CLIMATE PROGRAM OFFICE

Atmospheric Composition and Climate Program

How are human-produced aerosols affecting climate?

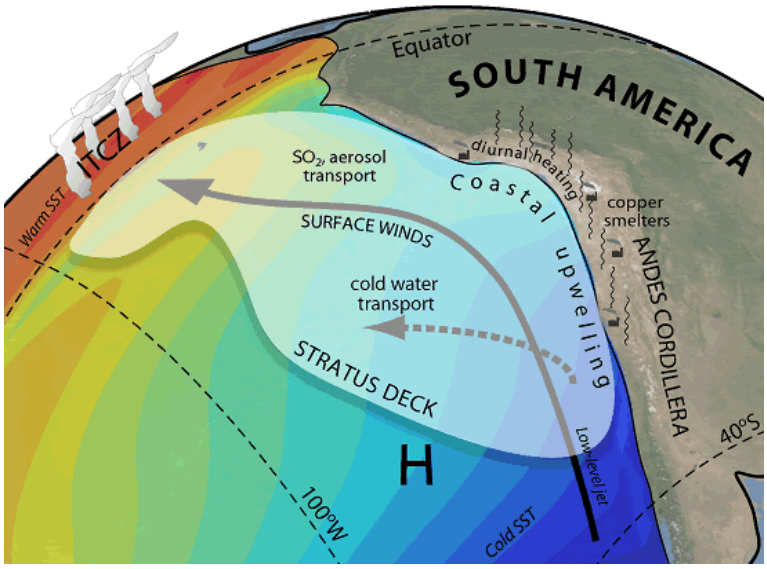
What is the condition of the ozone layer now that humans have stopped releasing gases that were harmful to it?

The Atmospheric Composition and Climate Program (ACCP) supports research on aerosols—small solid and liquid particles suspended in the atmosphere—focusing on their interactions with radiation and clouds. These climate components currently have the lowest level of scientific understanding among all the major factors known to influence climate. This research has significant potential to advance climate science, ultimately improving climate models and informing policy.

The ACCP also supports research to improve understanding of the effect of chemically active greenhouse gases on climate. The program works with other federal agencies and international partners to monitor and model the recovery of the ozone layer in the upper atmosphere and to clarify its role in climate change.

ACCP Objectives

- Improve understanding of how aerosols influence clouds.
- Improve understanding of how chemically active greenhouse gases such as surface-level ozone influence the climate system.
- Monitor and understand the recovery of the stratospheric ozone layer.
- Clarify the role of stratospheric ozone in climate change.



Robert Wood, University of Washington

A field campaign in the southeastern Pacific Ocean focused on collecting detailed measurerments about clouds, aerosols, and atmospheric circulation.

Approaches

Through a range of interdisciplinary collaborations and research activities, the ACCP develops instruments, collects regional- to global-scale observations, conducts laboratory studies, and performs experiments using theoretical modeling. ACCP provides support to groups that:

- Perform data analysis or modeling projects to improve scientific understanding of the interdependent land-ocean-atmosphere system of the Southeast Pacific. These projects aim to improve the modeled representation of tropical rainfall, sea surface temperature, and winds on seasonal and longer time scales.
- Analyze field data and engage in modeling to shed light on the role of aerosols in the Arctic climate system, specifically focusing on springtime sources and transport mechanisms, evolution of aerosols and gases into and within the Arctic, and the climate impacts of haze and ozone in the Arctic.

Atmospheric Composition and Climate Program http://climate.noaa.gov/cpo_pa/acc

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Approaches (continued)

- Improve our understanding of processes governing water vapor in the upper troposphere and lower stratosphere. Water vapor in the upper troposphere has a large influence on the climate system, but is currently not well understood, due to a lack of measurements.

Collaboration with other NOAA Facilities

ACCP partners with groups at Earth Science Research Laboratory, Geophysical Fluid Dynamics Laboratory, and Pacific Marine Environmental Laboratory to conduct laboratory research, gather field measurements, and perform modeling studies on atmospheric aerosols. The program also relies on data obtained and provided by the National Environmental Satellite, Data, and Information Service and the National Weather Service.

ACCP Highlights

Variability of the American Monsoon (VAMOS) Ocean-Land-Atmosphere Study

In October and November 2008, NOAA deployed the Research Vessel *Ronald H. Brown* to the southeastern Pacific Ocean to participate in the VAMOS Ocean-Cloud-Atmosphere-Land Study. ACCP supports several research groups in this field project.

The region off the west coast of South America has the largest and most persistent subtropical deck of stratocumulous clouds in the world. This mass of clouds has a major impact upon Earth's radiation budget as the clouds reflect sunlight and trap heat. The climate in this region involves poorly understood interactions among clouds, aerosols, and circulation patterns in the atmosphere and the ocean. Climate in this area also has great economic impacts: the regional fisheries there represent almost one-fifth of the worldwide marine fish catch. This unique system is very sparsely observed, yet its variations have important impacts on global climate.

Unexpected Benefits from the Montreal Protocol

The Montreal Protocol, an international agreement designed to protect Earth's Ozone layer, has also helped to slow climate change. The agreement banned the use of chlorofluorocarbons (CFCs), substances that deplete ozone in the stratosphere. CFCs also act as greenhouse gases that contribute to global warming.

Monitoring of the atmosphere since the Montreal Protocol was enacted in 1987 enabled researchers to estimate the amount of global warming influence that was avoided through the reduction of ozone-depleting substances. Data show that implementing the agreement resulted in the avoidance of about a decade's worth of carbon dioxide-equivalent emission growth worldwide. These findings contributed directly to a recent amendment to the Montreal Protocol that will phase out another set of ozone-depleting gases, hydrofluorocarbons or HFCs.

Eric James

A NOAA P3 research aircraft flies over the Arctic as part of a research project to investigate the role of aerosols in the loss of sea ice.

Transport of absorbing aerosols to the Arctic and their role in Arctic climate

In March and April 2008, NOAA deployed its atmospheric research aircraft to Fairbanks, Alaska, and commissioned the Woods Hole Oceanographic Institute's Research Vessel, *Knorr,* to the North Atlantic Ocean. Both were involved in a study of the role of aerosols in Arctic ice melt, conducted under the auspices of the International Polar Year, a coordinated effort to increase knowledge about the polar regions. Some aerosols darken the snow surface and thus enhance melting; they also change heating rates of surface air and influence cloud formation.

A potential result of the recent dramatic decline in Arctic sea ice is the opening of the Northwest Passage; this would allow the establishment of shipping routes with significant political, economic, and environmental ramifications. This study will contribute to understanding of the factors that control pollution transport to the Arctic and how aerosols affect the Arctic climate system, ultimately improving our ability to predict future changes in sea ice extent.