Daily News epaper

Saturn's moon Titan has a surprisingly Earth-like landscape

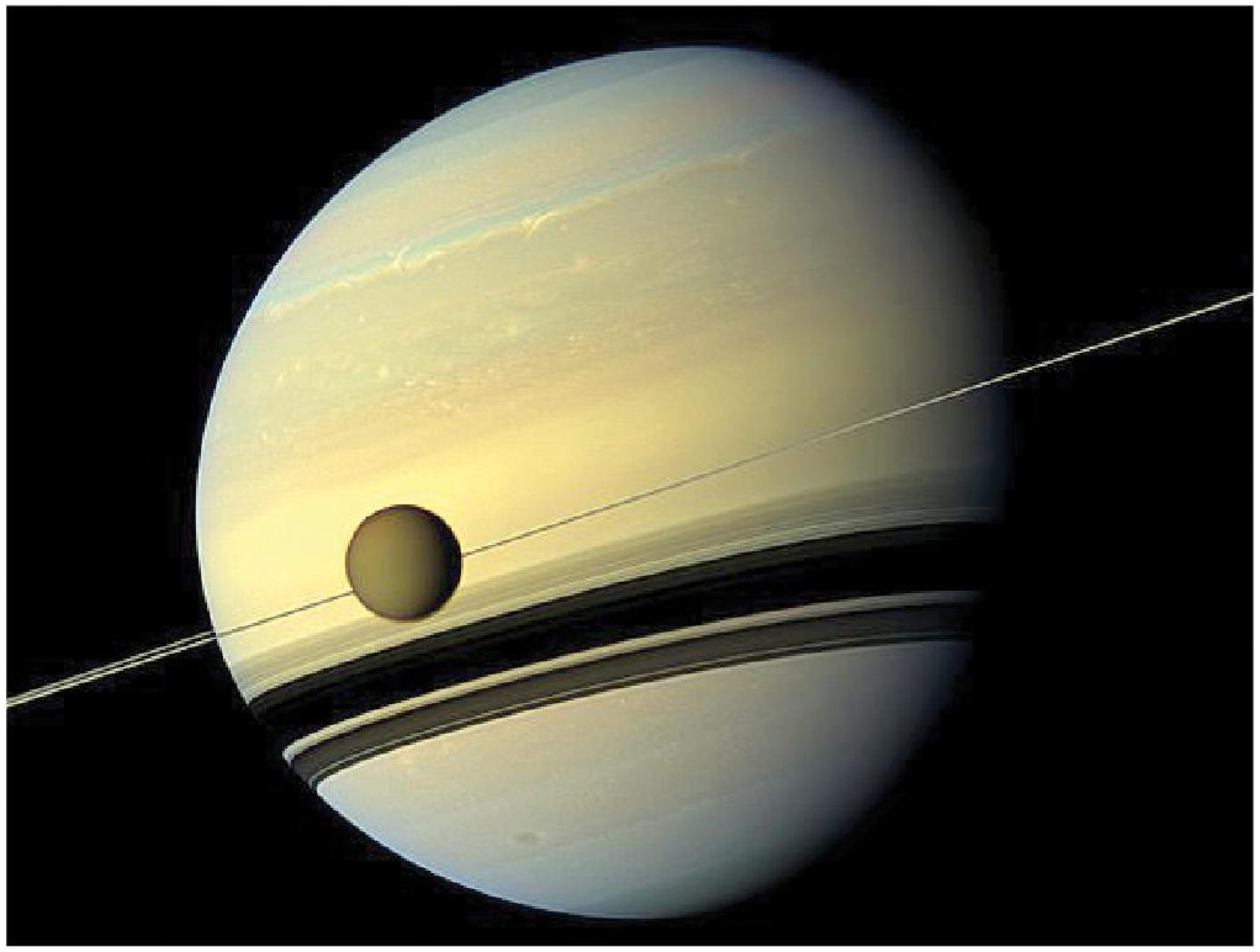
Saturn's largest moon, Titan, is surprisingly Earth-like when it comes to landscape formations, according to new models produced by planetary scientists.

When looked at from space, the moon, larger than the planet Mercury, has other similarities to Earth - including rivers, lakes and seas filled with falling rain - although on Titan the rain is liquid methane, falling through nitrogen winds.

These materials produce hydrocarbon sand dunes that are vastly different to silicate sedimentary structures elsewhere in the solar system, according to a team of planetary scientists from Stanford University in California.

The formation of the sand dunes, near to the rivers, lakes and oceans filled with liquid methane, was enigmatic and hard to pin down, the team explained.

They created a series of computer models that revealed an Earth-like seasonal cycle within the atmosphere drives the movement of grains over the moon's surface, allow for clumps of hydrocarbons to come together, and form the dunes and plains.



When looked at from space, the moon, larger than the planet Mercury, has other similarities to Earth - including rivers, lakes and seas filled with falling rain - although on Titan the rain is liquid methane, falling through nitrogen winds

Prime candidate

Titan is seen by many scientists as a prime candidate for future human colonisation, due to its relative habitability, including the seasonal cycle, and weather system.

Mathieu Lapôtre, geologist and study lead author, explained that their breakthrough was in identifying a process that would allow for hydrocarbon-based substances to form sand grains or bedrock depending on how often winds blow and streams flow,

This allowed them to understand how Titan's distinct dunes, plains, and labyrinth terrains could be formed.

Titan is the only other body in our solar system, after the Earth, that has an Earth-like, seasonal liquid transportation cycle, and the new model shows how that seasonal cycle drives the movement of grains over the moon's surface.

'Our model adds a unifying framework that allows us to understand how all of these sedimentary environments work together,' said Lapôtre, an assistant professor of geological sciences at Stanford's School of Earth, Energy & Environmental Sciences.

'If we understand how the different pieces of the puzzle fit together and their mechanics, then we can start using the landforms left behind by those sedimentary processes to say something about the climate or the geological history of Titan—and how they could impact the prospect for life on Titan.'

To build a model that could simulate the formation of Titan's distinct landscapes, Lapôtre and his colleagues first had to solve one of the biggest mysteries about sediment on the planetary body - the fragility of organic compounds.

Organic compounds are thought to be much more fragile than inorganic silicate - as found on Earth and Venus - transforming into dust rather than wearing down.

On Earth, silicate rocks and minerals on the surface erode into sediment grains over time, moving through winds and streams to be deposited in layers of sediments that eventually turn back into rocks.

Those rocks then continue through the erosion process and the materials are recycled through Earth's layers over geologic time.

On Titan, researchers think similar processes formed the dunes, plains, and labyrinth terrains seen from space.

Unlike on the terrestrial planets, Earth, Mars and Venus, where silicate rocks dominate and produce sediment, on Titan it comes from solid organic compounds.

Scientists so far have not been able to demonstrate how these compounds grow into sediment grains that can be transported across the moon's landscapes and over geologic time.

'As winds transport grains, the grains collide with each other and with the surface,' Lapôtre explained.

Grain size

'These collisions tend to decrease grain size through time. What we were missing was the growth mechanism that could counterbalance that and enable sand grains to maintain a stable size through time,' he said.

They found a solution by looking at a special type of sediment found in shallow tropical seas on the Earth - known as ooids, they are small, spherical grains.

Ooids form when calcium carbonate is pulled from the water column and attaches in layers around a grain, such as quartz.

What makes ooids unique is their formation through chemical precipitation, which allows ooids to grow, while the simultaneous process of erosion slows the growth as the grains are smashed into each other by waves and storms.

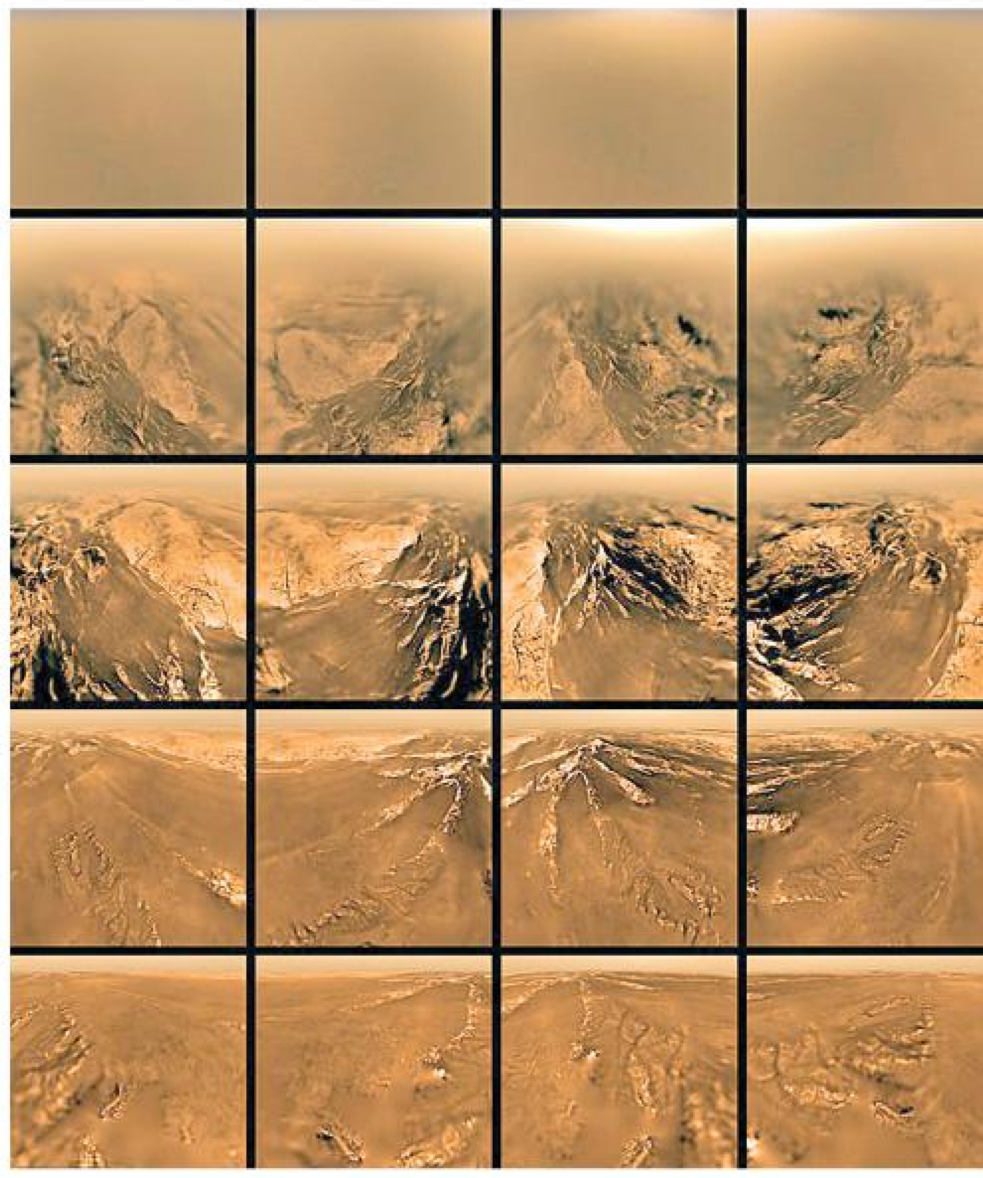
These two competing mechanisms balance each other out through time to form a constant grain size — a process the researchers suggest could also be happening on Titan.

'We were able to resolve the paradox of why there could have been sand dunes on Titan for so long even though the materials are very weak, Lapôtre said.

'We hypothesized that sintering—which involves neighboring grains fusing together into one piece—could counterbalance abrasion when winds transport the grains.'

Armed with a hypothesis for sediment formation, Lapôtre and the study co-authors used existing data about Titan's climate and the direction of wind-driven sediment transport to explain its distinct parallel bands of geological formations.

That is dunes near the equator, plains at the mid-latitudes, and labyrinth terrains near the poles. Atmospheric modelling and data from the Cassini mission reveal that winds are common near the equator, supporting the idea that less sintering and therefore fine sand grains could be created there — a critical component of dunes. The study authors predict a lull in sediment transport at mid-latitudes on either side of the equator, where sintering could dominate and create coarser and coarser grains, eventually turning into bedrock that makes up Titan's plains. Sand grains are also necessary for the formation of the moon's labyrinth terrains near the poles.



The formation of the sand dunes, near rivers, lakes and oceans filled with liquid methane, was enigmatic and hard to pin down

Researchers think these distinct crags could be like karsts in limestone on Earth—but on Titan, they would be collapsed features made of dissolved organic sandstones.

River flow and rainstorms occur much more frequently near the poles, making sediments more likely to be transported by rivers than winds.

A similar process of sintering and abrasion during river transport could provide a local supply of coarse sand grains - the source for the sandstones thought to make up labyrinth terrains.

'We're showing that on Titan—just like on Earth and what used to be the case on Mars—we have an active sedimentary cycle that can explain the latitudinal distribution of landscapes through episodic abrasion and sintering driven by Titan's seasons,' Lapôtre said.

'It's pretty fascinating to think about how there's this alternative world so far out there, where things are so different, yet so similar.'

-Mail Online