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*Last Updated: 05/01/2024*

THE WHITE HOUSE

Office of the Press Secretary  
(Santa Barbara, California)

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For Immediate Release

April 5, 1988

STATEMENT BY THE PRESIDENT

I am pleased to sign the instrument of ratification for the "Montreal Protocol on Substances that Deplete the Ozone Layer." The Protocol marks an important milestone for the future quality of the global environment and for the health and well-being of all peoples of the world.

Unanimous approval of the Protocol by the Senate on March fourteenth demonstrated to the world community this country's willingness to act promptly and decisively in carrying out its commitments to protect the stratospheric ozone layer from the damaging effects of chlorofluorocarbons and halons.

But our action alone is not enough. The Protocol enters into force next January only if at least 11 nations representing two-thirds of worldwide consumption of chlorofluorocarbons and halons ratify the agreement. Our immediate challenge, having come this far, is to promote prompt ratification by every signatory nation.

I believe the Montreal Protocol, negotiated under the auspices of the United Nations Environment Programme, is an extremely important environmental agreement. It provides for internationally coordinated control of ozone-depleting substances in order to protect a vital global resource. It requires countries that are parties to reduce production and consumption of major ozone-depleting chemicals by 50 percent by 1999.

It creates incentives for new technologies -- chemical producers are already working to develop and market safer substitutes -- and establishes an ongoing process for review of new scientific data and of technical and economic developments. A mechanism for adjustment of the Protocol is established to allow for changes based upon the review process. The wisdom of this unique provision is already being realized

Data made available only during the last few weeks demonstrate that our knowledge of ozone depletion is rapidly expanding. For our part, the United States will give the highest priority to analyzing and assessing the latest research findings to assure that the review process moves expeditiously.

The Montreal Protocol is a model of cooperation. It is a product of the the recognition and international consensus that ozone depletion is a global problem, both in terms of its causes and its effects. The Protocol is the result of an extraordinary process of scientific study, negotiations among representatives of the business and environmental communities, and international diplomacy. It is a monumental achievement.

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But our action alone is not enough. The Protocol enters into force next January only if at least eleven nations representing two-thirds of worldwide production and consumption of chlorofluorocarbons and halons ratify the agreement. Our immediate challenge, having come this far, is to promote prompt ratification by every signatory nation so the Protocol becomes a living instrument of environmental progress as quickly as possible. I will use the full weight of my office to see to it that we achieve this goal.

I believe the Montreal Protocol is the most important international environmental agreement in history. It provides for internationally coordinated control of ozone-depleting substances in order to protect a vital global resource. It requires countries that are parties to reduce production and consumption of major ozone-depleting chemicals by fifty percent by 1998. It creates incentives for new technologies -- chemical producers are already working to develop and market safer substitutes.

The Protocol also establishes an on-going process for review of new scientific data and of technical and economic developments. A mechanism for adjustment of the Protocol is established to allow for changes based upon the review process. The wisdom of this unique provision is already being realized.

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## MONTREAL PROTOCOL SIGNING STATEMENT

Today marks an important milestone for the future quality of the global environment and for the health and well-being of all peoples of the world. I am pleased to ratify the "Montreal Protocol on Substances That Deplete the Ozone Layer."

Unanimous approval of the Protocol by the Senate March 14 demonstrated to the world community this country's willingness to act promptly and decisively in carrying out its commitments to protect the stratospheric ozone layer from the damaging effects of chlorofluorocarbons and halons.

But our action alone is not enough. The Protocol enters into force next January only if at least 11 nations representing two-thirds of worldwide production and consumption of CFCs and halons act as we have. Our immediate challenge, having come this far, is to promote prompt ratification by every signatory nation so the Protocol becomes a living instrument of environmental progress as quickly as possible. I will use the full weight of my office to see to it that we achieve this goal.

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The Protocol also establishes an on-going process for review of new scientific data and of technical and economic developments. A mechanism for adjustment of the Protocol is established to allow for changes based on the review process. The wisdom of this unique provision is already being realized.

Preliminary data made available only during the last few weeks demonstrate that our knowledge of ozone depletion is expanding all the time. These data suggest the need to reconvene all parties to the Protocol as early as 1990. For our part, the United States will begin now to fully analyze and assess the latest research findings to assure that the process leading to this meeting moves expeditiously.

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Ronald Reagan

## Signing Ceremony -- Ozone Protocol

I am pleased to sign the instrument of ratification for the September 1987 Montreal Protocol on Substances that Deplete the Ozone Layer. It is gratifying that the United States Senate unanimously consented to ratify this historic agreement in less than three months after my transmittal of the Protocol.

The United States played a leading role in the negotiations, and now we are a leader in the effort to place this treaty into force -- becoming the second nation to ratify the agreement. Progress in dealing with this threat to the earth's environment can only be accomplished through a unified global effort to control the substances that deplete the ozone layer. I, therefore, strongly encourage other nations to rapidly ratify the Protocol so that we can at the earliest moment have the level of international support needed for the treaty to enter into force.

I fully support efforts within the framework of the Protocol to reassess the control provisions of the agreement based upon the latest scientific evidence. This treaty represents an international response to the ozone depletion problem, and any revisions to this effort must be pursued within the international community, for only through this means can we obtain the global cooperation necessary to protect the people of the United States.

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CHLORINE AND STRATOSPHERIC OZONE  
A SUMMARY OF THE CURRENT SCIENTIFIC UNDERSTANDING

DAN ALBRITTON - NOAA  
BOB WATSON - NASA

OMB, 5 APRIL 88

OUR APPROACH...

● THE OZONE SCIENCE THAT LED TO THE MONTREAL PROTOCOL:

- WHAT IS THE PROBLEM?      1974      THE CHLORINE/OZONE HYPOTHESIS
- WHAT DID THEORY SAY?      } ~1986/7      "BOTTOM LINES"
- WHAT DID OBSERVATIONS SAY?      }
- HOW DID POLICY RESPOND?      SEP 87      MATCH: PROTOCOL VIS-A-VIS SCIENCE

● UNRESOLVED SCIENCE DURING PROTOCOL CRAFTING:

- THE SBUV SATELLITE DATA      1985      BELIEVABLE?
- THE ANTARCTIC OZONE "HOLE"      1985      CAUSE?

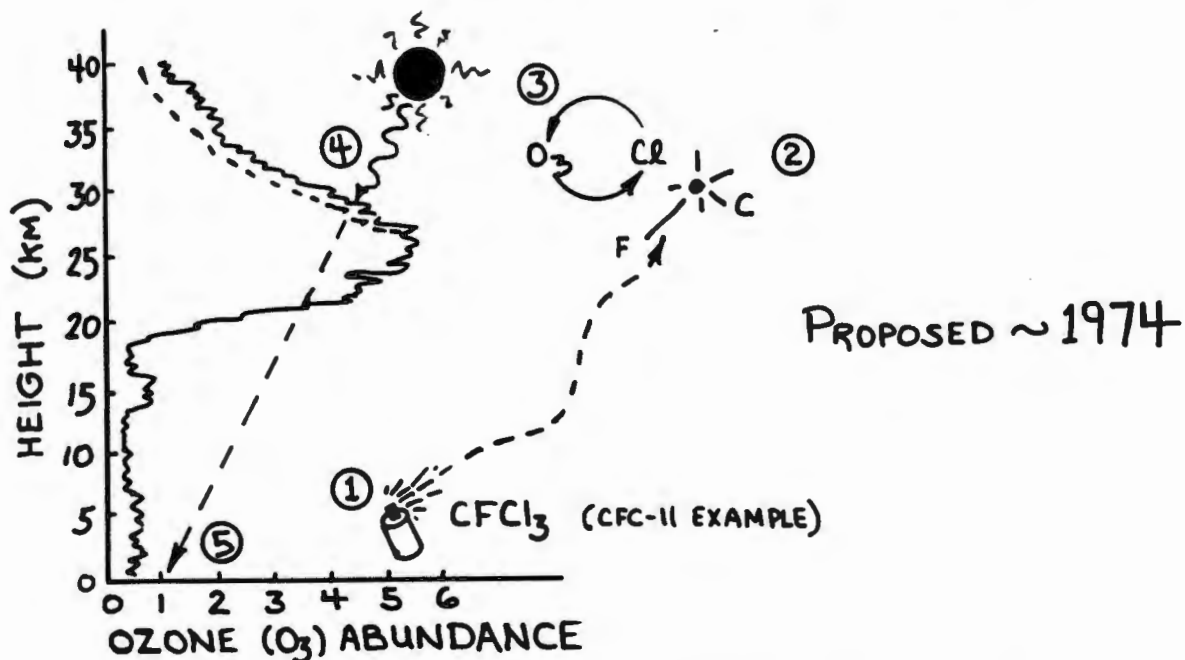
● OZONE/CHLORINE SCIENCE ADVANCES SINCE MONTREAL:

- ANTARCTIC OZONE CAMPAIGNS      1986/7      } RESULTS
- OZONE TRENDS REPORT      MAR 88      }



# GLOBAL STRATOSPHERIC OZONE

ISSUE: MAN-MADE CHLORINE CHEMICALS MAY BE DEPLETING THE OZONE LAYER



- ① MAN-MADE CHLORINE & BROMINE EMISSIONS >> NATURAL ONES.
- ② THE ONLY LOSS OF THE CHLOROFLUOROCARBONS IS BREAK-UP IN THE STRATOSPHERE.
- ③ THE CHLORINE OR BROMINE FRAGMENT DESTROYS OZONE.
- ④ THINNER OZONE LAYER PASSES MORE ULTRAVIOLET LIGHT.
- ⑤ INCREASED SURFACE RADIATION HARMFUL TO BIOTA.



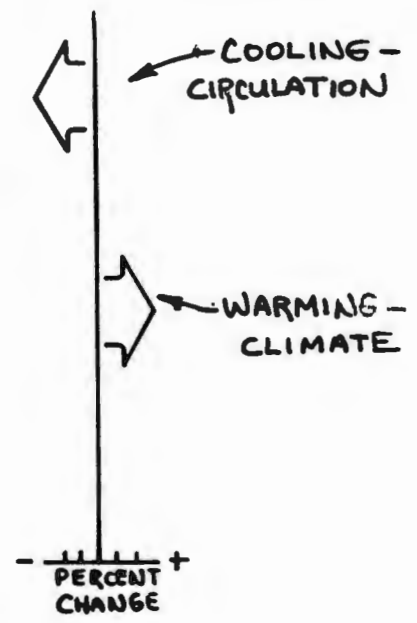
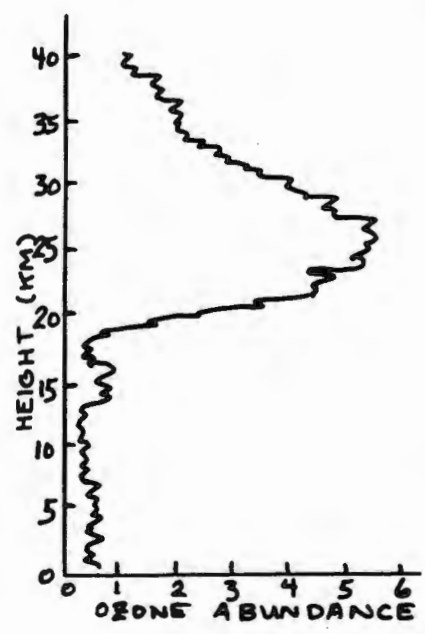
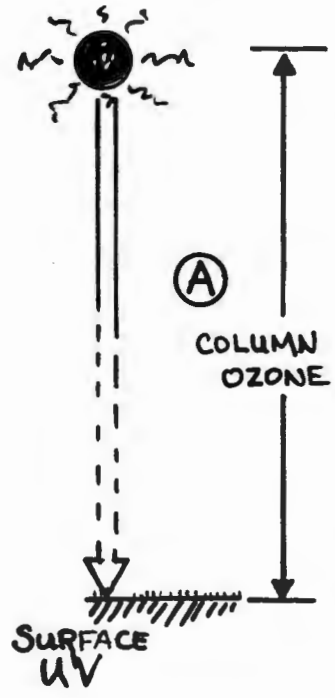
SINCE 1974: • THEORY - IMPROVE, TEST, PREDICT  
 • OBSERVATIONS - ESTABLISH OZONE VARIATIONS

Q: HOW DOES STRATOSPHERIC OZONE RESPOND TO CHLORINE?

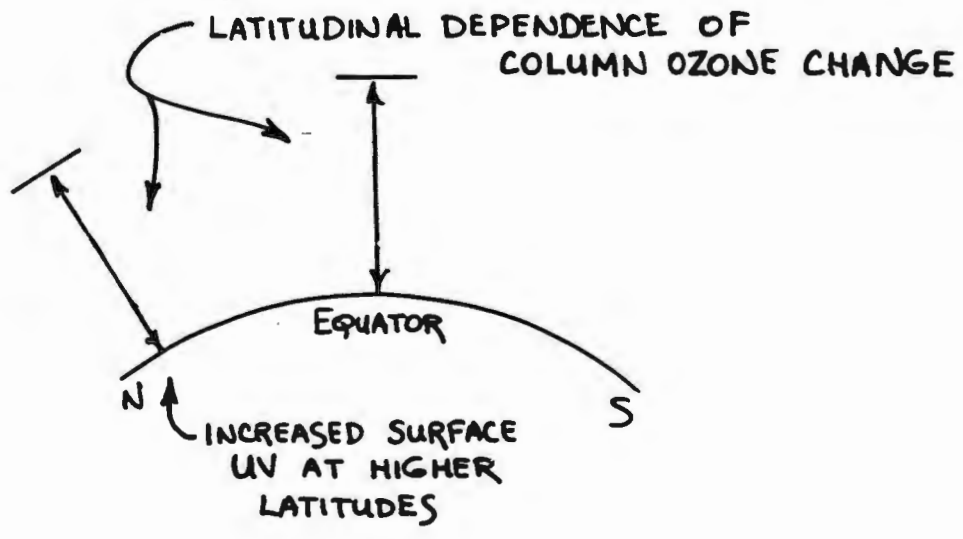
★ THEORY

OZONE RESPONSES: 3

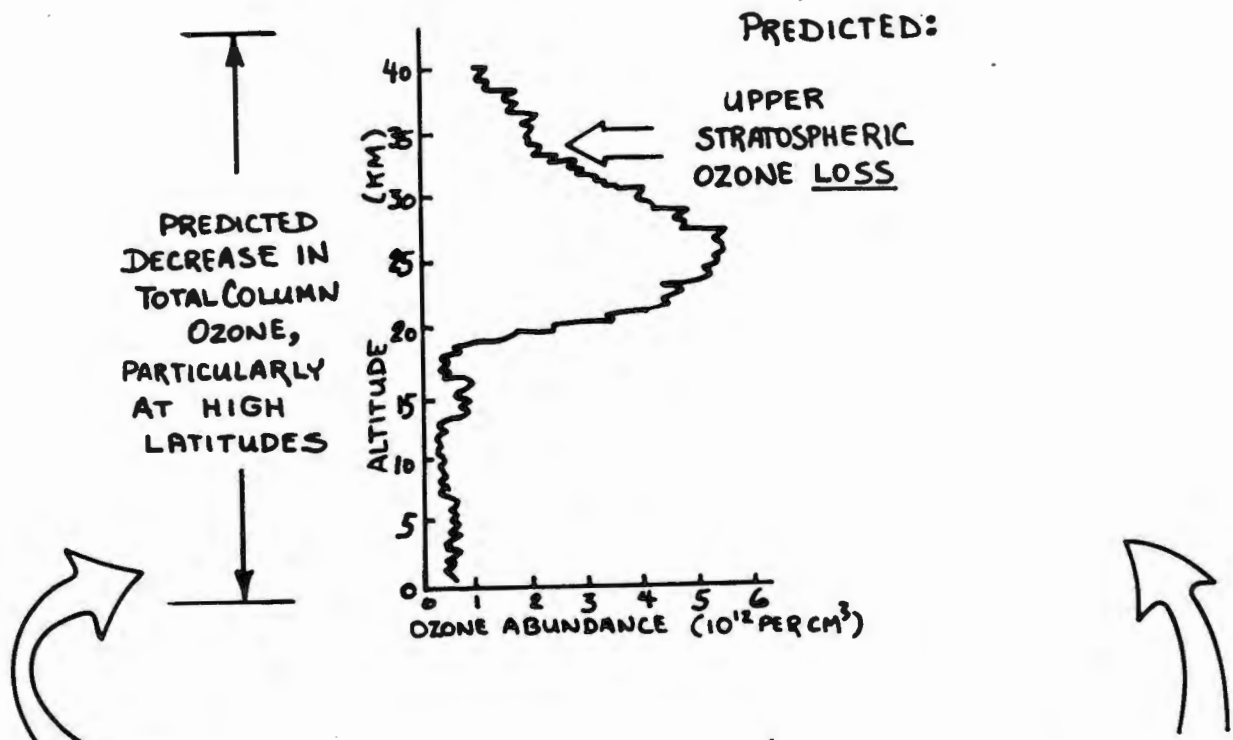
ⓑ VERTICAL OZONE



ⓒ



# SPECIFIC PREDICTIONS OF OZONE PERTURBATIONS:

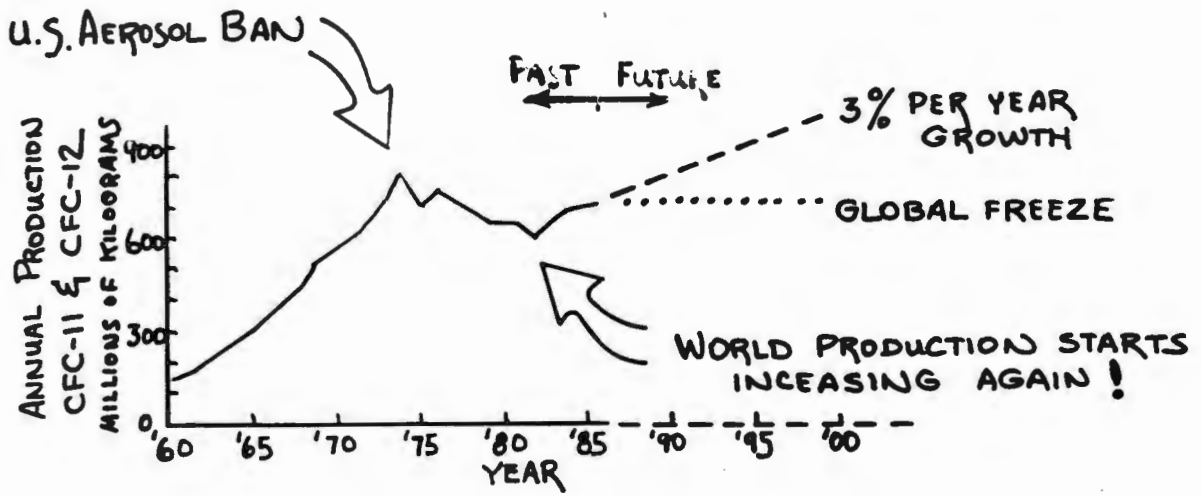


- GLOBAL:  
NOW - ~ A PERCENT OR SO  
FUTURE - SEVERAL %, IF CFC'S GROW  
 - 0-1%, IF FREEZE } assuming methane, CO2 increase...

- HI-LATITUDE:  
 X2-3 WORSE THAN AVERAGE, PARTICULARLY IN WINTER

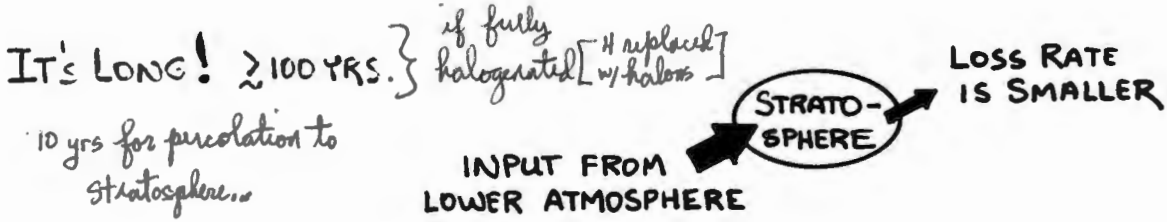
- HI-ALTITUDE:  
NOW - 5-12% AT 40 KM  
FUTURE -  
 ~ 25% AT 40 KM, EVEN WITH FREEZE

● THE WORLD PRODUCTION OF CFC's :

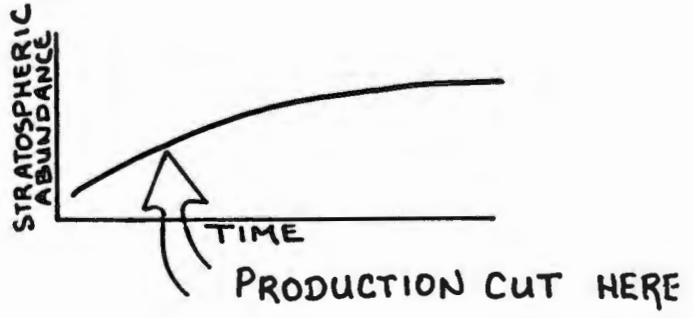


➡ THE CFC PROBLEM DID NOT GO AWAY.

● ATMOSPHERIC RETENTION TIME :



➡ STOPPING THE GROWTH RATE SOONER IS EASIER THAN LATER.



● CLIMATE ROLE OF CFC'S:

CO<sub>2</sub> IS NOT THE ONLY "GREENHOUSE" SPECIES...



- AND
- THEIR ABUNDANCES ARE ALSO INCREASING
  - THEIR ADDED EFFECTS EQUAL THAT OF CO<sub>2</sub>

CFC ROLE VIS-A-VIS CO<sub>2</sub>

- PREDICTION:
- IF 3% GROWTH RATE → ~40% OF CO<sub>2</sub> EFFECT
  - IF GLOBAL FREEZE → ~25% OF CO<sub>2</sub> EFFECT



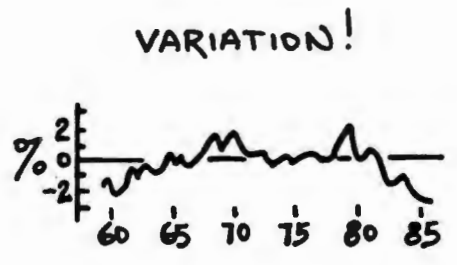
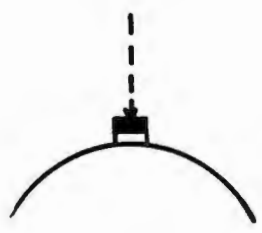
CFC'S: IT IS NOT JUST A OZONE/ULTRAVIOLET ISSUE.

Q: HAVE WE SEEN ANYTHING YET?

★ OBSERVATIONS (AS OF ~1985)

● GROUND-BASED "DOBSON" NETWORK

- GETS TOTAL OVERHEAD OZONE
- ~ 40 STATIONS WORLDWIDE



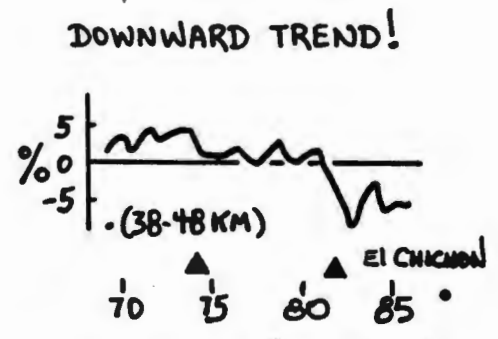
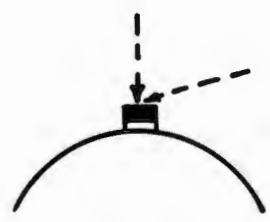
(MON. WEATHER REVIEW, '87)

Q: HOW MUCH OF THIS IS DUE TO CHLORINE, SOLAR CYCLE, OR GBO?

*circulation pattern*

● "UMKEHR" NETWORK

- GETS PROFILE ESTIMATE
- SEVERAL STATIONS

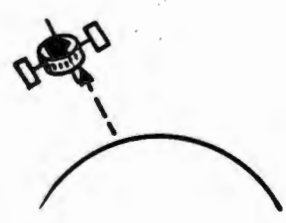


(MON. WEATHER REV. '87)

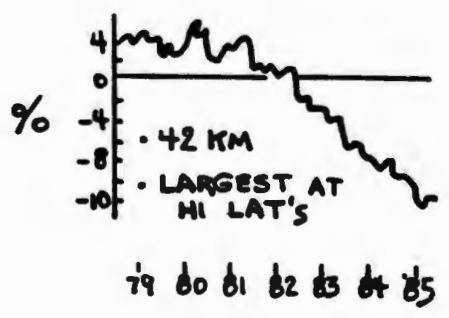
Q: WHAT IS AEROSOL ARTIFACT, NATURAL VARIATION, OR CHLORINE?

● SBUV SATELLITE

- GETS PROFILES & GLOBAL COVERAGE
- NASA: 1978 - PRESENT
- NOAA: 1985 LAUNCH



HORRIFYING DECREASE!



(THE NEW YORK TIMES, 85)

Q: HOW MUCH IS INSTRUMENT DRIFT OR OZONE CHANGE?

GLOBAL OZONE:

SUMMARY

OZONE & CLIMATE VARIATION... AS IT WAS UNDERSTOOD SEPT. 87:

- SCIENCE INPUTS:
  - OBSERVATIONS -
  - THE JURY WAS STILL OUT ON CHLORINE
  - THEORY - PREDICTIONS ("B")

> IF WE DO NOTHING RE/EMISSIONS...

SUBSTANTIAL COLUMN OZONE LOSS EVENTUALLY,  
PARTICULARLY AT HIGH LATITUDES

> IF WE FREEZE AT ~1985 RATES...

GLOBAL-AVERAGE COLUMN OK ✓ (IF CO<sub>2</sub>, CH<sub>4</sub> ↑)

BUT

> A SUBSTANTIAL REDUCTION IN EMISSIONS WOULD BE  
CONSISTENT WITH REDUCING...

HI-LATITUDE COLUMN OZONE LOSS - LESS THAN NATURAL  
(ULTRAVIOLET INCREASE) VARIATION

HI-ALTITUDE OZONE LOSS - "  
(COOLING/CIRCULATION?)

SURFACE TEMPERATURE WARMING - CFC EFFECT LESS  
THAN 1/4 THAT OF  
CO<sub>2</sub>

# THE MONTREAL PROTOCOL VIS-A-VIS THE SCIENCE

## SOME HIGHLIGHTS...

### • SCOPE:

ALL LONG-LIVED CFC'S

ELIMINATES LONG RETENTION TIME PROBLEM

3 COMMONLY USED HALONS

BROMINE COMPOUNDS

OZONE LOSS 10X THAT OF CHLORINE

### • TIMETABLE:

ENTRY IN FORCE, AS EARLY AS JAN 89

1990 - FREEZE CFC'S TO 1986 LEVELS

1994 - CUT TO 80% OF 1986 LEVELS

1999 - CUT TO 50% OF 1986 LEVELS

MAY BE AN APPROXIMATE "GLOBAL FREEZE"

A "SUBSTANTIAL" REDUCTION?

### • REVIEWS:

1990 - 1ST MEETING OF PARTIES  
- REVIEW APPROPRIATENESS

1989 MAJOR INTERNATIONAL SCIENCE REVIEW

• BETTER QUANTIFIED LATITUDINAL EFFECTS

• 2½ MORE YEARS OF OZONE TRENDS

• MECHANISM OF "OZONE HOLE"  
- GLOBAL IMPLICATIONS (?)



MONTREAL PROTOCOL

←→ { • CURRENT SCIENCE  
• LIKELY ADVANCES IN COMING YEARS



# OZONE TRENDS PANEL

## ● CHARACTERISTICS:

- 20 MEMBERS
- INDEPENDENT GROUP (BUT ~200 HELPED) W/REVIEWERS
- INTERNATIONAL
- RE-ANALYSIS OF ~ALL KEY DATA
- NOV 86 - MAR 88
- 12 TOPIC/CHAPTERS

## ● KEY FINDINGS: (15 MARCH 88)

NUMEROUS INTERESTING "NUGGETS", BUT THE PRIMARY TWO ARE...

① (THE "GOOD" NEWS)



THE ARCHIVED SBUV SATELLITE DATA CANNOT BE TAKEN AT FACE VALUE

### REASONS:

- IT DISAGREES WITH EVERYTHING ELSE.
- THE INSTRUMENT CALIBRATION HAS DEGRADED.
- THERE IS NO INTERNAL WAY TO CORRECT FOR IT.

### CONCLUSION:

INDEPENDENT, HI-QUAL GROUND-BASED DATA  
 ARE REQUIRED FOR

SBUV-1	(NASA)	} UP NOW
SBUV-2	(NOAA)	
SBUV-3	(NOAA)	
⋮		

② (THE "BAD" NEWS)



THERE APPEARS TO BE EVIDENCE THAT THE GLOBAL LOSS OF OZONE TO CHLORINE HAS BEGUN.

TOTAL COLUMN OZONE:

RE-ANALYZED DOBSON DATA SET

- NORTHERN HEMISPHERE,
- LATITUDINAL BANDS,
- SEASONAL DATA



MULTI-COMPONENT MODEL

- 11-YR SOLAR CYCLE -  $A_i$
- 26-MO QBO -  $B_i$
- LINEAR DECREASE SINCE 1979 -  $C_i$

RESULTS

✓ LINEAR TREND (1969-86)      SIGNIFICANT AT 2σ-3σ!

✓ LARGEST IN THE WINTER

obs.	+0.4 → -2.1%	SUMMER	cf.	THEORY	-0.5 → -1.0%
$\bar{x}$	-2.3 → -6.1%	WINTER		$\bar{x}$	-0.8 → -2.0%

✓ LARGEST AT HI LAT'S

	<u>30-39°N</u>	<u>40-52°N</u>	<u>53-64°N</u>
JAN'S:	-2.2 ± 1.5	-2.6 ± 2.1	-8.3 ± 2.2

VERTICAL PROFILE OF OZONE:

40 KM '79-'85	{	SAGE SATELLITE:	0 - 8%	THEORY: 5-12%	{	4-9% CFC's
		UMKEHR (GROUND-BASED):	5 - 13%			1-3% SOLAR

CONCLUSION:

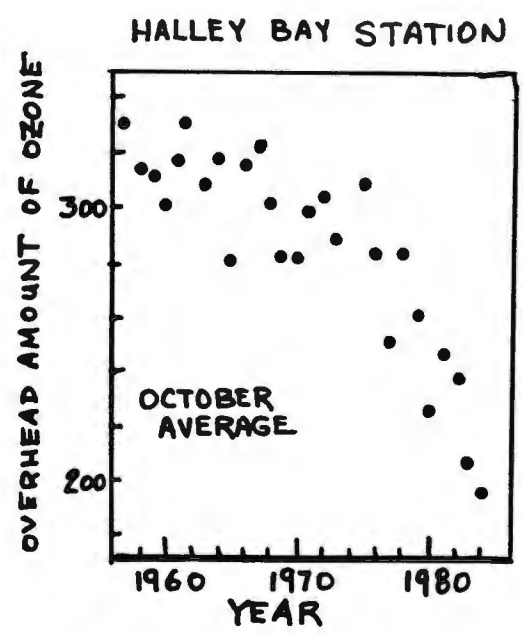
GLOBAL CHLORINE/OZONE SIGNATURE NOW POSSIBLY SEEN.

# ANTARCTIC OZONE "HOLE"

- ISSUE: - THERE IS NO QUIBBLING HERE ABOUT THE REALITY OF A FEW PERCENT;  
 ~HALF OF THE OZONE OVER ANTARCTICA HAS DISAPPEARED (IN A VERY CURIOUS FASHION)  
 - IT WAS TOTALLY UNANTICIPATED (WHICH IS RATHER UNSETTLING).

- JULY, 1985: DISCOVERY  
 BRITISH ANTARCTIC SURVEY, "DOBSON" DATA

- SINCE ABOUT ~1975
- IN THE ANTARCTIC SPRING,
- (AND ONLY IN THE SPRING),
- OVERHEAD OZONE HAS TENDED TO DECREASE,
- MORE & MORE EACH YEAR.



COULD THIS BE A LOCAL HALLEY-BAY PHENOMENON?

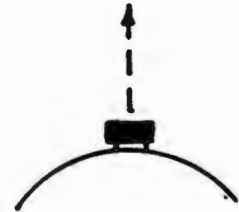
● DECEMBER, 1985: CONFIRMATION

OBSERVED IN OTHER DATA SETS:

• SATELLITE



• OTHER "DOBSON'S"



• BALLOON OZONESONDES



HENCE, - THE OZONE "HOLE" IS REAL!  
- IT COVERS ALL OF ANTARCTICA !



WHAT IS CAUSING IT ?

● EARLY 1986: THEORIES

• CHLORINE/BROMINE INCREASE:

- THE ANTARCTIC STRATOSPHERE IS EXTREMELY COLD,
  - THERE ARE A LOT OF ICE CLOUDS,
  - ICE MAY FREE REACTIVE CHLORINE,
- HENCE, CHLORINE/OZONE LOSS MAY BE ACCELERATED.

• SUNSPOT CYCLE:

- SOLAR PARTICLES MAKE REACTIVE NITROGEN,
- IT ACCUMULATES OVER ANTARCTICA,

HENCE, NITROGEN/CHLORINE LOSS MAY BE ACCELERATED.

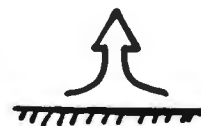


• CLIMATE CHANGE:

A. SLOWLY CHANGING CIRCULATION PATTERNS MAY BRING LESS OZONE TO ANTARCTICA:



B. SLOWLY CHANGING UPWARD WINDS MAY BRING OZONE-POOR AIR FROM ANTARCTIC SURFACE:



WHICH ONE(S) IS CORRECT? A DATA-SHORT SITUATION!

● 1986/87 CAMPAIGNS:

1987: AIRBORNE EXPERIMENTS

STRATOSPHERIC {  
IN-SITU: ER-2  
REMOTE-SENSING: DC-8



1986/87: GROUND-BASED EXPERIMENTS

REMOTE SENSING  
BALLOON BORNE

TYPES OF MEASUREMENTS:

OZONE

EVERY WAY IMAGINABLE!

CHLORINE/BROMINE

NITROGEN

} REACTIVE & RESERVIOR SPECIES

PARTICLES

SIZE & COMPOSITION

INERT TRACERS

E.G., N<sub>2</sub>O, CFC's, ...

PHYSICAL PARAMETERS

USUAL STUFF

ON-SITE THEORISTS

NEW APPROACH!



THE ANTARCTIC OZONE "HOLE": THE CURRENT PICTURE  
OF ITS CAUSE

- IT'S NOT DUE TO SUNSPOTS (OR RELATIVISTIC ELECTRONS,  
SPACE "SNOWBALLS"; )

BECAUSE  $\text{NO}_2$  IS VERY LOW, NOT HIGH.

- IT'S NOT DUE TO CHANGE IN DYNAMICS

BECAUSE THE TRACERS ARE NOT CONSISTENT  
WITH THE ARRIVAL OF OZONE-POOR AIR  
FROM ELSEWHERE.

- IT IS LIKELY A { SPECIAL-METEOROLOGY  
MAN-MADE CHLORINE } PHENOMENON.

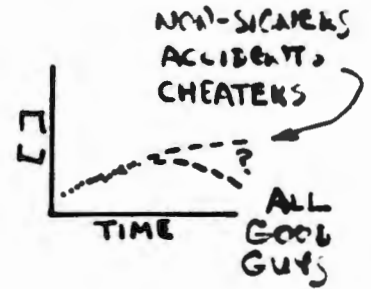
SPECIFICALLY...

- ANTARCTIC PHYSICAL CONDITIONS → FORMATION OF ICE PARTICLES.
- CLOUDS → • CHANGE CHLORINE FROM PASSIVE TO ACTIVE FORM.  
• REMOVE ACTIVE NITROGEN.
- LOW ACTIVE NITROGEN → ALLOWS ACTIVE CHLORINE TO PERSIST.
- HIGH ACTIVE CHLORINE → OZONE DESTRUCTION.

## OPEN QUESTIONS

### GLOBAL PROCESSES:

- WHAT WILL FUTURE CFC CONCENTRATIONS REALLY DO?
- WHY DO OBS. & THEORY OF  $O_3 \leftarrow CCl_2$  DIFFER BY 2-3x?
- HOW WELL DO DYNAMICAL/CHEMICAL MODELS HANDLE THE LATITUDINAL EFFECT?
- ARE SOURCE/CONSTITUENT CHANGES CONSISTENT?  
E.G.,  $[-CCl] \rightarrow CClO \rightarrow HCl$
- HOW WELL CAN WE PREDICT  $CO_2, CH_4, N_2O \dots$  CHANGES ON T, R,  $\leftrightarrow$
- HOW IMPORTANT ARE HETEROGENEOUS PROCESSES?



### POLAR PROCESSES:

- CLIMATIC CHANGE / ANTARCTIC PHYSICAL CONDITIONS / OZONE LOSS  
 $\leftarrow ? \text{ PAST + FUTURE ? } \rightarrow$
- WHAT IS THE EFFECT OF THE ANTARCTIC OZONE HOLE ON THE SOUTHERN HEMISPHERE?
- IS A SCALED-DOWN VERSION OF THE "HOLE" OCCURRING IN THE ARCTIC?

### GENERAL THOUGHT:

NATURE WAS KIND: THE OZONE "HOLE" OCCURRED IN THE ANTARCTIC.

WILL SHE BE AS CONSIDERATE FOR THE NEXT BIG RESPONSE TO HUMAN ACTIVITIES?



# AT A GLANCE

## AGRICULTURE

**Foreign-owned farms and parking lots**... Foreign ownership of U.S. farmland rose to a record 12.5 million acres in 1987, up 202,000 acres from 1986, according to an Agriculture Department report. That was still less than 1 per cent of U.S. agricultural land. Moreover, forest land accounted for half that acreage and cropland only a sixth. British corporations and citizens own 30 per cent of the land, and Canadians own 20 per cent. Despite all the concern in the late 1970s about foreigners controlling the U.S. food supply by buying up American cropland, U.S. land occupied by foreign-owned manufacturing facilities—land under the factories and land in use as parking lots—still exceeds the acreage of foreign-owned farmland.

## CONGRESSIONAL OPERATIONS

**Byrd's withdrawal**... The decision of Sen. Robert C. Byrd, D-W.Va., to step down as Majority Leader at the end of this term will have a major impact on the Senate's internal politics. Byrd said in an interview that he plans to become chairman of the Appropriations Committee—assuming the Democrats continue to control the Senate after the November elections—because he “can best serve” his economically troubled state by the switch, presumably by directing more federal dollars its way. He said that he also expects to become the Senate's president pro tempore, which has been a largely ceremonial position, but did not comment on possible changes in the post. Meanwhile, Democratic Sens. Daniel K. Inouye of Hawaii, J. Bennett Johnston Jr. of Louisiana and George J. Mitchell of Maine made clear that they will intensify their efforts to succeed Byrd. Though Byrd believes he could have garnered the votes to keep the leadership post, which he called “one of the toughest jobs in Washington,” there have been growing rumblings for him to step down. (See *NJ*, 4/9/88, p. 948.)

## DEFENSE MANAGEMENT

**Industrial base bill**... Sen. Alan J. Dixon, D-Ill., has amended his own bill, the Defense Industrial Base Preservation Act (S 1892) introduced last November, which strives to ease American dependence upon foreign suppliers for vital military materiel. It has already gone through six drafts. “Quite frankly, I was very concerned that earlier drafts were protectionist in nature,” Dixon said during a March 29 Armed Services Committee hearing. The substitute bill defines as a “domestic source” and part of the U.S. industrial base any firm that produces in the United States, even if the plant is foreign-owned. Any country that has a free-trade agreement with the United States would also be considered a domestic source, as would Canadian firms. Additionally, a new provision would crack down on the mounting practice of “offsets,” compensatory deals that many nations require as a price for buying American goods. Dixon's measure has evoked some wariness in the office of Defense undersecretary for acquisition Robert B. Costello, which is pressing a defense industrial base initiative of its own. But the Senator consulted closely with Costello about the legislation, which he hopes to see adopted as an amendment to the fiscal 1989 defense authorization bill. “My legislation will end the wounding

trend of dependence on foreign suppliers for materials necessary for our defense,” Dixon said. “Such a dependence is vulnerable to attack and a cutoff of many vital supplies, as seen during World War II.” (See *NJ*, 11/28/87, p. 3036; 3/29/86, p. 763.)

## ENVIRONMENT

**CFC phaseout**... Responding to the just-released data on stratospheric ozone depletion (and probably to the threat of state bans on plastic food packaging), the Foodservice & Packaging Institute Inc. announced that manufacturers of plastic foam food containers by the end of the year will phase out the two types of chlorofluorocarbons (CFCs) believed to contribute to ozone depletion. What makes the quick phase-out possible is the emergence of a substitute that is a cousin of those chemicals but that lacks the damaging properties. The institute promised to monitor use of the substitute while looking for alternative foam-blowing chemicals for use in making containers. Three major environmental organizations—the Environmental Defense Fund, Friends of the Earth Inc. and the Natural Resources Defense Council Inc.—are participating in the institute's program to phase out the chemicals. Environmental Protection Agency administrator Lee M. Thomas hailed the announcement, saying that “it demonstrates industry's ability to develop inexpensive, technological alternatives to CFCs.”

## INTERGOVERNMENTAL RELATIONS

**Ranking state economies**... Mirror, mirror on the wall, which states have the fairest economies of all? Connecticut, Maryland, Massachusetts, Minnesota, New Jersey and Vermont have the strongest economies, according to the Corporation for Enterprise Development, a nonprofit economic consulting firm, in its latest survey, “Making the Grade.” The laggards are Alabama, Idaho, Louisiana, Mississippi, Nevada, Oklahoma, South Dakota and Tennessee, the study said. Unlike other studies that focus on tax climate, the group's paper measured four factors: economic performance, business vitality, resources and development policy. “The Northeast is where today's economic action is,” the group's president Robert Friedman said at an April 12 press conference. But Michigan and South Carolina are giving these states a run for their money, he added. Meanwhile, a study by the Northeast-Midwest Institute concluded that the widely trumpeted Rustbelt revival is real. By 1986, the unemployment rate in the Rustbelt dipped below the national average for the first time in a decade. The region employed 2.6 million more people in 1986 than it did in 1980, the study said. Per capita income rose faster there than in either the South or the West. Capital investment soared, and expenditures per pupil in public schools by both northeastern and midwestern states increased more rapidly than those in the South and the West from 1981-85, the study said. The bad news, however, is that population losses will produce a loss of political power. The institute projected that the Northeast and Midwest will lose 14 seats following the 1990 census. After the 1980 census, the region lost 15 seats. “Thus, the region may lose a total of 13 per cent of its representation because of population shifts in the 1970s and 1980s,” the report concluded. (See *this issue*, p. 1024.)

NYT 5/18/88

## Hole in Arctic Ozone Is Feared

BALTIMORE, May 17 (AP) — A Canadian researcher says that a hole in the ozone layer may be developing in the stratosphere near the North Pole each winter just as a similar hole is created over the South Pole.

The researcher, W. F. J. Evans, a scientist with the Department of Environment in Canada, said Monday that instruments carried aloft by balloons indicated that a vast crater of depleted ozone forms near the North Pole in the winter months and could act as a "sink" for ozone throughout the Northern Hemisphere.

Mr. Evans said that the hole was discovered through measurements made from research balloons released from a base at Alert, a Canadian town near the North Pole, in the first four months of each year, starting in 1986.

The researcher, who gave a paper on his findings at the spring meeting here of the American Geophysical Union, said that the Antarctic ozone hole might be causing a decrease in the level of ozone protecting the whole Southern Hemisphere.

"If there is a similar hole in the Arctic, it could influence the ozone in the Northern Hemisphere in the same way," he said.

Atmospheric ozone forms a natural barrier against the ultraviolet rays of the sun. Overexposure to this type of radiation is associated with skin cancer. Satellite and aircraft studies have found an ozone hole that develops in cold months over the South Pole. The loss of atmospheric ozone has been attributed to chemical reactions initiated by chlorofluorocarbons, a type of chemical used as refrigerants and to make plastic foam.

Mr. Evans said that because of a difference in weather patterns, there is normally about 15 percent more ozone in the atmosphere over the Arctic than over the Antarctic. The Arctic ozone loss is much smaller, he said.

"Even if the effect is smaller in the Northern Hemisphere, the effect is more important because that is where most of the people are," he said of ozone depletion. The Northern latitudes contain most of the land mass and the human population.

R. R. Stolarski, an atmospheric scientist at the Goddard Space Center, said Mr. Evans findings were important, but added that more study needed to be done to make sure that the ozone hole Mr. Evans had found was not just a "cold weather phenomenon."

# Antarctica Ozone Loss Is Worst Ever Recorded

By PHILIP SHABECOFF

Special to The New York Times

GREENBELT, Md., Sept. 30 — The ozone shield over Antarctica dwindled this month to the lowest level observed since measurements began more than a decade ago, researchers reported today.

Preliminary findings indicate that both man-made chemicals and the extreme South Polar meteorological conditions are responsible for the depletion, said the scientists, whose Antarctic expedition was financed by Federal and private groups.

The shield protects the earth's surface from harmful ultraviolet radiation from the sun that can cause skin cancer and other health problems in humans.

## Ozone Hole Alarms Scientists

Already concerned that the buildup of certain chemicals would thin the ozone layer worldwide, scientists were alarmed by the recent discovery of a drastic seasonal depletion of ozone in Antarctica.

The depletion occurs each year in the Antarctic springtime. Between mid-August and mid-September this year, the expedition found, the ozone at an altitude of 11 miles had been reduced by 50 percent. Last year the ozone level had been reduced by 40 percent.

Leaders of the expedition cautioned, however, that because the causes of the Antarctic ozone hole are still not fully understood, it would be premature to draw any global conclusions based on the expedition's findings.

Earlier this month, when leaders of dozens of nations agreed at meeting in Montreal to freeze and later reduce use of chlorofluorocarbons, industrial chemicals that destroy ozone in the upper atmosphere, they left open the possibility that additional action might be taken if new information suggested that the problem was more severe than

thought. But the leaders of the expedition cautioned today against any such conclusions at this time.

Robert Watson, the chief scientist for the National Aeronautics and Space Administration's ozone project, said the data collected by the expedition were inadequate "for national or international policy making." The expedition was financed by NASA, the National Science Foundation and the Chemical Manufacturers Association. At a news conference at NASA's Goddard Space Flight Center here, Dr. Watson and Dr. Dan Albritton of the atmospheric agency said that more time and more research, including an intensive study of what is happening to the

## Man-made chemicals and the unusual climate are cited.

ozone layer in the temperate latitudes, was required before the implications of this expedition's findings were clearly understood.

Information collected by the expedition, which was gathered by two aircraft flying a series of missions with monitoring equipment over the Antarctic continent, did strongly support the view that chlorofluorocarbons were a key factor in the destruction of atmospheric ozone.

F. Sherwood Rowland, a scientist at the University of California who in the early 1970's first proposed the theory that the man-made chemicals could destroy the ozone layer, said in an interview today that a "key" finding of the Antarctic expedition was that there

were high levels of active chlorine in the Antarctic atmosphere.

"This confirms with lots of details that chlorine is very much involved," Dr. Rowland said.

A statement read by Dr. Watson said that "there is no longer debate" as to whether there is chlorine in the "perturbed region" at "abundances sufficient to destroy ozone if our current understanding of the chlorine-ozone catalytic cycle is correct."

Chlorofluorocarbons, widely used in refrigerants, foams, aerosols, packaging and other products, are also believed to be contributing to the warming of the earth's atmosphere by the buildup of gases that keep the sun's heat from escaping back into space.

But Dr. Albritton said the extreme cold of Antarctica, which is the coldest place on earth, seemed to be "moving at fast forward" changes that were occurring far more slowly elsewhere around the earth.

Dr. Watson said the researchers believed that chlorofluorocarbons "are having a role in the destruction of ozone at all latitudes." He added that in temperate zones the destruction seemed to take place at high latitudes, largely from about 15 to 18 miles from the earth's surface.

The expedition found that the rapid and extensive depletion of the ozone was almost entirely limited to the atmosphere over the Antarctic Continent itself. The expedition found that the loss of ozone was occurring so rapidly, once falling by 10 percent in a single day in one area, that the depletion could not be explained solely by a chemical reaction. For that reason, the researchers said, it also had to reflect a meteorological change, such as rapid temperature change or an influx of air from another region.

The explanation offered for the appearance of the ozone hole in the Antarctic springtime was that as the sun ap-

peared after the dark Antarctic winter, the chlorine adhering to ice crystals in the atmosphere was converted by the sunlight from passive to active molecules that then reacted with and destroyed the ozone. Dr. Albritton noted that the South Pole is colder than the North Pole and that the air there does not circulate as much.

The expedition found that the low temperatures and low water content of the Antarctic air reduced the levels of nitrogen in air. Nitrogen oxides tend to bind with chlorine and make it less destructive to the ozone; therefore, the less nitrogen there is, the more active is the chlorine in the air.

Dr. Watson said there was now twice as much chlorine in the Antarctic atmosphere as there was in 1975, when measurements were first taken.

Dr. Albritton noted that because chlorofluorocarbons stay in the air up to 250 years, they tended to be distributed evenly through the atmosphere. This means that levels of chlorine are no higher in the Antarctic atmosphere than they are over other regions of the globe.

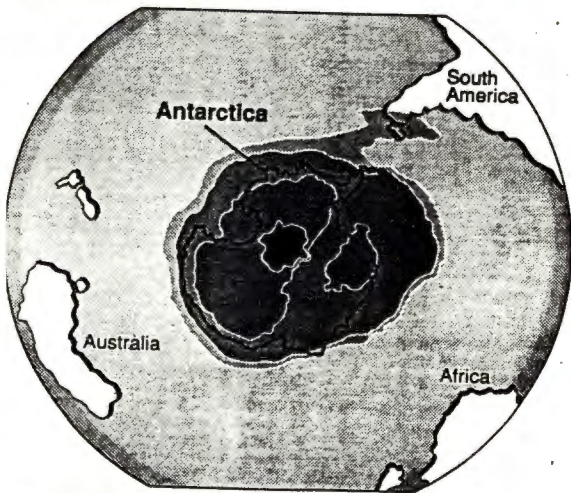
In some areas of the Antarctic, the chlorine levels reached as high as one part per billion in the atmosphere, levels that indicated an accumulation of chlorinated chemicals over the years.

Rafe Pomrance, senior associate of the World Resources Institute, a private policy and research group, said, "The results are so dramatic, particularly the findings of very high levels of CFC's, that it will increase pressure on all fronts, including pressures to ratify the Montreal protocol for the protection of the ozone layer, more research and faster reductions of CFC's."

Dr. Rowland, meanwhile, said that the results of this expedition make it clear that "the agreement in Montreal is only a good first step. We need to go further," he said, by reducing the consumption of CFC's by 90 percent.

WP/1 Oct 87

## Ozone Loss Over Antarctica Is Found to Worsen



Man-made chemicals and local weather reduced the ozone shield over Antarctica last month to the lowest level ever recorded, the space agency said. Data from Sept. 15 show the worst depletion at center, with less severe depletion indicated by successively lighter shades. Page B8.

The New York Times/Oct. 1, 1987

## Ozone Depletion Worsens, Is Linked to Man-Made Gas

### Antarctic Data Bolsters Effort Against CFCs

By Michael Weisskopf  
Washington Post Staff Writer

The ozone layer shielding Antarctica from ultraviolet radiation reached its thinnest point last month since measurements began, and government scientists said yesterday they have found the first hard evidence that the critical environmental loss can be blamed on a man-made gas.

Reporting on a six-week expedition to Antarctica coordinated by the National Aeronautics and Space Administration, the scientists noted that the effects of chlorofluorocarbons (CFCs) gas on the ozone layer in the stratosphere may be more severe in Antarctica than in the rest of the world because of the continent's weather patterns during its early spring.

But NASA program manager Robert Watson said that "CFCs can affect ozone globally," and the mission's report is expected to give impetus to an international agreement designed to halve world consumption of CFCs by early next century.

Stratospheric ozone forms a thin gaseous veil at least 12 miles above

the Earth's surface, which screens out harmful ultraviolet rays and prevents skin cancer, eye disease, withering of crops and damage to aquatic life. In recent years, CFCs—widely used as refrigerants, solvents and bubbling agents in foam products—have been suspected as ozone depleters once they break down in the upper atmosphere.

In 1985, scientists determined that the ozone layer over Antarctica had thinned since at least 1979, and they have monitored the continent to determine the extent and cause of the problem because of its implications for the rest of the world.

The NASA expedition, using airplanes to take the first tests within the ozone sphere, found a 15 percent greater depletion in the protective layer than occurred in 1985 and about a 55 percent overall loss since 1979, Watson told reporters at a Goddard Space Flight Center briefing.

A team of 60 scientists gathered enough data to rule out theories that attributed ozone depletion to changes in the sun's output or movement of low-ozone air masses.

But the researchers found ample reason to confirm the role of CFCs.

Chlorine monoxide, a byproduct of CFCs exposed to ultraviolet rays, was detected at levels 100 to 500 times higher than found at lower altitudes, Watson said. Moreover, he said, as concentrations of ozone fell, levels of chlorine monoxide rose.

"There is no longer debate as to whether [chlorine monoxide] exists within the chemically perturbed region . . . at abundances sufficient to destroy ozone," he said.

But the NASA scientist said the unusual meteorology of Antarctica, with its dehydrated atmosphere and extremely cold temperatures, especially during the Antarctic spring of August and September, is "critical" in explaining the release of active chlorine particles that so voraciously gobble up the ozone layer.

"The meteorology is important in setting up environmental conditions," he said. But he added that "chlorine has made the hole deeper," referring to the "ozone hole" concept used to describe the depleted layer.

Although Watson said the Antarctic experience could have implications for other regions of comparable climate, he emphasized that the findings were preliminary and it is too soon to project global meaning.

But environmentalists immediately interpreted the data as reason for CFC curbs and fast ratification of an international agreement tentatively approved by 46 nations earlier this month that would freeze world consumption of the chemical at 1986 levels and cut by half its use in the industrial world within a decade.

## Atmosphere Over North Pole May Also Be Losing Ozone

There is probably an "ozone hole" at the North Pole, similar to, but not as injurious as, the one at the South Pole, atmospheric chemists have concluded. Evidence that ozone destruction may be occurring at the North Pole was presented last month at a Polar Ozone Workshop in Snowmass Village, Colo.

The southern ozone hole is a seasonal phenomenon in which atmospheric conditions high over Antarctica break apart a significant number of the ozone molecules that shield the Earth from much of the sun's harmful ultraviolet radiation.

The chemistry is complex, beginning during the long, dark austral winter, when air temperatures are their coldest, and finishing during the austral spring, with the return of sunlight. During the rest of the year, winds replenish the polar air's ozone by taking it from middle latitudes. As a result, global ozone levels are steadily declining.

Most atmospheric scientists agree that the phenomenon is new, at least at the scale now taking place, because of chlorofluorocarbons (CFCs), the synthetic chemicals used as coolants and aerosol propellants. CFCs eventually evaporate, mix into the upper atmosphere and break down on the ice particles that form during the dark winter at high altitudes and at temperatures colder than 112 below zero Fahrenheit. When sunlight returns, the chlorine atoms released from CFCs attack ozone, converting it into ordinary oxygen—which does not have the same protective qualities that the oxygen variant, ozone, does.

Scientists had suspected a similar phenomenon at the North Pole, but the first evidence came only this spring. Measurements showed significantly increased amounts of chlorine gas in the air over Thule, Greenland. This was the same kind of evidence that alerted scientists several years ago to the South Pole problem. The Arctic chlorine levels are still only between one-half and one-fifth those over the Antarctic.

A loss of Arctic ozone has not been detected—attempts will be made later—but atmospheric chemists say the chlorine buildup means it is probably beginning to happen.

The Arctic findings were made by George Mount, Arthur Schmeltekopf and Susan Solomon of the National Oceanic and Atmospheric Administration's Aeronomy Laboratory in Boulder, Col., along with Ryan Sanders and Roger Jakoubek of the University of Colorado.