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Night-glowing Clouds Provide Climate Change Clues

Geophysical Institute scientists will join scientists around the world in a six-year project to study noctilucent clouds, the highest clouds in Earth's atmosphere and possible markers of climate change.

Scott Bailey, an assistant professor of space physics at the Geophysical Institute, is deputy principal investigator on a NASA-funded program known as Aeronomy of Ice in the Mesosphere (AIM). James Russell with Hampton University in Virginia, lead principal investigator, is working with Bailey and scientists from ten other institutions to find out how noctilucent clouds form and why their numbers seem to have been increasing in the last few decades.

Noctilucent, also known as "night-glowing," clouds form about 80 kilometers above Earth. People see these luminous, silver-white clouds long after the sun has set.

The first documented observation of a noctilucent cloud was recorded by Robert Leslie, who wrote a letter to the journal Nature in 1885: "(On) Monday evening, the 6th, about 10 p.m., a sea of luminous silvery white cloud lay above a belt of ordinary clear twilight sky, which was rather low in tone and color. . . . These clouds were wavelike in form, evidently at a great elevation, and must have received their light from the sun."

Since Leslie's observation, noctilucent clouds have been seen by many Northerners, most of them living at latitudes farther north than 55 degrees, about the latitude of Ketchikan, Alaska. During the last three summers, however, people in Utah, about 40 degrees north, also have reported seeing them. The apparent increasing frequency of sightings has scientists wondering if the clouds are an indicator of global change in the upper atmosphere.

NocNoctilucent, also known as "night-glowing," clouds have been observed more frequently in the last few decades, and scientists at the Geophysical Institute are among those trying to find out why. These noctilucent clouds were captured in the summer of 2001 in Fin-land's Renko (right), and Valkeakoski (below).

PHOTO BY TIMO LEPONIEMI

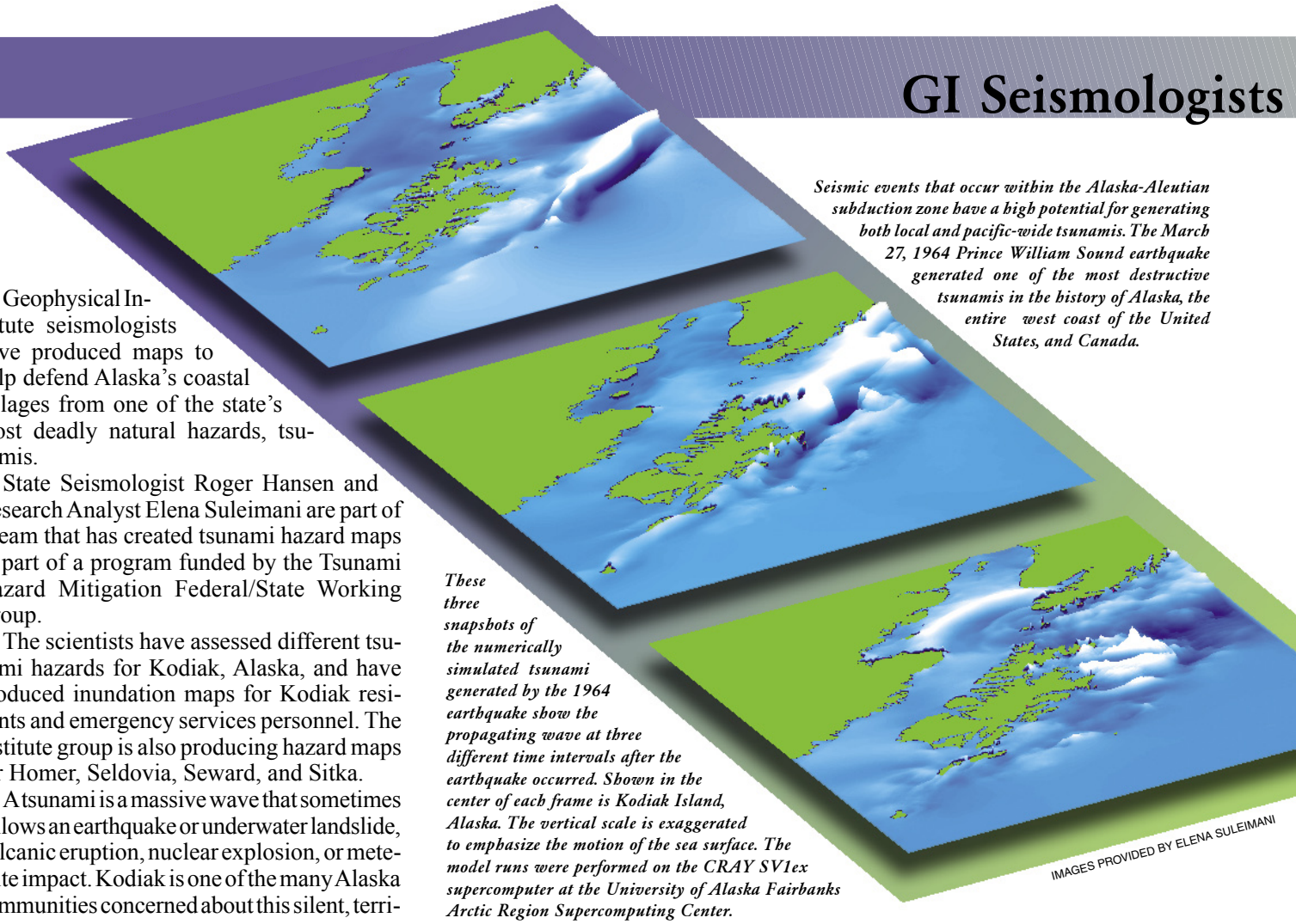
PHOTO BY TOM EKLUND

The clouds may form in a variety of ways: as the result of increased methane and carbon dioxide in the upper atmosphere; as a by-product of cooling in the upper atmosphere caused by warming in the lower atmosphere; and simply by water exhausted from rockets.

To learn more about these clouds, scientists on the AIM research team will use four science instruments onboard a satellite that will be launched from Vandenberg Air Force Base in California in 2006. The investigators will use data recorded during four seasons throughout the 23-month satellite flight. Investigators may use the Alaska Synthetic Aperture Radar (SAR) Facility's antenna on the top of the GI, potentially earning the University of Alaska Fairbanks up to $3 million during the six-year project.

Night-glowing clouds dominate the sky above Juneau, Alaska, in this scene captured by University of Colorado researcher Richard Keer during the summer of 2000.

GI Seismologists



IMAGES PROVIDED BY ELENA SULEIMANI

Seismic events that occur within the Alaska-Aleutian subduction zone have a high potential for generating both local and pacific-wide tsunamis. The March 27, 1964 Prince William Sound earthquake generated one of the most destructive tsunamis in the history of Alaska, the entire west coast of the United States, and Canada.

These three snapshots of the numerically simulated tsunami generated by the 1964 earthquake show the propagating wave at three different time intervals after the earthquake occurred. Shown in the center of each frame is Kodiak Island, Alaska. The vertical scale is exaggerated to emphasize the motion of the sea surface. The model runs were performed on the CRAY SV1ex supercomputer at the University of Alaska Fairbanks Arctic Region Supercomputing Center.

Geophysical Institute seismologists have produced maps to help defend Alaska's coastal villages from one of the state's most deadly natural hazards, tsunamis.

State Seismologist Roger Hansen and Research Analyst Elena Suleimani are part of a team that has created tsunami hazard maps as part of a program funded by the Tsunami Hazard Mitigation Federal/State Working Group.

The scientists have assessed different tsunami hazards for Kodiak, Alaska, and have produced inundation maps for Kodiak residents and emergency services personnel. The institute group is also producing hazard maps for Homer, Seldovia, Seward, and Sitka.

A tsunami is a massive wave that sometimes follows an earthquake or underwater landslide, volcanic eruption, nuclear explosion, or meteorite impact. Kodiak is one of the many Alaska communities concerned about this silent, terri-

Geographic Information Network of Alaska: Turning Data Into Useful

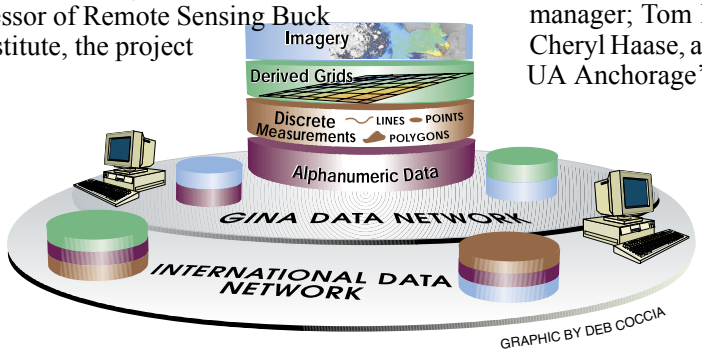
The Geographic Information Network of Alaska (GINA) is a new program designed to coordinate and expand University of Alaska (UA) capabilities in satellite remote sensing and Geographic Information Systems (GIS) technologies.

"The university collects tremendous amounts of geospatial data – measurements that are associated with a location and can be placed on a map or overlain on a satellite image. As a component of UA President Hamilton's Data Initiative, our job includes creating new uses for these data, not just within the university, but also throughout government agencies and within industry," said President's Professor of Remote Sensing Buck Sharpton of the Geophysical Institute, the project director of GINA.

GINA personnel are developing a web-based system to act as the principal data portal between university campuses and the outside world. This system will provide expedient access to university data sets and will include sophisticated GIS analysis tools so users can search and combine data sets, extract information and make decisions using desktop computers. GINA also provides training and expertise in satellite image processing and GIS software.

"The idea is to encourage broader use of our data and the analysis techniques that have been developed recently," Sharpton said. "Our team is dedicated to building new data sets, developing new tools, and providing training and expertise in various fields of satellite data and GIS technologies."

Among those on the GINA team are the Geophysical Institute's Kevin Engle, a research programmer; Shari George, a systems manager; Tom Heinrichs, a program analyst; and Cheryl Haase, a systems analyst. Also involved are UA Anchorage's Keith Boggs of the Alaska National Heritage Program, Steve Colt of the Institute of Social and Economic Research, and Cherie Northon of the Department of Geomatics, along with Carl Byers of UA Southeast's Department of Environmental Sciences and Kara Nance of UAF's Mathe-



GRAPHIC BY DEB COCCIA

Create Tsunami Hazard Maps

fying threat, because a tsunami destroyed much of the town in 1964.

On the afternoon of March 27, 1964, an earthquake with magnitude 9.2 ruptured Earth's crust about 14 miles beneath the seafloor of Prince William Sound.

Near the boundary of the massive Pacific and North American plates, part of the seafloor rose. The rise caused a sudden increase in sea level that gravity pushed back down, giving birth to a tsunami.

In the deep water of Prince William Sound, the tsunami began as a series of long waves of different amplitudes that extended for miles. The tsunami grew stronger as the waves moved like ripples in a pond into the Gulf of Alaska and the north Pacific Ocean.

The developing tsunami moved at the speed of a jet aircraft, slowing only when it reached coastal areas, such as the shores of Kodiak Island. At the coastline, the tsunami grew in height. It rose not as a great towering wave, but as a rapidly rising tide that flowed over into the boundaries of the small town. In its wake, eight people died and 158 houses were destroyed.

The magnitude 9.2 earthquake was the second largest ever recorded. It is credited with causing the death of 115 people in Alaska. Tsunamis triggered by the earthquake and landslides that followed the earthquake are blamed for 106 of those deaths.

The tsunami generated by the 1964 earthquake also reached the coast of California, where it killed 11 people in Crescent City. It also claimed the lives of four people camping on the coast of Newport, Oregon, when the ocean rose to engulf their campsite.

Hansen and Suleimani used hypothetical earthquake sources, bathymetry information, and topographic maps to produce the Kodiak inundation map. The inundation map shows colored boundaries indicating the extent of maximum flooding that would occur in Kodiak Island communities as a result of different earthquake scenarios.

The tsunami inundation generated by the 1964 earthquake is considered the worst-case scenario because seismologists do not expect another earthquake of that magnitude for several hundred years.

Suleimani used the Arctic Region Supercomputer at UAF to help create a variety of different tsunami scenarios. The earthquake and tsunami variables she used in her computer-generated models differ according to where the earthquake occurs, the underwater topography, and landforms in the area hit by the tsunami.

Because Kodiak officials already are using the tsunami map of Kodiak, Suleimani is working on hazard maps for other Alaska coastal communities.

Hawaiian emergency officials and others along the west coast of the U.S. and Canada also are interested in UAF's tsunami modeling results, according to Hansen.

"We are the exporters of tsunamis," Hansen said. "Hawaii and others import them. Alaskans are most likely to be hit with a local tsunami."

Information

matical Sciences Department.

Among GINA's early tasks is an effort to bring various university, government, and industrial partners together to develop updated topographic maps of Alaska based on modern remote-sensing approaches, such as those used by the GI's Alaska SAR Facility.

With GINA, Sharpton wants to promote the growth of industries using the emerging satellite and geospatial information technologies developed at the university and elsewhere.

"We want a stable Alaskan workplace to provide attractive jobs for our graduate students," Sharpton said.

One of the nodes of GINA's network is the International Ob-servatory of the North (ION), to be housed partly in the International Arctic Research Center and partly in the future West Ridge Research Building. ION personnel will be trained to handle large volumes of MODIS satellite data as well as information from LANDSAT and other Earth-observing satellites.

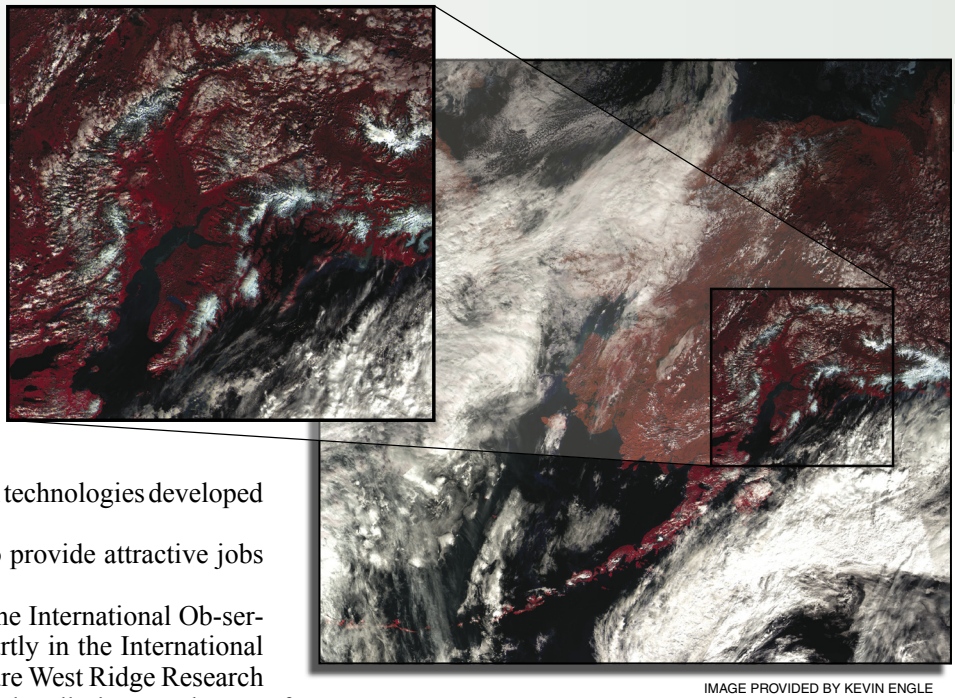
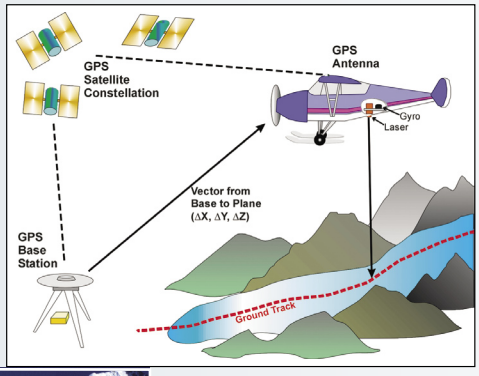


IMAGE PROVIDED BY KEVIN ENGLE

This MODIS image of Alaska was created from data acquired during several satellite orbits in August of 2002. The data was compiled by Geophysical Institute Research Programmer Kevin Engle, part of the GINA team.

GI Gaciologists' Study Gains Worldwide Attention

An article by Geophysical Institute glaciologists has attracted the attention of scientists and news media around the world. "Rapid Wastage of Alaska Glaciers and their Contribution to Rising Sea Level," published in the July 19, 2002 issue of the journal Science, has resulted in news stories that appeared in the Washington Post, USA Today, BBC News, the Toronto Star, the Daily Globe and Mail, and 36 other news outlets. Geophysical Institute Glaciologists Anthony Arendt, Keith Echel-meyer, Will Harrison, Craig Lingle and Virginia Valentine are the authors of the study. In the study, the scientists reveal that Alaska glaciers have produced double the estimated loss from the much-larger Greenland ice sheet.



This schematic by V. Valentine shows the main components of the laser altimetry system.

The journal article is the culmination of more than 10 years of work, led by Echelmeyer, a professor of Geology and Geophysics. Echelmeyer and GI staff members mounted a laser-measuring system in the belly of Echelmeyer's Piper aircraft. With the system, he measured more than 100 of Alaska's glaciers, 67 of which are cited in the study. Only a few Alaska glaciers were monitored long-term before the laser-measuring system was developed.

"To make confident predictions for the course of sea level rise in the 21st century, we must first understand its causes in the past century," wrote Mark F. Meier of the University of Colorado, Boulder, in an article on sea level change in the July 19, 2002 Science. "The work of Arendt et al. shows the way ahead. We need more laser altimeter studies of glaciers in areas where mass balance observations are few."

PHOTO BY KEITH ECHELMEYER

This aircraft was used to conduct laser altimetry near Mt. Hunter, Alaska.

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