

INVESTIGATIONS OF COASTAL DYNAMICS AT THE ACD KEY SITES IN THE WESTERN RUSSIAN ARCTIC (2001-2002 FIELD WORK)

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Precise geodetic and bathymetric measurements allowing to evaluate coastal retreat rates are of great importance for studying coastal dynamics.

The coastal survey conducted by our team included the following investigations:

- Determination of position and height of major fixed elements which can be used for the connection with both earlier conducted and following observations of coastal dynamics;
- Reconnaissance studies of existing geodetic points in the study area and determination of their precise coordinates in the WGS-84 system to calculate corrections providing the opportunity to use topographic and navigation maps as well as aerial photographs of the last years;
- Detailed tacheometric survey of the thermoerosional coast with precise fixation of the coastal scarp top and other morphostructures;
- Detailed survey of the bottom topography from the water level to the 10 m isobath at thermoerosional coasts using a NAVSTAR portable satellite device in differential regime and a digital echosounder;
- Determination of the current coastline position (i.e. water level, upper edge of the beach, upper edge of the coastal scarp) at the extended sections of both retreating and accumulative coasts using high-precision satellite equipment.

Following the ACD strategy field investigations should be implemented at specific key sites which are characteristic for the entire coastline. In the western Russian Arctic these key sites have been chosen in the Kara Sea (south-western coast of the Yamal Peninsula and Yugorsky coast) and in the Barents Sea (north-western coast of the Kolguev Island). In this paper we present some results of these investigations.

1. The Marre-Sale key site (69°43'N, 66°49'E) is situated at the south-western coast of Yamal Peninsula (Kara Sea). Earlier hydrographic investigations at this site were carried out in 1970. The subbottom topography was mapped from the pack ice. The depths were connected to the level of a fixed element which was installed at the polar station in 1952. A marine navigation map at a scale of 1: 25 000 was published in 1990. Systematic observations of coastal dynamics at the Marre-Sale key site were initiated by the Institute of Earth's Cryosphere RAS in 1978 and were conducted on a coastal section of ca. 4.5 km length. More than 60 observation ranges were arranged perpendicular to the coast. The results of these observations constituted the digital data base on coastal dynamics for the last 22 years. It was observed that coastal retreat rates cyclically vary in time (Vasilyev et al. 2000) with periods of 20 years. A correlation between sea wave energy and coastal retreat rates has been noted. In the context of the ACD program the scales of observations at the Marre-Sale key site were expanded and, particularly, observations were conducted not only at thermoerosional but also at accumulative coastal sections. Preliminary studies carried out in 2001 included the observations using modern geodetic and GPS technologies in addition to conventional studies.

The study area was significantly extended and covered not only thermoerosional but accumulative types of the coasts located 40 km southward of the site. The observations at the coastal area of 4.5 km length showed that the total coastal retreat between 1941 and 2001 accounted for 147 m. Repeated observations of the upper edge of the coastal scarp conducted in 2002 using GPS and an electronic tacheometer exhibited a maximum coastal edge displacement of 6 m per year in the northern part of the site with an average displacement of 1.9 m. The most affected are inflections of the edge lines where the capes are cut off and gully mouths are deepened.

2. The same investigations were conducted in 2001 at the key site located in the Shpindler area on the Yugorsky coast (south-western Kara Sea). The studied offshore area of the site was 1.6 km², the onshore area 0.3 km². The coastal survey fixing the average multiyear coastline and the upper and lower edges of the coastal scarp was carried out over 3 km.

3. During the field season of 2002 coastal investigations were carried out at the key site on the north-western coast of Kolguev island (Barents Sea), southward of Sauchikha River mouth. The studied area of the offshore site was 1.3 km², of the onshore site 0.2 km². In addition, a coastal segment of 12 km length was surveyed in respect of the position of the average multiyear coastline and the upper and lower edges of the coastal scarp.

The field observations in 2001 and 2002 resulted in the elaboration of jointly used hardware and software components, i.e. electronic tacheometer DTM-350, GeoExplorer 3 satellite device and a small-scale echosounder installed in the Zodiak-type sloop. The coastal segments were surveyed using a water level database of stations of the Russian Arctic containing information on sea level fluctuations from the 1960-80s. The accuracy of the coastal scarp contours is 0.1-0.3 m and the accuracy of the determinations of the current position of the sea level relative to the average sea level is 2-3 m. The positions of the points and contours were determined in the international coordinate system (UTM) and the elevation was recorded in national elevation system (Baltic).

All collected information on the offshore and onshore topography of the sites is available in digital form that allows to create 3D digital elevation and bathymetry models and enables the subsequent analysis of coastal dynamics by means of GIS-technologies. Thus, during the field seasons of 2001 and 2002 key observations were conducted and the three key sites were prepared for future studies of coastal dynamic in the western Russian Arctic.