Layman's summary

Pollutant remobilisation from permafrost (PER2Water)

Permafrost means perennially frozen ground, i.e. remaining under zero degrees for longer than a year. Its extent reaches approximately 25% of land surface on Earth. Permafrost may trap various contaminants, including the so-called persistent organic pollutants (POPs). POPs are substances produced e.g. during the combustion processes, both industrial and natural (e.g. volcanic, wildfire-related), as well as through purposeful production of chemicals in the past and currently. POPs are slow to decompose and thus remain for a long time in the environment: in soils, water and air. These compounds may be inhaled or consumed by living creatures, whose health is then negatively impacted (especially top predators and people eating a meat-rich diet). The rapid climate changes result in permafrost thaw, which in consequence opens the possibility of contaminant release. The research conducted to date already shows that such a phenomenon is possible.

Within the **PER2Water project,** we plan to comprehensively investigate the problem of persistent organic pollutant release from permafrost in eastern Siberia (in the Kolyma region), where there has been no research on the topic at all. Since this area is less polluted than western Siberia, and at the same time it harbours thick layers of frozen ground (permafrost), the location fits perfectly with the purpose of testing whether such a problem occurs only locally or worldwide. Furthermore, a detailed set of measurements, both hydrological (i.e. measuring how much water is liberated from thawing permafrost) and chemical (i.e. checking the amounts of pollution dissolved in water and suspended in it with sediment) will let us determine robustly how much of these contaminants reach ecosystems on land and in the sea.

The research hypotheses we are going to test read as follows:

(1) Organic pollution is locked in permafrost worldwide and may be remobilised with water flowing from permafrost as it thaws.
(2) Seasonally, the concentration of the released pollutants increases, during the so-called thaw pulse.
(3) The rapidly changing climate in the permafrost regions of the world lead to thaw reaching deeper and thus increasing the contaminant amount fed into the neighbouring ecosystems.
(4) The investigated chemicals come from a mix of sources. However, especially those connected to forest fires in Siberia will continue to accumulate in the Arctic. Thus the problem may be exacerbated for two reasons: due to enhanced permafrost thaw and an extra supply of pollution.

The mentioned hypotheses will be verified with the following tools: field research in Siberia, chemical analysis with advanced techniques for organic compound determination, and geographical data analysis. This work will be undertaken by an interdyscyplinary team of chemists and geographers, including researchers well acquainted with the study site. Among the project results, we plan to deliver publications with exact data on the release of pollution from permafrost in the Kolyma region, as well as determine the extent of the problem in the Northern Hemisphere by comparing our data with other published information from western Siberia and Svalbard.