Tracing mercury sources in the Arctic marine ecosystem

Marianna Pinzone[1], Fanny Cusset[1], Philipp Assmy[1], Allison Bailey[1], Dmitry Divine[1], Igor Eulaers[1], Sebastian Gerland[1], Lucie Goraguer[1], Geir Wing Gabrielsen[1], Anette Wold[1], Malin Daase[2], Sarah Tingey[3], Silje Waaler[3], Jemma Wadham[3], Olivier Chastel[4], Paul Renaud[5,6] and Heli Routti[1]

1 Norwegian Polar Institute, Fram Centre, 9296, Tromsø, Norway
2 Department of Arctic and Marine Biology, UiT – The Arctic University of Norway, 9037, Tromsø, Norway
3 Department of Geosciences, UiT – The Arctic University of Norway, 9037, Tromsø, Norway
4 Centre d'Etudes Biologiques de Chizé (CEBC), UMR 7372 CNRS - La Rochelle University, 79360 Villiers-en-Bois, France
5 Akvaplan-niva, Fram Centre, 9296, Tromsø, Norway
6 University Centre in Svalbard, 9171, Longyearbyen, Norway

The major challenges limiting the effectiveness of marine pollution prevention is the poor understanding of chemicals' sources and exposure pathways. The Arctic is a critical hotspot of global change, where the bioavailability and cycling of pollutants in marine food webs is expected to be permanently altered. Insufficient knowledge of the changing mercury (Hg) sourcing and dynamics within the context of a rapidly changing Arctic complicates the assessment of Hg exposure in marine predators. The novel analysis of Hg stable isotopes (Hg-SIA) has significant potential to improve our understanding of environmental and ecological drivers of Hg sources within the ecosystem. Funded by the EU Marie Curie program, the SEASOL (From the SEA to the SOLution) project aims to advance and exploit Hg-SIA to identify Hg sources and pathways in a key sentinel species, the black-legged kittiwake (*Rissa trydactila*), as well as assess the potential impact of climate change on Hg pollution sources. Based on sampling from Kongsfjorden (79°N, 12°E, Svalbard), a recognized 'natural laboratory' for climate change research, we will conduct comprehensive Hg stable isotope analyses on a diverse range of marine ecosystem components. From April to September 2024, samples of marine sediments, sea-ice algae, suspended particulate organic matter, meso- and macrozooplankton, invertebrate benthic macrofauna, various fish species, as well as blood samples from black-legged kittiwakes, were collected. Lower trophic level ecosystem components (all except fish and kittiwakes) were collected from the Atlantic-influenced mouth of the fjord to the glacial-influenced inner fjord to assess Hg exposure along an environmental gradient. Most samples were collected at three different times during the season. While carbon, nitrogen, and sulphur stable isotopes will serve as proxies for the trophic ecology of the black-legged kittiwakes, Hg stable isotopes will proxy spatio-temporal Hg sourcing. Data interpretation will also include consideration of abiotic environmental variables and processes. Finally, Bayesian Network Analysis will enable plausible "what-if" projections of the impact of climate change on Hg sourcing, supporting the development of a digital decision tool to mitigate future impact of local and global Hg pollution in the marine Arctic.