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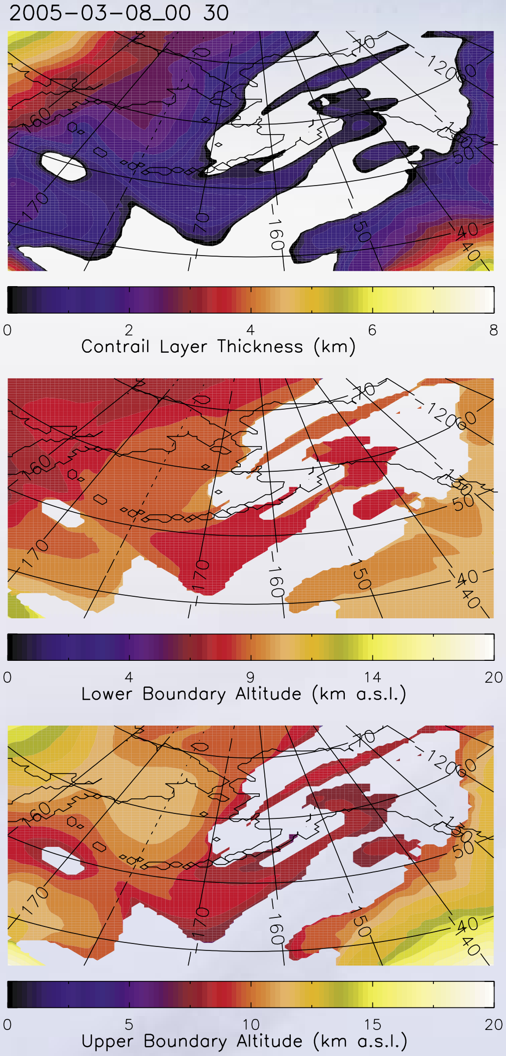
GI Researchers Develop Contrail Forecasts

Contrails that form behind jet aircraft when atmospheric conditions are cold and moist can affect the local climate. Geophysical Institute Professor Emeritus Gerd Wendler and Research Associate Martin Stuefer have developed a contrail forecast system for skies above Alaska. The daily forecasts, which predict the flight levels at which jet aircraft will create contrails, are available to pilots, climate researchers and the public at http://contrail.gi.alaska.edu.



FORECASTS—The charts above show the thickness, lowerboundary,andupperboundaryofforecastedcontraillayersfortheskyoverAlaska.Imagecourtesyofthe Alaska Climate Research Center

Short for "condensation trails," contrails appear as white lines in the sky behind aircraft. Contrails appear when conditions are right; their presence or absence depends on humidity, air temperature, type of aircraft, fuel used, air pressure, and other factors. Strong winds often cause contrails to spread and mimic cirrus clouds.

To create the contrail forecasts, Wendler and Stuefer use weather-balloon information from the National Weather Service, Federal Aviation Administration data on air traffic flying over Fairbanks, an all-sky camera mounted on UAF's Elvey Building, the MM5 weather forecast model, and their own observations of the Fairbanks sky. They have combined this data with algorithms to create the forecasts, and have written software that allows jet pilots to see where contrails will form along flight routes. Their program can be applied to airspace worldwide, but so far Wendler and Stuefer only have verified it for skies over Alaska.

The researchers have developed the forecasts as part of the University Partnering for Operational Support program, funded by the U.S. Department of Defense, in collaboration with the Applied Physics Laboratory at Johns Hopkins University. The forecasts are of interest to the military because contrails betray the location of aircraft. Contrails also are important to climate research because the ice crystals composing them reflect incoming sunlight and trap the warmth of the ground. Researchers need to know the temporal and spatial distribution of contrails and the vertical distribution of moisture in the atmosphere to estimate the potential for them to affect climate.

photo by Deborah Coccia Manning

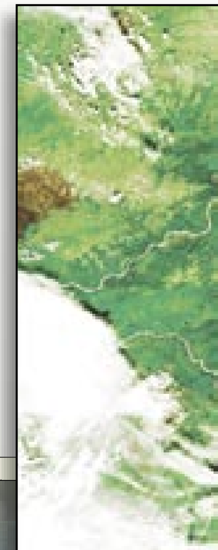
Contrails, such as these in the sky over the Denali Highway in the Alaska Range, can affect local temperatures.

Large numbers of contrails, such as those present over cities with busy airports, can cause warming at night and cooling during the day. Even in Fairbanks, a city with about 15 overflights each day, contrails may affect temperatures. "One contrail can affect the radiation balance," Stuefer said. "In the subarctic, contrails definitely could lead to warming in winter," Wendler added.

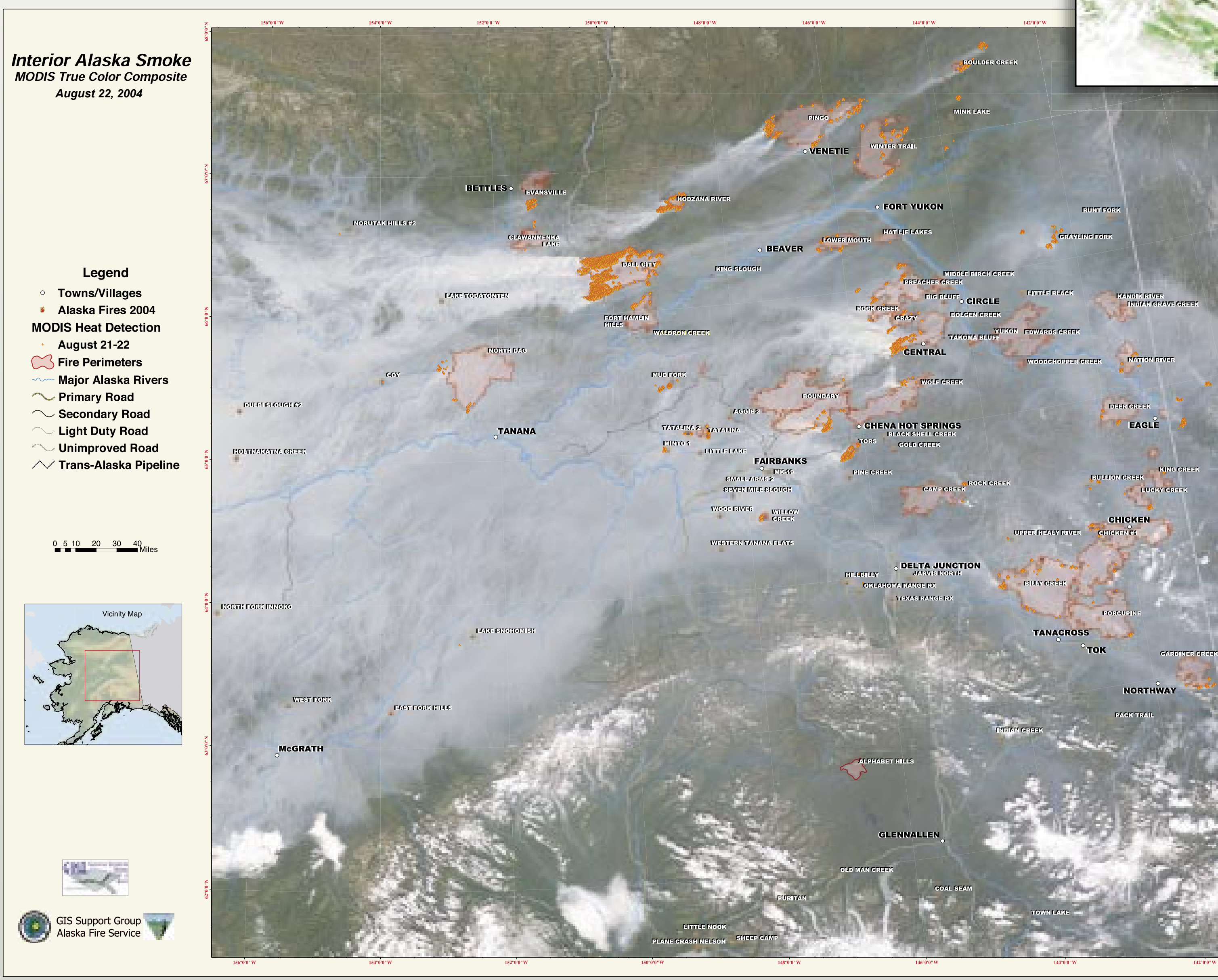
UAF UNIVERSITY OF ALASKA FAIRBANKS

GINA Delivers for Alaska Firefighters

In the summer of 2004, an area of Alaska larger than the state of Vermont went up in smoke. The smoke was so thick that planes used for mapping fires often couldn't leave the ground. On those days and others, the Geographic Information Network of Alaska (GINA) team at the Geophysical Institute provided near real-time information to Alaska firefighters. "This year (GINA data) proved to be extremely valuable, not only to see what we were doing on really smoky days, but even to detect a few fires," said Sean Triplett, an Alaska Fire Service GIS specialist who created up to 20 maps daily during Alaska's largest fire season on record. "Using GINA data, we found five or six fires we didn't know were there."



The GINA team, including Director Buck Sharpton, Ground Station Manager Kevin Engle and Technical Services Manager Tom Heinrichs, used MODIS satellite data to produce fire-detection products covering Alaska, Canada, and the Northwest Pacific region of the U.S. These products were delivered to local agencies and to the USDA Forest Service Remote Sensing Applications Center in Salt Lake City. Alaska fire managers used the images every day. "This summer, we were looking at them every satellite pass, several times a day," said Corey Doolin, a dispatch coordinator at BLM. "We would get nice,



GEOGRAPHIC INFORMATION NETWORK OF ALASKA
UNIVERSITY OF ALASKA

FOREST FIRE IMAGERY—Burn intensity and large-scale habitat effects as observed from space are shown in the GINA image below. Scars left by summer fires (August 4, 2004) are shown in brown. Thermal hotspots revealed by MODIS images (lower left) were used to detect fires.

full-color images of the smoke where you could really see its source."

MODIS is an Earth-imaging instrument that rides aboard two NASA satellites, Terra and Aqua. Engineers designed the MODIS sensor to include characteristics specifically for fire detection. Against the cool backdrop of Alaska surfaces, the MODIS algorithm can confidently identify a 700º C-hot fire smaller than a football field. The GINA team receives MODIS data using an antenna on the International Arctic Research Center roof and can deliver images and hot spot information to fire agencies within a half hour.

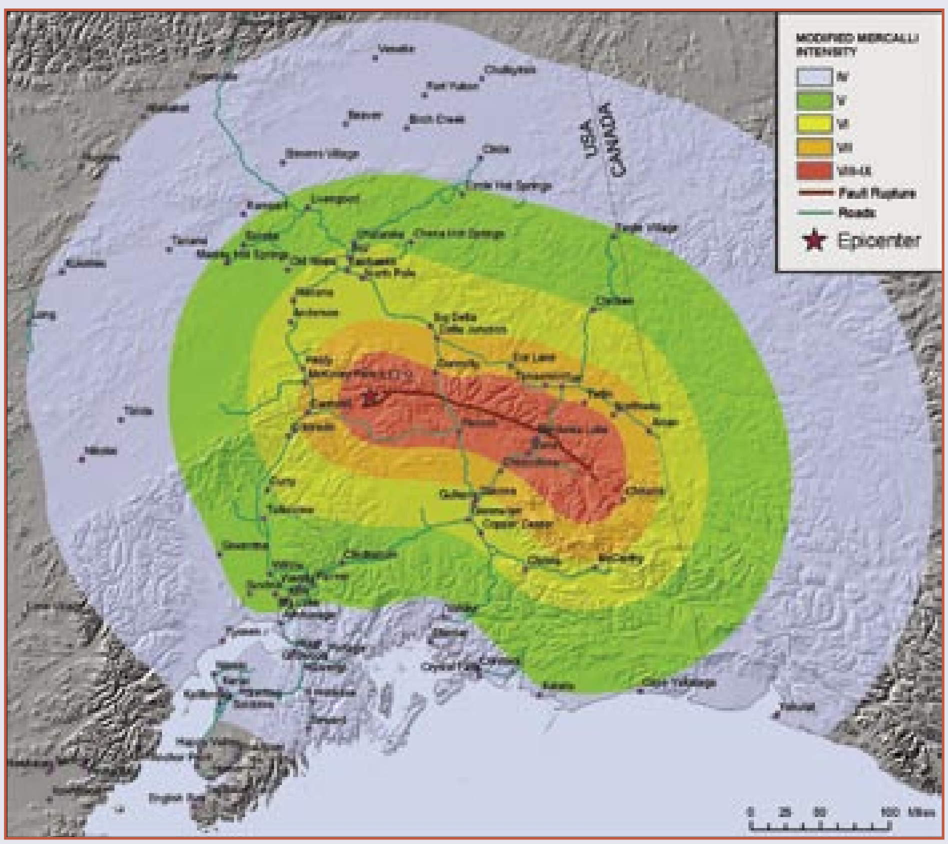
GINA also receives real-time data from NOAA satellites carrying an Advanced Very High Resolution Radiometer, or AVHRR. GINA's location enables enhanced reception loads for polar-orbiting satellites; on average it receives data from 24-44 AVHRR and 18 MODIS passes each day. GINA's reception mask covers the western Arctic and extends south to northern California.

A Shaking-Intensity Map of A Giant Alaska Earthquake

Artak Martirosyan, a research associate who studies strong earthquake motion at the Geophysical Institute, has used responses from people affected by the Denali Fault earthquake to refine a USGS earthquake model of shaking severity. The magnitude 7.9 Denali Fault earthquake occurred on November 3, 2002, ripping the ground surface along its path for about 330 kilometers. The earthquake shook Canadian high-rise dwellers, lit up seismometers in Yellowstone National Park, and sloshed water wells as far south as Louisiana.

The USGS model separates shaking zones by zip code, and because some Alaska zip codes cover areas larger than the state of Delaware, Martirosyan conducted interviews to obtain specifics about earthquake damage. One year after it occurred, Martirosyan traveled to areas affected by the earthquake and distributed questionnaires to local business owners. He also wrote down addresses of private homes in the earthquake zone, and then mailed questionnaires to residents. Ninety-nine of those questionnaires were returned, with comments such as, "I hit G-forces on the dozer that only astronauts are trained for," and, "You could hear the Alaska Range ripping apart."

The responses helped Martirosyan produce a new shaking-intensity map to supplement a USGS-made map based on more than 3,400 intensity reports received from people on its Web site, http://pasadena.wr.usgs.gov/shake/.



SHAKING-INTENSITY—Reports of shaking intensity are reflected in the map above. Reports that fall in the IV category include, "felt indoors by many and outdoors by few;" in the V category, "felt by nearly everyone;" in VI, "many frightened but damage slight;" in VII, "considerable damage in poorly built or badly designed structures;" and VIII-IX's description includes "heavy furniture overturned, buildings shifted off foundations." Image by Artak Martirosyan, UAF Geophysical Institute

Alaska Climate Research Center Wraps Up 2004

Climate Center reveals record-breaking summer

In addition to compiling detailed weather data and providing monthly weather summaries for locations throughout Alaska, researchers with the Alaska Climate Research Center post special features on the center's Web site, http://climate.gi.alaska.edu. The following is an excerpt from "Record Breaking Summer 2004," written by Geophysical Institute Research Professional and Climatologist Martha Shulski:

"Hot, dry, and smoky are three words that could be used to describe Alaska this summer. Just how warm were we? … Nome, Fairbanks, Anchorage, King Salmon, Valdez, and Juneau all experienced the warmest summer on record … Dry conditions also prevailed, mostly for the eastern Interior and southern regions. Fairbanks only had 38% of the normal summer precipitation total, but was almost one inch shy of the record lowest total, set in 1957."

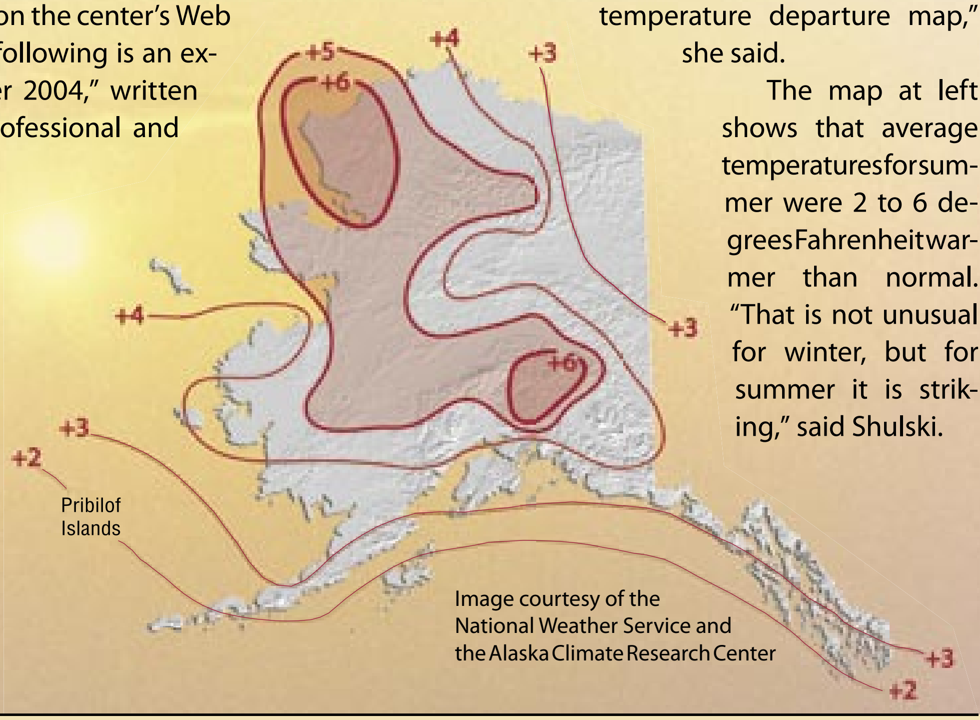


Image courtesy of the National Weather Service and the Alaska Climate Research Center

Shulski wrote the summary after receiving calls from people wanting to know how the summer compared with other years. "For me the most impressive thing is the temperature departure map," she said.

The map at left shows that average temperatures for summer were 2 to 6 degrees Fahrenheit warmer than normal. "That is not unusual for winter, but for summer it is striking," said Shulski.

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