MORGAN AND MORECAMBE OFFSHORE WIND FARMS: TRANSMISSION ASSETS

Annex to Applicants response to MMO and NE submission at Deadline 3: Assessment of Seabed Level Vertical Variability for Morgan Offshore Wind Farm- Appendix C

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C Landfall Assessment: Coastlines, Beaches and Nearshore Processes

C.1 North West England and North Wales SMP2

The Morgan ECC makes landfall at Blackpool Airport on the Fylde Peninsula, between the Ribble Estuary and Blackpool. The landfall is at the northern extent of the wide sandy beaches fronting Lytham St Annes, it is undefended and backed by vegetated dunes which protect the low-lying land behind. Immediately north at Blackpool, the beach narrows sharply as the coastal alignment changes to westerly facing, aligned normal to the prevailing conditions, and protected by sea defences.

The landfall is designated within the Ribble Estuary Site of Special Scientific Interest (SSSI) and Ribble and Alt Estuaries Ramsar Site and Special Protection Area (SPA) along with the Lytham Coastal Changes geological SSSI. The dunes between Clifton Drive North and the airport are also designated as a Site of Special Scientific Interest (Lytham St Annes Dunes) and Local Nature Reserve (Lytham St Annes).

The shoreline is managed primarily through the shoreline management plan (SMP) process which set out the policy for management over the next 100 years. The frontage lies within the sediment cell 11-B within the North West England and North Wales SMP2 (Halcrow, 2011a) which extends between Southport Pier to Rossall Point (including the Douglas and Ribble Estuaries). A dune management plan for the frontage was produced in 2008 on behalf of the Fylde Sand Dune Project Steering Group (Skelcher, 2008). The frontage is also within Zone 1 (Starr Hills Sand Dunes and Beaches) of the Fylde Council Coastal Strategy 2015-2032 (Fylde Council, 2015) with an objective to deliver the aims of the Sand Dunes Management Action Plan, to build the dunes as a soft sea defence to prevent flooding and coastal erosion, improve the dune habitat and to increase public appreciation of the dunes.

The landfall is located within subcell 11b-2 of the SMP, St Annes to Rossall Point. The plan for the whole 11b-2 frontage is to continue providing protection through maintenance of defences in combination with encouraging the natural dune system to evolve where possible as a natural form of defence. The landfall lies specifically within the natural dune system in Policy Unit 2.1, St Annes (northern boundary) to Squires Gate. The SMP policy is for dune management as follows:

- Short Term (0-20 years): Managed realignment - manage the dunes as the main front-line defence, while also determining specific requirements for a secondary defence line set back at the road south of Squires Gate to manage the risk of breaches in the dunes and implement if viable. Flood risk mapping needs to be improved in this area.
- Medium Term (20-50 years): Hold the line - manage flood risk by managing the dune system as the primary defence and maintaining secondary defences to an adequate standard.
- Long term (50-100 years): Hold the line - manage flood risk by managing the dune system as the primary defence and maintaining secondary defences to an adequate standard.

The coastal processes are described in Section H (Lytham Jetty to R.Wyre) of Appendix C of the SMP2 (Halcrow, 2011b) and is adapted below.

The coastline is predominantly cut into Triassic glacial sediments comprising of Kirkham mudstone with upper and lower boulder clays separated by sand and gravel deposits. At the landfall postglacial alluvial deposits dominate. The beach is composed of medium to fine sands and characterised by extensive ridge-runnel features in the inter-tidal zone (Halcrow, 2011b).

The landfall has some protection from the offshore banks at the mouth of the Ribble Estuary and there are residual circulatory currents offshore. The shoreline to the north being north-south aligned and principally wind and wave dominated, orientated almost normal to the prevailing conditions as evidenced by the narrowing of the beach to the north. Sediment is transported in a net southward direction although drift is variable and development along much of the coastline has reduced sediment supply (Halcrow, 2011b), an estimated feed of sediment is approximately 200,000m^3 per year from the Blackpool frontage (Skelcher, 2008).

Volumes of onshore movement are uncertain, with much of the sediment thought to be stored on Salter's Bank (just to the south of the frontage) at the estuary mouth (Halcrow, 2011b). Growth of Salter's Bank affects the ebb tide discharge, forcing it to flow either into the navigation channel of the Ribble, or further north. An area of low discharge may result on the Lytham St Annes frontage, causing increased accretion of fine sediments (Shoreline Management Partnership, 1999 cited in Halcrow 2011b)).

Sandwinning has been undertaken on Salter's Bank (St Annes Beach) since the 1960/70s, with a previous licence allowing the extraction of 160,000 m^3 per year equating to the overall removal of about two million m^3 sand since operations began (Sefton Council 2004 cited in Halcrow 2011b). Fylde Council is seeking to restart the sand extraction with the operational access via a track adjacent to the landfall off Clifton Drive North near Thursby Nursing Home and Dune Point where there is a small, fenced compound[2]. Sand extraction is unlikely to affect beach levels as sediment transport pathways from the bank are towards the Ribble estuary rather than the beach.

The dunes and estuary act as a sink for sediments, although sand banks at the mouth of the river are a store for much of the sand. This is due to the river channel acting as a barrier to longshore drift and the complex sediment circulations at the mouth of the estuary (Halcrow, 2011b).

Shoreline Movement

The shoreline between Lytham and Blackpool is generally stable but is influenced by changes to the estuary regime, the beaches at Lytham are accreting which also influence the wave exposure to the north.

The description of the coastal processes in the SMP describes net accretion along the frontage from north of St Annes Pier to Squires Gate on the west-facing coastline. Historically, these frontal dunes suffered erosion, with the Shoreline Management Partnership (1999) reporting steady erosion since the middle of the 19th Century. However, over the past 40 years the mean highwater line has moved seawards as the dunes accreted (Halcrow, 2011b).

The SMP predicts that the dunes at the landfall (Starr Hills protecting Blackpool Airport) are expected to erode, and the shoreline suffer recession associated with the predicted erosion further north. However, material arriving from updrift should be sufficient to maintain a dune system, albeit one that is vulnerable to erosion during storm events (Halcrow, 2011b). This prediction is cohobated by the National Coastal Erosion Risk Mapping[3] undertaken for the Environment Agency in 2018. This predicted that the coastline (dunes) will recede by between 2.4m and 4.6m under a no active intervention scenario (95%ile and 5%ile confidence limit respectively) and 1.4m and 2.6m following the SMP policy outlined above (95%ile and 5%ile confidence limit) by 2060. The SMP notes that the Ribble training walls are

[2] https://new.fylde.gov.uk/fylde-council-seeks-your-views-on-re-starting-sand-extraction-from-st-annes-beach/
[3] https://www.gov.uk/check-coastal-erosion-management-in-your-area

not maintained and should these fail, could result in significant (but unknown) changes to estuary morphology and hence the landfall frontage.

Considerations for the landfall:

- The frontage and dune system is of nature conservation importance for the dune morphology and ecology
- Construction works have the potential to de-stabilise the dune system depending upon the construction methodology
- The dunes are vulnerable to blow-outs as a result of construction activities, aeolian processes or extreme conditions

C.2 Difference in beach level between historical topographical surveys

Difference mapping has been undertaken using LiDAR and UAV drone surveys of the beach and coastline. It should be noted that the number of available surveys is limited and each survey provides only a snapshot of a dynamic system at discrete points in time. The difference between surveys may therefore not represent the full range of beach elevations experienced within or that will be experienced beyond the timeframe of the observations. Not all data sets provide full overlapping coverage with each other, or of all sites of interest – see the figure captions for more landfall specific details. The difference mapping therefore provides an indication of minimum realistic gross and local scale beach level variability on inter annual timescales but is likely to be an underestimate of the maximum possible range of variability at any given location over longer timescales.

Figure 31 illustrates the maximum difference in observed beach level elevations over a recent 17-year period (between 2006 to 2022) at and around the landfall area. For each survey, nearshore wave conditions in the 90 days prior to data collection are illustrated in Figure 45 to Figure 48. The 'elevation change' values describe the difference between the maximum and minimum local level observed in available flown LiDAR (6 February 2006, 11 March 2009, 5 February 2010, 7 November 2013, 28 February 2014, 11 March 2016, 26 April 2017, 29 June 2018, 15 October 2020 and 22 July 2021, from the Environment Agency) and UAV topographic surveys (17 May 2022 UAV drone survey from EnBW bp). Figure 32 more specifically shows the difference in beach level elevation between the most recent LiDAR dataset (2021) and the 2022 UAV drone survey captured by EnBW bp. Figure 34 shows transects from topographic beach surveys from 2008 to 2019.

The greatest overall difference in beach level over the foreshore of the available measured data is in the order of 1.1 to 1.5 m, primarily due to the movement of the ridge and runnel features. Areas of the dune system towards the back of the beach show greater variability over the 17-year period, with some areas changing (typically accreting) by more than 4 m. The area of the beach in front of the dunes has appeared to remain stable over the 17-year period.

C.3 Historical aerial imagery

More recent historic imagery of the beach at the landfall (between 2000 and 2021) is shown in **Figure 35** to **Figure 44**. For each survey, nearshore wave conditions in the 90 days prior to data collection are illustrated in Figure 45 to Figure 48. The figures illustrate the dune system on the upper foreshore and large ridge and runnel features on the sandy lower foreshore, trending approximately parallel to the coastline. Comparing the available historical images, the dunes surrounding the proposed cable route is associated with several large and dynamic dunes that are susceptible to movement.

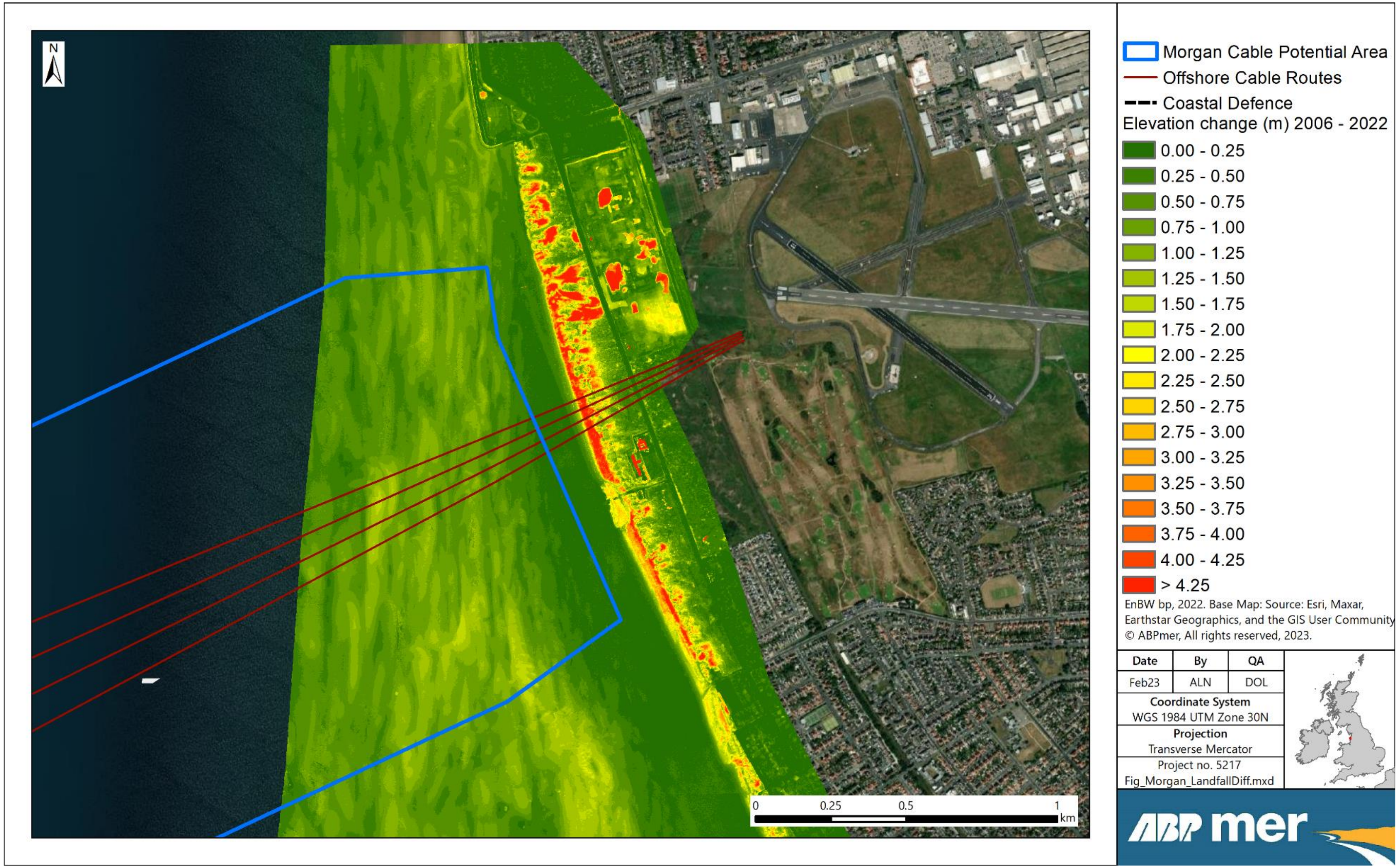


Figure 31. Range of observed beach levels (difference [maximum – minimum] local elevation) in the period 2006 to 2022 at the Morgan Landfall, including LiDAR surveys collected in 2006, 2009, 2010, 2013, 2014, 2016, 2017, 2018, 2020, 2021 and UAV survey data collected by EnBW bp in 2022

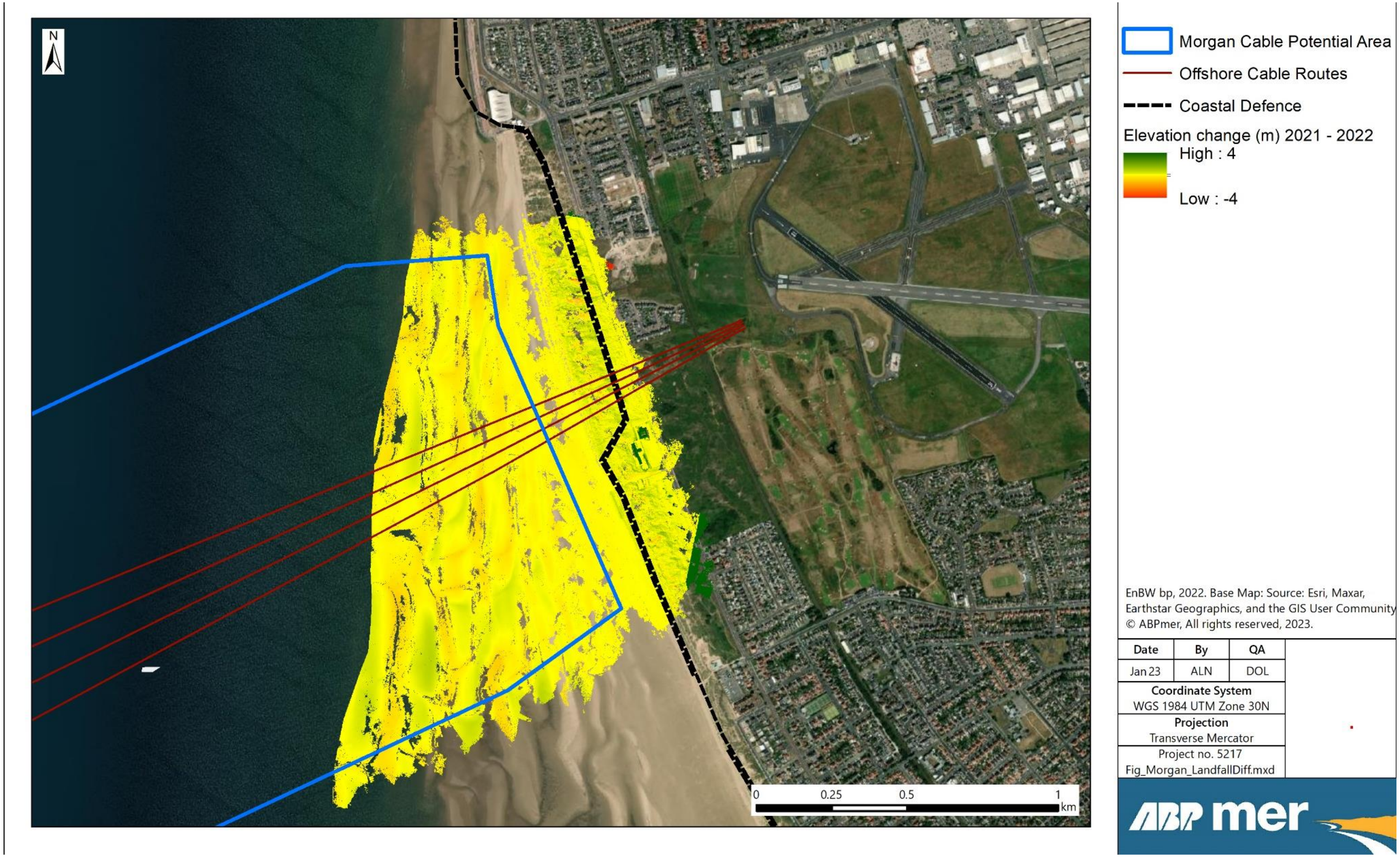


Figure 32. Difference in beach level between 2021 and 2022 at the Morgan Landfall, including the LiDAR survey collected 1 February 2021 and the UAV drone survey from EnBW bp collected 17 May 2022 (2022 minus 2021).

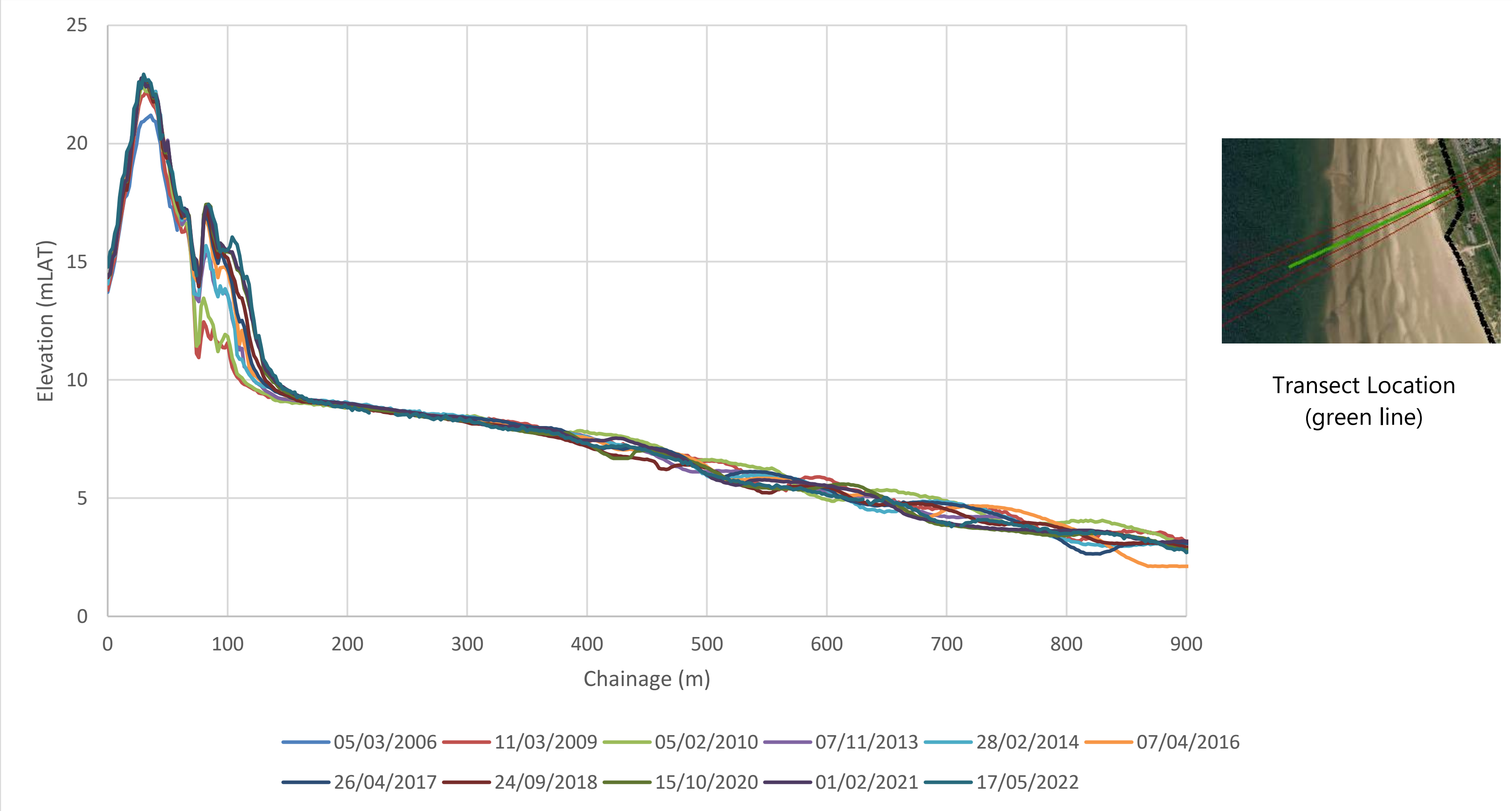


Figure 33. Transect of all available historical beach topography collected by LiDAR through the central part of the landfall corridor.

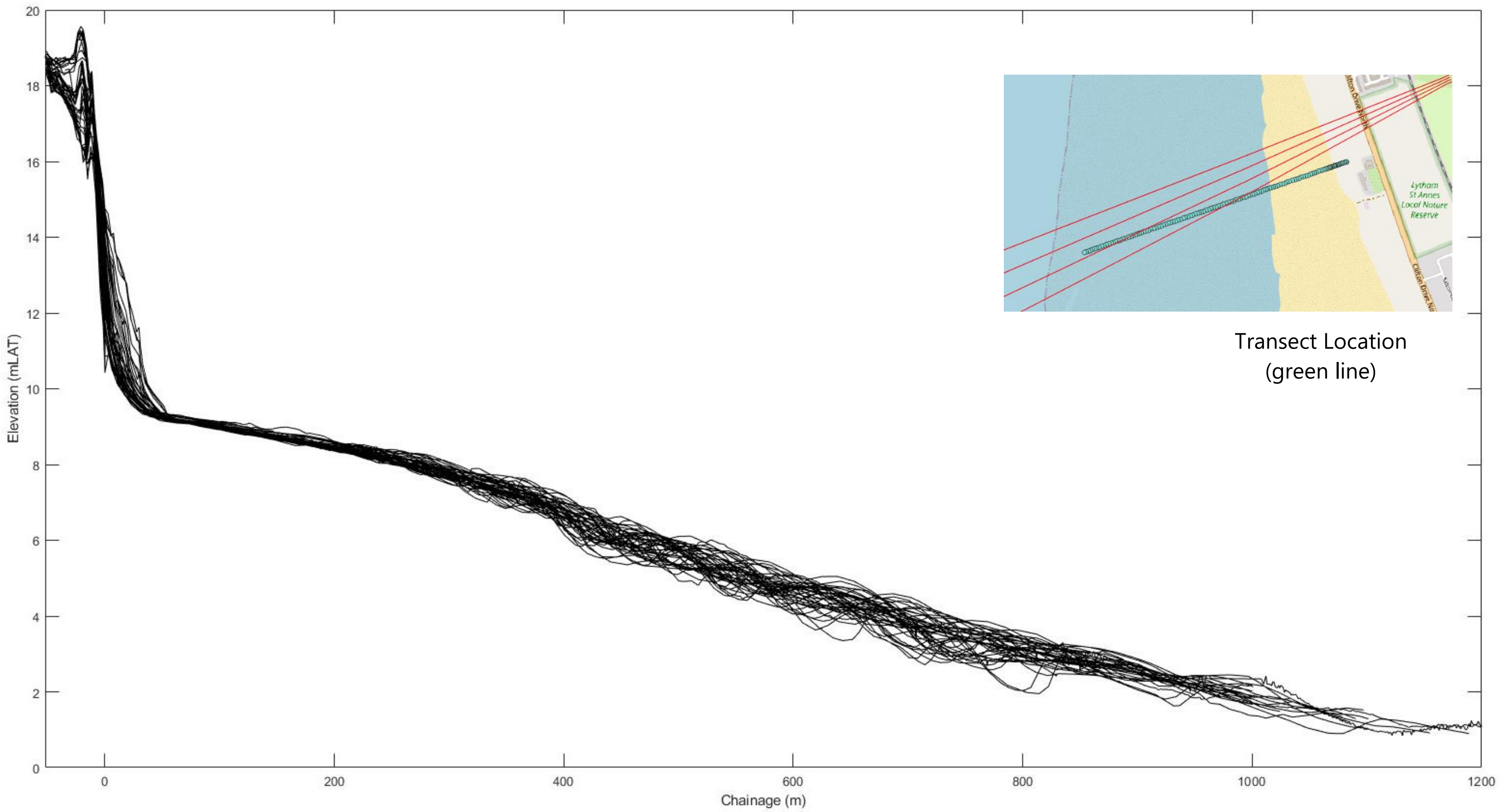
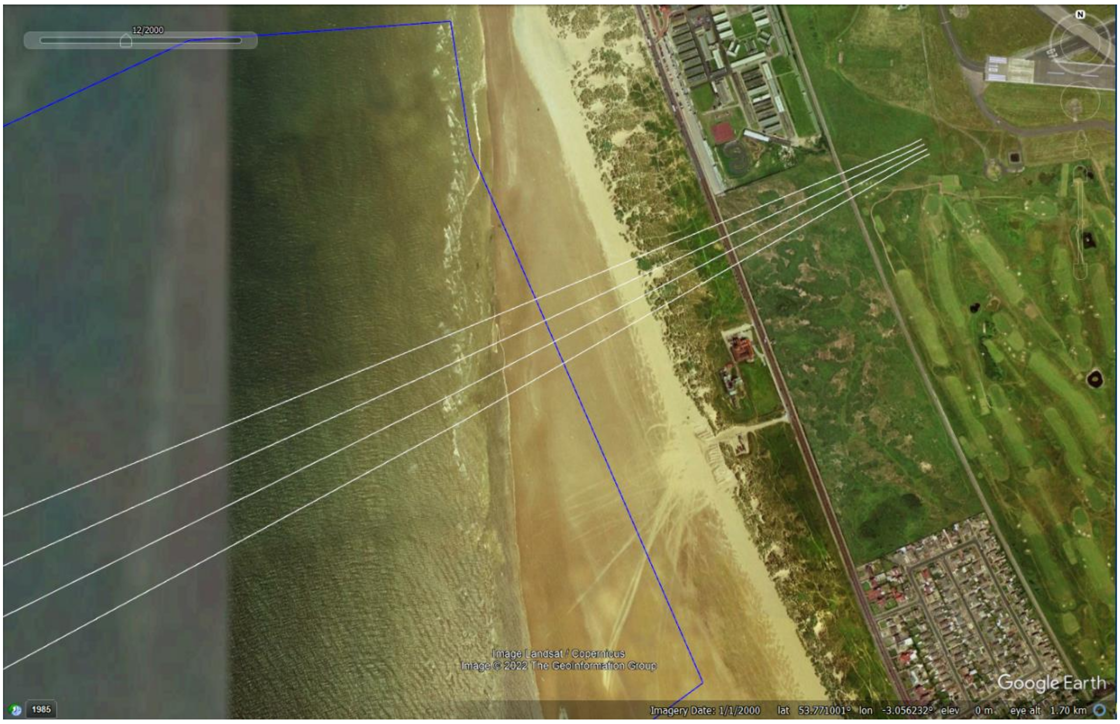


Figure 34. **Transect of all available historical beach topographic surveys collected by discrete topo profile surveys, dating from 2008 – 2019, through the central part of the landfall corridor.**



Also showing: cable corridor potential extent (blue line); indicative cable routes (white lines)

Figure 35. Satellite Imagery of Morgan Landfall (1 January 2000)

Also showing: cable corridor potential extent (blue line); indicative cable routes (white lines)

Figure 36. Satellite Imagery of Morgan Landfall (1 January 2005)

Also showing: cable corridor potential extent (blue line); indicative cable routes (white lines)

Figure 37. Satellite Imagery of Morgan Landfall (19 April 2011)

Also showing: cable corridor potential extent (blue line); indicative cable routes (white lines)

Figure 38. Satellite Imagery of Morgan Landfall (22 April 2015)

Also showing: cable corridor potential extent (blue line); indicative cable routes (white lines)

Figure 39. Satellite Imagery of Morgan Landfall (11 March 2016)

Also showing: cable corridor potential extent (blue line); indicative cable routes (white lines)

Figure 40. Satellite Imagery of Morgan Landfall (17 July 2017)

Also showing: cable corridor potential extent (blue line); indicative cable routes (white lines)

Figure 41. Satellite Imagery of Morgan Landfall (29 June 2018)

Also showing: cable corridor potential extent (blue line); indicative cable routes (white lines)

Figure 42. Satellite Imagery of Morgan Landfall (24 April 2020)

Also showing: cable corridor potential extent (blue line); indicative cable routes (white lines)

Figure 43. Satellite Imagery of Morgan Landfall (27 May 2020)

Also showing: cable corridor potential extent (blue line); indicative cable routes (white lines)

Figure 44. Satellite Imagery of Morgan Landfall (22 July 2021)

C.4 Metocean conditions prior to topographic data collection at the landfalls

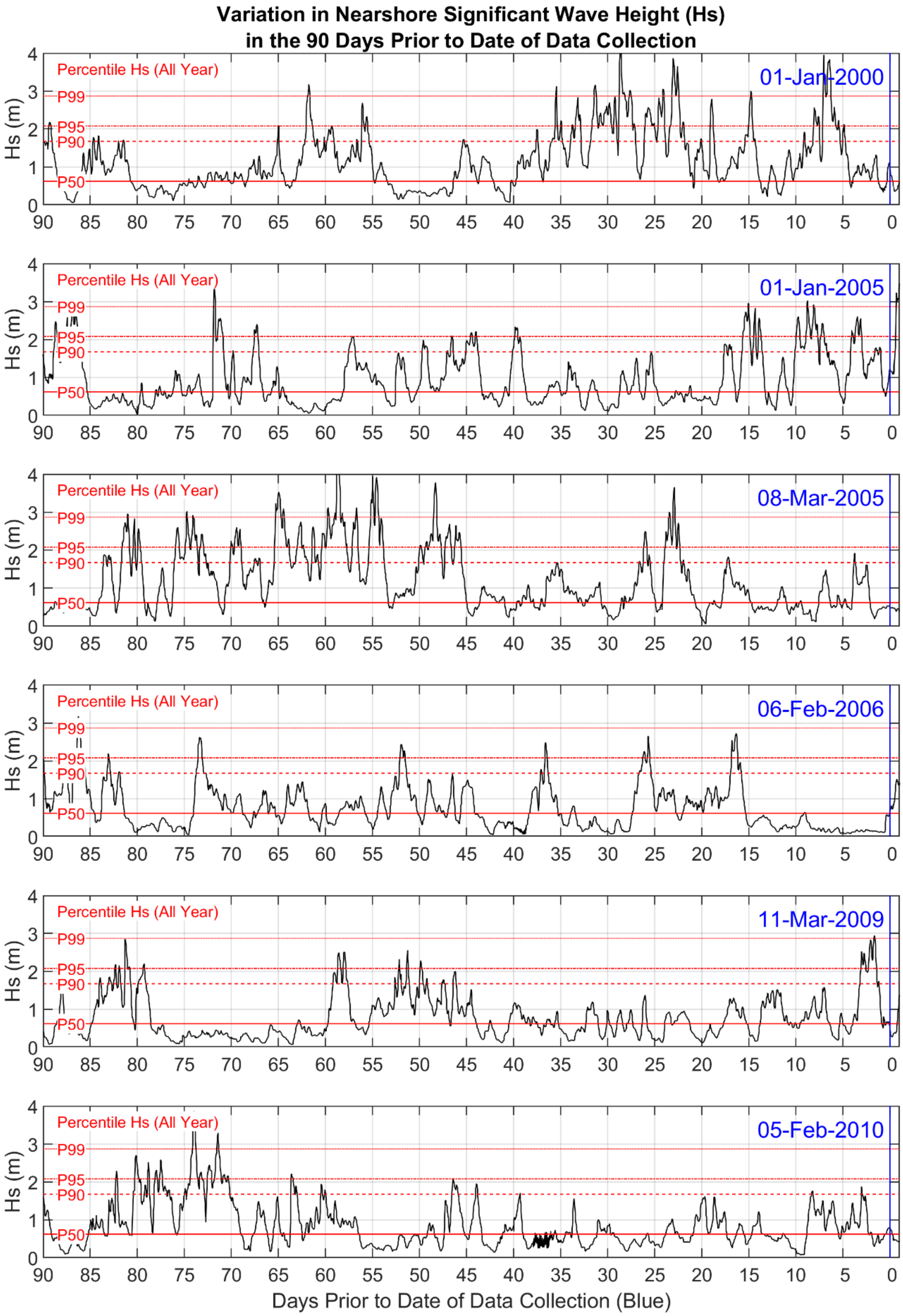


Figure 45. Nearshore wave climate prior to topographic data collection, 2000 to 2010.

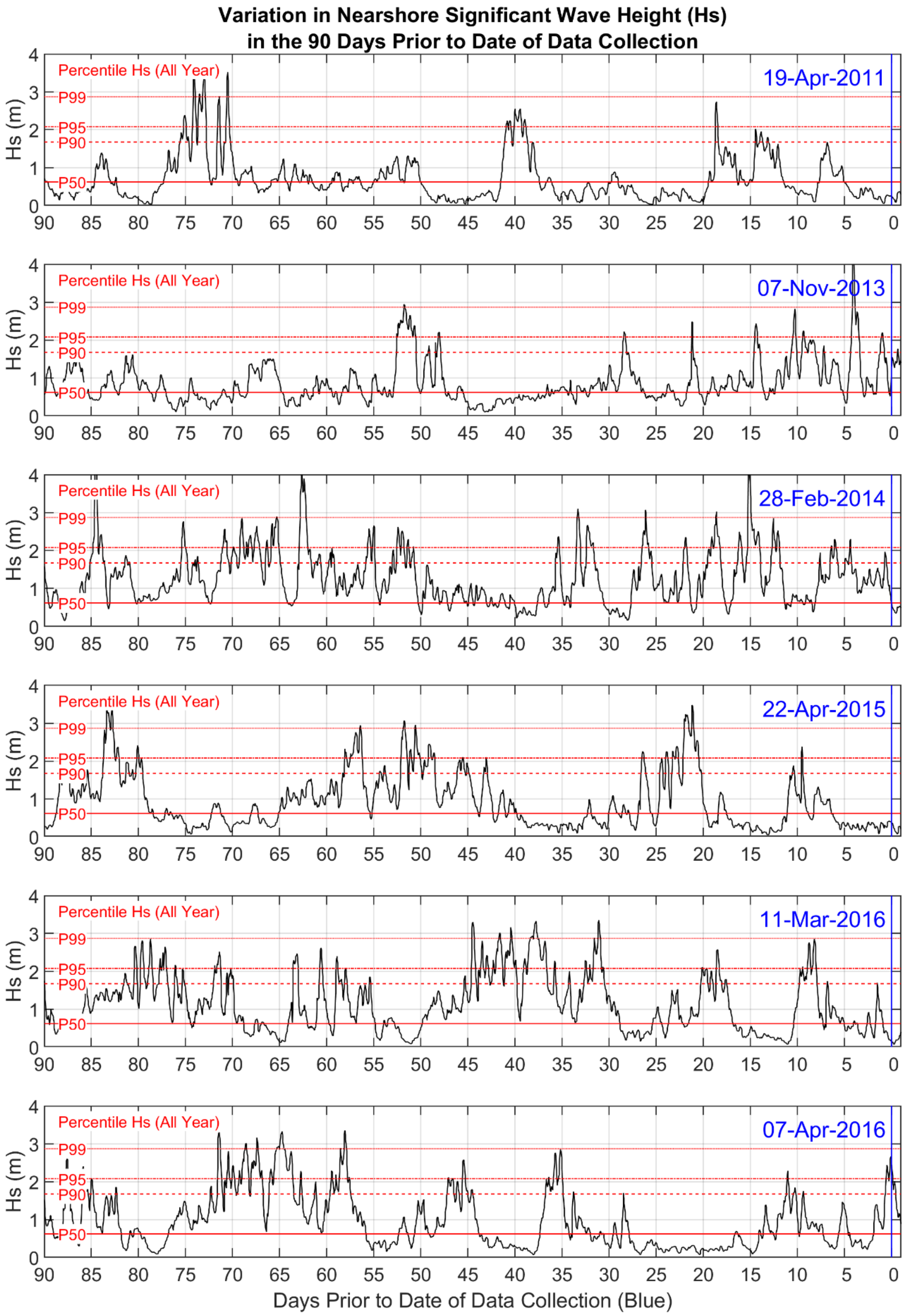


Figure 46. Nearshore wave climate prior to topographic data collection, 2011 to 2016.

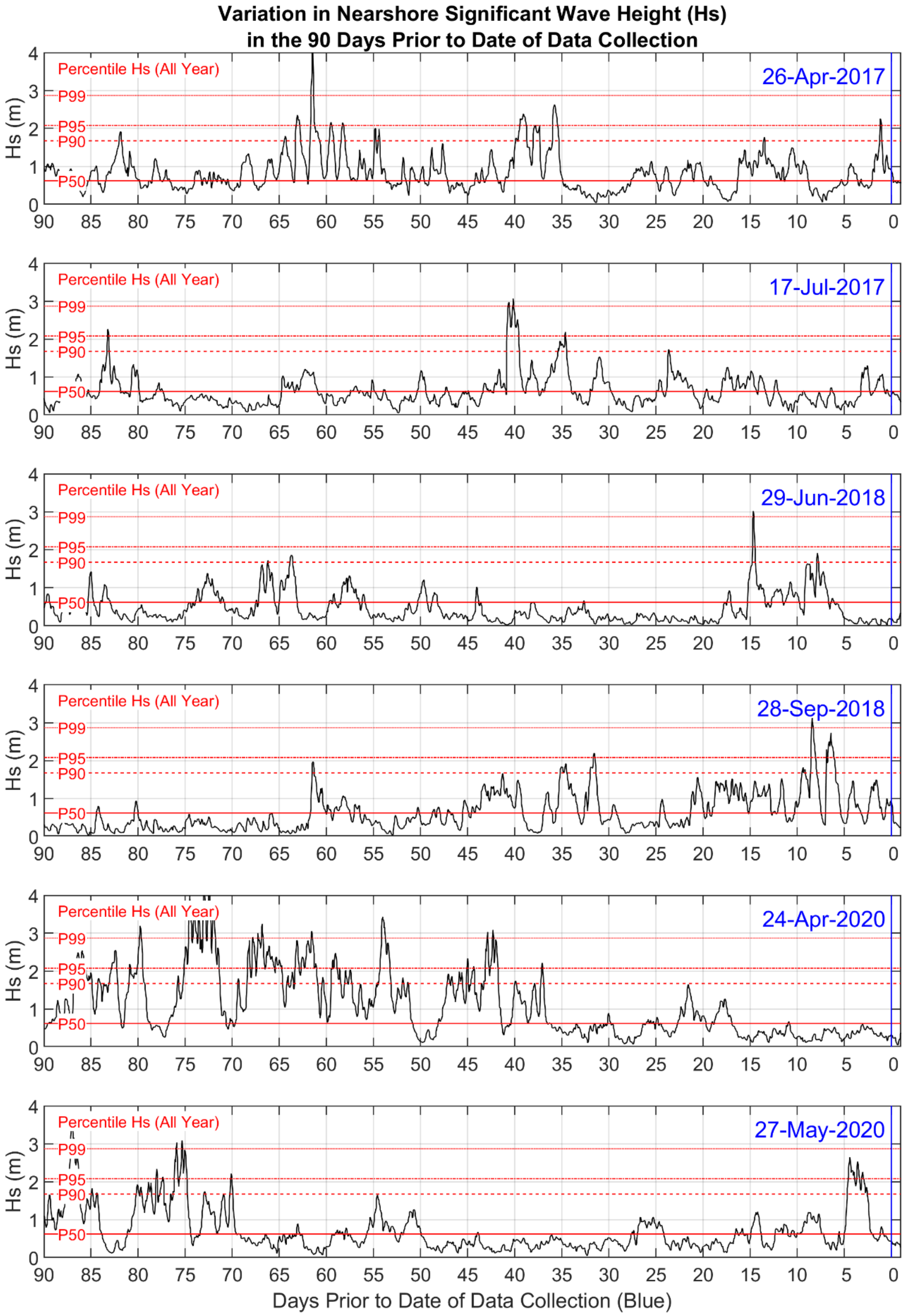


Figure 47. Nearshore wave climate prior to topographic data collection, 2017 to 2020.

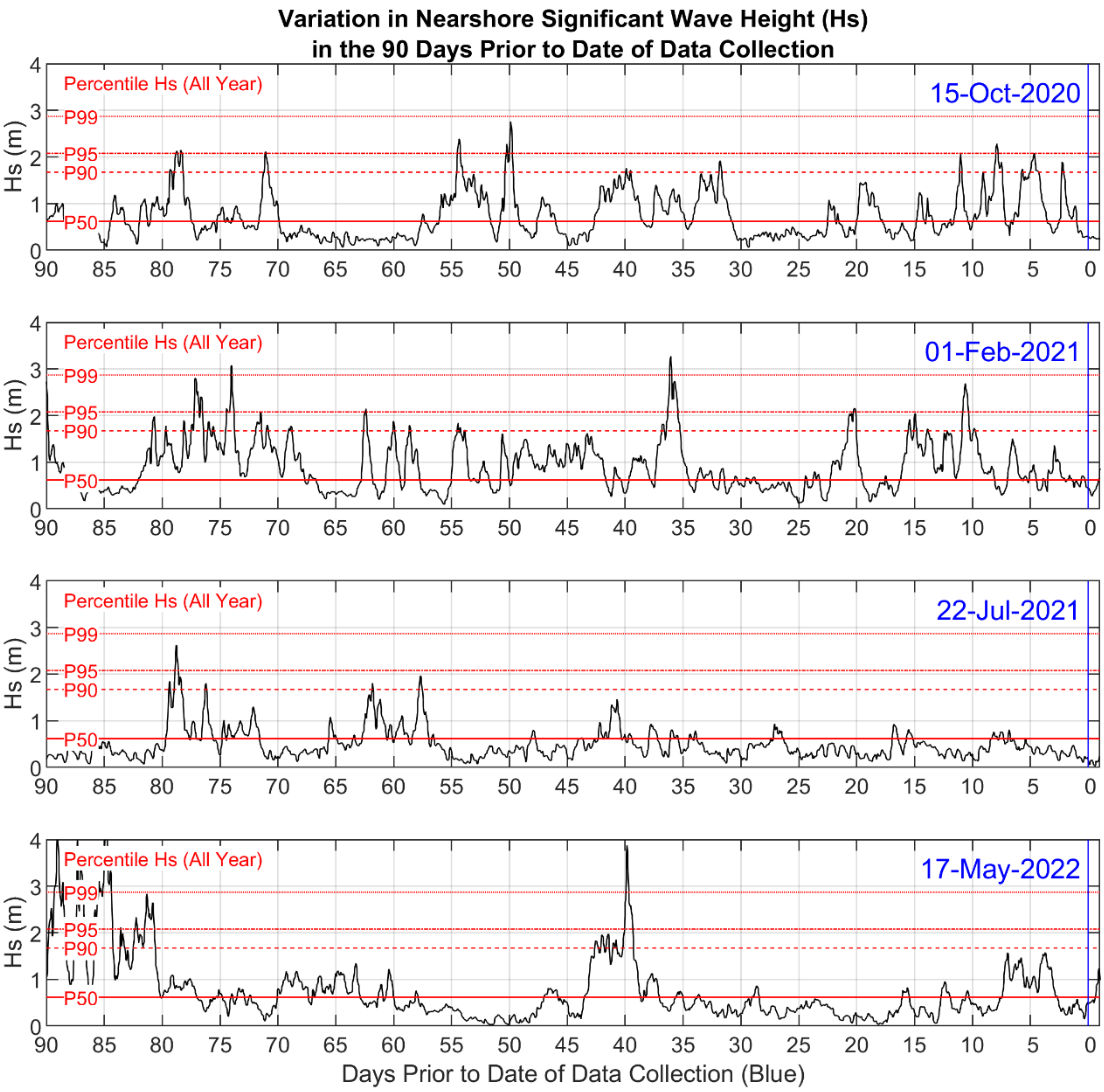


Figure 48. Nearshore wave climate prior to topographic data collection, 2020 to 2022.