Space & Astronomy | Nov 20, 2026 | 5 min read | By Bryan White

Basal Dry-Ice Sublimation Turns Martian Polar Sand Avalanches Into an Overhead 'Forest' Illusion

Environment * Climate Change * Atmospheric Physics

High-resolution orbital imagery captured near Mars 's north pole by NASA's Mars Reconnaissance Orbiter (MRO) using its High Resolution Imaging Science Experiment (HiRISE) camera reveals what appears at first glance to be rows of dark, scraggly pine trees standing upright across snow-covered dunes. Highlighted by ScienceAlert in November 2026, the striking scene contains no trees or living organisms -- instead, it captures dark basaltic sand avalanching down seasonal carbon dioxide (CO 2) frost slopes, arranged by overhead perspective into a classic planetary optical illusion.

Behind that visual trick lies an active cryospheric process unique to thin-atmosphere planets. Because Mars's atmosphere is composed predominantly of carbon dioxide and drops below the freezing point of dry ice during polar winter, entire dune fields become encased beneath translucent CO 2 ice sheets -- setting the stage for explosive springtime sublimation bursts.

Translucent Dry Ice and Basal Sublimation Physics

During the frigid Martian polar winter, atmospheric carbon dioxide condenses directly onto the surface as a pale blanket of dry ice and frost. Unlike water ice, pure seasonal CO 2 slab ice can be remarkably translucent, allowing incoming sunlight during Martian spring to pass through the frozen crust and warm the dark basaltic sand grains trapped beneath.

At Mars's low surface atmospheric pressure, solid carbon dioxide cannot melt into a stable liquid phase. Instead, as solar heating warms the dark underlying sand, the base of the dry-ice slab sublimes -- converting directly from solid to pressurized CO 2 gas. As first formalized by Hugh H. Kieffer, Philip R. Christensen, and Timothy N. Titus in Nature (2006), trapped gas pressure builds beneath the translucent ice sheet until the crust fractures, venting jets of CO 2 gas that entrain loose dark sand and trigger miniature avalanches down the steep slipfaces of the dunes.

| Feature / Mechanism | | Visual Illusion Appearance | | Actual Planetary Physics |

| Bright Ground Blanket | | Terrestrial snowfield on rolling hills | | Seasonal frozen CO 2 (dry ice) frost over polar dunes |

| Dark "Tree Trunks" | | Rows of dark conifers standing upright | | Basaltic sand streaks sliding down dune slipfaces |

| Driving Energy Source | | Biological growth or wind-sculpted vegetation | | Sunlight warming sand under translucent CO 2 slab ice |

| Triggering Process | | Seasonal spring thaw | | Solid-to-gas CO 2 sublimation rupturing the ice crust |

Why Overhead Perspective Creates the Optical Illusion

The illusion of upright pine trees depends on how the human visual system interprets shading and geometry when looking straight down from orbit. On Earth, we instinctively assume light comes from above and objects project vertically off the ground; when dark, tapered sand streaks cascade down bright, frost-covered dune crests toward the bottom of an orbital frame, our brains misread the downhill avalanche fans as upright trunks and branches casting shadows across snow.

Rotating the HiRISE frame upside down immediately breaks the illusion, revealing the true three-dimensional topography: smooth, wind-sculpted sand dunes dusted with white frost and streaked by gravity-driven dark sand slides.

Active Surface Geology on Modern Mars

Although Mars is often pictured as a geologically static desert, repeated HiRISE monitoring across successive Martian years demonstrates that seasonal CO 2 sublimation is one of the most energetic landscape-shaping forces operating on the planet today. Basal gas venting and dry-ice avalanches continually rework polar dune crests, carve dendritic troughs known as araneiforms ("spiders") in the southern hemisphere, and loft fine dust into the thin Martian atmosphere every spring.

By tracking how these frost-driven sand flows evolve from orbit, planetary scientists gain a real-time window into Martian sediment transport, polar energy budgets, and seasonal volatile cycles -- showing how pure dry-ice thermodynamics can sculpt landscapes that look uncannily alive.

References & Primary Sources

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