

Estimation of volume changes of the coastline between Mt. Reynisfjall and Kúðafljót river, South-Iceland, during the 20th and 21st centuries.

The coastline between Reynisfjall mountain and Kúðafljót river in south Iceland has undergone large changes since the beginning of the 20th century. With new data on coastline position, the changes in coastline position and volume between 1904 and 2024 were calculated, including a new calculation of the volume of Kötlutangi protrusion soon after the 1918 glacial outburst flood caused by an eruption in Katla volcano. The new volume is about 325 Mm³ of material deposited below the 0 meters in chart datum, increasing the total volume by about 25-75 Mm³ from previous calculations.



Figure 1. A map that shows all coastlines that extend over the research area along with the profiles set up to calculate changes in coastline location and volume. Each dot on the map is where the profiles intersect the line of each mapped coastline.

To break down the data for more precise results, the research area was split into two and each part into several different smaller parts based on beach names from the area. The five beaches on the western part all show similar evolution over the period, with advancing coastline in the decades following 1918 but then the coastline started to retreat and is still doing so at all beaches. The start of the advancement and retreat differs between beaches, where the closer the beach is to the Kötlutangi protrusion, the quicker the advance and the consequent retreat started. The Víkurfjara beach, which is the most western most beach, started to advance after 1926 at a rate of about 9,1 meters per year until 1969 and 1971. After 1971, the beach started to retreat at a rate of about 5,5 m per year until 2021. The volume of the western part of the research area declined during the period between 1904 and 2024 by about 1,3 million (M) cubic meters (m³), while the eastern part grew about 160 Mm³. There are indications that the 1918 glacial outburst flood had large impacts on the volume of the western part at least until 1973, but after 1973 the volume decreased almost to the same as it was in 1904. Although the volume for the western part decreased overall between 1904 and 2024, the three westernmost beaches had an increase in volume over the period, while the other two lost volume, indicating that the suspected volume increase due to the 1918 glacial outburst flood has not completely disappeared on the western part. The Víkurfjara beach has a high number of

bathymetric survey data available. There, the volume increase for the 15 profiles on the beach is only 400 m³/m, and in total about 80 thousand m³, but surveys in-between show an almost continues decrease since 1971 that would suggest that there was a large increase in volume as some point between 1904 and 1971.

The six beaches on the eastern part do not show a similar evolution, as the two most western ones have a net retreat from 1904 to 2024, while the other four advance during the same period. All six beaches retreated in the first decades following the 1904 coastline but then start to advance around 1930 and onwards with only minor periods of retreat in between. The three easternmost beaches underwent the larges advancement, well over 200 m. The total volume for the eastern part increased from 1904 to 2024, and despite the coastline retreat of the two westernmost beaches, all the beaches increased their volume during the period.

Figure 2. The calculated changes of each period (in meters) and cumulative changes for the coastline position at each beach of the western part (above) and the eastern part (below) of the research area

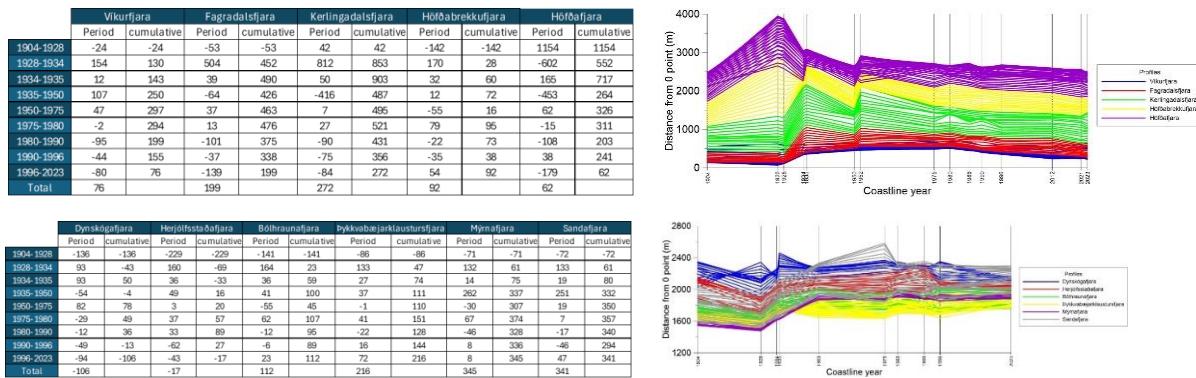


Figure 3. The total difference of changes in volume on the western and eastern part of the research area between 1904 and 2022/2024. The changes are also broken down into individual beaches and the section average change of each profile of that beach, along with the distance of the coastline to the 20 m depth line.

	Total volume change (m ³)	Section average change (m ³)	Average distance to 20 depth (m) in 1904	Average distance to 20 depth (m) in 2024
Western part	-1.339.991	-15.402	2.219	1.936
Víkurfjara	80.033	6.669	2.394	2.287
Fagradsfjara	824.043	68.670	2.318	1.955
Kerlingadalsfjara	484.867	32.324	2.380	1.850
Höfðabrekkufljara	-2.387.354	-183.643	2.387	1.897
Höfðafjara	-341.580	-10.674	1.955	1.843

	Total volume change (m ³)	Section average change (m ³)	Average distance to 20 depth (m) in 1904	Average distance to 20 depth (m) in 2024
Eastern part	160.186.226	1.686.171	1.149	1.764
Dynskógarfjara	25.837.968	1.614.873	652	1.681
Herjólfsstaðarfjara	25.553.755	1.825.268	629	1.575
Bólhraunafjara	44.835.486	1.949.369	962	1.712
þykkvabækjarklaustursfjara	49.535.844	1.501.086	1.538	1.857
Mýrnafjara	14.423.172	1.602.575	1.813	1.969

Figure 4. The total difference of changes in volume from 1904 to after the glacial outburst flood in 1918. The changes are also broken down into individual beach and the average change of each profile section of that beach.

	Total volume change (m ³)	Section average change (m ³)
Kötlutangi	324.728.420	5.412.140
Kerlingadalsfjara	43.772.162	2.918.144
Höfðabrekkufljara	37.924.996	2.917.307
Höfðafjara	243.031.263	7.594.727