The future of Arctic sea-ice biogeochemistry and ice-associated ecosystems: *a complex tale of winners and losers*

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1. Motivation

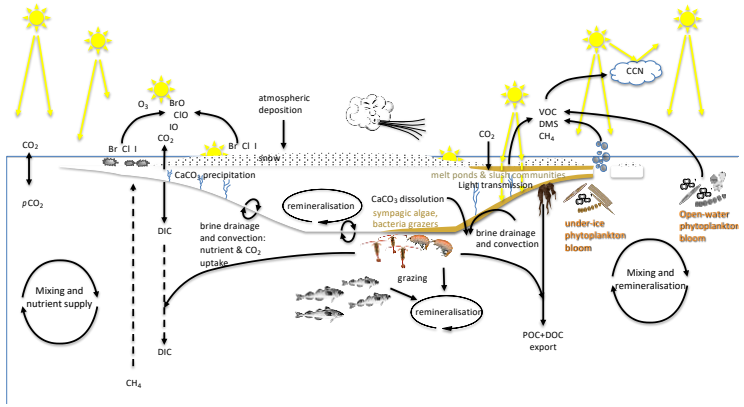

Fig. 1 | Schematic of seasonal sea-ice biogeochemical processes in the Arctic Ocean.

Sea ice influences the climate system, provides food and supports businesses.

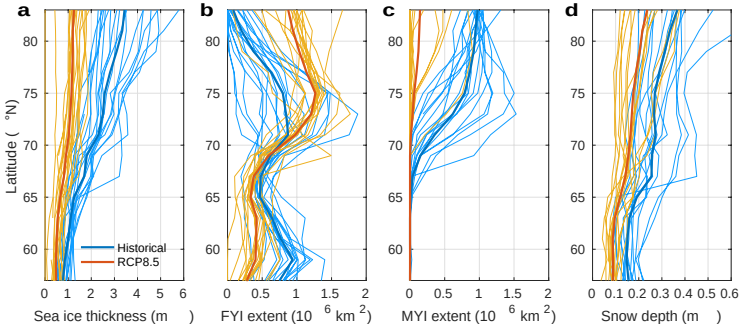

Fig. 2 | Past and predicted changes in sea-ice physical characteristics along latitudes.

Arctic sea ice is becoming thinner, younger, warmer and more ephemeral: What are the effects on biological productivity and emission and capture of greenhouse gases?

2. Framework

Regions:
(1) Western Arctic (perennial sea ice);
(2) Central Basin (seasonal and perennial sea ice);
(3) Eastern Arctic (seasonal sea ice).

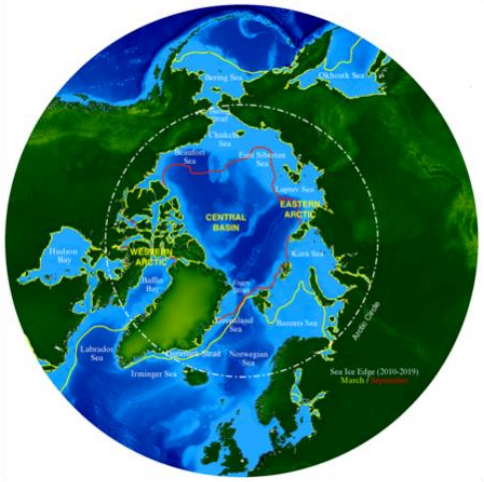

Fig. 3 | Map of the Arctic Ocean.

Variables:
(1) Environmental conditions (light, habitat, nutrients);
(2) Biota (algal communities, microbial loop, metazoan, higher trophic levels and biological pump of carbon);
(3) Climate-active gases (CO_2, DMS, CH_4 and halogens).

Categories:
(1) Changes in sea-ice coverage (horizontal changes);
(2) Changes in sea-ice properties (vertical changes).

4. Recommendations

Urgent need for the establishment of long-term observing platforms in climate-sensitive sea-ice regions.

3. What to expect

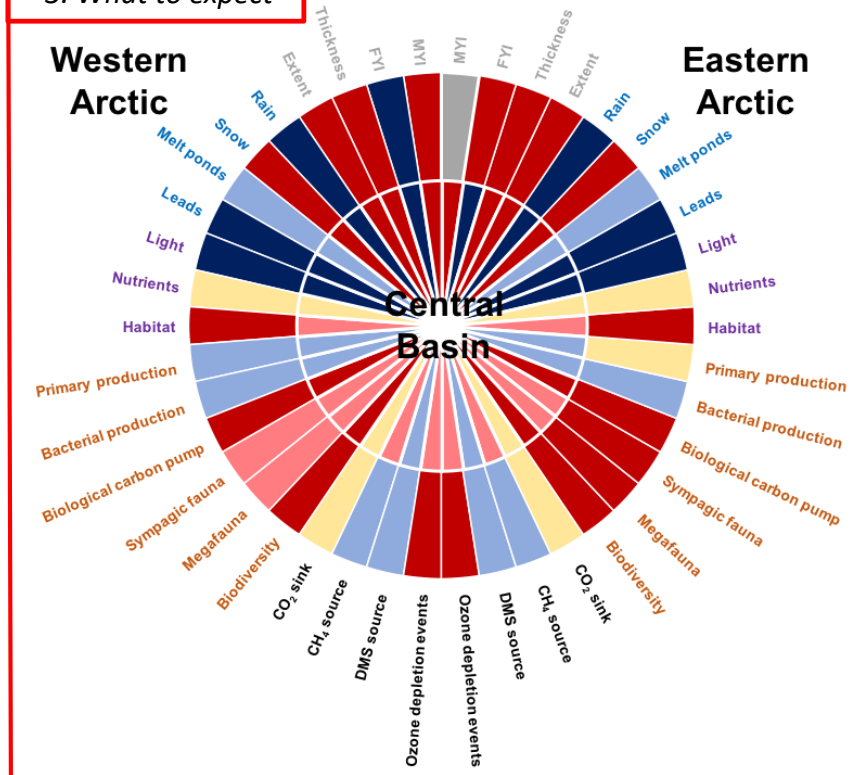

Fig. 4 | Future expectations of changes in the sea-ice biogeochemical system in the Arctic.

Key Results:
(1) Marine primary productivity will increase and capture more CO_2, but the most successful algal species will also be smaller and therefore transport less carbon to the ocean floor;
(2) Greater dominance of zooplankton species with lower nutritional value for fish, leading to a decline in species like the Arctic cod;
(3) Sea-ice dependent predators like ringed seals, beluga whales and polar bears could face local and regional scale extinctions.

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