

## Modern rates of thermal denudation and thermal abrasion on western Kolguev Island

Alexander Ivanovich Kizyakov<sup>1</sup>, Mikhail Viktorovich Zimin<sup>1,2</sup>, Anton Vladimirovich Sonyushkin<sup>2</sup>, Marina Oskarovna Leibman<sup>3</sup>, Natalia Vitalievna Pravikova<sup>4</sup>, & Frank Günther<sup>5</sup>

<sup>1</sup>*Lomonosov Moscow State University, Faculty of Geography, Russian Federation*

<sup>2</sup>*ScanEx Research and Development Center, Russian Federation*

<sup>3</sup>*Earth Cryosphere Institute SB RAS, Russian Federation*

<sup>4</sup>*Lomonosov Moscow State University, Faculty of Geology, Russian Federation*

<sup>5</sup>*Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research, Germany*

Destruction mechanisms and dynamics of the Arctic coast, also in the western sector of the Russian Arctic, are studied in detail, including the use of remote sensing data. However, data on thermal abrasion and thermo denudation of Kolguev island is quite limited. Some estimates were presented in article of M.A. Velikotsky (1998). Estimation of thermo denudation rates near the Sauchiha river mouth for the period 1948-2002 years was done by the authors earlier (Kizyakov & Perednya, 2003).

To obtain data about the modern (after 2002) shoreline retreat rates and growth of thermal cirque a high resolution remote sensing data were involved in our research.

Part of the western coast of the Kolguev island was inspected in field work conducted on 2002 by ECI SB RAS, together with VNIIOkeangeologia. The object of research was the part of coast, including a group of three coastal thermal cirques, located 3.5 km south of the Sauchiha river mouth. In 2012, within the framework of the project 'Geoportal of MSU' operational satellite imaging was done on Kolguev island by satellite FORMOSAT-2. High resolution satellite imagery provides ample opportunities for visual interpretation of coastal landforms.

Aerial photographs (1948 and 1968), surveying materials (2002), high-resolution satellite images (2009 and 2012) became basis to study the dynamics of the coast and thermal cirques in the key area.

For key area were calculated:

- retreat rates of the edge of the coastal terraces

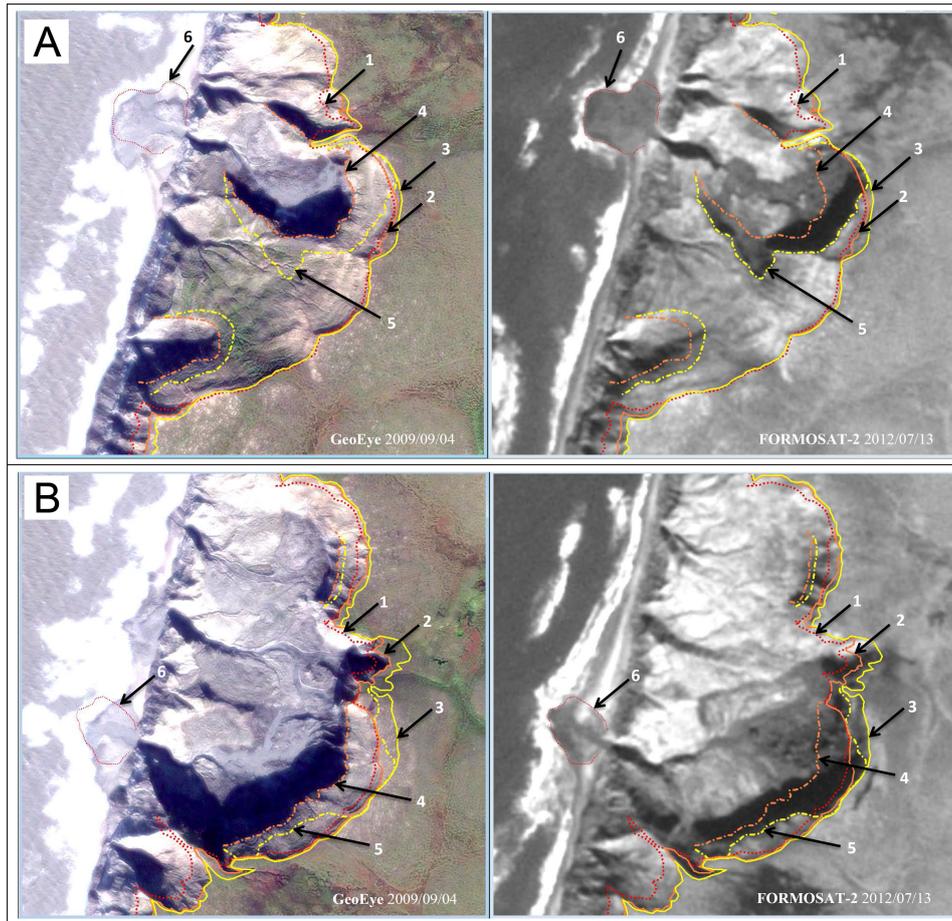
and thermal cirques for the periods 1948-1968, 1968-2002, 2002-2009, 2009-2012;

- retreat rates of the foot of the coastal terrace for the periods 2002-2009, 2009-2012;
- volume of the material enters the coastal zone by the thermal abrasion for one linear km of a coast (Kizyakov et al., 2013).

Average long-term rates of retreat of the coastal terrace during 1948-2012 varied from 0.7 to 2.4 m/year; 2002-2012 varied from 1.7 to 2.4 m/year. Identified rates are distinctive for the part of coast from the mouth of Krivaya river to the curve of coastline near the mouth of the Gusinaya river - a length is 60.5 km. These rates are in 1.1-1.5 times lower than average rates of retreat of thermal cirque edges which are connected with melting of massive ice deposits.

Averaged growth rates of the thermal cirques in 1948-2002 was 2.4 m/year; in 2002-2012 was - 2.6 m/year. The maximum growth rate on some sections in 2009-2012 were 14.5-15.1 m/year. These rates are the largest for the previously recorded in the Western sector of the Russian Arctic. The cause of the abnormally high rates is an increase the annual amount of positive air temperatures, which in 2011-2012 was 1.4-1.5 times higher than the long-term average.

The determined rates of the development of thermal cirque can be extended to the north from the key area (near the Sauchiha river mouth) to the Gusinaya river mouth with total length of 32.3 km.



**Figure 1:** The scheme of thermal cirques edges retreat in 2002, 2009, 2012. A – Central; B – Southern thermo-cirque. Edges: 1 – in 2002, 2 – in 2009, 3 – in 2012, 4 – lower edge in 2009, 5 - lower edge in 2012, 6 - proluvial cones in 2012

The next plans on studying the coastal dynamics on Kolguev Island - using additional satellite images for the purposes of:

- detailization of interannual dynamics through the analysis of more short time span series of satellite images,
- definition of variations of the coastal destruction rates on the Western and Northern coasts.

References:

Velikotsky M.A. Characteristics of modern coastal dynamics of the Kolguev Island // Dynamics of the

Russian Arctic coasts, Moscow, MSU – 1989 – P.93-101 (In Russian)

Kizyakov A.I., Perednya D.D. Destruction of coasts on the Yugorsky Peninsula and on Kolguev Island (Russia) // Permafrost: Abstr. of the 8<sup>th</sup> Intern. Conf. (Zurich, Switzerland, 21–25 July 2003). Zurich, Switzerland – 2003 – P. 79–80.

Kizyakov A.I., Zimin M.V., Leibman M.O., Pravikova N.V. Monitoring the rate of thermal denudation and thermal abrasion on the western coast of Kolguev Island using high resolution satellite images // Earth Cryosphere (Kriosfera Zemli). – 2013, XVII, No. 4 – P. 15-25 (In Russian)