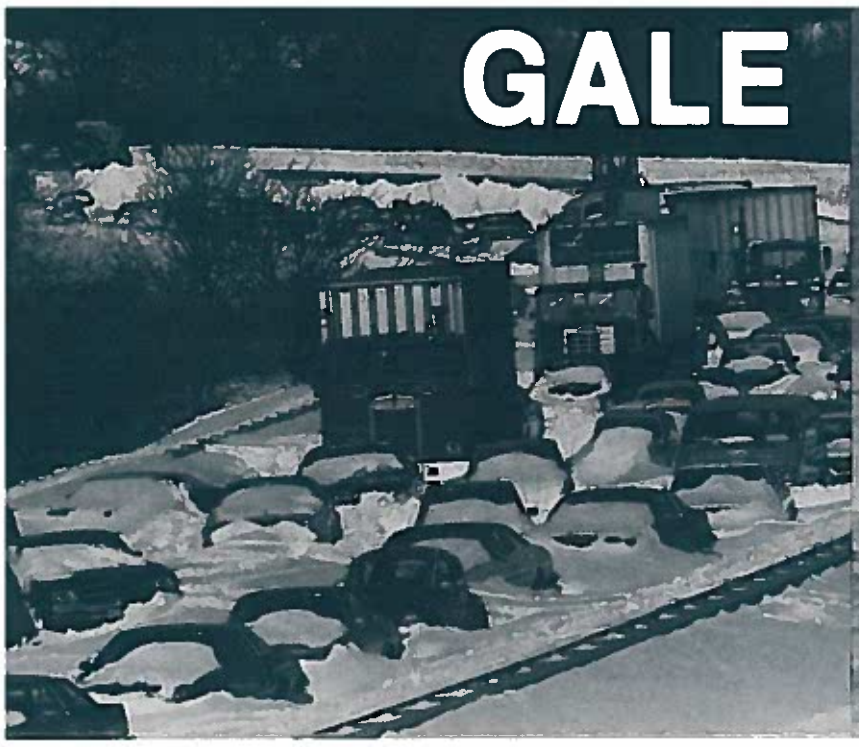
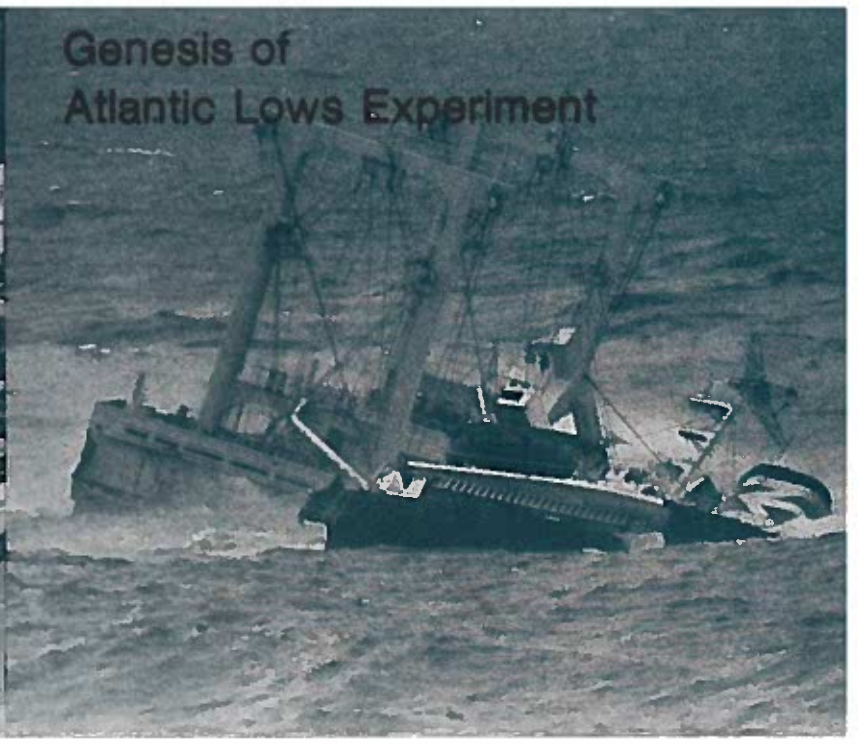
GALE

Genesis of Atlantic Lows Experiment





(Wide World Photos, Inc.)

The Problem

Savage winter storms, often characterized by crippling ice, heavy snow, and damaging gale-force winds, annually batter the East Coast, causing more than a billion dollars in property damage and unfortunate loss of life. These East Coast cyclones, as they are called, generate havoc in one of the largest megalopolis regions of the world, the northeast U.S. coast, and can affect more than 30 million people.

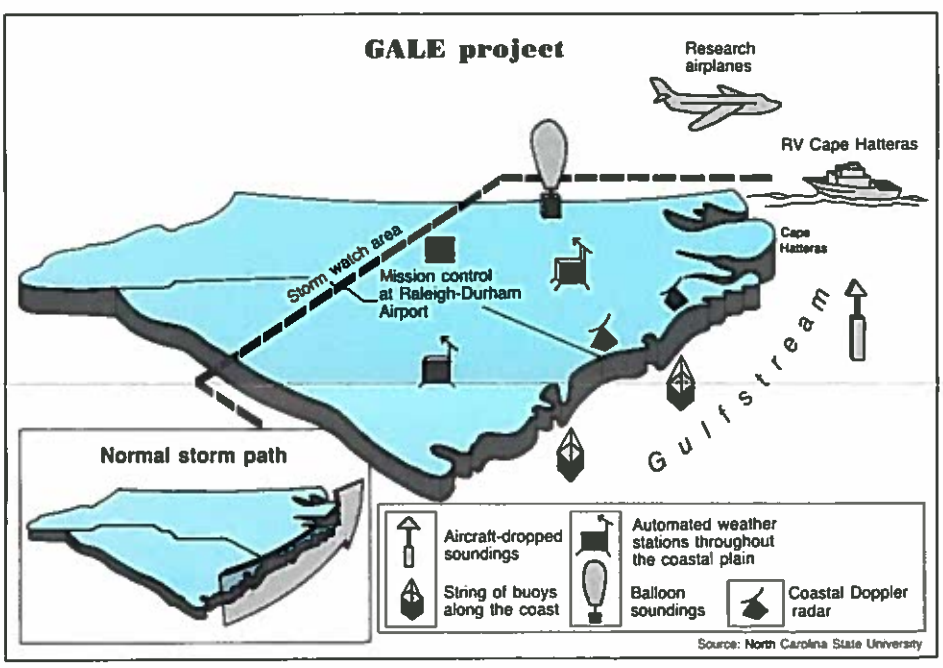
These storms develop very rapidly just off the Carolina coasts and move northward. They are often poorly predicted. Scientists believe that this lack of precise prediction is due, in part at least, to inadequate understanding of regional and air-sea interaction processes within these storms and to a lack of data on space and time scales commensurate with their development.

The Project

To better understand what generates these massive winter storms, federal and university scientists will launch a $10 million research project this winter termed GALE, for Genesis of Atlantic Lows Experiment. Specifically, the researchers hope to improve short-range forecasting of coastal storms and the knowledge of the interaction between these storms and the ocean, and to develop more refined computer models to predict them.

The field experiment, the largest of its kind ever undertaken, will be headquartered at the Raleigh/Durham, North Caorlina, airport for a two-month period between January 15 and March 15, 1986. The National Science Foundation (NSF) is the lead agency for the project.

During the GALE field experiment, approximately 200 scientists, engineers, and technicians from 25 research groups in the United States will collaborate. The researchers hope to determine how the Appalachian Mountains, the coastal landscape, and the Atlantic Ocean, particularly the Gulf Stream, contribute to the formation of winter storms.



(Raleigh News and Observer)

Strategy and Objectives

The principal objectives of GALE are:

- To describe the airflow, mass, and moisture fields in East Coast winter storms, with special emphasis on regional-scale and air-sea interaction processes.
- To understand the physical mechanisms controlling the formation and rapid development of these storms.
- To develop and test computerized models for the prediction of the storms.

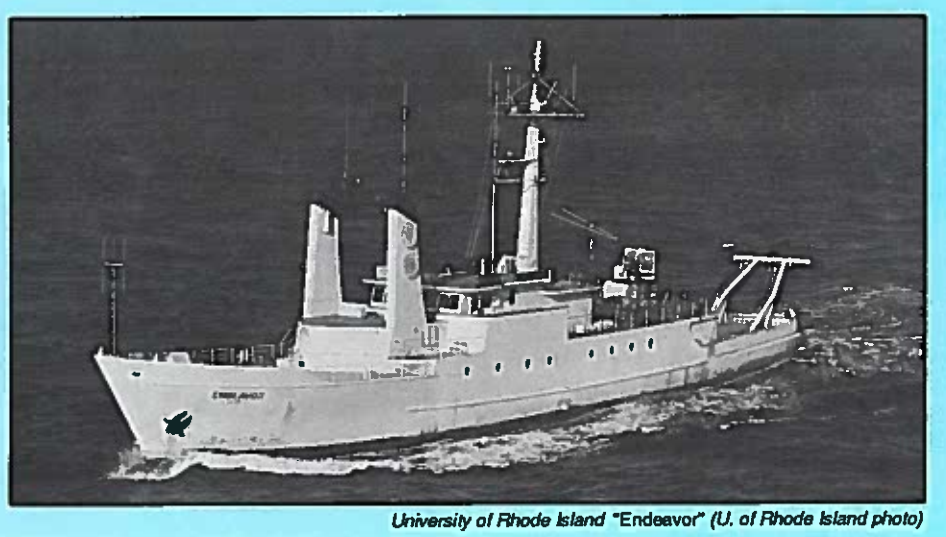
Supporting objectives of GALE are to study:

- Cloud and precipitation processes associated with East Coast cyclones, with emphasis on simultaneous radar and aircraft measurements
- The role of atmospheric gravity waves and other mechanisms in the organization of precipitation bands
- The evolution of stratospheric and tropospheric exchange processes in relation to the rapid birth of winter cyclones
- The influence of cold-air outbreaks over the relatively warm coastal ocean at the onset of fronts and winter cyclones
- The response of the coastal ocean waters to winter storms
- The application of conceptual storm models and enhanced meteorological data to short-range forecasting of significant weather
- The subsequent evolution of major winter cyclones traveling northward from the GALE observational network.

The meteorological observing base of GALE will be used by several companion research projects. Studies in atmospheric chemistry will use available space on GALE aircraft. In addition, researchers from the Department of Energy's acid rain program—Processing of Emissions by Clouds and Precipitation (PRECP)—will deploy and operate a ground precipitation network in the GALE area and coordinate special aircraft flights. Also, a comanion meteorological study of the regional aspects of winter storms will be conducted in the Canadian Maritime Provinces. Entitled the Canadian Atlantic Storms Program (CASP), this study will be carried out concurrently with GALE and will involve coordinated observations when major storms move along the northeast coast from the GALE area into the CASP study region.

Applications

GALE is one of several current national research and development projects devoted to the improvement of short-term weather prediction, detection, and warning. By concentrating high-technology observing systems in a small area, vast improvements in zero-to-six-hour forecasts can be made.



University of Rhode Island "Endeavor" (U. of Rhode Island photo)

NOAA P-3 (National Oceanic and Atmospheric Administration photo)

Results of GALE will be used particularly by the National Oceanic and Atmospheric Administration (NOAA) National Weather Service and by Canada's Atmospheric Environment Service to provide refined weather forecasts for commercial vessels and pleasure craft plying the East Coast shipping lanes, as well as for residents of the coastal areas.

Observing Systems

Although regional-scale storm phenomena will form the focus of the core research effort for GALE, there will be adequate measurements on the larger national scale to better diagnose the contributions of scale-interactive processes. Accordingly, the routine National Weather Service (NWS) measurements will be supplemented as follows:

- The frequency of weather balloon launches at 41 existing NWS sites will be increased from once every 12 hours to once every 3 hours during periods of intensive GALE measurements.
- Five of the NWS weather radars located close to the East Coast at Athens, Georgia; Charleston, South Carolina; Hatteras, North Carolina; Volens, Virginia; and Wilmington, North Carolina, will be digitized for GALE. These will provide quantitative radar reflectivity measurements from Georgia to Virginia.
- In additional to routine satellite products, it is expected that special GOES (Geostationary Operational Environmental Satellite) rapid-scan data, as well as NOAA orbiter soundings and high-resolution data will be available.

In support of the intensive regional studies within the primary area designated for the GALE field studies, the following facilities will be deployed:

- Twelve additional land-based sites from which instrumented weather balloons will be launched every 3 hours during intensive GALE studies. Eight of the sites are equipped with Cross-chain Loran Atmospheric Sounding Systems (CLASS), developed by the National Center for Atmospheric Research (NCAR).
- A network of 50 portable automated mesonet (PAM II) solar-powered weather stations, designed by NCAR, will be spaced approximately 60 kilometers (36 miles) apart and extend from South Carolina to Virginia, providing automatic and high-resolution measurements of pressure, temperature, humidity, and wind speed and direction. Four of the stations will be located along a line extending across the Appalachian Mountains.
- Eight new meteorological buoys will be added off the Carolina and Georgia coasts (two from NOAA and six from North Carolina State University).
- Six existing towers for measurements of temperature, humidity, and winds will collect special observations: three are located inland, two on the coast, and one offshore.
- Eight research aircraft: NCAR's North American Sabreliner, Lockheed Electra, and Beechcraft Super King Air: NOAA's Lockheed P-3 and Cessna Citation-II: and NASA's Lockheed Electra and ER-2, and the University of Washington's Convair C-131A.
- Four scanning Doppler radars, including two portable systems from NCAR and one from the Massachusetts Institute of Technology which will be located on the coasts of the Carolinas, and NASA's SPANDAR radar at Wallops Island, Virginia. Also the University of Washington's vertically pointed Dopplerized radar located on the North Carolina coast at Cape Hatteras.
- Duke University's research vessel Cape Hatterras will operate off the North Carolina coast. This will provide an offshore platform for turbulence, energy flux and three-hour instrumented weather balloon measurements. A second research vessel, the University of Rhode Island's Endeavor, will operate part of the research period off the South Carolina coast.
- Dropwindsondes, developed by NCAR to obtain meteorological data over ocean surfaces, will be parachuted from several aircraft at 150-kilometer intervals and six-hour periods. The sondes transmit temperature, pressure, and humidity data as they descend. Wind information is obtained when the sonde receives and retransmits navigational signals.

List of Participants (as of November 1985)

National Center for Atmospheric Research (sponsored by the National Science Foundation)

Universities
Drexel University
Florida State University
University of Illinois
Massachusetts Institute of Technology
North Carolina State University
Old Dominion University
Pennsylvania State University
Skidaway Institute of Oceanography, University of Georgia
State University of New York, Albany
University of Miami
University of North Carolina
University of Texas
University of Washington
Universtiy of Wisconsin
Yale University

Federal Government
National Science Foundation
National Aeronautics and Space Administration
National Oceanic and Atmospheric Administration
Office of Naval Research
Naval Postgraduate School
Naval Research Laboratory
U.S.Army Corps of Engineers

Commercial
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Upper left: CP-4 radar, upper right: PAM station, bottom: NCAR Beechcraft Super King Air (National Center for Atmospheric Research/National Science Foundation photos)