

Simulated increases of future Arctic dimethylsulfide (DMS) emissions and production

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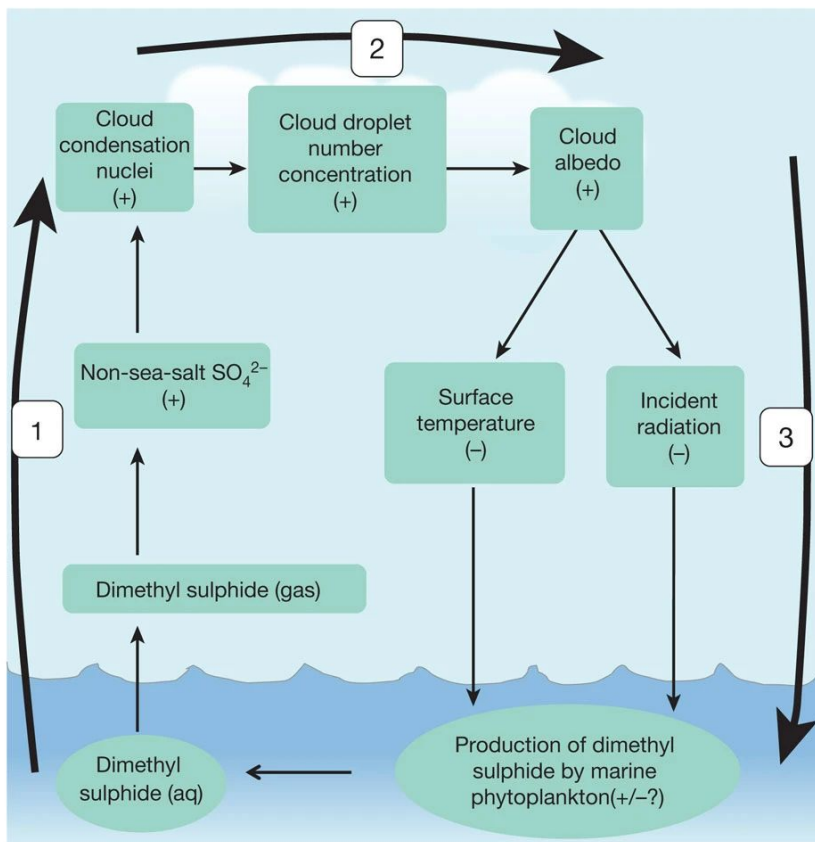
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DMS-climate interactions



DMS feedback ?

- (1) DMS source of cloud condensation nuclei (CCN)
 - Other sources of CCN
 - Sensitivity of CCN to change in DMS emission?
- (2) Change in CCN → change in cloud albedo
 - Complex aerosol-cloud interactions
- (3) Change in cloud albedo → change in DMS production
 - Weak sensitivities

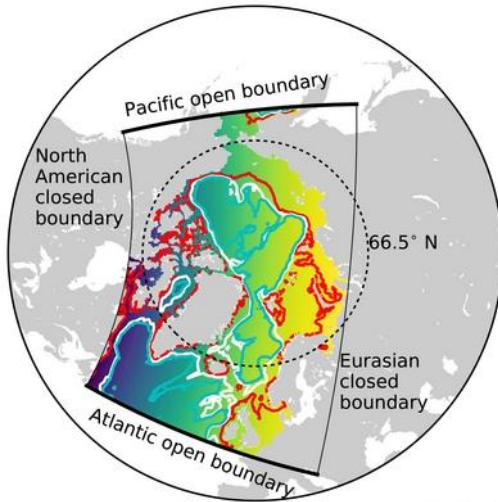
Arctic:

- Low background particle concentrations
- Cold temperatures
 - Favourable conditions for the formation of CCN from DMS

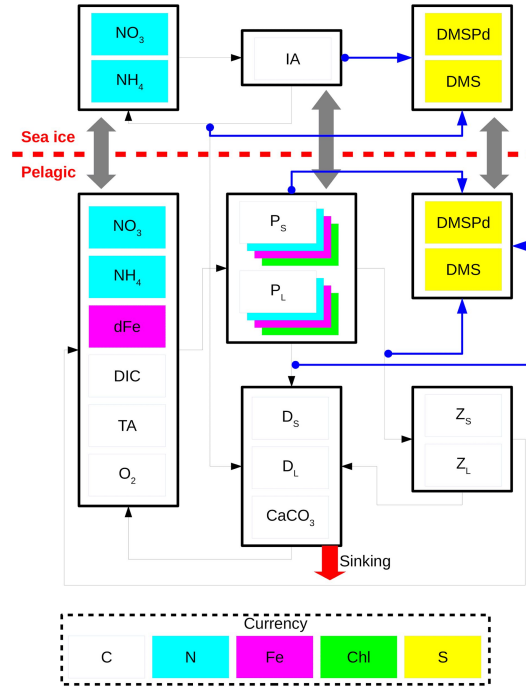
Charlson, R., Lovelock, J., Andreae, M. et al. *Oceanic phytoplankton, atmospheric sulphur, cloud albedo and climate.* (1987).

Ocean and sea ice model

- NEMO 3.4 + LIM2
- Historical (1979-2015)
 - Atmosphere: DFS
 - Lateral boundaries: ORAS4
- RCP8.5 (2016-2085)
 - Atmosphere: CanRCM4
 - Lateral boundaries: CanESM2



Horizontal resolution (km)



CSIB (Canadian Sea Ice Biogeochemistry model)

- Skeletal layer
- Ice algae
- N, S biogeochemistry

CanOE (Canadian Ocean Ecosystem Model)

- 2 phytoplankton
- 2 zooplankton
- 2 detritus
- C, N biogeochemistry
- + S cycle
- - Fe limitation

Hayashida et al. 2019. CSIB v1 (Canadian Sea-ice Biogeochemistry): A Sea-Ice Biogeochemical Model for the NEMO Community Ocean Modelling Framework.

Christian et al. 2022. Ocean Biogeochemistry in the Canadian Earth System Model Version 5.0.3: CanESM5 and CanESM5-CanOE.

May–August mean DMS emissions

2016-2035

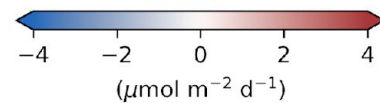
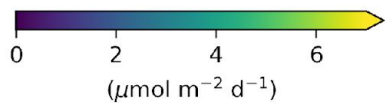
(a)

2066-2085

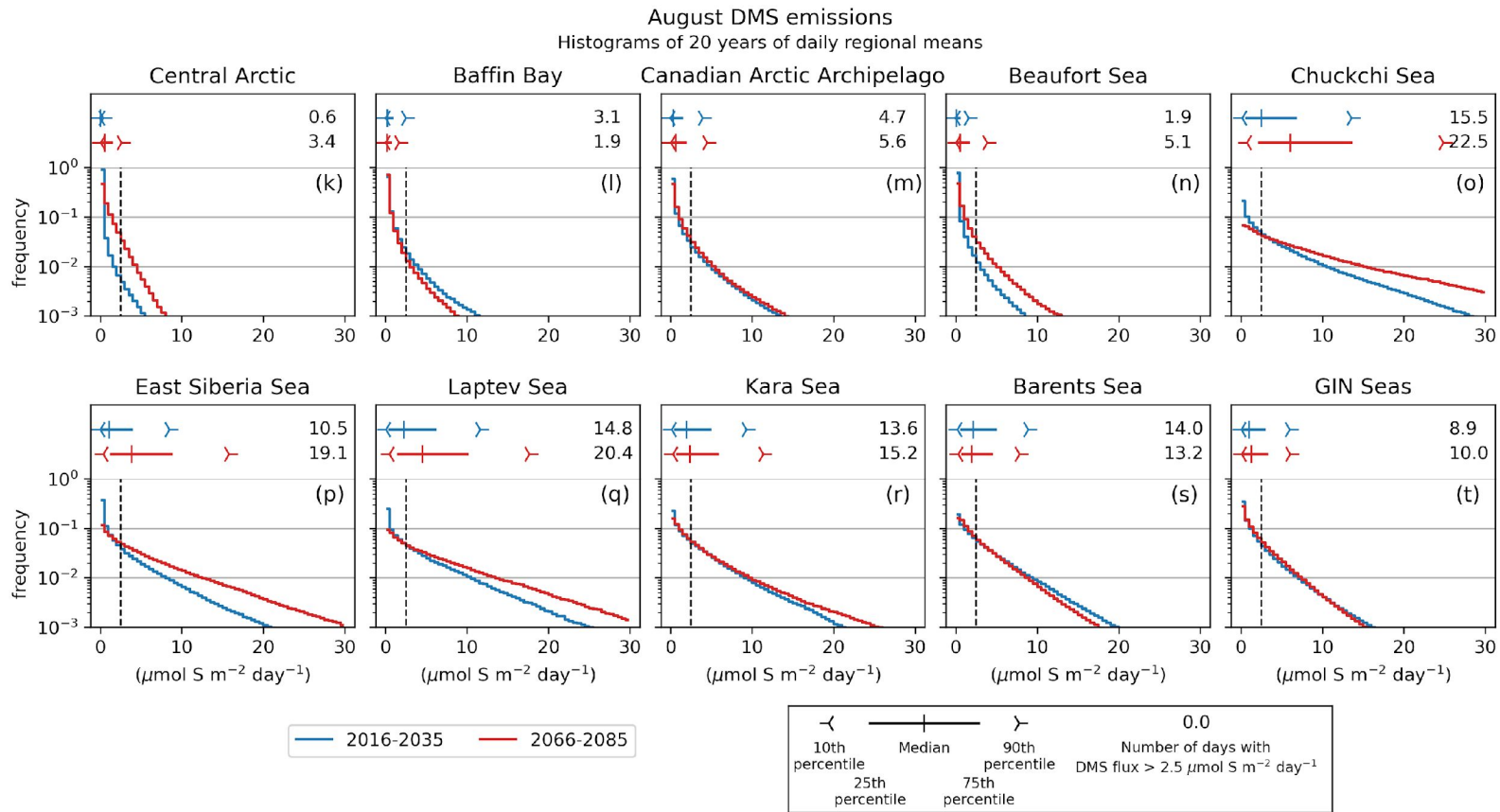
(b)

Change [2066-2085] - [2016-2035]

(c)

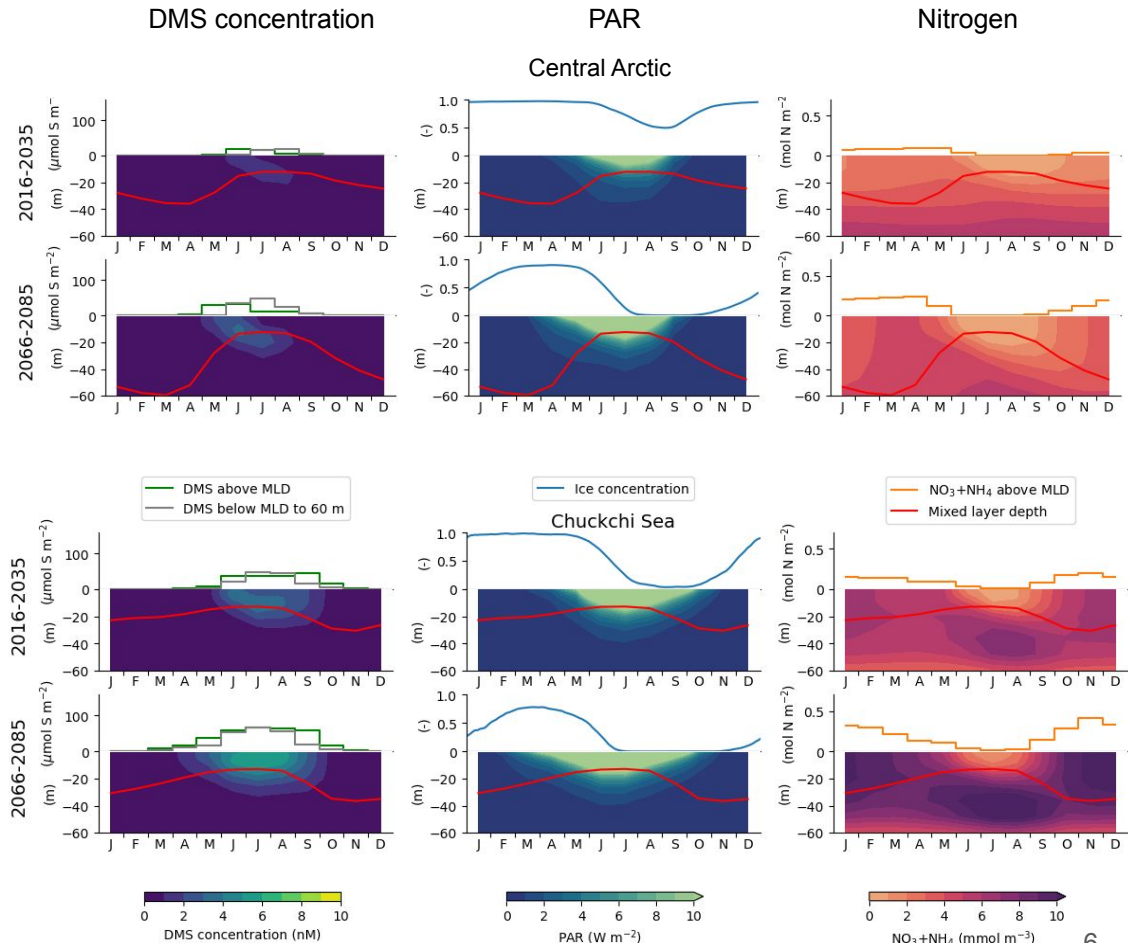
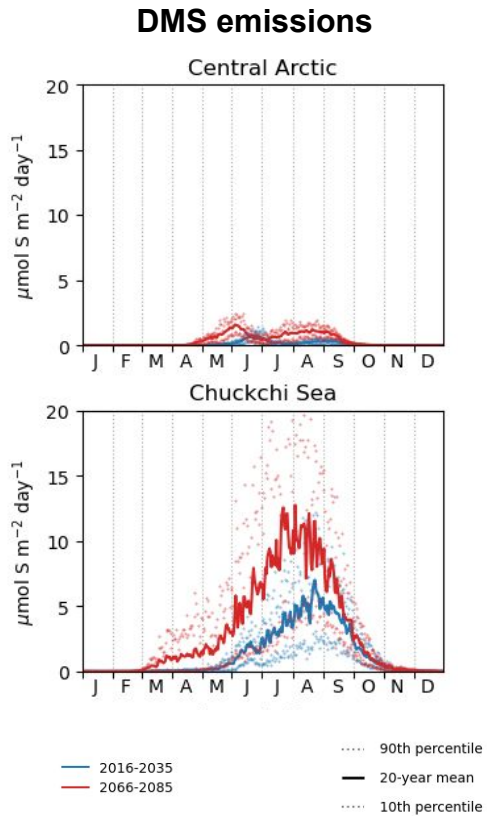


Temporal variability of DMS emissions



→ Bursts of high DMS emissions even in area of low mean DMS emissions

Regional mean ocean vertical profiles



Key points

DMS emissions

- Increased at higher latitudes
- Bursts of emissions: impact of wind variability



Impact on atmosphere and climate?



Offline coupling with WRF-Chem
(Rémy Lapere et al.)

Sea ice DMS production

- High DMS concentrations in sea ice
- No bursts and low emissions simulated during sea ice break-up



Sub-grid scale representation of lead?
Representation of meltwater lens?

Ocean DMS production

- Earlier from thinner sea ice and earlier break-up
- DMS production below mixed layer trapped



Impact of brief mixing events, supplying
deep DMS to ocean surface?

Thank you for your attention!

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This project has received funding from the National Science and Engineering Council New Frontiers in Research Fund (NSERC-NFRFG-2020-00451) in association with the European Union's Horizon 2020 research and innovation program under grant agreement No 101003826 via project CRices (Climate Relevant interactions and feedbacks: the key role of sea ice and Snow in the polar and global climate system)

