

Contents

1	Introduction	1
1.1	Shoreface-connected sand ridges	1
1.2	Geographical differences: influence of tides	4
1.3	Stability analysis	5
1.4	Previous models	7
1.5	Objectives and outline of the thesis	7
2	Steady model	9
2.1	Model formulation	10
2.1.1	Equations of motion	10
2.1.2	Basic state and stability analysis	11
2.1.3	Scaling and linearized model	13
2.2	Solution procedure	14
2.3	Model Results	15
2.3.1	Basic state and parameter values	15
2.3.2	Linear sediment transport, $m=1$, and linear friction	15
2.3.3	Cubic sediment transport, $m=3$, and nonlinear friction	22
2.3.4	Exploration with respect to m	27
2.4	Physical mechanisms	28
2.4.1	Introductory remarks	28
2.4.2	Transverse bottom slope mechanism	29
2.4.3	Vorticity mechanisms: role of bottom friction and Coriolis	30
2.5	Conclusions	33
3	Tidal model	37
3.1	Governing equations and boundary conditions	38
3.2	Basic state	40
3.3	Linear stability analysis	41
3.4	Results	43
3.4.1	Introductory remarks	43
3.4.2	Storm-dominated shelves: $\beta = 1$	43
3.4.3	Fair weather conditions: $\beta = 0$	48
3.4.4	Probabilistic mode: experiments with varying β	50
3.5	Physical instability mechanisms	55
3.6	Conclusions	59
4	Nonlinear stability analysis	61
4.1	Model	62
4.2	Stability analysis	63
4.2.1	Basic state	63
4.2.2	Perturbed equations	64
4.3	Results	75
4.4	Conclusions	79

5 Overall conclusions and further research	83
5.1 Further research	84
A Weather fluctuations in the forcing	87
B Solution procedure: Steady model	91
B.1 Equations	91
B.2 x -discretization	92
B.3 Discretized equations	93
B.3.1 FOT-problem	93
B.3.2 Bottom evolution equation	94
C Analytical approximation	95
D Sediment transport parametrization	97
E Solution procedure: Tidal model	99
E.1 Equations	99
E.2 Discretization	100
E.2.1 FOT-problem	100
E.2.2 Bottom evolution equation	102
E.3 Galerkin integrals	103
E.3.1 ' I, J, K '-coefficients	103
E.3.2 Auxiliary integrals	105
F Nonlinear tools	107
F.1 Adjoint operator	107
F.2 Nonlinear system	107
F.3 Time integration scheme	109
F.4 $k = 0$ mode	109
Bibliography	111