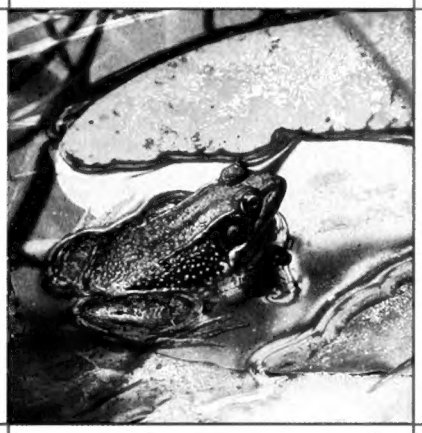

The Changing Illinois Environment: Critical Trends

Technical Report of the Critical Trends Assessment Project Volume 7: Bibliography

Illinois Department of Energy and Natural Resources

June 1994 ILENR/RE-EA-94/05(7)

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Technical Report of the Critical Trends Assessment Project Volume 7: Bibliography

Illinois Department of Energy and Natural Resources
Illinois State Geological Survey Division
615 East Peabody Drive
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June 1994

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Volume 1: Air Resources

Volume 2: Water Resources

Volume 3: Ecological Resources

Volume 4: Earth Resources

Volume 5: Waste Generation and Management

Volume 6: Sources of Environmental Stress

Volume 7: Bibliography

Volume 7: Bibliography

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ABOUT THE CRITICAL TRENDS ASSESSMENT PROJECT

The Critical Trends Assessment Project (CTAP) is an on-going process established to describe changes in ecological conditions in Illinois. The initial two-year effort involved staff of the Illinois Department of Energy and Natural Resources (ENR), including the Office of Research and Planning, the Geological, Natural History and Water surveys and the Hazardous Waste Research and Information Center. They worked with the assistance of the Illinois Environmental Protection Agency and the Illinois departments of Agriculture, Conservation, Mines and Minerals, Nuclear Safety, Public Health, and Transportation (Division of Water Resources), among other agencies.

CTAP investigators adopted a "source-receptor" model as the basis for analysis. Sources were defined as human activities that affect environmental and ecological conditions and were split into categories as follows: manufacturing, transportation, urban dynamics, resource extraction, electricity generation and transmission, and waste systems. Receptors included forests, agro-ecosystems, streams and rivers, lakes, prairies and savannas, wetlands, and human populations.

The results are contained in a seven-volume technical report, *The Changing Illinois Environment: Critical Trends*, consisting of *Volume 1: Air Resources*, *Volume 2: Water Resources*, *Volume 3: Ecological Resources*, *Volume 4: Earth Resources*, *Volume 5: Waste Generation and Management*, *Volume 6: Sources of Environmental Stress*, and *Volume 7: Bibliography*. Volumes 1-6 are synopsized in a summary report.

The next step in the CTAP process is to develop, test, and implement tools to systematically monitor changes in ecological and environmental conditions in Illinois. Given real-world constraints on budgets and human resources, this has to be done in a practical and cost-effective way, using new technologies for monitoring, data collection and assessments.

As part of this effort, CTAP participants have begun to use advanced geographic information systems (GIS) and satellite imagery to map changes in Illinois' ecosystems and to develop ecological indicators (similar in concept to economic indicators) that can be evaluated for their use in long-term monitoring. The intent is to recruit, train, and organize networks of people — high school science classes, citizen volunteer groups — to supplement scientific data collection to help gauge trends in ecological conditions.

Many of the databases developed during the project are available to the public as either spreadsheet files or ARC-INFO files. Individuals who wish to obtain additional information or participate in CTAP programs may call 217/785-0138, TDD customers may call 217/785-0211, or persons may write:

Critical Trends Assessment Project
Office of Research and Planning
Illinois Department of Energy and Natural Resources
325 West Adams Street, Room 300
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Copies of the summary report and volumes 1-7 of the technical report are available from the ENR Clearinghouse at 1/800/252-8955. TDD customers call 1/800/526-0844, the Illinois Relay Center. CTAP information and forum discussions can also be accessed electronically at 1/800/528-5486.

FOREWORD

"If we could first know where we are
and whither we are tending,
we could better judge what we do
and how to do it..."
Abraham Lincoln

Imagine that we knew nothing about the size, direction, and composition of our economy. We would each know a little, i.e., what was happening to us directly, but none of us would know much about the broader trends in the economy — the level or rate of housing starts, interest rates, retail sales, trade deficits, or unemployment rates. We might react to things that happened to us directly, or react to events that we had heard about — events that may or may not have actually occurred.

Fortunately, the information base on economic trends is extensive, is updated regularly, and is easily accessible. Designed to describe the condition of the economy and how it is changing, the information base provides the foundation for both economic policy and personal finance decisions. Typical economic decisions are all framed by empirical knowledge about what is happening in the general economy. Without it, we would have no rational way of timing these decisions and no way of judging whether they were correct relative to trends in the general economy.

Unfortunately, this is not the case with regard to changes in environmental conditions. Environmental data has generally been collected for regulatory and management purposes, using information systems designed to answer very site-, pollutant-, or species-specific questions. This effort has been essential in achieving the many pollution control successes of the last generation. However, it does not provide a systematic, empirical database similar to the economic database which describes trends in the general environment and provides a foundation for both environmental policy and, perhaps more importantly, personal decisions. The Critical Trends Assessment Project (CTAP) is designed to begin developing such a database.

As a first step, CTAP investigators inventoried existing data to determine what is known and not known about historical ecological conditions and to identify meaningful trends. Three general conclusions can be drawn from CTAP's initial investigations:

Conclusion No. 1: The emission and discharge of regulated pollutants over the past 20 years has declined, in some cases dramatically. Among the findings:

- Between 1973 and 1989, air emissions of particulate matter from manufacturing have dropped 87%, those of sulfur oxides 67%, nitrogen oxides 69%, hydrocarbons 45%, and carbon monoxide 59%.
- Emissions from cars and light trucks of both carbon monoxide and volatile organic compounds were down 47% in 1991 from 1973 levels.
- Lead concentrations were down substantially in all areas of the state over the 1978-1990 period, reflecting the phase-out of leaded gasoline.
- From 1987 to 1992, major municipal sewage treatment facilities showed reductions in loading of biological/carbonaceous oxygen demand, ammonia, total suspended solids and chlorine residuals that ranged from 25 to 72%.
- Emissions into streams of chromium, copper, cyanide, and phenols from major non-municipal manufacturing and utility facilities (most of them industrial) also showed declines over the years 1987-1992 ranging from 37% to 53%.

Conclusion No. 2: Existing data suggest that the condition of natural ecosystems in Illinois is rapidly declining as a result of fragmentation and continual stress. Among the findings:

- Forest fragmentation has reduced the ability of Illinois forests to maintain biological integrity. In one Illinois forest, neotropical migrant birds that once accounted for more than 75% of breeding birds now make up less than half those numbers.

- In the past century, one in seven native fish species in Lake Michigan was either extirpated or suffered severe population crashes and exotics have assumed the roles of major predators and major forage species.

- Four of five of the state's prairie remnants are smaller than ten acres and one in three is smaller than one acre — too small to function as self-sustaining ecosystems.

- Long-term records of mussel populations for four rivers in east central Illinois reveal large reductions in numbers of all species over the last 40 years, apparently as suitable habitat was lost to siltation and other changes.

- Exotic species invasions of Illinois forests are increasing in severity and scope.

Conclusion No. 3: Data designed to monitor compliance with environmental regulations or the status of individual species are not sufficient to assess ecosystem health statewide. Among the findings:

- Researchers must describe the spatial contours of air pollutant concentrations statewide using a limited number of sampling sites concentrated in Chicago and the East St. Louis metro area.

- Much more research is needed on the ecology of large rivers, in particular the effects of human manipulation.

- The length of Illinois' longest stream gaging records is generally not sufficient to identify fluctuations that recur less frequently than every few decades.

- The Sediment Benchmark Network was set up in 1981 with some 120 instream sediment data stations; by 1990 the network had shrunk to 40 stations, the majority of which have data for only one to three years.

CTAP is designed to begin to help address the complex problems Illinois faces in making environmental policy on a sound ecosystem basis. The next edition of the Critical Trends Assessment Project, two years hence, should have more answers about trends in Illinois' environmental and ecological conditions to help determine an effective and economical environmental policy for Illinois.

Table of Contents

Foreword

This bibliography was compiled to assist in all phases of the Illinois Critical Trends Assessment Project (CTAP). It contains references for relevant methodologies and modeling, as well as for the application of various methods to the analysis of environmental conditions in Illinois. The bibliography also includes examples of similar reports by municipalities, other states, and foreign countries. Because various statistical methods may be necessary to analyze environmental data that exhibit spatial uncertainty, references on statistical analysis are included in this document. Public participation may be vital to the assessment of critical trends, so the bibliography includes reports on how the public perceives environmental issues. Other references provide examples of how public participation has been utilized by various governmental organizations involved in these studies. It is hoped that this bibliography will be useful to other states and local government agencies that may need guidance in the beginning stages of comparative risk assessment, environmental trend analyses. The bibliography may also prove useful to scientists, environmentalists, legislators, and other citizens interested in environmental issues.

The bibliographic entries were compiled from journal articles; abstracts; conference proceedings; local, state and federal government documents and technical reports; public and private library collections; bibliographies; and various other sources. Many entries have short annotations. Although this list of references is fairly comprehensive, its compilation has revealed gaps in available resources. Omissions or errors in resource information are inadvertent. The compilers would appreciate being notified of any additions and/or corrections that would improve the document.

All publications cited in this bibliography are classified under one of the subjects presented in the table of contents. For references that include information related to more than one subject, full citations have been given under the most appropriate heading and cross-referenced by author, date, and title under other relevant headings. Entries under each heading are arranged alphabetically by author, then chronologically by year of publication. Specific citations can be located by searching under the subject heading or by utilizing the author index at the back of the bibliography.

This bibliography was originally compiled using NOTEBOOK II, a commercial bibliographic database package. The data were then transferred into Word Perfect 5.1, for final formatting, organization, and editing. The document is available on diskette in Word Perfect 5.1 format, which allows for the utilization of the word-search capabilities in that program.

Acknowledgments

The ISGS Library staff are gratefully acknowledged for their assistance in the preparation and review of this document. We also thank David Witzany, then a member of the ISGS Geologic Mapping and Digital Cartography Section, for his technical assistance in the use of the NOTEBOOK II software package.

Environmental Quality and Environmental Trends

General References

Alfsen, K. H., K. A. Brekke, F. Brunvoll, H. Luras, K. Nyborg, and V. Saebo, 1992, Environmental Indicators: Norway Central Bureau of Statistics, Discussion Paper no. 71.

Bergstrom, J. C., 1990, Concepts and measures of the economic value of environmental quality: A review. For complete reference, see ***Economic Analyses, General References,*** p. 35.

Bishop, J. (editor), 1980, Illinois in the '80's...Trends in Natural Resource Management: Illinois Institute of Natural Resources, Document no. ILLDOE-81/23, Springfield, Illinois, 98 p.

Boden, T. A., P. Kanciruk, and M. P. Farrell, 1990, Trends '90: A Compendium of Data on Global Change. For complete reference, see ***Global Climate Change Issues,*** p. 106.

Conservation Foundation, 1984, State Environmental Data Summaries: The Conservation Foundation, Washington, D. C., 245 p.

Non-comprehensive summary of environmental quality and trends for each state. The information presented for Illinois covers population and economic trends, hazardous waste generation figures, estimates of air and water quality, and an analysis of land use and ecosystem conditions.

Council on Environmental Quality, Executive Office of the President, 1981, Environmental Trends: Council on Environmental Quality, Washington, D.C, 346 p.

Summary of national environmental trends, along with social trends that affect environmental quality. Colorful, easy-to-read text that includes many graphs and maps. Excellent format that could be an example for CTAP.

Council on Environmental Quality, Executive Office of the President, 1989, Environmental Trends: Council on Environmental Quality, Washington, D. C., 152 p.

National environmental trends are outlined in this book's 367 graphic representations.

Council on Environmental Quality, Executive Office of the President, 1990, Environmental Quality: Twentieth Annual Report, Council on Environmental Quality, Washington, D. C.

Council on Environmental Quality, Executive Office of the President, 1991, Environmental Quality: Twenty-first Annual Report, Council on Environmental Quality, Washington, D. C., p. 1-382.

Darnay, A. J. (editor), 1992, Statistical Record of the Environment: Gale Research, Inc., Detroit, Michigan, 855 p.

A presentation of environmental, economic, and social statistics (mostly for the U. S.) in the form of tables and charts. Provides data summaries, but no analysis or discussion of the data's implications. Includes a very useful reference section.

Dexter, R. N., L. S. Goldstein, P. M. Chapman, and E. A. Quinlan, 1985, Temporal Trends in Selected Environmental Parameters Monitored in Puget Sound: National Oceanic and Atmospheric Administration, Rockville, Maryland, Technical Memorandum NOS OMA 19, 158 p.

Environmental data on Puget Sound was analyzed to identify temporal trends. It was concluded that the majority of the trends detected represented improvements in the environmental quality of Puget Sound.

Goldemberg, J., T. B. Johansson, A. K. N. Reddy, and R. H. Williams (editors), 1988, Energy for a Sustainable World: Wiley Eastern Limited, New Delhi, India, 517 p.

Hall, B., and M. L. Kerr, 1991, 1991-1992 Green Index: Island Press.

Hammond, K. A., G. Macinko, and W. B. Fairchild (editors) 1978, Sourcebook on the Environment: A Guide to the Literature: The University of Chicago Press, Chicago, Illinois, 613 p.

Overviews major environmental topics and provides comprehensive reference lists.

Hunsaker, C. T., and D. E. Carpenter (editors), 1990, Ecological Indicators for the Environmental Monitoring and Assessment Program: U. S. Environmental Protection Agency, Office of Research and Development, Research Triangle Park, North Carolina, EPA 600/3-90-060.

Illinois Environmental Protection Agency, 1990, Environmental Progress, 1970-1990: Illinois Environmental Protection Agency, Supplemental Transition Document, Springfield, Illinois, 48 p.

Overview of Illinois' progress in pollution control and pollution prevention from 1970-1990. Presents statistics, usually in the form of percent change in pollution, and numerous graphs and charts.

Jarrett, R., R. Reuter, J. Stratta, and R. Jain, 1992, Environmental Trends--Policy Implications for the U. S. Army: Army Environmental Policy Institute, Champaign, Illinois, Document no. AEPI-PS-192, 41 p.

Brief presentations of the 41 environmental trends expected to most strongly influence Army policy decisions in the near future. Bibliographic references are provided for each trend. Also includes a comprehensive introduction that addresses the need for trends analysis. Excellent source for trends information and references.

Johnston, R. J., 1989, Environmental Problems: Nature, Economy and State: Belhaven Press, London, 211 p.

Khoshoo, T. N., 1984. Environmental Concerns and Strategies: Indian Environmental Society, New Delhi, India, 296 p.

Kneese, A. V., and B. T. Bower, 1972, Environmental Quality Analysis: Theory and Method in the Social Sciences: Proceedings, Resources for the Future Conference on Research on Environmental Quality: Theoretical and Methodological Studies in the Social Sciences, Washington, D. C., June, 1970, Johns Hopkins University Press, Baltimore, Maryland, 408 p.

Sampling of work from RFF program on the quality of the environment: 1) the environment and economic growth; 2) management programs, including mathematical modeling; 3) political and legal institutions and their role in environmental quality decision-making. Focuses on the social science aspect of environmental problems. How to deal with common property natural resources in an economic sense.

Landsberg, H. H., L. L. Fischman, and J. L. Fisher, 1963, Resources in America's Future-Patterns of Requirements and Availabilities 1960-2000: Resources for the Future, Johns Hopkins University Press, Baltimore, Maryland, 1017 p.

Will the U. S. be able to meet future demands for natural resources? This question is central to the analysis of America s resources. The authors project future resource needs and demand based on historical and current trends and "reasonable" assumptions about the future. They then assess the adequacy of our resource base.

Lund, H. G., and G. Preto (Technical Coordinators), 1990, Global Natural Resource Monitoring and Assessments: Preparing for the 21st Century: Proceedings, International Conference and Workshop on Global Natural Resource Monitoring and Assessments: Preparing for the 21st Century, Venice, Italy, September 24-30, 1989, American Society for Photogrammetry and Remote Sensing, Bethesda, Maryland, Three volumes.

Volume 1 centers on the following subject areas: 1) global monitoring; the planning, environmental and socioeconomic perspective; 2) major global natural resource issues; 3) monitoring environmental health; 4) water resources; 5) inventory monitoring and assessment/relationship to sustainable development.

Volume 2 concentrates on 1) natural resource inventories; 2) remote sensing strategies suitable for forest inventory and monitoring; 3) technical forecasting; 4) global coordination efforts; 5) resource management planning; 6) policy aspects of monitoring; 7) ecological approaches to inventory and monitoring.

Volume 3 contains papers on the following topics: 1) future satellite sensing capabilities; 2) resource measurements and modeling; 3) databases and geographic information systems; 4) remote sensing opportunities. An author index for all three volumes is included.

Meadows, D. H., D. L. Meadows, and J. Randers, 1992, Beyond the Limits, Chelsea Green Publishing Co., Post Mills, Vermont, 300 p.

National Oceanic and Atmospheric Association, W. H. Hooke, J. M. Bishop, J. L. Wickham, and I. C. Sheifer, 1990, National Oceanic and Atmospheric Association Environmental Digest: Selected Environmental Indicators of the United States and the Global Environment: Office of the Chief Scientist, National Oceanic and Atmospheric Administration, U. S. Department of Commerce, Washington, D. C. 66 p.

Examines the global environment through the parameters of atmosphere, ocean, cryosphere, and biosphere.

Organization for Economic Cooperation and Development (OECD), 1991, Environmental Indicators: OECD Publications, Paris, France, 77 p.

This publication provides a preliminary set of environmental indicators by which to measure environmental performance. Includes 18 environmental indicators, some relating to environmental quality, some to national environmental goals, and some to international environmental agreements and issues. For each indicator, information on trends since 1970, along with information on the present state is included. A very good model to use for CTAP.

Ornstein, R., and P. Ehrlich, 1989, New World, New Mind: Doubleday, NY.

Ott, W. R., 1978, Environmental Indices, Theory and Practice: Ann Arbor Science Publisher, Inc. Ann Arbor, Michigan, 371 p.

This text, in the author's own words, focuses on "quantitative techniques for interpreting and presenting information on the State of the Environment." He discusses trends analysis,

environmental quality profiles and damage functions. Though very forward-looking, the fact that the text is nearly 15 years old limits its applicability to CTAP.

Reilly, P. C., 1978, Environmental Quality Profile 1972-1976, Winnebago County, Illinois: Institute for Environmental Quality, Chicago, Illinois, 105 p.

Broad look at environmental conditions in Winnebago County. Addresses air and water quality, resource conservation, and solid waste issues.

Risser, H. E., 1972, Trends in Energy Supply: Proceedings, Outlook for Energy Conference, Upper Midwest Council, Minneapolis, Minnesota, December, 1972, Illinois State Geological Survey, Champaign, Illinois, Reprint Series 1973E, p. 13-20.

Overview of trends in U. S. consumption of energy from approximately 1955-1970.

Sansoni, B., 1987, Multi-Element Analysis for Environmental Characterization and Its Future Trends: Proceedings, International Symposium on New Sensors and Methods for Environmental Characterization (SMEC), Kyoto, Japan, November 10-12, 1986, Federal Republic of Germany, JUEL-SPEZ--393, 80 p.

Before starting to characterize the environment by its elemental composition, it may be useful to ask about the objective of this effort. This includes questions about the scope of environmental protection, the definition of the environment, and the limitations of its characterization by elemental composition alone. In the second part of this text, examples are given of the elemental composition of well-analyzed samples from the atmosphere, hydrosphere, lithosphere and biosphere. The third part introduces the principle of multi-element analysis and the fourth part gives examples. Finally, future aspects of modern chemical analysis are outlined with respect to the multi-element principle.

Schaefer, M., 1991, The Federal research puzzle-Making the pieces fit: Environment, v. 33, no. 9, November, p. 16-42.

Guide to/Critique of U. S. Federal Government environmental research and development efforts.

Simon, J. L., 1980, Resources, population, environment: An oversupply of false bad news, Science, v. 210, no. 1431.

Speth, G. (editor), 1980, Environmental Quality-1980: Executive Office of the President, 11th Annual Report, Council on Environmental Quality, Washington, D. C., 497 p.

Stigliani, W. M., 1990, 2030 is just around the corner: Naturopa, no. 64, p. 28-29.

This article presents several different scenarios (e.g. present economic and environmental trends continue, environmental responsibility increases worldwide) and their predicted impact on the environment in Europe, 2030.

Tunstall, D. B., 1983, Supporting Data for Environmental Trends: U. S. Geological Survey, Reston, Virginia, Open File Report 83-0534, 296 p. Microfiche.

Provides environmental data summaries. General topics covered include population, land use, solid waste, resource consumption, toxic substances, wildlife, energy, water quality, and air quality.

U. S. Department of Agriculture, 1989, The Second RCA Appraisal: Soil, Water, and Related Resources on Nonfederal Land in the United States: Analysis of Condition and Trends: U. S. Department of Agriculture, Washington, D. C., Five volumes.

This document is comprised of five volumes:

Resource Condition: Water

Although localized or wide-scale water shortages of varying intensity and duration are occurring in most parts of the U. S., many problems could be reduced with careful planning. Farmers have increased their efficiency in using irrigation water. Competition for water will intensify in the future if current trends continue. Improved management of irrigation water and soil moisture, increased infiltration, and reduced runoff may improve water availability in the future.

Resource Condition: Land

Resource Condition: The Environment

In appraising the status of environmental quality in the U. S., flood damages are found to be increasing, offsite effects of erosion and runoff are observed to be severe, and atmospheric deposition is causing popular concern. The known effects of acidic deposition on crops, forests, soils, and surface waters are reviewed, as is USDA's role in studying this phenomenon.

Analysis of Condition and Trends

Resource Projections:

Future status of cropland resources, irrigation supplies, erosion problems, and livestock management issues in the U. S. is projected.

U. S. Department of Energy, 1981, Environmental Trends to the Year 2000: U. S. Department of Energy, Washington, D. C., 20 p.

This report was prepared as required by the National Energy Policy Plan. Air pollution, water pollution, and solid waste generation trends were analyzed, as well as trends in water and energy consumption.

U. S. Environmental Protection Agency, 1979, Profile of Environmental Quality, Region V, the Midwest: U. S. Environmental Protection Agency, Region V, Chicago, 30 p.

Colorful overview of environmental quality and environmental programs in Illinois, Wisconsin, Minnesota, Michigan, Indiana, and Ohio. Contains many graphics, but not much detail--rather general in scope.

U. S. Environmental Protection Agency, Office of Research and Development, 1989, Protecting the Environment; A Research Strategy for the 1990s: U. S. Environmental Protection Agency, Washington, D. C., 68 p.

Overview of U. S. EPA's future research and development strategies. Addresses the need to shift from a local-regulatory focus to a global-preventative focus. Lists as the number one priority the development of an environmental monitoring and assessment program (EMAP). EMAP is similar to our critical trends analysis. It is designed to answer the question "What is the condition of the environment and how is it changing?" Also discusses the importance of risk assessment research. Increases in grants to the academic research community, and the need to expand existing databases on human exposure to pollutants are two more priorities addressed in this document.

U. S. Environmental Protection Agency, Office of Pollution Prevention, 1991, Pollution Prevention 1991: Progress in Reducing Industrial Pollutants, U. S. Environmental Protection Agency, Washington, D. C., EPA 21P-3003, 242 p.

Relates the various programs and initiatives currently being undertaken to reduce industrial pollution. Nationally, focus has begun to switch from end-of-pipe pollution clean-up to pollution prevention. The success of this endeavor depends on cooperative industrial (vs. regulatory) action.

U. S. Soil Conservation Service and Iowa State University Statistical Laboratory, 1982, Basic Statistics: 1977 National Resources Inventory: U. S. Department of Agriculture, Soil Conservation Service, Washington, D. C., and Iowa State University Statistical Laboratory, 267 p.

U. S. Soil Conservation Service and Iowa State University Statistical Laboratory, 1987, Basic Statistics: 1982 National Resources Inventory: U. S. Department of Agriculture, Soil Conservation Service, Washington, D. C., and Iowa State University Statistical Laboratory.

Water Quality 2000, Water Pollution Control Federation, 1991, Challenges for the Future--Interim Report. For complete reference, see ***Surface Water Quality, General References,*** p. 61.

Webb, L., and J. Tryens (editors), 1984, An Environmental Agenda for the States: The Conference on Alternative State and Local Policies, Washington, D. C., 86 p.

Offers specific legislative, regulatory, and programmatic ideas for environmental action in 14 general areas (e.g. air, groundwater).

"State of the Environment" Reports

Agarwal, A., and S. Narain (editors), 1985, The State of India's Environment 1984-85, The Second Citizens' Report: Ravi Chopra for the Centre for Science and Environment, New Delhi, India, 393 p.

This report provides a comprehensive look at the state of the environment in India. It details a variety of environmental issues and provides information on linkages that operate at interface areas between different ecological spaces, between people and their environment, and between the economics of towns and villages in India.

Barney, G. O., 1980, The Global 2000 Report to the President of the U. S.: Pergamon Press, New York, 171 p.

Bird, P. M., and D. J. Rapport, 1986, State of the Environment Report for Canada: Supply and Services Canada, Canadian Government Publishing Centre, Hull, Quebec, Canada, 263 p.

First comprehensive report undertaken on the State of the Environment for Canada. Identifies patterns of environmental change. Organizes, assesses and condenses data.

Brown, L. R., A. Durning, C. Flavin, L. Heise, J. Jacobson, S. Postel, M. Renner, and C. P. Shea, 1989, State of the World 1989: A Worldwatch Institute Report on Progress Toward a Sustainable Society: L. Starke (editor), W. W. Norton & Co, New York, 256 p.

Describes problems of land degradation, ozone depletion, overreliance on automobiles, and the global AIDS epidemic. Includes a global action plan aimed at mobilizing the world community to fight environmental deterioration and social disintegration by slowing population growth, meeting

future food needs, reversing deforestation, and improving energy efficiency through grass-roots organizations and international institutions.

Central Bureau of Statistics of Norway, 1991, Natural Resources and the Environment 1990: Central Bureau of Statistics, Norway, 150 p.

Commission of the European Communities, 1979, State of the Environment, Second Report 1979: Office for Official Publications of the European Community. Luxembourg, 127 p.

A "State of the Environment" report for the European Communities, which selects a number of topics felt to be of particular interest and presents them in a non-technical manner to the public. This is the second report in this series. Discusses the integration of an environmental dimension into economic growth. Discusses trends in environmental legislation/policy related to studies being performed and proposals put forth in the first report by the Commission of European Communities. Very nice publication addressing issues similar to CTAP.

Conservation Foundation, 1984, State of the Environment: An Assessment at Mid-Decade: The Conservation Foundation, Washington, D. C., 586 p.

A look at the current state of the environment in the U. S. and associated trends. Focuses strongly on U. S. environmental quality and policy, but includes a chapter on intergovernmental cooperation. Specifically analyzed are trends in population and the economy, pollutants and natural resources. Contains many maps, graphs,and charts. Also includes a chapter on risk assessment methodology. Overall, a good model for CTAP.

Conservation Foundation, 1987, State of the Environment--A View Toward the Nineties: The Conservation Foundation, Washington, D. C., 614 p.

An assessment of U. S. environmental quality. This report differs from earlier Conservation Foundation "State of the Environment" reports in that its focus is on more long-term trends.

Department of Ecology, 1991, The 1991 State of the Environment Report: Department of Ecology, Washington, D. C., p. 1-139.

El-Hinnawi, E., and M. H. Hashmi, 1987, The State of the Environment: Butterworths, London, England, 182 p.

In this volume, the "state of the environment" reports produced by the U.N. Environmental Programme since 1974 have been consolidated and updated to produce a comprehensive report on the state of the world environment. Contemporary and future environmental issues are highlighted, especially those of global significance.

Environmental Quality Commission, 1992, State of Kentucky's Environment: A Report of Progress and Problems: Environmental Quality Commission, State of Kentucky, p. 1-332.

European Commission, 1987, The State of the Environment in the European Community, 1986, Commission of the European Communities, Brussels.

Gerrard, M., et al. (editors), 1991, State of the Environment--Report for Manitoba: Minister of Environment, Manitoba, Canada, 191 p.

Hinrichsen, D., and G. Enyedi (editors), 1990, State of the Hungarian Environment: Statistical Publishing House, Budapest, Hungary, 143 p.

Provides an overall picture of the state of the environment in Hungary. Part 1 is entitled "Environment and Society". Chapter 1 covers trends in economic and urban development and their environmental implications. Chapter 2 focuses on environmental policy in Hungary. Part 2 covers basic resources such as air quality and pollution control, freshwater resources, water quality, soil quality, and land use. Part 3 focuses on nature conservation issues, while Part 4 discusses international cooperation. This publication includes numerous graphs and maps depicting trends in Hungarian environmental issues.

Organization for Economic Co-operation and Development (OECD), 1979, The State of the Environment in OECD Member Countries, OECD Publications, Paris, France, 177 p.

This report assesses the state of the environment in OECD member countries based on three areas of concern: 1) trends in human activity negatively impacting the environment, 2) conditions of environmental media and other natural resources and 3) mitigation efforts. The report also addresses the need for more complete data.

Organization for Economic Cooperation and Development (OECD), 1985, The State of the Environment: OECD Publications, Paris, France, 282 p.

Organization for Economic Cooperation and Development (OECD), 1989, France Environmental Data Compendium, OECD Publications, Paris, France.

Organization for Economic Co-operation and Development (OECD), 1991, The State of the Environment: OECD Publications, Paris, France, 297 p.

Latest version of this publication. Emphasizes relationship between the state of the environment and economic growth/structural changes. Very trend-oriented, lots of graphics. Excellent model for Illinois CTAP to use in determining scope and format of our study.

Tolba, M. K., 1983, The State of the World Environment 1983: United Nations Environment Programme. 18 p.

Broad overview of the environmental problems facing the world in 1983. Presents the problems and the actions taken or planned to combat them.

State and Local Comparative Risk Analysis Projects

Colorado, State of, 1989, Environmental Status Report--A Summary of the Technical Analysis of the Colorado Environment 2000 Project: Colorado Department of Natural Resources and Colorado Department of Health, Denver, Colorado, 34 p.

A comparative risk analysis project undertaken by the State of Colorado. Thirty-one environmental issues were analyzed by four technical work groups: air, land, water and natural resources. A comparative risk analysis and ranking of these issues followed. This document contains the major conclusions of the technical work groups, as well as general discussions on the 31 environmental issues that were analyzed.

Colorado, State of, 1990, Colorado Environment 2000: Final Report of the Governor's Citizen Advisory Committee, Colorado Department of Natural Resources and Colorado Department of Health, Denver, Colorado, 88 p.

Part of a comparative risk analysis project undertaken by the State of Colorado. In this report, the CE 2000 Citizen Advisory Committee has inventoried the major environmental challenges facing

Colorado, identified these challenges, defined environmental protection goals, and proposed a series of actions to solve these problems. Initiatives for action were specific to the individual, neighborhood, business community, and local government and state sectors.

Lashof, D., and E. Washburn, 1990, The Statehouse Effect: State Policies to Cool the Greenhouse, National Resources Defense Fund, Washington, D. C.

Louisiana Department of Environmental Quality, 1991, LEAP to 2000, Louisiana's Environmental Action Plan: Project Report, Department of Environmental Quality, Baton Rouge, Louisiana, 40 p.

A comparative risk analysis project undertaken by the State of Louisiana. This text is a combination of the findings of the Public Advisory and the Steering Committees. Provides a ranking of the 35 most important environmental issues in the State of Louisiana. Includes a vision statement that describes environmental policy goals for the next 10 years. The report concludes with guiding themes for implementation.

Seattle Environmental Priorities Project, Technical Advisory Committee, 1991, Environmental Risks in Seattle: A Comparative Assessment: City of Seattle Planning Department, Seattle, Washington, 126 p.

Presents the results of a comparative risk assessment undertaken by the City of Seattle. Environmental problems are ranked according to the magnitude of risk posed to human health and the environment, in order to facilitate efficient environmental planning and policy-making.

Thompson, R. C., S. T. McCreary, and A. Clipp, 1991, LEAP to 2000, Louisiana Environmental Action Plan: Technical Supplement, Department of Environmental Quality, Baton Rouge, Louisiana, 153 p.

Part of a comparative risk analysis project undertaken by the State of Louisiana. This document describes the structure of the "Leap to 2000" project, and the methods used to analyze the data by the Technical Committee/Work Groups.

Vermont Agency of Natural Resources, 1991, Environment 1991: Risks to Vermont and Vermonters, in Strategy for Vermont's Third Century: Public Advisory Committee, Vermont Agency of Natural Resources, Waterbury, Vermont, 48 p.

Part of a comparative risk analysis project undertaken by the State of Vermont. Twenty of the most serious environmental problems in Vermont were chosen for study by the Public Advisory Committee. These problems were ranked in order of the risks to three areas: ecosystems, human health, and quality of life.

Vermont Agency of Natural Resources, 1991, Environment 1991: Risks to Vermont and Vermonters: Technical Appendix, Vermont Agency of Natural Resources, Waterbury, Vermont, 642 p.

A comparative risk analysis project conducted by the State of Vermont. This technical appendix contains the technical reports and data upon which the analysis and rankings were based. Three technical work groups contributed to this document; one focused on health risks, one on risks to Vermont s ecosystems, and one on quality of life. These technical reports analyzed 20 specific environmental issues/problems.

Washington Department of Ecology, 1989, The State of the Environment Report, A Product of Washington Environment 2010: Department of Ecology, Olympia, Washington, 66 p.

A comparative risk analysis project undertaken by the State of Washington. Features current and projected status of Washington s environmental resources. Twenty-three environmental threats were analyzed and ranked for risk to human health, ecological systems, and economic risks. Sets preliminary priorities for the state.

Washington Department of Ecology, 1990, A Citizen's Guide to Washington's Environment: Department of Ecology, Olympia, Washington, 42 p.

Part of a comparative risk analysis project undertaken by the State of Washington. This handbook is designed to teach the citizens of Washington ways that they can change their lifestyles to benefit the environment and future generations, without affecting the overall quality of their lives.

Washington Department of Ecology, 1990, Toward 2010, An Environmental Action Agenda: Department of Ecology, Olympia, Washington, 58 p.

Part of a comparative risk analysis project undertaken by the State of Washington. This action agenda began the implementation plan of the Washington Environment 2010 project. Major environmental challenges that face the state of Washington are identified and a number of recommendations for addressing these problems are presented.

Risk Assessment and Risk Management: Methodologies and Case Studies

Anderson, E. L., and C. J. Henry, 1988, Risk assessment/risk management as a toxic control strategy, Toxic Contamination in Large Lakes: Sources, Fate and Controls of Toxic Contaminants. For complete reference, see ***Surface Water Quality, Aquatic Toxicity,*** p. 61.

Andrews, R. N. L., 1988, Environmental impact assessment and risk assessment: Learning from each other. For complete reference, see ***Environmental Impact Assessments***, p. 17.

Bascietto, J., D. Hinckley, J. Plafkin, and M. Slimak, 1990, Ecotoxicity and ecological risk assessment: Regulatory applications at EPA: Environmental Science and Technology, v. 24, no. 1, p. 10-15.

Calabrese, E. J., and E. M. Kenyon, 1991, Air Toxics and Risk Assessment. For complete reference, see ***Air Quality, General References,*** p. 81.

Chesson, J., J. J. Marois, and G. Bruening, 1990, Data Requirements for Environmental Risk Assessment. For complete reference, see ***Data Quality and Reliability,*** p. 33.

Chicken, J. C., and M. R. Hayns, 1989, The Risk Ranking Technique in Decision Making: Pergamon Press, New York, 123 p.

Clark, J. M., and C. L. Fuller, 1987, A Total Exposure and Risk Assessment for Drinking Water Contaminated with Volatile Organic Compounds. For complete reference, see ***Public Drinking Water Supplies,*** p. 72.

Cothern, C. R., 1989, Some scientific judgments in the assessment of the risk of environmental contaminants: Toxicology and Industrial Health, v. 5, no. 3, p. 479-491.

Covello, V. T., and J. P. Fiskel, 1985, The Suitability and Applicability of Risk Assessment Methods for Environmental Applications of Biotechnology: National Science Foundation, Washington, D. C., Document no. NSF/PRA 8502286.

Covello, V. T., Mumpower, P. J. M. Stallen, and V. R. Uppuluri, 1985, Environmental Impact Assessment, Technology Assessment, and Risk Analysis. For complete reference, see ***Environmental Impact Assessments,*** p. 17.

Covello, V. T., J. Menkes, 1991, Risk Assessment and Risk Management Methods: The State of the Art: National Science Foundation, Washington, D. C.

Dixon, W. G., Jr., T. P. Adams, A. L. Erdmann, and M. S. Summers, 1990, Assessing Environmental Risk in an Urban Environment: Proceedings of the Association of Engineering Geologists, 33rd Annual Meeting, Engineering Geology for the 90s, Pittsburgh, Pennsylvania, October 1-5, 1990, Illinois State Geological Survey, p. 80.

Reviews the unique problems encountered when conducting environmental site assessments in urban areas. Focuses on difficulties associated with both historical research and field work.

Eisenbeis, J. J., R. H. Montgomery, and T. G. Sanders, 1986, A Risk Assessment Methodology for Hazardous Waste Landfills. For complete reference, see ***Hazardous and Radioactive Waste Disposal Issues/Injection Wells,*** p. 128.

Fiskel, J. R., and V. T. Covello, 1986, Biotechnology Risk Assessment: Issues and Methods for Environmental Introductions: Pergamon Press, New York, 174 p.

Fogarty, M. J., A. A. Rosenberg, and M. P. Sissenwine, 1992, Fisheries risk assessment, Sources of uncertainty--A case study of Georges Bank Haddock: Environmental Science and Technology, v. 26, no. 3, p. 440-447.

A case study demonstrating the use of risk assessment in the development of renewable resource exploitation strategies.

Freudenburg, W. R., 1988, Perceived risk, real risk: Social science and the art of probabilistic risk assessment: Science, v. 242, October, p. 44-49.

Argues that social science input to risk assessment is needed for more accurate calculations of risk consequences and probabilities, and for identifying potential biases created by certain risk assessment procedures, as well as in analyzing and explaining public responses to risk. Discusses findings that suggest that the dichotomy between "real" and "perceived" risk is less "real" than is often assumed.

Garrick, B. J., W. C. Gekler, C. Chess, R. E. Kasperson, and C. Travis (editors), 1989, The Analysis, Communication, and Perception of Risk: Proceedings, Annual Meeting of the Society for Risk Analysis, October 29-November 1, 1989, San Francisco, California, Plenum Press, New York, v. 9, 713 p.

Gerrity, T. R., and C. J. Henry (editors), 1990, Principles of Route-to-Route Extrapolation for Risk Assessment: Proceedings of Workshops held March 19-21, 1990, Hilton Head, South Carolina, and July 10-11, 1990, Durham, North Carolina, Elsevier Science Publishing Company, New York, 322 p.

Proceedings of workshops intended to provide a scientific foundation for route-to-route extrapolations and to determine future research priorities. Extrapolation of data based on one route

of exposure to another route of exposure is a common practice due to data gaps. However, the U. S. EPA has no formal guidelines dictating this process. Scientifically unsupported extrapolations lead to poor or increasingly uncertain risk assessments.

Gilbertson, M. (editor), 1989, Proceedings of Workshop on Cause-Effect Linkages, Chicago, Illinois, March 28-30, 1989, International Joint Commission, Windsor, Ontario, 45 p.

Discusses the methodology behind determining cause-effect linkages. Includes several case studies on non-human and human animals; two are specific to Lake Michigan.

Goodman, G. T., and W. D. Rowe (editors), 1979, Energy Risk Management: Academic Press, London, 351 p.

Discusses the risks to society of exploitation of alternative energy sources like nuclear power, solar energy, coal and natural gas, biogas or alcohol, rather than the quickly depleting oil. Emphasis on how usable risk analysis studies really are as a tool in energy policy formulation and management. Concern regarding "objective" vs. "perceived" risk. What constitutes an "acceptable" risk level? Problem of data availability and accuracy is addressed. Delves into cost-benefit analysis use as an aid to risk analysis.

Haimes, Y. Y., V. Chankong, and C. Du, 1984, Risk Assessment for Groundwater Contamination. For complete reference, see ***Groundwater Quality, Risk Assessments,*** p. 68.

Haimes, Y. Y., and E. Z. Stakhiv (editors), 1989, Risk Analysis and Management of Natural and Man-Made Hazards. For complete reference, see ***Natural/Geologic Hazards, General References,*** p. 110.

Haimes, Y. Y., and E. Z. Stakhiv (editors), 1990, Risk-Based Decision Making in Water Resources: Proceedings, Fourth Conference, Santa Barbara, California, October 15-20, 1989, Engineering Foundation and National Science Foundation, American Society of Civil Engineers, New York, 333 p.

Hallenbeck, W. H., 1986, Risk Assessment of Exposure to Radium and Fluoride in Illinois Public Water Supplies. For complete reference, see ***Public Drinking Water Supplies,*** p. 73.

Hallenbeck, W. H., 1987, Risk Assessment of Exposure to Waterborne and Airborne Radon-222 in Illinois. For complete reference, see ***Radon,*** p. 104.

Hattis, D., and J. A. Smith, 1985, What's Wrong with Quantitative Risk Analysis?: Proceedings, Conference on Moral Issues and Public Policy Issues in the Use of the Method of Quantitative Risk Assessment, Georgia State University, Atlanta, Georgia, September 7-26, 1985.

Hinchee, R. E., J. H. Reisinger, D. Burris, B. Marks, and J. Stepek, 1986, Underground Fuel Contamination, Investigation, and Remediation: A Risk Assessment Approach to How Clean Is Clean. For complete reference, see ***Groundwater Quality and Availability, Petroleum Contamination,*** p. 72.

Inman, R. L., W. J. Conover, and J. E. Campbell, 1980, Risk Methodology for Geologic Disposal of Radioactive Waste: Small Sample Sensitivity Analysis Techniques for Computer Models, with an Application to Risk Assessment. For complete reference, see ***Hazardous and/or Radioactive Waste Disposal Issues/Injection Wells,*** p. 135.

Jones, K., 1992, The Role of Science in Comparative Risk: Paper presented at the Comparative Risk Conference, Northeast Center for Comparative Risk, Vermont, 3 p.

Kates, R. W., 1978, Risk Assessment of Environmental Hazard: Workshop on Comparative Risk Assessment of Environmental Hazards in an International Context, Woods Hole, Massachusetts, March 31-April 4, 1975, SCOPE Report 8, John Wiley and Sons, 112 p.

Focuses on societal implications of risk assessment. Includes a section on benefit-risk analysis and a chapter on trends in assessing environmental threat.

Kent, R. T., and M. E. Bentley, 1985, Risk Assessment of Deep-Well Injection Systems. For complete reference, see ***Hazardous and/or Radioactive Waste Disposal Issues/Injection Wells,*** p. 135.

Kite, G. W., 1977, Frequency and Risk Analysis in Hydrology: Water Resources Publications, Fort Collins, Colorado, 224 p.

Kobrin, S. J., 1982, Managing Political Risk Assessment: Strategic Response to Environmental Change: University of California Press, Berkeley, California, 224 p.

Lafond, G., Institute for Risk Research, 1988, Risk Assessment and Management: Emergency Planning Perspectives: University of Waterloo Press, Ontario, Canada, 352 p.

Contains a chapter on multiple hazard mapping. Also contains a paper that describes a computer program, called HAZARD, that simulates the atmospheric effects of chemical emissions. The model is map-based and user-friendly.

Landis, W. G., and W. H. Van der Schalie (editors), 1990, Aquatic Toxicology and Risk Assessment. For complete reference, see ***Aquatic Toxicology,*** p. 62.

Lave, L. B. (editor), 1982, Quantitative Risk Assessment in Regulation: The Brookings Institute, Washington, D. C., 264 p.

Presents arguments for including risk assessments in the regulatory decision-making process via six case studies. (The case studies are on ozone, benzene, coke oven emissions, ionizing radiation, chlorobenzilate, and food additives and contaminants.) Also includes a chapter on risk assessment methodology.

Lave, L. B., V. T. Covello, A. Moghissi, and V. R. R. Uppuluri (editors), 1987, Uncertainty in Risk Assessment, Risk Management and Decision-Making: International Workshop on Uncertainty in Risk Assessment, Risk Management, and Decision Making, Knoxville, Tennessee, September 30-October 3, 1984, Advances in Risk Analysis, v. 4, Plenum Press, New York, 538 p.

Portrays uncertainty as possibly the biggest problem facing risk assessors and decision-makers. Lists four sources of uncertainty: 1) definitions; 2) scientific facts; 3) risk perceptions; and 4) values. Illustrates the role of uncertainty in risk assessment via papers from the social sciences, environmental sciences and mathematical sciences. One paper of note assesses the impact of incomplete data on uncertainty levels.

Long, F. A., and G. E. Schweitzer (editors), 1982, Risk Assessment at Hazardous Waste Sites. For complete reference, see ***Hazardous and/or Radioactive Waste Disposal Issues/Injection Wells,*** p. 135.

McKone, T. E., and K. T. Bogen, 1991, Predicting the uncertainties in risk assessment: Environmental Science and Technology, v. 25, no. 10, p. 1674-1681.

A California groundwater case study.

Megill, R. E. (editor), 1985, Evaluating and Managing Risk: A Collection of Readings: SciData Publishing, Tulsa, Oklahoma, 152 p.

Compilation of papers on risk assessment and risk management. Topics addressed include uncertainty and risk assessment methodology.

National Research Council, 1983, Risk Assessment in the Federal Government: Managing the Process: National Academy Press, Washington, D. C., 191 p.

Onishi, Y., S. M. Brown, A. R. Olsen, M. A. Parkhurst, S. E. Wise, and W. H. Walters, 1982, Methodology for Overland and Instream Migration and Risk Assessment of Pesticides: U. S. Environmental Protection Agency, Office of Research and Development, Environmental Research Laboratory, Athens, Georgia, EPA-600/3-82-024, 171 p.

Overview of the Chemical Migration and Risk Assessment (CMRA) Methodology. This methodology is used to predict surface water contamination due to non-point agricultural runoff, and to assess risk to aquatic biota.

Partridge, L., 1985, The Application of Quantitative Risk Assessment to Assist in Evaluating Remedial Action Alternatives, in Aller, L., J. H. Lehr, and K. Butcher (editors), Association of Ground Water Scientists and Engineers Eastern Regional Ground Water Conference, Portland, Maine, July 16-18, 1985, National Water Well Association, Worthington, Ohio, p. 51-63.

Pearce, D. W., 1981, Overview of Risk Assessment: Use and Misuse: Proceedings, The Assessment and Perception of Risk, a discussion organized by Sir Frederick Warner, F. R. S., and D. H. Slater, Study Group on Risk, Royal Society of London, London, United Kingdom, v. 376, no. 1764, p. 181-192.

This paper argues that a risk assessment cannot be accurately performed without a knowledge of the affected population s risk perceptions. Incorporating cost-benefit analysis avoids this problem by bringing individuals utility functions into the assessment process.

Richardson, M. L., 1988, Risk Assessment of Chemicals in the Environment: Proceedings, European Conference on Chemistry and the Environment, Royal Society of Chemistry, London, United Kingdom, 579 p.

Discussion of risk assessment in four general areas: predictive accuracy, incidental emissions, intentional emissions, and toxicological contributions. Of particular interest to CTAP are a paper on lead in the environment, and a paper on risk assessment techniques for carcinogens.

Rose, J. B., and C. P. Gerba, 1991, Use of risk assessment for development of microbial standards: Water Science and Technology (WSTED4), v. 24, no. 2, p. 29-34.

Science Advisory Board of the U. S. Environmental Protection Agency, Committee on Relative Risk Reduction Strategies, 1990, Reducing Risks: Setting Priorities and Strategies for Environmental Protection, U. S. Environmental Protection Agency, Washington, D. C., SAB-EC-90-021. 26 p.

Summary of a three-volume report by U. S. EPA's Science Advisory Board (SAB). This report evaluates and expands upon EPA's 1987 report, Unifinished Business: A Comparative Assessment of Environmental Problems. The SAB summary offers ten recommendations to the U. S. EPA geared toward improving their prioritization methods.

Scientific Committee on Problems of the Environment (SCOPE) of the International Council of Scientific Unions (ICSU), 1980, SCOPE Report 15, in Whyte, A. V., and I. Burton (editors), Environmental Risk Assessment: John Wiley and Sons, Chichester, England/New York, 157 p.

Nice overview of risk assessment. Covers environmental modeling, benefit-risk analysis and other economic considerations. Includes a table of priority pollutants and major environmental risks. Uses a modified source-linkage-receptor model.

Sheih, L. C., J. J. Johnson, J. E. Wells, J. C. Chen, and P. D. Smith, 1985, Simplified Seismic Probabilistic Risk Assessment: Procedures and Limitations. For complete reference, see ***Seismic Risk,*** p. 111.

Stara, J. F., and L. S. Erdreich (editors), 1984, Selected Approaches to Risk Assessment for Multiple Chemical Exposures. For complete reference, see ***Environmental Health Assessments and Concerns,*** p. 23.

Starr, C., 1985, Risk management, assessment and acceptability: Risk Analysis, v. 5, p. 97-102.

Stevenson, D. E., 1989, Risk Assessment in Setting National Priorities, in Bonin, J. J., and D. E. Stevenson (editors), Advances in Risk Analysis: Plenum Press, New York, v. 7, 686 p.

Contains over 75 papers presented at the 1987 annual meeting of the Society for Risk Analysis. Discussed are aspects of risk analysis from definitions to methodology to communication. Includes many diverse case studies, including an analysis of the impact of risk assessment and risk management in the State of New Hampshire. Several modeling methodologies are presented; of particular interest are the pathways exposure model (similar to our source-agent-receptor linkage model) and the matrix-based assessment model. Contains one report on data quality assurance. Very good source for risk assessment models and data quality assurance information.

Suter, G. W., II, and J. M. Loar, 1992, Weighing the ecological risk of hazardous waste sites--the Oak Ridge case. For complete reference, see ***Hazardous and/or Radioactive Waste Disposal Issues/Injection Wells,*** p. 139.

U. S. Environmental Protection Agency, 1984, Risk Assessment and Management: Framework for Decision Making: U. S. Environmental Protection Agency, Washington, D. C., EPA 600/9-85/002, 38 p.

Discusses how EPA is using the risk assessment/management approach to prioritize needs for program development and policy decisions. Important to look at "trends" or what risk-reduction effect a regulation has. Steps of a risk assessment include: 1) hazard identification: does a particular substance exhibit a particular adverse health effect? 2) dose-response assessment; 3) exposure assessment: direct measurement, estimation, mathematical models; 4) risk characterization: exposure multiplied by potency. Uncertainty abounds in risk assessment due to extrapolation between animals and humans and lack of data.

U. S. Environmental Protection Agency, 1986, Development of a Qualitative Pathogen Risk Assessment Methodology for Municipal Sludge Landfilling. For complete reference, see ***Wastewater Treatment Plants,*** p. 121.

U. S. Environmental Protection Agency, Office of Policy, Planning and Evaluation, Office of Policy Analysis, 1987, Unfinished Business: A Comparative Assessment of Environmental Problems: U. S. Environmental Protection Agency, Washington, D. C., Five volumes.

The complete work includes five volumes: Overview; Appendix I, Report of the Cancer Risk Work Group; Appendix II, Non-Cancer Risk Work Group; Appendix III, Report of Ecological Risk Work Group; and Appendix IV, Report of Welfare Risk Work Group.

U. S. Environmental Protection Agency, 1988, EPA's Ecological Risk Assessment Research Program, October 1985-March 1988: U. S. Environmental Protection Agency, Washington, D. C., EPA 600/M-88/011, 7 p.

U. S. Environmental Protection Agency, 1989, Biological Data for Pharmacokinetic Modeling and Risk Assessment, Report: "Workshop on Biological Data for Pharmacokinetic Modeling and Risk Assessment", May 23-25, 1988: U. S. Environmental Protection Agency and ILSI Risk Science Institute, Asheville, North Carolina, EPA/600/3-90/019, 47 p., Microfiche.

Overview of risk assessment and the use of pharmacokinetic modeling to reduce some of the uncertainties inherent to risk assessments.

U. S. Environmental Protection Agency, 1991, A Risk Analysis of Twenty-Six Environmental Problems: U. S. Environmental Protection Agency, Washington, D. C., 26 p.

Results of EPA Region V's risk analysis of 26 problem areas. Risk to human health and the environment were studied. Risk assessments were compared and ranked as high high, medium high, medium low, low, or risk not assessed/no known impacts.

U. S. House of Representatives, 1980, Comparative Risk Assessment: Hearings before the Subcommittee on Science, Research, and Technology, Committee on Science and Technology, U. S. House of Representatives, 96th Congress, Second Session, May 14-15, 1980, U. S. Government Printing Office, Washington, D. C., Document no. 129, 571 p.

Senate hearing on comparative risk analysis methodology and its use in regulatory decision-making. Cost-benefit analysis and its incorporation into the decision-making process was also covered.

U. S. House of Representatives, Committee on Science and Technology, Subcommittee on Science, Research, and Technology, 1983, A Review of Risk Assessment Methodologies: Report: U. S. Government Printing Office, Washington, D. C., 78 p.

Urban, D. J., and N. J. Cook, 1986, Ecological Risk Assessment: Hazard Evaluation Division, Standard Evaluation Procedure, U. S. Environmental Protection Agency, Office of Pesticide Programs, Washington, D. C., EPA-540/9-85-001, 96 p.

Vermont Agency of Natural Resources, 1991, Environment 1991: Risks to Vermont and Vermonters: Agency of Natural Resources, Waterbury, Vermont, p. 1-48.

Venkataraman R. R., and G. V. Johnson, 1988, Impact of Risk and Planning Horizons on the Selection of Soil Conservation Management Systems, in V. Novotny (editor), Proceedings of the Symposium on Nonpoint Pollution; 1988, Policy, Economy, Management, and Appropriate Technology: American Water Resources Association, Bethesda, Maryland, Technical Publication v. 4, p. 107-116.

Examines the effects of incorporating risk assessments into the process of choosing a soil conservation management plan.

Whelan, G., B. L. Steelman, 1985, Development of Improved Risk Assessment Tools for Prioritizing Hazardous Waste Disposal Sites. For complete reference, see ***Hazardous and/or Radioactive Waste Disposal Issues/Injection Wells,*** p. 143.

Williams, G. R., and D. S. Mileti, 1986, Inclusion of Social Variables in Models of Risk Assessment, in S. R. Abt, J. D. Nelson, T. A. Shepherd, R. E. Wardwell, and D. van Zyl (editors), Proceedings, 8th Annual Symposium on Geotechnical and Geohydrological Aspects of Waste Management, Fort Collins, Colorado, February 5-7, 1986, A. A. Balkema, Rotterdam, Netherlands, p. 375-379.

Wilson, R., and E. A. C. Crouch, 1987, Risk assessment and comparisons: An introduction: Science, v. 236, April 17, p. 267.

Risk assessment is presented as a way of examining risks so that they may be better avoided, reduced, or otherwise managed. Risk estimates are compared and contrasted to display their similarities and differences.

Wolka, K. K., L. W. Turley, and W. G. Petruzzi, 1990, A Well Field Risk Assessment. For complete reference, see ***Groundwater Quality, Risk Assessments,*** p. 69.

Environmental Impact Assessments

Andrews, R. N. L., 1988, Environmental impact assessment and risk assessment: Learning from each other, in Wathern, P. (editor), Environmental Impact Assessment Theory and Practice, Unwin Hyman, Ltd., London, p. 85-97.

Comparison/contrast of risk assessment and environmental impact assessment. Suggests that consolidation of the two methods may, in many cases, improve analysis and policy decisions.

Bisset, R., 1980, Methods for environmental impact analysis: recent trends and future prospects: Journal of Environmental Management, v. 11, no. 1, July, p. 27.

Burchell, R. W., and D. Listokin, 1975, The Environmental Impact Handbook: Centre for Urban Policy Research, Rutgers University, New Jersey, 234 p.

Clark, B. D., 1984, Basic Concepts of Environmental Impact Assessment and Environmental Health Impact Assessment. For complete reference, see ***Environmental Health Assessments and Concerns,*** p. 20.

Covello, V. T., J. L. Mumpower, P. J. M. Stallen, and V. R. Uppuluri, 1985, Environmental Impact Assessment, Technology Assessment, and Risk Analysis, in Series G: Ecological Sciences, NATO Advanced Study Institute on Environmental Impact Assessment, Technology Assessment, and Risk Analysis, Bourgh-St. Maurice, France, August 21-31, 1983, Springer-Verlag, Berlin Heidelberg, Germany, 1068 p.

Offers views on the role of risk assessments and environmental impact assessments in the decision-making process. The psychology of risk perception is also presented. Includes papers on uncertainty in risk analysis and risk assessment methodology.

Culhane, P. J., H. P. Friesema, and J. A. Beecher, 1987, Forecasts and Environmental Decision Making--The Content and Predictive Accuracy of Environmental Impact Statements. For complete reference, see ***Forecasting,*** p. 52.

Ditton, R. B., and T. L. Goodale (editors), 1972, Environmental Impact Analysis: Philosophy and Methods: Proceedings, Conference on Environmental Impact Analysis, Green Bay, Wisconsin, January 4-5, 1972, U. S. Dept. of Commerce, National Sea Grant Program, National Oceanic and Atmospheric Administration, University of Wisconsin Sea Grant Program, Madison, Wisconsin, WIS-SG-72-111, 171 p.

Ellis, D., 1989, Environments at Risk: Case Histories of Impact Assessment: Springer-Verlag, Berlin, 329 p.

Environmental Impact Center, Inc., 1973, A Methodology for Assessing Environmental Impact of Water Resources Development: Environmental Impact Center, Inc., Cambridge, Massachusetts, 148 p.

Hipel, K. W., 1988, Nonparametric approaches to environmental impact assessment. For complete reference, see ***Statistical Analyses of Environmental Data, General References,*** p. 42.

Leopold, L. B., F. E. Clarke, B. B. Hanshaw, and J. R. Balsley, 1971, A Procedure for Evaluating Environmental Impact: U. S. Geological Survey, Circular 645, 13 p.

Proposes a matrix system for assessing environmental impact in an attempt to develop a uniform environmental impact statement. This report was written in response to a 1969 article in "Science" criticizing the National Environmental Policy Act of 1969 for not being specific enough to be a useful guideline.

Overcash, M. R., and J. M. Davidson (editors), 1980, Environmental Impact of Nonpoint Source Pollution: Ann Arbor Science Publishers Inc., Ann Arbor, Michigan, 449 p.

Rao, K. S., and L. Satterfield, 1983, A Study of the Probable Environmental Impact of Fugitive Coal Dust Emissions at the Ravenswood Power Plant, New York. For complete reference, see ***Electricity Generation/Coal and Nuclear Power Plants/Radiation Hazards,*** p. 124.

Rosen, S. J., 1976, Manual for Environmental Impact Evaluation, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 192 p.

Schlesinger, B., and D. Daetz, 1975, Development of a procedure for forecasting Long-Range Environmental Impacts. For complete reference, see ***Forecasting,*** p. 54.

Smith, M. A., 1974, Field Test of an Environmental Impact Assessment Methodology: Environmental Resources Center, Georgia Institute of Technology, Atlanta, Georgia, Document no. ERC 1574, 197 p.

Stout, G. E., K. McGregor, J. L. Spaeth, K. A. Reinbold, G. L. Wheeler, G. L. Rolfe, and D. Studtman, 1978, Baseline Data Requirements for Assessing Environmental Impact: Illinois Institute for Environmental Quality, Chicago, Illinois, IIEQ Document no. 78/05, 140 p.

Presents a procedure for gathering the baseline data necessary for an environmental impact assessment of a rural development project.

U. S. Department of the Army, 1975, Handbook for Environmental Impact Analysis: U. S. Army AG Publications Center, Department of the Army, St. Louis, Missouri, #200-1, 98 p.

Warner, M. L., and E. H. Preston, 1974, A Review of Environmental Impact Assessment Methodologies: U. S. Environmental Protection Agency, Office of Research and Development, Washington, D. C., EPA-600/5-74-002, 27 p.

Westman, W. E., 1985, Ecology, Impact Assessment, and Environmental Planning, in Environmental Science and Technology Series: John Wiley and Sons, Inc., New York, 532 p.

General text that includes such topics as environmental decision-making, environmental impact analysis, risk analysis and environmental modeling/forecasting.

Environmental Health Assessments and Concerns

Ad Hoc Study Group of the Hazardous Materials Advisory Committee, Science Advisory Board, U. S. Environmental Protection Agency, 1975, Assessment of Health Risk from Organics in Drinking Water, Science Advisory Board, U. S. Environmental Protection Agency, Washington, D. C., 59 p.

Overview of a study to determine the risk to human health from low levels of organic compounds in drinking water. Emphasis on data gaps and research needs.

Allen, B. C., et al., 1988, Investigation of Cancer Risk Assessment Methods (Project Summary): Office of Health and Environmental Assessment, U. S. Environmental Protection Agency, Washington, D. C., EPA/600/S6-87/007, 3 p.

Results of a study undertaken to assess the underlying assumptions used in cancer risk assessments. The study found that animal and human risks are highly correlated, strengthening the validity of using this assumption in cancer risk assessments.

Bailey, D. A., P. F. Ricci, and G. Whelan, 1986, Groundwater Health Risk Assessment: A Case Study. For complete reference, see ***Groundwater Quality, Risk Assessments,*** p. 68.

Bennett, B. G., 1976, Transuranic Element Pathways to Man: Proceedings, Symposium on Transuranium Nuclides in the Environment, San Francisco, California, November 17-21, 1975, International Atomic Energy Agency, Vienna, Austria, p. 367-383.

Analysis of inhalation and ingestion pathways of plutonium to human receptors. Also considered are long-term pathways such as plant uptake.

Blumenthal, D. S. (editor), 1985, Introduction to Environmental Health: Springer Publishing Company, New York, 258 p.

Introductory text on environmental health, written for medical and public health students.

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Halogenated Chlorofluorocarbons; Barium; Selected Mycotoxins; Deltamethrin; Tricresyl Phosphate; Tri-N-Butyl Phosphate; Methyl Isobutyl Ketone; Tributyltin Compounds; Triphenyl Phosphate; Beryllium; 2-Methoxyethanol, 2-Ethoxyethanol, and their Acetates; Inorganic Mercury; n-Hexane; Aldrin and Dieldrin; Hexachlorocyclopentadiene; Dimethylformamide; Aldicarb; Nickel; Dimethoate; and Allethrins.

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Kopp, R. J., and V. K. Smith, 1989, Benefit Estimation Goes to Court: The Case of Natural Resource Damage Assessments: Resources for the Future, Washington, D. C., Discussion Paper QE89-09, 39 p.

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Sheff, R. L., 1979, Environmental Benefits Assessment in Economic Impact Studies: A Review: Illinois Institute of Natural Resources, Chicago, Illinois, Document no. 79/19, 51 p.

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Space of the Committee on Commerce, Science, and Transportation, United States Senate, Washington, D. C., U. S. Government Printing Office, 36 p.

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Statistical Analyses of Environmental Data

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Polycyclic aromatic hydrocarbon levels at two urban sites (one with heavy and one with light traffic) were related to meteorological conditions and analyzed via linear multiple regression analysis.

Draper, N. R., and H. Smith, 1981, Applied Regression Analysis: John Wiley & Sons, Inc., New York.

El-Shaarawi, A. H., and E. Damsleth, 1988, Parametric and nonparametric tests for dependent data: Water Resources Bulletin, v. 24, no. 3, June, p. 513-519.

Simulation and analytical results show that ignoring serial dependence can have serious effects on the performance of the t, sign, and Wilcoxen tests. In particular, the true significance levels of these tests are altered significantly from the intended nominal levels. Modifications for these tests are given and shown to have the correct significance levels.

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Addresses two components of the problem of estimating the magnitude of step trends in surface water quality. The first is finding a robust estimator appropriate to the data characteristics expected in water-quality time series. Second, the effectiveness of various sampling strategies are examined using Monte Carlo simulation coupled with application of this estimator.

Hopke, P. K., N. Johnson, and D. Staske, 1988, Statistical Analysis of the Background Air Quality Data Obtained for Champaign-Urbana, Illinois: prepared for the Illinois Department of Energy and Natural Resources.

Examines the impact of coal-burning by the Abbott Power Plant, University of Illinois at Urbana-Champaign, on the local urban environment. Dispersion modeling studies were done using EPA's single source CRSTER model (Friedland, 1984).

Joynt, M. I., P. A. McCormick, and G. D. V. Williams, 1975, Regression analyses of Canadian prairie crop-district cereal yields, 1961-1972, in relation to weather, soil and trend: Canadian Journal of Soil Science, v. 55, no. 1, February, p. 43.

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Statistical analysis of the association between excess mortality by age group and ambient levels of manganese and total suspended particulates (TSPs).

Olsen, A. R., and S. E. Wise, 1982, Frequency Analysis of Pesticide Concentrations for Risk Assessment (Franko Model): Environmental Research Laboratory, Office of Research and Development, U. S. Environmental Protection Agency, Athens, Georgia, 116 p.

Snedecor, G. W., and W. G. Cochran, 1980, Statistical Methods: The Iowa State University Press, Ames, Iowa, 7th edition, p. 192.

U. S. Environmental Protection Agency, Office of Health and Environmental Assessment, 1990, Statistical Methods for Estimating Risk for Exposure above the Reference Dose (Project Summary): U. S. Environmental Protection Agency, Washington, D. C., EPA/600/S8-90/065.

A statistical method has been developed that provides a risk estimate for noncarcinogenic effects at a given dose. The method uses a categorical regression procedure to model severity of effect as it relates to experimental dose. Complete report entitled "Statistical methods for estimating for exposure above the reference dose. " NTIS PB 90-261 504/AS.

Verly, G., M. David, A. G. Journel, and A. Marechal (editors), 1984, Geostatistics for Natural Resources Characterization, Parts 1 and 2, in Series C: Mathematical and Physical Sciences, Proceedings, NATO Advanced Study Institute on Geostatistics for Natural Resource Characterization, Stanford Sierra Lodge, South Lake Tahoe, California, September 6-17, 1983: D. Reidel Publishing Company, Dordrecht, Holland, v. 122, 1091 p.

Part 1 contains papers on several applied geostatistics topics, including a section on kriging. Very mathematical--could be a good data analysis source for CTAP. Part 2 contains a wide variety of applied geostatistics papers. Of particular interest to CTAP is the section on geostatistical applications for pollution control, and the many references to kriging.

Vinzani, P. G., and P. J. Lamb, 1985, Temporal and spatial visibility variations in the Illinois vicinity during 1949-1980. For complete reference, see ***Visibility***, p. 93.

Trends Analysis

Avara, E. P., and B. T. Miers, 1971, Comparison of Linear Trends in Time Series Data Using Regression Analysis: Atmospheric Sciences Laboratory, Army Electronics Command, White Sands Missile Range, New Mexico, Document no. ECOM-5403, 44 p.

Under the assumption that each of two sets of time series data contains a linear trend and stationary Gaussian autocorrelated noise, equations are developed to test the null hypothesis that the trends are the same.

Baldys, S., 1991, Trend analysis of selected water-quality constituents in the Verde River Basin, central Arizona: U. S. Geological Survey, Denver, Colorado, Water Resources Investigation, Document no. 90-4128, 55 p.

Beardsley, J. W., 1976, Fog on the Central California Coast for 1973, Analysis of Trends: M.S. thesis, Naval Postgraduate School, Monterey, California. 117 p.

Surface visibility data for selected stations on the central California coast in 1973 are analyzed. Radiosonde data from Oakland for the same period are used to derive meteorological indices.

Benkovitz, C. M., 1992, Trends analysis of vegetation exposure indices in rural areas of the U. S.: Atmospheric Environment, v. 26A, no. 6, p. 1121-1136.

Berryman, D., B. Bobee, D. Cluis, and J. Haemmerli, 1988, Nonparametric tests for trend detection in water quality time series: Water Resources Bulletin, v. 24, no. 3, June, p. 545-556.

A review of nonparametric tests for trend leads to the conclusion that Mann-Whitney, Spearman, and Kendall tests are the best choices for trend detection in water quality time series.

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Cechova, I., and E. M. Davis, 1973, Trend surface analysis and seasonal distribution patterns of primary nutrients and chlorophyll in unstratified Gulf Coast estuaries: Water Resources Research, v. 9, no. 6, December, p. 1543.

Chock, D. P., R. W. Herrman, and S. Kumar, 1982, An analysis of trends in oxidant air quality in the South Coast Air Basin of California: Atmospheric Environment, v. 16, no. 11, p. 2615-2630.

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Craig, C. D., W. P. Lowry, and D. Faulkenberry, 1980, The application of ridit analysis to detect trends in visibility: Atmospheric Environment, v. 14, no. 10, p. 1205.

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Davenport, T. E., 1982, Water Resources Data and Preliminary Trend Analysis for the Blue Creek Watershed Project, Pike County, Illinois, Phase I and Phase II: Division of Water Pollution Control, Illinois Environmental Protection Agency, Springfield, Illinois, IEPA/WPC/82-008 (Phase I), 127 p.; IEPA/WPC/82-008 (Phase II), 173 p.

The primary purpose of this monitoring and evaluation project was to determine the actual yield of pollutants from a variety of agricultural practices to downstream receiving water, and examine their effect upon the water quality and reasonable uses of the water resources. These reports present and briefly interpret preliminary trends in water quality data collected from project inception through September 30, 1981 as part of the Blue Creek Watershed project.

Davenport, T. E., and M. H. Kelly, 1982-1986, Water Resource Data and Preliminary Trend Analysis for the Highland Silver Lake Monitoring and Evaluation Project, Madison County, Illinois, Phase I (1982), Phase II (1983), Phase III (1984), and Phase IV, (1986): Division of Water Pollution Control, Illinois Environmental Protection Agency, Springfield, Illinois, IEPA/WPC/82-010 (Phase I), 139 p.; IEPA/WPC/83-013 (Phase II), 160 p.; IEPA/WPC/84-030 (Phase III), 245 p.; IEPA/WPC/86-001 (Phase IV), 209 p.

This report is a product of the Comprehensive Monitoring and Evaluation Program for the Highland Silver Lake Watershed. Purpose of this report is to present and briefly interpret trends in water quality data collected from project inception through March 31, 1983, as part of the Highland Silver Lake project. The primary purpose of this monitoring and evaluation project is to determine the impacts of the Rural Clean Water Project on the water resources of the watershed. Report on Phase IV is a product of the Comprehensive Monitoring and Evaluation Program for Highland Silver Lake Watershed and summarizes over three years of water quality and loading data gathered at the watershed and field level. Another purpose of the project is to evaluate the effectiveness of various agricultural resource management strategies in controlling non-point source pollution.

Delcourt, H. R., and W. F. Harris, 1980, Carbon budget of the southeastern U. S. biota: analysis of historical change in trend from source to sink: Science, v. 210, no. 4467, October 17, p. 321-324.

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Edwards, D., and B. C. Coull, 1987, Autoregressive trend analysis: An example using long-term ecological data: Oikos, v. 50, no. 1, September, p. 95.

Faoro, R. B., and J. A. Manning, 1981, Trends in benzo(a)pyrene 1966-77: Journal of the Air Pollution Control Association, v. 31, no. 1, p. 62-64.

Analysis of benzo(a)pyrene (BP) emissions trends in 26 U. S. cities over the 12-year period from 1966-1977.

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Ferguson, G. A., 1965, Nonparametric Trend Analysis: McGill University Press, Montreal, 61 p.

Fernando, R., 1987, Lake Erie Central Basin total phosphorus trend analysis from 1968 to 1982: Journal of Great Lakes Research, v. 13, no. 4, p. 667-674.

Total phosphorus data from 1968 to 1982 in the Lake Erie Central Basin trend study area were analyzed to determine in-lake responses to the Great Lakes Water Quality Agreement Phosphorus Loading Reduction Program.

Gerrodette, T., 1987, A power analysis for detecting trends: Ecology, v. 68, no. 5, October, p. 1364-1372.

Glasser, J. E., 1985, Successional trends on tree islands in the Okefenokee Swamp as determined by interspecific association analysis: American Midland Naturalist, v. 113, no. 2, April, p. 287.

Henderson, S. E., and M. A. Lopez, 1989, Trend Analysis of Lake Parker Stage and Relation to Various Hydrologic Factors, 1950-86, Lakeland, Florida: U. S. Geological Survey, Reston, Virginia, Document no. USGS/WRI-89-4037, 19 p.

Analyzes existing data on lake stage, groundwater levels, public water supply pumpage, and climatic data to determine: if Lake Parker stage is in a long-term declining trend, and if any detected trends are occurring only at Lake Parker, or are typical of regional trends. Scope of the investigation included statistical analyses of hydrologic data collected at Lake Parker and other sites within a 30 mile radius.

Hendrey, G. R., C. G. Hoogendyk, and N. F. Gmur, 1984, Analysis of Trends in the Chemistry of Surface Waters of the United States. Annual Report for NAPAP Projects E1-8 and E2-11. Final Report for IAG no. DW89930347-01-0. Volume 1, BNL-34956-V. 2. Appendix III, Trend List. Volume 2, BNL-34956-V. 2: Brookhaven National Laboratory, Upton, New York, v. 1, 205 p.; v. 2, 359 p.

The Acidification Chemistry Information Database (ACID) was established to analyze regional and national effects of acid deposition on surface waters. Linear trend analysis of the data showed SO_4 and H concentrations declining and alkalinity increasing in the New England-New York region. Volume 2 contains a complete list of trend analyses on all 6117 stations in ACID for which adequate data are available. Adequate data were defined as at least 10 measurements on the variable of interest representing at least five years.

Hipel, K. W., A. I. McLeod, and R. R. Weiler, 1988, Data analysis of water quality time series in Lake Erie: Water Resources Bulletin, v. 24, no. 3, June, p. 533-544.

Comprehensive data analysis study is carried out for detecting trends and other statistical characteristics in water quality time series measured in Long Point Bay, Lake Erie.

Hirsch, R. M., J. R. Slack, and R. A. Smith, 1982, Techniques of trend analysis for monthly water quality data, Paper #1W1744: Water Resources Research, v. 18, no. 1, February, p. 107-121.

Some of the characteristics that complicate the analysis of water quality time series are non-normal distributions, seasonality, flow relatedness, missing values, values below the limit of detection, and serial correlation. Presented here are techniques that are suitable in the face of the complications listed above for the exploratory analysis of monthly water quality data for monotonic trends.

Hughes, J. P., and S. P. Millard, 1988, A tau-like test for trend in the presence of multiple censoring points: Water Resources Bulletin, v. 24, no. 3, June, p. 521-531.

Hughes, V. M. P., A. L. Podio, and K. Sepehrnoori, 1990, A computer-assisted analysis of trends among Gulf Coast blowouts: In Situ, v. 14, no. 2, p. 201.

Jensen, A., and Z. Cheng, 1987, Statistical analysis of trend monitoring data of heavy metals in flounder (Platichthys flesus): Marine Pollution Bulletin, v. 18, no. 5, May, p. 230.

Kessler, C. J., T. H. Porter, D. Firth, T. W. Sager, and M. W. Hemphill, 1992, Factor analysis of trends in Texas acidic deposition: Atmospheric Environment, v. 26A, no. 6, p. 1137-1146.

Khalil, M. A. K., R. A. Rasmussen, and M. J. Shearer, 1989, Trends of atmospheric methane during the 1960s and 1970s: Journal of Geophysical Research, v. 94, no. D15, December, p. 18,279-18,288.

Sporadic measurements of atmospheric methane, using gas chromatography, have been taken since the early 1960s. Analyzes these measurements to estimate the trends of methane between 1960 and 1980.

Koehler, U., K. Wege, R. Hartmannsgruber, and H. Claude, 1988, Comparative Assessment of Various Instruments for Atmospheric Ozone Monitoring and Trend Analysis. For complete reference, see ***Ozone,*** p. 98.

Komeiji, J., K. Aoki, V. Koyama, and T. Okita, 1990, Trends of air quality and atmospheric deposition in Tokyo: Atmospheric Environment, v. 24A, no. 8. p. 2099-2104.

Article summarizes trends in Tokyo's air quality over the last 20 years and addresses the factors that contributed to the changes (both positive and negative) in air quality.

Korsog, P. E., and G. T. Wolff, 1991, An examination of urban ozone trends in the northeastern U. S. (1973-1983) using a robust statistical method: Atmospheric Environment, v. 25B, no. 1, p. 47-57.

Summary of a study conducted to determine ozone trends in eight metropolitan areas. The article gives a detailed description of the statistical methodology used in their trends analysis. The authors also discuss in detail the reasons behind the choice of certain statistical procedures. Effects of the changes in the late 1970s in ozone calibration methodology and of meteorology on the trends were examined as well. The study determined that there was a decrease of a few parts per billion per year in ozone at most of the urban centers studied.

Kuo, M., 1975, Precipitation Trend and Storm Analysis in Colorado: M.S. thesis, Colorado State University, Department of Atmospheric Science, Fort Collins, Colorado, 73 p.

Precipitation trends in Colorado were studied statistically using 56 years of data collected at 61 stations. 80% of the annual volume of water was found to be produced by 30% of the storms.

Lee, D. O., 1985, A preliminary analysis of long-term visibility trends in central Scotland: Journal of Climatology, v. 5, no. 6, November-December, p. 673.

Lefohn, A. S., and D. S. Shadwick, 1991, Ozone, sulfur dioxide, and nitrogen dioxide trends at rural sites located in the United States: Atmospheric Environment, v. 25A, no. 2, p. 491-501.

Investigation of the existence of trends for ozone, sulfur dioxide, and nitrogen dioxide at rural sites in the U. S.

Lettenmaier, D. P., 1977, Detection of Trends in Stream Quality: Monitoring Network Design and Data Analysis: Department of Ecology, Washington State, Olympia, Washington, Document no. HHL-TR51, 181 p.

This report is the result of a study funded by the Washington State Dept. of Ecology (DOE) to conduct a theoretical review of DOE s existing ambient stream quality monitoring program (Part I) and to analyze certain records from the existing network for possible trends (Part II). A computer program was developed to assist in the data analysis. Description and documentation included.

Lettenmaier, D. P., 1988, Multivariate nonparametric tests for trend in water quality: Water Resources Bulletin, v. 24, no. 3, June, p. 505-512.

Lettenmaier, D. P., E. R. Hooper, C. Wagoner, and K. B. Faris, 1991, Trends in stream quality in the continental United States, 1978-1987: Water Resources Research, v. 27, no. 3, March, p. 327-339.

Nonparametric seasonal Kendall s test, and a related multivariate test were used to analyze 403 National Stream Quality Accounting Network stations for trend, for the period from 1978-1987.

Lewis, R., D. Nychka, G. Reinsel, G. C. Tiao, and M. N. Wang, 1981, Statistical analysis of stratospheric ozone data for the detection of trends: Atmospheric Environment, v. 15, no. 9, p. 1569-1577.

Lindsay, R. W., J. L. Richardson, and W. L. Chameides, 1989, Ozone trends in Atlanta, Georgia: Have emission controls been effective? For complete reference, see ***Ozone,*** p. 98.

Lin Jiumn, W., 1979, TSP Air Quality Trend Analysis for Chicago, in Proceedings, APCA Quality Assurance in Air Pollution Measurement Conference, New Orleans, March 11-14, 1979: Chicago Department of Environmental Control, Chicago, p. 110-118.

Trend analysis for total suspended particulate data is essential for local air pollution control agencies whose primary function is to design effective control strategies. The trend in TSP data at one sampling site in Chicago from January 1964-December 1977 was analyzed to evaluate the general downward trend seen in recent years.

Lins, H. F., 1987, Trend analysis of monthly sulfur dioxide emissions in the conterminous United States, 1975-1984: Atmospheric Environment, v. 21, no. 11, p. 2297-2309.

Trends in monthly sulfur dioxide emissions for the 48 conterminous United States during the decade 1975-1984 are identified using a robust nonparametric procedure. Statistically significant downward trends are indicated in 32 states, upward trends appear in 10 states, and no significant trend is apparent in six states.

Lipfert, F. W., and M. L. Daum, 1983, Correlation Analysis of Long Term Trends in Air Pollution Emissions Concerning Air Quality and Precipitation Chemistry in the Northeastern United States, Proceedings, CACGP Symposium on Tropospheric Chemistry, Oxford, England, August 28, 1983, BNL-34372; Conf-8308137-2. New York, Pergamon Press. 21 p.

Loftis, J. C., R. C. Ward, R. D. Phillips, and C. M. Taylor, 1989, An Evaluation of Trend Detection Techniques for Use in Water Quality Monitoring Programs: U. S. Environmental Protection Agency, Washington, D. C., EPA/600/3-89-037, NTIS PB90-100058, 139 p.

Loftis, J. C., C. H. Taylor, and P. L. Chapman, 1991, Multivariate tests for trend in water quality: Water Resources Research, v. 27, no. 7, July, p. 1419-1429.

Reviews both parametric and nonparametric approaches to testing for multivariate trend and compares their performance using synthetic data.

Logan, J. A., 1985, Tropospheric ozone: seasonal behavior, trends, and anthropogenic influence: Journal of Geophysical Research, v. 90, no. D6, October 20, p. 10,463-10,482.

An analysis of data for tropospheric ozone with a focus on spatial and temporal variation. Data shown for St. Louis and northern Wisconsin.

Mackiewicz, M. C., 1989, Simple Trend Analysis and Graphical Presentation for Short-Term Forecasting of Ground Water Contaminant Levels at Closed Facilities, in Proceedings, Fourth International Conference on the Use of Models to Analyze and Find Working Solutions to Ground Water Problems, Solving Ground Water Problems with Models: International Ground Water Modeling Center, Holcomb Research Institute, Butler University, Indianapolis, Indiana, February 7-9, 1989, p. 671-682.

Evaluation of SuperCalc3, a software package with trend analysis capabilities. Could be useful to CTAP for data analysis information, though only short-term trends were analyzed.

Merriam, D. F. (editor), 1968, Computer Applications in the Earth Sciences: Colloquium on Trend Analysis: State Geological Survey, University of Kansas, Lawrence, Kansas, Computer Contribution no. 27.

Miesch, A. T., and J. J. Connor, 1968, Stepwise Regression and Nonpolynomial Models, in Merriam, D. F. (editor), Trend Analysis: State Geological Survey, The University of Kansas, Lawrence, Kansas, Computer Contribution no. 27, 40 p.

Discussion of a methodology for trend analysis of geologic map data.

Misra, R. K., J. F. Uthe, 1987, Methods of time trends analysis applied to contaminant levels in Canadian Atlantic Cod (Gadus morhua): Canadian Journal of Fishery and Aquatic Science, v. 44, no. 4, April, p. 859-865.

Similarities and differences between multiple linear regression (MLR) and analysis of variance (ANOVA) approaches that have been used as two seemingly different methodologies in time trend studies are explained.

O'Neil, C. P., E. J. deSteiguer, G. W. North, and M. E. Jennings, 1975, Trend Analysis of Vegetation in Louisiana's Atchafalaya River Basin: Final Report: Office of the Assistant Secretary for Fish and Wildlife and Parks, Department of the Interior, Washington, D. C., 72 p.

A trend analysis of forest vegetation in Louisiana s Atchafalaya Basin to: (1)determine trends of vegetation succession, (2) produce a current vegetation map of the Basin, and (3) develop a mathematical model capable of predicting changes in vegetation, based on changes in various hydrologic factors.

Okabe, A., 1982, A qualitative method of trend curve analysis: Environment and Planning, v. 14, no. 5, May, p. 623-627.

This paper presents a method for analyzing qualitative characteristics of a trend curve and an empirical application.

Pellerin, J., R. Roy, 1982, On long term air quality trends and intervention analysis: Atmospheric Environment, v. 16, no. 1, p. 161-169.

Penner, J. E., 1982, Trend prediction for O_3: an analysis of model uncertainty with comparison to detection thresholds: Atmospheric Environment, v. 16, no. 5, p. 1109-1115.

Psut, N. P., and J. R. Alle, 1975, Trend-surface analysis of ocean outfall plumes: Photogrammetric Engineering and Remote Sensing, v. 41, no. 6, June, p. 721-731.

Application of aerial photographic measurements to water quality is studied. Water quality associated with ocean outfall effluent plumes is measured through use of standard photographs that are transformed into numerical data sets and handled by the statistical technique of trend-surface analysis.

Renne, D. S., W. R. Barchet, A. R. Olsen, J. D. Shannon, and D. L. Sisterson, 1990, Analysis of source-receptor relationships for sulfur compounds using spatial and trend techniques, Proceedings, 71st Annual Meeting of American Meteorological Society, New Orleans, Louisiana, January 13-18, 1991, October, 15 p.

Salmon, L., D. H. F. Atkins, E. M. R. Fisher, and D. V. Law, 1978, Retrospective trend analysis of the content of U. K. air particulate material 1957-1974: Science of the Total Environment, v. 9, no. 2, March, p. 161-200.

Daily particulate air samples were collected from a high volume air sampler at Chilton, U. K. in a semi-rural area, from 1959-74. Neutron activation analysis was used to determine the concentrations of 27 elements and ions. Seasonal fluctuations were observed, particularly for volatile elements.

Schmitt, H. W., and H. Sticher, 1986, Long-term trend analysis of heavy metal content and translocation in soils: Geoderma, v. 38, no. 1-4, September, p. 195-207.

Serrano, E., E. Zurita, and M. Castro, 1989, Analysis of the annual trend in SO_2 and particulate matter emissions in Madrid (Spain): Atmospheric Environment, v. 23, no. 3, p. 631-642.

Severs, R. K., and L. A. Chambers, 1972, Different metal area distribution displayed by trend-surface analysis: Archives of Environmental Health, v. 25, no. 2, August, p. 139-146.

Shively, T. S., 1990, An analysis of the long-term trend in ozone data from two Houston, Texas monitoring sites: Atmospheric Environment, Part B: Urban, v. 24B, no. 2, p. 293.

Skalski, J. R., 1990, A design for long-term status and trends monitoring: Journal of Environmental Management, v. 30, no. 2, p. 139-144.

Presents statistical limitations to traditional environmental monitoring from fixed locations. The author suggests using rotational survey design and sampling with partial replacement to overcome these limitations.

Sloane, C. S., 1982, Visibility trends--I. Methods of analysis: Atmospheric Environment, v. 16, no. 1, p. 41-51.

Smith, R. A., 1982, Analysis and Interpretation of Water Quality Trends in Major U. S. Rivers, 1974-81: U. S. Geological Survey, Reston, Virginia, Water Supply Paper 2307, 25 p.

Staehelin, J., and W. Schmid, 1991, Trend analysis of tropospheric ozone concentrations utilizing the 20-year data set of ozone balloon soundings over Payerne (Switzerland): Atmospheric Environment, v. 25A, no. 9, p. 1739-1749.

Stensland, G. J., and R. G. Semonin, 1982, Another interpretation of the pH trend in the United States: Bulletin of the American Meteorological Society, v. 63, no. 11, November, p. 1277-1284.

Concern about the apparent increase in the acidity of rainfall from the 1950s to the 1970s prompted reexamination of data from the intermittent, short-term sampling networks that are the basis of the trend estimates.

Szentimrey, T., T. Farago, and S. Szalai, 1992, Window technique for climate trend analysis: Climate Dynamics, v. 6, p. 127-134.

Taylor, B. J., P. U. Lucke, and N. S. Laulainen, 1977, Analyses of atmospheric extinction data obtained by astronomers--I. A time-trend analysis of data with internal accidental errors obtained at four observatories: Atmospheric Environment, v. 11, no. 1, p. 1.

Thomson, A. J., 1986, Trend surface analysis of spatial patterns of tree size, mocrosite effects, and competitive stress: Canadian Journal of Forest Research, v. 16, no. 2, April, p. 279.

Tiao, G. C., G. C. Reinsel, D. Xu, J. H. Pedrick, X. Zhu, A. J. Miller, J. J. DeLuisi, C. L. Mateer, and D. J. Wuebbles, 1990, Effects of autocorrelation and temporal sampling schemes on estimates of trend and spatial correlation: Journal of Geophysical Research, v. 95, no. D12, November 20, p. 20,057-20,517.

This paper is concerned with temporal data requirements for the assessment of trends and for estimating spatial correlations of atmospheric species.

Torelli, L., and P. Tomasi, 1977, Interpolation and trend analysis: Two geohydrological applications: Journal of the International Association for Mathematical Geology, v. 9, no. 5, p. 529-542.

Presents two geohydrological case studies that use regression methodology in performing a trends analysis. Relatively basic statistical analysis. Note that this article is approximately 15 years old.

Tubbs, J. D., J. L. Engvall, and Q. A. Holmes, 1977, Pattern recognition of Landsat data based upon temporal trend analysis. For complete reference, see ***Mapping/Satellite Imagery,*** p. 57.

Walker, H. M., 1985, Ten-year ozone trends in California and Texas: Journal of Air Pollution Control Association, v. 35, September, p. 903-912.

Summarizes the analysis of ozone trends of 50 California and 12 Texas sites. Discusses the statistical significance of the observed trends. Also addresses data quality issues.

Wells, F. C., and T. L. Schertz, 1983, Statistical Summary of Daily Values and Trends Analysis of Dissolved-Solids Data at National Stream Quality Accounting Network (NASQAN) Stations: U. S. Geological Survey, Washington, D. C., Water-Resources Investigations Report 83-4172, 526 p.

Summarizes the National Stream Quality Accounting Network (NASQAN) dissolved-solids data for 1973-1981. Also presents the results of regression analyses and graphs of trend analyses.

Yassi, A., M. Cheang, M. Tenebein, G. Bawden, J. Spiegel, and T. T. Redekop, 1991, An analysis of occupational blood lead trends in Manitoba, 1979 through 1987: American Journal of Public Health, v. 81, no. 6, June, p. 736.

Zeldin, M. D., 1978, Use of Meteorological Data in Air Quality Trend Analysis: Office of Air Quality Planning and Standards, U. S. Environmental Protection Agency, Research Triangle Park, North Carolina, EPA/450/3-78/024, 101 p.

This report surveys existing methods for meteorologically adjusting air quality trends, including a review of known relationships between specific air pollutants and various meteorological parameters. It presents a recommended methodology to normalize air quality trends with respect to typical year meteorology.

Forecasting

Beck, M. B. (editor), 1991, Forecasting Environmental Change: Journal of Forecasting, John Wiley and Sons, Ltd., v. 10, nos. 1 and 2 (special issue).

The entire issue is relevant and could be of use for information on forecasting methodologies. The first article discusses the general methodological issues involved in forecasting environmental change. Other articles address such issues as smoothing uncertainty and prediction errors. Several case studies are also included.

Bennett, R. J., 1979, Spatial Time Series-Analysis-Forecasting-Control: Pion, Ltd., London, 674 p.

A practical guide to the steps in the analysis of the systems that arise in environmental and socioeconomic processes. Deals with analyses of sequences of observations of variables measured over time, space, or a combination of space-time. Text assumes a familiarity with statistics/mathematics. Part 3 focuses on forecasting models.

Bignoli, G., and E. Sabbioni, 1984, Environmental assessment of arsenic released from potential pollution sources. For complete reference, see ***Electricity Generation/Coal and Nuclear Power Plants/Radiation Hazards,*** p. 122.

Bognár, S., 1989, Quasi-2D Transport and Morphological Forecasting in Large River Systems. For complete reference, see ***Environmental Models,*** p. 28.

California Air Resources Board, 1974, Emissions Forecasting Methodologies: Office of Planning and Research, California Air Resources Board, Sacramento, California, 79 p.

Profiles then current available methodologies for forecasting future air pollution emissions. The described methodology only allows for short-term (5-10 years) forecasts.

Chen, J. C., 1978, Application of Modeling Techniques to the Study and Forecasting of Energy Needs, Energy Supply, Environmental Impacts, the Assessment of New Technology, and Alternatives. For complete reference, see ***Environmental Models,*** p. 28.

Chiarantini, L., et al., 1989, A Contribution of Microwave Remote Sensing for Soil Erosion Forecasting. For complete reference, see ***Erosion,*** p. 77.

Culhane, P. J., H. P. Friesema, and J. A. Beecher, 1987, Forecasts and Environmental Decision Making--The Content and Predictive Accuracy of Environmental Impact Statements: Westview Press, Inc., Boulder, Colorado, 306 p.

Evaluates the analytical quality (i. e. the predictive accuracy) of environmental impact statements (EIS) based on a study of a random sample of 239 1980 U. S. EPA EISs. The book discusses environmental decision-making processes from a theoretical political science perspective.

Faruqui, A., D. Button, C. Sabo, and K. Seiden, 1990, Uncertainty in Forecasting, v. 1: Barakat & Chamberlin, Inc., Oakland, California, Document no. CU-6855, Research Project 2919-2, various pagings.

Overview of available forecasting methods and models; discusses uncertainty in forecasting. Publication is geared toward utility industry, but may be generally applicable to CTAP in terms of models.

Gibson, D. K., and G. Pantelis, 1988, Forecasting the Effect of Mine Site Rehabilitation Works on Local Groundwater Quality, in Proceedings, Mine Drainage and Surface Mine Reclamation Conference, Pittsburgh, Pennsylvania, April 17-22, 1988: U. S. Bureau of Mines, Washington, D. C., p. 248-252.

Models for forecasting the time needed for water quality to improve significantly after being contaminated by mining operations are presented.

Land, K. C., and S. H. Schneider (editors), 1987, Forecasting in the Social and Natural Sciences: D. Reidel Publishing Company, Dordrecht, Holland, 381 p.

Discusses current trends in forecasting in several fields. Lists and explores four "pure" types of forecasting methodologies: extrapolation, leading indicators, causal methods (linkages) and stochastic methods. The book also addresses the predictability of forecasting models, errors and model identification.

Mackiewicz, M. C., 1989, Simple Trend Analysis and Graphical Presentation for Short-Term Forecasting of Ground Water Contaminant Levels at Closed Facilities. For complete reference, see ***Trends Analysis,*** p. 49.

Makridakis, S., et al., 1982, The accuracy of extrapolation (time series) methods: Results of a forecasting competition: Journal of Forecasting, v. 1, no. 2, p. 111-153.

Compares and contrasts various time series (extrapolation) methodologies with respect to time and cost of analysis and overall accuracy. The conclusion of the study was that using a combination of forecasting methods produced the best results.

Makridakis, S., S. C. Wheelwright, and V. E. McGee, 1983, Forecasting: Methods and Applications: John Wiley and Sons, New York, 922 p.

A mathematical/statistical overview of forecasting methodologies with detailed sections on time series analysis, regression analysis and smoothing methods. Also discusses data requirements and the selection of appropriate forecasting methodology.

Martino, J. P., 1983, Technological Forecasting for Decision Making: Elsevier Science Publishing Company, Inc., New York, 385 p.

Discussion of forecasting changes in technology with an emphasis on the use of these forecasts in the decision-making process. Contains many chapters on forecasting methodologies (e. g. trend extrapolation and causal methods) that could be generally applicable to CTAP. Also includes a chapter on the common mistakes of forecasters.

Nishenko, S. P., and G. A. Bollinger, 1990, Forecasting damaging earthquakes in the central and eastern United States. For complete reference, see ***Seismic Risk,*** p. 111.

Pickup, G., and V. H. Chewings, 1988, Forecasting patterns of soil erosion in arid lands from Landsat MSS data: International Journal of Remote Sensing, v. 9, no. 1, p. 69-84.

Describes a technique for forecasting large-scale patterns of soil erosion and soil deposition in arid lands with Landsat Multispectral Scanner (MSS) data. This forecasting technique uses the "erosion cell mosaic approach" and involves fitting a first-order simultaneous autoregressive (s.a.r.) model.

Schlesinger, B., and D. Daetz, 1975, Development of a procedure for forecasting Long-Range Environmental Impacts, report to the Resource and Land Investigations (RALI) Program, U. S. Geological Survey: Department of Industrial Engineering, Stanford University, Stanford, California, 137 p.

Presents a method for quantitatively forecasting the long-range environmental, social, and economic effects of large-scale projects.

Swain, J., T. Haverson, F. Rossini, A. Porter, and H. Xu, 1991, Markov formulation of cross-impact analysis for impact assessment and forecasting: Impact Assessment Bulletin, v. 9, no. 3, p. 55-74.

Statistical model for forecasting using trends: Very complex-looking mathematical model to be studied at more depth to determine its usefulness for CTAP.

Vorob'yeva, L. A., and L. L. Novykh, 1986, Forecasting of calcium removal from soils by neutral and weakly alkaline drainage by water: Soviet Soil Science, v. 18, no. 6, November-December, p. 52-58.

Presents a method for forecasting the mean calcium concentration in neutral or weakly alkaline soils using a solubility diagram.

Mapping/Satellite Imagery

Engineering Geology and/or Environmental Geology Maps

Bracinac, Z., and M. Janjic, 1978, Engineering-Geological Maps of Seismic Regions: Bulletin of the International Association of Engineering Geology, no. 18, p. 27-32.

Brook, D., and B. R. Marker, 1987, Thematic Geological Mapping as an Essential Tool in Land Use Planning, in Planning and Engineering Geology, in Culshaw, M. G. (editor), Proceedings, 22nd Annual Conference of the Engineering Group of the Geological Society, Plymouth Polytechnic, September 8-12, 1986, Engineering Group, Geological Society of London, London, United Kingdom, v. 4, p. 211-214.

Chrosniak, C. E., D. G. Mose, G. W. Mushrush, and I. Zietz, 1989, Development of Radon Potential Maps on a Regional Scale. For complete reference, see ***Radon,*** p. 104.

Coe, C. J., 1981, The use of geologic, hydrologic and geochemical mapping techniques in environment assessment: Groundwater, v. 19, no. 6, November-December, p. 626-634.

Develops a method to determine the environmental and economic impact of mining from the perspective of the operator. The method consists of developing geologic, hydrologic, and geochemical maps that can be used to provide a three-dimensional view of the subsurface environment before, during and after mining. Case studies are discussed that illustrate environmental problems associated with common mining issues, such as dewatering and mining recharge areas.

Culshaw, M. G., P. D. Jackson, and D. M. McCann, 1987, Geophysical Mapping Techniques in Environmental Planning, in Culshaw, M. G. (editor), Planning and Engineering Geology, Proceedings, 22nd Annual Conference of the Engineering Group of the Geological Society, Plymouth Polytechnic, September 8-12, 1986, Engineering Group, Geological Society of London, London, United Kingdom, v. 4, p. 171-177.

Dearman, W. R., et al., 1973, Techniques of Engineering Geological Mapping with Examples from Tyneside, in Engineering Geology of Reclamation and Development, Proceedings, Regional Meeting of the Engineering Group of the Geological Society of London. Durham, United Kingdom, p. 31-34.

Demek, J. (editor), 1972, Manual of Detailed Geomorphological Mapping: Academia, Prague, Czechoslovakia, 24 p.

Demek, J., and C. Embleton (editors), 1978, Guide to Medium-Scale Geomorphological Mapping: E. Schweizerbart'sche Verlagsbuchhandlung, Stuttgart, 348 p.

Discusses geomorphological classification and geomorphological mapping methodology. Addresses the application of these maps to planning, natural resource conservation, and the prediction of human impact on the environment.

Dickerson, E. J., 1974, Environmental Geologic Mapping of Flood-Prone Areas: An Alternative to Engineering Methods. Approaches to Environmental Geology: Bureau of Economic Geology, University of Texas at Austin, Investigation no. 81, p. 220-228.

Gozzard, J. R., 1985, Medium-scale engineering and environmental-geology mapping of the Perth Metropolitan Region, Western Australia: Engineering Geology, v. 22, no. 1, p. 97-107.

The need to present geological information in a form usable by planners, administrators, and the general public prompted the preparation of medium-scale geology maps for the Perth metropolitan region. The thematic map approach is used to identify map units on the basis of lithology, morphology, slope category, hydrogeology, hydrography, and soil and rock properties.

Journaux, A. (editor), 1987, Integrated Environmental Cartography: A Tool for Research and Land Use Planning: Scientific and Cultural Organization, United Nations Educational, (UNESCO), Paris, France, 53 p.

An overview of environmental cartography, a form of cartography that integrates environmental factors and environmental dynamics. Part I presents the methodology, and Part II presents case studies, including the resultant maps.

Luttig, G., 1978, Geoscientific maps for land-use planning: A certain approach how to communicate by new types of maps: International Yearbook of Cartography, v. 18, p. 95-101.

Luttig, G., 1982, Contributions of the geoscientific cartography to the solutions of conflicts arising from utilization of natural resources and the protection of the environment, in Fisher, W. B., and P. W. Kent (editors), Resources, Environment and the Future, German Academic Exchange Service, London, p. 203-227.

McCall, G. J. H., 1988, The "Alternative" Earth Science Mapping: Mapping for Planning and Development, Geoscience in Development, in Proceedings, International Conference on the Application of Geology in Developing Countries, September 26-30, 1988: Institution of Mining and Metallurgy, Institution of Geologists, Nottingham University, Geological Society of London.

Nieto, S. M., O. Segrera, and J. Obarti, 1988, Environmental Cartography and Management of Natural Resources: Service of Geological Resources, Provincial Deputation of Valencia, Valencia, Spain, 11 p.

Odum, L. A., and D. G. Mose, 1989, Radon Potential Risk Maps for Florida, Georgia and Alabama. For complete reference, see ***Radon***, p. 105.

Radbruch-Hall, D. H., 1979, Environmental aspects of engineering geological mapping in the United States: Bulletin of the International Association of Engineering Geology, v. 19, p. 351-358.

Discusses "geology for planning" mapping, and develops a technique for evaluating the cost of different types of construction and land development in terms of the cost of a number of earth science factors. Covers the development of predictive and susceptibility mapping for earthquakes, landslides, karst and other geologic factors, and suggests ways to combine this mapping to portray the relations between physical conditions and resources.

Rush, S. M., 1987, Preparation of National Maps of Geological Factors Influencing Natural Radon Concentrations. For complete reference, see ***Radon,*** p. 106.

Rockway, J. D., 1976, The influence of map scale on engineering geology mapping: Bulletin of the International Association of Engineering Geology, v. 14, p. 119-122.

United Nations Educational, Scientific and Cultural Organization (UNESCO), (editor), 1976, Engineering Geological Maps: A Guide to their Preparation: Earth Sciences, United Nations Educational, Scientific and Cultural Organization Paris, France, Publication no. 15.

Wolff, F. C. (editor), 1987, Geology For Environmental Planning, in Proceedings, International Symposium on Geological Mapping in the Service of Environmental Planning, Trondheim, Norway, May 6-9, 1986: Geological Survey of Norway, Trondheim, Norway, 121 p.

This compilation of papers and abstracts includes papers on planning for coastal areas, environmental geologic mapping, and, of particular interest to CTAP, geological hazards mapping and the mapping of radon risk potential.

Wolman, M. G., 1971, Evaluating alternative techniques of floodplain mapping: Water Resources Research, v. 7, no. 6, December, p. 1383-1392.

Discusses the need, due to the costs and uncertainties involved in floodplain mapping, for localized evaluations of alternative mapping methods.

Geographic Information Systems (GIS)

Committee of Enquiry into the Handling of Geographic Information, 1987, Handling Geographic Information: Her Majesty's Stationery Office, London, 208 p.

Comprehensive overview of current and potential GIS uses. Contains recommendations to expand the use and accessibility of GIS technology.

Curtis, P. A., 1989, Groundwater Sensitivity Modeling Using GIS Technology, in Proceedings, Mississippi Water Resources Conference: Water Resources Research Institute, Mississippi State, Mississippi, v. 19, p. 9-16.

Overview of Mississippi s groundwater protection strategy. Their program involves using a GIS, Mississippi Automated Resource Information System (MARIS), to model groundwater sensitivity and to prioritize future water quality investigations.

Hewitt, M. J., 1990, Environmental Monitoring and Assessment Program, Geographic Information System Conceptual Design: U. S. Environmental Protection Agency, Washington, D. C., 26 p.

Weathersby, R. W., 1990, Using GIS for Pollution Susceptibility Mapping, in Abstracts with Programs, Geological Society of America, Southeastern Section, 39th Annual Meeting, Tuscaloosa, Alabama, April 5-6, 1990, v. 22, no. 4, p. 68.

The Georgia Geological Survey is currently working to create a GIS for use in environmental management. One specific project in the works is a groundwater pollution susceptibility assessment. They are using a modified version of the U. S. EPA's DRASTIC system. The project involves mapping seven different environmental characteristics related to groundwater pollution, then overlaying the maps using GIS to determine areas of high pollution potential.

Satellite Imagery

Barrett, E. C., C. H. Power, and A. Micallef, 1990, Satellite Remote Sensing for Hydrology and Water Management: The Mediterranean Coasts and Islands, Current Topics in Remote Sensing, v. 1, New York, Gordon and Breach Science Publishers. 322 p.

Good overview of remote sensing techniques and applications. Details the stages of data analysis for hydrogeological and phytogeographical applications. Contains a chapter on deriving land cover and land use maps from remote sensing data. Strong emphasis on methodology, data interpretation and analysis.

Bogucki, D. J., and G. K. Gruendling, 1978, Remote Sensing to Identify, Assess and Predict Ecological Impact on Lake Champlain Wetlands: Office of Water Research and Technology, U. S. Department of Interior, Washington, D. C., Document no. C-6075, 191 p.

Details a study of Lake Champlain wetlands. The study had four objectives: 1) to investigate methods for phytogeographical mapping using remotely sensed images; 2) to produce such maps for priority Lake Champlain wetlands; 3) to analyze the effect of naturally fluctuating water levels on plant distribution and character; and 4) to predict potential effects of changes in water level due to a proposed dam and proposed waste level regulations.

Chiarantini, L., et al., 1989, A Contribution of Microwave Remote Sensing for Soil Erosion Forecasting. For complete reference, see ***Erosion,*** p. 77.

MacDonald, H. C., K. F. Steele, and E. Gaines, 1977, LANDSAT Linear Trend Analysis: A Tool for Groundwater Exploration in Northern Arkansas: Arkansas Water Resources Research Center, Fayetteville, Arkansas, PUB-49, 108 p.

Linear trends interpreted from LANDSAT can be useful in the search for more reliable groundwater sources.

Pickup, G., and V. H. Chewings, 1988, Forecasting patterns of soil erosion in arid lands from Landsat MSS data. For complete reference, see ***Forecasting,*** p. 53.

Tubbs, J. D., J. L. Engvall, and Q. A. Holmes, 1977, Pattern recognition of Landsat data based upon temporal trend analysis: Remote Sensing of Environment, v. 6, no. 4, p. 303.

Surface Water Quality

General References

Alexander, R. B., and R. A. Smith, 1988, Trends in lead concentrations in major U. S. rivers and their relation to historical changes in gasoline-lead consumption: Water Resources Bulletin, v. 24, no. 3, June, p. 557-569.

Declines in concentrations of dissolved lead occurred at nearly two-thirds of 306 locations on major U. S. rivers from 1974 to 1985. Statistically significant increases in dissolved lead concentrations occurred at only six percent of the sites, clustered in the Texas-Gulf and Lower Mississippi regions.

Alvord, J. W., and C. B. Burdick, 1919, Consulting Engineers for the Department of Public Works and Buildings: Division of Waterways, Rivers and Lakes Commission Report on the Illinois River and Its Bottom Lands, 137 p.

Brabets, T. P., 1984, Runoff and Water Quality Characteristics of Surface-Mined Lands in Illinois. For complete reference, see ***Mineral Resources: Location and Impacts of Extraction,*** p. 115.

Critchley, R. F., 1983, An Assessment of Trace Metal Inputs and Pathways to the Marine and Terrestrial Environments. For complete reference, see ***Soil Quality, Heavy Metals,*** p. 79.

Davenport, T. E., 1982, Water Resources Data and Preliminary Trend Analysis for the Blue Creek Watershed Project, Pike County, Illinois, Phase I (IEPA/WPC/82-008), and Phase II (IEPA/WPC/82-008). For complete reference, see ***Trends Analysis,*** p. 44.

Davenport, T. E., and M. H. Kelly, 1982-1986, Water Resource Data and Preliminary Trend Analysis for the Highland Silver Lake Monitoring and Evaluation Project, Madison County, Illinois; Phase I (1982, IEPA/WPC/82-010), Phase II (1983, IEPA/WPC/83-013), Phase III (1984, IEPA/WPC/84-030), and Phase IV (1986, IEPA/WPC/86-001). For complete reference, see ***Trends Analysis,*** p. 45.

Davidson, B. M., 1924, Seventh annual report of the Department of Agriculture: State of Illinois, p. 22-24.

Demissie, M., and L. Keefer, 1991, Preliminary Evaluation of the Risk of Accidental Spills of Hazardous Materials in Illinois Waterways: Illinois Hazardous Waste Research and Information Center, Champaign, Illinois, 77 p.

Dexter, R. N., L. S. Goldstein, P. M. Chapman, and E. A. Quinlan, 1985, Temporal Trends in Selected Environmental Parameters Monitored in Puget Sound. For complete reference, see ***Environmental Quality and Environmental Trends, General References,*** p. 1.

Division of Waterways, 1929, Flood Control Report: An Engineering Study of the Flood Situation in the State of Illinois: W. F. Mulvihill and L. D. Cornish, The Division of Waterways, 402 p.

Drost-Hansen, W., and A. Thorhaug, 1974, Biologically Allowable Thermal Pollution Limits: Office of Research and Development, U. S. Environmental Protection Agency, Washington, D. C., EPA 600/3-74-003, various pagings.

Freeman Ward, O., A. R. Schmidt, and R. D. McFarlane, 1989, Storm Runoff and its Effects on the Water Quality and Bottom-Material Quality of Cedar Creek, West-Central Illinois, 1985-86: U. S. Geological Survey, Urbana, Illinois, Water-Resources Investigation Report 89-4088, 194 p.

Haimes, Y. Y., and E. Z. Stakhiv (editors), 1990, Risk-Based Decision Making in Water Resources. For complete reference, see ***Risk Assessment and Risk Management: Methodologies and Case Studies,*** p. 12.

Hendrey, G. R., C. G. Hoogendyk, and N. F. Gmur, 1984, Analysis of Trends in the Chemistry of Surface Waters of the United States. Annual Report for NAPAP Projects E1-8 and E2-11. For complete reference, see ***Trends Analysis,*** p. 46.

Hipel, K. W., A. I. McLeod, and R. R. Weiler, 1988, Data analysis of water quality time series in Lake Erie. For complete reference, see ***Trends Analysis,*** p. 46.

Hren, J., C. J. Oblinger Childress, J. M. Norris, T. H. Chaney, and D. N. Myers, 1990, Regional water quality: Evaluation of data for assessing conditions and trends: Environmental Science and Technology, v. 24, no. 8, August, p. 1122-1127.

Illinois Environmental Protection Agency (IEPA), 1990, Title 35: Environmental Protection, Subtitle C: Water Pollution, Chapter 1, Pollution Control Board, Springfield, IL.

Illinois Environmental Protection Agency, 1990, Illinois Water Quality Report 1988-1989: Illinois Environmental Protection Agency, Springfield, Illinois, IEPA/WPC/90-160, 324 p.

Detailed analysis of the quality of Illinois rivers, streams, and lakes (including Lake Michigan) for the years 1988 and 1989. Also addresses wetland issues.

Illinois Environmental Protection Agency (IEPA), 1992, Illinois Water Quality Report 1990-1991, 405 p.

Illinois State Board of Health, 1901, Report of the Sanitary Investigations of the Illinois River and Its Tributaries: Phillips Bros., State Printers, Springfield, IL, 219 p.

Illinois State Water Plan Task Force, 1984, Illinois State Water Plan: Critical Issues, Cross-Cutting Topics, Operating Issues: Illinois Department of Transportation, Springfield, IL, January, 59 p.

Illinois State Water Plan Task Force, 1987, Illinois River Action Plan: Illinois Department of Transportation, Springfield, IL, Special Report no. 11.

Illinois State Water Plan Task Force, 1992, Memorandum and Draft Document, "IEPA Watershed Document," August, 18 p.

Illinois State Water Plan Task Force, 1992, Memorandum and Draft Document, "Remaining Issues and Implementation Requirements," November, 18 p.

Keith, L. H., W. Crummett, J. Deegan, R. A. Libby, J. K. Taylor, and G. Wentler, 1983, Principles of Environmental Analysis: Analytical Chemistry, v. 55, p. 2210-2218.

Kendall, M. G., 1970, Rank Correlation Methods: Griffin, London, 4th edition.

Knapp, H. V., 1990, Kaskaskia River Basin Streamflow Assessment Model: Hydrologic Analysis: Illinois State Water Survey, Contract Report no. 499.

Leahy, P. P., J. S. Rosenshein, and D. S. Knopman, 1990, Implementation Plan for the National Water-Quality Assessment Plan: U. S. Geological Survey, Denver, Colorado, Open File Report 90-174, 10 p.

Lettenmaier, D. P., 1977, Detection of Trends in Stream Quality: Monitoring Network Design and Data Analysis. For complete reference, see ***Trends Analysis,*** p. 47.

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Lopinot, A. C., 1973, 1972 Surface Water Inventory: Illinois Department of Conservation, Special Fisheries Report no. 40, Springfield, IL.

Mathis, B., and G. E. Stout, 1987, Conference Summary and Suggestions for Action, in Proceedings of the Governor's Conference on Management of the Illinois River System: The 1990s and Beyond: Water Resources Center, University of Illinois, Urbana, IL, Special Report no. 16.

Office of the Governor, 1967, Water for Illinois — A Plan of Action, 452 p.

Ramamurthy, G. S., 1993, Analysis of Ambient Water Quality Trends in Streams and Lakes: Illinois State Water Survey, Champaign, IL, unpublished report.

Rose, J. B., and C. P. Gerba, 1991, Use of risk assessment for development of microbial standards. For complete reference, see ***Risk Assessment and Risk Management: Methodologies and Case Studies,*** p. 14.

Schaeffer, D. J., H. W. Kerster, J. A. Perry, and D. K. Cox, 1985, The environmental audit. I. Concepts: Environmental Management, v. 9, no. 3, p. 191-198.

Discusses the expansion of water quality monitoring from the traditional collection and analysis of samples to the assessment and increased understanding of the environment. In this way, water quality monitoring could play a valuable role in the environmental decision-making process.

Singh, K. P., and A. Durgunoglu, 1990, An Improved Methodology for Estimating Future Reservoir Capacities: Application to Surface Water Supply Reservoirs in Illinois: Illinois State Water Survey, Contract Report no. 493.

Smith, R. A., 1982, Analysis and Interpretation of Water Quality Trends in Major U. S. Rivers, 1974-81. For complete reference, see ***Trends Analysis,*** p. 50.

Smith, R. A., R. M. Hirsch and J. R. Slack, 1982, A Study of Trends in Total Phosphorus Measurements at NASQAN Stations: U. S. Geological Survey Water-Supply Paper, no. 2190.

U. S. Environmental Protection Agency, 1973, Effects of pesticides in water: A report to the states: U. S. Environmental Protection Agency, Washington, D. C., 145 p.

U. S. Environmental Protection Agency, 1973, Methods for Identifying and Evaluating the Nature and Extent of Non-point Sources of Pollutants. For complete reference, see ***Air Quality, General References,*** p. 87.

U. S. Environmental Protection Agency, 1989, U. S. Progress in Implementing the Great Lakes Water Quality Agreement: U. S. Environmental Protection Agency, Washington, D. C.

U. S. Environmental Protection Agency, Office of Water Supply, 1989, Nonpoint Sources: Agenda for the Future, in Nonpoint Source Solutions, U. S. Environmental Protection Agency, Washington, D. C., January, 1989, Report no. WH-556, 31 p.

Presents U. S. EPA's National Nonpoint Source agenda for 1990-1995 in light of the 1987 Water Quality Act. Contains an overview of the nonpoint source problem, emphasizing its variability in time and space.

U. S. Environmental Protection Agency, 1990, The Quality of Our Nation's Water: A Summary of the 1988 National Water Quality Inventory: U. S. Environmental Protection Agency, Washington, D. C., EPA 440/4-90-005, 23 p.

Water Quality 2000, Water Pollution Control Federation, 1991, Challenges for the Future-Interim Report: Water Pollution Control Federation/Water Quality 2000, Alexandria, Virginia, 95 p.

This report is the result of Phase II of a multi-organizational effort known as Water Quality 2000. Phase II is an overview of the "root causes" of water pollution. It also presents an assessment of current water quality and discusses the obstacles to solving water quality problems. Phase III will discuss solutions to water quality problems and is previewed in this report.

Water Resources Center, 1989, Proceedings of the Second Conference on the Management of the Illinois River System: the 1990s and Beyond: University of Illinois, Urbana, IL, Special Report no. 18.

Wells, F. C., and T. L. Schertz, 1983, Statistical Summary of Daily Values and Trends Analysis of Dissolved-Solids Data at National Stream Quality Accounting Network (NASQAN) Stations. For complete reference, see ***Trends Analysis,*** p. 51.

Zipper, C. E., G. I. Holtzman, S. Rheem, and G. K. Evanylo, 1992, Surface Water Quality Trends in Southwestern Virginia, 1970-1989: 1. Seasonal Kendall Analysis: Virginia Water Resources Center, VPI-VWRRC-BULL 173.

Aquatic Toxicology

Allan, R. J., A. J. Ball, V. W. Cairns, G. A. Fox, A. P. Gilman, D. B. Peakall, D. A. Piekarz, J. C. Van Oostdam, D. C. Villeneuve, and D. T. Williams, 1991, Toxic Chemicals in the Great Lakes and Associated Effects: Vol. I: Contaminant Levels and Trends; Vol. II: Effects: Health and Welfare Canada, Department of Fisheries and Oceans, Environment Canada, Toronto, Canada, 755 p.

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Stevens, R. K., T. G. Dzubay, C. W. Lewis, and R. W. Shaw, Jr., 1984, Source apportionment methods applied to the determination of the origin of ambient aerosols that affect visibility in forested areas: Atmospheric Environment, v. 18, no. 2, p. 261-272.

An aerosol characterization, visibility, and receptor modeling study was conducted in the Shenandoah Valley, Virginia, between July 14 and August 15, 1980. The objectives of this study were to: 1) determine the origin of the ambient particles, 2) determine the major chemical species contributing to the light extinction coefficient, 3) evaluate analytical methods to characterize aerosols and 4) provide data for comparison with chemical composition of aerosols collected in the Great Smoky Mountains and in the Abastumani Mountains of the Georgian Soviet Socialist Republic.

Vinzani, P. G., and P. J. Lamb, 1985, Temporal and spatial visibility variations in the Illinois vicinity during 1949-1980: Journal of Climate and Applied Meteorology, v. 24, no. 5, May, p. 435-451.

Changes in visibility and the occurrence of smoke or haze during the last three decades are identified for eight locations in and around Illinois. The analyses utilize individual daily data and are performed on both a seasonal and an annual basis. Visibility variation is investigated using cumulative percentiles and mean ridits.

Wendland, W. M., and R. A. Bryson, 1970, Atmospheric dustiness, man, and climatic change: Biological Conservation, v. 2, no. 2, p. 125-128.

Wolff, G. T., N. A. Kelly, and M. A. Ferman, 1981, On the sources of summertime haze in the eastern United States: Science, v. 211, February 13, p. 703-705.

The summertime haze transported from the Gulf Coast northward in maritime tropical air masses is partially formed from emissions in the midwestern and northeastern United States.

Wolff, G. T., N. A. Kelly, and M. A. Ferman, 1982, Source regions of summertime ozone and haze episodes in the eastern United States: Water, Air, and Soil Pollution, v. 18, p. 65-81.

Investigates haze caused by sulfate aerosol and haze "blobs" moved by synoptic WX systems.

Acid Rain/Nitrates/Sulfates

Altshuller, A. P., 1980, Seasonal and episodic trends in sulfate concentrations (1963-1978) in the eastern United States: Environmental Science and Technology, v. 14, no. 11, November, p. 1337-1348.

Ambient air quality data for sulfates and sulfur dioxide available through 1978 have been analyzed for seasonal trends and episodic characteristics. Monitoring sites available were grouped into five sets.

Barnard, J. E., A. A. Lucier, R. T. Brooks, P. H. Dunn, A. H. Johnson, and D. F. Karnosky, 1990, Changes in Forest Health and Productivity in the United States and Canada: National Acid Precipitation Assessment Program, Washington, D. C., State of Science/Technology Report no. 16, p. 16-155 to 16-159.

Barnard, W. R., G. J. Stensland, and D. F. Gatz, 1986, Alkaline Materials Flux from Unpaved Roads: Source Strength, Chemistry, and Potential for Acid Rain Neutralization: Water, Air, and Soil Pollution, v. 30, p. 285-293.

Barrett, E., and G. Brodin, 1955, The Acidity of Scandinavian Precipitation: Tellus, v. 7, p. 251-257.

Charles, D. F., R. W. Battarbee, I. Renberg, H. van Dam, and J. P. Smol, 1989, Paleoecological Analysis of Lake Acidification Trends in North America and Europe Using Diatoms and Chrysophytes. For complete reference, see ***Lakes and Ponds,*** p. 171.

Demmy, J. L., W. M. Tax, and T. E. Warn, 1989, Area Source Documentation for the 1985 NAPAP Inventory (Project Summary): Air and Energy Engineering Research Laboratory, U. S. Environmental Protection Agency, Research Triangle Park, North Carolina, EPA/600/S8-88/106, 3 p.

Complete report entitled "Area source documentation for the 1985 NAPAP inventory". NTIS PB 89-151 427/AS.

Eynon, B. P., 1988, Statistical analysis of precipitation chemistry measurements over the eastern United States. Part II: Kriging analysis of regional patterns and trends. For complete reference, see ***Statistical Analyses of Environmental Data, General References,*** p. 42.

Flower, R. J., R. W. Battarbee, and P. G. Appleby, 1987, The recent paleolimnology of acid lakes in Galloway, south-west Scotland: diatom analysis, pH trends, and the role of afforestation. For complete reference, see ***Lakes and Ponds,*** p. 171.

Gschwandtner, G., J. K. Wagner, and R. B. Husar, 1988, Comparison of Historic SO_2 and NO_x Emission Data Sets (Project Summary): Air and Energy Engineering Research Laboratory, U. S. Environmental Protection Agency, Research Triangle Park, North Carolina, EPA/600/S7-88/009, 3 p.

Compares in detail emission estimates derived by Gschwandtner et al. and Husar. Attempts to determine the methodological differences that result in different emission estimates. Complete report entitled "Comparison of historic SO_2 and NO_x emission data sets. " NTIS PB 89-103956.

Hidy, G. M., D. A. Hansen, R. C. Henry, K. Ganesan, and J. Collins, 1984, Trends in historical acid precursor emissions and their airborne and precipitation products: Journal of the Air Pollution Control Association, v. 34, no. 4, April, p. 333-354.

This paper discusses historical bulk deposition data and ambient air quality data for sulfate and nitrate in relation to estimated changes in sulfur dioxide and nitrogen oxide emissions since the turn of the century. Focuses on northeastern United States and southeastern Canada.

Husain, L., and V. A. Dutkiewicz, 1990, A long-term (1975-1988) study of atmospheric SO_{2-4}: Regional contributions and concentration trends: Atmospheric Environment, v. 24A, no. 5, p. 1175-1187.

A long-term study of aerosol SO_{2-4} concentrations has been conducted at Mayville and Whiteface Mountain in New York State.

Kessler, C. J., T. H. Porter, D. Firth, T. W. Sager, and M. W. Hemphill, 1992, Factor analysis of trends in Texas acidic deposition. For complete reference, see ***Trends Analysis,*** p. 46.

Langstaff, J. E., and J. K. Wagner, 1987, Estimation of Uncertainty for the 1980 NAPAP Emissions Inventory (Project Summary): U. S. Environmental Protection Agency, Research Triangle Park, North Carolina, EPA/700/S7-86/055, 3 p.

Complete report entitled "Estimation of uncertainty for the 1980 NAPAP emissions inventory". NTIS PB 87-145 397/AS.

Lebowitz, L. G., and A. S. Ackerman, 1988, Flexible Regional Emissions Data System (FREDS) Documentation for the 1980 NAPAP Emissions Inventory (Project Summary): Air and Energy Engineering Research Laboratory, U. S. Environmental Protection Agency, Research Triangle Park, North Carolina, EPA/600/S7-87/025, 3 p.

Documents the development of FREDS. Complete report entitled "Flexible Regional Emissions Data System for the 1980 NAPAP emissions inventory." NTIS PB 88-129 499/AS.

Lefohn, A. S., and D. S. Shadwick, 1991, Ozone, sulfur dioxide, and nitrogen dioxide trends at rural sites located in the United States. For complete reference, see ***Trends Analysis,*** p. 47.

Lins, H. F., 1987, Trend analysis of monthly sulfur dioxide emissions in the conterminous United States, 1975-1984. For complete reference, see ***Trends Analysis,*** p. 48.

Lipfert, F. W., and M. L. Daum, 1983, Correlation Analysis of Long Term Trends in Air Pollution Emissions Concerning Air Quality and Precipitation Chemistry in the Northeastern United States. For complete reference, see ***Trends Analysis,*** p. 48.

Meyers, T. P., B. B. Hicks, R. P. Hosker, Jr., J. D. Womack, and L. C. Satterfield, 1991, Dry Deposition Inferential Measurement Techniques--II. Seasonal and Annual Deposition Rates of Sulfur and Nitrate: Atmospheric Environment, v. 25A, p. 2361-2370.

Nicholson, I. A., I. S. Paterson, and F. T. Last, 1980, Methods for studying acid precipitation in forest ecosystems. For complete reference, see ***Forest Ecosystems,*** p. 153.

Pacyna, J. M., 1990, Emission Inventories in the EMEP Countries: NAPAP 1990 International Conference on Acidic Deposition, State of Science and Technology, February 11-16, 1990, Hilton Head Island, USA, p. 5.

At present, there are two major programs in Europe carrying out emission inventories: the ECE Co-operative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP) and the EEC programme CORINAIR. The emission activity within EMEP is presented in this work.

Peden, M. E., S. R. Bachman, J. Brennan, B. Demir, K. O. James, B. W. Kaiser, J. M. Lockard, J. E. Rothert, J. Sauer, L. M, Skowron, and M. J. Slater, 1986, Methods for Collection and Analysis of Precipitation: Illinois State Water Survey, Champaign, IL, Contract Report no. 381.

Placet, M., and D. G. Streets, 1988, Historical and Future Emissions of Acidic Deposition Precursors from Man-made Sources: Abstracts of Papers, Third Chemical Congress of North America, Toronto, Canada, June 5-10, 1988, American Chemical Society, Washington, D. C.

This paper assesses sulfur dioxide, nitrogen oxides and volatile organic compound emissions, past, present, and future. The authors present several different scenarios for the future (e. g. increased clean coal technology) and their corresponding projections for levels of these pollutants.

Renne, D. S., W. R. Barchet, A. R. Olsen, J. D. Shannon, and D. L. Sisterson, 1990, Analysis of source-receptor relationships for sulfur compounds using spatial and trend techniques. For complete reference, see ***Trends Analysis,*** p. 50.

Robertson, W. D., J. A. Cherry, and S. L. Schiff, 1989, Atmospheric sulfur deposition 1950-1985 inferred from sulfate in groundwater: Water Resources Research, v. 25, no. 6, June, p. 1111-1123.

Groundwater sulfate that occurs at concentrations of 6-27 mg/L in a shallow water table sand aquifer, at a forested site 100 km east of Sudbury, Ontario, was used to deduce the trend in atmospheric sulfur deposition between 1950 and 1985.

Seilkop, S. K., and P. L. Finkelstein, 1987, Acid precipitation patterns and trends in eastern North America, 1980-84: Journal of Climate and Applied Meteorology, v. 26, no. 8, August, p. 980-994.

Using data compiled from seven nationwide precipitation chemistry networks in the United States and Canada, the spatial distribution of hydrogen, sulfate and nitrate ions in North America is discussed. Geographic patterns of concentration and deposition are characterized using isopleth maps that are presented and interpreted for the years 1980-84.

Serrano, E., E. Zurita, and M. Castro, 1989, Analysis of the annual trend in SO_2 and particulate matter emissions in Madrid (Spain). For complete reference, see ***Trends Analysis,*** p. 50.

Solanki, D. L., P. R. McCurdy, F. F. Cuttitta, and G. P. Schechter, 1988, Hemolysis in Sickle Cell Disease as Measured by Endogenous Carbon Monoxide Production: A Preliminary Report: American Journal of Clinical Pathology, v. 89, p. 221-225.

Stelling, J. H., M. A. Bloomhardt, and I. M. McKenzie, 1987, VOC Emission Factors for NAPAP Emission Inventory (Project Summary). For complete reference, see ***Volatile Organic Compounds (VOCs)***, p. 101.

Stensland, G. J., and V. C. Bowersox, 1984, Quality Assurance in Acid Precipitation Monitoring through the Use of Ion Balance Calculations, in Johnson, T. R., and S. J. Penkala (editors), Transactions of APCA Specialty Conference on Quality Assurance in Air Pollution Measurements: Air Pollution Control Association, Pittsburgh, PA, p. 425-443.

Stensland, G. J., and R. G. Semonin, 1982, Another interpretation of the pH trend in the United States. For complete reference, see ***Trends Analysis***, p. 50.

Stockton, M. B., and J. H. E. Stelling, 1987, Criteria Pollutant Emission Factors for the 1985 NAPAP Emissions Inventory (Project Summary): U. S. Environmental Protection Agency, Research Triangle Park, North Carolina, 3 p.

Complete report entitled "Criteria pollutant emission factors for the 1985 NAPAP emissions inventory". NTIS PB 87-198 735/AS.

U. S. Environmental Protection Agency, 1974, Human Studies Laboratory. Health Consequences of Sulfur Dioxides: U. S. Environmental Protection Agency, Research Triangle Park, North Carolina, May, EPA-650/1-74-004.

Warn, T. E., S. Zelmanowitz, and M. Seager, 1990, Development and Selection of Ammonia Emission Factors for the 1985 NAPAP Emissions Inventory (Project Summary): Air and Energy Engineering Research Laboratory, U. S. Environmental Protection Agency, Research Triangle Park, North Carolina, EPA/600/S7-90/014, 4 p.

Identifies the most appropriate ammonia (NH_3) emission factors available for inclusion in the 1985 NAPAP Emissions Inventory. Complete report entitled "Development and selection of ammonia emission factors for the 1985 NAPAP emissions inventory." NTIS PB 90-235 094/AS.

White, J. C. (editor), 1988, Acid Rain: The Relationship Between Sources and Receptors: Proceedings, conference sponsored by Center for Environmental Information, Inc., Rochester, New York, Elsevier Science Publishers, New York, 223 p.

Includes papers in two general topic areas: legal aspects and scientific/technical aspects. Included in the scientific/technical section are papers on why we need to understand source-receptor relationships, and the information we need to complete our understanding. Also included are papers on atmospheric chemistry in the context of source-receptor relationships and papers on the mathematical modeling of these relationships.

Wilson, J. H., Jr., E. H. Pechan, and K. Graves, 1989, Assessment of National and Regional Acid Deposition Precursor Emission Trends (Project Summary): Air and Energy Engineering Research Laboratory, U. S. Environmental Protection Agency, Research Triangle Park, North Carolina, EPA/600/Si-89/042, 2 p.

Summarizes current knowledge on acid trends in emissions of pollutants considered to be acid deposition precursors. Special emphasis was placed on recent trends and on new information learned by researchers since 1983, although comparisons were made with emission trends from

1940 to 1980 for perspective. Complete report entitled "Assessment of national and regional acid deposition precursor emission trends." NTIS PB 89-180 483/AS.

Ozone

Illinois Environmental Protection Agency, Bureau of Air, 1990, Illinois State Implementation Plan: 1990 Ozone Precursors Emissions Inventory for the Metro-East St. Louis Area, Springfield, IL.

Illinois Environmental Protection Agency, Bureau of Air, 1990, Illinois State Implementation Plan: 1990 Ozone Precursors Emissions Inventory for the Chicago Area, Springfield, IL.

Illinois Environmental Protection Agency, 1992, 1990 Ozone Prescursors Emissions Inventory for the Chicago Area, Illinois Ozone State Implementation Plan, October.

Kelly, N. A., G. T. Wolff, and M. A. Ferman, 1984, Sources and sinks of ozone in rural areas: Atmospheric Environment, v. 18, no. 7, p. 1251-1266.

Based on data collected at rural sites in South Dakota, Louisiana and Virginia during the summers of 1978-1980, the factors controlling the diurnal behavior of O3 near the surface were determined.

Koehler, U., K. Wege, R. Hartmannsgruber, and H. Claude, 1988, Comparative Assessment of Various Instruments for Atmospheric Ozone Monitoring and Trend Analysis, Final Report: Meteorologisches Observatorium, Hohenspeissenberg, Deutscher Wetterdienst, Federal Republic of Germany, Document no. GSF-BPT-1/88, 127 p.

Discusses a number of new and established measuring instruments and methods available today for the monitoring of atmospheric ozone. German language.

Korsog, P. E., and G. T. Wolff, 1991, An examination of urban ozone trends in the northeastern U. S. (1973-1983) using a robust statistical method. For complete reference, see ***Trends Analysis,*** p. 47.

Lefohn, A. S., and D. S. Shadwick, 1991, Ozone, sulfur dioxide, and nitrogen dioxide trends at rural sites located in the United States. For complete reference, see ***Trends Analysis,*** p. 47.

Lewis, R., D. Nychka, G. Reinsel, G. C. Tiao, and M. N. Wang, 1981, Statistical analysis of stratospheric ozone data for the detection of trends. For complete reference, see ***Trends Analysis,*** p. 48.

Lindsay, R. W., J. L. Richardson, and W. L. Chameides, 1989, Ozone trends in Atlanta, Georgia: Have emission controls been effective?: Journal of Air Pollution Control Association, v. 39, no. 1, p. 40-43.

Summary of a nine-year study to determine a trend in ozone levels as related to VOC emissions. The outcome indicated that either emissions have not dropped as much as claimed, or that VOC emissions are not a significant factor in ambient ozone levels. The researchers recommend a new look at ozone strategies for metropolitan areas.

Logan, J. A., 1985, Tropospheric ozone: seasonal behavior, trends, and anthropogenic influence. For complete reference, see ***Trends Analysis,*** p. 48.

Penner, J. E., 1982, Trend prediction for O_3: an analysis of model uncertainty with comparison to detection thresholds. For complete reference, see ***Trends Analysis,*** p. 49.

Quone, J. E., and R. A. Wadden, 1975, Oxidants in the Urban Atmosphere: Institute for Environmental Quality, IIEQ Project no. 10.034, January.

Reddy, V. R., D. N. Baker, and J. M. McKinion, 1989, Analysis of effects of atmospheric carbon dioxide and ozone on cotton yield trends: Journal of Environmental Quality, v. 18, no. 4, October-December, p. 427.

Sexton, K., and H. Westberg, 1983, Photochemical ozone formation in urban and point-source plumes: Environmental Science and Technology, v. 17, no. 4, April, p. 224-227.

Results of aerial measurements in plumes from large urban areas, petroleum refineries, automotive-painting operations, fossil-fuel power plants, and controlled burning of forest slash are presented. Field monitoring studies occurred during summer months between 1974-1980.

Shively, T. S., 1990, An analysis of the long-term trend in ozone data from two Houston, Texas monitoring sites. For complete reference, see ***Trends Analysis,*** p. 50.

Shively, T. S., 1991, An analysis of the trend in ground-level ozone using non-homogeneous Poisson processes: Atmospheric Environment, v. 25B, no. 3, p. 387-395.

Staehelin, J., and W. Schmid, 1991, Trend analysis of tropospheric ozone concentrations utilizing the 20-year data set of ozone balloon soundings over Payerne (Switzerland). For complete reference, see ***Trends Analysis,*** p. 50.

Walker, H. M., 1985, Ten-year ozone trends in California and Texas. For complete reference, see ***Trends Analysis,*** p. 51.

Wolff, G. T., N. A. Kelly, and M. A. Ferman, 1982, Source regions of summertime ozone and haze episodes in the eastern United States. For complete reference, see ***Visibility,*** p. 94.

Lead/Polychlorinated Biphenyls (PCBs)

Boline, D. R, 1981, Some Speciation and Mechanistic Aspects of Trace Metal in Biological Systems: Environmental Health Chemistry.

Burnham, C. D., C. E. Moore, T. Kowalski, and J. Krasniewski, 1970, A detailed study of lead determinations in air-borne particulates over Morton Grove, Illinois by atomic absorption spectroscopy: Applied Spectroscopy, v. 24, no. 4, p. 411-414.

Careful examination of an analytical method for the determination of lead concentrations in atmospheric particulates has confirmed that a low temperature ashing technique is preferable to the ashing of organic matter in a muffle furnace when preparing samples for metals analyses, and that use of the standard additions technique for the avoidance of interferences in the analyses by atomic absorption spectroscopy is justified. Samples collected 1964-67.

Cooper, J. A., and C. A. Frazier, 1983, Source Apportionment of TSP and Lead in Granite City, Illinois, Using Chemical Mass Balance Receptor Model Methods: NEA, Inc., Beaverton, Oregon, v. 1: Final Report; Vol. 2: Appendices.

Objective of this study was to use chemical mass balance (CMB) methods to determine the major lead sources contributing to lead levels in Granite City, in order to provide a database for the development of future control strategies.

Daines, R. H., Motto, H., and Chilko, D. M., 1970, Atmospheric Lead: Its Relationship to Traffic Volume and Proximity to Highways: Environmental Science and Technology, v. 4, p. 318-322.

Griffin, T. B., and J. H. Knelson (editors), 1975, Lead, in Environmental Quality and Safety. For complete reference, see ***Soil Quality, Heavy Metals,*** p. 79.

Holsen, T. M., K. E. Noll, S. Liu, and W. Lee, 1991, Dry deposition of polychlorinated biphenyls in urban areas: Environmental Science and Technology, v. 25, no. 6, p. 1075-1081.

Atmospheric transport is an important pathway for the transfer of polychlorinated biphenyls (PCBs) from land to natural waters. The PCB dry deposition flux was measured in Chicago from May to November 1989, and from May to June 1990.

Ludwig, J. H., D. R. Diggs, H. E. Hesselberg, and J. A. Maga, 1965, Survey of Lead in the Atmosphere of Three Urban Cities: A Summary: American Industrial Hygienists Association Journal, v. 26, p. 270-284.

Monitoring of Hazardous Substances: Lead, 1972, Prepared for Illinois Institute for Environmental Quality, September.

National Academy of Science-National Research Council, 1971, Airborn Lead in Perspective, (Interim Report): Environmental Protection Agency Contract CPA70-42, NAS, Washington, D. C.

Provenzano, G., 1978, Motor vehicle lead emissions in the United States: an analysis of important determinants, geographic patterns and future trends: Journal of the Air Pollution Control Association, v. 28, no. 12, December, p. 1193-1199.

This paper presents a simple method that utilizes composite emission factors to estimate motor vehicle lead emissions for large areas.

Tsuchyia, K., M. Sugita, and C. B. Park, 1976, Biological effects of exposure to lead in ambient air among Tokyo inhabitants: Keio Journal of Medicine (Tokyo), v. 25, p. 193-211.

Outlines a study undertaken in response to public concerns over traffic-related air pollution in Tokyo. The study looks at the adverse human health effects of ambient lead concentrations in Tokyo in the early 1970s.

Volatile Organic Compounds (VOCs)

Aronian, P. F., P. Scheff, and R. A. Wadden, 1989, Wintertime source-reconciliation of ambient organics: Atmospheric Environment, v. 23, no. 5, p. 911-920.

The application of a Chemical Mass Balance air pollution model to ambient measurements of volatile organic compounds (VOCs) is presented. Twenty-six air samples were collected at three sites in the Chicago metropolitan area and analyzed for the concentration of 23 compounds including alkanes, aromatics and chlorinated organics.

Cohen, M. A., P. B. Ryan, J. D. Spengler, H. Ozkaynak, and C. Hayes, 1991, Source-receptor study of volatile organic compounds and particulate matter in the Kanawha Valley, West Virginia--I, Methods and descriptive statistics; II, Analysis of factors contributing to VOC and particle exposures: Atmospheric Environment, v. 25B, no. 1, p. 79-107.

The Kanawha Valley region of West Virginia includes a deep river valley with a large population living in close proximity to many potential sources of ambient volatile organic compounds (VOCs). This combination of topography, local meteorological conditions, and the chemical industry potentiate in the Kanawha Valley, West Virginia, contributed to elevated concentrations of volatile organic compounds (VOCs) emitted within the region. An integrated approach designed to assess pollutant exposure in this region was implemented between April 1987 and March 1988. To investigate exposures to VOCs emitted by the local industry, simultaneous measurements of 19 VOCs, particle pH, particle elemental composition, inorganic gases, and meteorological parameters were collected over an entire year. The results suggest that multivariate relationships may be found that will be useful in source identification.

Gschwandtner, G., and J. K. Wagner, 1988, Historic Emissions of Volatile Organic Compounds in the United States from 1900 to 1985 (Project Summary): Air and Energy Engineering Research Laboratory, U. S. Environmental Protection Agency, Research Triangle Park, North Carolina, EPA/600/S7-88/008, 2 p.

Presents an estimate of historic emissions of volatile organic compounds (VOCs) for each state. Uncertainty of the emission estimates was calculated based on the methodology developed previously by NAPAP. Data presented in Appendix B are available in Lotus 123 format on floppy disks. Complete report (paper copy and diskettes) entitled "Historic emissions of volatile organic compounds in the United States from 1900 to 1985". NTIS PB 88-208 723/AS. Diskettes: PB 88-250-311/AS.

McAlister, R. A., W. H. Moore, J. Rice, D.-P. Dayton, R. F. Jongleux, P. L. O'Hara, R. G. Merrill, and J. T. Bursey, 1989, 1988 nonmethane organic compound monitoring program, Vol. II: urban air toxics monitoring program: Office of Air Quality Planning and Standards, U. S. Environmental Protection Agency, Research Triangle Park, North Carolina, EPA-450/4-89-005.

McAlister, R. A., E. Bowles, J. DeGarno, J. Rice, R. F. Jongleux, R. G. Merrill, and J. T. Bursey, 1991, 1990 urban air toxics monitoring program: Office of Air Quality Planning and Standards, U. S. Environmental Protection Agency, Research Triangle Park, North Carolina, EPA-450/4-91-024.

Scheff, P. A., R. A. Wadden, B. A. Bates, and P. F. Aronian, 1989, Source fingerprints for receptor modeling of volatile organics: Journal of Air Pollution Control Association, v. 39, no. 4, April, p. 469-478.

The development of receptor models for the determination of the sources of an ambient air pollutant requires that the composition of the pollutant at the point of emissions be known. For this study, composition information for 10 sources of volatile organic compounds (VOCs) were evaluated and source fingerprints developed.

Shah, J. J., and E. K. Heyerdahl, 1988, National Ambient Volatile Organic Compounds(VOCs) Data Base Update (Project Summary): Atmospheric Sciences Research Laboratory, U. S. Environmental Protection Agency, Research Triangle Park, North Carolina, EPA/600/S3-88/010, 11 p.

Data on the observed concentrations of 320 volatile organic compounds were compiled, critically evaluated, and assembled into a relational data base. Ambient measurements, indoor data, and data collected with personal monitors are included, primarily from the period 1970-1987 for locations within the United States. Complete report (paper copy and diskettes) entitled "National ambient volatile organic compounds (VOCs) data base update." NTIS PB 88-189 022/AS.

Stelling, J. H., M. A. Bloomhardt, and I. M. McKenzie, 1987, VOC Emission Factors for NAPAP Emission Inventory (Project Summary): Air and Energy Engineering Research Laboratory, U. S. Environmental Protection Agency, Research Triangle Park, North Carolina, 3 p.

Complete report entitled "VOC emission factors for NAPAP emission inventory." NTIS PB 87-141 040/AS.

Sweet, C. W., 1991, Toxic Volatile Organic Chemicals in Urban Air in Illinois: Hazardous Waste Research and Information Center, Champaign, Illinois, 64 p.

Sweet, C. W., and S. J. Vermette, 1992, Toxic volatile organic compounds in urban air in Illinois: Environ. Sci. & Technol., v. 26, no. 1, p. 165-173.

U. S. Environmental Protection Agency, 1973, Regulation of Fuels and Fuel Addititves: 40 CFR 80, 38 Federal Register, Dec. 6, p. 33734-33741.

Watson, J. J., J. A. Probert, and S. D. Piccot, 1991, Global Inventory of Volatile Organic Compound Emissions from Anthropogenic Sources (Project Summary): Air and Energy Engineering Research Laboratory, U. S. Environmental Protection Agency, Research Triangle Park, North Carolina, EPA/600/S8-91/002, 6 p.

Estimates the global atmospheric concentration of ozone in an effort to assess the potential environmental impacts of global climate change. Presents global inventory for seven VOC reactivity classes. Complete report entitled "Global inventory of volatile organic compound emissions from anthropogenic sources." NTIS PB91-161687/AS.

Methane

Khalil, M. A. K., R. A. Rasmussen, and M. J. Shearer, 1989, Trends of atmospheric methane during the 1960s and 1970s. For complete reference, see ***Trends Analysis,*** p. 47.

Tyler, S. C., 1986, Stable carbon isotope ratios in atmospheric methane and some of its sources, Paper no. 6D0484: Journal of Geophysical Research, v. 91, no. D12, November, p. 13,232-13,238.

Dioxins/Dibenzofurans

Czuczwa, J. M., and R. A. Hites, 1986, Airborne dioxins and dibenzofurans: Sources and fates: Environmental Science and Technology, v. 20, no. 2, p. 195-200.

Polychlorinated dibenze-p-dioxins (PCDD) and dibenzofurans (PCDF) were found in urban air particulates and Great Lakes sediments. Combustion of municipal and chemical wastes was the most likely source of these compounds.

Edgerton, S. A., and J. M. Czuczwa, 1988, Source apportionment of dioxins and dibenzofurans in ambient air in Ohio: APCA International Specialty Conference, "Receptor Models in Air Resources Management," San Francisco, California, February, 1988, p. 10.

Eduljee, G. H., 1987, Comment on Airborne dioxins and dibenzofurans: Sources and fates: Environmental Science and Technology, v. 21, no. 9, p. 922-924.

Hites, R. A., 1991, Atmospheric Transport and Deposition of Polychlorinated Dibenzo-p-dioxins and Dibenzofurans (Project Summary): Atmospheric Research and Exposure Assessment Laboratory, U. S. Environmental Protection Agency, Research Triangle Park, North Carolina, EPA/600/S3-91/002, 2 p.

Complete report entitled "Atmospheric transport and deposition of polychlorinated dibenzo-p-dioxins and dibenzofurans." NTIS PB 91-144 667/AS.

Indoor Air Pollution

General References

Bierma, T. J., O'Neill, J., Anderson, M. R., and Langhorn, J., 1991, A Guide to Indoor Air Quality for Home Weatherization Practitioners: Illinois Department of Energy and Natural Resources, Springfield, IL, ILENR/RE-ER-91/04.

Diamond, R. C., and D. T. Grinsrud, Lawrence Berkeley Laboratory, Applied Science Division, 1984, Manual on Indoor Air Quality: Electric Power Research Institute, Inc., Palo Alto, California, EPRI EM-3469 Research Project 2034-3, 101 p.

A general reference manual on indoor air quality. This manual is intended to guide utility companies in advising homeowners on indoor air issues.

Seifert, B., and H. J. Abraham, 1982, Indoor air concentrations of benzene and some other aromatic hydrocarbons: Ecotoxicology and Environmental Safety, v. 6, no. 2, p. 190-192.

Hydrocarbon concentrations at various indoor locations and at nearby outdoor locations were analyzed and compared.

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