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Editorial: Noise and vibrations in offshore wind farms and their impact on aquatic species

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Editorial on the Research Topic
Noise and vibrations in offshore wind farms and their impact on aquatic species

1 Introduction

Offshore wind energy is environmentally friendly for humans, but it may not be so for aquatic life. Underwater noise and seabed vibrations are generated during the construction, maintenance, operation and decommissioning of offshore wind farms. The potential impact of the generated noise and the seabed vibrations on aquatic species may hinder further deployment of offshore wind farms and marine ranching. Thus, it is of great importance to understand the physics of the generation and propagation of the underwater noise (Reinhall and Dahl, 2011; Lippert et al., 2016; Tsouvalas, 2020; He et al., 2023), the seabed vibrations and their impact on aquatic species during the whole lifetime of a wind farm. Moreover, it becomes urgent to propose marine biological acoustic protection technology (Madsen et al., 2006; Helen et al., 2010; U.S. Offshore Wind Synthesis of Environmental Effects Research, 2022).

The aim of this Research Topic is to discuss the underwater noise and seabed vibrations generated during the construction and operation of offshore wind farms and their potential impact on aquatic species, as well as relevant underwater noise and vibration mitigation strategies. It is hoped that the papers published in this Research Topic will help one to better understand the interactions between offshore wind farms and aquatic species, and to summarise the latest achievements in relevant acoustic mitigation technologies.

2 Vibrations and underwater noise and their impact on aquatic species

In total, nine papers have been published in this Research Topic. The papers are of high quality and cover a wide range of topics related to seafloor vibrations and underwater noise. Southall et al. presented a biologically based framework for assessing the overall risk to marine mammals from human disturbance in defined scenarios. The aim is to provide a simple tool to objectively assess potential biological risk and to identify actionable risk reduction measures. Zhang et al. proposed a semi-analytical solution for the dynamic response of a multilayered seafloor under nonlinear ocean waves. Dahl et al. investigated the vector acoustic properties of underwater noise from pile driving. The well-known Mach wave characteristics are observed in both pressure and particle motion measurements. It provides an experimental reference for the choice of instrumentation for acoustic monitoring of offshore pile driving. The impact of underwater survey noise was studied in detail by Huang et al. From the field data, hammering noise is an impulsive sound with the dominant frequency below 10 kHz, which can cause a high risk of hearing damage to marine mammals. Vibrating and drilling sounds, on the other hand, are periodic sounds that can only cause hearing damage to marine mammals at a distance of about 40 meters. Fang et al. recorded the responses of Indo-Pacific finless porpoises to pile-driving activity at the Jinwan offshore wind farm, China. They found that there was a significant negative correlation between porpoise acoustic activities and pile driving, and that the interval between porpoise acoustic activities during pile driving increased compared to the period without pile driving. Yoon et al. measured underwater noise near a 3 MW wind turbine off the southwest coast of Korea. The underwater noise was found to be highly related to the acceleration of the tower vibration, the wind speed and the rotor speed. The peak level of the underwater noise at a frequency of 198 Hz increased by at least 20 dB at the rated rotor speed. Based on collected field data, Niu et al. analysed the differences between underwater noise from impact pile driving and vibratory pile driving, and the effects of the two types of noise on the large yellow croaker. The range of behavioral disturbance for adult large yellow croaker is predicted to be 4798 m and 1779 m for impact pile driving and vibratory pile driving, respectively. Molenkamp et al. investigated underwater noise and seabed vibrations from vibratory pile driving using pile-soil contact spring elements to account for the influence of pile-soil contact relaxation. It is found that the pile-soil interaction becomes crucial in the case of vibratory pile driving while in the case of impact pile driving this is of secondary importance. Finally, Peng et al. proposed a multi-physics model for modelling underwater pile driving noise mitigation including multiple air-bubble curtains. This multi-physics model can help investigating the water- and ground-borne wave transmission paths in a systematic way. The difference between single air-bubble curtain and double air- bubble curtain is also evaluated. The adopted modelling framework can help the offshore industry to optimize the deployment of the air-bubble curtain systems to achieve maximum noise reduction.

Author contributions

RH: Writing – original draft. AT: Writing – review & editing. XX: Writing – review & editing. LD: Writing – review & editing.

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