

Research: Starlight and 'air glow' help scientists see Earth's clouds in new way

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(Phys.org)—Colorado State University researchers discovered that a combination of starlight and the upper atmosphere's own subtle glow can help satellites see Earth's clouds on moonless nights.

During the daytime, ultraviolet light from the sun bombards the Earth's upper atmosphere and breaks apart gaseous molecules and atoms. During

the nighttime, these molecules and atoms recombine, emitting faint visible light in the process.

This "air glow" combined with starlight illuminates clouds at night, and by using a new and improved [satellite instrument](#), scientists can take advantage of this signal for the first time from space, according to a groundbreaking new study published in the [Proceedings of the National Academy of Sciences](#) by Steve Miller, a research scientist at CSU's Cooperative Institute for Research in the Atmosphere (CIRA), along with colleagues from [National Oceanic Atmospheric Administration](#) (NOAA), [Northrop Grumman](#) and the U.S. Department of Defense (DoD).

Miller and his research team captured the data from a new advanced weather-and-climate monitoring satellite. The satellite, a joint venture between NASA and NOAA, is called the Suomi National Polar-orbiting Partnership, or Suomi NPP, and carries five advanced instruments at an orbit approximately 512 miles above the earth.

"We actually thought there might be a problem with the instrument, at first," said Miller. "It took us a minute to realize that what we were seeing was something real and extraordinary."

This new ability to see clouds at night could have significant implications for weather and [climate observations](#) for forecasters and research scientists alike.

"This development is exciting and impressive," said Mary Kicza, assistant administrator for NOAA's Satellite and Information Service. "This could be especially useful to our meteorologists in areas like Alaska, where the winter months have long periods of darkness."

Among these sensors is the Visible/Infrared Imager/Radiometer Suite

(VIIRS), which includes a "Day/Night Band" that is sensitive to extremely low levels of light. Researchers at CIRA, collaboration between CSU and NOAA, perform many instrument check-out activities for the NPP mission.

"The Day/Night Band is a new capability for NOAA users," said Mitch Goldberg, program scientist at NOAA Joint Polar Satellite System (JPSS) Office. "We are very encouraged by this remarkable discovery by the CIRA scientists."

The scientists were applying methods to reduce "noise" in the Day/Night Band measurements, when they found that the instrument was sensitive enough to see clouds and other objects in what would appear to the human eye as complete darkness. The new capability will be useful for improving our views of very low clouds and features such as sea ice at night, potentially benefiting travel and commerce.

"Most weather satellites aren't even sensitive enough to see the lights from a large city like Denver, much less the reflected moonlight, which is nearly a million times fainter than sunlight. These air glow/starlight sources are 100-1000 times fainter still," Miller said. "Instead of using visible light, nighttime observations are typically relegated to infrared (heat) measurements, where near-surface features (such as fog) can blend into their surroundings because they have nearly the same temperature."

The Day/Night Band was intended to advance the low light-sensor technology pioneered in the 1960's on the DoD's meteorological satellite program, but no one expected it to see clouds on moonless nights, Miller said. "In some ways, the day just got twice as long and that's pretty exciting for scientists," he added.

In addition to the [clouds](#), Miller said that sensitivity of the Day/Night

Band to direct emissions from air glow allows the sensor to see waves moving through the [upper atmosphere](#), forced by thunderstorms below – which appear like ripples in a pond atop some of the stronger storms.

Goldberg added that the [NOAA](#) JPSS Proving Ground supports activities promoting the use of the Day/Night Band for our National Weather Service.

"We are very fortunate to have Dr. Miller as part of our team," Goldberg said.

"To most of us, it's a small revelation in itself that the night really isn't as dark as we might think," said Miller. "We're literally seeing our world in a 'new light.'

Provided by Colorado State University

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