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► To cite this version:

Sylvain Gabarrou, Gonéri Le Cozannet, Eric J. R. Parteli, Rodrigo Pedreros, Etienne Guerber, et al.. Modelling the retreat of a coastal transverse dune under changing wind conditions. International Coastal Symposium (ICS2018), May 2018, Busan, South Korea. hal-01689393

HAL Id: hal-01689393 https://brgm.hal.science/hal-01689393

Submitted on 22 Jan 2018 $\,$

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

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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.