Eco-Light: 2018 field programme

Ecosystem functions controlled by sea ice and light in a changing Arctic

Germany: Giulia Castellani*, Hauke Flores, Michael Karcher, Frank Kauker, Marcel Nicolaus + Post-Doc/s

UK: Jeremy Wilkinson*, Julienne Stroeve Alex Hayward (UCL Master) + Post-Doc/s

Korea: Joo-Hong Kim + Eunjin Yang

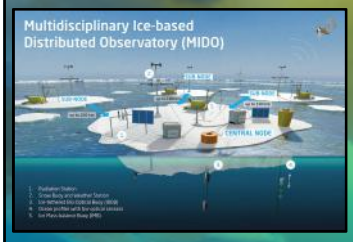
Canada: Randy Scharien

Norway: Jorgen Berge

* Leads: German/UK

Birmingham: 15 January 2019

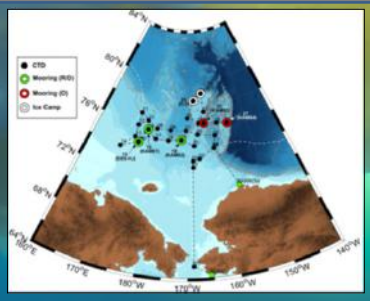
Additional resources:



AWI: Multidisciplinary Ice-based Distributed Observatories (MIDO). Additional platforms. Contact: Benjamin Rabe

KOPRI: cruise 2018 and 2019 Araon + additional data. Contact: Joo-Hong Kim

One of the fastest changing areas



Beaufort/ Chukchi Sea region

- Region that has seen the biggest decrease in MYI and snow holding.
- Transition from MYI to FYI summer ice cover corresponds to an increase of 200% in light transmittance into the upper ocean.
- Two cruises supported by KOPRI
  - August 2018 and 2019
  - Full support from KOPRI team

Additional area of study:
Transpolar drift stream

Different ice/snow and water masses

- Oden 2018
  - Similar assets deployed
- MOSiAC, 2019
  - Personnel overlap
  - Similar measurements

Objectives:

EcoLight

Ecosystem functions controlled by sea ice and light in a changing Arctic

OBSERVATIONS ⟺ MODELING

Changes in the **timing** and duration of **primary production** events, as well as changes in the **grazing** habits of zooplankton, mirror the variability in the **light** climate, which is driven by changes in the **snow and sea-ice** regimes

- WP 1: Integrated bio-physical observations on local and pan-Arctic scale
- WP 2: Understanding the seasonality of light-driven processes in the sea-ice ecosystem
- WP 3: Simulating and upscaling the biophysical system to pan-Arctic scale
- WP 4: Project Governance

2018 field pr

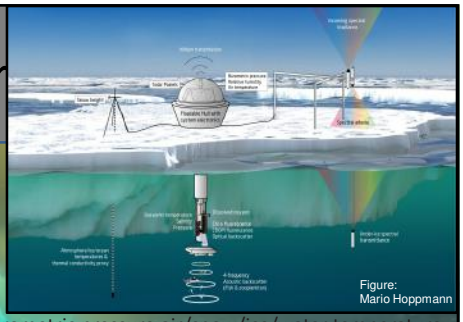
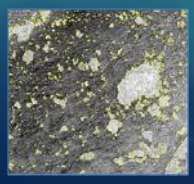


Figure: Mario Hoppmann

Need for year round presence/measurements: Role for Autonomous platforms

All instruments deployed in a cluster from *Araon*:

- **2 x IMB-SRs :**
  - sea ice and snow thickness + camera, up and down-looking radiometers, salinity, barometric pressure air/snow/ice/water temperature.
- **2 x Snow Buoys:**
  - 4 x snow measurement + Barometric Pressure, Air Temperature and Sea Surface Temperature.
- **1 x Spectral Radiation/Ice-Tethered Bio-Optical Buoys***
  - IMB (with snow pinger), 2 x TriOS RAMSES radiometer above ice, TriOS RAMSES radiometer below ice - Wetlabs Eco Triplet-W fluorometer- Aanderaa Optode 4330- Seabird SBE37-SIP Microcat
- **1 x Zoo Plankton Buoy (prototype)**
  - ASL-AZFP: Acoustic Zooplankton Fish Profiler + other sensors



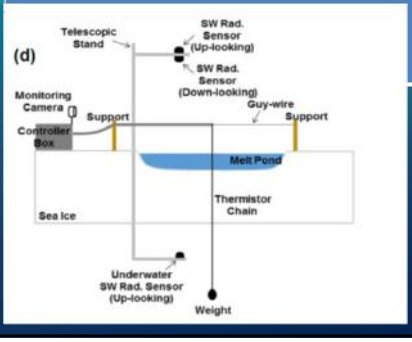
Two realisations of our clusters.

One in 2018 & 2019 (main field season)

All data freely available from the AWI and BAS websites

IMBs: Light, temperature and meltponds

IMB 069 deployment site – view from the IMB case.



IMB 069 on-board sensors:

- Camera
- Internal Temperature and Humidity
- Atmospheric Pressure
- GPS
- 5m temperature chain
- Solar Radiation Air (Net-Radiometer) looking up and down with tilt-meter (x,y)
- Solar Radiation Water in melt pond and under the ice looking up.
- Conductivity in melt pond and in sea water under the melt pond.
- Snow depth and ice depth acoustic sensors.
- Iridium SBD (data @ http://bruncin.ydns.eu/kopri/dashboard.php)
- **Died 2019-01-05**

Joo, H. M., Moon, W., Wells, A., Wilkinson, J., Langton, T., Hwang, B., ... Jones, D. R. (2018). Salinity control of thermal evolution of late summer melt ponds on Arctic sea ice. *Geophysical Research Letters*. https://doi.org/10.1029/2018GL078077

IMBs: Light and meltponds

IMB 046 deployment site – view from the IMB case

IMB 046 on-board sensors:

- Camera
- Internal Temperature and Humidity
- Atmospheric Pressure
- GPS
- 5m temperature chain
- Solar Radiation Air looking up and down with tilt-meter (x,y)
- Solar Radiation Water in melt pond and under the ice looking up.
- Conductivity in melt pond and in sea water under the melt pond.
- Iridium RUDICS (data @ http://frazil.nerc-bas.ac.uk/ice-arc)

Dead: 2018-10-18

IMB 047 site – surface sensors in melt pond.

iMB 047 on-board sensors:

- Camera
- Internal Temperature and Humidity
- Atmospheric Pressure
- GPS
- 5m temperature chain
- Solar Radiation Air looking up and down with tilt-meter (x,y)
- Solar Radiation Water in melt pond and under the ice looking up.
- Conductivity in melt pond and in sea water under the melt pond.
- Iridium RUDICS (data @ http://frazil.nerc-bas.ac.uk/ice-arc)

Still active: 15 Jan 19

Snow Buoys:

Snow Buoy 4820 deployment site.

Snow Buoy 2018S82 on-board sensors:

- Atmospheric Temperature, Humidity, and Pressure
- GPS
- 4x Acoustic snow depth
- Iridium SBD (data available on meereisportal.de)

Still active 15 Jan

Snow Buoy 2018S83 deployment site.

Snow Buoy 2018R83 on-board sensors:

- Atmospheric Temperature, Humidity, and Pressure
- GPS
- Acoustic snow depth
- Iridium SBD (data available data.meereisportal.de)

Dead 14.09.18

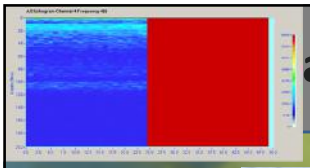
Spectral Radiation/Ice-Tethered Bio-Optical Buoys

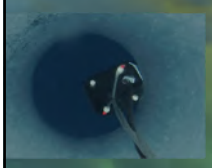
IMB 072 deployment site

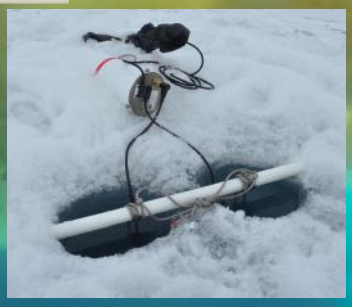
2018R6 on-board sensors:

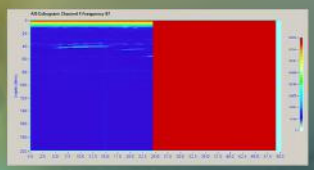
- Camera
- Internal Temperature and Humidity
- Atmospheric Pressure
- GPS
- 4m temperature chain
- Snow depth.
- Solar Radiation Spectra in Air – looking up and down.
- Solar Radiation Spectra in Water – looking up.
- ECO Triplet, Oxygen Optode, MicroCAT in water.
- Conductivity in sea water.
- Iridium RUDICS (data @ http://bruncin.ydns.eu/awi/dashboard.php and data.meereisportal.de)
- **Dead 2018-11-22**

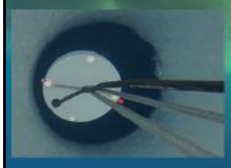
ankton Buoy (prototype)

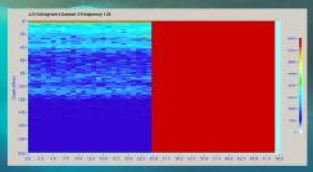


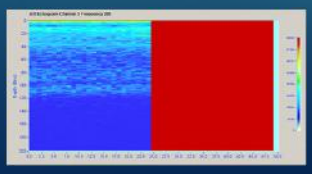


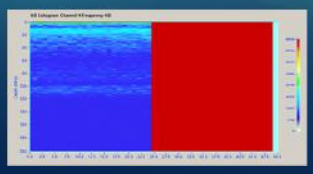








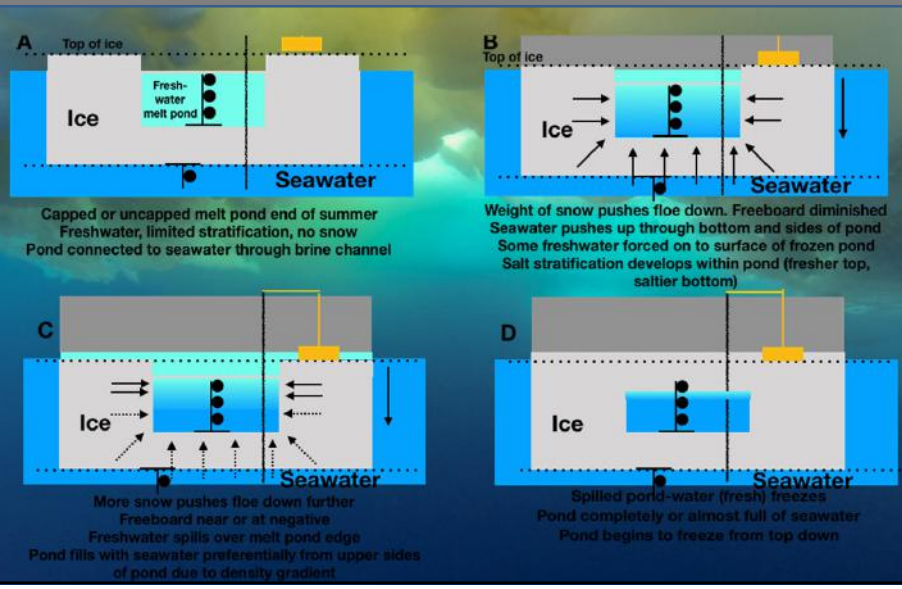




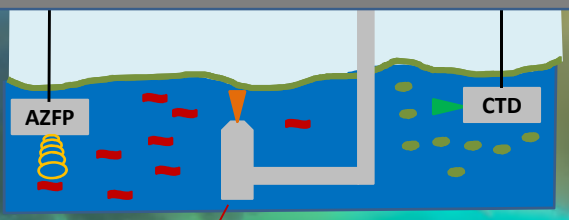
Longevity of systems compromised by ice conditions in Chukchi region

- No multi-year ice in region
- Ice thickness limited at end of summer
- For survivability system should to float!
- **Developing Zoo Plankton Buoy and**
- **Developing Spectral Radiation/Ice-Tethered Bio-Optical Buoys**
- **IMB and snow buoys not possible**
- **WIMBO buoy for 2019 deployment**
  - **150m T chain 0.25m spacing and 5 sal**

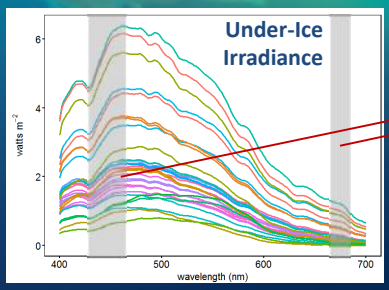
New physics: Importance of early season snow



In situ measurements



- **CTD** surface water properties and phytoplankton standing stocks
- **AZFP** vertical migration of grazers → grazing pressure on sea-ice algae and phytoplankton



Chl *a* absorption bands

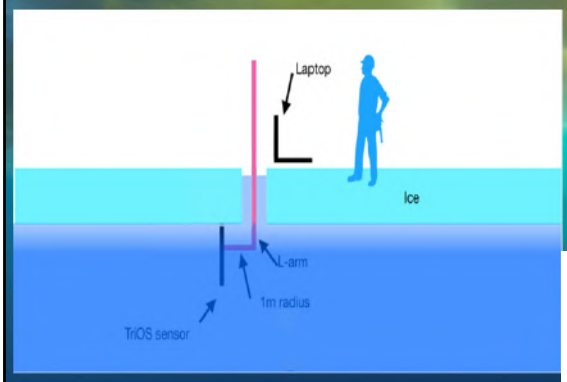
Bio-optical model for retrieval of in ice chlorophyll *a*

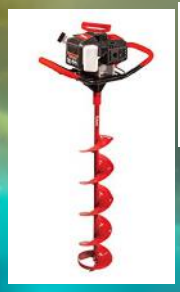
Recipe For Collecting Light Measurements

Recipe

- Drill a 10” auger hole
- Measure snow depth, ice thickness and freeboard
- Set up TriOS sensors & hook them up to L-Arm / Laptop
- Turn on portable battery
- Extend the L-arm Under the Ice
- Take 10 measurements around a hemisphere, ensuring the inclination is <10°

Ingredients For Collecting Light Measurements



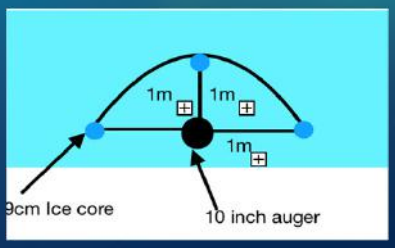


Sampling Sites

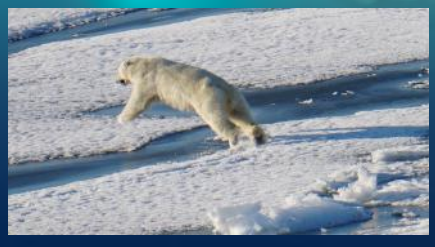
How we chose sample sites:

- Ice type / characteristics
- Thickness
- Snow Depth
- Melt ponds
- Lack of polar bears
- Spatial Variability

Ice Cores



Polar Bears



Main Scientific contact points:

Germany: Giulia Castellani, giulia.castellani@awi.de

UK: Jeremy Wilkinson, jpw28@bas.ac.uk