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Eastward elongation of Titan's dunes by transient westerlies during the passage of the intertropical convergence zone

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Numerous linear dunes with eastward streamline pattern exist on Saturn's moon Titan, particularly in the equatorial region. They have mostly been interpreted as evidence of predominantly westerly (eastward) tropical surface winds, but such winds are meteorologically hard to understand considering the angular momentum balance. This study addresses the subtle relationship between the surface wind direction and dune orientation on Titan by calculating relevant dune orientation parameters using the output of a general circulation model. In Titan's equatorial region the surface wind is dominated by the cross-equatorial meridional wind of the global Hadley circulation with superposed steady weak easterlies. The meridional wind reverses seasonally and form linear dunes along the circles of latitude. This wind system by itself cannot cause an eastward orientation of dunes. However, near the equinoxes when the Hadley circulation reverses, westerly winds temporarily appear during the brief equatorial passage of the intertropical convergence zone (ITCZ). These westerlies are turbulent and stronger than the persistent easterlies in other seasons. The eastward streamline pattern of Titan's linear dunes may have been shaped by eastward elongation of dunes by these occasional strong westerlies near equinoxes. The global migration of the ITCZ from south pole to north pole and vice versa is a result of Titan's slow rotation and Saturn's large obliquity.

Keywords: Titan, meteorology, dunes