A Computer Tutorial for Great Lakes Ice Cover Climatology

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ABSTRACT

An interactive menu-driven computer tutorial was developed to provide an overview of the annual Great Lakes ice cycle. The tutorial includes an animation to aid in visualizing the normal seasonal progression and the spatial patterns of ice cover for the base period 1960 - 1979 (Assel and Ratkos 1991). The computer algorithm was developed from data contained in the NOAA Great Lakes Ice Atlas (Assel et al. 1983). Computer diskettes needed to load and run the tutorial are being made available (Assel and Ratkos - in press) to the public at large. This paper abstracts information from that forthcoming publication.

INTRODUCTION

An interactive menu-driven computer tutorial on the contemporary ice cover climatology (winters 1960 to 1979) of the Great Lakes of North America was developed for educational purposes. The information presented in that tutorial is primarily descriptive in nature. The computer algorithm contains two text modules (1) background information on ice cover data sources and analysis methodology, and (2) an overview of the annual ice cycle (fall cooling, ice formation, ice thickness, maximal ice coverage, ice loss, ice as a hazard) and one animation module (animation of the seasonal progression of the spatial pattern of ice cover of each Great Lake). These data are being made available in floppy diskette format (Assel and Ratkos - in press). Readers interested in receiving a copy should write the author. A Macintosh Plus computer with at least 2 mega-bytes of memory is required to run the tutorial. Methods used to create the animation and the spatial and seasonal patterns of the normal ice cover for the decade of the 1960s and 1970s are discussed below.

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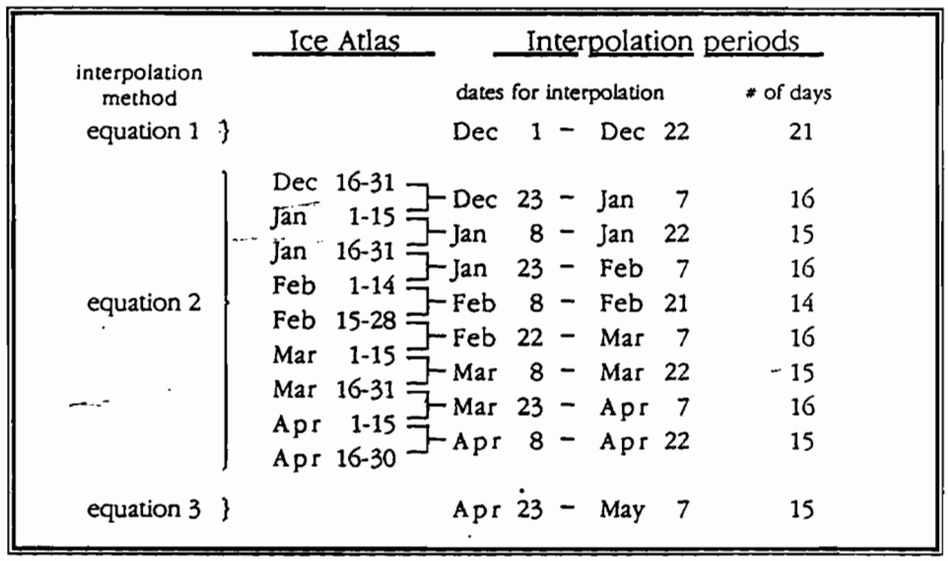
THE ICE COVER ANIMATION

The ice cover animation portrays the progression of the daily spatial distribution of five ranges of ice concentration for each Great Lake from December 1 to May 7. Ice concentration is the percentage of a unit of surface area covered by ice. The daily ice charts are calculated from the normal seasonal distribution of ice cover for nine half-month periods (December 16-31 to April 16-30) given in the NOAA Great Lakes Ice Atlas (Assel et al. 1983) and (the daily ice charts) represent the transition from the normal ice cover distribution pattern from one half-month-period to the next as approximated by a linear interpolation of the normal ice concentration between midpoint dates of the nine half-month periods (Figure 1). It should be cautioned that the daily time series of ice charts produced using this method may not be representative of the true daily normal ice cover distribution pattern for a given date in the winter season or for a given area in the Great Lakes. Nevertheless, it is a useful way to visualize an approximation to the normal seasonal progression of ice cover on the Great Lakes. The lakes were assumed to be ice free on December 1. Ice formation between December 1 and December 22 and ice loss between April 23 and May 7 was arbitrarily simulated as non-linear functions of time and initial ice concentration.



equation 1: $i(t) = i(p1) \times t^3 / Days^3$

equation 2: $i(t) = i(t_1) + \{[di / Days] \times t\}$

equation 3: $i(t) = i(p9) \times \{[1/t] - [1/15]\}$

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Where:
$i(t_1)$ = ice concentration at start of period, from ice atlas.
$i(t)$ = interpolated ice concentration for day t.
t = any day in a given interpolation period.
Days = the number of days in a given period.
di = difference in ice concentration between consecutive ice atlas plates.
i(p1) = ice concentration for ice atlas plate 1 (December 16 -31).
i(p9) = ice concentration for ice atlas plate 9 (April 16 - 30).

Figure 1. Half-month periods in Ice Atlas and associated interpolation periods and equations used to produce daily ice charts of each Great Lake.

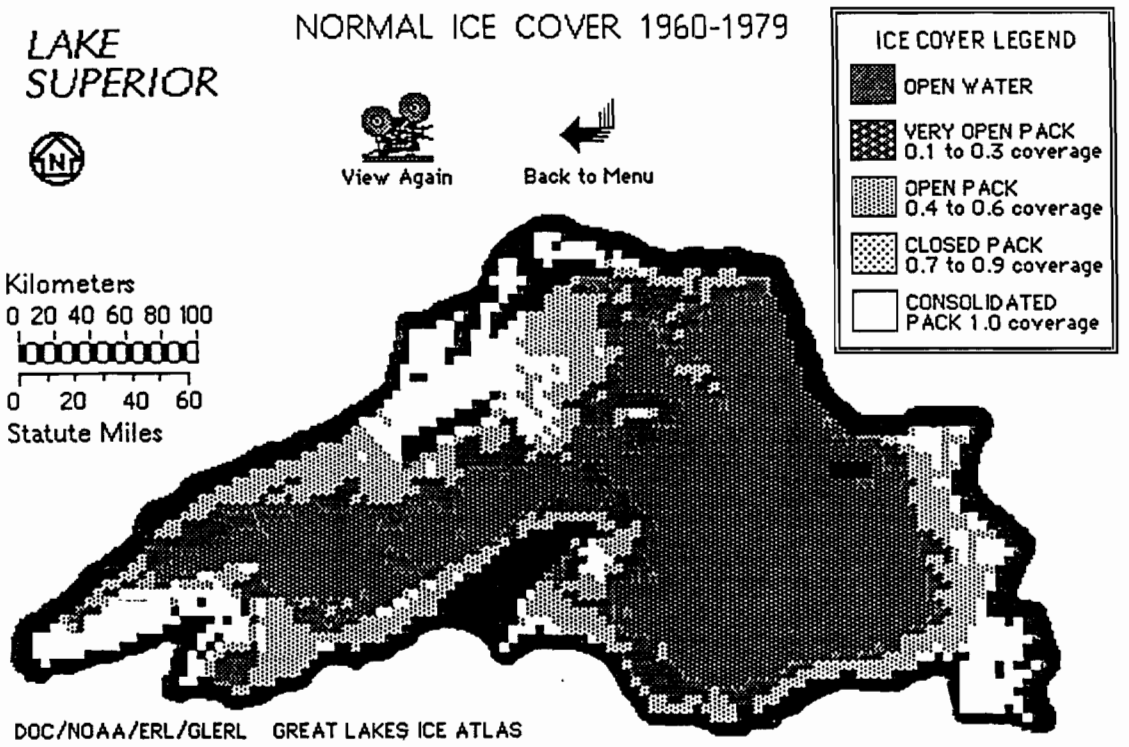

Figure 3. Interpolated Lake Superior ice chart for February 7.

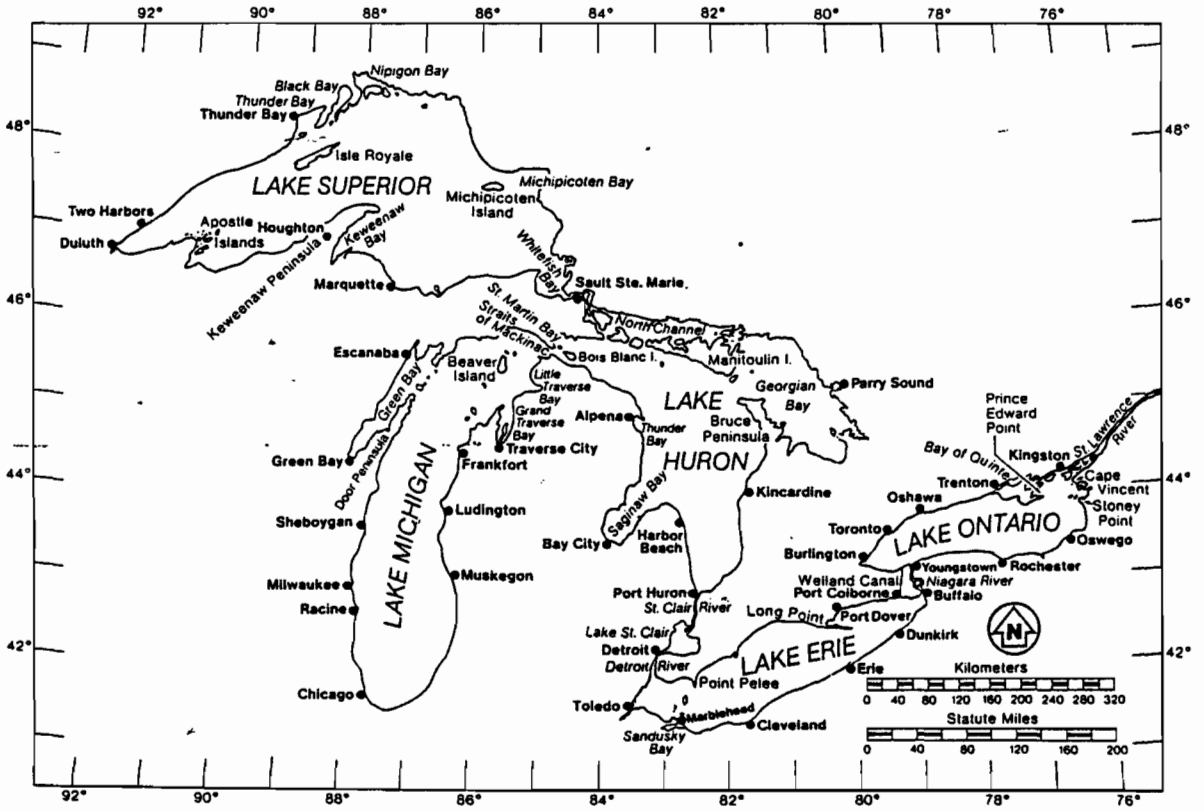

Figure 4. Place Names on the Great Lakes.

CONCLUDING REMARKS

Because the information presented in this tutorial is simplified to facilitate understanding by non-technical users, it is recommended that it only be used to gain a general overview of the normal ice cover and even then only of the normal ice cover of the 1960s and 1970s. Those readers interested in receiving the computer diskettes needed to run the tutorial should write to the author.

ACKNOWLEDGMENTS

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Assel, R.A., F.H. Quinn, G.A. Leshkevich, and S.J. Bolsenga. NOAA Great Lakes ice atlas. 1983. Great Lakes Environmental Research Laboratory, 2205 Commonwealth, Ann Arbor, MI.