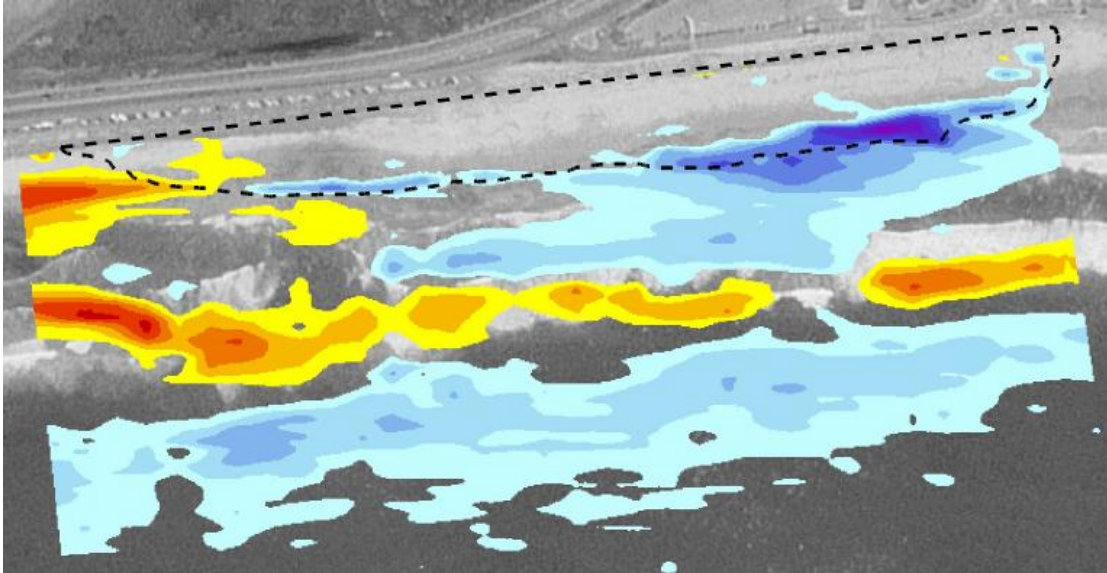


# Southern California Beach Processes Study

*Torrey Pines Field Site*



**2nd Quarterly Report  
31 August 2001**

*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 250,000 cubic m of sand. The material was deposited on the beach above the low tide level and over a 500 m alongshore span. The Torrey Pines Beach Nourishment Project is described on the website <http://cdip.ucsd.edu/SCBPS/index.shtml>. Thus far, the site includes a Project Overview and a description of Field Operations. The analyzed data will be posted in the future.

## **SAND LEVEL SURVEYS:**

Since the last quarterly report, 5 additional surveys of sand levels have been acquired at approximately 2 week intervals. The region surveyed is the same as in first 5 surveys. Cross-shore survey transects extend from the base of the Torrey Pines cliffs or Highway 101 onshore to about the 8 meter depth contour offshore. The alongshore spacing between cross-shore survey lines is 20 meters for a 700 meter-long stretch of beach centered on the originally nourished site, and 100 meters for additional 1 km-long stretches of beach up and down coast of the original nourishment. Tracks for each survey are shown in the (a) panels of Figures 1-5, and indicate the surveys had generally good spatial coverage including overlap between the high-tide jetski surveys and the low tide beach-dolly surveys. Occasionally, a few jetski transects are lost owing to poor satellite coverage (e.g. the missing tracks in Figure 4a).

Bathymetry measured with the closely (20 m) spaced alongshore lines near the nourishment site are shown in the (b) panels of Figures 1-5. The unusual alongshore irregularities in the -1.0 and -0.5 m depth contours on 17 July 01 (Figure 4b) are real features, not survey errors or contouring artifacts. The origin of these relatively short-lived features (they were observed in only this survey) is unknown.

Changes in sand level near the nourishment site, relative to the first post-nourishment survey (27 April 01), are shown in the (c) panels. Persistent patterns of change are seen in all surveys and increase over time. By 1 August 01, the last survey included in this report, erosion of up to 1.6 m had occurred on the seaward face of the nourishment pile (deep blue band overlaying the black dashed line), and accretion of up to 1.0 m (dark reds) was measured directly to the north and adjacent to the nourishment pile. Erosion of roughly 50 cm (possibly associated with the seasonal onshore migration of a sand bar) was observed further offshore in about 2.0 m mean depth.

Bathymetry for the entire 2.7-km long reach of surveyed beach is shown in Figure 6a, and changes in sand level relative to the first post-nourishment survey (27 April 01) are shown in Figure 6b. Note that significant (greater than 1 m) accretion of the most shoreward portion of the beach occurs over the entire 2.7 km reach, not only in the immediate vicinity of the nourishment. Similarly, the (light blue) band of erosion in about 2 m depth extends over the entire reach. Thus, there are large changes to the beach profile associated with normal, seasonal processes as well as with distribution of the nourishment sand.

## **WAVE MEASUREMENTS AND MODELING:**

Continuous wave data was collected during the last quarter at the Torrey Pines Outer Buoy site (550m depth), the Torrey Pines Buoy Inner site (20m), and outside the surf zone of the nourishment site (7.5m). Wave parameters from the two buoys are shown in Figures 7a-c. The data at the 7.5m site is being collected by a self-contained pressure gage (non-directional) and is not yet available for analysis.

In addition, directional wave data was collected at the 7.5m site from July 10-16 using a Nortek AquaDopp acoustic wave and current sensor. Wave height and peak period parameters from this instrument are shown in Figure 7b (black line). Problems were encountered when analyzing the directional data from the sensor, but we believe this is a software rather than a hardware (non-recoverable) problem and are discussing a fix with the manufacturer.

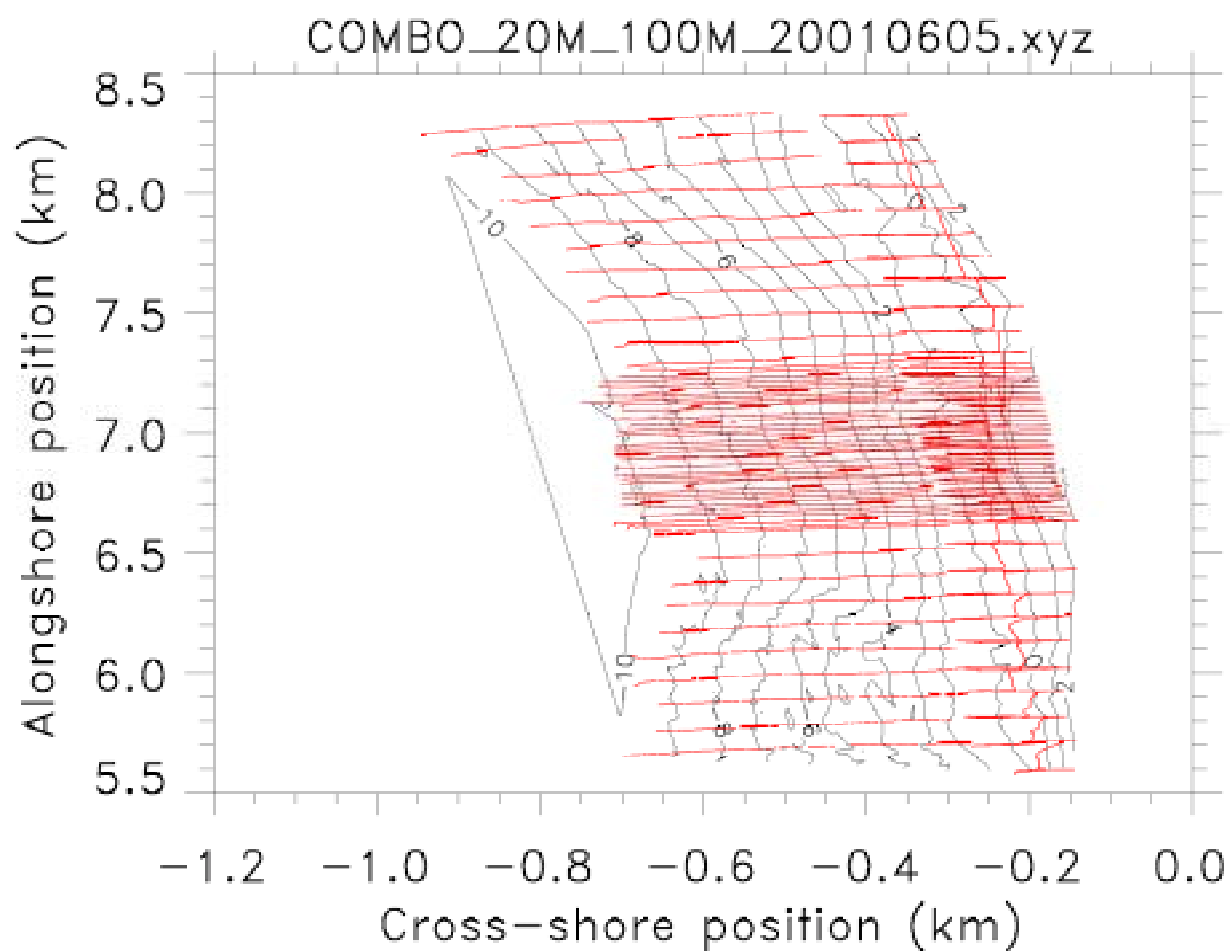
The measured wave parameters from the Torrey Pines Inner Buoy (red lines, Figures 7a-c) show that the local wave climate in June-August 2001 was an interesting mix of long period south swell (driving northward sediment transport) and short period W-WNW seas (driving southward transport). An approximate beach normal for the nourishment area is shown on the wave directional plots (bottom panels, Figures 7a-c) for reference. The WNW local seas signal seems to be the dominant one at the inner site over the 3 month period, suggesting net southward wave-driven transport, but a more detailed estimate of the along shore radiation stress ( $S_{xy}$ ) at 7.5m depth will be performed in the coming quarter.

The summertime-southward transport scenario runs counter to the normal rule of thumb that summer = south swell dominated conditions = northward transport. However, the Torrey Pines coastline is somewhat unusual for the San Diego region because it is sheltered from south waves by Pt. La Jolla. Note the decrease in wave height between the exposed Outer (blue lines, Figures 7a-c) and the sheltered inner buoy when the peak period is large and wave direction is from the south. As a result, the seasonal local seas from the WNW play a more significant role at the nourishment site and, conversely, pre-frontal wind seas from the south in the winter likely play a reduced role. Regional wave prediction models suggest that the sheltering effect of Pt. La Jolla is greatly diminished north of Del Mar.

## **BEACH RESPONSE MODELING:**

A copy of the Corps of Engineers NEMOS modeling software, which includes the GENESIS and SBEACH software suites, was purchased and installed on a Windows computer. The initial (post nourishment) contours have been entered in the GENESIS model and MATLAB routines have been written to characterize the measured waves at the Torrey Pines Inner Buoy in the singular wave format demanded by this software. These routines also provide for determination of water depth at each wave measuring interval. The GENESIS model will be exercised as a test during the following quarter.

Dr. Seymour attended the Coastal Dynamics '01 in Lund, Sweden in June. Many of the papers were concerned with pertinent modeling progress and discussions were held with modelers from a number of countries. Following that conference, Dr. Seymour visited the Danish Hydraulic Institute and Delft Hydraulics. Preliminary discussions were held which may lead to the testing of their models against this data set.



**FIGURE 1a** : Survey starting 5 June 01. Straight lines are survey tracks and wiggly lines are depth contours in meters (relative to mean sea level).

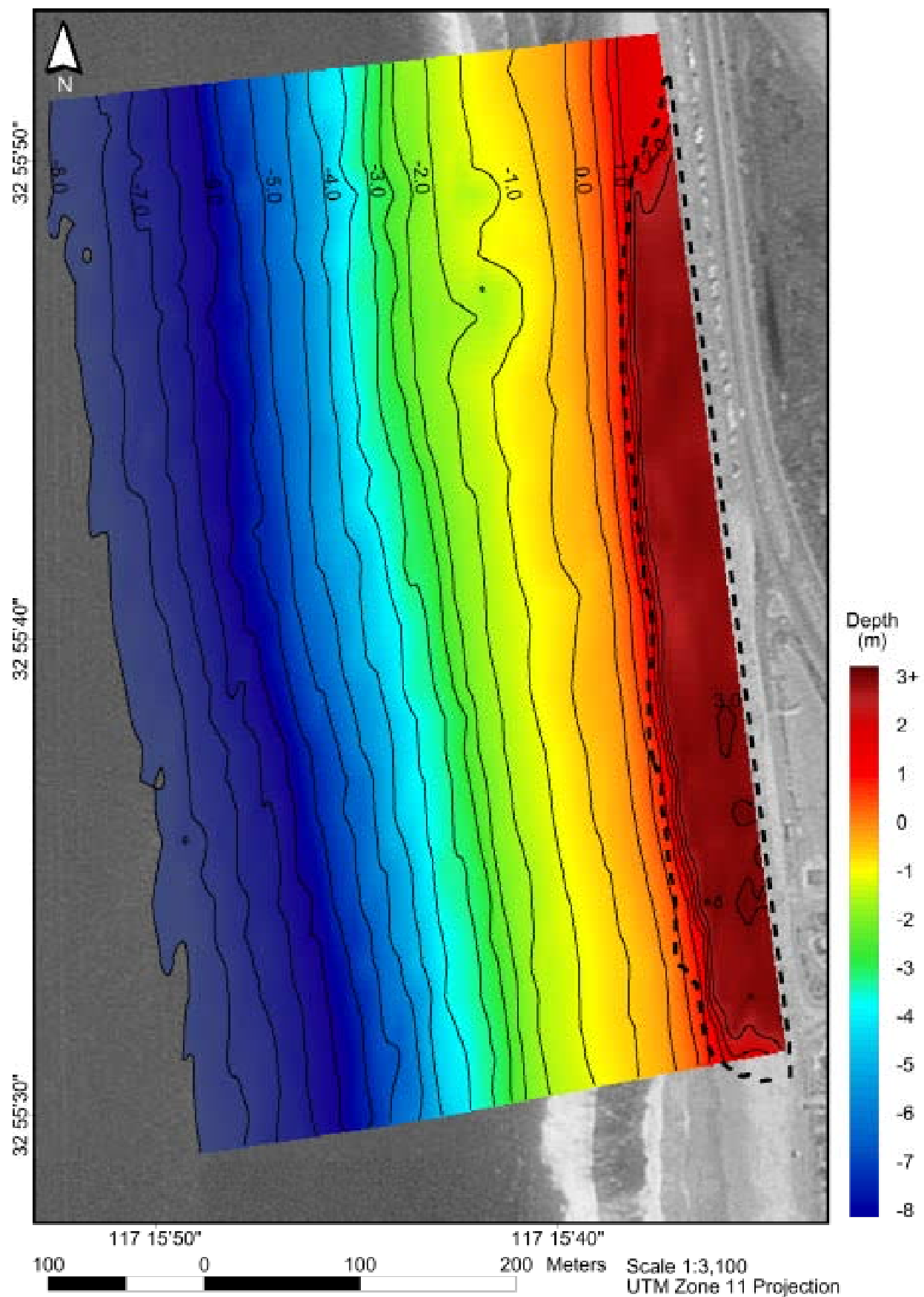


FIGURE 1b: Bathymetry measured 05 June 01 near the nourishment site. The depth contour interval is 0.5 m. The black dashed line, the 1.5 m elevation contour on 27 April 01 (the first post-nourishment survey), bounds the initially nourished region.

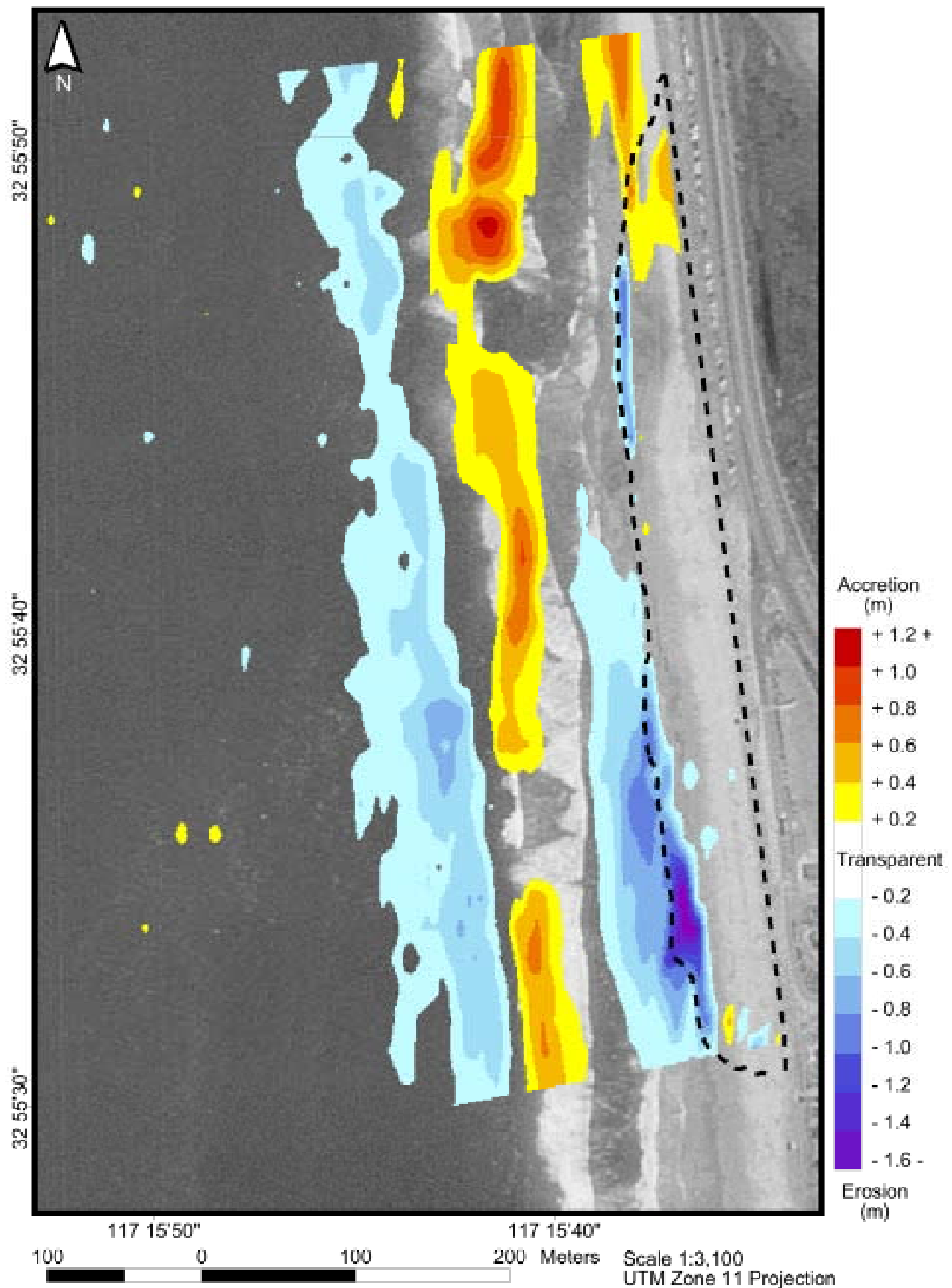
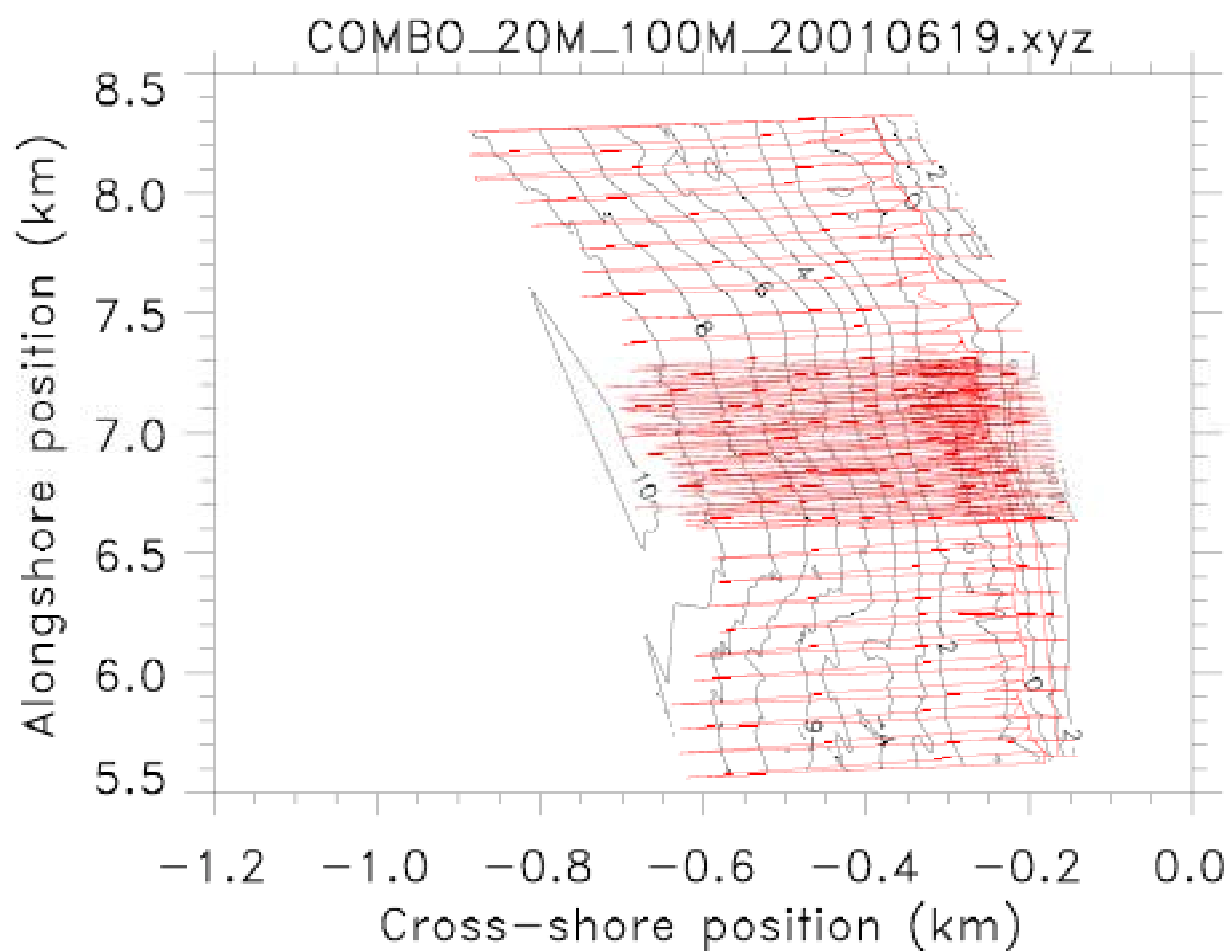


FIGURE 1c: Changes in sand level on 05 June 01 relative to 27 April 01 (the first post-nourishment survey). The black dashed line bounds the initially nourished region. Reds indicate accretion and blues indicate erosion (elevation changes less than +/- 0.2 m are ignored).



**FIGURE 2a :** Survey starting 19 June 01. Straight lines are survey tracks and wiggly lines are depth contours in meters (relative to mean sea level).

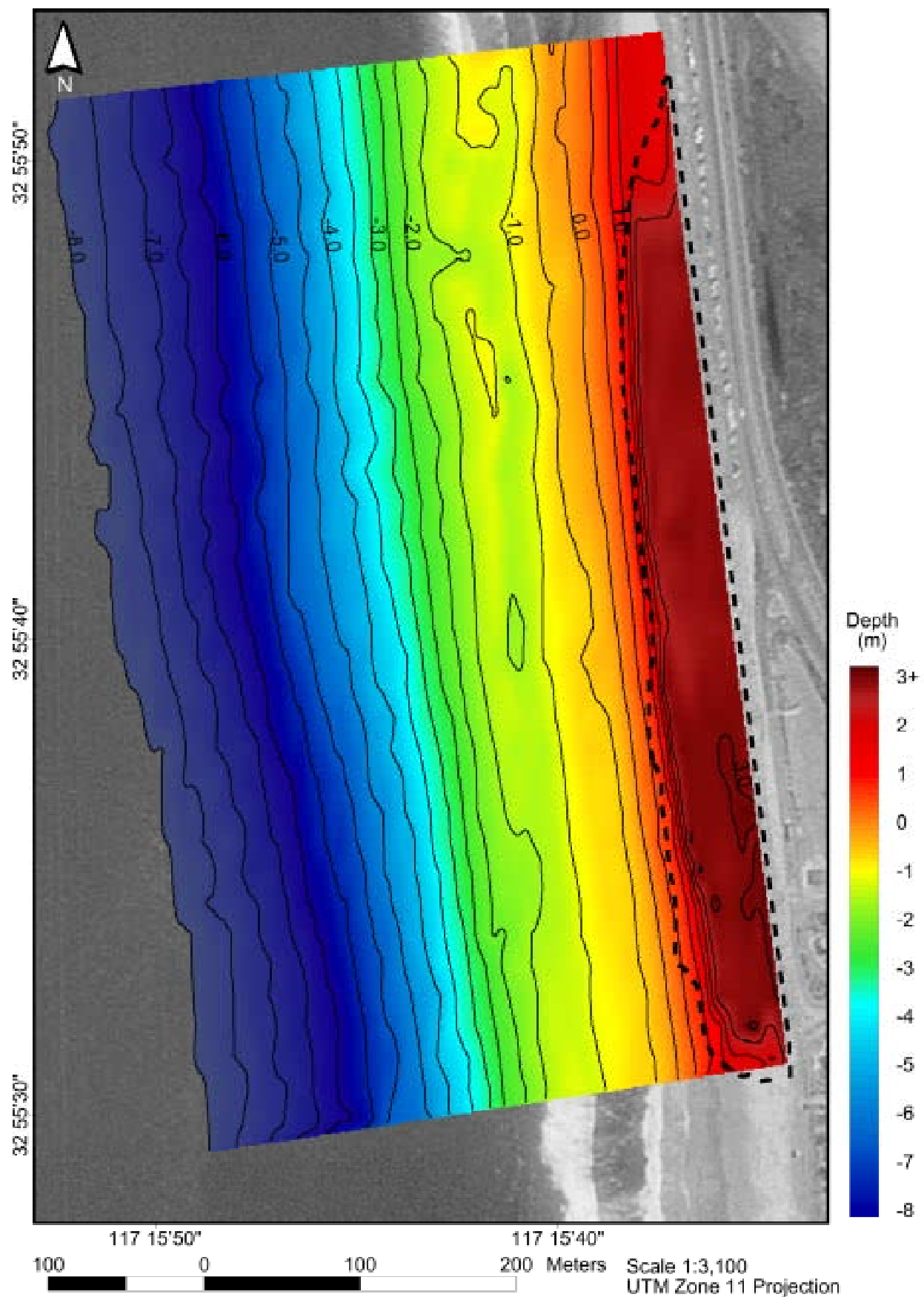


FIGURE 2b: Bathymetry measured 19 June 01 near the nourishment site. The depth contour interval is 0.5 m. The black dashed line, the 1.5 m elevation contour on 27 April 01 (the first post-nourishment survey), bounds the initially nourished region.



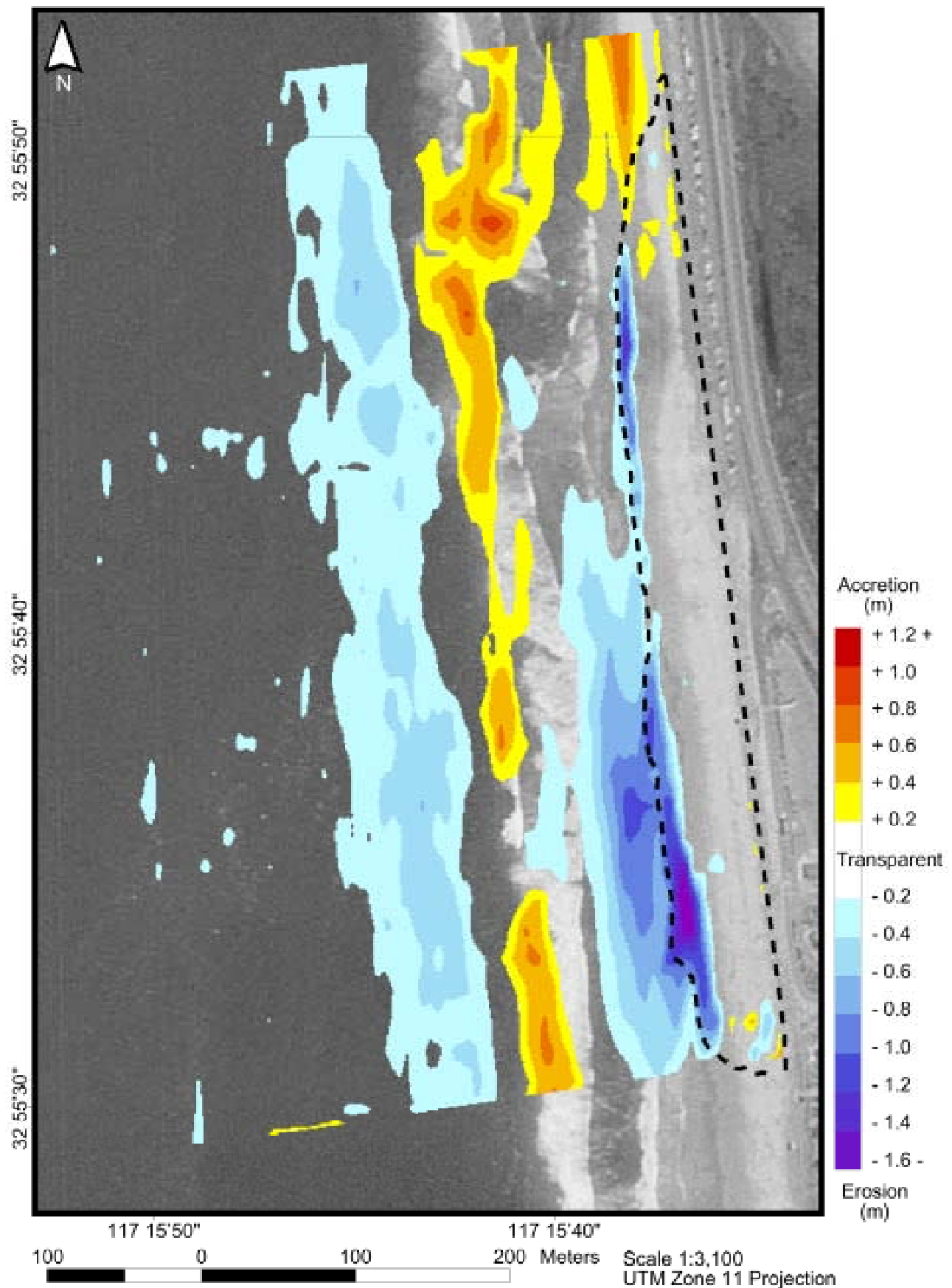


FIGURE 2c: Changes in sand level on 19 June 01 relative to 27 April 01 (the first post-nourishment survey). The black dashed line bounds the initially nourished region. Reds indicate accretion and blues indicate erosion (elevation changes less than +/- 0.2 m are ignored).



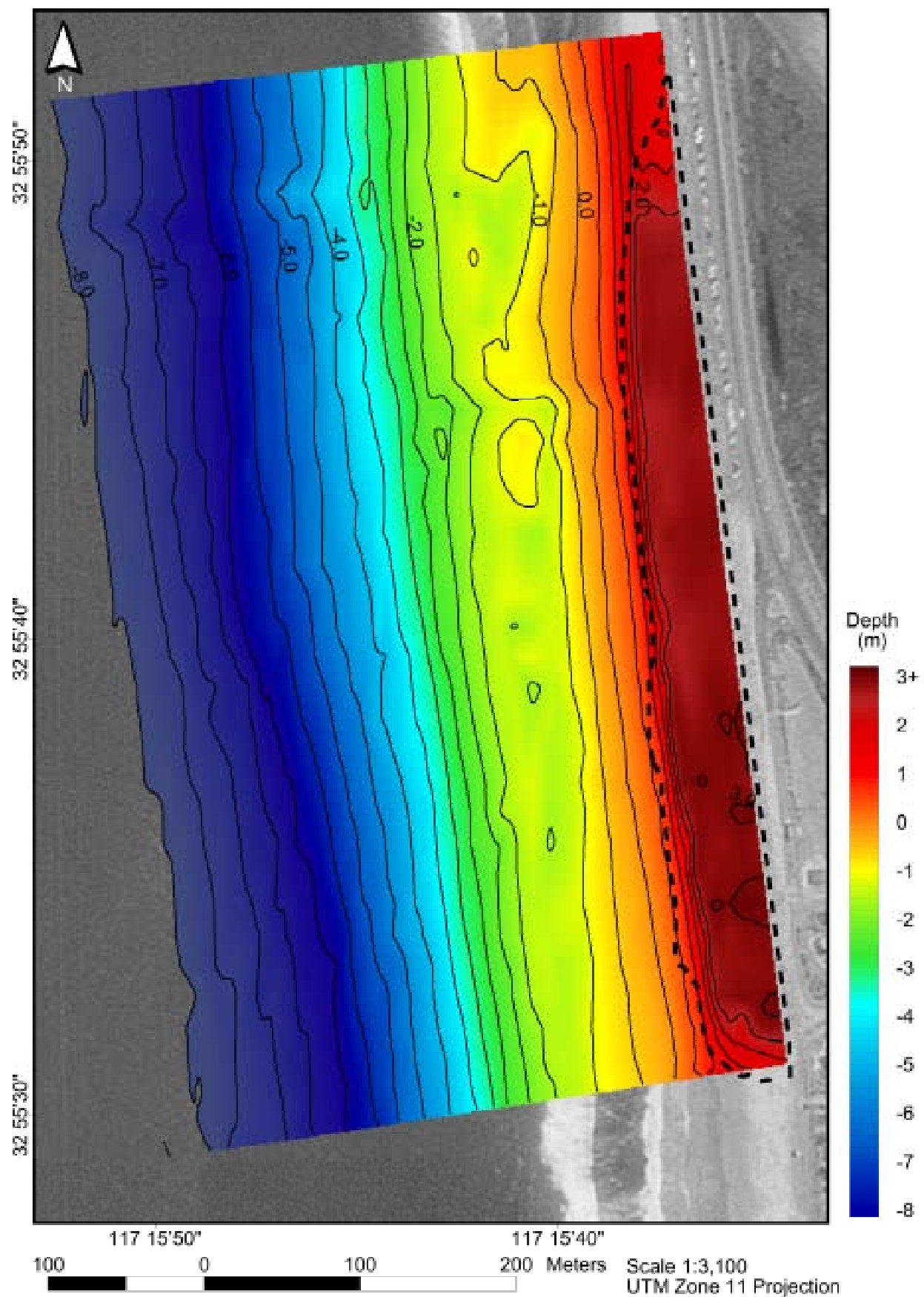


FIGURE 3b: Bathymetry measured 01 July 01 near the nourishment site. The depth contour interval is 0.5 m. The black dashed line, the 1.5 m elevation contour on 27 April 01 (the first post-nourishment survey), bounds the initially nourished region.

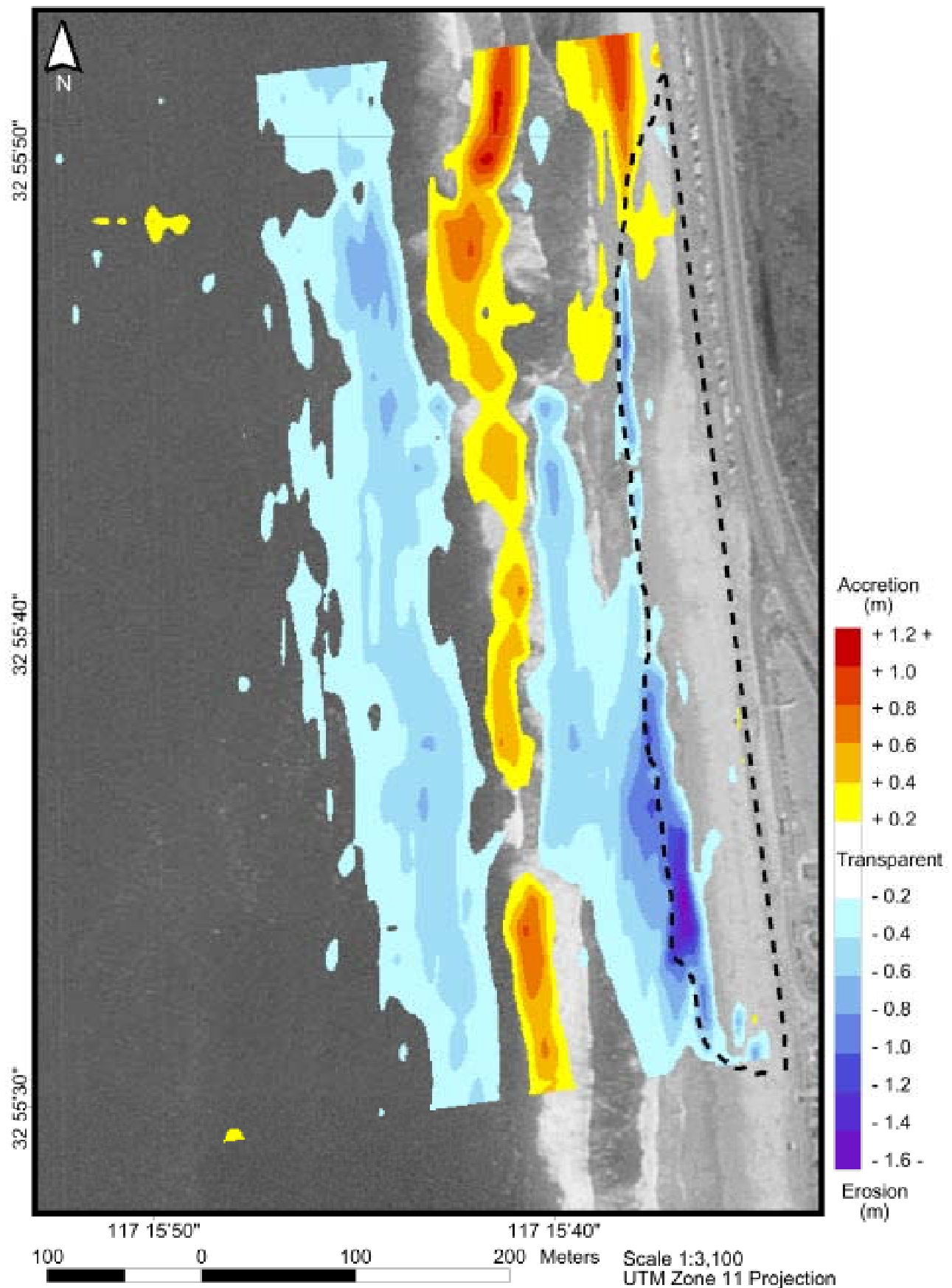
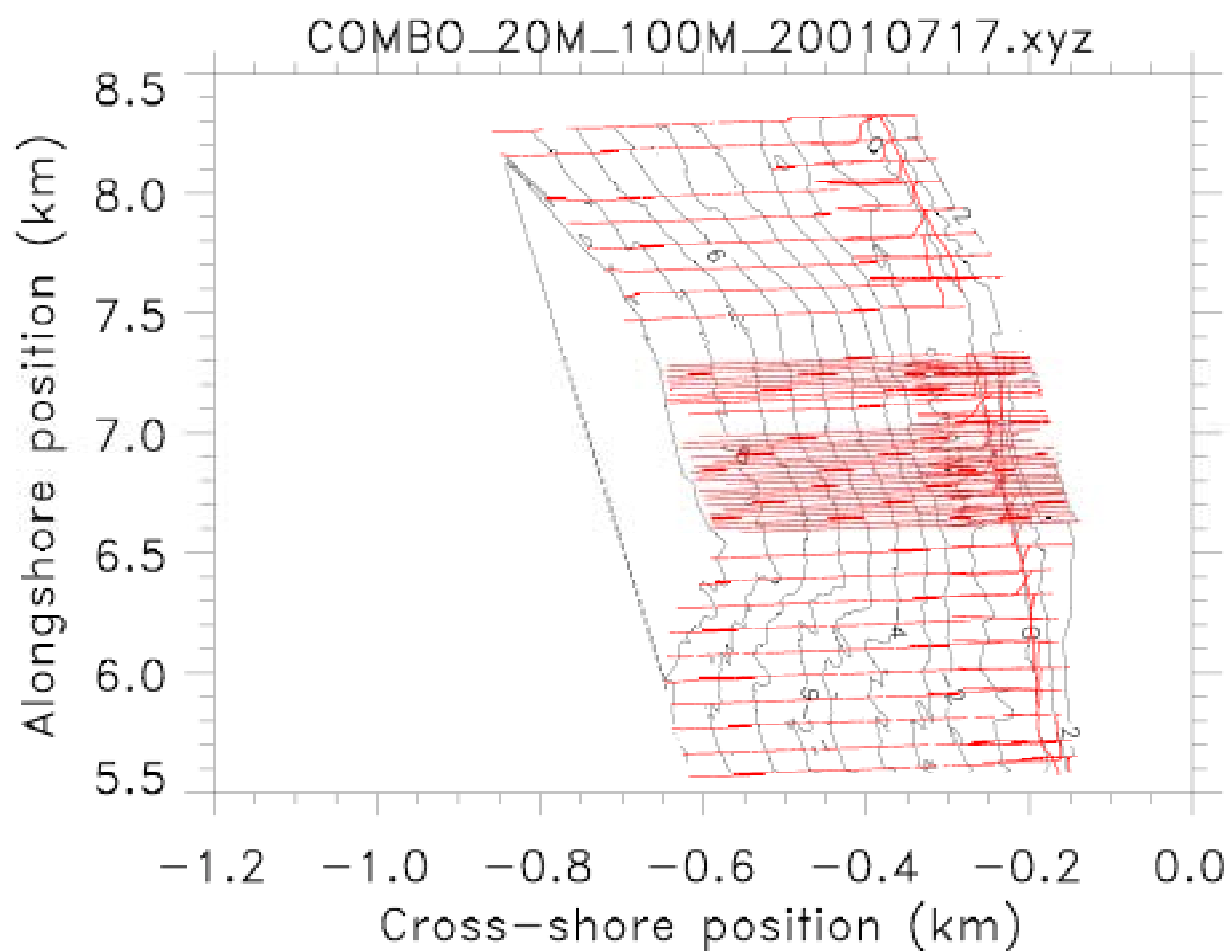


FIGURE 3c: Changes in sand level on 01 July 01 relative to 27 April 01 (the first post-nourishment survey). The black dashed line bounds the initially nourished region. Reds indicate accretion and blues indicate erosion (elevation changes less than +/- 0.2 m are ignored).



**FIGURE 4a :** Survey starting 17 July 01. Straight lines are survey tracks and wiggly lines are depth contours in meters (relative to mean sea level).

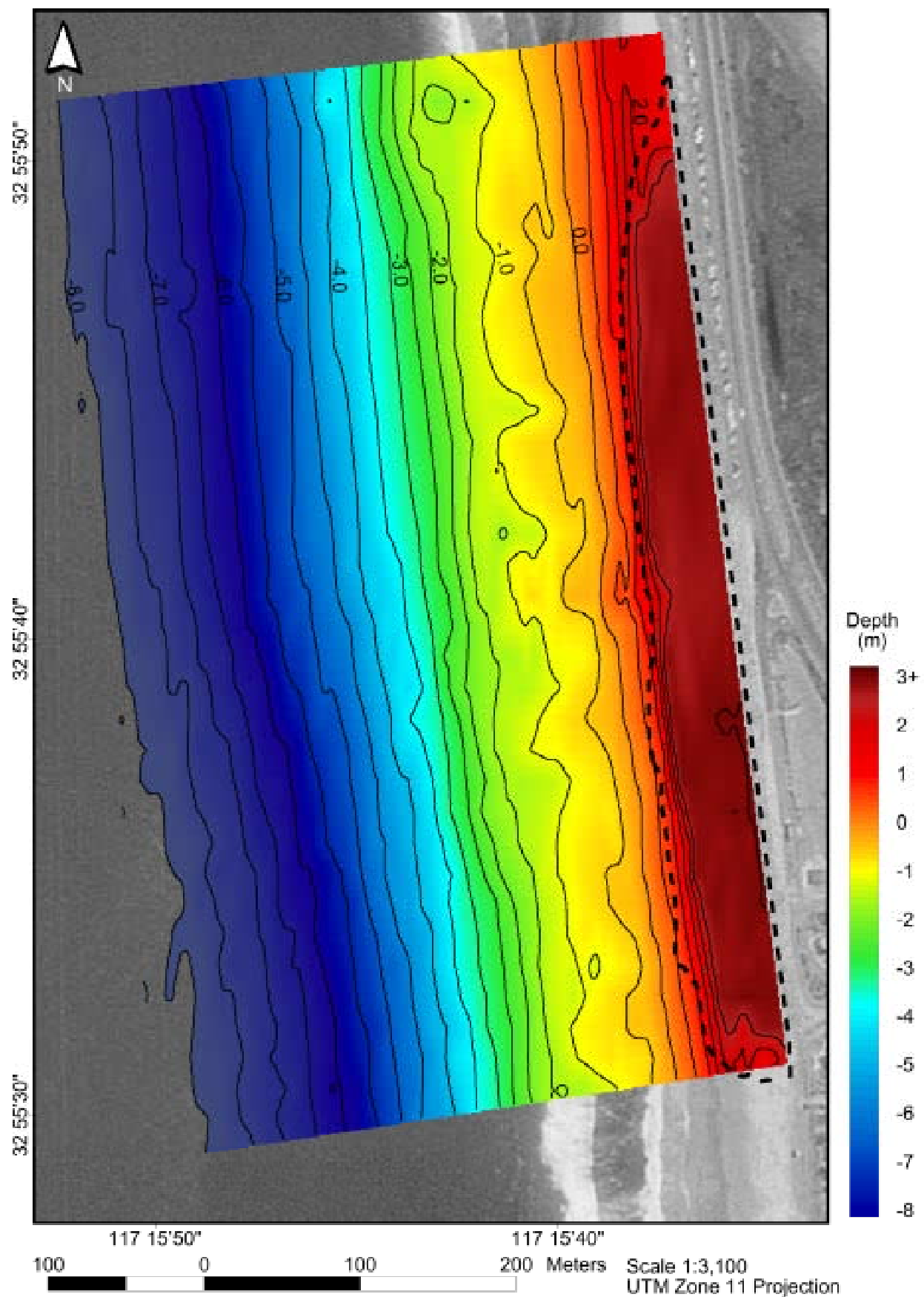


FIGURE 4b: Bathymetry measured 17 July 01 near the nourishment site. The depth contour interval is 0.5 m. The black dashed line, the 1.5 m elevation contour on 27 April 01 (the first post-nourishment survey), bounds the initially nourished region.

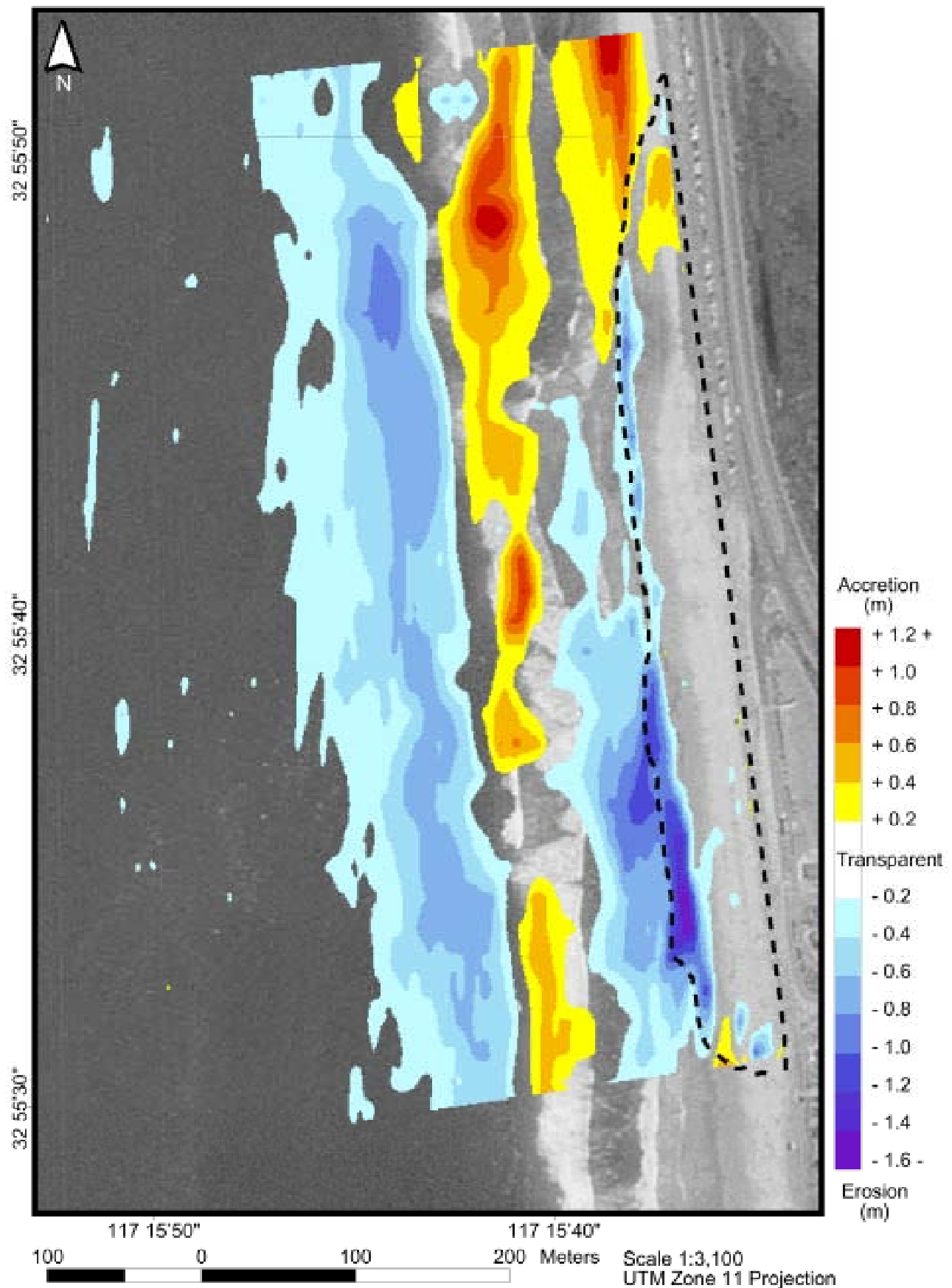
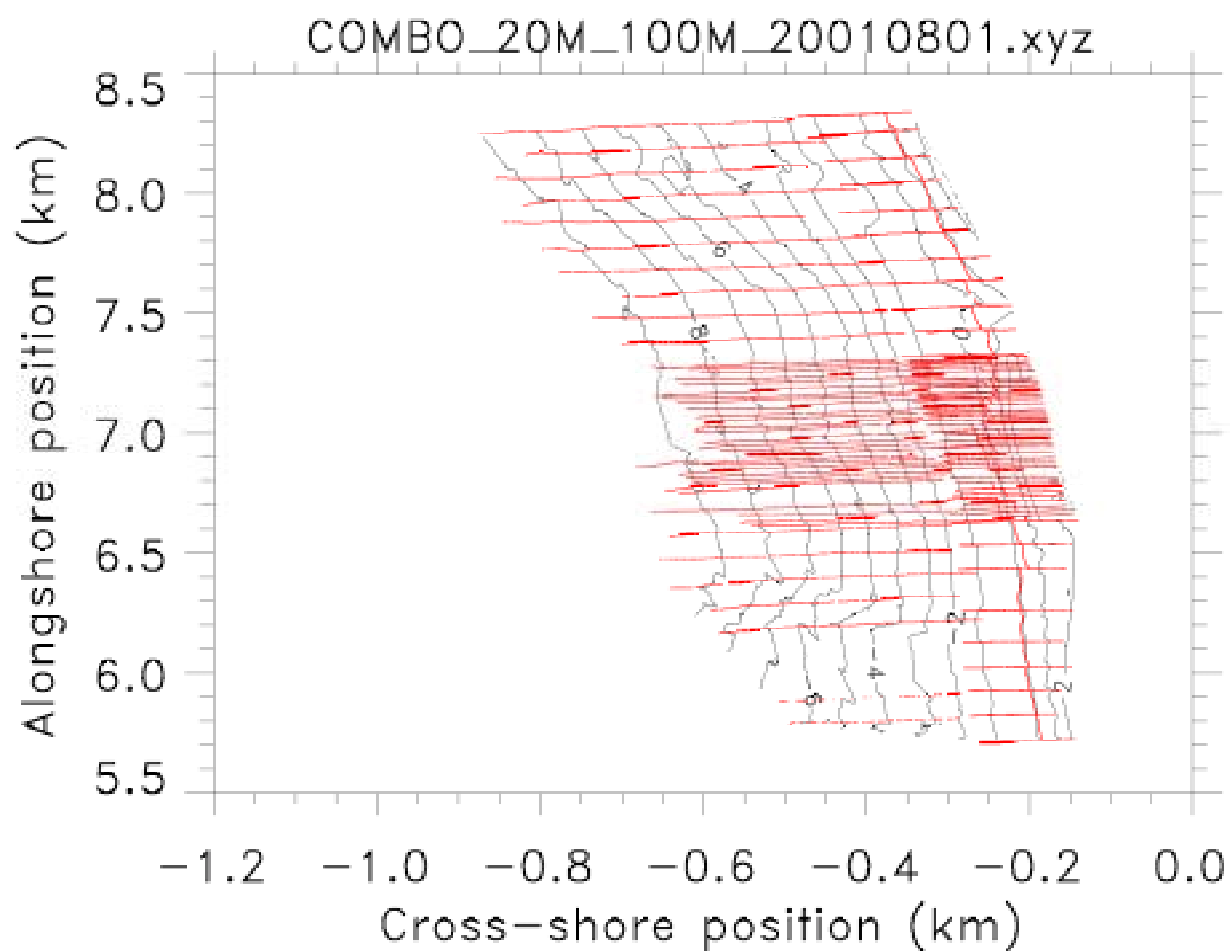


FIGURE 4c: Changes in sand level on 17 July 01 relative to 27 April 01 (the first post-nourishment survey). The black dashed line bounds the initially nourished region. Reds indicate accretion and blues indicate erosion (elevation changes less than +/- 0.2 m are ignored).



**FIGURE 5a :** Survey starting 1 August 01. Straight lines are survey tracks and wiggly lines are depth contours in meters (relative to mean sea level).



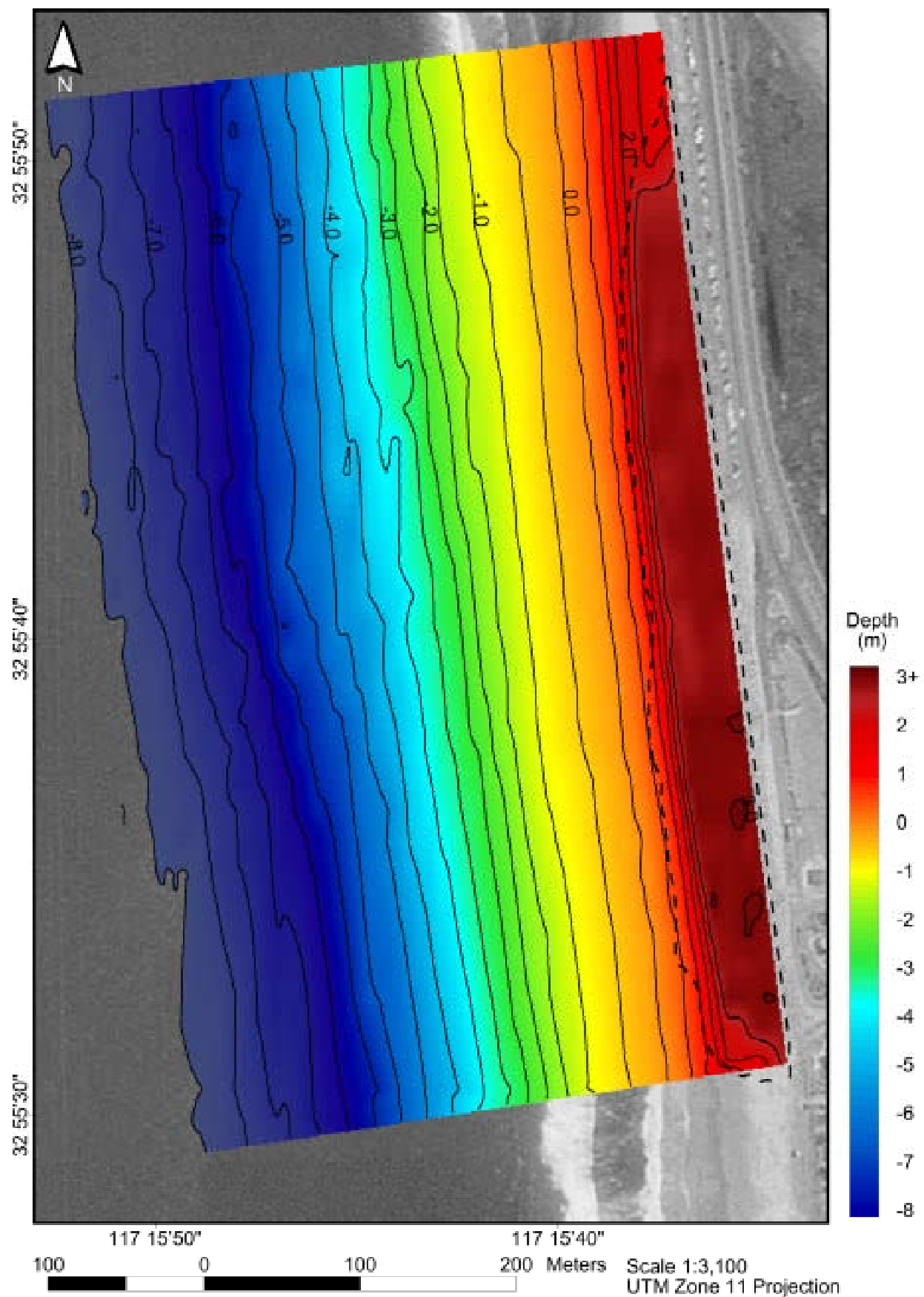


FIGURE 5b: Bathymetry measured 01 August 01 near the nourishment site. The depth contour interval is 0.5 m. The black dashed line, the 1.5 m elevation contour on 27 April 01 (the first post-nourishment survey), bounds the initially nourished region.

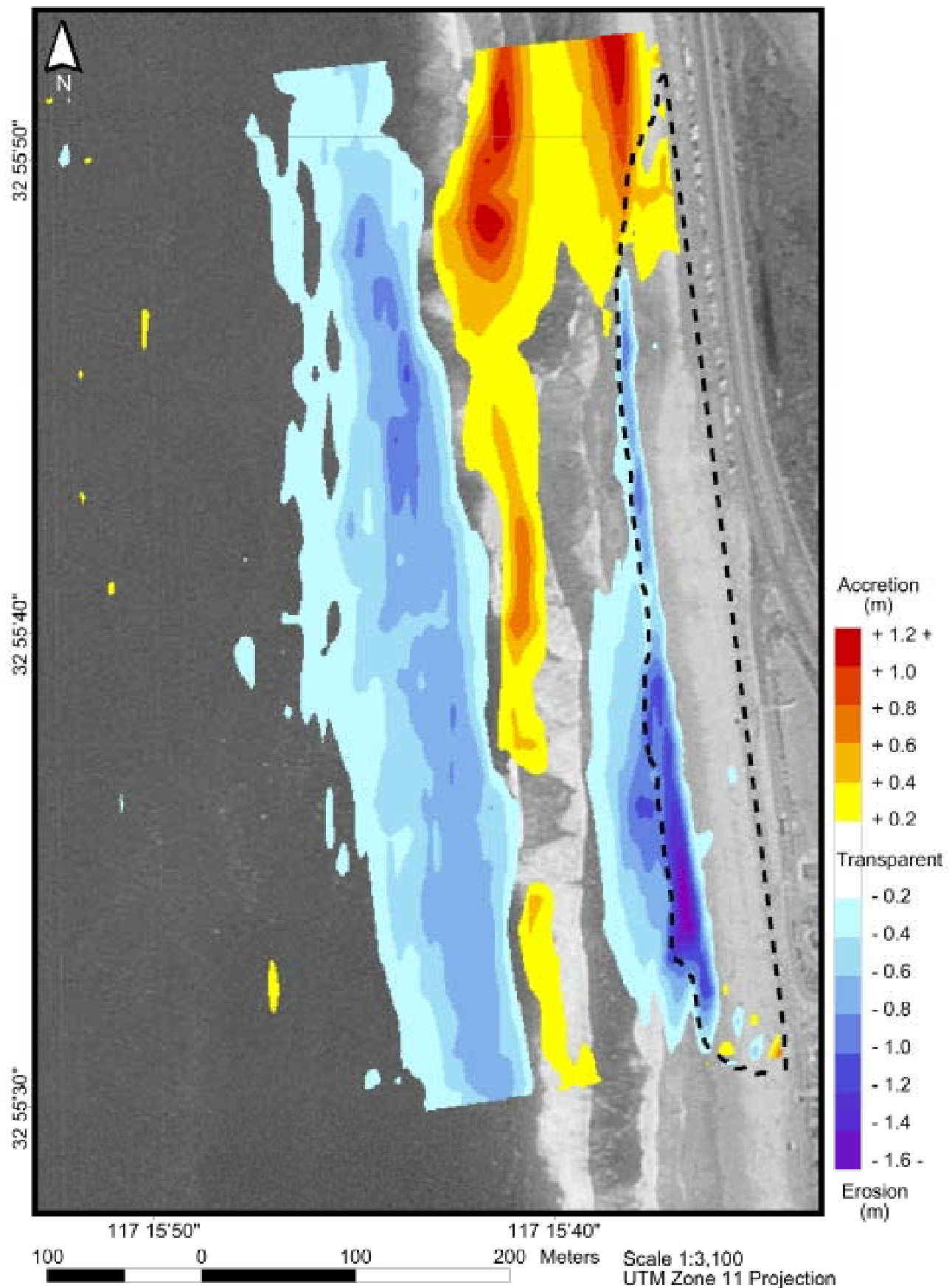


FIGURE 5c: Changes in sand level on 01 August 01 relative to 27 April 01 (the first post-nourishment survey). The black dashed line bounds the initially nourished region. Reds indicate accretion and blues indicate erosion (elevation changes less than  $\pm 0.2$  m are ignored).

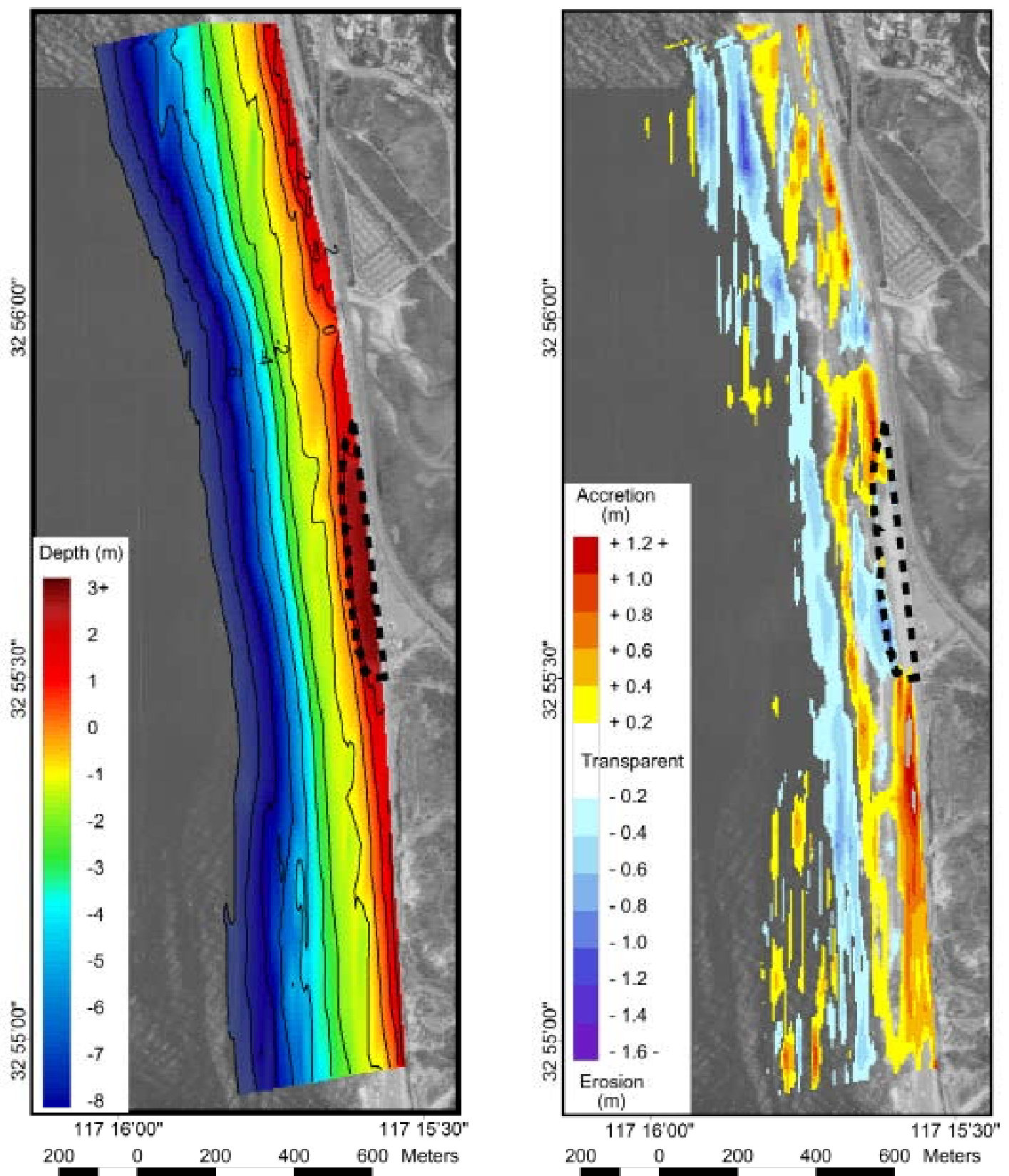
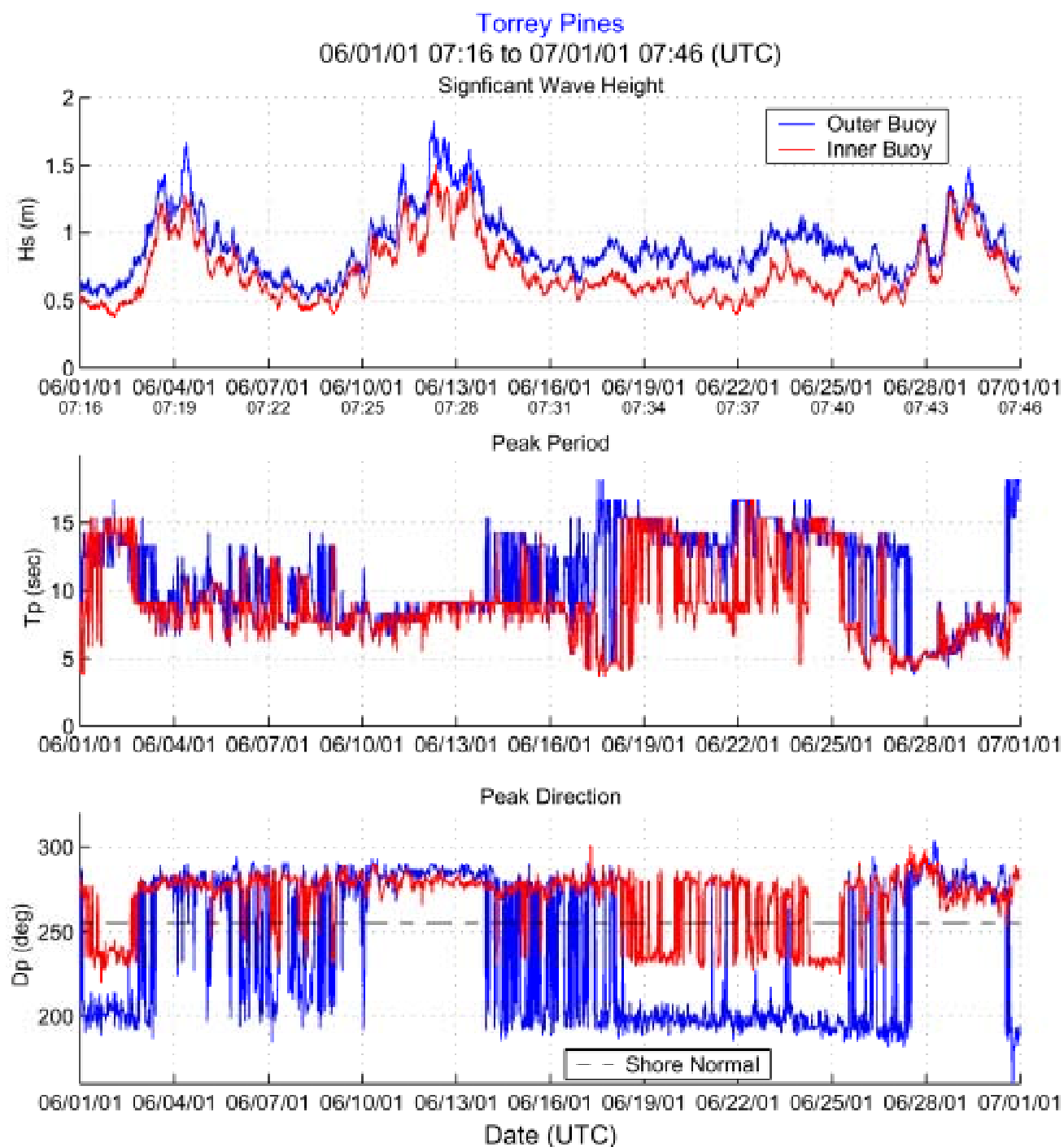


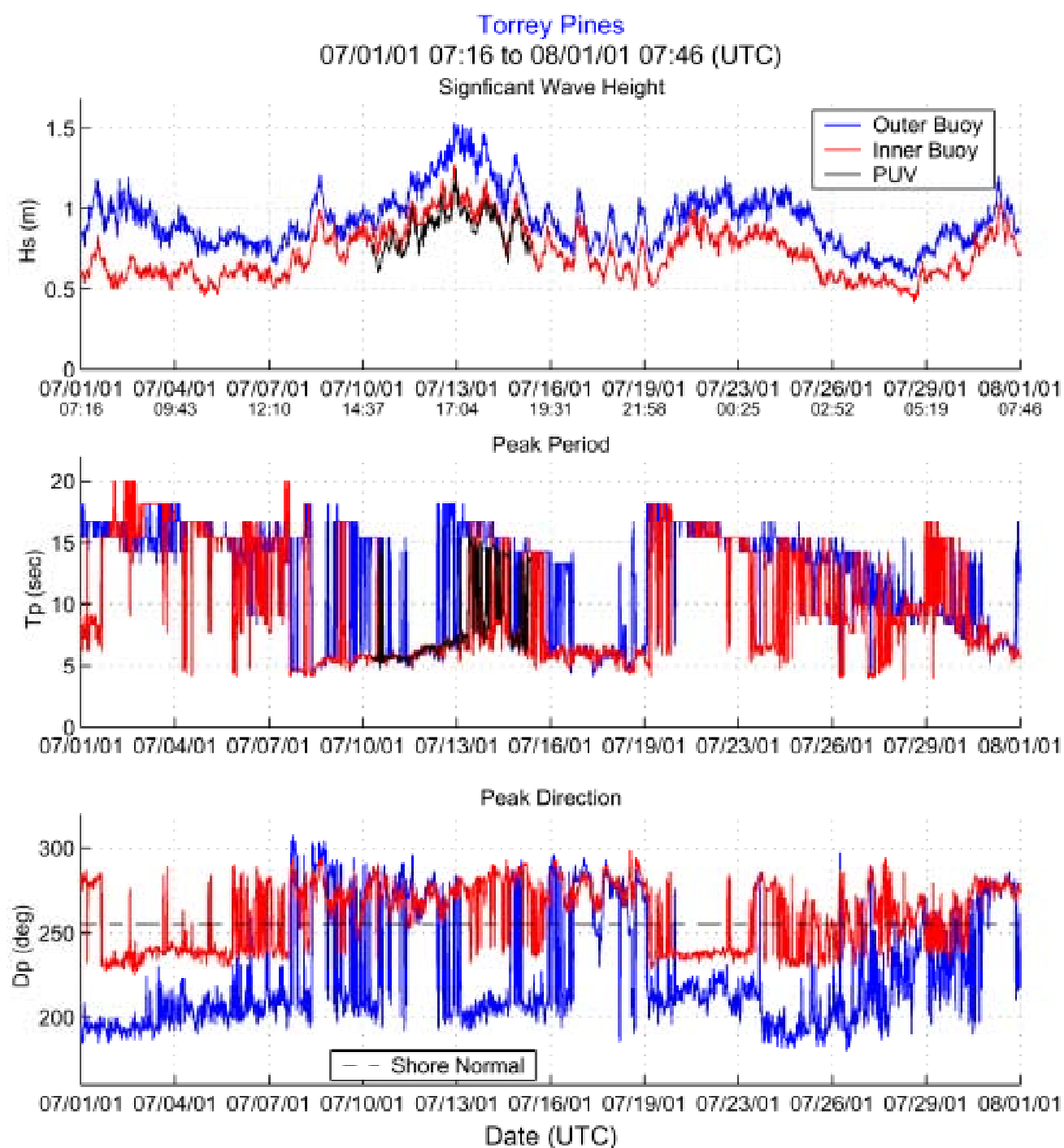
FIGURE 6.

Left: Bathymetry measured 01 July 01 in a 3-km long strip centered on the initially nourished region (bounded by the black dashed line). The depth contour interval is 1.0 m.

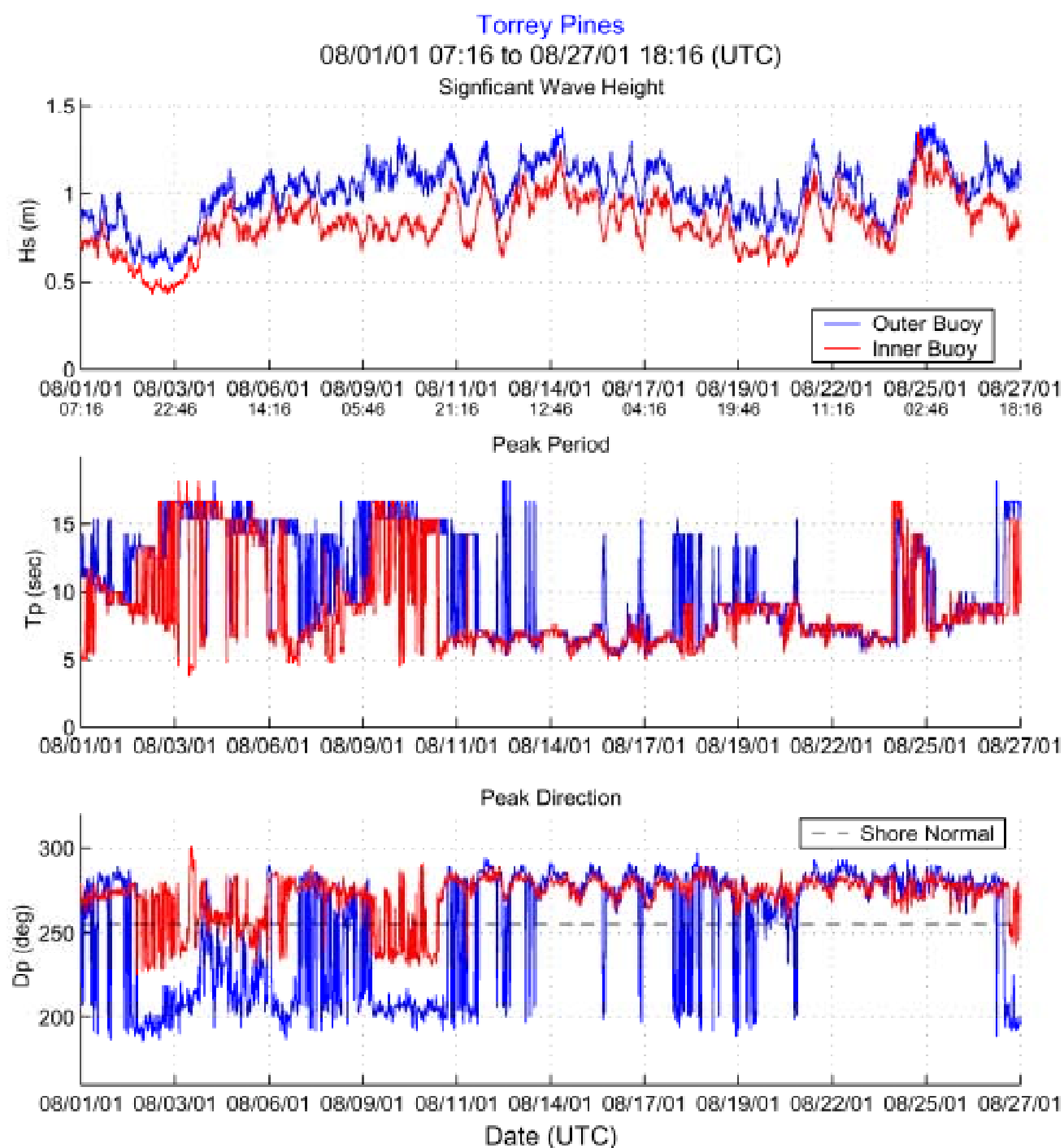
Right: Changes in sand level on 01 July 01 relative to 27 April 01 (the first post-nourishment survey). Volume changes during this period (ignoring elevation changes less than  $\pm 0.2$  m) are accretion = 62,550  $\text{m}^3$  and erosion 35,240  $\text{m}^3$ .



**Figure 7a: June Wave Data for Torrey Pines Inner and Outer Buoys**



**Figure 7b: July Wave Data for Torrey Pines Inner and Outer Buoys, and PUV**



**Figure 7c: August Wave Data for Torrey Pines Inner and Outer Buoys**