One ozone hole returns, another is found

The most recent satellite data show that, as of mid-September, the ozone layer above the South Pole was beginning to thin, just as it has thinned each Antarctic spring for the last several years (SN: 3/1/86, p.133). The hole "has definitely not disappeared," says Arlin J. Krueger at NASA Goddard Space Flight Center in Greenbelt, Md. The ozone levels are lower than they were in 1984, he says, and appear at this stage to be similar to what was observed last year.

With an October press conference scheduled to take place directly from Antarctica, where researchers are intently studying the growing hole, and with the November GEOPHYSICAL RESEARCH LETTERS to be devoted to the topic of ozone depletion, the Antarctic ozone hole has captured the public and scientific spotlight. But while everyone's attention has been riveted on the atmosphere above Antarctica, a NASA researcher has discovered what he believes is another ozone cavity that forms each October through February on the other side of the world, near the North Pole.

This Arctic ozone hole is "not as large in magnitude, but it's unquestionably there," says Donald F. Heath at Goddard.

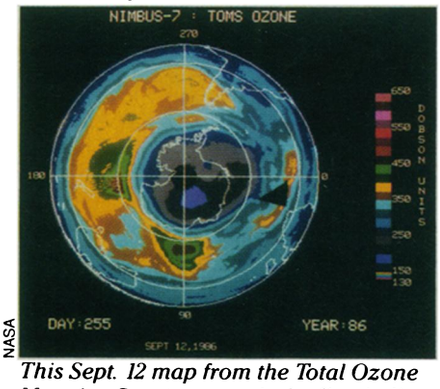
Heath, using the Nimbus 7's Solar Backscatter Ultraviolet (SBUV) instrument, also recently found what may be the first observation of a global drop in ozone (SN: 6/28/86, p.404) — about 3 percent in a six-year period. Depending on its cause, this could be quite serious, considering that scientists and policymakers have worried about the consequences of projected decreases in ozone of about 8 percent in the next century. NASA scientists could find no obvious flaws with Heath's data or analysis for either the global numbers or the Arctic hole. But since they have had very little time to review the data or to confirm them using other measurements, they are reluctant to speculate on its significance. "Given that we don't understand what's going on in Antarctica, it's very hard to say whether [we should expect] a similar phenomenon to occur in the Arctic as well," says Robert Watson at NASA headquarters.

If the basic processes responsible for the Antarctic hole are also operating in the Arctic, then scientists think the effect on the Northern Hemisphere would be less severe because of the different weather patterns. Indeed, the largest drop in Arctic ozone, according to Heath, occurs in February and is equivalent to a decrease of 2.6 percent a year — a little more than half the depletion rate he measures for Antarctica in October, when the ozone loss there is the greatest. The Arctic cavity is also one-third the size of its southern cousin.

In addition, the shapes and relative placements of the two holes are different. The Antarctic ozone hole is centered over the South Pole and is surrounded by a ring of high ozone concentrations, reflecting the giant circular wind patterns around the pole called the polar vortex. In contrast, the Arctic polar vortex is much weaker and is altered by the movement of air to the pole from lower latitudes. The Arctic cavity is centered over Spitsbergen, Norway, 700 miles away from the North Pole, where there is a high-pressure zone. The region of maximum ozone content corresponds to a low-pressure zone over Alaska.

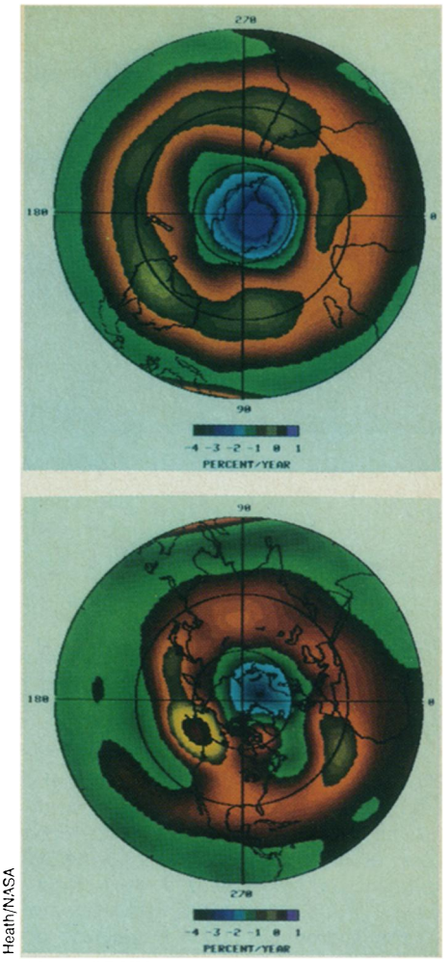
The formation of both holes, Heath says, is tied to the regions of coldest temperatures. His data show that in the Antarctic, the hole begins to develop in the upper stratosphere in May, when that part of the atmosphere is especially cold. The ozone hole then follows the coldest temperatures as they move down to lower altitudes, which become their coldest in October. In the Arctic, says Heath, the temperature changes are not as sharply defined; the stratosphere as a whole tends to be at its coldest in midwinter. Scientists say the ozone-temperature link is important, but no one fully understands its cause.

It may not be as important to understand the seasonal formation of the holes every year as the steady decrease in ozone in the holes, and everywhere else — if Heath's data are correct. In a paper on the Antarctic hole, to appear in GEOPHYSICAL RESEARCH LETTERS, NASA Goddard's Richard Stolarski and his colleagues have found that as ozone disappears from a region over the South Pole in September and October, the ozone in a surrounding ring actually grows — so that the total ozone in southern latitudes stays approximately constant during the Antarctic spring. "The ozone is being blown from one place to another by a disturbance whose source we're not very sure of," says Stolarski.



NASA

This Sept. 12 map from the Total Ozone Mapping Spectrometer is the first indication that Antarctic ozone is thinning (purple and gray areas in center) again this year.



Heath/NASA

These SBUV maps of changes in ozone levels from 1978-84 show the different sizes and placement of "ozone holes" above the Antarctic (top) and above the Arctic (bottom).

While the net loss of ozone in the Southern Hemisphere between August and October may be very small, Heath's global observations show that annual losses, if sustained for a number of years, could be serious. His results confirm the predictions of two-dimensional chemical models that ozone depletion should be the greatest at high latitudes. But his observed depletion rates are much greater than the predictions.

This could mean that scientists have underestimated the effects of chlorofluorocarbons and other ozone-attacking chemicals in the models. But it is more likely, says Heath, that other forces — such as the 1982 eruption of El Chichón — may be at work.

The recent ozone discoveries indicate that atmospheric ozone may be much more susceptible to large changes than anyone had thought, notes Watson. "We've probably made a lot of progress in understanding the physics and chemistry of the stratosphere," he says. But "there are probably a lot of surprises left in store for us." — *S. Weisburd*

News of the week continued on p. 221