution of the beach profile at the northern boundary of the facility. Once the locations were estimated, the CRAB was used to install the gages at the proper distance from the shoreline.

Final gage locations were determined and documented using a survey instrument on the research pier. The offshore gage (Seapac) was installed seaward of the offshore bar in a water depth of 3.2 meters. The middle gages were installed 75 meters landward of the offshore gage and inshore of the bar in a water depth of 3.4 meters. The two middle gages (a Seapac and an ADVO) were separated by a distance of 6.0 meters in the longshore direction and 0.5 meters in the offshore direction. The inshore gage (an ADVO) was installed 50 meters landward of the middle gages and landward of the trough in a water depth of 1.7 meters. All gages were marked with a warning float tethered to a separate pipe anchor jetted into the bottom 2-3 meters from each gage.

Instrument retrieval took place on 3 November 1997. All gages, mounts and marker pipes were successfully recovered. Data were downloaded and archived for future analysis.

RESULTS

A review and preliminary analysis of the data indicated that all instruments had 100% data recovery. Data quality parameters indicate that all data channels operated effectively with very little noise. The inshore gage, an ADVO, had been buried by sand accretion and subsequently re- exposed twice during the experiment. Two storm events occurred during the experiment.

Examples of field results are presented in Figure 3. The plot illustrates the occurrence of two events of significance during the measurement period. Coincident wave data, although depth limited at all measurement sites, show a rapid variation in wave statistics (height, period and direction) and a well-defined profile of longshore current across the surf zone. These data demonstrate their value as a method for defining the boundary conditions on the northern side of the FRF measurement area.

IMPACT/APPLICATIONS

It is expected that, once analyzed, the collected data will form part of the total data set for the SandyDuck experiment. As shown in Section 5, these data demonstrate success in collecting a well-defined northern boundary condition for the measurement area. They will form an integral part of our testing of the SHORECIRC numerical circulation model and hopefully will also be useful to other researchers working on modelling of the SandyDuck flow conditions.

TRANSITIONS

Nothing to report yet.

RELATED PROJECTS

The following are related projects in which the first PI is involved in conjunction with the Coastal Dynamics program of ONR, the ARO, and the NOAA Sea Grant program:

- 1) The mechanisms behind the formation of rip currents and the 3D effects of the vertical variation of the velocities within such currents are being studied (PhD project)
- 2) Development of a Boussinesq model for breaking waves in the surfzone and its application to forcing of nearshore circulation models.

The following are related projects in which the second PI is involved in conjunction with the Army Corps of Engineers:

- 1) Acquisition of wave and current data in nearshore coastal environments adjacent to coastal inlets (WES Coastal Inlets Research Program).

Figure 1. Figure illustrating location of gages deployed by Svendsen and Grosskopf along northern boundary of experiment area.

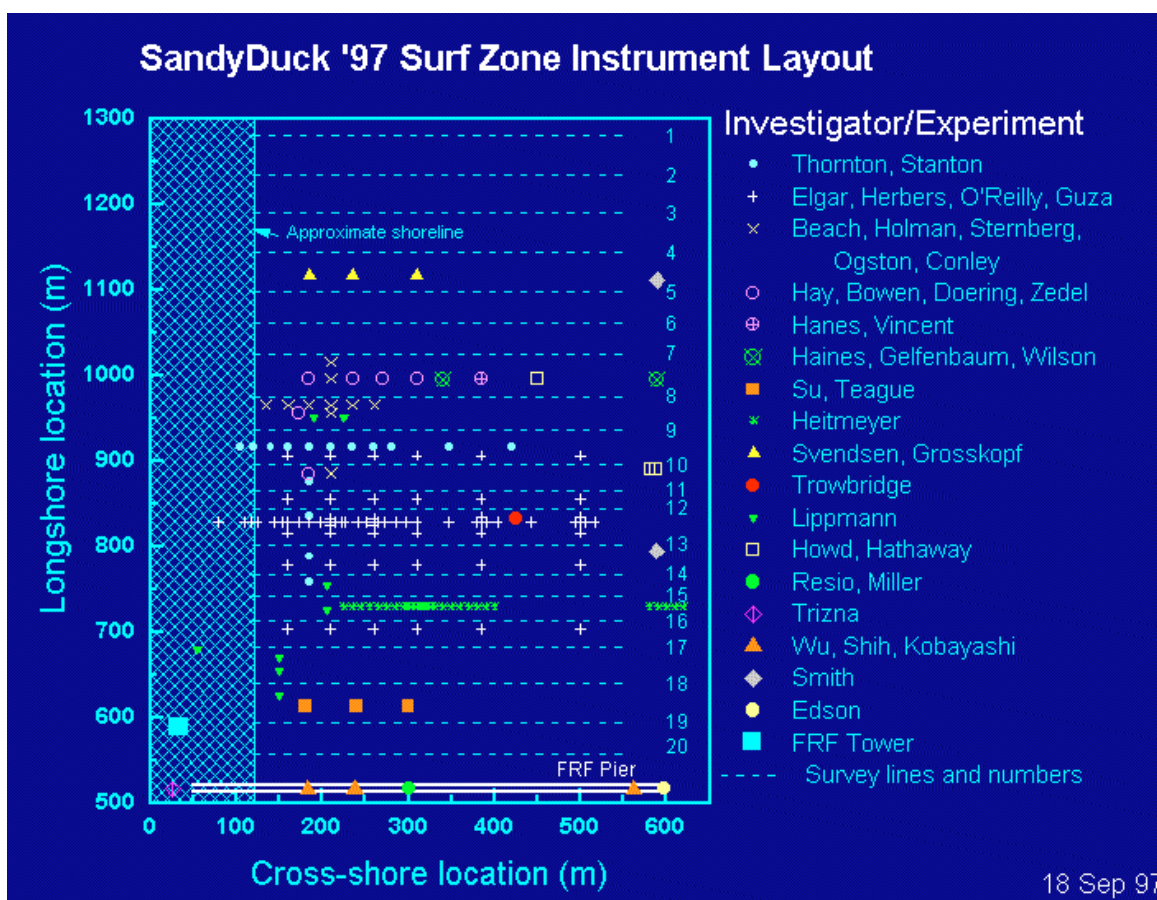


Figure 2. Acoustic current meter on pipe mount (on trailer ready to be transported to deployment area)

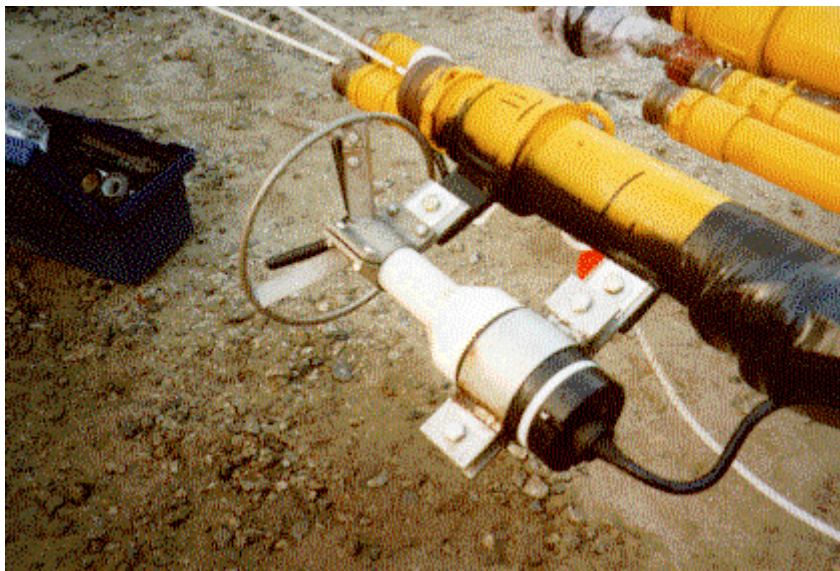


Figure 3. Time history of longshore current from middle location during Sandyduck experiment.

