September 19, 2011
CFC-799-10

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Subject: Bolsa Chica May 2011 Beach Profile Survey

Ms. Woodfield:

This letter report presents the methods and results of the Bolsa Chica May 2011 Beach Profile Survey. The survey represents the tenth such effort conducted in support of the Bolsa Chica Lowlands Restoration Project Beach Monitoring Program. The sections that follow provide an overview of the monitoring program, discuss the May 2011 beach profile survey, and present the results. Beach profile plots accompany this report in Attachment A.

The vertical datum used throughout this report is North American Vertical Datum of 1988 (NAVD88), with units expressed in meters. At the project site, NAVD88 lies approximately 0.06 m above National Ocean Service (NOS) Mean Lower Low Water (MLLW) and 0.79 m below NOS Mean Sea Level (MSL; NOS, 2011). In the case of the geo-referenced data, the horizontal positions are given in meters relative to California State Plane Zone 6, North American Datum of 1983 (NAD 83).

Overview

The objective of the beach monitoring program is to develop a quantitative understanding of changes in the condition of the beaches adjacent to the newly constructed Bolsa Chica Lagoon entrance channel. The program, which commenced in January 2007, is comprised of semi-annual beach profile surveys and monthly beach width measurements at seven sites located along a 5.3 km section of coastline between Bolsa Chica State Beach and 17th Street in Huntington Beach. The beach profile surveys are conducted by Coastal Frontiers Corporation, while the beach width measurements are obtained by Moffatt and Nichol.

Figure 1 shows the locations of the beach profile transects used in the monitoring program. Two of these were established specifically for the monitoring program, and were first surveyed in January 2007. Five of the transects had been established previously, and were included in the Coast of California Storm and Tidal Waves Study for the Orange County Region (CCSTWS-OC) conducted by the U.S. Army Corps of Engineers.

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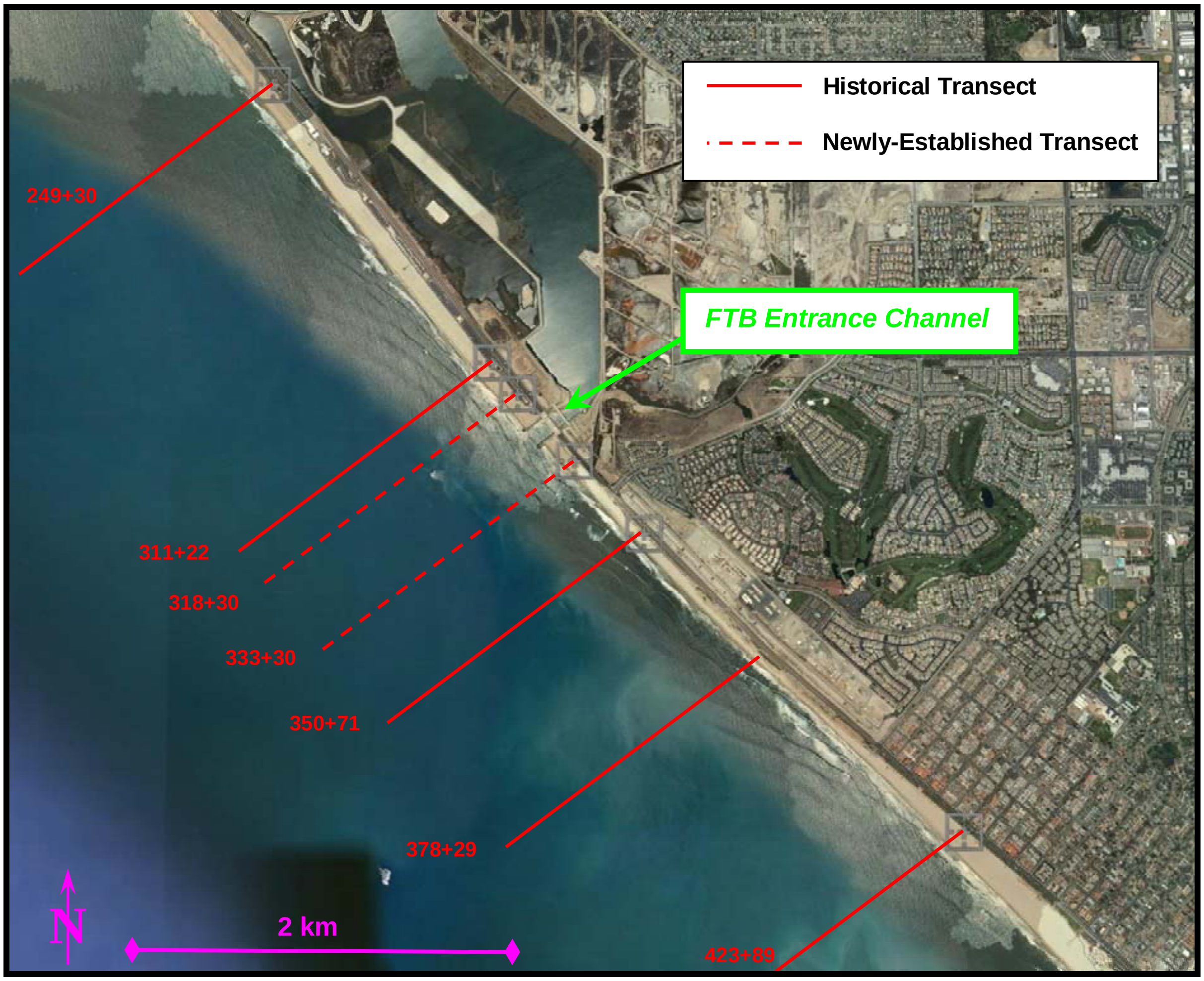


Figure 1. Location Map

<u>May 2011 Beach Profile Survey</u>

Field activities were conducted on May 12, 2011. The methods employed were similar to those used on previous Orange County surveys. In consequence, the results are directly comparable. The following sections discuss the data acquisition and reduction methods for the May 2011 Beach Profile Survey.

Beach Profile Data Acquisition

The wading and bathymetric portions of the survey were performed concurrently by two crews. Data were acquired along each transect from the back beach to a depth of approximately 14 m below NAVD88. At the time of the May 2011 survey, the wave heights were typically less than 1 m, while the wind speeds remained below 10 kts.

The beach and surf zone were surveyed using a total station and a survey rodman. The total station was used to determine the position and elevation of the beach at each location occupied by the rodman. Each transect was surveyed from the back beach seaward through the surf zone until the survey rod no longer protruded above the water surface when held erect. This location, typically in a water depth of 3.0 to 3.5 m below NAVD88, provided substantial overlap with the landward portion of the bathymetric survey.

Bathymetric data were collected with a digital acoustic echo sounder operated from a shallow-draft inflatable survey vessel. A dynamic motion sensor, which provides real-time corrections to the echo sounder for wave-induced vessel heave, also was utilized. A GPS receiver was used to determine the position of each sounding. To improve the accuracy of each position, differential corrections transmitted in real-time from U.S. Coast Guard beacons were utilized (DGPS). All systems were interfaced to a laptop computer using the Hypack Max survey package.

The boat traveled along each transect from the offshore terminus to the surf zone guided by DGPS navigation. Soundings were acquired on a continuous basis (approximately 3 soundings per second), while positions were recorded at 1-second intervals. The DGPS position data and sounding data were merged using the Hypack software, with interpolated positions being assigned to the soundings acquired between position fixes.

The calibration of the echo sounder was checked at periodic intervals during the survey using a standard “bar check” procedure. In addition, measurements of the speed of sound in sea water also were obtained at the offshore end of each transect using a recording conductivity, temperature, and depth (CTD) instrument.

Beach Profile Data Reduction

The data from the wading portion of the survey were processed using software developed by Trimble. The raw total station data were read by the software, and the coordinates and elevation of each data point were calculated and inserted into a CAD drawing.

The raw data from the bathymetric portion of the survey consisted of Hypack files containing the position data and heave-compensated soundings. These data were edited for outliers using the Hypack Single-Beam Processing Module. The dynamic motion sensor utilized during the survey removed the majority of the wave contamination from the record in real time. However, to further minimize the influence of wave-induced vessel motion on a limited number of transects, a smooth line was faired through select portions of the echo sounder record prior to digitizing it with the Hypack software package.

Corrections for the draft of the transducer and the measured speed of sound in sea water then were applied to the measured depths. The speed-of-sound profiles were confirmed using the results of the “bar check” calibration procedure. Finally, the corrected soundings were adjusted to NAVD88 Datum using tide measurements made by the U.S. Department of Commerce, NOAA, at Los Angeles Harbor. To provide a more accurate representation of local tide conditions, the water levels recorded at Los Angeles Harbor were adjusted to the project site using the time and height differences published by NOAA (NOS, 2008).

The adjusted soundings were thinned to a nominal interval of 3 m to produce a file size suitable for developing beach profile plots. The resulting x, y, z data (easting, northing, and elevation) were inserted into the CAD drawing containing the wading data. As indicated above, the field work was conducted in such a manner as to provide substantial overlap between the wading and bathymetric portions of the survey. The processed data were examined in this region to insure that the two data sets were compatible. Once this confirmatory inspection had been completed, only the more detailed data in the region of overlap were retained (typically the bathymetric data). The less detailed data were purged, after which the wading and bathymetric data were merged to create a single digital file.

Based on past experience, the vertical accuracy of the processed soundings is approximately ±15 cm. According to the Hemisphere GPS equipment specifications, the accuracy of horizontal positions obtained in the manner described above is less than 60 cm. The electronic total station used to conduct the survey is capable of measuring ranges to within ±15 cm and elevation differences to within ±3 cm. However, because the swimmer encountered waves and currents in the surf zone, the horizontal accuracy perpendicular to each transect (parallel to the shoreline) varied from minimal at short ranges to approximately ±5 m at the offshore end.

Results

The May 2011 beach profile data were used in conjunction with data from the historical surveys to create profile plots and compute changes in beach width. The beach profile plots developed from the survey data are provided in Attachment A, while the beach width changes are presented below. The range on each profile plot represents the distance in meters seaward of the transect origin. The CCSTWS-OC survey monument serves as the origin for the historical transects, while the survey markers are used for the newly-established transects. The elevations are given in meters relative to NAVD88.

The beach profile plots developed from the May 2011 survey data show those profiles obtained during the 5.5-year period from October 2005 to May 2011 as well as the envelope of all available profile data that preceded the opening of the Bolsa Chica entrance channel (May 1963 to March 2006). These plots also include two panels for each transect - one isolating the nearshore region of the profile and another displaying the entire profile length.

The May 2011 beach profile data were delivered electronically, and contained ASCII files of: (1) range and elevation for each profile, and (2) northing, easting, and elevation triplets (n,e,z) for the entire survey. In the case of the geo-referenced data, the horizontal positions are in meters relative to California State Plane Zone 6, NAD 83. As indicated previously, elevations are given in meters relative to NAVD88. It is important to note that revisions were made to the survey control at Transect 378+29 at the time of the October 2007 survey. Consequently, the results of the previous two surveys (January 2007 and May 2007) were resubmitted and should supersede all previous data deliverables.

A detailed assessment of beach changes will be provided in the annual report. General observations are offered, however, based on the profile plots (Attachment A) and the MSL beach width data presented in the tables and figures below. The MSL beach width data are reckoned from the landward extent of the sandy beach.

1.) Beach Widths (Table 1, Figure 2): At the time of the May 2011 Survey, MSL beach widths in the Bolsa Chica study area ranged from 16.0 m at Transect 378+29 to 106.6 m at Transect 423+89. Figure 2 shows the May 2011 beach widths in addition to the envelope of historical Spring beach widths (1963-2002). Beach width values exceeded the historical maximums at the nearest two transects north and south of the Full Tidal Basin (FTB) entrance channel. Similarly, Transect 423+89 also exceeded the historical Spring beach width envelope. At the two remaining transects (249+30 and 378+29), the May 2011 beach widths were within the range of historical values.

2.) Seasonal Shoreline Changes (Table 2): Converse to the expected trend of shoreline recession that typically occurs during the winter season (October through May), shoreline advance predominated during the winter 2010/2011 at Bolsa Chica-area beaches. During this period, the shoreline retreated at two of the seven sites, advanced at four, and was essentially unchanged (3 m or less) at the remaining location. The greatest shoreline loss, 6.7 m, occurred at the southern end of the study area at Transect 423+89. The greatest shoreline advances occurred directly south of the entrance channel at Transects 333+30 and 350+71, with gains of 26.2 m and 26.7 m, respectively. These gains are attributable to the placement and downcoast dispersal of dredge spoils from the FTB entrance channel maintenance activities. Given the trend of shoreline retreat at these sites since completion of the Bolsa Chica Lowlands Restoration Project, the gains may be short-lived.

3.) Annual Shoreline Changes (Table 2): During the one-year period between the May 2010 and May 2011 surveys, the MSL shoreline retreated at two sites and advanced at the remaining five locations. The greatest shoreline loss, 6.1 m, occurred at Transect 423+89 The greatest shoreline advance over the previous year, a gain of 52.5 m, occurred at

Transect 333+30. As noted previously, the sizeable gains noted immediately south of the FTB entrance channel are likely due to the FTB maintenance activities.

4.) <u>Bolsa Chica Monitoring Period Shoreline Changes (Table 2, Figure 3):</u> During the approximately five-year period (March 2006 to May 2011) encompassing the construction of the Bolsa Chica Lowlands Restoration Project, the MSL shoreline advanced at five sites and retreated at the remaining two transects. Similar to previous years, shoreline advances predominated north of the entrance channel (Transect 249+30 to 318+30). Gains were also evident immediately south of the entrance channel at Transects 333+30 and 350+71. However, these shoreline advances likely resulted from the placement of dredged material from the entrance channel maintenance activities and may be short-lived considering the trend of shoreline retreat at these sites since the FTB was constructed. The two transects at the southern end of the study area (378+29 and 423+89) both realized shoreline retreat during the five-year period. The greatest shoreline gain occurred at Transect 318+30, measuring 36.8 m. The greatest shoreline loss measured 4.7 m and occurred at Transect 378+29.

Table 1. MSL Beach Widths Derived From Profile Data

Transect	*MSL Beach Width (m)* [1, 2,3]											
	Oct 2005	***Mar 2006***	***Jan 2007***	***May 2007***	***Oct 2007***	***May 2008***	***Oct 2008***	***May 2009***	***Oct 2009***	***May 2010***	***Oct 2010***	***May 2011***
249+30	85.9	71.2	86.8	84.7	91.0	74.5	87.1	86.1	83.8	81.7	77.5	76.8
311+22	63.4	64.6	70.3	76.2	85.5	86.3	87.1	83.0	85.9	92.3	91.4	96.5
318+30	70.5	64.1	85.9	86.1	82.7	93.5	93.5	97.2	104.1	97.3	97.3	100.9
333+30	79.3	67.5	66.6	61.9	72.3	46.8	80.5	72.2	78.7	40.6	66.9	93.1
350+71	62.1	53.6	54.1	48.9	54.8	42.6	57.2	47.6	59.8	46.5	50.6	77.3
378+29	36.1	22.3	23.9	27.8	41.1	21.3	26.4	25.1	30.7	10.0	20.8	16.0
423+89	120.2	111.3	110.5	106.9	113.3	108.8	106.6	103.2	111.9	112.7	113.3	106.6

Notes:

(1) Mean Sea Level (MSL) lies 0.79 m above NAVD88 datum.
(2) MSL beach width reckoned from the landward extent of the sandy beach.
(3) October 2005 and March 2006 beach profile data generated from LIDAR with a TIN model, topography only.

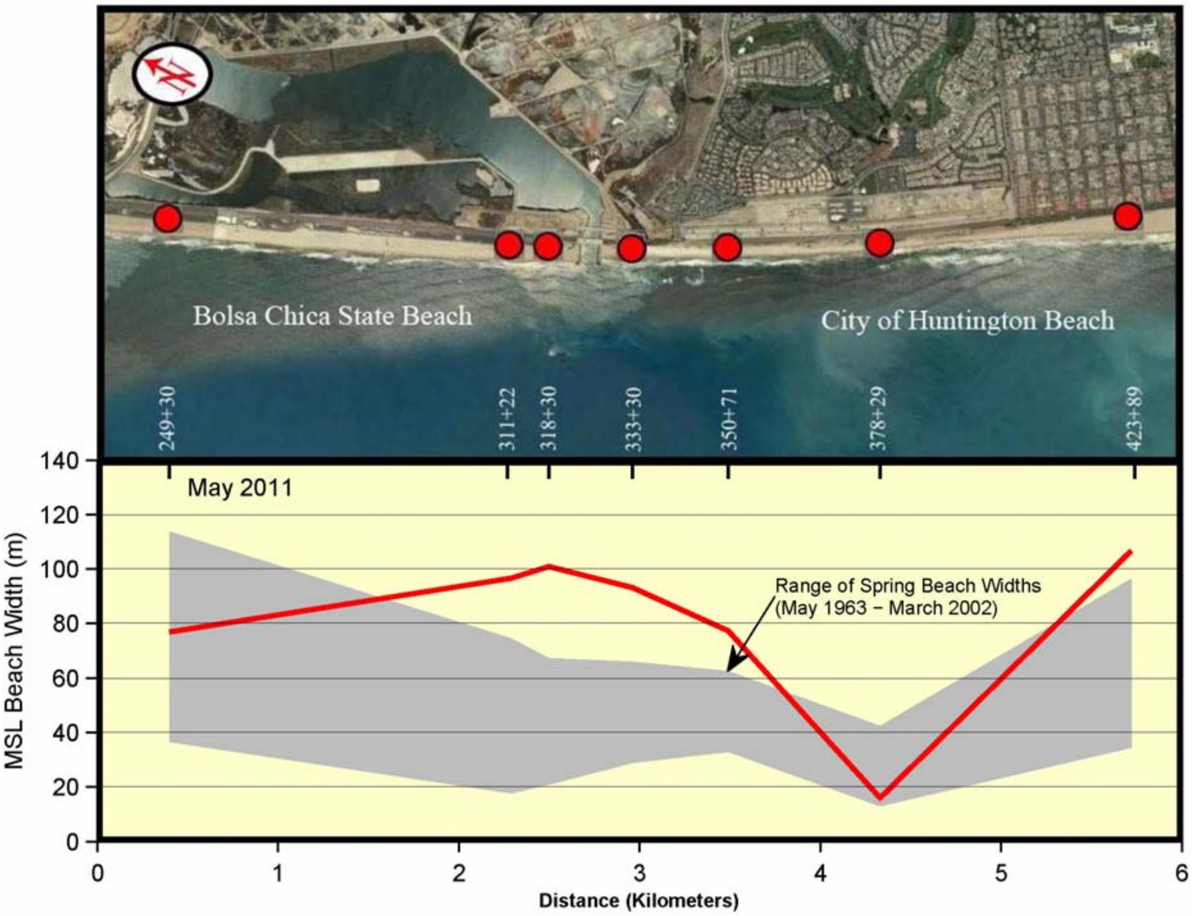


Figure 2. May 2011 Beach Widths

Table 2. MSL Shoreline Changes Derived From Beach Profile Data

Transecto	*MSL Shoreline Change (m)*		
	Annual	**Winter Seasonal**	**Bolsa Chica [1] Monitoring Period**
	May 2010 - May 2011 (12 months)	***October 2010 - May 2011 (7 months)***	***March 2006 - May 2011 (~5 years)***
249+30	-4.9	-0.7	5.6
311+22	4.2	5.1	31.9
318+30	3.6	3.6	36.8
333+30	52.5	26.2	25.6
350+71	30.8	26.7	23.7
378+29	6.0	-4.8	-6.3
423+89	-6.1	-6.7	-4.7

Note:

(1) March 2006 beach profile data generated from LIDAR with a TIN model, topography only.

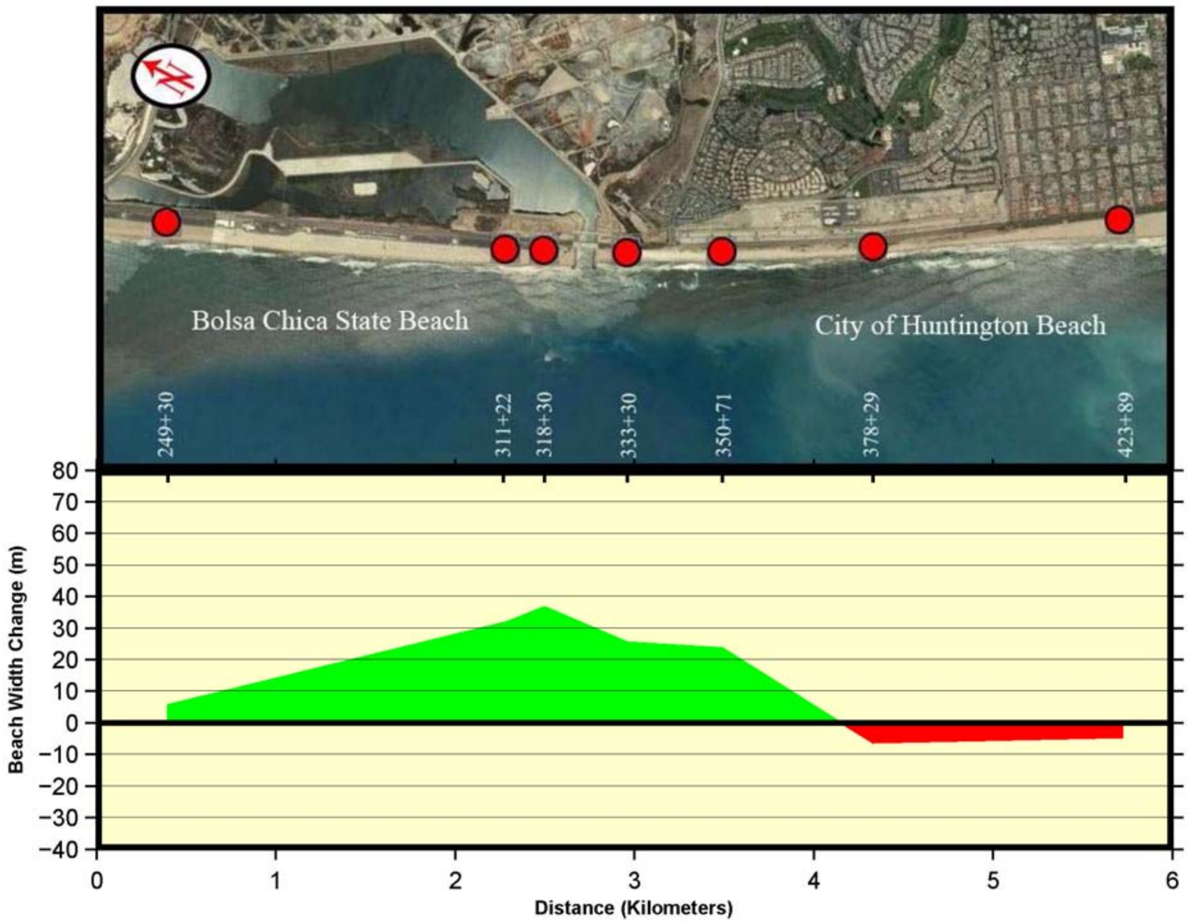


Figure 3. Bolsa Chica Monitoring Period Shoreline Changes, March 2006 to May 2011

We have sincerely appreciated the opportunity to assist Merkel and Associates, and look forward to continued participation in the Beach Monitoring Program. Please do not hesitate to contact us if you have any questions or require additional information.

Sincerely,
Coastal Frontiers Corporation

Gregory E. Hearon, P.E.	Brady Richmond, P.E.
Principal	Project Engineer

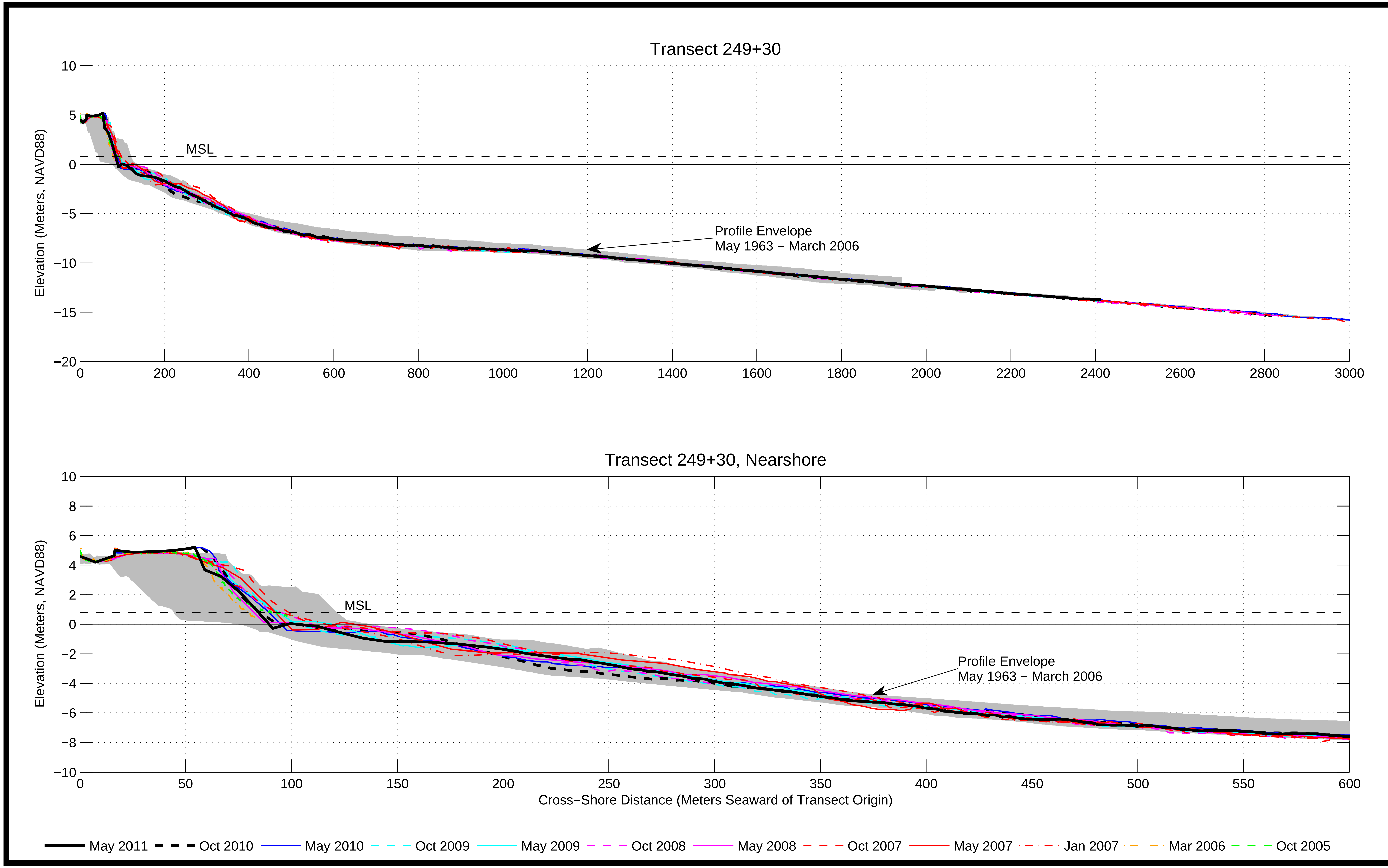
Attachments: (A) Beach Profile Plots

References

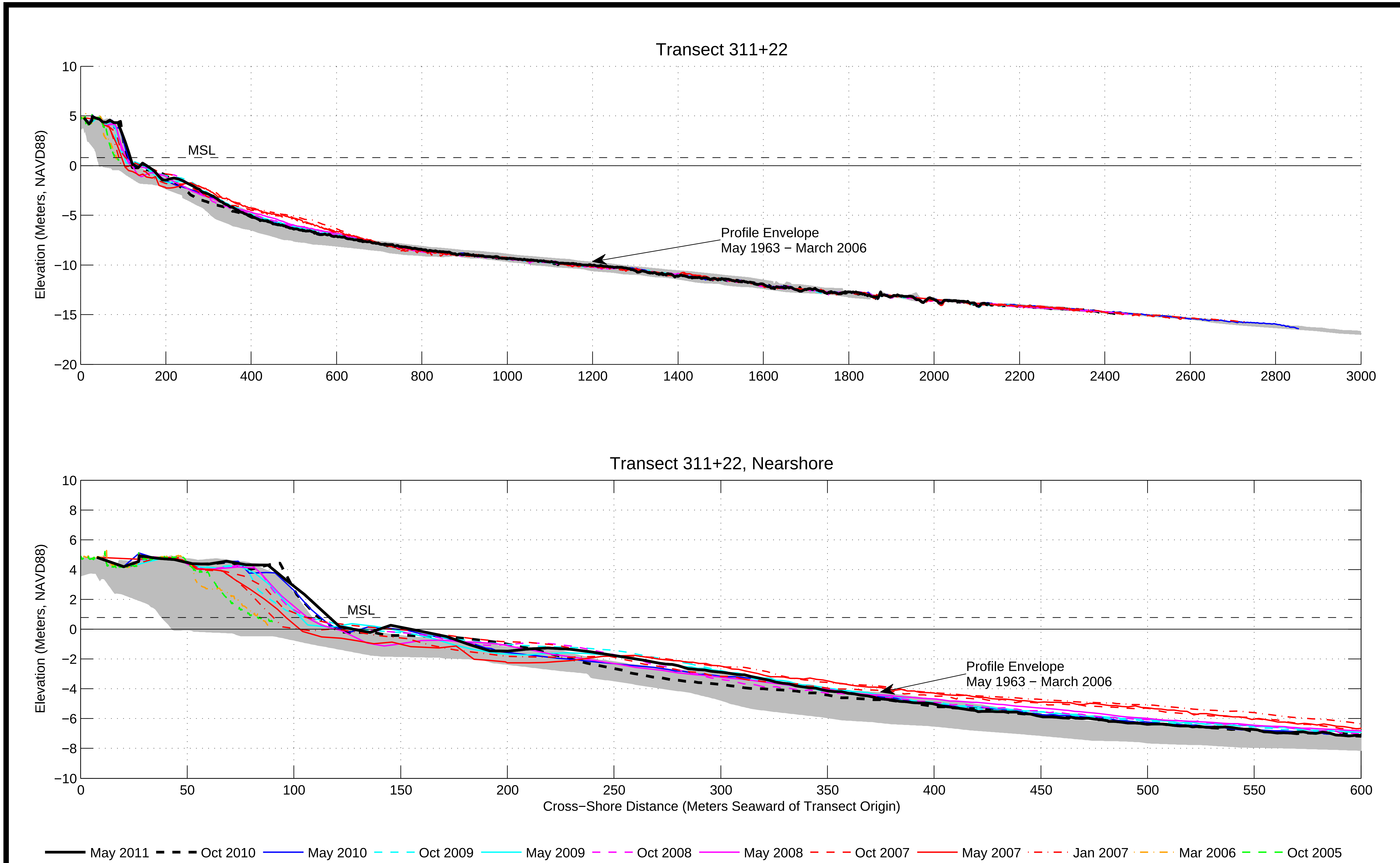
National Ocean Service (NOS). 2011. Center for Operation Oceanographic Products and Services. http://co-ops.nos.noaa.gov.

Attachment A

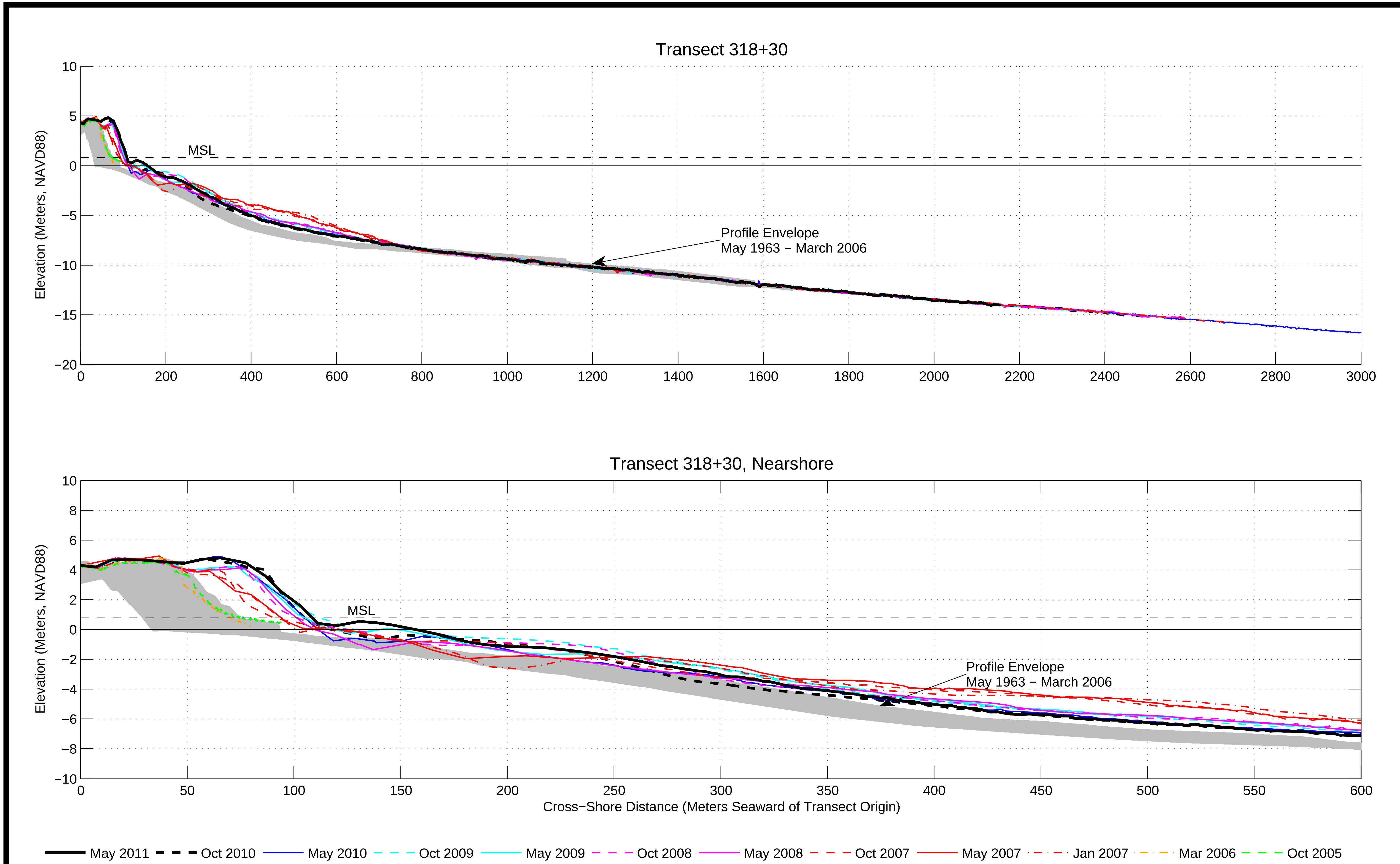
Beach Profile Plots



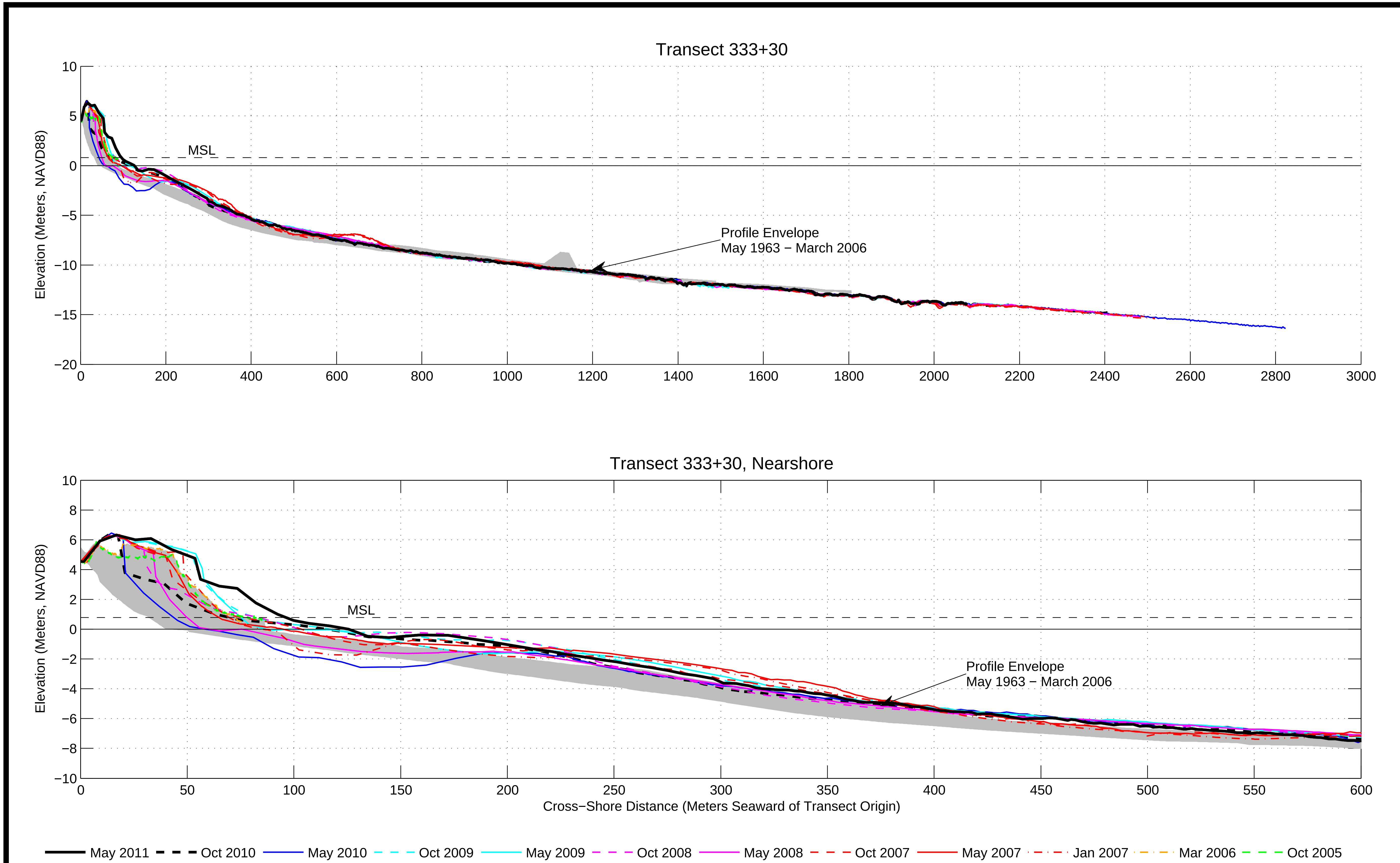
Transect 249+30
Elevation (Meters, NAVD88)
MSL
Profile Envelope
May 1963 − March 2006
Transect 249+30, Nearshore
Cross−Shore Distance (Meters Seaward of Transect Origin)
May 2011
Oct 2010
May 2010
Oct 2009
May 2009
Oct 2008
May 2008
Oct 2007
May 2007
Jan 2007
Mar 2006
Oct 2005



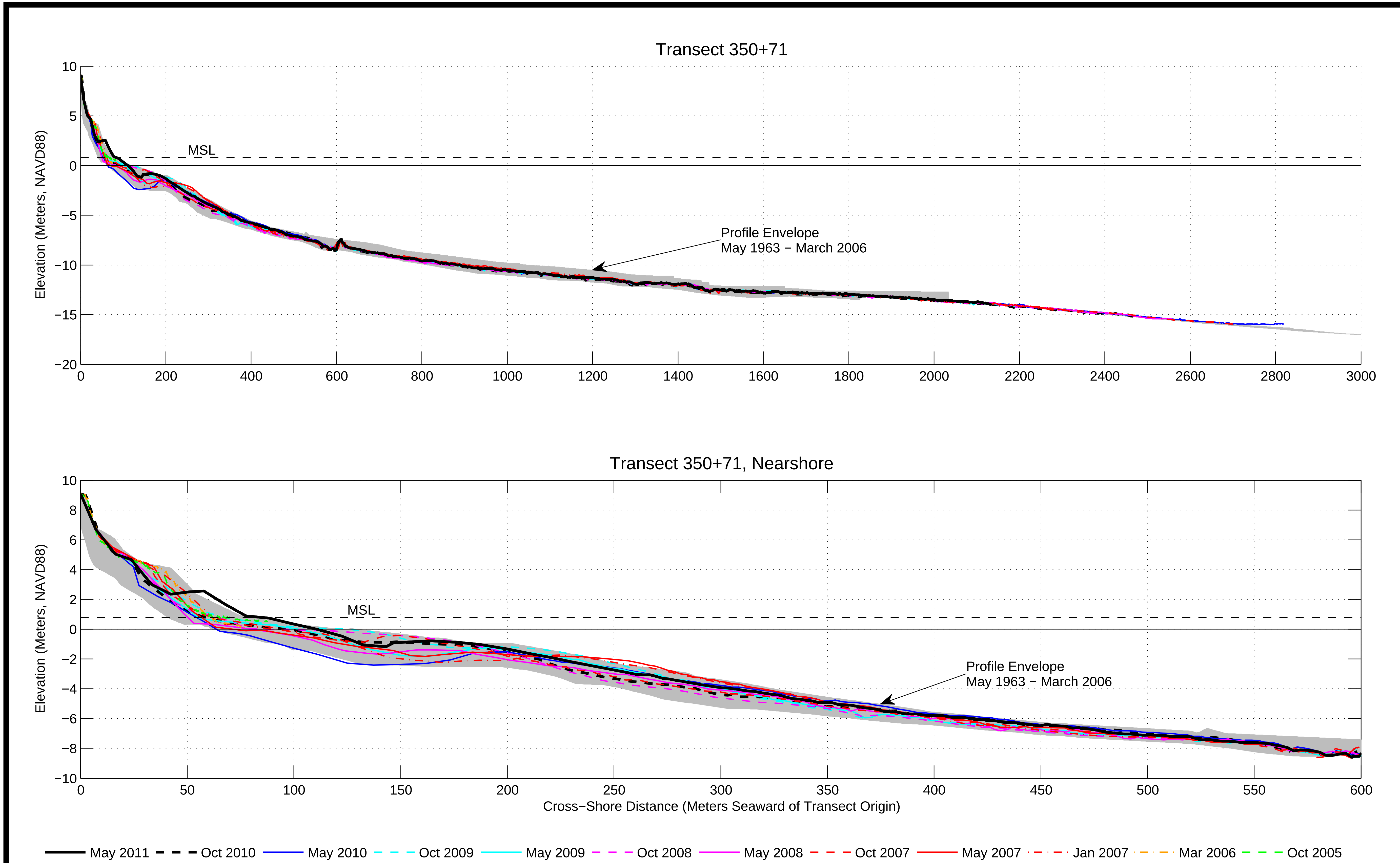
Transect 311+22
Elevation (Meters, NAVD88)
MSL
Profile Envelope
May 1963 − March 2006
Transect 311+22, Nearshore
Cross−Shore Distance (Meters Seaward of Transect Origin)
May 2011
Oct 2010
May 2010
Oct 2009
May 2009
Oct 2008
May 2008
Oct 2007
May 2007
Jan 2007
Mar 2006
Oct 2005



Transect 318+30
Elevation (Meters, NAVD88)
MSL
Profile Envelope
May 1963 − March 2006
Transect 318+30, Nearshore
Cross−Shore Distance (Meters Seaward of Transect Origin)
May 2011
Oct 2010
May 2010
Oct 2009
May 2009
Oct 2008
May 2008
Oct 2007
May 2007
Jan 2007
Mar 2006
Oct 2005



Transect 333+30
Elevation (Meters, NAVD88)
MSL
Profile Envelope
May 1963 − March 2006
Transect 333+30, Nearshore
Cross−Shore Distance (Meters Seaward of Transect Origin)
May 2011
Oct 2010
May 2010
Oct 2009
May 2009
Oct 2008
May 2008
Oct 2007
May 2007
Jan 2007
Mar 2006
Oct 2005


Transect 350+71
Elevation (Meters, NAVD88)
MSL
Profile Envelope
May 1963 − March 2006
10
5
0
−5
−10
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−20
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
3000
Transect 350+71, Nearshore
Elevation (Meters, NAVD88)
MSL
Profile Envelope
May 1963 − March 2006
10
8
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−2
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−8
−10
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250
300
350
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450
500
550
600
Cross−Shore Distance (Meters Seaward of Transect Origin)
May 2011
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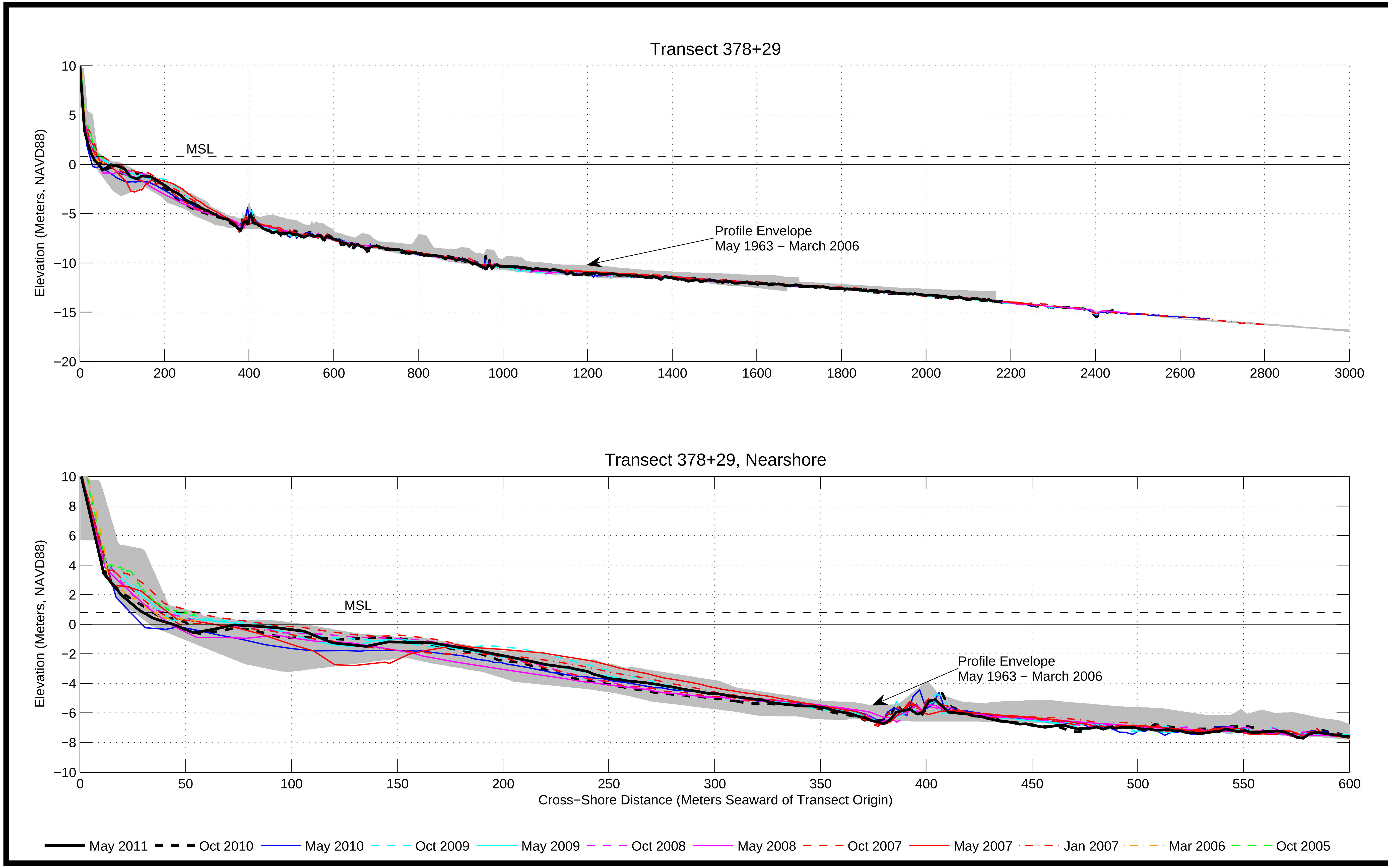
Oct 2009
May 2009
Oct 2008
May 2008
Oct 2007
May 2007
Jan 2007
Mar 2006
Oct 2005


Transect 378+29
Elevation (Meters, NAVD88)
MSL
Profile Envelope
May 1963 − March 2006
Transect 378+29, Nearshore
Elevation (Meters, NAVD88)
MSL
Profile Envelope
May 1963 − March 2006
Cross−Shore Distance (Meters Seaward of Transect Origin)
May 2011
Oct 2010
May 2010
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May 2008
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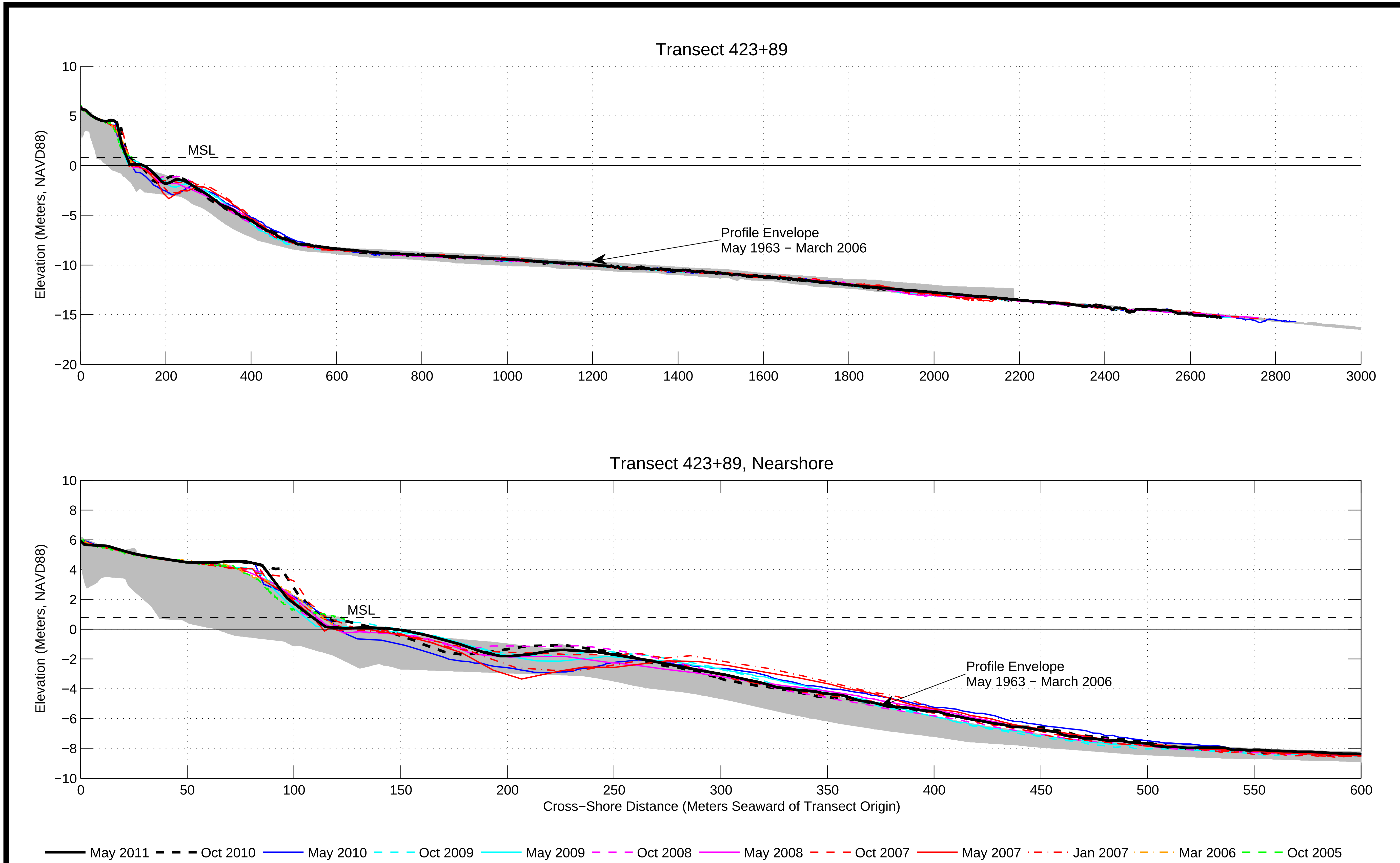
Mar 2006
Oct 2005



Transect 423+89
Elevation (Meters, NAVD88)
MSL
Profile Envelope
May 1963 − March 2006
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2200
2400
2600
2800
3000
Transect 423+89, Nearshore
Elevation (Meters, NAVD88)
MSL
Profile Envelope
May 1963 − March 2006
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350
400
450
500
550
600
Cross−Shore Distance (Meters Seaward of Transect Origin)
May 2011
Oct 2010
May 2010
Oct 2009
May 2009
Oct 2008
May 2008
Oct 2007
May 2007
Jan 2007
Mar 2006
Oct 2005