



1992

# Annual Report

## Illinois Global Climate Change Program

A Program To Provide Illinois  
with Comprehensive Information  
about Climate Change and Its  
Impacts on Illinois

Illinois State Water Survey  
Champaign, Illinois

Stanley A. Changnon, Program Director  
Stephen J. Vermette, Assistant Director

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September 1992

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Illinois Global Climate Change Program Logo  
Designed by: David Cox

## INTRODUCTION

The Illinois Global Climate Change Program (hereafter referred to as the Program), is housed at the Illinois State Water Survey. Joint House Resolution 81 of the Illinois General Assembly designated the Survey as Illinois' center for scientific research and information related to global climate change in 1991. The Program is formed as a natural extension of the Survey's water resource and climate research since the turn of the century and a response to mounting questions about global climate change and its impacts. It will provide accurate, timely information to Illinois decision makers, the general public, and the scientific community about the potential future state of the climate, and how altered climate conditions may affect Illinois. The Program's goal is to provide for Illinois a center of expertise addressing the global climate change issue with a three-way focus: studies of climate change and its effects, monitoring of climate-related environmental changes, and the timely dissemination of information.

This document, the first report of the Program's activities, covers the period from January 1991 to September 1992. Since its inception, the Program has promoted research and information on climate change. Program milestones of the past year include:

- the writing of a Program Plan (MP-135) which reviews past Survey activities related to climate change and serves as a guide to future growth;
- adoption of the joint resolution by the General Assembly which formalizes the Program's role as a statewide center of expertise addressing the global climate change issue;
- establishment of a climate change collection (currently holding over 500 items) housed at the Survey's library;
- hiring of an Assistant Director;
- new publication series "By Degrees";
- planning of a statewide conference and workshop focusing the climate change issue on Illinois concerns;
- promotion of multidisciplinary projects;
- a strong list of funded and proposed research projects.

The following pages describe in some detail each of these and many other Program achievements.

## MANAGEMENT ISSUES

### Staffing

The Program is staffed by a Director (25 percent appointment), Assistant Director (70 percent appointment), and administrative support. A job search was conducted to fill the position of Assistant Director, which was filled by Dr. Stephen Vermette.

To achieve Program objectives and perform the functions of the Office, the Director established three standing advisory teams composed of Water Survey staff members. Meetings occur at the discretion of the Director.

The **Implementation Team** assists the Program Office in the implementation of individual projects, and helps develop ideas for the research projects and monitoring activities. Team members include Tom Butts (Water Quality), Mike Demissie (Surface Water), Tom Holm (Environmental Chemistry), Kenneth Kunkel (Climatology), Mark Peden (Chemistry), Ken Rehfeldt (Ground Water), John Shafer (Hydrology), Gary Stensland (Atmospheric Sciences), and Allen Williams (Atmospheric Chemistry).

The **Climate Scenario Team** designs the critical research dealing with the physical and statistically based aspects of future climate conditions. Team members include Kenneth Kunkel (Climatology), Wayne Wendland (State Climatologist), and Van Bowersox (Precipitation Quality).

The **Information Team** designs and helps conduct the Program's informational activities. Team members include Laurie Talkington, Eva Kingston, and Linda Hascall (Publication Services), Steven Hilberg (Extension Services), and Frances Drone- Silvers (Librarian).

### House Resolution

During the 1991 Fall Session of the 87th General Assembly, a resolution naming the Illinois State Water Survey as the lead agency for addressing the Global Climate Change issue in Illinois passed the Illinois House (Joint House Resolution 81). This resolution is a result of interactions with several members of the Illinois General Assembly and with staff of the Illinois Agricultural Association.

### Global Climate Change Task Force

The House resolution also called for the creation of a Task Force on Global Climate Change. The Task Force mandate is to monitor national policy and to study and make recommendations by June 1994 for State policies and programs regarding climate change. The Task Force is to be composed of twenty members including representatives from six state agencies, from the state legislature, and representatives from business, agriculture, academic institutions, and environmental organizations. The Program staff has worked

closely with staff from the Department of Energy and Natural Resources Office of Research and Planning to better define the mission and identify potential appointees of the Task Force.

## **RESEARCH PROGRAM**

The Illinois State Water Survey is the primary agency in Illinois concerned with water and atmospheric resources. Water Survey scientists have conducted numerous projects relating to climate, climate change, and climate impacts. A visible example is the St. Louis METROMEX study, the largest field experiment of its type to define the influence of urban areas on regional climate. Through this and other studies, Water Survey scientists were pioneers in the field of climate change as a result of human activities. While basic and applied research in climate, air quality, and water resources continues, a growing number of the projects either wholly or partially relate to climate change. The Program actively encourages and promotes these research efforts and encourages the involvement of scientists (and institutions) in addition to those at the Water Survey. The Program also actively coordinates a number of multidisciplinary projects to study the regional effects of climate change across disciplinary boundaries. Hydrologists, climatologists, economists, ecologists and others collaborate on these projects, which include the effects of climate change on large urban areas such as Chicago and its effects on the Great Lakes.

### **Funded Projects**

- **The Development and Use of Climate Scenarios**

Stanley Changnon and Kenneth Kunkel, Illinois State Water Survey  
Funded by the Illinois State Water Survey and the Global Climate Change Program

One of the primary research functions of the Program is to ascertain the impacts of altered climate on various physical systems such as surface waters and ground waters, and in turn on various societal issues. Such futuristic estimations of impacts rely on the quantified presentation of future climatic conditions. At the regional scale, such as for the state of Illinois, future conditions cannot be developed reliably from the global climate models. Thus, historical data and climatological judgement are used to predict potential realistic future climatic conditions. One effort, conducted by the Midwestern Climate Center in conjunction with the Great Lakes Environmental Research Laboratory of the National Oceanic and Atmospheric Administration (NOAA), is to develop transferred climate scenarios based on forty years of historical data from five different U.S. regions, including the hot/dry climate of Texas-Oklahoma, the warm/dry climate of the northern High Plains, and the warm/wet climate of the Alabama-Georgia region.

- **The Effect of Early Season Temperature on Corn Yield**

Steven Hollinger and Stanley Changnon, Illinois State Water Survey  
D.G. Bullock, University of Illinois (Agronomy Department)  
Funded by the National Oceanic and Atmospheric Administration

The goal of this work is to determine how early season temperature affects final corn yield. Soil temperature is controlled in the growing point region of corn from planting to tassel initiation. During this period frequent measurements are taken of leaf area and stages of development. After the temperature treatment has been removed from the plots, there is continued observation of plant canopy growth. At harvest the final yield and the various yield components are measured to determine the effects of early season temperature treatments.

- **The Response of Corn Yield to Water Application During Different Growth Stages**

Steven Hollinger and Stanley Changnon, Illinois State Water Survey  
Funded by the National Oceanic and Atmospheric Administration

Rain shelters are used to keep all natural rainfall off of 72 plots of corn. Throughout the growing season (from planting to maturity) water is applied to each plot during different growth stages. Three water treatments are used: no water, 50% of evapotranspiration, and 100% of evapotranspiration since the previous water application. Each treatment is applied to different plots based on the corn's growth stage. One plot in the experiment receives no water throughout the growing season, and one plot receives 100% of evapotranspiration throughout the growing season. The other 70 plots receive water during different growth stages so that for each growth stage one or more plots received no water, 50% of evapotranspiration, or 100% of evapotranspiration. At maturity, the final yield and yield components are measured to determine the effect of drought during different growth stages.

- **Climate Change and the Seasonal and Annual Ground-Water Balance**

Jean Bowman, Illinois State Water Survey  
Ken Bowman, University of Illinois (Department of Atmospheric Sciences)  
Funded by the Illinois Department of Energy and Natural Resources

This interdisciplinary project documents the effects of climate change on shallow ground-water levels and on ground-water demand for irrigation. A simple water-balance model has been validated by comparing observed and estimated irrigation amounts in Illinois. Evaporation quantities have been measured and adjusted for transpiration, then compared with computed total evaporation amounts from the Midwestern Climate Center. A series of sensitivity studies has been conducted with the model using climatic input variables from two global climate model experiments.

The first model represents climatic conditions and estimates present irrigation demand for the Midwest region. The second model represents changed climatic conditions (global warming and other "greenhouse effect" changes) and estimates midwestern irrigation demand under such conditions.

- **The Effect of Jet Contrails on Cirrus Cloud Development in Illinois**

Andrew Carleton, Indiana University  
Wayne Wendland and Stanley Changnon, Illinois State Water Survey  
Funded by the National Oceanic and Atmospheric Administration

This three-year project builds upon earlier Water Survey research which investigated the possibility that high density jet aircraft flights across Illinois and surrounding areas were leading to increases in high cirrus clouds. The new project, largely being done at Indiana University, is using satellite data to assess the broad scale development of cirrus clouds from contrails over the Midwest. In particular, conditions leading to wide area coverage of these false cirrus clouds are being investigated as a means of assessing considerable change in midwestern cloud cover, as well as resulting effects on solar radiation and surface heating and their ties to climate change.

- **Understanding the Effects of St. Louis on Summer Clouds, Rainfall and Storminess**

Stanley Changnon, Illinois State Water Survey  
Funded by the National Oceanic and Atmospheric Administration

This two-year study was completed in 1992. Its aim was to investigate development of ensuing clouds, radar echo (rainfall), and thunderstorms when local cloud formation was favored within 50 miles of St. Louis. The analysis revealed a very localized high incidence of initial cloud development centered over St. Louis and north to the Alton-Wood River industrial area. This area was also found to be an area of preferred rainfall initiation in 80% of the cases studied. In all instances, thunderstorm activity, related to the cloud and rainfall initiation, developed over Illinois in the area 10 to 20 miles east of St. Louis. Study of sequencing of events helped establish the direct linkage of the urban daytime heat island, and induced convergence field, to the ensuing favored development of summer clouds and rainfall in the region.

- **Effects of Climate Change on Urban Governments in the Great Lakes Region**

Henry Lambright, Syracuse University  
Stanley Changnon, Illinois State Water Survey  
Funded by the National Oceanic and Atmospheric Administration

Earlier studies of St. Louis and Chicago show how these cities influence their climates with higher surface temperatures, reductions in wind speeds, changed humidities, and more rain and storms. The concern over global climate change and in particular its impacts on society and the potential responses to global warming have raised the issue of potential governmental responses. This project is studying the effects of the already changed climate of Chicago and Toronto during extreme weather situations, and the responses from city agencies as a result of these climatic aberrations. These analogy-based studies will illustrate the types of problems and reactions that may occur due to an altered climate. The results should provide guidance as to the types of responses that urban governments may consider in dealing with a change to a potentially more stressful future climate.

- **Historical Variations in Weather Catastrophes in the United States and Their Implications for Climate Change**

Stanley Changnon and Joyce Changnon, Illinois State Water Survey  
Funded by the National Science Foundation

Extreme storm events (causing > \$100 million in damage) from 1950 through 1989 were subjected to an extensive study of the temporal distribution of losses by storm type and frequency, shifts in the areal extent of storms during the 40-year period, and changes in storm intensity as measured in dollar losses. The two-year project revealed that in the north-central United States, which includes Illinois, the maximum storm losses and activity occurred during the 1950s. This was followed by relatively low storm activity in the 1960s and 1970s, and then an increase in storm activity during the 1980s. Comparison of the temporal distribution of the storm frequency in Illinois and the surrounding states, showed a strong relationship to the mean temperature distribution over this 40-year period. The results thus suggest that a warmer, drier climate in the central United States might well be associated with an increase in major storm losses.

- **Historical Fluctuations in Precipitation over the Great Lakes Basin**

Stanley Changnon, Illinois State Water Survey  
Funded by the Illinois Global Climate Change Program

Global climate change in the central United States is expected to lead to a warmer, drier climate. Such a climate on the Great Lakes Basin would lead to major reductions in water availability in the Great Lakes. Levels of Lake Michigan are predicted to drop between 3 and 9 feet below present averages. Such changes to the world's largest fresh water supply and to the water supply for 60% of Illinois citizens could be disastrous. To better understand this potential situation we have amassed the historical precipitation data for all weather stations in the basin from 1896 to 1990 ~ a 95-year period. These data are being used to study the temporal behavior

and fluctuations in past precipitation in Illinois and other Great Lake states. This includes an analysis of anomalous periods of relatively wet and dry years as analogs to what might occur in the future. This analysis will be the basis for establishing potential dry-period climate scenarios on the Great Lakes Basin.

- **Climate Fluctuations and River Flow Behavior in Adjacent Major Basins**

Michael Demissie, Illinois State Water Survey  
Funded by the National Oceanic and Atmospheric Administration

A major problem in isolating the effect of varying climate conditions on river flows relates to basin physical characteristics and shifting changes in land use over many decades. To address this issue, two large adjacent basins (Iroquois River and Kankakee River) are being analyzed along with their respective climatological data. The climatic conditions relevant to streamflow over most years is relatively similar across both basins, however, the land use patterns between basins have changed at very different rates. Thus, the climate fluctuations can be normalized and the effects of shifting land uses can be identified. Once land use effects are separated, the direct influence of the climatic conditions, including precipitation and temperature in different seasons, can be defined with the normalized data. The results are expected to measure the relationship of various weather conditions to streamflow. The resulting mathematical models can in turn be used to project streamflow effects from different combinations of climate that might occur in the future.

- **Potential Effects of Chicago on Precipitation Conditions over Lake Michigan**

William Woodley, Woodley Weather Associates  
Robert Scott and Stanley Changnon, Illinois State Water Survey  
Funded by the National Oceanic and Atmospheric Administration

Earlier Water Survey studies of precipitation conditions over and adjacent to the Chicago metropolitan area indicated that the city, in concert with lake-effects, was producing additional cloudiness and rainfall on certain summer days. Some of this rainfall was heavy and related to urban flooding. This research is attempting to analyze three years of historical satellite data (calibrated with shoreline raingage data) to estimate the altered rainfall conditions over Lake Michigan. Initial results of this two-year study indicate that precipitation related to Chicago has increased over southern Lake Michigan, and that without the urban influence convective precipitation elsewhere over Lake Michigan has decreased during the summer. The inadvertent modification of the precipitation climate occurs over a water resource of great importance to Illinois, and has great relevance to the broader issue of global climate change.

- **Determining the Chemical Composition of Cloud Condensation Nuclei**

Allen Williams, Illinois State Water Survey  
Funded by the U.S. Department of Energy

Cloud condensation nuclei (CCN) are atmospheric particulates that produce freely growing water drops when exposed to supersaturations such as are found in clouds. Increased CCN concentrations have been linked to global cooling, such that a doubling of CCN concentrations could produce a cooling effect that would approximately offset the effect of doubling carbon dioxide concentrations. Sulfur dioxide emissions have been linked to CCN trends with sulfates as their main constituent. There is some doubt about the composition of CCN as their small size makes direct measurement of their composition difficult. The goal of this project is to develop the instrumentation (a haze chamber, a cloud chamber, and three virtual impactors) to collect CCN in sufficient amounts to determine their chemical composition, to mount it on a trailer for mobility and to use it to survey CCN composition in different climates through a series of field measurements.

- **Critical Trends Assessment: The Illinois Environment - Past, Present, and Future**

Michael Terstriep and Donald Gatz, Illinois State Water Survey  
Funded by the Illinois Department of Energy and Natural Resources

The state of Illinois has undertaken a comprehensive look at its environment, assessing environmental trends and conditions, providing a measure of environmental change, and allowing for the capability to forecast future conditions. The three State Survey's (Water, Natural History, and Geologic) and the Department of Energy and Natural Resources are involved in this project. At the Water Survey, assessments on water resources, air and precipitation quality, and climate are presently being undertaken. The climate assessment will include the use of historical analogs to develop scenarios for climate change. The overall assessment is a necessary step to better understand the condition of our state's environment, the linkages between resources, and to prepare for the effects of a potential climate change.

- **Development of an Illinois Action Plan for Greenhouse Gas Emissions: A Pilot Project**

Bob Lieberman and David Baker, Illinois Department of Energy and Natural Resources  
Funded by the U.S. Environmental Protection Agency

The USEPA's Climate Change State Program is developing methodologies and tools designed to assist states in assessing what can and should be done to control greenhouse gas emissions. This two-year pilot project will test USEPA's preliminary

methodologies and develop this capacity within Illinois. The project has two phases. During the first phase, a comprehensive greenhouse gas emissions inventory will be developed for Illinois. Emissions will be catalogued for greenhouse gases. The second phase, a State Action Plan will be developed for Illinois, which identifies and analyzes actions Illinois could take to reduce greenhouse gas emissions.

### **Proposed Individual Projects**

- **The Effect of Atmospheric Aerosols on Optical and Radiative Properties of the Atmosphere**

Susan Larson, University of Illinois (Department of Civil Engineering)  
Sheldon Lansberger, University of Illinois (Department of Nuclear Engineering)  
Stephen Vermette, Illinois State Water Survey  
Submitted to the National Oceanic and Atmospheric Administration

- **Stable Isotopes in Cloud Tops: An Investigation of the Water Budget of the Upper Troposphere**

Robert Rauber, University of Illinois (Department of Atmospheric Sciences)  
Harry Ochs, Illinois State Water Survey  
Submitted to the National Science Foundation

- **Determining the Most Technically and Economically Efficient Strategies for Slowing Growth of Greenhouse Gas Concentrations: A Collaborative Pilot Project**

Bob Lieberman, Illinois Department of Energy and Natural Resources  
Stanley Changnon and Stephen Vermette, Illinois State Water Survey  
Submitted to the John D. and Catherine T. MacArthur Foundation

- **A Study of the Solubility Properties and Volatilization Temperatures of Cloud Condensation Nuclei**

Allen Williams, Illinois State Water Survey  
Mark Rood, University of Illinois (Department of Civil Engineering)  
Submitted to the National Oceanic and Atmospheric Administration

- **Investigations Applied to Climate Change of Intra-Seasonal Variations in Coalescence Activity**

Robert Czys, Illinois State Water Survey  
Submitted to the National Oceanic and Atmospheric Administration

- **An Investigation of Properties of the Stratospheric Aerosol**

Naihui Song and Allen Williams, Illinois State Water Survey  
Submitted to University of Illinois Research Board

- **Effects of Wetland Drainage and Climate Change on Flooding**

Michael Demissie, Abdul Khan, and Abi Akanbi, Illinois State Water Survey  
Submitted to the U.S. Department of Energy

- **Use of Ground-Water Temperatures for Sensing Climate Change**

John Shafer, Illinois State Water Survey  
Submitted to the National Science Foundation

- **An Investigation of Effects of Stratospheric Aerosol on Cirrus Clouds**

Naihui Song and Allen Williams, Illinois State Water Survey  
Submitted to the National Atmospheric and Space Administration

### **Proposed Multidisciplinary Projects**

In addition to individual research projects, complex multidisciplinary assessments of climate change are needed for regions that are physically, economically, and socially homogeneous. Two such comprehensive regional studies are being actively pursued by the Program: 1) an investigation of climate change effects on the Great Lakes Basin, and 2) the effects of climate change on the city of Chicago. The Program's role is to secure major sources of funding and coordinate the activities of scientists from a broad spectrum of disciplines.

- **Investigations of Climate Change on the Great Lakes Basin**

Survey scientists recognize that a changed climate in the Midwest would produce a myriad of impacts on the Great Lakes Basin. The Program has been involved in the planning of a comprehensive, multidisciplinary research program, involving both U.S. and Canadian scientists, to define the effects of climate change on the basin.

- **Development of a Plan to Investigate Climate Change and its Impacts on the Great Lakes Basin**

Stanley Changnon and Stephen Vermette, Illinois State Water Survey  
Submitted to the National Oceanic and Atmospheric Administration

- **Regional Climate Modeling of the Great Lakes Basin and Climate Change Scenario Development for Impact Assessment**

Stanley Changnon, Illinois State Water Survey  
National Center for Atmospheric Research Staff Members  
Submitted to the National Oceanic and Atmospheric Administration

- **Climate Change Effects on the Chicago Metropolitan Area**

An effort has been undertaken to promote an investigation of the effects, impacts, and responses that climate change would produce in a major American city such as Chicago, Illinois. This is seen as a valuable and necessary endeavor in a broad-based national research program. Impacts from major shifts in climate could potentially affect aspects of urban environments such as water demand and supply, water quality treatment and wastewater distribution, air quality, business and commerce, housing, heating and air conditioning, the urban physical environment, recreational facilities, and local government. To attract a major source of funding, a number of demonstration projects are planned. The first of these includes funded research on the "Effects of Climate Change on Urban Governments in the Great Lakes Region" and two proposed demonstration projects:

- **The Lake Michigan Diversion: An Analog of Local Impacts and Responses to Global Climate Change**

Stanley Changnon, Illinois State Water Survey  
Michael Glantz, National Center for Atmospheric Research  
Submitted to the National Oceanic and Atmospheric Administration

- **Effect of Climate Change on Urban Air Quality**

Stephen Vermette, Illinois State Water Survey  
Submitted to the U.S. Environmental Protection Agency

## **INFORMATION DISSEMINATION**

An important Program component is the provision of updated data and information on climate change to all impacted and interested parties in Illinois. This has taken a number of forms, including advisory services, research and Program publications; a seminar series; numerous talks, lectures and interviews; a workshop and conference; and a special library collection. The following pages describe in some detail each of these outreach efforts.

## **Advisory Services**

Program staff have maintained numerous state and federal interactions. These include extensive interactions with the Office of Oceanic and Atmospheric Research of the National Oceanic and Atmospheric Administration, the Urban Forest Climate Program of the U.S. Department of Agriculture, the U.S. EPA's Climate Change Program, and the National Science Foundation. There have been interactions with the Illinois Department of Agriculture, the Illinois Department of Transportation, the State of Illinois Washington Office, and several interactions with the Illinois Department of Energy and Natural Resources, including briefings about climate change and activities relating to the establishment of the Climate Change Task Force.

Professional memberships of Stanley Changnon include membership on the Technical Advisory Committee to the U.S. EPA Program on Global Change; a member of the Advisory Committee to the Electric Power Research Institute for their Global Climate Change Research Program; and membership on the Science Advisory Council to the Climate Systems Modeling Program of the National Center for Atmospheric Research. Stephen Vermette serves as Assistant Coordinator of the Air & Waste Management Associations Intercommittee Task Force on Global Climate Change.

## **Research Publications**

- "Potential Effects of Changed Climates on Rainfall Frequencies in the Midwest," S.A. Changnon and F.A. Huff, *Water Resources Bulletin*, 27, 1-7, 1991.
- "Illinois Precipitation Research: A Focus on Cloud and Precipitation Modification," S.A. Changnon, R. Czys. R. Scott and N. Westcott. *Bulletin*, American Meteorological Society, 72,587-605,1991.
- "Temporal Fluctuations in Weather Catastrophes in the United States," S.A.Changnon and J. Changnon, *Proceedings, 7th Conference on Applied Climate*, American Meteorological Society, Boston, 1991.
- "Development and Use of Climate Analogues," S.A. Changnon, *Proceedings, of Symposium on Climate Scenarios*, University of Waterloo, Canada, 49-58, 1991.
- "Development of New Rainfall Frequency Relations for Nine Midwestern States," J. Angel and F.A. Huff, *Proceedings, 7th Conference on Applied Climatology*, American Meteorological Society, Boston, 1-6, 1991.
- "Inadvertent Weather Modification in Urban Areas: Lessons for Global Climate Change," S.A. Changnon, *Bulletin*, American Meteorological Society, 73, 619-627, 1992.

- "Temporal Variability of Floods and Heavy Precipitation Events in the Midwest," R.T. Shealy, K.E. Kunkel, and S.A. Changnon, *Proceedings, 5th Statistical Conference*, American Meteorological Society, Boston, 1992.
- "A Research Program to Assess Climate Change in the Great Lakes Basin," S.A. Changnon and S. Sonka, *Report on the Symposium on Climate Change in the Great Lakes Basin*, Illinois Global Climate Change Program Report, Miscellaneous Publication 141, Champaign, 1992.
- "Inadvertent Weather Modification: Its Status and Relevance to Global Climate Change," S.A. Changnon, *Proceedings, Symposium on Land and Inadvertent Weather Modification*, American Meteorological Society, Boston, 63-69, 1992.
- "Are We to Always Fail in Drought Management?" S.A. Changnon, *Proceedings, National Forum on Water Management Policies*, American Water Resources Association, Washington, DC, 1-14, 1992.
- "Impacts on the Climatological Unique Year (1991) in the Midwest and Implications for Climate Change," S.A. Changnon and K.E. Kunkel, *Physical Geography* (in press).
- "Temporal Fluctuations in Weather Disasters: 1950-1989," S.A. Changnon and J.M. Changnon. *Climate Change*, (in press).
- "Storm Catastrophes in the United States," S.A. Changnon and J.M. Changnon, *Natural Hazards*, (in press).
- "Shifts in Perceptions of Climate Change: A Delphi Experiment Revisited," S.A. Changnon, W.M. Wendland, and J.M. Changnon, *Bulletin*, American Meteorological Society, in press.
- Applications of Statistical Methods to the Study of Climate and Flooding Fluctuations in the Central United States.* K.E. Kunkel, S.A. Changnon, and R.T. Shealy, Water Survey Contract Report 523, 1992.
- "Extreme Precipitation Events: The Link to Temporal Variability in Seasonal Precipitation," K.E. Kunkel, S.A. Changnon, and R.T. Shealy, *Monthly Weather Review*, (in press).
- "Determining the Chemical Composition of Cloud Condensation Nuclei," A.L. Williams, D.J. Alofs, D.E. Hagen, D.R. White, A.R. Hopkins, and M.B. Trueblood, *Proceedings, of the Fifth International Conference on Precipitation Scavenging and Atmospheric-Surface Exchange Processes*, Richland, WA, 215-224, 1992.

"Obtaining a Select Chemical Sample of the Smallest Atmospheric Aerosol Particles that can Nucleate Natural Clouds," A.L. Williams, D.J. Alofs, D.E. Hagen, D.R. White, and J.L. Schmitt, *Proceedings, 13th International Conference on Nucleation and Atmospheric Aerosols*, Salt Lake City, UT, 213-216, 1992.

## **Program Publications**

The Program has prepared a number of brochures and fact sheets for the general public, which are available from the Water Survey. "By Degrees" series focuses on specific aspects of the climate change issue. These fact sheets are routinely presented at talks and conferences, and sent in response to inquiries by the general public. Over 300 copies (our first printing) have been distributed. Plans call for continued publication of new titles and their distribution to library systems throughout the state, and to school teachers as part of a yearly mailing. A request has been made by the State of Illinois' Washington Office to use the publication "By Degrees" in educating federal legislatures on Global Climate Change issues.

- The Plan for the Illinois Global Climate Change Program (MP 135)
- Global Climate Change and Illinois (MP131)
- Climate Change on the Great Lakes Basin (MP 141)
- "By Degrees": The Illinois Global Climate Change Program (MP137-1)
- "By Degrees": What Is the Greenhouse Effect? (MP137-2)
- "By Degrees": What Are the Greenhouse Gases? (MP137-3)
- "By Degrees": Past Climates of Illinois (MP137-4)
- "By Degrees": What Can We Do about Global Warming? (MP137-5)

## **Seminar Series**

This series of seminars is aimed at informing Water Survey staff and interested outsiders about various key aspects of global climate change issues. These aspects include research programs, studies of atmospheric processes, investigations of physical effects and socioeconomic impacts, adaptation and mitigation responses, and policy development. These seminars are provided by Survey staff involved in global climate change research and by experts from other institutions.

- **The Dimensions of the New Illinois Global Climate Change Program**  
Presented by Richard Semonin and Stanley Changnon (Illinois State Water Survey)  
February 1991
- **Global Climate Models**  
Presented by Kenneth Bowman (University of Illinois)  
March 1991
- **Climate Scenarios and Their Development**  
Presented by Kenneth Kunkel (Illinois State Water Survey)  
March 1991
- **Issues Involved in Climate Change**  
Presented by Michael Glantz (Director, Environmental and Societal Impacts Group, National Center for Atmospheric Research)  
March 1991
- **Regional Impacts of Global Warming: Canadian Case Study**  
Presented by Stewart Cohen (Canadian Climate Center)  
May 1991
- **The Global Climate Change Program**  
Presented by Stanley Changnon and Stephen Vermette (Illinois State Water Survey)  
November 1991
- **The Chicago Urban Forest Climate Project**  
Presented by Gregory McPherson and David Nowak (U.S. Department of Agriculture)  
December 1991
- **The MINK Project**  
Presented by Norman Rosenberg (Resources for the Future)  
December 1991
- **Comparing Observed & GCM Climates in the Midwest: Taking a Closer Look at the Land Surface Hydrology**  
Presented by Jean Bowman and Ken Kunkel (Illinois State Water Survey) and Ken Bowman (University of Illinois)  
March 1992

- **Should You Recognize Climate Through the Eyes of a Model?**  
Presented by Wayne Wendland (Illinois State Water Survey)  
April 1992
- **Climate Change and the Great Lakes Basin: Canadian Plan**  
Presented by Linda Mortsch (Canadian Climate Centre)  
September 1992

### **Presentations, News Releases and Interviews**

Program staff and Water Survey scientists have presented their research findings at numerous scientific conferences. They have also have taken an active role in communicating about climate change issues through news releases, media interviews, talks to organizations, and lectures to university classes. Plans are to expand this type of informational outreach program so that information about global climate change issues is more accessible to the citizens of Illinois.

#### **Presentations (within Illinois)**

- **The Knowns and Unknowns of Climate Change**  
Presented by Kenneth Kunkel to the Junior Leagues of Illinois State Public Affairs Committee, September 1991.
- **The Status of Climate Change and the Illinois Research Program**  
Presented by Stanley Changnon to the Board of Natural Resources and Conservation, Champaign, October 1991.
- **The National Global Climate Change Program**  
Presented by Stanley Changnon at a State Geological Survey Seminar, Urbana, November 1991.
- **IGCCP Research Dimensions**  
Presented by Stanley Changnon at a University of Illinois Atmospheric Sciences Department Seminar, Urbana, February 1992.
- **A Plan of Climate Research for the Great Lakes Basin**  
Presented by Stanley Changnon at the Annual Meeting of the American Association for the Advancement of Science, Chicago, February 1992.
- **Climate Changes in Illinois**  
Presented by Stanley Changnon as a lecture to the University of Illinois, Department of Geography, Urbana, March 1992.

- **Impact of Climate Change on Illinois' Resources**  
Presented by Stephen Vermette at the Annual Meeting of the Illinois Geographical Society, Macomb, April 1992.
- **Global Climate Change**  
Presented by Kenneth Kunkel at the Annual Meeting, Illinois Chapter, American Waterworks Association, April 1992.
- **Principles of Climate Change**  
Presented by Wayne Wendland as a lecture to the University of Illinois Department of Geography, Urbana, April 1992.
- **Climates of the Past and Implications for the Future**  
Presented by Wayne Wendland as a lecture to the University of Illinois Department of Geography, Urbana, April 1992.
- **Man's Influence on Global Warming**  
Presented by Stanley Changnon at a Banking Conference, Reserve Bank of Chicago, Chicago, July 1992.
- **Global Climate Change**  
Presented by Wayne Wendland as a lecture to Augustana Geology Department, Rock Island.
- **Global Warming**  
Presented by Wayne Wendland as a lecture to the University of Illinois Department of Geography, Urbana.

**Presentations (elsewhere)**

- **Climate Change Scenarios**  
Presented by Stanley Changnon at a conference on Climate Change in Canada for the International Joint Commission, Waterloo, Canada, June 1991.
- **Drought Management and Climate Change**  
Presented by Stanley Changnon at a Natural Hazards Workshop, University of Colorado, Boulder, CO, July 1991.
- **Climate Change and Flooding**  
Presented by Stanley Changnon at the American Meteorological Society Conference on Applied Climatology, Salt Lake City, UT, September 1991.

- **Inadvertent Weather Modification and Global Climate Change**  
Presented by Stanley Changnon at the American Meteorological Society National Meeting, Atlanta, GA, January 1992.
- **Weather Catastrophes and Climate Shifts**  
Presented by Stanley Changnon at a Massachusetts Institute of Technology Climate and Water Conference, Boston, January 1992.
- **Is the Climate Changing - So What?**  
Presented by Stanley Changnon as a Trewartha Memorial Lecture, University of Wisconsin, Madison, WI, April 1992.
- **Two Million Years of Climate Change on the Great Lakes Basin**  
Presented by Stanley Changnon at a Workshop on Climate Change in the Great Lakes Basin, National Center for Atmospheric Research, Boulder, CO April 1992.
- **Are We Doomed to Fail with Drought Management?**  
Presented by Stanley Changnon at National Forum on Water Management Policy, Washington, DC, June 1992.
- **The Illinois Research and Information Program, and Policy Development for Climate Change**  
Presented by Stanley Changnon at a Conference on Climate Change and Water Resources, Office of Technology Assessment and NCAR, Boulder, CO, July 1992.
- **Credibility of Climate Change**  
Presentation by Stanley Changnon given at Purdue University, Lafayette, IN, September 1992.

#### News Releases

- **Illinois Establishes a Climate Change Program**  
Stanley Changnon and Laurie Talkington, April 1991.
- **Record Weather Conditions of the Summer of 1991 Do Not Signify the Start of Global Climate Change**  
Stanley Changnon, September 1991.

## Interviews

- **Global Climate Change**  
Television Interview by Wayne Wendland with Chicago ABC affiliate, Chicago, October 1991.
- **Global Climate Change**  
Television Interview by Wayne Wendland with WILL-TV, Urbana, April 1992.
- **State Adds to Global Warming with Fuel Burning, Car Exhaust**  
Newspaper Interview by Stephen Vermette with *The Daily Illini*, Urbana, June 1992.
- **Global Climate Change**  
Newspaper Interview by Stephen Vermette with the *Columbus Dispatch*, Columbus, OH, April 1992.

## Workshops and Conferences

The Program will conduct a climate change workshop as part of the Illinois Science Teachers Association annual meeting on October 2, 1992 at St. Charles, Illinois. The workshop will provide science teachers throughout the state with an update on climate change research, potential effects on Illinois' resources, and a demonstration of tactics to teach climate change concepts to students.



A one-day conference, *Global Climate Change: Focus on Illinois, An Economic and Business Perspective* will be held on October 29th in Bloomington, Illinois. The conference was organized by the Program staff, and is being co-sponsored by the Illinois Power Company, for public officials; representatives from business, industry, agriculture, and forestry; and everyone concerned about the impact of climate change and climate change-driven policies on the state of Illinois. Experts from state natural resources agencies and from industry will provide an overview on climate change, examine Illinois' climate trends, and focus on climate change effects and mitigation issues as they relate to business, agriculture, and industry interests within the state. The conference proceedings will be published.

This conference is fourth in a series of climate change conferences/workshops sponsored by the Water Survey (the first sponsored by the Program). The Program anticipates promoting a continuing series of workshops and conferences highlighting different aspects of the global climate change issue.

## **Library Collection and Database**

The goal of the global climate change collection and database, begun in early 1991 at the Water Survey Library, is to provide timely access to well-indexed information on this topic. Much of the information appears in so-called "gray literature", such as technical reports or conference proceedings, which are often hard to obtain. The Library attempts to collect such material that is relevant to atmospheric, hydrologic, or agricultural research. Of particular interest are reports from the National Academy of Science, the U.S. Department of Energy, the U.S. Environmental Protection Agency, the National Research Council, and the Intergovernmental Panel on Climate Change.

To facilitate browsing by users, materials are housed together in a special section of the Library. Because only limited funds are available for this collection, the Library is very selective about the materials it actually purchases, which include technical reports, conference proceedings, or relevant texts. Records for pertinent materials already in the Library were added to the newly created climate change database. On-line searches of several CD-ROM databases at the University of Illinois libraries produced relevant citations. Additional searches are run as needed. Several journals and newsletters are also regularly scanned for reports and/or articles to acquire for the collection. When an item of interest is found, a written request is sent asking for a copy or a reprint. The Library acquires from five to ten items a month in this manner.

The database currently has records for over 500 items, and new items are always being added. At the end of each month, a list of selected new acquisitions is created and routed through the Water Survey, as well as to other state agency and university libraries.

The database was created using software by Inmagic, Inc., Cambridge, MA, which has special application packages for libraries. This text-based software easily handles variable length fields, accommodates a variety of searching techniques, and can produce specialized bibliographies on demand.

A record of each new acquisition is input in the database, and the item is immediately accessible. Indexing terms were agreed upon early in the project by the Director of the Global Climate Change Program and the Librarian. Additional terms may also be used to make the item more accessible. Materials considered to be of long-term usefulness, such as conference proceedings, are also classified as a part of the Library's main collection and then shelved in the special area. Materials considered to be of shorter term usefulness, such as article reprints, are given an accession number and stored in a file cabinet.

In response to a user request about a specific aspect of climate change, library staff search the database to quickly locate items held in-house before checking other libraries or databases. Users of the global climate change collection include Water Survey scientists and staff, University of Illinois faculty and students, and others.

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A Division of the Illinois Department of  
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The Illinois State Water Survey was founded in 1895. It is the primary agency in Illinois concerned with water and atmospheric resources. Research and service programs encompass the assessment and evaluation of ground, surface, and atmospheric water resources as to quantity, quality, and use. Scientific research anticipates and reacts to practical problems in the state of Illinois. Much of the Survey's work is facilitated by an extensive database collected and developed over the course of a century.

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