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Wave statistics from ship mounted sensors in the marginal ice zone

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Ocean surface waves are known to have a large impact on sea ice. Theoretical aspects of wave-ice interactions have been studied for a century. Field observations are on the other hand more sparse due to the inaccessibility of the regions where sea ice is present, combined with the harsh and dangerous environment. Recent changing conditions in the polar regions have made empirical information of wave propagation and attenuation particularly interesting. Thorough understanding of these phenomena is a necessity in a number of applications, from risk reduction of human activities in the Arctic to climate predictions. To further develop models and theories within this topic, more field data are required. Here we present a methodology for wave measurements in the Marginal Ice Zone (MIZ), which can be incorporated at a low cost on any vessel that is partly stationary.

In this study, single point ocean surface elevation has been measured with ship mounted instruments. The system combines an ultrasonic gauge and a motion correction device. Surface elevation relative to the ship bow is measured with an ultrasonic gauge. An inertial motion unit (IMU) with three-axis accelerometers, gyros and magnetometers, also mounted in the ship bow is used for motion correction, and estimated absolute surface elevation is obtained. Significant wave height, mean period and other integrated parameters, as well as one-dimensional wave spectra are derived from the combined system. The results are compared with wave model data from the same time and place supplied by the Norwegian meteorological institute in order to confirm the reliability of the method.

Wave damping is investigated by looking at change of significant wave height as the ship moves longitudinally through the MIZ within time intervals where the wave field is assumed constant. Data have been gathered from a two week cruise with the oceanic research vessel “Kronprins Haakon” in the Arctic ocean. The ship was mainly located near the polar ice edge in the Barents sea. Wave data have been synchronized with ship parameters such as location and cruising speed retrieved from the ship monitoring system and are only considered valid when the cruising speed is below a threshold.