

The Arctic Ocean may be the planet's smallest ocean, but over the past decades it has become a focus of interest on account of its rapidly changing climate. The Arctic has been warming at a rate about three times faster than the global mean and one of the reasons is a significant increase in the transport of Atlantic water from lower latitudes. The increasing Atlantic influence in the Arctic region is called "atlantification" or "borealization". Progressive atlantification leads to significant changes in the Arctic ecosystem, modifying primary productivity, food webs' complexity, and biodiversity. From the marine biology perspective, atlantification creates optimal conditions for boreal organisms to live, leading to a northward shift of these species' distribution and an increase in their abundance. However, the knowledge about the influence of atlantification on biodiversity and ecosystem functioning is still incomplete, especially regarding microorganisms.

Understanding the past variability of the process of atlantification is crucial in providing a longer perspective on the modern Arctic changes. The past is key to the future; thus, exploring climate and environmental changes in the geological past is key to understanding the current changes. Arctic experienced periods of intensive Atlantic Water inflow in the past and it affected biological communities. However, our current view of marine biodiversity and organisms' responses to past environmental changes is limited to a few groups of organisms whose remains are preserved in fossil records. The limitations of classical, morphology-based approaches may be overcome by analyzing genetic material preserved in marine sediments across geological times, the so-called sedimentary ancient DNA. Although this DNA is strongly degraded, it is still possible to recover its fragments and identify their origin. Thus, the marine sediments provide invaluable archives of almost everything that has been living there in the past.

In this project, we will use DNA archived in marine sediments to describe changes in biological communities across time and space. We will focus on the times since the Last Glacial Maximum, which is the period of significant reorganization of oceanographic conditions in the Arctic. We will use a range of indirect sources of information, such as mineral and chemical composition of sediments, microfossils, and their elemental composition to reconstruct climatic and environmental changes in the Arctic Ocean in the geological past. The sedimentary ancient DNA record will give us an insight into the biological communities, including organisms that are never preserved in the fossil record. The proposed project has the potential to fill many gaps in our very limited understanding of biodiversity changes in the Arctic since the Last Glacial Maximum and the role of these changes in ecosystem functioning. The proposed project has the potential not only to evidence major turnovers in marine biodiversity related to atlantification but also to predict the direction of future climate changes in the Arctic.