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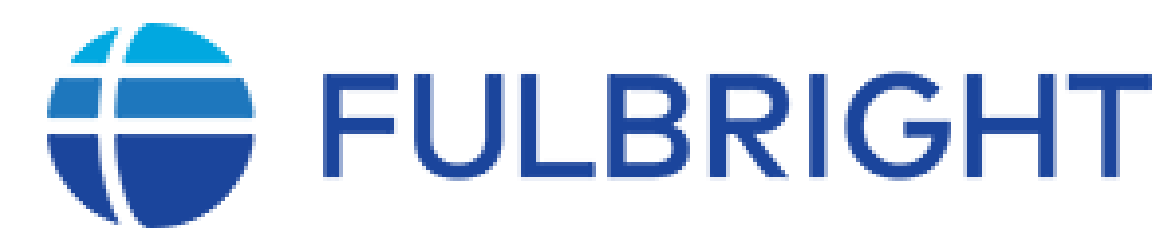
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How to measure nuclear weapons testing impact on glaciers melting pace in Novaya Zemlya archipelago in the Russian Arctic

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Introduction

For more than half a century glaciers in the Novaya Zemlya archipelago had been impacted by the nuclear weapons testing. The recent advances in remote sensing technologies allowed us to collect and analyze data about glaciers, compare and analyze what impact such military activities had on ice cover in the Arctic. Under the circumstances of climate change, the environmental conservation problem in the Arctic has become a number one priority in the international conservation policies (Carr, Bell, Killick, & Holt, 2017). Recent research (Zeeberg & Forman, 2001) showed that the Arctic ice is melting at an increased pace more than 2 times than glaciers in mountains. Remote satellite sensing provides thousands of space images a day, and collected images over the last 30 years give an insight into how glaciers' shape has been changed over time. The timeline of the known nuclear weapon testing can be used to discover a correlation with long-time increases in the melting pace.

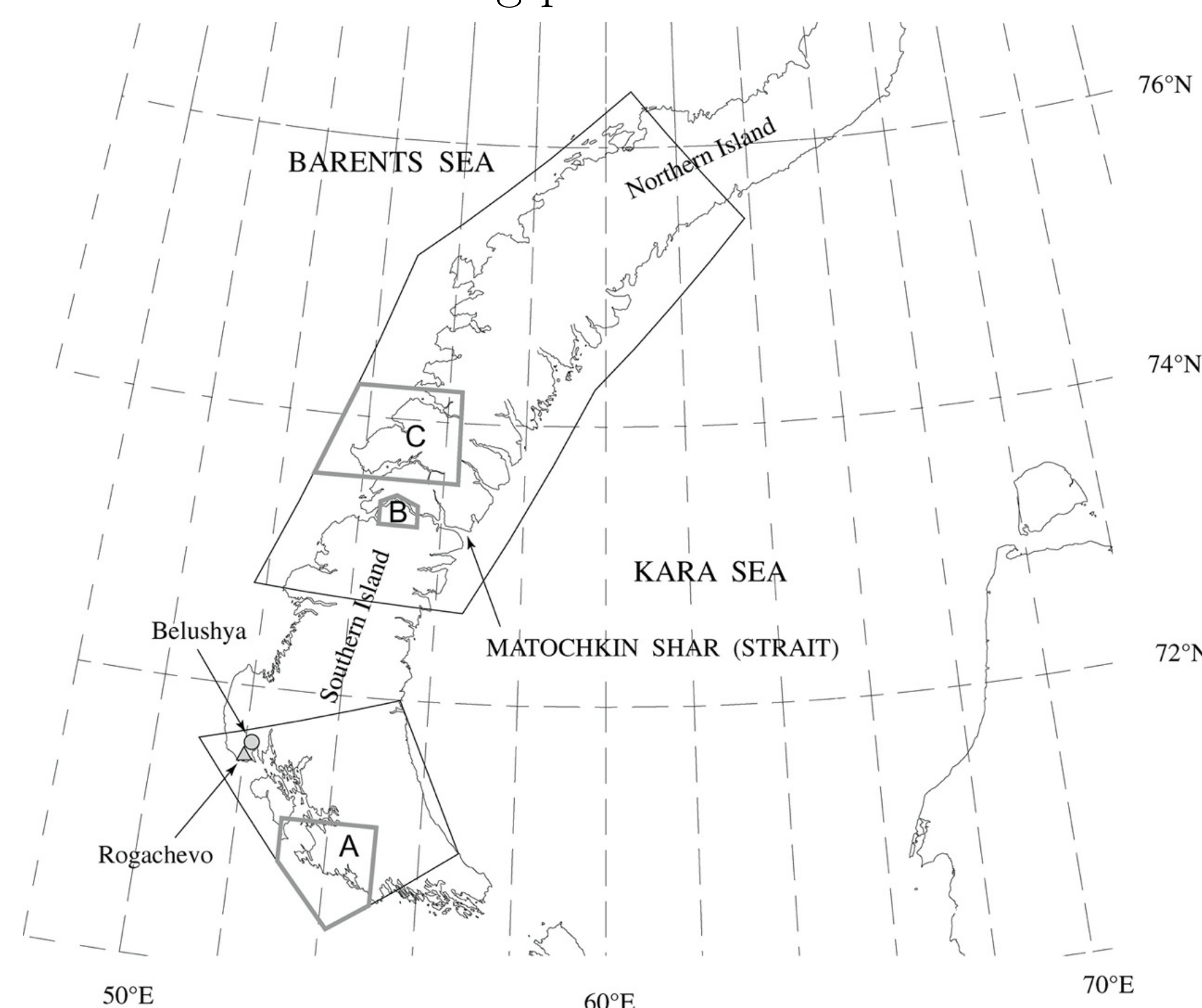


Figure 1: Nuclear testing sites at Novaya Zemlya Archipelago. Zone A was used for underwater, underground tests. Zone B was used for nuclear tests conducted in tunnels. Zone C was used for atmospheric explosions including the most powerful nuclear explosion of Tsar Bomb of 58 mt, 30 Oct 1961.

Source: Khalturin et al., 2005, p. 3

Remote Sensing Technology Overview

Remote satellite sensing is a technology that allows collecting various kinds of data including space shots, atmosphere, and hydrosphere tests, at distance, usually from the satellites (Edson, 2017). Over the last 30 years, satellites obtained a huge amount of various data from the Earth's surface (Zeeberg & Forman, 2001). There are various focuses on remote sensing technology. One of the most famous is deforestation control in the Amazon forests. A few research groups used remote sensing in order to predict and evaluate deforestation impact on the Amazon ecosystems (Edson, 2017).

Nuclear Weapons Testing Impact on the Environment

The nuclear weapons testing polygon was established in 1954 to satisfy Moscow's military ambitions in the Soviet-American arms race. From 1954 till 1991 more than 130 nuclear weapons testings both atmospheric and underwater were held leaving a significant impact on the local environment, ecosystems, and biodiversity (Khalturin et al., 2005).

Suggested methods to measure the impact could be a correlation between nuclear weapon testings (date, power, location) and specific images of the glaciers taken in different years. Therefore, a mathematical model may include variables about the timeline, explosions in megatons, mg, location, and space images shoot. This kind of model may be built for each of the glaciers in Novaya Zemlya.

The model may answer the question if there's a correlation between nuclear weapon testing and extensive glaciers melting in Novaya Zemlya. Fortunately, this model may not explain a direct consequence of such testings on the melting pace as there's no experimental data on this topic.

Glaciers in the Russian Arctic

The Russian Arctic is not only a common thing to name all Russian territories above the Arctic Circle but also a national park at the upper Novaya Zemlya. In recent years scientists repeatedly report that glaciers all over the globe melt at a rapidly increasing pace. The Novaya Zemlya archipelago has two types of glaciers: land- and water-terminating depending where the glacier's end-line is (Deschamps-Berger et al., 2019). The Vera glacier (to the north from C zone on Figure 1) for example lost 4 km during 1952-1992 which may be correlated alongside both climate change and extensive military activities nearby.

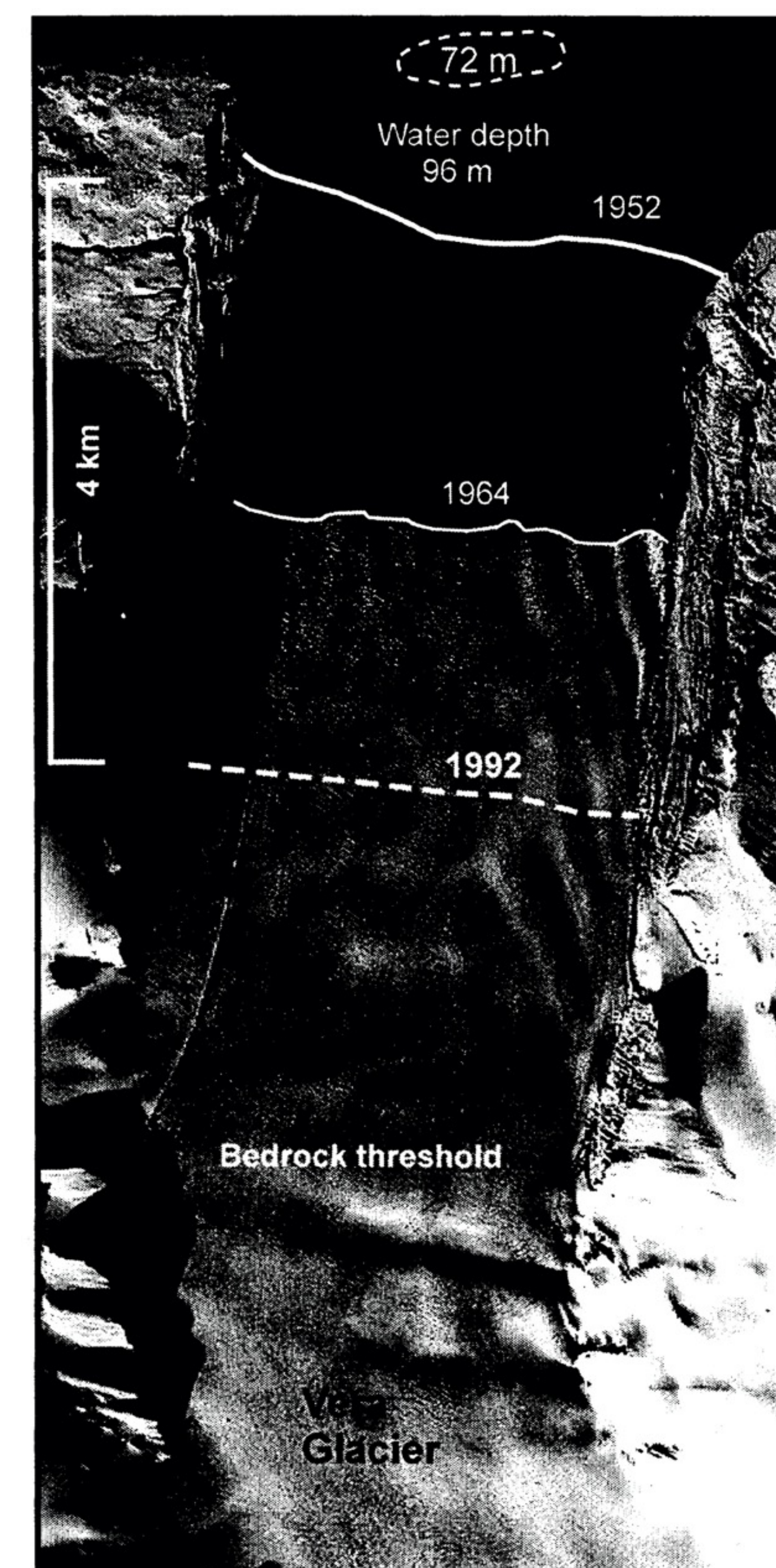


Figure 2: Corona-image (1964) showing inferred extent between 1952 and 1993 of the Vera Glacier. Source: Zeeberg & Forman, 2001, p. 170

Conclusion

Recent hostile actions like extensive nuclear weapons testing had left an everlasting footprint on the future of remote and uninhabited places. Novaya Zemlya archipelago, known for harsh climate conditions and picturesque landscapes, has become a sacrifice to the Soviet, later Russian, nuclear supremacy.

Remote sensing is a keystone to understanding the current state of the Earth's surface. The rapidly increasing amount of various data collected through satellites allows extending knowledge about the evolution of the landscape. Space snapshots give a huge insight into the development of glaciers, the melting process. The exact impact of nuclear weapon testing may open insight into how industrial and military activities accelerate the melting pace. Further study may open a new perspective towards environmental conservation and sustainable energy infrastructure.

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