Introduction of the Atmospheric Turbulence and Diffusion Division (ATDD) of ARL
Presented at the ARL Laboratory Review May 3, 2011

Narrator -We're here at the Air Resources Laboratory's Atmospheric Turbulence and Diffusion Division in Oak Ridge, Tennessee. Dr. Bruce Baker is the Director and he will tell us about ATDD's research.

Bruce - Welcome. ATDD was originally created to develop diffusion models to track the dispersion of accidental releases of contaminants. This research led to participating in scientific campaigns that examined atmospheric flows in complex terrain and urban areas and transport and exchange of nitrogen, sulfur, and mercury compounds. ATDD is still heavily involved in urban meteorology research and how land surface interactions affect the atmosphere and air chemistry. We are also heavily invested in NOAA's climate observing systems which includes designing, testing, installing and maintaining stations in all 50 states.

Narrator – Bruce mentioned that ATDD studies the effects of pollutants like nitrogen and mercury on the air quality of the lowest part of the atmosphere; where people live and breathe and also in remote places like the Arctic and Antarctic.

LaToya Myles- The atmosphere doesn't have boundaries or borders, so it's our responsibility to understand how pollutants travel in the air, so that we can maintain healthy ecosystems and communities. We study ammonia gas that's emitted from agricultural activities, like fertilizing crops and raising livestock. We measure how ammonia is transferred from the air to crops, soil, and other surfaces. Our air quality research is vital to human and ecosystem health.

Steve Brooks- I'm Steve Brooks. I've been privileged to work in some of the most remote regions on Earth to advance our understanding of the global dynamics of mercury pollution. We are measuring halogen chemistry in Antarctica and Greenland, and learned that halogens, recycled in the surface snow, are primarily responsible for the oxidation and deposition of gaseous elemental mercury from long range transport into the polar environments. Over the ice sheets deposited mercury is sequestered in glacial ice, and over the marine environment it accumulates in the biota causing physiological and behavior changes in top predators, such as polar bears.

Narrator – And of course we must examine the impacts of weather patterns on urban areas…our cities and coastal regions.

Will Pendergrass- The DCNet urban meteorology program addresses the issue of weather within the lowest layer of the atmosphere. ATDD's focus is on how the urban environment controls transport and dispersion of any possible airborne release of hazardous materials. While our emphasis has been on providing first responders with time assessments and forecasts, the 17 DCNet weather stations deployed within the

National Capital Region have served as a prototype urban testbed providing weather data ranging from Homeland Security applications to Public Health issues to building HVAC controls.

Narrator - Fixed weather stations tell only part of the story. To get a complete picture ATDD uses airborne platforms to compare meteorology aloft with ground based measurements.

Ed Dumas- We have a long history using aircraft to make scientific measurements. A collaboration with Harvard University aims to measure fluxes of CO2 and methane from an aircraft over the North Slope of Alaska and Siberia in the summers of 2011 through 2013. Turbulence will be measured using our BAT Probe, which was tested in the Wright Brother's wind tunnel at the Massachusetts Institute of Technology. This test allowed the probe to be calibrated under flight conditions.

Another study in cooperation with the University of Tennessee Space Institute measures the spatial variability of surface temperature around NOAA's Climate Observing Stations. An aircraft has been instrumented to carry an infrared temperature sensor and other spectral instruments to measure incoming and reflected solar radiation. Test flights have been performed over climate observing stations in both Oak Ridge and Crossville, Tennessee.

Dave Senn- Some airborne measurements don't need all the capabilities that an airplane offers. In those cases we turn to balloons. This 90 g (3 oz) package transmits temperature, humidity, and location by radio to a computer on the ground. This information is used to study the planetary boundary layer. The layer of air we live in.

Narrator – To fully understand the Earth's climate, we must measure the energy exchange between the atmosphere and the Earth's surface, and study the long term trends in temperature and precipitation.

Tilden - Our reputation at ATDD for taking high quality observations has made this laboratory a great asset of NOAA. The Climate Reference Networks, tell us with confidence, *how* the climate of the U.S, is changing. The Surface Energy Budget Network, helps explain *why* the regional climates have changed. Understanding these processes and feedbacks are important for predicting future climate and weather and are necessary for managing our fresh water resources. The Climate Networks are designed to provide high quality data to detect and document the climate signal on a national and regional basis. The locations of the sites were meticulously chosen to be in areas that would not be artificially influenced and would accurately represent the area. All of our sensors are calibrated against NIST traceable standards and the primary measurements have triple redundancy to assure confidence and completeness of the data record. We have sustained greater than 99.8% data recovery for the networks.

Narrator – A constant challenge with our research is getting the BEST measurement possible. A reliable, accurate measurement assures scientific integrity.

John Kochendorfer- Sonic anemometers measure wind speed, and are used to research the exchange of energy and greenhouse gases between the earth's surface and the atmosphere. This experiment has helped us understand wind speed measurement errors. We also study precipitation gauges. Air moving past a gauge is deflected, causing large measurement errors in snowy, windy conditions. We are evaluating different wind shields to help minimize this problem.

Narrator – Often, Industry comes to us for scientific expertise to improve their efficiency. For example in the area of green energy, we've signed a research and development agreement with Duke Energy to improve short-term forecasts of wind fields where wind turbines operate.

Chris Vogel - There are still significant challenges in making these forecasts for specific localized areas; and because the amount of power that is produced is very sensitive to the amount of wind available, accurate forecasts are essential in improving the cost efficiency of the power production. In short, this research could prove critical in further optimizing wind energy production for our nation.

Bruce Baker - We've explored ATDD's research and how it affects people, animals, and plants. So, what do we do with our knowledge? How do we put our research to practical use? We share it with industry, communities, public officials, other scientists, and environmentalists to enable them to make informed decisions that benefit the Earth and her peoples.