Total amounts of the artificial radionuclide caesium -137 in Baltic Sea sediments

Author: HELCOM Monitoring of radioactive substances expert group (HELCOM MORS EG)
Corresponding author: Iisa Outola, STUK - Radiation and Nuclear Safety Authority, Finland

Key message

The most significant source of artificial radioactivity in the Baltic Sea sediments is the fallout from the Chernobyl accident. The distribution pattern of Cs-137, the radionuclide of main radiological significance in the Chernobyl deposition, is patchy due the uneven deposition and sediment accumulation to the bottoms. The highest amounts occur in the sediments of the Bothnian Sea and the eastern Gulf of Finland. The total inventory of Cs-137 in the Baltic Sea sediments was estimated to be about 2 280 TBq in 2010. Nonetheless, most of the radioactivity in the sediments of the Baltic Sea originates from naturally occurring radionuclides. At present the radioactivity in the sediments is not expected to cause harmful effects to the Baltic Sea wildlife. The continuous monitoring work and observations of time trends of the radioactive substances are the bases for knowing and understanding the state of the radioactivity in the Baltic Sea.

Results and assessment

The main sources of Cs-137 have been the fallout from the Chernobyl accident in 1986 and the global fallout caused by nuclear weapon tests in the 1950s and 1960s [1]. The total input of Cs-137 activity from Chernobyl to the Baltic Sea was estimated at 4 700 TBq while that from the global fallout was 900 TBq [3]. In the course of time a significant share of cesium has sunk to the bottom and accumulated into the sediments [4, 5].

The distribution pattern of Chernobyl-derived Cs-137 in the drainage area and in the sediments of the Baltic Sea was very scattered [1, 3, and 4]. The highest deposition values occurred in the areas surrounding the Gulf of Bothnia and the eastern Gulf of Finland and also the highest total amounts of Cs-137 activities (Bq/m^2) are still observed in the bottom sediments of these areas (figure 1). In the Baltic Proper, Belt Sea, Kattegat and Sound the amounts are considerably lower than in the northern parts of the Baltic Sea [2, 4]. In addition to uneven deposition, the total amounts have also been affected by the type of the bottom sediments, bottom topographies, sediment accumulation rates in different sea areas, unstable sedimentation processes and river discharges [2, 4, 5].

Figure 1. Cs-137 (Bq/m^2) in the Baltic Sea sediments in 2007-2010 in different sampling stations [2].

The total inventory of artificial Cs-137 in the seabed of the Baltic Sea was estimated to be about 2 280 in 2010. The Bothnian Sea, the main accumulation basin for Chernobyl cesium, contains 58% of the total inventory as illustrated in figure 2. Chernobyl-derived cesium has continued to deposit into the seabed, but due to the different sedimentation conditions there is spatial variation in the results (figure 3). Currently the inventory of Cs-137 is about 8-9 times higher compared to the pre-Chernobyl level indicating that the concentrations of artificial radionuclides are still higher than the target of the HELCOM ecological objective “radioactivity at pre-Chernobyl level”. However, most of the radioactivity in the sediments of the Baltic Sea originates from naturally occurring radionuclides, such as K-40. The inventory of K-40 is estimated to be roughly 8 500 TBq, four times higher than the total inventory of Cs-137 given above [3].

While there are still considerable amounts of artificial radioactivity in the Baltic Sea sediments due to the radionuclides with long half-lives, the radioactivity is not expected to cause harmful effects to the Baltic Sea wildlife.

Figure 2. Distribution of Cs-137, as percent of total inventory in sediment, between different subregions of the Baltic Sea [2]. The other subregions not specified in the graph are included in the share of Baltic proper.

Figure 3. Cs-137 (Bq/m^2) in sediments of different sampling stations in the Baltic Sea during 1984 - 2011. Notice different scales used in the graphs.

References

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Metadata

Description of data

The monitoring programme of HELCOM MORS-PRO includes 55 permanent sampling stations for bottom sediments. This report is based on the regular data reported by all the Contracting Parties to the HELCOM MORS database. The data are given as total amounts of Cs-137 in Bq/m^2.

Technical information

The samples were taken with different types of sediment corers tested and compared [6]. The sediment cores were sectioned into slices of 1-5 cm, the slices were freeze-dried and homogenised. The dried samples were analysed by gamma-ray spectrometry.

Quality information

The quality of the analytical data submitted to the MORS database is tested through on-going intercomparison exercises, which show that the quality of data is very good [1, 7].

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