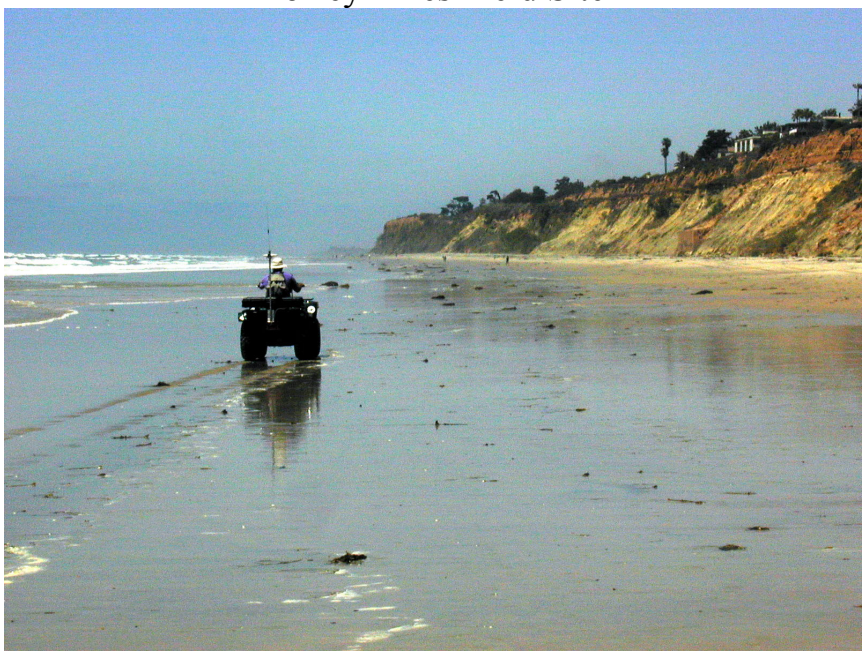
Southern California Beach Processes Study

Torrey Pines Field Site



5th Quarterly Report
31 May 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 (Figure 1b for nourishment location). 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. A description of the Torrey Pines Beach Nourishment Project may be accessed through the http://cdip.ucsd.edu/SCBPS/homepage.shtml website. In addition to a Project Overview and Field Operations section, examples of survey ranges and bathymetry are displayed. Following publication, the Quarterly Reports are included on this site.

SAND LEVEL SURVEYS:

Since the last quarterly report, three additional surveys of sand levels have been acquired that span the same region as in the first 22 surveys. 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. Tracks for each of these three surveys are shown in the (a) panels of Figures 1-3, and indicate the surveys had generally good spatial coverage including overlap between the high-tide jetski surveys and the low tide beach surveys. Occasionally, a few jetski transects are lost owing to poor satellite coverage, or overlap is lacking owing to rough wave conditions. Bathymetry for the entire surveyed region, and for the closely (20 m) spaced alongshore lines near the nourishment site, are shown in the (b) panels of Figures 1-3. Changes in sand level near the nourishment site, relative to the first post-nourishment survey (27 April 01), and relative to the preceding survey are shown in the (c) panels of Figures 1-3. Prior to the surveys described in this report, the beach face adjacent to the nourishment pile had eroded substantially in response to the November storm and continuing large winter waves in December through February. This trend continued through the next survey in late March (Figure 1c, right panel) with significant offshore movement at depths of about 3 m with accumulation at about the 4 m contour. This occurred in almost the entire surveyed region except where the sand dredged from

the lagoon was deposited on the beach in the previous quarter. At this location the seaward movement occurred dominantly from the beach face. During April (Figure 2) the trend reversed and onshore movement dominated. The offshore bar was narrowed and sand began to move onto the beach face, particularly in the location of the original nourishment. The ebb tide shoal off the lagoon mouth steepened and moved shoreward. By the May survey (Figure 3) there was accretion on the beach throughout the region. The ebb shoal at the lagoon moved closer to shore. About 0.5 m of accretion was measured on much of the original nourishment location. It is interesting to note that the accretion at this site exceeded that on the unnourished beaches to the north or south by a factor of about two.

WAVE MEASUREMENTS AND MODELING:

Wave data was collected continuously during the last quarter at the Torrey Pines Outer Buoy site (550 m depth) and the Torrey Pines Inner Buoy site (20 m). Wave parameters from the two buoys are shown in Figures 4a-c. March-May are transitional months for the California wave climate as weather systems in the North Pacific are less active and Southern Ocean weather systems become more energetic. The distant Southern Ocean storms result in smaller, long period south swell arrivals at Torrey Pines that enhance the shoreward and northward transport of sediment. Interestingly, the wave conditions during the month of May 2002 were significantly different from May 2001, at the beginning of the Torrey Pines study. May 2001 was a relatively benign "beach building" month, with one North Pacific swell event (Hs = 1.5 m) at the beginning of the month, followed by numerous smaller south swell events. In contrast, the North Pacific was very active in May 2002 with four north swells exceeding 1.5 m in height at Torrey Pines. As a result, the summer migration of the offshore sand bar towards the beach may be delayed in 2002 compared to 2001.

BEACH RESPONSE MODELING:

The modeling efforts initiated last quarter under Mellon Foundation funding have concentrated on attempting to reproduce the significant erosion observed during the storm in late November 2001. This work, involving collaboration with scientists at the Naval Postgraduate School (Monterey, California) and Delft University (Netherlands), uses a version of DELFT3D (a numerical model widely used in Europe). Initial efforts have shown promise in modeling the response of the nourished section of Torrey Pines Beach to the storm, as illustrated in Figure 5.

SAND FINGERS:

The unusual rhythmic erosion patterns from the November 2001 storm described in the

last quarterly report, and still evident in the February survey, had essentially disappeared by the survey at the end of March. Figures 6a and 6b contrast the appearance of the back beach between November 2001 and May 2002.

FEDERALLY FUNDED REGIONAL STUDY:

Beginning in early May, the Army Corps of Engineers initiated the funding of a significant addition to the SCBPS program. Assuming funding can be continued, this is planned as a five year program. This research involves data gathering within a 90 km region extending from Point La Jolla in the south to Dana Point in the north. Because the Torrey Pines project falls within this region, strong synergy between the two projects is anticipated. The federal program emphasizes the development and evaluation of remote sensing techniques suitable for regional management of shoreline protection. During mid-May the first of four seasonal surveys of the region were made using LIDAR (airborne laser altimetry.) Concurrently, airborne video coverage was obtained. Although the video has lower resolution than the LIDAR and does not measure elevations, it is considerably less expensive and can respond rapidly after major storms. Intercomparisons between the two techniques will allow the assessment of the usefulness of the video as an adjunct to the LIDAR. Originally, it was planned to conduct an offshore survey using the SHOALS system (a water-penetrating laser altimeter that provides bathymetric data) during this same period. However, weather conditions in Alaska have delayed the SHOALS team and this operation will be put off until the 6th quarter. The Torrey Pines site was surveyed at the same time as the LIDAR and video overflights and is available as ground truth to determine the accuracy and resolution of the airborne techniques.

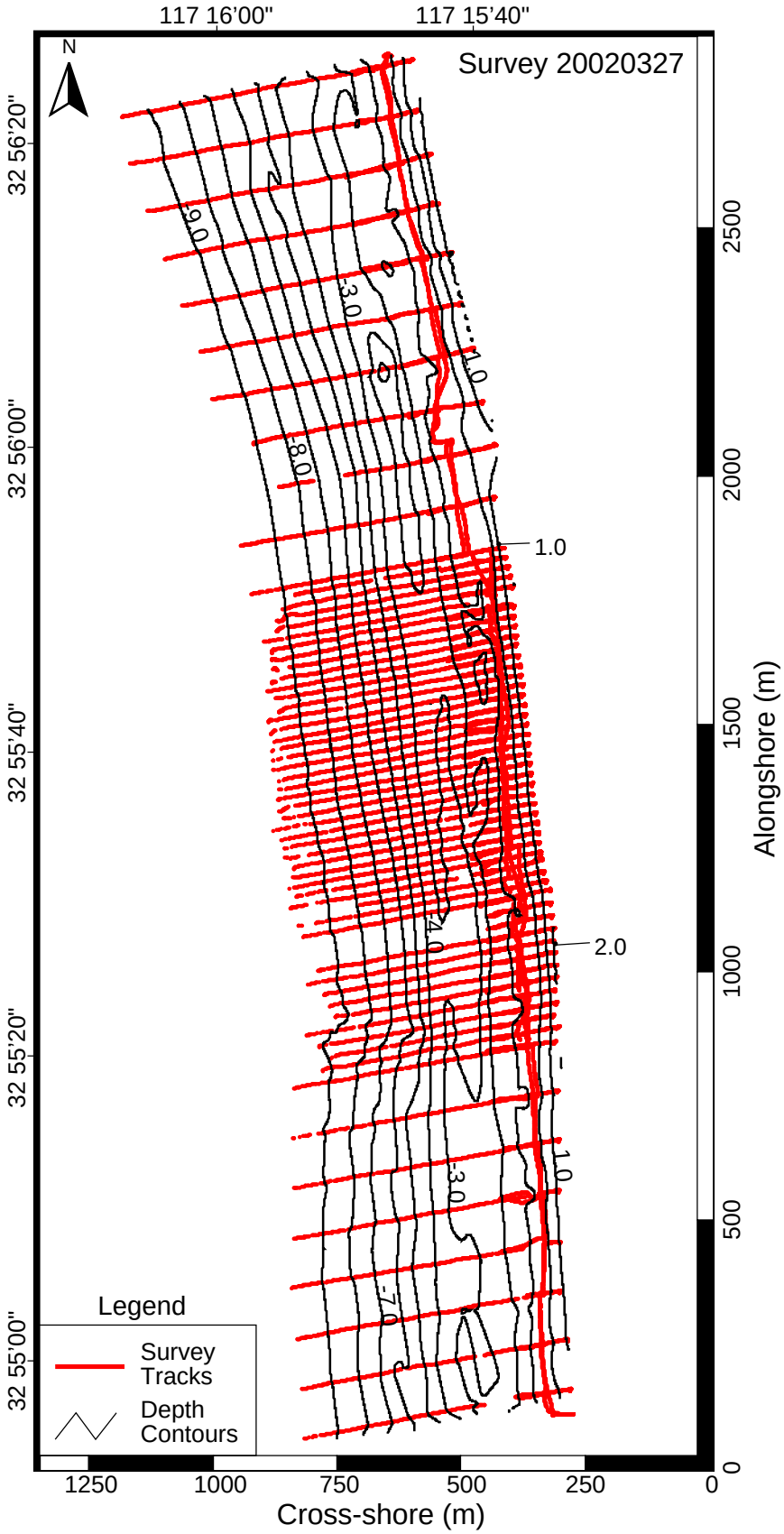


FIGURE 1a.
Survey starting 27 March 02. Red lines are survey tracks. Black lines are depth contours in meters (relative to mean sea level).

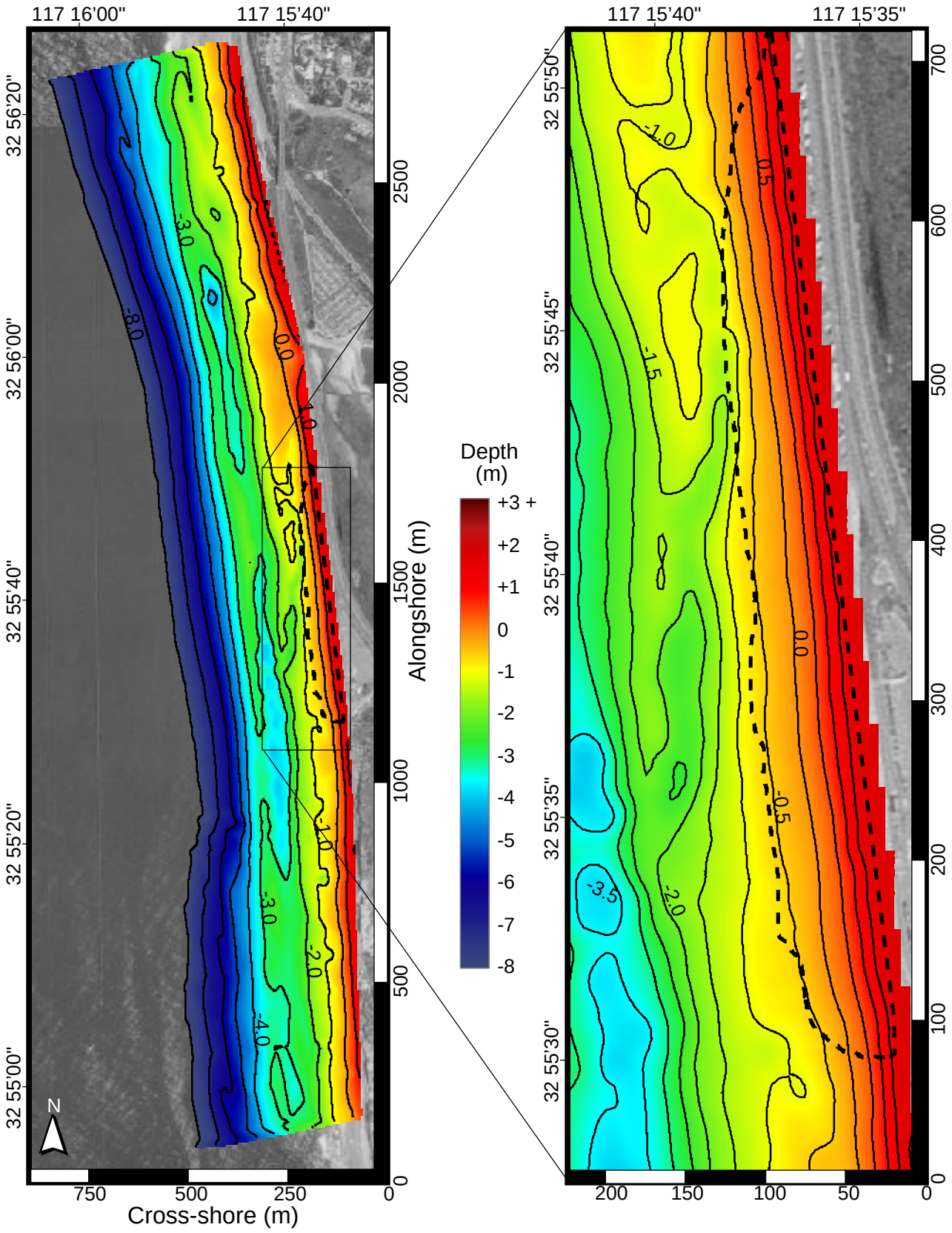


FIGURE 1b.
Left: Bathymetry measured 27 March 02 in a 3-km long strip centered on the initially nourished region (bounded by the black dashed line). The contour interval is 1.0 meters.
Right: Nourishment zone enlarged. The contour interval is 0.5 meters.

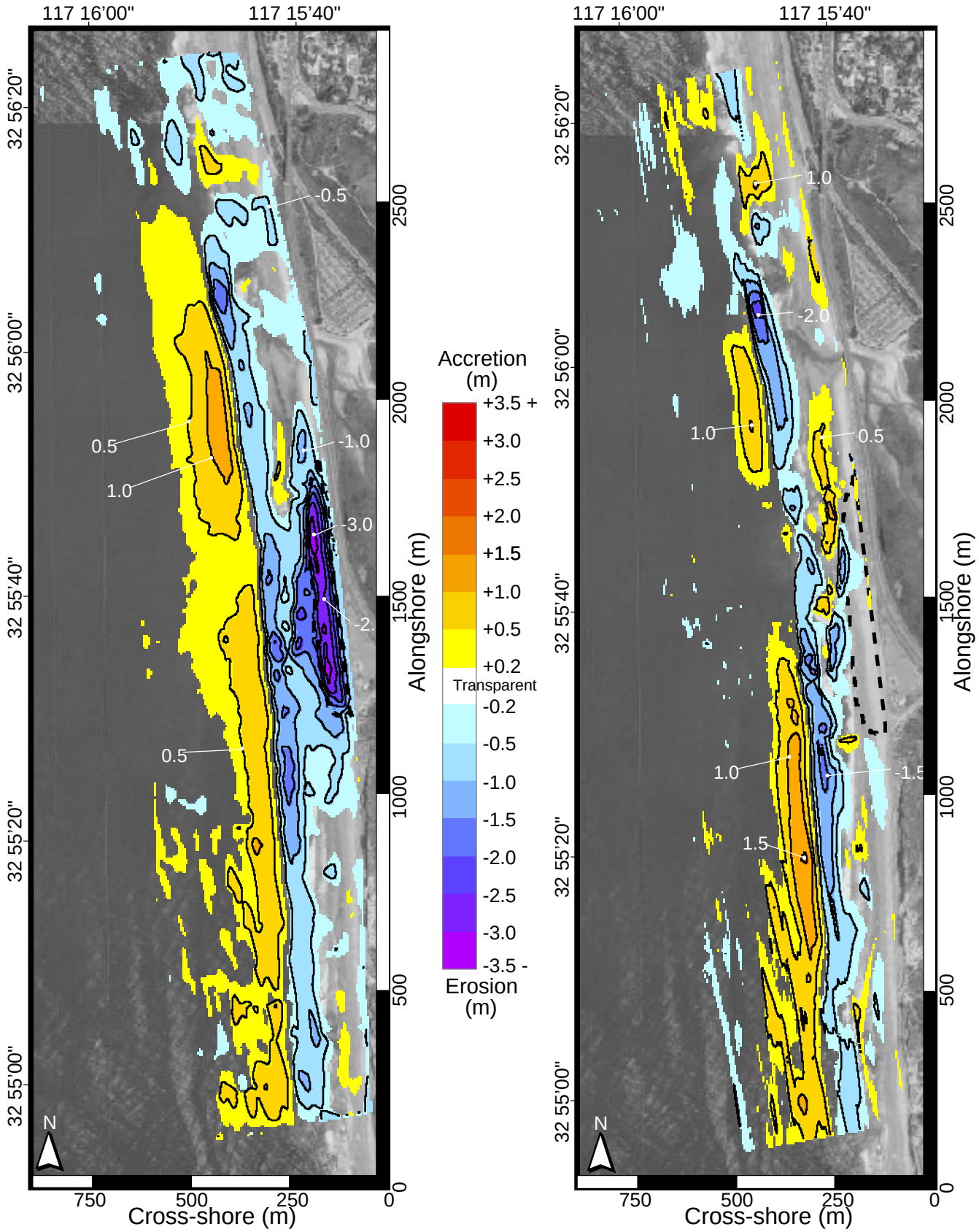


FIGURE 1c.
Left: Changes in sand level on 27 March 02 relative to 27 April 01 (the first post-nourishment survey). The contour interval is 0.5 meters (ignoring changes less than +/- 0.2 meters).
Right: Changes in sand level on 27 March 02 relative to 28 February 02 (the previous survey).

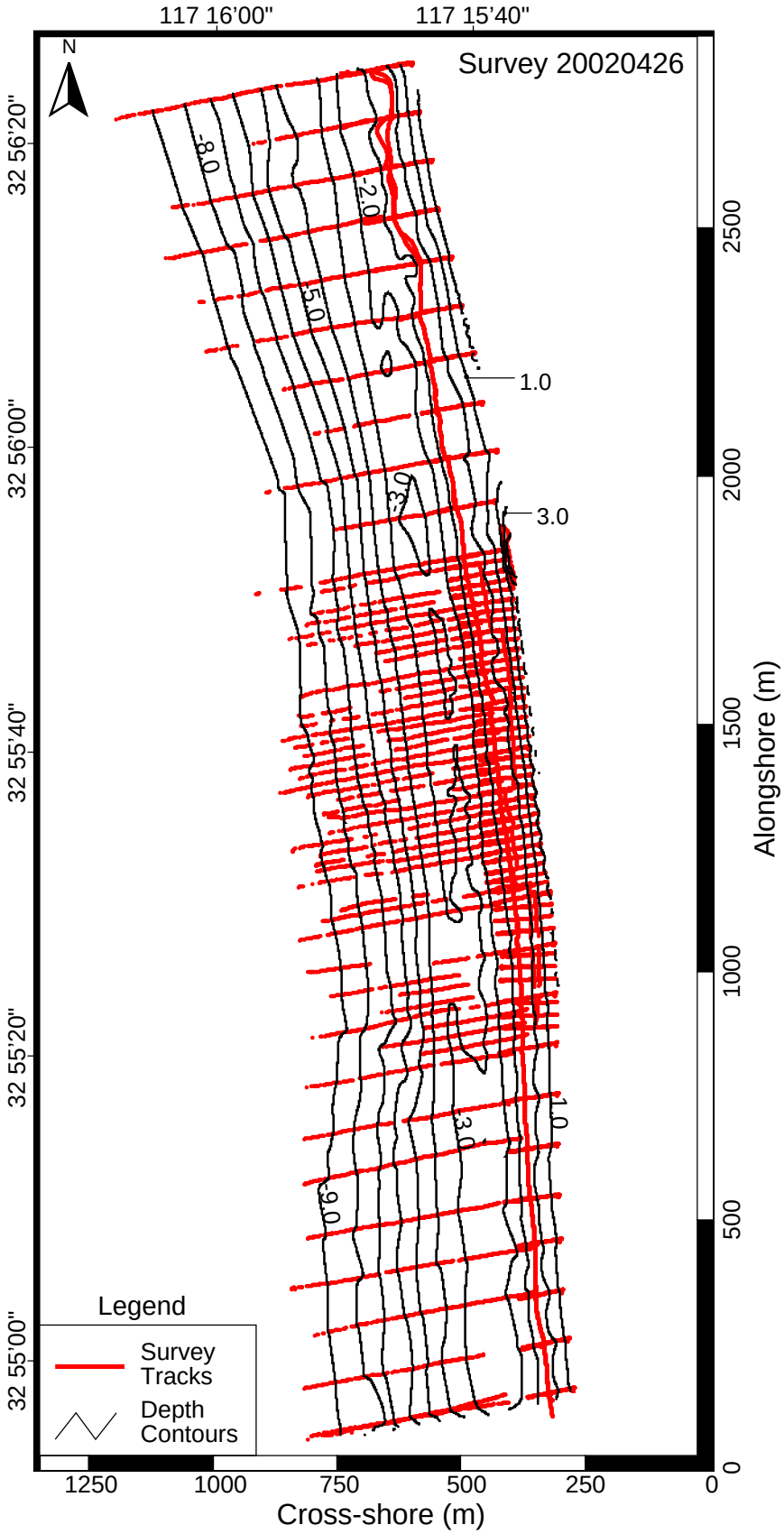
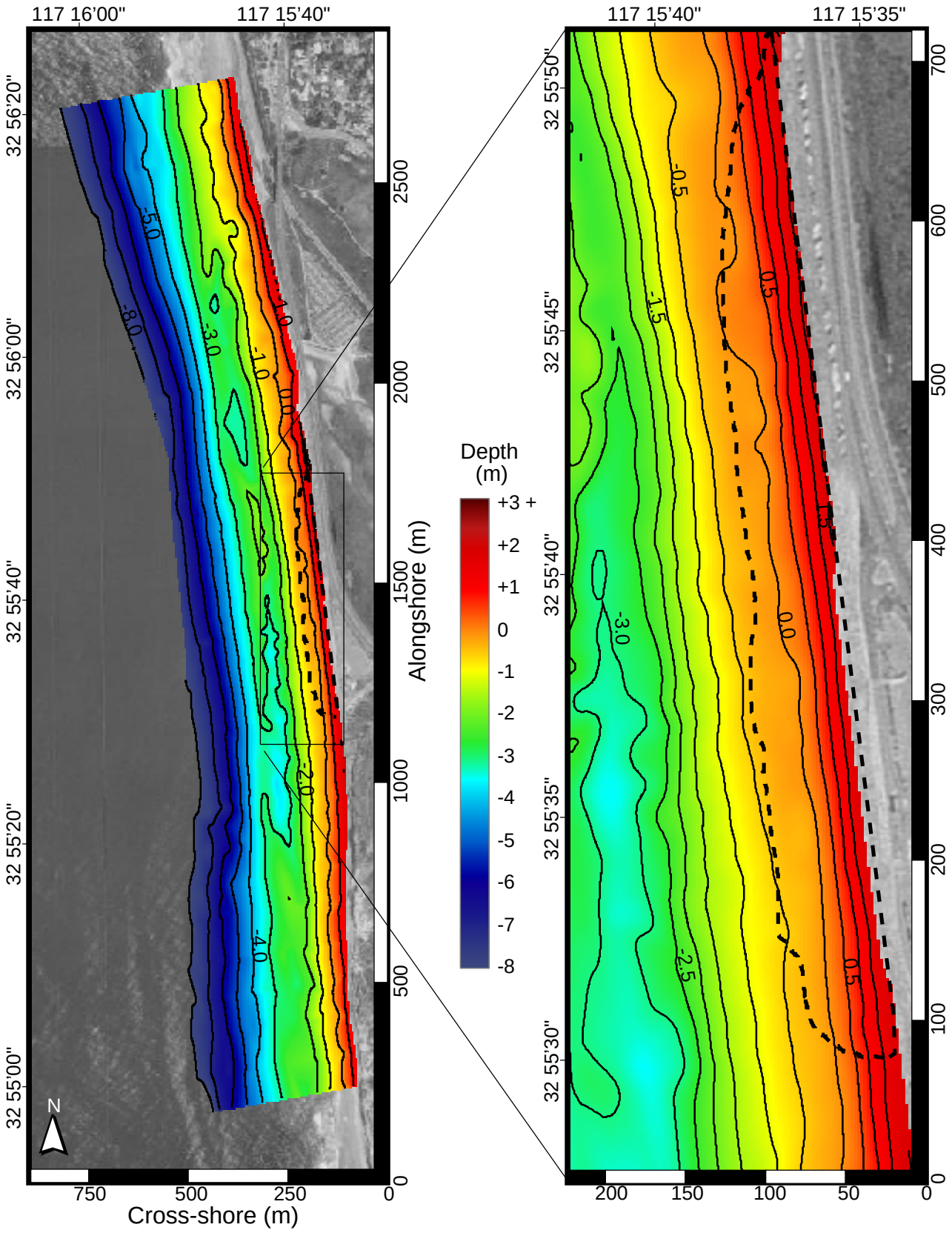


FIGURE 2a.
Survey starting 26 April 02. Red lines are survey tracks. Black lines are depth contours in meters (relative to mean sea level).



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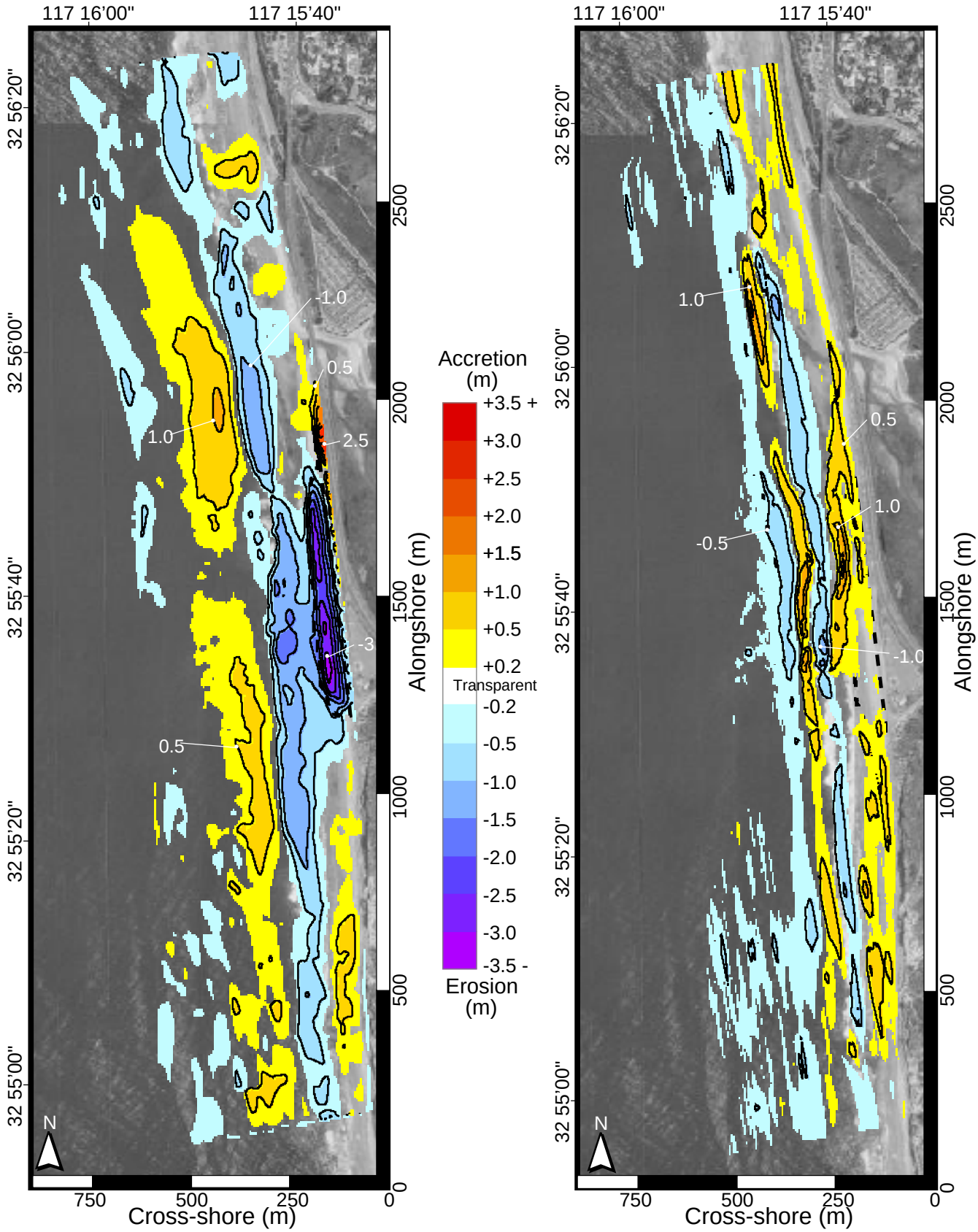

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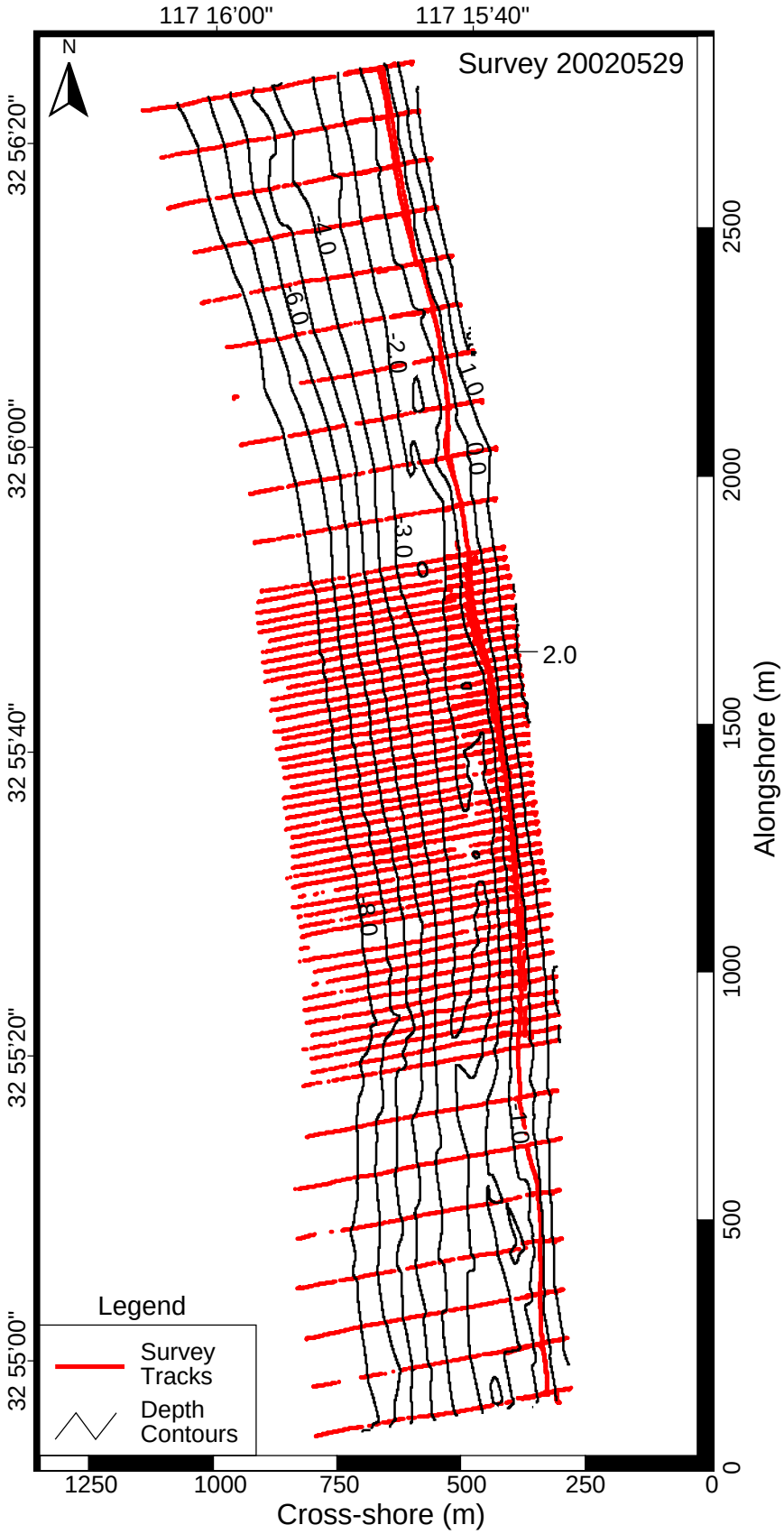

FIGURE 3a.
Survey starting 29 May 02. Red lines are survey tracks. Black lines are depth contours in meters (relative to mean sea level).

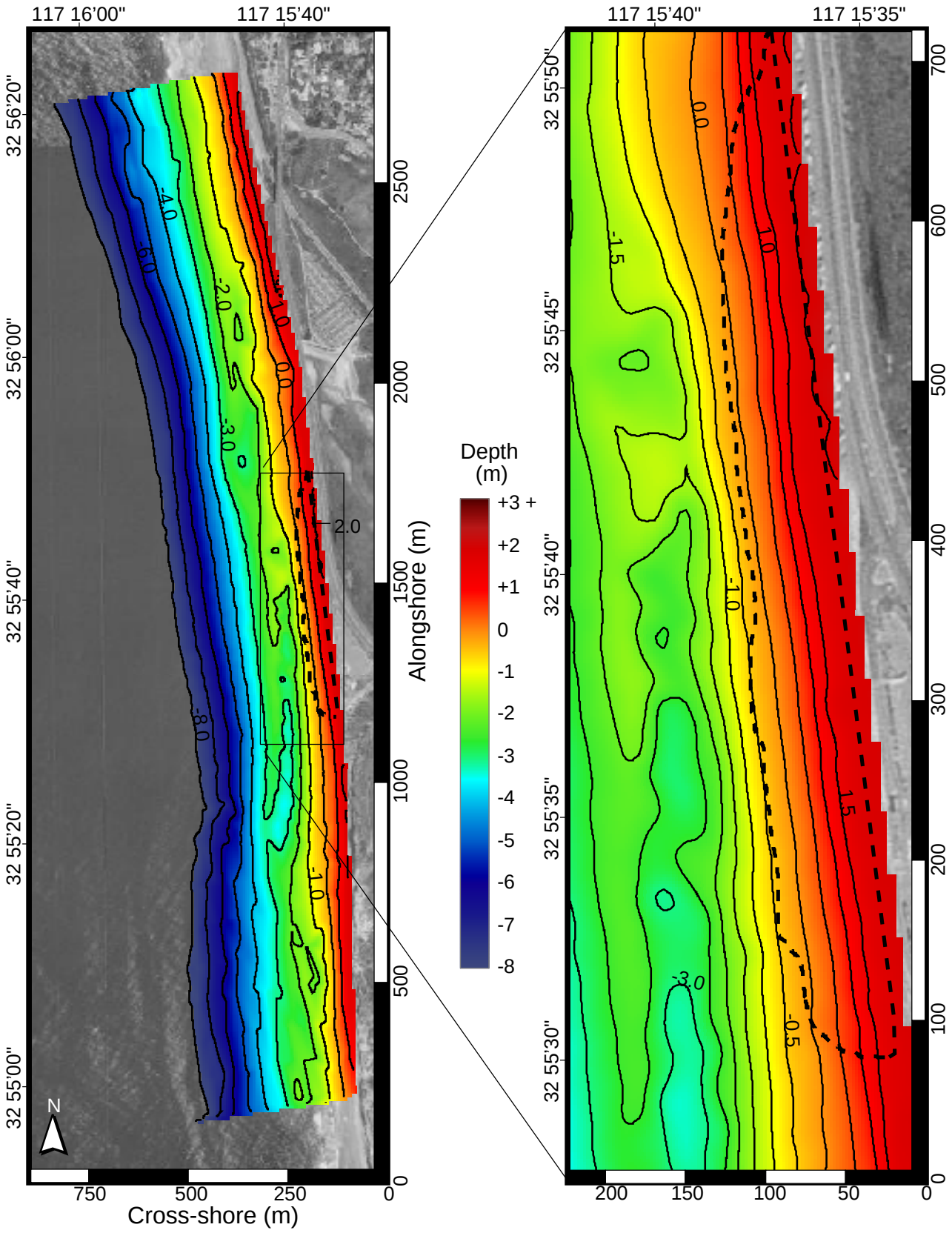

FIGURE 3b.
Left: Bathymetry measured 29 May 02 in a 3-km long strip centered on the initially nourished region (bounded by the black dashed line). The contour interval is 1.0 meters.
Right: Nourishment zone enlarged. The contour interval is 0.5 meters.

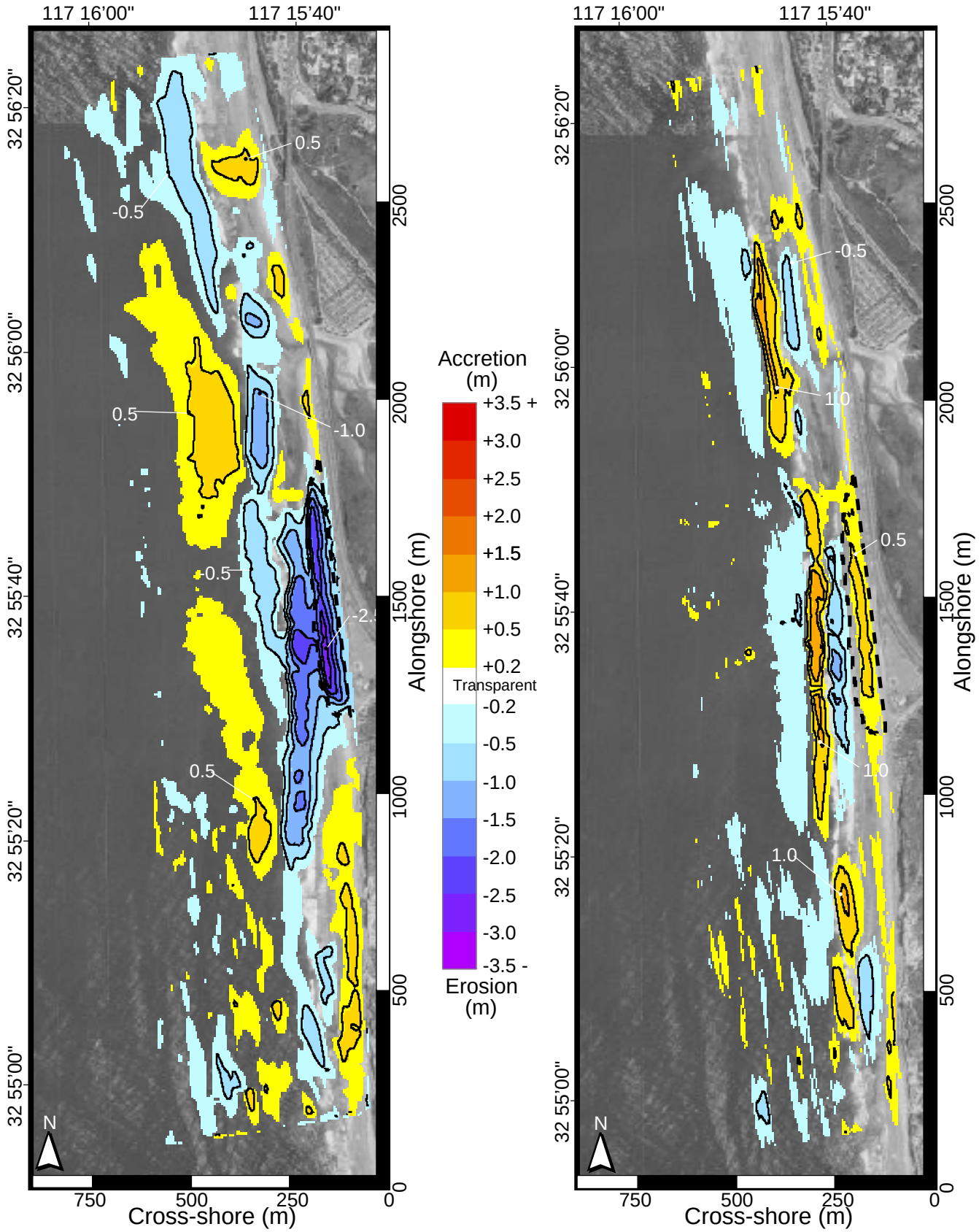

FIGURE 3c.
Left: Changes in sand level on 29 May 02 relative to 27 April 01 (the first post-nourishment survey). The contour interval is 0.5 meters (ignoring changes less than +/- 0.2 meters).
Right: Changes in sand level on 29 May 02 relative to 26 April 02 (the previous survey).

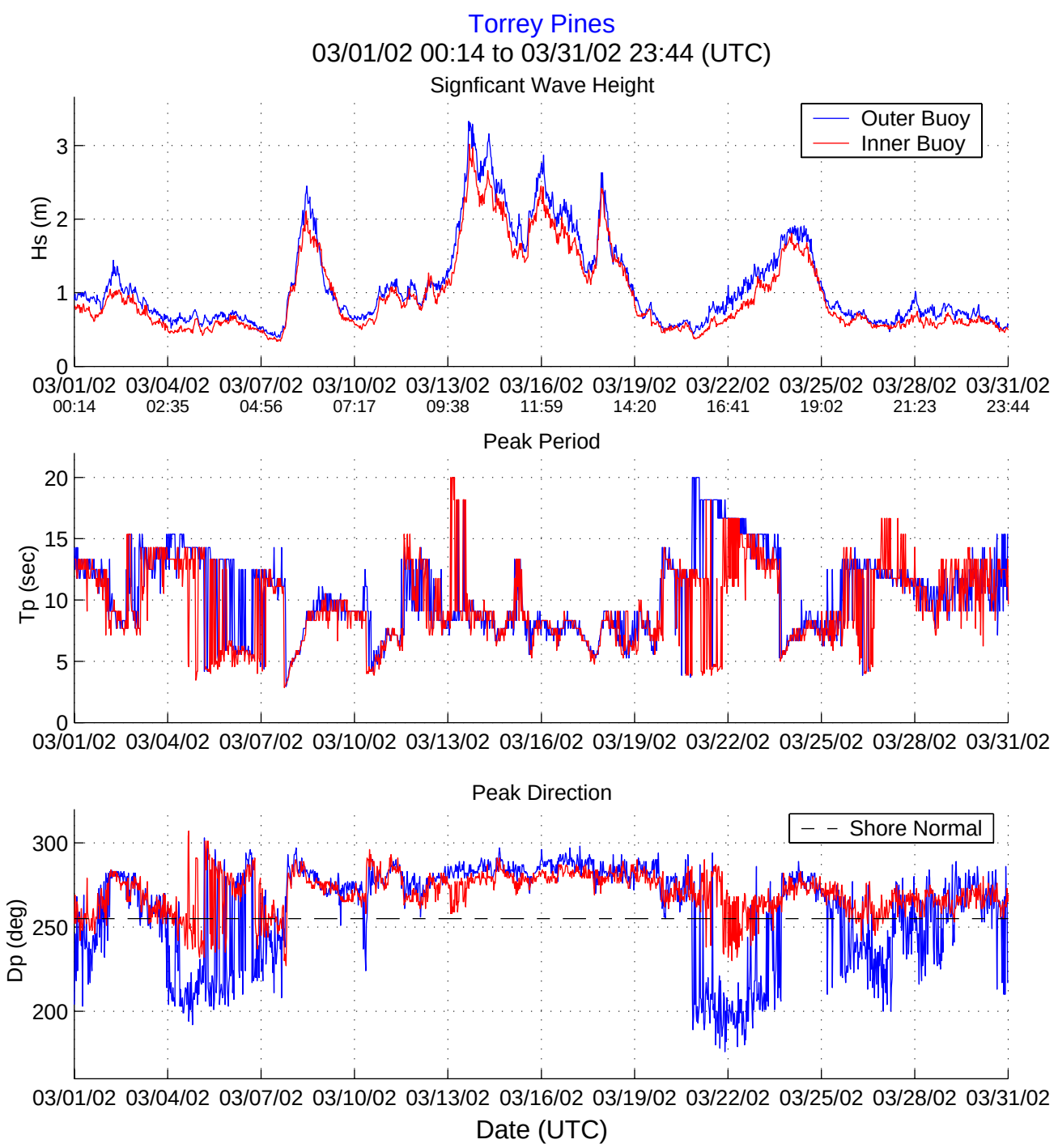

Figure 4a: March Wave Data for Torrey Pines Inner and Outer Buoys

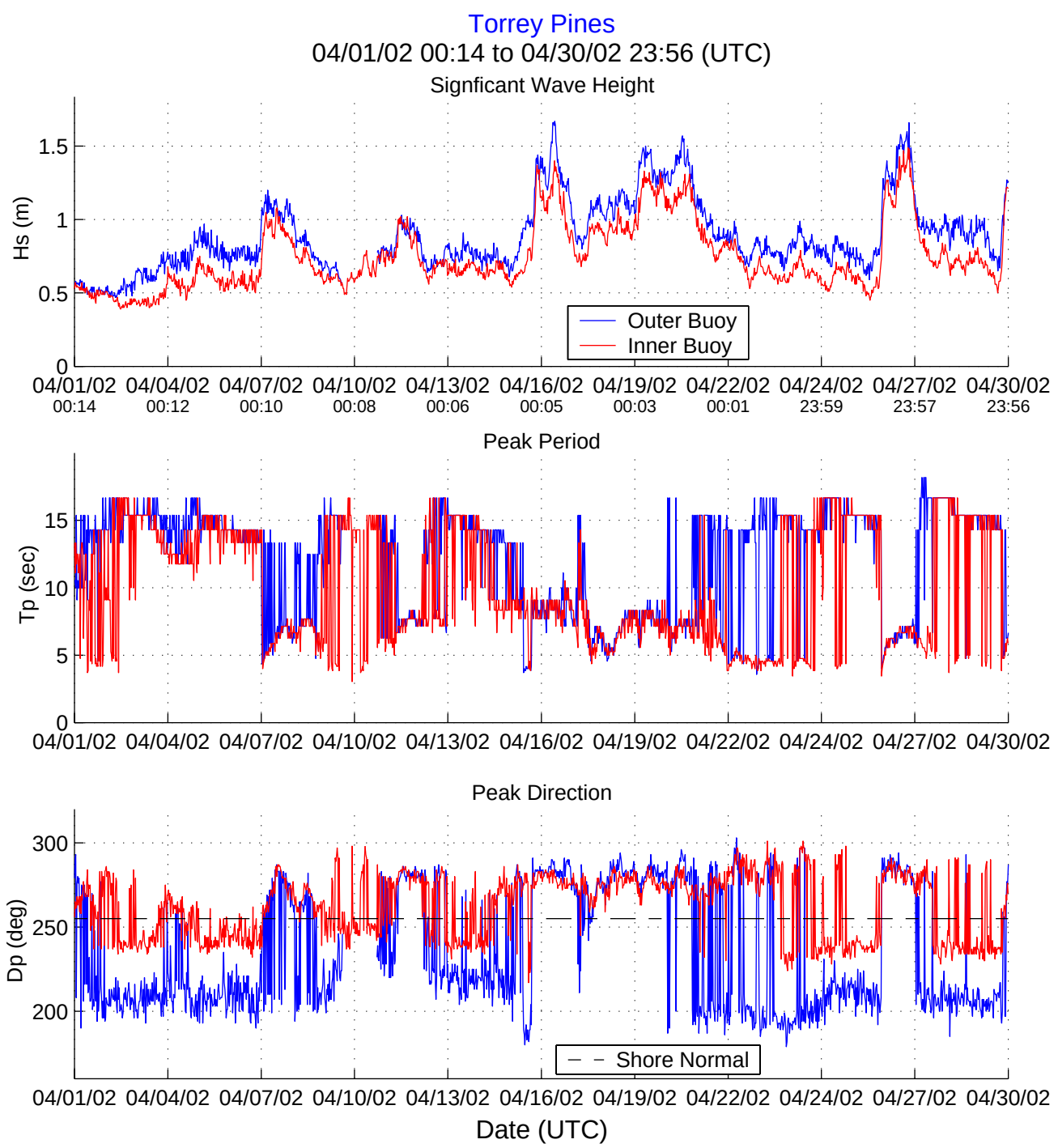

Figure 4b: April Wave Data for Torrey Pines Inner and Outer Buoys

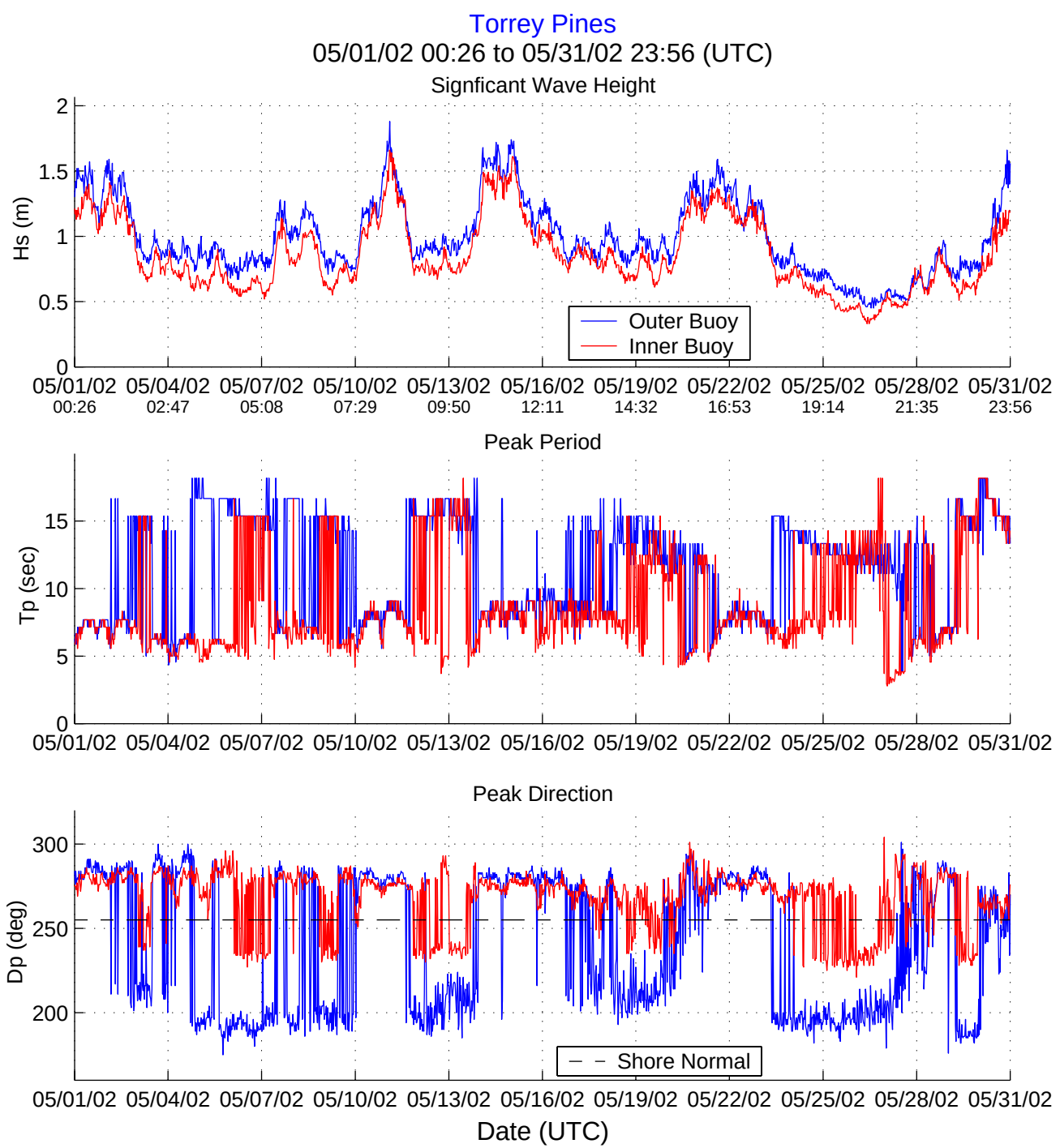

Figure 4c: May Wave Data for Torrey Pines Inner and Outer Buoys

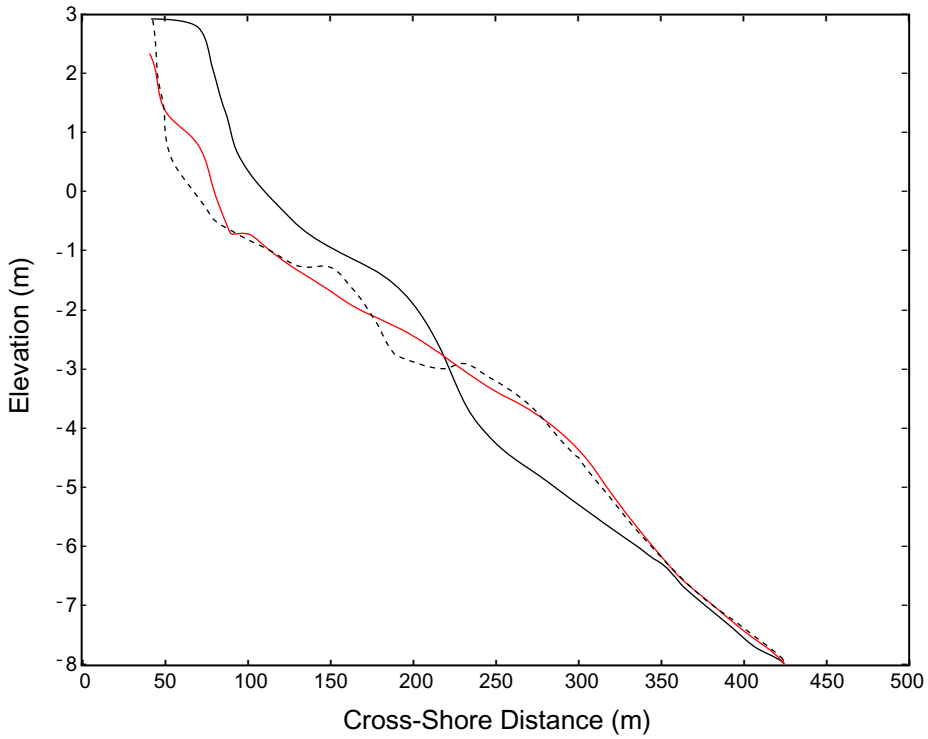

Figure 5. Changes to a cross-shore depth profile near the center of the nourishment site. The solid black curve is the observed pre-storm profile, the red curve is the observed post-storm profile and the dotted black curve is the model prediction.

(a) (b)

Figure 6. Sand fingers following November 2001 storm (a) and smooth back beach in May 2002 (b).