University Corporation for Atmospheric Research
Public Policy Agenda for FY 2017 and FY 2018

Approved by the UCAR Advocacy for the Science Community (UASC) Committee, September, 2016

The University Corporation for Atmospheric Research (UCAR) is a nonprofit consortium of more than 100 North American member colleges and universities focused on research, education, and training in the atmospheric, earth, and related sciences. It was founded in 1960 to manage the National Center for Atmospheric Research (NCAR) on behalf of the National Science Foundation (NSF). Today UCAR's mission is to empower its Member Institutions and NCAR by: promoting research excellence; developing fruitful scientific collaborations; managing unique resources; creating new capabilities; building critical applications; expanding educational opportunities; and engaging in effective advocacy.

After consulting with the UCAR Board of Trustees and UCAR Advocacy for the Science Community (UASC) Committee, UCAR has established this public policy agenda to guide its advocacy efforts to support the academic atmospheric, earth, and related sciences for FY 2017 and FY 2018.

A focused investment of federal resources in the atmospheric, earth, and related sciences will make significant contributions towards meeting important societal concerns including: protection of American lives and property; expansion of new economic opportunities; enhancement of national security; and strengthening the U.S. leadership in research and development.

UCAR's public policy priorities focus on the following research areas:

- Weather;
- Water;
- Climate;
- Air Quality;
- Space Weather;
- Education and Training

These research priorities relate directly to the Federal agencies for which the atmospheric, earth, and related sciences play an important role in their missions – including the Office of Science and Technology Policy (OSTP); NSF, the National Oceanic and Atmospheric Administration (NOAA), the National Aeronautics and Space Administration (NASA); the Department of Energy (DOE), Department of Agriculture (USDA), the Federal Aviation Administration (FAA); the Department of Defense (DOD); the Department of Homeland Security (DHS); the Department of the Interior (DOI); the Environmental Protection Agency (EPA); and others.

These research priorities are also consistent with pending legislation including the American Innovation and Competitiveness Act, the Weather Research and Forecasting Innovation Act of 2015, the Seasonal Forecasting Improvement Act, the Space Weather Research and Forecasting Act, as well as current and past guidance provided by the House and Senate Appropriations Committees.

UCAR Public Policy Agenda for the Atmospheric, Earth, and Related Sciences

The goal of UCAR advocacy is to improve the viability of the atmospheric, earth, and related sciences. UCAR implements this goal by providing that community with access to state-of-the-art research support, computing, and observational capabilities at NCAR, and through UCAR Community Programs (UCP) which provide innovative resources, tools, and services in support of the research and educational goals of the atmospheric, earth, and related sciences community. A major focus is working to ensure the research outcomes from NCAR and UCAR institutions is translated in useful ways to meet the needs of society.

NCAR was established as a center of excellence for research and education in the atmospheric sciences; and providing research support, facilities, and services for the atmospheric, earth and related sciences and the wider geosciences community. NCAR is designated as an NSF Federally Funded Research and Development Center (FFRDC) with approximately 750 full-time equivalent staff. The NCAR mission is to understand the behavior of the atmosphere, earth, and related systems; to support, enhance, and extend the capabilities of the university community and the broader science community, nationally and internationally; and to foster the transfer of knowledge and technology for the betterment of life on earth. This mission is accomplished through scientific research; the development, improvement, and operation of a number of facilities; and educational and outreach programs.

In collaboration with the university research and education community, NCAR focuses on fundamental research aimed at improving our ability to predict meteorological, air quality, and space weather hazards and increasing our understanding of the variability in and changes to the earth's climate system at regional and global scales. These research themes are enabled by NCAR-operated facilities such as unique aircraft; petascale supercomputing capabilities; and state-of-the-art community models. Partnerships with researchers in complementary fields, such as hydrology, cryospheric science, oceanography, terrestrial biology, public health and social sciences, broaden NCAR's activities beyond the traditional atmospheric, earth, and related sciences.

UCAR, as the manager of NCAR for NSF, is responsible for:

- Planning, executing, staffing, and managing the NCAR program;
- Providing and maintaining advanced observational, computational, and modeling facilities and services to support the research and education community;
- Operating and maintaining the NCAR buildings and facilities, developing and incorporating new facilities, as appropriate;
- Recruiting, developing and retaining a highly competent and diverse staff;
- Planning for and implementing future initiatives;
- Overseeing and sustaining an innovative and vigorous program of basic and applied research in support of the atmospheric, earth, and related sciences.

UCAR believes that in order for the research and education community to contribute both the knowledge and human resources needed by society, it is essential that the NSF, NOAA, NASA and the other related mission agencies receive priority support for their research and education activities as well as the continued improvement of operational programs. In addition, the agencies should be commended for and encouraged to build on their highly collaborative relationships not only within the Federal enterprise, but also with the academic and private sector.

UCAR provides important scientific support not only for the university based atmospheric, earth, and related sciences community, but also for the agencies with missions that require research, data analysis and management, and training in these disciplines. UCAR endorses a set of core values to ensure the Nation's research and education enterprise remains strong, vital, and productive. These values include:

- Dependence on merit review and the pursuit of objectivity in research;
- The federal investment in research and education should to be broad and inclusive if we are to be successful in the endeavors discussed below; and
- The responsibility of the research and education community to enable the beneficial use of scientific discovery by society.

WEATHER: The goal of weather prediction is to provide timely and accurate information that will serve to reduce weather-related losses, protect life and property, improve public health and safety, support economic prosperity and national security, and improve the quality of life for all citizens.

According to the National Academies, the benefit of investing to improve public weather forecasts and warnings is substantial: the estimated annualized benefit is about $31.5 billion, compared to the $5 billion spent annually by the Federal Government for generating the baseline information.

Improvements in short term and seasonal forecasting would benefit society in many ways beyond being better prepared for severe weather events. Weather-related aircraft delays could be reduced which would reduce operational costs for the commercial airline industry. Use of weather information will allow for better options in the decision-making of various stake holders in the transportation sector (i.e. commuters, tourists, transit operators, commercial trucking and shipping managers, transportation maintenance operators, etc.).

Improved seasonal forecasts would be of value to the agricultural economy allowing farmers and others to either take full advantage of predicted beneficial weather conditions as well as prepare for forthcoming challenging weather conditions such as drought or flooding.

The United States should unambiguously lead in operational numerical weather prediction and earth observing capabilities yet by some measures, our capabilities lag behind our international competitors. This suggests the U.S. could be mitigating economic , national security, and public safety implications of severe weather more effectively. The university community is working to develop a better fundamental understanding of the integration of earth system sciences as well as improved observing capabilities and models (and the computing capabilities needed to use such models) to simulate local, regional, national and global-scale conditions that impact severe storm development. This, however, is an area in need of a sustained investment of resources.

The university community also supports the need for the sophisticated integration of the social sciences in the design and execution of future weather and climate research activities as well as the dissemination of weather and climate relevant information. Such research will enable better predictions of and responses to storms and other forms of severe weather that can reduce loss of life and property, and limit economic damage to areas experiencing severe weather.

Fundamental research and research training, via support provided by NSF and, to a more limited extent, other Federal agencies, underpins all efforts to improve the quality of weather forecasts. This includes: studies of the physics, chemistry, and dynamics of earth's upper and lower atmosphere and its space environment; research on weather and climate processes and variations; and research to understand the natural global cycles of gases and particles in earth's atmosphere.

Given the continuing evolution of the weather enterprise – particularly the significant growth of the private sector's ability to provide unique weather related products and services, and the demise of some observing capabilities, there is a real need for one or more forums that enable public-private sector strategic planning. A valuable contribution would be a National Academies' decadal survey related to weather, involving representatives of the public and private sectors. Such a survey could develop a prioritized set of Federal (domestic and defense related) research and operational priorities for weather research and weather forecasting which should be useful for decision and policy makers in an era of constrained resources.

WATER: Water challenges are facing communities and regions across the United States and the world, impacting billions of lives and costing billions of dollars in damages. These challenges are particularly problematic in predominantly poor, minority, or rural communities, where water inequality can go hand-in-hand with socioeconomic inequality. Recent events, including record-breaking drought in the West, severe flooding in the Southeast, and the water-quality crisis in Flint, MI, have elevated a national dialogue on the state of our Nation's water quality, resources and infrastructure. This dialogue is increasingly important as a growing population and changing climate continue to exacerbate these water challenges. Issues related to water quality, water resource management, and water infrastructure are even more challenging in developing countries.

Weather and climate models are fundamental for understanding the earth's water cycle and issues related to availability, quality, water resource management, energy production, flooding, and

drought. One focus of water research is to reduce uncertainty through improved understanding and integration of the water cycle in weather and climate models. Another component of the effort is the examination of the impact of climate change on water systems, and to determine potential effects on water management policy.

Research support is needed in areas related to improving modeling that will deliver more timely and detailed flooding forecasts. Research can facilitate the improvement of the nation's existing urban water systems through the development of innovative water technologies, management tools and systems-level analysis. A complete understanding of the water system requires an approach that extends beyond the atmosphere to include how the earth's water system is linked with climate change, land use and ecosystems.

CLIMATE: Today's global climate changes are having a noticeable impact via heat waves, extended drought, wildfires, migration of disease-carrying insects and pests, warming oceans, and other events. Global climate change has already had observable effects on the environment. Sea level is rising, glaciers have shrunk, plant and animal ranges have shifted, and trees are flowering sooner.

Global climate is projected to continue to change over this century and beyond. The magnitude of climate change beyond the next few decades depends primarily on the amount of heat-trapping gases emitted globally, and how sensitive the earth's climate is to those emissions.

Understanding global climate change is critical to this country's and the world's welfare. Fundamental use-inspired research, made possible by cutting-edge tools for collecting and analyzing data, can provide the knowledge that governments, businesses, and communities need as they address the climate-related changes that pose growing risks to life, property, natural resources, and the economy.

Climate research advances understanding of the interacting physical, chemical, biological, and societal components of the earth system; the vulnerability and resilience of its natural and human dimensions; and the means by which scientific knowledge can effectively inform responses to global change. Such research depends on sustained programmatic investments in multidisciplinary observations, process studies, advanced computing, and modeling. These components of scientific inquiry require their own expertise, infrastructure, and planning horizons, but they ultimately work together to produce a more comprehensive and integrated understanding of global change.

AIR QUALITY: Air quality affects broad sectors of society, from human health to crop yields to enjoyment of our national parks. Particulate matter, in addition to ozone, triggers most air quality alerts and health effects. Scientists are improving pollutant tracking and developing detailed air quality predictions. Research is also focused on developing detailed air quality forecasts days in advance. Improved forecasts offer the promise of significant benefits to society.

Additional work is needed regarding the development of modeling tools to characterize air quality and predict exposures at local to urban scales, regional to continental scales, and global to hemispheric scales; and the linkage of air modeling tools with modeling tools for other media (e.g. water) and development of an integrated multi-media modeling system.

SPACE WEATHER: Space weather can disrupt vital technology – both space based as well as ground based -- that forms the backbone of this country's economic vitality and national security, including satellite and airline operations, communications networks, navigation systems, and the electric power grid. Effective actions to prepare for space weather events require a better understanding of the sun-earth connection. Benchmarks will help government and industry assess the vulnerability of critical infrastructure, establish decision points and thresholds for action, understand risk, and provide points of reference to enable mitigation procedures and practices and to enhance response and recovery planning.

Opportunity exists to improve the fundamental understanding of space weather and increase the accuracy, reliability, and timeliness of space-weather observations and forecasts (and related products and services). The underpinning science and observations will help drive advances in modeling capability and improve the quality of space-weather products and services. A better capacity to develop and transition

the latest scientific and technological advances into space weather operations centers will enable an improved rate of forecast improvement.

To advance space weather capabilities, it is essential that relevant Federal agencies coordinate their actions and their assets to improve, and design appropriately, observation systems. A mix of assets is needed: space-based measurements that provide the coverage necessary for detecting space weather hazards, some of which cannot be discovered from the ground, and ground-based measurements that provide more extensive spatial coverage.

EDUCATION & TRAINING: The success of the research challenges described above is dependent on a science, technology, engineering and mathematics (STEM) education system that produces a diverse and well-prepared workforce of scientists, technicians, engineers, mathematicians and educators and a well-informed citizenry that have access to the ideas and tools of science and engineering. STEM education – at all levels, from K-12, to the undergraduate level, and graduate level -- will contribute to the enhancement of the quality of life of all citizens and the health, prosperity, welfare and security of the nation.

The goals for this Nation's STEM education activities should be to: prepare the next generation of STEM professionals – in the geosciences and beyond -- and attract and retain more Americans to STEM careers; develop a robust research community that can conduct rigorous research and evaluation that will support excellence in STEM education and that integrates research and education; increase the technological, scientific and quantitative literacy of all Americans so that they can exercise responsible citizenship and live productive lives in an increasingly technological society; and broaden participation (individuals, geographic regions, types of institutions, STEM disciplines) and close achievement gaps in all STEM fields.

Understanding how the earth system works and transforming this knowledge into action will allow our nation and the world to effectively respond and adapt to changing environmental conditions. National investment and leadership combined with enhanced partnerships across all levels of government, the private sector, the academic sector, and the nongovernmental organization sector are necessary to make this vision a reality. Enhancing research and education support in the areas outlined above will better enable individuals, communities, businesses, and governments to manage risks, adapt and mitigate in due to changing environmental conditions, and enhance national security and economic and social prosperity.