Southern California Beach Processes Study

Torrey Pines Field Site

7th Quarterly Report
30 November 2002

to

California Resources Agency
and
California Department of Boating and Waterways

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BACKGROUND:

The objective of the Southern California Beach Processes Study is to develop an improved understanding of how sand is transported by nearshore waves and currents, thus improving the technical basis for the design of beach nourishment projects. The first project in this study, funded by the State of California, involves the simultaneous observations of nearshore waves and sand level changes at the SANDAG-sponsored beach nourishment project at Torrey Pines State Beach. These observations will be used to calibrate and evaluate existing computer models for the wave-driven evolution of a nourished beach, and eventually for the development and testing for new models. Torrey Pines Beach, located at the border between the cities of San Diego and Del Mar was nourished during late April 2001 with nominally 191,000 cubic m of sand. The sand was deposited on the beach above the low tide level and over a 500 m alongshore span, forming an elevated pad of sand. This study was described in a presentation at the California Shore and Beach Preservation/California Coastal Coalition 2001 Annual Conference Restoring the Beach, Science, Policy and Funding, held in San Diego on 8-10 November 2002. A description of the SCBPS project may be accessed through http://cdip.ucsd.edu/SCBPS/homepage.shtml. This site has now expanded to include both the Torrey Pines Nourishment Project and the airborne shoreline change observations. Following publication, the Quarterly Reports are included on this site.

SAND LEVEL SURVEYS:

Since the last quarterly report, two additional surveys of sand levels have been acquired that span the same region as the first 24 surveys. The first began on 12 September 2002 and the second on 24 October 2002. Cross-shore survey transects extend from the base of the Torrey Pines cliffs or Highway 101 onshore to about the 8 m depth contour offshore. The alongshore spacing between cross-shore survey lines is 20 m for a 700 m-long stretch of beach centered on the originally nourished site, and 100 m for additional 1 km-long stretches of beach up and down coast of the original nourishment. In the first survey, spatial coverage was good except for four offshore lines at the southern end of the survey area where jetski positioning was degraded by poor GPS satellite configuration (Figure 1a). The second survey had generally good spatial coverage including overlap between the high tide jetski surveys and the low tide beach surveys (Figure 2a). Bathymetry for the entire surveyed region, and for the closely (20 m) spaced alongshore lines near the nourishment site, are shown in Figures 1b and 2b. Changes in sand level near the nourishment site, relative to the first post-nourishment survey (27 April 2001), and relative to the preceding survey are shown in Figures 1c and 2c. The right hand panels show the continuing shoreward migration of sand (yellow and orange, accretion on the shore face above mean sea level) since the previous surveys. Cross-shore profiles at alongshore locations representative of the fill area and the beaches to the north and south (transects 108, 96, and 89, Figure 3a) also show continuing beach face accretion (the red line is above the blue line in Figures 3b,c for $z > 0$).

WAVE MEASUREMENTS AND MODELING:

Wave data were collected continuously during the last quarter at the Torrey Pines Outer (550m depth) and Inner (20m) sites. Wave parameters from the two buoys are shown in Figures 4a-c. Summer "beach building" wave conditions, characterized by modest size south swells and alternating north- and southward wave-driven transport, continued in September and October. South swell is apparent (Figures 4a and 4b) with long peak wave periods greater than about 15 seconds (middle panels), and peak directions at the outer buoy near 200 degrees (blue line, lower panels) . The alternating north- and southward transport is inferred from the peak direction and the inner buoy (red line, lower panels) shifting above and below the estimated shore normal at the inner buoy site (dashed black line, lower panels) as the local wave climate is alternately dominated by long period south swell or short period local northwest seas. Beginning in November, the North Pacific storm track became active and Torrey Pines has been dominated by waves from the north (southward sediment transport) (lower panel, Figure 4c). The first large wave event of the 2002-2003 winter season occurred on 9 November (Figure 4c) with a peak wave height of 2.5 m. This is slightly earlier than last year, when a 3 m event arrived on 21 November 2001 (Figure 9a of 4th Quarterly Report). While the first 2001 winter event was slightly larger, the recent 11/9/2002 event was preceded by local seas from the south, indicated by the brief dominance of short peak wave periods and southerly peak wave directions on 11/08/2002 (blue lines, middle and lower panels of Figure 4c). Southerly seas, commonly generated by the pre-frontal southerly winds of a low pressure weather system passing directly through Southern California, might drive sediment northward on west-facing beaches prior to the arrival of the storm-generated swell from the north, and a subsequent reversal of the alongshore transport direction to the south. Interestingly, Torrey Pines beach is sheltered from southerly seas by Pt. La Jolla (inner buoy red lines do not show a dominant local sea on 11/08/2002 in the middle and lower panels of Figure 4c). During Southern California winter storms enhanced net southward sediment transport may occur at this beach compared with beaches further north that are not sheltered by Pt. La Jolla.

BEACH RESPONSE MODELING:

GENESIS, the Corps of Engineers-developed software for modeling shoreline change caused by longshore transport was run on a short time series to check out the various file configurations. Substantial effort was devoted to rectifying format discrepancies that are not listed in the software documentation. For example, the documentation allows for the wave and tide events to be identified either by a sequential event number or by the actual date and time. The program, however, crashes without any identifying message if the event number option is selected. GENESIS also crashed without an error message when supplied with a non-monotonic profile, a condition that often occurs. This required smoothing and re-gridding the profiles. The short test run was executed successfully and does not give unreasonable results. The full time series through the last survey in this quarter will be run during the next quarter.

FEDERALLY FUNDED REGIONAL STUDY:

The Dana Point to Point La Jolla survey program funded by the Corps of Engineers was described in the 5th quarterly report (31 May 2002). Lidar and aerial video surveys of the region were completed in May 2002, as previously reported, and a second Lidar survey was made in September 2002, during the period of this report. Non-classified (no artifacts removed) data have been received from the contractor, who is still engaged in the classification operation. Meanwhile, a thorough quality control program has been undertaken to validate the navigation and elevation accuracy of these Lidar surveys. Figure 5a shows the locations of accurately surveyed benchmarks used in this validation. The May 2002 Lidar survey results also have been compared with a 1998 NASA survey. Figure 5b shows elevations for the Oceanside pier in the vicinity of the benchmark for the two Lidar surveys. The uncorrected (for bias) UT Lidar is about 20 cm lower than the benchmark while the NASA results are less than about +5 cm. Over the entire pier, the UT elevation is about 18 cm lower than the NASA results (Figure 5c). Comparisons at other locations indicate the UT Lidar bias is about 19 cm. After correction for this bias, the UT Lidar agrees well with benchmarks and earlier NASA surveys of piers, roads, and parking lots. Difficulties with the SHOALS survey last summer have resulted in a decision by the Corps of Engineers to redo the survey in its entirety during the last half of 2003.

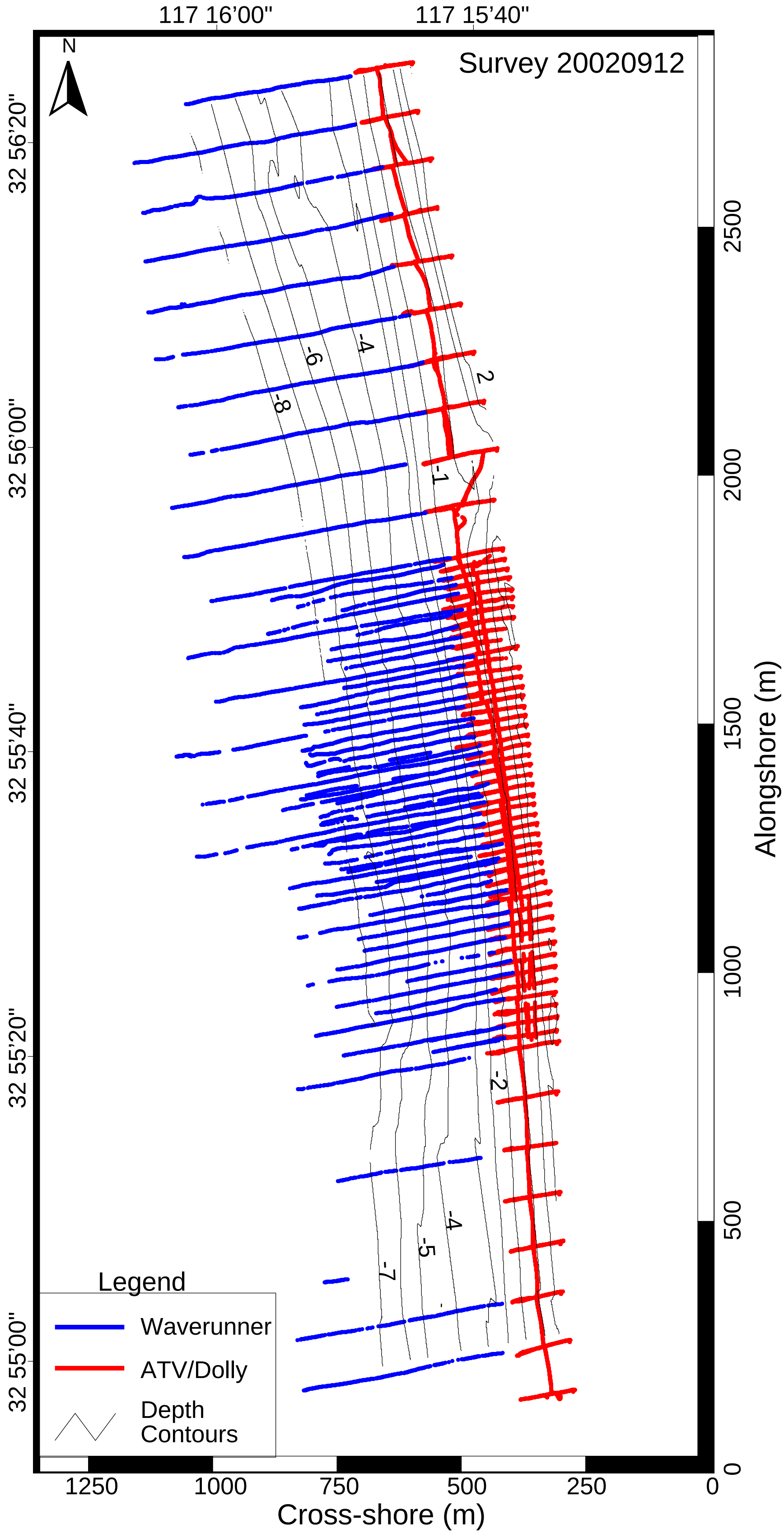


FIGURE 1a.

Survey starting 12 September 02. Blue lines are waverunner tracks (offshore). Red lines are ATV/dolly tracks (onshore). Black lines are depth contours in meters.

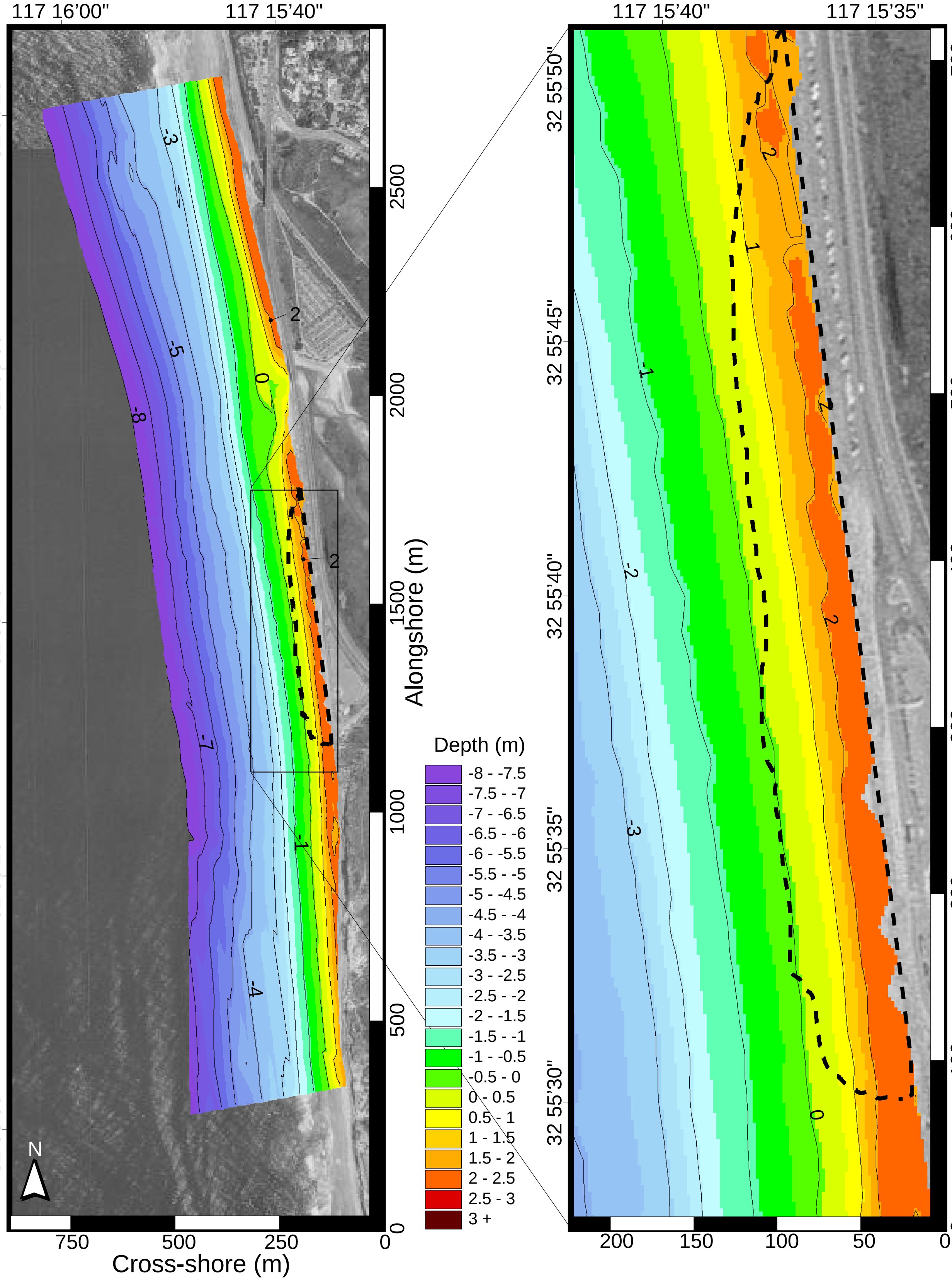


FIGURE 1b.

Left: Bathymetry measured 12 September 02 in a 3-km long strip centered on the initially nourished region (bounded by the black dashed line). The contour interval is 1.0 meters.

Right: Nourishment zone enlarged. The contour interval is 1.0 meters.

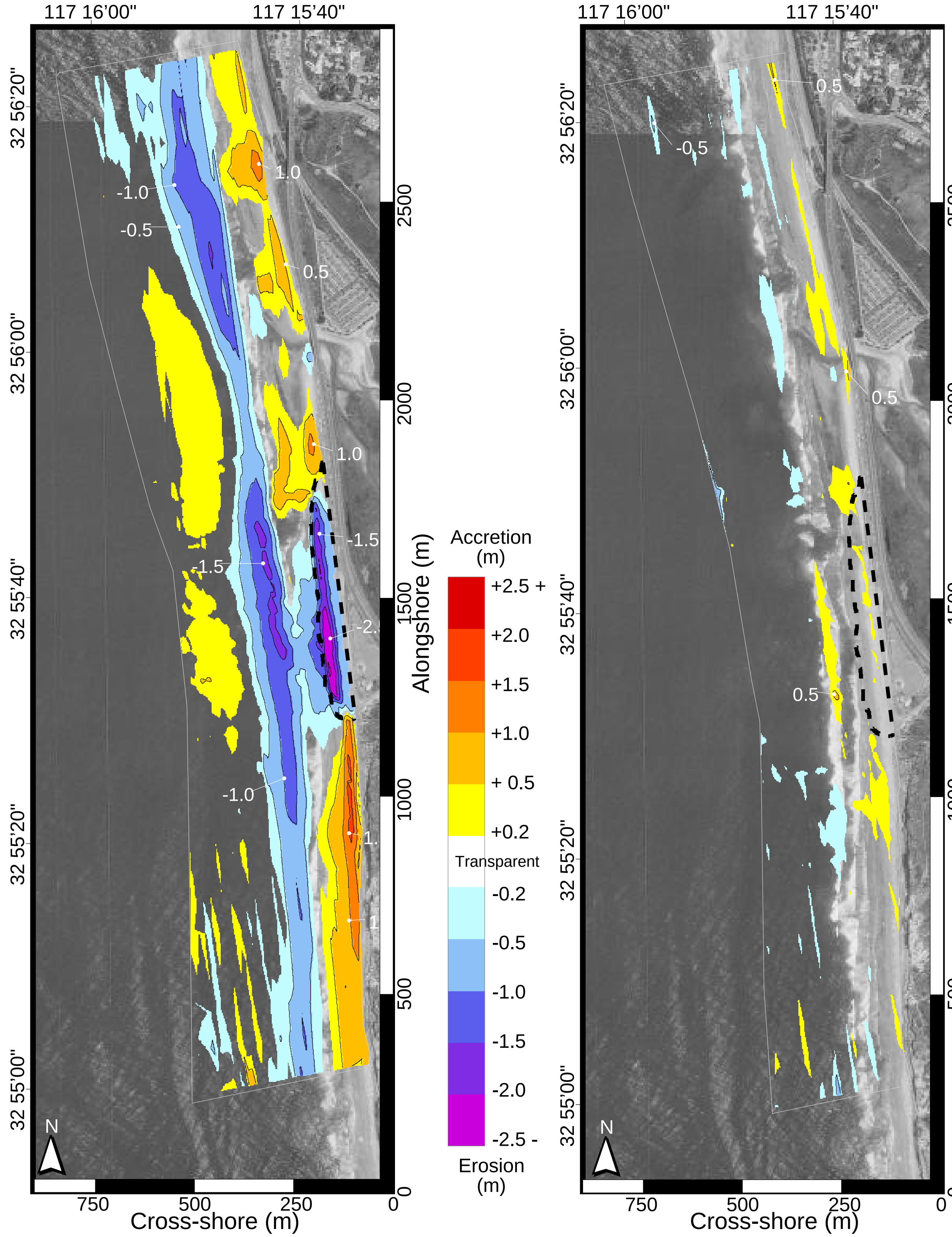


FIGURE 1c.
Left: Changes in sand level on 12 September 02 relative to 27 April 01 (the first post-nourishment survey). The contour interval is 0.5 meters (ignoring changes less than +/- 0.2 meters).
Right: Changes in sand level on 12 September 02 relative to 13 August 02 (the previous survey).

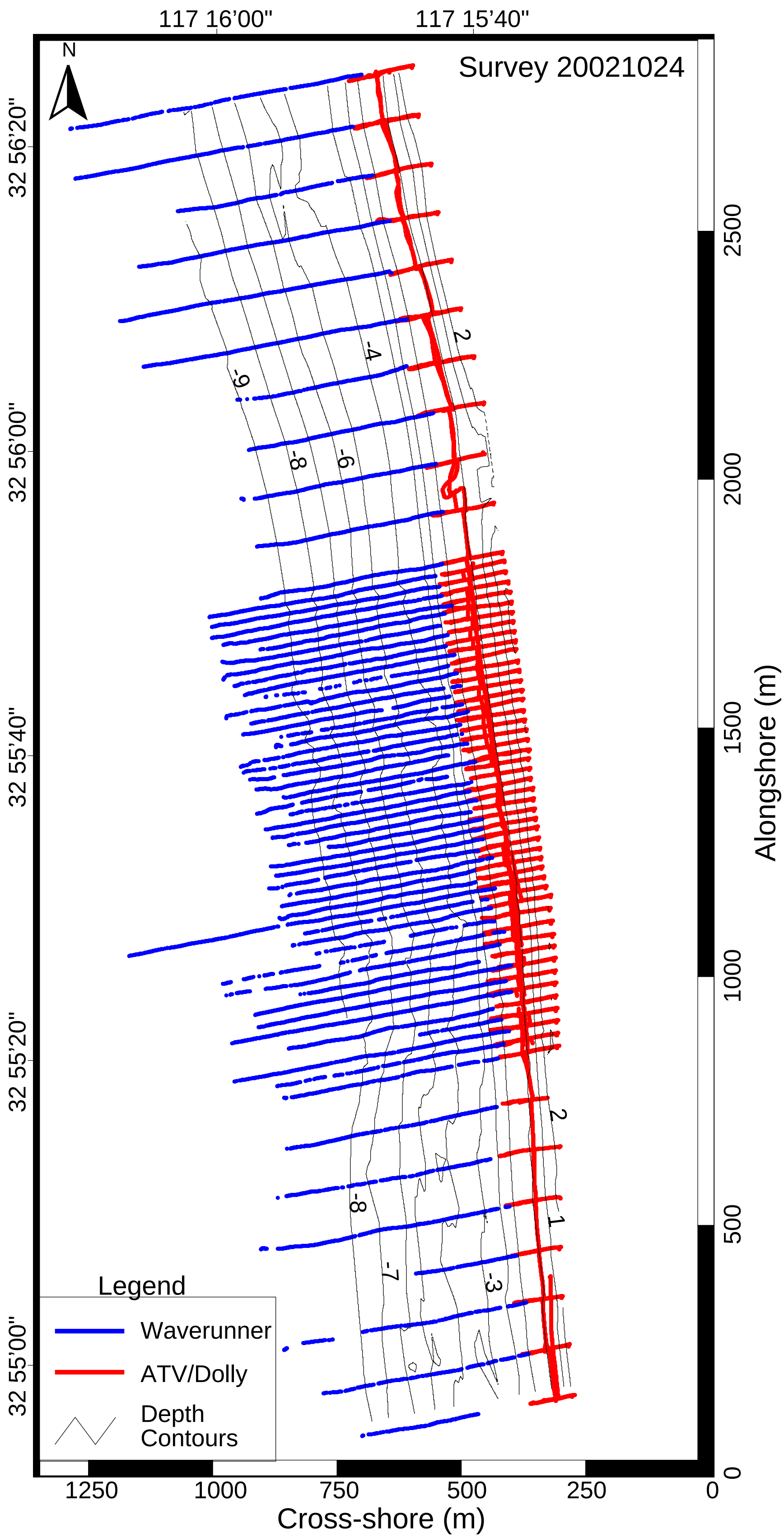


FIGURE 2a.
Survey starting 24 October 02. Blue lines are waverunner tracks (offshore). Red lines are ATV/dolly tracks (onshore). Black lines are depth contours in meters.

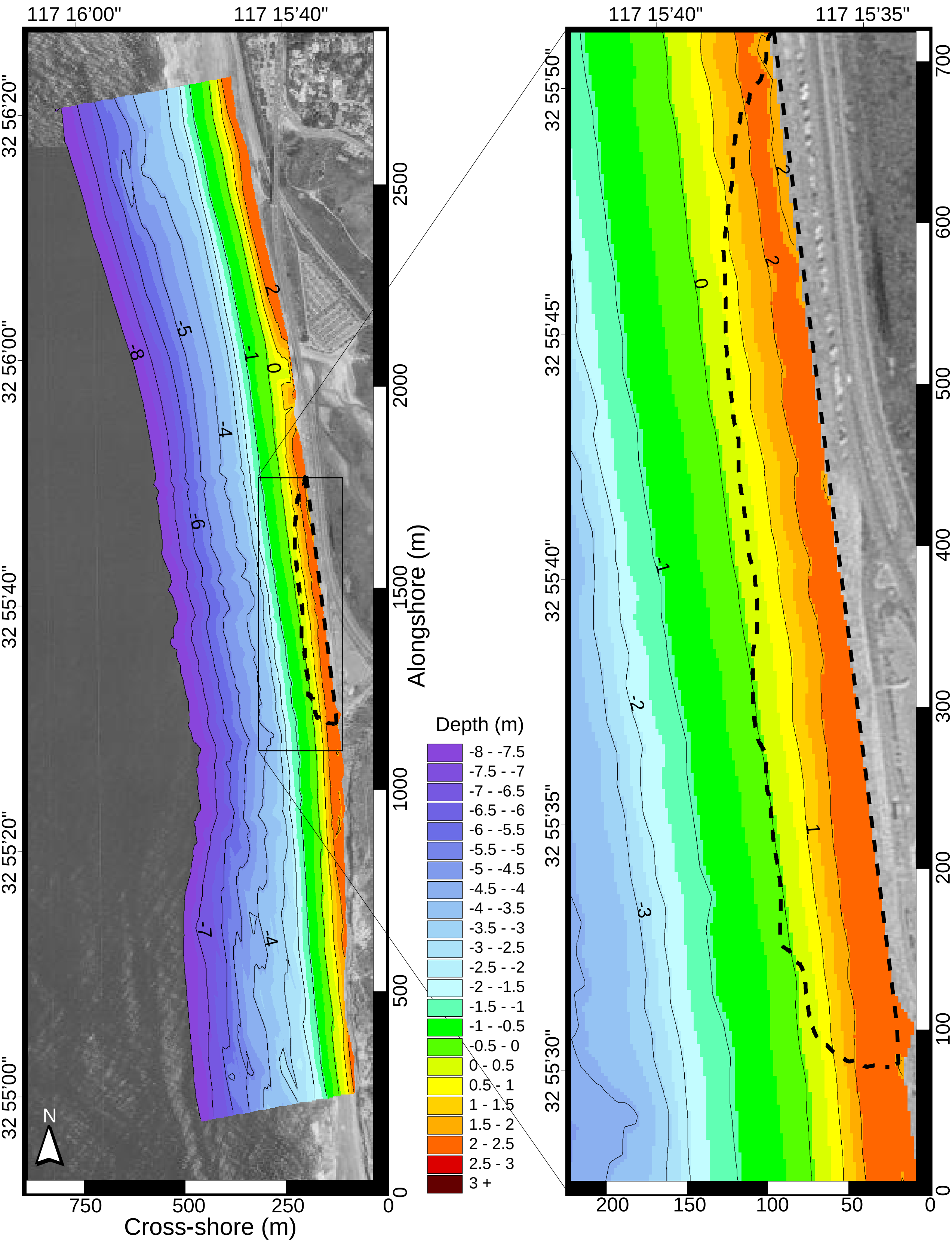


FIGURE 2b.

Left: Bathymetry measured 24 October 02 in a 3-km long strip centered on the initially nourished region (bounded by the black dashed line). The contour interval is 1.0 meters.

Right: Nourishment zone enlarged. The contour interval is 1.0 meters.

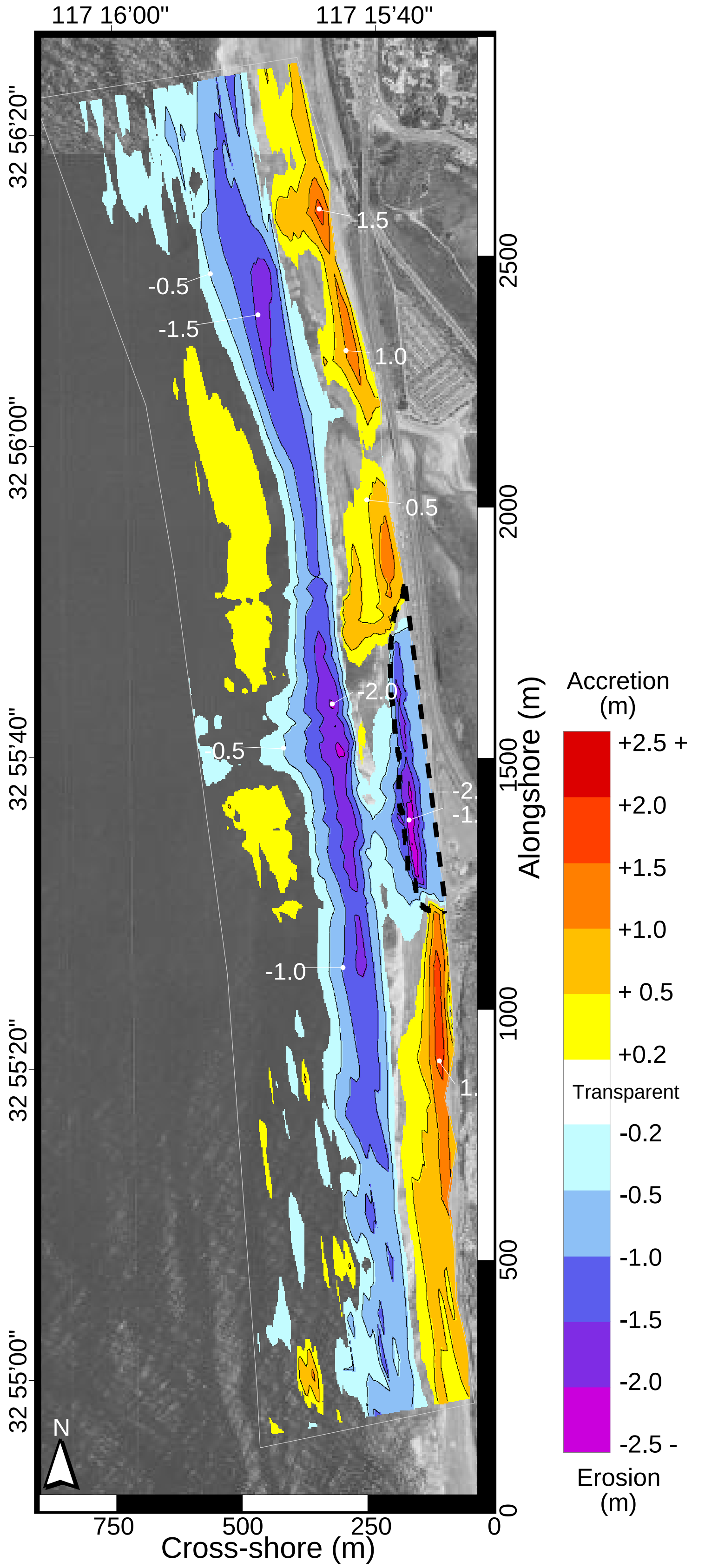


FIGURE 2c.
Left: Changes in sand level on 24 October 02 relative to 27 April 01 (the first post-nourishment survey). The contour interval is 0.5 meters (ignoring changes less than +/- 0.2 meters).
Right: Changes in sand level on 24 October 02 relative to 12 September 02 (the previous survey).

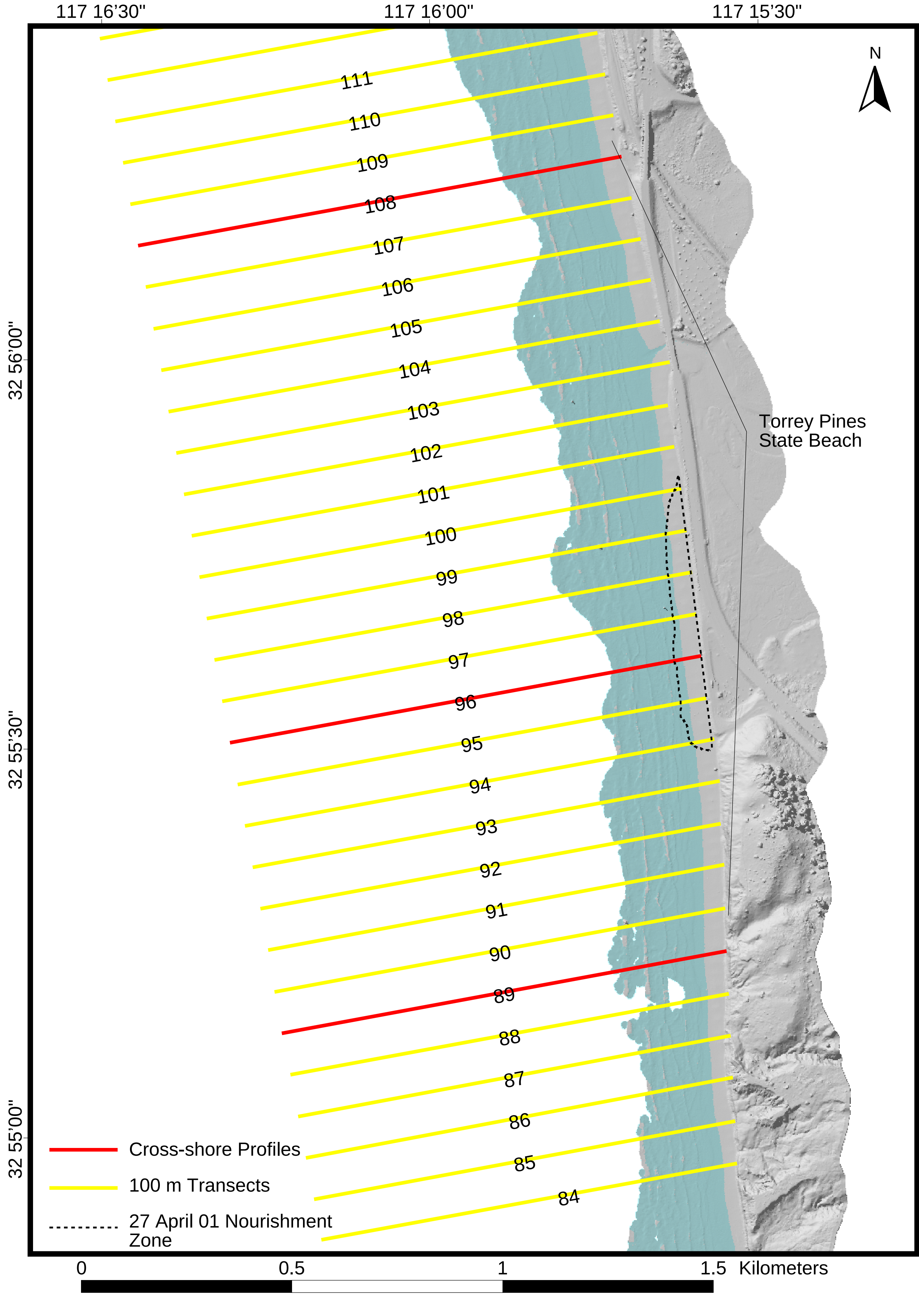


Figure 3a: Overview of cross-shore transects at Torrey Pines State Beach Study Site. Red lines are profiles in following figures (3b-c). Gray-shaded/blue image represents a sun-shaded surface derived from Lidar data collected 22 May 2002.

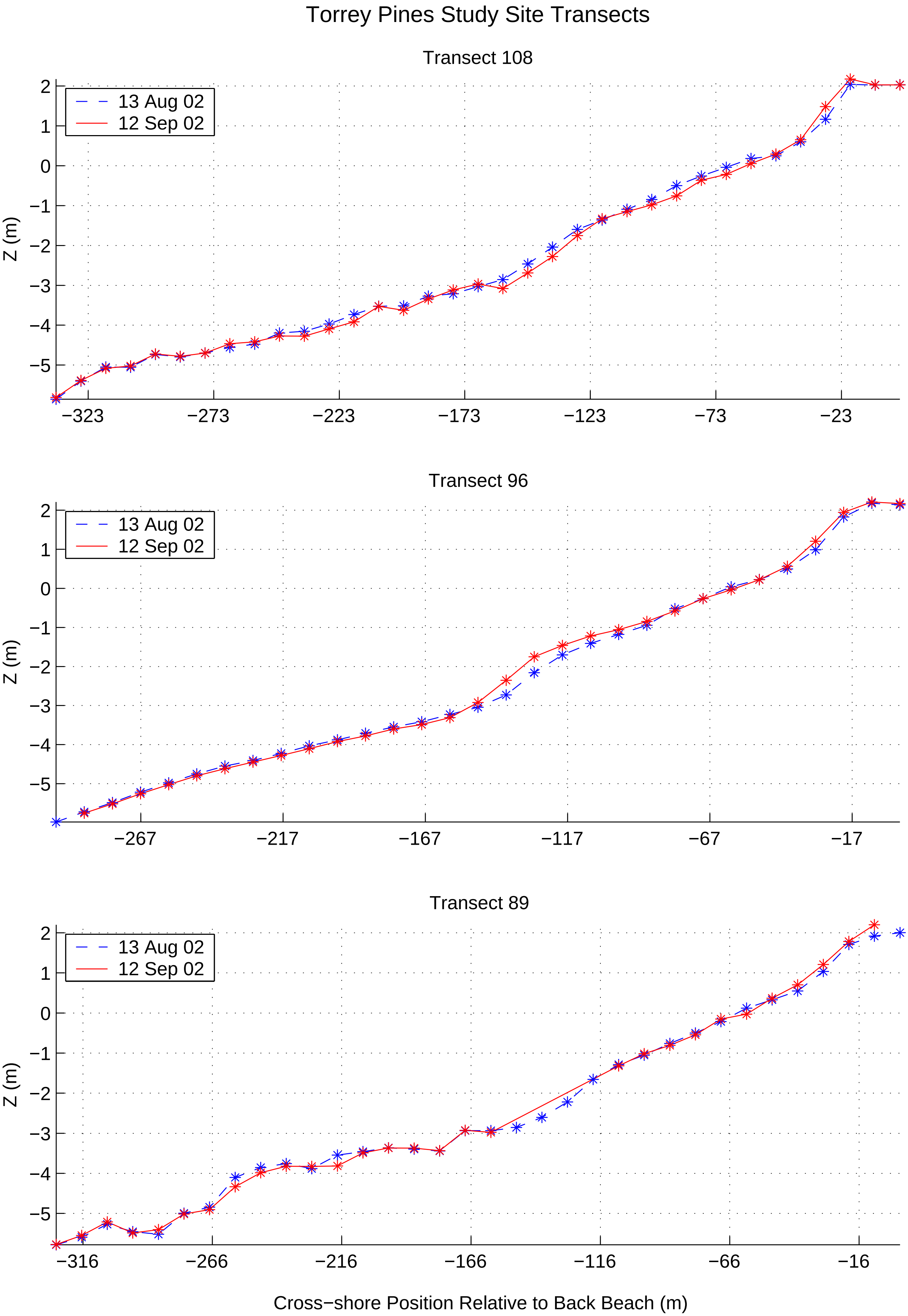


Figure 3b: Three cross−shore profiles at Torrey Pines State Beach: 13 Aug. 02 (blue) and 12 Sep. 02 (red). See Figure 3a for transect locations. Data points have been binned (averaged) at 10 m intervals.

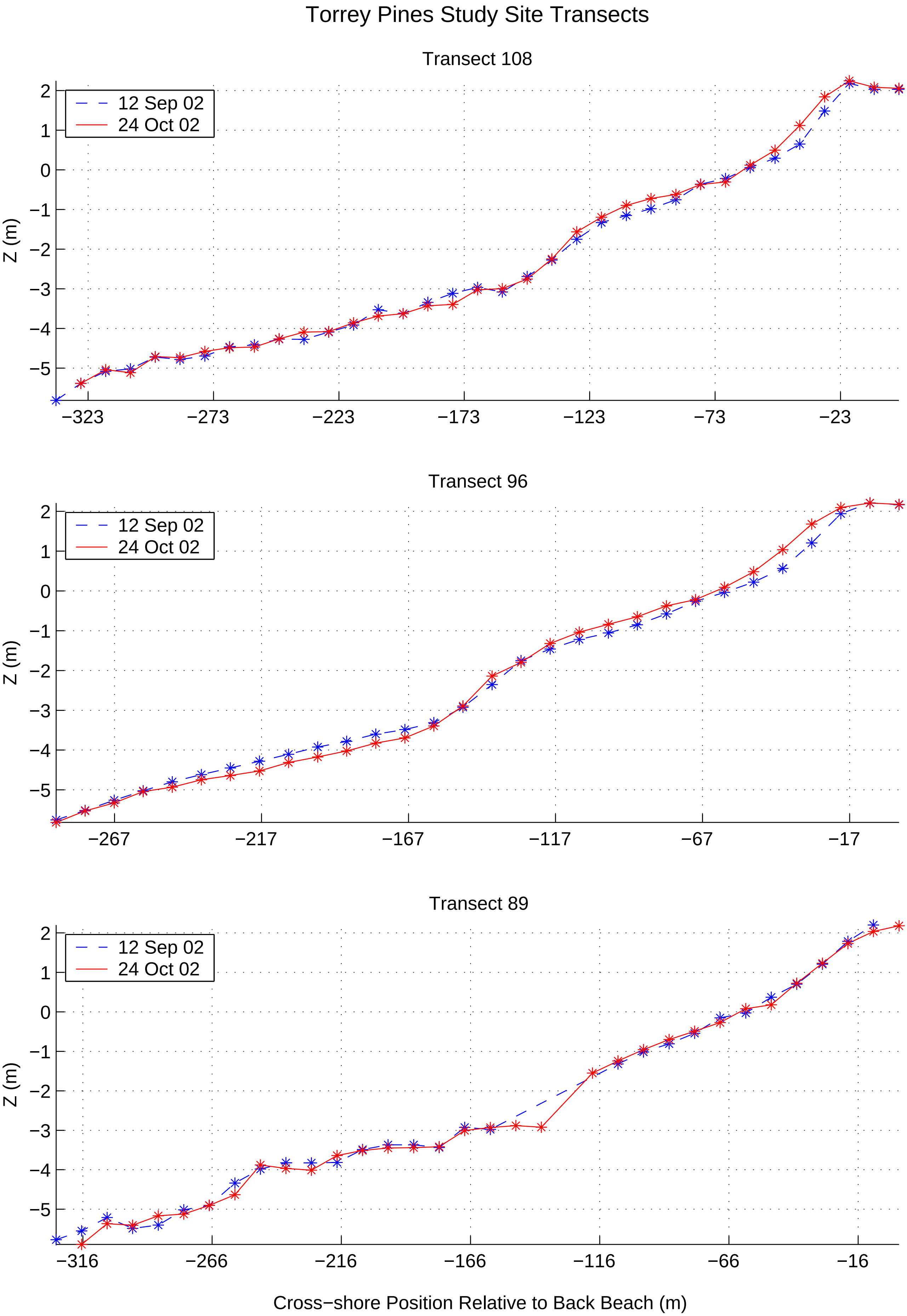


Figure 3c: Three cross−shore profiles at Torrey Pines State Beach: 12 Sep. 02 (blue) and 24 Oct. 02 (red). See Figure 3a for transect locations. Data points have been binned (averaged) at 10 m intervals.

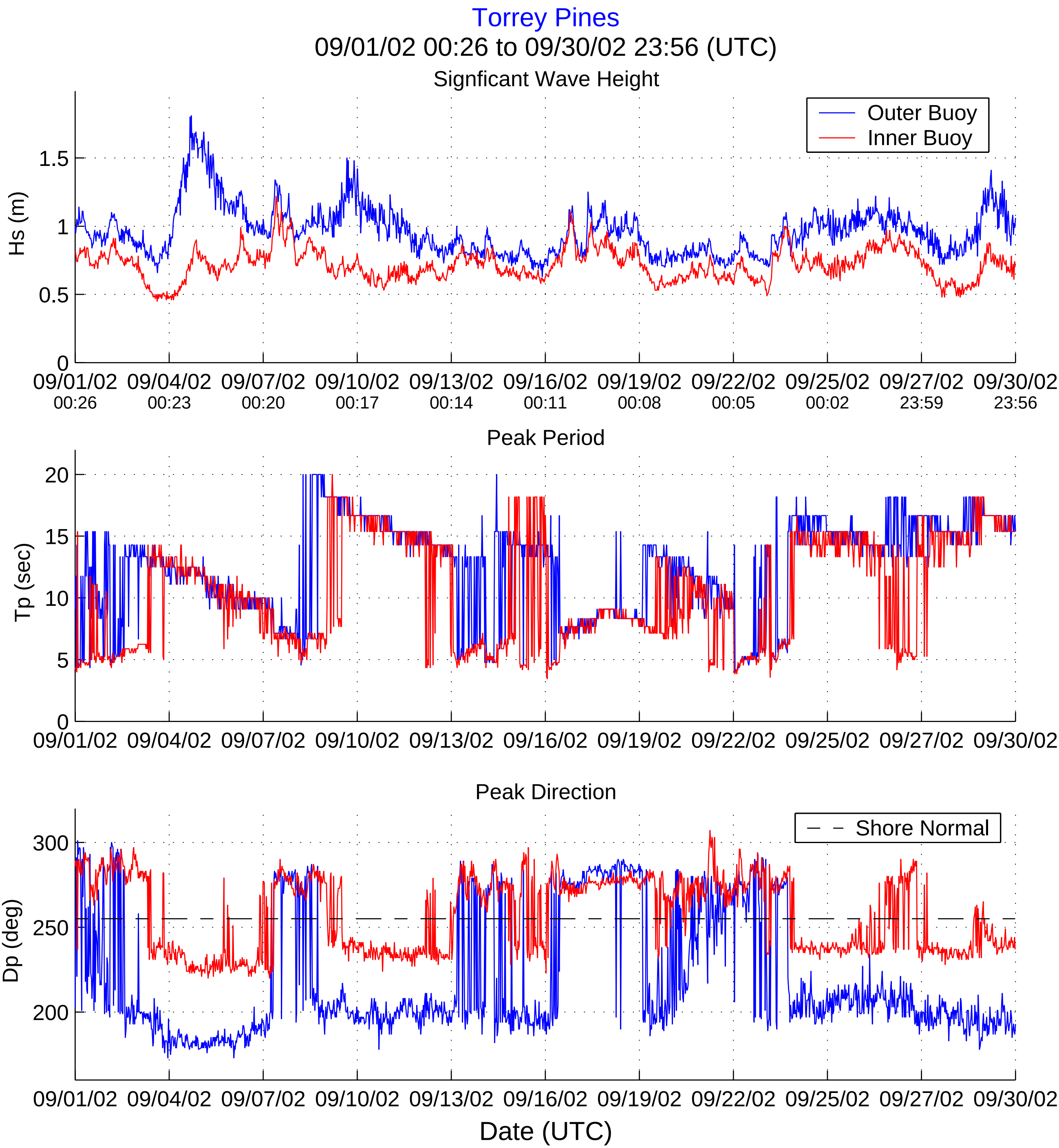


Figure 4a: September Wave Data for Torrey Pines Inner and Outer Buoys

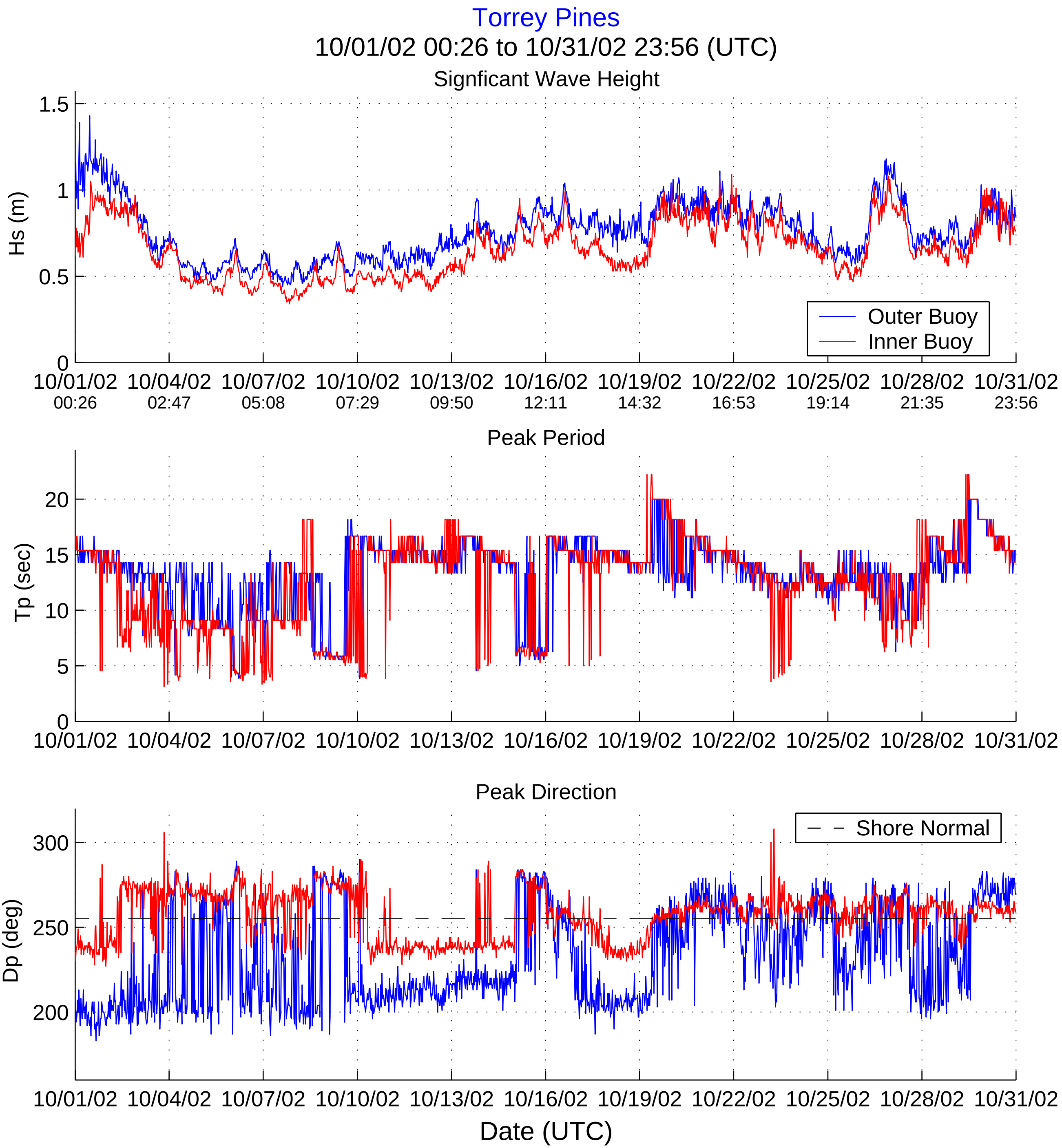


Figure 4b: October Wave Data for Torrey Pines Inner and Outer Buoys

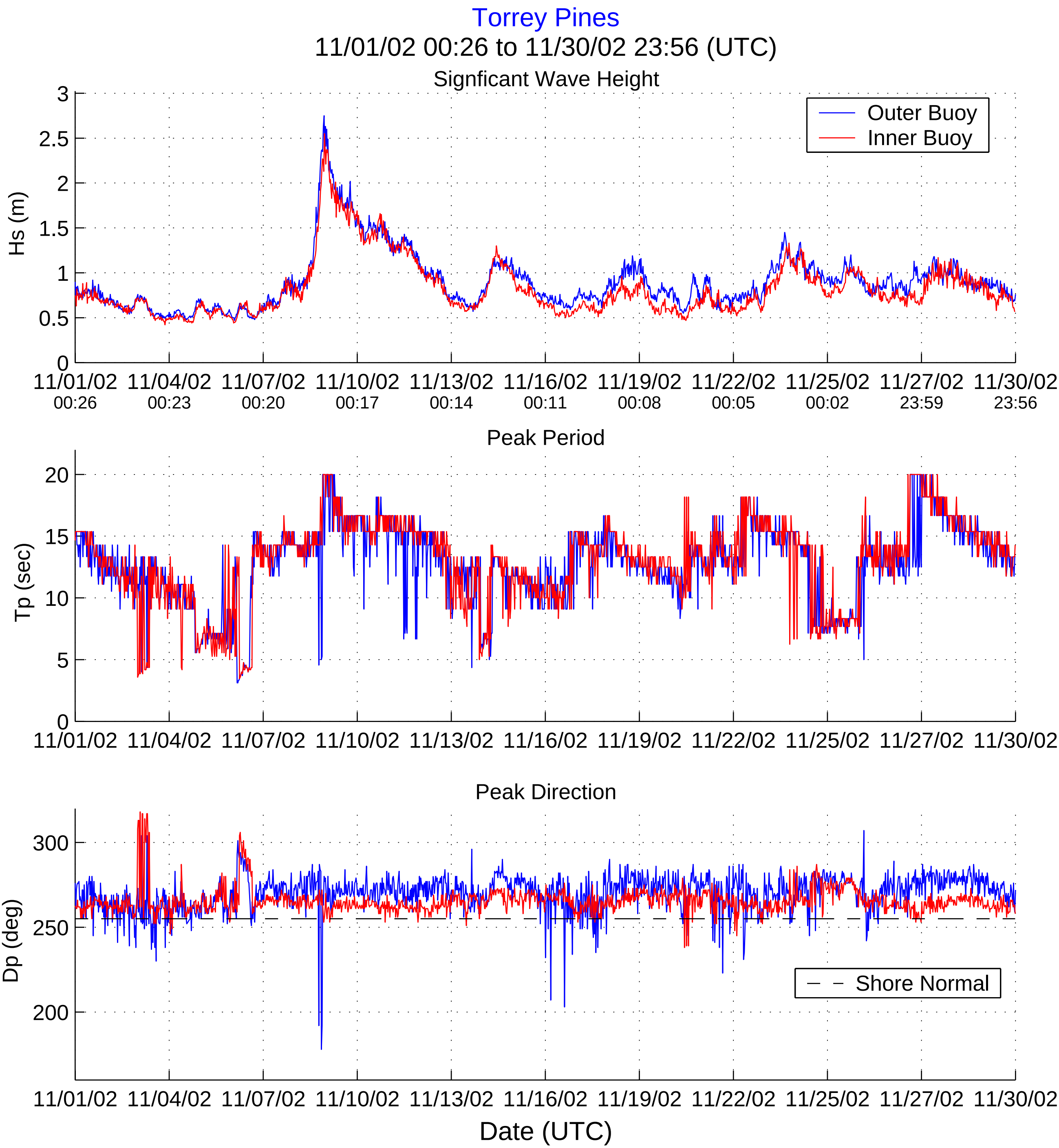


Figure 4c: November Wave Data for Torrey Pines Inner and Outer Buoys

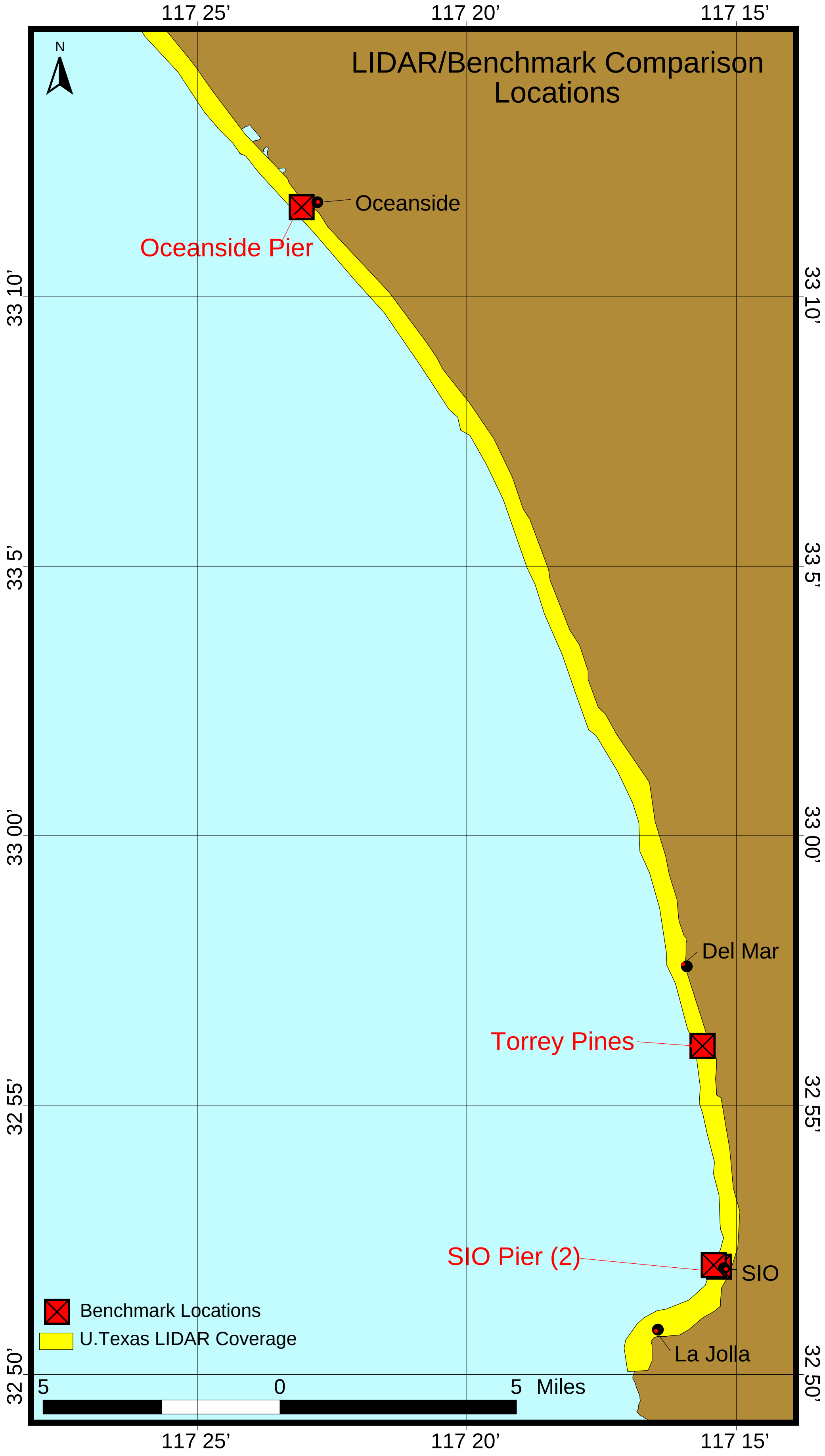
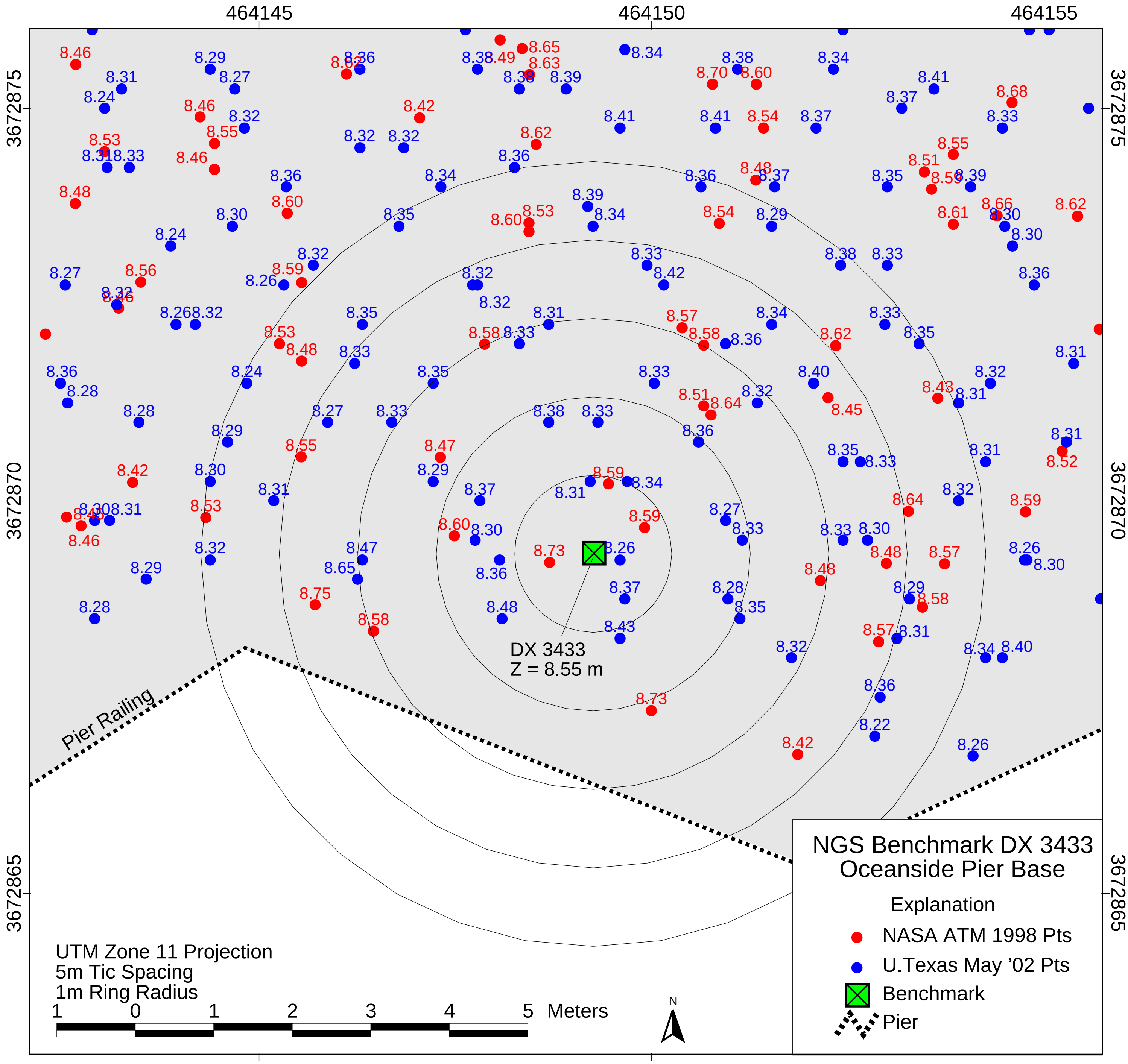


Figure 5a.
Locations of LIDAR/Benchmark comparisons.



U.Texas Statistics

Radius (m)	Mean (m)	N	StdDev (m)	Range (m)	Diff_Bench (LIDAR - Bench)
1	8.31	3	0.06	0.11	-0.24
2	8.34	15	0.06	0.22	-0.21
3	8.34	24	0.06	0.22	-0.21
4	8.35	39	0.07	0.39	-0.20
5	8.34	58	0.06	0.43	-0.21

NASA ATM Statistics

Radius (m)	Mean (m)	N	StdDev (m)	Range (m)	Diff_Bench (LIDAR - Bench)
1	8.64	3	0.08	0.14	+0.09
2	8.63	4	0.07	0.14	+0.08
3	8.59	10	0.09	0.26	+0.04
4	8.57	19	0.09	0.33	+0.02
5	8.56	30	0.08	0.33	+0.01

Figure 5b.
LIDAR comparisons using an established benchmark at the base of Oceanside Pier. The uncorrected (for bias) UT LIDAR is about 20 cm lower than the benchmark.

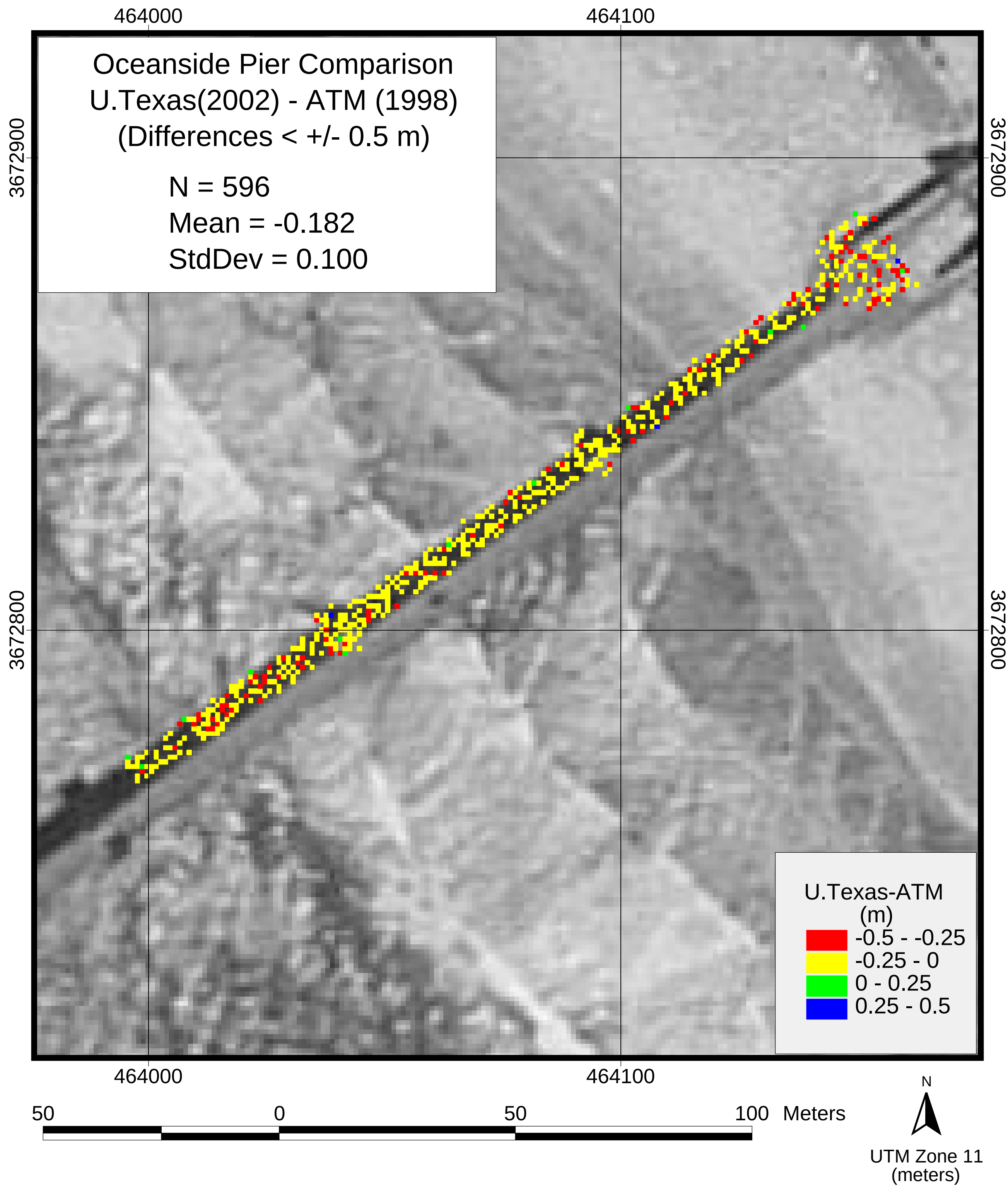


Figure 5c.

Difference of (uncorrected) U.Texas (2002) and NASA (1998) elevations of the Oceanside pier. Statistics are shown in upper-left. U.Texas elevations are on average 18 cm lower than NASA.