

Proceedings of the 61st Annual
Eastern Snow Conference, June 9-11, 2004
Portland, Maine

A Laurentian Great Lakes Ice Cover Climatology

RAYMOND ASSEL¹

EXTENDED ABSTRACT

INTRODUCTION

Composite ice charts, a blend of observations from different data sources (ship, shore, aircraft, and satellite) that cover the entire area of the Great Lakes for a given date, and which may contain some estimated ice cover data, were produced starting in the 1970s. Recently, a 30-winter (1973-2002) set of composite ice charts was digitized, and a multi-winter statistical analysis of the climatology of the ice cover concentration was completed. The result of this analysis was published as an electronic National Oceanic and Atmospheric Administration Great Lakes Ice Atlas, which is available for browsing on the Internet (Asset 2003a). A series of reports (Asset 2004, Asset 2003b, Asset 2003c, Asset et al. 2003, Asset et al. 2002, Asset and Norton 2001) document and supplement data and products given in the electronic atlas. However, because the atlas contains approximately 1.4-gigabytes of data, much of which is in compressed files, it is not practical to download the entire atlas from the Internet. Therefore, it is available on CD-ROM and DVD formats. To request a copy of the atlas send an email to iceatlas@noaa.glerl.gov.

ORIGINAL ICE CHARTS

The original ice chart data set consists of over 1200 digitized ice charts. These ice charts display observed ice cover over each Great Lake throughout every winter season from 1973 to 2002. Ice chart data is available as Arc/Info Export, ASCII grids, and graphic files. The ASCII grids are at a nominal spatial resolution of 2.56 x 2.56 km. The primary information given on ice charts is ice concentration, i.e., the percent of a unit of surface area covered by ice, supplemented by categorical information on ice age (ice thickness) and ice form (type of ice: attached to shore, pack, floe size). Only total ice concentration was used in the multi-year analysis due primarily to frequency of observations.

ANALYSIS PRODUCTS

There are three analysis products. The first product includes ice charts and ASCII grids of dates of the first ice, last ice, and ice duration for each winter. In addition, there are ice charts that portray the composite maximum, minimum, and 30-winter average of each variable. The second product is the 30-year annual daily ice cover time series. The daily ice concentration time series was produced for each winter by making a linear interpolation between consecutive grids of the original ice charts. The daily time series was used to create computer animations of spatial patterns of ice cover for each winter and line plots of the daily lake-averaged ice cover for each lake, for each of the 30 winter seasons. The third product is weekly statistics. Ice concentration grids that

¹NOAA Great Lakes Environmental Research Laboratory, 2205 Commonwealth Blvd.
Ann Arbor, Michigan 48105

were aggregated into weekly periods and statistics of ice concentration were calculated for each grid cell for each week, December 1 to May 22. There are weekly ice charts and ASCII grids of maximum, 3rd quartile, median, 1st quartile, and minimum ice cover concentrations for the 30-winter base period. The weekly statistics are based on the original ice chart data set.

CONCLUDING REMARKS

The NOAA Great Lakes Ice Atlas is a resource for those seeking information on Great Lakes ice cover climatology. It provides a benchmark of ice cover and ice cover variation of the Great Lakes during the last quarter of the 20th century and early years of the 21st Century. The atlas and dataset are archived at the National Snow and Ice Data Center (<http://nsidc.org/>). The Great Lakes Environmental Research Laboratory (GLERL) will maintain the Internet version of the atlas for several years and will continue to supply CD-ROM and DVD versions of the atlas.

ACKNOWLEDGMENTS

This work was funded in part by NOAA's Earth System and Data Information Management program. The NOAA National Ice Center and the Canadian Ice Service provided the historic ice charts. Mr. David Norton's (GLERL) contributions to this project were critical for its successful completion. University of Michigan's Cooperative Institute for Limnology and Ecosystems Research (CILER) staff; D. Meyers, B.A. Hibner, N. Morse, P.J. Trimble, K. Cronk, and M. Rubens and GLERL staff; Ms. Deborah Lee, provided invaluable contributions to this project. Ms. Janet, Szczesny (CILER), Ms. Cathy Darnell (GLERL), and Mr. Gregory Lang (GLERL) were instrumental in the development of the Graphic User Interface. This is GLERL contribution number 1329.

Keywords: Lake Ice, Great Lakes, Climatology

REFERENCES

- Assel RA. 2004. Lake Erie Ice Cover Climatology-Basin Averaged Ice Cover: Winters 1898- 2002. NOAA Technical Memorandum GLERL-128. NOAA, Great Lakes Environmental Research Laboratory, Ann Arbor, MI. ftp://ftp.glerl.noaa.gov/publications/tech_reports/glerl-128
- Assel, R.A. 2003a. An Electronic Atlas of Great Lakes Ice Cover, Winters 1973-2002. NOAA Atlas. NOAA, Great Lakes Environmental Research Laboratory, Ann Arbor, MI, 2 CD-ROM Set or DVD. <http://www.glerl.noaa.gov/data/ice/atlas>
- Assel RA. 2003b. Great Lakes Ice Cover, First Ice, Last Ice, and Ice Duration: Winters 1973-2002. NOAA Technical Memorandum GLERL-125. Great Lakes Environmental Research Laboratory, Ann Arbor, MI. ftp://ftp.glerl.noaa.gov/publications/tech_reports/glerl-125/tm-125.pdf
- Assel RA. 2003c. Great Lakes monthly and seasonal accumulations of freezing degree days-Winters 1898-2002. NOAA Technical Memorandum GLERL- 127. NOAA, Great Lakes Environmental Research Laboratory, Ann Arbor, MI. ftp://ftp.glerl.noaa.gov/publications/tech_reports/glerl-127
- Assel RA, Cronk K, Norton DC. 2003. Recent Trends in Great Lakes Ice Cover *Climate Change* 57(1): 185-204. <http://www.glerl.noaa.gov/pubs/fulltext/2003/20030001.pdf>
- Assel RA, Cronk K, Norton DC. 2002. A Great Lakes Digital Ice Cover Data Base for Winters 1973-2000. NOAA Technical Memorandum GLERL- 121, Great Lakes Environmental Research Laboratory, Ann Arbor, MI. <http://www.glerl.noaa.gov/data/ice/atlas/references/tm-121.pdf>
- Assel RA, and Norton DC. 2001. Visualizing Laurentian Great Lakes ice cycles. *EOS Transactions* 82(7): 83. <http://www.agu.org/eoselec/00259e.html>.