

Introduction

This report presents the change in elevation recorded by three LiDAR surveys of Bawdsey Beach within Hollesley Bay on the Suffolk coast. The extent of the area assessed runs from just north of East Lane Bawdsey to the beach fronting Bawdsey Manor.

This report is produced as part of the Anglian Coastal Monitoring (ACM) project. The ACM project is a partnership programme of coastal surveys providing long term data for coastal monitoring and analysis. More information about the project can be found at: <http://www.coastalmonitoring.org/anglia/> and at the East Anglia Coastal Group: http://www.eacg.org.uk/default_monitoring.asp.

Data collection and analysis

This report assesses change measured by three airborne LiDAR surveys on the following dates.

- 13 January 2012
- 19 November 2012
- 06 October 2013

In addition, data from our walked GNSS topographic transect surveys is used to show how the LiDAR data compare to the surveys collected on the ground every summer and winter since 1991. The difference model is overlaid on our summer 2014 aerial photography.

All data are collected by the Environment Agency as part of the ACM project. For information on airborne LiDAR as a method of measuring ground elevation please read our LiDAR Survey Information sheet. For information about ground topographic surveys of beach transects please read our Topographic Survey Information sheet. Both are available from the project website or by request to ACM@environment-agency.gov.uk

The output of the LiDAR survey is a point cloud of millions of data returns, each containing location information, signal intensity and an elevation. From this we produce a Digital Surface Model (DSM), this is an unfiltered representation of the beach and ground surfaces. The LiDAR has a 1 m spatial resolution, this means an elevation measurement every metre on the ground. From this DSM a cross section or profile, along the same transect line that we survey on foot, is extracted. These beach cross sections are then compared to the annual topographic survey data. The DSMs themselves are compared by creating a difference model, which shows the change between two DSMs from two LiDAR survey datasets. Two difference models are shown in this report (January 2012 – November 2012 and January 2012 – October 2013). To minimise any errors caused by systematic offset between the two LiDAR datasets, the data are normalised based on areas of no change such as concrete and tarmac surfaces, before any analysis is carried out.

The LiDAR datasets provide an observation of change over three surveys across 2012 and 2013. A 2015 dataset will soon be available for comparison. However the topographic surveys extend from 1991 through to present and are surveyed every summer and winter. Therefore these surveys provide a better picture of the trends and longer term changes of the beach profile. The profiles only provide an indicator of what is happening along the frontage, whereas the LiDAR survey provides data coverage of the whole beach. The difference models also clearly identify potential sediment movement alongshore, and areas of accumulation and erosion.

LiDAR elevation change

In the following plots increased elevation, such as the result of deposition and accumulation of sediment on the beach is shown in a graded scale of blue. Areas of erosion or lowering elevation are coloured red. When there is no significant change (\pm 25 cm) the data is not included in the difference model.

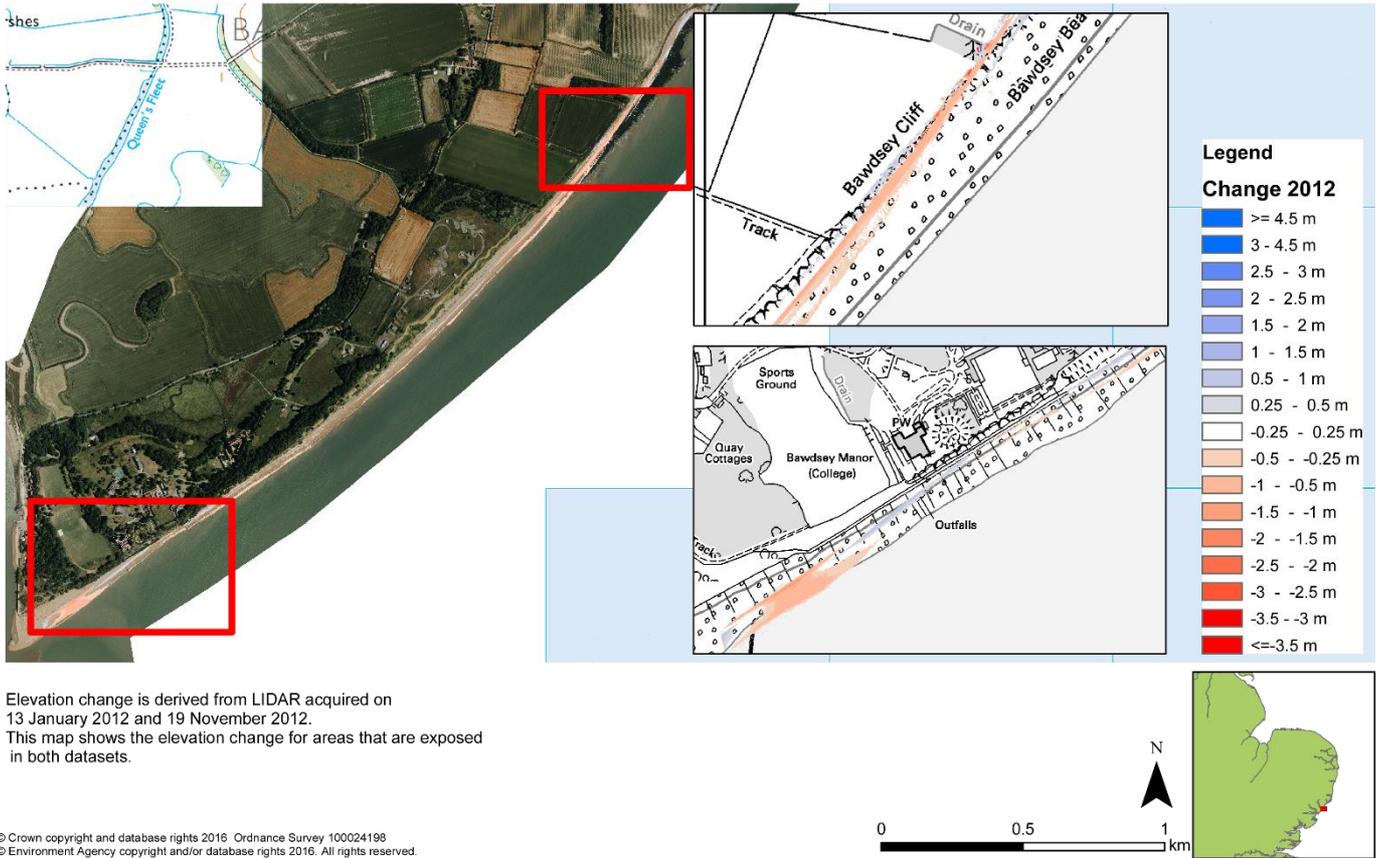


Figure 1: LiDAR difference model showing elevation change between January 2012 and November 2012.



Figure 2: Land survey (2015) and aerial photograph (2014) of the beach at the location of transect BW072

There is a noticeable area of erosion south of Bawdsey Manor, however over the year sediment can be seen to have accumulated at the point to feed on to The Knolls in the River Deben. This accumulation on the lower beach can be seen in the profiles at transect BW072 (Figure 4).



Figure 3: LiDAR difference model showing elevation change between January 2012 and October 2013.

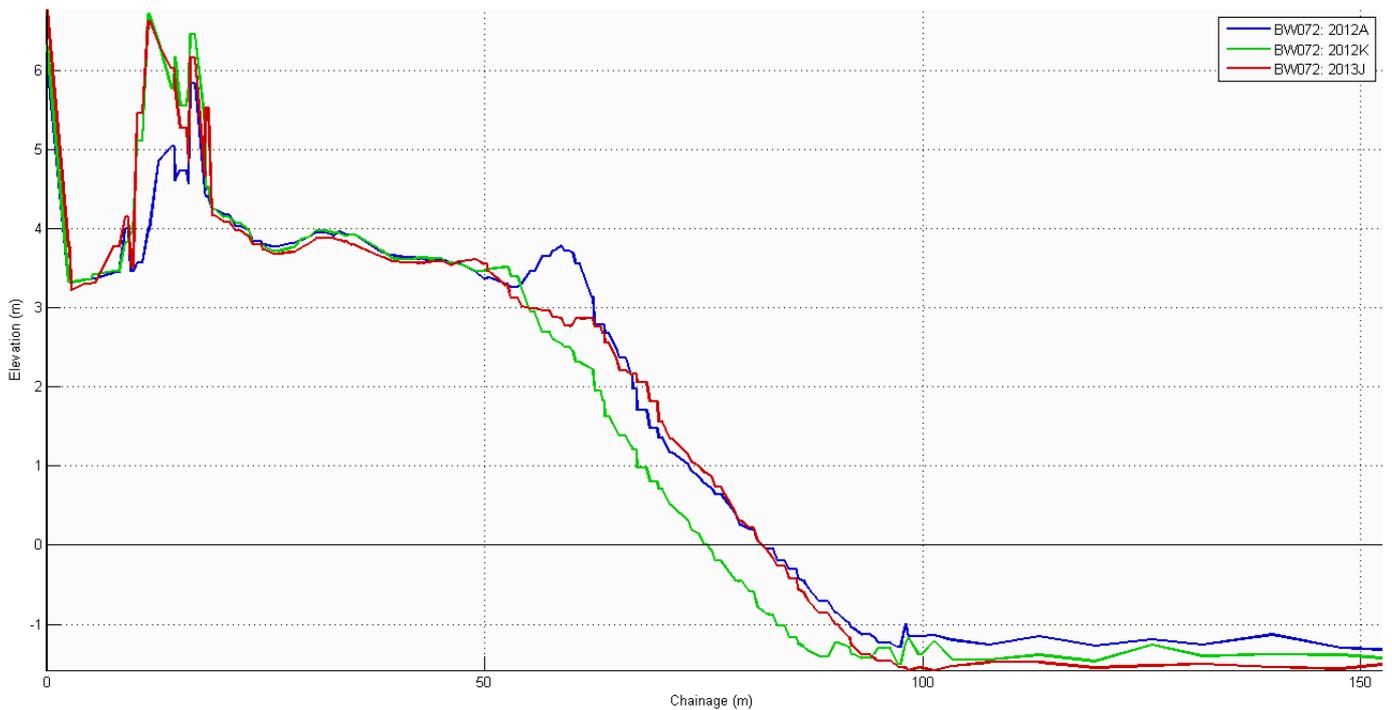


Figure 4: Beach profiles extracted from the three LiDAR surveys along transect BW072 at the southern end of Bawdsey Beach.

There is erosion on the upper beach section fronting Bawdsey Cliffs. The soft cliffs here are fronted with a shingle beach. Whereas the lower beach is exposed clay and relatively stable. The profiles extracted from the LiDAR seen in Figure 5 show that the erosion is the movement of the shingle beach that runs from the toe of the cliff. This is not a redistribution of the sediment across the beach profile and the longer topographic surveys show the cliff toe is exposed when the shingle beach is not present, such as in October 2013. However at transect BW016, just south of the Martello Tower at East Lane Bawdsey the most significant cliff erosion recorded occurred between 2009 and 2011, where the cliff face moved back 20 m. At this time the shingle beach was removed, and although the beach is now at a much lower elevation the cliff erosion has slowed significantly. The beach, a mix of shingle and fallen material, has built up around the toe of the cliff, the photograph in 2015 also shows vegetation growth.

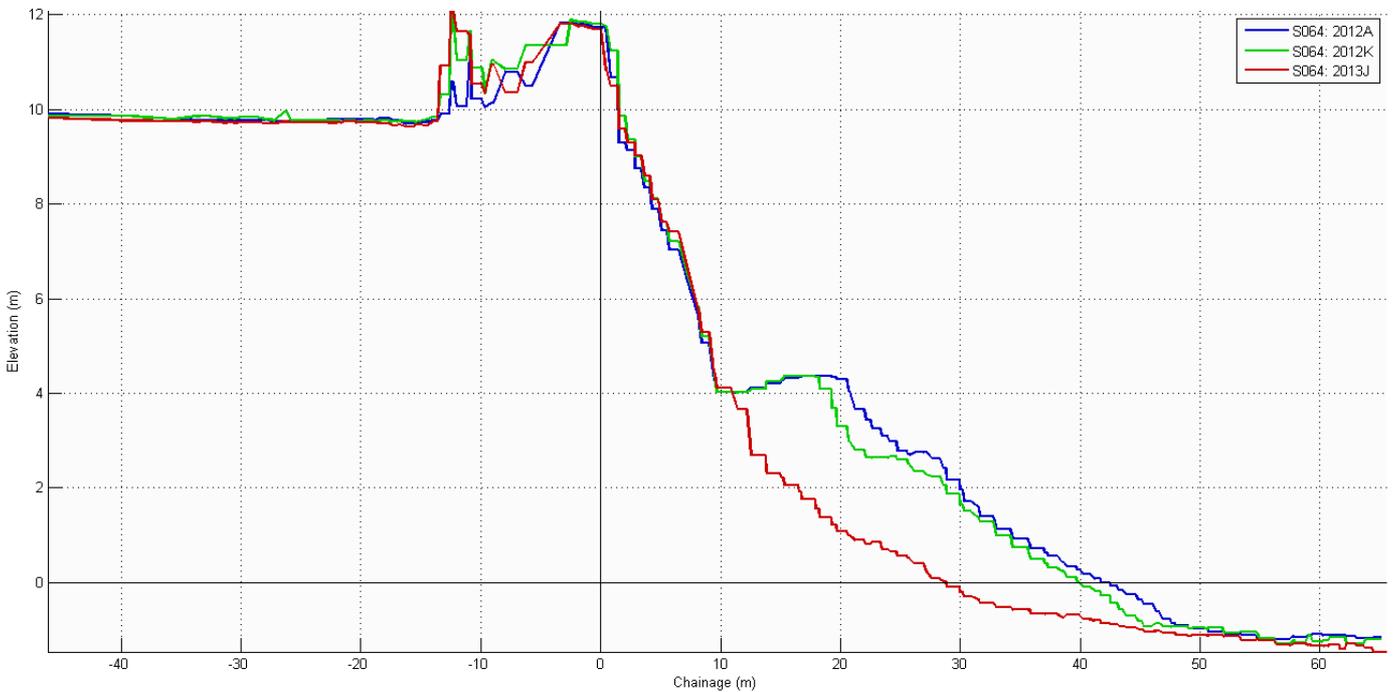


Figure 5: Beach profiles extracted from the three LiDAR surveys along transect S064 at Bawdsey cliffs.



Figure 6: Left: aerial photograph (2014) of the beach south of East Lane. Top right: the beach at transect S064 in August 2009. Bottom right: the lowered shingle beach in August 2015.

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Figure 7: Left: The beach at transect BW016 striped of shingle in July 2010. Right: In 2015 a lower profile shingle beach than previously existed is now present and currently stable.

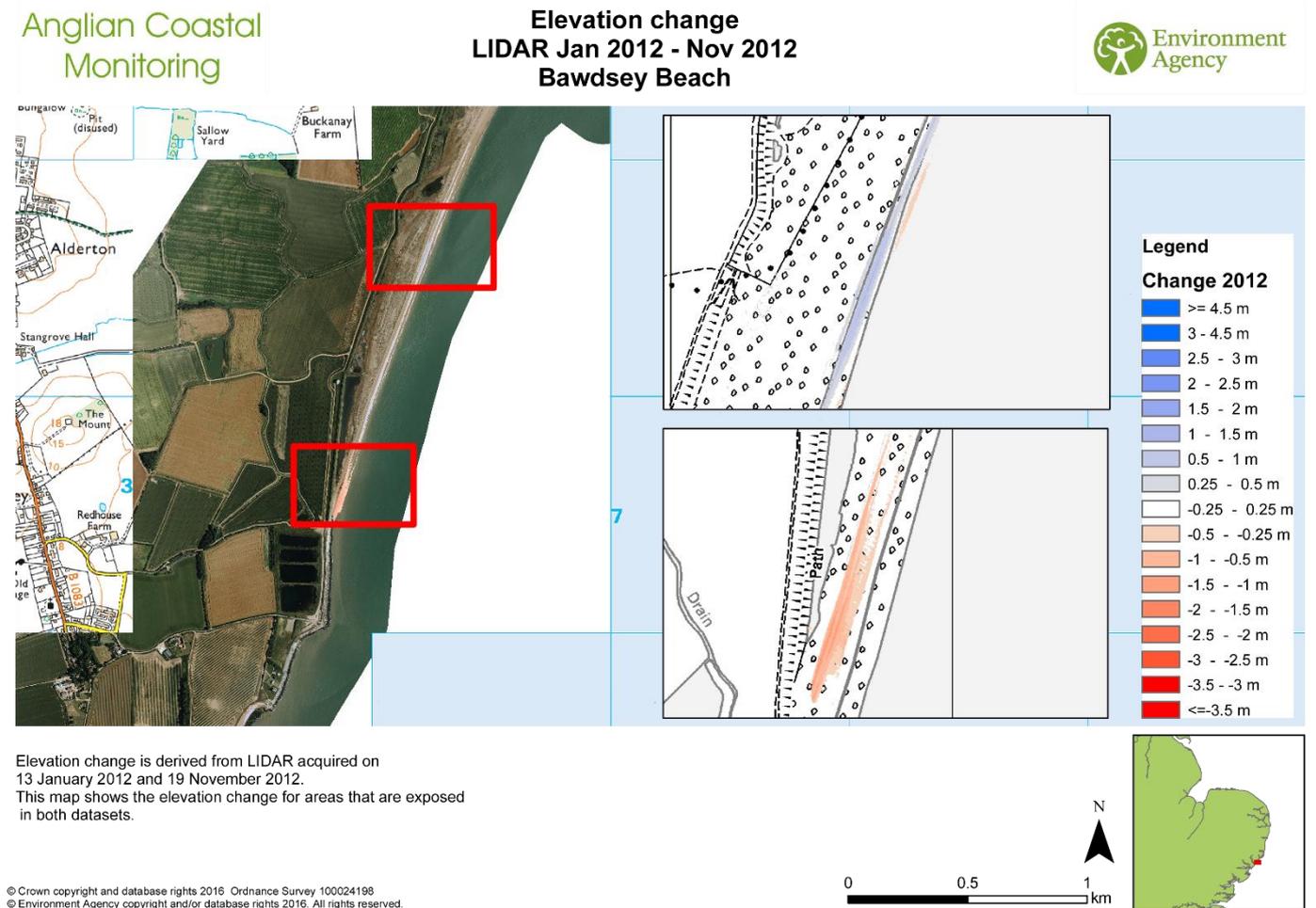


Figure 8: LiDAR difference model showing elevation change between January 2012 and November 2012.

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Figure 9: Aerial photography in 1992, 2012 and 2015 of the beach and lagoon north of East Lane.

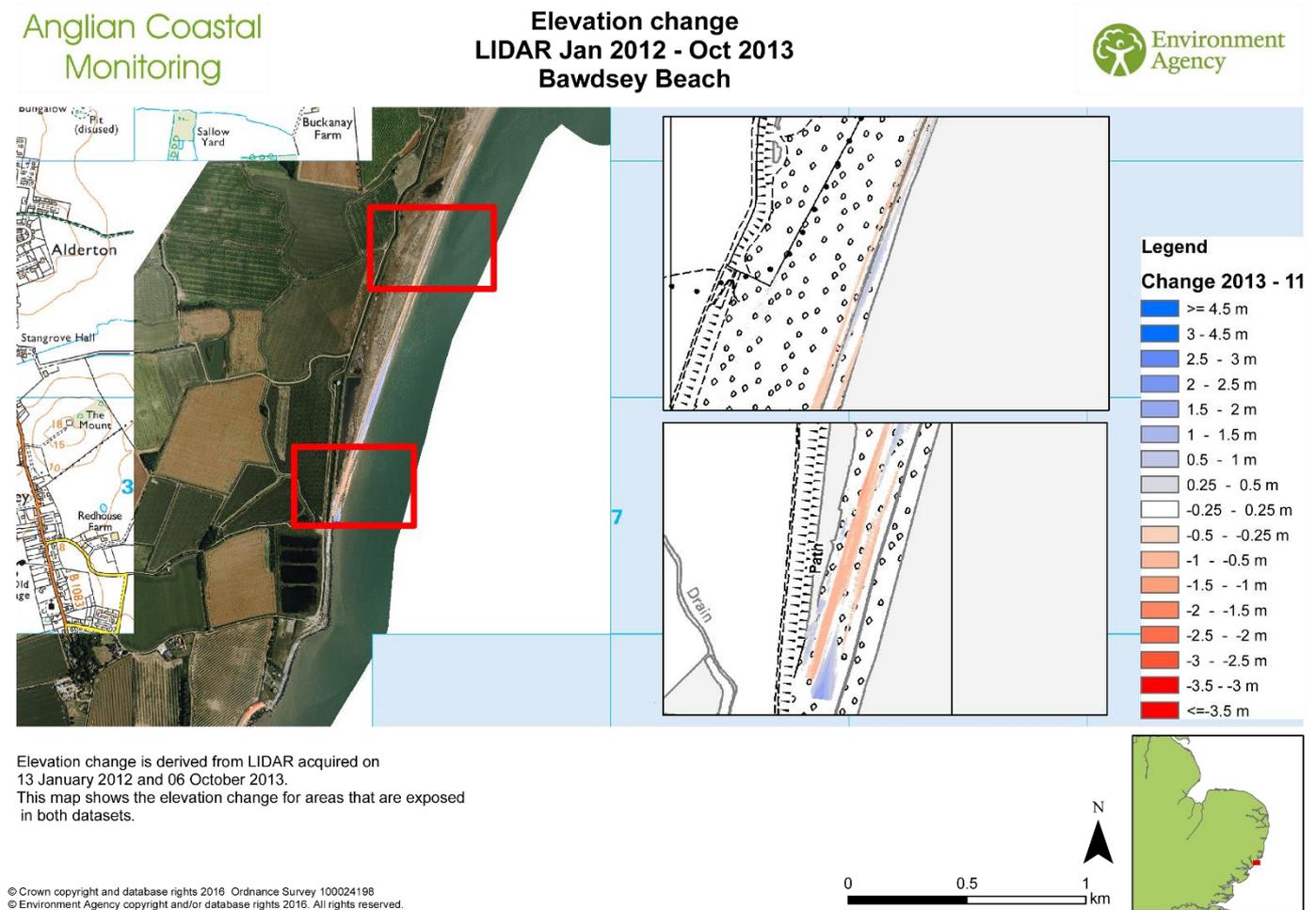


Figure 10: LiDAR difference model showing elevation change between January 2012 and October 2013.

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North of East Lane Bawdsey, the beach fronting the lagoon has been steadily eroding (Figure 9). The difference model shows over a metre fall in elevation over the year as the beach slope lowers. There is however a build-up of sediment alongside the rock defence and terminal groyne. To the north, at the north end of the lagoon where the Martello Tower is located, the beach is observed to be accumulating sediment. Further north from the location of transect HL048 the beach is considered to be relatively stable (Figure 11). There is an observed balance in sediment movement, elevation differences likely reflecting changes in the beach berms.

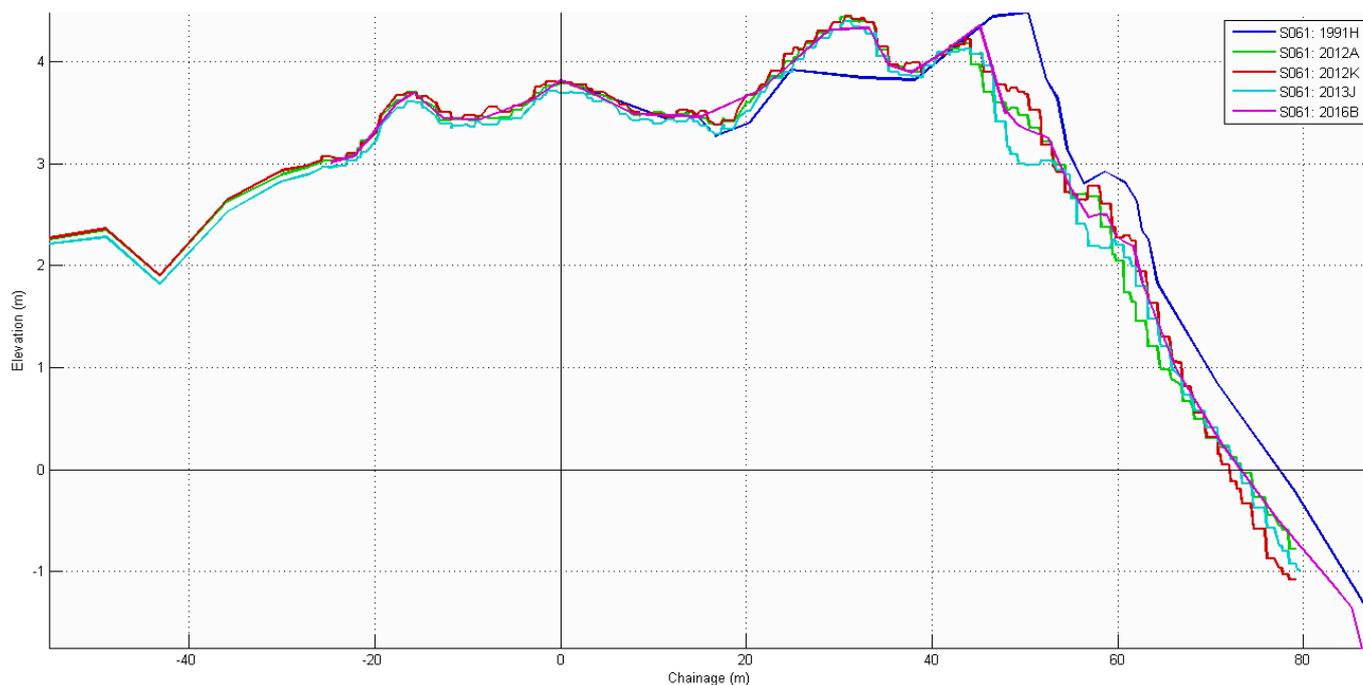


Figure 11: Beach profiles extracted from the three LiDAR surveys with August 1991 (blue) and February 2016 (pink) walked topographic surveys along transect S061.

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