RANS MODELLING OF CROSS-SHORE SEDIMENT TRANSPORT AND MORPHODYNAMICS IN THE SWASH-ZONE

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INTRODUCTION
Most numerical studies of sediment transport in the swash zone use depth-averaged models. However, such models still have difficulty predicting transport rates and morphodynamics. Depth-resolving models could give detailed insight in swash processes but have mostly been limited to hydrodynamic predictions. We present a depth-resolving numerical model, based on the Reynolds Averaged Navier-Stokes (RANS) equations, capable of modelling sediment transport and morphodynamics in the swash zone.

MODEL SETUP
The model is based on the model by Jacobsen et al., (2014), i.e. based on OpenFOAM to solve the RANS equations and coupled with a turbulence model. We use the stabilized k-ω model by Larsen and Fuhrman (2018). The air-water interface is modelled using a Volume Of Fluid (VOF) scheme.

Sediment transport is modelled as a combination of bed-load and suspended load (see Jacobsen et al., 2014). For both suspended load and the formulations by Engelund Fredsøe (1976) are used. The bed level changes are calculated by solving the sediment conservation equation.

To validate the model the solitary wave experiments by Young et al (2010) are used. In these experiments a solitary wave of height H=0.6m generates a swash event on a fine-sand beach (D50 = 0.2mm) with a slope of 1:15.

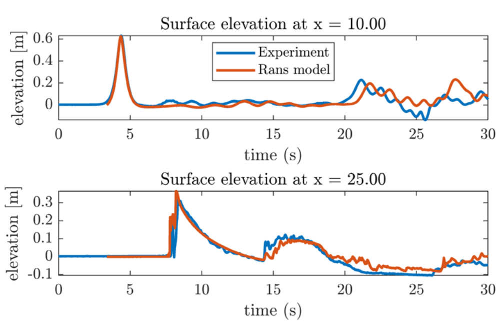

Figure 1 - Comparison between the model and the experiment regarding the surface elevation in a solitary wave swash event at two locations.

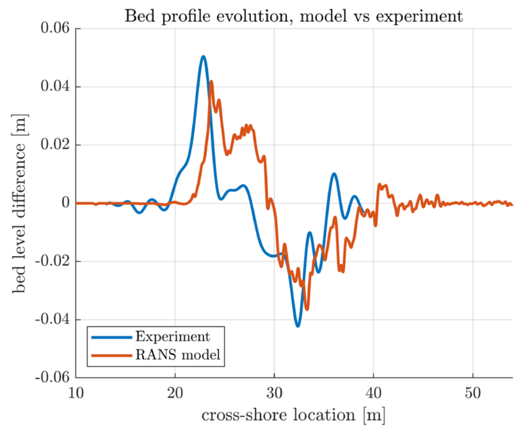

Figure 2 - Comparison between the modelled and the experimental bed level change caused by a solitary wave swash event.

RESULTS
The model can reproduce the surface elevation (figure 1) and the bed profile evolution reasonably well (figure 2). However, the model predicts a profile that is shifted slightly more onshore. Still these results show that this is a promising model for studying sediment transport related processes in the swash zone.

ACKNOWLEDGEMENTS
This work is part of the Shaping The Beach project. Shaping The Beach (2018-2023) is an NWO-TTW funded research project (no. 16130), with in-kind support by Deltares. This work was carried out on the Dutch national e-infrastructure with the support of SURF Cooperative.

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