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Courtesy of The Norman Transcript–Oct. 26, 2009

Oklahoma – The world's leading atmospheric observatory

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During the last 40 years, Oklahoma has become the world's leading atmospheric observatory. Three notable events -- the late 2006 completion and occupancy of the OU-NOAA National Weather Center, the recent passing of former Governor and U.S. Senator Henry Bellmon and new funding from the American Recovery and Reinvestment Act (ARRA) -- have prompted the following explanation of this accomplishment.

Bellmon's death inspired a review of his many laudable contributions to the state and nation. Missing from those accolades, however, was Bellmon's crucial role during the late 1980s in establishing the statewide 120-station Oklahoma Mesonet. With at least one weather station in each of Oklahoma's 77 counties, the Mesonet is unique among atmospheric observing systems worldwide. Mesonet data now is used routinely in agricultural decision making and the management of water resources, among many longer-term applications, and for the preservation of life and property during extreme weather events such as in the days after the bombing of the Murrah Federal Building and during the hours straddling the May 3, 1999, and May 8 and 9, 2003, tornadoes.

As Governor, Bellmon encouraged and substantially facilitated the initiation of the Mesonet. Over the years, the Mesonet has received national and international recognition of its excellence -- winner of a 2001 Innovations in American Government Award from Harvard University; finalist in the Stockholm Challenge Award for Technology Innovation; and recipient of a 2005 award from the American Meteorological Society for "service to Oklahoma and the meteorological community." Recently, the Mesonet was complemented with a much more dense 40-station counterpart (known as the Micronet) in Oklahoma City that is measuring the city's effects on the atmosphere.

The establishment of the Mesonet was a defining yet only intermediate step in the development of the supreme atmospheric observatory that now is Oklahoma. Beginning in the early 1970s, electrical engineers and meteorologists at the NOAA National Severe Storms Laboratory on the OU Campus in Norman successfully adapted the military technology of Doppler radar for weather surveillance. The result was the national NEXRAD Radar Network. More importantly, NEXRAD wind measurements now provide the basis for the tornado warnings on TV. Because of the severe weather threat here, the national deployment of NEXRAD radars began in Oklahoma in the early 1990s. Since that time, the national NEXRAD Network has been operated by the interagency (NOAA and Department of Defense) Radar Operations Center on the OU Campus.

Recently, NOAA and OU engineers and scientists have upgraded the NEXRAD radars, designed and built several mobile radars for tornado and hurricane chasing and started another military-to-

meteorology radar adaptation (Phased Array) that can reduce substantially tornado warning lead-times and may replace the NEXRAD systems in 10-15 years. Concurrently, several short-range radars have been tested southwest of Oklahoma City with the goal of enhancing low-level tornado surveillance between the NEXRADs.

Coinciding with the establishment of the Oklahoma Mesonet and the national NEXRAD Network, the U.S. Department of Energy -- as the first step in its global ARM Climate Research Facility -- initiated the Southern Great Plains (SGP) field site across much of Oklahoma and southern Kansas in the early 1990s. The SGP site is the world's largest climate observatory and the "crown jewel" of the U.S. Department of Energy's climate change research programs. It was located here partly because of anticipated synergy with the NEXRAD Network and the Mesonet. As testament to its value, the SGP has survived and been developed progressively during the last 20 years under varying presidential administrations and congressional majorities. The site has many instruments concentrated at its central facility near Lamont, 30 miles west of Ponca City, and within a few miles of the Bellmon home farm -- plus 23 smaller instrument clusters scattered throughout its domain.

Instruments at the SGP site collect continuous atmospheric data that are needed to improve the computer models that simulate climate change. These models are the only tool we have to anticipate how global and regional climate will change in response to the increasing atmospheric greenhouse gases. The continuous ground-based measurements focus particularly on the development and characteristics of clouds and their interactions with the radiation that is received from the sun and emitted back to space from the earth and lower atmosphere. Measurements of the Oklahoma atmosphere from the SGP site are being used to improve the computer simulation of the future climate for the whole world, including by scientists in several other countries such as the U.K. and Australia. To date, the cost of the SGP instrumentation and supporting infrastructure is approximately $21 million.

Occasionally, the routine ground-based SGP data collection is supplemented by special "field campaigns" that obtain data from aircraft and satellite platforms. For instance, June 19, 2007, five airplanes were vertically stacked up over the central facility at the exact time a meteorological satellite passed overhead. At the bottom of the pile of airplanes was a helicopter skimming the wheat crop, while at the top of the stack a scientific version of the U-2 spy plane made satellite-type measurements from 70,000 feet. Four other airplanes took simultaneous observations nearby. The total of nine aircraft operating at the same time in such a restricted area likely was a world record for an atmospheric science field campaign.

The latest stage in the building of the Oklahoma Atmospheric Observatory soon will occur with $12 million of funding from the American Recovery and Reinvestment Act (ARRA). This stimulus is permitting the U.S. Department of Energy to enhance significantly the cloud observing capability throughout its global ARM climate research facility, including the SGP site's central facility. The addition of seven new radars there, together with substantial upgrading of several existing instruments, will permit the most detailed documentation of cloud characteristics and their time evolution ever obtained anywhere in the world. Because of the great variety of Oklahoma clouds, the resulting improvements in the computer modeling of future climate will have global impact.

All these components of the Oklahoma Atmospheric Observatory are being advanced by scientists and engineers housed in the new National Weather Center on the OU campus. The 256,725 square feet and $69.5 million facility is scientifically unique because it not only co-locates but, more importantly, intermingles a wide variety of educational, operations, engineering and research units from both OU and NOAA. The need for this facility first was recognized in the late 1980s and early 1990s by NOAA and OU leaders. Planning for it accelerated after former governor and U.S. Senator

David Boren assumed the OU presidency in 1994, and its potential value was championed by President Bill Clinton in the aftermath of the May 3, 1999, tornadoes.

However, the National Weather Center became a reality only after an extraordinary effort by President Boren to raise the necessary funding from the state and federal governments. His pursuit of these monies was dogged, ultimately completely successful, and inspired by recognition that the facility was essential for Oklahoma to advance further among the world's atmospheric science leaders. As a result, no other atmospheric science program on the globe ever has been bequeathed such an outstanding facility from which to increase its accomplishments and raise its international structure.

The late 2006 completion and occupancy of the National Weather Center and imminent expansion of the ARM climate research facility in Oklahoma substantiate the anticipation of the first ARM chief scientist in the mid-1990s, that "if we build it they will come." His borrowing of this signature line from the movie "Field of Dreams" now applies to the entire Oklahoma Atmospheric Observatory. The atmosphere over Oklahoma is measured more intensively than for any other area of similar size across the world. Oklahoma is the role model for other states and nations in this regard, for which the foresight and persistence of Boren and Bellmon deserve significant credit.
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