Pluto’s ice-capped peaks are like Earth’s—but not

Enlarge / “What dusts the peaks of Cthulhu?” is not an arcane riddle.

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We can often use our knowledge of planet Earth to explain the things we see on other worlds, although we may have to tweak the physics to account for a different temperature or a tenuous atmosphere. But planetary scientists can’t always assume that a familiar landscape feature formed in a familiar way.

When the New Horizons spacecraft gave us our first close-up look at Pluto, there were alien wonders aplenty. But there were also mountaintops dusted with something bright, looking very similar to Earth’s snowcapped peaks. On Earth, these snow caps are produced by enhanced precipitation as air rises over the mountains and cools, combined with the colder temperatures at higher elevations.

On Pluto, that explanation can’t work, for several reasons. First, temperatures generally *increase* as you go up a few kilometers from Pluto’s surface because of gases absorbing solar energy. Winds also tend to blow *downslope* since the colder surface chills the air near it, making it denser. So what forms the bright dusting and how does it get there?

West of Pluto’s heart-shaped bright plain is a dark-colored

region dubbed Cthulhu. Within that region there are some mountain chains that stand out due to their bright caps. Analyzing spectral data from imagery of this area, the researchers say that the bright areas are mostly methane ice. It also shows up on north-facing rims and walls of impact craters in the region.

Enlarge / For a terrestrial comparison, a satellite image of the Alps is on the right.

To look at why methane ice would form in those locations, the researchers turned to a climate model of the dwarf planet. The model allowed ices of methane and nitrogen to form (or vanish by turning to gas), and the researchers targeted the conditions at the time of New Horizons' visit. Just by putting in the physics and topography, the model successfully makes methane ice on the mountains and craters of Cthulhu. Many places can see some methane frost form at night but disappear during the day. But a greater concentration of methane gas at higher altitudes leads to a net accumulation on the mountain tops over that daily cycle.

That extra methane higher up is put there by patterns of atmospheric circulation. The behavior of nitrogen ice is important to Pluto's atmosphere, with sublimation in the northern hemisphere and condensation in the south driving north-to-south winds above the heart-shaped plains. Methane is

also lifted into that loop. The higher topography at the western edge of the plains also helps push methane higher over Cthulhu.

So ultimately, the reason for the white-capped peaks is simply that methane is enriched in the air around them. And on the north-facing walls and rims of the impact craters, the methane dusting is probably related to weaker sunlight during the long Plutonian winter.

The researchers say that this pattern of methane ice accumulation at higher altitudes might help explain the formation of the areas of “bladed terrain” on Pluto. These jagged ridges are also made primarily of methane ice. By analogy to the snow penitentes found in a few places on Earth, it has been thought that the bladed terrain was related to sublimation. But instead of sublimation deepening low spots, this study suggests a way for deposition to favor high spots. Both could be happening at the same time, the researchers say—one process familiar and the other unfamiliar.

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