Climate Change on the Great Lakes Basin. 1992. 45 pp. $—free. Paperbound. Miscellaneous Publication 141. Illinois State Water Survey and the Canadian Climate Centre.

This publication is a compilation of five papers presented at the Symposium of Climate Change on the Great Lakes Basin held as part of the annual meeting of the American Association for the Advancement of Science in Chicago in February 1992. The results given provide an overview of various aspects of climatic change relative to the Great Lakes Basin. The usual caveats regarding use and interpretation of double CO_2 scenarios output from various global circulation models are mentioned in several of the papers. The third and fourth papers are of particular interest and are the major contributions to this work. The third paper describes the rationale for further studies and a Canadian pilot project, and the fourth paper reviews the background of policy issues and the decision-making process. The reader who is interested in learning more about climate change issues and studies in the Great Lakes is advised to consult the references as a starting point.

The first paper, "Great Lakes 20th Century Climate Variability: Implications for Future Scenarios?," is a statistical analysis of regional, seasonal, and spatial trends of temperature and precipitation at annual, monthly, and daily time scales. Climatic data at 23 stations and all the state climatic divisions (on the U.S. side of the Great Lakes Basin) are used in the analysis. A statistically significant increasing trend is found for summer, autumn, and annual precipitation between the years 1895 and 1990. Working on the assumption that the greenhouse climate models are correct, the characteristics of past warmer-than-normal episodes are briefly described as a possible analog of a future warm Great Lakes climate; details are given in the report. A potentially serious defect of this paper lies in the fact that the station network chosen does not include the vast Canadian portion of the Great Lakes Basin. A recently completed study (unpublished) includes Canadian stations and indicates significant seasonal temperature trends that have occurred over the 1901–1987 period (S. J. Bolsenga 1992, personal communication).

The second paper, "Effects of Climate Change on the Water Resources of the Great Lakes," summarizes the results of two recent studies: "Laurentian Great Lakes Double-CO_2 Climate Hydrological Impacts" (Croley 1990) and "Climate Change Impacts on Laurentian Great Lakes Levels" (Hartmann 1990). These studies examine the potential sensitivity of the Great Lakes levels and water supply to climate change using a series of hydrological models driven by output of three global circulation models (GCMs) operating under double CO_2 scenarios: the Geophysical Fluid Dynamics (GFDL) Model, the Goddard Institute of Space Science (GISS) Model, and the Oregon State University (OSU) Model. Potential impacts on the Great Lakes include a decreasing water supply, increase in evapotranspiration and lake evaporation, smaller runoff, and lower lake levels . . .

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crease in evapotranspiration and lake evaporation, smaller runoff, and lower lake levels (0.5 to 2.5 meters). Potential impacts on water resources include the need to dredge shipping channels, some loss of hydropower generating capacity, change in fishery species composition, increased consumptive water use, new lake regulation plans, and reduction or elimination of Great Lakes wetlands.

The third paper, "Climate Change in the Great Lakes Basin: Impacts, Research Priorities and Policy Issues," provides tabular summaries and comparisons of seasonal and spatial patterns of temperature (Table 1) and precipitation (Table 2) for the GISS, GFDL, OSU, and the Canadian Climate Centre GCM double CO_2 scenarios over the Great Lakes Basin. The major portion of the paper, however, deals with the need to conduct further "second generation" studies of "the interaction of various economic sectors within a region under a scenario of a warmer climate and explore possible adaption strategies to deal with climate change and variability." The point is made that such studies are critical in the development of "effective policies and response strategies on a regional scale." A Canadian project proposal for an integrated study of the Great Lakes–St. Lawrence River Basin Pilot Project on responses to the impacts of climate change is described in three subsequent sections of the paper.

The fourth paper, "Climate and Global Change: The Responses and Policy Issues Related to Climate Change in the Great Lakes Basin," describes two possible alternative responses to climate change relative to water resource policy and policy issues: 1) react to change once it has occurred, or 2) "adopt a Basin Water Management Program sensitive to projected impacts of climate change; and nurture the development of policy responses that are anticipatory, preventive and adaptive in nature." The remainder of the paper details public policy significance of Great Lakes hydrology; projected impact of climate change on Great Lakes water levels, economic, environmental, and policy implications; and recommendations on ways to make present and future policy based on past experience.

The last paper, "A Proposed U.S. Research Program to Assess Climate Change in the Great Lakes," reviews the rationale for developing a U.S. research program to assess climate change in the Great Lakes. The paper points out that rationales were developed over the past 6-year period during four scientific/planning meetings, an international joint commission study, and a series of U.S. EPA 1-year funded studies. The United States, unlike Canada, has not yet developed an integrated Great Lakes climate change research plan or program. The author of this paper expresses frustration at the lack of such a plan, and he presents the outline of a plausible 5-year research program consisting of "studies of how future climatic change would 1) affect hydrological and biological systems, 2) create socioeconomic impacts, 3) lead to social and institutional responses, and 4) affect policy." Such a research program could be developed if a U.S. research plan were in place.—*R. A. Assel.*

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References

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Mid-Latitude Weather Systems. Toby N. Carlson. 1991. 507 pp. $35.00. Paperbound. Routledge, Chapman & Hall. ISBN 0-04-551116-0.

One of the most noticeable deficiencies of the meteorological literature has been the lack of modern textbooks on synoptic meteorology, with texts that integrate observational and dynamical perspectives being the most egregiously absent. Although venerable textbooks on the subject, such as *Atmospheric Circulation Systems* by Palmén and Newton (1969) and *Weather Analysis and Forecasting* by Petterssen (1956), remain valuable references, they are clearly out of date and lack many topics essential for a modern review of the subject. More recent collections of articles such as *Extratropical Cyclones: The Erik Palmén Memorial Volume* (Newton and Holopainen 1990) and *Mesoscale Meteorology and Forecasting* (Ray 1986) do review contemporary developments in synoptic meteorology but lack the scope, integration, and completeness found in a good textbook. Fortunately, a veritable flood of synoptic and synoptic/dynamics textbooks are now becoming available, the first of which is *Mid-Latitude Weather Systems* by Toby Carlson of The Pennsylvania State University.

The overriding philosophy of this textbook, and its great strength, is the integration of synoptics and dynamics. This integration is centered around the development of quasigeostrophic dynamics and its application to midlatitude cyclonic disturbances. Consistent with this emphasis, the author has deliberately left out material on weather observations and forecasting such as numerical weather prediction, forecasting and analysis techniques, and remote sensing. The topics of the book (presented in the order found in the text) include the following:

- Basic mathematical operations and dynamical concepts such as the primitive equations, vector operations, thermal wind and hypsometric relationships, and the vorticity and thermodynamic energy equations.
- The development and illustration of the quasigeostrophic omega and pressure tendency equations and a description of quasigeostrophic energetics.
- Midtropospheric wave development from both barotropic and baroclinic viewpoints, covering topics such as Rossby wave dynamics, equivalent barotropic models, steering, and a two-level quasigeostrophic model of development.
- Alternative expressions for vertical motion and divergence including the Sutcliffe development theorem, the Petterssen development equation, and the