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How to inform decision making under uncertainty? Quantifying and evaluating different sources of uncertainty in environmental modelling

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Adaptation to environmental changes requires decision making under uncertainty. Providing forecasts of the potential impact of different management options is a common task for environmental modellers. However, we rarely succeed in conveying uncertainties as relevant information to distinguish management options regarding their expected value and its uncertainty. Quite to the contrary, the reality in the modelling of complex systems under climate change often leads to similar mean values and broad uncertainty bands. Both may irritate users and even lead to indecision and inaction despite an urgent call for action.

In the inter- and transdisciplinary project RUINS (Risk, Uncertainty and Insurance under Climate Change. Coastal Land Management on the German North Sea), we address a region that is sensitive to changes in relative sea level, weather patterns and land-use practices. We develop methods to quantify the uncertainty of adaptation measures through the chain of models for climate, hydrology and landscape management. The aim is to provide tools for the evaluation of forecasted effects of management options, where uncertainty itself is considered an evaluation criterion.

We will present examples to point out pitfalls and potentials of uncertainty quantification in environmental model forecasting for management decision making: (i) we highlight different sources and different kinds of uncertainty with an example of agricultural production; (ii) we address trade-offs between expected wind power production and the security of its provision; moreover, (iii) we highlight the role of temporal data resolution and capacity of drainage structures in the assessment of flood protection during extreme rain events.