ALFRED-WEGENER-INSTITUT
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Year-round under-ice research on MOSAiC using a remotely operated vehicle (ROV)

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ROV program on MOSAiC

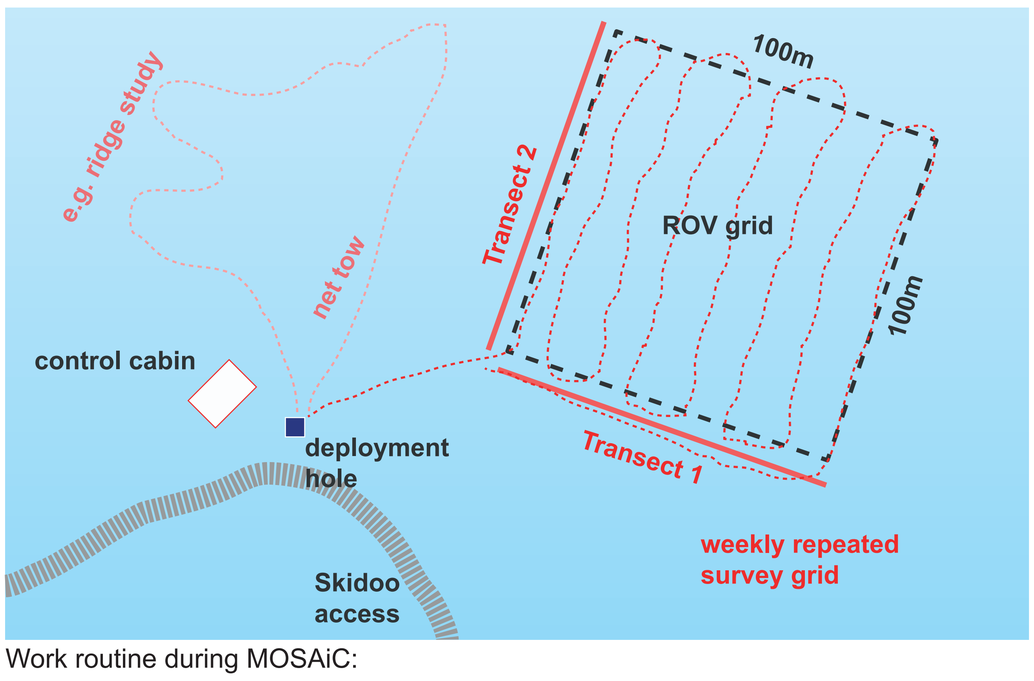
To provide easy and reliable access to the underside of the sea ice during the MOSAiC expedition, the Alfred-Wegener-Institute will operate its new remotely operated vehicle during the full duration of the drift directly from an access hole on the ice. The vehicle provides a stable sensor platform, as well as inspection and intervention capabilities. It has a maximum range of 300m from the designated access hole(s) and a depth rating of 100m. The ROV operations under sea ice will allow repeat measurements during the entire drift with little impact to the sea ice, the upper ocean, the ecosystem and other objects of interest.

The main task of the vehicle will be repeated mapping of the spatial variability of the various parameters on a weekly basis. In addition, we plan to use it for deployment and retrieval of under-ice sensor packages and perform inspection and manipulation tasks. The ROV operations can easily be conducted by a small on-board sea ice team due to the reliable and redundant system architecture.

In combination with surface measurements, like aerial photography and terrestrial laser scanning, a full 3D characterization of the local ice cover will enable areal upscaling of the obtained results also using remote sensing data. Ideally these high resolution measurements at the MOSAiC central observatory will be extended with regular missions of an autonomous underwater vehicle (AUV), which can travel longer distances in spite of a small logistical footprint, to tie the local observations into the context of the larger spatial scale of the MOSAiC distributed measurement network.

Scientific objectives

- **Spatio-temporal evolution of sea ice and its associated ecosystem**
- **Linking upper ocean dynamics with the thermodynamic and dynamic development of the ice cover**
- **Observation of the under-ice ecosystem throughout the entire year**
- **High resolution ice thickness mapping**
- **Lateral, vertical and temporal variability of ice optical properties and the under-ice light field**
- **The vehicle is capable to include YOUR instrument to realize YOUR ideas! Please contact us!**

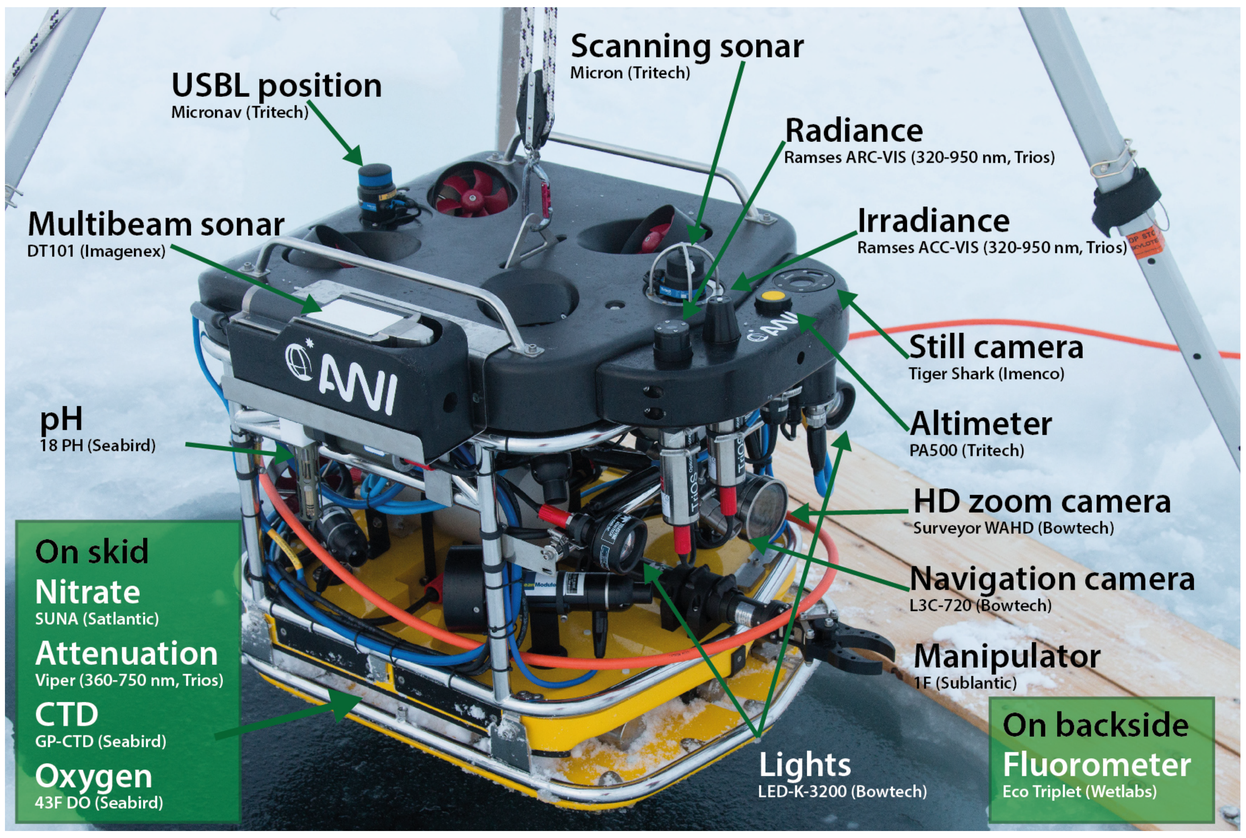


Work routine during MOSAiC:

- 100m x100m grid area framed by two transect lines (no-go & no drilling area)
- weekly repeat surveys in the ROV grid
- diving close to the ice and at depth
- weekly repeated vertical profiles in several grid locations
- irregular dives for specific experiments / device deployments such as net tows, ridge studies, sensor inspection and documentation

- ROV control from heated cabin on the ice
- positioning system and marker sticks frozen into the ice floe
- operation requires a trained pilot and a trained engineer

Funding for vehicle and personnel is already committed by AWI, so the ROV will be operated during the entire MOSAiC drift, also during winter.



Positioning system:	MicronNav USBL supported by LBL (planned) floe relative navigation
Cameras:	HD-zoom video camera (10x zoom) 2 SD video cameras Still camera (14 MP) with flashlight 2 LED lights (3200 lumen) zooplancton camera (planned)
Manipulator arm:	1 function manipulator (open/close; 8kg force) 6 degrees of freedom ROV control
Rescue system:	Fully redundant and modular system architecture with divereadу backup and rescue system

	Sensors	Measurements
optical	hyperspectral radiometers: TriOS RAMSES-ARC/ACC	- light transmittance through sea ice - under-ice light field - hyperspectral detection of ice algae
	hyperspectral extinction: TriOS VIPER	- optical properties of seawater
	Nitrate UV-Spectrometer: SUNA V2	- nitrate concentration - UV-absorption spectra
	Fluorometer: ECO-Triplet	- Chlorophyll - optical backscatter - FDOM (fluorescent dissolved organic matter)
acoustic	altimeter: (0.-10m)	- distance to ice (data correction) - ice thickness
	multibeam sonar: Imagenex DT101	- ice thickness - 3D geometry of ice underside
	scanning sonar:	- obstacle avoidance
	ADCP: Nortek Aquadopp (2MHz)	- under-ice currents - turbulence - acoustic backscatter
ocean	CTD:	- sea water salinity / conductivity - sea water temperature - dissolved oxygen
	pH-sensor:	- pH
sampling	zooplancton net:	- horizontal zooplankton sampling underneath ice - ROV-SUIT (surface & under-ice trawl)
	water sampler:	- 1L Niskin bottle (mechanical release) - slurp sampler (planned)

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