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Study Pinpoints Source of Banned Gas That Saps Ozone Layer: Eastern China

A refrigerator factory in Shandong Province, China. A study points to Shandong and other provinces as the source of emissions of a banned gas that is used to make foam insulation.CreditGilles Sabrié for The New York Times

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By Henry Fountain and Chris Buckley

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Rogue emissions of a gas that harms the ozone layer are coming from eastern China, primarily from two heavily industrialized provinces, an international team of researchers said Wednesday.

The findings confirm what many scientists, environmental groups and policymakers had suspected after an initial study a year ago reported new global emissions of the gas, CFC-11, but could only locate the source generally as East Asia.

The new research will add to international pressure on the Chinese government to curtail the illegal use of CFC-11. It also confirms the results of several investigations, including one by

The New York Times, which found evidence that factories in Shandong, one of the provinces specified in the study, were still making or using the gas to manufacture foam insulation.

CFC-11 is one of a class of compounds called chlorofluorocarbons that destroy atmospheric ozone. They are also potent greenhouse gases that contribute to atmospheric warming.

Chlorofluorocarbons were outlawed for almost all uses by the Montreal Protocol, an international pact negotiated decades ago to preserve the layer of ozone that blocks ultraviolet radiation from the sun. Excessive amounts of some types of UV radiation can cause skin cancer and eye damage in people and are harmful to crops and other vegetation.

After the initial study last year, China denied that there were serious violations of the ban on the chemical, but also promised to eradicate any illegal production and use.

The Chinese Ministry of Ecology and Environment said Wednesday that it was preparing answers to questions about the new findings that The Times sent last week.

In a statement, Joyce Msuya, acting executive director of the United Nations Environment Program, which administers the Montreal Protocol, said that action on CFC-11 "is being taken by all parties at the international level and by China domestically."

"All parties appreciate the urgency to ensure the ongoing protection of the ozone layer," she added.

The declines in chlorofluorocarbon emissions under the Montreal Protocol were expected to lead to a full recovery of the ozone layer by the middle of the century. The new emissions could delay that recovery by a decade or more, scientists say.

The new study, which was published in the journal Nature, used data from monitoring sites in South Korea and Japan that analyze air samples taken every few hours. The data was fed into computer simulations that model how the atmosphere disperses pollutants.

Four independent models were used, said Sunyoung Park, a researcher at Kyungpook National University in Daegu, South Korea, and a lead author of the paper.

"All the results are consistent," she said. "It's very convincing." In addition to Shandong, the study cited Hebei Province as a primary source of the emissions.

Matt Rigby, an atmospheric scientist at the University of Bristol in Britain and another lead author, said the work benefited from using data from sites relatively close to China. Both monitoring stations are on islands that are only several hundred miles from the Chinese coast. In the 2018 study, the closest data was collected in Hawaii, 5,000 miles away.

"The atmosphere is very dispersive, it likes to mix things around quite rapidly," Dr. Rigby said. "As you get farther away, the picture gets more blurry."

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After the initial findings last year, some experts had suggested some of the CFC-11 could be originating from North Korea. But the new work effectively rules that out, Dr. Rigby said. “We couldn’t find a statistically significant rise in emissions,” he said.

But the study does not account for the origins of all of the new emissions of CFC-11, which it estimated were between 11,000 and 17,000 metric tons a year. Some may be coming from locations that are far from monitoring sites — areas in South America or Africa, perhaps, or even other parts of China.

“Other places, other countries, could contribute,” Dr. Park said. “But we don’t have the data.”

Although the Montreal Protocol called for phasing out CFC-11 production and use by 2010, some emissions continued as products that use it were destroyed and the chemical was released.

CFC-11 has a lifetime of about half a century, so the emissions, combined with breakdown of the chemical, should have caused its concentration in the atmosphere to decline more rapidly every year.

But beginning in 2013, scientists noticed that the rate of decline was slowing down — an indication that newly produced CFC-11 was entering the atmosphere.

That prompted the initial study, led by Stephen A. Montzka, an atmospheric scientist with the National Oceanic and Atmospheric Administration. Dr. Montzka contributed to the new research as well.

The Chinese authorities held to their two-pronged position — downplaying the problem while promising a clampdown — after that paper was released in May and after the investigations by The Times and the Environment Investigation Agency, an independent group, found evidence that CFC-11 was being used widely in China to make foam.

In a clampdown started in the second half of 2018, officials checked 1,172 businesses and found only 10 whose materials contained CFC-11, Liu Youbin, a spokesman for the Chinese Ministry of Environment and Ecology, said at a news conference in October.

More recently, Chinese environmental officials continued to suggest that illegal CFC-11 production was not widespread in China and would not be enough to explain the unexpected levels of the chemical in the atmosphere.

“The Chinese government has always taken a zero tolerance attitude toward illegal activity regarding ozone depleting substances,” Guo Jing, the head of the international cooperation department of the Chinese Ministry of Environment and Ecology, said in March, according to Xinhua, China’s official news agency.

Avipsa Mahapatra, leader of the climate campaign at the Environment Investigation Agency, said the Chinese government had taken the CFC-11 issue very seriously.

“They have engaged with us and with the international community in a very constructive manner to ensure that they are not just treating the symptoms by clamping down a few factories, but are trying to address the systemic challenge,” she said.

“However, the magnitude of emissions from this region now scientifically shown in this paper show that much remains to be done.”