

## PUBLIC HEALTH

# Ozone: Changing Environmental Outcomes Through Discovery and Mitigation

### *Impact* Curbing ozone emissions by petrochemical facilities to reduce respiratory illness

Most of us know the phrase “ozone hole,” but what exactly is it? And how does it affect our lives? Dr. Susan Solomon is the OAR scientist qualified to provide you with answers.

Solomon’s story began in the 1980s, when the scientific community first discovered that chlorofluorocarbons (CFCs) were becoming more prevalent in the atmosphere at the same time that ozone was lessening. This was distressing because the ozone layer protects the Earth from the Sun’s damaging ultraviolet-B (UVB) radiation. Too much UVB radiation can result in cancer. In 1986, Solomon and colleagues offered a theory for diminished ozone: Human-produced chlorine compounds interacting with stratospheric ice clouds. In the unique meteorological setting of the Earth’s polar regions, this interaction could produce extreme ozone losses. It was a remarkable insight and scientific breakthrough.

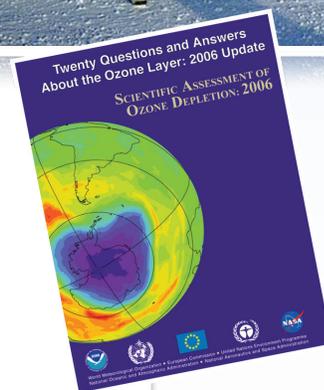
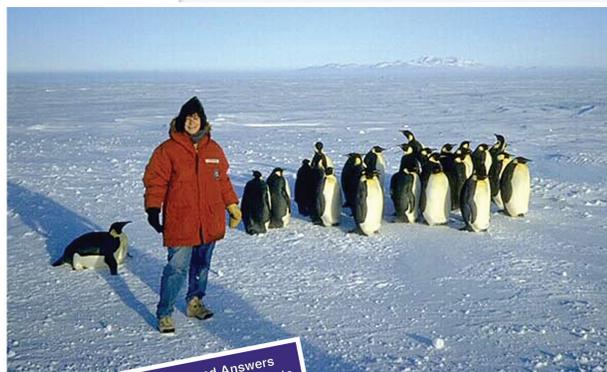
Solomon and her colleagues were right. Together with colleagues from the international scientific community, NOAA scientists embarked on the National Ozone Expeditions of 1986 and 1987 to Antarctica. The data they collected confirmed their theory as the only explanation that fit the observations.

Recognizing the implications of the data, governments around the world agreed to the Montreal Protocol on Substances that Deplete the Ozone Layer on September 16, 1987. The Montreal Protocol put policies in place to reduce production and consumption of man-made compounds that deplete atmospheric ozone.

In late 2008, a NOAA-led assessment of the global ozone layer found the United States has reduced by 97-98 percent the production of ozone damaging substances since the late 1980s.

In 1999, Dr. Susan Solomon earned the U.S. National Medal of Science for “key insights in explaining the cause of the Antarctic ozone hole.”

As a result of this research, the Montreal Protocol put policies in place to reduce production and consumption of the man-made compounds that were depleting atmospheric ozone. Ratified by 180 nations, it is considered by many to be the most successful multilateral environmental agreement to date.



*Images, top to bottom: Dr. Susan Solomon and some new friends on Antarctic ozone expedition in 1987 near McMurdo Station; Twenty Questions and Answers About the Ozone Layer: 2006 Update, a joint publication of NOAA, NASA, the U.N. Environmental Program, and the World Meteorological Organization.*

### Learn More:

[www.esrl.noaa.gov/csd](http://www.esrl.noaa.gov/csd)  
[www.esrl.noaa.gov/gmd](http://www.esrl.noaa.gov/gmd)

## Air Quality: Nailing Down the Source of Ozone Pollution

High concentrations of ground level ozone can cause shortness of breath, wheezing, coughing, headaches, and nausea. These effects are worse for children and those who already suffer from lung diseases.

**Impact**  
**Curbing ozone emissions by petrochemical facilities to reduce respiratory illness**

When the state of Texas planned in the late 1990s to solve their ozone pollution problems, they targeted cars as the number one concern. Officials were surprised when OAR researchers said that the real culprits were hydrocarbon emissions leaking from petrochemical facilities heavily concentrated on the Texas Gulf Coast. What was even more astounding was that emission reductions recommended by OAR researchers could save Texas \$9 billion and 64,000 jobs over 10 years compared to alternative options. The economic study was conducted by The University of Chicago and The University of Houston.

OAR's Earth System Research Laboratory (ESRL) led the Texas Air Quality studies in 2000 as part of a State Improvement Plan aimed to bring the region into compliance with the Clean Air Act. Prior to the study, Texas had taken a traditional approach to reducing nitrogen-containing pollutants, focusing on reducing automobile emissions. When ESRL researchers released their findings, they changed the course of the state's plans, and – doing what OAR does best – provided needed expertise and data to devise practical environmental action, which will save taxpayers and industry money.

Asked to assess the effectiveness of targeted reductions, OAR researchers along with multiple federal, state, and local governmental agencies and academics followed up with a 2006 study. The new information shed light on complex air quality problems elsewhere in the Nation and assisted efforts to meet Environmental Protection Agency standards for ozone, airborne particles or aerosols, and regional haze. NOAA's primary planning and funding partners in the 2006 study were the Texas Commission on Environmental Quality and the Texas Environmental Research Consortium.

*Image: Houston skyline.*



**The Texas Gulf Coast is home to two-thirds of the Nation's petrochemical production. It suffers from the highest ozone pollution levels in the country, exceeding Federal standards an average of 32 days each year (1999-2002).**

**Emission reductions by petrochemical facilities were estimated to save the state of Texas \$9 billion and 64,000 jobs over 10 years.**

## A Breath of Fresh Air: Improving Air Quality Predictions for the Nation

### Impact Air quality forecasts and warnings for health and safety

Whether it's ground-level ozone, fine particulate matter, or other airborne substances, all three may be carried through the air into our lungs. OAR's Air Resources Laboratory (ARL) has developed models that predict where airborne substances will go so at-risk people can be warned.

High ozone levels near the ground cause thousands of premature deaths annually in the U.S. The familiar "code red" ozone alerts issued by state governments warn the public when pollution levels are expected to be high. These alerts also allow people to voluntarily reduce air pollution by driving less and mowing their lawn when conditions improve. OAR's ARL developed the ozone modeling system that forecasters use to determine when alerts should be issued.

The accidental or intentional release of chemical, biological or nuclear agents can have a significant health, safety, national security, economic, and ecological implications. The Hybrid, Single Particle Lagrangian Integrated Trajectory or HySPLIT Model developed by ARL can be used to predict the path of multiple types of airborne hazards. For example, air quality forecasters rely on HySPLIT predictions to determine when their communities will be affected by forest fire smoke. Airlines rely on HySPLIT to steer aircraft around volcanic ash plumes, which can ruin plane engines. The World Meteorological Organization and the International Atomic Energy Agency rely on HySPLIT to predict and track radiation from large nuclear incidents. And local emergency managers also depend on HySPLIT to map the path of chemical plumes, so that first responders and the public can move out of harm's way.

**HySPLIT predicts smoke plume locations from forest fires, and allows aircraft to avoid dangerous ash from volcanic eruptions. Understanding sources of hazardous air pollutants allows air quality managers to mitigate critical air quality problems.**

*Images, top to bottom: NOAA prediction of ground-level ozone; ash from volcanic eruptions is a serious aviation hazard; forest fires can significantly degrade air quality.*

### Air Aware

NOAA works with the Environmental Protection Agency (EPA) and state, local, and tribal governments to provide the public with accurate warnings about unhealthy levels of air pollution.

