Modeling the influence of storms on sand wave formation: a linear stability approach

G.H.P. Campmans, P.C. Roos, H.J. de Vriend, S.J.M.H. Hulscher

www.elsevier.com/locate/csr

PII: S0278-4343(16)30393-4
DOI: http://dx.doi.org/10.1016/j.csr.2017.02.002
Reference: CSR3550

To appear in: *Continental Shelf Research*

Received date: 20 July 2016
Revised date: 25 January 2017
Accepted date: 6 February 2017

Cite this article as: G.H.P. Campmans, P.C. Roos, H.J. de Vriend and S.J.M.H. Hulscher, Modeling the influence of storms on sand wave formation: a linea stability approach, *Continental Shelf Research* http://dx.doi.org/10.1016/j.csr.2017.02.002

Modeling the influence of storms on sand wave **formation**: a linear stability approach

G.H.P. Campmans[a,*], P.C. Roos[a], H.J. de Vriend[a], S.J.M.H. Hulscher[a]

[a] *Water Engineering and Management, PO Box 217, 7500AE Enschede, The Netherlands*

Abstract

We present an idealized process-based morphodynamic model to study the effect of storms on sand wave formation. To this end, we include wind waves, wind-driven flow and, in addition to bed load transport, suspended load sediment transport. A linear stability analysis is applied to systematically study the influence of wave and wind conditions on growth and migration rates of small-amplitude wavy bed undulations. The effects of the wind and waves of various magnitudes and directions are investigated. Waves turn out to decrease the growth rate of sand waves, because their effect on the downhill gravitational transport component is stronger than their growth-enhancing effect. The wind wave effect is strongest for wind waves perpendicular to the tidal current. In the case of a symmetrical tidal current, wind-driven flow tends to breach the symmetry, thus causing sand wave migration. Wind effects on sand wave behavior are strongly influenced by the Coriolis effect, in magnitude as well as direction. **Stirring due to wind waves enhances sand wave migration.** Next to bed load transport, suspended load also has a growing and a decaying mechanism, being the perturbed flow and the perturbed suspended sediment concentration respectively. The decaying mechanism outcompetes the growing mechanism for bed forms with shorter wavelengths**, resulting in an increase in the preferred wavelength**. Wind waves increase the growth rate due to suspended load, but **this** is outcompeted by the reduction in growth rate by wind waves due to bed load transport. We conclude that storms significantly influence sand wave dynamics **in their formation stage.**

Keywords: tidal sand waves, storm effects, wind-driven flow, wind waves, linear stability analysis, morphodynamics