Review of the paper «Observing sea ice flexural-gravity waves with ground-based radar interferometry» by D.O. Dammann, M. A. Johnson, A.R. Mahoney, and E.R. Fedders

The paper is devoted to the description of the experience to observe waves propagating below floating ice with a Gamma Portable Radar Interferometer (GPRI). GPRI was used in the staring mode. According to the manual "very fast movements of millimetres to meters per second can be observed in this mode. The fast acquisition rate up to 4 kHz and pulse-to-pulse interferograms from a fixed antenna position (staring) can reveal rapid motion and vibrations." Therefore, the use of GPRI for the observations of flexural-gravity waves corresponds to the purpose of the unit. Sampling frequency of 100 Hz during 30 s allowed to reconstruct shape of ice surface deformed by waves along one of two staring directions. The water depth 10 m was measured in the region, and the ice thickness was investigated with EM-31. Wave periods measured with Ice Wave Riders were estimated above 30 s. Therefore, long wave approximation was used, and wave speed was estimated of about 10 m/s.

Sea ice in the region consisted of smooth ice of 1 m thickness in the frozen lead extended along the shore and rough ice around the lead with thickness changing from 0.6 m to several meters. The ice boundaries between the smooth lead ice and rough ice are curved. Length scale over which curvature changes are visible is 3 km. The GPRI was placed on the top of grounded iceberg 6 m above the water level. The iceberg was on the onshore boundary of the lead.

Two events (E1 and E2) of wave motion recorded with GPRI along offshore staring direction are discussed in the paper. In each event the wave speed along the specific direction was calculated by the comparing of wave phases in different points of the staring ray. The direction of wave propagation was calculated using assumption that the projection of measured speed on the direction of wave propagation equals 10 m/s. The GPRI data collected in E1 were interpreted as a record of wave form with amplitude about 0.9 mm propagating onshore with phase speed 10 m/s. Wave period and wavelength were estimated 30 s and 0.3 km. In E2 the GPRI data were compared with the accelerations recorded by two Ice Wave Riders (IWRs) deployed offshore the frozen lead. According to the GPRI and IWR data the period of observed wave motion was 43 s. The IWR data were interpreted as a record of wave form with amplitude about 10 mm propagating onshore with speed 10 m/s. The wavelength was 430 m. The GPRI data showed wave speed 27 m/s along the staring ray and amplitude of wave motion about 1 mm.

The processing of GPI data for the observations of harmonic wave is described in Sections 2.1 and 2.3. The influence of vertical motion of GPRI on the interpretation of harmonic wave records is discussed in the Appendix.

General comments to the paper are as follows.

The paper consists of theoretical part focused on the description of the methods of the data processing and experimental part describing organizing of the field works and obtained results. Performed measurements are new and interesting, but the theory doesn't explain observed features of wave motion. Discussion in the end of the paper is not specific enough. I recommend improving this gap.

Authors discuss that superposition of waves including waves reflected from the iceberg and waves reflected from the lead may influence the GPRI records. In this case wave motion in the region is not reduced to one harmonic wave. Therefore, methods described in Section 2.3 should be adjusted to the situation of wave superposition. Some simple demonstrations of possible effects would be useful to understand if wave superposition may explain the observations.

Incoming long waves may influence iceberg tilts and tilts of the GPRI. It leads to changes of the angle theta in equation (1.2). Analysis of this effect could be useful for the interpretation of the GPRI records.

Most strange result is that in E2 the GPRI records didn't show the wave propagating onshore which was registered with the IWRs. It is possible that incident onshore wave excites natural oscillations of ice in the lead propagating along the lead. But the incident wave should have an input in ice motions in the lead. Theoretical explanation of this result would benefit the paper.

Detailed comments.

Line 170. Reference on Table 2 is given in the text, but Table 2 is not presented in the text.

Line 170. C_0=-10 m/s. If it is speed, then it should be positive. The onshore direction is mentioned in the text.

IWR35 is listed in Table 1, but the information about records of IWR35 is not given in the text.

Line 195. C_0=-27. m/s ?. What means sign - ? The speed is positive/

The paper fits the journal profile and worth the publication after the revision. According to the comments above I recommend major revision.