Modelling the retreat of a coastal transverse dune under changing wind conditions

Sylvain Gabarrou, Gonéri Le Cozannet, Eric J. R. Parteli, Rodrigo Pedreros, Etienne Guerber, Bastien Millescamps, Carlos Oliveros, Cyrill Mallet

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Gabarrou S [1], Le Cozannet G [1], Parteli E J R [3], Pedreros R [4], Guerber E [5], Millescamps B [6], Oliveros C [7], Mallet C [8]

[1] BRGM, French Geological Survey, 3 avenue C. Guillemin, 45000 Orléans, France, g.lecozannet@brgm.fr

[3] Institute for Multiscale Simulation, University of Erlangen-Nuremberg, Nägelsbachstraße 49b, 91052 Erlangen, Germany, ericparteli@googlemail.com

[4] BRGM, French Geological Survey, 3 avenue C. Guillemin, 45000 Orléans, France, r.pedreros@brgm.fr

[5] BRGM, French Geological Survey, 24 avenue Léonard de Vinci, 33600 Pessac, France.

[6] BRGM, French Geological Survey, 24 avenue Léonard de Vinci, 33600 Pessac, France, c.mallet@brgm.fr

ABSTRACT

Coastal dunes can move in response to winds and cause serious hazard to human assets. Changes in wind patterns, potentially occurring as a consequence of climate change or variability, could affect rates of aeolian transport and migration velocity of coastal dunes. Understanding the response of coastal dune mobility to changes in transport conditions is a fundamental aspect of coastal zones management. However, most of previous modeling studies were conducted by assuming that aeolian bedforms are subject to a constant wind velocity. In the present work, we perform a modeling study of the mobility of a coastal transverse dune under varying wind velocities based on the example of the Dune du Pilat in Aquitaine. We apply well-established models and empirical formula for aeolian dune migration, including a model previously validated against measurements of real profiles of desert and coastal dunes. The average migration velocity of Pilat dune predicted by the models is about 3m/year, which is in good agreement with in-situ measurements of the dune retreat rates. To test the response of transverse dune mobility to changing winds and the impact of extreme events on dune migration rates, we generate virtual, but still realistic wind time series using a stochastic model. The approach consists in modifying a few parameters of the stochastic model, in order to generate virtual time series with different characteristics than today. The results suggest that more frequent storms have less impacts than more intense winds, but also that both lead to moderate changes in the average dune velocity in

the case study presented here. Our study shows that the approach of combining a stochastic model for winds with a morphodynamic dune model can provide valuable insight into how aeolian bedforms respond to changes in flow conditions potentially caused by climate change.