The remarkably cross-Europe increase of use of pharmaceuticals and their large disposal volumes raised concern about the ubiquitous occurrence and impacts of these compounds in natural marine ecosystems. Human pharmaceuticals (drugs) are nowadays considered emerging contaminants of environmental threat not only in coastal waters adjacent to point source release but also in more distant marine areas due to possible transport of drugs at long range. Though pharmaceuticals undergo biotic and abiotic degradation in the marine environment, owing to specific physic-chemical properties they can remain in the aqueous phase for long time which induces potential for long-range transport and impact on living organisms in distant areas. Recently, the occurrence of pharmaceuticals was detected even in the European Arctic waters. As a relatively pristine and remote system, the Artic is particularly susceptible to any environmental change, including pharmaceutical pollutants. Not surprisingly, the presence of drugs receives attention of scientific community and local authorities in international research collaboration to support environmental risk assessment in the Arctic.

The PHARMARINE project will contribute to this policy by providing new experimental knowledge on unknown yet transport vectors and fate of human drugs *via* ocean currents from the continental Europe to polar regions in the European Arctic. Potential aqueous pathways of pharmaceuticals will be investigated at several locations along a northward transect going from the South (the Baltic Sea and the North Sea) through the Norwegian Coastal Current and warm North Atlantic Current to the Spitsbergen fjords (Hornsund and Kongsfjorden) in the North. In addition, potential of pharmaceuticals to accumulate in the benthic macroinvertebrates will be unravelled in order to assess contamination status of the Arctic fauna. Biomagnification of pharmaceuticals in benthic food web will be also studied at one Arctic location employing stable nitrogen isotope ratio as an indicator of trophic position. By exposing benthic and pelagic faunal species to selected pharmaceuticals at environmental and above-environmental concentrations under simulated cold Arctic conditions in a series of experiments, harmful effects on animals will be quantified. Biological responses will be measured at different levels of biological organisation (from genes and cells to metabolic activity) using early-warning biomarkers such as DNA and proteins. Results of the laboratory experiments will thus provide novel empirical information on biological impacts and threat pharmaceuticals pose currently on the Arctic marine ecosystem.

Based on physic-chemical properties, consumption rates and sale volumes, potential to bioaccumulate and detection records in water and marine organisms in the Svalbard Archipelago, four pharmaceuticals were selected for investigations: Diclofenac (nonsteroidal anti-inflammatory drug), Tetracycline (antibiotic), Fluoxetine (antidepressant) and Simvastatin (lipid lowering medication). Their concentration in field samples will be analysed using modern analytical techniques such as high-resolution mass spectrometers (so called orbitraps).

The PHARMARINE project will use the available field and laboratory facilities and expertise of Polish-Norwegian research teams of complementary competence, to study important and environmentally relevant issues.

The proposed project will produce new data and conceptual understanding of:

1) potential transport pathways of pharmaceuticals with water masses from mid-latitude more contaminated areas to the European Arctic;
2) bioaccumulation and biomagnification processes of drugs in the Arctic;
3) biological impacts of pharmaceutical pollutants on sedentary benthic species.

The resulting biological indicators of stress induced by the presence of drugs in the ambient environment can also provide a useful tool to forecast and assess environmental risk assessment in the European Arctic.