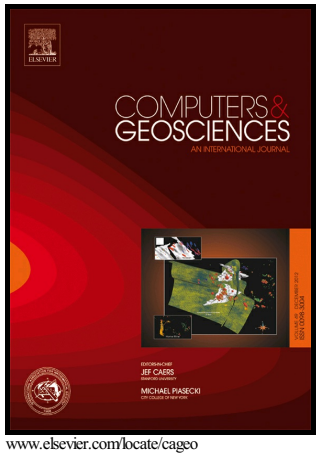
Modelling the interaction of aeolian and fluvial processes with a combined cellular model of sand dunes and river systems

Baoli Liu, Tom J Coulthard



www.elsevier.com/locate/cageo

PII: S0098-3004(16)30850-0
DOI: http://dx.doi.org/10.1016/j.cageo.2017.05.003
Reference: CAGEO3957

To appear in: *Computers and Geosciences*

Received date: 22 December 2016
Revised date: 5 May 2017
Accepted date: 6 May 2017

Cite this article as: Baoli Liu and Tom J Coulthard, Modelling the interaction o aeolian and fluvial processes with a combined cellular model of sand dunes an river systems, *Computers and Geosciences* http://dx.doi.org/10.1016/j.cageo.2017.05.003

Modelling the interaction of aeolian and fluvial processes with a combined cellular model of sand dunes and river systems

Baoli, Liu[1], Tom, J, Coulthard [2, *]

(1) College of the Environment and Ecology, Xiamen University, Xiamen, China

(2) School of Environmental Sciences, University of Hull, Cottingham Road, Hull, HU6 7RX, UK

* Corresponding Author

Abstract

Aeolian and fluvial processes are important agents for shaping the surface of the Earth, but are largely studied in isolation despite there being many locations where both processes are acting together and influencing each other. Using field data to investigate fluvial-aeolian interactions is, however, hampered by our short length of record and low temporal resolution of observations. Here we use numerical modelling to investigate, for the first time, the interplay between aeolian (sand dunes) and fluvial (river channel) processes. This modelling is carried out by combining two existing cellular models of aeolian and fluvial processes that requires considerable consideration of the different process representation and time stepping used. The result is a fully coupled (in time and space) sand dune – river model. Over a thousand-year simulation the model shows how the migration of sand dunes is readily blocked by rivers, yet aeolian processes can push the channel downwind. Over time cyclic channel avulsions develop indicating that aeolian action on fluvial systems may play an important part in governing avulsion frequency, and thus alluvial architecture.

1. Introduction

1.1 Background and rationale

Fluvial and aeolian processes are important for shaping the surface of the Earth and creating a diverse range of landscapes. Traditionally, field and modelling studies have presented research on *only* fluvial *or* aeolian processes, yet there are many areas where both processes interact with each other in contemporary (e.g. Bourke et al., 2009; Li et al., 1999; Smith and Smith, 1984; Tastet and Pontee, 1998) and paleo settings (Langford and Chan, 1989; Mazzullo and Ehrlich, 1983; Song et al., 2006; Veiga et al., 2002). Only a few researchers have examined fluvial and aeolian interactions, but their studies show a range of interesting interplays and feedbacks between the processes. For example, rivers can act as barriers to sand dunes – stopping their progression - as shown by the Colorado River acting to block the transport of sand from the Mojave Desert (Muhs et al., 2003; Sweet et al., 1988). Conversely, sand dunes can deflect and confine rivers, and in turn define their