The importance of mesoscale bedforms with respect to flow and morphology

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I. Introduction

Most natural rivers tend to meander and show a general large scale point bar-pool topography in the river bends, on which smaller scale 'dune forms' are transported. The flow field shows a highly complex three-dimensional pattern [1], of which a more detailed understanding is required in order to enable river management decisions. This research investigates the effect of migrating dune forms on the flow field and sediment transport in a sharp, open channel, meander bend.

II. Test setup and measuring techniques

A mobile bed experiment was carried out in a laboratory flume representing a 193 degree open channel bend of constant radius of curvature, $R = 1.7$ m and constant width of $B = 1.3$ m, in which quasi-uniform sand ($D_{50} = 1.6 - 2.2$ mm) is placed on the bed with an initially horizontal cross section. During the experiment, velocity profiles and turbulence characteristics were measured at several positions by means of an Acoustic Doppler Velocity Profiler (ADVP) [1], and the bend topography was registered using laser altimetry.

III. Results

Under the influence of the flow, the typical point par and pool topography is developed, on which migrating dunes are superimposed. The experimental dune characteristics and celerity agree very well with those calculated using empirical fomulas [2], indicating the relevance of the experiment. The flow measurements demonstrate a signifact influence of the migrating dunes on the flow field. Near the bed, zones with peak transversal and vertical velocities can be distinguished, as well as a zone of minimal longitudinal velocity at the lee side of the dunes caused by flow seperation at the dune crests. Also, increased bed shear stress and turbulent kinetic energy are clearly associated with the migrating dune forms.

IV. Conclusions

A mobile bed experiment has been carried out, resulting in a typical point bar-pool topography with superimposed migrating dunes. These migrating dune forms cause local changes to the flow field and turbulence, showing the importance of incorporating these dune forms in numerical modelling efforts.

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References

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