# Simulating sea salt aerosol emissions from sea ice leads in the Arctic


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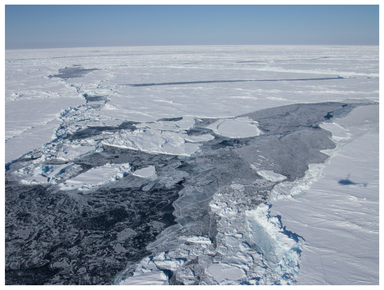
## MOTIVATION

### Sea ice leads may play dominant role in Arctic sea salt aerosol emissions during the cold season




Cracks in sea ice ("leads") through which sea spray can release salt have been identified as a source of sea salt aerosols in the Arctic since the early 1970s. Recent observations suggest they are a leading source of Arctic sea salt aerosols in the cold season (see Figures 1 and 2). This source is currently missing from chemical transport and climate models, leading to potentially large biases in simulations of Arctic aerosols and a critical gap in our understanding of future Arctic climate change. Ongoing summertime sea ice loss and changes in sea ice properties will likely increase the frequency of Arctic sea ice leads and their aerosol emissions, with potential feedbacks that must be quantified.

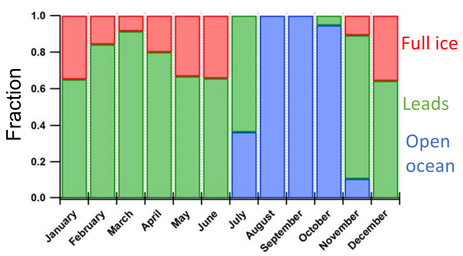



*Figure 1. Sea ice conditions on a fractional basis (2006-2009 sampling period) from May et al. (2016) near Utqiaġvik, Alaska.*

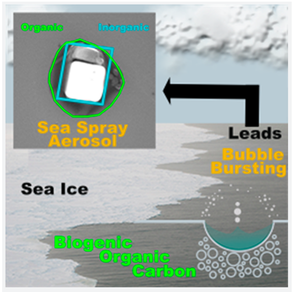
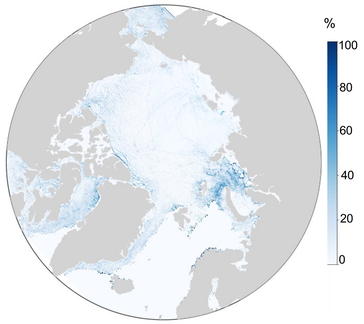


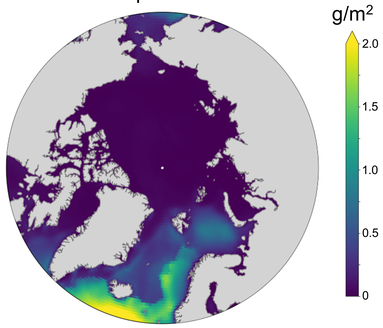

*Figure 2. Single-particle observations from Jan-Feb 2014 in Utqiaġvik, Alaska (Kirpes et al., 2019).*

### Satellite locations of sea ice leads suggest additional Arctic sea salt emissions are possible

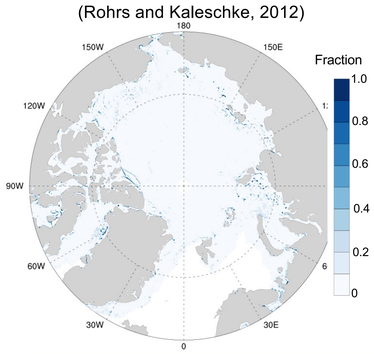
MODIS Ice Surface Temperature-derived Lead Frequency (Reiser et al., 2020)




Standard GEOS-Chem Emissions, April 2006




AMSR-E derived Lead Area Fraction (Rohrs and Kaleschke, 2012)

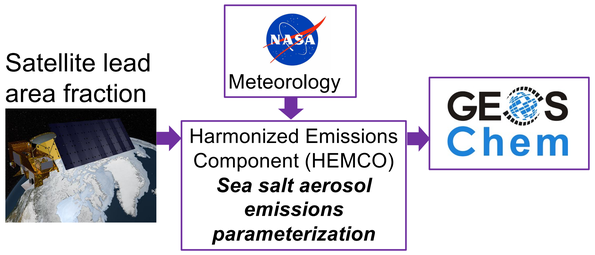



Locations of leads observed from satellites like MODIS and AMSR-E (left) in the example month of April 2006 show locations of leads where sea salt aerosol emissions in GEOS-Chem are currently 0 (above).

We implement emissions of sea salt aerosols from leads using the satellite lead fraction from AMSR_E for the location of emissions and as a scaling factor using HEMCO. We use the same emissions dependencies as the open ocean as a first step.

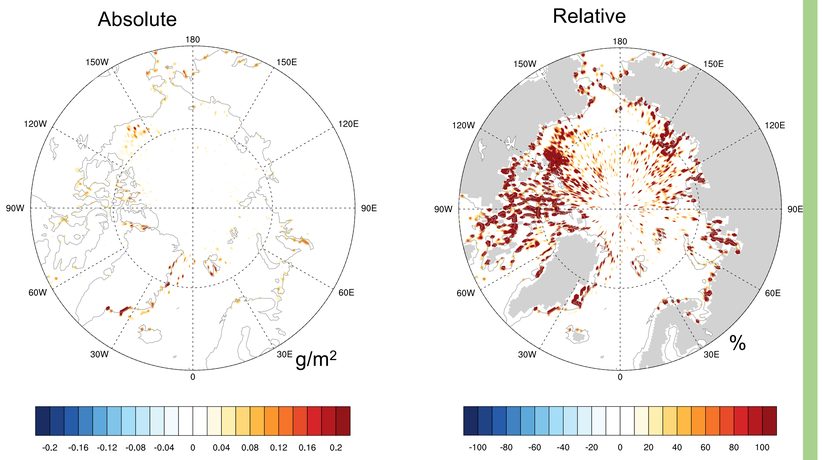
| | |
|---|---|
| GCClassic 13.2.1 (DOI: 10.5281/zenodo.5500717) | |
| HEMCO (Harmonized Emissions component) 3.1.1 (DOI: 10.5281/zenodo.5504133) | |
| Meteorology: NASA MERRA-2 reanalysis – January 2019 | |
| Resolution: | HEMCO emissions calculated at **0.5˚x0.625˚** |
| Default sea salt aerosol emissions: | Jaegle et al. (2011) for open ocean; Huang et al. (2018) for blowing snow |
| Default size bins: | Accumulation Mode: rdry = 0.01–0.5 μm<br>Coarse Mode: rdry = 0.5–8 μm |

## METHODS




## RESULTS

Jan 2019 SALA+SALC emissions difference



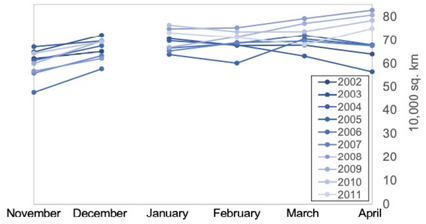

| | REF= DEFAULT EMISSIONS (Tg) | DEV= DEFAULT+ LEAD EMISSIONS (Tg) | REF – DEV (Tg) | PERCENT DIFFERENCE |
|---|---|---|---|---|
| SALA | 0.106 | 0.107 | 0.001 | *1.1%* |
| SALC | 1.68 | 1.75 | 0.07 | *4.2%* |

Total differences for >70˚ N

## Future Work

- Monthly-varying lead area fraction
- Using MODIS IST lead frequencies
- Improving wind-dependence and size distribution
- Evaluating against observations

Total monthly Arctic lead area (AMSR-E)

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- Kerri Pratt, University of Michigan

**References:**
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