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TITLE: Quantitative environmental risk assessments in the context of marine spatial management: current approaches and some perspectives

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ABSTRACT:

Abstract Marine spatial planning (MSP) requires spatially explicit environmental risk assessment (ERA) frameworks with quantitative or probabilistic measures of risk, enabling an evaluation of spatial management scenarios. ERAs comprise the steps of risk identification, risk analysis, and risk evaluation. A review of ERAs in the context of spatial management revealed a synonymous use of the concepts of risk, vulnerability and impact, a need to account for uncertainty and a lack of a clear link between risk analysis and risk evaluation. In a case study, we addressed some of the identified gaps and predicted the risk of changing the current state of benthic disturbance by bottom trawling due to future MSP measures in the German EEZ of the North Sea. We used a quantitative, dynamic, and spatially explicit approach where we combined a Bayesian belief network with GIS to showcase the steps of risk characterization, risk analysis, and risk evaluation. We distinguished 10 benthic communities and 6 international fishing fleets. The risk analysis produced spatially explicit estimates of benthic disturbance, which was computed as a ratio between relative local mortality by benthic trawling and the recovery potential after a trawl event. Results showed great differences in spatial patterns of benthic disturbance when accounting for different environmental impacts of the respective fleets. To illustrate a risk evaluation process, we simulated a spatial shift of the international effort of two beam trawl fleets, which are affected the most by future offshore wind development. The Bayesian belief network (BN) model was able to predict the proportion of the area where benthic disturbance likely increases. In conclusion, MSP processes should embed ERA frameworks which allow for the integration of multiple risk assessments and the quantification of related risks as well as uncertainties at a common spatial scale.

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