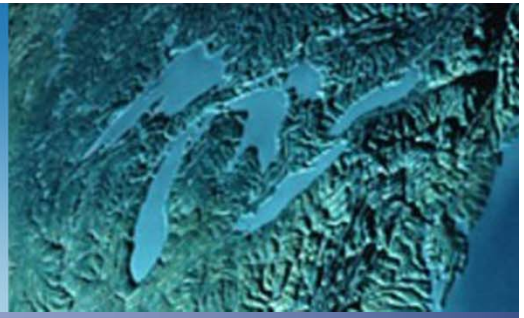
Great Lakes Coastal Flood Mapping Program

greatlakescoast.org



FEMA

Great Lakes Coastal Flood Study

Alan R Lulloff , P.E., CFM

Association of State Floodplain Managers

alan@floods.org

US ARMY CORP OF ENGINEERS DETROIT DISTRICT

ERDC

FEMA

RiskMAP

Increasing Resilience Together

Association of State Floodplain Managers

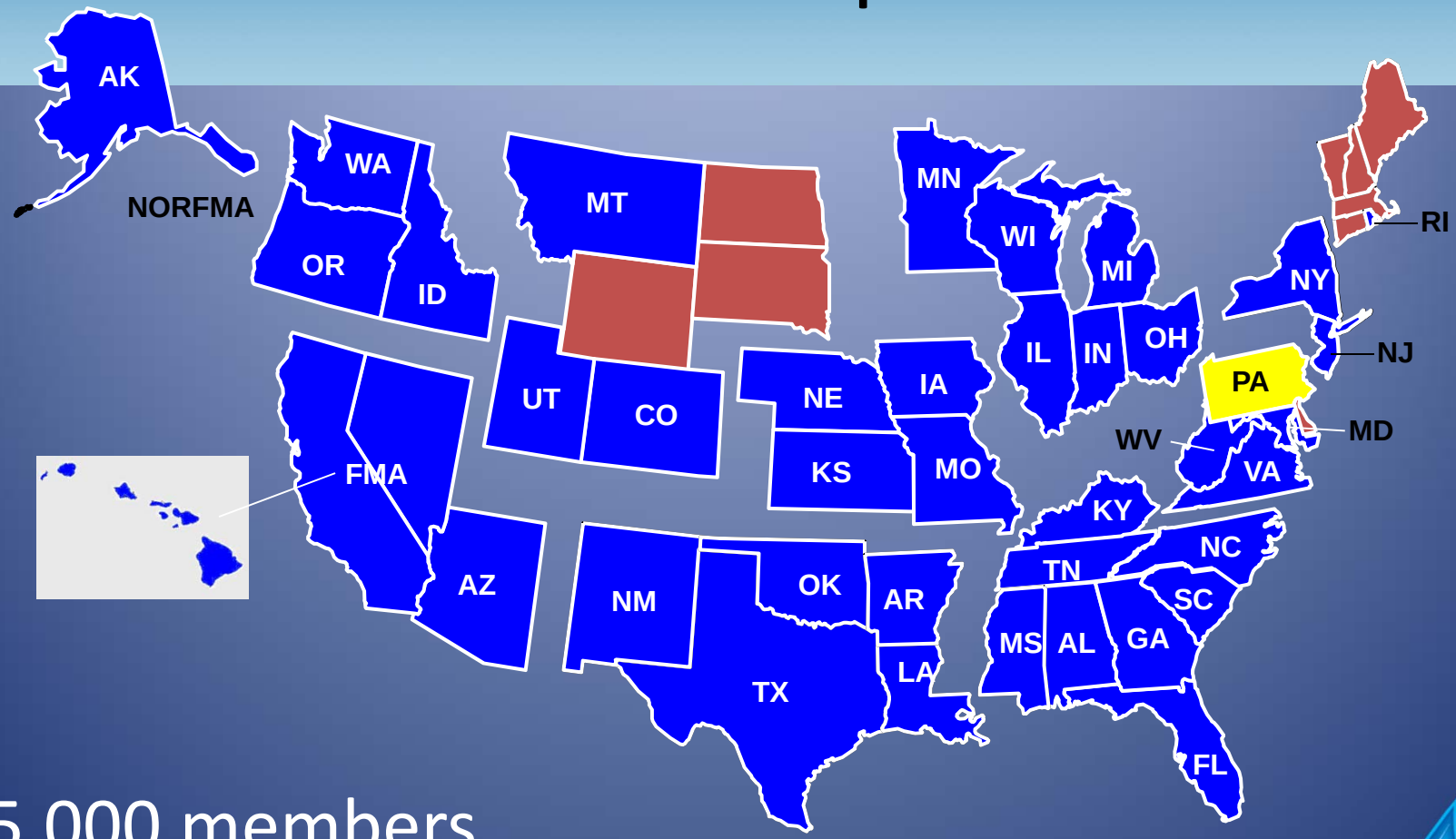
ASFPM's Mission

Mitigate the losses, costs, and human suffering caused by flooding.

and

Protect the natural and beneficial functions of floodplains.

ASFPM Chapters



15,000 members

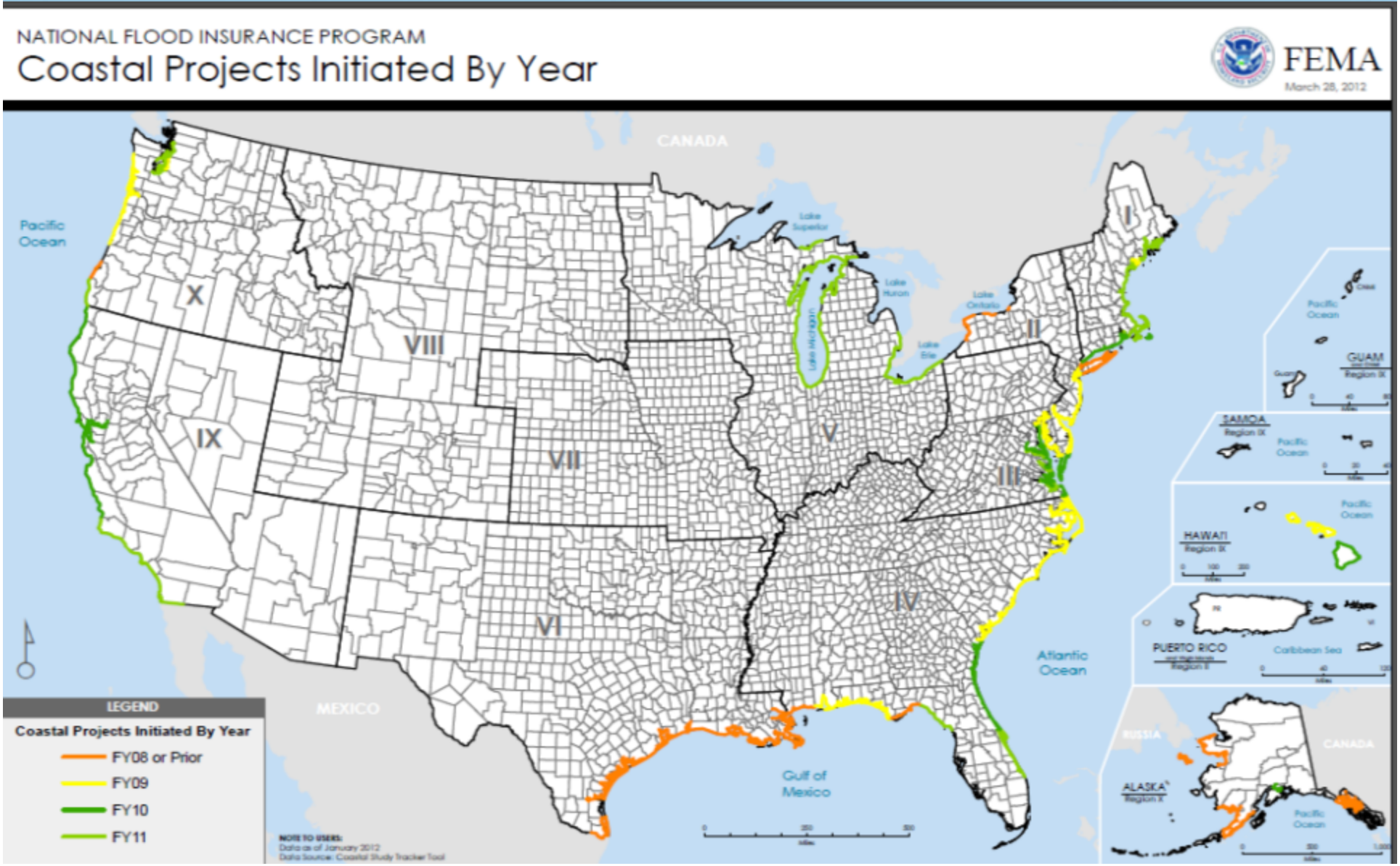
35 Chapters

State Associations & Pending Chapters

Title

- Water levels (short title)
- Why is FEMA mapping flooding hazards when lake levels are low?

FEMA Coastal Studies



Great Lakes Coastal Flood Study

The initiative is a system-wide solution that provides a comprehensive analysis of storm and high water events within the Great Lakes Basin

Generalized Coastal Zone Schematic

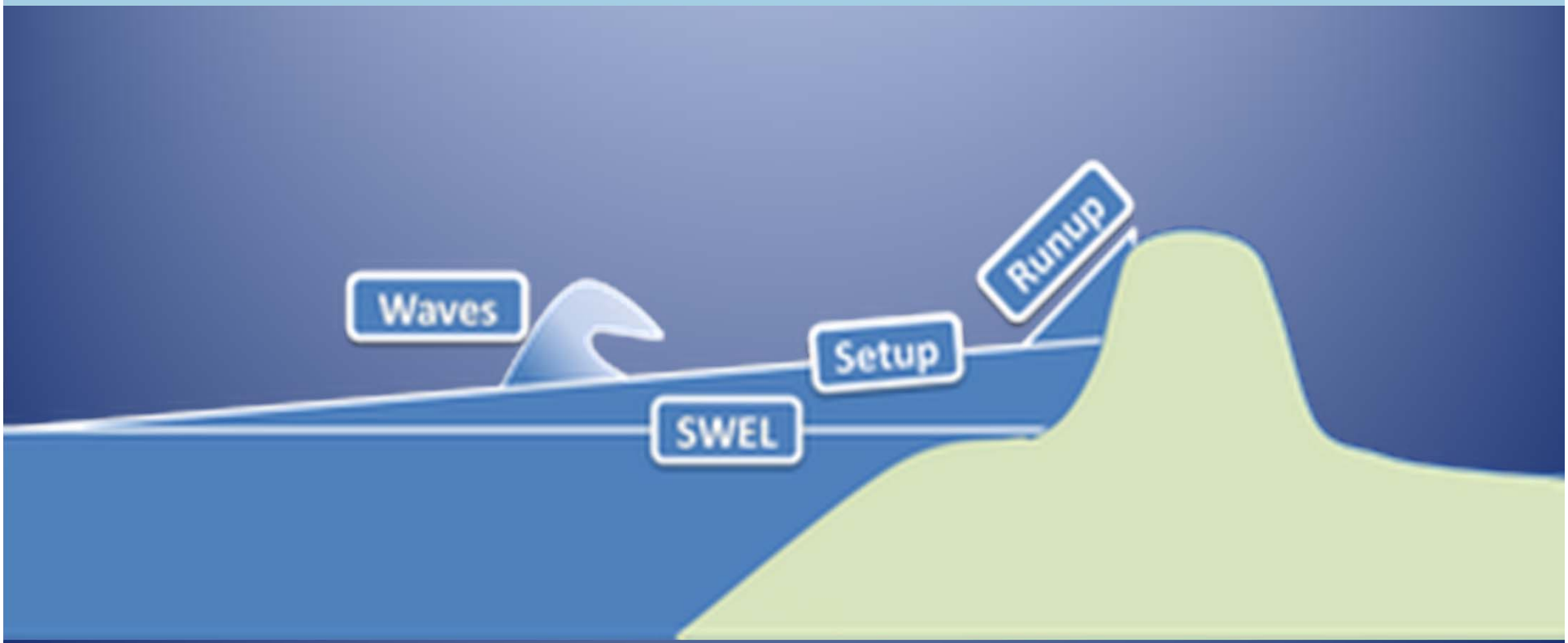
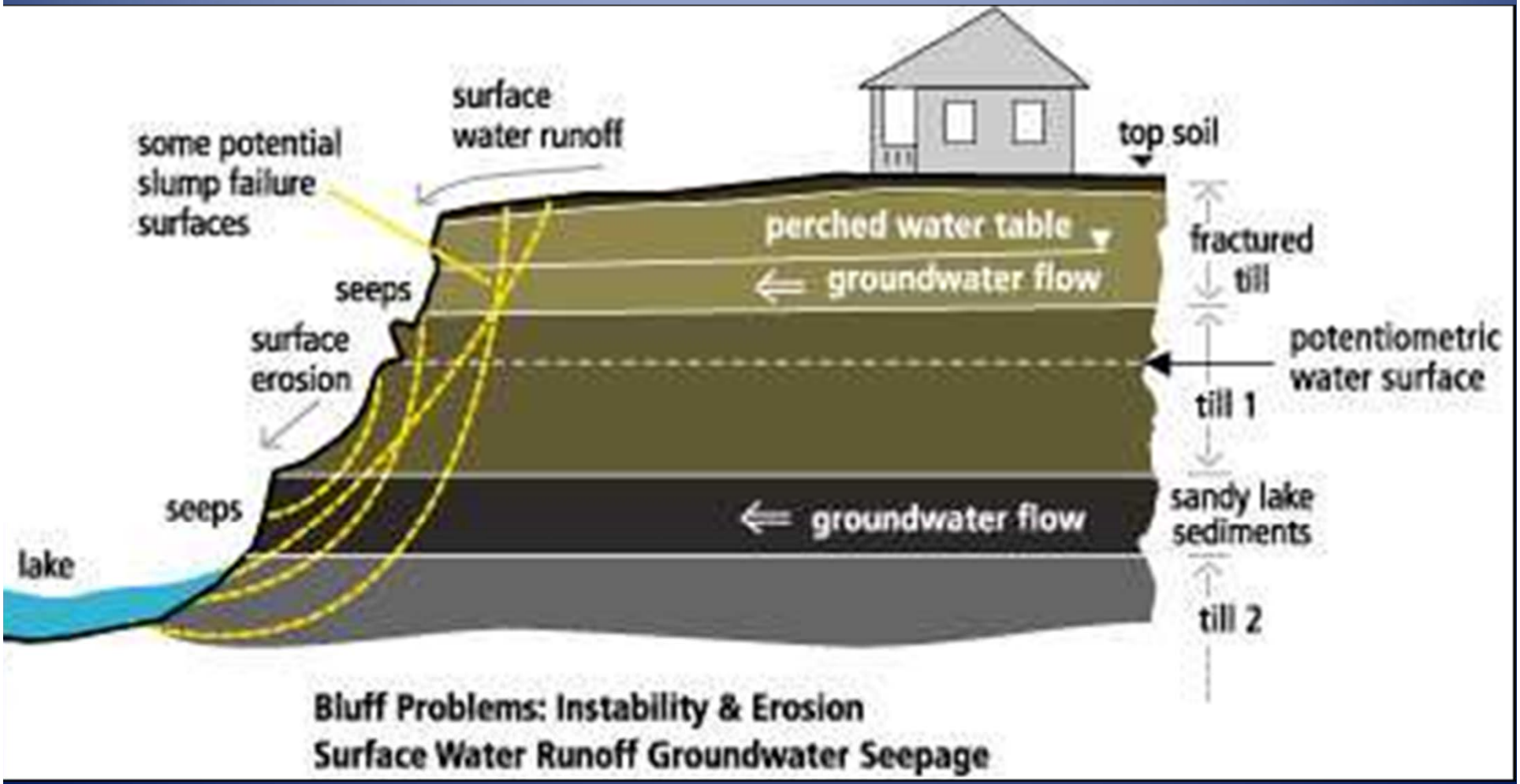
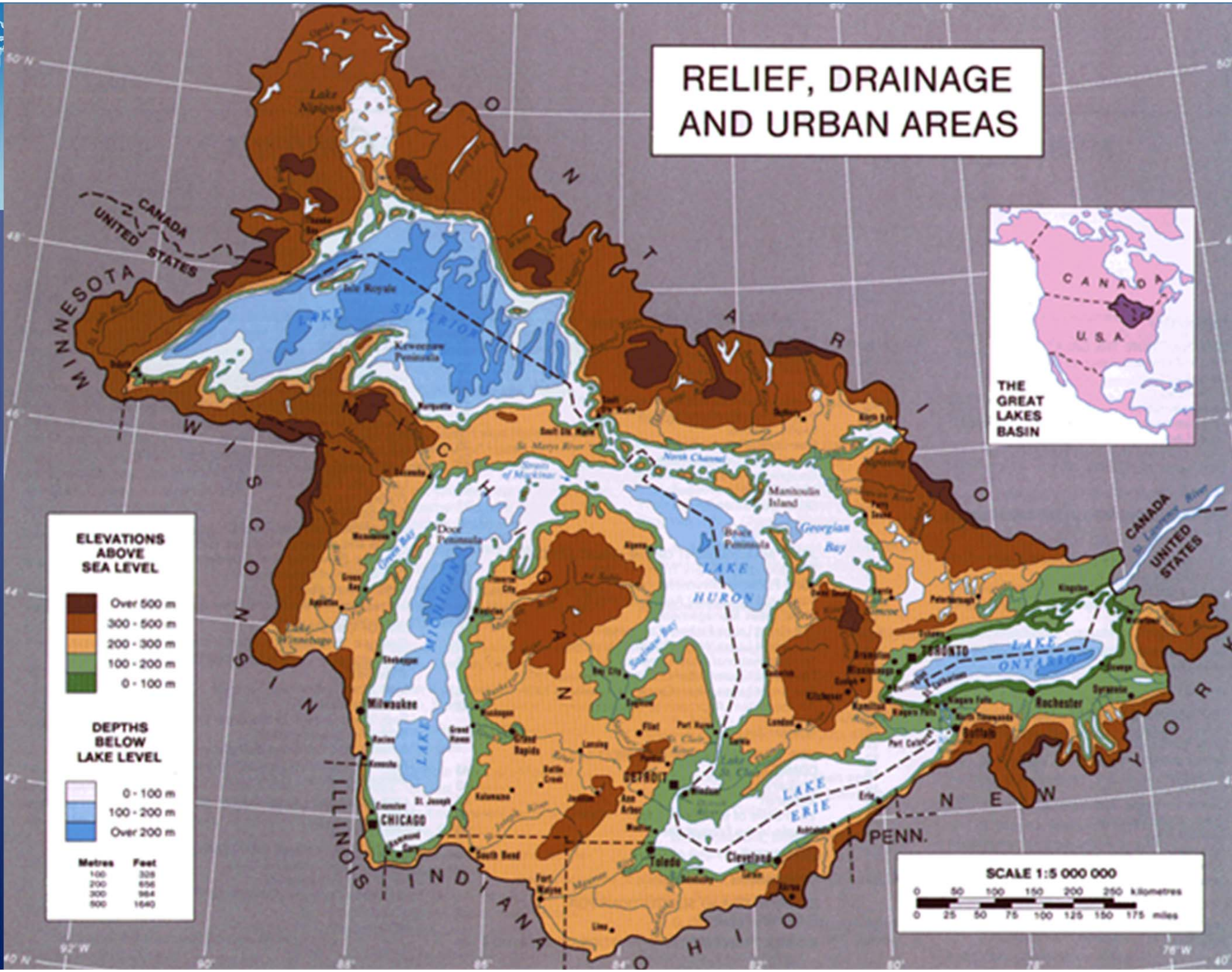
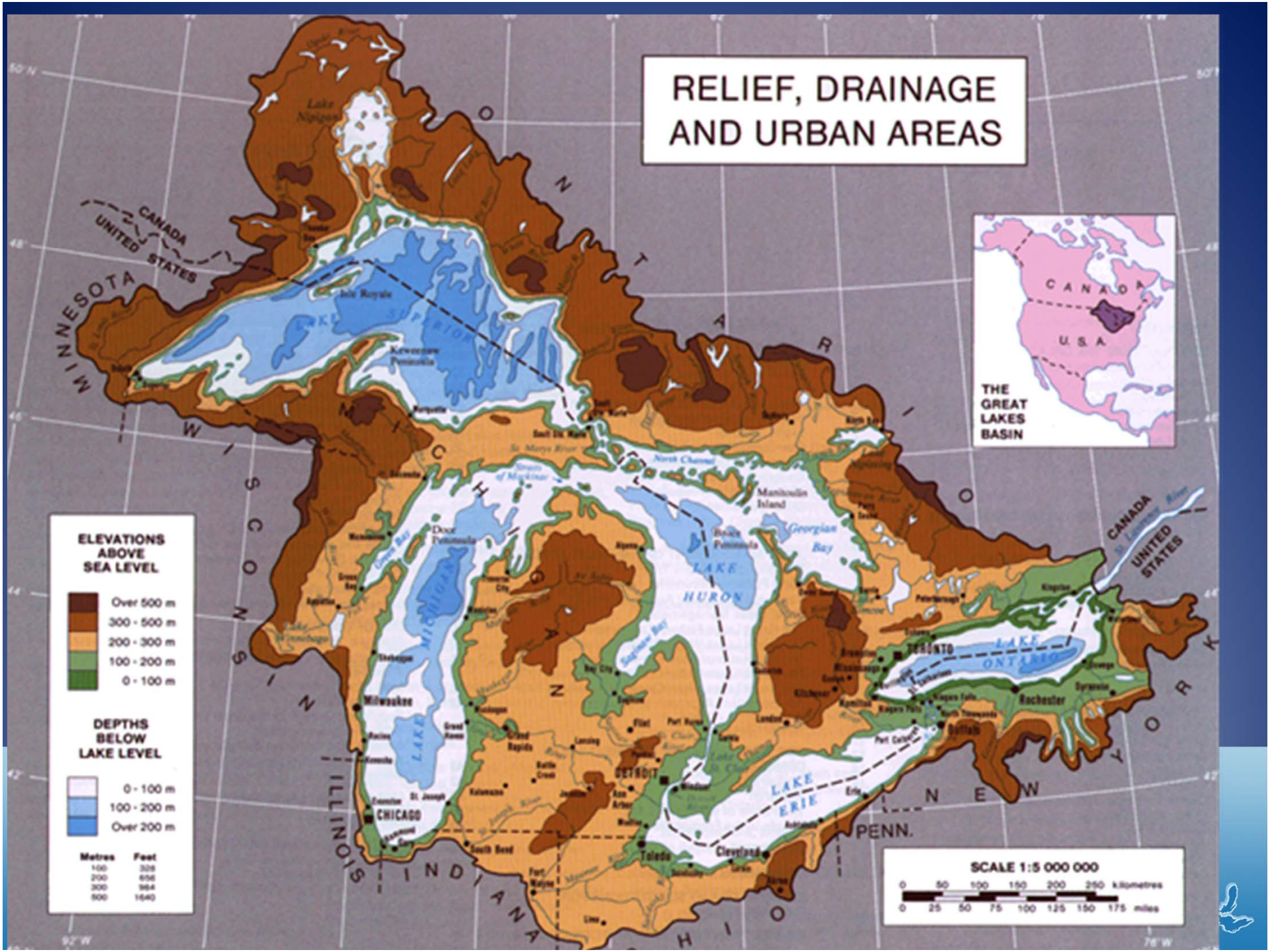


Photo: *Timaru Herald*


surface
water runoff
some potential
slump failure
surfaces
top soil
perched water table
groundwater flow
fractured
till
seeps
surface
erosion
potentiometric
water surface
till 1
seeps
groundwater flow
sandy lake
sediments
lake
till 2
Bluff Problems: Instability & Erosion
Surface Water Runoff Groundwater Seepage


RELIEF, DRAINAGE AND URBAN AREAS
ELEVATIONS ABOVE SEA LEVEL
Over 500 m
300 - 500 m
200 - 300 m
100 - 200 m
0 - 100 m
DEPTHS BELOW LAKE LEVEL
0 - 100 m
100 - 200 m
Over 200 m
Metres
Feet
100
328
200
656
300
984
500
1640
THE GREAT LAKES BASIN
CANADA
U.S.A.
SCALE 1:5 000 000
0
50
100
150
200
250
kilometres
0
25
50
75
100
125
150
175
miles
CANADA
UNITED STATES
MINNESOTA
WISCONSIN
ILLINOIS
INDIANA
OHIO
PENN.
NEW YORK
MICHIGAN
ONTARIO
LAKE SUPERIOR
LAKE MICHIGAN
LAKE HURON
LAKE ERIE
LAKE ONTARIO
Georgian Bay
Manitoulin Island
Milwaukee
CHICAGO
DETROIT
TORONTO
Rochester
Buffalo
Cleveland
Toledo


RELIEF, DRAINAGE AND URBAN AREAS
CANADA
UNITED STATES
MINNESOTA
WISCONSIN
MICHIGAN
ILLINOIS
INDIANA
OHIO
PENN.
NEW YORK
ONTARIO
Lake Nipigon
Isle Royale
Keweenaw Peninsula
Door Peninsula
Bruce Peninsula
Manitoulin Island
Georgian Bay
LAKE HURON
LAKE MICHIGAN
LAKE ERIE
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ELEVATIONS ABOVE SEA LEVEL
Over 500 m
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0 - 100 m
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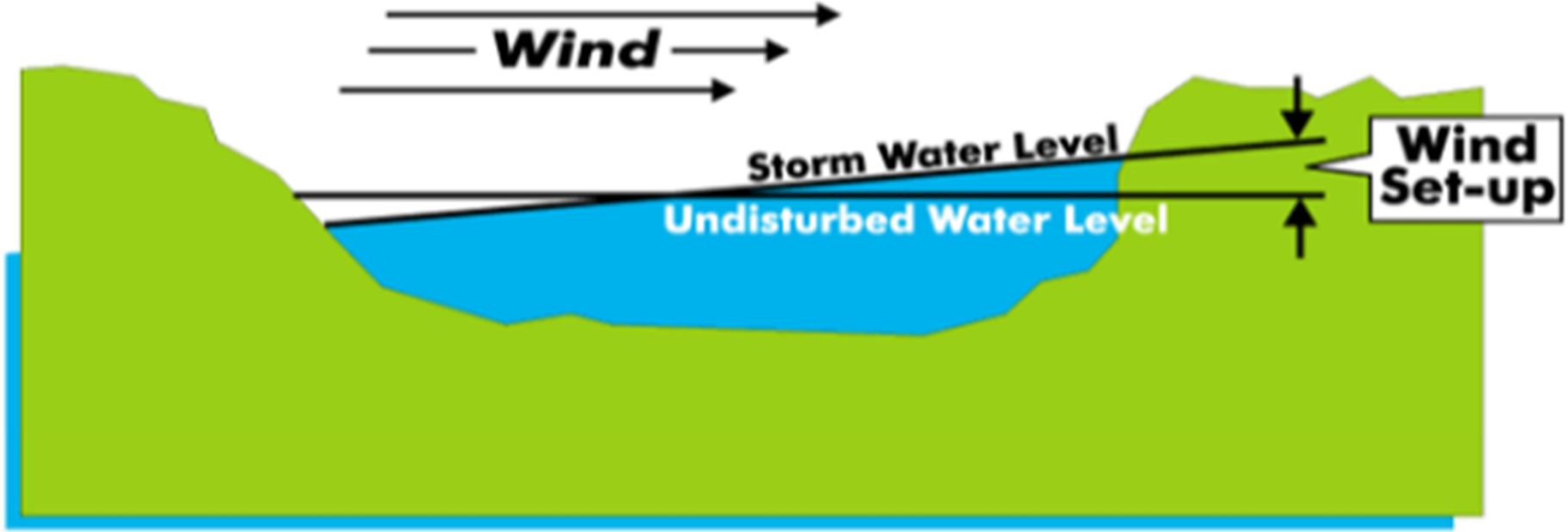
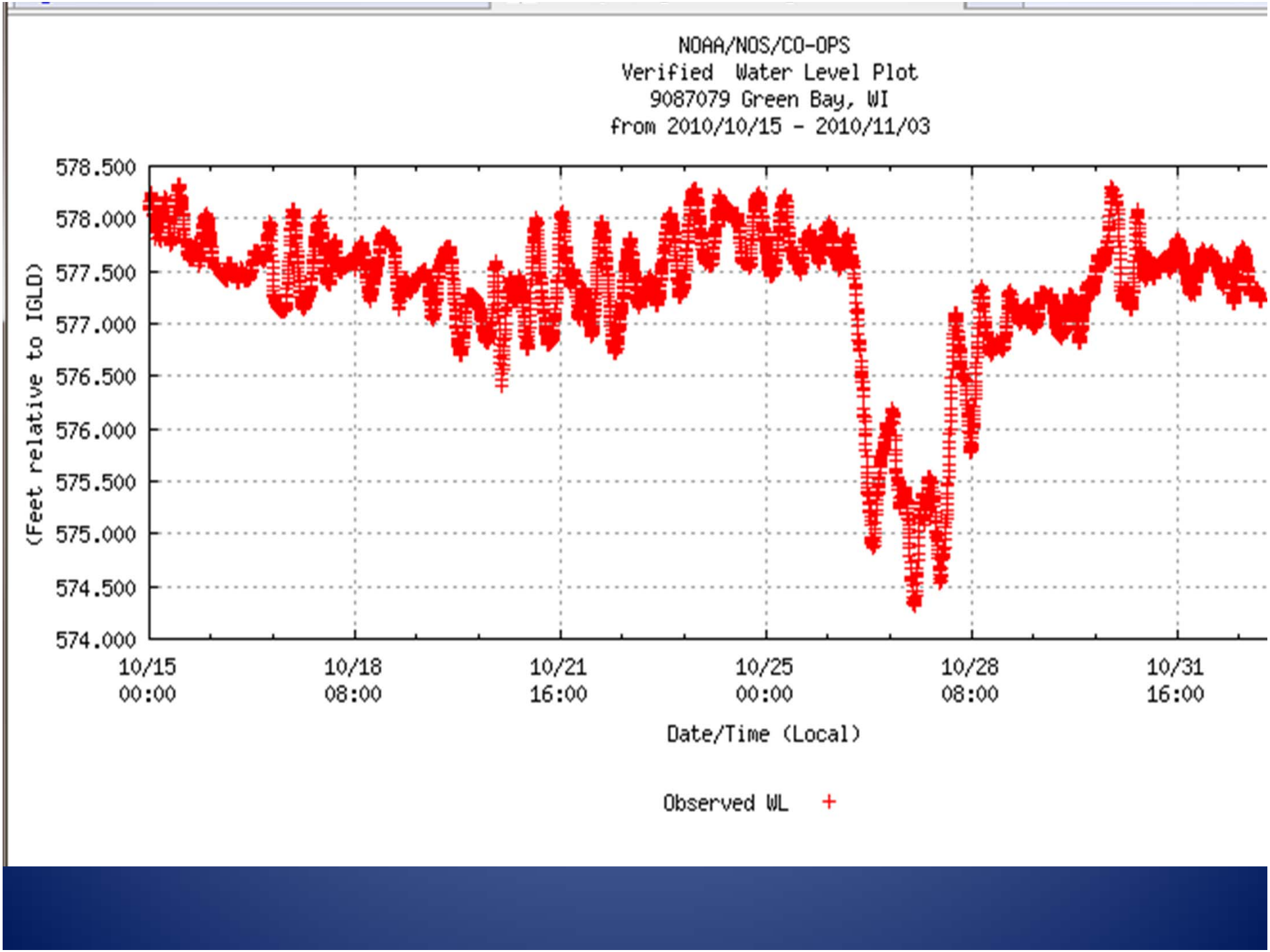
0 - 100 m
100 - 200 m
Over 200 m
Metres Feet
100 328
200 656
300 984
500 1640
SCALE 1:5 000 000
0 50 100 150 200 250 kilometres
0 25 50 75 100 125 150 175 miles



Lake profile showing wind set-up


NOAA/NOS/CO-OPS
Verified Water Level Plot
9087079 Green Bay, WI
from 2010/10/15 - 2010/11/03
(Feet relative to IGLD)
578.500
578.000
577.500
577.000
576.500
576.000
575.500
575.000
574.500
574.000
10/15
00:00
10/18
08:00
10/21
16:00
10/25
00:00
10/28
08:00
10/31
16:00
Date/Time (Local)
Observed WL

Great Lakes Flood Hazard Mapping (GLFHM)

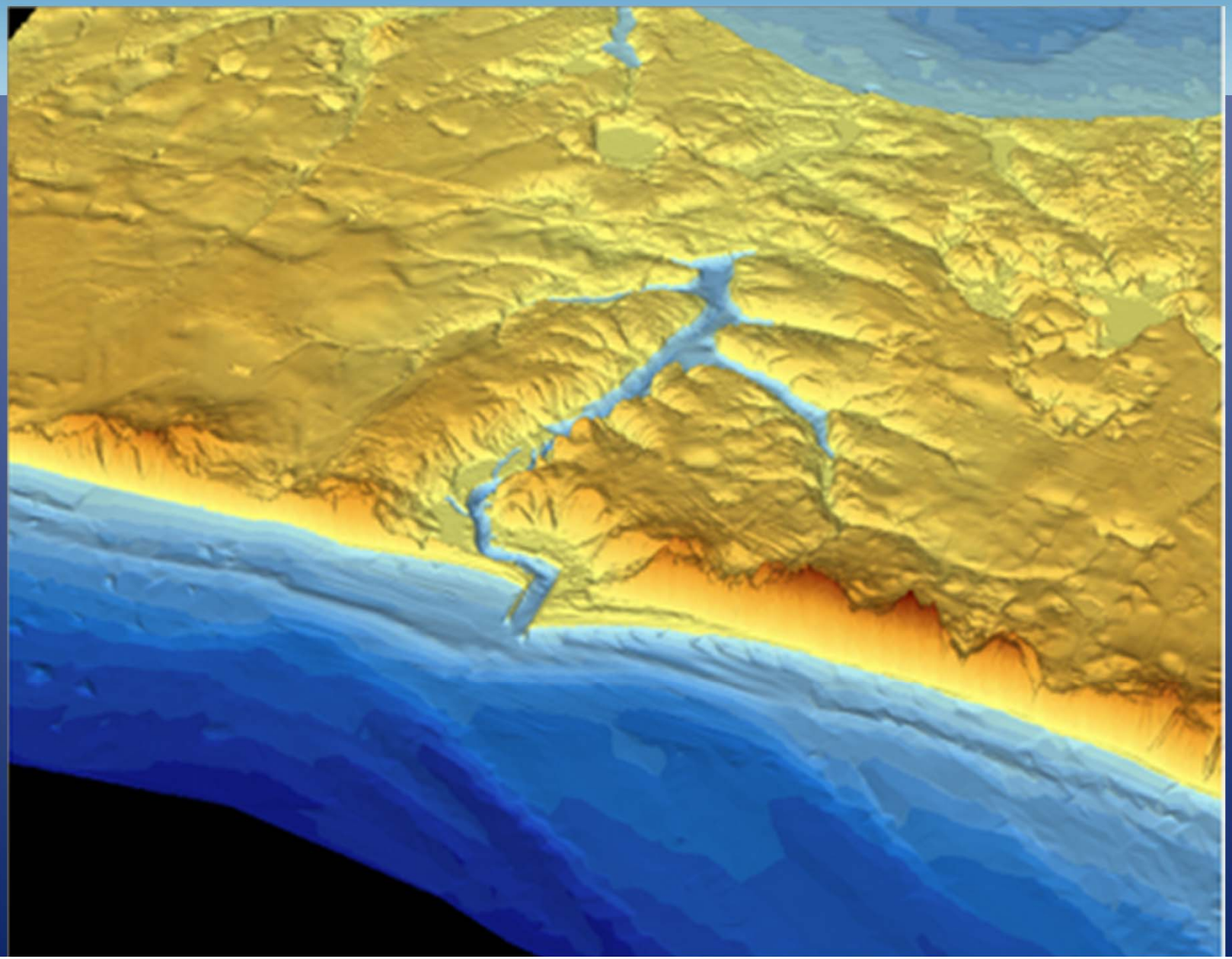
Collaborative Project Between:

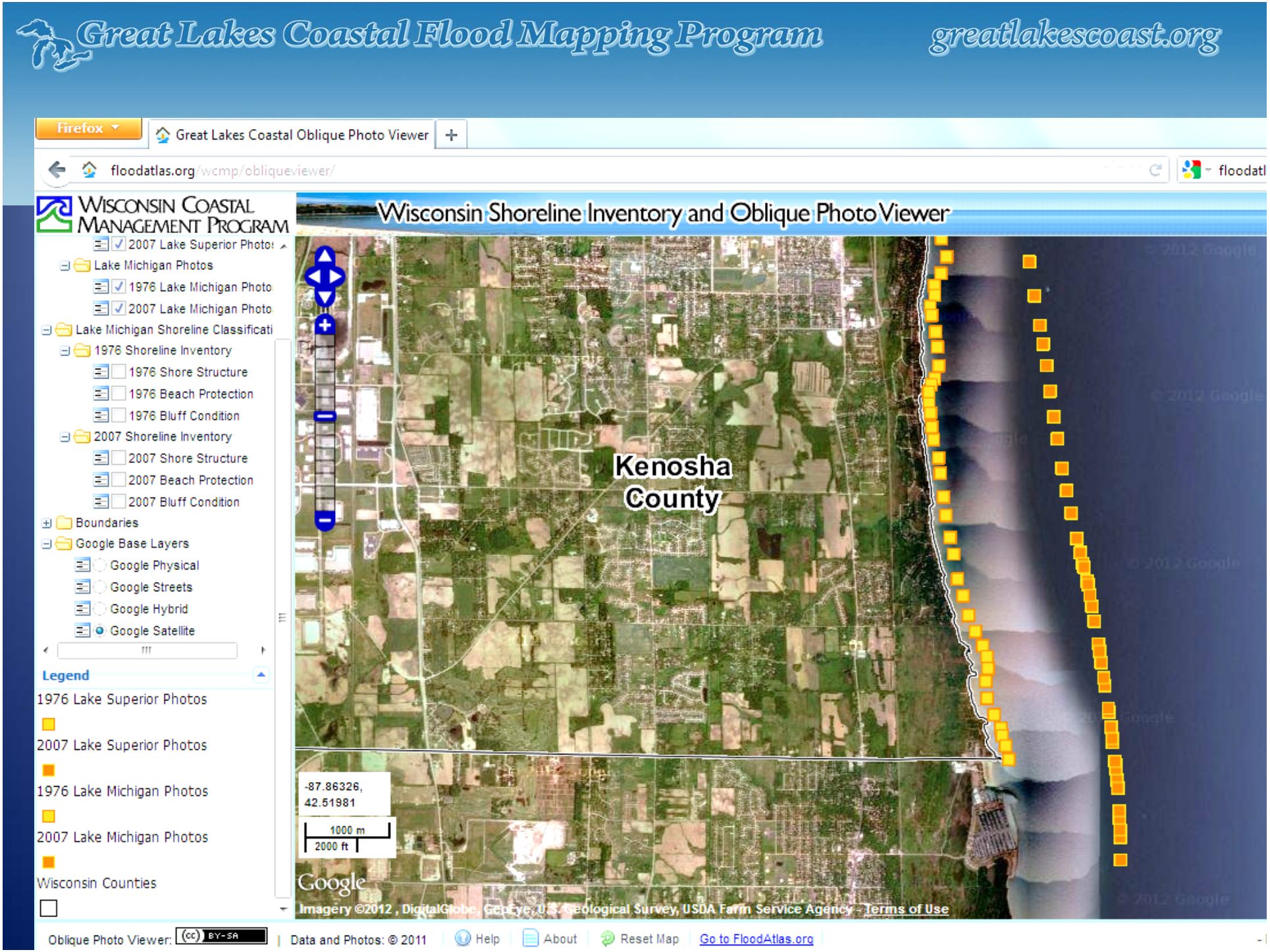
FEMA Region 5 (Lead)

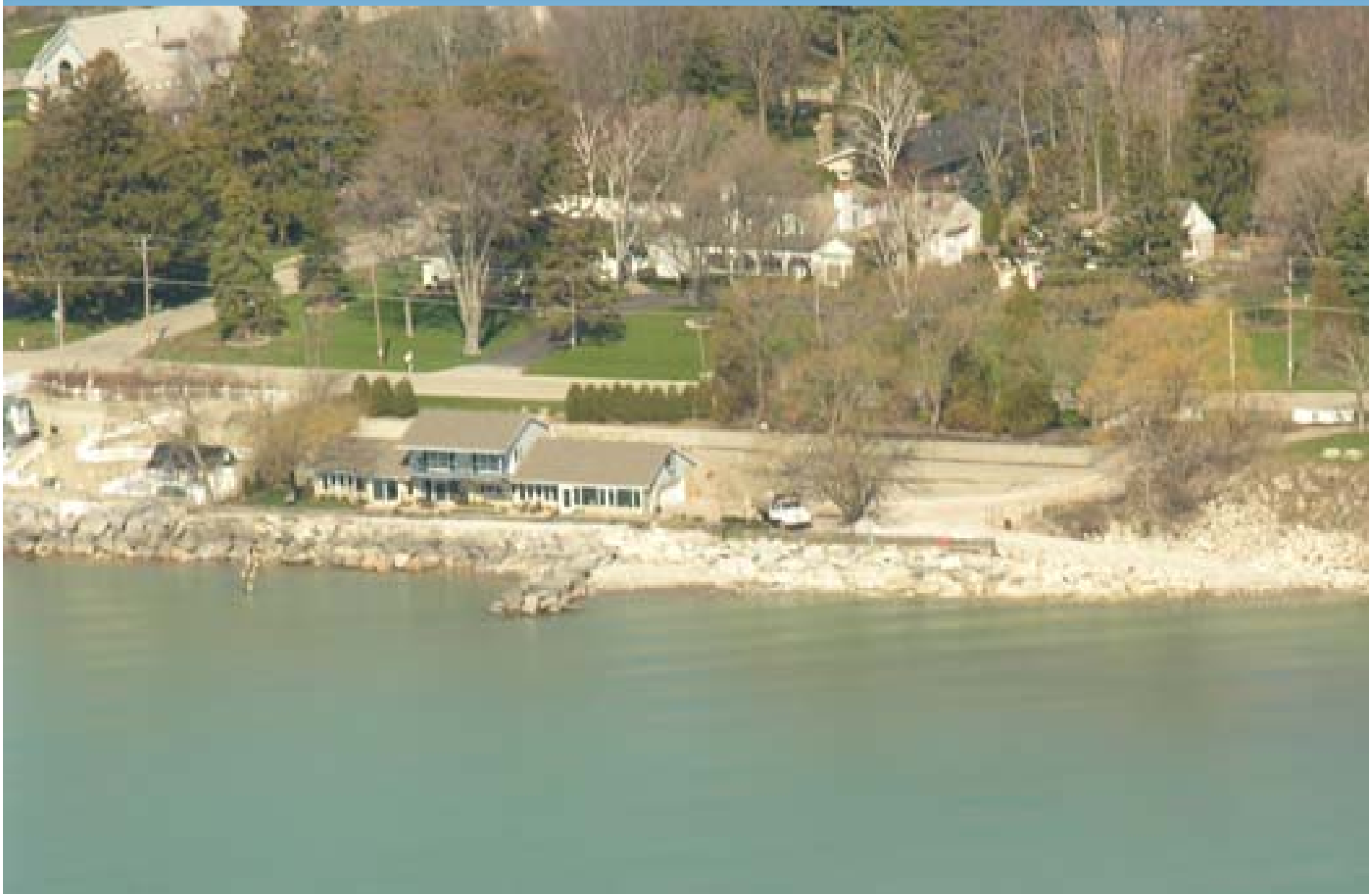
FEMA Region 2

FEMA Region 3

Detroit District USACE




Great Lakes Coastal Flood Mapping Program
greatlakescoast.org
Firefox
Great Lakes Coastal Oblique Photo Viewer
floodatlas.org/wcmp/obliqueviewer/
Wisconsin Coastal Management Program
Wisconsin Shoreline Inventory and Oblique Photo Viewer
2007 Lake Superior Photos
Lake Michigan Photos
1976 Lake Michigan Photos
2007 Lake Michigan Photos
Lake Michigan Shoreline Classificati
1976 Shoreline Inventory
1976 Shore Structure
1976 Beach Protection
1976 Bluff Condition
2007 Shoreline Inventory
2007 Shore Structure
2007 Beach Protection
2007 Bluff Condition
Boundaries
Google Base Layers
Google Physical
Google Streets
Google Hybrid
Google Satellite
Legend
1976 Lake Superior Photos
2007 Lake Superior Photos
1976 Lake Michigan Photos
2007 Lake Michigan Photos
Wisconsin Counties
Kenosha County
-87.86326, 42.51981
1000 m
2000 ft
Google
Imagery ©2012 , DigitalGlobe, GeoEye, U.S. Geological Survey, USDA Farm Service Agency - Terms of Use
Oblique Photo Viewer:
Data and Photos: © 2011
Help
About
Reset Map
Go to FloodAtlas.org



Welcome to GreatLakesCoast.org

- Great Lakes Coastal Analysis & Mapping
  - Wind Surge Study
  - Coastal Hazard Analysis & Mapping
  - Great Lakes Flood Zones Overview
  - Technical Resources
  - Outreach
    - Fact Sheets
    - Newsletters
    - Presentations
    - Events
    - Discovery Reports
- Additional Resources
- Contact Information
- Site Map

Search for:
Search

Home > Great Lakes Coastal Analysis & Mapping > **Technical Resources**

Technical Resources

Project Data Centers

- **C-STORM** [cstormdb.erdc.dren.mil] – Basin wave and storm surge database platform, for access to wind, waves, pressure, ice, and water level data at near-shore "Save Points"
  Note: This site will start with Lake Michigan data, followed by Lake St. Clair and Lake Erie data.
- **U.S. Army Corps of Engineers Great Lakes Oblique Photo Viewer** [greatlakes.usace.army.mil]
- **LiDAR** [csc.noaa.gov] – High-resolution bathymetric and topographic data housed at NOAA's Coastal Service Center
- **Great Lakes Shoreline Geodatabase (.gdb)** [2.4 MB .zip]
- **CSHORE** [sites.google.com] – CSHORE is a one-dimensional time-averaged nearshore profile model for predictions of wave height, water level, wave-induced steady currents, and profile evolution.

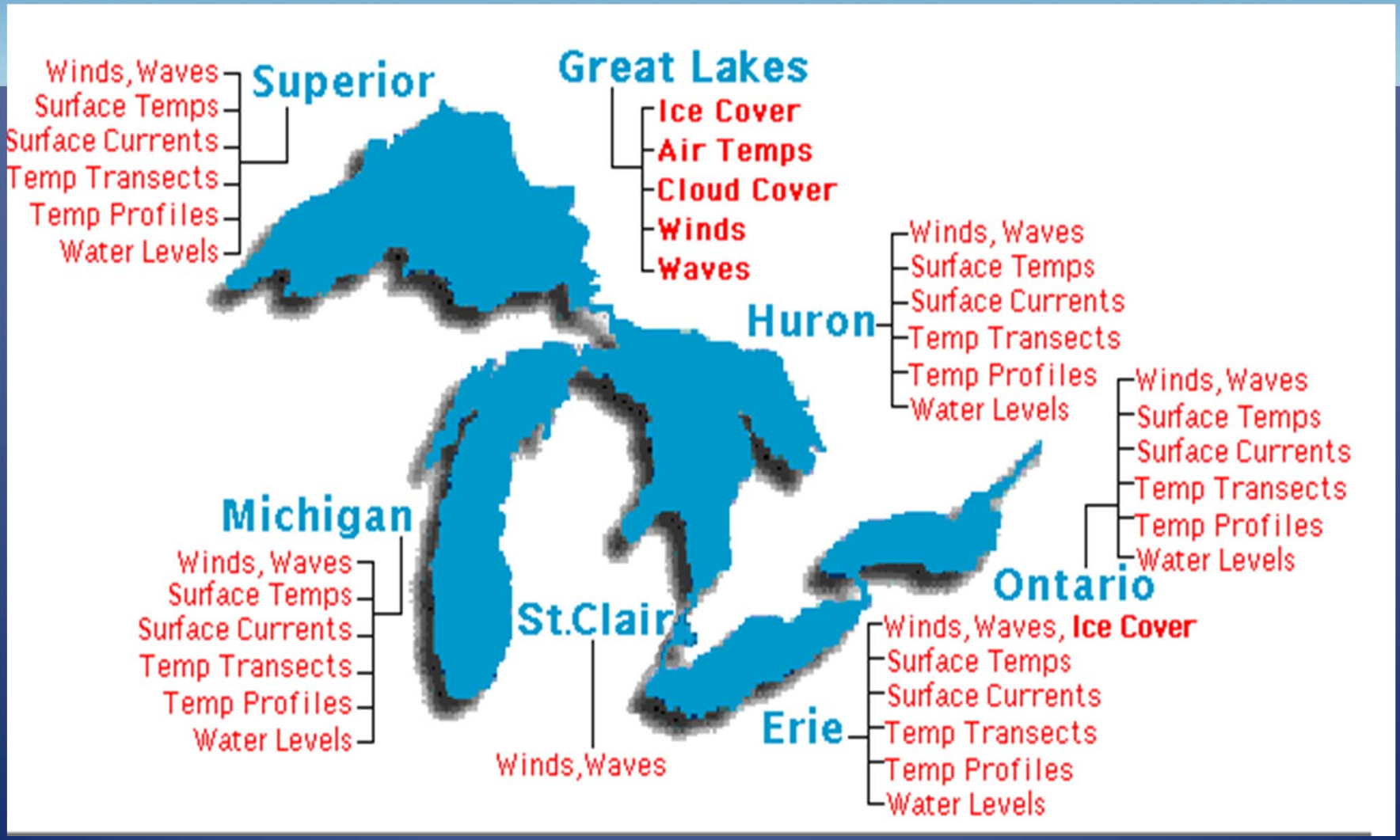
Great Lakes Coastal Flood Study, 2012 Federal Inter-Agency Initiative: Guidance Documents and Reports

- ***Statistical Analysis and Storm Sampling for Lakes Michigan and St. Clair*** [3.68 MB .pdf],
  Norberto C. Nadal-Caraballo, Jeffrey A. Melby, and Bruce A. Ebersole, U.S. Army Corps of Engineers
  (Final Published Report, September 2012)
- ***Lake Michigan: Prediction of Sand Beach and Dune Erosion for Flood***

RSS Feed
- Great Lakes Coast RSS

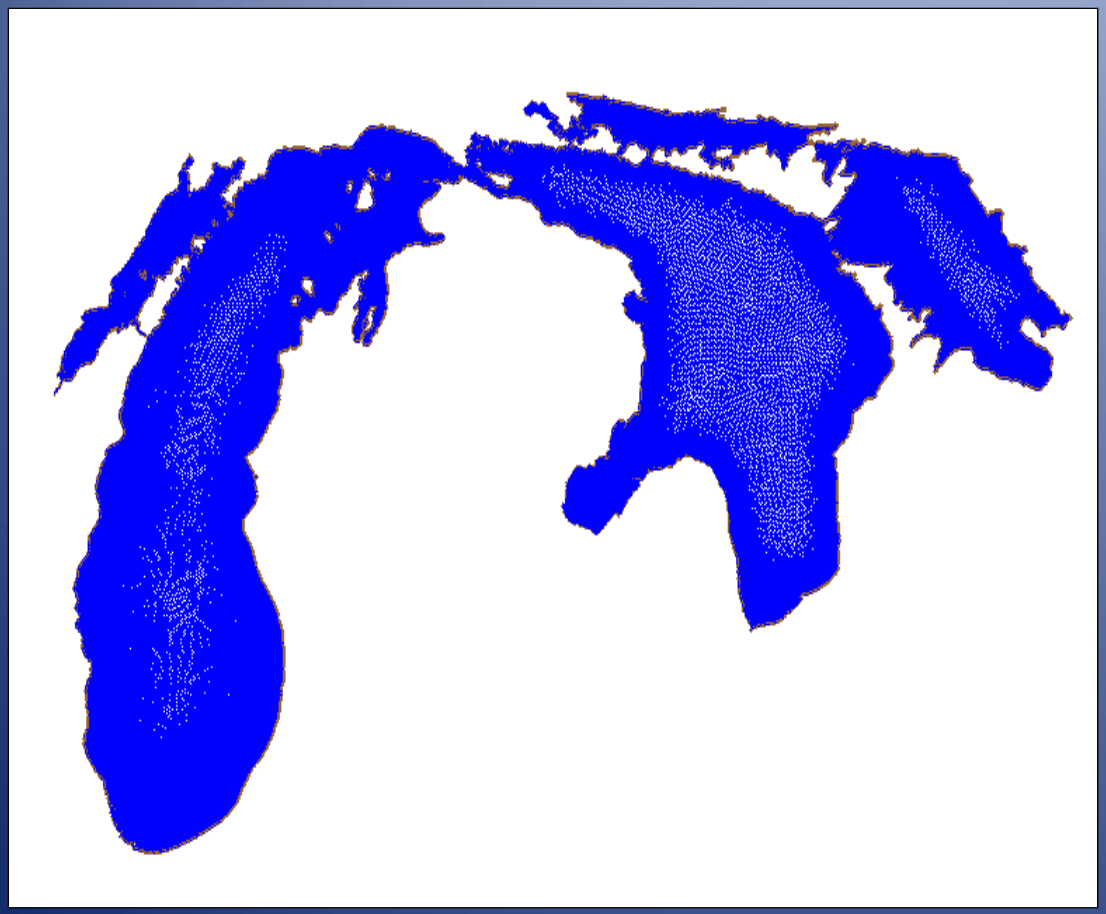
Archives
- October 2012 (1)
- August 2012 (1)
- July 2012 (1)
- June 2012 (1)
- May 2012 (2)
- April 2012 (3)

Great Lakes Coastal Forecasting System



http://www.glerl.noaa.gov/res/glcfs/

Storm Surge Modeling with ADCIRC

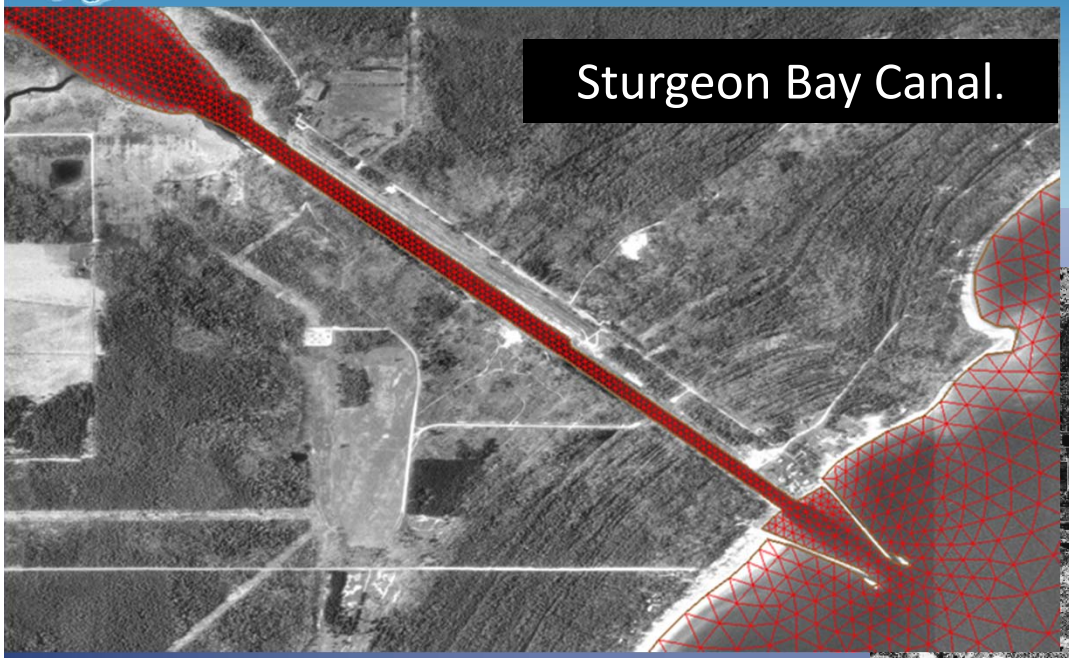


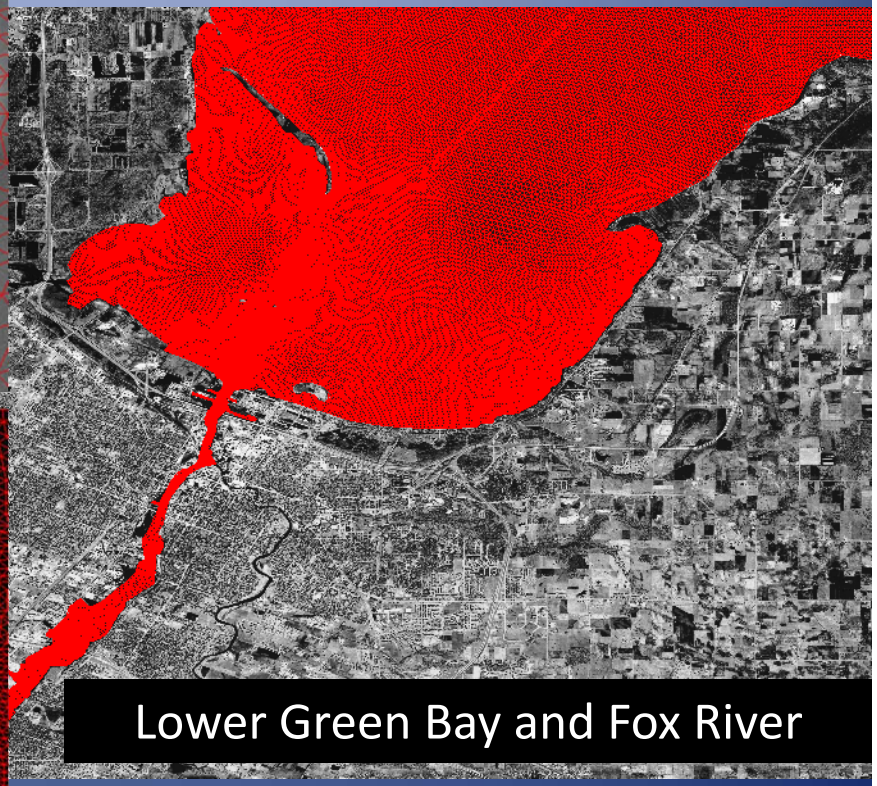
- Coupling of lakes required to accurately model water exchange between lakes associated with moving low pressure systems

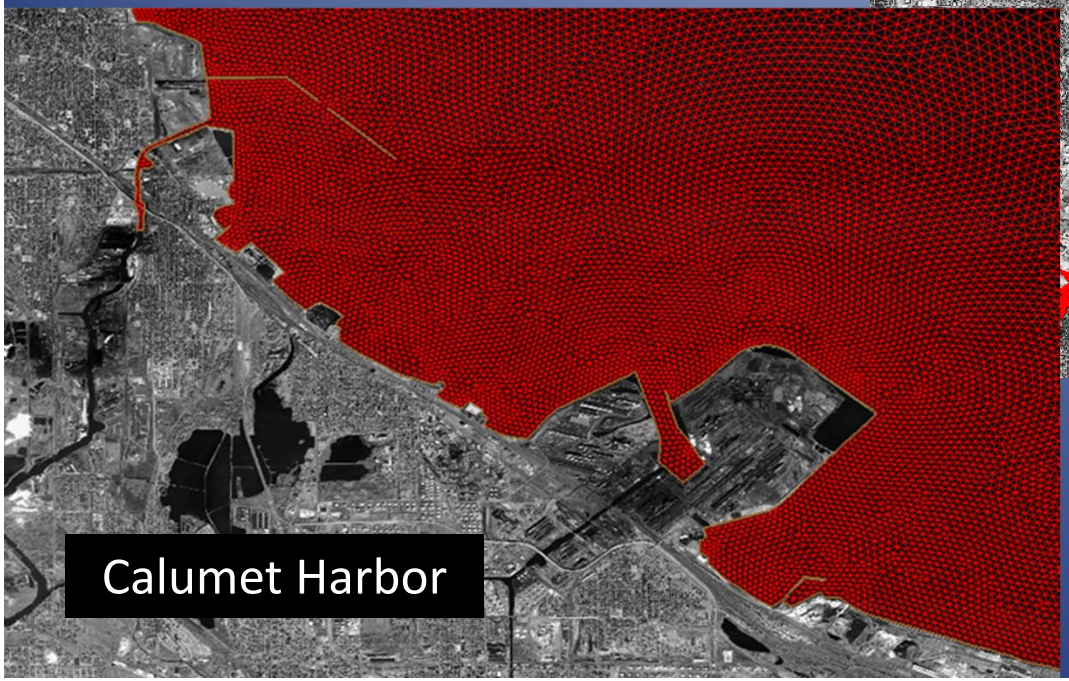
- Can increase water level throughout Lake Michigan and Green Bay by as much as 1.5 ft

Great Lakes Coastal Flood Mapping Program

greatlakescoast.org

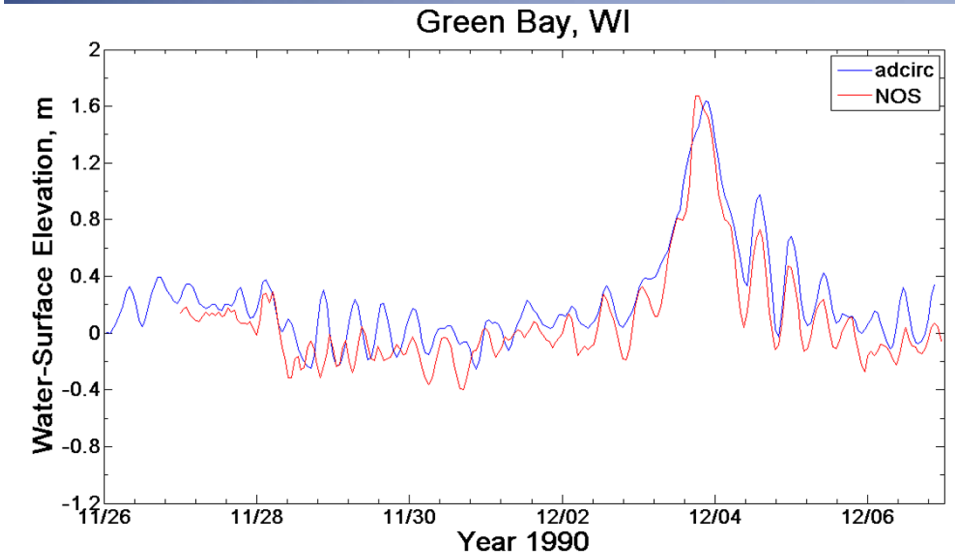


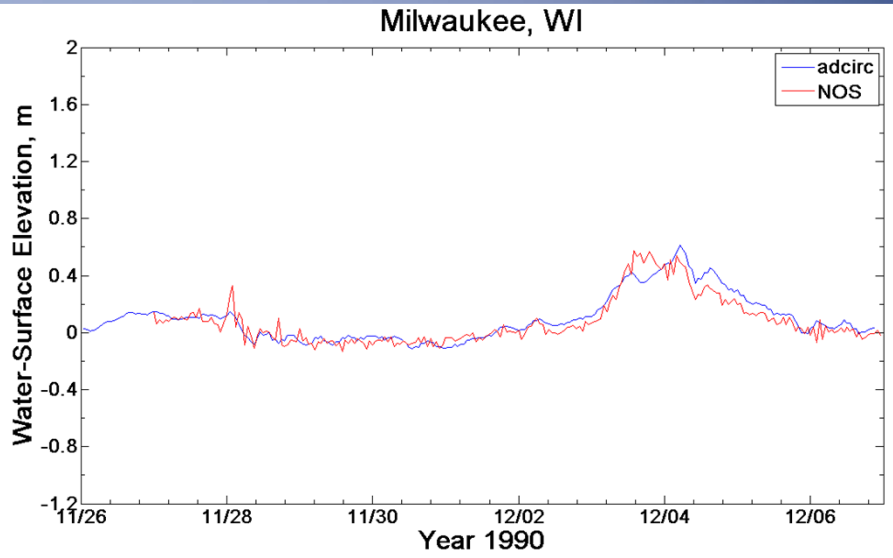


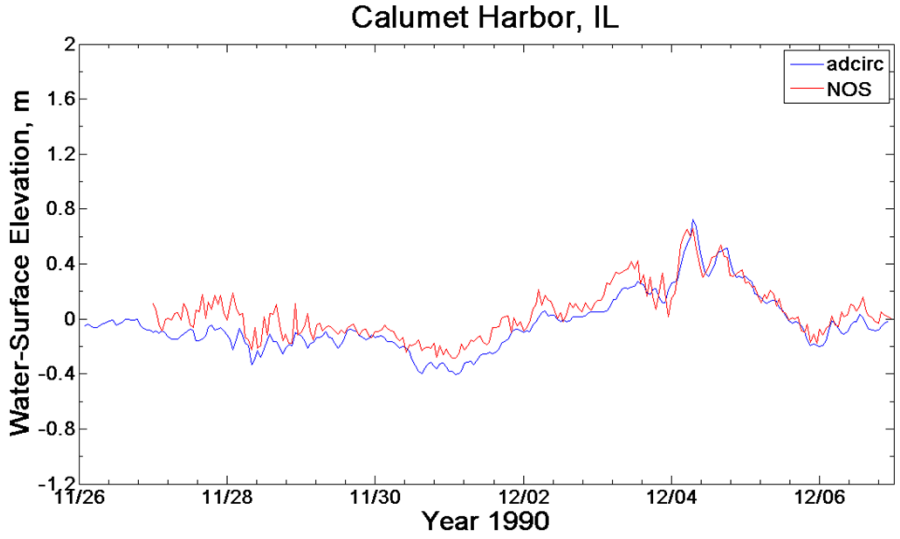


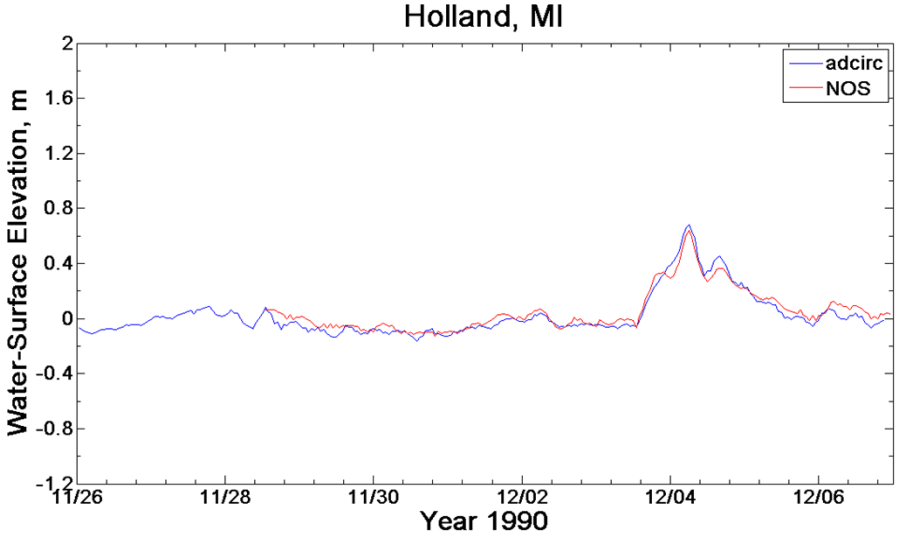
Water Level Measurement Locations

ADCIRC Model Comparisons to Measurements (Dec 1990 Storm)

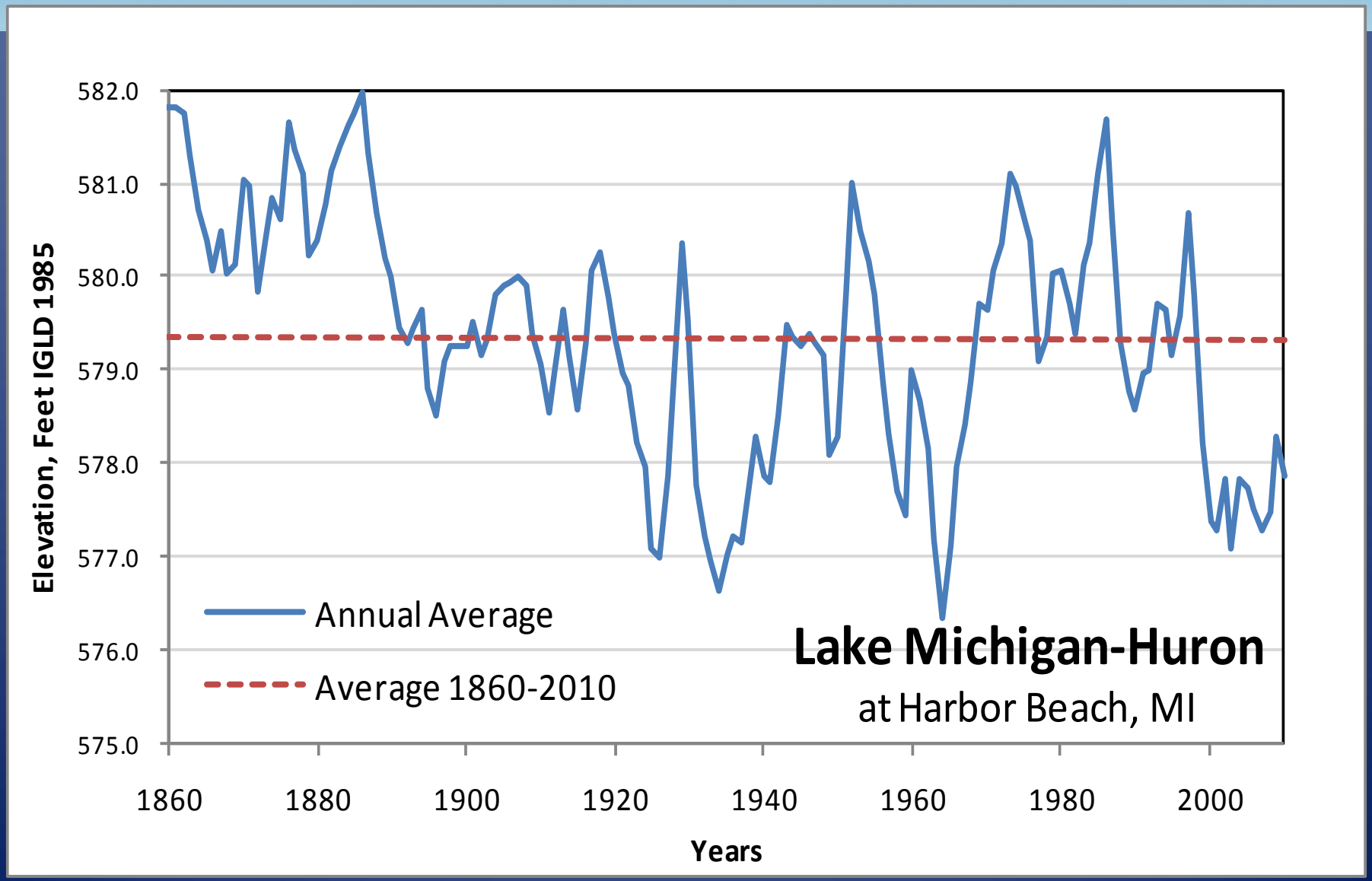


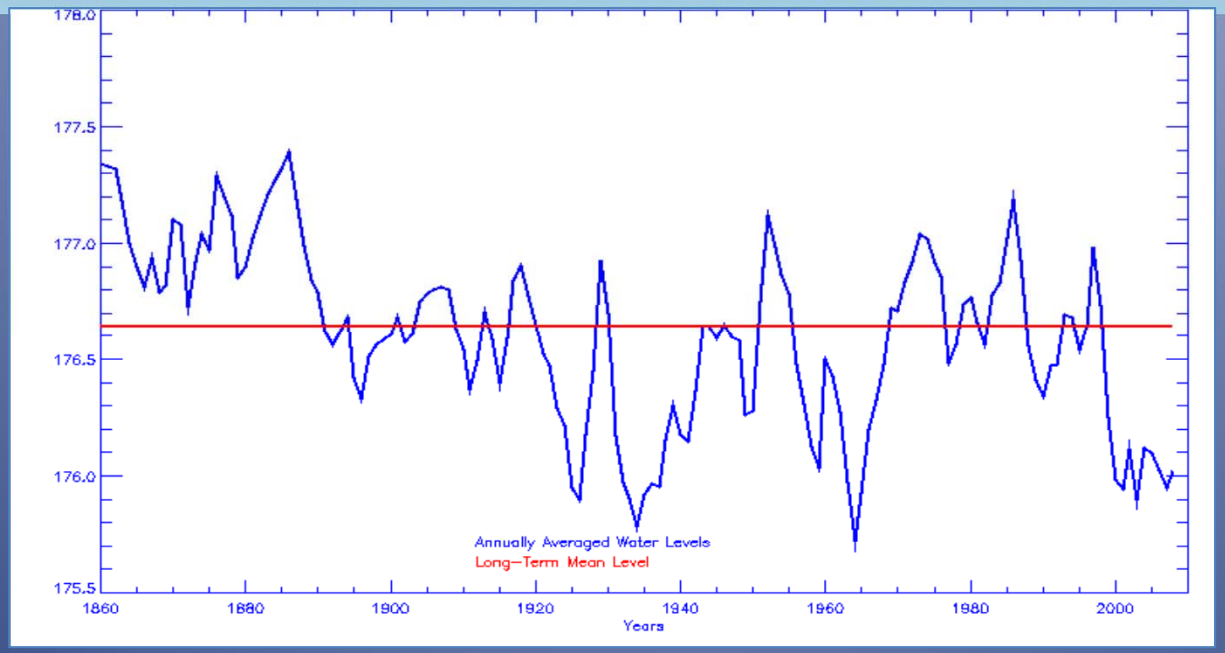


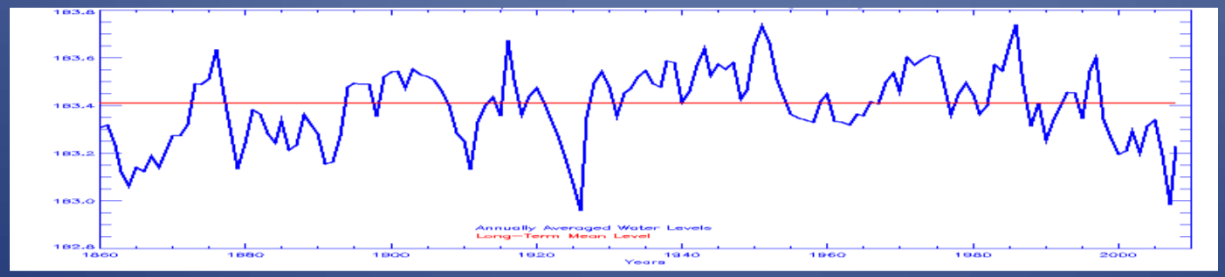




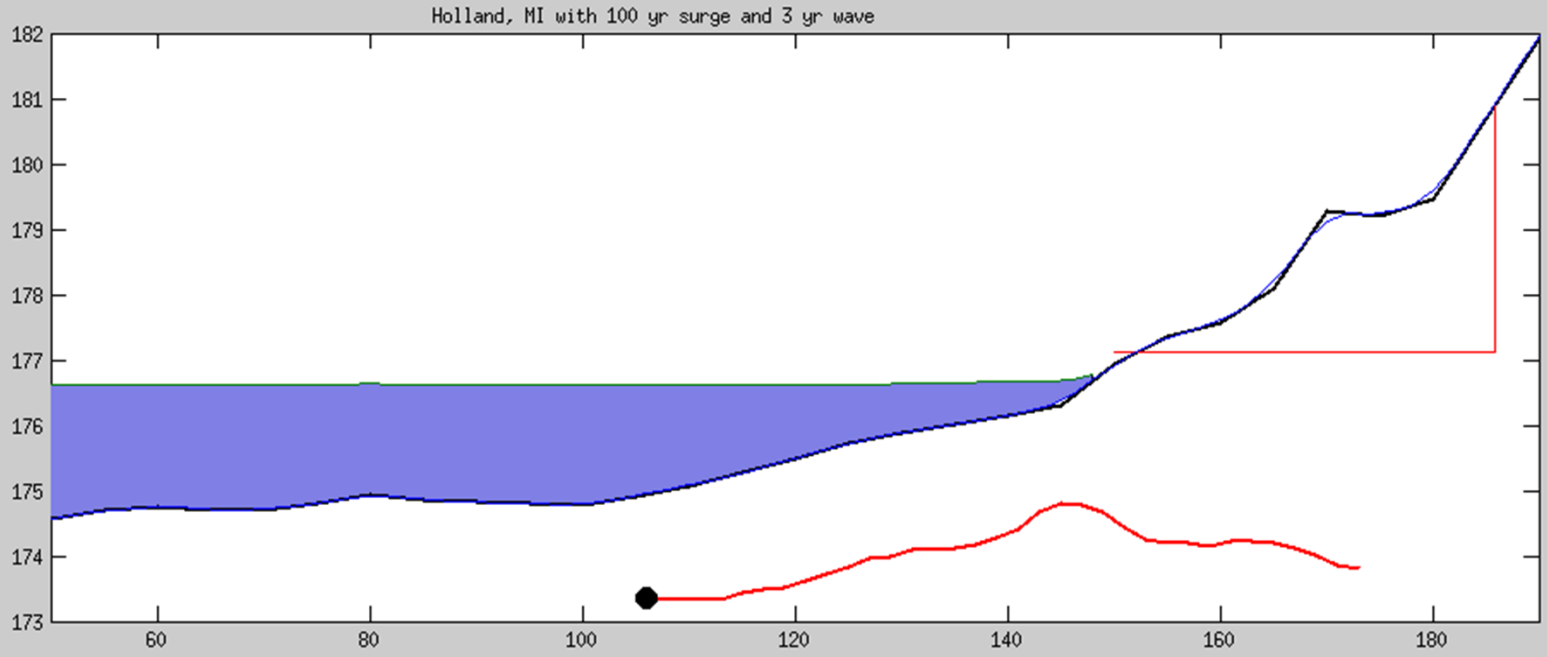
Lake Michigan-Huron



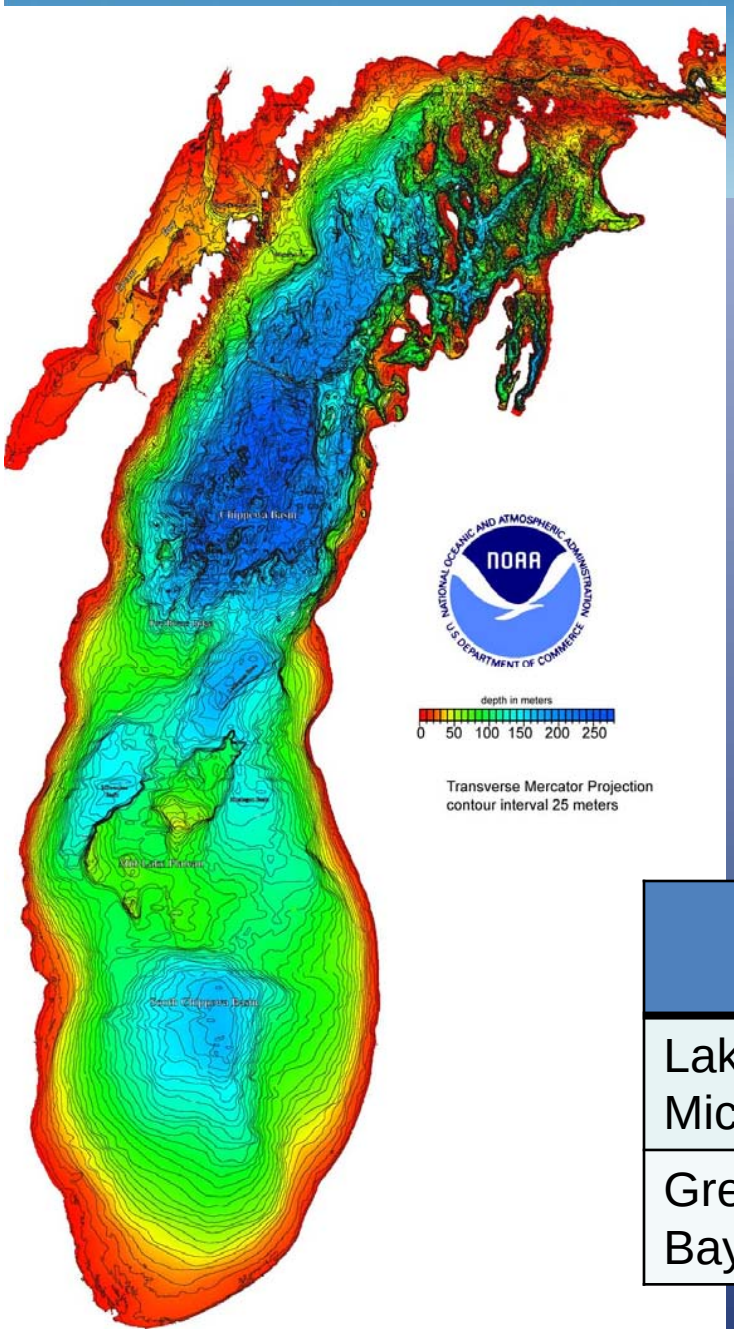

178.0
177.5
177.0
176.5
176.0
175.5
1860
1880
1900
1920
1940
1960
1980
2000
Years
Annually Averaged Water Levels
Long-Term Mean Level


183.6
183.4
183.2
183.0
182.8
1860
1880
1900
1920
1940
1960
1980
2000
Years
Annually Averaged Water Levels
Long-Term Mean Level

Beach Erosion Simulations



Holland, MI morphology change using CSHORE



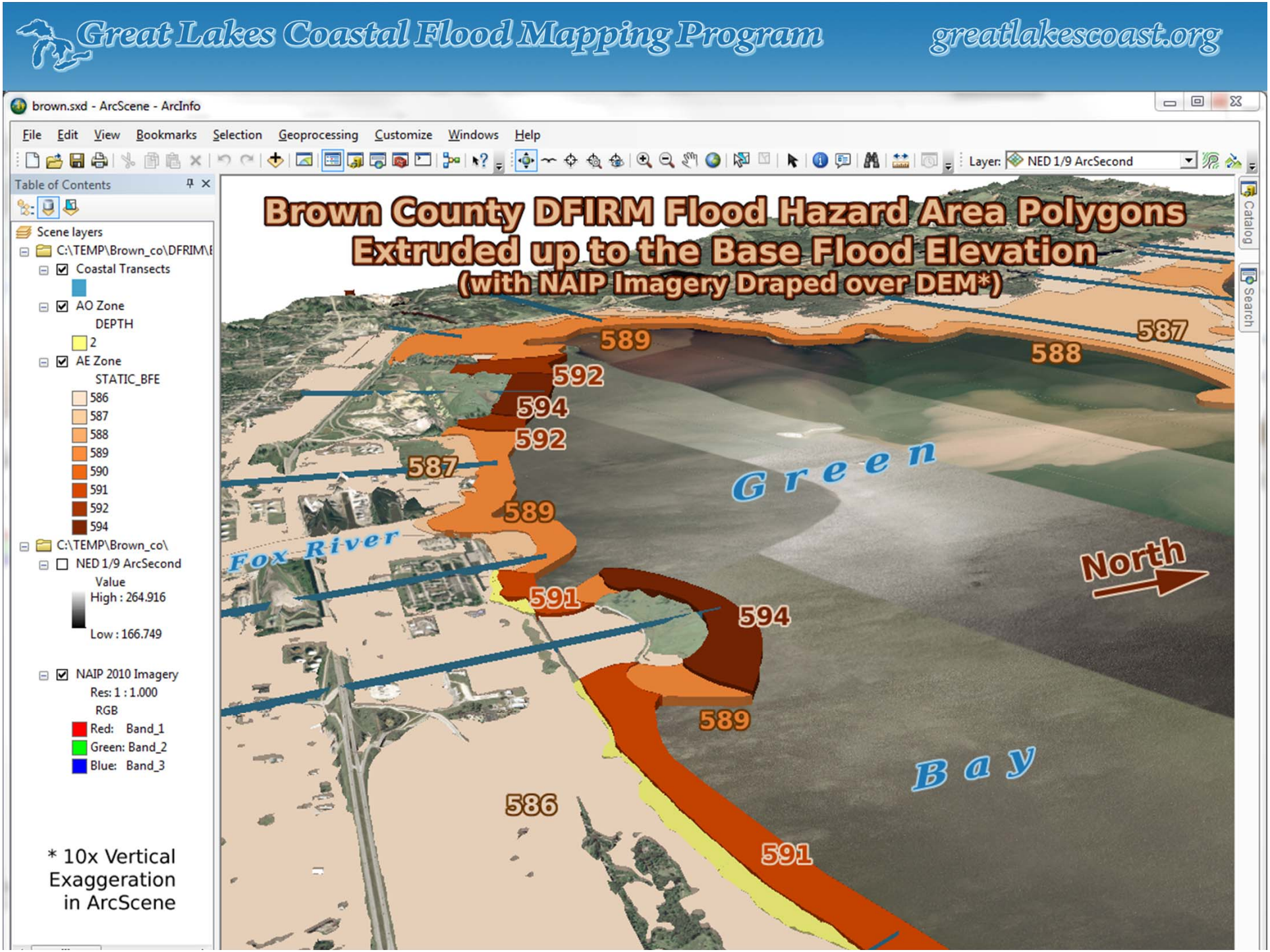
Contributors to BFEs Approximate Magnitudes

- Long-term lake level changes
- Seasonal lake level changes
- Storm waves and surge

	Lake Level	Storm Surge	Waves	Beach Run-up
Lake Michigan	+/- 3 ft	3 ft	H = 20 ft T= 8 sec	4 to 7 ft
Green Bay	+/- 3 ft	5 ft	H = 9 ft T = 6 sec	2 to 3 ft


ZONE VE
(EL 588)
1218
1217C
ZONE A E
(EL 584)
ZONE VE
(EL 586)
1217B


586
588


Great Lakes Coastal Flood Mapping Program
greatlakescoast.org
brown.sxd - ArcScene - ArcInfo
File Edit View Bookmarks Selection Geoprocessing Customize Windows Help
Layer: NED 1/9 ArcSecond
Table of Contents
Scene layers
C:\TEMP\Brown_co\DFRIM\
Coastal Transects
AO Zone
DEPTH
2
AE Zone
STATIC_BFE
586
587
588
589
590
591
592
594
C:\TEMP\Brown_co\
NED 1/9 ArcSecond
Value
High : 264.916
Low : 166.749
NAIP 2010 Imagery
Res: 1 : 1.000
RGB
Red: Band_1
Green: Band_2
Blue: Band_3
* 10x Vertical Exaggeration in ArcScene
Brown County DFIRM Flood Hazard Area Polygons
Extruded up to the Base Flood Elevation
(with NAIP Imagery Draped over DEM*)
589
587
588
592
594
592
587
589
591
594
589
586
591
Green Bay
Fox River
North
Catalog
Search

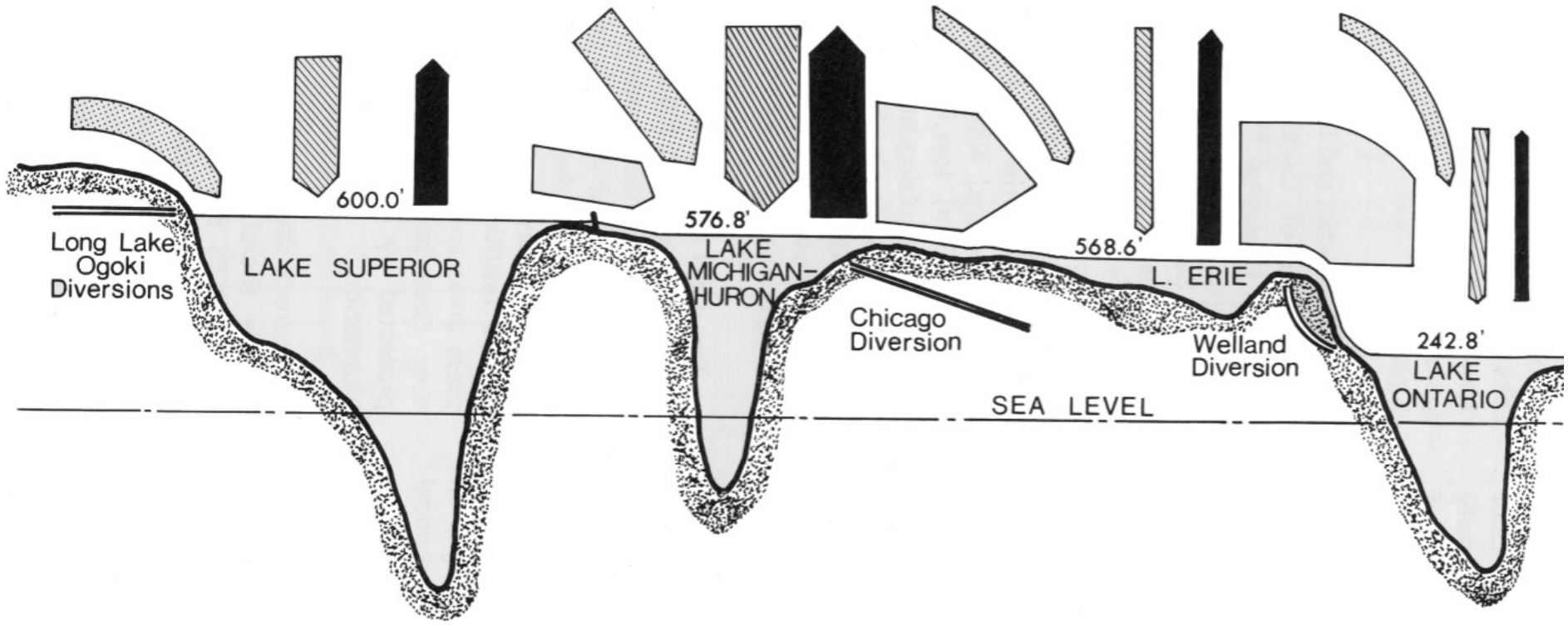

592
589
589
588
590
587
586
Green
Bay

Summary

- Technically superior methodology
- Detailed wave and surge modeling under way for ~150 storms per lake
- Does not address future conditions

Great Lakes – major factors impacting water levels

- Water
  - Inflow (precip + watershed runoff)
  - Evaporation
- Land
  - Isostatic Adjustment
- Anthropogenic Impacts



Outflow

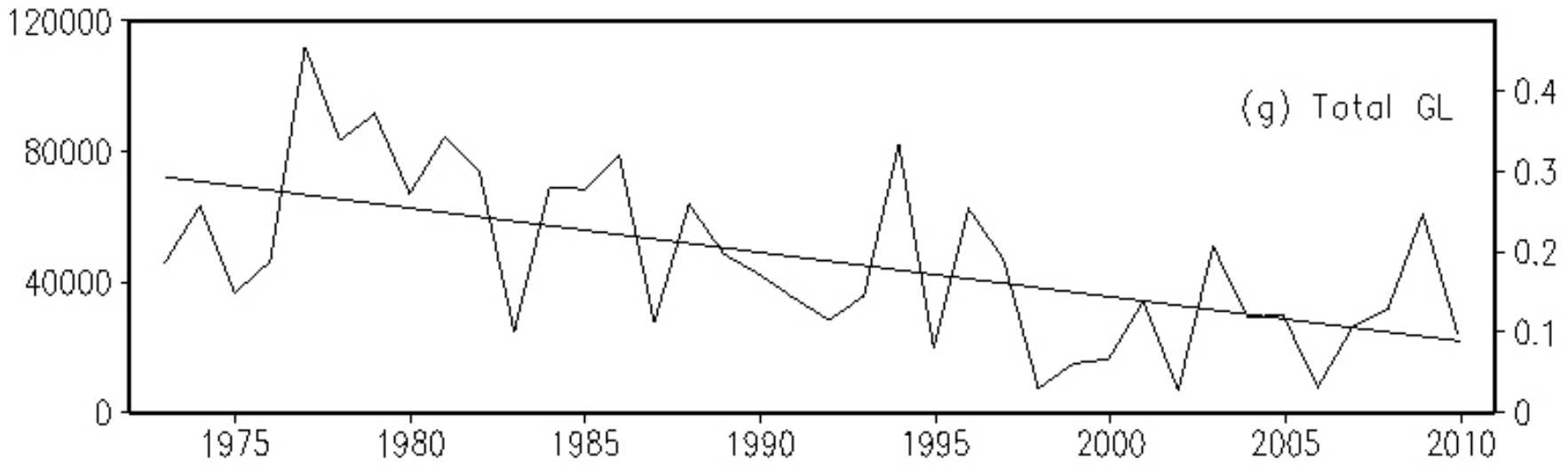
Precipitation

Runoff

Evaporation

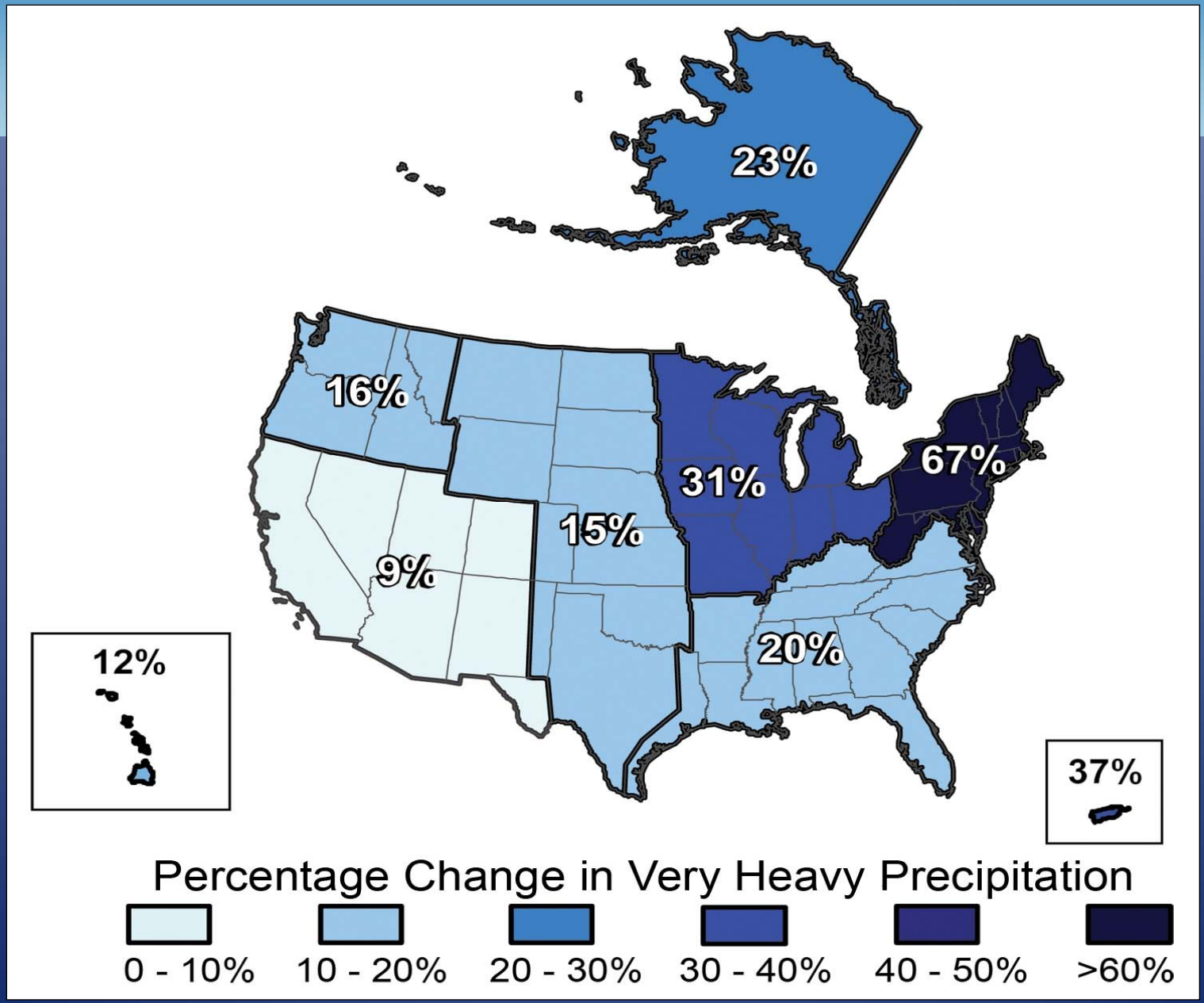
Width of arrows represents relative magnitudes of various factors

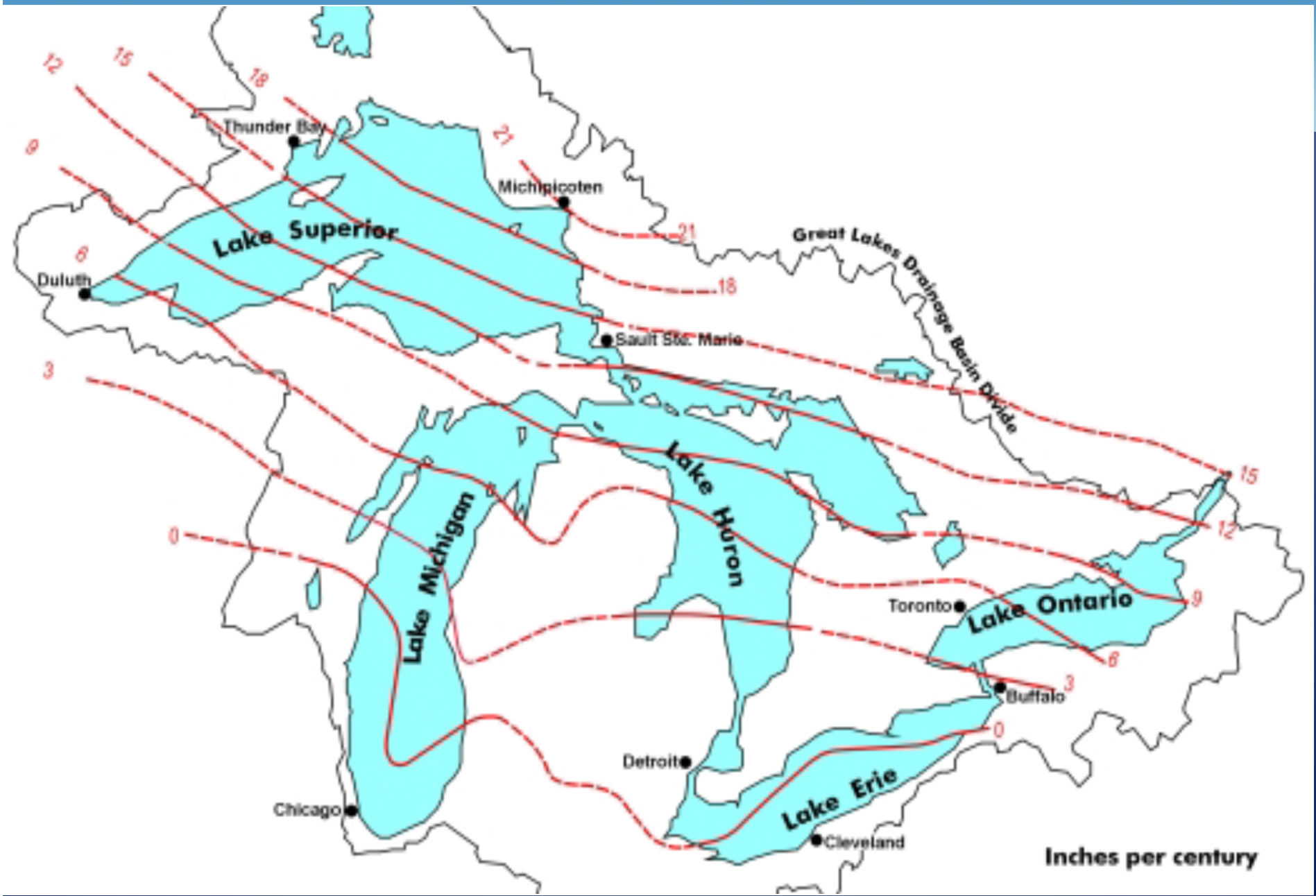
Great Lakes – ice cover



% decrease from 1973 to 2010

- Superior 79
- Michigan 77
- Huron 62
- St. Clair 37
- Erie 50
- Ontario 88
- Total GL 71


23%
16%
31%
67%
15%
9%
20%
12%
37%
Percentage Change in Very Heavy Precipitation
0 - 10%
10 - 20%
20 - 30%
30 - 40%
40 - 50%
>60%


Thunder Bay
Michipicoten
Lake Superior
Duluth
Great Lakes Drainage Basin Divide
Sault Ste. Marie
Lake Michigan
Lake Huron
Toronto
Lake Ontario
Buffalo
Detroit
Lake Erie
Chicago
Cleveland
Inches per century


Thank you for your time!
Questions???

Great Lakes Coastal Flood Mapping Program

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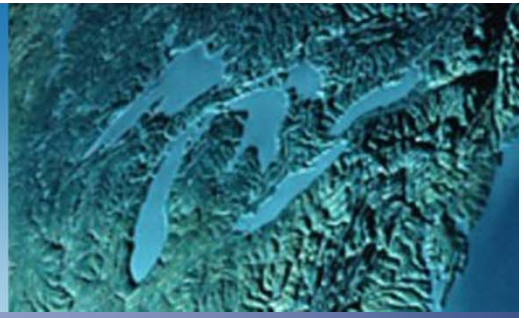

Visit ***greatlakescoast.org*** for more information

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alan@floods.org

US ARMY CORP OF ENGINEERS DETROIT DISTRICT

ERDC

FEMA

RiskMAP

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