UNIVERSITY of NORTH CAROLINA WILMINGTON

To Whom It May Concern,

This is to provide information regarding the status of scientific findings that resulted from the oceanographic expedition to Fram Strait in May 2020 aboard the MY Arctic Sunrise.

The main scientific focus of this expedition was on the impact of sea ice melt on the spring ecosystem dynamics in this region. It has been hypothesized that sea ice melt is important for kickstarting the growth of algae early in the season, with knock-on effects for higher trophic levels. Here, we aimed to collect data that would shed light on the dynamic interactions between the physical components of the regional climate system and the ecosystem.

The expedition resulted in the collection of following datasets (location of sampling is shown in the map appended below):

- Rosette dives (*9*) to ~300 m depth, with continuous CTD, dissolved oxygen, fluorescence, and turbidity measurements. Water was typically sampled at 6 distinct depths.
- CTD-only dives to ~300 m depth (*26*), including dissolved oxygen, fluorescence, and turbidity measurements.
- Dives using a Castaway CTD to up to 50 m depth (*46*), some of which through holes in sea ice.
- Surface water collection (*23*) analyzed for alkalinity and total carbon content.
- Ice thickness measurements on *7* ice floes.
- Ice core extraction on *7* ice floes.
- Ocean current measurements of ocean surface layer (~ 20 m depth) at *10* locations.
- Zooplankton collection at *35* locations.
- Trace metal collection at *9* locations.

Water and ice core samples have been processed for isotopes $\delta^{13}C$ and $\delta^{15}N$, as well as $\delta^{2}H$ and $\delta^{18}O$ using the mass-spectrometry facilities at UNCW. The samples were processed at the University of Washington for *nutrient* concentrations (nitrate, phosphate, silicic acid, and nitrite). To-date a subset of water samples have further been processed at UNCW for *pigment* concentrations.

These in situ measurements have been supplemented with satellite, reanalysis, and climate modeling data to obtain a wider understanding of the processes at play. In summary, the two central findings of our work so far are:

1. Sea ice melt at the ice edge during spring in Fram Strait enhances the stratification of the water column and facilitates enhanced phytoplankton growth. It thus presents a crucial driver of the spring awakening of the ecosystem in the region.
2. Recent increases in sea ice melt in Fram Strait, due to increased ice advection from the central Arctic combined with generally warmer temperatures, has helped driving the occurrence of algae super-blooms that have in recent years become both more intense and more widespread.

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So far, these findings have been presented at a number of professional conferences and invited seminars and have been the topic of two undergraduate honors theses and one (ongoing) Master's thesis. Presentations include:

- Elizabeth Bailey, Till J.W. Wagner, Mattias R. Cape, A. Castagno, Sara Rivero-Calle, Alexa H Alipour, Catharina Alves-de-Souza, and Robert York, *"Differences in First and Multi-Year Sea Ice Melt Signatures and Impacts on the Local Ecosystem during Spring in Fram Strait",* AGU Ocean Science Meeting, San Diego, CA, February 2020
- Conner Lester, Till J.W. Wagner, Dylan McNamara, Mattias R. Cape, Heather Koopman and Sara Rivero-Calle, *"The influence of sea ice melt on phytoplankton spring bloom dynamics in Fram Strait",* AGU Ocean Science Meeting, San Diego, CA, February 2020
- Andrew Castagno, Till J. W. Wagner, Mattias R. Cape, H. Koopman, H. Glandon, E. Bailey, C. Lester, Y. Marsan and D Wells *"Sea Ice-Ocean-Ecosystem Interactions During a High Phytoplankton Productivity Spring Bloom Event in the Fram Strait",* AGU Fall Meeting, San Francisco, CA, December 2019
- Till J. W. Wagner *"The New Arctic Ocean",* Planet Ocean Seminar Series, UNCW, February 2020
- Till J. W. Wagner *"Boom and bust? How spring blooms depend on ice melt in the Arctic ocean",* Global Marine Science Summit, UNCW, October 2019

The findings of item (*1*) above have recently been accepted for publication in *Geophysical Research Letters*:

> Conner Lester, Till J.W. Wagner, Dylan McNamara, and Mattias R. Cape *"The influence of sea ice melt on phytoplankton spring bloom dynamics in Fram Strait",* Geophysical Research Letters, in press

A preprint of this article is available from the authors upon request.

Statement regarding data availability and sharing: We believe that science progresses best and its positive impact is maximized if data and results are shared freely. We are thus committed to removing hurdles to access as much as we can. Although much of the collected data has not yet been published in the form of peer-reviewed articles, we are happy to freely share this data with any interested party who wants to use it for the purpose of scientific research. We are furthermore finalizing quality assessment and will move all data to the open-access repository GitHub once QA is completed.

Please feel free to contact me if there are any questions regarding the expedition, data collected, or the scientific findings that have resulted from this work.

With kind regards,

Till Wagner

Till Wagner, PhD (Lead Scientist)

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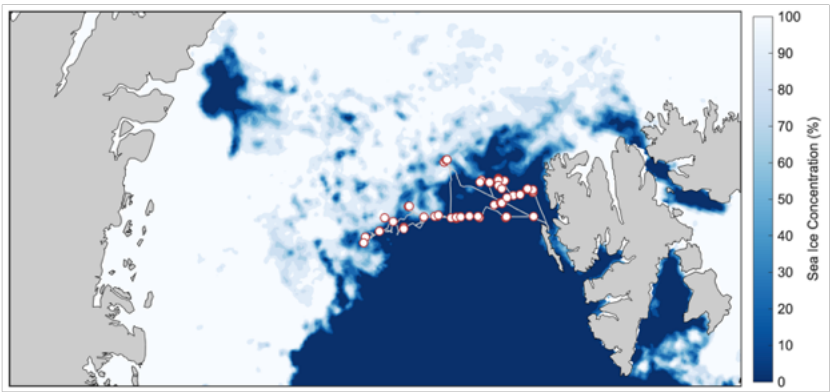
Attachment

Fram Strait Sampling Stations



A map of open-ocean and in-ice stations (red dots) during the May 2019 cruise. Sea ice concentration shown is from 30 May 2019 [Fetterer, et al MASAM2: Daily 4 km Arctic Sea Ice Concentration, Version 1. Boulder, Colorado USA. NSIDC].