Atmospheric System Research

The U.S. Department of Energy's (DOE) Atmospheric System Research (ASR) program seeks to advance process-level understanding of the key interactions among aerosols, clouds, precipitation, radiation, dynamics, and thermodynamics, with the ultimate goal of reducing the uncertainty in global and regional climate simulations and projections.

ASR works in partnership with DOE-funded modeling programs such as Regional and Global Climate Modeling, Earth System Modeling, and Terrestrial Ecosystem Science. ASR also works with the DOE-funded Atmospheric Radiation Measurement (ARM) Climate Research Facility, using ARM data sets gathered over a range of environmental conditions at several fixed and mobile sites situated in climatically diverse locations. Continuous ARM data sets are supplemented with laboratory studies and shorter-duration ground-based and airborne field campaigns to target specific atmospheric processes under a diversity of locations and atmospheric conditions. ASR researchers use these data, together with models, to understand the processes that govern the atmospheric components and their interactions across a range of spatial and temporal scales.

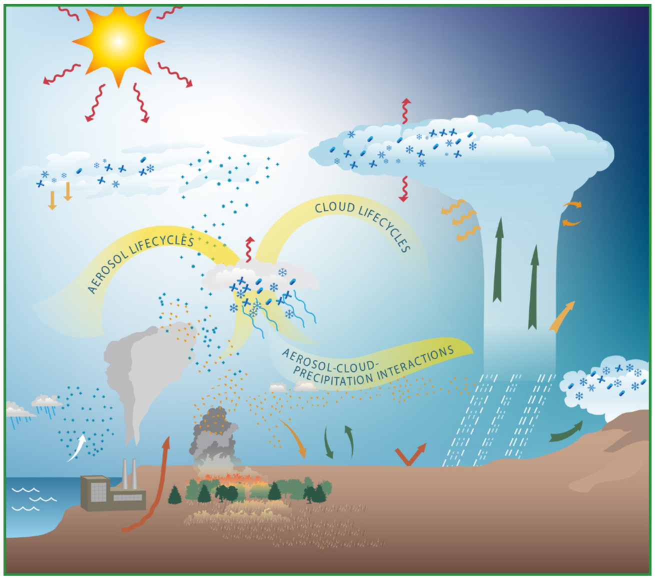
ASR research results are incorporated into Earth system models developed by other DOE-funded programs in order to better understand atmospheric processes and to improve the accuracy of the models. Through these activities, ASR supports the development of national energy and climate policy.

Working Groups

ASR's primary research objectives are grouped according to the themes of aerosol life cycle, cloud life cycle, and cloud-aerosol-precipitation interactions. Working groups formed along these themes provide a structured forum for scientists to collaborate with each other. Each group includes both modelers and measurement scientists, so that improved understanding of observed atmospheric processes can be translated into better representation of these processes in models.

Aerosol Life Cycle

The primary objective of the Aerosol Life Cycle Working Group is to understand and quantify the processes associated with the aerosol life cycle, the



This depiction of the atmospheric system shows some of the atmospheric processes that must be understood and accurately represented in climate models.

direct impact of aerosols on the Earth's radiative balance, and the nature and distribution of cloud condensation nuclei. These details will allow ASR researchers to improve the representation of aerosols in global and regional climate simulations and projections. Research themes include:

- secondary organic aerosol origin and properties
- optical properties of absorbing aerosol
- new particle formation and growth
- mixing state and phase impacts on aerosol properties.

Cloud Life Cycle

The mission of the Cloud Life Cycle Working Group is to use observations and modeling to develop understanding of the dynamical, thermodynamical, microphysical, and radiative processes that determine the evolution of clouds from formation to dissipation, and to translate this understanding into methods for representing cloud processes in numerical weather and climate models. Research themes include:

- organization and diurnal cycle of convection
- evolution of boundary-layer clouds
- phase partitioning in mixed-phase clouds
- processes controlling the ice particle size distribution.

Funding Opportunities

Funding opportunities for ASR are posted on the Office of Science Grants & Contracts website at ***http://www.science.doe.gov/grants/***. This website also contains information about preparing and submitting applications. A list of current ASR research projects is available at ***http://asr.science.energy.gov/science/research-projects***.

Cloud-Aerosol-Precipitation Interactions

The mission of the Cloud-Aerosol-Precipitation Interactions Working Group is to improve understanding and model representation of the influence of aerosol particles on clouds and precipitation, radiative impacts from the microphysical and macrophysical structure of clouds, and cloud processing of aerosol. Research themes include:

- aerosol effects on clouds and precipitation
- influence of aerosol absorption on cloud radiative forcing
- physically based models of aerosol effects on ice nucleation.

ASR Scientists

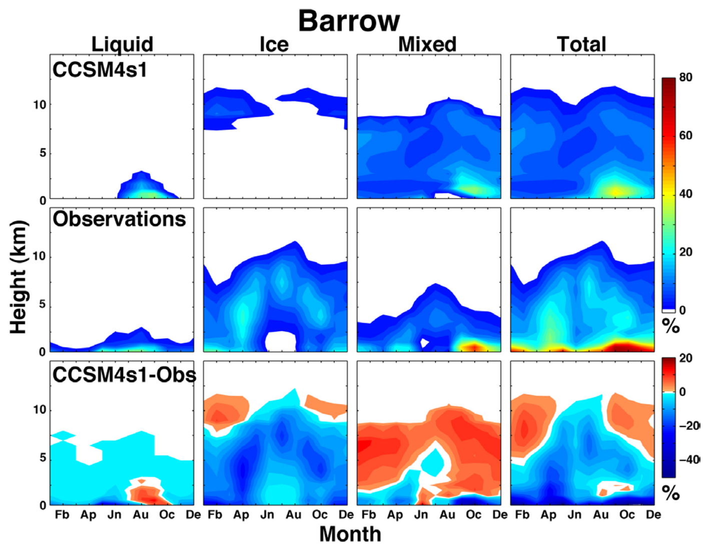
Scientists who receive a funding award from ASR lead research studies, laboratory studies, or field campaigns. They publish approximately 150–200 peer reviewed articles per year in journals such as the *Journal of Geophysical Research,* the *Journal of Climate,* and *Atmospheric Chemistry and Physics* and also serve as reviewers for journals.

The ASR science community meets twice a year. The ASR Science Team Meeting is dedicated to sharing results and discussing ongoing investigations; the Working Group Meetings allow ASR scientists to discuss priorities and directions of each of the three working groups. ASR scientists also present research results at major conferences such as the American Geophysical Union Fall Meeting and the American Meteorological Society Annual Meeting.

Research Highlights

Research highlights summarizing ASR-funded research are posted on the ASR website. These highlights summarize the results of the research and usually include a link to a relevant journal publication. Highlights can be viewed at ***http://asr.science.energy.gov/science/research-highlights***.

In one example, ASR scientists used ARM Facility observations to evaluate version 4 of the Community System Climate model. They discovered that simulated clouds occurred less frequently than those observed and had larger liquid water paths when they did occur.



This figure shows time-height cross-sections of simulated (top) and observed (second row) cloud phase at Barrow, Alaska. The difference between the frequencies of occurrence of each phase is indicated in the third row.

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http://asr.science.energy.gov

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