Shedding Light on the Aurora

Scientists typically study the aurora at night, but the nighttime-only view limits what researchers can learn about the detailed physics of the aurora. A Geophysical Institute aurora physicist and his colleagues at the Jet Propulsion Laboratory in Pasadena, California, are proposing to use giant balloons that would hoist near-infrared all-sky imagers to observe auroras on the sunlit side of Earth.

"On the dayside, the aurora is directly connected to the solar wind," said Geophysical Institute Research Professor Dirk Lummerzheim, one of the scientists hoping to observe daytime auroras. "The solar wind essentially pounds in on the magnetosphere and produces auroras right away (as opposed to flowing around Earth and then creating auroras)."

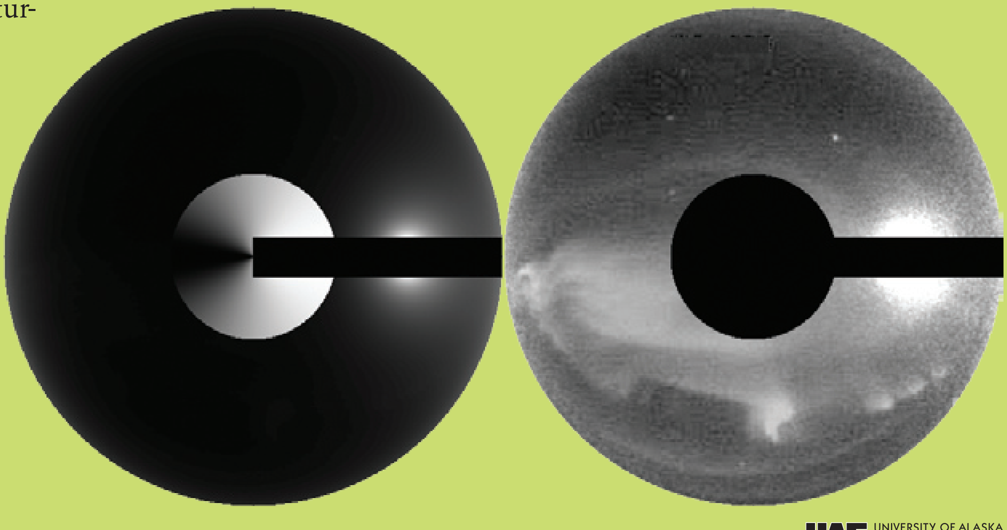
Lummerzheim has joined Sarath Gunapala and Xiaoyan Zhou of the Jet Propulsion Lab in developing near-infrared all-sky imagers to be launched in gondolas beneath NASA-designed balloons able to operate 40 to 50 kilometers above Antarctica. At that elevation, the atmosphere is dark enough to allow imaging of daytime auroras. In addition to capturing pressure pulses or "shock auroras," caused by sudden increases in solar wind pressure, the researchers hope to capture examples of conjugate auroras over the South Pole that mirror simultaneous auroras over the North Pole. Any imaging of daytime auroras would broaden scientists' knowledge of the phenomena.

"We don't even know what the aurora in broad daylight looks like," Lummerzheim said.

Lummerzheim's plan is still in the early stages, with grants yet to be funded and instruments yet to be developed and tested. If all goes as planned, three imager-equipped balloons will be deployed during the Antarctic summer in a few years. While other scientists have captured satellite images of a daytime aurora during a brief daytime window of visibility over Svalbard, Lummerzheim said the balloon method is worth a try.

"It's a risky experiment, but we can do this for less than a tenth of the cost of doing it by satellite," he said.

Instrumentation used to gather data on daytime auroras will be tethered under giant, ultra-long duration balloons that will rise high above Earth.



The simulated images at right display an anticipated view of the sky from under a balloon (center circle on both images) using near-infrared all-sky imagers to record daytime auroral activity. The left image depicts the sun behind a metal strip blocking direct sunlight; the sky is too bright to see the aurora and appears black. After processing (right), the same image is expected to show auroral activity.

Instrumenting Alaska's Extreme Impact Zone

The pyramid of Mount St. Elias scratches the sky at 5,489 meters (18,008 feet) above sea level. Yet, as Alaska's second highest mountain, it is within only 20 kilometers of the nearest tidewater in Taan Fiord. The mountain's dramatic rise from the sea is the result of the collision between a wedge of Earth's crust, known as the Yakutat block, and southern Alaska. The collision is shoving the St. Elias Mountains upward faster than the area's massive glaciers can erode them down. This dynamic corner of Alaska is the subject of a five-year multidisciplinary study, called the St. Elias Erosion and Tectonics Project (STEEP), which involves many Geophysical Institute scientists.

Funded by the National Science Foundation, the researchers hope to develop a comprehensive model for the St. Elias region that includes the interaction of regional plate tectonic processes, the rise of mountains, ice dynamics, and rapid erosion caused by glacial ice.

In the summer of 2005, Geophysical Institute seismologists installed eight digital broadband seismic stations from a base camp at the terminus of Bering Glacier. By the end of the five-year project, they hope to have 22 stations installed in a 150-square-kilometer area surrounding Bering Glacier. The new, high-quality seismic data that results from the instrumentation effort will allow for more reliable automatic earthquake detection in the region with a lower magnitude threshold. With the enhanced seismic network, the scientists hope to better understand a region affected by plate tectonics, glacial rebound, and incredible rates of glacial erosion.

"We're trying to understand what's under glaciers in the area, and if the seismology shows there is a subduction zone beneath it all," said Steve Estes, senior project engineer at the institute. "The challenge is to find ice-free locations, on bedrock, large enough to install equipment and still have a helicopter landing zone nearby."

Ten universities are involved in the STEEP project. In addition to Alaska Earthquake Information Center seismologists, other involved Geophysical Institute scientists include Professor Jeff Freymueller, Research Associate Chris Larsen, and graduate student Julie Elliott, who are measuring uplift, crustal deformation, and strain in the area with precise GPS receivers. Their measurements show how the Yakutat block is crushing southern Alaska.

"The amount of strain built up across these (St. Elias) mountains is several times greater than in the Himalayas, where India is ramming Eurasia," Larsen said.

Below, graduate student Julie Elliott sets up a GPS station above Bering Glacier. Metal GPS survey benchmarks are installed and used to track bedrock motions in the eastern Chugach Mountains.

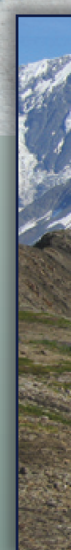
photo by Chris Larsen

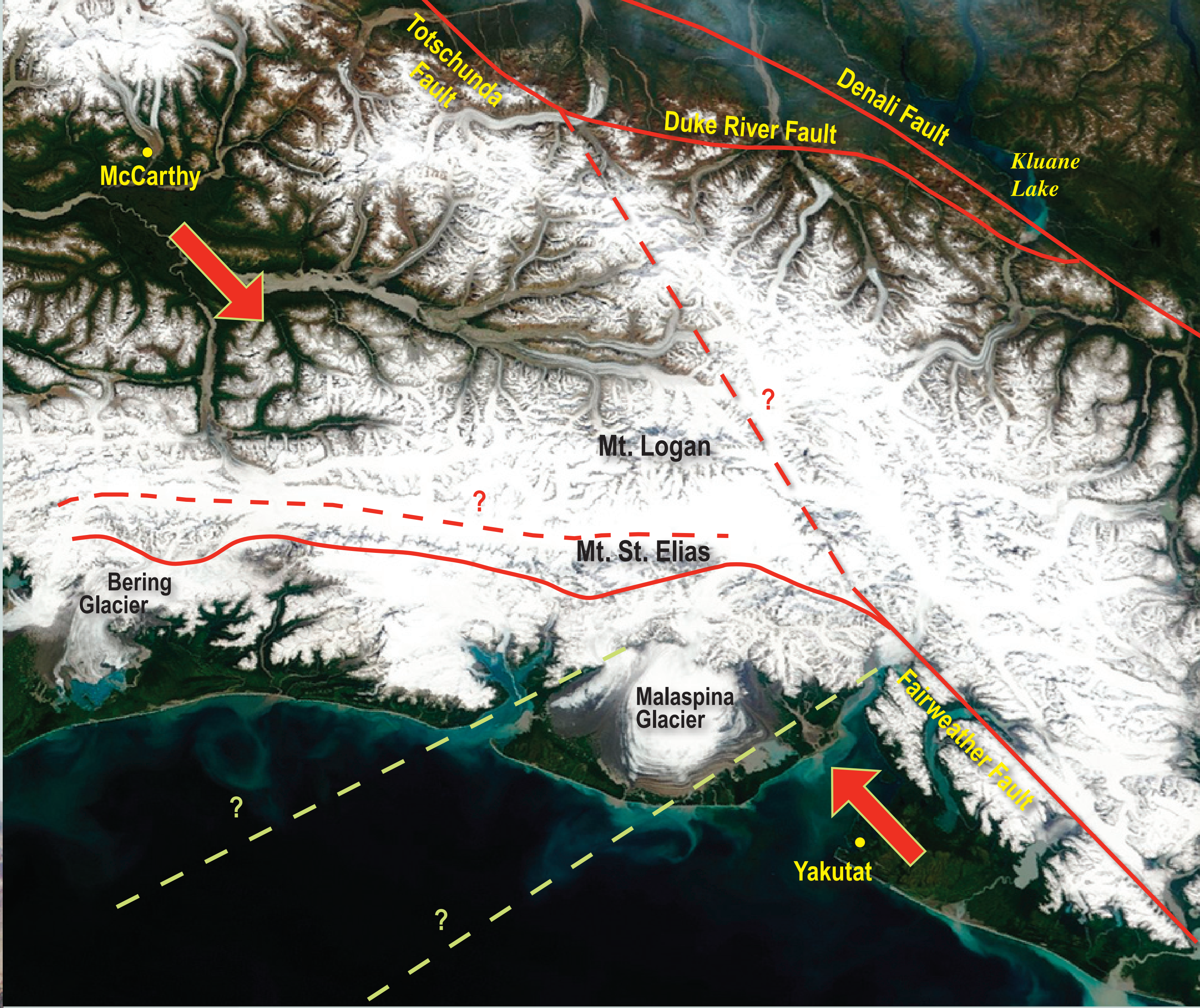
photo by Chris Larsen

Pictured above, glacier erosion is barely keeping pace with the rapid tectonic uplift near White River Glacier in the Chugach Mountains.

At right, Jamie Roush and Josh Stachnik, with the Alaska Earthquake Information Center, and their pilot George Carter (standing) install a seismometer in the Khitrov Hills overlooking Bering Glacier.

At far right, folded rocks of Chugach Terrane are pictured.





Above, a MODIS image of the STEEP region shows known fault lines (solid red lines), postulated fault locations (dashed red lines), and offshore postulated fault locations (dashed green lines). The arrows show the direction of convergence in the area between Yakutat and McCarthy. The MODIS image was processed by the Geographic Information Network of Alaska, and the overlay information was created by Chris Larsen and Julie Elliott.

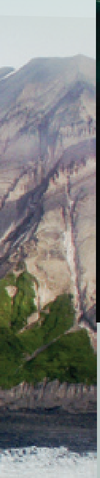


photo by Steve Estes

photo by Chris Larsen

Dinosaur Track Discovered in Denali

On June 27, 2005, while looking at rocks in Denali National Park, University of Alaska Fairbanks student Susi Tomsich found a track, pictured at right, which was left behind in sandy mud about 70 million years ago by a three-toed, theropod dinosaur. The track covers the same area (six by nine inches) as a large grizzly bear track. Tomsich and student Jeremiah Drewel were with Paul McCarthy, Geophysical Institute associate professor of geology, along the Denali Park road looking at outcrops of rock that reminded McCarthy of similar formations he'd seen in Alberta and Utah.

"In those areas you'd sometimes see toeprints hanging down below sandstone from where a dinosaur had stepped," McCarthy said. "I told the students they should look for them, and Susi pointed and said, 'Like this one?,' and there it was. It was just luck that we fell upon it."

The track is the first evidence of dinosaurs found in Denali National Park and Preserve, and follows years of searching by Anthony Fiorillo of the Dallas Museum of Natural History, who partnered with McCarthy for his expertise with fossil soils. Having located the ground-breaking find, Tomsich has decided to pursue her master's degree in geology under McCarthy's supervision. She will study rocks near where the track was found as part of her graduate research.

photo courtesy National Park Service

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University of Alaska Fairbanks
903 Koyukuk Drive
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