

ARCTOME

A deep-dive in the sea biome

1- Extensively document the biological and functional diversity of microorganisms inhabiting sea ice

2- Identify the key metabolic pathways that drive this ecosystem

3- Link i) and ii) to the physical and chemical characteristics of sea ice that shape this biome

Massive use of transformative sensors and omics tools will enable us to break the boundaries of small-scale sea-ice exploration

-> Evaluate the resilience of this ecosystem, its role in fostering evolution, and its potential for hosting life in other ocean worlds

ARCTOME



Sea ice is a major biome throughout Earth's history. Yet, one of the least known.

Concentrator of life and hotspot for evolution on Earth and other ocean worlds

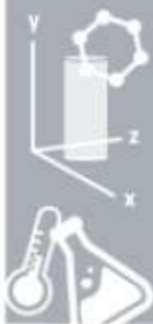
Under climate change pressure, summer ice will be gone in

20-40 years



Methodological breakthroughs are required to explore sea-ice micro-niches, and taxonomical and functional diversity

WP1 Groundbreaking methods for exploring the sea-ice microbiome



Methodology optimisation for: small-scale sea-ice chemistry and physics taxonomic and metabolic diversity

Establishment of sea-ice microorganisms cultured models



WP2 Key phases shaping the sea-ice microbiome over seasons and years

Intensive, full-year surveys of sea-ice microbiome

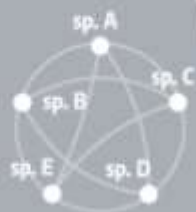
3 contrasting locations in the Arctic



WP4 Holistic conceptualisation of the sea-ice biome

Holistic analysis of generated datasets

Addressing hypothesis on microbial evolution and astrobiology



WP3 Experimental assays using cultured model sea-ice microorganisms

Laboratory experiments to explore the resilience or acclimation strategies

Growth rate experiments under different conditions

Effects on metabolic pathways and functional traits

Genomics and transcriptomics



Table 1. Key characteristics of the three locations at which seasonal time series will be documented in WP2. Information derived from ^{9,65-70}.

Location of seasonal time series	Latitude	Polar night duration (days)	Number of days with sun elevation < -6°	Number of days with sun elevation < -12°	Number of midnight-sun days	Total annual freezing degree-days	Average sea-ice thickness in March-April (m)	Surface water origin index (Atlantic = 0, Pacific = 1)
Qikiqtarjuaq	68°N	13	-	-	48	4376	1.4	0.4-0.8
Melville Bay	75°N	92	51	-	142	~3000	<1	< 0.1
CFS Alert	82.5°N	122	106	66	152	7725	4	> 0.9

First Year Ice (FYI)

Qikiqtarjuaq



Multi Year Ice (MYI)

CFS Alert



Sea-ice ecosystem seasonality

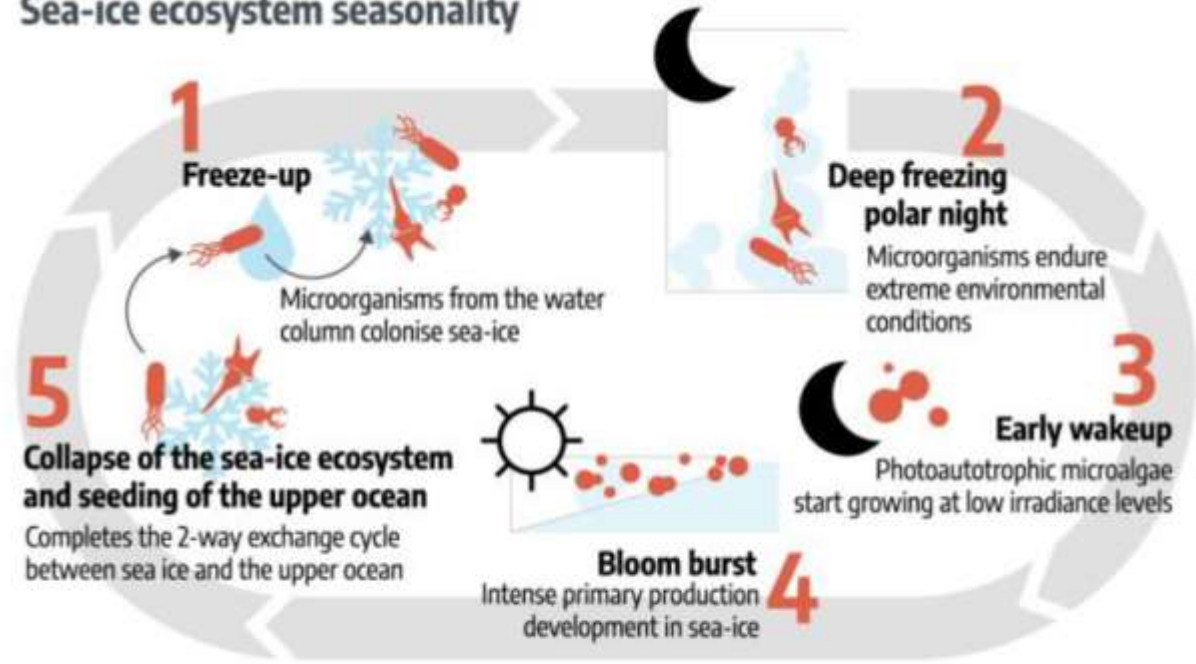


Fig. 2. Left panel: Two images of the fieldwork sampling stations in the AO: Qikiqtarjuaq and the Canadian Forces Station (CFS) Alert. Right panel: the five phases of sea-ice ecosystem seasonality.

