

Plastic, 'wrong-way' dunes arise on Saturn moon Titan

May 16 2014, by Blaine Friedlander



Thanks to the orbital eccentricities of Saturn and its moon Titan, the equatorial dunes - made of sandlike plastic - appear to be going the wrong way.

(Phys.org) —The dunes of Titan tell cosmic tales. A Cornell senior and researchers have narrowed theories on why the hydrocarbon dunes – think plastic – on Saturn's largest moon are oriented in an unexpected direction, a solar system eccentricity that has puzzled space scientists.

Physics major George McDonald '14, who graduates May 25, attributes

the oddball orientation of the [dunes](#) to long timescale changes in Saturn's and Titan's orbit around the sun, similar to the changes that cause ice ages on Earth.

On Earth, silica forms fine sand. On Titan, sandlike dunes form from hydrocarbon grain particulate – essentially a plastic version of Earth's sand. Planetary scientists expected the dunes to respond to easterly winds. Instead, they observed via images from NASA's Cassini mission to Saturn that the equatorial dunes appear to move in the "wrong" direction – from west to east.

"I studied whether changes in Titan's climate – due to orbital variations over a 45,000-year timescale – could affect the orientations of the dunes at the equator. The results suggest that they could," McDonald said.

"This could help to explain why the current dune orientations don't seem to match what we'd expect, given the modern wind circulation found today."

McDonald presented this work, "Examining Effects of Orbital Forcing on Titan's Dune Orientations," at the Lunar and Planetary Science Conference in Houston in March.

Long before McDonald studied the wrong-way dune images from Cassini, scientists Ryan Ewing, assistant professor of earth science at Texas A&M, and Alex Hayes, Cornell assistant professor of astronomy, collaborated and theorized that the dunes were shaped by winds that change because of orbital forcing. Ewing and Hayes mentored McDonald in his research.

McDonald analyzed Cassini radar images, which use microwaves instead of light. The radar imager pierces the murky moon's atmosphere, unveiling its strikingly familiar geologic surface features.

Titan's geologic features possess down-to-Earth familiarity. The moon's thick atmosphere is in a perpetual state of organic smog, while wind and methane rain carve dunes, rivers, lakes and seas into its cold surface. NASA scientists believe Titan can provide insight into the processes that drive Earth's climate and surface.

Like a tethered child, Titan accompanies Saturn in orbit. The ringed planet's own 29.5-year orbit around the sun is slightly eccentric, as summer in Titan's southern hemisphere occurs when Saturn (and Titan) are closest to the sun. This makes southern summer warmer and faster, when compared to northern ones.

Like Earth, these orbital conditions change with time. Thirty-five thousand years ago, for example, Titan's northern summers were hotter. These variations – called Croll-Milankovitch cycles on this planet – drive Earth's ice ages.

McDonald completed an exhaustive analysis using climate models from additional collaborators to examine dune orientation for the past 45,000 years. On Earth, giant dunes can take thousands of years to reorient to changing wind conditions. The slow wind speeds on Titan suggest that timescales for its dunes are even longer.

"This has brought us to the point of believing that these long-term orbital changes could indeed be affecting the dunes," he said.

This fall, McDonald will pursue his doctoral degree in planetary science at the Georgia Institute of Technology.

Provided by Cornell University

Citation: Plastic, 'wrong-way' dunes arise on Saturn moon Titan (2014, May 16) retrieved 6 May

2024 from <https://phys.org/news/2014-05-plastic-wrong-way-dunes-saturn-moon.html>

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