The Earth's biosphere is predominantly cold, as the psychrosphere (i.e. polar and alpine regions, deap sea and oceans environments, cave systems etc.) occupies about 90% of oceans and 70% of terrestrial environments. Moreover, about 20% of Earth's surface is permanently frozen and constitutes a cryosphere. Those environments are inhabited by cold-adapted microorganisms, i.e. psychrotolerants and psychrophiles. Both groups can survive extremely low temperatures, since all components of their cells, from membranes and transport systems to intracellular solutes, DNAs/RNAs and proteins, as well as all fundamental cellular processes of metabolism, replication, transcription and translation are suitably adapted to withstand the cold.

The cold-adapted microorganisms and their products (enzymes and secondary metabolites) find applications in a broad range of industrial, agricultural, scientific and medical processes. It is a consequence of their characteristic features and the market demands, as the possibility of using the lower temperature for particular biotechnological process reduces the overall energy usage, which consequently provides the reasonable economic benefit.

The main aim of this project is to perform complex analyses of siderophores, surfactants and cold-active bacteria producing those secondary metabolites in course of revealing their biological activities, ecological role and biotechnological potential. The detailed objectives of the presented research proposal are as follows:

- identification and analysis of genetic modules responsible for the synthesis of siderophores and biosurfactants by cold-active bacteria;
- identification and biochemical analysis of novel, siderophores and surfactants (with unrevealed activities) produced by psychrotolerant bacteria;
- determination of the potential role of identified secondary metabolites in biology and adaptation of analyzed psychrotolerant strains;
- revealing the ecological role of siderophores, surfactants and cold-active bacteria producing those secondary metabolites, i.e. their influence on both abiotic (participation in biogeochemical processes) and biotic (influence on co-residing organisms, including bacteria, fungi and plants) components of the ecosystems;
- revealing the biotechnological potential of siderophores, surfactants and cold-active bacteria producing those secondary metabolites as novel bioremediation or antimicrobial agents and plant- or bacteria-promoting factors.

We believe that the most significant advantage of the project is that it integrates the results of genomic and biochemical analyses to microbial ecology, environmental microbiology and biotechnology (mostly environmental biotechnology). Such combined approach may shed a new light on the molecular mechanisms of siderophores and surfactants (produced by cold-active bacteria) functioning and their biological role (scientific goal), as well as enable reliable planning of a potential application of those metabolites (and their bacterial producers) in various biotechnologies (including bioremediation, agriculture, biomedicine and even molecular biology) in the future (applied goal).