The Svalbard Archipelago: when distant erosion monitoring warns of the magnitude of climate impacts in the rest of the overpopulated world. Contribution of the Space for Shore consortium to the ESA's Coastal Erosion Program

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Arctic coastal areas can experience higher erosion rates than temperate regions due to the combined influence of seasonal permafrost melt and extreme temperatures. In addition to these ordinary dynamics, high latitude coastal areas are even more affected by climate-induced changes such as increased weather hazards, rising temperatures or changes in river discharges and sediment supply.

The Svalbard region consists of an archipelago of Arctic islands and a rocky and sandy coastline chiseled by numerous fjords connected to glaciers and a complex hydrographic network. Highly sensitive and exposed to the impacts of climate change, this coastal area is a perfect witness to the environmental changes of our century.

The Svalbard Archipelago has recently become a key hotspot with an increasing number of studies, mainly focusing on glacier melt, temperature change or soil destabilization. The environmental, geographical, and geomorphological conditions of Svalbard make it extremely difficult to monitor coastal change on a large-scale. However, several studies, including Lim et al. (2020), Jaskolski et al. (2018), and Sisneros-Kidd et al. (2019), have highlighted the strong pressure of climate change, population, and human activities on the Svalbard coastal area.

This littoral is fully in line with our approach to apprehend the past, present, and expected consequences of climate change on the environment and populations.

In close collaboration with local researcher Maria Jensen from the University of Svalbard (UNIS) and other experts in France (Agnès Baltzer and Franck Garestier), we have explored the potential of the Copernicus satellite images to produce key information on the past and recent dynamics of nearly 300 km of coastline in the Svalbard archipelago. This is a major challenge, given the complexity of the environment and the meteorological and climatic conditions of the region, which limit the volume of usable spatial data (cloud cover and seasonal ice on the monitored sediments).

After a first phase of adaption of our in-house algorithms to this new typology of coastal areas, we extracted the coastline over 25 years, computed associated coastline changes as well as the evolution of the banks and the extent of the hydrographic network along several major

fjords in Svalbard. Particular attention was given to Advenfjorden to improve our effort, due to the greater availability of in situ data to validate the satellite products. We experienced satellite-derived bathymetry into the fjord. This information was one of the most complex challenge in terms of methodology and algorithm development regarding the environmental context, but it is also a crucial insight to consider the full climate change impact on coastal sediment dynamics. Finally, we extracted another coastal indicator to focus on changes in the deltaic areas, namely the pioneer vegetation coverage, which reveals the impact of warming on these highly dynamic regions.

For the first time, we present our new results issued from these investigations.

Keywords: coastal erosion, climate change, Svalbard Archipelago, Arctic coast, remote sensing