EPSC Abstracts
Vol. 8, EPSC2013-85, 2013
European Planetary Science Congress 2013

Looking for Mega-Yardangs on Titan: A Comparative Planetology Approach

Ph. Paillou (1), J. Radebaugh (2)
(1) Université de Bordeaux, UMR 5804, LAB, Floirac, France (paillou@obs.u-bordeaux1.fr), (2) Department of Geological Sciences, Brigham Young University, Provo, USA

Abstract

We perform a comparative study of the radar signature of linear dunes and mega-yardangs on Earth, in order to be able to discriminate the two structures on the surface the Titan.

Introduction

The Cassini-Huygens mission has been studying the Saturn system since 2004. The Ku-band (13.8 GHz) Radar instrument onboard the Cassini spacecraft is a combined altimeter / scatterometer / imaging radar that has enabled study of the surface of Titan, the largest moon of Saturn, through its optically-opaque atmosphere [1]. This instrument has revealed the richness of the surface of Titan, as seas, lakes, rivers, cryo-volcanic flows and dunes have been discovered. Linear dunes are a major geomorphological feature present on the surface of Titan, since they cover more than 10 million km^2, mainly in equatorial regions [2]. However, the resolution of the Cassini Radar instrument (around 300m at the closest point of the flyby) is not good enough to allow a detailed study of the morphology of Titan's dunes. In particular, it does not allow discrimination between dunes and mega-yardangs. The latter are wind-abraded ridges formed in cohesive rocks [3] and are likely to have a radar signature similar to the one of linear dunes.

Terrestrial Analogs

We are conducting a comparative study of the geometrical radar response of both linear dunes and mega-yardangs, based on two representative terrestrial test sites: the linear dunes of the Great Sand Sea in western Egypt and the mega-yardangs of the Lut Desert in eastern Iran (cf. Figure 1).

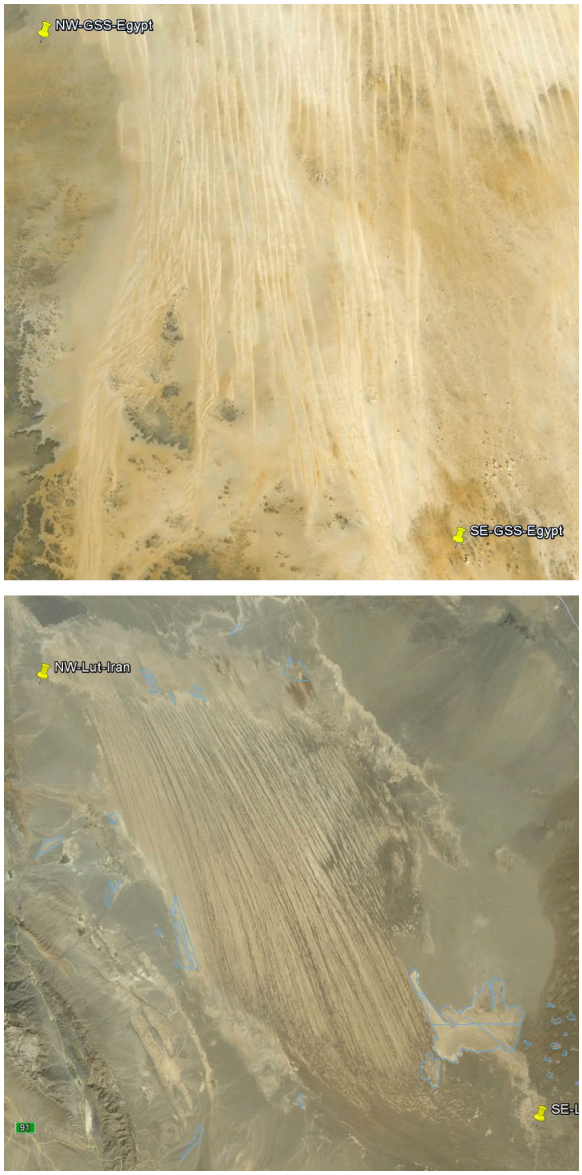

Figure 1: Linear dunes of the Great Sand Sea – Egypt (top) and mega-yardangs of the Lut Desert – Iran (bottom). Each image covers 150x150km.

We modeled the radar response of the linear dunes of the Great Sand Sea in Egypt, using a single surface scattering term whose parameters were estimated from X-SAR (9.6 GHz) scenes [4]. These results are input into a geometrical model that allows generation of simulated Synthetic Aperture Radar (SAR) images from the topography information provided by SRTM data [4]. Figure 2 shows simulated SAR images of linear dunes and mega-yardangs: both structures present a similar radar signature in general, that of alternating parallel dark and bright lines.

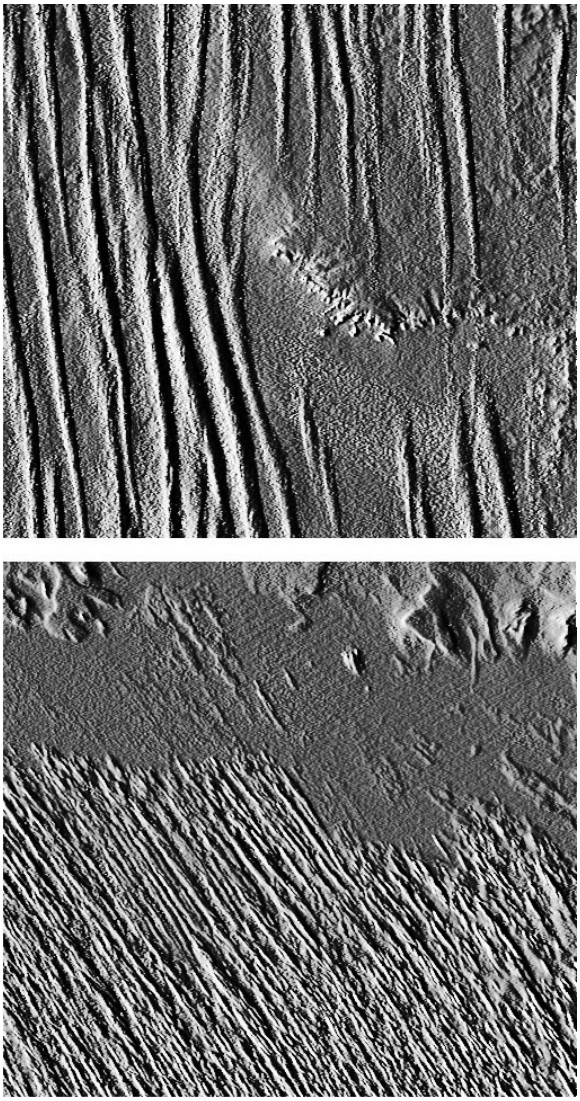

Figure 2: Simulated SAR images of linear dunes (top) and mega-yardang (bottom) structures. Scenes cover 50x50km.

However, variations seen in the radar response of dunes are the result of gentle undulations, or sinuosity, in the linear dune form, while for mega-yardangs these variations are the result of tapering and widening of the yardang form, while overall straightness is strongly preserved.

Mega-Yardangs on Titan ?

We shall combine our modeling approach to the analysis of high resolution (5m) TerraSAR-X [6] imagery of both terrestrial sites, in order to derive a radiometric discrimination between the radar signature of linear dunes and mega-yardangs. The results will be applied to the study of potential mega-yardangs locations on Titan, which were possibly wrongly classified as linear dunes. Some linear forms on Titan have been observed to lack sinuosity, making them good candidate mega-yardangs (cf. Figure 3). If mega-yardangs are identified on Titan, this would have consequences for our understanding of soil erosion and climatic processes for this satellite.

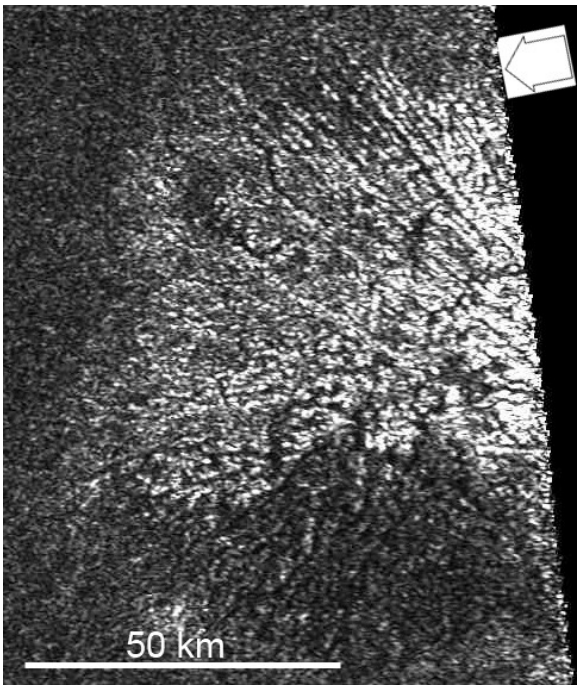

Figure 3. Linear features bearing morphologies more like mega-yardangs than dunes on Titan, located 41N-210W (from T64 acquisition, Dec. 2009).

References

[1] Elachi C., et al., “Cassini Radar views the surface of Titan”, *Science*, vol. 308, pp. 970–974, 2005.

[2] Lorenz R.D., et al., “The sand seas of Titan: Cassini Radar observations of longitudinal dunes”, *Science*, vol. 312, pp. 724-727, 2006.

[3] Goudie A.S., “Mega-yardangs: A global analysis”, *Geography Compass*, vol. 1, pp. 65-81, 2007.

[4] Paillou Ph., D. Bernard, J. Radebaugh, R. Lorenz, A. Le Gall, T. Farr, “Modeling the SAR Backscatter of Linear Dunes on Earth and Titan”, *Icarus*, 2013, in press.

[5] Paillou Ph., Y. Lasne, E. Heggy, J.-M. Malézieux, “A study of P-band SAR applicability and performance for Mars exploration: Imaging subsurface geology and detecting shallow moisture”, *Journal of Geophysical Research*, vol. 111, E06S11, 2006.

[6] http://terrasar-x.dlr.de/