Florida Coastal Forcing Project

- Waves and Winds in the Nearshore -

Progress Report #7

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 February 7, 2002 to April 17, 2002)

1. Wave Gauge Network

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

Since the previous progress report, effort has focused on installing the cable for the wave gauge at Spessard Holland North Beach Park, and completing the shore station and weather station. In detail:

- On February 12, 2002, the self-recording wave gauge was swapped a 'final' time, in order to open a 33-day window so that testing of the cable system, power supply, and data acquisition equipment could be completed, and to wait for calm weather required for installing the cable.

- On February 13 a trench was dug from the Park's bath house to the shore station shed (~150 ft), and electrical conduit installed.

- Electrical service was installed by a local contractor on February 15 and 18.

- On March 13, in preparation for installing the cable, the seaward end of the directionally drilled conduit was located, uncovered, and cleared of sand blockage.

- On March 14, 2002 the steel-armored power & communications cable was pulled between the shore station and the wave gauge spud, and a fresh instrument was installed. This instrument was set up in self-record mode, but allowing for additional reporting of the data over the cable to the shore station. However, because significant beach accretion had taken place during the night, the end of the conduit had become buried too deeply (more than 14 inches!) to find by manual digging. Consequently the cable was temporarily connected to the data collection system in the shed and left overnight, covered by only a few inches of sand. Real-time data recording on the shed's computer was initiated.

- At low tide late the following day (March 15), the end of the conduit was located with the aid of the drilling contractor. By sliding leftover cable from the spool into the landward end of the conduit, the contractor connected electrical cable-finding equipment and managed to determine the location of the seaward end of the conduit, which was then dug up. The gauge-cable was disconnected from the data acquisition system, and successfully pulled through the conduit and into the shore-station shed. Believing the gauge was still recording data on-board, the cable was not immediately reconnected because additional work was required to plumb the conduit into the shed.

- The additional conduit plumbing work was conducted early the following week, after which, upon reconnecting the cable to the shore station computer, it was discovered that communication with the wave gauge could not be established. Several days of testing and troubleshooting led to the supposition that a short-circuit had somehow occurred when the exposed end of the cable was passed through the flooded conduit, and that the instrument was stuck in a communication-error loop. This problem could not be corrected from the shore station because the gauge had onboard battery power as backup. A previously un-encountered wave gauge system flaw was hence identified.

- A rescue mission was quickly mounted, and fortunately a small weather-window opened on March 26th. Because of the dedication of Captain Gurlek, who interrupted a vacation and returned to Melbourne to assist, the troublesome gauge was replaced by an instrument that had no on-board batteries. Shore-station communication was again established, and real-time data collection successfully re-initiated.

- An autopsy on the retrieved gauge revealed that the instrument had indeed been stuck in a communication error, and that no data had been recorded in the on-board memory since March 15th. The unfortunate end result of this mishap is an 11-day gap in the record of the Melbourne Beach gauge. However this important flaw has now been identified and a solution determined (i.e. no batteries in the gauge). Discovering the flaw later on in the data collection program may have had dire consequences.

- On April 10-11 the concrete foundation pad for the shore station tower was constructed, and on April 17 a 30-ft tall Rohn® tower was installed using a 'cherry-picker' lift.

- Also on April 17, two directional antennas were installed, one on the tower and the second on the roof of Surfbreak's office building. Direct wireless network communication was established between the computers in the shore station and the office, thereby completing the data-link that will soon enable files to be sent via ftp directly to BSRC for immediate posting on the new website.

- At the same time the problems with the wave gauge were being dealt with, it became evident that the Brevard County Beach Nourishment Project was not going to stop short of Spessard Holland Park as had been originally planned, but that construction was to take place all the way south to the PAFB Tracking Station. The dredge outfall and bulldozers were literally bearing down on the site at the time the rescue mission was completed. Meetings with Great Lakes Dredge & Dock Company and Army Corps officials were held to alert them to the situation with the newly installed cable, and thereafter periodic field-checks were made by Surfbreak staff to insure the cable remained undisturbed. It is now buried under an additional 5 ft of dredged material.

To complete the shore station 1) an uninterrupted power supply will be developed and installed, 2) the shed will be insulated and, if required, a climate control system installed, and 3) an R.M. Young® directional wind instrument (recently purchased) will be installed at the top of the station's tower.

The ramification of problem with the communication error is that, in using the cable, there appears to be no viable means of employing on-board batteries as back-up power should the shore station fail. Once in this loop, there is no way to 'break in' to a self-powered instrument and correct the situation. The end result is that the cable is now an even more essential component of the system, and that data collection will stop should the cable ever be damaged.

1.2 Results from Final Self-Record Deployments at Spessard Holland

As indicated above, after the previous swap on January 9, the self-recording wave gauge was retrieved on February 12 and again on March 14, at which time the cable was installed. These data, as well as the Canaveral Buoy data, are presented in Figures 1-6, and have already been emailed to the BSRC.

As shown in the figures, January was relatively quiet, whereas February experienced three storms in which the significant wave height in the offshore reached or exceeded 3 m. However, the nearshore waves never exceeded 2 m.

2. Wave Hindcast Database: Energy Loss Enigma

2.1 STWAVE Modeling Using New WIS Data as Input

The newly acquired WIS data described in progress Report #6 have now been used to drive STWAVE, in order to examine the premise that the conspicuous wave energy loss between Buoy 41009 and the nearshore gauge was not represented by earlier wave modeling with STWAVE because input spectra were synthesized from gross hindcasted parameters rather than complete directional spectra. The time-periods modeled include Oct.-Dec., 1996, Jan.-Mar., 1997, and Jan.-Mar. 1999.

As typical results, those from 1996 are presented in Figures 7-12. It is clear from Figures 7, 9, and 11 that the previous inability of STWAVE to represent the enigmatic energy losses observed between deep and shallow water was not due to the necessity of driving the model with constructed spectra. That is, driving STWAVE with 'true' fully directional spectra did not improve the model's ability to predict the nearshore observations. With this possible explanation of the energy losses now eliminated, future modeling investigation will focus on bottom friction as the energy sink.

Using fully directional, '360-degree' spectra as input did however resolve the problem of artificially eliminated energy that occurred when the peak direction of the constructed input waves was pointed offshore. That is, contrasting Figure 1 of Progress Rpt. #2 with Figure 7 of this report shows that with 360-degree spectra as input, significant wave height does not artificially plunge to zero at times when the majority of energy is directed offshore (e.g. October 8-10, 1996). This positive finding is critical to the eventual development of a FCFP hindcast database, in that a half-plane model such as STWAVE <u>can</u> be used effectively to bring deepwater hindcasts to the nearshore, if the input spectra are fully 360-degree.

2.2 Cross-Shelf Experiment

Planning and design work for the cross-shelf experiment continues, and a reasonably detailed cost-estimate has been developed. As the overall budget for the

FCFP will be tight during the upcoming fiscal year due to the number of activities planned, the personnel directing the Waves Program at the Coastal and Hydraulics Laboratory of the Army Corps were solicited for support. They indicated that they are unable to participate at this time, but expressed keen interest in the experiment.

The experience gained in erecting the 30-foot tall Rohn® tower at the Melbourne Beach shore station has already proven valuable in guiding the design and deployment scheme for the submerged towers. Because the fit of the tubular connections is extremely snug, it is clear that as many sections of the tower as possible should be pre-assembled on dry land. In result, the short, shallow-water (50-ft depth) towers should be relatively simple to transport to their sites and erected, because they require only two sections (i.e. 20 ft). However, the deep-water tower constitutes a major undertaking. The water depth in which the divers will be working is nominally 80 ft, which notably limits allowable no-decompression bottom time. The tower will require five sections (50 ft), which actually is longer than the work-boat to be used (34 ft). Consequently, either the tower will have to be partially assembled in the water, or else pre-assembled and towed to the site.

One positive development in the design of the cross-shelf experiment is the realization that during the periodic checks & servicing of the instruments, although downloading the data onboard ship is not practical due to the time required (~4 hours), it is feasible to swap the loaded memory cards with fresh ones, and then read the collected data back at the office. Using this approach, data can be retrieved (and any problems detected) as the experiment is running, rather than accepting the risk of waiting for final retrieval of the instruments at the end of a 3-month deployment.

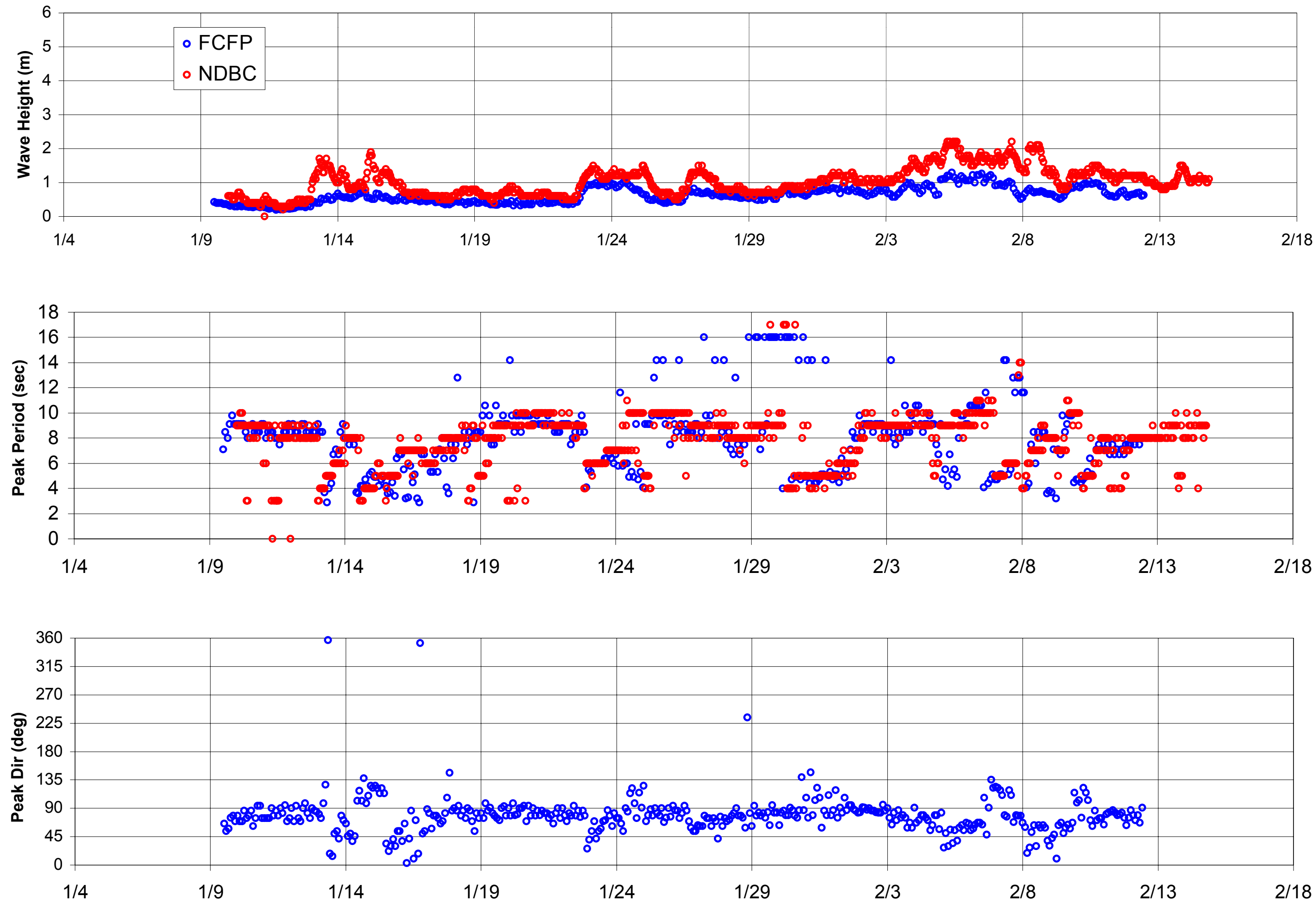

Figure 1 – Wave data from Melbourne Beach gauge for January 9 – February 12, 2002. Data from NDBC 41009 shown for comparison.

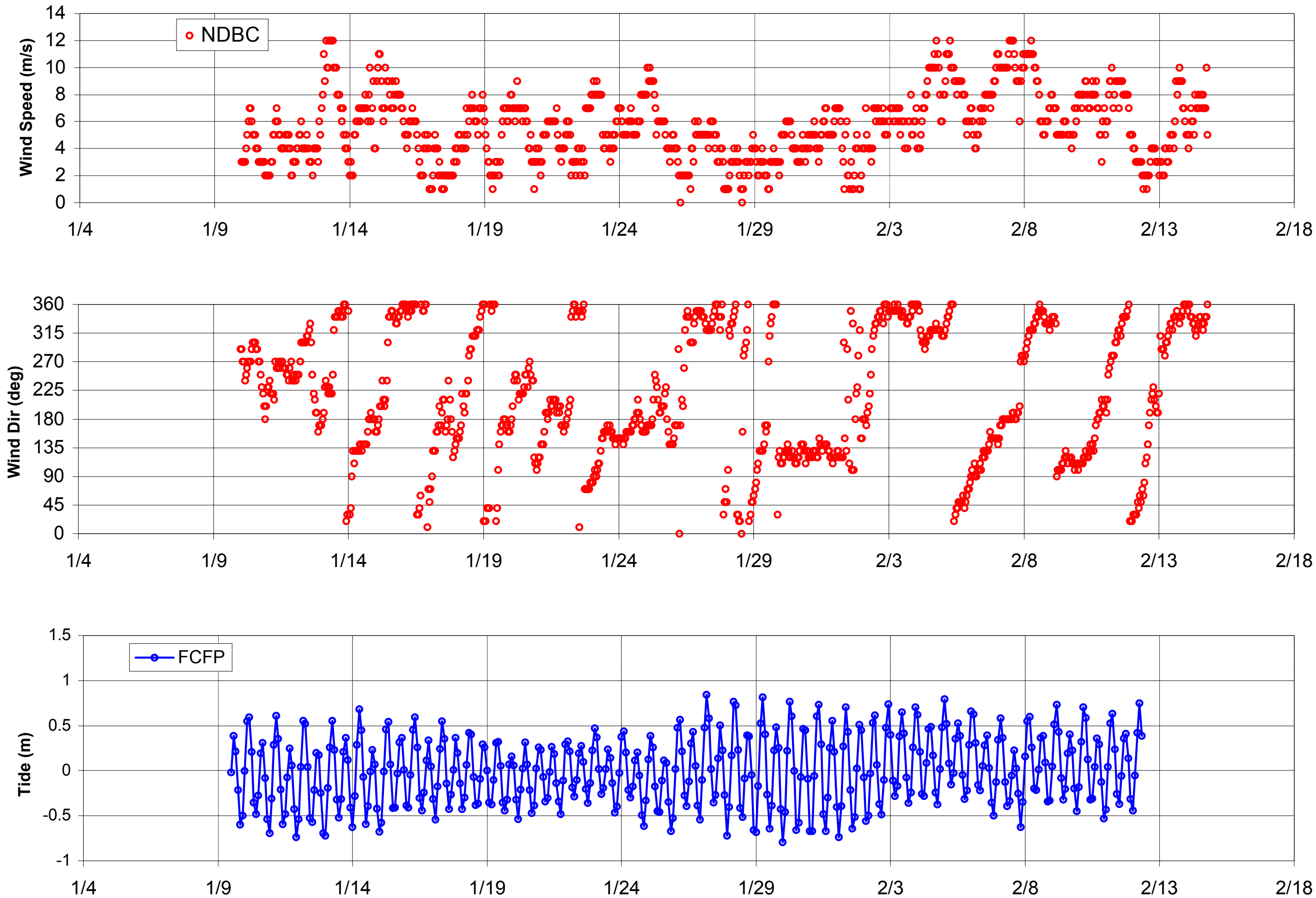

Figure 2 – Wind data from NDBC 41009 and tide data from Melbourne Beach gauge for January 9 – February 12, 2002.

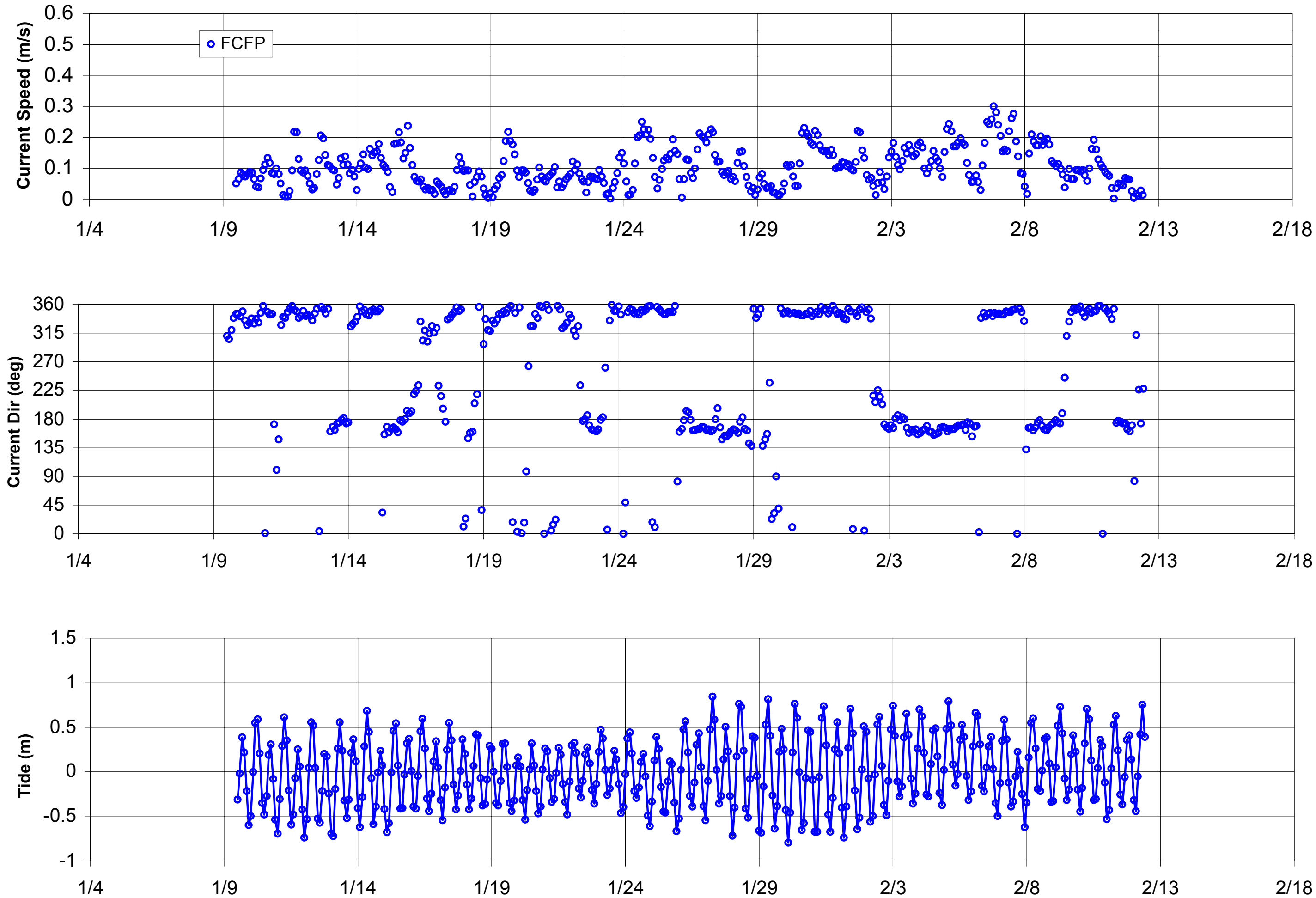

Figure 3 – Current and tide data from Melbourne Beach gauge for January 9 – February 12, 2002.

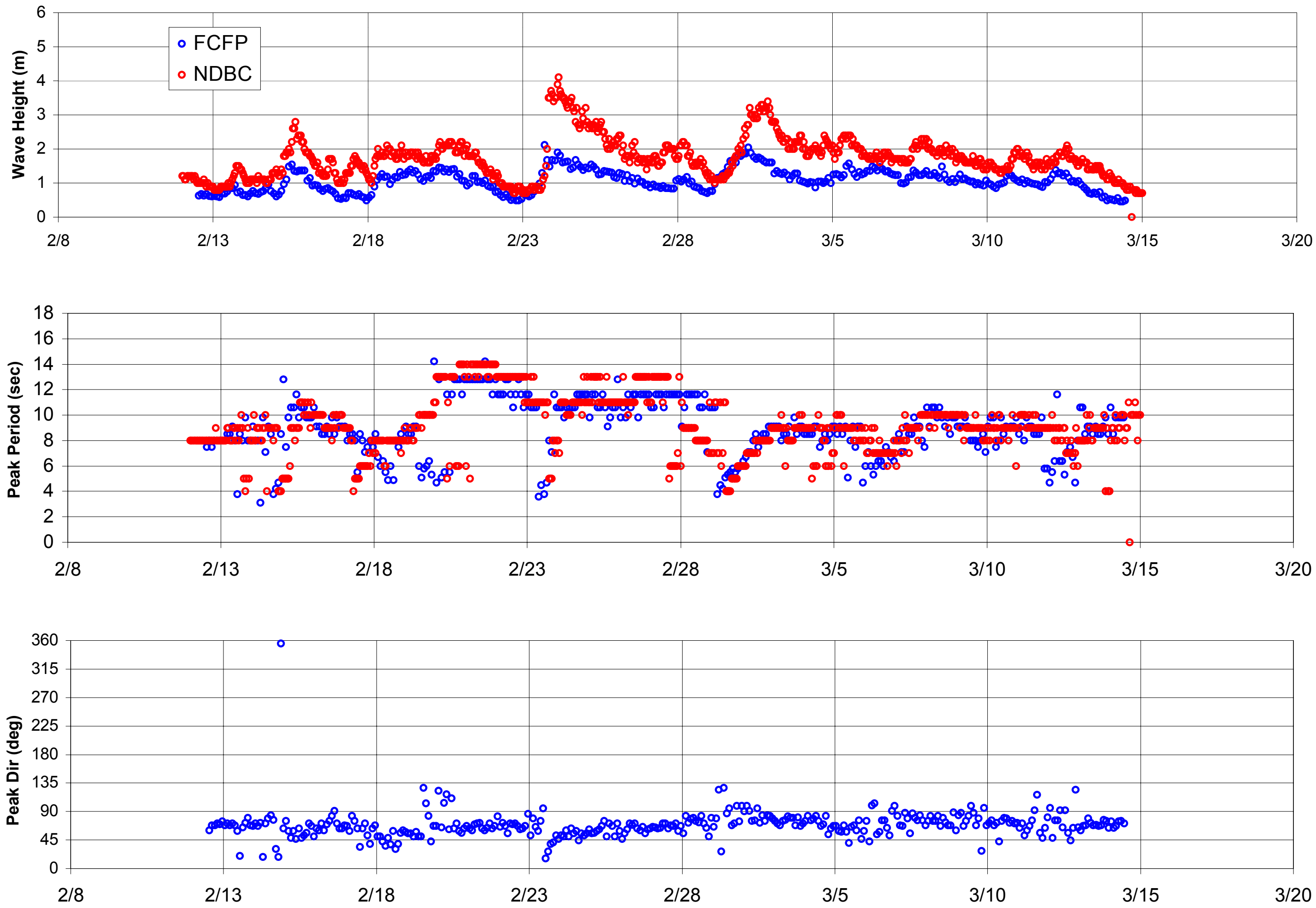

Figure 4 – Wave data from Melbourne Beach gauge for February 12 – March 14, 2002. Data from NDBC 41009 shown for comparison.

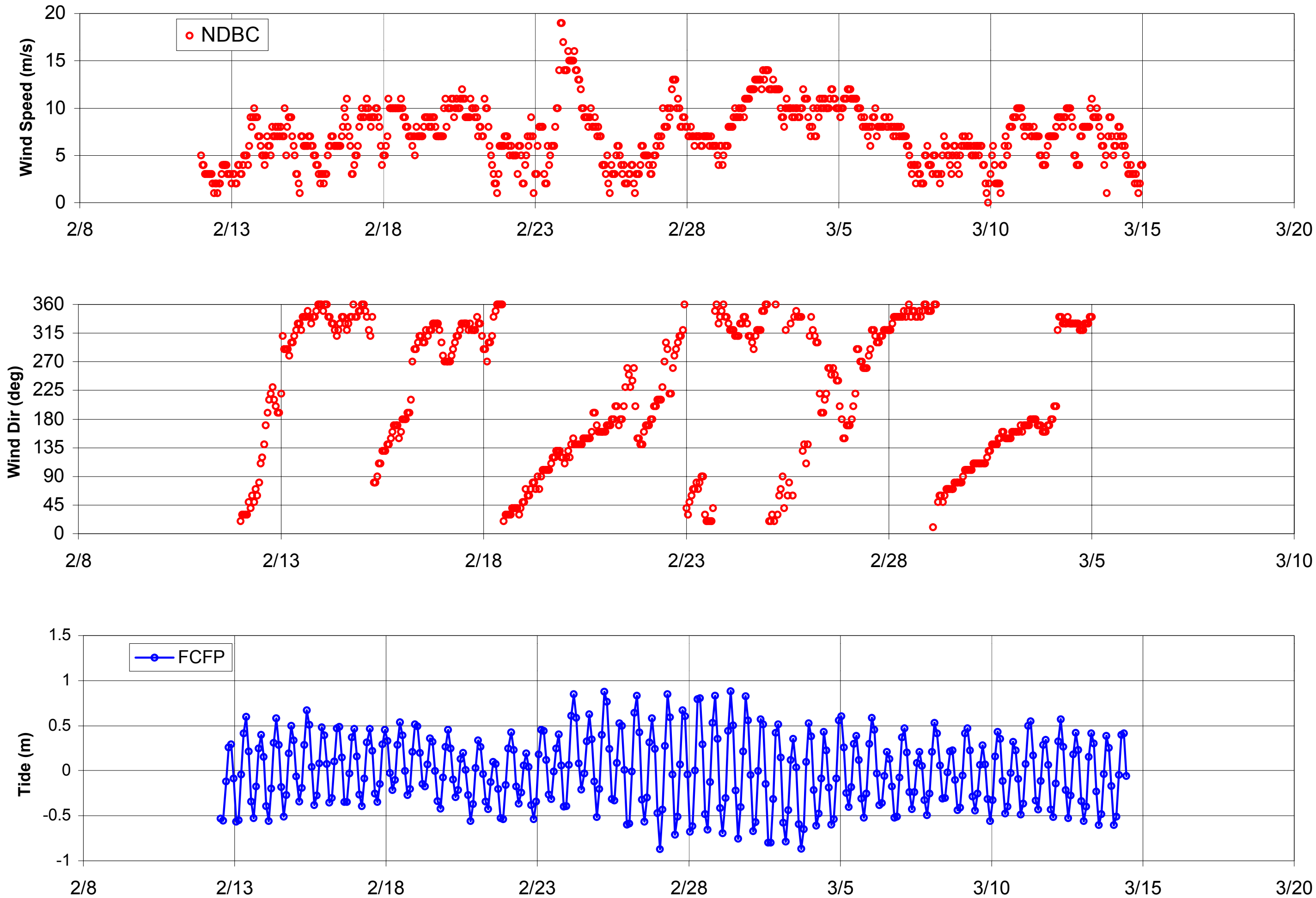

Figure 5 – Wind data from NDBC 41009 and tide data from Melbourne Beach gauge for February 12 – March 14, 2002.

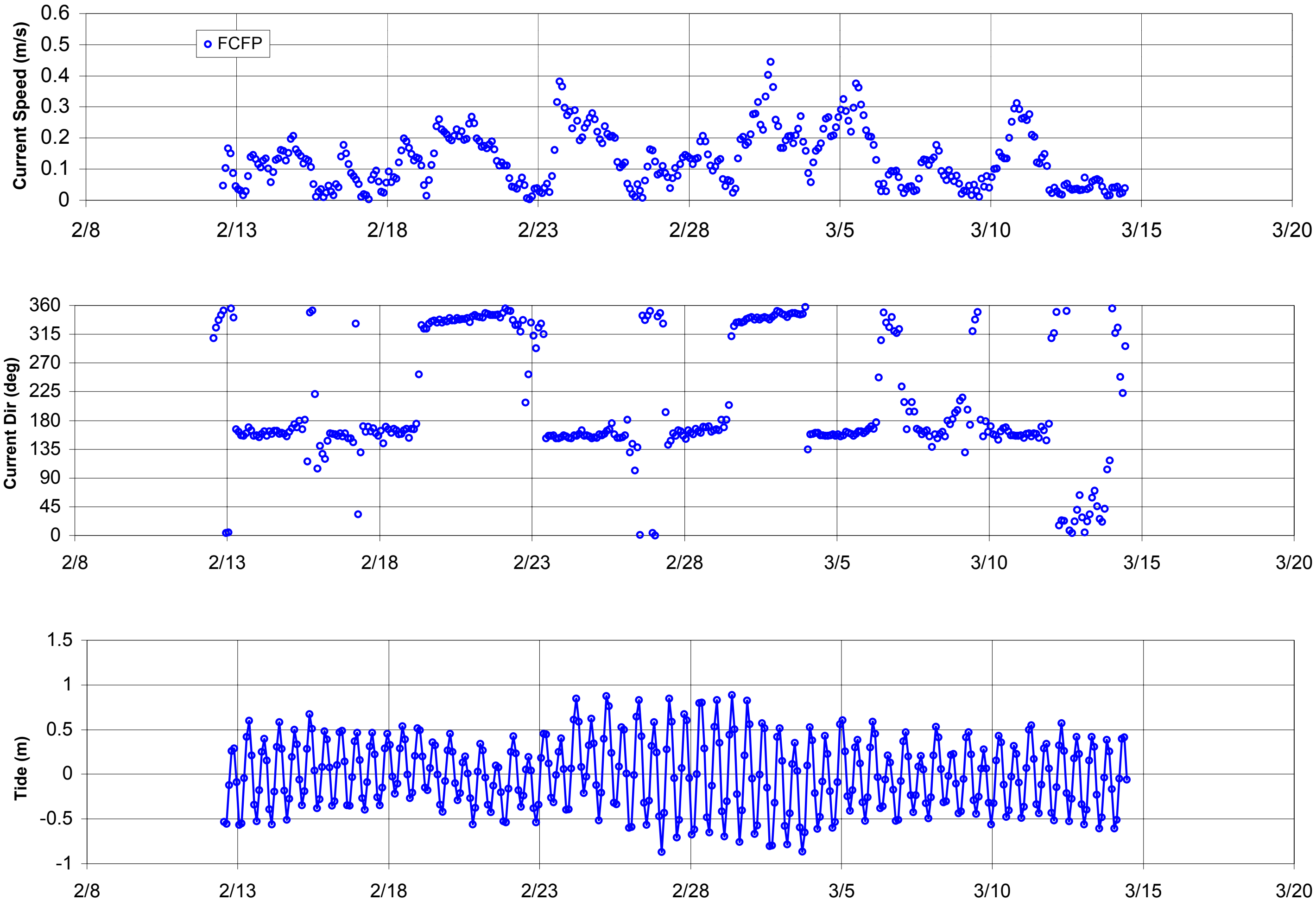

Figure 6 – Current and tide data from Melbourne Beach gauge for February 12 – March 14, 2002.

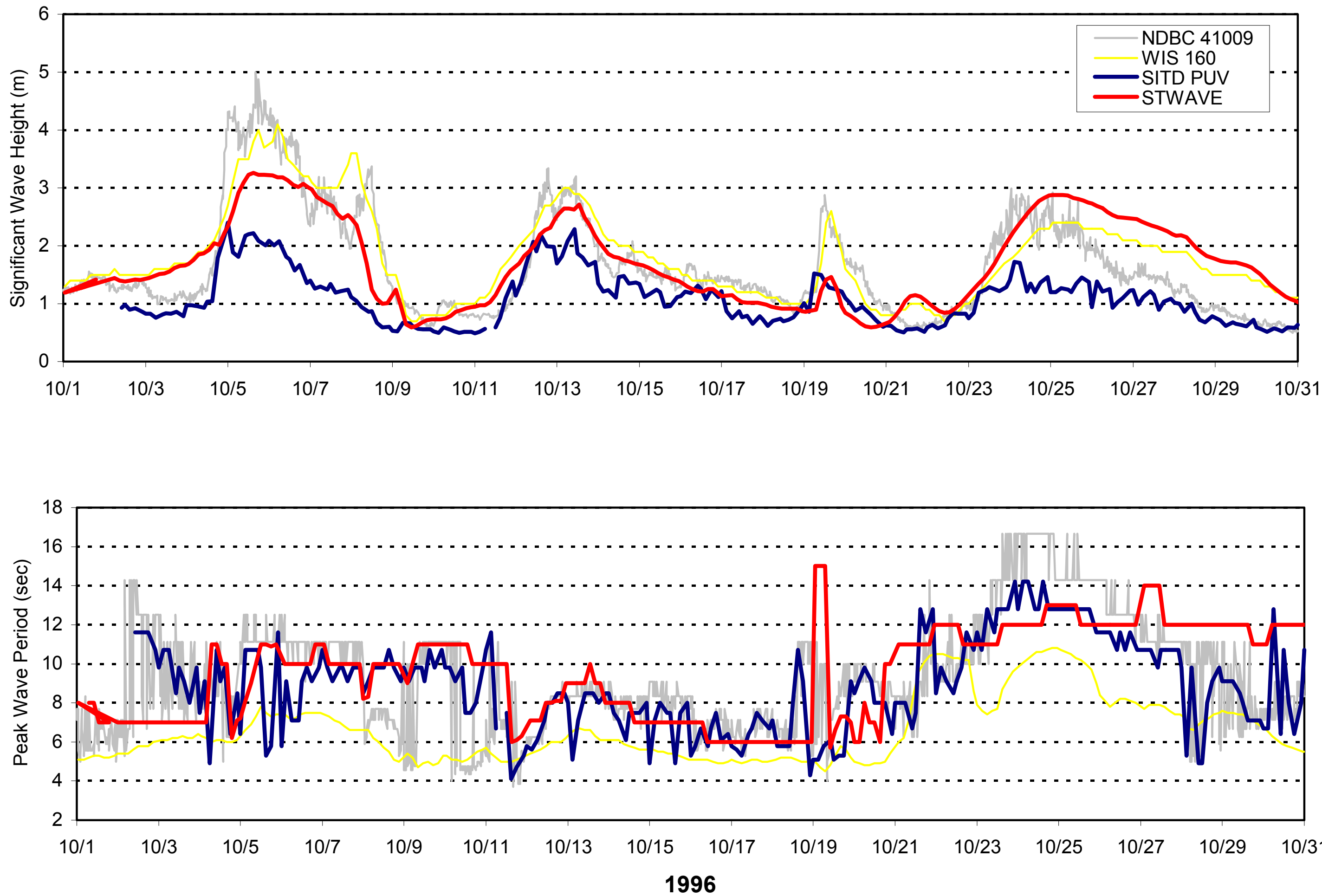

Figure 7 – Comparison of STWAVE model output to measurements from Sebastian Inlet PUV gauge for October, 1996. New WIS data used as model input (average period shown). NDBC 41009 data shown for comparison.

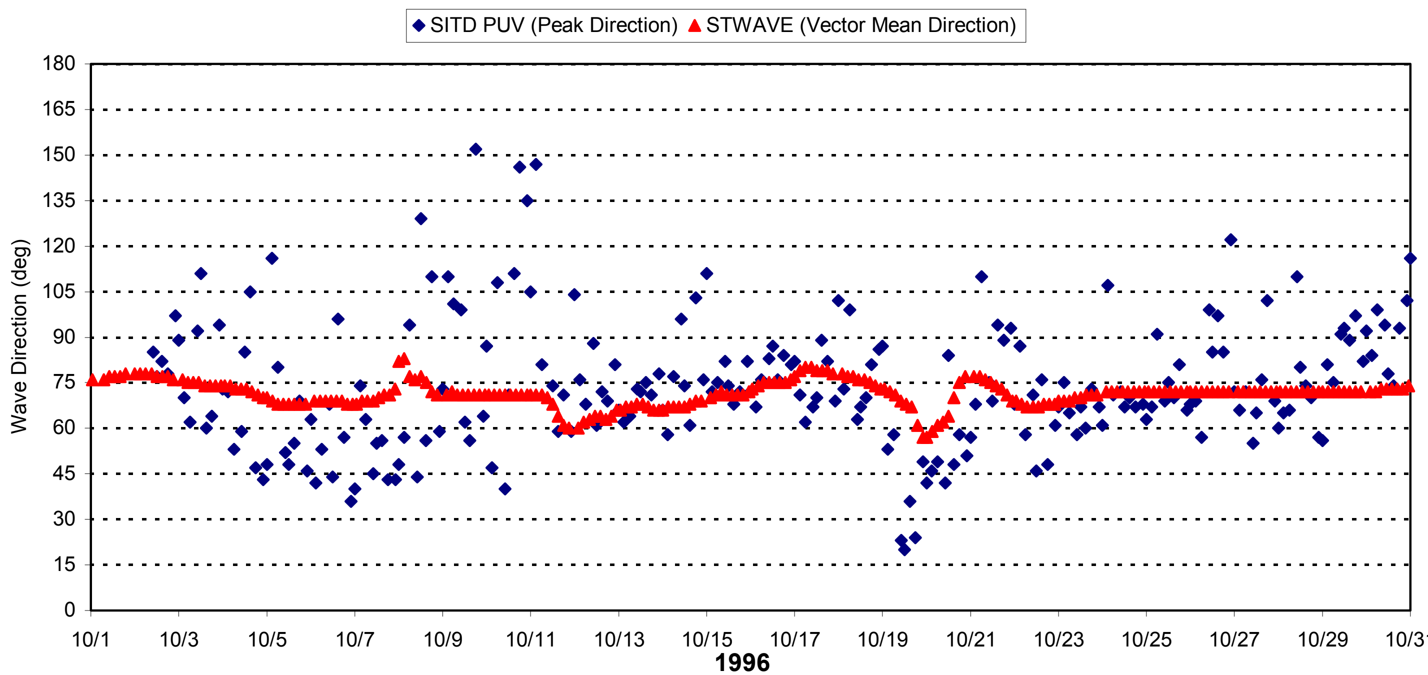

Figure 8 – Comparison of wave direction from Sebastian Inlet PUV and STWAVE model output for October 1996.

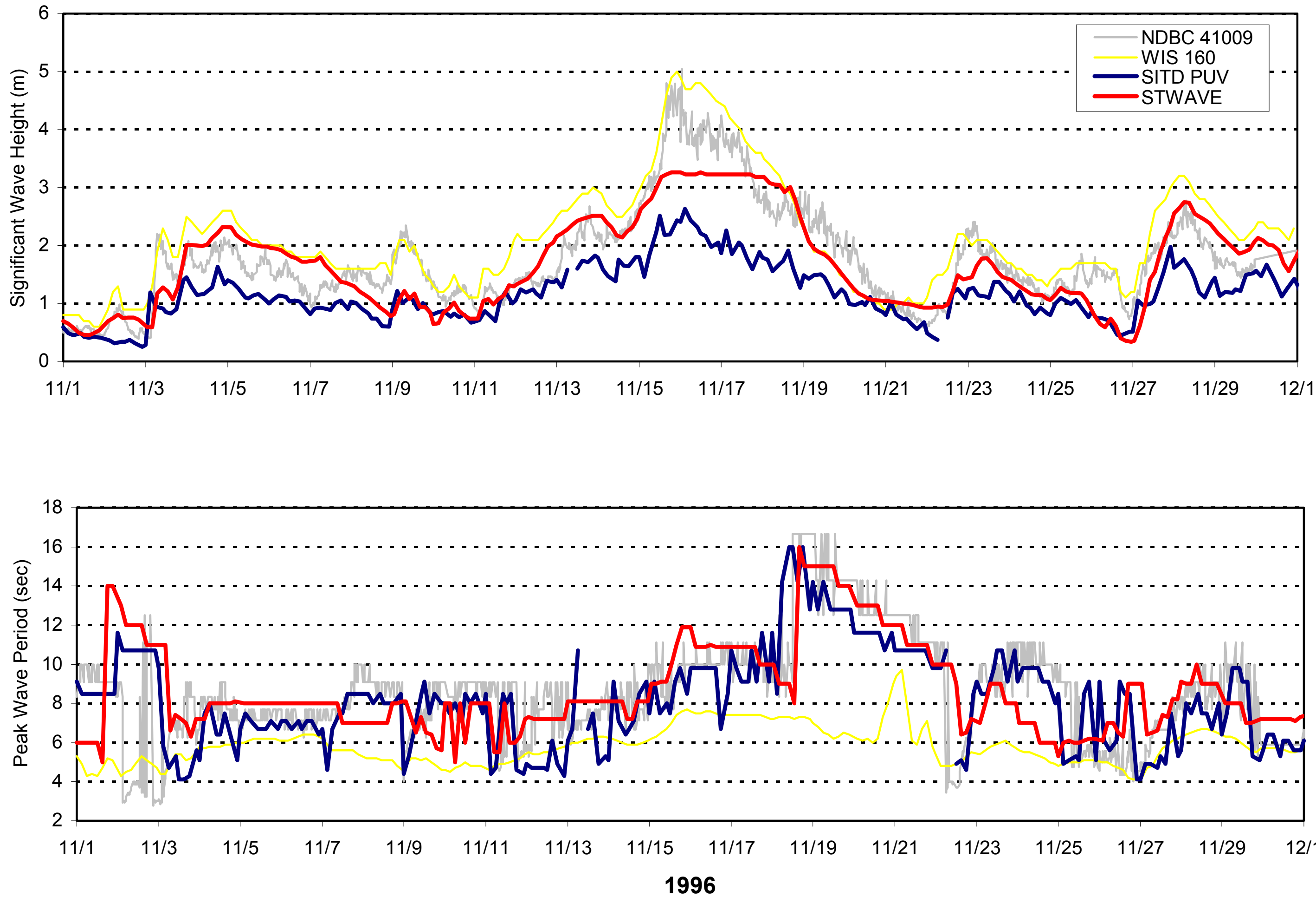

Figure 9 – Comparison of STWAVE model output to measurements from Sebastian Inlet PUV gauge for November, 1996. New WIS data used as model input (average period shown). NDBC 41009 data shown for comparison.

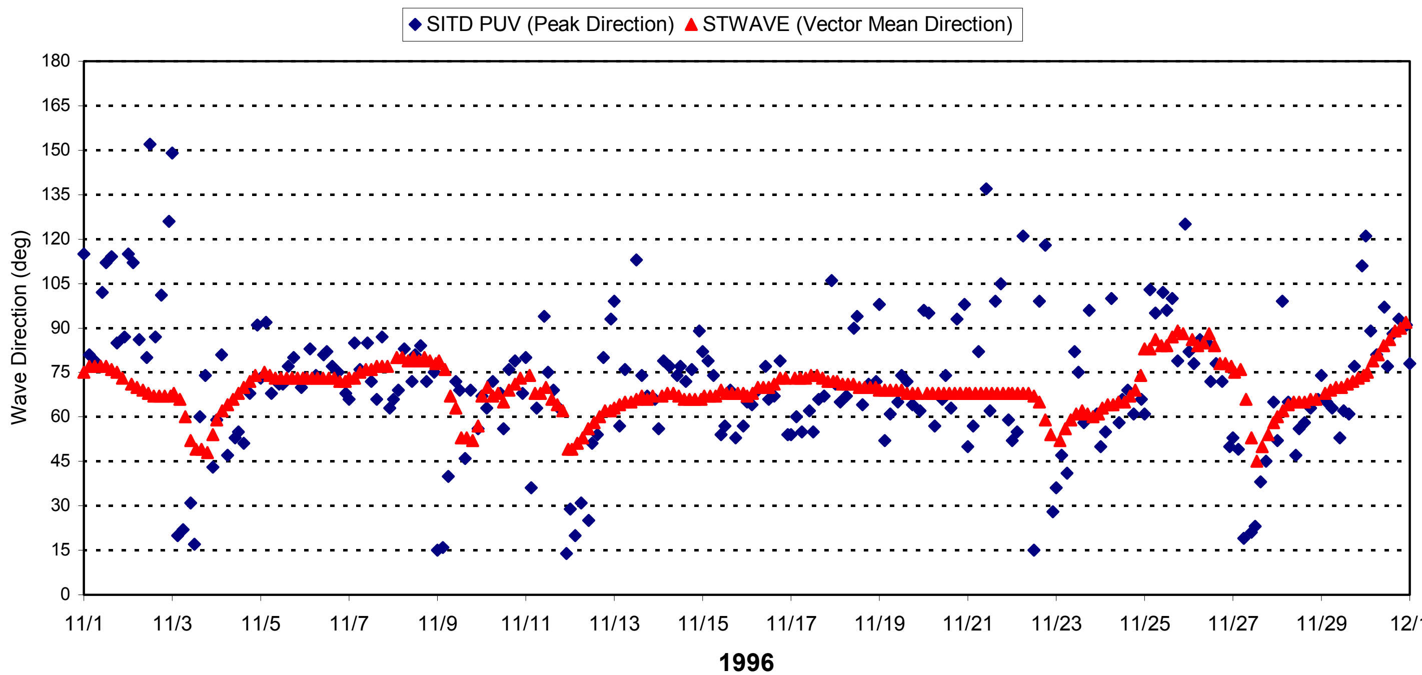

Figure 10 – Comparison of wave direction from Sebastian Inlet PUV and STWAVE model output for November 1996.

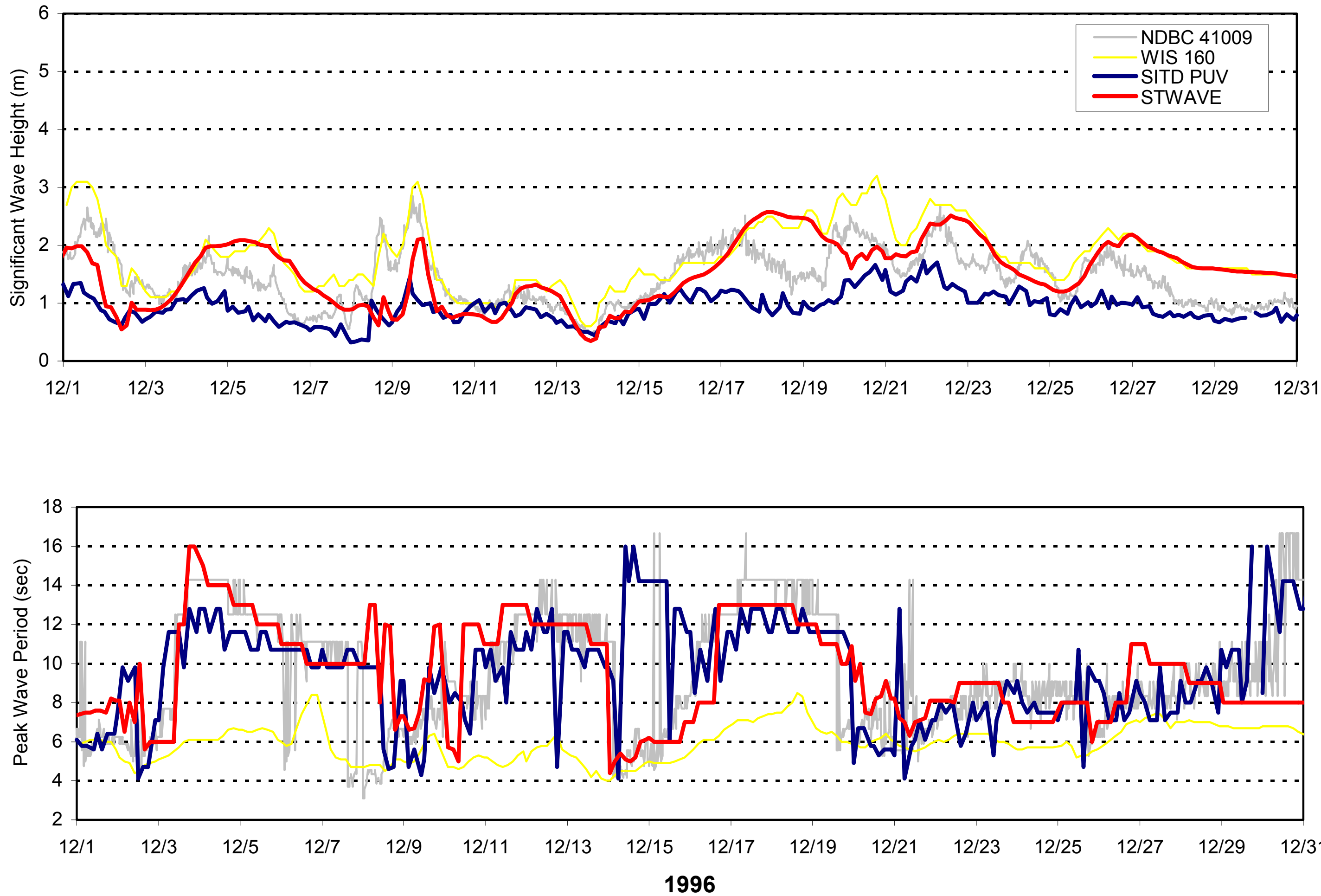

Figure 11 – Comparison of STWAVE model output to measurements from Sebastian Inlet PUV gauge for December, 1996. New WIS data used as model input (<u>average</u> period shown). NDBC 41009 data shown for comparison.

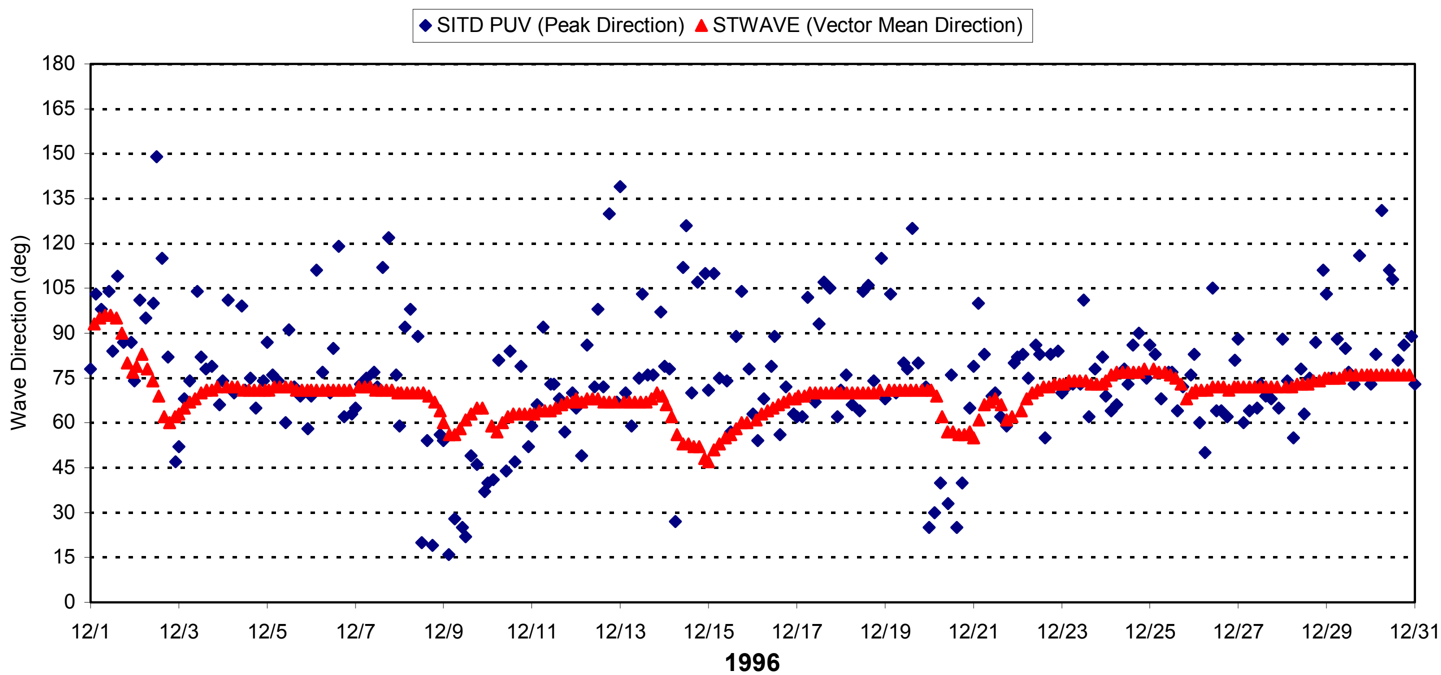

Figure 12 – Comparison of wave direction from Sebastian Inlet PUV and STWAVE model output for December 1996.