GLERL Potential Impacts of ENSO on Great Lakes Climate Research Project

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This Project Ended in 2000

Overview

Variations in Great Lakes climate represents a regional climatic signature. Previous studies have demonstrated that hemispheric upper air circulation and tropical sea surface temperatures affect regional climate. However, in the Great Lakes region there is a need to better define the linkages between regional and global climate. The object of this study is to analyze the potential effects of El Niño (La Niña) Southern Oscillation (ENSO) events on Great Lakes ice extent, Great Lakes monthly air temperature and precipitation, and Great Lakes water levels related to storms.

2000 Plans

Present the results of our analysis of ENSO signals in Great Lakes monthly temperature and monthly precipitation at a formal scientific meeting.

2000 Accomplishments

An analysis of El Niño Southern Oscillation (ENSO) signals in seasonal temperature and precipitation records at individual stations in the Great Lakes regions were presented at a the 43rd annual conference of the International Association for Great Lakes Research held May 21-26, 2000 at Cornwall, Ontario, Canada.. Relatively weak but significant ENSO signals were found over discrete portions of the Great Lakes.

1999 Plans

A more detailed analysis of the of 1997-98 ENSO winter in the Great Lakes will be made in FY 1999. This analysis will include: ice cover, synoptic climatology, winter severity. A comparison will also be made of water levels and precipitation for winter 1997-98 and other strong ENSO winters since 1950. Collaborators in this project will include staff form the National Center for Environmental Prediction, the National Weather Service, the National Ice Center, and GLERL. We will write a report of the results of the seasonal temperature and precipitation ENSO analysis. We will continue to digitize hourly precipitation data at selected Lake Michigan sites as part of an analysis of the long-term impact of ENSO on water levels.

1999 Accomplishments

Winter 1998: Great Lakes ice cover and winter severity were analyzed and documented to placed this strong ENSO winter in a historical perspective relative to the existing ice cover and winter severity climatology. The impacts of the 1997-1998 ENSO on regional winter weather

and on the Great Lakes ice cover and the importance of documenting this anomalous winter are summarized in Assel (1999) and can be viewed in the FY 1999 Milestone report below.

Water Levels and Storms: A pilot study was conducted to examine the feasibility of using water level data for assessing the frequency and intensity of storms during ENSO years. As part of this study software and methods were developed and applied to hourly water level data at Ludding, Buffalo, Toledo and Calumet. This pilot study showed there was a decrease in the number and intensity of storms during El Niño years. These results were used in various outreach activities but no written reports have been made. Further analysis requires digitizing more water level data which is currently underway at National Ocean Service (NOS) and at GLERL.

1998 Accomplishments

Average regional winter severity and modeled annual regional maximum ice cover were found to be significantly (statistically) lower for the winters following the onset year of a strong warm El Niño event relative to the average of other winters in a 1950-1994 base period (Assel, 1998a, 1998b). These results are potentially useful in the development of improved long-range models/forecasts of ice formation and ice loss. Such improved forecasts have applications for a better understanding of under ice ecology; improved models of whitefish year class strength; improved understanding of spring lake ecosystem processes; improved lake levels forecasting; and cost savings for Great Lakes winter operational activities.

Winter 1997-98 produced one of the least extensive ice covers on the Laurentian Great Lakes of North America this century. Winter 1997-98 followed one of the strongest warm El Niño events of at least the past 50 years. Only the mature phase of the 1982 El Niño event was stronger than the 1997 event during the past half century. Despite this, ice cover during winter 1997-98 was less extensive than winter 1982-83. We made a preliminary and generalized analysis of the seasonal progression of ice cover extent and concentration for these two extremely strong warm El Niño events. Temporal trends in lake averaged ice cover for the combined area of all five Great Lakes for the 1982-83 and 1997-98 winters were compared with a 20-winter normal (1960-1979) derived from the NOAA Great Lakes Ice Atlas. The spatial distribution pattern of ice cover near the time it is estimated to have approached its seasonal maximum coverage was portrayed for winter 1982-83, winter 1997-98, and the normal given in the NOAA Great Lakes Ice Atlas.

Analysis of seasonal temperature and precipitation records (1900-1990) for El Niño, La Niña, and non-ENSO years showed that seasonal average temperatures are significantly cooler in the spring (La Niña onset year), summer, and fall (El Niño onset year), and late fall to winter (following the La Niña onset). Seasonal average temperatures are significantly warmer for the

Products

Herche, L., and R.A. Assel. 2000. ENSO Signals in Monthly Great Lakes Air Temperatures and Precipitation. Abstract Book for 43rd IAGLR meeting May 21-26, 2000. Cornwall, Ontario, Canada.

Assel, R.A. et al. 2000: Laurentian Great Lakes Ice and Weather Conditions for the 1998 El Niño Winter. Bulletin of the American Meteorological Society, 81 (4) : 703-717.

Assel, R.A., J.E. Janowiak, D.C. Norton, and C. Oconnors. 1999. Climate Perspective of the 1997-98 Laurentian Great lakes Ice Cover. Preprint, 10th Symposium on Global Change Studies, 79th Annual Meeting of the American Meteorological Society. January 1999.

Assel, R.A. 1998a. The 1997 ENSO event and implications for North American Laurentian Great Lakes Winter Severity and Ice Cover. Jol. Geophysical Research Letters 25(5):1031-1033.