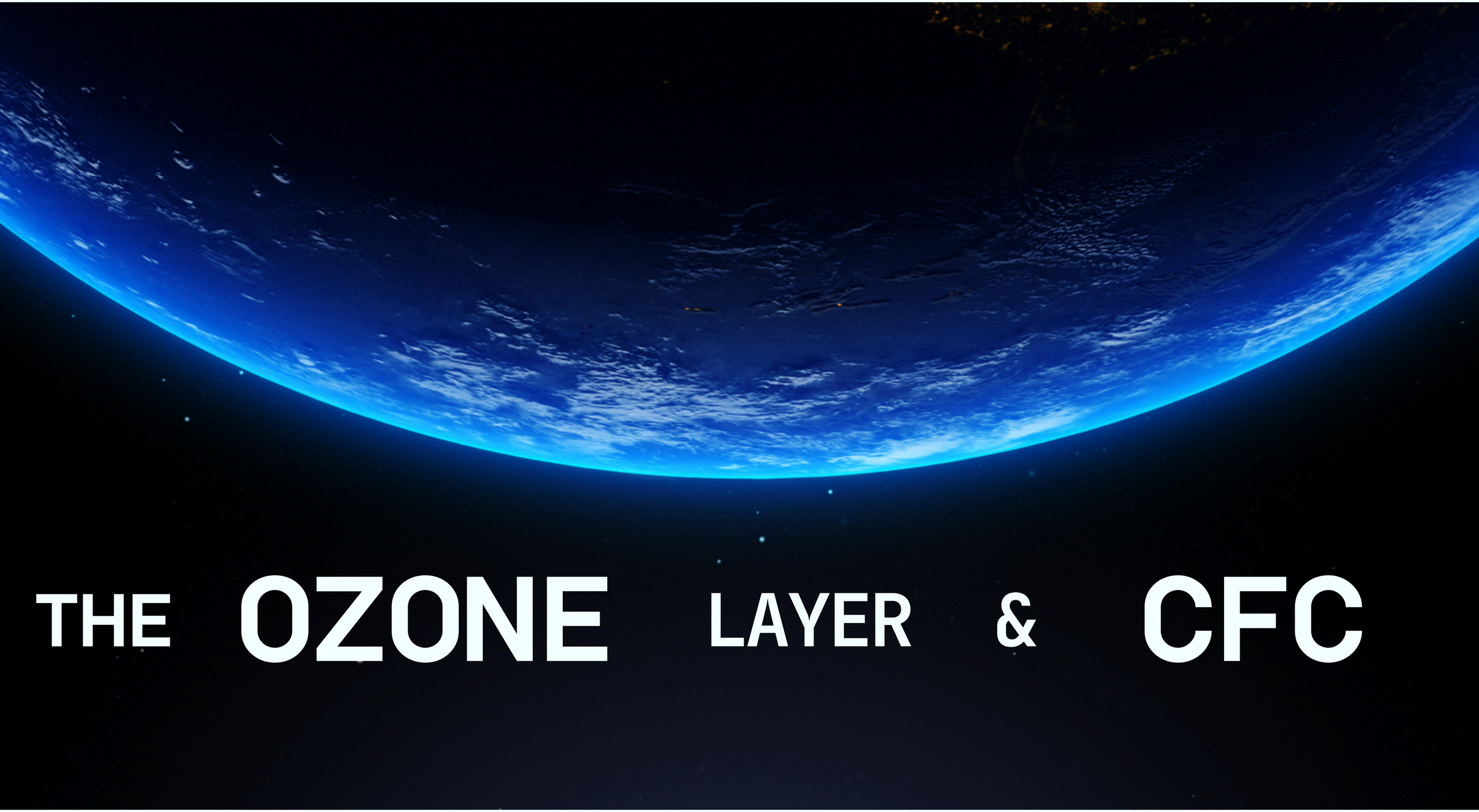
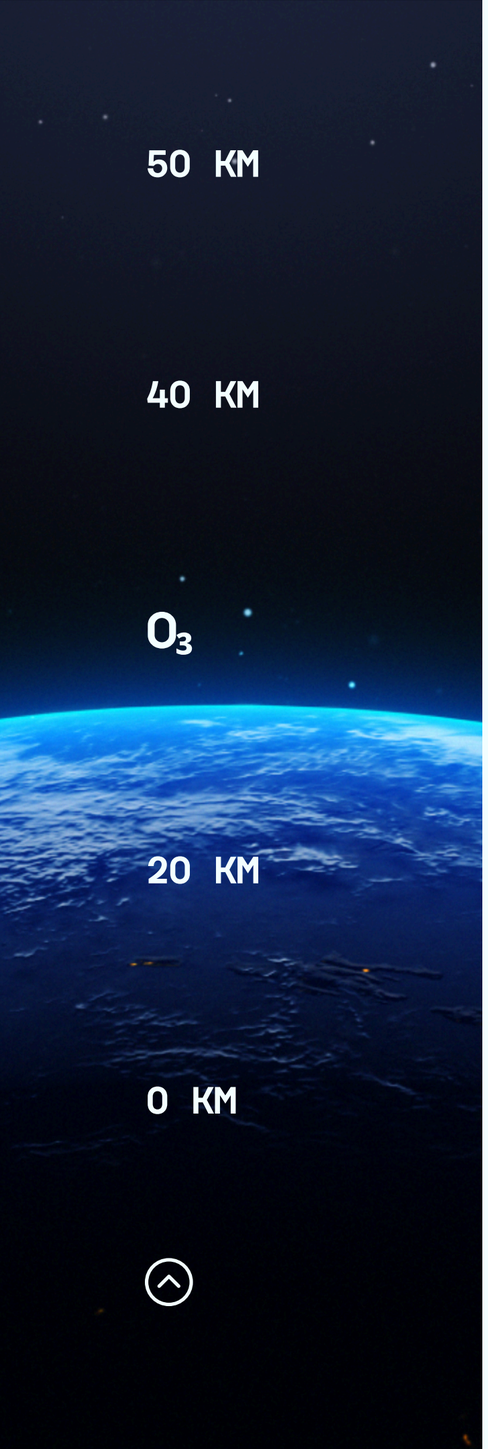
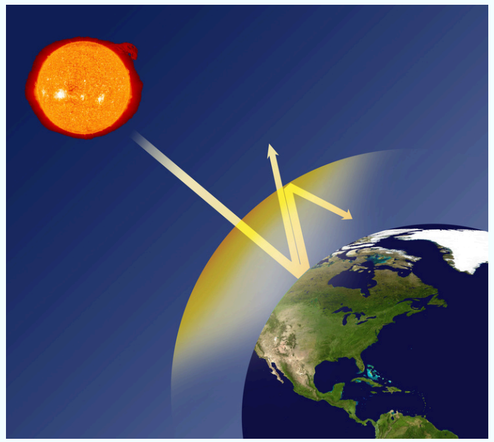

THE OZONE LAYER & CFC



OUR QUESTION



I WONDER HOW THE TYPE AND RELIABILITY OF SCIENTIFIC DATA ABOUT THE OZONE LAYER CHANGE BETWEEN THE FIRST WARNINGS IN 1974 AND THE DISCOVERY OF THE OZONE HOLE IN 1985, AND WHY WERE POLITICIANS AND CHEMICAL COMPANIES SLOW TO ACT ON THE EARLIER STATISTICAL EVIDENCE?



WHY WE CHOSE THIS QUESTION

WE CHOSE THIS QUESTION BECAUSE IT HIGHLIGHTS HOW SCIENTIFIC EVIDENCE CAN CHANGE PEOPLE'S UNDERSTANDING OF AN ISSUE AND LEAD TO MAJOR CHANGES IN GOVERNMENT POLICY.

WHAT IS THE OZONE LAYER & CFCs

OZONE LAYER

THE OZONE LAYER IS A LAYER OF GAS HIGH IN THE EARTH'S ATMOSPHERE THAT ABSORBS HARMFUL UV RADIATION FROM THE SUN. IT HELPS PROTECT LIVING THINGS FROM TOO MUCH UV RADIATION



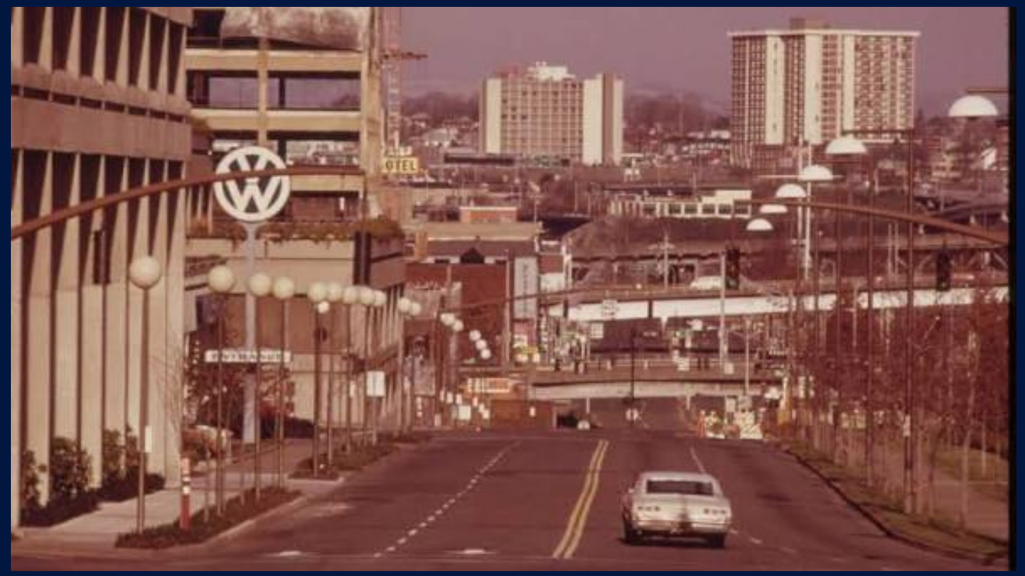
&

CFC

CFCS WERE CHEMICALS USED IN FRIDGES, AIR CONDITIONING AND AEROSOL SPRAYS BECAUSE THEY WERE STABLE AND NON-FLAMMABLE. IN THE UPPER ATMOSPHERE, THEY RELEASE CHLORINE THAT BREAKS DOWN OZONE MOLECULES.



THE OLD BELIEF

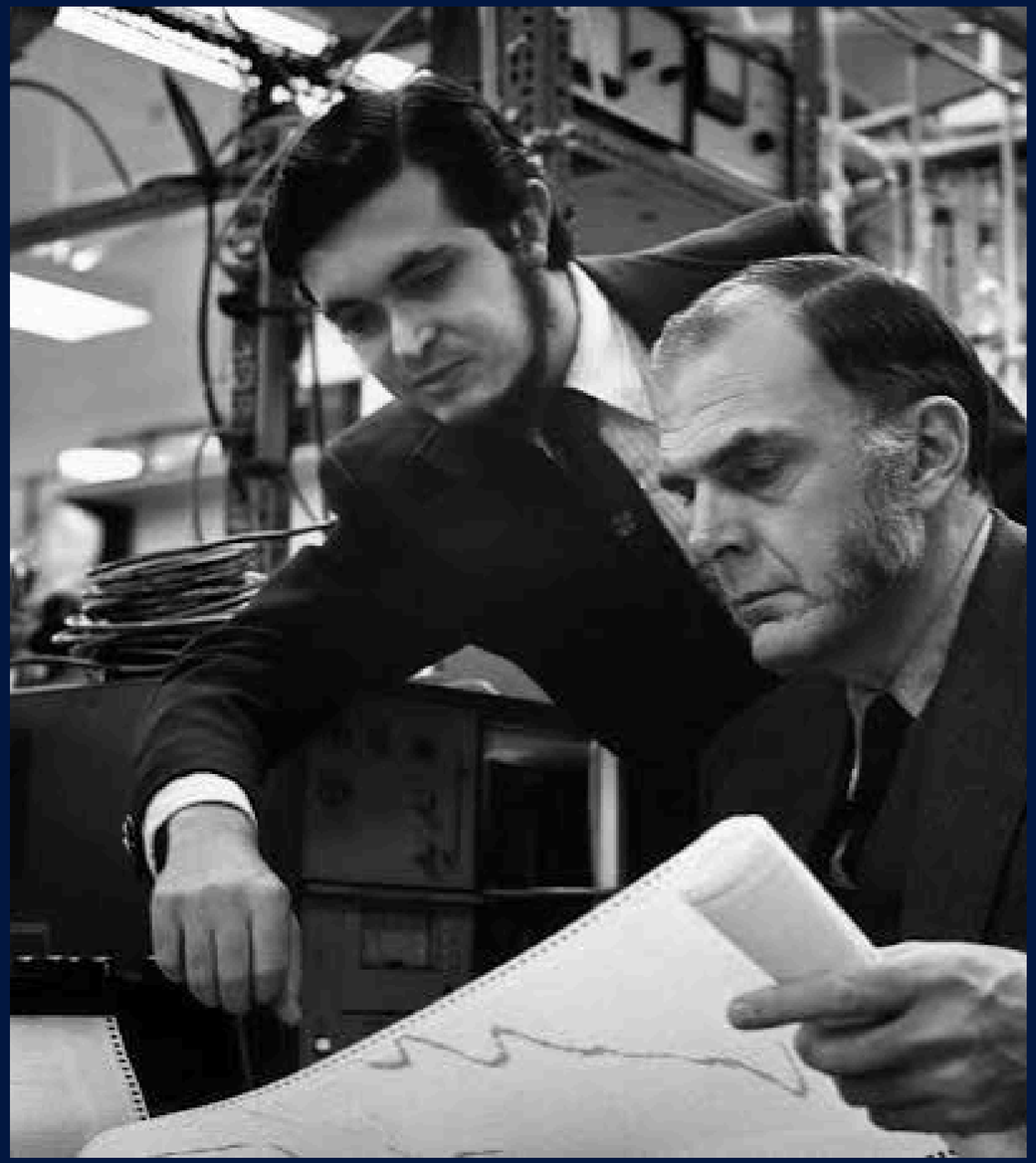




THE BELIEF: FROM THE 1950S TO 1980S, CFCS WERE VIEWED AS USEFUL AND HARMLESS CHEMICALS.

WHY IT SEEMED SAFE: CFCS WERE NON TOXIC, NON FLAMABLE, AND UNREACTIVE NEAR THE EARTH'S SURFACE.

WORLDWIDE USE: BECAUSE OF THIS, THEY WERE USED GLOBALLY IN PRODUCTS LIKE FRIDGES, AIR CONDITIONERS, AND SPRAY CANS.



THE 1974 EARLY WARNING

WHAT THAY DID IN 1974: SCIENTISTS MARIO MOLINA AND SHERWOOD ROWLAND PUBLISHED A PAPER SHOWING THAT CFC CHEMICALS COULD BREAK DOWN OZONE IN THE ATMOSHERE. THEY DISCOVERED THAT UV LIGHT SPLITS CFCS APART, RELEASING CHLORINE, WHICH ACTS LIKE A CHAIN RECTION, MEANING A SINGLE CHLORINE MOLUCLE CAN DESTROY THOUSANDS OF OZONE MOLUCLES.

WHY IT WAS THERETICAL: THEIR WARNING WAS BASED ENTIRELY ON MATH, CHEMICAL REACTIONS, AND LAB MODELS, NOT ACTUAL DATA FROM THE ATMOSPHERE. IN 1974, SCIENTISTS DID NOT YET HAVE THE TECHNOLOGY OR DATA TO PROVE OZONE WAS ACTUALLY DISAPPEARING. BECAUSE IT WAS JUST A THEORY ON WITH NO PHYSICAL PROOF YET, CHEMICAL COMPANIES DIDNT LISTEN TO THE WARNINGS AND REFUSED TO STOP MAKING CFCS.

THE EVIDENCE

WHO COLLECTED IT:

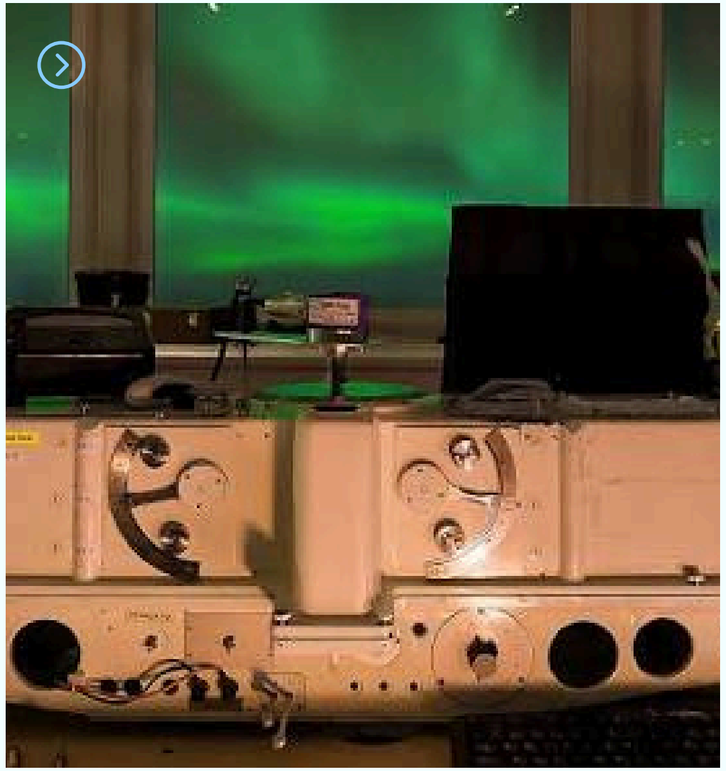
JOE FARMAN, BRIAN GARDINER AND JONATHAN SHANKLIN COLLECTED OZONE MEASUREMENTS AT THE BRITISH ANTARCTIC SURVEY'S HALLEY RESEARCH STATION IN ANTARCTICA. THEY USED DOBSON SPECTROPHOTOMETERS TO MEASURE OZONE LEVELS OVER TIME.

TYPE OF EVIDENCE:

THE DATA WAS PRIMARY AND OBSERVATIONAL. IT WAS PRIMARY BECAUSE THE SCIENTISTS COLLECTED THE MEASUREMENTS THEMSELVES. IT WAS OBSERVATIONAL BECAUSE THEY RECORDED NATURAL CHANGES IN OZONE LEVELS WITHOUT CHANGING OR CONTROLLING ANYTHING.

WHAT DID THEY FIND?

THEY FOUND THAT OZONE LEVELS OVER ANTARCTICA WERE FALLING MUCH FASTER THAN EXPECTED, LEADING TO THE DISCOVERY OF THE OZONE HOLE IN 1985.



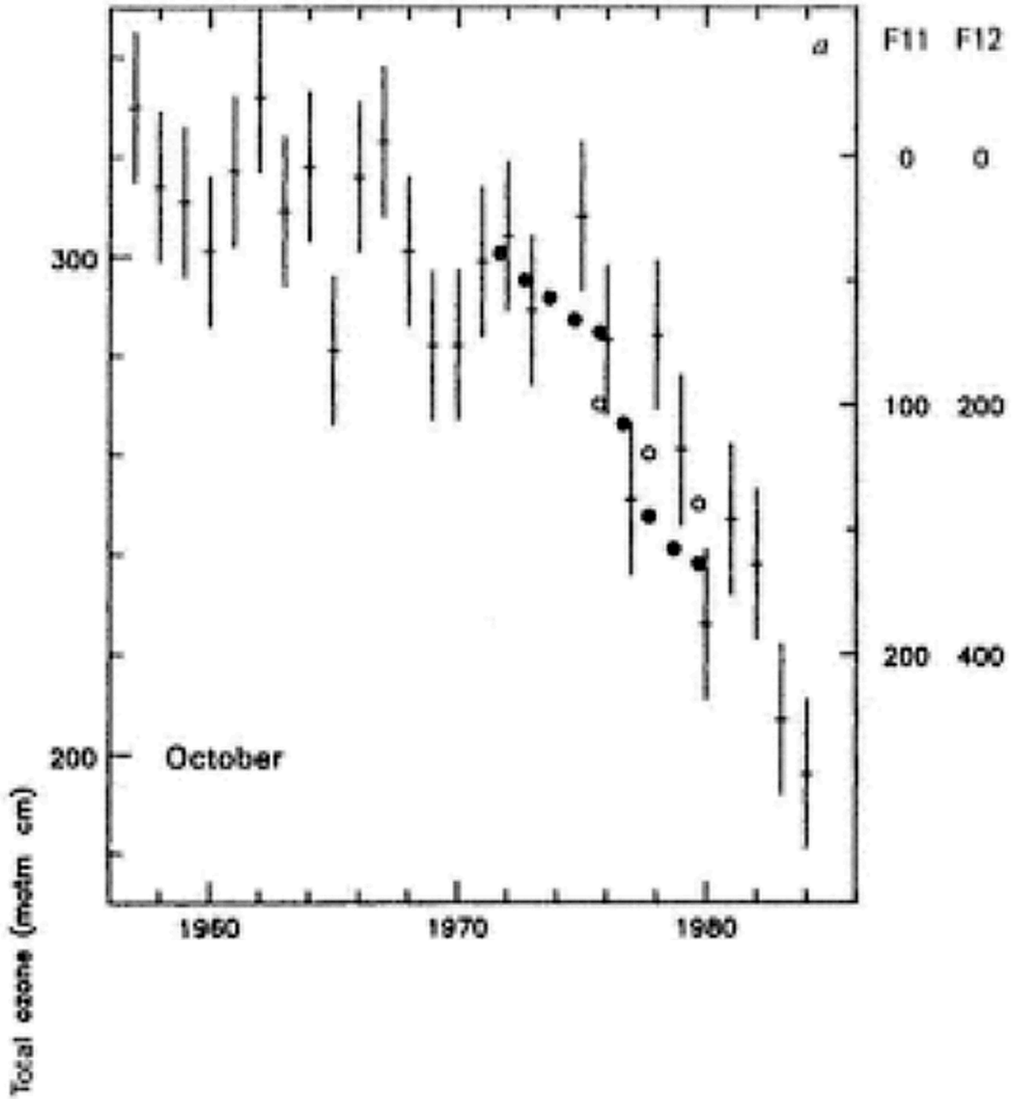
ANTARCTIC OCTOBER OZONE DROP VS ATMOSPHERIC CFC LEVELS (1957-1984)

X-AXIS: TIME IN YEARS (1957-1984)

Y-AXIS LEFT: TOTAL OZONE MEASURED IN MILLI ATMOSPHERE CENTIMETERS

Y-AXIS RIGHT: ATMOSPHERE CFC CONCENTRATIONS MEASURED IN PARTS PER TRILLION.

KEY PATTERN: FROM 1957 TO AROUND 1970, OZONE LEVELS REMAINED STABLE. AS ATMOSPHERE CFC CONCENTRATION (F11 AND F12) STARTED TO INCREASE RAPIDLY, TOTAL OCTOBER OZONE LEVELS OVER ANTARCTICA DEACREASED. THIS SHOWS A LINK BETWEEN INCREASING CFC CHEMICALS IN THE ATMOSPHERE AND THE LOSS OF THE OZONE LAYER.

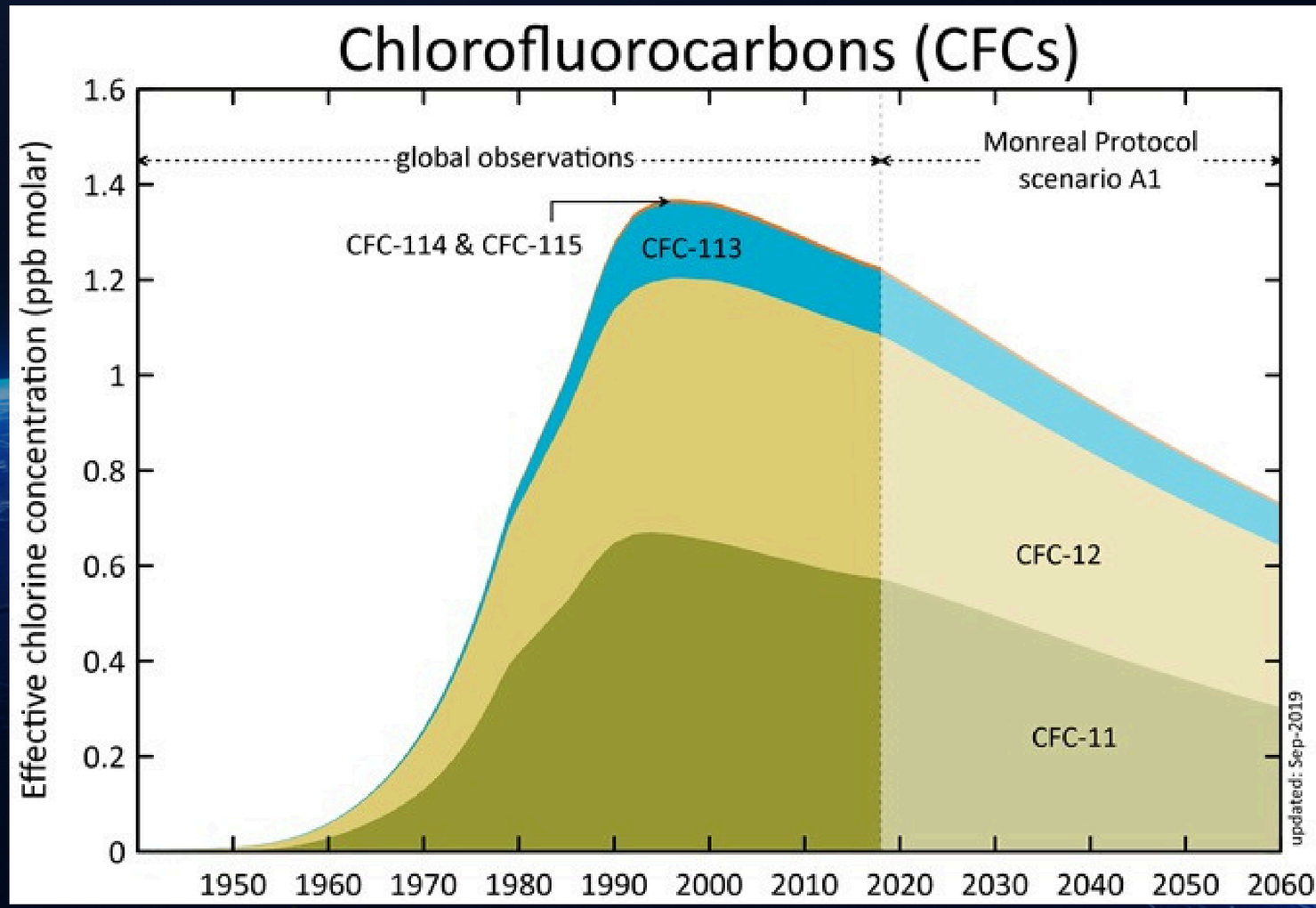


GLOBAL CFC CONCENTRATION TRENDS

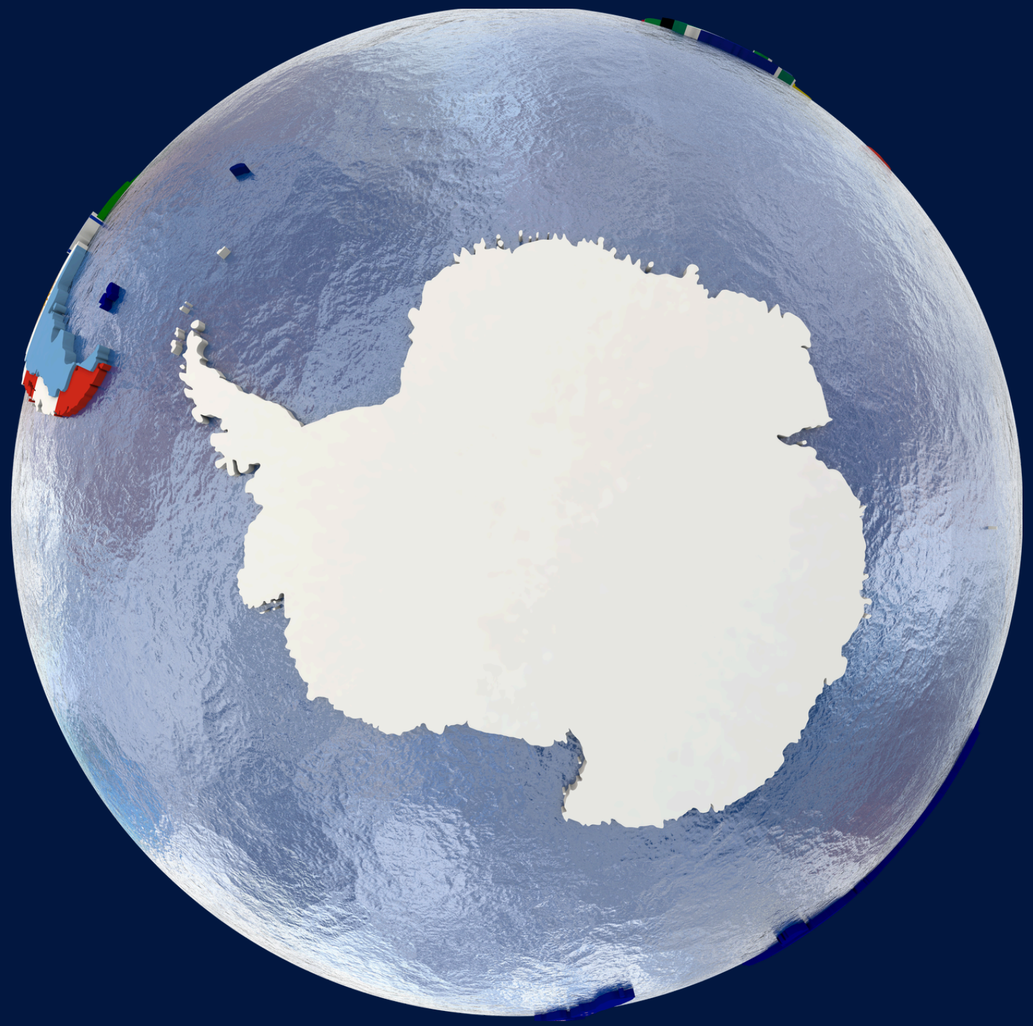
X-AXIS: TIME IN YEARS (1950-2060)

Y-AXIS: EFFECTIVE CHLORINE CONCENTRATION MEASURED IN PARTS PER BILLION.

KEY PATTERN: ATMOSPHERIC CHLORINE CONCENTRATIONS ROSE FROM 1950 UNTIL PEAKING AROUND THE LATE 1990S, BEFORE MAKING A STEADY DECLINE THAT'S PREDICTED TO CONTINUE THROUGH 2060 BECAUSE OF THE MONTREAL PROTOCOL.



GRAPH FROM CSIRO OCEANS AND ATMOSPHERE



THE RESISTANCE

WHO RESISTED: CHEMICAL COMPANIES THAT PRODUCED CFCS AND INDUSTRIES THAT RELIED ON THEM FOR FRIDGES, AIR CONDITIONING, AND SPRAY CANS RESISTED THE EVIDENCE.

FINANCIAL IMPACT: COMPANIES MAKING AND USING CFCS WERE MAKING MASSIVE PROFITS FROM CFCS, AND TRANSITIONING TO NEW, ALTERNATIVE PRODUCTS WAS VERY EXPENSIVE.

EARLY UNCERTAINTY: BEFORE THE DISCOVERY OF THE OZONE, EARLY SCIENTIFIC UNCERTAINTY LED COMPANIES TO DOUBT THE SERIOUSNESS OF THE PROBLEM.

WHAT CHANGED?

THE EVIDENCE GOT STRONGER

1974: MOLINA AND ROWLAND WARNED THAT CFCS COULD DAMAGE THE OZONE LAYER.

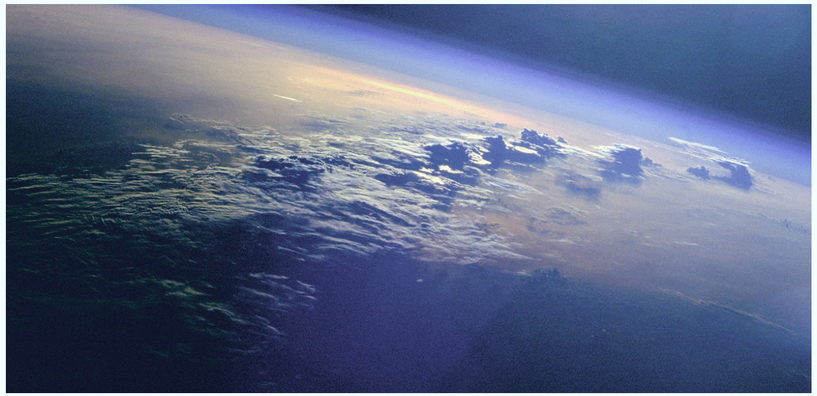
1985: SCIENTISTS DISCOVERED THE ANTARCTIC OZONE HOLE, PROVIDING CLEAR EVIDENCE THAT OZONE DEPLETION WAS HAPPENING.

NEW DATA

MEASUREMENTS FROM ANTARCTICA SHOWED A MAJOR DROP IN OZONE LEVELS. SATELLITE DATA AND FURTHER RESEARCH SUPPORTED THE DISCOVERY.

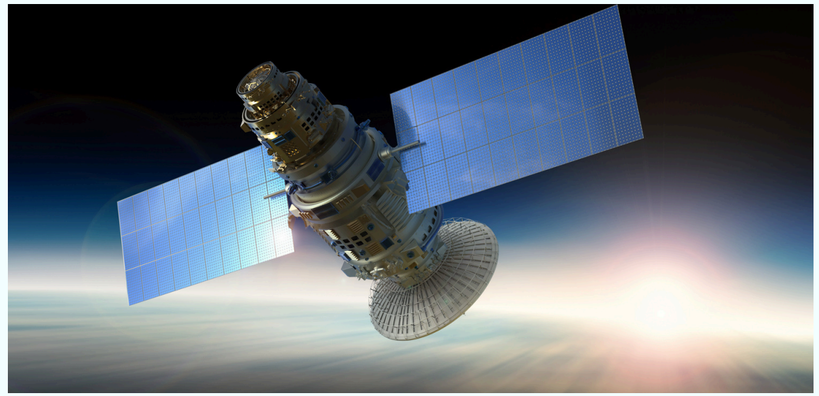
PUBLIC & POLITICAL PRESSURE

THE DISCOVERY MADE OZONE DEPLETION HARDER TO IGNORE. GOVERNMENTS FACED INCREASING PRESSURE TO RESPOND TO THE GROWING SCIENTIFIC EVIDENCE.



INTERNATIONAL ACTION

IN 1987, COUNTRIES AGREED TO THE MONTREAL PROTOCOL, WHICH RESTRICTED AND BEGAN PHASING OUT CFCS AND OTHER OZONE-DEPLETING CHEMICALS.



1974: SCIENTISTS HAD A WARNING
1985: REAL-WORLD MEASUREMENTS SHOWED A MAJOR PROBLEM
1987: GOVERNMENTS ACTED

WHY IT MATTERS

IT STOPPED A DIRECT THREAT TO HUMAN LIFE

WITHOUT ACTION, EXTREME UV RADIATION WOULD HAVE CAUSED MILLIONS OF ADDITIONAL SKIN CANCER AND CATARACT CASES WORLDWIDE WHILE ALSO DESTROYING VITAL ECOSYSTEMS.

SLOWED GLOBAL WARMING

AS WELL AS BEING HARMFUL FOR THE OZONE LAYER, MANY CFCS ARE ALSO POWERFUL GREENHOUSE GASES SO GETTING RID OF THEM PREVENTED SIGNIFICANT ADDITIONAL GLOBAL WARMING ALONGSIDE PROTECTING THE OZONE LAYER.

IT PROVED THAT HUMANITY COULD DESTROY THE PLANET

THE DISCOVERY OF THE OZONE HOLE PROVED THAT HUMAN ACTIVTY AND INDUSTRIAL CHEMICALS AND PRODUCTS COULD ALTER EARTHS ATMOSPHERE ON A GLOBAL SCALE.

PROVES THAT GLOBAL COOPERATION WORKS

THE MONTREAL PROTOCOL SHOWED THAT EVERY CONTRY CAN UNITE TO SOLVE AN ENVIROMENTAL CRISIS TOGETHER WHITH GIVES HOPE FOR CURRENT GLOBAL ISSUES SUCH AS CLIMATE CHANGE.