TWO MODES FOR DUNE ORIENTATION ON MARS. L. Fernandez-Cascales[1], A. Lucas[2], S. Rodriguez[2], C. Narteau[1], P. Allemand[3], A. Spiga[4], S. Courrech du Pont[5], A. Garcia[2]. [1]Institut de Physique du Globe de Paris, Sorbonne Paris Cité, University Paris Diderot, UMR 7154 CNRS, Paris, France, [2] Laboratoire AIM - Université Paris 7, Planetology, Gif/Yvette, France, [4] LMD IPSL, Paris, France, [3] Laboratoire Sciences de la Terre, UMR 5570, CNRS Université Claude Bernard Lyon 1, Lyon, France, [4] LMD IPSL, Paris, France, [5] Laboratoire Matière et Systèmes Complexes, Sorbonne Paris Cité, Université Paris Diderot, CNRS UMR 7057, Paris, France.

Introduction: Recent numerical simulations [1], laboratory experiments [2], and field measurements [2-4] show that, under the same multidirectional wind regime, dune crests can have two different orientations depending on sediment availability. In zones of high sand availability (i.e., mobilizable sediment in the inter-dune areas), dunes can grow in height following the orientation for which the sum of the normal to crest components of transport is maximum [5], henceforth referred to as the *"bed instability mode"*. In zones of low sand availability (i.e., non-mobilizable bed in the inter-dune areas), dunes elongate in the direction of the resultant sand flux by deposition of the sediment which is transported along the crest, henceforth referred to as the *"fingering mode"*. Thus, sediment availability is a key parameter that selects the dune growth mechanism and controls the subsequent dune orientation.

From wind data to dune orientation and vice-versa: A more complete forward model to predict dune orientation from the winds has been developed by [2], now taking into account the two growth mechanisms. This may significantly refines the inverse method commonly used to derive wind regime from dune orientation.

The direct model has been used in terrestrial deserts and has shown an excellent ability for predicting dune orientation for a great variety of environmental conditions [2,9]. We recently considered these two modes on other planetary bodies where dune fields have been observed. On Titan, the fingering mode coupled with the predictions of Global Circulation Models has proven to be the only one able to reconcile all the observations and conjointly explain the actual shape, orientation, direction of propagation and equatorial confinement of the dunes [8].

Exploring the two modes for dune orientation on Mars: Our aim is now to test the occurrence of both dune growth mechanisms on Mars, selecting regions where the bed instability and fingering modes seem to be explicitly expressed. First, dune orientations are extracted from CTX images using an automatic linear segment detection method (Figures 1 and 2). Second, dune orientation are derived from Martian General Circulation Models (GCM), which have been developed using different climatic scenarios. Then, we can directly compare the prediction of the models to the orientation measured from the satellite images to distinguish among the different climatic scenarios. In addition, looking at the inverse problem and assuming a limited number of dominant winds, we can try to reconstruct the family of wind regimes that can satisfy such observations. So we hope to contribute to the improvement of the GCM and provide new constraints on the past winds regimes.

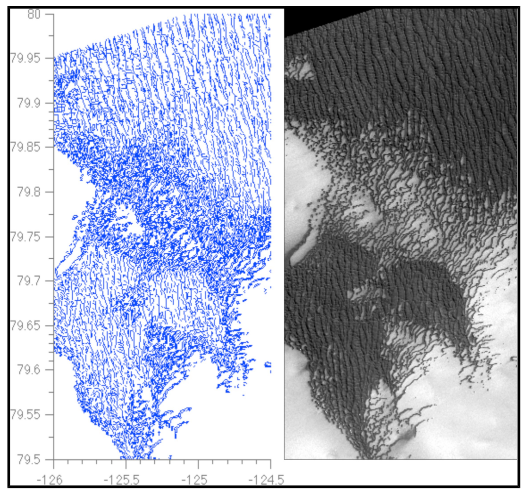

***Figure 1** : Crest orientation (left) obtained from linear segment detection method (see [8]) applied on a CTX image (right).*

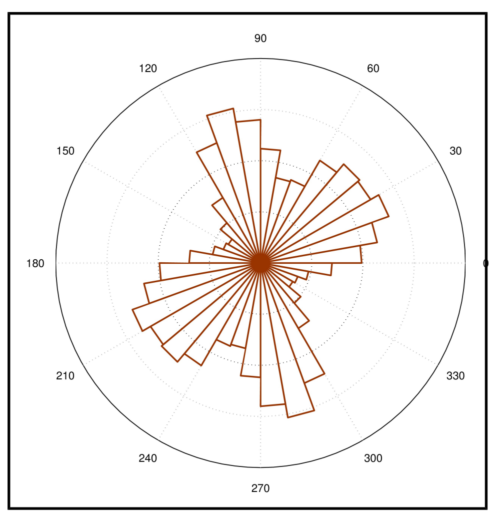

Figure 2 *: Crest orientation distribution from linear segment detection method (see Figure 1 and [8]). More tham 3.410^{4} segments are obtained. Two orientations are detected: i) 28º and -75º from East.*

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