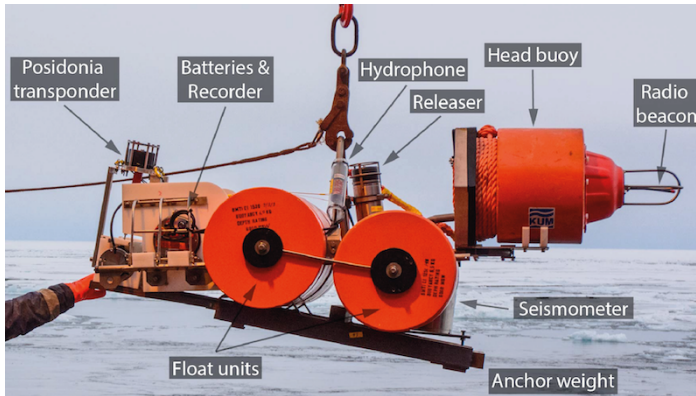


First Ocean Bottom Seismometer network underneath the ice-covered Arctic Ocean: Operational challenges and chances for monitoring the state of the sea ice cover

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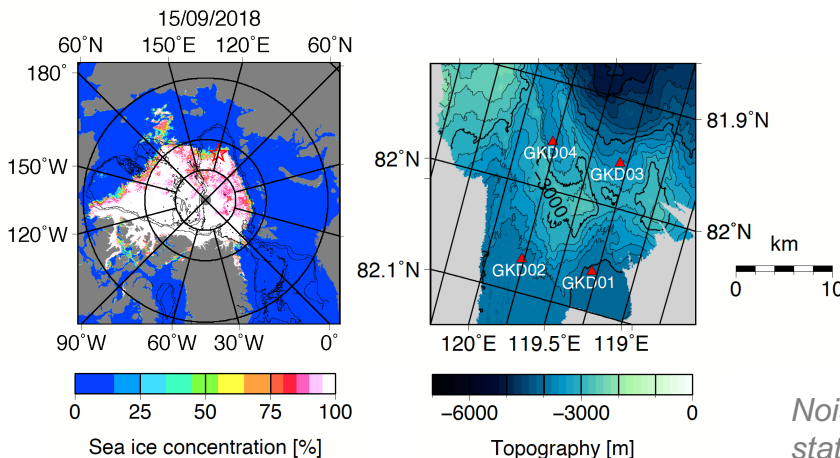
Operation of OBS underneath sea-ice



Modified Lobster OBS¹ upon deployment

From September 2018 to September 2019 we operated a network of 4 ocean bottom seismometers (OBS) at Gakkel Ridge (Arctic Ocean) as a test for routine use of OBS in sea-ice covered oceans¹.

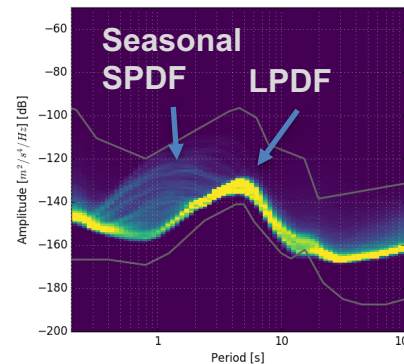
- Sea-ice concentration was 50-75% during deployment and recovery and 100% during the remaining year.
- Tracking the OBS with a Posidonia transponder during descent, ascent and recovery from underneath sea-ice proved vital for successful recovery of the OBS.
- Initial processing consisted of probabilistic power spectral density (PPSD) plots² and spectrograms of spectral power in one minute time windows.



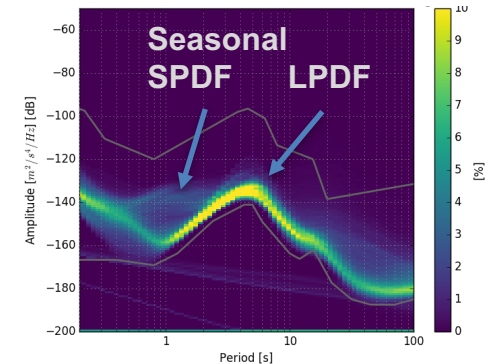
Sea-ice cover upon deployment of network (red star)

OBS network near Gakkel Deep on Gakkel Ridge

PPSD: GKD03

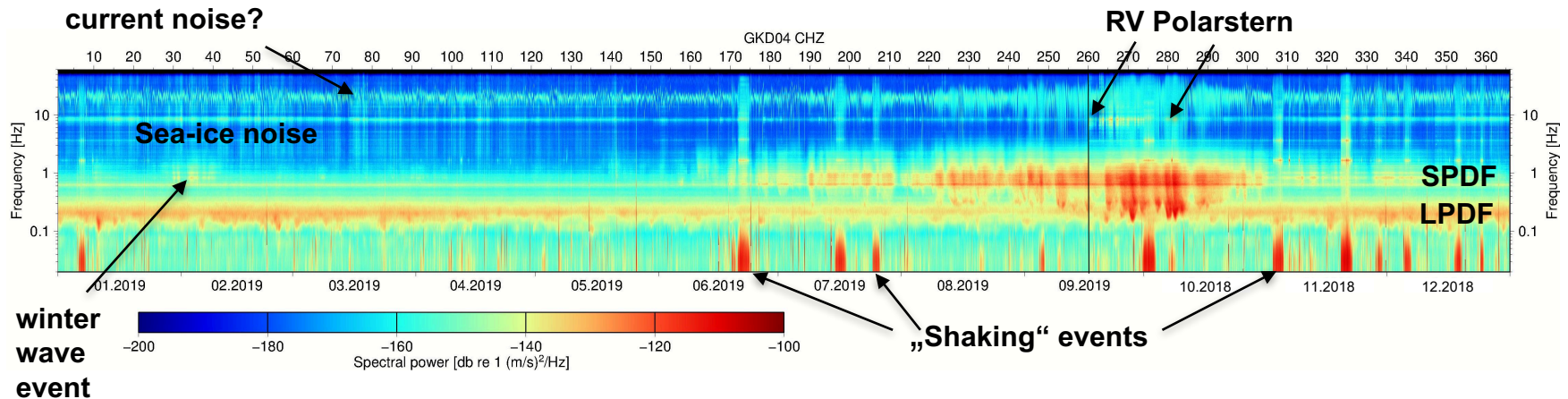


TIXI



Noise conditions of sub-sea-ice OBS GKD03 and onshore seismic station TIXI. Short-period double frequency (SPDF) microseismic noise at twice the ocean wave frequency³ occurs only seasonally and is stronger in the open ocean compared to coastal TIXI. Long-period DF (LPDF) noise shows similar amplitudes throughout the year at both stations demonstrating the low noise levels at the bottom of the ice-covered Arctic Ocean.

Noise conditions at the bottom of the Arctic Ocean



Preliminary assessment of noise conditions:

- SPDF noise occurs seasonally, depending on sea-ice cover of the Arctic Ocean. Its frequency decreases as the fetch for wave evolution increases. SPDF events in winter may indicate disruption of sea-ice cover during swell events. **SPDF may serve as proxy of Arctic Ocean wave climate.**
- **LPDF noise is not created in Arctic Ocean.** It has increasing intensity during winter and appears unaffected by the sea-ice cover.
- **High-frequency noise** in short events may be caused by **ice-breaking vessels and sea-ice motion.**
- Specific to **GDK04**: potentially current-induced noise with periodically varying frequencies between 10-25 Hz, disrupted by „shaking events“ of about 2 days duration, affecting entire frequency band – related to OBS location in canyon-like structure and **topography induced currents?**

Acknowledgements: OBS were deployed from RV Polarstern during cruise PS115 (grant AWI_PS115/2_01) and recovered during PS122/1a. OBS stem from the German Instrument Pool for Amphibian Seismology (DEPAS). Data for Global Seismograph Network station TIXI were downloaded from IRIS: [doi: 10.7914/SN/IU](https://doi.org/10.7914/SN/IU).

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2) McNamara, D.E. & Buland, R. (2004). Ambient Noise Levels in the Continental United States, *Bull. Seismol. Soc. Am.*, **94**, doi:10.1785/0120030001, 2004.
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