An overview of multi-OpenMetBuoy wave observations in the melting Greenland Sea marginal ice zone

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14 OpenMetBuoys (OMB) (Rabault et al. 2022) that measure ocean waves in sea ice were deployed in the Greenland Sea marginal ice zone (MIZ) north west of Svalbard (another buoy, OMB-744, was deployed in the fast ice offshore of east Greenland) during the Polarstern expedition in July--Aug 2022 (PS131). The OMBs were deployed on ice floes of various dimensions ranging from 15 m to as large as ~2km, and thickness, when measured, ranged from 1 m to >2 m. They were spatially distributed to try to cover broad width of the MIZ. The OMBs were deployed opportunistically primarily using the mummy chair (and sometimes using a helicopter) as well as at the three ice camp sites that were revisited three times during PS131. At the ice camp sites, we also deployed Inertial Measurement Unit (IMU) data loggers to capture accelerometer and GNSS time series at roughly 10 Hz frequency. The measurement duration of each OMB varied; the likely reason for instrument ceasing transmissions is that OMB's Iridium communication was affected because the buoy moved sideways (i.e., the antenna is not facing the sky), covered by snow that interfere with radio waves, and/or fell in the ocean as floes melted. Figure 1 shows the OMB trajectories from 12 Jul to 12 Oct 2022.

The primary objective of the PS131 wave buoy deployment was to observe ocean wave effects on the sea ice melt. In this regard, the observation team got the firsthand observational evidence of ice break up due to ocean waves because the ice floe broke into pieces on two occasions during the OMB deployments, of which one was at the ice camp floe that broke into two pieces while they were setting up the camp and deploying instruments. We will introduce the visual footage and wave data for these times in the presentation. There were several other weather events that were captured during the OMB deployments, which we will also introduce.

The power density spectrogram of surface elevation corresponding to the Figure 1 measurement period is provided in Figure 2. The figure shows that various events were captured at different stages of the measurement period. As the ice break up/melts, the floe dimensions were also changing. This is interesting and challenging at the same time; ice floes the buoys were deployed on effectively serve as a floating platform for the wave buoys and their dimensions are changing with time. The scale of ice floes (including horizontal dimension and ice thickness) and incoming wave wavelengths are an important consideration to the wave-ice interaction. So we envisage the dataset (that include ice thickness measurements and TerraSAR match ups) obtained during the PS131 expedition will provide us opportunities to study various aspects of wave-ice interaction including the ocean wave effects on sea ice melt. We will provide overview of the multi-OMB wave deployment data.

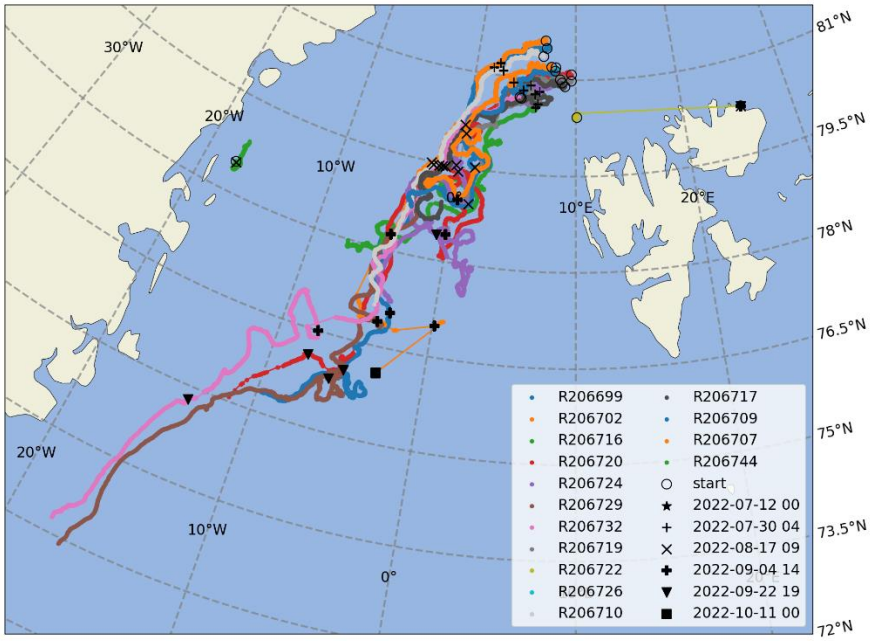

Figure 1. OMB trajectories between 12 Jul and 12 Oct 2022 in the Greenland Sea.

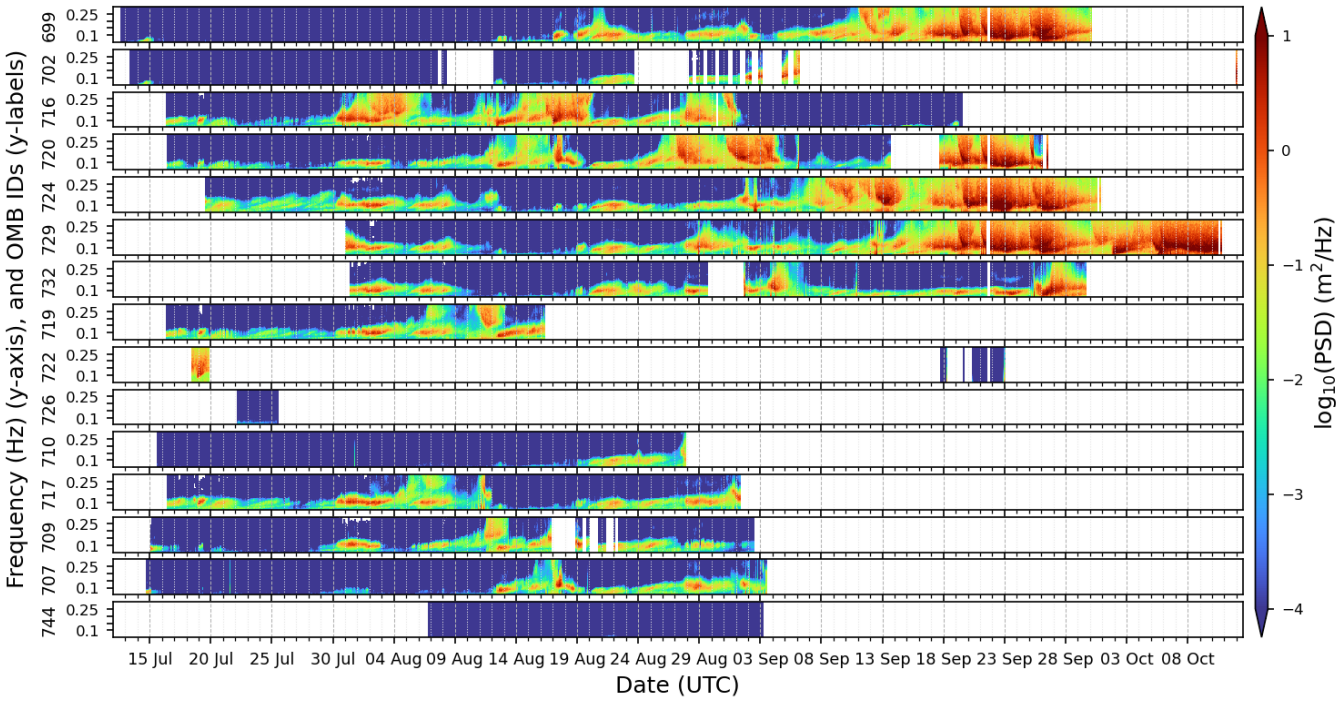

Figure 2. OMB power density spectrogram of surface elevation between 12 Jul and 12 Oct 2022.

Reference

Rabault J., Nose T., Hope G., Müller M., Breivik Ø., Voermans J., Hole L.R., Bohlinger P., Waseda T., Kodaira T., Katsuno T., Johnson M., Sutherland G., Johansson M., Christensen K.H., Garbo A., Jensen A., Gundersen O., Marchenko A., and Babanin A. (2022). OpenMetBuoy-v2021: An Easy-to-Build, Affordable, Customizable, Open-Source Instrument for Oceanographic Measurements of Drift and Waves in Sea Ice and the Open Ocean. Geosciences 12, no. 3: 110. https://doi.org/10.3390/geosciences12030110