Florida Coastal-Forcing Project

- Waves and Winds in the Nearshore -

Progress Report #2

submitted to

The Florida Department of Environmental Protection
Office of Beaches and Coastal Systems

and

The Beaches and Shores Resource Center

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1. Wave Gage Network

1.1 Wave Gauge Selection and Purchase

The wave gauge selection process is now complete, and the first wave gauge has been purchased. The RD Instruments "Sentinel", ADCP-based directional wave gauge was selected as the most suitable technology. SES personnel are now familiarizing themselves with the instrument, and configuring a data acquisition computer in preparation for the short-term deployment described in Section 1.4 below. If the gauge performs to expectations during this deployment, an identical back-up gauge will then be ordered.

1.2 Search for Semi-Permanent Test Site

Since the previous progress report was submitted, substantial effort has been devoted to finding a suitable location for a semi-permanent test-site for development of the prototype wave and weather monitoring system. The site found to have the greatest potential is the 'Melbourne Beach Optical Tracking Annex' (ROTI Building #7) operated by Patrick Air Force Base (PAFB). This secure, beach-front facility is located approximately 1 mile from SES offices, thereby affording great convenience. It is fronted by open, sandy beach, and straddled north-and-south by Spessard Holland Park (Brevard County). Offshore bathymetry, as shown on navigation charts and supported by FDEP profile data in the area, is characterized as smooth and well-behaved. FDEP personnel contacted PAFB, and a meeting was held on January 8, 2001 between SES and PAFB personnel at the tracking station to explore the situation. Air Force personnel were very helpful and in general support of the idea, encouraged by the fact that NOAA had been allowed to use the facility for monitoring winds. NOAA recently vacated of their own volition. In fact a mounting spar for a wind vane and anemometer remains in place, and was identified as a likely place for FDEP's wind station. A formal request for use of the facility has been drafted, including a detailed description of the activities envisioned. The draft is present under review by PAFB personnel, and the final version will be formally submitted promptly.

Only two potential shortcomings for the Tracking Annex site have been encountered thus far. Firstly, it is known that rock outcroppings can be found at the low water line along much of

Melbourne Beach, which must be considered in regard to installing and maintaining the wave gauge cable. The rock is soft Anastasia formation, which should not pose a problem to the conduit-drilling methods that are being considered for future system 'hardening'. The second shortcoming of the site is that because of Air Force security regulations, at present SES/FDEP personnel cannot be allowed autonomous access to the site and the ROTI Building, and system installation and maintenance must therefore be conducted when PAFB personnel are available. This is generally only during regular business hours, and so access to the shore station under extraordinary circumstances (e.g. surrounding a hurricane evacuation) is unlikely. If in the coming months the Tracking Annex proves its potential, it is recommended that additional arrangements be sought to allow unsupervised access to the shore station without compromising Air Force security regulations.

For completeness, the other sites that were considered are:

a) McLarty Treasure Museum The museum had great potential as a gauge site because it is a secure FDEP facility. However treasure hunting leases, owned by Fisher Salvers, Inc., front the site, and fearing that the gauge's steel-armored cable would interfere with the use of magnetometers, access was denied by the salvage company.

b) Ambersand Park This park is located south of McLarty Museum and outside of the treasure easements. However, this is an unimproved Indian River County Park, and security would be a concern at this location.

c) Sebastian Inlet State Park The northern side of the Inlet park affords a FDEP-owned, secure site where the SITD shore station is housed. However, the shed is remote from the beach as compared to the Tracking Annex site, and so cable-laying is a more difficult undertaking. The data collected would be redundant with the SITD gauge. Also, the site is 18 miles distant from SES offices, which makes the option of daily site-visits impractical for the long-term.

d) Spessard Holland Park - This park is a Brevard County Park located in Melbourne Beach, which in fact straddles the Tracking Annex. If permission to use the PAFB site cannot be obtained, it is recommended that the Spessard Holland site then be pursued. Although this park contains two bath houses with utilities, a free-standing shed may be required for the shore-station.

1.3 Cable Selection

With the aid of technicians at RD Instruments, several types of suitable power & communications cables have been identified. The type selected is a 7-conductor, insulated, double

steel-armored cable. Three potential suppliers have already been identified. One option is to buy only raw cable, with potting of the underwater-pluggable connector done either in-house or by a subcontractor. A second option is to order the cable and connectors pre-assembled, which requires more certain *a priori* knowledge of the required cable length. Selection of the best option depends ultimately on cost and convenience, and the long-term maintenance requirements of the FDEP network as a whole. The cable for the first wave gauge will be ordered as soon as site selection is finalized. It is noted that at the Tracking Annex, the gauge would be located approximately 2,200 ft offshore, in a water depth of roughly 26 ft.

1.4 Preparation for Short-Term Test at Sebastian Inlet

While awaiting developments in regard to the use of the Tracking Annex as a semi-permanent test site, a short-term test is being prepared. This test is to take place at Sebastian Inlet, with the new ADCP gauge located in close proximity to the existing PUV gauge. The new gauge will be operating in self-record mode, and deployed intermittently over a period of several weeks, with monitoring and retrieval performed by divers. A gauge mounting apparatus is presently under design.

This short-term test will be beneficial in several ways:

a) It will afford initial experience with the new gauge without the additional complexities of cable-supplied power and communication.

b) It will provide a test-bed for refinement of the gauge mounting apparatus, before employing it at the permanent test site.

c) The data collected will allow direct comparison of the new wave-measurement technology to older technology, in hopes of confirming improvements.

d) The measurements are to be spot-checked by visual observations, so that issues that have arisen from the wave modeling (discussed below) can be investigated.

2. Wave-Hindcast Database

2.1 Initial STWAVE Testing

Initial tests of the STWAVE model, driven by AES-40 waves at its offshore boundary, have been conducted for the time period 8/96-12/96. The domain used in the modeling is centered on Sebastian Inlet, affording direct comparison to data available from the SITD directional wave gauge. This gauge is a bottom-mounted PUV type, located approximately 1,200 ft from shore in roughly 26 ft depth. Sample results for the month of October are shown in Figures 1, 2, and 3. Figure 1 presents results for energy-based significant wave height (HS). The red curve is data from the SITD gauge, the blue curve is from the STWAVE model, and the green curve is from the AES-40 deepwater boundary condition, provided for reference. Marked discrepancies exist between the gauge and the STWAVE results for wave energy, which are discussed below. Figure 2 presents comparisons for the peak wave period (TP). Accepting that the gauge data contain notable scatter (a common feature of measurements of this type), the model results track the observations closely. Figure 3 presents comparisons for wave direction. The measurement plotted is the peak wave direction (again containing scatter), whereas the model results are for vector mean direction. Once again, the STWAVE results track the gauge reasonably well. All of the other months of comparisons made thus far yield similar findings, i.e. close agreement for wave period and direction, but not for height. The year 1998 is now being analyzed, and findings will be presented in a subsequent progress report.

Upon closer examination of Figure 1, it is clear that HS from the STWAVE model is consistently greater than that reported by the PUV gauge. At the present time it is unclear if the problem lies with the STWAVE model, the PUV gauge, or a combination of both. Although not shown in the figures, comparisons for the AES-40 data to NOAA Buoy 41009, located offshore of Cape Canaveral, are in good agreement, so it is doubtful that much of the problem is due to the boundary condition specified for STWAVE. Curiously, previous shallow-water wave hindcasting efforts that employed a nested-grid application of the WISWAVE model produced better results at the SITD gauge (Dally, W., Grosskopf, W., and Harris, L., 1998, "Wave Climate Studies for Sebastian Inlet," *Proc. 5th International Workshop On Wave Hindcasting and Forecasting*, pp.56-70).

One final issue with the STWAVE model that has come to light during the work thus far is a restriction imposed by the fact that STWAVE is a 'half-plane' model. That is, waves can only propagate *into* the model grid through the offshore boundary, and not outwards. The practical ramification is that at times when the AES-40 data dictate outwardly propagating energy in some directional bins, this energy must be ignored. At times when nearly all boundary energy is directed out of the grid the wave energy in the STWAVE model artificially drops to zero, as is found in Figure 1 around October 8-10. This restriction must be taken into account when selecting the models and methods to be used ultimately in developing the shallow water hindcast database for Florida.

2.2 Wave Gauge Truthing and Continued Model Testing

Investigation of the model/measurements discrepancies for shallow water wave energy will proceed along two fronts. Firstly, the planned short-term deployment of the new ADCP gauge next to the existing PUV gauge, coupled with local visual observations and continued measurements by Buoy 41009, will provide a rigorous check of the performance of the PUV. This should permit either the confirmation or the denial of the notable energy losses that appear between deep and shallow water. Secondly, the earlier WISWAVE exercise will be revisited in search of insight as to the relative success with this model when compared to the STWAVE results obtained thus far. Also, communication will be maintained with researchers working on the Corps' Wave Information Study modeling effort, in which both WISWAVE and STWAVE are being tested.