Classification of ice tremor recorded at Syowa Station in Antarctica

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It was found that tectonic earthquakes and tremors related ice (ice tremor) have been occurred by seismic observations in Antarctica. The ice tremor is the tremor which is originated in collision of sea ice, crack opening and closing, collapse of icebergs and so on (Kanao et al., 2012). However, there are only few reports related to the waveform of ice tremors and seasonality in Antarctica. Purposes of this study are to classify ice tremors based on the feature of their waveforms and to reveal the time variation in the number of generation.
We use the north -south component of the waveform data recorded by STS -1 at Syowa Station. Analysis duration is from January to December in 2014. We made seismic waveform image and spectrogram and counted ice tremors with them. We define here 'ice tremor' as the tremor of which P-wave and S-wave are not clear and duration is longer than 5 minutes.
We found total 231 ice tremors in 2014. Monthly number of ice tremors changed similarily to monthly mean temperature except for from January to March. Monthly cumulative duration of ice tremors changed similarily to monthly mean temperature except for January. The number of ice tremors is low in February, but the cumulative duration is longest. We classified ice tremors into 4 types based on the feature of their spectral time variation. Type A is the ice tremor which duration is long (about ten thousands seconds) and amplitude is small over the waveform. Type B is the one which dominant frequency changes irregularly over the waveform. Type C is the one which dominant frequency continuously decreases and the overtone can be seen. Type D is the one which duration is short (about hundreds) and the amplitude gradually increases and after that gradually decreases.
Microbaroms data are useful tool for characterizing ocean wave climate (Ishihara et al., 2015), so we compared them with seismic data. In summer, both seismic amplitude and microbaroms amplitude is large and the peak of type A is almost same with the peak of microbaroms, so type A is considered to be excited by sea wave. In winter, only the amplitude of microbaroms is large, so ice tremor wave is considered to be not recorded well because of grown coastal ice (Grob et al, 2011). On April in 2006, at Neumayer Stations in Antaectica, an ice tremor was recorded and the source of that is seems to be the iceberg (Eckstaller et al., 2006). The spectral feature of this is similar to which of type C, so type C may be occurred by iceberg.

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