Southern California Beach Processes Study

Torrey Pines Field Site

3rd Quarterly Report
30 November 2001

to

California Resources Agency
and
California Department of Boating and Waterways

R.T. Guza[1], W.C. O'Reilly[1], R.J. Seymour[1], S.L. Elgar[2]

[1]Scripps Institution of Oceanography, University of California, San Diego
[2]Woods Hole Oceanographic Institution

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.

A presentation on this study was made at the California Shore and Beach Preservation/ California Coastal Coalition 2001 Annual Conference *Restoring the Beach, Science, Policy and Funding*, which was 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 website. In addition to a Project Overview and Field Operations section, examples of survey ranges and bathymetry are displayed. Following publication, the Quarterly Reports will also be included on this site.

SAND LEVEL SURVEYS:

Since the last quarterly report, 6 additional surveys of sand levels have been acquired at approximately 2 week intervals. The region surveyed is the same as in first 10 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 survey are shown in the (a) panels of Figures 1-6, 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. 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 1-6. 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. Persistent patterns of change since the nourishment are seen in all surveys and increase over time. By 31 October 01, the last survey included in this report, erosion of up to 1.7 m had occurred on the seaward face of the nourishment pile (deep blue band overlaying the black dashed line in the left-hand panel of figure 6c), and accretion of up to 1.5 m (dark reds) was measured directly to the north and adjacent to the nourishment pile. Erosion of roughly 1.25 m (associated with the seasonal onshore migration of a sand bar) was observed further offshore in about 2.0 m mean depth. 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 (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. Changes between successive profiles are relatively small. The surveying-ATV has been compared with the manually pushed dolly and shows excellent agreement. Future beach surveys will use the ATV to survey above the water line, the dolly to survey between the water

line and wading depth, and the jetski to survey deeper than wading depth. The addition of the ATV is expected to reduce the person-hours needed for each survey.

SAND CHARACTERISTICS

Prior to nourishment, surface sand samples were obtained at 9 locations on each of 3 cross-shore transects between 8 m depth and the shoreward limit of the beach. Immediately after nourishment, 8 cores of the nourishment sand were sampled nominally 0.3, 2 and 3 m below the sand surface, for a total of 17 usable samples (Figure 7). These sand samples have been analyzed by a commercial company (GEOCON) to characterize the size distribution of the existing sand prior to nourishment and of the nourishment sand. The sizes of the existing and nourishment sand are similar. Of 27 pre-nourishment samples, 21 had median diameters between 0.15-0.25 mm, and 3 were finer and 2 coarser. Of 18 nourishment sand samples, 17 had median diameters between 0.15-0.25 mm, and 1 was coarser.

WAVE MEASUREMENTS AND MODELING

Wave data was collected continuously 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 8a-c. The data at the 7.5m site is being collected by a self-contained pressure gage (continuous, but non-directional). In addition, directional wave data was collected at the 7.5m site from July 31-August 2, and October 25 - November 1 using a Nortek AquaDopp acoustic wave and current sensor. The data from all 7.5m sensors is currently being analyzed, with an initial review indicating nearly 100% data return.

August-October are transitional months for the California wave climate as the North Pacific weather systems become more energetic, producing swell that pass through the offshore islands and approach Torrey Pines from 275-290 degrees, enhancing the southward transport of sediment. The measured wave parameters from the Torrey Pines Inner Buoy (red lines, Figures 8a-c) show that the local wave climate in August-October 2001 was a continued mix of long period south swell (driving northward transport) and short period W-WNW seas (driving southward sediment transport). An approximate beach normal for the renourishment area is shown on the wave directional plots (bottom panels, Figures 8a-c) for reference. Several interesting wave events occurred during this quarter. In August 2001, two time periods were dominated by WNW waves: local seas (Tp = 6 seconds) from August 12-17 (Fig. 8a), and a combination of local seas and the first significant North Pacific swell event of the season, from August 20-27. In each instance, the dominant wave direction at the inner buoy shows incident wave angles consistently north of the estimated shore normal (above dashed line, bottom panel, Figure 8a) which would result in southward sediment transport. The second significant north swell of the season occurred from September 3-7, and the remainder of September through October was a balanced mix of WNW local seas and south swells. Maximum wave heights at the inner buoy remained modest in size (1.00-1.25m) for this time period.

BEACH RESPONSE MODELING:

Discussions have been held with Dr. Kraus (one of the creators of the GENESIS software) over difficulties encountered with actually exercising the model and he has agreed to provide

assistance. He feels that the diffusion phase that the Torrey Pines nourishment site is undergoing will probably not be modeled as well by GENESIS as will translation during winter storms. Effort continues to take existing profile, wave and tide data and translate it into the very restrictive formats demanded by GENESIS.

Collaboration with scientists at the Naval Postgraduate School (Monterey, California) and Delft University (Netherlands) is planned. The observed changes in beach morphology will be compared with predictions of DELFT3D (a numerical model widely used in Europe). Funding for the modeling effort will be provided by the Mellon Foundation, and the work will begin in Spring 2002.

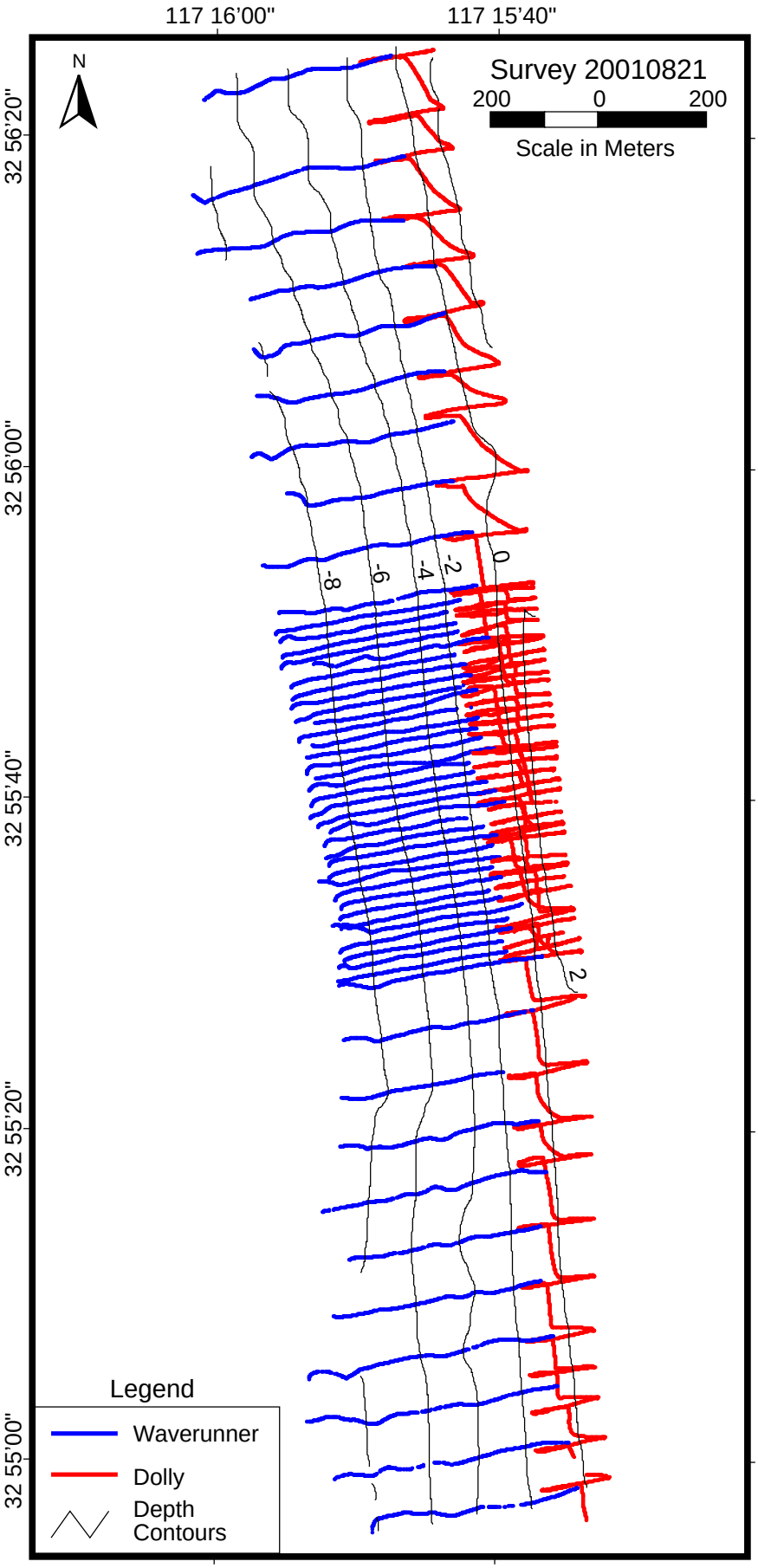


FIGURE 1a : Survey starting 21 August 01. Blue and red lines are survey tracks (waverunner and dolly respectively). Black lines are depth contours in meters (relative to mean sea level).

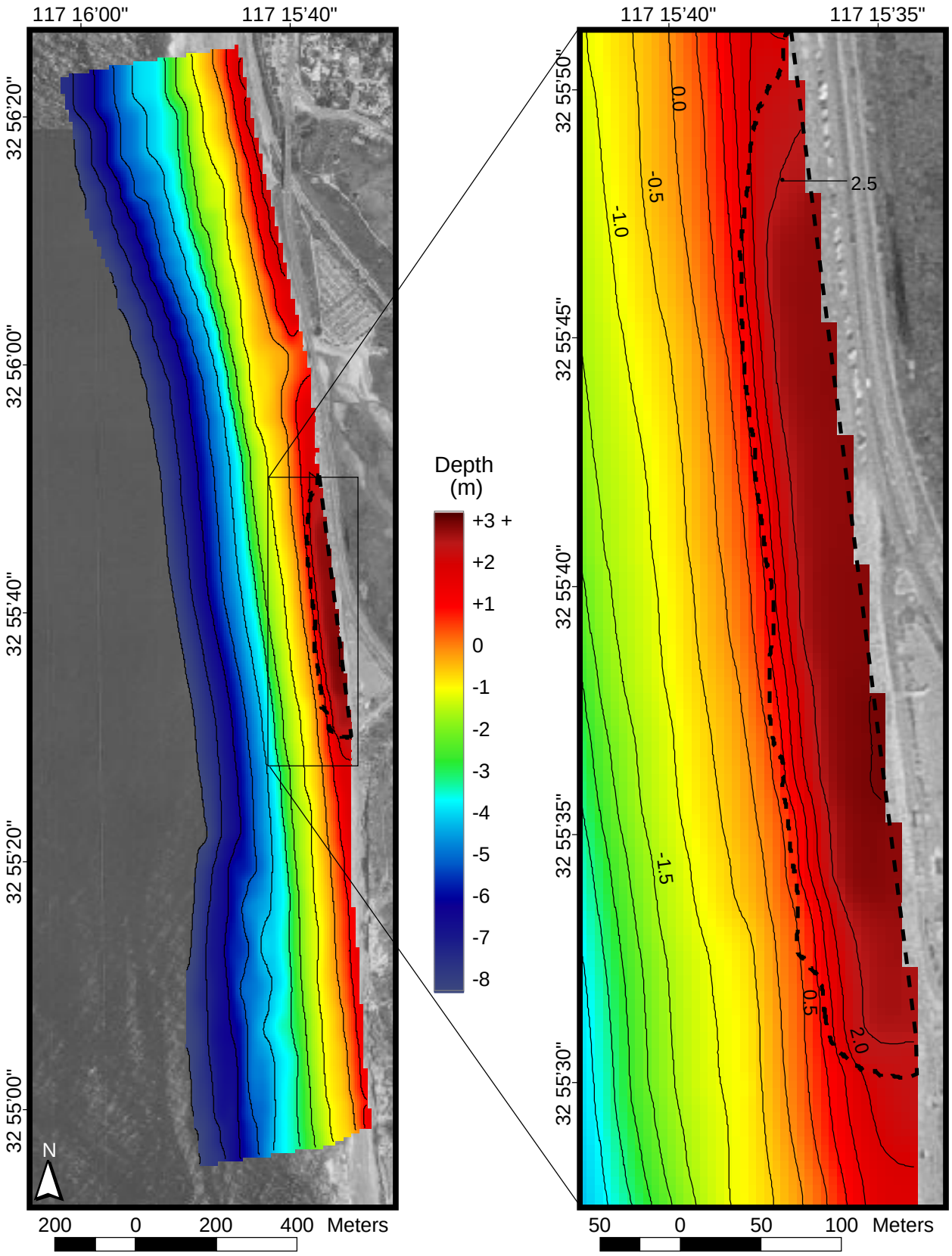


FIGURE 1b:
Left: Bathymetry measured 21 August 01 in a 3-km long strip centered on the initially nourished region (bounded by the black dashed line). The contour interval is 1.0 meters.
Right: Nourishment zone enlarged. The contour interval is 0.5 meters.

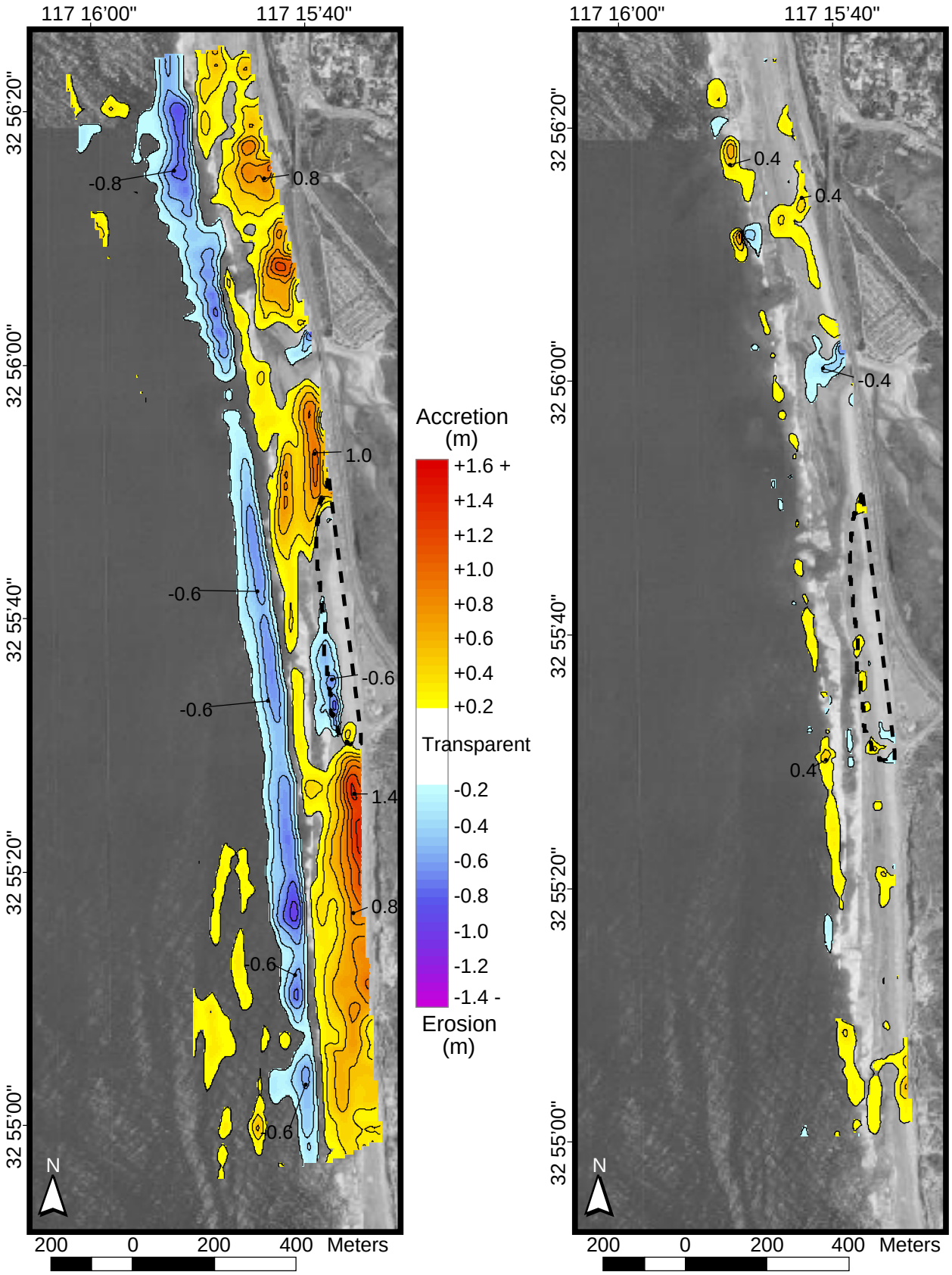


FIGURE 1c.
Left: Changes in sand level on 21 August 01 relative to 27 April 01 (the first post-nourishment survey). The contour interval is 0.2 meters (ignoring changes less than +/- 0.2 meters).
Right: Changes in sand level on 21 August 01 relative to 01 August 01 (the previous survey).

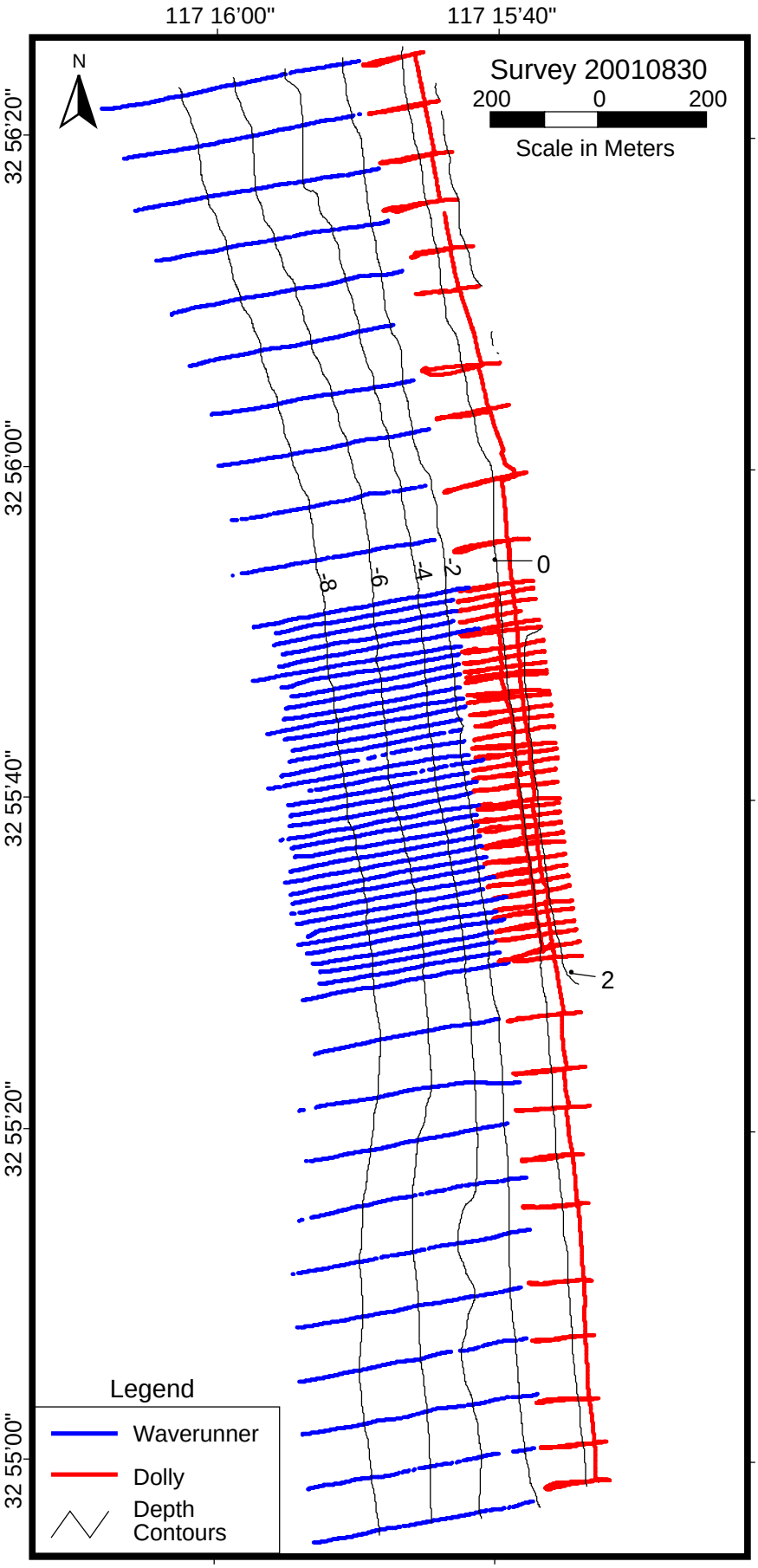


FIGURE 2a : Survey starting 30 August 01. Blue and red lines are survey tracks (waverunner and dolly respectively). Black lines are depth contours in meters (relative to mean sea level).

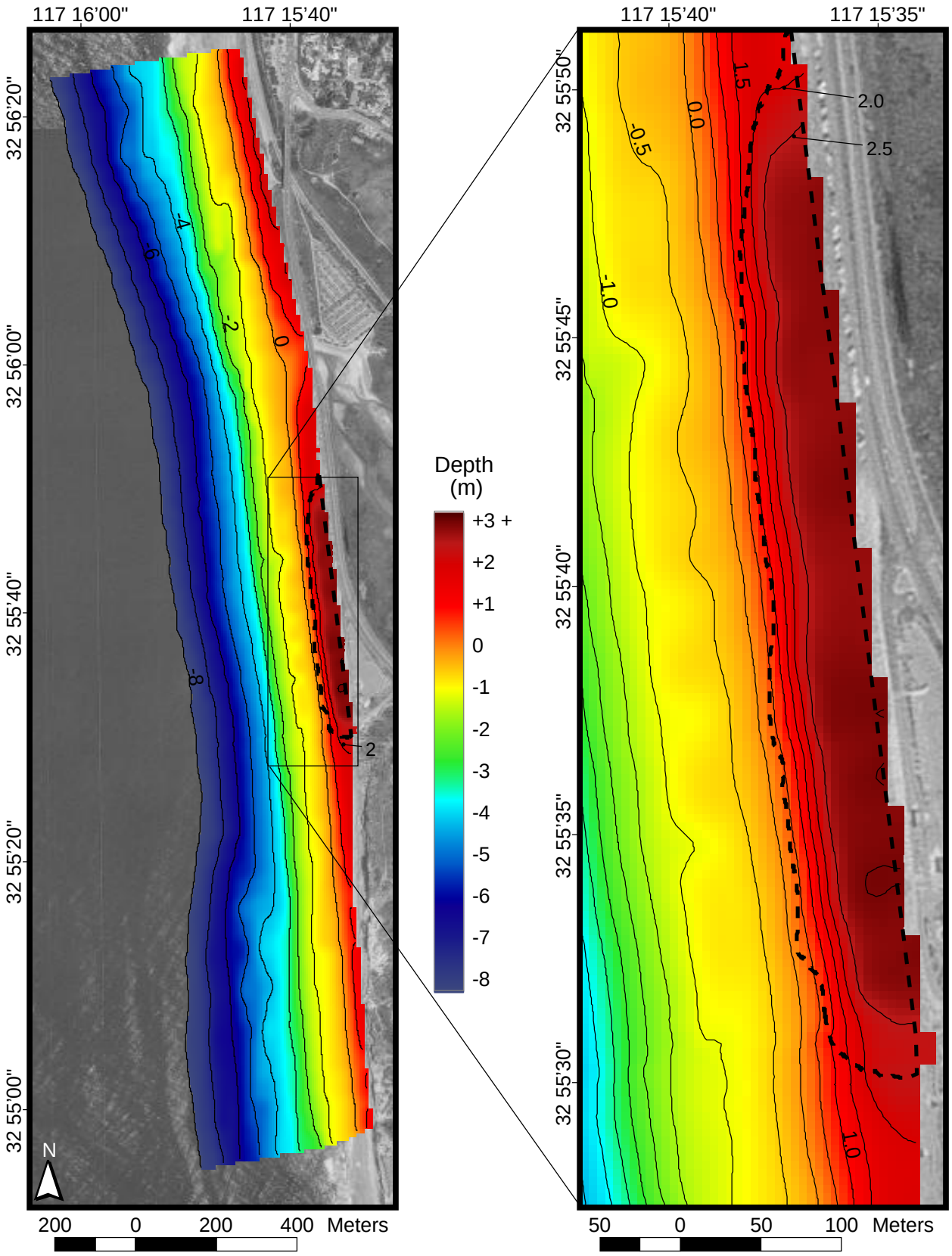


FIGURE 2b:
Left: Bathymetry measured 30 August 01 in a 3-km long strip centered on the initially nourished region (bounded by the black dashed line). The contour interval is 1.0 meters.
Right: Nourishment zone enlarged. The contour interval is 0.5 meters.

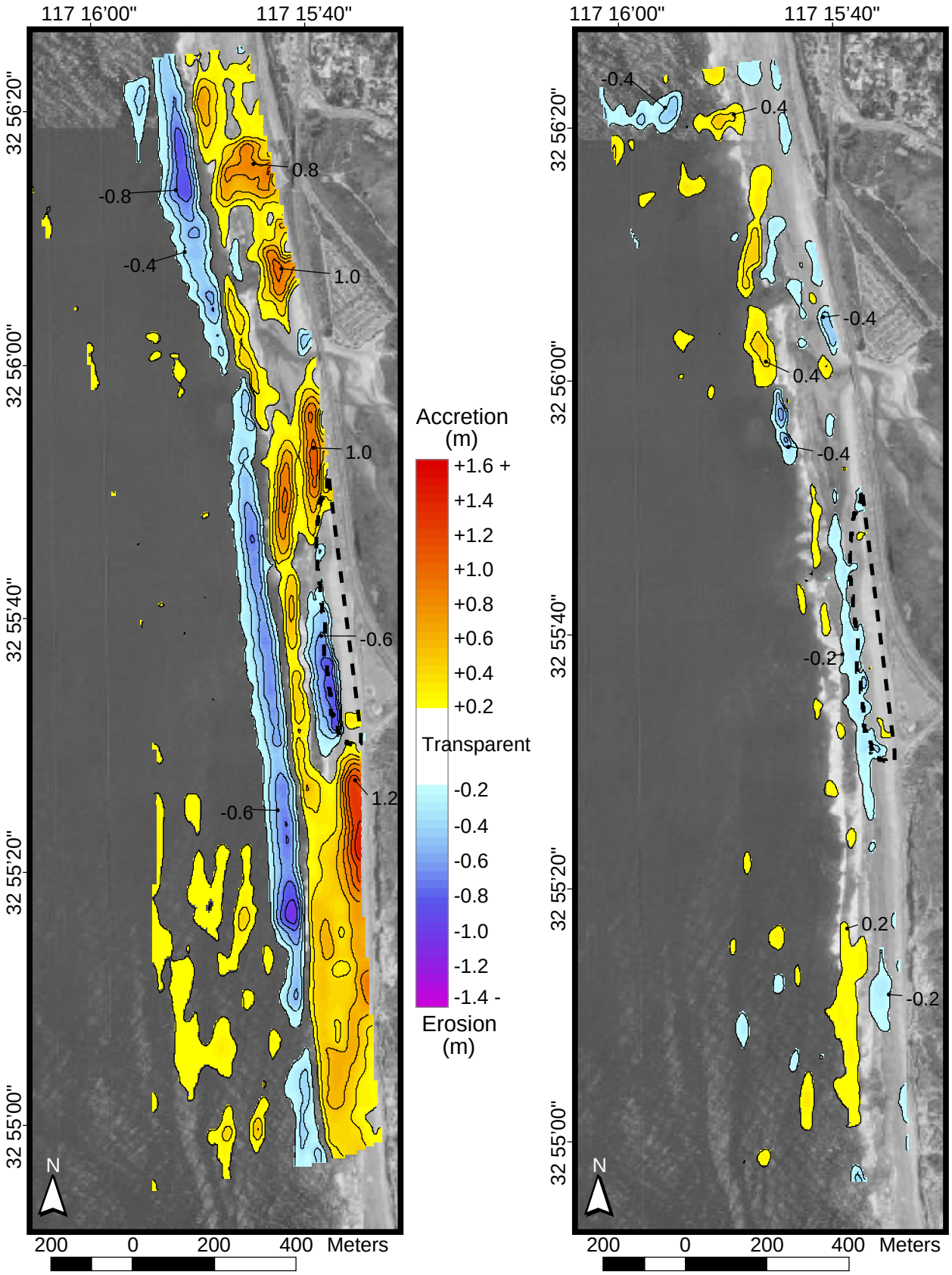


FIGURE 2c.
Left: Changes in sand level on 30 August 01 relative to 27 April 01 (the first post-nourishment survey). The contour interval is 0.2 meters (ignoring changes less than +/- 0.2 meters).
Right: Changes in sand level on 30 August 01 relative to 21 August 01 (the previous survey).

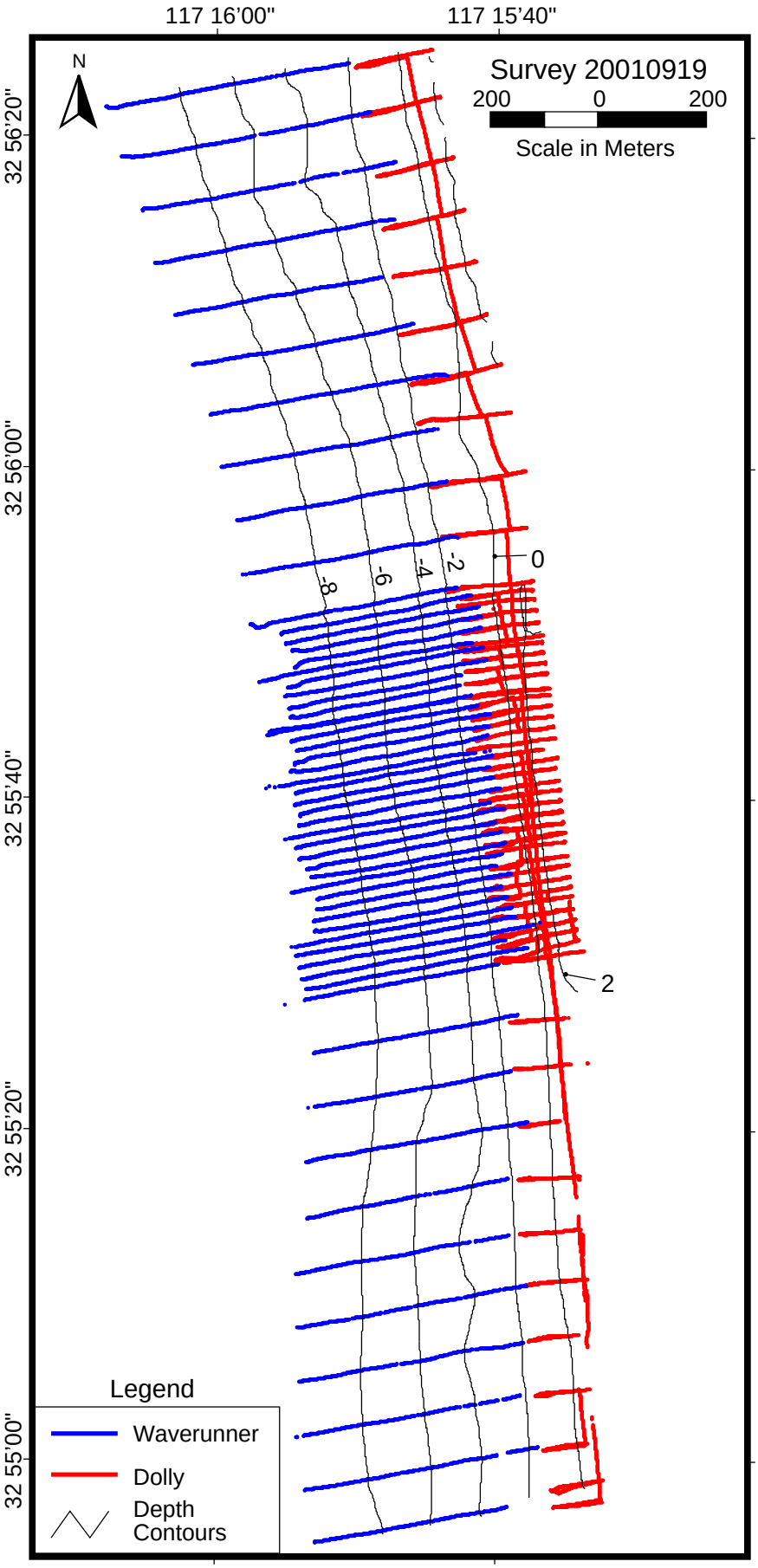


FIGURE 3a : Survey starting 19 September 01. Blue and red lines are survey tracks (waverunner and dolly respectively). Black lines are depth contours in meters (relative to mean sea level).

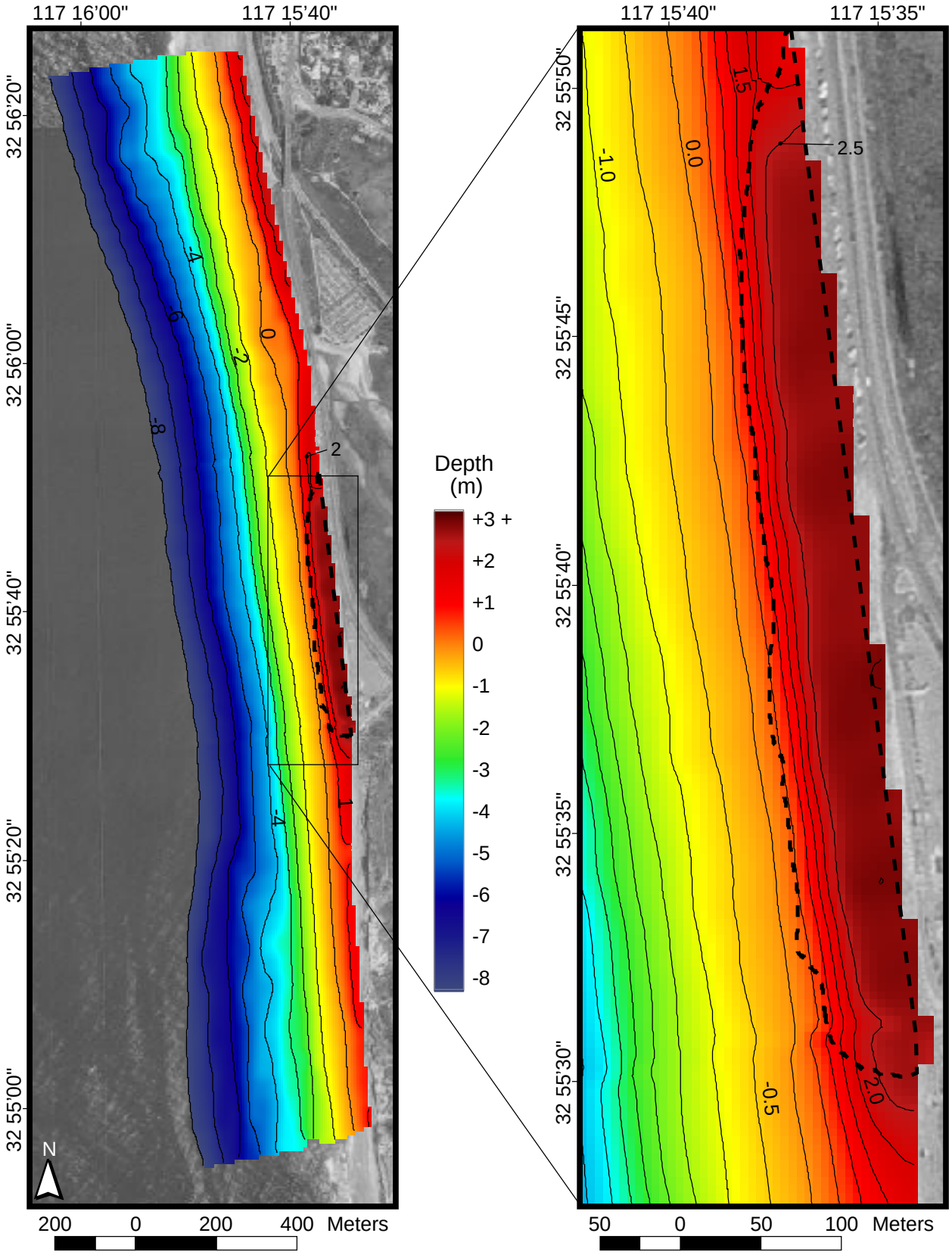


FIGURE 3b:
Left: Bathymetry measured 19 September 01 in a 3-km long strip centered on the initially nourished region (bounded by the black dashed line). The contour interval is 1.0 meters.
Right: Nourishment zone enlarged. The contour interval is 0.5 meters.

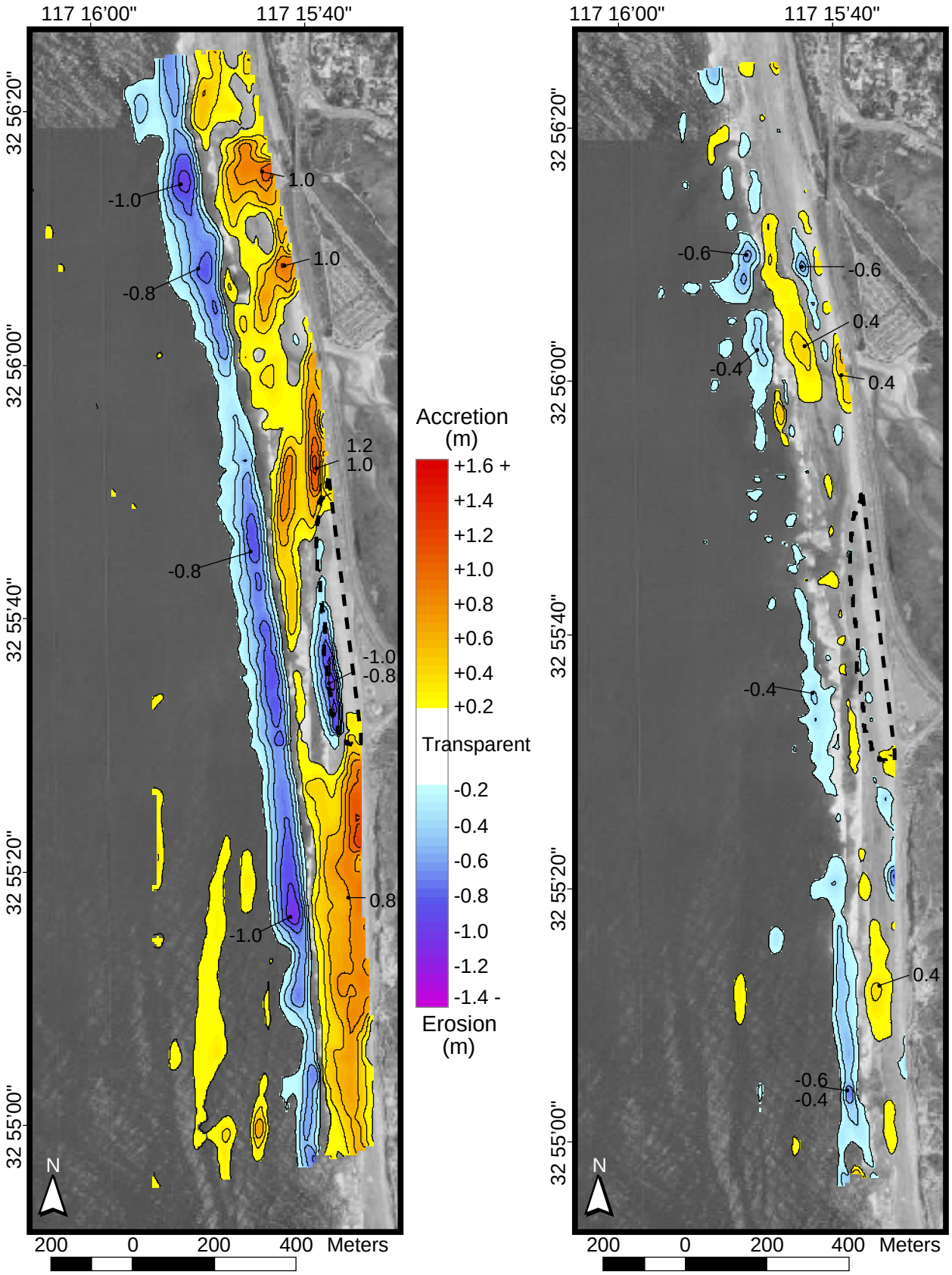


FIGURE 3c.
Left: Changes in sand level on 19 September 01 relative to 27 April 01 (the first post-nourishment survey). The contour interval is 0.2 meters (ignoring changes less than +/- 0.2 meters).
Right: Changes in sand level on 19 September 01 relative to 30 August 01 (the previous survey).

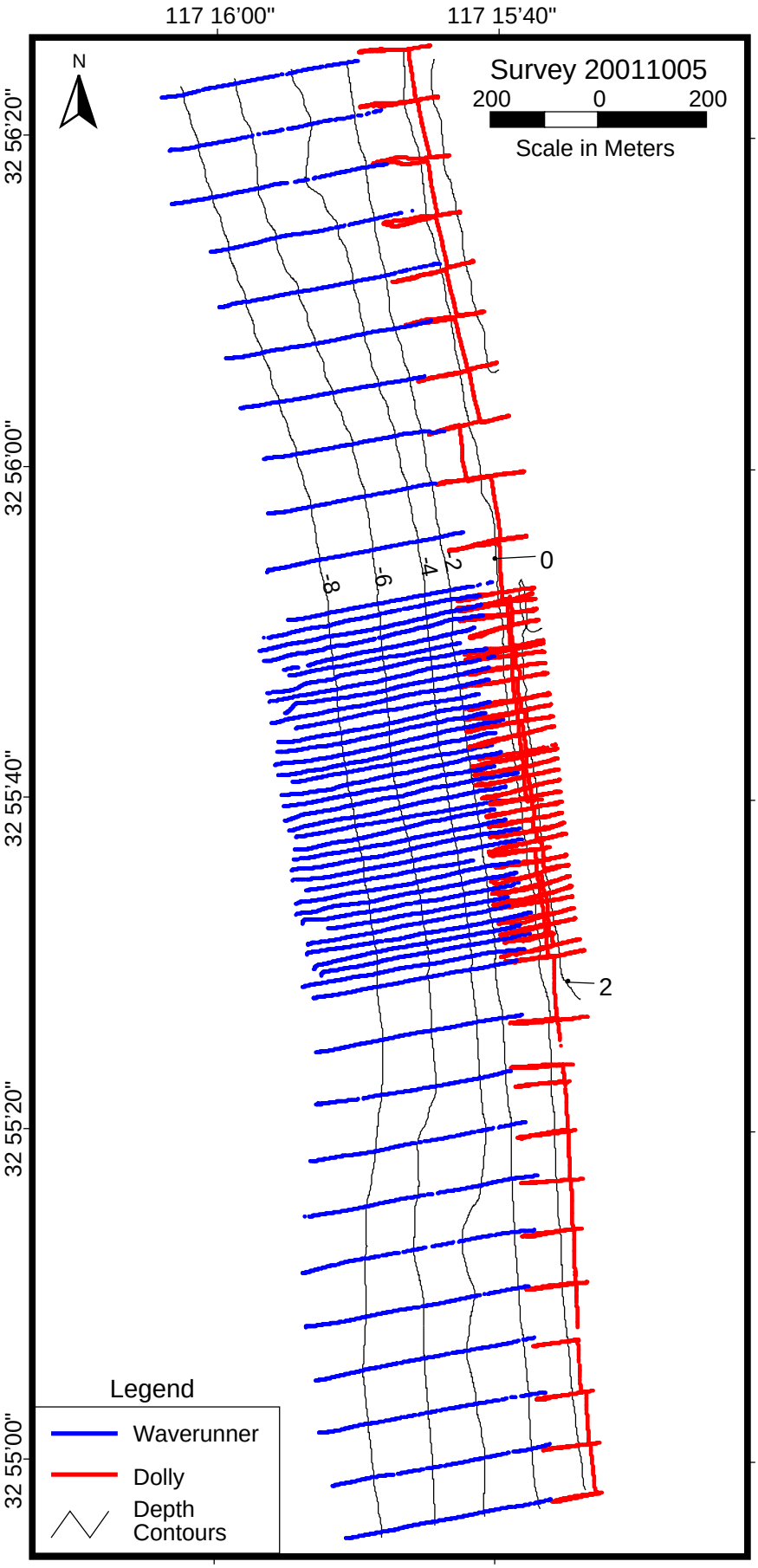


FIGURE 4a : Survey starting 05 October 01. Blue and red lines are survey tracks (waverunner and dolly respectively). Black lines are depth contours in meters (relative to mean sea level).

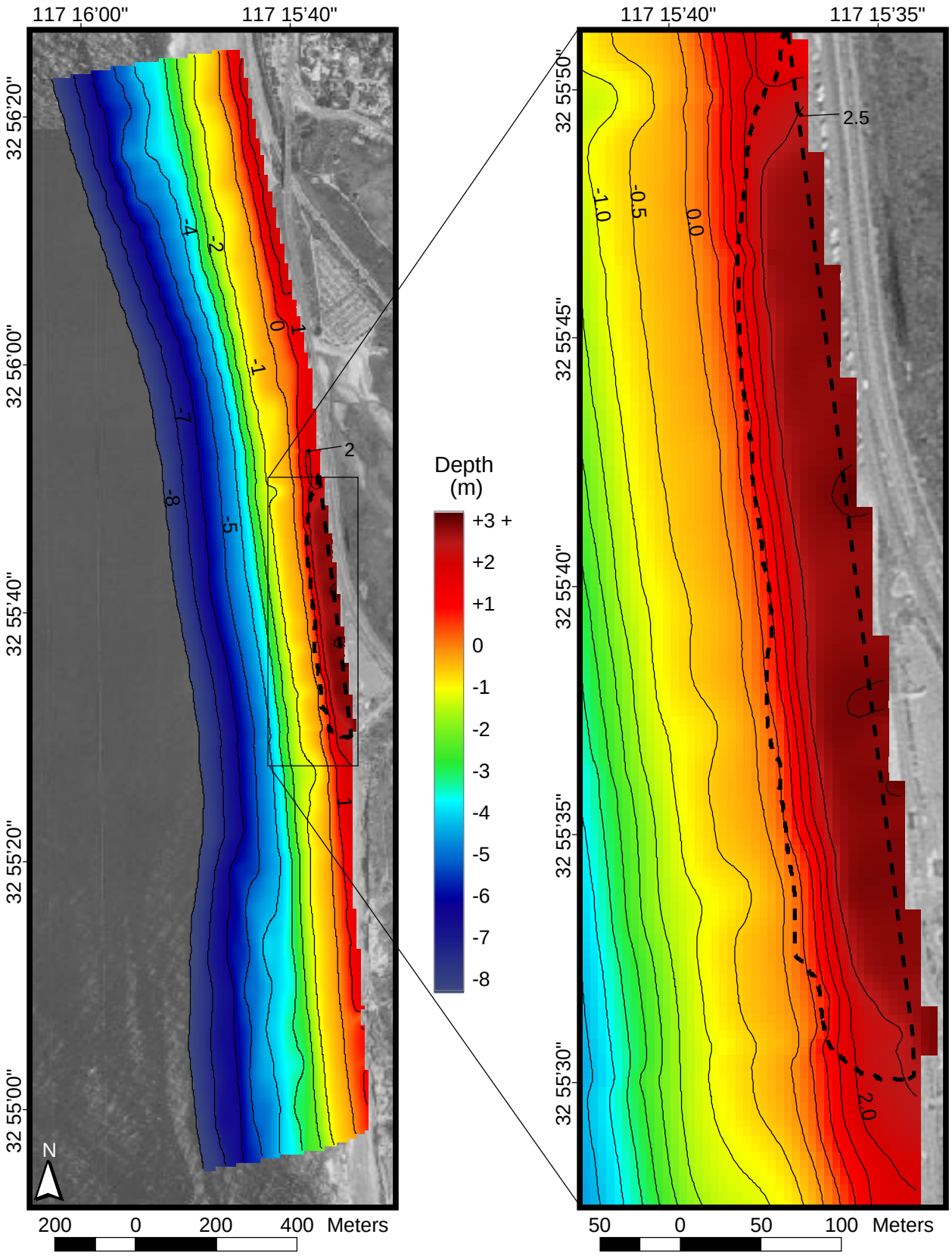


FIGURE 4b:
Left: Bathymetry measured 05 October 01 in a 3-km long strip centered on the initially nourished region (bounded by the black dashed line). The contour interval is 1.0 meters.
Right: Nourishment zone enlarged. The contour interval is 0.5 meters.

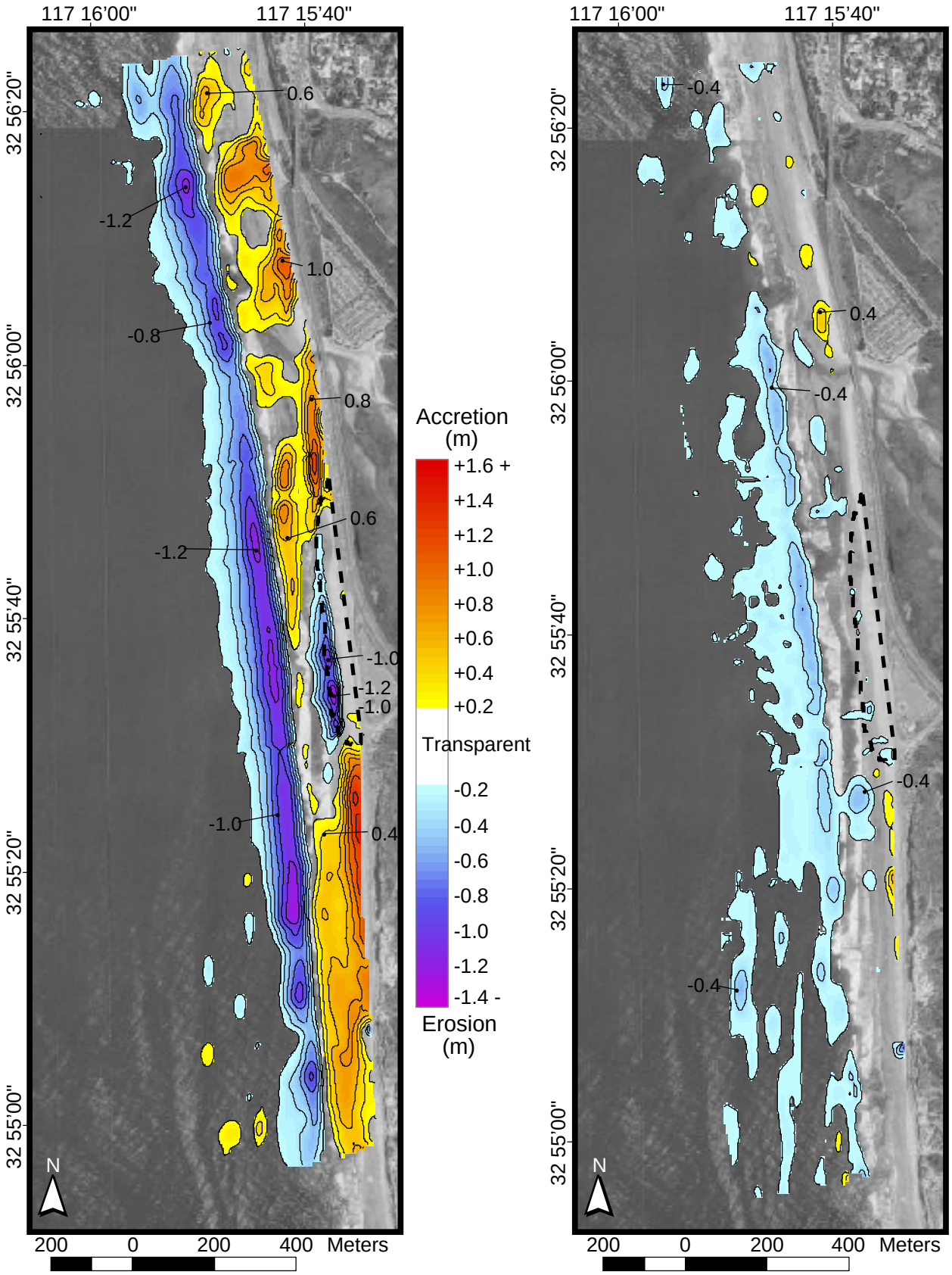


FIGURE 4c.
Left: Changes in sand level on 05 October 01 relative to 27 April 01 (the first post-nourishment survey). The contour interval is 0.2 meters (ignoring changes less than +/- 0.2 meters).
Right: Changes in sand level on 05 October 01 relative to 19 September 01 (the previous survey).

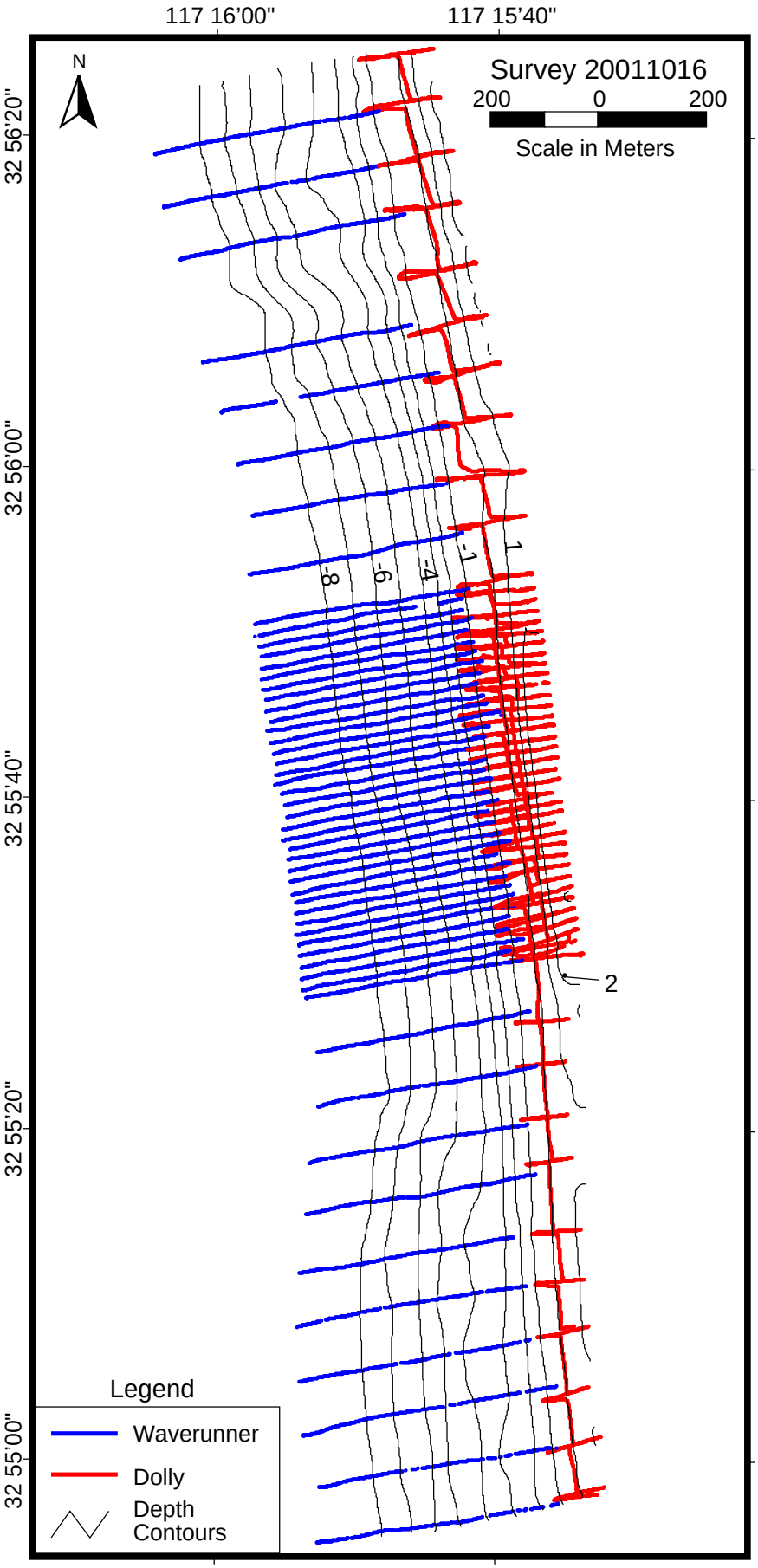


FIGURE 5a : Survey starting 16 October 01. Blue and red lines are survey tracks (waverunner and dolly respectively). Black lines are depth contours in meters (relative to mean sea level).

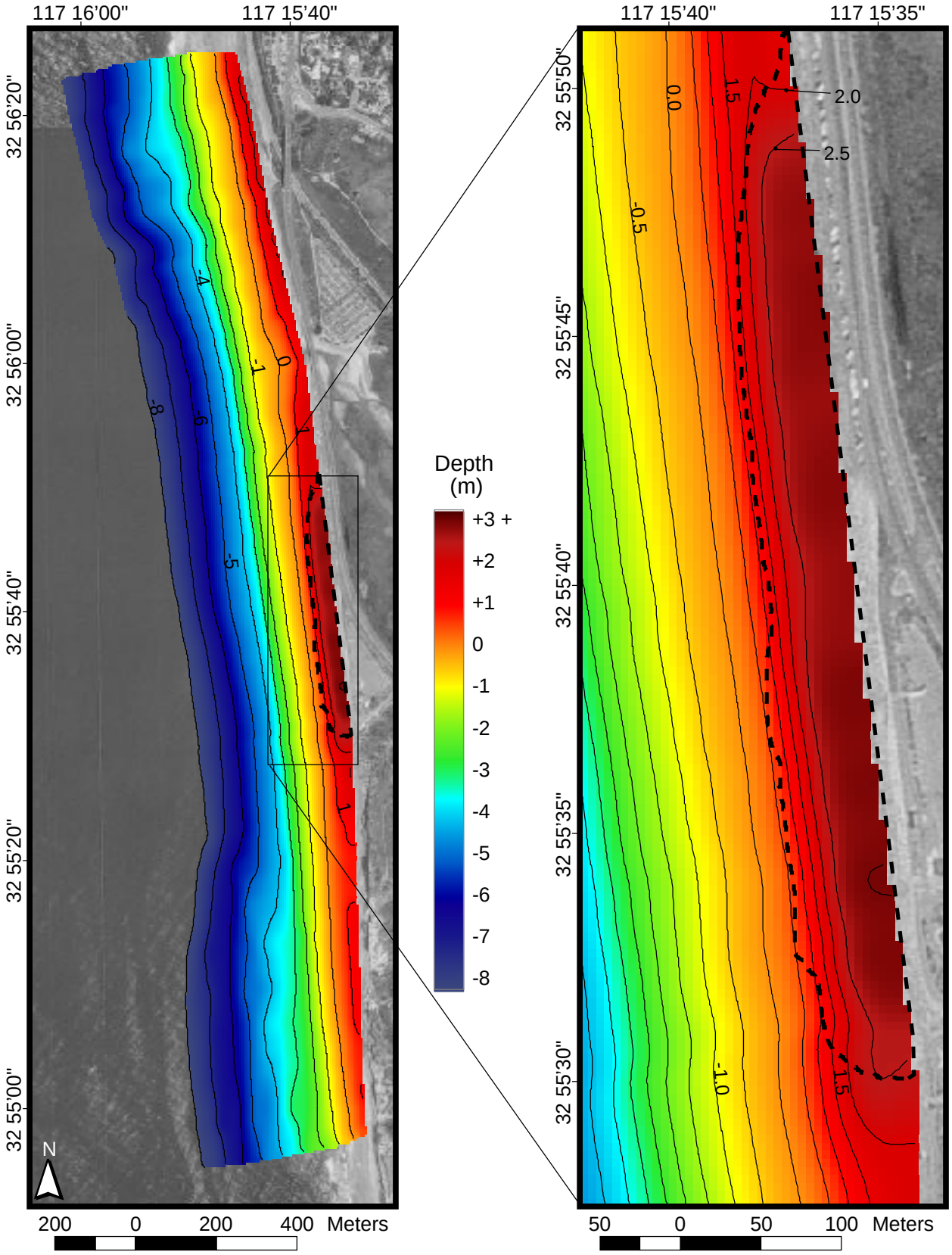


FIGURE 5b:
Left: Bathymetry measured 16 October 01 in a 3-km long strip centered on the initially nourished region (bounded by the black dashed line). The contour interval is 1.0 meters.
Right: Nourishment zone enlarged. The contour interval is 0.5 meters.

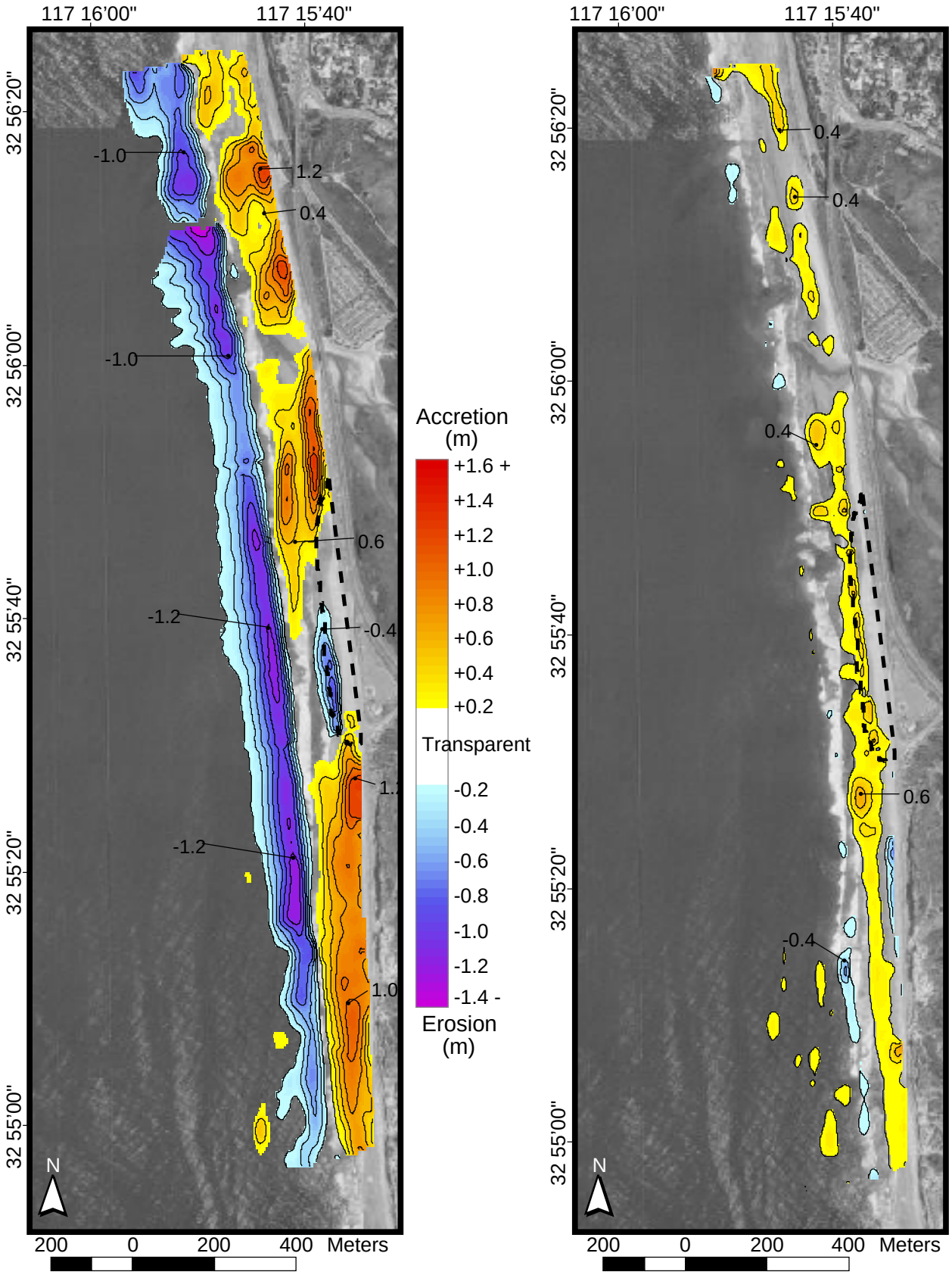


FIGURE 5c.
Left: Changes in sand level on 16 October 01 relative to 27 April 01 (the first post-nourishment survey). The contour interval is 0.2 meters (ignoring changes less than +/- 0.2 meters).
Right: Changes in sand level on 16 October 01 relative to 05 October 01 (the previous survey).

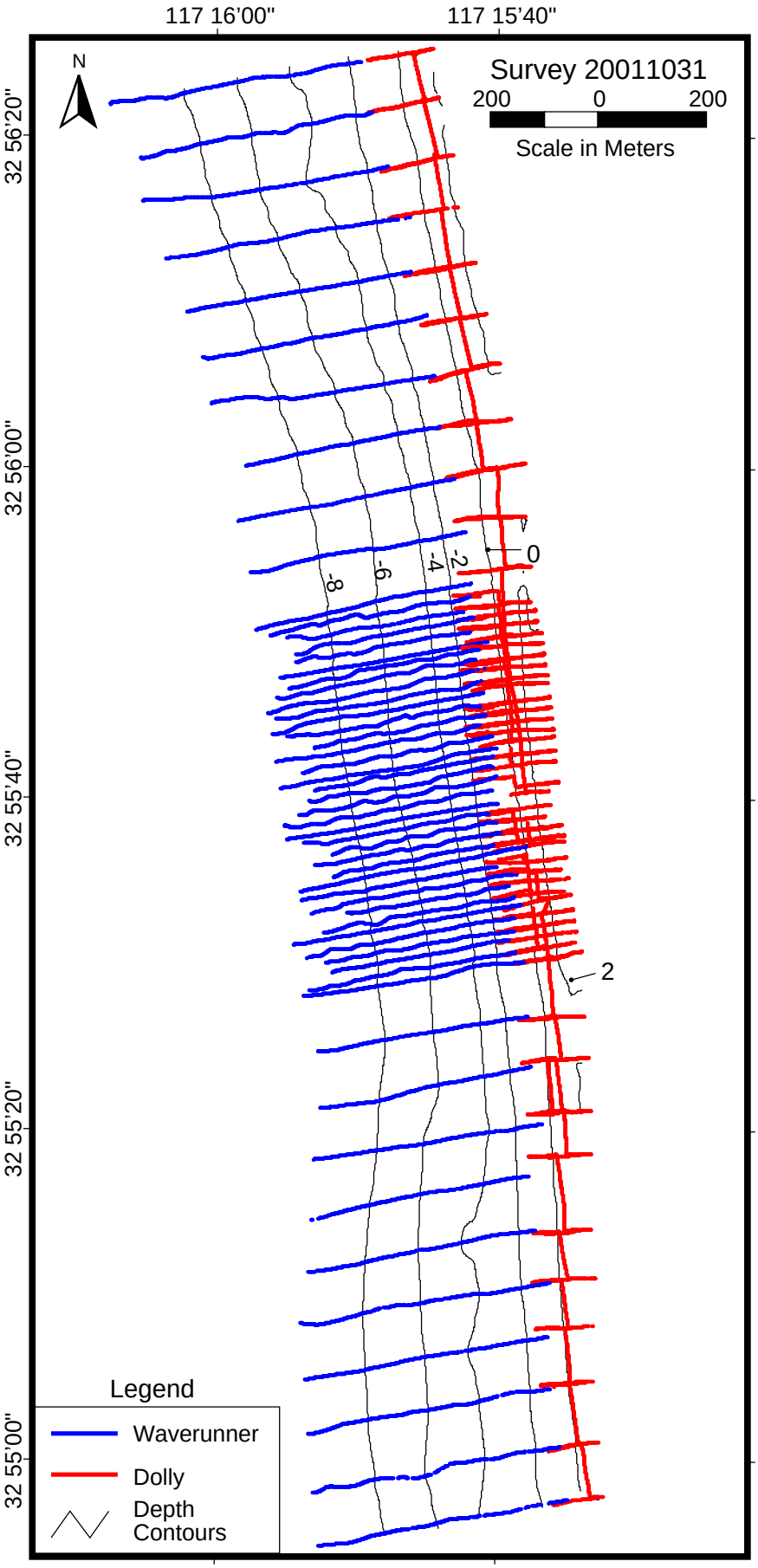


FIGURE 6a : Survey starting 31 October 01. Blue and red lines are survey tracks (waverunner and dolly respectively). Black lines are depth contours in meters (relative to mean sea level).

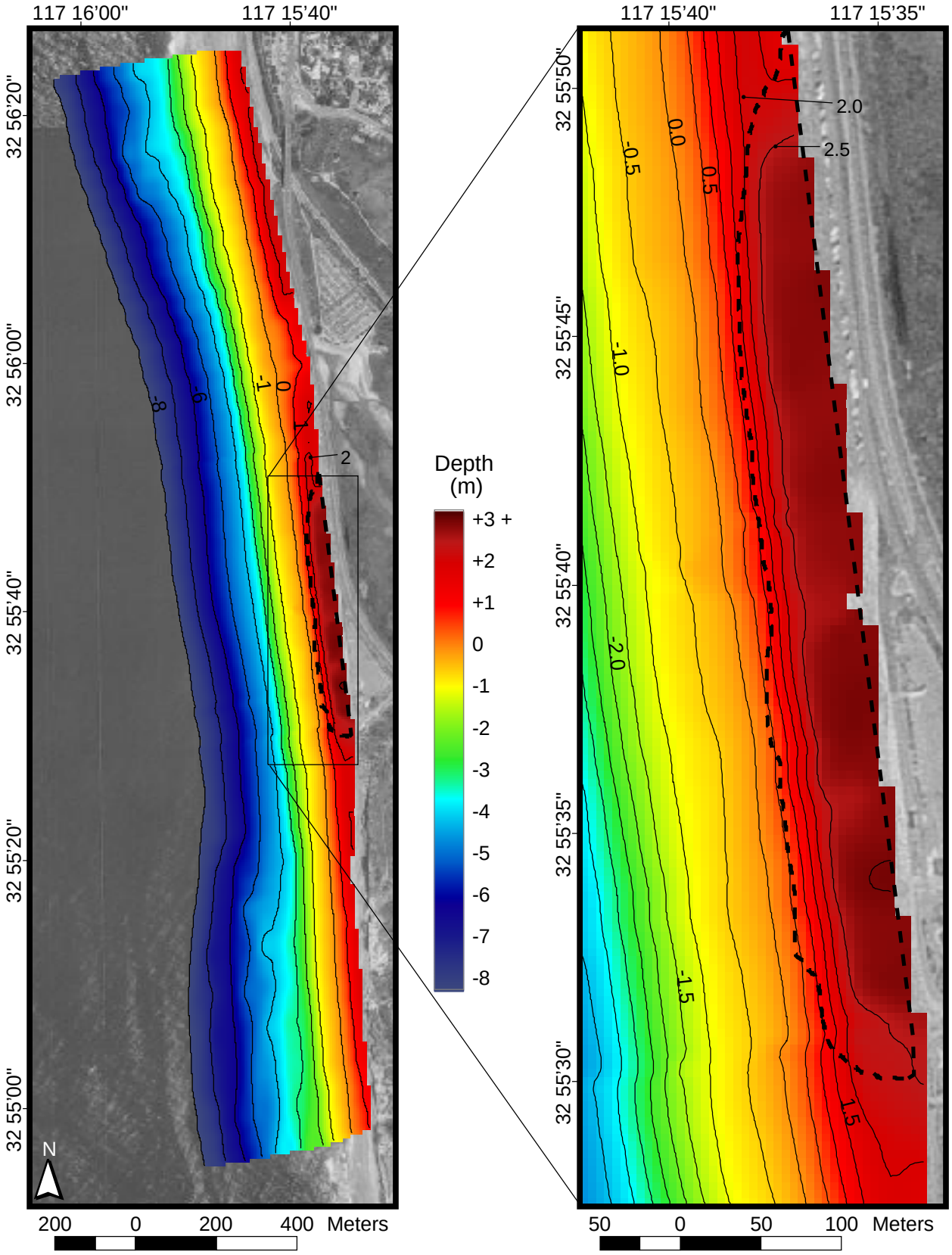


FIGURE 6b:
Left: Bathymetry measured 31 October 01 in a 3-km long strip centered on the initially nourished region (bounded by the black dashed line). The contour interval is 1.0 meters.
Right: Nourishment zone enlarged. The contour interval is 0.5 meters.

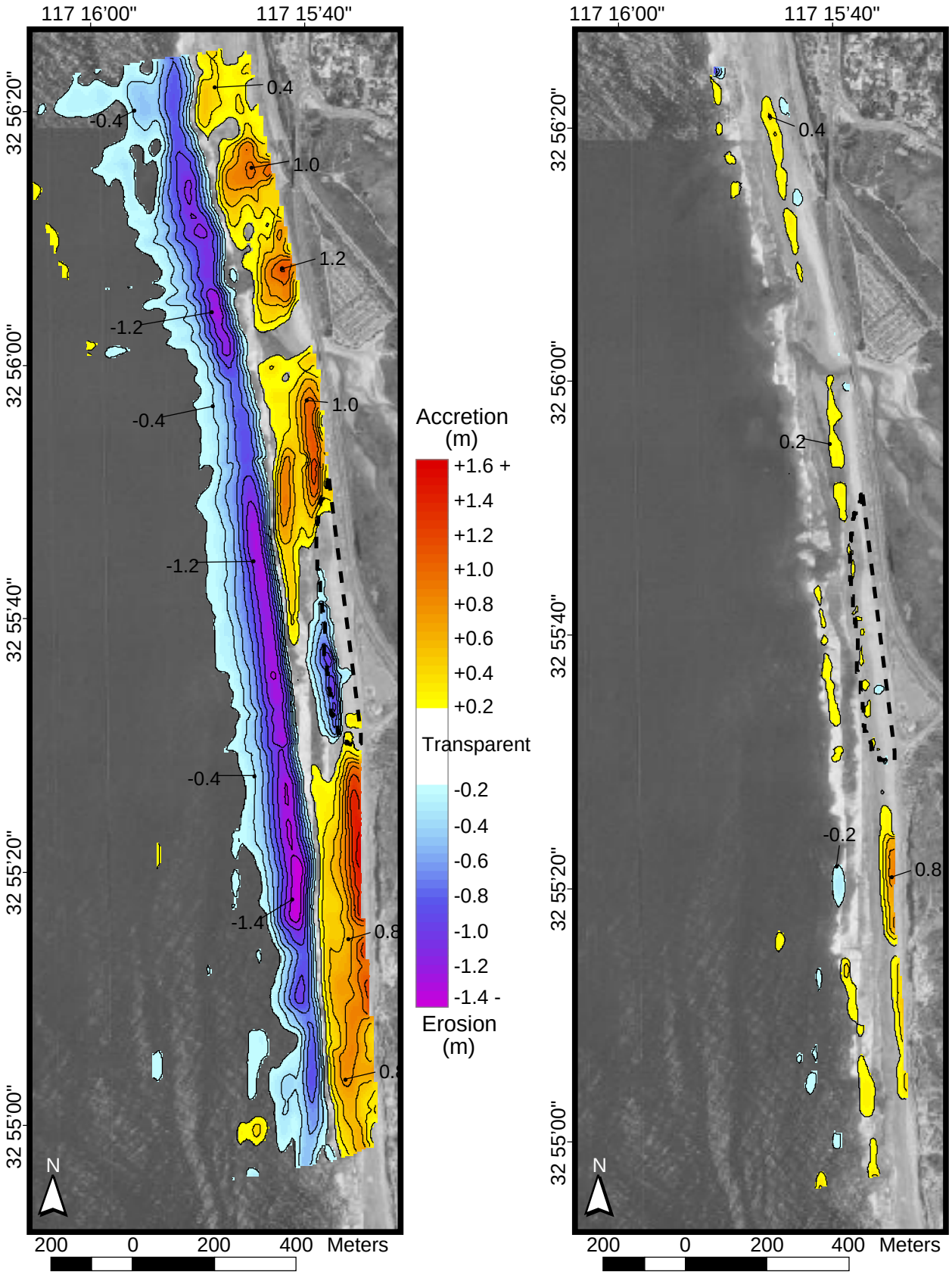
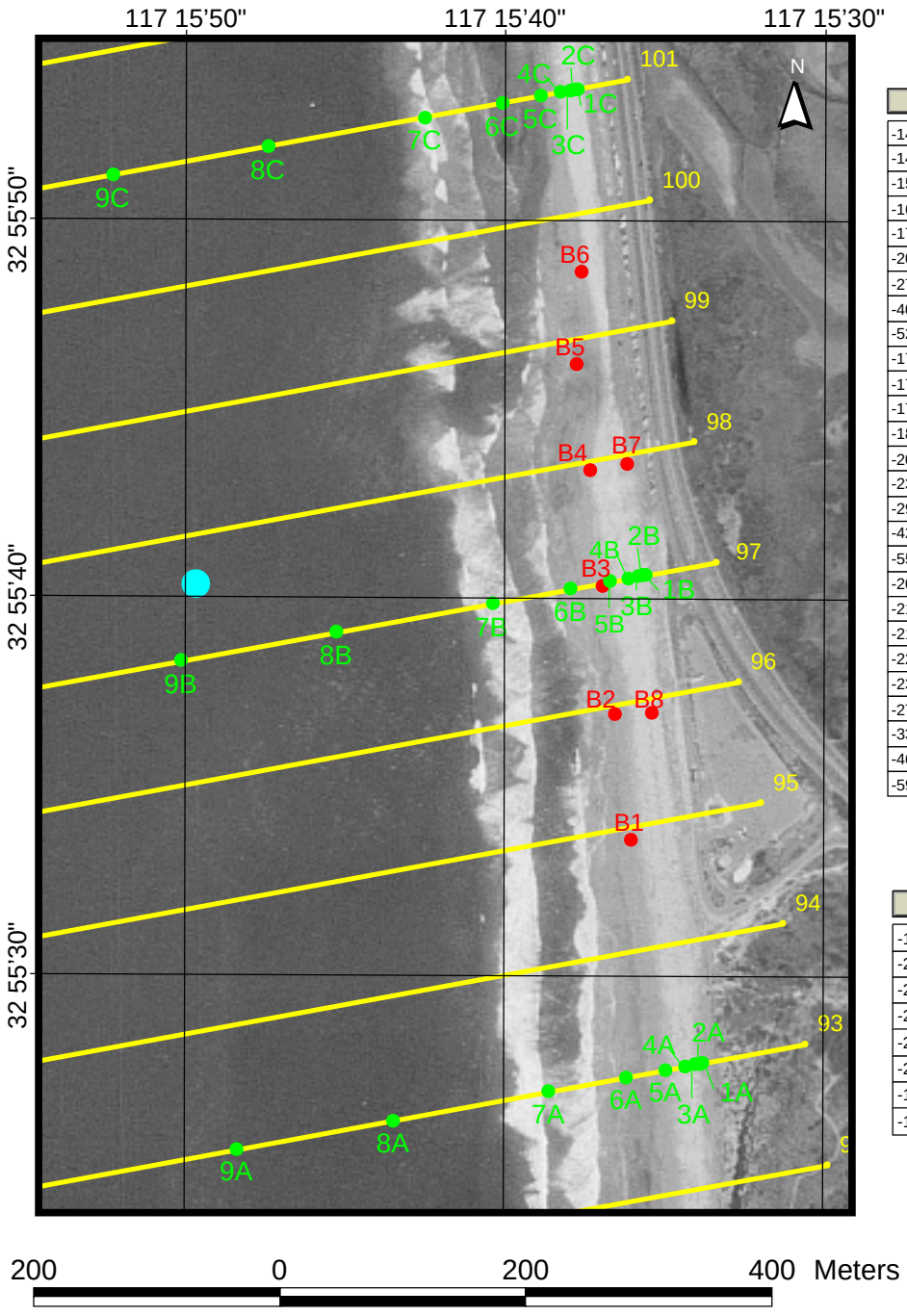


FIGURE 6c.
Left: Changes in sand level on 31 October 01 relative to 27 April 01 (the first post-nourishment survey). The contour interval is 0.2 meters (ignoring changes less than +/- 0.2 meters).
Right: Changes in sand level on 31 October 01 relative to 16 October 01 (the previous survey).

Regional Beach Sand Project

Core and Sand Sample Locations



Pre-nourishment Sand Samples

X	Y	Msl (m)	Label
-146.4751	6539.5159	1.6562	1A
-148.4651	6539.1949	1.5188	2A
-152.4651	6538.7132	1.2579	3A
-160.4651	6537.5893	0.7703	4A
-176.4651	6535.5021	0.0404	5A
-208.4651	6531.1673	-0.8199	6A
-272.4651	6522.4980	-1.2517	7A
-400.4651	6505.1605	-5.0420	8A
-528.4651	6487.9853	-7.8310	9A
-172.9441	6939.6151	1.6095	1B
-174.8441	6939.2940	1.4464	2B
-178.8441	6938.8123	1.1248	3B
-186.8441	6937.6884	0.6672	4B
-202.8441	6935.6012	-0.0021	5B
-234.8441	6931.2663	-0.8385	6B
-298.8441	6922.5967	-1.8895	7B
-426.8441	6905.2590	-3.9367	8B
-554.8441	6888.0834	-8.0167	9B
-209.3177	7338.2693	0.9963	1C
-211.2177	7337.9481	0.8535	2C
-215.2177	7337.4665	0.6080	3C
-223.2177	7336.3426	0.1839	4C
-239.2177	7334.2553	-0.4970	5C
-271.2177	7329.9203	-1.3036	6C
-335.2177	7321.2508	-1.8645	7C
-463.2177	7303.9128	-4.5733	8C
-591.2177	7286.7369	-8.0460	9C

Post-nourishment Core Samples

X	Y	Msl (m)	Label
-195.713	6724.159	2.89	B1
-203.541	6827.291	3.00	B2
-208.404	6932.350	2.55	B3
-214.234	7027.386	2.58	B4
-220.838	7113.705	2.84	B5
-213.309	7188.929	2.66	B6
-184.194	7030.371	3.17	B7
-173.605	6826.881	2.93	B8

Legend

- Core Samples
- Sand Samples
- Wave Recording Array (7.5 meters depth)
- 100 meter transects

FIGURE 7: Locations of core and surface sand samples.

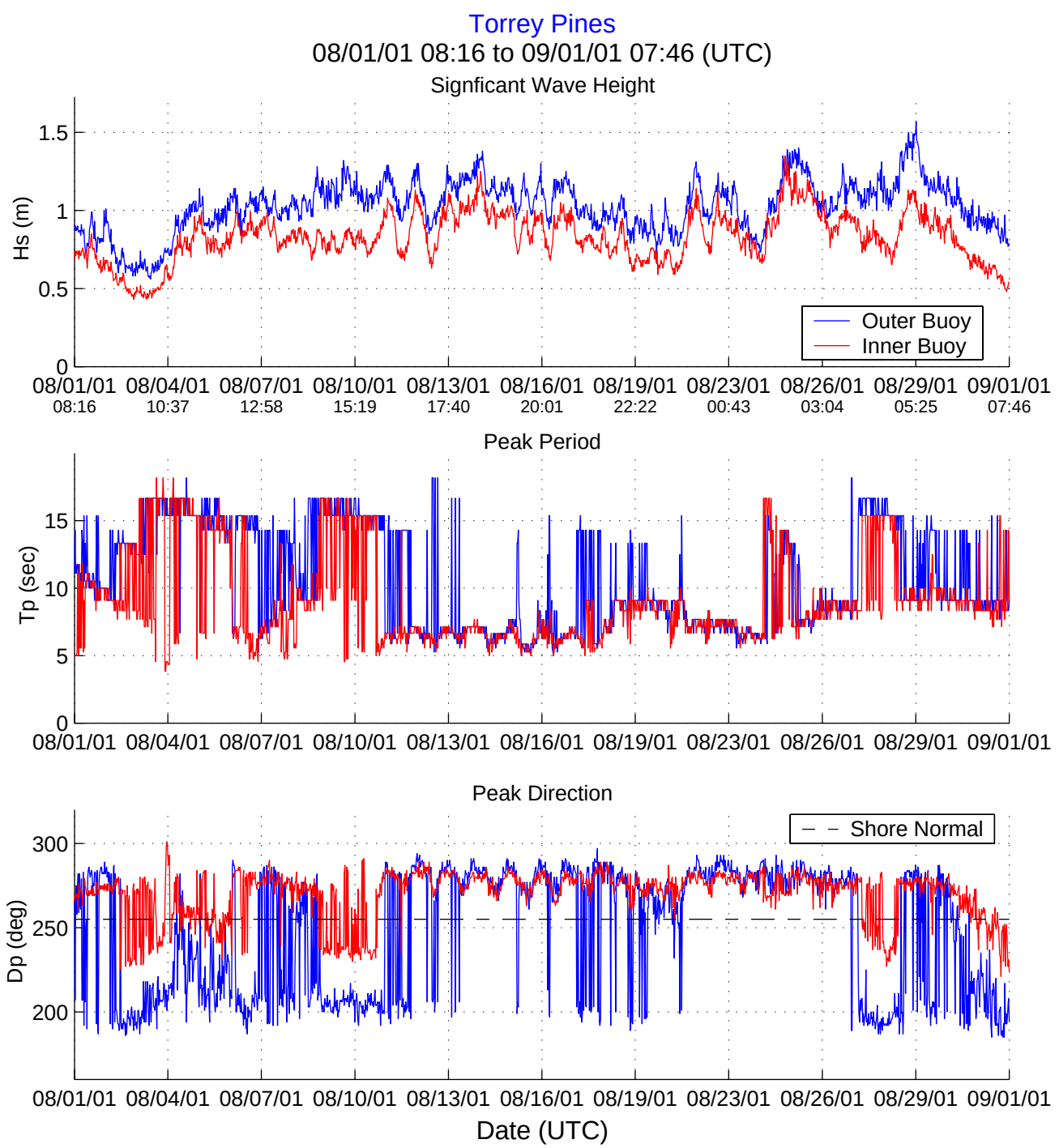


Figure 8a: August Wave Data for Torrey Pines Inner and Outer Buoys

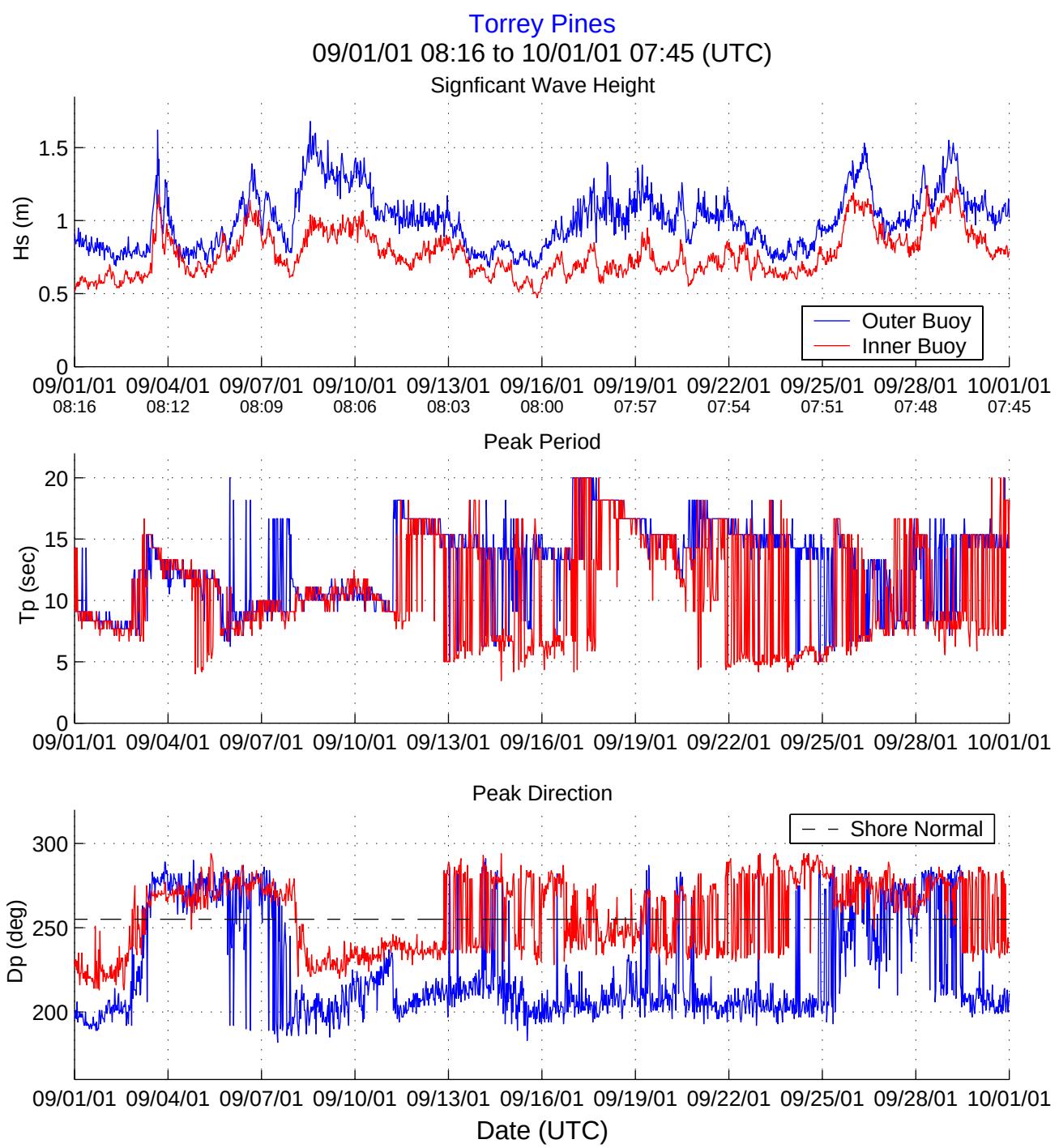


Figure 8b: September Wave Data for Torrey Pines Inner and Outer Buoys

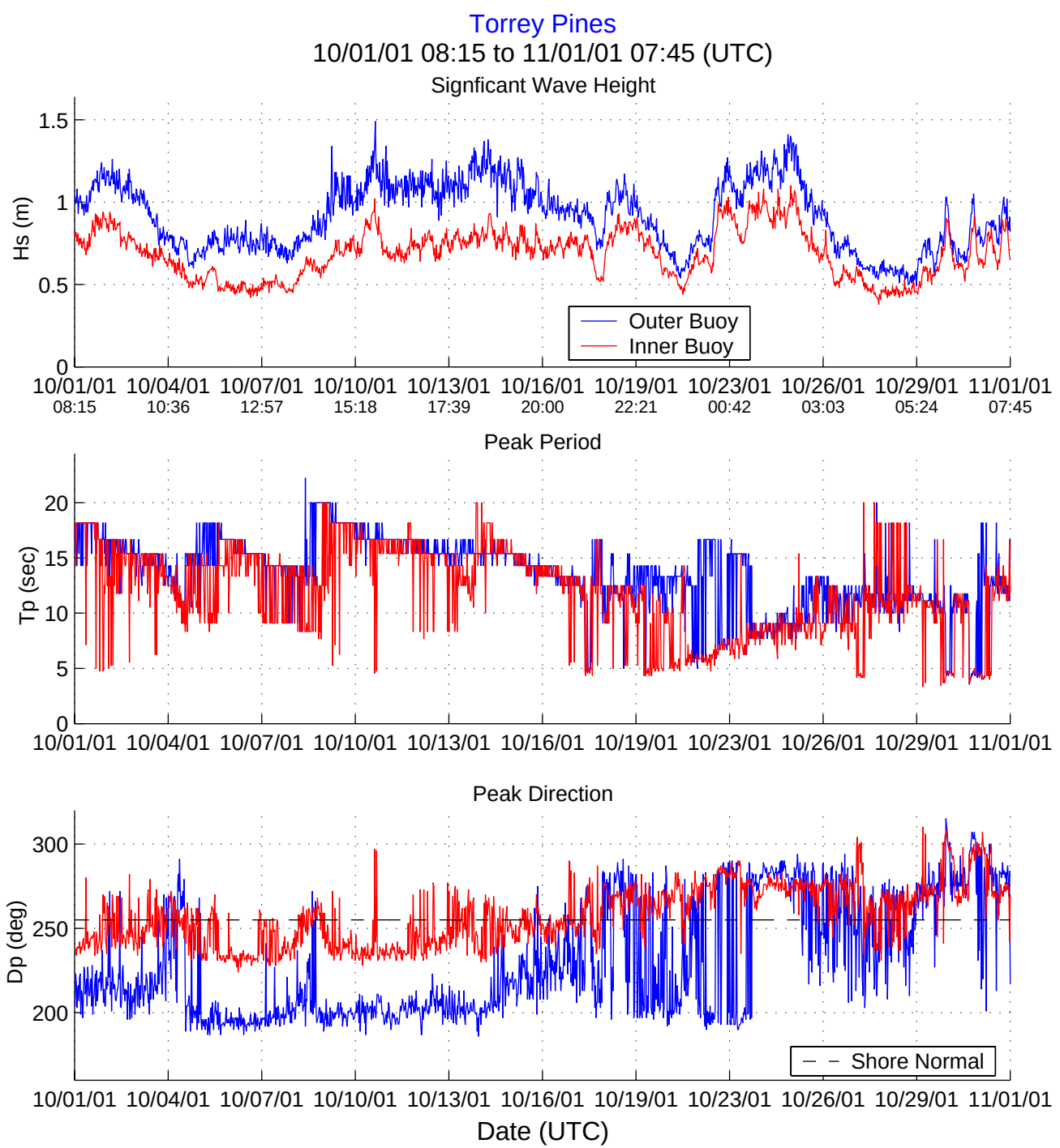


Figure 8c: October Wave Data for Torrey Pines Inner and Outer Buoys