SPRINGTIME COUPLING BETWEEN ARCTIC SEA ICE EXPORT AND PHYTOPLANKTON BLOOMS IN THE GREENLAND SEA

N. Mayot¹, P. Matrai¹, A. Arjona¹,², C. Marchese³, T. Jaegler³ and S. Bélanger³
¹Bigelow Laboratory for Ocean Sciences (nmayot@bigelow.org), ²Harvard University, ³ARCTUS inc.

INTRODUCTION

The Greenland sector of the Arctic has large permanently open water areas and therefore, has the highest total annual phytoplankton production in the pan-Arctic (above 66°N)¹. However, the Greenland Sea located in this sector is also exposed to major Arctic sea ice export. What are the impacts of the exported Arctic Sea ice on the regional ocean dynamics and primary production of the Greenland Sea?

¹Pabi et al., J. Geophys. Res., 2008

RELATIONSHIP BETWEEN THE EXPORTED ARCTIC SEA ICE AND THE SEA ICE DISTRIBUTION IN THE GREENLAND SEA

(a) Estimates of the exported Arctic sea ice in April through Fram Strait between 1935 to 2018. After 2003, estimates are only from Synthetic Aperture Radar (SAR) observations.

(b) Mean anomaly of the sea ice concentration in May, for the years with high (top, red arrows in a) and low (bottom, blue arrows in a) exported Arctic sea ice.

The primary production was estimated with a light photosynthesis model applied to satellite observations². To reduce the number of missing values a Data Interpolating Empirical Orthogonal Functions method was applied.

The black line represents the location of the ice edge (sea ice concentration = 15 %) in May for each year studied.

²Bélanger et al., Biogeosciences, 2013

ANOMALY OF THE SPRING (IN MAY) PRIMARY PRODUCTION FOR EACH YEAR BETWEEN 2003 AND 2018

The primary production was estimated with a light photosynthesis model applied to satellite observations². To reduce the number of missing values a Data Interpolating Empirical Orthogonal Functions method was applied.

The black line represents the location of the ice edge (sea ice concentration = 15 %) in May for each year studied.

²Bélanger et al., Biogeosciences, 2013

RELATIONSHIP BETWEEN SPRINGTIME SALINITY, SEA ICE DISTRIBUTION, AND THE ANNUAL PHYTOPLANKTON CYCLES

(a) All salinity profiles available in May between 2003 and 2018 and divided into 3 groups: years with positive (top) and negative (middle) anomalies of spring primary production, and all the other years (bottom).

(b) Two MODIS Corrected Reflectance (True Color) images obtained in May, 2011 and 2006.

(c) Annual cycles of observed specific rate of change in phytoplankton biomass (r), derived from satellite chlorophyll-a concentration.

Results...

- Years with low exported Arctic sea ice display negative anomalies of spring primary production (except 2018, blue squares)
- Four years, with higher exported Arctic sea ice, have areas with high primary production anomalies (red squares)

ACKNOWLEDGMENTS

This work was funded by NASA Ocean Biology & Biogeochemistry (80NSSC18K0081). We thank K. Kloster and S. Sandven (Nansen Environmental and Remote Sensing Center) for their courtesy in providing ice area flux data.