An autonomous zooplankton profiler in the Central Arctic Ocean

Ways forward in monitoring ecosystems in inaccessible regions

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& The EcoLight Team

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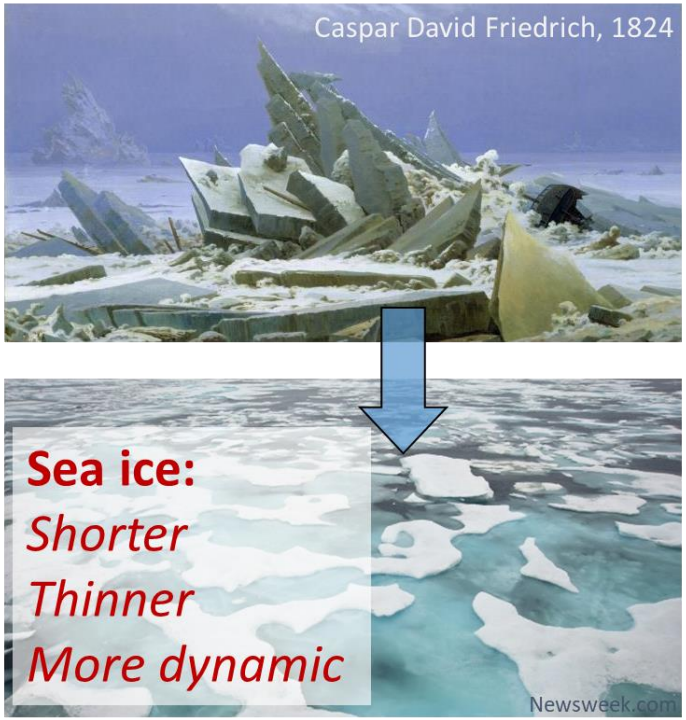
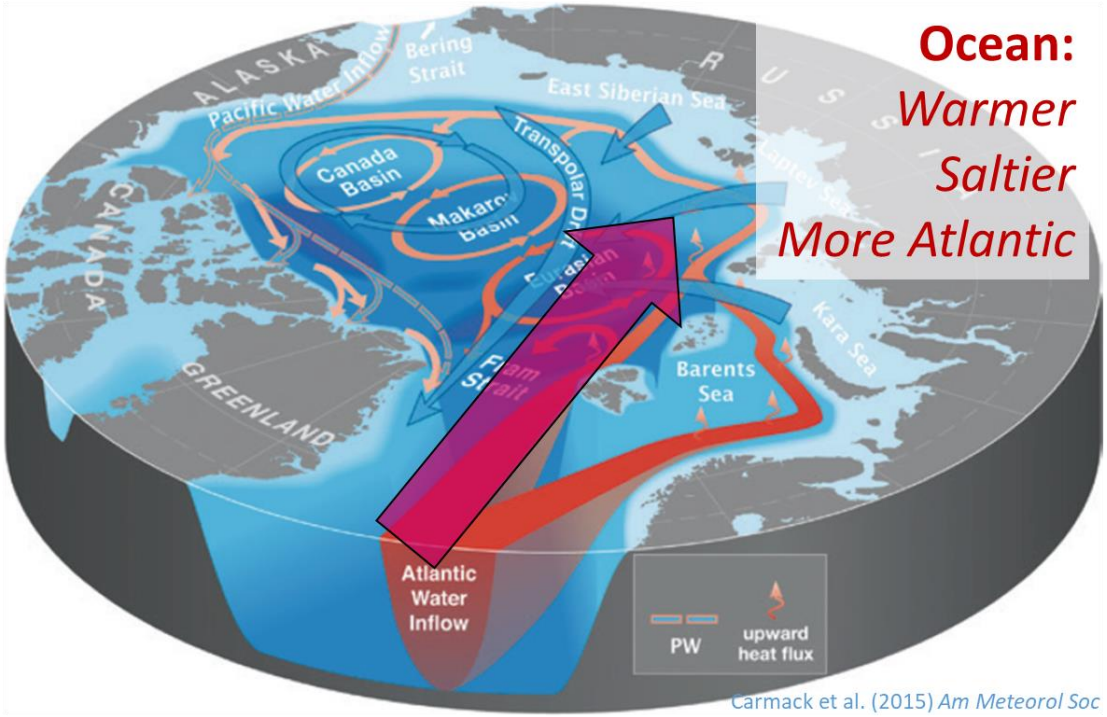
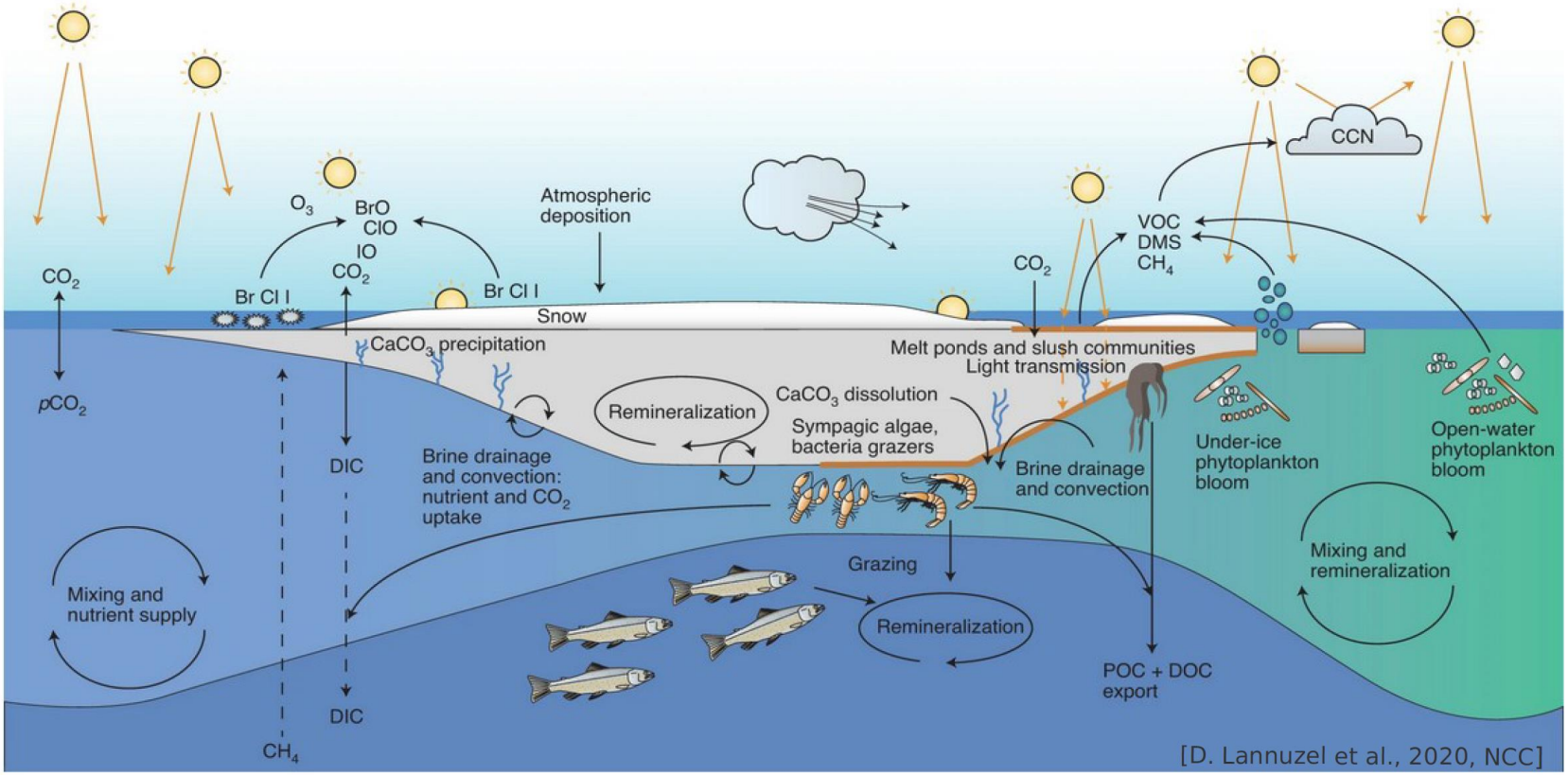
The Changing Arctic Ocean





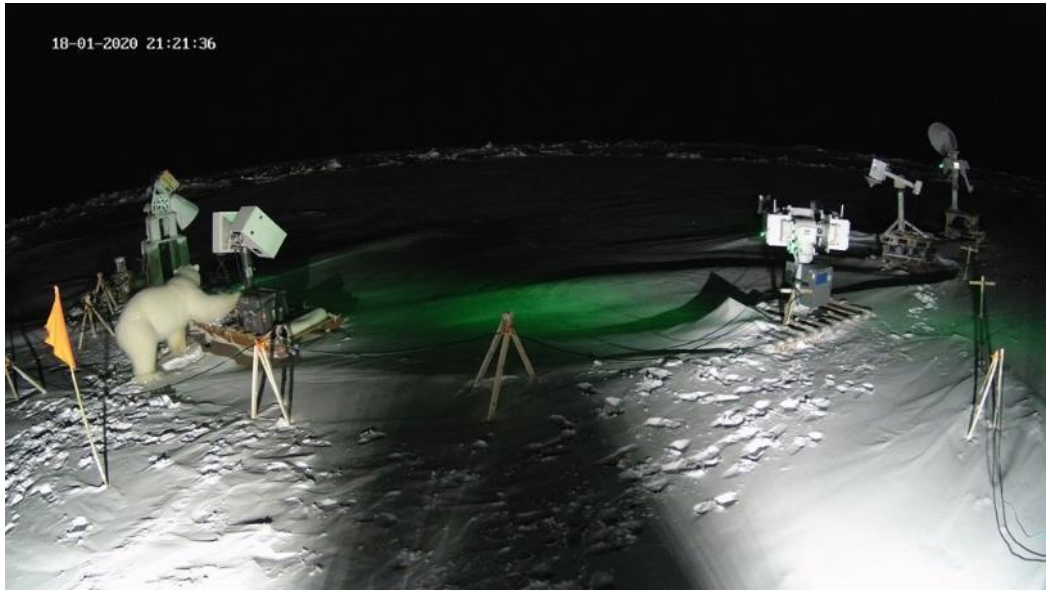
The Changing Arctic Ocean

Changes in sea ice lead to **changes in habitat, food type and availability, and species distribution**, thus affecting ecosystem dynamics and biogeochemical cycling



Objectives of EcoLight

- Investigate the effect of the changing under-ice light field on the abundance and vertical distribution of zooplankton
- Analyze interaction of zooplankton distribution with hydrography and food availability
- Evaluate autonomous AZFP for future studies in the CAO



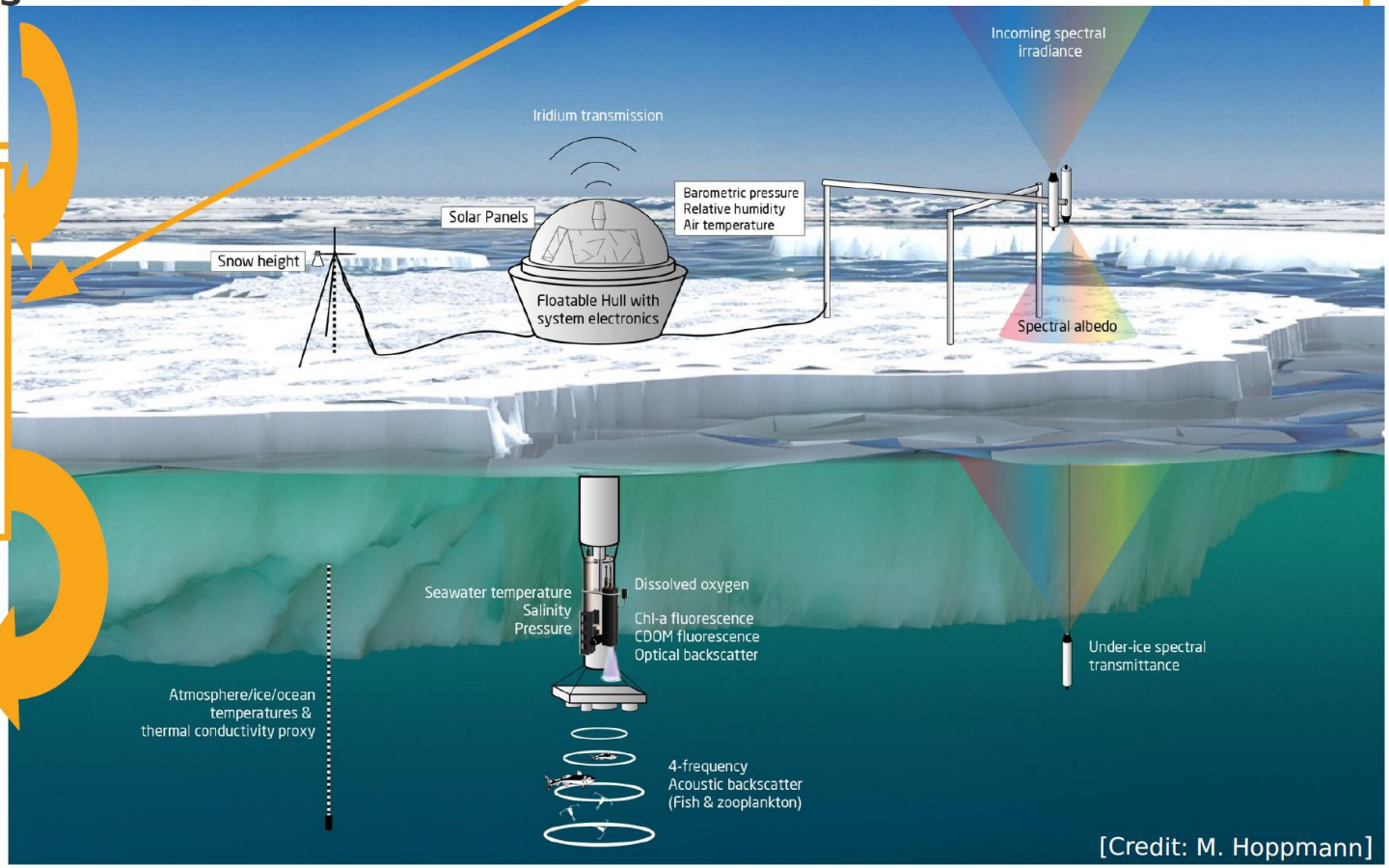
Automomous buoy array

Future Arctic research needs a **holistic coupled physical-biological approach** and **continuous year-round observations**

Buoys cluster

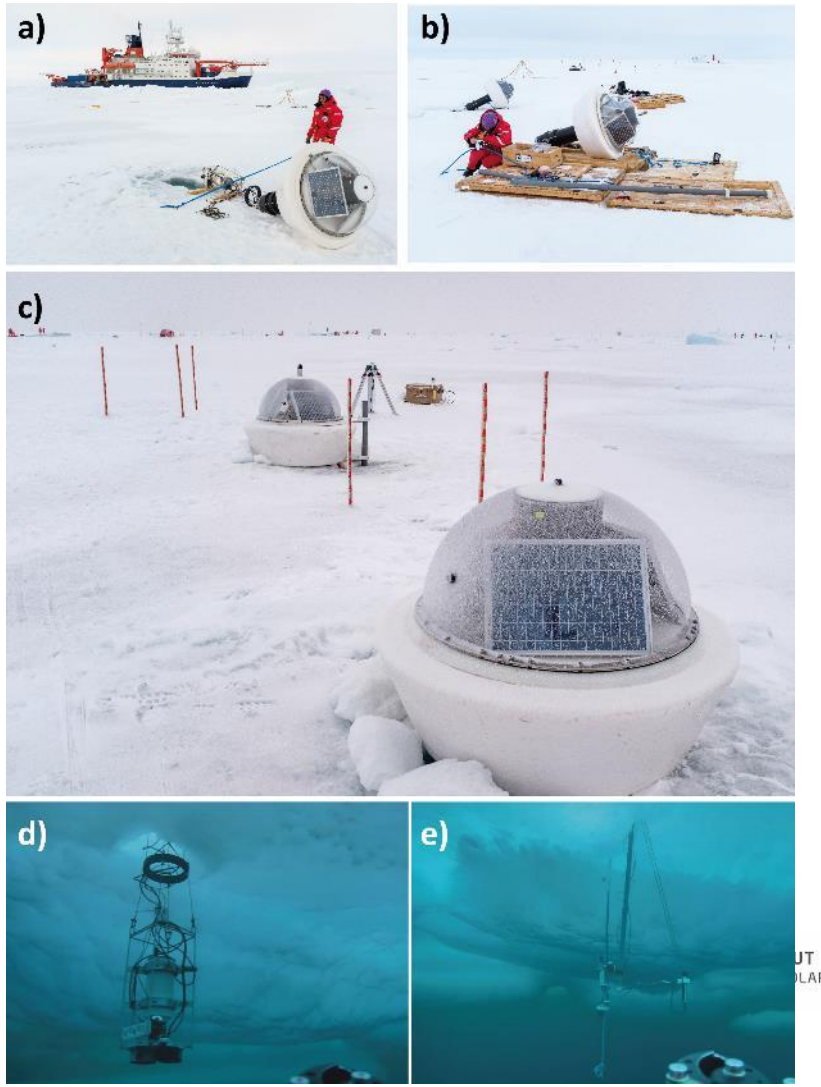
- CTD
- Ice mass balance
- Snow
- **Zooplankton**
- **Radiation**

[M. Hoppmann]



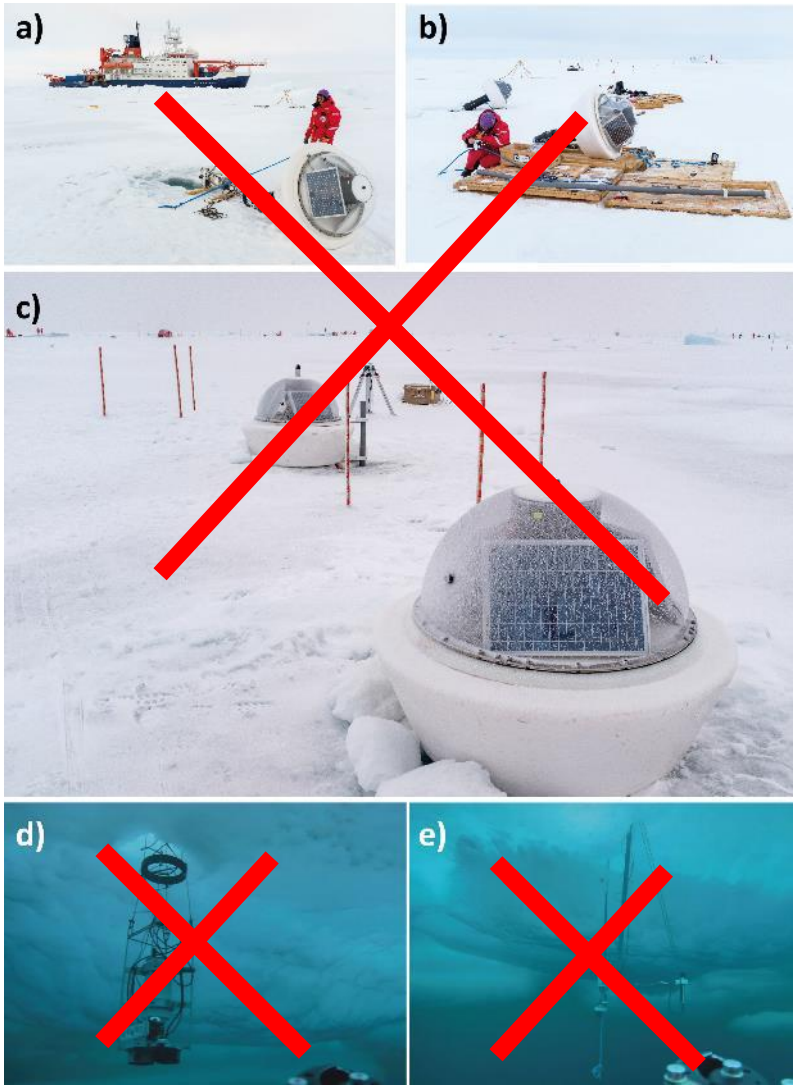
AZFP buoy prototype

Parameter	Sensor Model
GPS position	Garmin 18x
Atmospheric pressure	Bosch B280
Air temperature	Honeywell
4 active acoustic channels (70, 125, 200, and 455 kHz)	**ASL Acoustic Zooplankton Fish Profiler**
Chl-a fluorescence	Turner Cyclops
Salinity (under ice)	Solumetrix BKIN50
Incoming PAR	Apogee
Inner buoy temperature, humidity	Bruncin
Battery voltage/current, CPU load	Bruncin
Camera (air)	Bruncin
Camera (underwater)	Bruncin

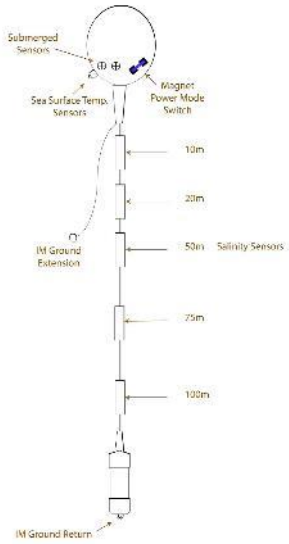


“Ice-tethered bio-optical buoy” (iBOB)

Parameter	Sensor Model
GPS position	Garmin 18x
Atmospheric pressure	Bosch B280
Air temperature	Honeywell
Spectral irradiance (air: up)	TriOS RAMSES ACC-VIS
Spectral irradiance, tilt, pressure (under ice: up)	TriOS RAMSES ACC-VIS with inclination/pressure
700nm backscatter	Wetlabs Eco Triplet-W
Chl-a fluorescence	Wetlabs Eco Triplet-W
CDOM fluorescence	Wetlabs Eco Triplet-W
Dissolved oxygen	Aanderaa 4330SW
Salinity (under ice) at 2m	Solumetrix BKIN50
Seawater temperature, salinity, pressure	Seabird SBE37 CTD
Inner buoy temperature, humidity	Bruncin
Battery voltage/current, CPU load	Bruncin
Camera (air)	Bruncin
Camera (underwater)	Bruncin



Backup: CTD chain buoy, irradiance buoy

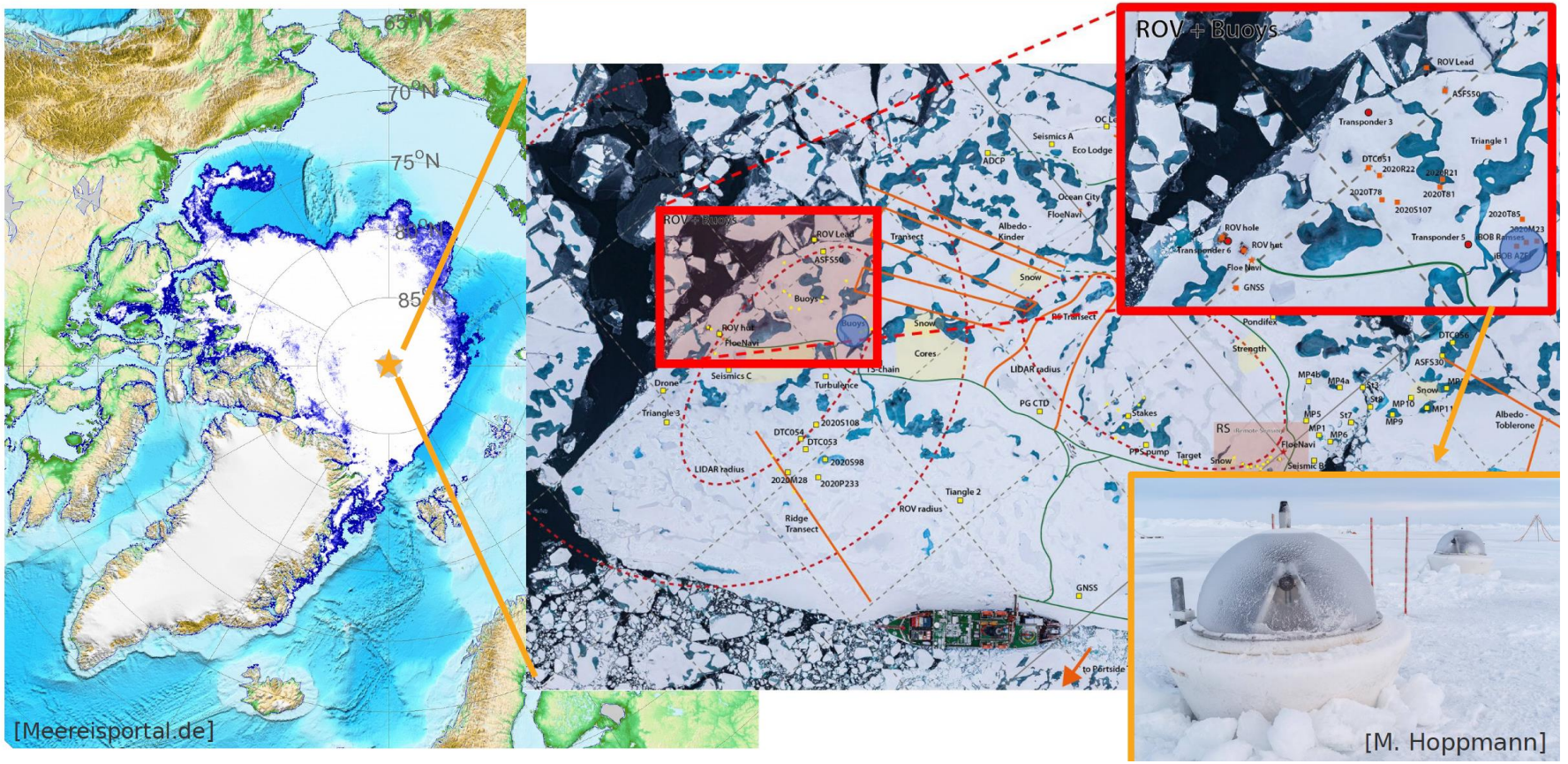


- 5 Seabird SBE37IMP CTDs
- Conductivity, temperature, pressure
- Depths: 10, 20, 50, 75 and 100 m

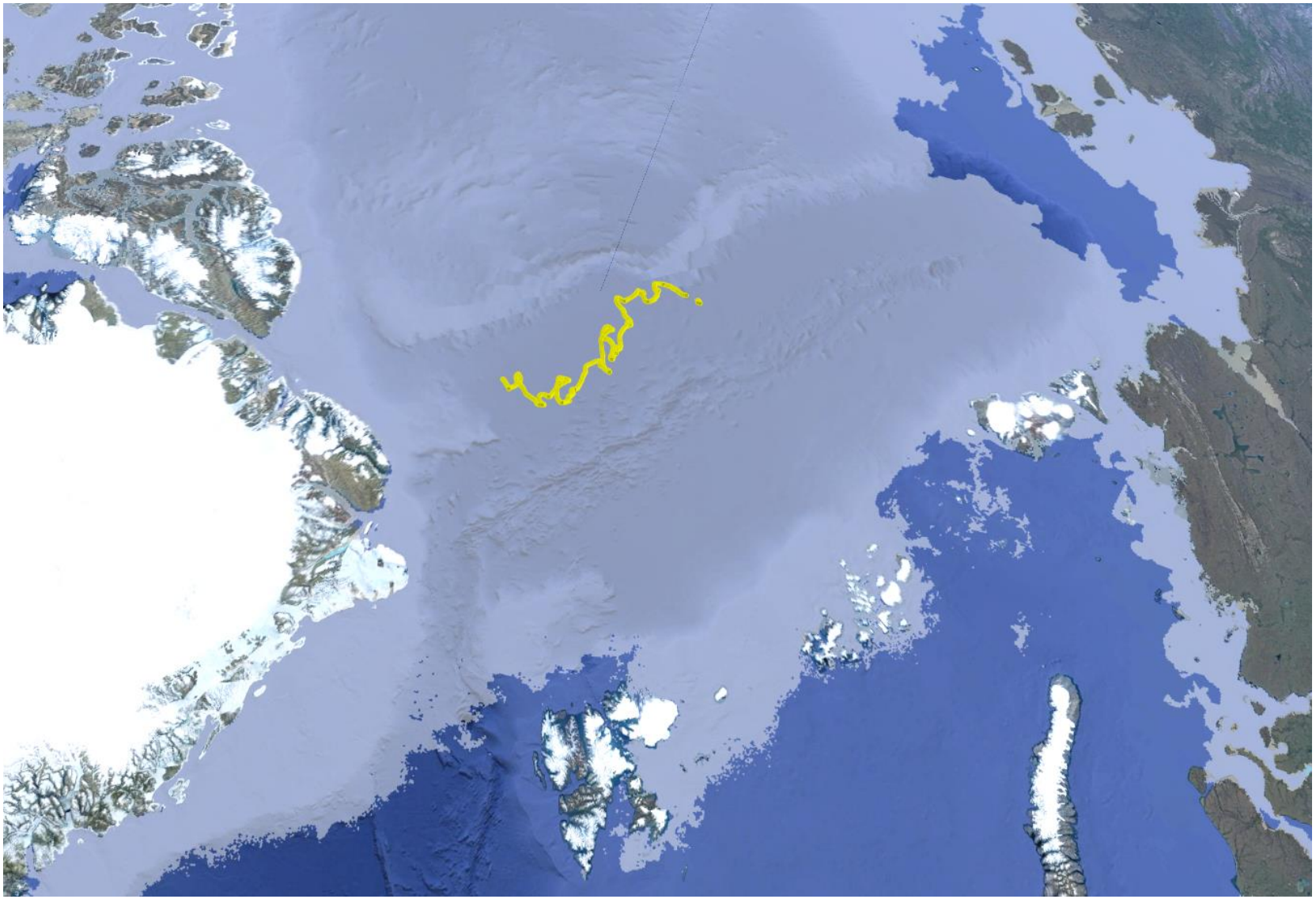
- 3 RAMSES ACC-VIS spectral radiometers
- Incoming, reflected, transmitted irradiance
- (also on the image: light chain, thermistor chain)

Deployment

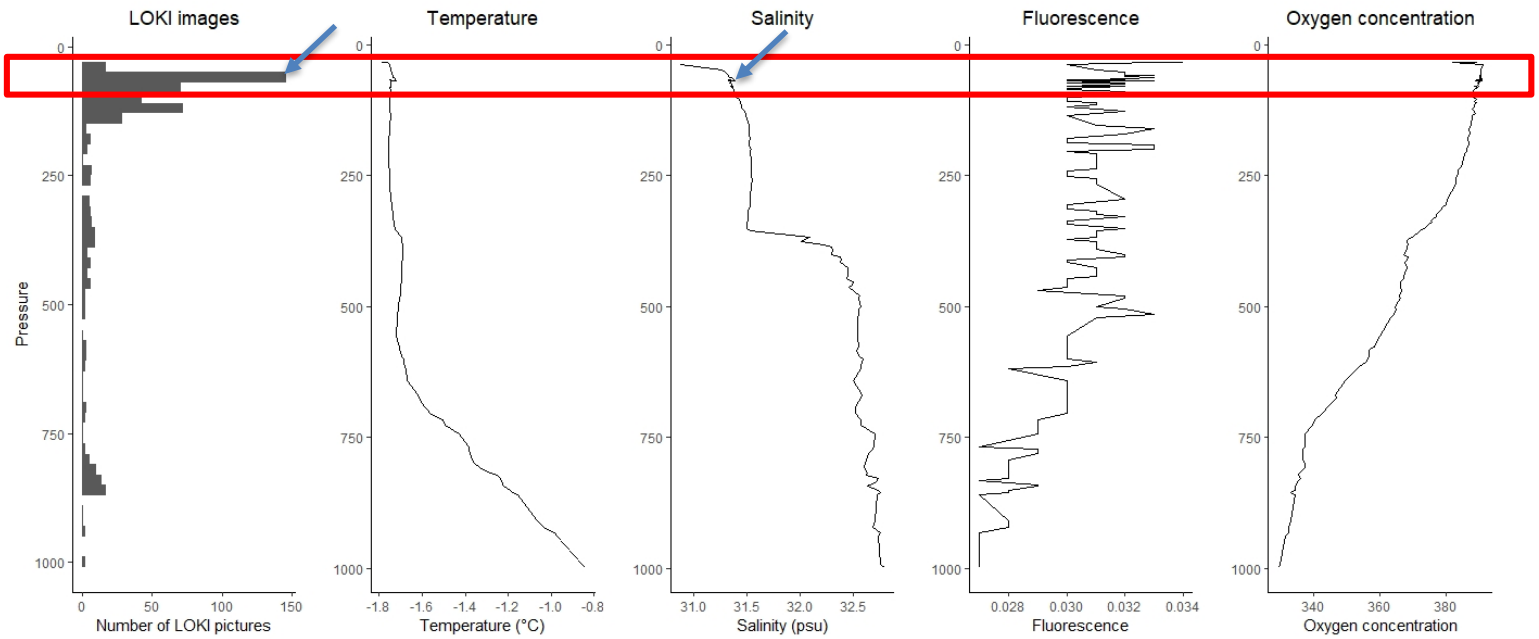
Deployments: MOSAiC September 2020, 89.05°N 107.10°E



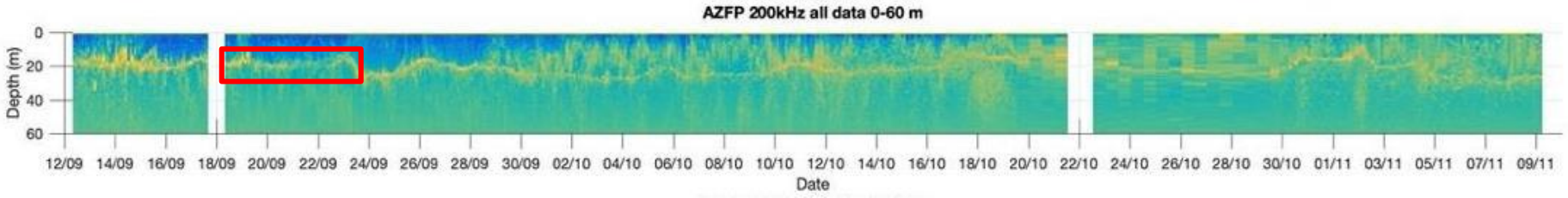
Drift 09/12/20 – 02/01/21



First results: Pycnocline

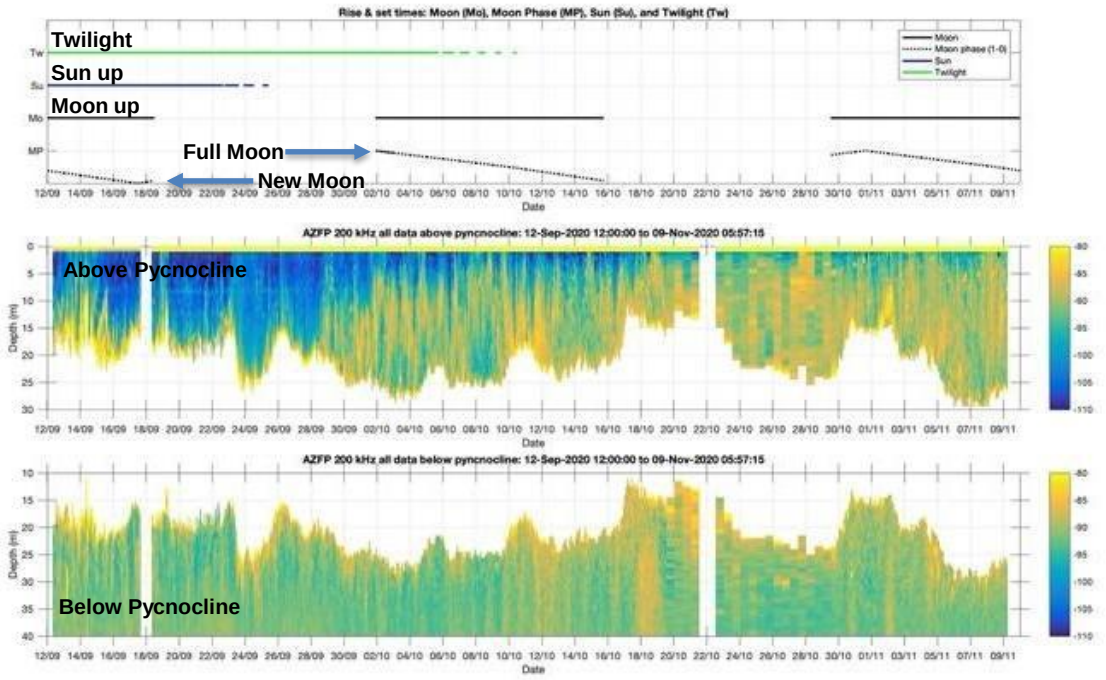


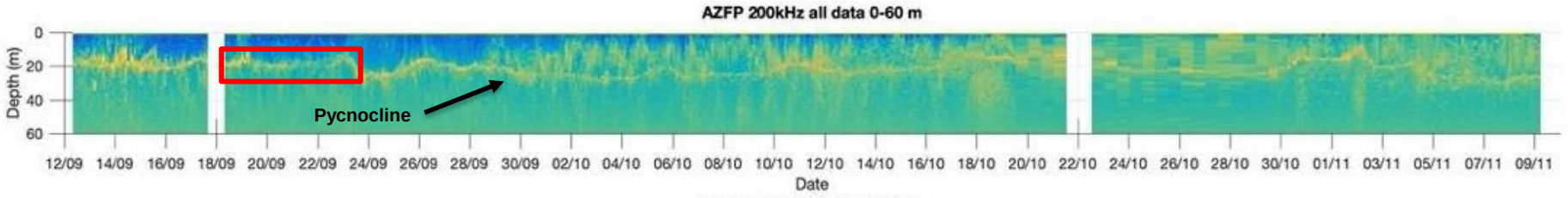
Credit: Nicole Hildebrandt



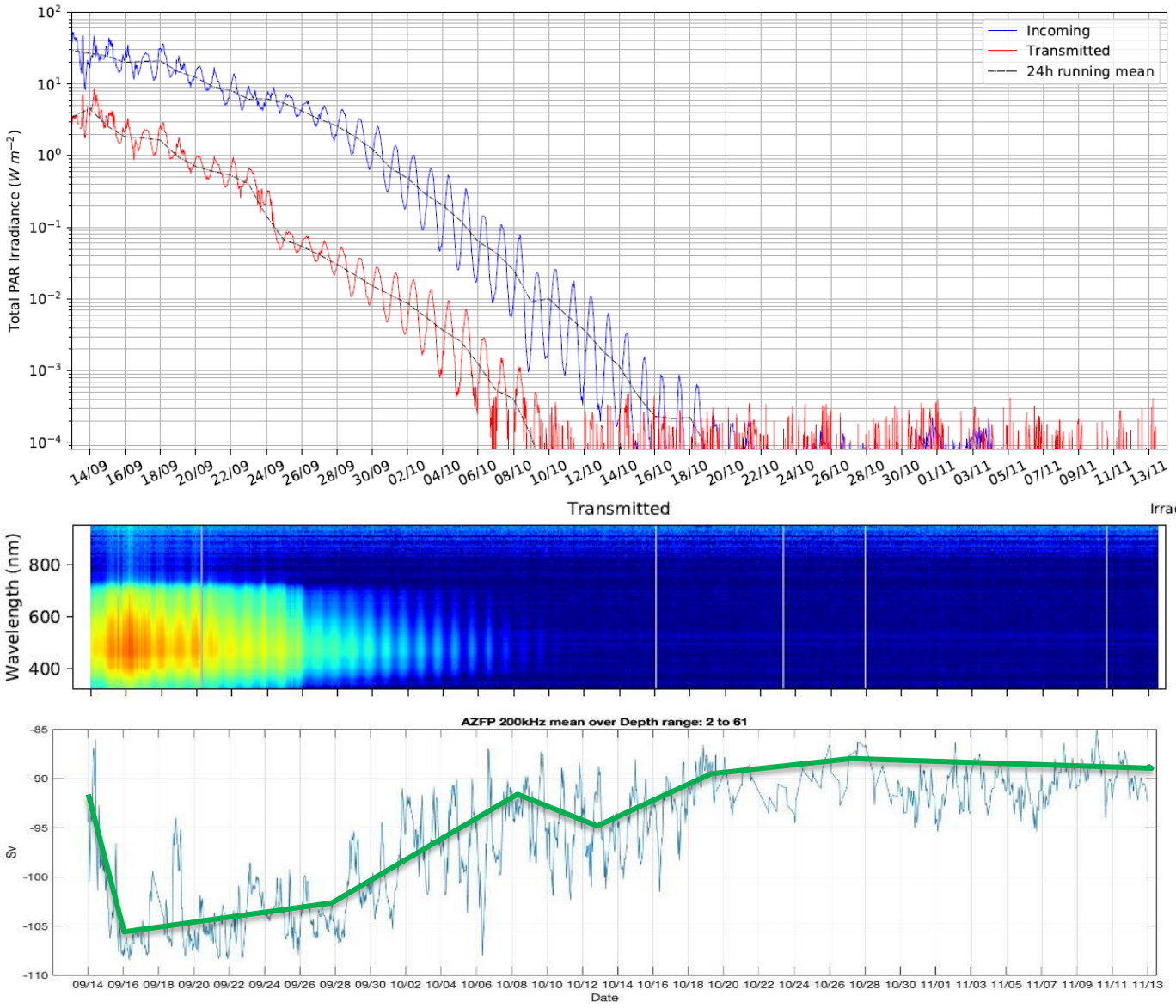
First results: Light

- Difference above and below pynocline (PC)
- Increased bacscatter above PC at „polar dusk“
- Periodic vertical shifts above PC during twilight
- „even“ distribution below PC

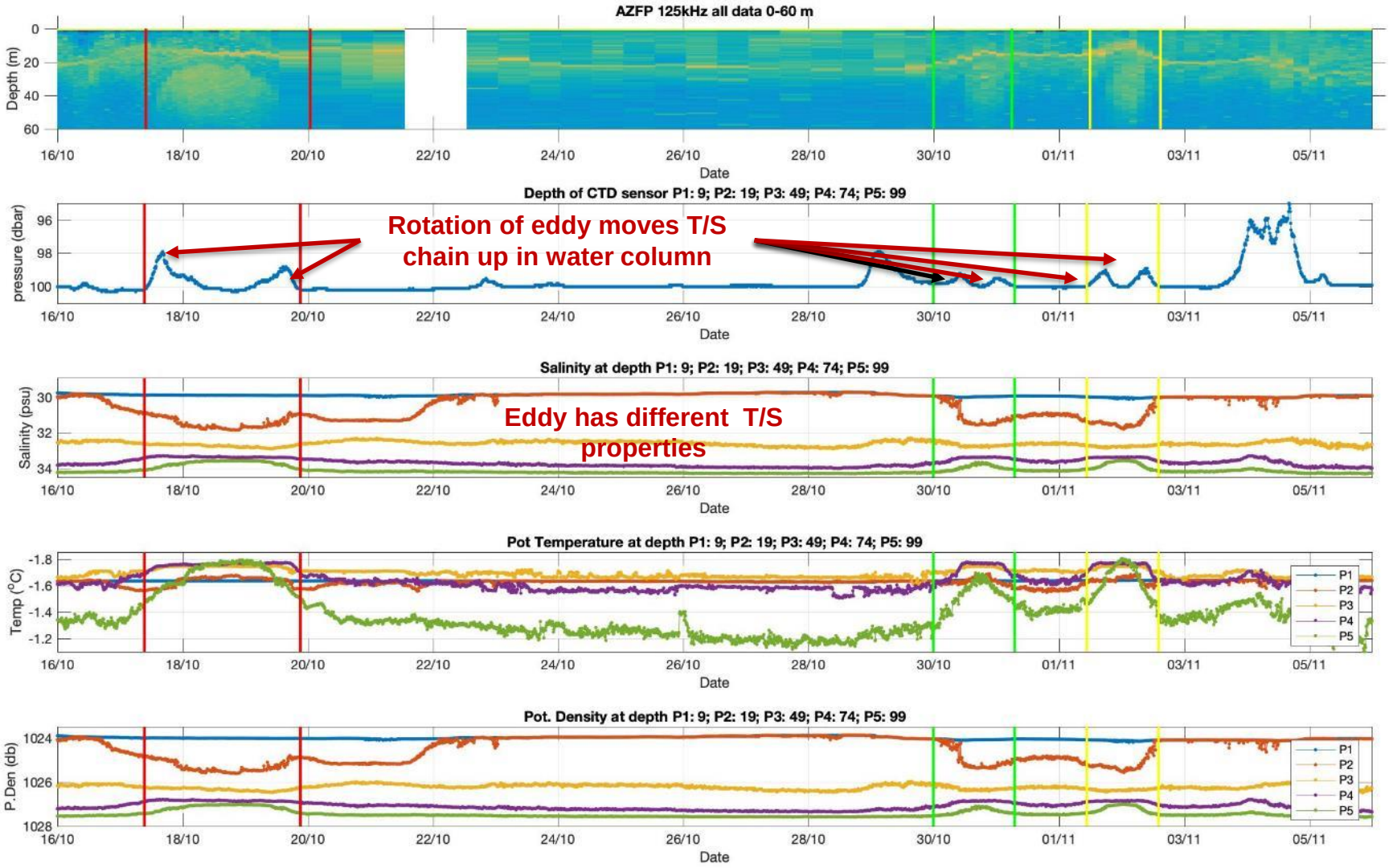




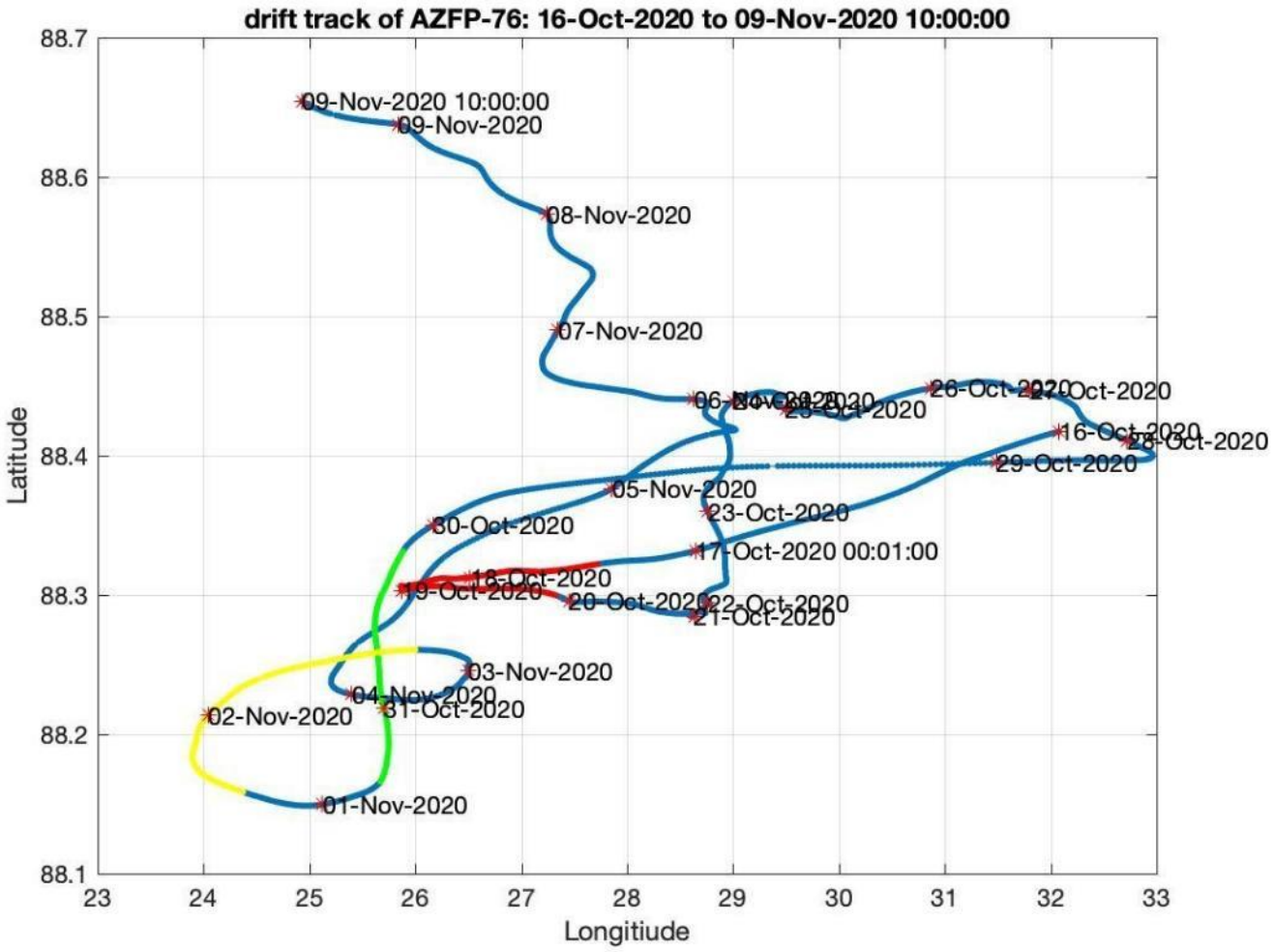
First results: Light



First results: Eddie



First results: Eddie



Main improvements

- Holistic observations of the coupled physical-biological system
- Capture transition phases when we are usually not there
- Observation of particular events (eddies)
- Possibility to transmit data at (almost) real time
- Remote monitoring of the battery level
- Possibility to remotely change the sampling settings in order to optimize battery consumption

Major challenges

- Polar bears love them!!
- Icing of sensors
- Ridging and rafting of ice
- Communication issues for data transmittance
- Internal software issues
- Sometimes we don’t know, we are not there!

Future improvements

- Everything must float!
- Wildlife resistant solutions
- Iridium Certus integration
- More powerful battery for winter sampling
- Deploy more clusters to capture spatial variability
- Towards the development of multidisciplinary buoys