

Modelling the finite amplitude dynamics of tidal sand waves with SWASH

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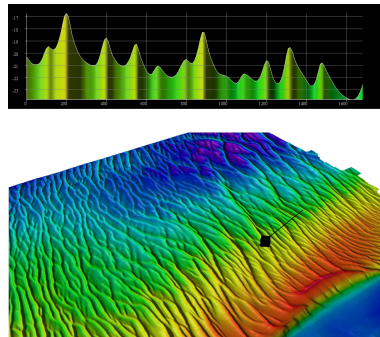
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Sand waves ?

- These bed forms occur in **shallow seas** (30 m)
- **Wavelength** of $\mathcal{O}(100)$ m
- **Amplitude** of a few metres
- Able to **migrate**
- **Perpendicular** to the main tidal current direction



Motivation and aim

Motivation

Employing a stability analysis, [Blondeaux and Vittori, 2011] illustrated the influence of the non-hydrostatic pressure component on the generation of sand waves.



Aim

Analyse of the impact of non-hydrostatic part of the flow field on the finite amplitude dynamics of sand waves.

Approach

Hydrodynamics

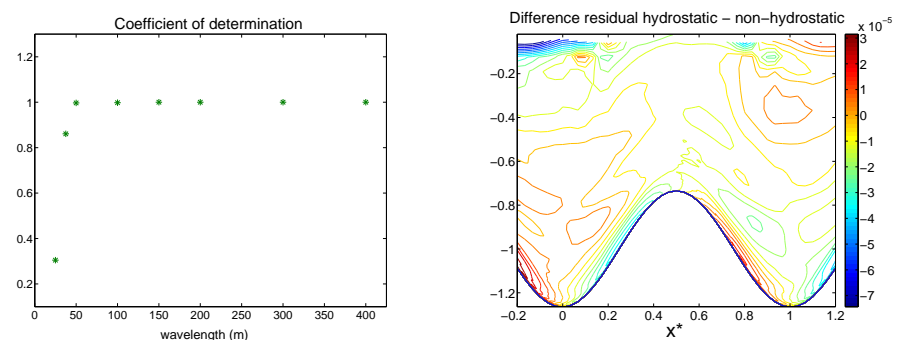
SWASH [Zijlema *et. al*, 2011] :

- OPEN-source, finite difference
- Staggered, orthogonal curvilinear grid
- Non-hydrostatic, with pressure correction technique
- $k - \epsilon$ model
- Tidal wave imposed with additional force in momentum balance

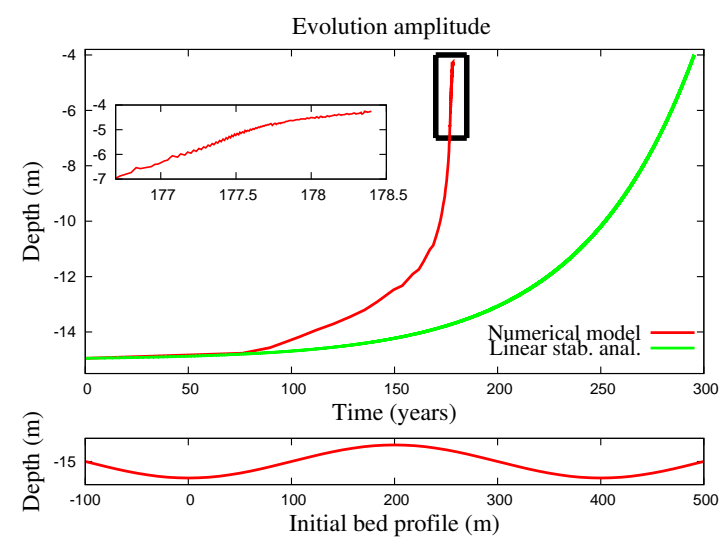
Morphodynamics

- Bottom roughness due to ripples
- Shear stress evaluated with constitutive law
- Bed load transport [Van Rijn, 1991]
- Bed slope transport following van den Berg *et. al* [2012]

Results: Impact non-hydrostatic pressure

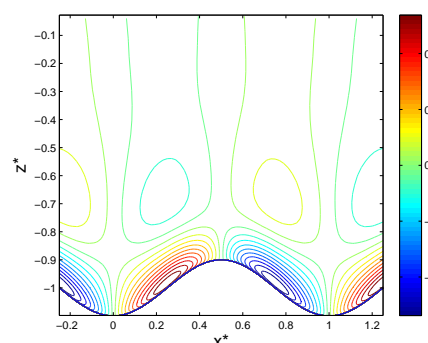


Results: Evolution amplitude



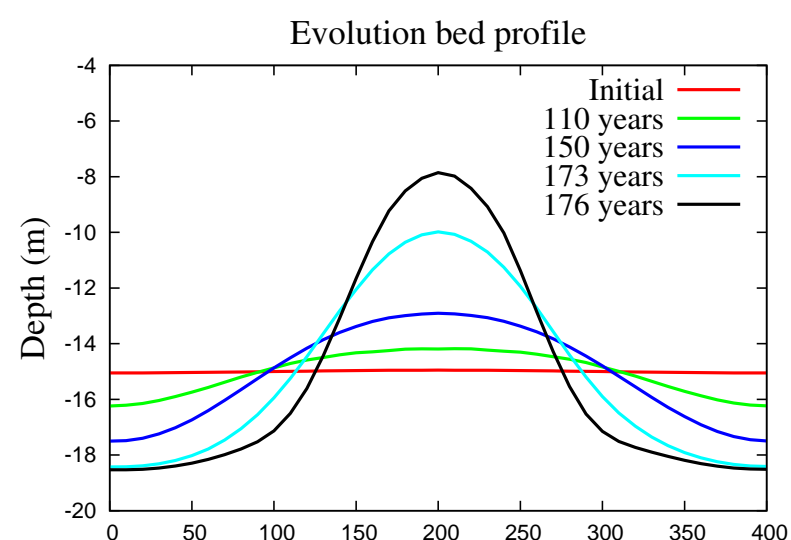
- Initial amplification resembles lin. stab. analyses
- Finite amplitude is characterised by oscillations however.

Results: Flow field



Contourplot of the residual horizontal flow for a sand wave with amplitude of 4 m in a depth H of 20 m and a maximum depth averaged flow velocity of 0.5 ms^{-1} . The dimensionless distance in the horizontal direction x^* and the vertical direction z^* is plotted on the x and z -axes, respectively.

Results: Evolution profile of the bed forms



A flattening of the troughs and a sharpening of the wave crests is found similar to the results of van den Berg and van Damme [2007].

Discussion and conclusions

- Development of morphodynamic model for the finite-amplitude evolution of tidal sand waves based on SWASH is presented.
- Finite amplitude dynamics of the bed forms is not yet well resolved.
- Non-hydrostatic component of the flow field impacts particularly bed forms with small wavelengths, in accordance with results presented by Blondeaux and Vittori [2011].
- Impact of bottom boundary condition!

References

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