Florida Coastal Forcing Project

- Waves and Winds in the Nearshore -

Progress Report #8

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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(work performed April 18, 2002 to June 30, 2002)

1. Wave Gauge Network

1.1 <u>Development of the Permanent Test Site</u>

Since the previous progress report, effort has focused on 1) establishing the real-time data link with the FDEP website, 2) finishing the shed, 3) bringing the wind instrument on-line, and 4) maintaining the gauge and cable. In detail:

- A directional wind instrument (R.M. Young®) has been installed at the top of the station's tower, and is presently measuring wind speed and direction. However, suitable means for reducing the raw data to a useful format and transferring the result to the FCFP website (at the 2-hr observation interval of the wave gauge) has to be developed in-house. Fortran software was written to sample and then average the wind data, in preparation for uploading to the website but, in the end, computer buffer/cache problems rendered this approach unworkable. LabVIEW® software, which promises to be well-suited for this task, is to be purchased with FY '02-03 funds.

- Two 750VA uninterrupted power supplies have been installed in the shed to support all equipment (DC power supply, two laptops, RS-232/RS-422 converter, and the wind instrument) in the event of a power failure. A test designed to establish the actual endurance of the system will be conducted next FY. In addition, other hardware/methods are being sought with the intent of both extending endurance and simplifying the system.

- The shed has been fully insulated and a small air conditioner has been installed (the AC unit is not on UPS backup).

- The tower and been grounded against lightening strikes. Although the power panel in the shed is grounded to the Park's bath house, it will also be grounded locally.

- On approximately April 25, the first test of the FTP file upload to the FCFP website, via the wireless LAN, proved successful.

- Although the cabled wave gauge became fully operational on March 26, on May 4 the instrument went dead. This occurred at 0400 hrs in the morning and, surprisingly, under benign wave conditions. On May 8 a diving operation was conducted, during which it was discovered that the neoprene umbilical cable (used to maintain connection while bringing the instrument to the boat for servicing) had been pulled from its splice with the main, steel-armored cable. A self-recording gauge was immediately installed. The cause of the cable damage is unknown. Wave-induced fatigue is a possible explanation, but the final failure occurred during quiescent conditions. A lesser possibility is that a powerful marine creature (e.g. dolphin, manatee, shark), perhaps momentarily entangled, pulled on the cable until the splice failed. It is unlikely that the cable was snagged by an anchor because the area is not popular for fishing, plus the fact that the failure occurred in the middle of the night.

- On June 14 a field-splice of the cable was successfully completed on board the dive boat, and real-time communication with the instrument re-established. The new splice was strapped to a short wooden 'splint' to better isolate it from strain. The splint was then strapped directly to the instrument spud, and the umbilical cable coiled in a fashion so as to minimize its exposure.

- After working flawlessly for nearly two months, the wireless LAN failed on or about June 25. An inordinate amount of time has been spent since then troubleshooting and conferring with the manufacturer. The exact cause of the failure remains unknown, although it occurred after several weeks of particularly rainy weather. Every component in the system (2 wireless bridges, two directional antennas, and two antenna cables) has been replaced, but to no avail. Frustrated, a less sophisticated, but more robust, means of transferring data from the shore station to the FCFP website is being pursued. This effort will be described in the next progress report, and hopefully the final solution to the shed-to-office communication problem reported. In the mean time, data are being stored on the laptop in the shore station, and periodically transferred 'by hand' to the FCFP website.

1.2 Continuing Data Collection at the Wave Gauge at Melbourne Beach

Data collected from the Melbourne Beach wave gauge between March 15 and June 30, 2002, along with the concurrent data from the Canaveral Buoy (#41009) are provided in Figures 1, 2, & 3. The nearshore data have already been sent to the FCFP website.

As is evident in the data, a weak Northeaster occurred April 6-13. A moderate, late-season Northeaster occurred May 19-25, during which waves offshore exceeded 3 m but maxed at about 2 m at the inshore gauge. Also, a weak 'Southeaster' occurred June 18-24.

1.3 Web Site Design

The website established on the server at the Beaches and Shores Resource Center at FSU continues to be expanded and refined by FDEP & BSRC personnel, with input from Surfbreak Engineering. At the writing of this report, the website contained nearly one year of high-quality, nearshore directional-wave, water level, and current information from the Melbourne Beach gauge. Data return since August 28, 2001 has been at a rate of roughly 95%.

2. Wave Hindcast Database: STWAVE with Bottom Losses

In the quest to identify the source(s) of the enigmatic energy losses between the deepwater buoy and nearshore wave gauges that are commonly observed in the data from the Canaveral Bight, the energy losses associated with three bottom-interaction phenomena have been added to the STWAVE model. These phenomena are: 1) bottom friction, 2) percolation, and 3) bottom boundary layer dynamics.

Preliminary study has focused upon the ability of these processes to, either individually or in concert, account for the observed wave energy losses when realistic values of their empirical coefficients are adopted. For bottom friction, the coefficient is the friction factor, C_f (dimensionless); for percolation it is the permeability coefficient, κ (dimensions L^2); and for boundary layer dynamics it is the kinematic viscosity of water, ν (dimensions L^2/T). For realistic values of ν, the predicted losses are insufficient, and so it does not appear that the bottom boundary layer is the explanation. In regard to percolation, the order of magnitude of the losses, on average, can be well-represented using a value of κ that is within the (broad) range cited in soil mechanics textbooks for sand. However, preliminary investigation indicates that the sole use of percolation in STWAVE does not represent the detailed structure of the wave climate, tending to overestimate the losses observed during the peaks of storms.

As a singular phenomenon, it is bottom friction that appears to provide the best explanation of the energy losses for most wave conditions. Typical results are shown in Figures 4 & 5 which, for significant wave height, display marked improvement over model predictions without friction. However, the complete answer is perhaps a combination of all three processes. Wave data to be collected during the upcoming Canaveral Cross-Shelf Experiment, supplemented by information on bed composition and characteristics, will help guide further modeling investigation.

3. Canaveral Cross-Shelf Experiment

Planning and design work for the cross-shelf experiment is now complete. In fact the first tower has recently been deployed (without a wave gauge) and its performance is being monitored. This effort will be discussed in the first progress report of FY ’02-03.

With the intent of protecting, to some degree, the submerged aparatus from fishing trawlers, the idea is to locate each tower in the vicinity of a well-known shipwreck or rock reef obstruction, which trawler captains avoid dutifully so as not to entangle their nets. The caveat is that the tower must be set far enough away from the wreck/rock so as not to accidentally attract sport fishermen and divers. Also, the bed at the tower location must be composed of a sand layer thick enough to allow the use of jetted pipes and helical anchors (5-10 ft), which provide the foundation for the tower. The first such site identified that is in suitable proximity to the Melbourne Beach nearshore installation is the wreck of a tug boat. This wreck is located nominally 3.5 Nm to the north, about 4.2 Nm offshore and in 62 ft depth. A 30 ft tall tower has recently been deployed there for testing.

The deepwater installation will most likely be located near the wreck of a Liberty Ship reportedly located 15 Nm offshore in 75-80 ft depth. This site will be explored in the upcoming weeks. The third installation is to be located about 1.5 Nm south of the Melbourne Beach gauge, in about 57 ft depth and 3.2 Nm offshore. Unfortunately, this location is not protected by a nearby wreck.

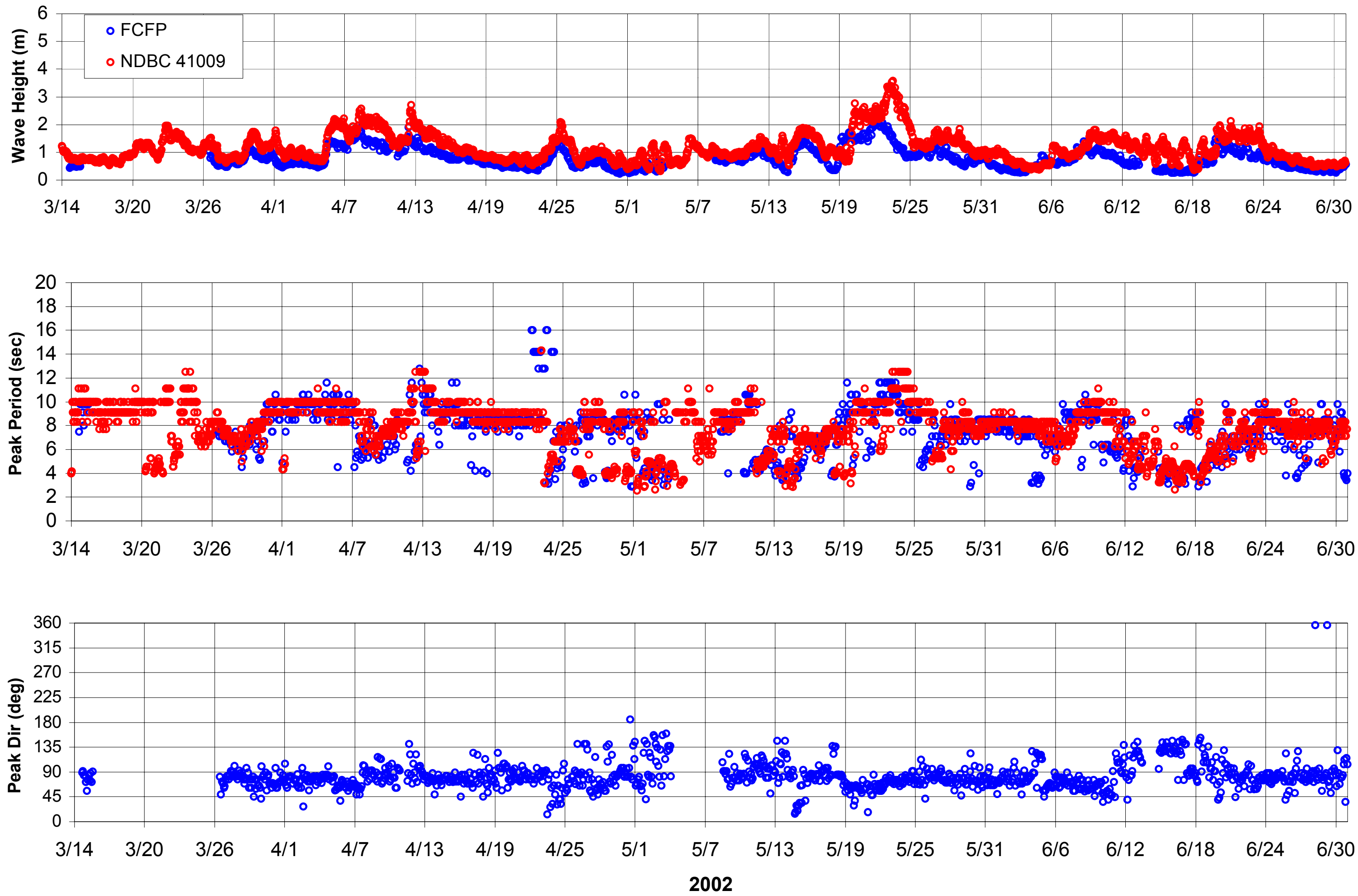

Figure 1 – Wave data from Melbourne Beach gauge for March 15 – June 30, 2002. Data from NDBC 41009 shown for comparison.

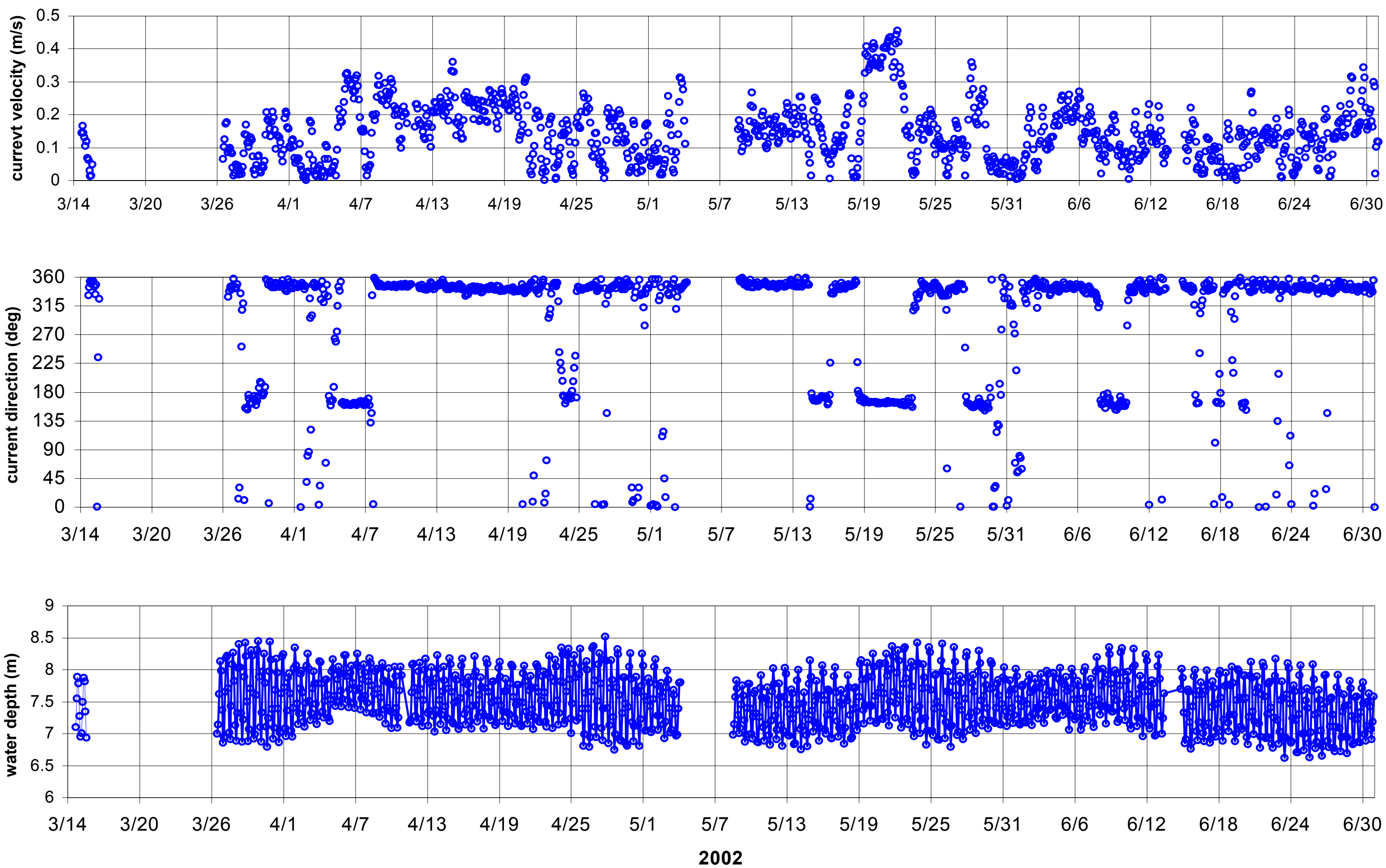

Figure 2 – Current and tide information data from the Melbourne Beach gauge for March 15 – June 30, 2002.

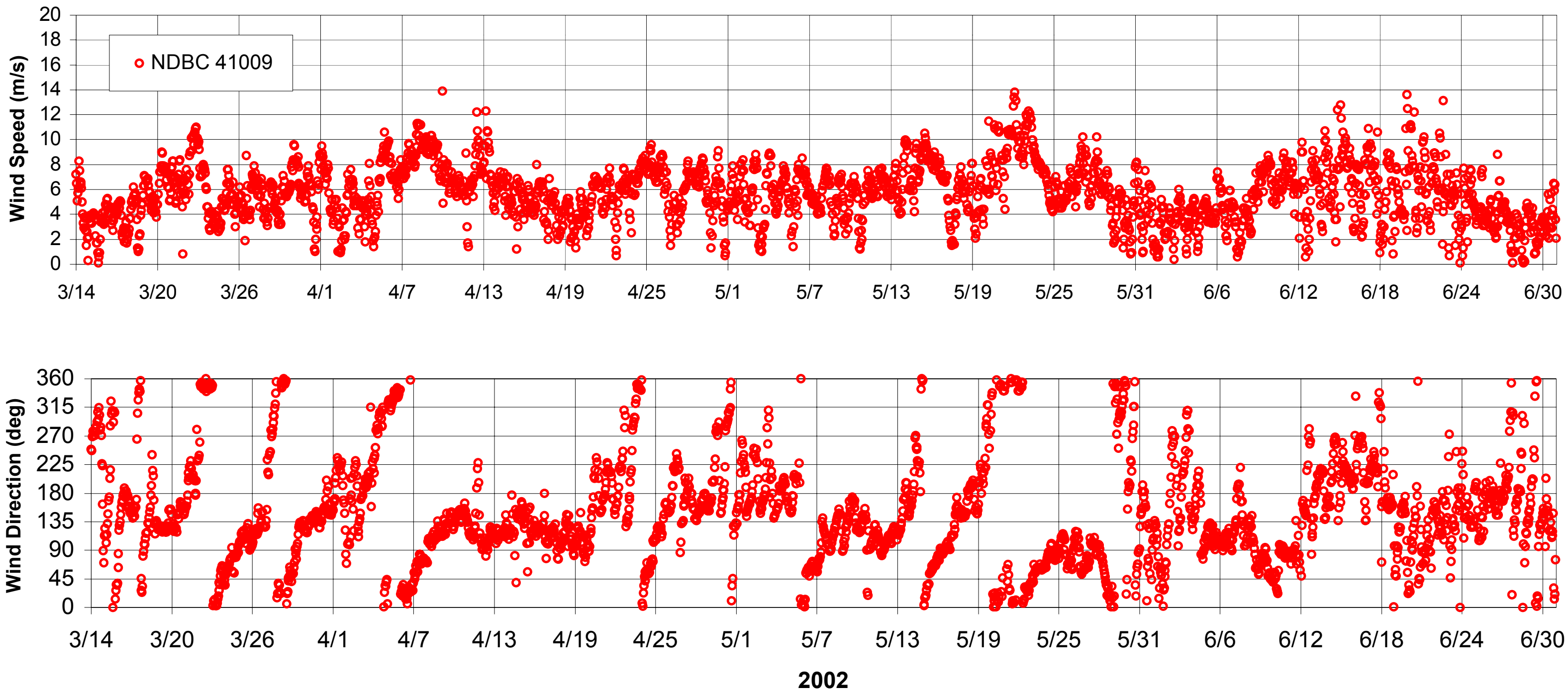

Figure 3 – Wind data from the NDBC station #41009 for March 15 – June 30, 2002.

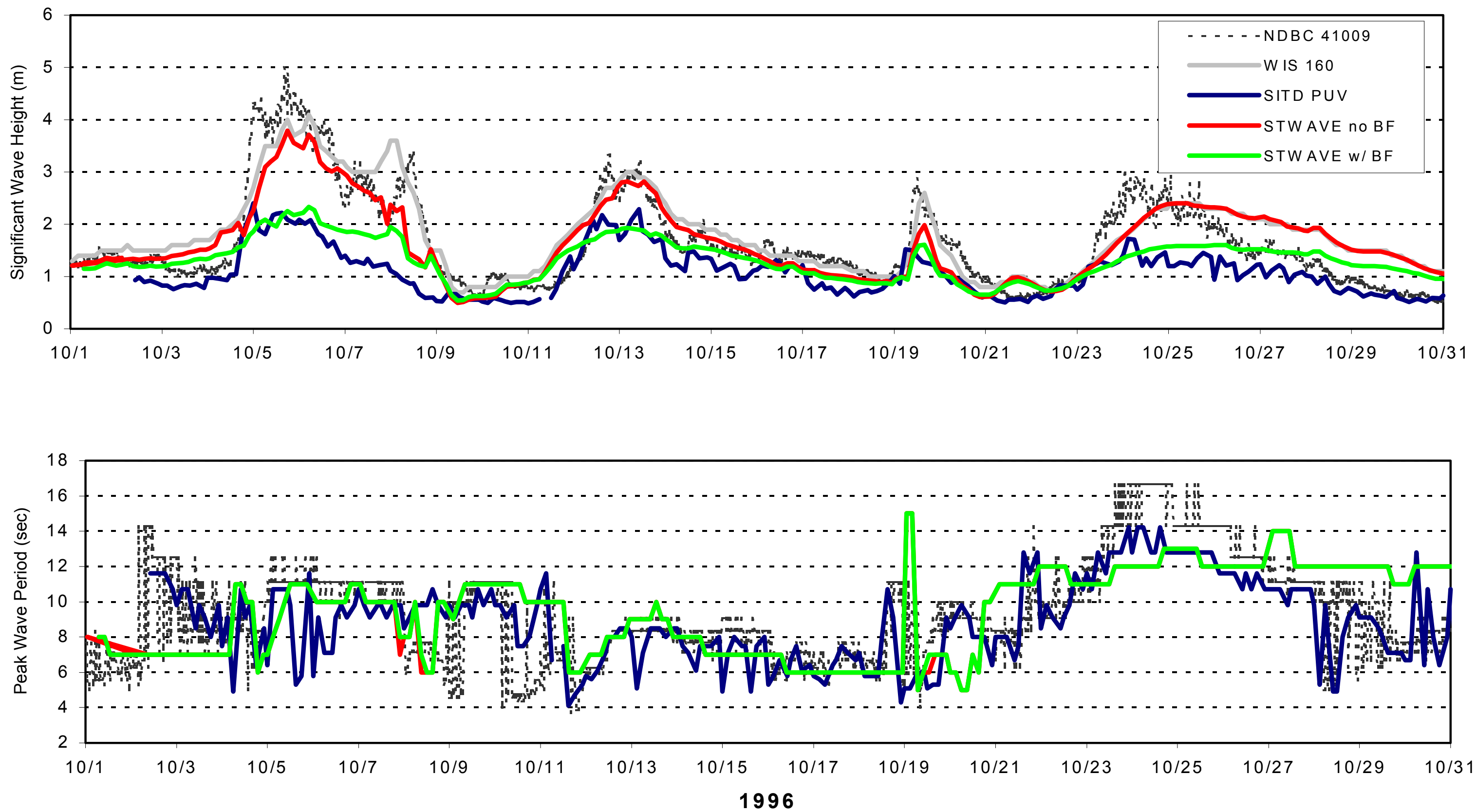

Figure 4 – Comparison of STWAVE model output, with ($C_f = 0.023$) and without ($C_f = 0.0$) bottom friction, to measurements from Sebastian Inlet PUV gauge for October, 1996. New WIS data used as model input. Deepwater NDBC 41009 data shown for comparison. Upper panel is significant wave height; lower panel is peak wave period.

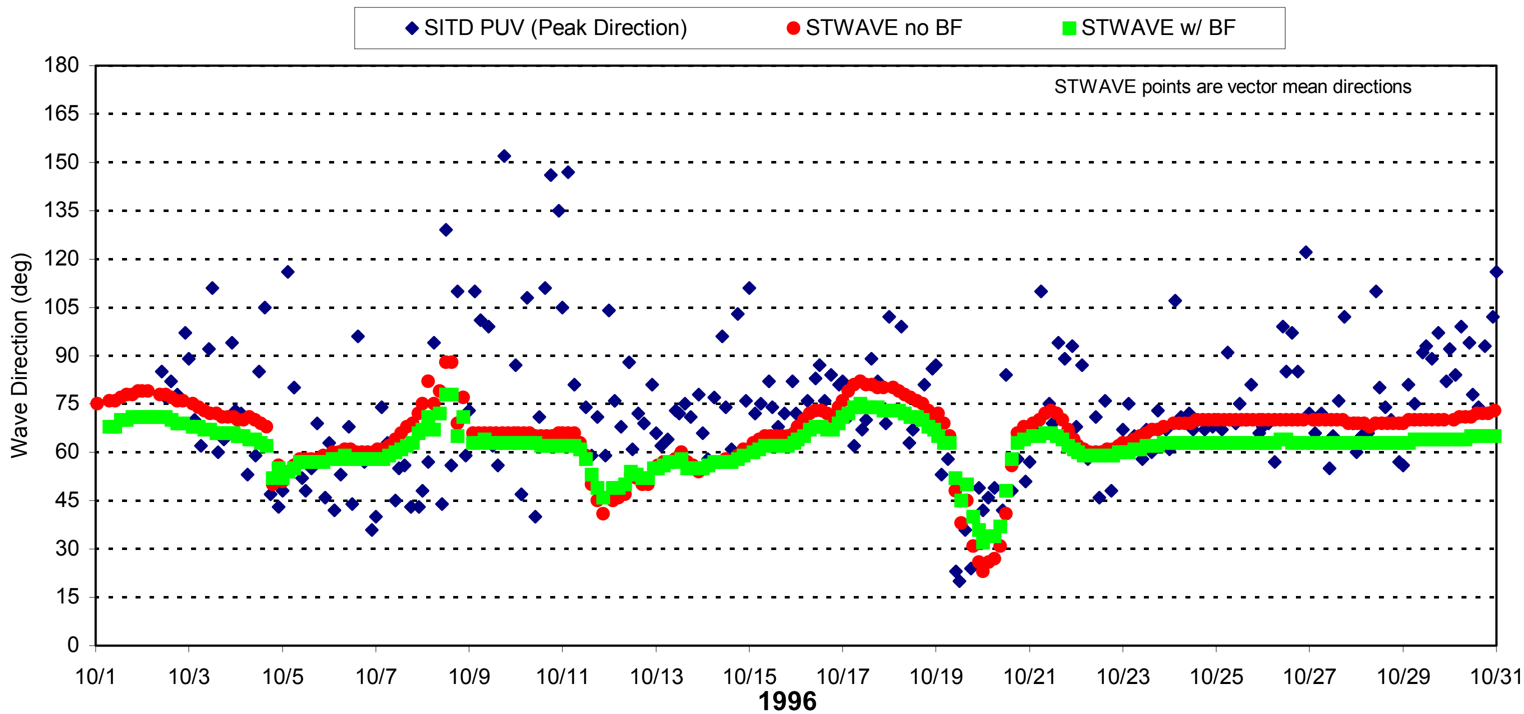

Figure 5 – Comparison of wave direction from Sebastian Inlet PUV and STWAVE model output with ($C_f = 0.023$) and without ($C_f = 0.0$) bottom friction, for October 1996.