STOCHASTIC MODELLING OF BEDFORM DIMENSIONS

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Bedform dimensions affect form drag and thus the total hydraulic roughness of the river or sea bed. As this hydraulic roughness influences water levels significantly, it is important to improve insight in the behaviour of bedforms in order to develop adequate predictive models of bedform dimensions. A wide variety of models is able to predict bedform dimensions such as mean dune height and mean dune length. However, bedforms are not periodic features that can easily be described by mean values; in reality, bedforms are three-dimensional and irregular in size, shape and spacing. Such variations in geometry affect the bed roughness and should not be neglected when modelling bedform dimensions. Besides its effect on hydraulic roughness, the variation in bedform dimensions is important for the modelling of vertical sorting of sediment within river dunes and for modelling the effect of sorting on morphodynamic changes of the river bed. Both of these models require a subroutine describing the probability density function (PDF) of dune dimensions. In the present research the variability of bedform dimensions are investigated by analysing four sets of flume experiments. The experiments used different flume size, sediment distribution and flow velocity. In all experiments dunes occurred and the experiments were conducted until an equilibrium phase arose. There was no net aggradation or degradation. For all experimental runs, PDFs of relative dune height or relative trough elevation divided by their mean value are constructed. It appeared that the standard deviation of the height of individual dunes relative to its mean value is within a narrow range for nearly all flume experiments. This appeared to be valid for the relative trough elevation as well. This means that the variation in dune height or trough elevation can be modelled by predicting only the mean dune height or mean trough elevation and simply assuming the standard deviation to be constant. This is interesting when modelling, for instance, the time evolution of the PDF of trough elevations, because then only predictions of the time evolution of the mean trough elevation are needed.
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