Physical and bacterial controls on inorganic nutrients and dissolved organic carbon during a sea ice growth and decay experiment

We investigated how physical incorporation, brine dynamics and bacterial activity regulate the distribution of inorganic nutrients and dissolved organic carbon (DOC) in artificial sea ice during a 19-day experiment that included periods of both ice growth and decay. The experiment was performed using two series of mesocosms: the first consisted of seawater and the second consisted of seawater enriched with humic-rich river water. We grew ice by freezing the water at an air temperature of −14°C for 14 days after which ice decay was induced by increasing the air temperature to −1°C. Using the ice temperatures and bulk ice salinities, we derived the brine volume fractions, brine salinities and Rayleigh numbers. The temporal evolution of these physical parameters indicates that there were two main stages in the brine dynamics: bottom convection during ice growth, and brine stratification during ice decay. The major findings are: (1) the incorporation of dissolved compounds (nitrate, nitrite, ammonium, phosphate, silicate, and DOC) into the sea ice was not conservative (relative to salinity) during ice growth. Brine convection clearly influenced the incorporation of the dissolved compounds, and the non-conservative behavior of the dissolved compounds was particularly pronounced in the absence of brine convection. (2) Bacterial activity further regulated nutrient availability in the ice: ammonium and nitrite accumulated as a result of remineralization processes, although bacterial production was too low to induce major changes in DOC concentrations. (3) Different forms of DOC have different properties and hence incorporation efficiencies. In particular, the terrestrially-derived DOC from the river water was less efficiently incorporated into sea ice than the DOC in the seawater. Therefore the main factors regulating the distribution of the dissolved compounds within sea ice are a complex interaction of brine dynamics, biological activity and in the case of dissolved organic matter, the physico-chemical properties of the dissolved constituents themselves.

General information
State: Published
Organisations: National Institute of Aquatic Resources, Section for Marine Ecology and Oceanography, Universite de Liege, Alfred Wegener Institute, Hamburger Schiffbau-Versuchsanstalt, Bangor University, Finnish Environment Institute, Universite Libre de Bruxelles, University of Helsinki
Pages: 59-69
Publication date: 2014
Peer-reviewed: Yes

Publication information
Journal: Marine Chemistry
Volume: 166
Issue number: 193
ISSN (Print): 0304-4203
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 3.59 SJR 1.83 SNIP 1.213
Web of Science (2017): Impact factor 3.337
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 3.2 SJR 1.46 SNIP 1.046
Web of Science (2016): Impact factor 2.457
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 3.09 SJR 1.372 SNIP 1.344
Web of Science (2015): Impact factor 3.412
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 3.21 SJR 1.528 SNIP 1.402
Web of Science (2014): Impact factor 2.735
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 3.86 SJR 2.248 SNIP 1.737
Web of Science (2013): Impact factor 3.2
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 3.15 SJR 2.026 SNIP 1.267
Web of Science (2012): Impact factor 3
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 3.24 SJR 2.119 SNIP 1.301
Web of Science (2011): Impact factor 3.074
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 1.681 SNIP 1.095
Web of Science (2010): Impact factor 2.751
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 1.737 SNIP 1.379
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 1.776 SNIP 1.423
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 1.908 SNIP 1.6
Web of Science (2007): Indexed yes
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 1.556 SNIP 1.219
Scopus rating (2004): SJR 1.717 SNIP 1.693
Scopus rating (2003): SJR 1.717 SNIP 1.713
Web of Science (2003): Indexed yes
Scopus rating (2002): SJR 1.773 SNIP 1.453
Scopus rating (2001): SJR 2.202 SNIP 1.249
Web of Science (2001): Indexed yes
Scopus rating (2000): SJR 2.261 SNIP 1.2
Web of Science (2000): Indexed yes
Scopus rating (1999): SJR 2.241 SNIP 1.365
Original language: English
Keywords: Sea ice, Brine dynamics, Bacterial activity, Inorganic nutrients, Dissolved organic carbon
DOIs:
10.1016/j.marchem.2014.09.013
Source: FindIt
Source-ID: 272478746
Research output: Research - peer-review ; Journal article – Annual report year: 2014