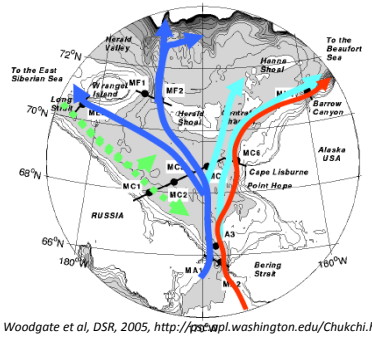
Literature review of nutrients, Primary Production and phytoplankton community in the Pacific Arctic

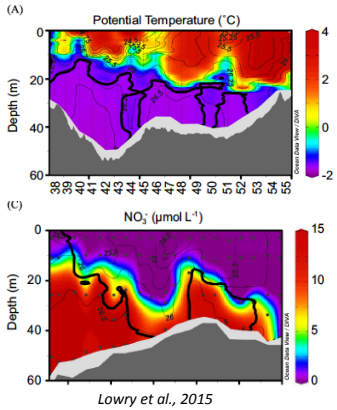
Nicola Sabata, PhD
Department of Marine Chemistry, Zhejiang University

Where do nutrients come from?

Advection of Pacific waters



Woodgate et al, DSR, 2005, http://psc.apl.washington.edu/Chukchi.html



Lowry et al., 2015

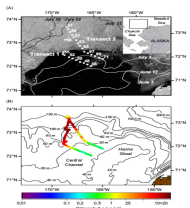
Clear correlation between physical water proprietes and nutrient concentration

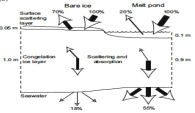
What controls phytoplankton blooms?

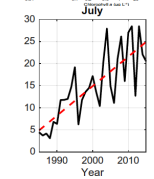
Ice conditions triggers light and nutrient limitation

Under-ice blooms
Changing Arctic PP paradigm?

Massive under ice phytoplankton blooms have been reported under thin ice and melt ponds

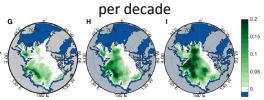




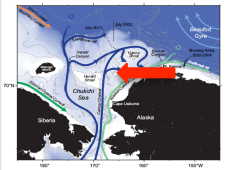


Horvat et al., 2017

Under ice blooms Increasing by 7% per decade



Under-ice PP underestimated by an order of magnitude?!



Spall et al., 2014

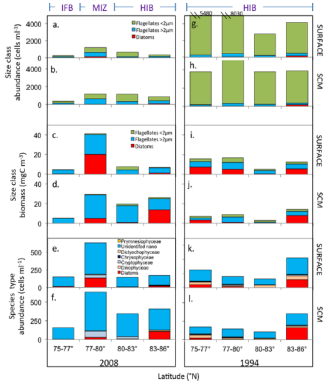
Local upwelling

Under strong easterly winds Chla concentrations have been reported on the shelf-break zone

Different phytoplankton ecosystems

Similar inventory but different proportion of each species in ice and under-ice blooms could indicate seeding

Shift to smaller phytoplankton size in ice-free waters?



Coupel et al, 2012

Freshening enhances oligotrophy

- Decrease in phytoplankton abundance and cell biomass of large cells
- Higher production of nanoplankton

Contradictory with Primary Production increasing predictions

Key questions regarding climate change scenarios

Impact of ice conditions?

Impact of Pacific water inflow?

Impact of atmospheric forcing?

Differences between shelf and basin?

References

Arrigo, K.R., Perovich, D.K., Pickart, R.S., Brown, Z.W., van Dijken, G.L., Lowry, K.E., Mills, M.M., Palmer, M.A., Balch, W.M., Bates, N.R., Benitez-Nelson, C.R., Brownlee, E., Frey, K.E., Laney, S.R., Mathis, J., Matsuoka, A., Mitchell, B.G., Moore, G.W.K., Reynolds, R.A., Sosik, H.M., Swift, J.H., 2014. Phytoplankton blooms beneath the sea ice in the Chukchi sea. Deep-Sea Res. II 105, 1–16. https://doi.org/10.1016/j.dsr2. 2014.03.018.

Coupel, P., Ruiz-Pino, D., Sicre, M. A., Chen, J. F., Lee, S. H., Schiffrine, N., Li, H. L., and Gascard, J. C., 2015. The impact of freshening on phytoplankton production in the Pacific Arctic Ocean. Progress. Oceanogr., 131: 113-125

Horvat, C., Jones, D. R., Iams, S., Schroeder, D., Flocco, D., & Feltham, D. (2017). The frequency and extent of sub-ice phytoplankton blooms in the Arctic Ocean. Science Advances, 3(3), e160119.https://doi.org/10.1126/sciadv.1601191

Lowry, K. E., Pickart, R. S., Mills, M. M., Brown, Z. W., van Dijken, G. L., Bates, N. R., & Arrigo, K. R. (2015). The influence of winter water on phytoplankton blooms in the Chukchi Sea. Deep-Sea Research Part II, 118, 53–72. https://doi.org/10.1016/j.dsr2.2015.06.006

Spall,M.A.,Pickart,R.S.,Brugler,E.T.,Moore,G.W.K.,Thomas,L.,Arrigo, K.R.,2014. Role of shelfbreak upwelling in the formation of a massive under-ice bloom in the Chukchi Sea. Deep Sea Res.II105,17–29, http://dx.doi.org/10.1016/ j.dsr2.2014.03.017.

Woodgate R., Aagard K., Weingartner T., DSR, 2005, http://psc.apl.washington.edu/Chukchi.html