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Closeup of the TOPAZ instrument inside the mobile measurement truck.

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Intrusive Ozone: When Good Ozone Goes Bad

Officials at the Department of Air Quality in Clark County, Nev., asked National Oceanic and Atmospheric Administration (NOAA) researchers to help them solve a mystery: Why is the region experiencing episodes of high ozone pollution in the springtime—so high that the county sometimes exceeds the federal standards for air quality?

NOAA researchers from Boulder, Colo., traveled west in the spring of 2013 to Angel Peak, about 30 miles northwest of Las Vegas, to investigate. They brought with them a unique technology known as the “Tunable Optical Profiler for Aerosol and oZone,” or TOPAZ for short.

TOPAZ incorporates state-of-the-art technologies to measure ozone and fine particles in the atmosphere. Sending out a laser beam pointed at heights of about 40 feet to 2 miles above ground level, TOPAZ detects the light that returns after being absorbed or scattered by ozone and particles, yielding information about their distribution and abundance in the atmosphere.

TOPAZ’s design makes it compact and lightweight, with modest power consumption—all traits that allow it to be deployed on small aircraft or, as in the Las Vegas study, in a truck outfitted as a mobile ground research platform. Researchers found that in the Las Vegas region, the unwelcome ozone was coming from above—the atmosphere’s natural motions were bringing down air from the region of the atmosphere called the stratosphere, where the ozone layer is located.

The TOPAZ measurements of ozone at different heights in the atmosphere were just the diagnostic needed to document these naturally occurring “intrusions” of ozone-rich stratospheric air. During

the six-week study, researchers showed that stratospheric intrusions led directly to three of Clark County’s instances of surpassing the federal ozone standard.

“Stratospheric intrusions are nothing new. But in today’s more polluted lower atmosphere, the ozone coming down from the stratosphere sometimes pushes Clark County over the limit,” said Andy Langford, a research chemist at NOAA.

Clark County has used the NOAA information in its documentation of the 2013 high levels. The stratosphere, a region 8 to 30 miles above Earth, contains the ozone layer and over 90 percent of the atmosphere’s ozone. This is the “good ozone,” filtering harmful ultraviolet radiation from the sun. But at Earth’s surface, ozone is a pollutant that’s harmful to human health and other living things. Areas at higher elevations, particularly in the intermountain western United States, have always been especially prone to stratospheric intrusions. With background levels of surface ozone gradually rising over the last few decades due to increases in human emissions of pollutants, the “extra” ozone that comes occasionally from the stratosphere now sometimes pushes some areas over the federal limit.

“For air quality managers in Clark County, these results explain why high ozone values sometimes occur in springtime—well before the midsummer peak expected for ozone formed as a result of local pollution,” Langford said.

For atmospheric researchers, it’s a classic illustration of how good ozone goes bad when it moves from the protective ozone layer to ground level.