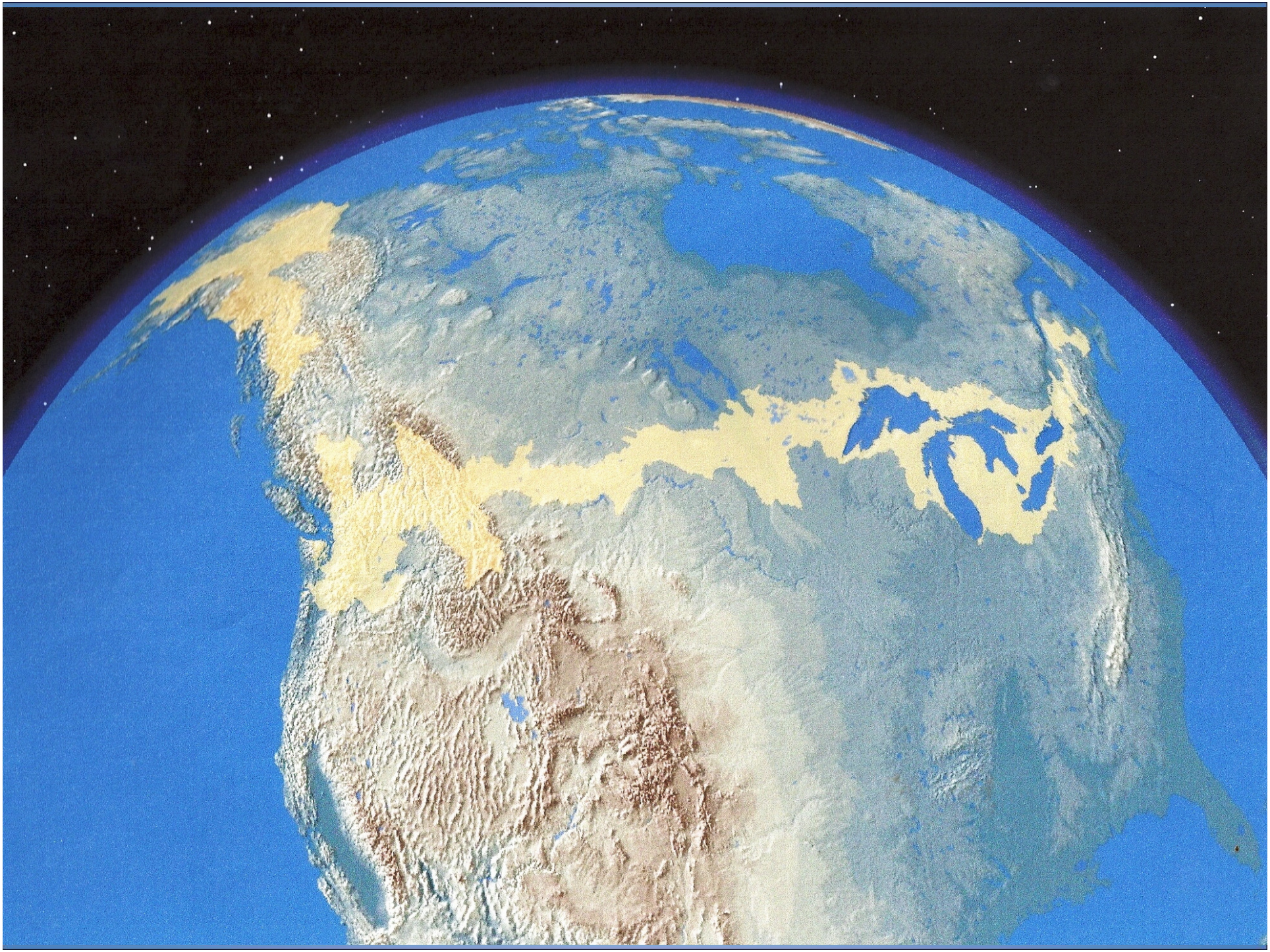
SUSTAINABILITY LINKAGES IN THE FEDERAL GOVERNMENT

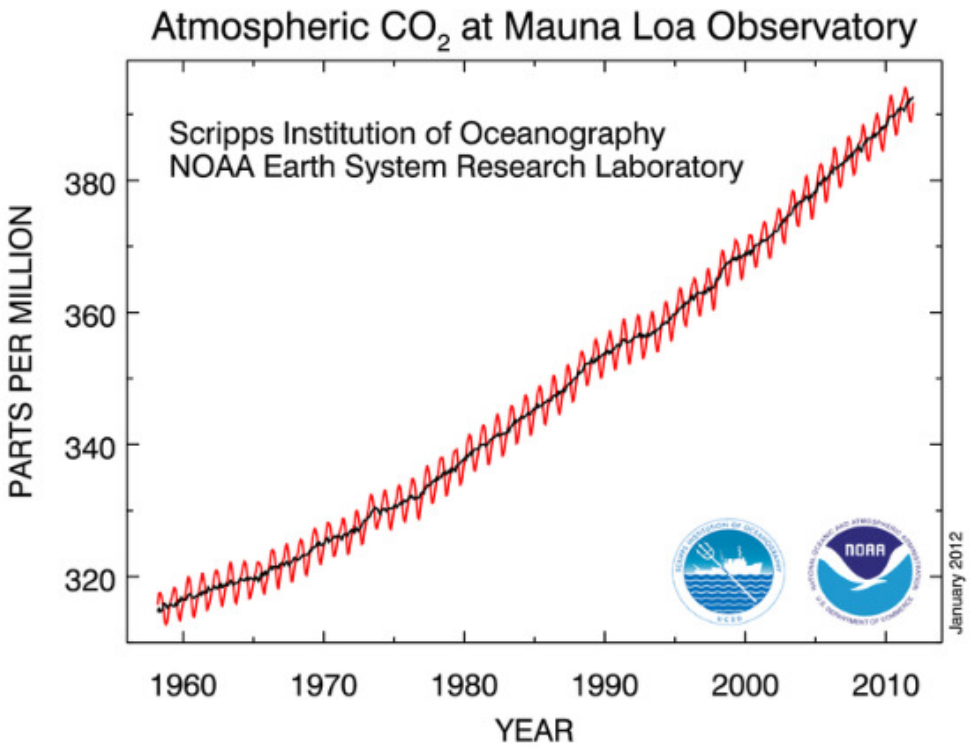
THE NATIONAL ACADEMIES: SEATTLE
Feb. 7 – 8, 2012

THE LAURENTIAN GREAT LAKES IN A CHANGING CLIMATE

(The Energy-Water Nexus)

J. P. Bruce





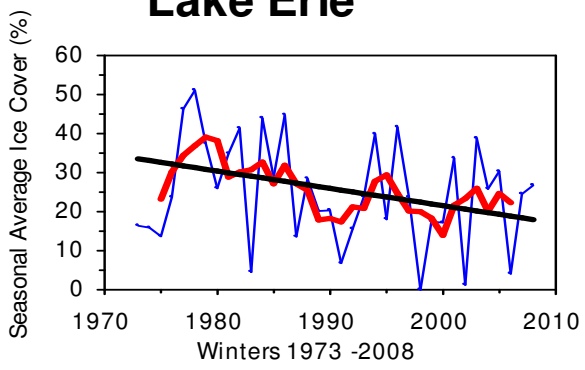
The concentration of carbon dioxide is higher today than in a million years.

INTERNATIONAL ENERGY AGENCY REPORT: NOVEMBER 2007

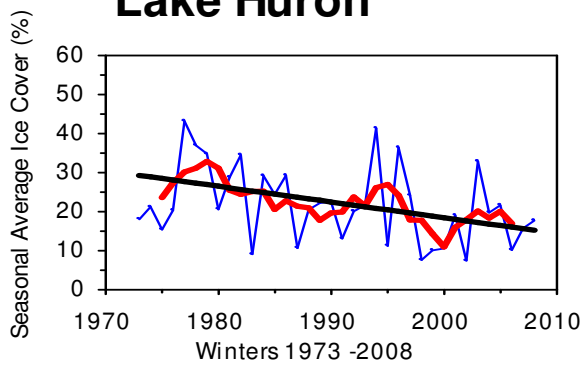
GLOBALLY: between 2005 and 2030

- **Primary energy requirements up 55%**
- **Unchecked growth in fossil fuel use will hasten climate change**
- **Emissions jump 57% - greater than highest IPCC scenario**
- **2/3 of contributions from U.S.A., China, Russia and India**
- **warming and rain intensities will increase more rapidly than IPCC projections**

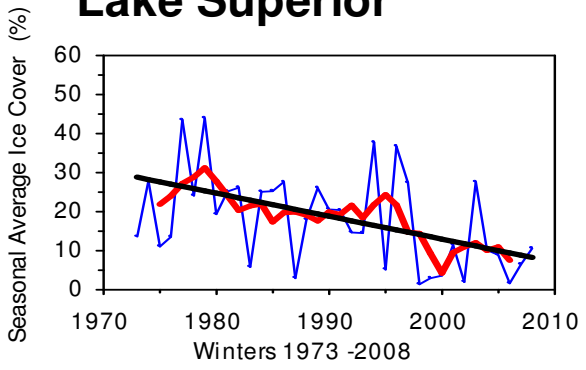
Lake Erie



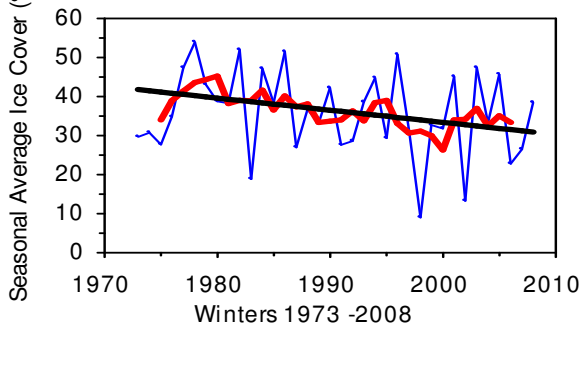
Lake Huron



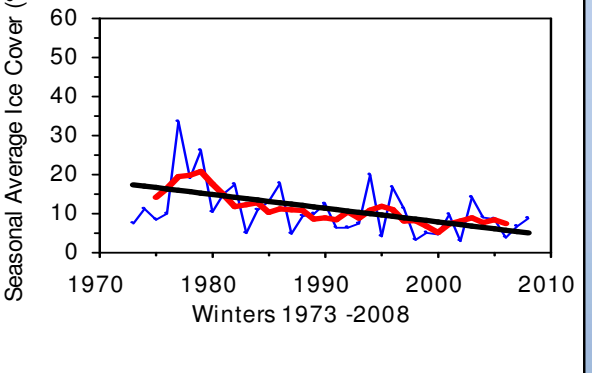
Lake Superior



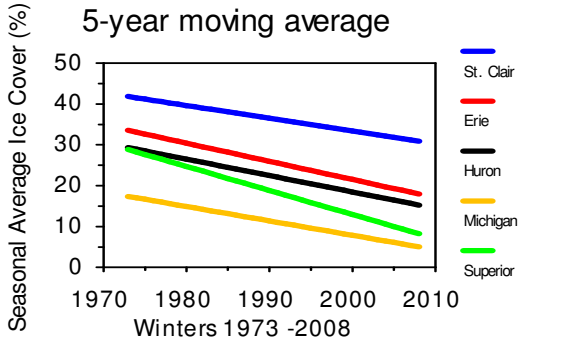
Lake St. Clair



Lake Michigan



Linear Trends

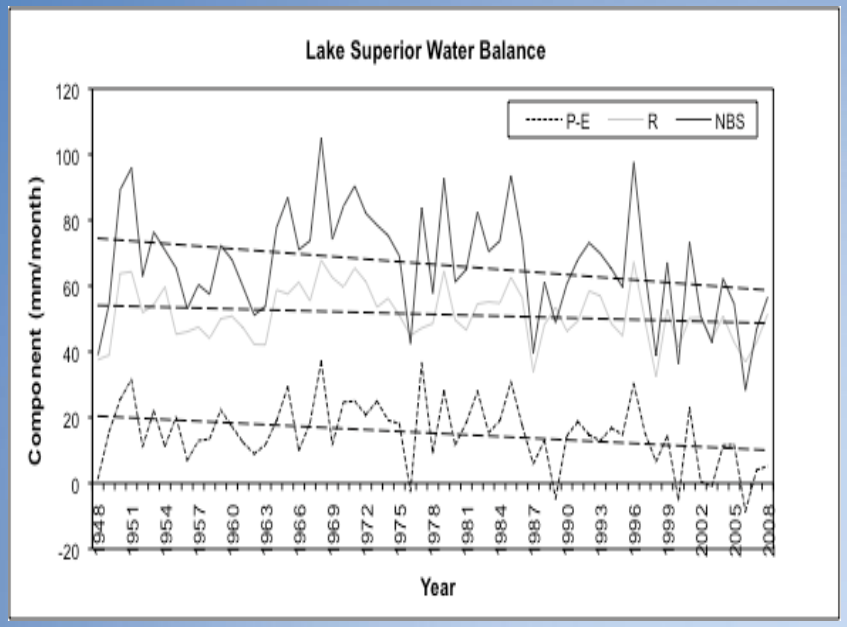


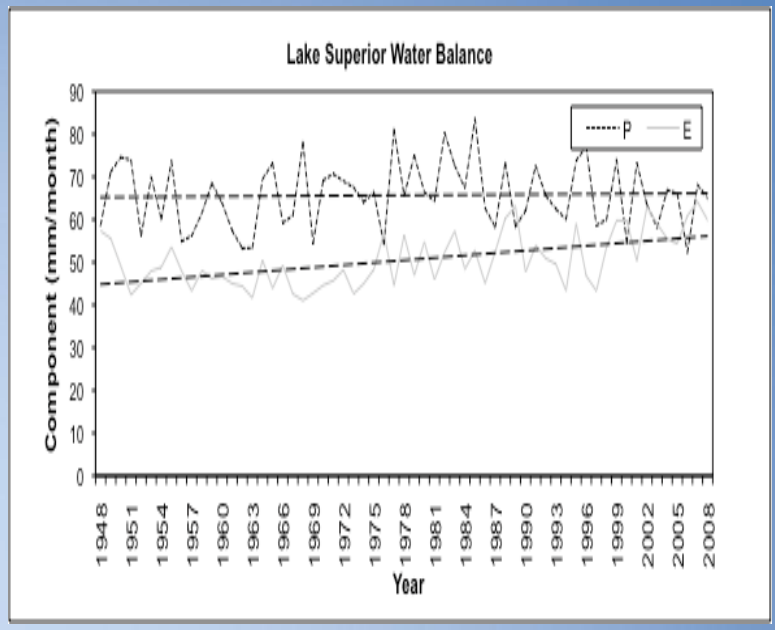
A WORLD WITHOUT ICE
By Henry Pollack

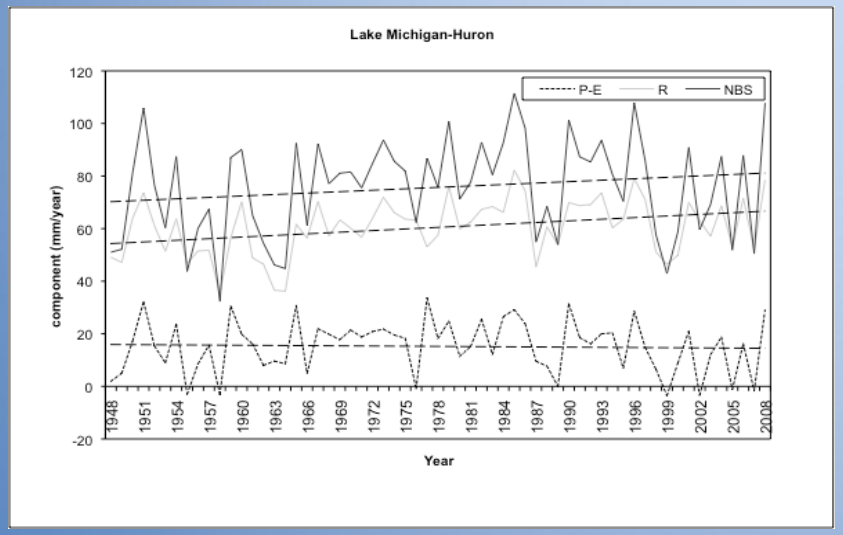
Ice asks no questions, presents no arguments, reads no newspapers, listens to no debates. It is not bounded by ideology and carries no political baggage … it just melts.

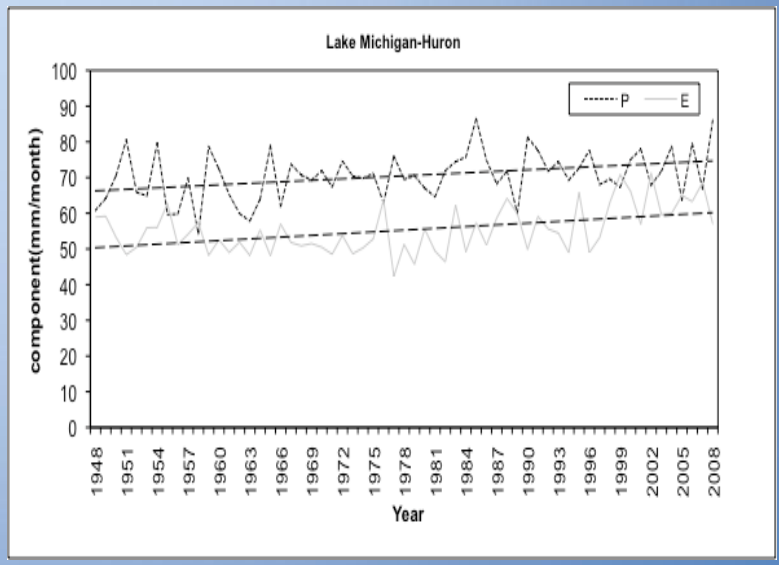
GREAT LAKES PHYSICAL CHANGES OBSERVED PAST 4-5 DECADES

- Loss of winter lake ice cover
- Higher water temperatures
- Amplified seasonal cycle of lake levels
- Longer stratification periods
- Increased spring storminess
- Increased wind speeds, especially autumn and winter
- Increased lake evaporation
- Increased lake-effect precipitation









Grunewald and Fortin, 2011

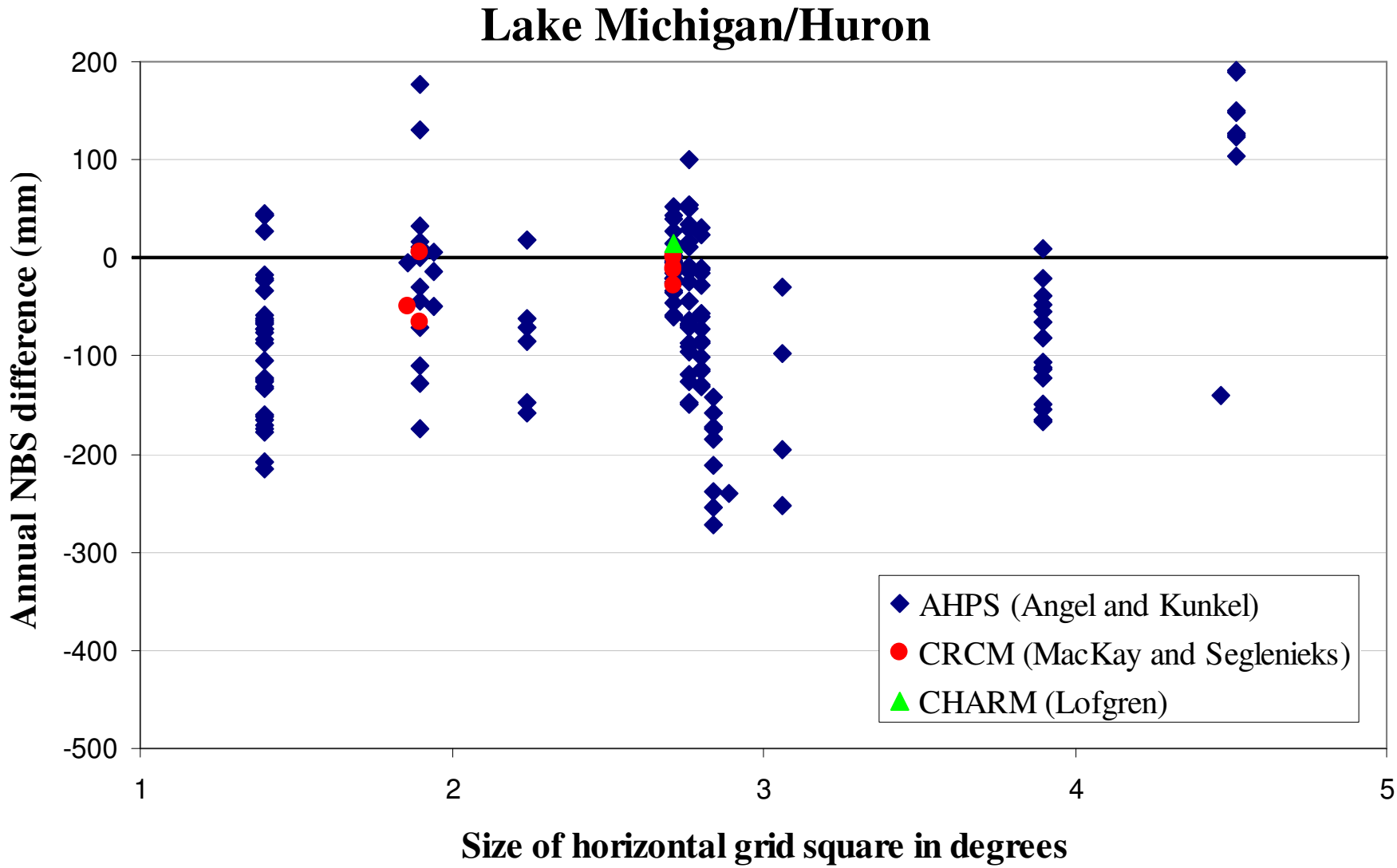
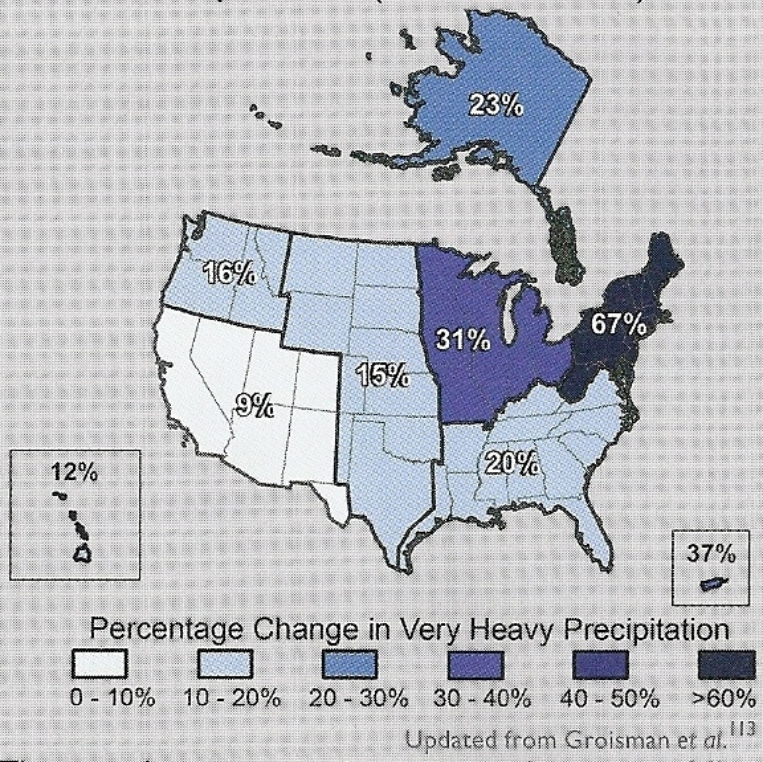


Figure 15 -Annual NBS difference using different downscaling method for Lake Michigan-Huron.

U.S. Global Change Research Program

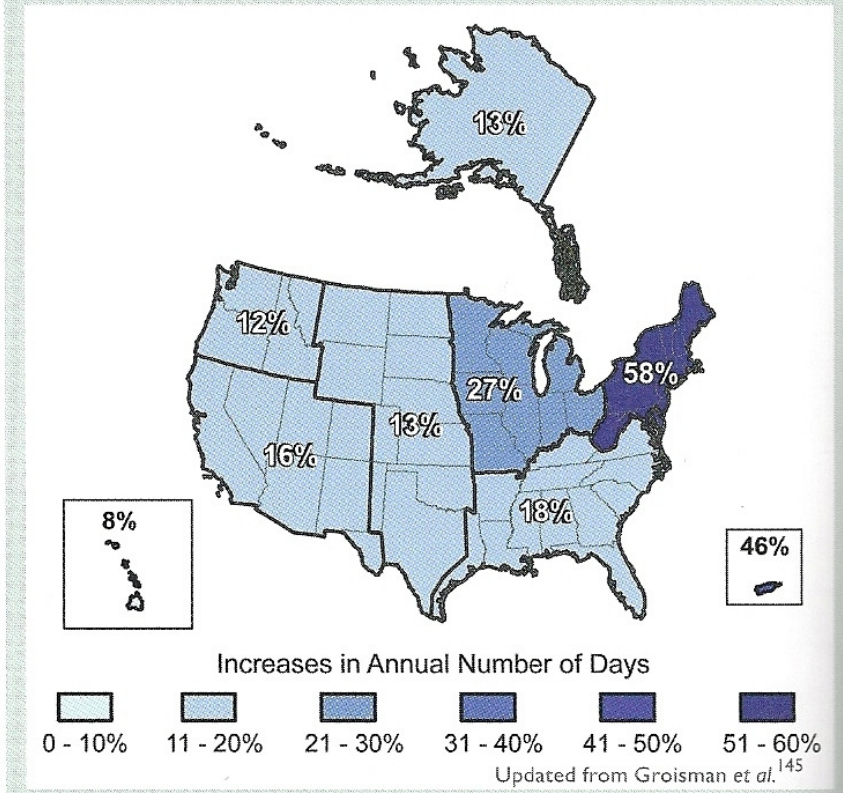
Increases in Amounts of Very Heavy Precipitation (1958 to 2007)



Updated from Groisman *et al.*[113]

The map shows percent increases in the amount falling in very heavy precipitation events (defined as the heaviest 1 percent of all daily events) from 1958 to 2007 for each region. There are clear trends toward more very heavy precipitation for the nation as a whole, and particularly in the Northeast and Midwest.

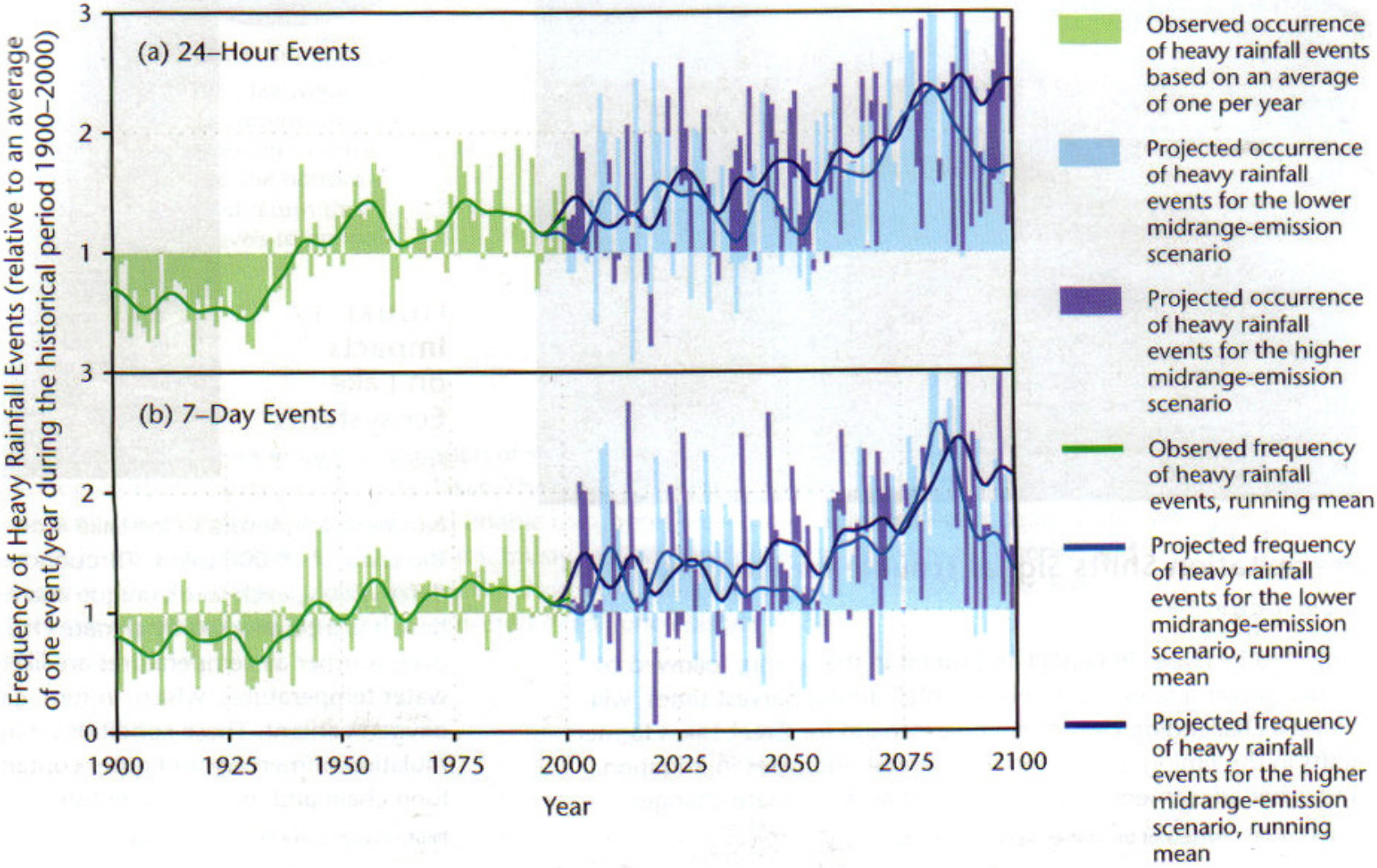
Increases in the Number of Days with Very Heavy Precipitation (1958 to 2007)

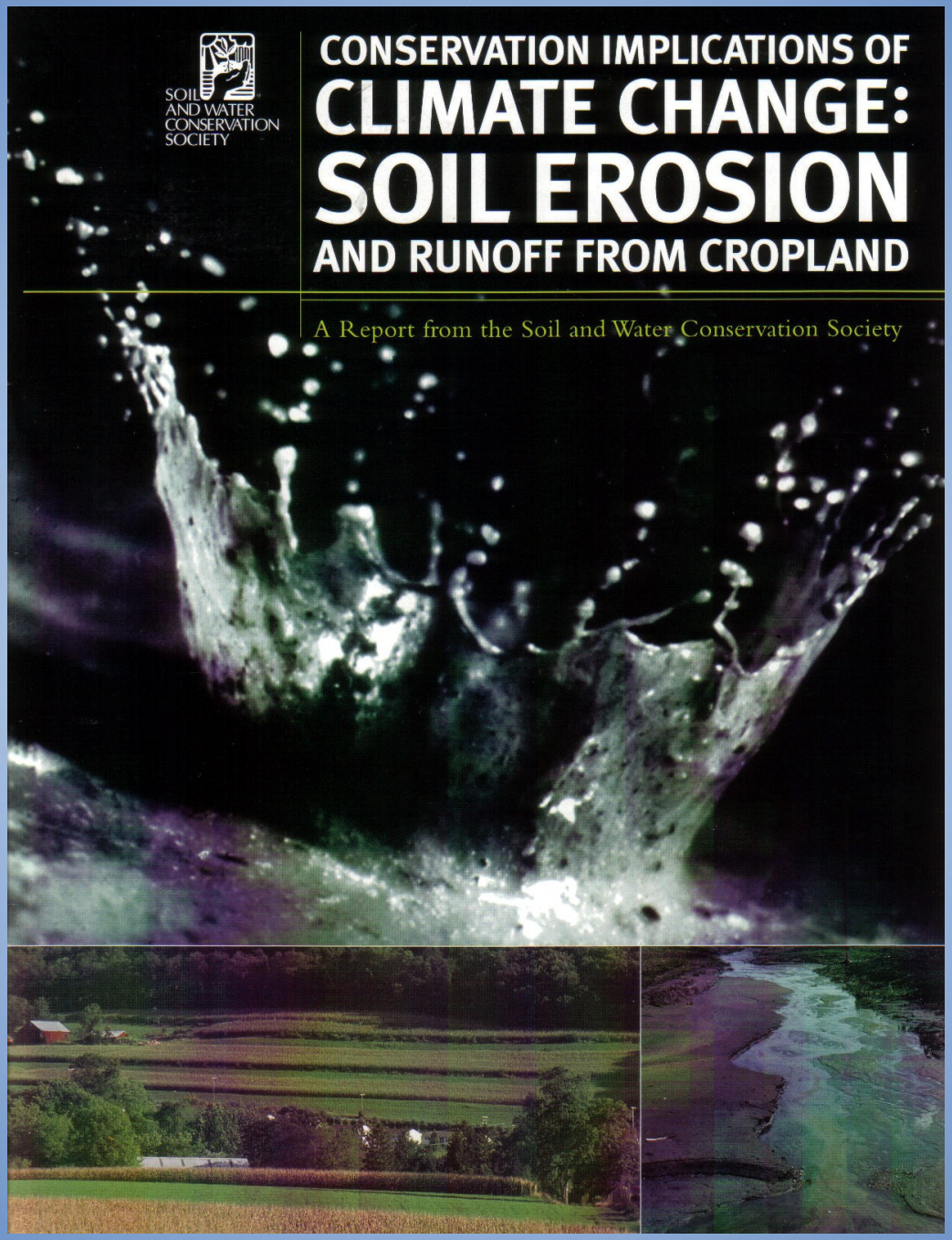


Updated from Groisman *et al.*[145]

The map shows the percentage increases in the average number of days with very heavy precipitation (defined as the heaviest 1 percent of all events) from 1958 to 2007 for each region. There are clear trends toward more days with very heavy precipitation for the nation as a whole, and particularly in the Northeast and Midwest.

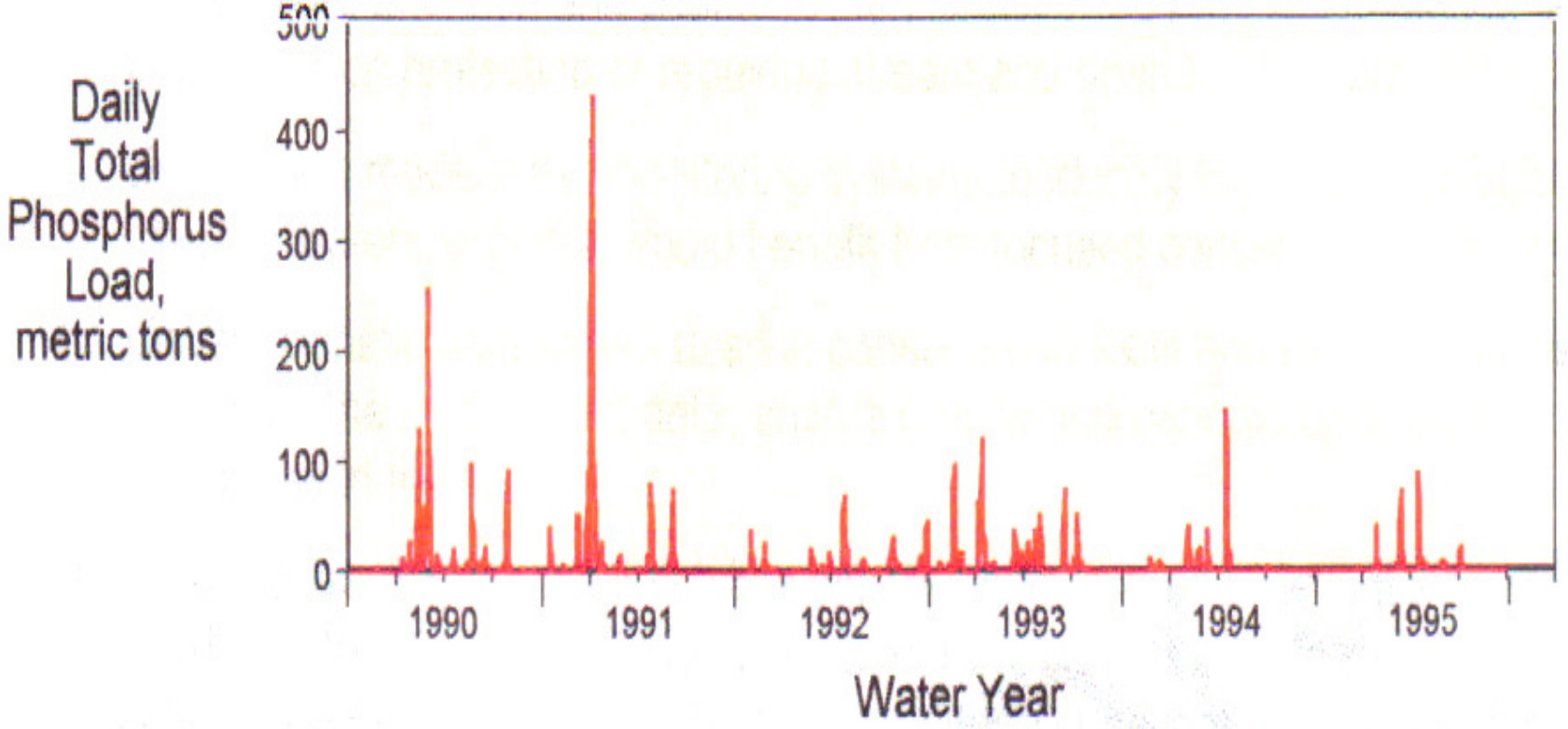
Heavy Rainfall Events in the Great Lakes Region



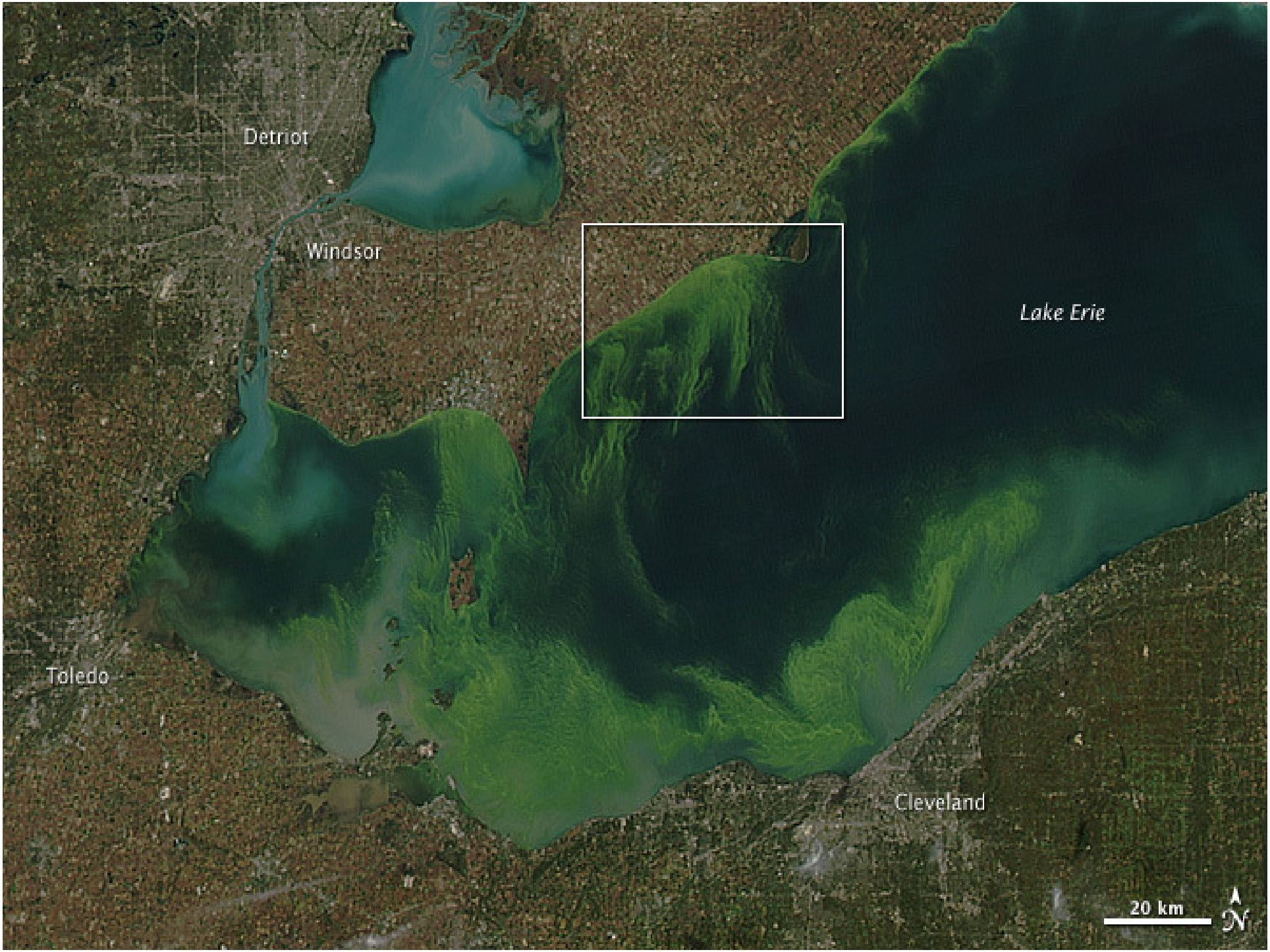

SOIL AND WATER CONSERVATION SOCIETY
CONSERVATION IMPLICATIONS OF
CLIMATE CHANGE:
SOIL EROSION
AND RUNOFF FROM CROPLAND
A Report from the Soil and Water Conservation Society

Impact of Severe Storms on Lake Erie

Daily Loads of Phosphorus from the Maumee River, Ohio




Lake Erie
5 km
N


Detriot
Windsor
Lake Erie
Toledo
Cleveland
20 km
N