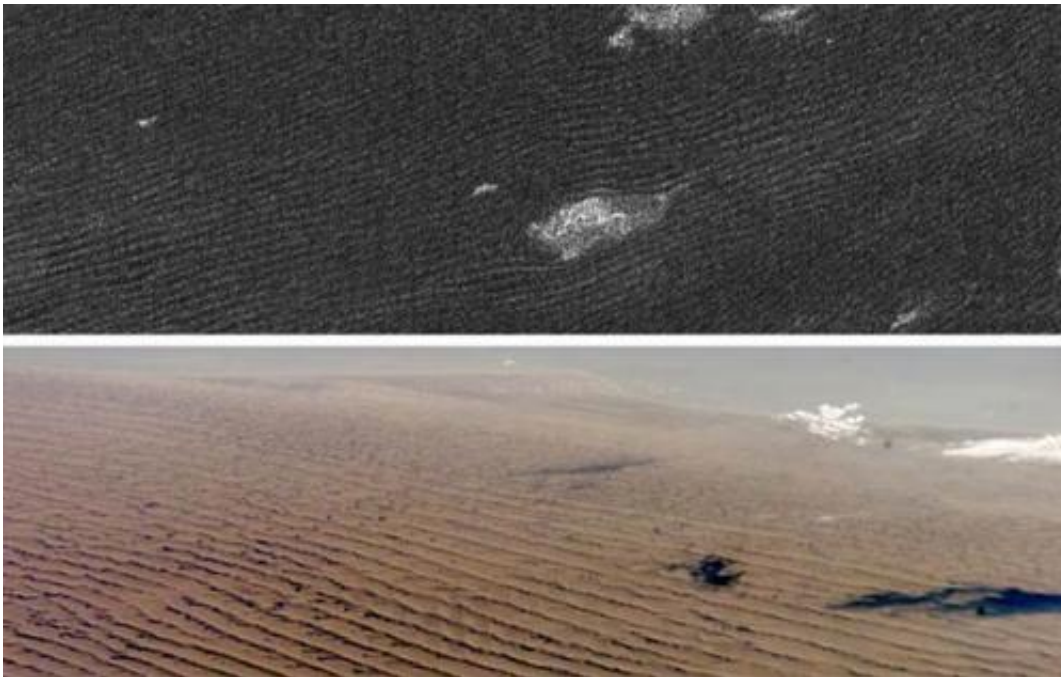


# Study offers explanation for Titan dune puzzle

December 8 2014

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Cassini radar sees sand dunes on Saturn's giant moon Titan (upper photo) that are sculpted like Namibian sand dunes on Earth (lower photo). The bright features in the upper radar photo are not clouds but topographic features among the dunes.  
Credit: NASA

Titan, Saturn's largest moon, is a peculiar place. Unlike any other moon, it has a dense atmosphere. It has rivers and lakes made up of components of natural gas, such as ethane and methane. It also has windswept dunes that are hundreds of yards high, more than a mile wide and hundreds of

miles long—despite data suggesting the body to have only light breezes.

Research led by Devon Burr, an associate professor in the Earth and Planetary Sciences Department at the University of Tennessee, Knoxville, shows that winds on Titan must blow faster than previously thought to move sand. The discovery may explain how the dunes were formed.

The findings are published in the current edition of the academic journal *Nature*.

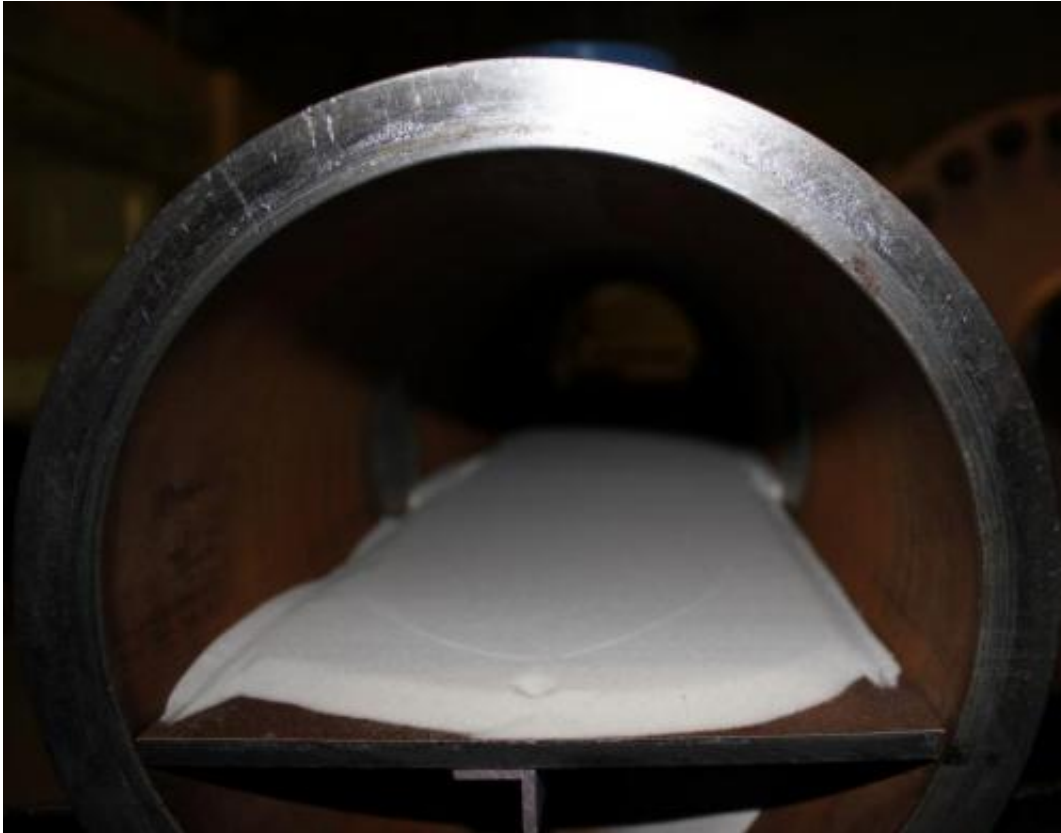
A decade ago, Burr and other scientists were amazed by the Cassini spacecraft's pictures of Titan that showed never-before-seen dunes created by particles not previously known to have existed.

"It was surprising that Titan had particles the size of grains of sand—we still don't understand their source—and that it had winds strong enough to move them," said Burr. "Before seeing the images, we thought the winds were likely too light to accomplish this movement."

The biggest mystery, however, was the shape of the dunes. The Cassini data showed that the predominant winds that shaped the dunes blew from east to west. However, the streamlined appearance of the dunes around obstacles like mountains and craters indicated they were created by winds moving in exactly the opposite direction.

To get to the bottom of this conundrum, Burr dedicated six years to refurbishing a defunct NASA high-pressure [wind tunnel](#) to recreate Titan's surface conditions. She and her team then turned up the tunnel's pressure to simulate Titan's dense atmosphere, turned on the wind tunnel fan, and studied how the experimental sand behaved. Because of uncertainties in the properties of sand on Titan, they used 23 different varieties of sand in the wind tunnel to capture the possible sand behavior

on Titan.

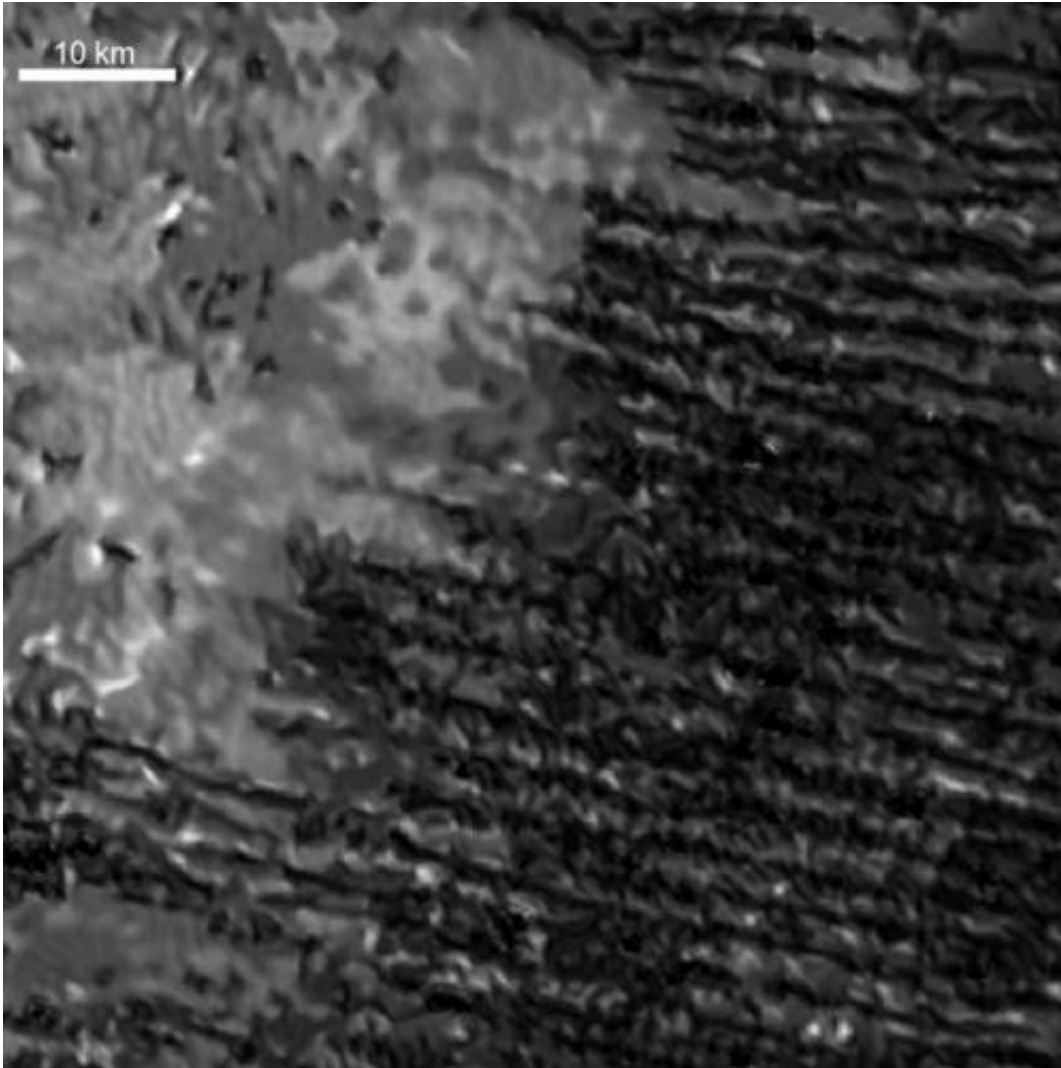


Sediment inside the Titan wind tunnel for testing. Credit: University of Tennessee

After two years of many models and recalibrations, the team discovered that the minimum wind on Titan has to be about 50 percent faster than previously thought to move the sand.

"Our models started with previous wind speed models but we had to keep tweaking them to match the wind tunnel data," said Burr. "We discovered that movement of sand on Titan's surface needed a wind speed that was higher than what previous models suggested."

The reason for the needed tweaking was the dense atmosphere. So this finding also validates the use of the older models for bodies with thin atmospheres, like comets and asteroids.



Degraded sand dune patterns seen in this radar image taken by the Cassini spacecraft show evidence of shifting winds on Titan. Credit: Cornell/Laboratoire AIM Paris-Diderot

The discovery of the higher threshold wind offers an explanation for the

shape of the dunes, too.

"If the predominant winds are light and blow east to west, then they are not strong enough to move sand," said Burr. "But a rare event may cause the winds to reverse momentarily and strengthen."



The high-pressure wind tunnel at Arizona State University's Planetary Aeolian Laboratory was originally built to simulate winds at the surface of Venus, where atmospheric pressures are about 90 times greater than on Earth. After modifications, it became the Titan Wind Tunnel, with researchers using it to determine how fast winds on Titan need to blow to start dune particles moving. Other wind tunnels and chambers at the laboratory let scientists simulate conditions on Earth and Mars. Credit: Devon Burr

According to atmospheric models, the wind reverses twice during a Saturn year which is equal to about 30 Earth years. This reversal happens

when the sun crosses over the equator, causing the atmosphere—and subsequently the winds—to shift. Burr theorizes that it is only during this brief time of fast winds blowing from the west that the [dunes](#) are shaped.

"The high [wind speed](#) might have gone undetected by Cassini because it happens so infrequently."

**More information:** — *Nature* paper: [dx.doi.org/10.1038/nature14088](https://doi.org/10.1038/nature14088)

— Related *Nature Geoscience* paper: [dx.doi.org/10.1038/ngeo2323](https://doi.org/10.1038/ngeo2323)

Provided by University of Tennessee at Knoxville

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