Modelling the Formation and Maintenance of Headland Associated Linear Sandbanks

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LONG-TERM GOALS

To investigate, using field and numerical modelling approaches, coastal physical oceanographic and sediment transport processes in estuarine, nearshore and continental shelf regions.

OBJECTIVES

Sandridges or Linear sandbanks are located globally in areas where there are strong currents and an abundance of sand (Pattiaratchi and Collins, 1987). They are present on continental shelves, near coastal regions, in embayments and in estuarine regions. The objectives of this project are to: (1) develop a morphological model will be which allow dominant hydrodynamic and sediment transport processes leading to the formation of headland associated linear sandbanks to be determined; (2) extend the morphological model to include estuary mouth sandridges; (3) determine the importance of surface gravity waves in the formation and location of sandridges; and, (4) apply the model to south Florida mine burial observation site, as well as other areas of course-grained nearshore sediments identified by the Mine Burial Prediction Program for study.

APPROACH

To investigate the hydrodynamic and sediment transport processes responsible for the formation of headland associated linear sandbanks, a morphological model will be developed. The morphological model will include models of hydrodynamic and sediment transport processes coupled through a bottom evolution module based on sediment conservation (de Vriend et al., 1993). In this project, we aim to develop a model that includes the feedback processes between morphology and hydrodynamics to examine the formation of tidal sandbanks.

Model applications

After the construction of the model, several model scenarios will be undertaken as follows: *'Idealised' situation*: idealised headlands (eg a gaussian shape, rectangular headland); *'Real' situation*: This would be similar to the above case, except that the model will be applied to headlands in Shark Bay (off Cape Levillain) and Portland Bill (UK).

WORK COMPLETED

The hydrodynamic model has been applied to two different cases: idealised gaussian headland and Portland Bill (UK). Sediment transport modules have been developed and the morphological model is being constructed.

RESULTS

Gaussian Headland

The hydrodynamic flow past an idealised gaussian headland is shown on Figures 1-3. It is apparent that an eddy is observed only when the tidal currents reverse from the flood to ebb stage of the tide or vice-versa similar to those observed elsewhere (Pattiaratchi et al., 1986; Green, 1998; Pattiaratchi, 1998). During this slack water period, the tidal currents are generally weak (Figure 1). During the mid-flood or mid-ebb stages of the tide, when the currents are strongest (max sediment transport rates) no eddy is formed (Figure 2). Hence, it is unlikely that the 'flow in a tea-cup' analogy is applicable for the formation of sandbanks (Pingree, 1978) although this theory has been generally accepted as the only plausible mechanism for the formation of such sandbanks (Wright, 1995).

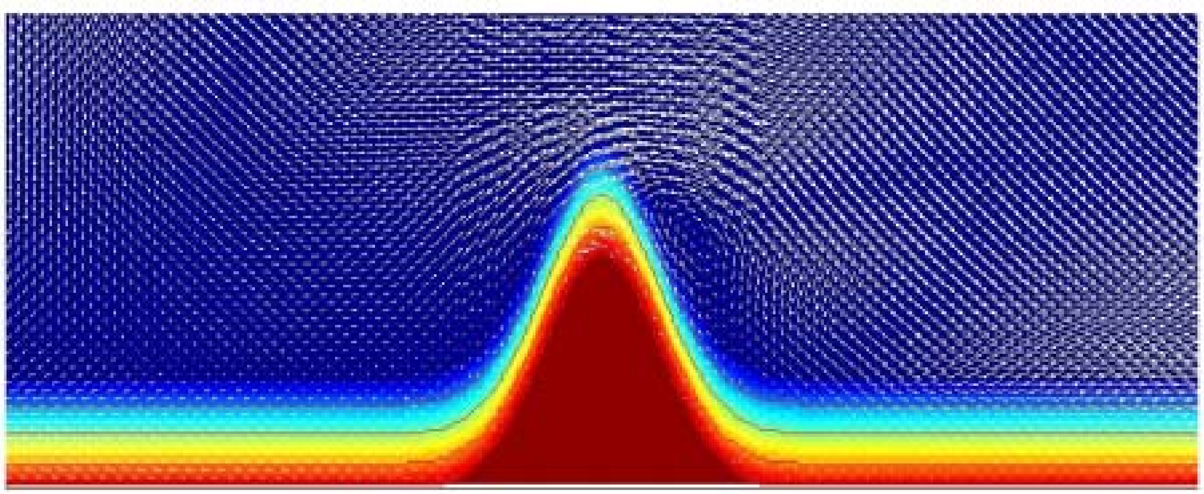

Figure 1. Flow past the gaussian headland at slack water.
[Figure showing eddy on the lee of the gaussian headland at slack water]

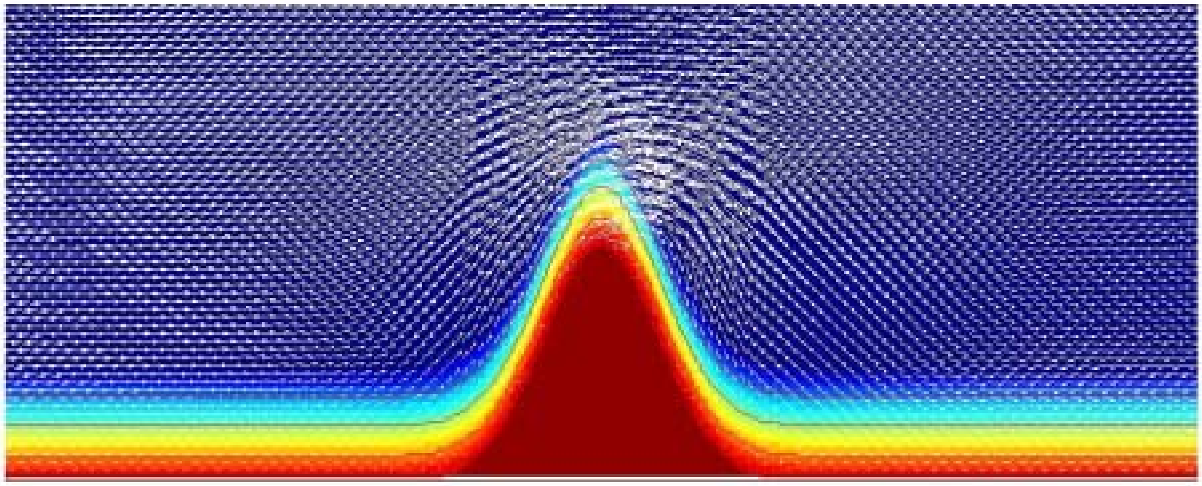

Figure 2. Flow past the gaussian headland under maximum currents.
[Figure showing flow past the gaussian headland under maximum currents, absence of eddy]

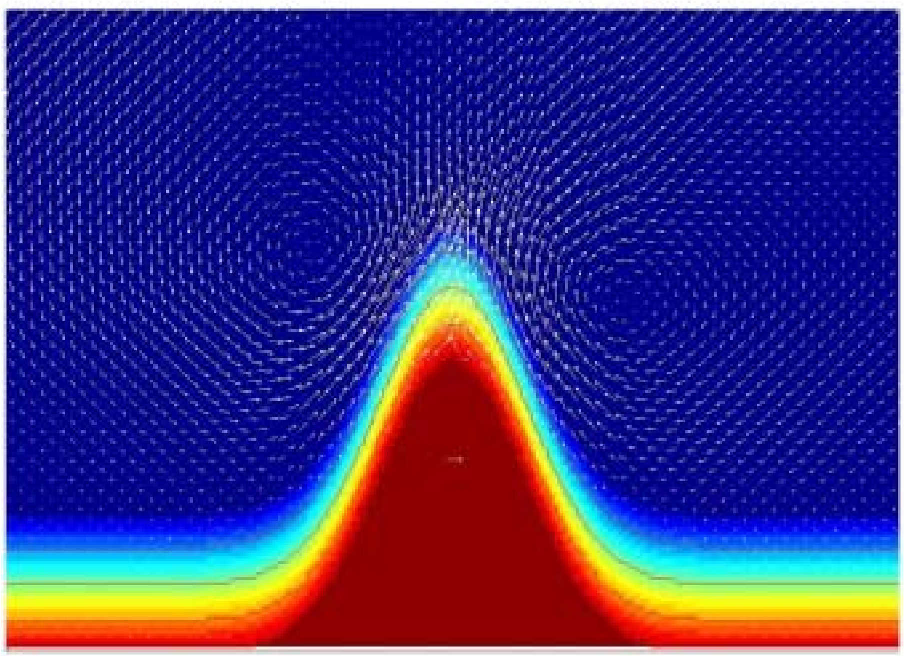

Figure 3. Residual currents in the vicinity of the gaussian headland.
[Figure showing residual currents in the vicinity of the gaussian headland showing two eddies on either side of the headland]

Portland Bill (UK)

Flow past Portland Bill, located on the south coast of England is shown on Figure 4. This is the location of the study at which Pingree (1978) developed his theory for sandbank formation. These results are considered preliminary as no validation studies of the model have been undertaken as yet.

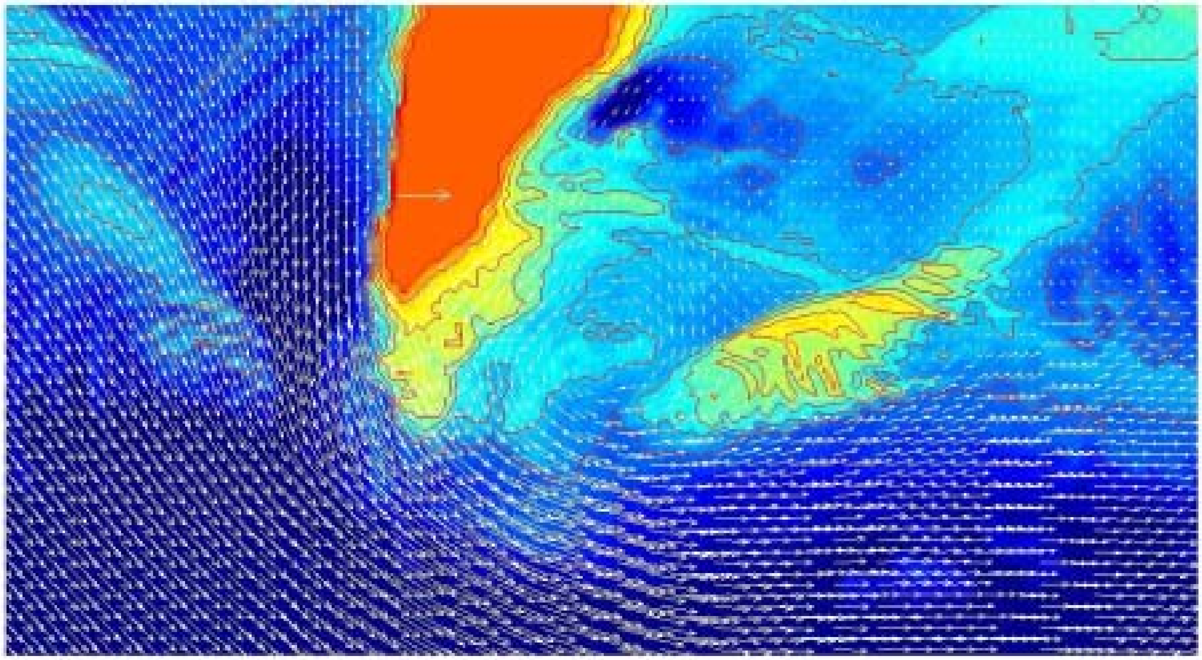

Figure 4. Flow past Portland Bill under maximum flood tidal currents.
[Figure showing tidal currents offshore Portland Bill showing an eddy on the lee side of the headland but not centred on the sandbank.]

IMPACT/APPLICATIONS

Initial results support the initial hypothesis that the 'flow in a tea-cup' analogy is not applicable for the formation of headland associated linear sandbanks. Development of the morphological model will indicate more conclusive results and processes responsible for the formation of these sedimentary features.

TRANSITIONS

The results obtained from this study is very preliminary. We are interacting with the scientific personnel from the Souhampton Oceanography Centre (UK) to validate and exchange information with regard to the Portland Bill application.

RELATED PROJECTS

The coastal oceanography group undertakes fundamental and applied research projects in coastal oceanography, in particular on coastal and estuarine sediment dynamics, nearshore processes and circulation and mixing on the continental shelf. Current and recent projects appear on the University of Western Australia, Centre for Water Research, Coastal Oceanography home page (http://www.cwr.uwa.edu.au/space/CoastalOceanography/index.html). A summary version may also be found at: http://www.ehis.navy.mil/onrnews/butler/metoc-00-01.doc.

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PUBLICATIONS

None

PATENTS

None