Geophysical Research Abstracts
Vol. 12, EGU2010-5329-2, 2010
EGU General Assembly 2010

Morphogenesis and dynamics of transverse and longitudinal dunes

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In deserts where winds blow successively in two different directions, dunes are found to be linear ridges whose trend depends on the winds transport capacity and the angle between the two wind directions. When the two winds have comparable magnitude and period, dunes are either perpendicular (transverse dunes) or parallel (longitudinal dunes) to the average sand transport direction. Besides their different domain of existence, respectively for small and large angle between winds, transverse and longitudinal dunes are morphologically different: while longitudinal dunes are coherent and extend on tens of kilometers, transverse dunes are sinuous and often look like barchanoid ridges. We reproduce these structures experimentally and underwater, so that their space and time scales are reduced by a factor of one thousand. Thanks to these controlled experiments, and to numerical simulations, we reveal the physical mechanisms at play in the formation, selection, and long-time evolution of these dunes.