Source: University of Colorado at Boulder

Date: April 11, 2007

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Spectacular 'Night-shining' Clouds Could Be A Harbinger Of Climate Change

Science Daily — An international research team is to study spectacular 'night-shining' clouds, thought by some to a harbinger of global environmental change.

A satellite carrying two University of Colorado at Boulder instruments to study silvery-blue clouds that mysteriously form 50 miles above Earth's polar regions every year is slated to launch from Vandenberg Air Force Base in California on April 25.

Noctilucent clouds over northern Europe (Credit: Pekka Parvianien)

The spectacular clouds, known as noctilucent clouds, will be probed by NASA's Aeronomy of Ice in the Mesosphere mission, or AIM, to determine why they form and how they change. First spotted in Earth's atmosphere in 1885, the clouds have been increasing in frequency in recent decades and may be related to increases in carbon dioxide and methane emissions tied to human activity on Earth, said Senior Research Scientist Dave Rusch of CU-Boulder's Laboratory for Atmospheric and Space Physics.

The NASA mission, which consists of two CU-Boulder instruments and an instrument from Utah State University, is being managed by CU-Boulder's LASP and will be controlled from the Space Technology Building at the

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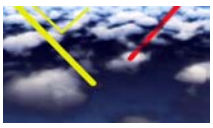

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CU Research Park. The mission's principal investigator is Jim Russell of Hampton University in Virginia.

"We have seen a definite increase in the brightness of these clouds in the past 25 years, which gives us cause for concern," said Rusch, principal investigator for one of the three AIM instruments. "This mission will give us an unprecedented look at how the mesosphere, which is a very sensitive region of Earth's atmosphere, is changing."

Also known as polar mesospheric clouds, noctilucent clouds have become more common and have been moving into Earth's lower latitudes in recent decades, he said. They now are visible in the summer months from the United States-Canada border to the Arctic Circle and comparable latitudes in the Southern Hemisphere. In 1999 they were spotted as far south as Coal Creek Canyon near Boulder, Colo., and Logan, Utah.

About the size of a small piano, the 430-pound AIM spacecraft will be launched from a Pegasus expendable-launch vehicle built by Orbital Sciences Corp., of Dulles, Va. The rocket will be carried to an altitude of 40,000 feet by a jet aircraft over the Pacific Ocean and dropped in a five-second free-fall. It will then ignite horizontally and accelerate in front of the jet, then climb and place the AIM satellite in a polar orbit about 370 miles above Earth, Rusch said.

The clouds are made up of tiny ice crystals the size of smoke particles in the coldest region of Earth's atmosphere, but exactly how and why they form is still unknown, said Rusch. Some scientists suspect large amounts of methane move from Earth's lower atmosphere into the mesosphere, or middle atmosphere, where it reacts chemically to form water vapor. The water molecules likely adhere to tiny dust particles in the region to form ice crystals, the basis of the clouds, he said.

Ironically, greenhouse gases like CO2 that warm Earth's lower atmosphere also cool the upper atmosphere, possibly enhancing conditions for ice crystal formation, said Rusch, lead scientist for the Cloud Imaging and Particle Size experiment, or CIPS. Consisting of four cameras positioned at different angles for a two-dimensional look at the clouds from above, CIPS will allow scientists multiple, panoramic views of the cloud banks and help them better determine the size and nature of the ice particles.

A second LASP instrument, the Cosmic Dust Experiment, or CDE, headed by LASP Research Associate Mihaly Horanyi, will chart space dust raining down in the mesosphere from the cosmos, which scientists believe plays a key part in noctilucent cloud formation. The instrument is nearly identical to the Student Dust Counter, a LASP student instrument launched on NASA's New Horizons spacecraft in early 2006 for Pluto and the outer reaches of the solar system.

A third instrument known as the Solar Occultation For Ice, or SOFIE, built by Utah State University researchers, will measure cloud particles as well as temperatures and atmospheric gases thought to be involved in noctilucent cloud formation. The instrument will be able to identify "recipes" of chemicals that may trigger the formation of the bizarre, night-shining clouds, said Rusch.

Other science team members from LASP on the AIM team include Gary Thomas, Cora Randall, William McClintock and Aimee Merkel, as well as an engineering and science support group of faculty, staff and students. LASP's Michael McGrath is the AIM project manager.

LASP, which has controlled NASA satellites since the 1980s and is now operating nine different instruments from campus for various space missions, will upload commands to the AIM spacecraft and download data twice a day by connecting to several ground stations around the world, said Rusch. "We've done these kinds of missions before, so it's pretty much a slam dunk for us now," he said.

CU-Boulder students will be involved in all aspects of the mission. Each pass of the satellite will be controlled by one professional and one student, and a number of

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undergraduates and graduate students will be involved in day-to-day science and data analysis. "We love to involve students in our research," he said. "I'm getting a lot of phone calls lately from students wanting to participate."

CU-Boulder received about $20 million from NASA for the design and construction of CIPS and CDE and will receive additional funding for the management of the mission over the next several years, said Rusch. The AIM mission is part of NASA's Small Explorer Program, designed to provide frequent, low-cost access to space for physics and astronomy missions with relatively small spacecraft.

In addition to CU-Boulder, Hampton University and Utah State, other institutions include Virginia Tech, the U.S. Naval Research Laboratory, George Mason University, the British Antarctic Survey and GATS Inc., an aerospace company in Newport News, Va. AIM Deputy Principal Investigator Scott Bailey of Virginia Tech received his master's degree and doctorate from CU-Boulder and previously worked at LASP.

Noctilucent clouds first were sighted in northern Europe in 1885, two years after a huge volcanic eruption on the island of Krakatoa in Indonesia injected millions of tons of water vapor into the air, said Rusch. But the clouds have persisted long after the effects of the volcano should have dissipated. Scientists hope the AIM mission will resolve unanswered questions about the beautiful but unsettling clouds.

Note: This story has been adapted from a news release issued by University of Colorado at Boulder.