Seasonal ~~Long-term~~ monitoring of zooplankton-mediated fecal pellet carbon fluxes in the Pacific Arctic region

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Kyoung-Ho Cho, Jong-Kuk Moon, Hye-Ju Yoo and Eun-Jin Yang

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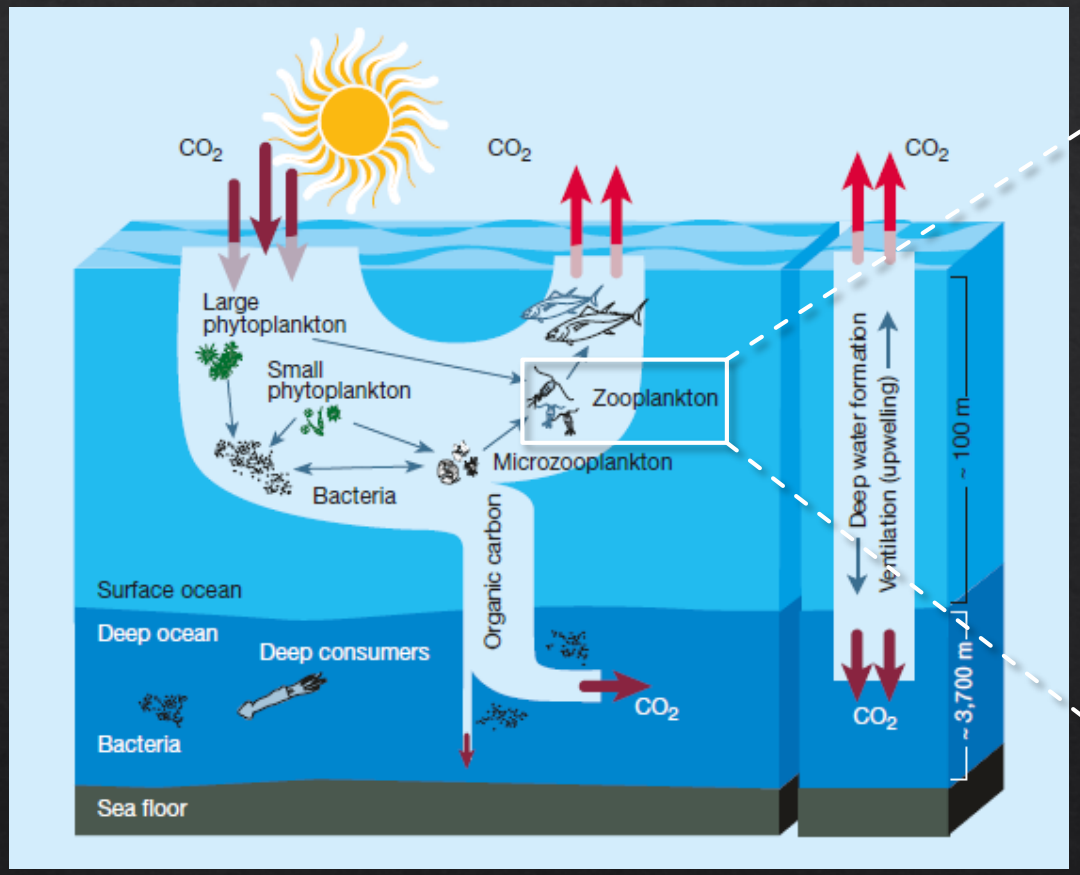
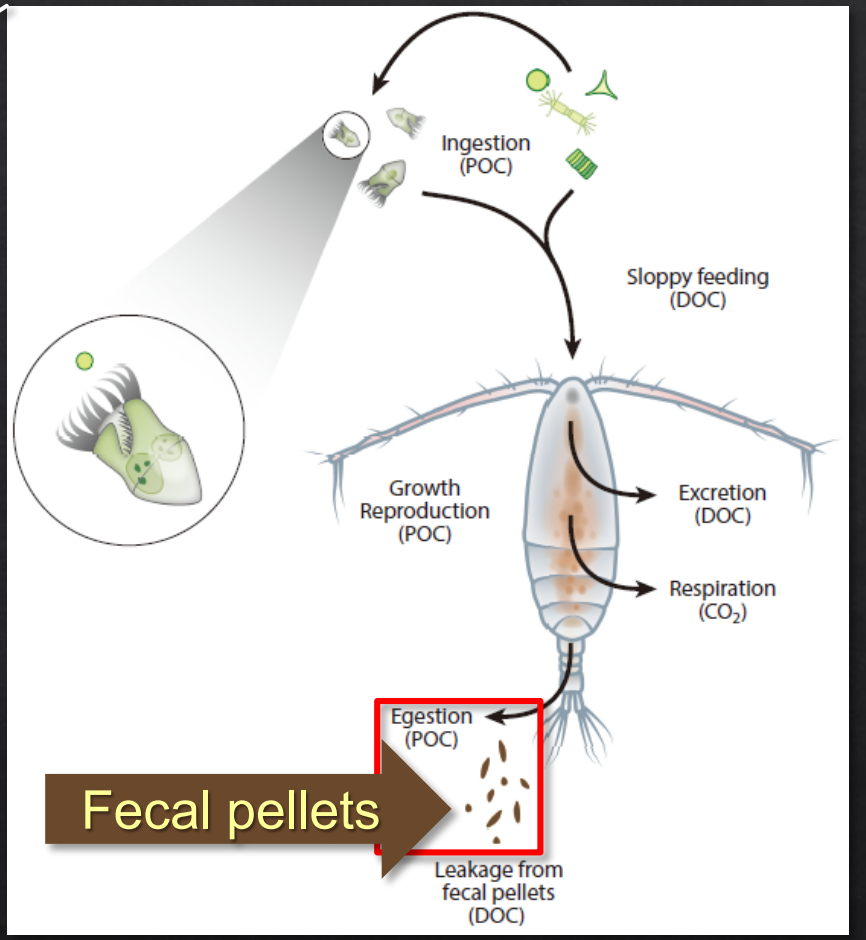
Zooplankton and the biological carbon pump

Biological carbon pump



Chisholm (2000)

Carbon utilization by zooplankton

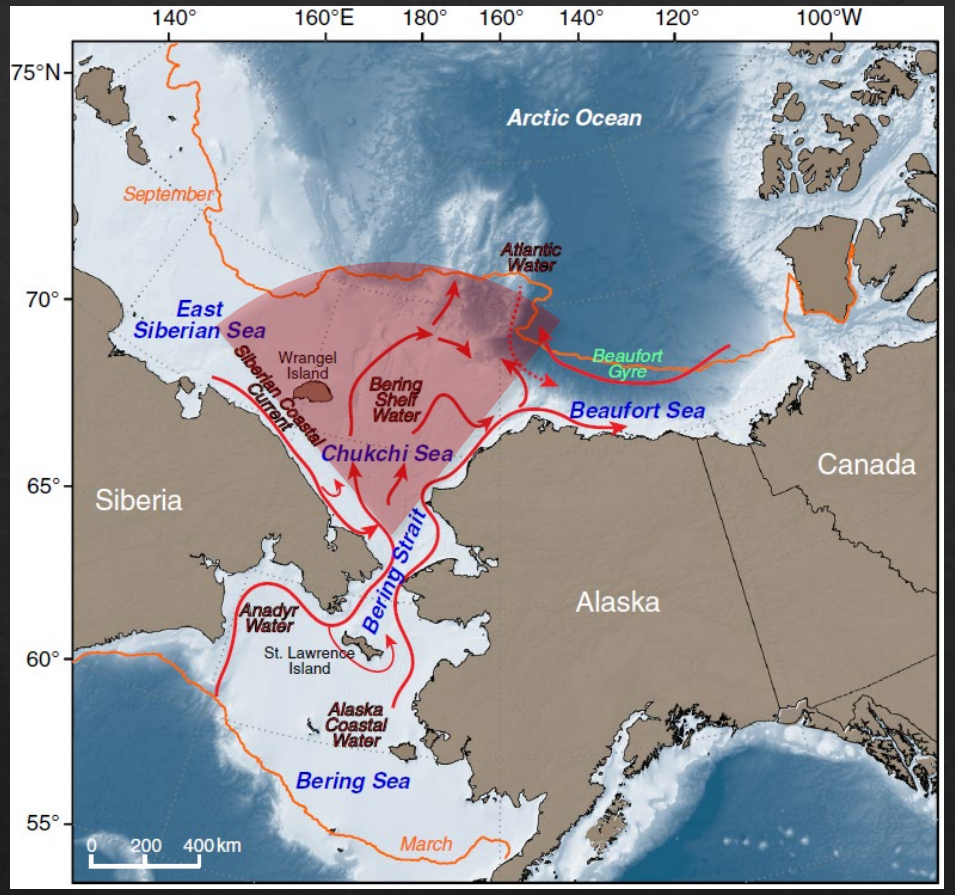


Steinberg and Landry (2017)

"Zooplankton fecal pellets play an important role in the biological carbon pump."

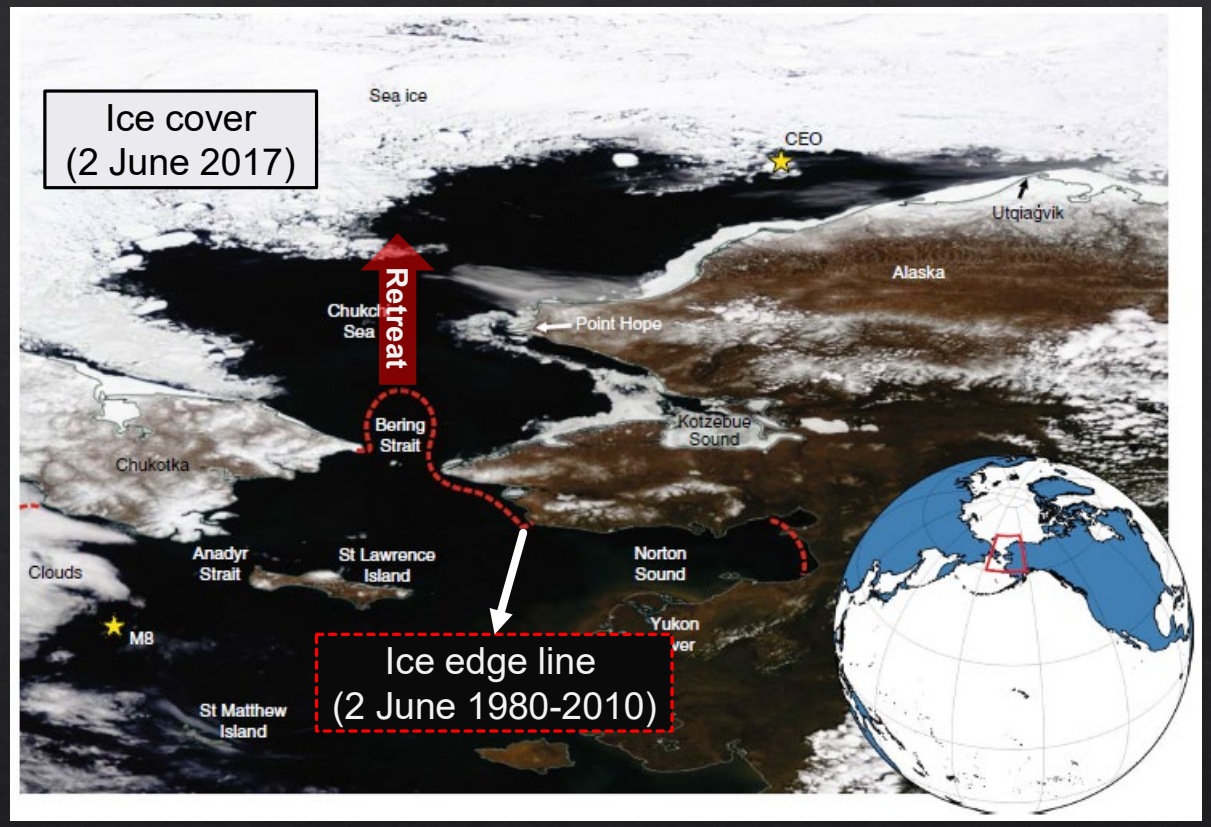
Pacific Arctic region (Western Arctic Ocean)

Pacific Arctic region



Moore et al. (2015)

Larger sea ice retreat in recent years

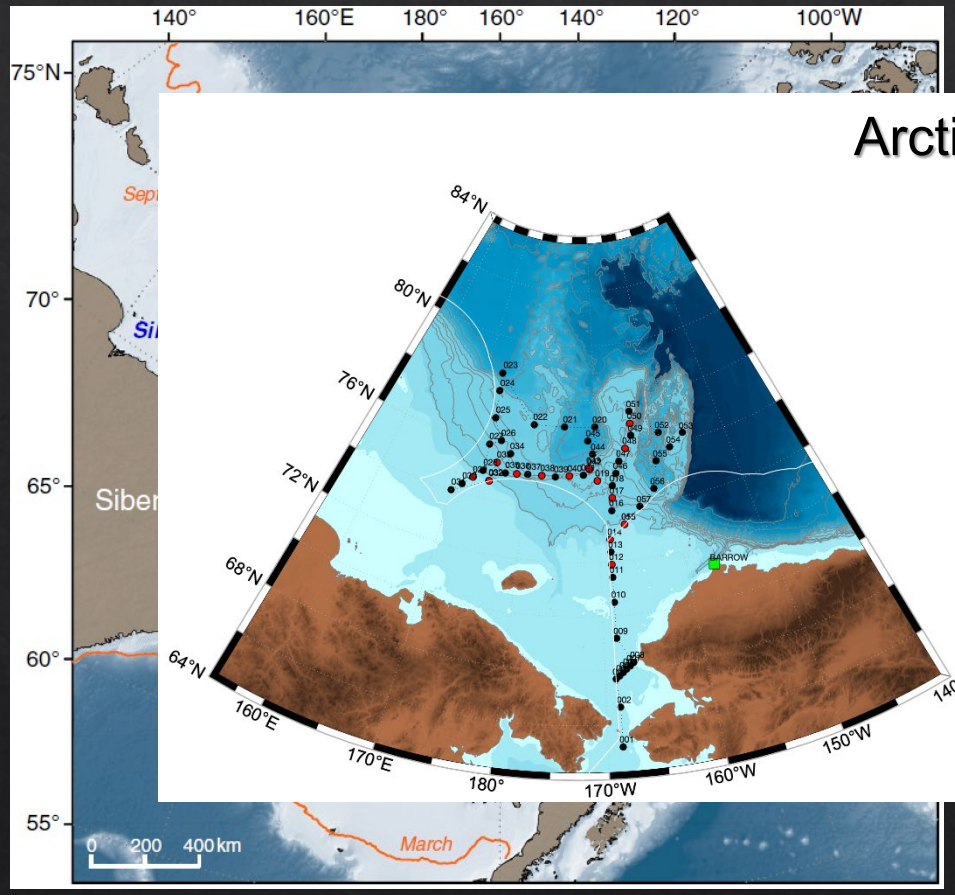


Huntington et al. (2020)

- Include some of the most productive areas in the world ocean (Grebmeier et al. 2006).
- Unprecedented sea ice loss due to shifting winds and a warmer inflow of Pacific waters (Danielson et al. 2020)

Pacific Arctic region (Western Arctic Ocean)

Pacific Arctic region



Moore et al. (2015)

Arctic cruise expedition

Larger sea ice retreat in recent years

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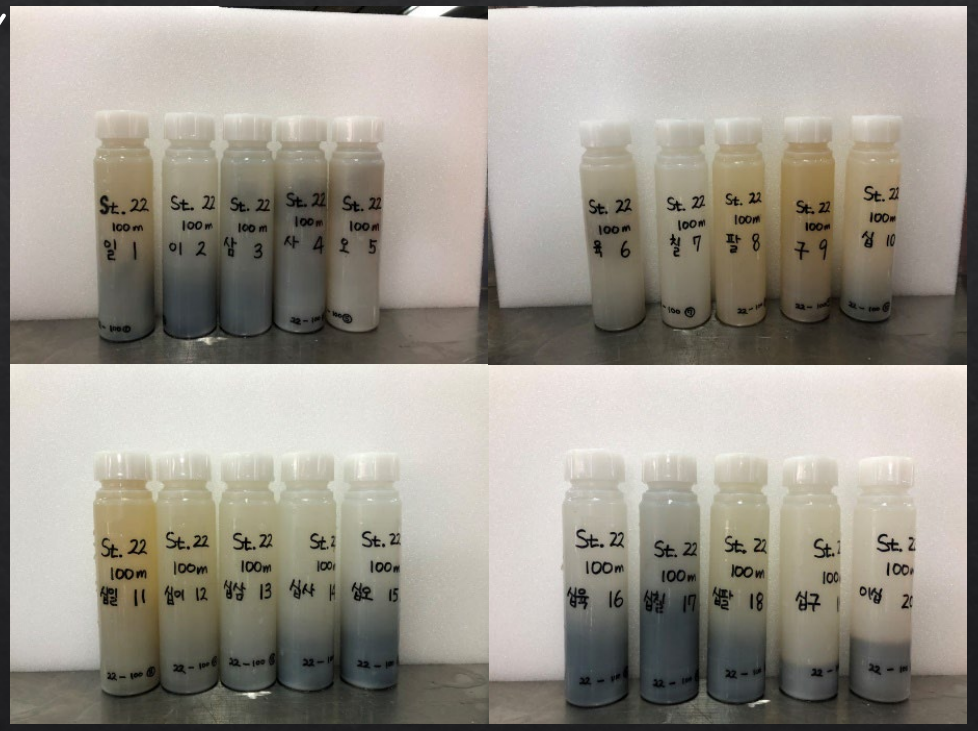
Sediment trap

Sediment trap

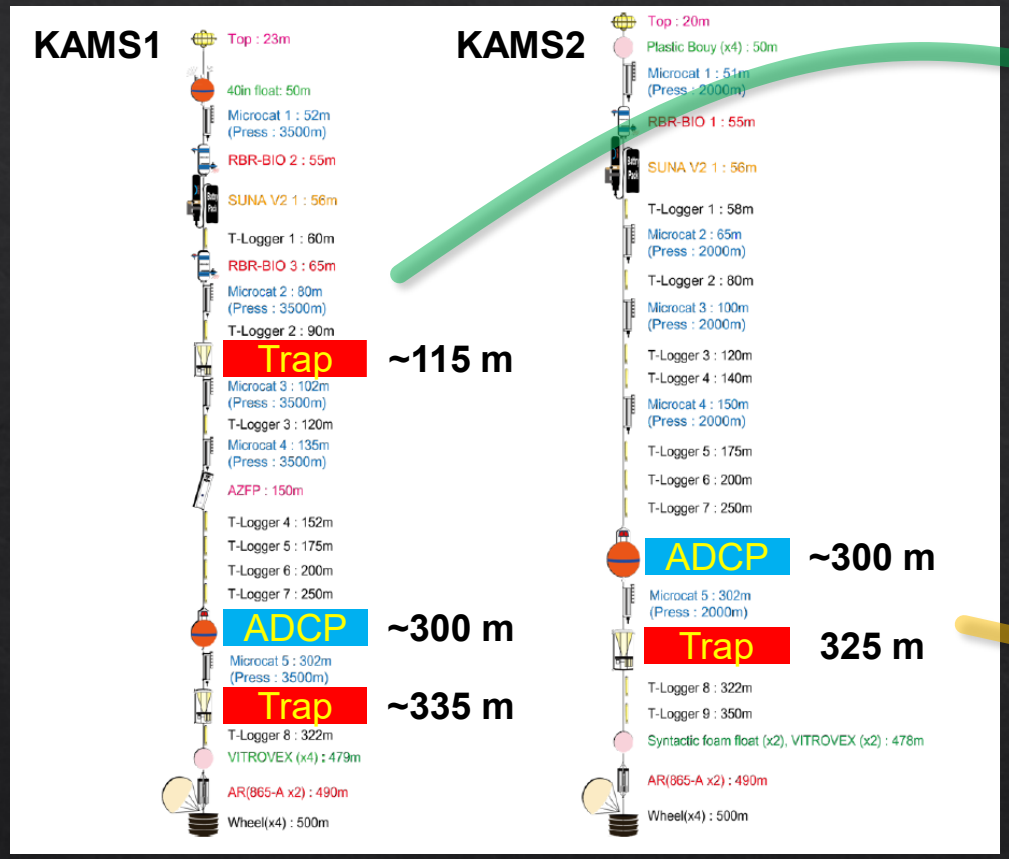
Time series data



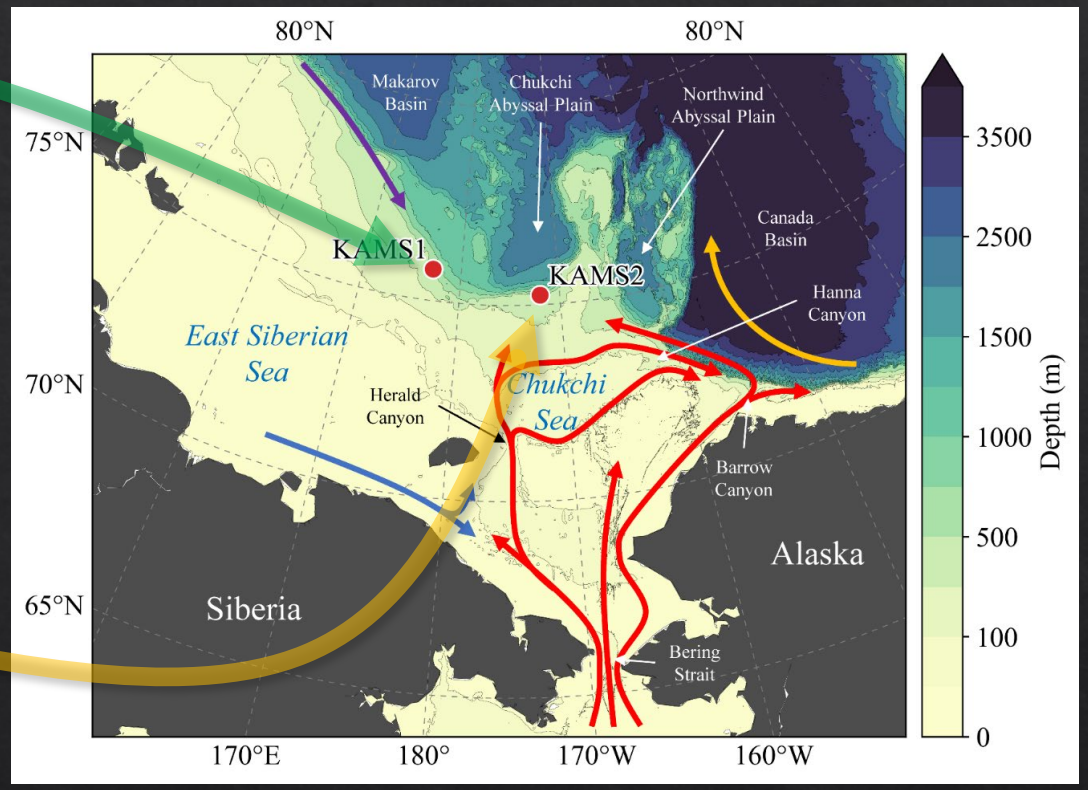
Credit: J-H Kim

Study area

Korea Arctic Mooring System (KAMS)



Study area



Kim et al. (under review)

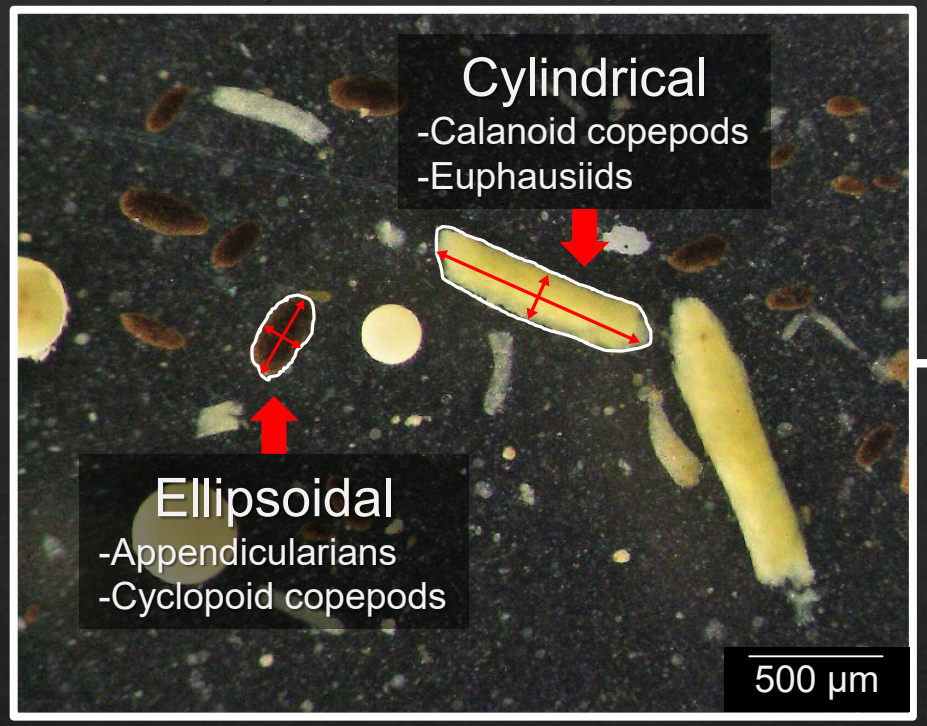
Mooring station	Deployment period	Water depth (m)	Trap depth (m)	ADCP depth (m)
KAMS1	Aug 18 2017 - Aug 13 2018	532	115, 335	307
	Aug 16 2018 - Aug 20 2019	515	118, 338	318
KAMS2	Aug 12 2017 - Aug 14 2018	510	325	297
	Aug 17 2018 - Aug 19 2019	505	325	305

Objectives

- To identify factors affecting the timing, composition, and magnitude of fecal pellet carbon (FPC) fluxes
- To assess the importance of FPC fluxes in the biological carbon pump

Laboratory analyses

Zooplankton fecal pellets



Kim et al. (under review)

Zooplankton (ind. m^{-2} d^{-1})

FPC fluxes (mg C m^{-2} d^{-1})

POC fluxes (mg C m^{-2} d^{-1})

FPC contributions (%)

Fecal pellet average widths (µm)

Sea ice concentrations (%)

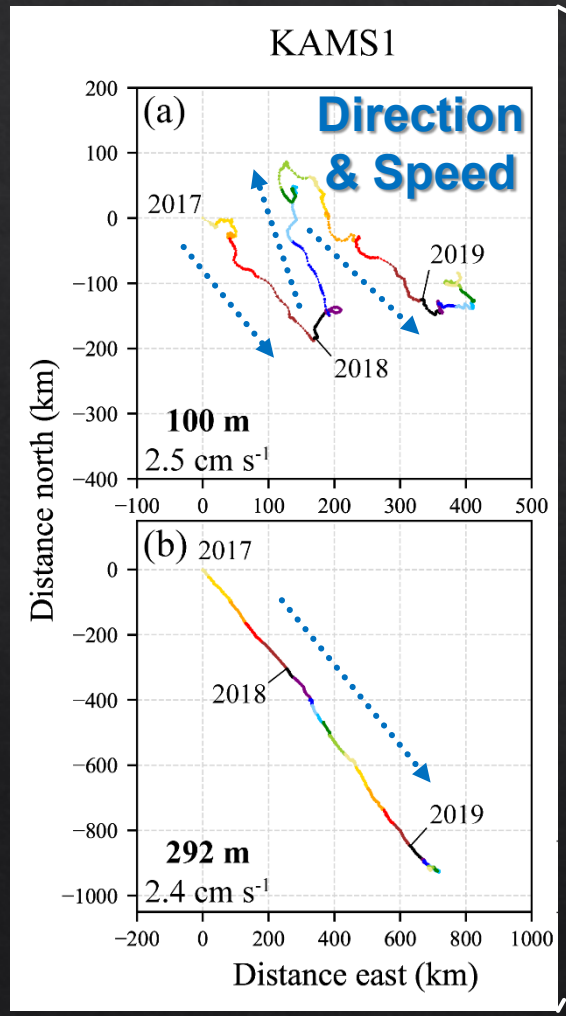
Current velocities (cm s^{-1})

Calanoid copepods

Appendicularians

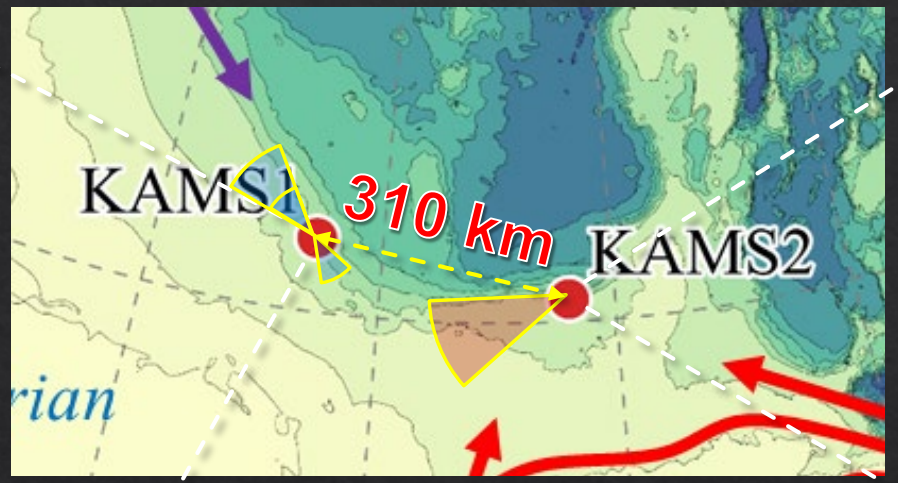
Origin of fecal pellets

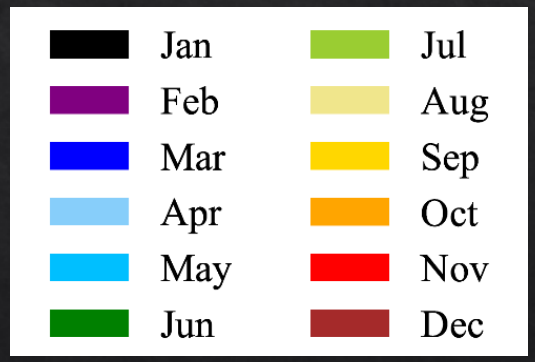
Progressive vector diagrams



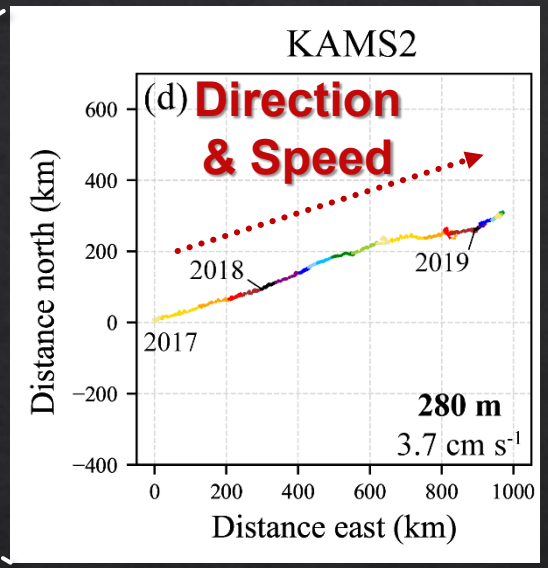
Kim et al. (under review)

Location





Progressive vector diagrams

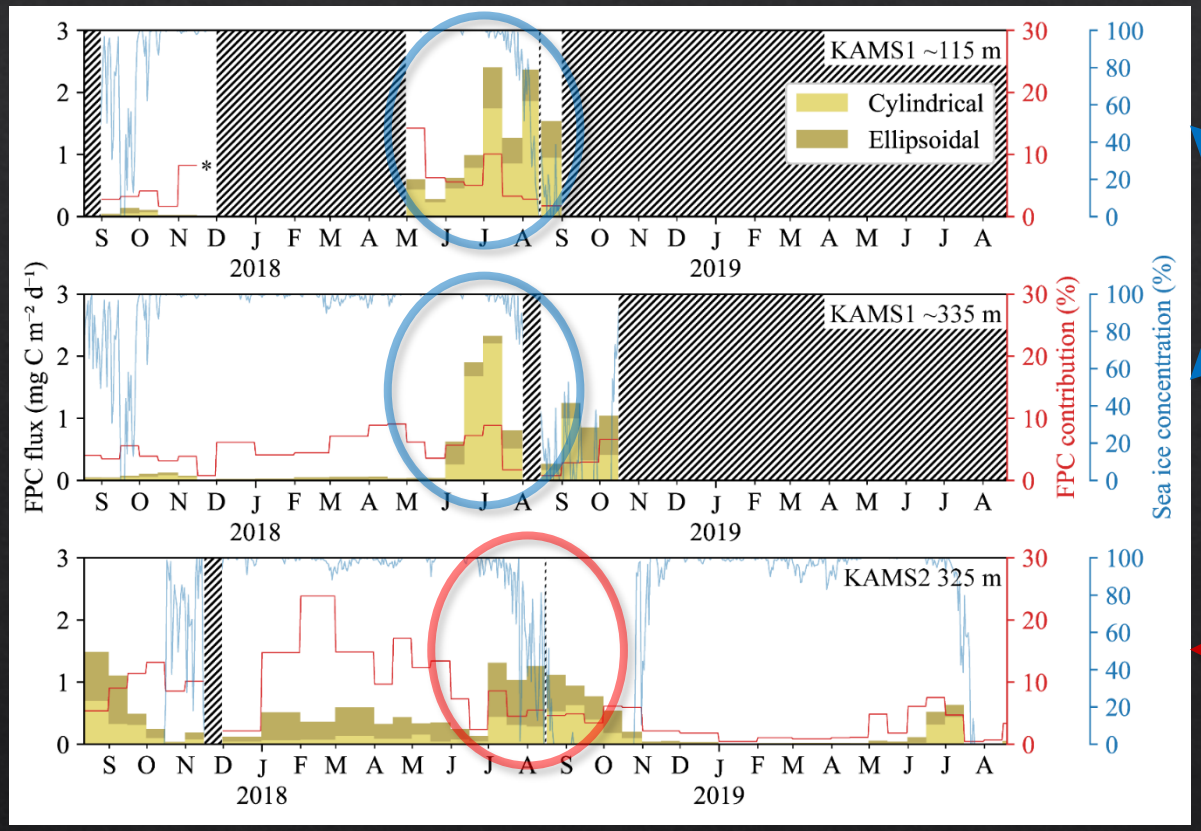


Kim et al. (under review)

✓ Fecal pellets produced by distinct local zooplankton communities

FPC fluxes

FPC fluxes and their contributions to the POC fluxes

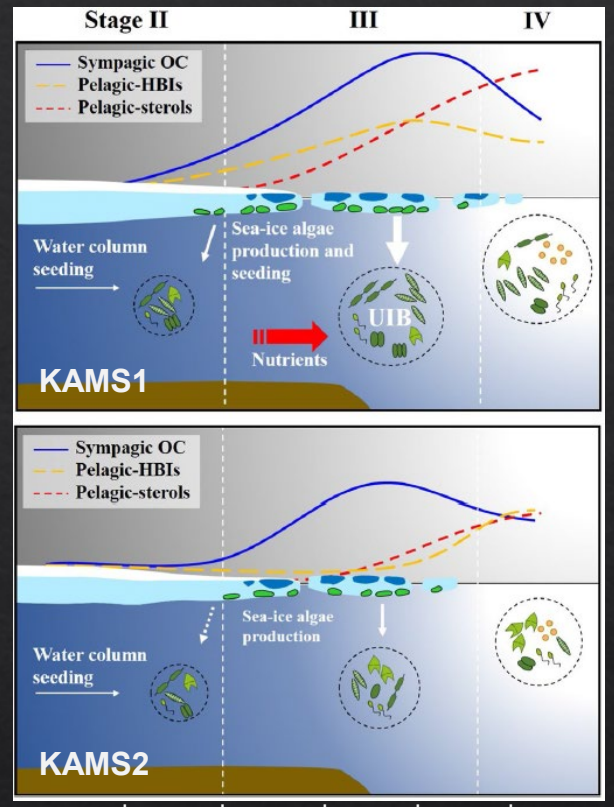


East Siberian Sea slope

Chukchi Sea slope

Kim et al. (under review)

Under-ice bloom

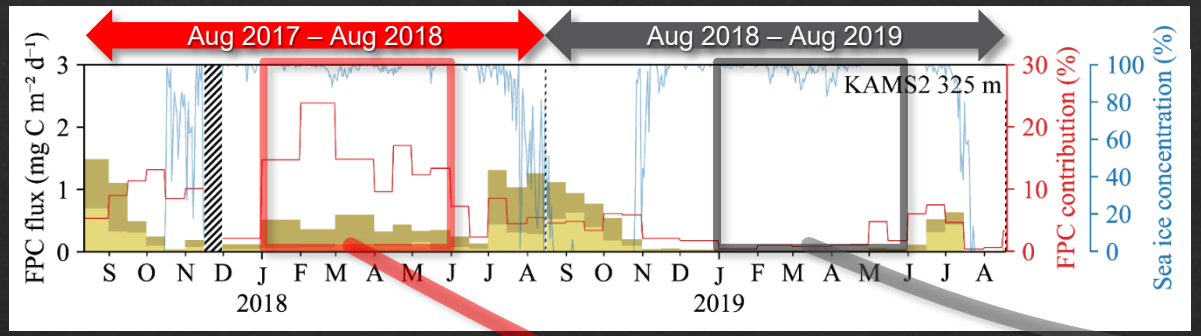


Gal et al. (2022)

- Higher export by cylindrical pellet producers over the East Siberian Sea slope
- Enhanced grazing on under-ice blooms in 2018 (Gal et al. 2022)

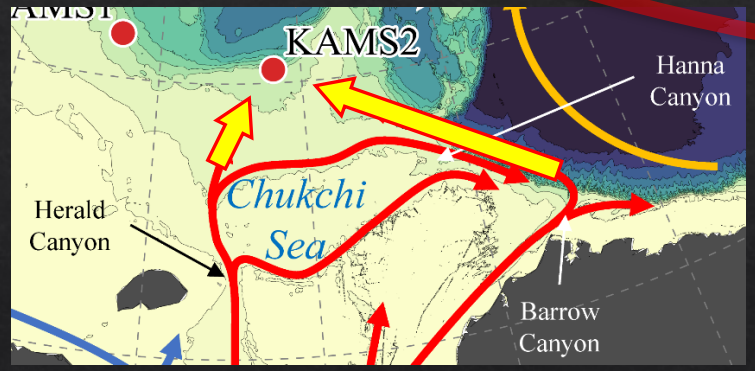
FPC fluxes

FPC fluxes and their contributions to the POC fluxes



Kim et al. (under review)

Currents near KAMS2



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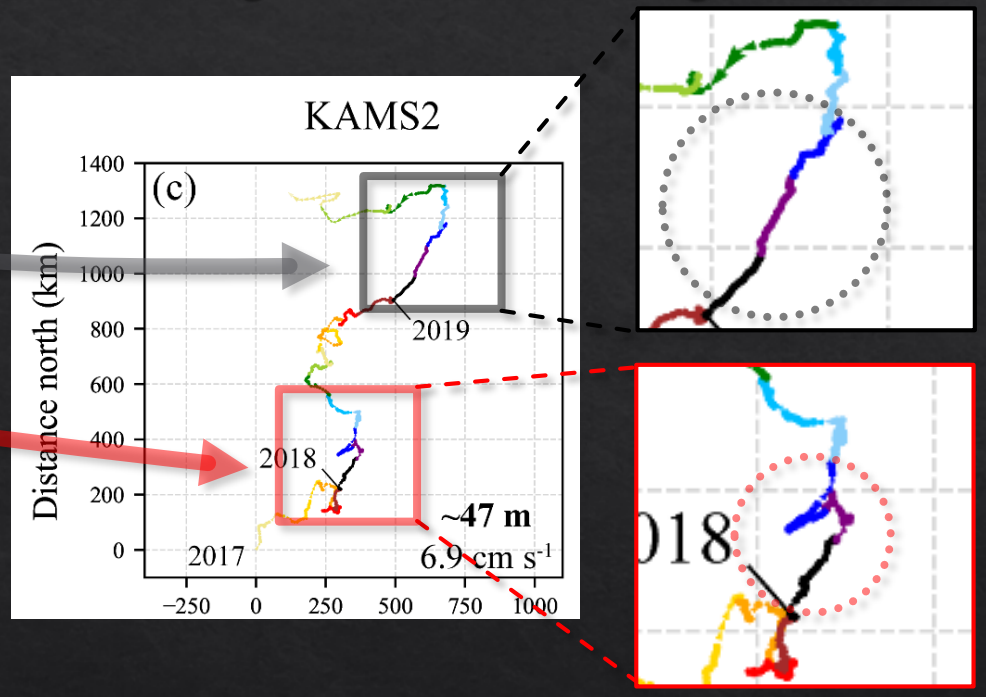


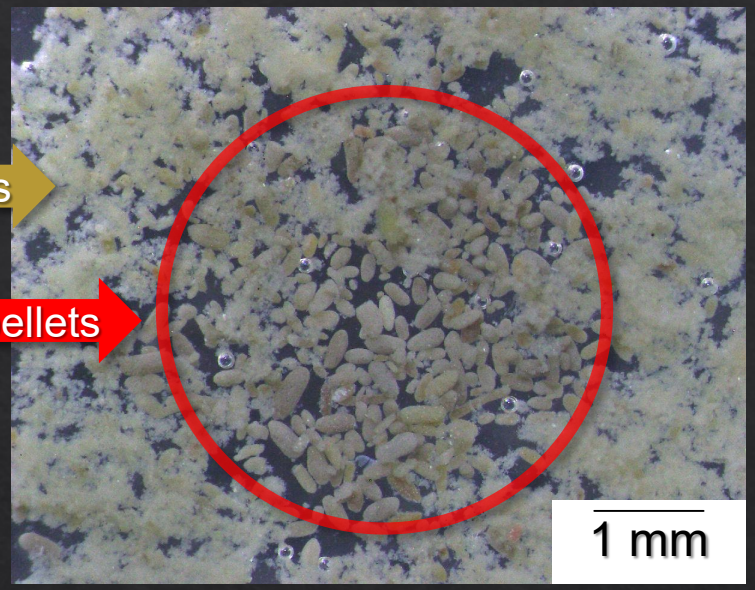
Kim et al. (under review)

- Sustained export by overwintering zooplankton over the Chukchi Sea slope
- Organic particles transported by the Chukchi Slope Current in 2017-2018 winter (Watanabe et al. 2017)

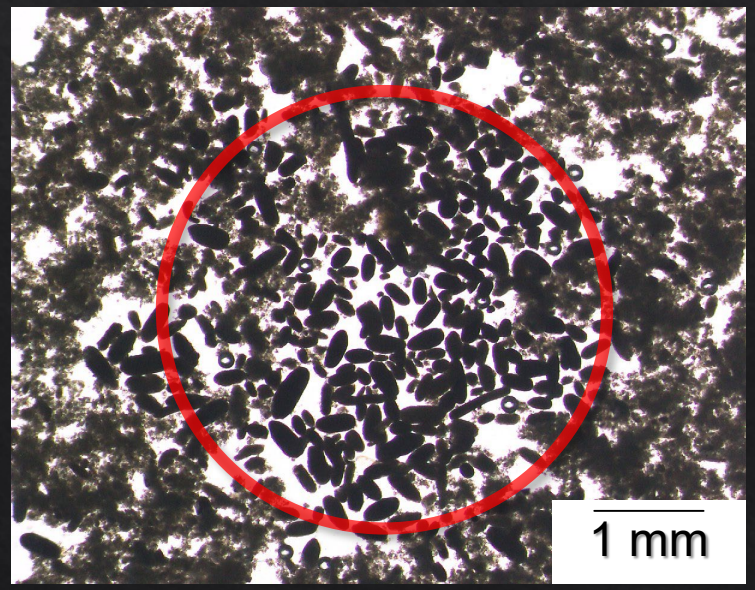
Comparison between 2018 and 2019

February 2018

Dark field

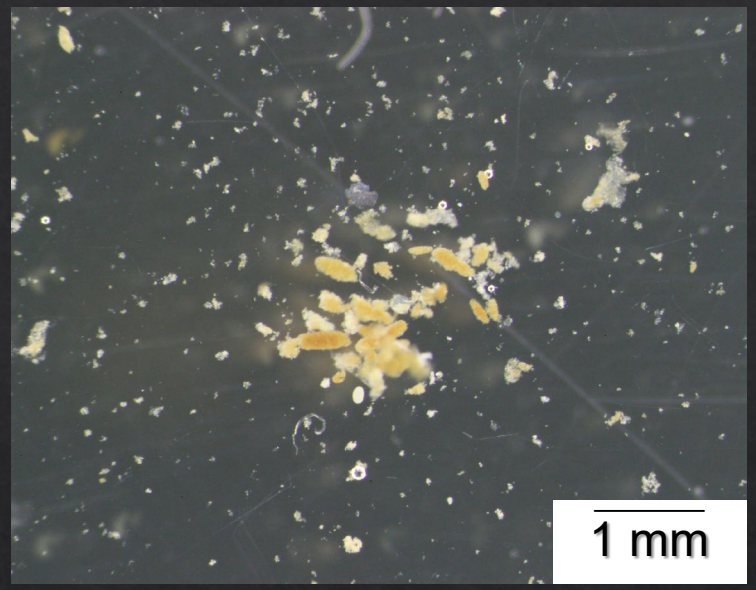


Bright field



February 2019

Dark field



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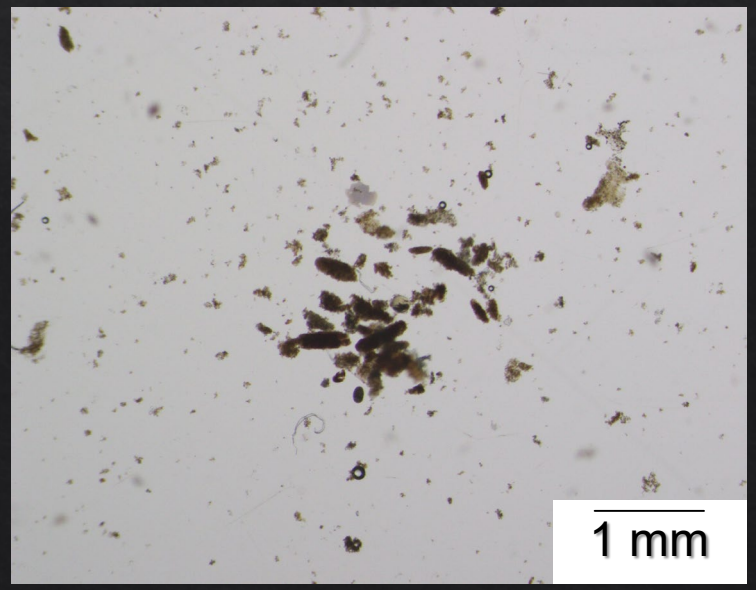
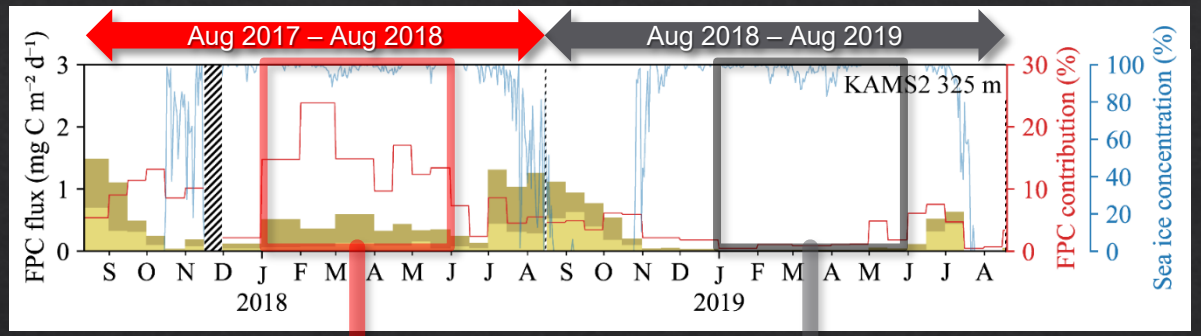


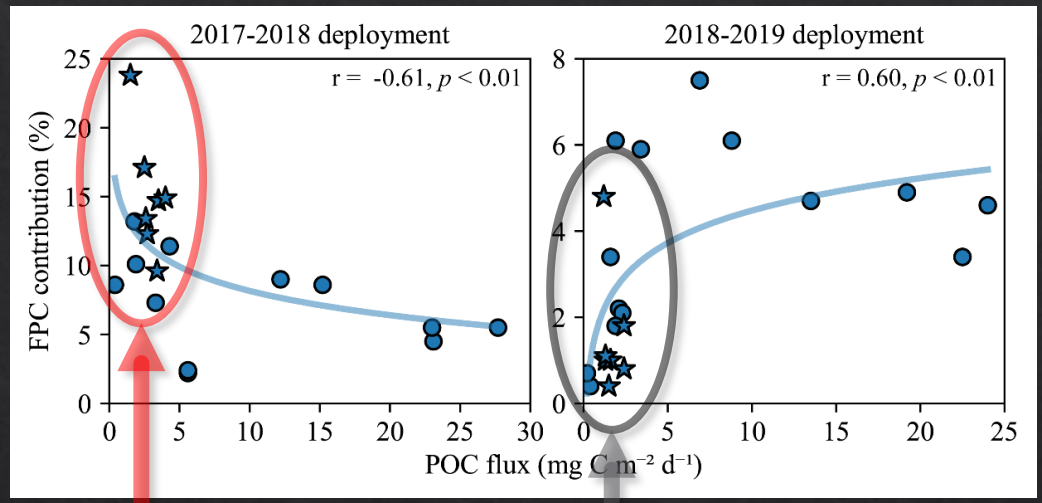
Credit: J-H Kim

POC fluxes & FPC contributions to the POC fluxes

Correlations between POC fluxes and FPC contribution to the POC fluxes



Kim et al. (under review)



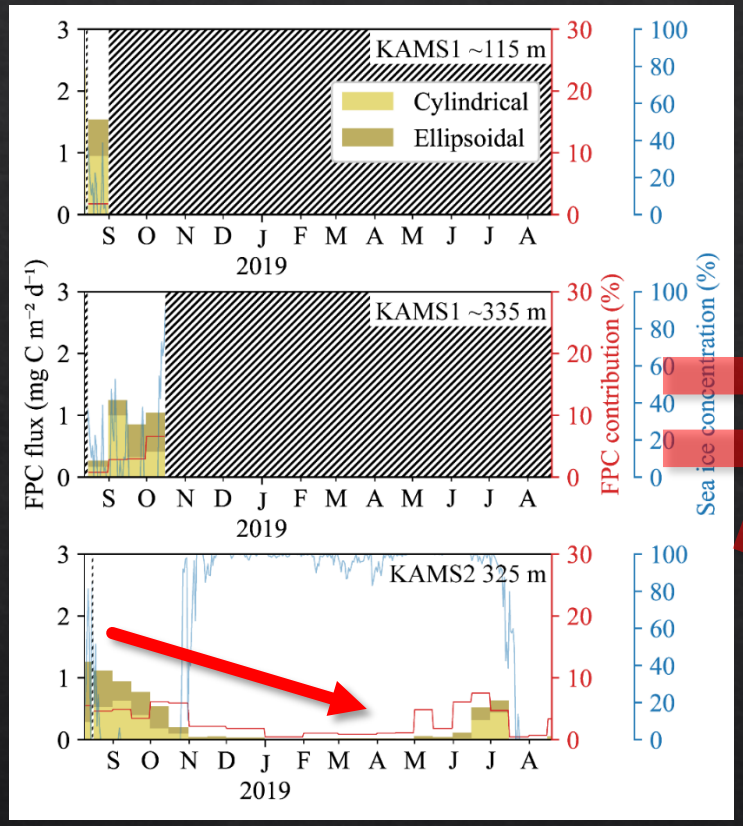
Kim et al. (under review)

A negative correlation during the 2017-2018 deployment over the Chukchi Sea slope

→ ***Fecal pellets are a sporadically important carbon source when POC fluxes are low.***

Zooplankton collected in sediment traps

FPC fluxes & FPC contributions



Kim et al. (under review)

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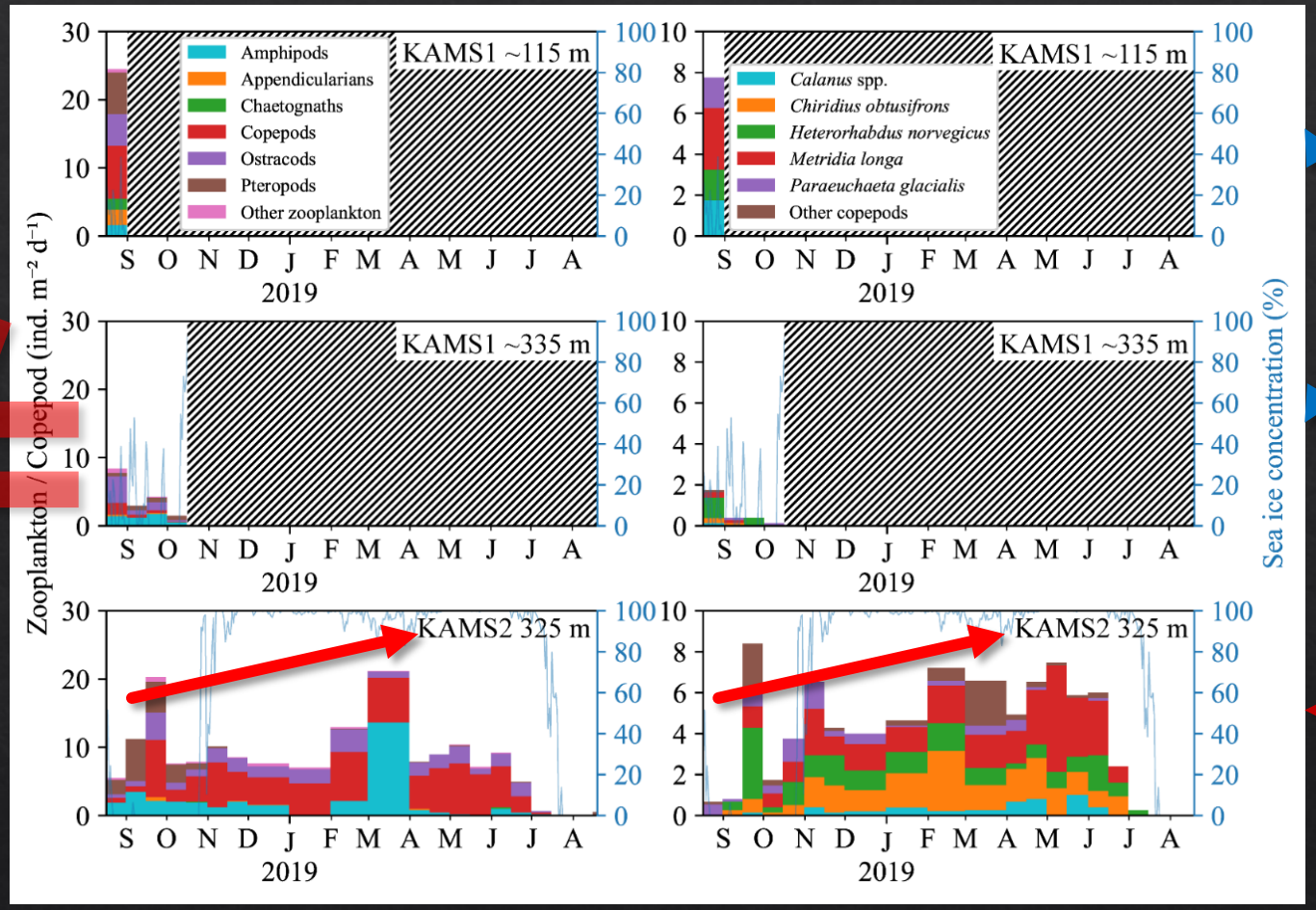
Zooplankton collected in sediment traps



East Siberian Sea slope

Chukchi Sea slope

Kim et al. (under review)

- Seasonal fluctuations of zooplankton collected in sediment traps and FPC fluxes differed.
- Reflected the challenge of matching fecal pellets and zooplankton collected at the trap depths.

Conclusion

- Fecal pellet fluxes exhibited distinct seasonality in the Pacific Arctic region.

- Fecal pellets were at times an important carbon source in the Pacific Arctic region during the ice-covered period.

In the future, sea ice retreat may affect the distribution of overwintering zooplankton, potentially resulting in a lower contribution of fecal pellets to the POC fluxes.

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- The captain and crew of IBRV *Araon*
- Research participants
- And audience…

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