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Evaluation of high frequency ghost cavitation emissions for two different seismic air-gun arrays using numerical modelling

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Sound is deployed by marine mammals for variety of vital purposes such as finding food, communication, echolocation, etc. On the other hand human activities generate underwater noise. One major type of acoustic source is marine seismic acquisition which is carried out to image layers beneath the seabed exploiting reflected acoustic and elastic waves. Air-gun arrays are the most common and efficient marine seismic sources. Field measurements using broad band hydrophones have revealed that acoustic energies emitted by air-gun arrays contains frequencies from a few Hz up to tens of kHz. Frequencies below ∼200 Hz benefit seismic imaging and the rest is normally considered as wasted energy. On the other hand, the high frequency range (above 200 Hz) overlaps with hearing curves of many marine mammals and especially toothed whales and may have an impact on their behavior. A phenomenon called ghost cavitation is recently recognized to be responsible for a major part of these high frequencies (> 5 kHz). Acoustic pressure waves of individual air guns reflected from sea surface can cause the hydrostatic pressure to drop towards zero close to the source array. In these regions there is a high probability for water vapor cavity growth and subsequent collapse. We have simulated ghost cavitation cloud using numerical modelling and the results are validated by comparing with field measurements. The model is used to compare the amount of high frequency noise due to ghost cavitation for two different air gun arrays. Both of the arrays have three subarrays but the array distance for the one with 2730 in3 air volume is 6 meters and for the slightly bigger array (3250 in3 in air volume) the subarrays are separated by 8 meters. Simulation results indicate that the second array, despite larger subarray distance, generates stronger ghost cavitation signal.