

The ambient sound budget of the Bering Sea: Contrasted to other Pacific Ocean locations

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There are many ocean environments where maintaining surface moorings to monitor oceanographic processes is difficult due to severe weather and remote locations. The Bering Sea is one such location. The Bering Sea supports the largest fishery in the US EEZ and is a location where climate change is likely to have a big impact on the ecosystem. To monitor the physical environment, an array of moorings has been established and maintained by NOAA since 1995[1]. However, the surface components of these moorings can not be maintained during the harsh winter. Augmenting these moorings with passive acoustic sensors compliments the suite of measurements of the physical environment, and allows monitoring of surface conditions from sub-surface moorings during all seasons. Furthermore, passive acoustic sensors provide monitoring of sound-producing biological activities, including the detection and identification of important cetacean species [2]. During the summer of 2004 a Passive Aquatic Listener (PAL) was placed at a depth of 60m on mooring M2 (56.87°N, 164.05°) in the Bering Sea. M2 is a long-term mooring deployed in water depth of 72m. During the summer M2 is surface mooring that measures a suite of atmospheric variables including wind velocity. The PAL was deployed to demonstrate the utility of passive acoustic monitoring of the physical environment.

Sound in the ocean provides quantitative information about the marine environment. Sound is produced by physical processes including wind wave breaking and rainfall. Sound is also produced by biological activities, including the communication and hunting calls of many endangered or threatened marine mammals such as humpback, fin, bowhead, right and killer whales, various seals, and some types of fishes. Unique spectral features of each of these sound sources allow them to be acoustically classified. An ambient sound budget [3] describes this partition of the sound and quantifies, for example, the percentage of time that each sound source is dominant and its relatively loudness. Sounds from human activities, including fishing, shipping and other activities are also detected and quantified.

The PAL is a low-duty cycle passive acoustic recorder. It is small, durable, easy to mount on moorings and designed for autonomous deployments of up to one year. It records a time series of spectral data from 1-50 kHz rather than the temporal time series, allowing compression of the acoustic data into manageable data file sizes. They have been deployed at several locations in the Pacific Ocean including the tropical ITCZ, the SE Pacific, the western warm pool, the Gulf of Alaska and coastal waters of Washington State. The sound recorded at M2 was dominated by the sound of wind waves breaking 90% of the time, interspersed with the sound of light rainfall 3% of the time and shipping just 1% of the time. Short transient sounds due to whale calls and mooring self-noise (banging) were also detected. The PAL sampling strategy was designed to reduce the contamination of the data by the mooring self-noise. The sampling strategy can be modified to optimize the detection and quantification of a particular signal, for example, rainfall or killer whale calls.

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