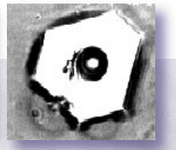
GI Researcher Finds Sea Creatures and Halos over the US Great Plains



Geophysical Institute Professor Kenneth Sassen, Atmospheric Sciences Group leader, recently earned national attention following the publication of an article about the discovery of plankton cells in clouds above the US Great Plains.

Sassen and his colleagues sampled cirrus clouds over Oklahoma and discovered that tiny sea creatures and sea salt swept up by the strong winds of Hurricane Nora served as condensation nuclei for ice crystals. Dozens of media outlets, including CNN and USA Today, featured stories on Sassen's research, published in the April 1, 2003 Journal of the Atmospheric Sciences.

In 1997, Hurricane Nora moved up Mexico's Baja Peninsula coast, picking up microscopic sea creatures in droplets of ocean water, then transporting them incredible distances. Samples containing the sea creatures were obtained by research aircraft studying air 30,000 to 40,000 feet over Oklahoma.

The presence of sea creatures in air above the US interior focused national attention on Sassen's research of cirrus clouds, which are composed of ice crystals high in the troposphere. Ice crystals within cirrus clouds frequently create colorful halos around the sun or moon. Halos over Oklahoma were particularly vivid, probably due to the addition of sea salt.

Sassen currently is studying cirrus clouds above Alaska using advanced lidar and radar systems to help determine how cirrus clouds reflect incoming sunlight and trap outgoing thermal radiation. The balance between the two helps determine the state of the climate.

"Climate modelers need better input parameters for cirrus clouds, but cirrus clouds are so high they haven't been studied much using aircraft," Sassen said.

CRYSTALS—Plate and column ice crystals containing plankton and other ocean microbes found in cirrus clouds over Oklahoma are shown above in photos provided by Sassen. Air samples high above the US Great Plains were obtained using research aircraft.

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Keeping Tabs on Hubbard Glacier

In the summer of 2002, Hubbard Glacier pushed sediment into a nearby point of land and turned Russell Fiord into the largest glacier-dammed lake in North America. Before summer ended, the dam broke and Russell Fiord was again connected to the ocean.

Geophysical Institute scientists have viewed changes in North America's largest tidewater glacier at close range. Research Associate Professor Roman Motyka, Assistant Professor of Physics Martin Truffer, and Research Technician By Valentine visited Hubbard Glacier as part of a fall research campaign on Southeast Alaska glaciers.

Residents of Yakutat, a fishing village of about 800 people, also have been keeping close watch on the glacier's behavior. If the glacier closes Russell Fiord permanently, meltwater and rain could cause the resulting lake to overflow its banks and spill into the Situk River drainage, near Yakutat. Yakutat commercial fishermen and guides depend on the Situk River, which supports salmon and steelhead fisheries. Hydrologists estimate the flooded channel could swell to nearly 37 times larger than the present one.

Motyka took water depth measurements near Hubbard Glacier's 70-meter-high face by piloting a boat in Russell Fiord and Disenchantment Bay, about 30 miles northeast of Yakutat. The 123-kilometer-long glacier tends to advance faster than normal when water is shallow and to retreat in deeper water. When Hubbard Glacier moves, it bulldozes gravel and rock, creating a "push moraine." The glacier's moraine dammed Russell Fiord in June 2002, when huge mounds of mud, sand and gravel shoved up against Gilbert Point. Several weeks later, lake water rising from torrential rains overtopped the dam, eroding the moraine and creating the second-largest outburst flood ever recorded.

Motyka was able to use a transponder to acquire depths for areas buried under hundreds of feet of ice weeks before. The resulting data was used to update a NOAA map of the area produced in 1999 and supplement aerial photos of the glacier. Motyka also recorded water temperatures of 7-9 degrees Celsius at several depths at the face of the glacier. At the calving fronts of most tidewater glaciers, such as Hubbard, relatively warm late-summer salt water mixes with fresh buoyant meltwater from beneath the glacier, creating a convection current that melts submarine glacier ice and may drive the seasonal retreat of the ice front.

Meanwhile, Truffer set up a 35-mm time-lapse camera on a hillside near Gilbert Point. The camera is scheduled to take photos of the glacier at 1 p.m. every day for 400 days to record the glacier's terminus in different phases—advancing, which is common in spring and mid-summer, and retreating, which is common in fall. Although the glacier undergoes a calving retreat of a few hundred meters each fall, scientists expect Hubbard to advance and eventually seal off Russell Fiord.

Ninety-five percent of Hubbard Glacier is in the accumulation zone, where more snow and ice is gained in winter than is lost in summer. That impressive ratio increases the odds that Truffer's camera will capture Hubbard Glacier's march into Gilbert Point sometime soon.

PHOTO BY NED ROZELL

PHOTO BY DENNIS TRABANT, USGS

ON THE MOVE—Hubbard Glacier and its emerging morained amof glaciomarine sediments (shown at center being pushed against Gilbert Point and Haenke Island in upper Disenchantment Bay) closed the entrance to Russell Fiord in June 2003. The water level in Russell Lake had risen to about one meter above sea level when this photo was taken.

RECORD—GI Assistant Professor Martin Truffer sets up a camera scheduled to capture the glacier's terminus in different phases of advance (above, right).

UAF UNIVERSITY OF ALASKA FAIRBANKS

PHOTO BY CHUCK JOHNSON, CLEARY SUMMIT B & B

Seven Rockets Launched from Poker Flat Research Range

Aurora scientists launched seven rockets from Poker Flat Research Range from January to March 2003.

The HIBAR Experiment

At 10:50 p.m. on January 27, Dartmouth College Associate Professor James LaBelle led a team of scientists in launching a two-stage Terrier-Black Brant IX rocket from Poker Flat. The rocket captured measurements of high-frequency wave signals related to the aurora as part of the High Bandwidth Auroral Rocket (HIBAR) experiment.

The rocket flew through the aurora (385 kilometers high) to measure high-frequency waves and turbulence. The resulting data will be combined with measurements made with different instruments carried by rockets launched from Poker Flat in 1997 and 2002, then analyzed to test theories about wave characteristics.

"Because the waves cycle millions of times per second, special, high-bandwidth instruments were used to measure them," said LaBelle, the HIBAR principal investigator. "The special instruments allowed us to receive data from the rocket at a rate higher than any previous aurora sounding rocket to date."

Horizontal E-Region Experiment

Geophysical Institute Assistant Professor Mark Conde was principal investigator for the "HEX" project, which involved launching two rockets on March 25.

One of the two rockets was designed to tip on its side during flight, a method that had not been attempted before.

"The trajectory was perfect. We hit the aurora arc spot on," Conde said. "It was a resounding success."

Once HEX's three-stage, Black Brant X rocket was free of the drag imposed by lower atmosphere gases, it tipped on its side, enabling the rocket to pierce a curtain of aurora horizontally.

Nineteen minutes later, a Terrier-Orion rocket was launched in a more conventional, vertical trajectory for comparative observation and study.

Each rocket released long brilliant white trails of the chemical trimethyl

PHOTO BY DIRK LUMMERZHEIM

aluminum (TMA) in the upper atmosphere. Cameras at Toolik Lake and Arctic Village, Alaska, and in Old Crow, Yukon, recorded the luminous trails and their movement in upper atmospheric winds.

The 55-foot tilting HEX rocket also contained instrument payloads designed by Geophysical Institute Professor of Physics John Craven with assistance from Bruce Johnson, a former electrical engineering graduate student supervised by Professor of Electrical Engineering Joe Hawkins.

"We are extremely happy with the trajectory, the chemical trail imaging, and the resulting instrument data," Conde said.

JOULE FLIGHT—The fourth JOULE flight was captured at left by a camera looking south from Toolik Lake. The rocket is shown moving upward from Poker Flat as the experiment began its on-off pattern of TMA releases.

PHOTO BY JOHN CRAVEN

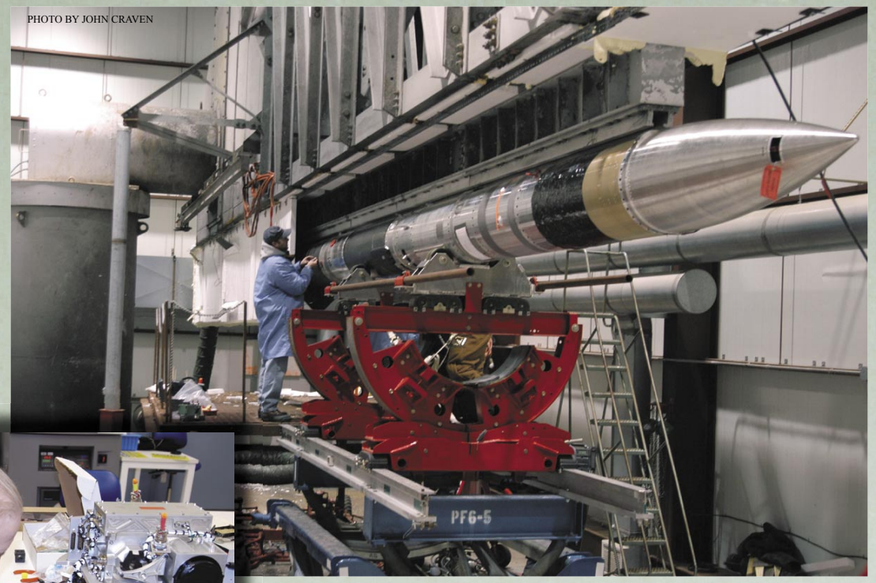

PHOTO BY MARK CONDE

HEX—Portions of the 3-stage HEX Black Brant X rocket are shown on the launch rail above. The rocket carried instruments designed at the GI.

WIRED—GI Electronic Engineering Technician Rick Ruhkick wires a photometer designed by Professor Craven for HEX.

JOULE—The silver booms supporting small spheres on one JOULE instrumentation package (right) were deployed in flight for electric field measurements.

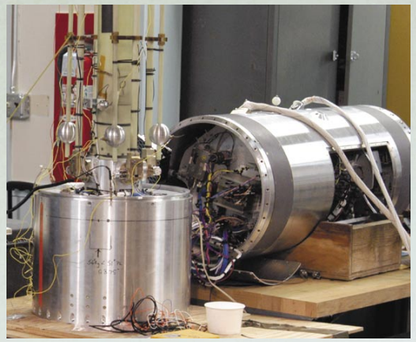

PHOTO BY MARK CONDE

The JOULE Mission

Clemson University Professor Miguel Larsen led the JOULE mission, during which four rockets were launched within five minutes on March 27. Data collected by instruments carried by the rockets will help scientists determine the speed and direction of wind in the upper atmosphere.

The first and third rockets carried instruments designed to measure light and small-scale electrical currents in the upper atmosphere. The second and fourth rockets were to release white chemical tracers of TMA into the upper atmosphere.

Luminous tracers released by the fourth rocket were photographed at ground stations at Toolik Lake, Arctic Village, Coldfoot, and Allakaket, Alaska, at Old Crow, Yukon, and at an automated site in Fort Yukon, Alaska. The second rocket, a 41.028 Terrier-Orion, did not reach predicted altitude. Range personnel recovered the rocket's second stage and payload 5.8 nautical miles north of the range in a designated land-use area for rocket booster impact. "It would have been nice to see tracers from both rockets, but one provided the data we needed," said Larsen, JOULE principal investigator. "The mission was a success."

Poker Flat, owned by the University of Alaska and operated by the GI under contract to NASA, is located 30 miles northeast of Fairbanks. The next launches from the range are scheduled for 2005.

HEX TMA TRAILS—Above right, the upper TMA trail from the vertical rocket is shown south of the Brooks Range above an aurora, while the lower trail from the horizontal flight is shown off Alaska's north coast.

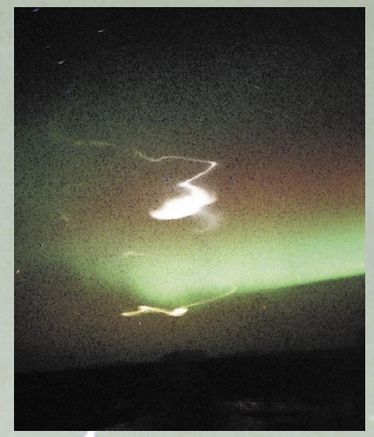

PHOTO BY CHUCK JOHNSON, CLEARY SUMMIT B & B

SAFETY—NASA flight safety personnel monitored HEX flights and the reorientation maneuver of the third stage (below).

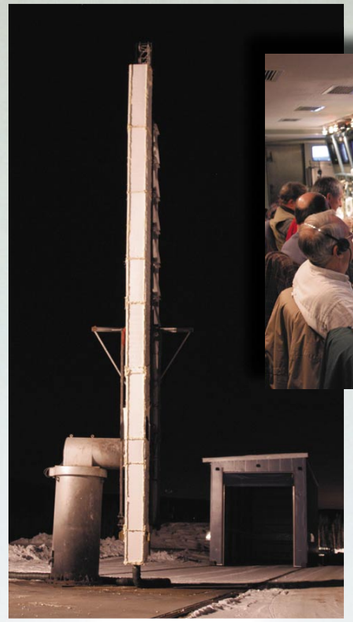

PHOTO BY JOHN CRAVEN

PHOTO BY MARK CONDE

INSULATION PANELS—The HEX Black Brant X rocket is pictured in launch position at left. The rocket is surrounded by insulating panels to keep the rocket motors warm for peak performance.

TRAJECTORY—The HEX horizontal trajectory is outlined by a TMA trail (shown below from right to left) as the payload passes through an aurora above Toolik Lake.

PHOTO BY DIRK LUMMERZHEIM