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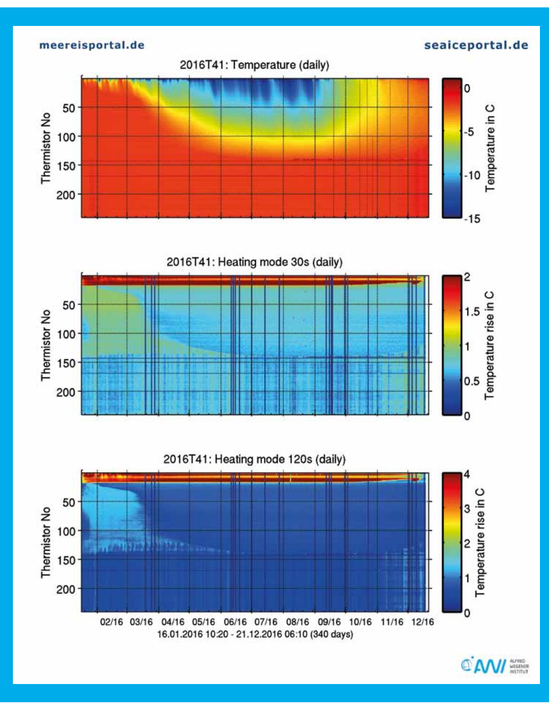
A distributed network of temperature chains to autonomously monitor sea ice evolution on an ice floe during MOSAiC

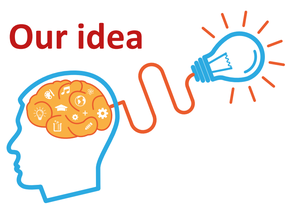
Background: Thermistor chains are usually used on sea ice mass balance buoys to measure temperature profiles of air, snow, sea ice and water at a fixed location on an ice floe. From this high resolution data, snow depth and ice thickness can be derived and the energy balance of an ice cover can be calculated.

Recent developments also enable those temperature chains to also record the temperature rise after a period of active heating. Using this technology, important changes in the seasonal evolution of an ice cover can be detected. These include for example: surface flooding, snow ice formation, melt onset, melt pond formation & -refreezing, internal melt & -refreezing, ...

However, the cost for such an instrument, combined with the additional burden of satellite transmission fees for the large amount of profile data, limit the number of buoys that can be deployed in a given timeframe and area.

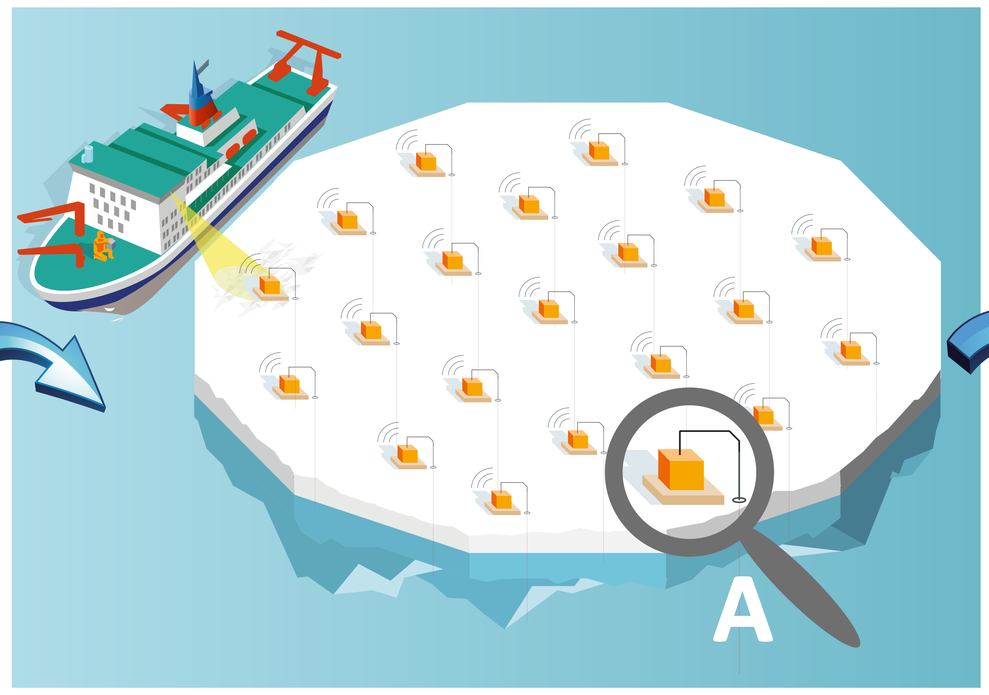


Our idea

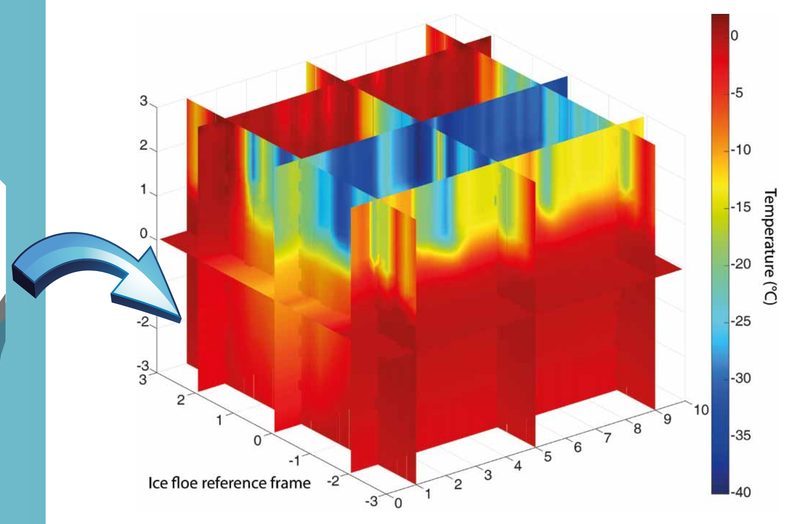


Utilize a new digital temperature chain technology to build a network of autonomous monitoring sites on the central ice floe during MOSAiC.

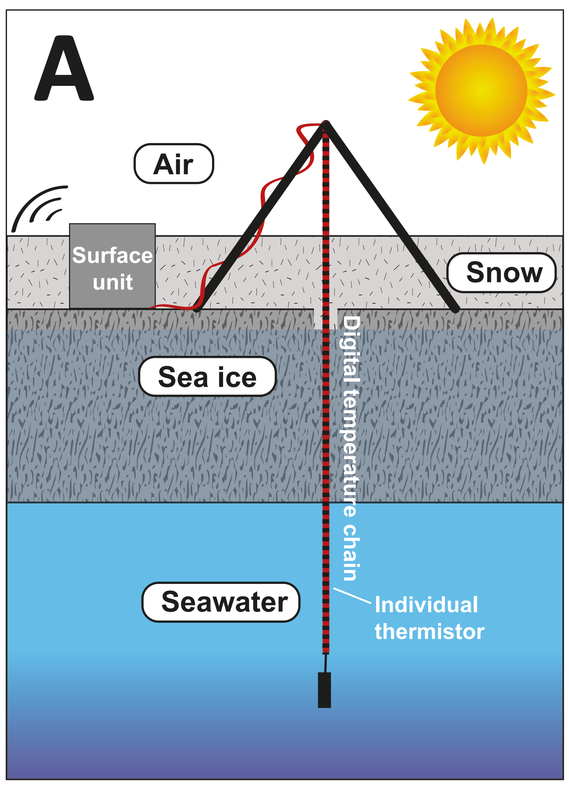
The observation of sea ice physical & biogeochemical properties and their seasonal evolution is a key task of MOSAiC. The central ice floe to which Polarstern is anchored will be subject to a myriad of regular measurements from various disciplines.



The idea proposed here is to support the manual observations with a network of autonomously operating digital temperature chains, which transmit the measured temperature and heating profiles to the ship via WLAN in regular (e.g. hourly) intervals.

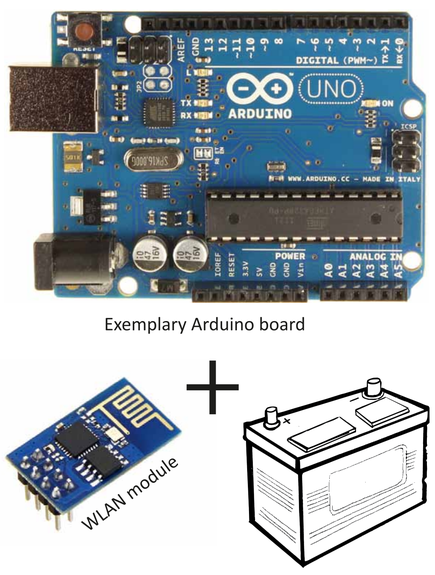


A central receiving & processing unit onboard Polarstern combines all the data into floe-scale temperature maps in near-real time. From this data, further products can be derived.



Scheme of individual monitoring site

The key elements of this floe-scale autonomous ice observatory is a recently developed digital temperature chain (DTC) with thermistors & heated resistors in 2 cm spacing.



Exemplary Arduino board

Through its RS232 interface, the DTC is able to communicate to any commercially available, low-cost (mini-)computer, such as Arduino, Raspberry Pi or Micropython. The computer will be equipped with a WLAN module and the system is powered by a rechargeable battery.

Why on MOSAiC?

Despite the relatively simple setup, the temperature chains themselves are still not cheap. A long operational time would therefore be favorable.

It is impossible to send the massive data amount over satellite. A base station in WLAN reach is necessary.

The presence of personnel enables battery changes and general troubleshooting.

A lot of other work (e.g. sea ice biology & biogeochemistry) could be supported by the data from this project.

Additional chains can be deployed on sampling sites that become of special interest throughout the different seasons.

The result would be an unprecedented dataset, characterizing in utmost detail the seasonal evolution of an entire pack ice floe. Cool, huh?

Your input is needed: Does this make any sense?

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