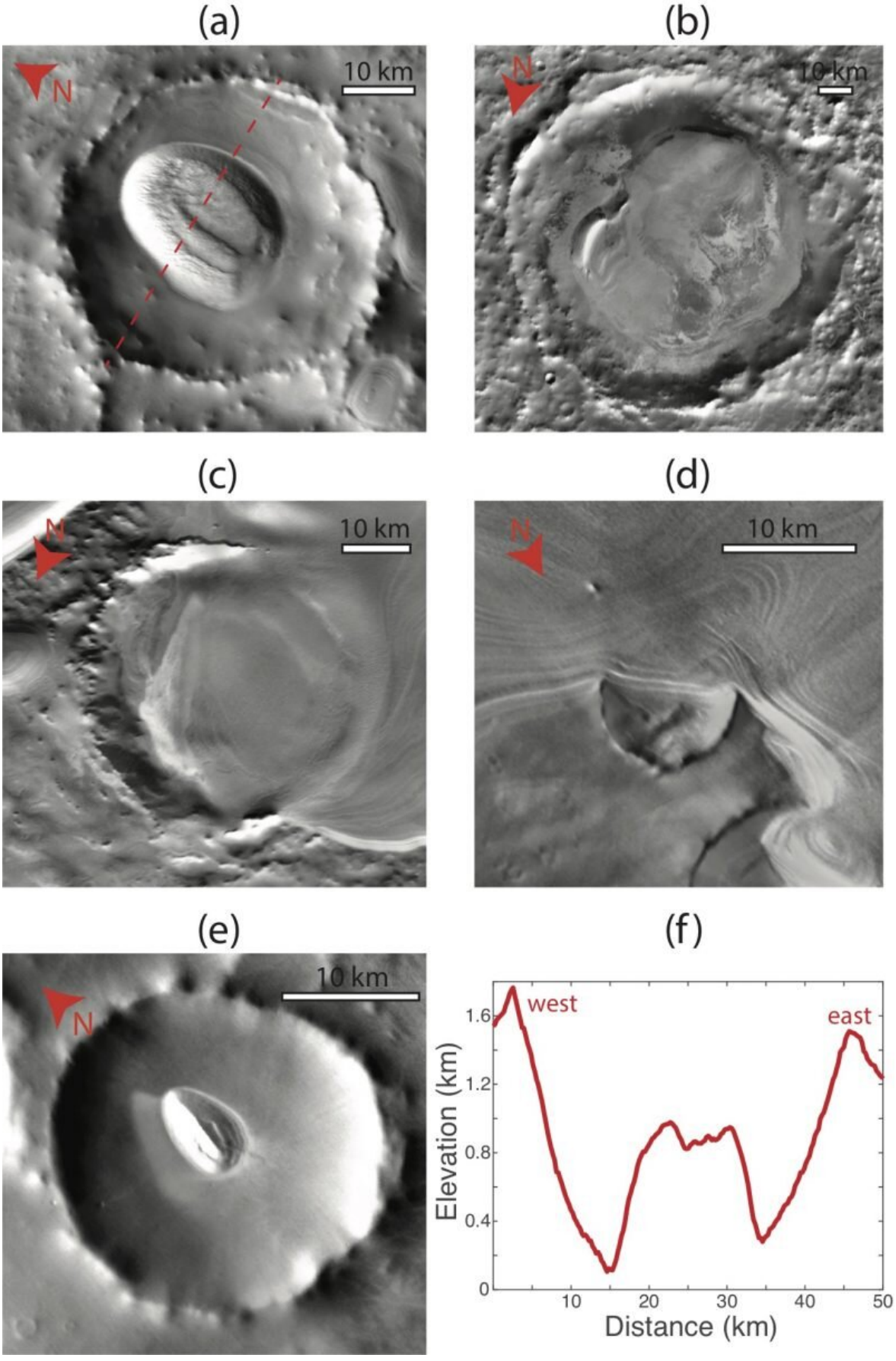
Ice islands on Mars and Pluto could reveal past climate change

September 24 2019, by Joshua Rapp Learn


(a)
N
10 km
(b)
N
10 km
(c)
N
10 km
(d)
N
10 km
(e)
N
10 km
(f)
west
east
Elevation (km)
1.6
1.2
0.8
0.4
0
10
20
30
40
50
Distance (km)

Examples of crater deposits from the daytime THEMIS IR mosaic in the southpolar region of Mars. (a) circumpolar crater filling deposits in an unnamed crater (b) “Stacked” circumpolar crater filling deposits in South crater. (c) Marginal deposit in Elim crater. (d) The south polar layered deposits overprinting an unnamed crater. (e) Irregular deposit in unnamed crater. (f) West-east topographic profile from MOLA data through the circumpolar crater filling deposits in (a), with location represented by the dashed line in (a). (From Sori, et al., 2019, JGR: Planets)

Many of the craters of Mars and Pluto feature relatively small ice islands unattached to their polar ice caps.

These ice islands could be records of past climate change on Mars and Pluto, and could also provide clues about the workings of Martian water and ice, said Mike Sori, a planetary scientist at the University of Arizona and the lead author of a new study in AGU's *Journal of Geophysical Research: Planets* detailing the new findings.

Most previous work on ice on Mars had examined the northern polar ice cap on the planet, where other researchers noticed that small domes of ice dozens of miles across persisted inside craters beyond the reach of the main ice sheet.

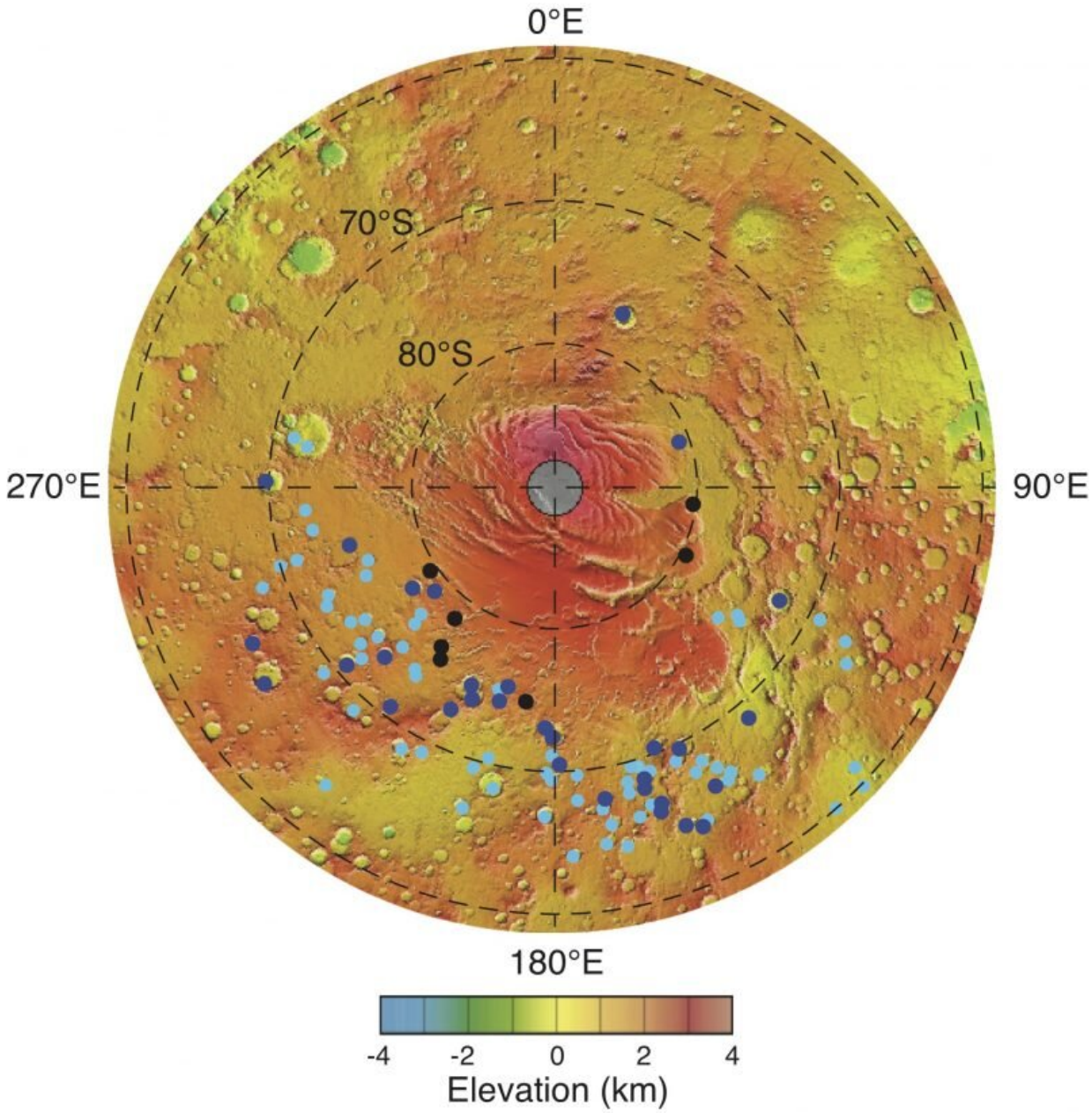
Sori wanted to see if these features were unique to the planet's north pole, and to find out more about these understudied features.

"It's a mountain within a hole," he said.

The study's authors used different types of instruments from orbiting space craft to examine these features, including images showing the

features and topography maps made by the Mars Orbiter Laser Altimeter (MOLA).

They found 104 large impact craters that had deposits inside, including 31 with relatively circular, domed ice cones in craters in the southern polar region. The other craters had more irregular deposits.



Locations of circumpolar crater filling deposits (dark blue points), marginal deposits (black points), and irregular deposits (light blue points) on a southern polar projection of elevation represented by MOLA-derived colored shaded relief. (From Sori, et al., 2019, JGR: Planets)

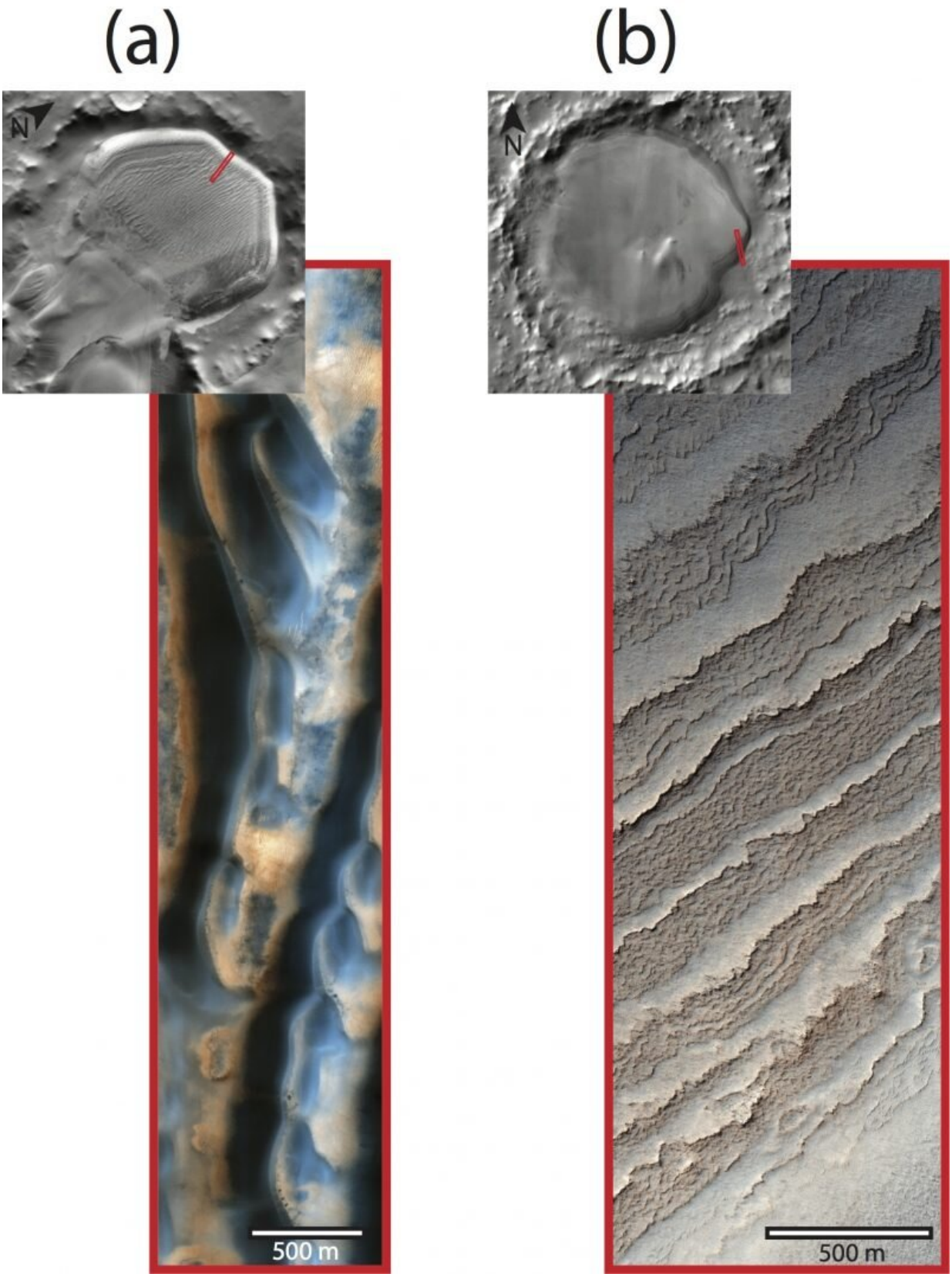
Sori and his co-authors focused on the 31 more regular ice cones for this work since they were most confident that these formations were composed mostly of frozen water.

"They don't appear as bright white stuff in images, so it's not super obvious that they're ice if you just look at them," he said.

Once the study authors determined these ice mountains seemed to be a recurring process on Mars, they widened their study to see if they could find similar features elsewhere in the solar system. They looked at Pluto, which has a big bright ice sheet called Sputnik Planitia.

Even though Pluto's ice is made of frozen nitrogen, the ice sheets were about the same size: about 1,000 kilometers in diameter and a few kilometers thick. Pluto also has similar crater topography.

While the available images of Pluto aren't as good as those of Mars, Sori and his colleagues measured five craters with ice deposits in an area roughly the same distance from Pluto's main ice sheet as those they found on Mars.


(a)
N
500 m
(b)
N
500 m

HiRISE images of circumpolar crater filling deposits, shown as insets in daytime THEMIS IR mosaics. (a) Enhanced color portion of HiRISE image ESP_031749_1080 showing dunes on the circumpolar crater filling deposits in Richardson crater (89 km crater diameter, 72.5ºS, 180.2ºE). (b) Enhanced color portion of HiRISEimage ESP_057439_1075 showing layer exposures of the circumpolar crater filling deposits in Burroughs crater (110 km crater diameter, 72.3ºS, 116.6ºE). (From Sori, et al., 2019, JGR: Planets)

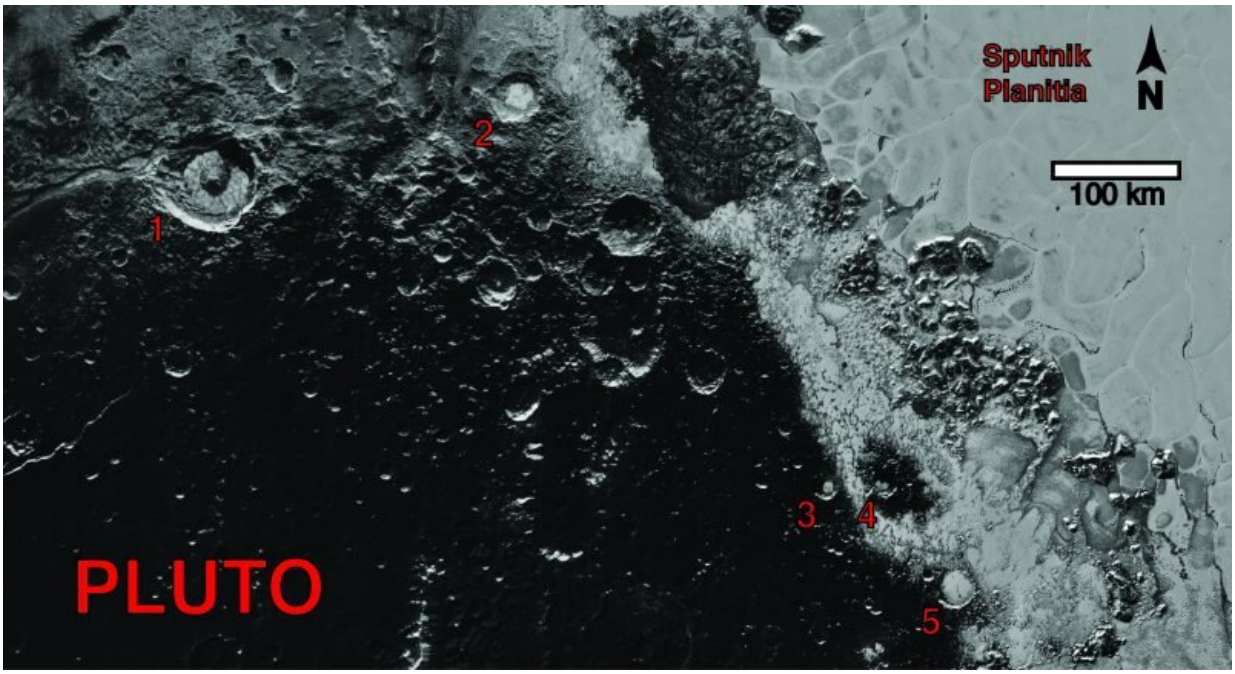
"Broadly speaking it was reasonably similar," Sori said, adding that the researchers couldn't measure topography on Pluto as well due to poorer data.

The shapes aren't exactly dome-shaped on Pluto either, but Sori said it's still interesting that Pluto's ice islands are deposited in craters.

"There's some sort of climate reason or topography reason why holes in the ground are good place for ice to go," he said.

The researchers aren't totally sure why this is, but Sori said that in Mars' southern polar region the ice islands are usually to the west of the center of the craters, which is the way the wind blows there.

"Wind has to play some sort of role," Sori said.



Map of five outliers of nitrogen ice within impact craters on Pluto. Labels are to the lower left of each crater on a LORRI image mosaic. Topography data comes from New Horizons stereo images (Schenk et al., 2018).

How or why the ice islands form is also a mystery. For example, researchers don't know if craters collect ice or retain ice. They found a few of the ice mounds that are still connected a little to the main ice sheet on Mars, and it's possible that the other ice mounds were once part of the main ice sheet. If so, this would mean the ice sheets were once bigger on Mars and Pluto, and that they are gradually declining, with the craters retaining some small amount of the ice that once covered them.

While Earth doesn't have many craters like Pluto or Mars, Sori said there is a crater in Greenland that has an ice mound connected still to the main ice sheet, and that it may be part of the same phenomenon happening on Mars and Pluto.

More information: Michael M. Sori et al. Islands of ice on Mars and Pluto, *Journal of Geophysical Research: Planets* (2019). DOI: 10.1029/2018JE005861

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