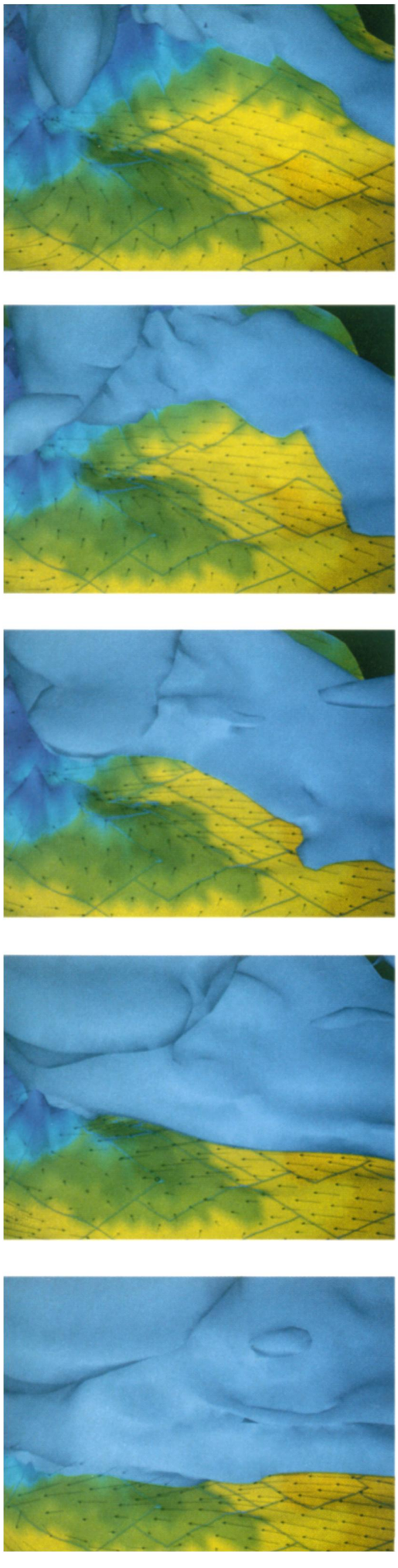


Gust Work

Meteorologists decipher the winds with radar

By MICHAEL STROH

Sunday, March 8 began in Denver as a mild spring day with temperatures in the 50s. Since the weather was so nice, meteorologist A.E. MacDonald decided to have dinner in the city that evening — a 30-mile drive from his home in Boulder. His decision would prove a mistake.

Early in the afternoon, thunderstorms began building high over northeastern Colorado. The National Weather Service issued a forecast that called for heavy rains to soak Denver toward evening and then change to snow around midnight, accumulating 3 to 6 inches by morning. MacDonald went ahead with his dinner plans anyway.

But the snowstorm arrived early, and with more punch than predicted. At 7 p.m., flakes started to fall. Fifty-knot winds soon belted the city, whipping the snow into a blizzard. Telephone lines went down. Motorists got stuck on the roadways, and upon leaving the restaurant, MacDonald became stranded too. Monday morning found Denver buried beneath 22 inches of snow.

MacDonald runs the Forecast Systems Laboratory at the National Oceanic and Atmospheric Administration (NOAA) facility in Boulder. If he had called his lab before leaving for Denver, he might have decided to eat in.

A computer model in his lab had forecast the arrival time and ferocity of the blizzard. How? For one thing, the computer had access to hourly data on upper-atmosphere winds — information the National Weather Service didn't have.

"If you don't know which way the wind is blowing," says MacDonald, "you're not going to make a very good weather forecast."

Chronicle of a storm foretold: Using wind profiler data, a computer model created by researchers at Colorado State University in Fort Collins predicted the massive snowstorm (light blue) that hit Denver on March 8, 1992. Arrows indicate wind direction.

John Snook/NOAA

Since World War II, meteorologists have used weather balloons to measure wind, temperature and humidity in the upper atmosphere. Every 12 hours, an instrument-packed helium balloon is launched at each of 70 sites around the United States. The balloons provide the data used to make the country's weather forecasts. But 12-hour balloon launches have one fundamental weakness. "The darn weather goes faster than we can send them up," MacDonald says.

The weather may be losing its edge, however. In May, NOAA officials announced that 29 experimental wind profilers are now operating in the nation's midsection. These devices can measure wind speed and direction in the upper atmosphere — between 0.5 and 16 kilometers above the ground — and transmit the data to meteorologists every hour.

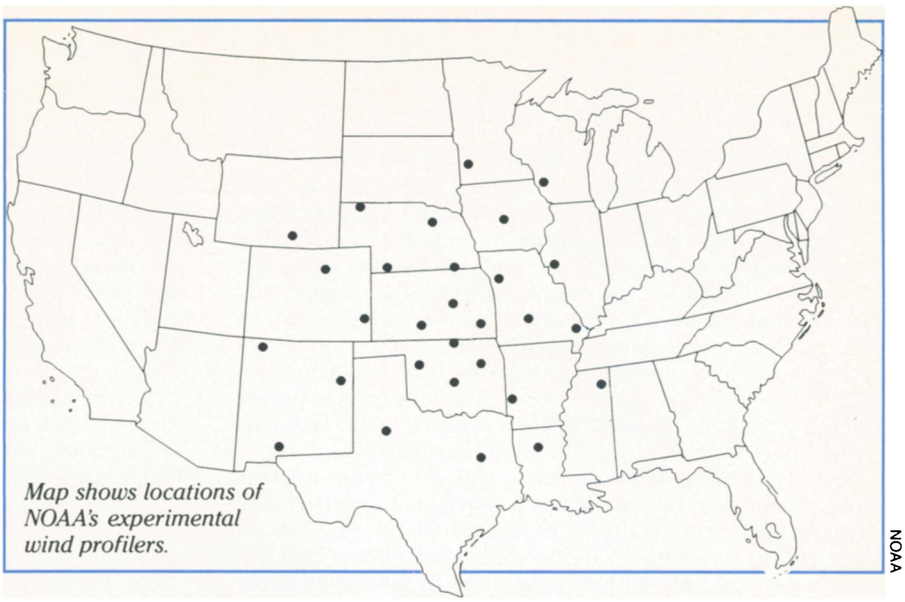
NOAA meteorologists think the profilers will not only help improve weather forecasts but also reveal more about how upper-atmospheric winds behave. And since the Great Plains region spawns some of the most severe weather in the country, the wind profilers should give scientists a much better notion of how these winds affect weather and vice versa, MacDonald says.

Wind profilers use Doppler radar and operate much like the radar guns police use to nab speeders. A wire-mesh antenna about half the size of a tennis court beams a signal straight up into the air. When this signal bumps into an air current, it bounces back down to a receiver on the ground. The collision also changes the signal's frequency in specific ways, and a computer hooked up to the wind profiler can compare the reflected signal with the original to determine the air current's speed and direction. Moreover, the signal's round-trip time reveals the air current's altitude.

Many meteorologists have started using wind profilers to improve their forecasts. The National Meteorological Center in Camp Springs, Md., now feeds

profiler data into the three computer models that generate the nation's mid-range forecasts. And many National Weather Service offices use the data to develop more accurate local forecasts.

Some meteorologists, however, still haven't figured out how to contend with all the incoming data. For instance, Michael A. Steinberg of Accu-Weather, a private weather service based in State College, Pa., says his computer models will need some retooling before they can take advantage of wind profiler data.



Map shows locations of NOAA's experimental wind profilers.

NOAA

Besides improving weather predictions, the wind profilers should help researchers learn more about an airstream known as the low-level jet. This current flows northward over the Great Plains at an altitude of 1 kilometer. (The jetstream, by comparison, flows from west to east at 12 kilometers.) The low-level jet often crisscrosses other air currents and creates wind shear, which helps spark thunderstorms and tornadoes.

Knowing how the low-level jet is behaving "may make the difference between a tornado watch and a thunderstorm watch," says Rick D. Ewald of the National Weather Service in Kansas City, Mo.

NOAA scientists foresee still other applications for the wind profilers. Air-traffic controllers could use them to route planes away from strong headwinds and into tailwinds, cutting fuel costs. And environmental researchers could use them to monitor the spread of airborne pollutants.

But meteorologists haven't grounded their weather balloons just yet. Right now, only eight of the 29 wind profilers can measure temperature and none can measure humidity, so balloons remain the only way to get this information. Furthermore, wind profilers cover only a small part of the United States, and it may take decades to outfit the rest of the country.

In the meantime, NOAA scientists hope to install wind profilers on Caribbean islands to help detect hurricanes, and in Alaska to spot nasty weather heading toward the lower states. But these plans will depend on the congressional climate over the next few years – and NOAA meteorologists know that forecasting this is impossible. □