

Forecasting Weather on the Ground and in Space

Geophysical Institute researchers are developing innovations in forecasting weather, both in Earth's atmosphere and in space through the University Partnering and Operational Support program. The UPOS program allows researchers to help improve space-weather and ground-weather tools used by the U.S. armed forces.

Twelve Geophysical Institute researchers are working on projects for the program, which is supported by funds from the U.S. Air Force and U.S. Army.

Institute scientists are collaborating on the program with researchers from the Applied Physics Lab at Johns Hopkins University. The team is working on 15 products this year. When the projects are completed, researchers will deliver the software to the Air Force Weather Agency at Offutt Air Force Base in Nebraska.

Geophysical Institute Director Roger Smith said the development of scientific products for the military fits with the institute's stated mission of serving the nation. While working on UPOS projects, institute scientists also will develop new capabilities for use in atmospheric science and space physics research.

The Puff model of volcano ash-cloud prediction, used by Ken Dean of the remote-sensing group for the Alaska Volcano Observatory, contributed to the UPOS program. Scientists Jeff Tilly, Cathy Cahill, Gerd Wendler, Richard Collins and Knut Stamnes are developing other products as additions to standard weather forecasting models.

These new applications will help Air Force forecasters anticipate when jet aircraft will leave trails in the sky, identify conditions that cause ice to develop on the surface of aircraft, detect the presence of ground fog, and determine the likelihood of local temperature inversions.

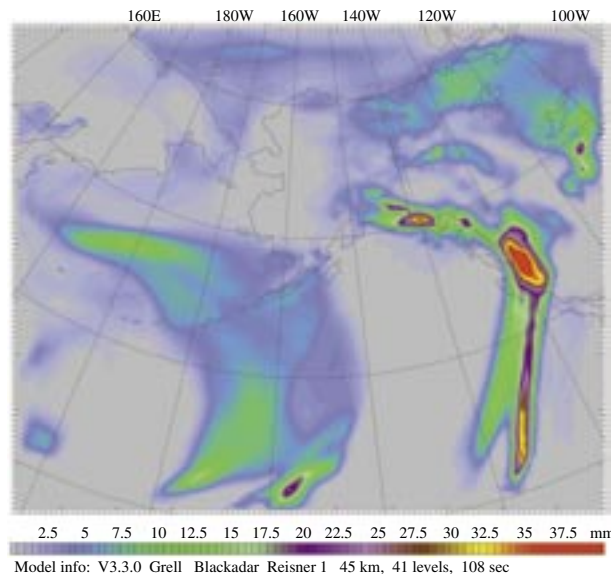
Space physics researchers examining the flow of solar wind and geomagnetic storms for the UPOS project include Bill Bristow, Wei Sun, Mark Conde, Charles

Deehr, Hans Nielsen, Dirk Lummerzheim, Dan Swift, and George Khazanov. Their space weather products include forecasts of the arrival of shocks resulting from solar flares and forecasts of the likelihood of magnetic storms.

Because activity in the ionosphere can disrupt high-frequency radio communications,

institute scientists are developing a forecast for usable HF communication pathways. In addition, researchers are creating a "nowcast" showing current boundaries of the aurora and indexes to predict fluxes in Earth's magnetosphere that affect inputs to computer models.

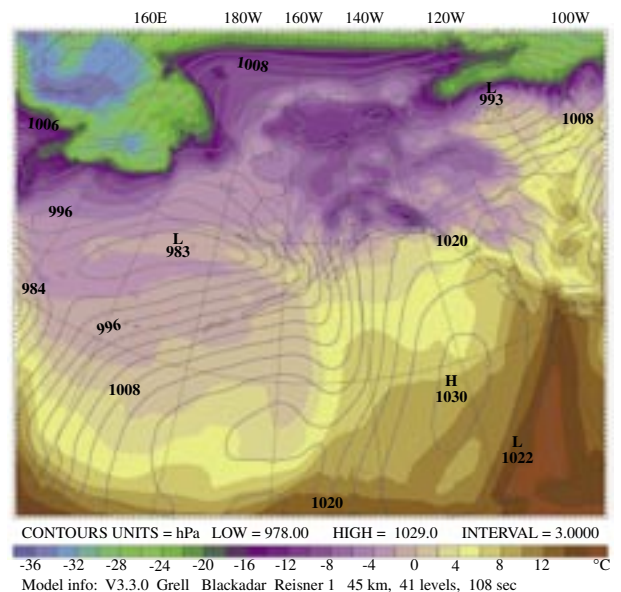
They also are designing a device to predict precipitating protons in the aurora that can disable communications satellites.



Weather Forecasts—Pictured are models used as the basis for Air Force Weather Agency forecasts. University Partnering and Operational Support System work related to terrestrial weather is performed at the GI to enhance the model's capabilities and use for the high-latitude environment.

The two panels show 24 hour forecasts, valid at 3 a.m. AST December 6, 2000, produced by the UAF implementation of AFWA's MM5 numerical weather prediction model.

The top panel shows a forecast of 12-hourly accumulated precipitation, while the lower panel shows a forecast of sea level barometric pressure (contours) and surface air temperature (solid colors).



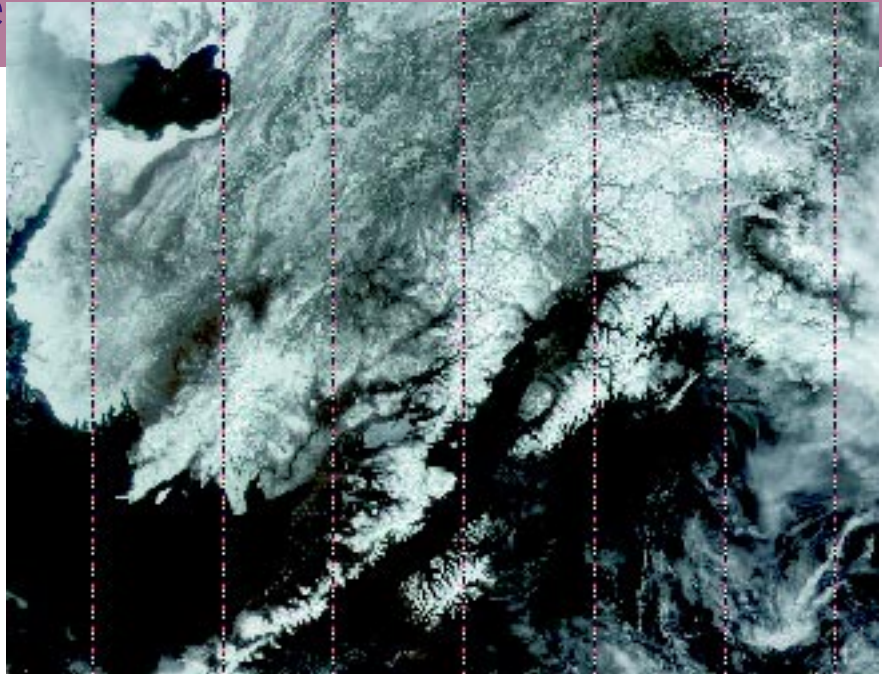
More information on the model forecasts, which are updated daily, as well as other links to the UPOS program, can be found on the web at <http://knik.iarc.uaf.edu>.

MODIS to Provide UAF with a Detailed View from Space

A new satellite-receiving station at the Geophysical Institute and International Arctic Research Center will allow scientists to determine the ocean's surface temperature and the abundance of plankton near the surface. The same system will pinpoint forest fires, show volcanic eruptions, and reveal the location of cracks etched on sea ice at the North Pole.

MODIS is the name of the imaging tool in space that will be available for scientists this year, after contractors build a receiving station at the University of Alaska Fairbanks. The Moderate Resolution Imaging Spectroradiometer is an instrument carried aboard two NASA satellites—the EOS Terra and the EOS Aqua. The satellites will transmit detailed images of Earth to the UAF station, which is scheduled to be built in August.

“MODIS is an important tool because it will produce frequent images of large portions of Alaska,” said Buck Sharpton, professor of geology and geophysics at the Geophysical Institute and principal investigator of the MODIS receiving-station project. MODIS has 36 spectral bands to



detect the energy emitted and reflected by everything on Earth. The Terra and Aqua satellites have a polar orbit, which means they pass over Alaska at least nine times each day, Sharpton said.

Ted DeLaca, director of the Arctic Re-

search Office at UAF and Dave Verblya of UAF's Forest Sciences Department also are investigators on the MODIS receiving station project. Researchers can use MODIS to study many features of the planet that are hard to examine from the

The Mystery of the Denali Gap

Mt. McKinley has never erupted and probably never will, but the highest mountain in North America has geological qualities that make Chris Nye wonder why it is not a volcano.

Nye, a state geological survey researcher with the Alaska Volcano Observatory at the Geophysical Institute, says the nature of two maars located near Healy, Alaska, suggests that processes operating beneath the central Alaska Range are the same as those operating under the volcanoes on the western shore of Alaska's Cook Inlet.

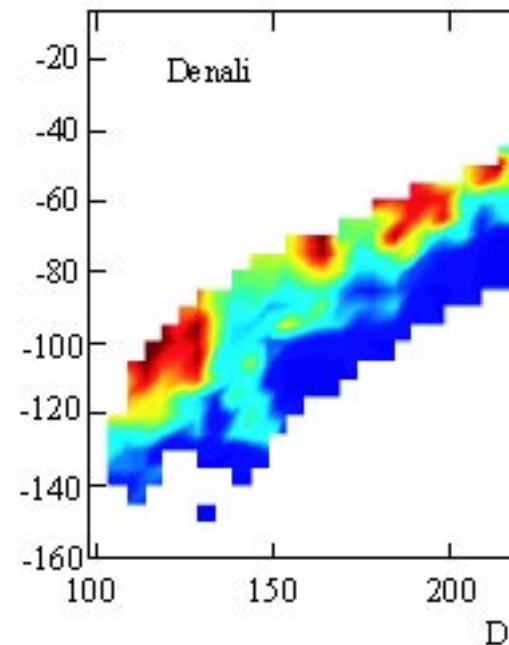
Maars are small volcanic vents formed by the explosive interaction of ascending magma and groundwater. The maars formed about 3,000 years ago, and are located near Buzzard Creek, north of Healy. The craters near Buzzard Creek have the same chemical signature of volcanoes in the Aleutian Arc.

Extending east from Russia's Kamchatka Peninsula, the Aleutian Arc curves

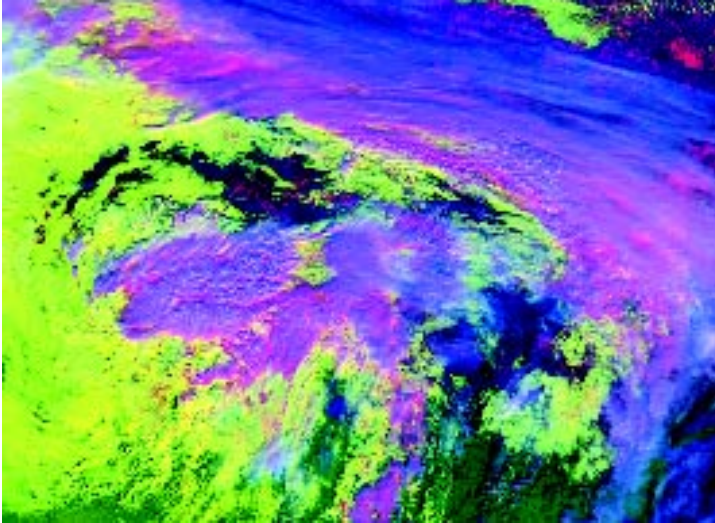
in a crescent shape that, if superimposed on the continental United States, would extend from San Francisco to St. Louis. Most of the arc is visible as the Aleutian Islands, home to about 100 volcanoes.

The northeasternmost long-lived stratovolcano in the arc, Mt. Spurr, is located across Cook Inlet from Anchorage, Alaska. Volcanic activity seems to end there, but the zone of earthquakes that occur when the North American plate is underthrust by the Pacific plate extends north to the Alaska Range. The Alaska Range features no volcanoes until the craters at Buzzard Creek. Nye calls the non-volcanic area between Mt. Spurr and Buzzard Creek “the Denali Gap.”

The area of the Denali Gap—a 200-mile stretch of high mountains—has all the ingredients needed for volcanic activity, but no volcanoes. One element necessary for volcanic activity is subduction, during which one of Earth's plates—a giant slab of crust—dives below another. Beneath



Cross Section—Shown is a map of the b-value in a cross section of the Denali Range. The b-value is a measure of the magnitude-frequency relationship. High b-values (warm colors) reflect a large proportion of small earthquakes. Low b-values (cool colors) reflect a large proportion of large earthquakes. Fluids released from the slab during metamorphic dewatering and fluid production in subduction zones.



MODIS Views

Far Left: Alaska

Left: Cloud variations

Below: the North Pole

Right: Black Sea phytoplankton

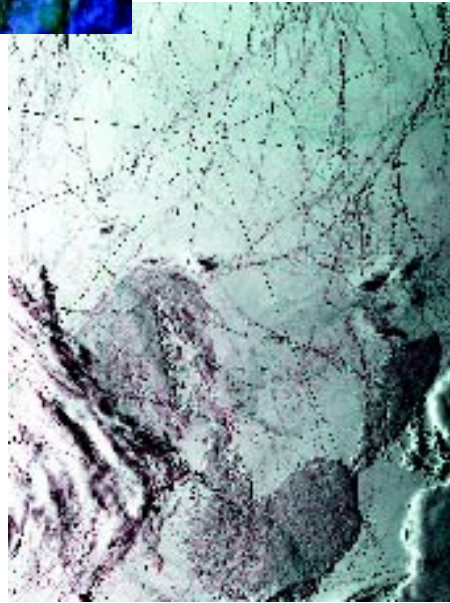


ground, such as the rate at which forests grow, the altitude and location of clouds, and ocean productivity. Sharpton said federal and state agencies will be able to use MODIS images to determine the location of hot spots within a forest fire.

“From the images, we can tell within two hours where a fire is located, its extent, and where it’s burning the hottest,” Sharpton said.

Commercial fishermen are among private business owners who might use MODIS images. Under the right conditions, MODIS can detect locations of plankton clusters that attract fish.

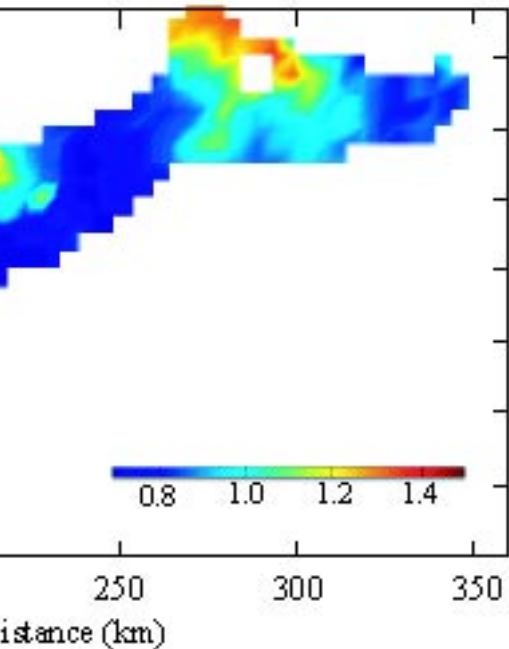
“Commercial fisherman could download updates of where fish might be sev-



eral times each day,” Sharpton said.

Sharpton hopes that by creating markets for products such as forest fire maps and ocean productivity maps, MODIS also will create jobs for graduate students at UAF who are learning to use the system.

“We need to build a user community, because we do not have one in place right now,” Sharpton said.



Frequency distribution of earthquakes in a volume of the earth. High frequency earthquakes and probably result from high pore-pressure due to magma reactions. These fluids are a critical ingredient for magma

the Denali Gap and much of Alaska, the Pacific plate grinds underneath the North American plate. As the Pacific plate descends, it gives off water and other fluids that mix with dense rock to form molten rock; that molten rock sometimes rises to form a volcano.

Most of the Aleutian volcanoes are located about 60 miles above the place where the Pacific plate meets the North American plate. The Buzzard Creek craters and the mountains of the Alaska Range are located about 60 miles above the interface of the giant plates, making some scientists wonder why volcanoes exist in the Aleutians but not the Alaska Range.

A large number of earthquakes recorded beneath the Alaska Range indicate that subduction is still occurring. According to GI Professor Max Wyss, the magnitude-frequency distribution of earthquakes in the subducted plate underneath Mt. McKinley is the same as that beneath other arcs worldwide, and beneath the Cook Inlet volcanoes. A small area 60 miles beneath Mt. McKinley

contains an excess of small earthquakes, a phenomenon encountered around active magma chambers near the surface that is sometimes associated with high pore pressure. For this reason, Wyss hypothesizes that liquids may be generated in the descending slab at that depth, and therefore a source of magma should exist 60 miles beneath Mt. McKinley.

What stopped the formation of volcanoes between Mt. Spurr and Buzzard Creek? One theory is that a block of crust under southern Alaska is plastered to the North American plate so firmly that molten rock can’t make its way to the surface in the western Alaska Range. Nye said scientists also once believed that the Pacific plate dried up on its journey beneath the North American plate before reaching Mt. McKinley. But volcanologists have found evidence of the very same wet matter that produces volcanic activity in the Aleutian Arc near the craters at Buzzard Creek.

Honeywell Signs on at Poker Flat



Honeywell has signed a 10-year lease with Poker Flat Research Range, sealing a deal that will provide a new building for range use and research dollars for Geophysical Institute scientists.

In May of 2000, representatives from Honeywell, a large corporation offering products ranging from Prestone antifreeze to aerospace services, installed an 11-meter satellite antenna at the range. In that same month, a contractor started construction on a support building for tracking satellites.

The University of Alaska Fairbanks paid about \$800,000 for the building and the antenna pad, a sum Honeywell will pay back with interest during the lease. Honeywell also will pay Poker Flat approximately \$75,000 each year for maintenance and upkeep and \$27,000 each year for joint Honeywell/Geophysical Institute research projects.

Greg Walker, manager of Poker Flat Research Range, said marketing the range is among his most important duties. The agreement with Honeywell is an example

of the type of business he wants to attract to Poker Flat.

“With Honeywell, we end up getting a new building; the university gets its money back; we get Honeywell’s business; and Roger (Smith, director of the Geophysical Institute) gets an opportunity to start research partnerships,” Walker said.

“With this money, we can hire graduate students, buy equipment, and fund investigations into the ionosphere,” Smith said.

Throughout the collaboration, Honeywell personnel will focus on satellites, while Poker Flat employees take care of ground operations and offer tracking assistance. Walker said the arrangement already has paid dividends for Honeywell.

“By partnering with us, they won the contract as a backup site for NASA (to track the agency’s satellites),” he said.

The map at left shows the layout of Poker Flat, the only university-owned rocket range in the world.

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