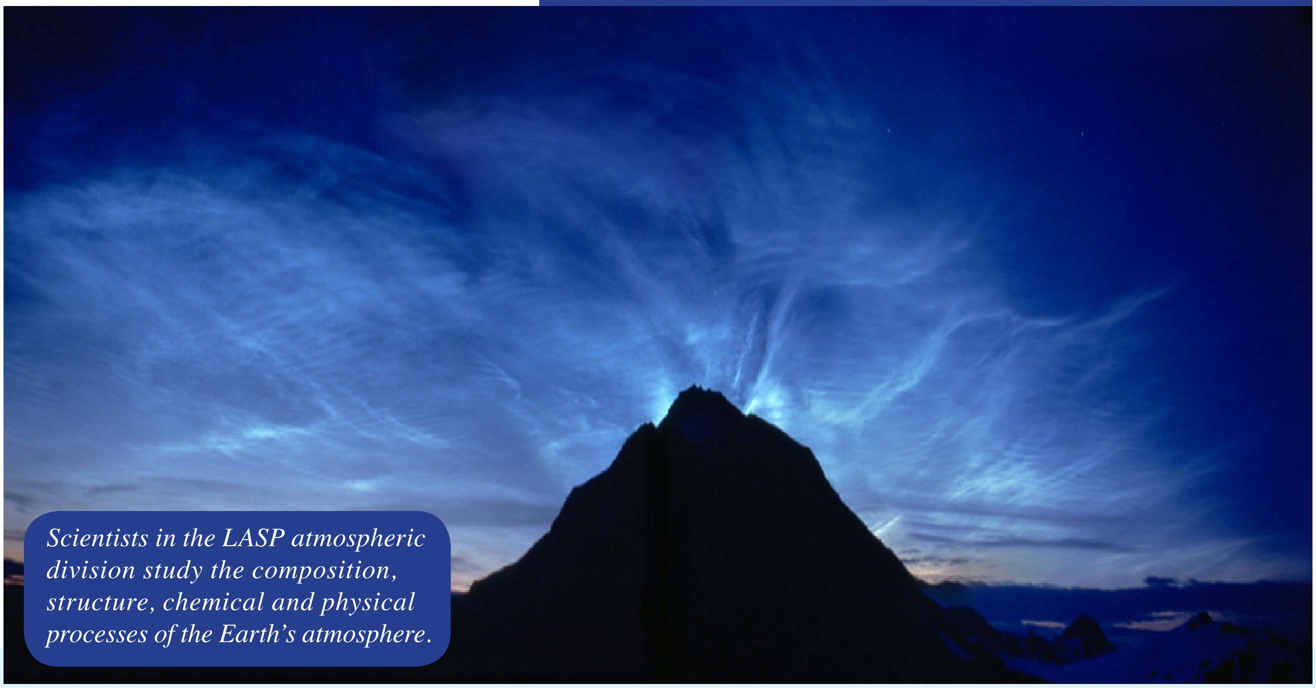
LABORATORY FOR ATMOSPHERIC AND SPACE PHYSICS
UNIVERSITY OF COLORADO **BOULDER**

Atmospheric Science



Scientists in the LASP atmospheric division study the composition, structure, chemical and physical processes of the Earth's atmosphere.

(Courtesy LASP)

The Earth's atmosphere, a layered sphere of gas extending upward more than 600 km from the surface, forms the environment for terrestrial life. It consists of the troposphere, where weather occurs; the stratosphere, where a blanket of protective ozone lies; the mesosphere, the home of beautiful noctilucent clouds (also known as polar mesospheric clouds or PMCs); and the thermosphere, host to the colorful aurora (northern/southern lights).

Scientists in the LASP atmospheric division study the composition, structure, chemical and physical processes of the Earth's atmosphere in four inter-related groups which focus on satellite, airborne and ground-based observations of atmospheric constituents (clouds, aerosols, gases), and modeling studies to better understand processes (for example, atmospheric dynamics, chemistry, radiation) not only on our planet, but others as well. Our atmospheric scientists have, with great success, combined scientific research with graduate and undergraduate education.

Airborne Science

LASP scientists are actively involved in airborne research using a variety of platforms, including NASA (WB-57F, DC-8 and ER-2), National Science Foundation (Gulfstream G-V, C-130) and university (University of Wyoming King Air) aircraft, as well as scientific balloons.

Our recent and current projects include:

- Studies of the formation of the Antarctic "ozone hole" using long-duration stratospheric balloons
- Investigations of wintertime cloud formation and the relationship between cloud properties and snowfall
- Development of instrumentation for high-altitude research aircraft

Atmospheric Radiation

LASP has expertise in measuring solar radiation, not only from space, but also in the atmosphere. Atmospheric radiation plays a critical role in studies of atmospheric remote sensing and LASP scientists regularly take part in field experiments to measure solar and infrared radiation on aircraft and unmanned airborne vehicles (UAVs). They consistently develop new data analysis and modeling tools to study the interaction of radiation with clouds, aerosols, and the surface, with an emphasis on spectrally resolved observations and modeling.

Measuring the radiative effects of aerosols from urban pollution and forest fires presents a challenge for space-based and airborne observations because of the variability of emission sources, plumes, topography, and surrounding clouds. Often, aircraft and scientific balloons are deployed to complement and validate existing satellite observations.

To further explore the link between satellite irradiance measurements and climate- and weather-relevant atmospheric radiative processes, NASA Goddard Space Flight Center and LASP established the collaborative Sun-Climate Research Center in 2011.

Clouds and Aerosols

Aerosols and clouds play key roles in the Earth's climate. Investigators at LASP study the production of aerosol particles and their lifetime in the atmosphere.

Some of the major types of aerosols studied include:

- Mineral dust from sandstorms and volcanoes
- Sea spray from the oceans
- Smoke from agricultural burning and forest fires
- Sulfate aerosols from fossil fuel combustion, marine life and volcanoes

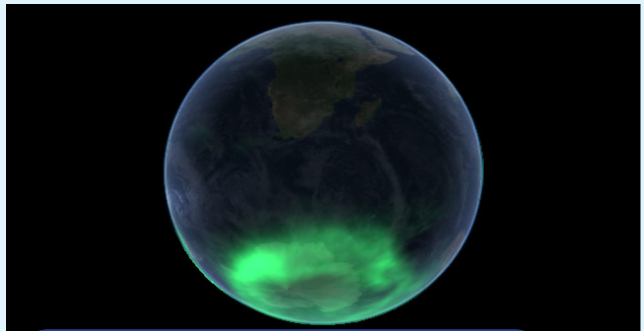
Cloud particles form from existing aerosols and remove aerosols from the atmosphere. Cloud particles serve as sites for interesting chemistry such as sulfur oxidation and activation of ozone-depleting chemicals. Clouds are also important for the regulation of the climate through their radiative properties—they can reflect the sun rays away from the surface, cooling the climate, but they also act as "blankets," trapping the Sun's radiative heat—and their control of water vapor, the most prevalent greenhouse gas within Earth's atmosphere.

LASP investigators study:

- Polar stratospheric clouds
- Cirrus clouds
- Cumulonimbus clouds
- Marine stratocumulus clouds

LASP investigators also examine potentially dramatic climate scenarios such as the effects of aerosols from small-scale nuclear conflict and proposals to engineer the atmosphere to counteract climate change. LASP provided two of the instruments for the Aeronomy of Ice in the Mesosphere (AIM) mission, which helps uncover why PMCs form and why they vary, quantifying the connection between PMC's and the meteorology of the polar mesosphere.

Crossover with Airborne Science and Atmospheric Radiation includes meteorological forecasts, aerosol forecasts, and flight planning for field campaigns. Crossover cloud and aerosol radiative effects with Planetary Science includes the study of the atmospheres of the Earth and various planets and satellites to improve our understanding of the formation and evolution of atmospheres on Venus, Earth, Mars and Titan.



From space, the aurora appears as a ring of light around the Earth's poles. LASP scientists and students are contributing to understanding these processes.

(Courtesy NASA)

Middle and Upper Atmosphere

The aurora, colorful curtains of light seen from Earth at high latitudes, are caused by charged particles energized by the Earth's magnetic field colliding with nitrogen and oxygen in the thermosphere. Particles with even greater energy penetrate to the lower thermosphere and mesosphere, forming nitric oxide that can descend to the stratosphere and contribute to the destruction of ozone. LASP scientists and students are contributing to the understanding of these important atmospheric processes.

LASP scientists also study ozone depletion in the polar lower stratosphere, a phenomenon closely linked to the occurrence of polar stratospheric clouds (PSCs). These rainbow-colored, shimmering clouds form only over the polar regions during the winter and early spring. PSCs set the conditions for the yearly ozone "hole" in Antarctica, and for significant ozone loss in the Arctic as well. When stratospheric ozone is depleted, more ultraviolet light penetrates to the Earth's surface, causing damage to terrestrial life. LASP scientists employ theoretical models and data from numerous satellite and aircraft instruments to quantify the relationship between PSCs and polar ozone depletion. The extent of ozone is monitored each year to gain a predictive understanding of stratospheric chemistry and transport.

To read more about Atmospheric Sciences at LASP, visit: http://lasp.colorado.edu/home/science/atmospheric.

The Laboratory for Atmospheric and Space Physics (LASP) combines all aspects of space exploration through our expertise in science, engineering, mission operations, and data management. As an institute at the University of Colorado Boulder, LASP includes students throughout our activities. Learn more at http://lasp.colorado.edu.