Space Station Crew Photographs Mysterious Clouds that Shine at Night

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They hover on the edge of space. Thin, wispy clouds, glowing electric blue. Some scientists think they're seeded by space dust. Others suspect they're a telltale sign of global warming.

They're called noctilucent or "night-shining" clouds (NLCs for short). And whatever causes them, they're lovely.

"Over the past few weeks we've been enjoying outstanding views of these clouds above the southern hemisphere," said space station astronaut Don Pettit during a NASA TV broadcast last month. "We routinely see them when we're flying over Australia and the tip of South America."

Skywatchers on Earth have seen them, too, glowing in the night sky after sunset, although the view from Earth-orbit is better. Pettit estimated the height of the noctilucent clouds he saw at 50 to 62 miles (80 to 100 km) ... "literally on the fringes of space."

"Noctilucent clouds are a relatively new phenomenon," says Gary Thomas, a professor at the University of Colorado who studies NLCs. "They were first seen in 1885" about two years after the powerful eruption of Krakatoa in Indonesia, which hurled plumes of ash as high as 80 kilometers into Earth's atmosphere.

Ash from the volcano caused such splendid sunsets that evening sky watching became a popular worldwide pastime. One sky watcher in particular, a German named T. W. Backhouse, noticed something odd. He stayed outside after the sun had set and, on some nights, saw wispy filaments glowing electric blue against the black sky. Noctilucent clouds. Scientists of the day figured the clouds were some curious manifestation of volcanic ash.

Eventually the ash settled and the vivid sunsets of Krakatoa faded. Yet the noctilucent clouds remained. "It's puzzling," says Thomas. "Noctilucent clouds have not only persisted, but also spread." A century ago the clouds were confined to latitudes above 50 degrees; you had to go to places like Scandinavia, Russia and Britain to see them. In recent years they have been sighted as far south as Utah and Colorado.

Astronaut Don Pettit is a long-time noctilucent cloud-watcher. As a staff scientist at the Los Alamos National Laboratory between 1984 and 1996, he studied noctilucent clouds seeded by high-flying sounding rockets. "Seeing these kinds of clouds [from space] ... is certainly a joy for us on the ISS," he said on NASA TV.

"Although NLCs look like they're in space," continues Thomas, "they're really inside Earth's atmosphere, in a layer called the mesosphere ranging from 50 to 85 kilometers high." The mesosphere is not only very cold (-193 Fahrenheit, or -125 Celsius), but also very dry--"one hundred million times dryer than air from the Sahara desert." Nevertheless, NLCs are made of water. The clouds consist of tiny ice crystals about the size of particles in cigarette smoke. Sunlight scattered by these crystals gives the clouds their characteristic blue color.

How ice crystals form in the arid mesosphere is the essential mystery of noctilucent clouds.

Ice crystals in clouds need two things to grow: water molecules and something for those molecules to stick to--dust, for example. Water gathering on dust to form droplets or ice crystals is a process called nucleation. It happens all the time in ordinary clouds.

Ordinary clouds, which are relatively close to Earth, get their dust from sources like desert wind storms. It's hard to waft wind-blown dust all the way up to the mesosphere, however. "Krakatoa may have seeded the mesosphere with dust in 1883, but that doesn't explain the clouds we see now," notes Thomas. "Perhaps," he speculates, "the source is space itself." Every day Earth sweeps up tons of meteoroids--tiny bits of debris from comets and asteroids. Most are just the right size to seed noctilucent clouds.

The source of water vapor is less controversial. "Upwelling winds in the summertime carry water vapor from the moist lower atmosphere toward the mesosphere," says Thomas. This is why NLCs appear during summer, not winter.

One reason for the recent spread of noctilucent clouds might be global warming. "Extreme cold is required to form ice in a dry environment like the mesosphere," says Thomas. Ironically, global warming helps. While greenhouse gases warm Earth's surface, they actually lower temperatures in the high atmosphere. Thomas notes that noctilucent clouds were first spotted during the Industrial Revolution--a time of rising greenhouse gas production.

Are NLCs a thermometer for climate change? A unusual sign of meteoroids? Or both? "So much about these clouds is

speculative," says Thomas.

A NASA spacecraft scheduled for launch in 2006 should provide some answers. The Aeronomy of Ice in the Mesosphere satellite, or AIM for short, will orbit Earth at an altitude of 342 miles (550 kilometers). Although it's a small satellite, says Thomas, there are many sensors on board. AIM will take wide angle photos of NLCs, measure their temperatures and chemical abundances, monitor dusty aerosols, and count meteoroids raining down on Earth. "For the first time we'll be able to monitor all the crucial factors at once."

Meanwhile, all we can do is wait ... and watch. There's never been a better time to see noctilucent clouds. "During the summer months, look west perhaps 30 minutes to an hour after sunset when the Sun has dipped 6 to 16 degrees below the horizon," advises Thomas. If you see luminous blue-white tendrils spreading across the sky, you've probably spotted an NLC. Observing sites north of 40 degrees latitude are favored.

One more thing: don't forget your camera. According to astronaut Don Pettit, "you can never have too many pictures of noctilucent clouds."

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