SAS Meeting 7-9 June 2023

Publications planned

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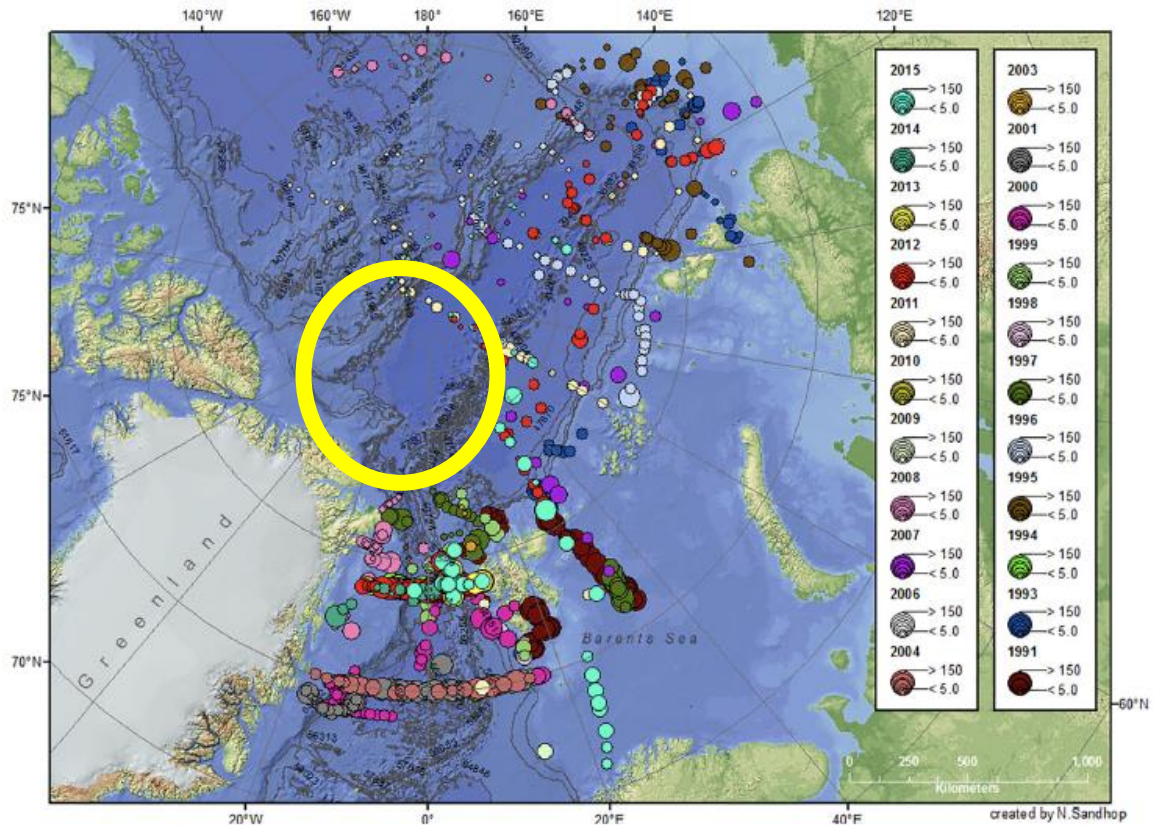
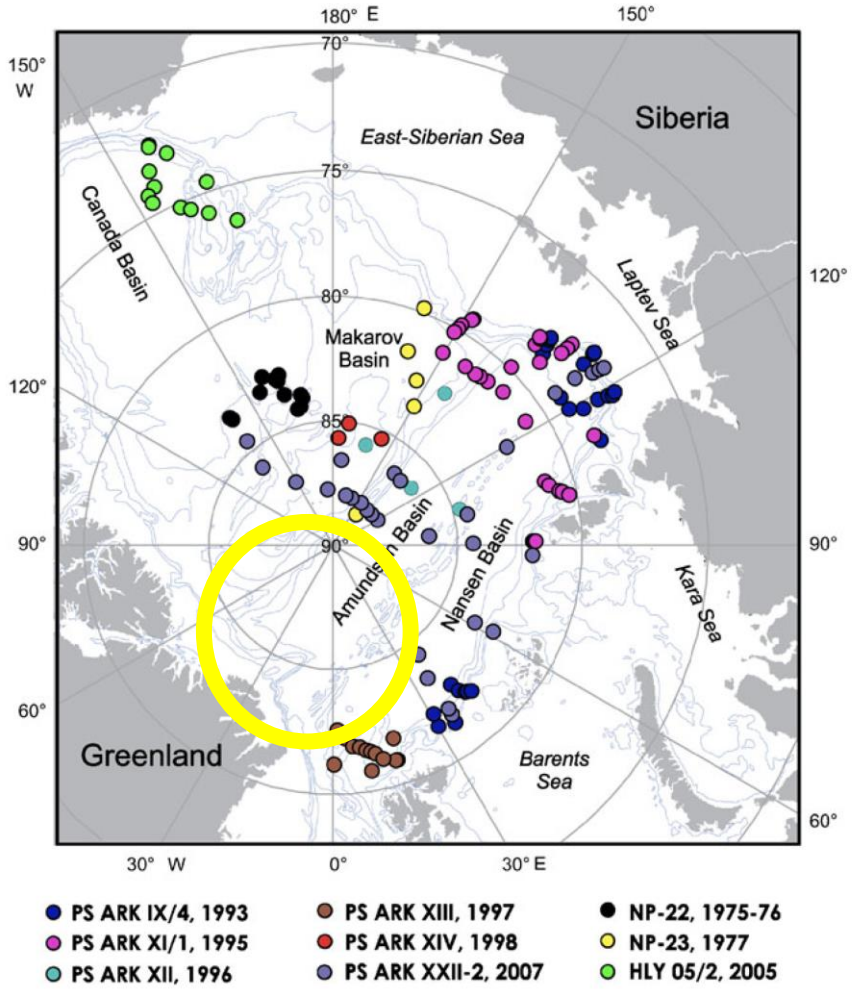
SAS-Oden July-September 2021
Central Arctic Ocean

Filling knowledge gaps in a missing corner of the CAO



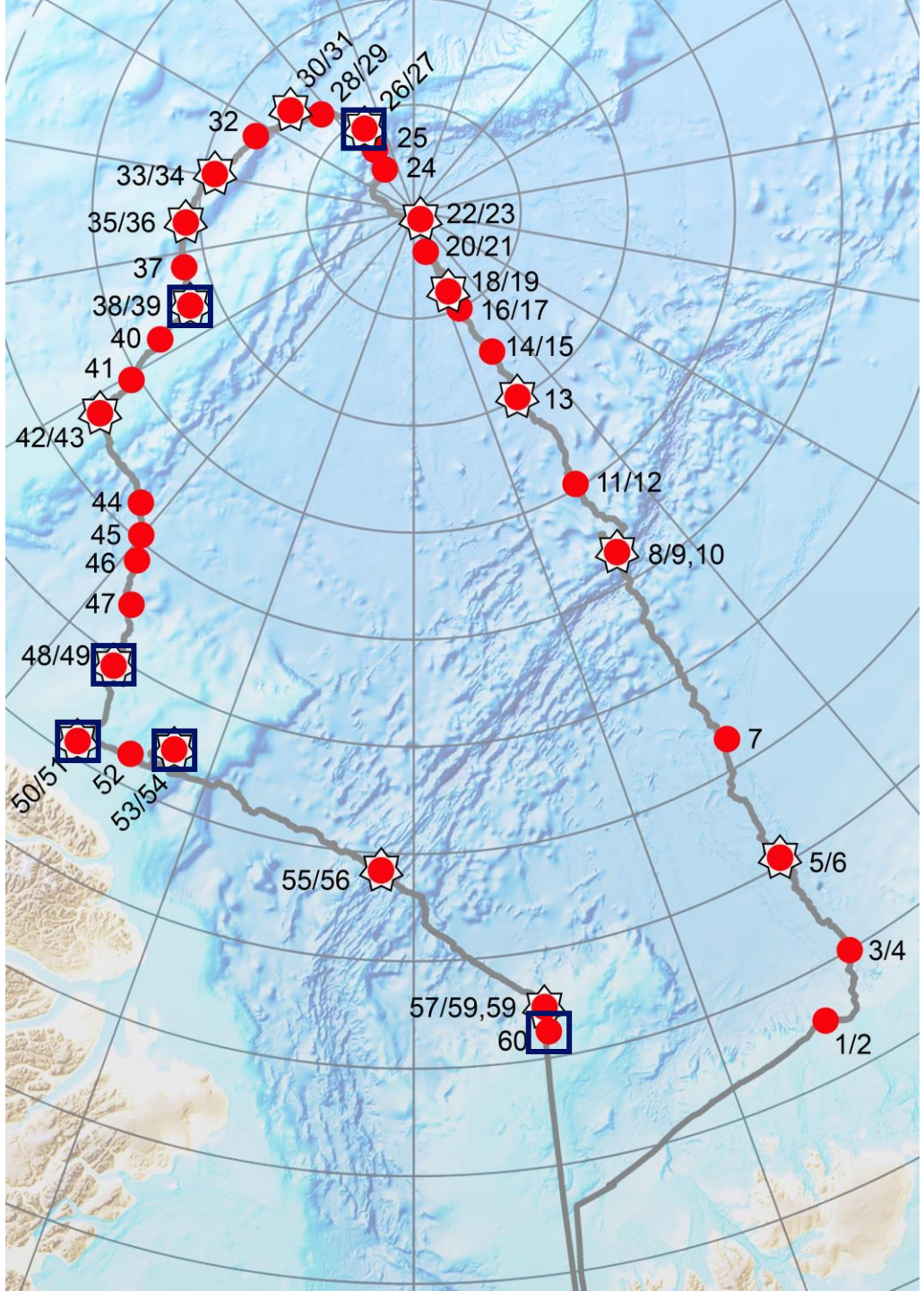
Chl *a* (mg m^{-2}) integrated over 0–100 m water depth from 1991 to 2015

Nöthig et al. (2020) Summertime chlorophyll *a* and particulate organic carbon standing stocks in surface waters of the Fram Strait and the Arctic Ocean (1991–2015). Frontiers in Marine Science.



Previously studied zooplankton stations

Kosobokova et al. (2011) Patterns of zooplankton diversity through the depths of the Arctic's central basins. Marine Biodiversity



SAS-Oden 2021

60 Sampling stations

(36 ship, 24 helicopter)

Red circle

CTDs (deep, bio, omics, extra)

White star

Ice station (24-36 hours), nets, etc.

Square

Box core station

SAS-Oden 2021

38 scientists

22 biologists
8 chemists
5 physical oceanographers
2 atmosphere
1 geologist

All SAS Core parameters in the SAS Science Plan

* = not in SAS Science Plan

Physics/chemistry

- Pressure (depth)
- Temperature
- Salinity (CTD)
- Dissolved oxygen (CTD)
- Dissolved oxygen (Niskin)
- Nutrients (NO_3/NO_2, PO_4, SiO_3)
- CFC-12 and SF_6 (ONLY in WATER)
- Dissolved Inorganic Carbon (DIC)
- Total Alkalinity (TA)
- pH
- Methane (CH_4)
- Nitrous oxide (N_2O) *
- $\delta^{18}O$ of H_2O
- Dissolved Organic Carbon (DOC)
- Particulate Organic Carbon (POC)

Biology

- Primary productivity (^{13}C)
- Chlorophyll concentrations (0.3-2 µm, 2-200 µm)
- HPLC pigment concentrations *
- Flow cytometry viruses & bacteria
- Flow cytometry primary producers
- CDOM fluorescence *
- Chlorophyll fluorescence
- Viruses (metagenomes)
- Bacteria and archaea (metagenomes)
- Primary producers (metagenomes)
- Microzooplankton (metagenomes)
- Mesozooplankton
- Macrozooplankton
- Fish
- Water column acoustics (biology/physics)
- Benthic fauna
- Benthic microbial communities (metagenomes)
- NOT INCLUDED: Seabirds and marine mammals

The SAS Core parameters were measured both in water and ice

Water column
24 SAS standard depths

No.	Depth (m)	No.	Depth (m)
1	10	13	400
2	20	14	500
3	30	15	700
4	40	16	1000
5	50	17	1500
6	75	18	2000
7	100	19	2500
8	125	20	3000
9	150	21	3500
10	200	22	4000
11	250	23	Bottom minus 50
12	300	24	bottom

Ice habitats
Eight SAS-Oden habitats

Habitat	Sampling
Snow	Shovel
Melt pond	Pump
Brackish brine	Pump
Ice upper	Melted upper 10 cm core
Ice upper-mid	Melted core section
Ice lower-mid	Melted core section
Ice lower	Melted lower 10 cm core
Ice-seawater	Pump

Data publication

Most SAS-Oden data: (metadata already there)

Bolin Centre Database, Stockholm University [https://bolin.su.se/data/]

Some SAS-Oden data: (CTD data already there)

PANGAEA Data Publisher for Earth & Environmental Science [https://www.pangaea.de]

Physical drivers - oceanography (SAS-Oden)

Research questions:

How are Arctic Ocean water masses and circulation responding to changes in sea ice properties, and atmospheric, advective and freshwater forcing? What are the states of, and changes in, heat and freshwater budgets in the Arctic region? What are the changes in water mass sources, sinks and transformations? in the eastern Eurasian Basin (from the SAS Science Plan)

Data and analyses:

Temperature, salinity, $\delta^{18}O$ of H_2O, CFC-12 and SF6, etc.

Data storage SAS-Oden 2021

Most SAS-Oden data: (metadata already there)

Bolin Centre Database, Stockholm University [https://bolin.su.se/data/]

Some SAS-Oden data (CTD data already there)

PANGAEA Data Publisher for Earth & Environmental Science [https://www.pangaea.de]

Carbon cycle and ocean acidification (SAS-Oden)

Research questions:

What is the contribution of the Arctic Ocean in maintaining the global ocean carbon dioxide reservoir and uptake? What is the input and fate of terrestrial and subsea carbon to the Arctic Ocean? What are the magnitude, drivers, and impacts of Ocean Acidification in the different regions of the Arctic? in the eastern Eurasian Basin (from the SAS Science Plan)

Data and analyses:

Dissolved Inorganic Carbon (DIC), Dissolved Organic Carbon (DOC), Total Alkalinity (TA), pH, etc

Ecosystem responses (SAS-Oden)

Research questions:

How does primary production and associated availability of nutrients vary in the eastern Eurasian Basin?
How does carbon flow vary in the eastern Eurasian Basin? (from the SAS Science Plan)

Data and analyses:

Particulate C,N,P, ^{13}C, ^{15}N, inorganic nutrients, Chla <2 μm, Chla 2-200 μm, HPLC pigments, ^{13}C uptake, flow cytometry primary producers (+bacteria), UVP particle distribution, community composition from metagenomes

Metagenomes and metatranscriptomes (SAS-Oden)

Research question:

What is the biodiversity and functional diversity of microbes in the eastern Eurasian Basin?
(presentation of the dataset)

Data and analyses:

ca. 400 metagenomes, ca. 300 metatranscriptomes (water, ice habitats, sediments)

Environmental DNA (SAS-Oden + MOSAiC + 4 more expeditions)

Research question:

Distribution patterns of eDNA confirm known distribution patterns of zooplankton, squid, fish, birds, and mammals in the CAO, but not for all species

Data and analyses:

Metagenomes, metatranscriptomes, COI and 12S amplicons, newly developed bioinformatics pipelines, data from six expeditions

Fish distributions (SAS-Oden + MOSAiC)

Hypothesis: Atlantic fish enter the CAO seasonally in May-June. The Atlantic inflow, the Atlantic Water Layer and zooplankton biomass determine fish distributions in the Eurasian Basin

Data and analyses: Acoustic data fish and zooplankton, GAM model, genetic data for cod & haddock, Stable isotope delta ^{18}O otholiths, migration model

Hypothesis: Adult polar cod and ice cod dominate the pelagic fish communities in the Eurasian Basin and have done so already during the last ice ice since 45 000 years ago (!?)

Data and analyses: Sediment otoliths, species identification (including morphometric analysis), fish age at death, ^{14}C dating, ^{18}O and ^{13}C analyses

Zooplankton diversity (SAS-Oden + ?MOSAiC?)

Research question:

The Atlantic inflow determines mesozooplankton distributions in the Eurasian Basin, zooplankton diversity and biomass patterns are explained by …, etc.

Data and analyses:

Multinet, LOKI, UVP zooplankton data (not UVP particles), multivariate analyses

Food-web interactions (SAS-Oden)

Research question:

The CAO food web is more complicated than previously assumed (predatory fish, etc.)

Data and analyses:

Macrozooplankton, stomach contents, stable isotopes ^{13}C + ^{15}N in zooplankton and fish, ^{13}C in fish otoliths, fatty acids in zooplankton and fish

16 projects with participants from 9 countries

Financed by the Swedish Government (SPRS) and the European Union (EFICA, ARICE)

Project		Acronym	Country	Discipline	Berths
1	Mesopelagic fish (EC)	EFICA	SE, DE, NL, B	Biology	7
2	Microbial metabolism	MIME	SE	Biology	3
3	Microbial interactions (ARICE)	ProMis	UK, DE, NO	Biology	2
4	Polar viruses	VIRUS	SE	Biology	1
5	Arctic prokaryotes	ASAP	SE	Biology	3
6	Picophytoplankton	PICO	SE	Biology	2
7	Phytoplankton	PHYTOP	SE	Biology	2
8	Zooplankton	ZOO	SE	Biology	1
9	Planktonic foraminifera	FORAM	SE, UK	Bio/geology	2
10	Carbon and tracer chemistry	CATCHEM	SE, DE, NO	Chemistry	4
11	Ventilation and anthropogenic carbon (ARICE)	VACAO	DE, DK, CH, SE	Chemistry	2
12	Trace gases cycling (ARICE)	TRACE	DE, DK, USA	Chemistry	1
13	Trace gas biogeochemistry	TGB	SE, USA	Chemistry	1
14	Mid-water acoustics	MWA	SE	Physical oceanography	4
15	Deep water hydrography	WAOW	SE	Physical oceanography	1
16	Arctic climate Across Scales	ACAS	SE	Atmosphere	2

Thank you for listening!