QUANTIFICATION OF PARAMETER AND CALIBRATION UNCERTAINTY IN MORPHOLOGICAL MODELLING

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INTRODUCTION
There are different sources of uncertainty in morphological modeling on time scales of years. The standard deterministic modelling approach does not provide any information on the amount of uncertainty contained in a forecast. This lack of information could provide a false sense of accuracy and skill. Quantitative insight in these prediction uncertainties is therefore of crucial importance for decision making in coastal engineering and management.

Recent work has shown that it is possible to transfer various sources of uncertainties (input and model related) to a prediction variable of choice (Kroon et. al., 2017). Long-term observations of climate related input variables (e.g. waves, setup) in combination with simplified model formulations allow for the quantification of the conditional probability of coastal response variables such as sediment loss (input uncertainty). However, the determination of the probability of free model parameter uncertainty and calibration uncertainty is less straightforward.

The goal of this research is to quantify the combined parameter and calibration uncertainty that is contained in a morphological model and propagate this through the model chain to obtain the total prediction uncertainty.

Ruessink (2005) presents a technique to assess parameter uncertainty called Generalised Likelihood Uncertainty Estimation (GLUE). GLUE assigns a model skill based likelihood to certain combinations of free parameter settings. In the present research this approach is extended, thus enabling a complete stochastic assessment of large-scale sandy interventions (Fig. 1).

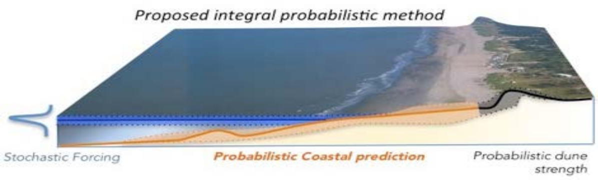

Figure 1 - Integral probabilistic approach in which different sources of uncertainty are propagated through the model chain.

METHODOLOGY
The combined parameter-calibration uncertainty (model uncertainty) is quantified for the modelling of a large-scale nourishment, by means of a multi-period calibration. For multiple hindcast periods the "best" calibration setting will be objectively selected by an appropriate skill criterion. A simple coastline model is used, but the proposed method also suits more advanced (numerical) models.

A large range of model simulations of varying calibration settings and wave statistics is then used to feed the stochastic approach. This results in the prediction uncertainty of the forecast indicator of choice (e.g. sediment loss of a mega-nourishment, Fig. 2).

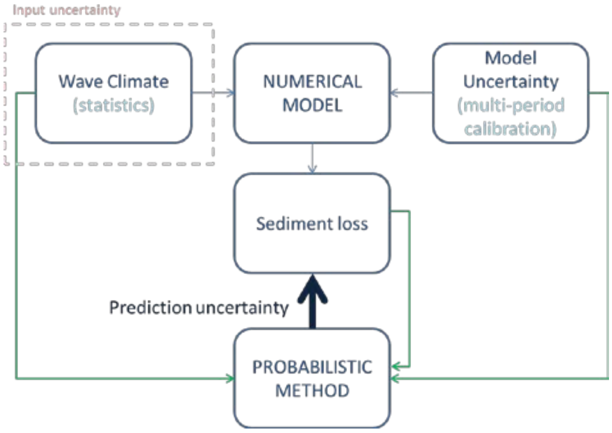

Figure 2 - Schematic overview of estimation of prediction uncertainty. Blue arrows indicate feeds to numerical model, green arrows indicate feeds to probabilistic method. Light blue text indicates method of quantification.

RESULTS
The combined data and multi period calibrated model runs reveal significant variation in model uncertainty and model settings. This uncertainty is found to originate in part from non-linear effects in the model and in forcing dependent calibration settings. The assessment of the different uncertainty sources and the results on the model uncertainty will be presented at the conference. Furthermore, the relative importance of model uncertainty with respect to input uncertainty will be discussed. This research presents a method to quantify prediction uncertainty which will contribute importantly to better-informed decision making in coastal maintenance.

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