



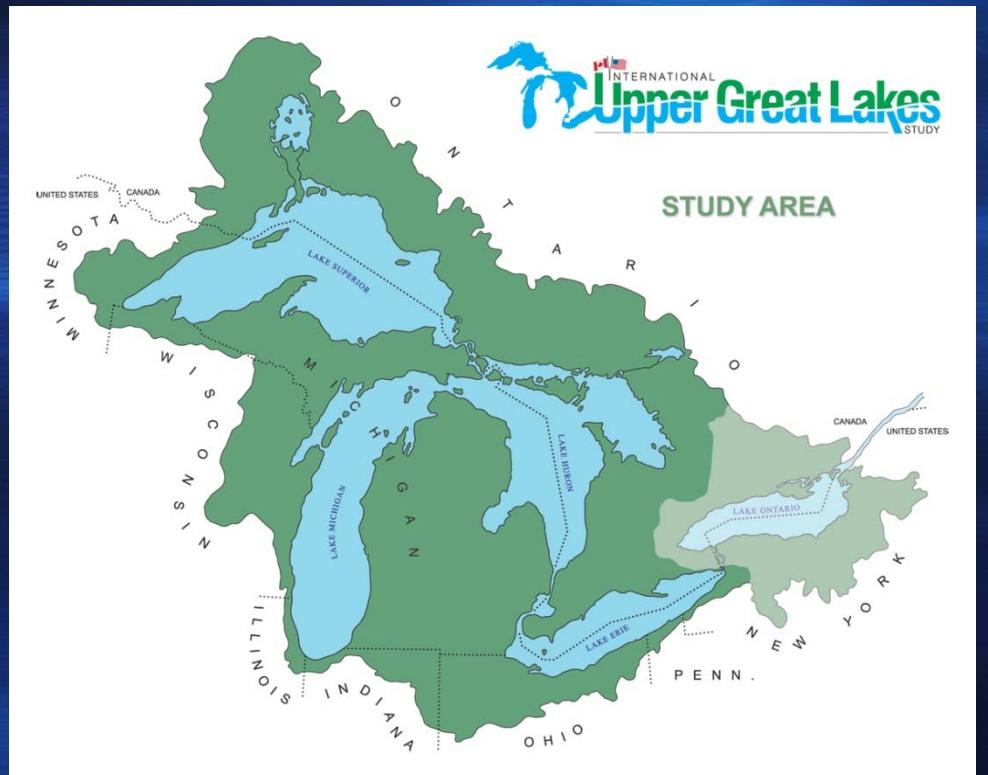
Impacts on Upper Great Lakes Water Levels: St. Clair River

Public Meetings
June 09-11, 2009



Presentation Outline

- The Issue
- Mandate of the Study Board
- Public Involvement
- Peer Review Process
- Study Strategy
- Findings
 - Sediment
 - Hydraulics
 - Hydroclimatology
 - Glacial Isostatic Adjustment
- Synthesis
- Recommendations
- Next steps



What is the Issue?

- Lake Huron-Michigan water levels were:
 - below average levels from 1999-2008, and
 - occasionally below chart datum (level specified for shipping)
 - declining relative to Lake Erie (drop in head difference)
- Why did this occur?
 - Was it dredging of the channel in 1962 that initiated bed erosion resulting in increased St. Clair River flows?
 - Was it due to changes in precipitation and evaporation, affecting water supplies to each lake basin?
 - Were there other contributing factors?

Study Mandate

First objective

- *Examine physical processes and possible ongoing changes in the St. Clair River and their impacts on levels of Lake Michigan-Huron and, if applicable, evaluate and recommend potential remedial options; and*



Study Mandate

Second objective

- *Review the regulation of Lake Superior outflows and assess the need for changes to address the evolving needs of and conditions affecting the interests of the upper Great Lakes.*



Public Plays Important Role

- ✓ Public Interest Advisory Group (PIAG) provides important input to the Study
 - ✓ values associated with different Great Lakes water levels.
 - ✓ advises on outreach and communications
 - ✓ vehicle to provide information to many diverse interest groups
- ✓ PIAG co-chairs serve on Study Board
- ✓ Hosted 15 public meetings attended by more than 1,500 residents throughout Study Area.



Midland Public Meeting
August 11, 2008

PIAG Membership

Canada

James Bruce Co-Chair

James Anderson, Ducks Unlimited

Doug Cuddy, Lake Superior

Conservancy

Dick Hibma, Conservation Ontario

Kenneth Higgs, Property Owner

William Hryb, Lakehead Shipping Co.

John Jackson, Great Lakes United

Don Marles, Lake Superior Advisory
Committee

Mary Muter, Georgian Bay Association

First Nation Representative

United States

Kay Felt, Co-Chair

David Powers – Save our Shoreline

Roger Smithe – International Great
Lakes Coalition

Dan Tadgerson – Sault Ste. Marie Tribe,
Chippewa Indians

Alan Steinman – Annis WRI

Kate Bartter – Ohio State University

Jim Weakley – Lake Carriers' Assn.

Jeff Vito – Cities Initiative

Dan Thomas – GL Sport Fishing Council

David Irish – Boat shop owner

Peer Review Process

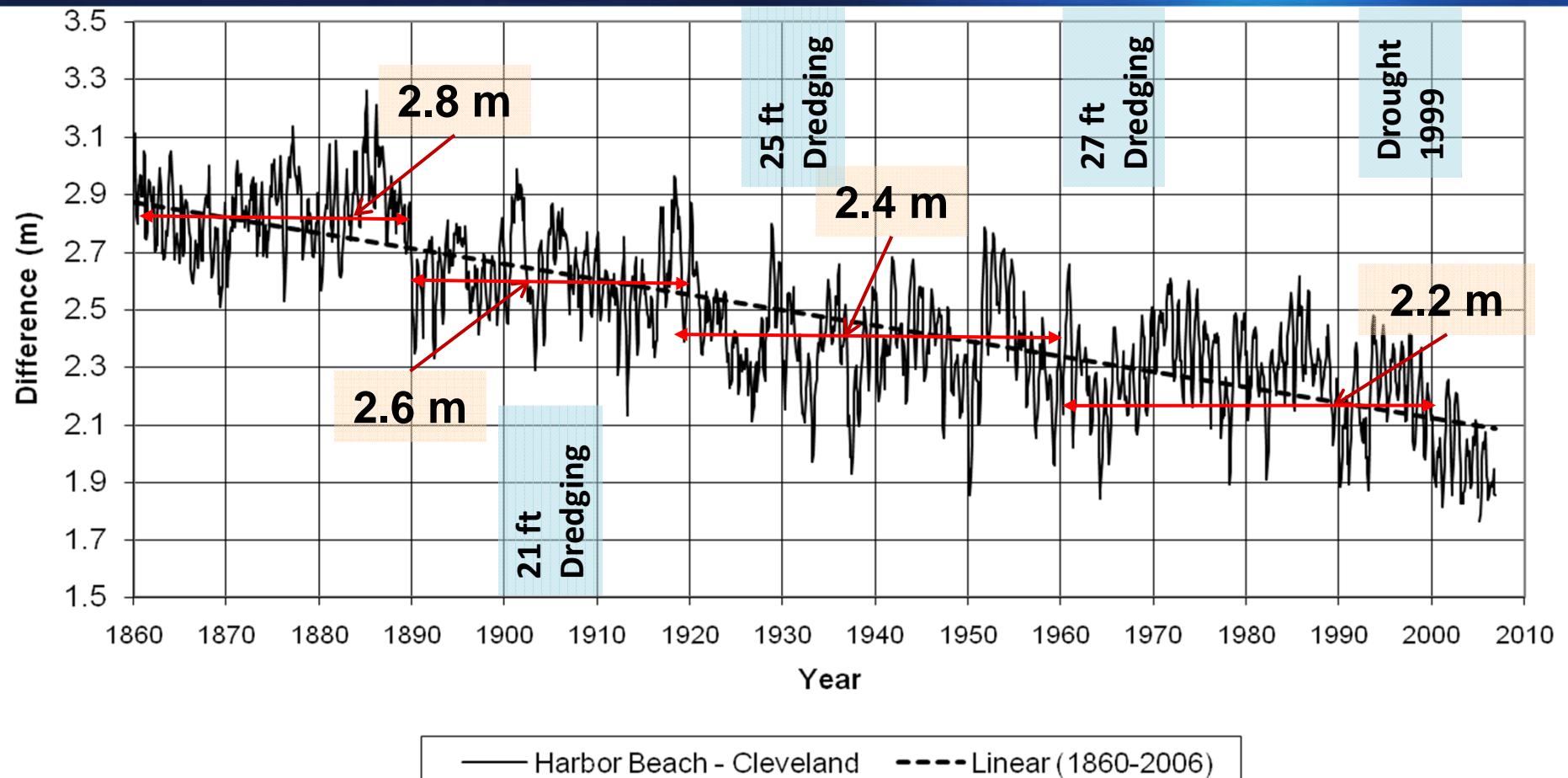
- Internal

- Reviewed by Study Scientists and Engineers
 - Reviewed by Study Board

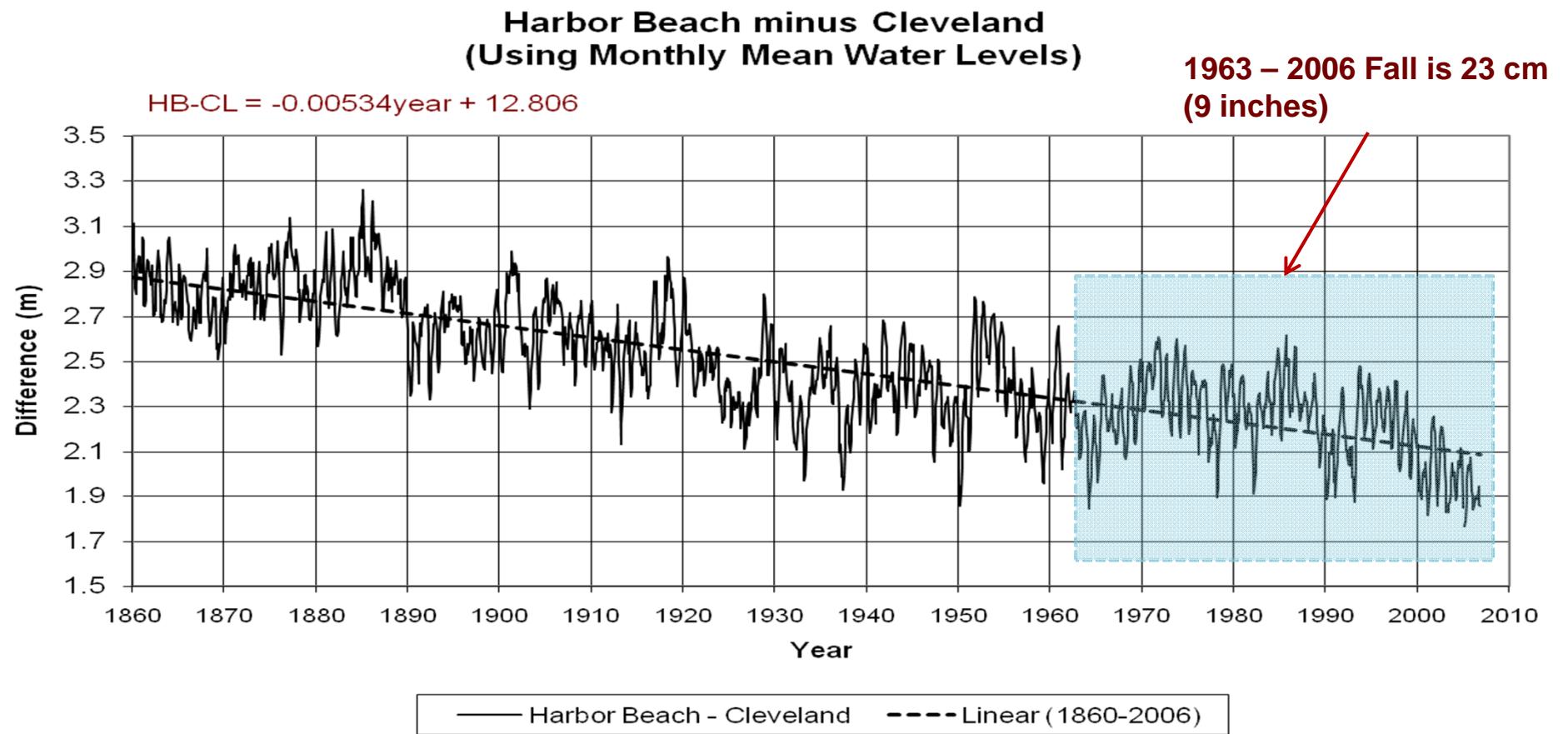
- External

- Two key Associations involved:
 - Canadian Water Resources Association
 - American Society of Civil Engineers
 - Products being reviewed
 - Methodological strategies (3)
 - Technical reports (8)
 - Key chapters
 - Full Study report

Quantifying the Issue

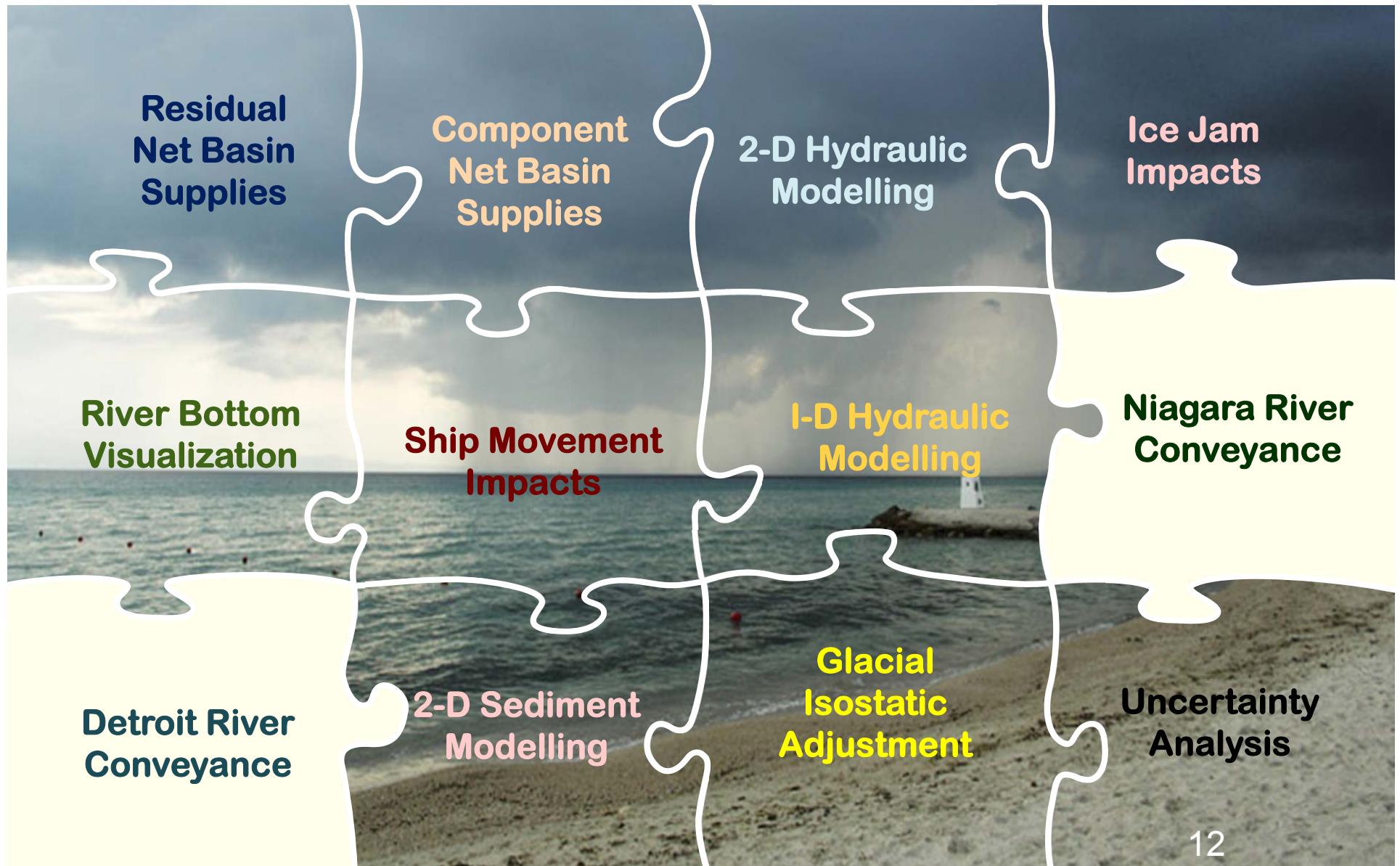


Quantifying the Issue





**Lake Michigan-Huron
To Lake Erie
Fall (drop in head)**



What are we Solving?

**Change in lake-to-lake fall,
between Harbor Beach &
Cleveland**

Components of the Fall

Change in fall from hydraulic property change

Change in lake-wide surplus or deficit from Net Total Supplies (NTS)

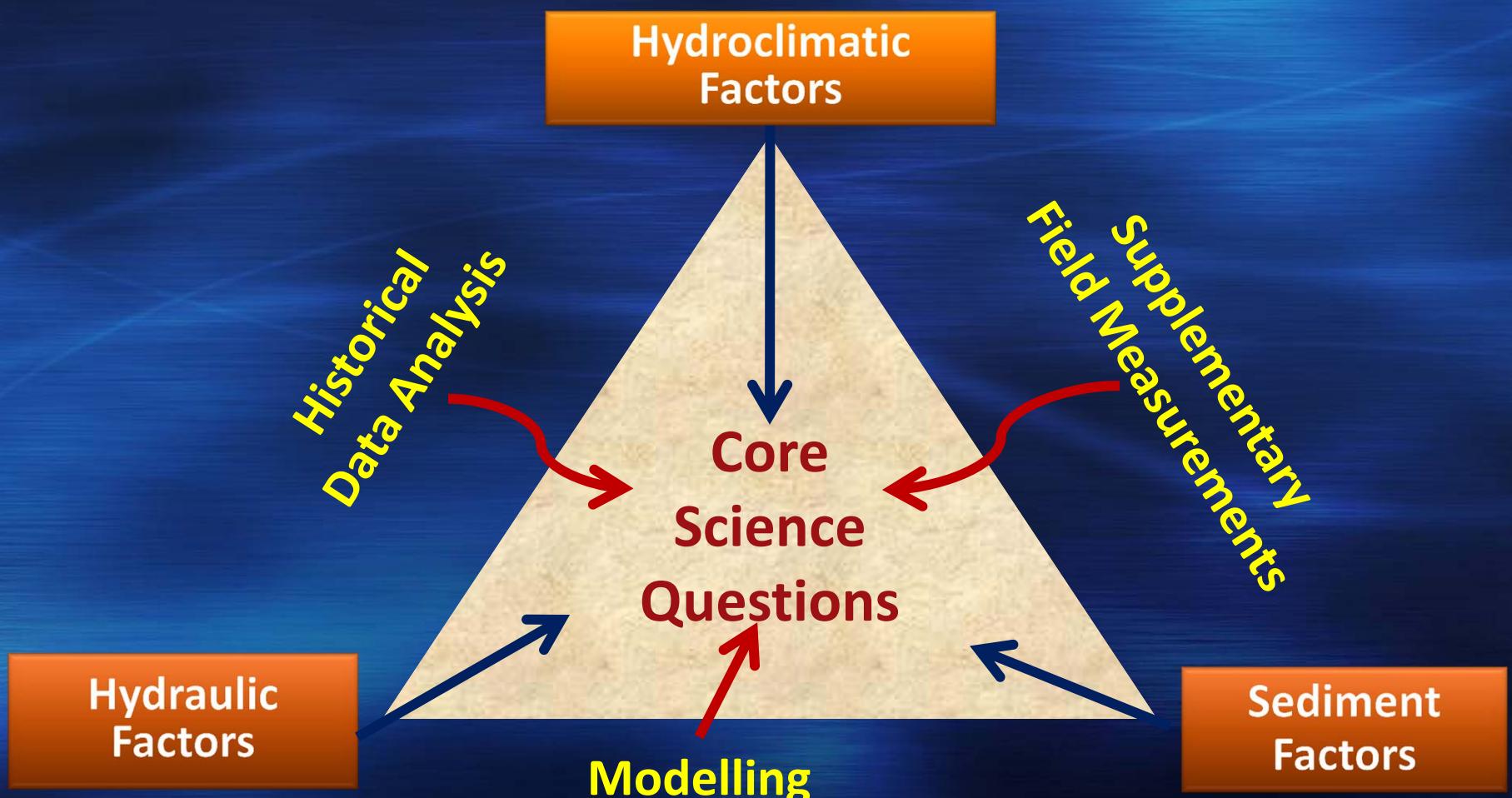
Change in fall due to difference in NTS between Erie & Michigan-Huron

Change in fall from Glacial Isostatic Adjustment

Change in fall between Erie & Michigan Huron from Niagara/Detroit

Rounding errors & unknowns

Study Approach



Sediment

- Science Questions:

Has the "Morphology" of the St. Clair River been altered since the 1962 dredging?

- a) *Is the St. Clair River bed stable or eroding?*
- b) *If the bed of the St Clair river is eroding, what initiated it, and when?*

1. Bathymetry changed between 1971 and 2007 (an enlarged channel).

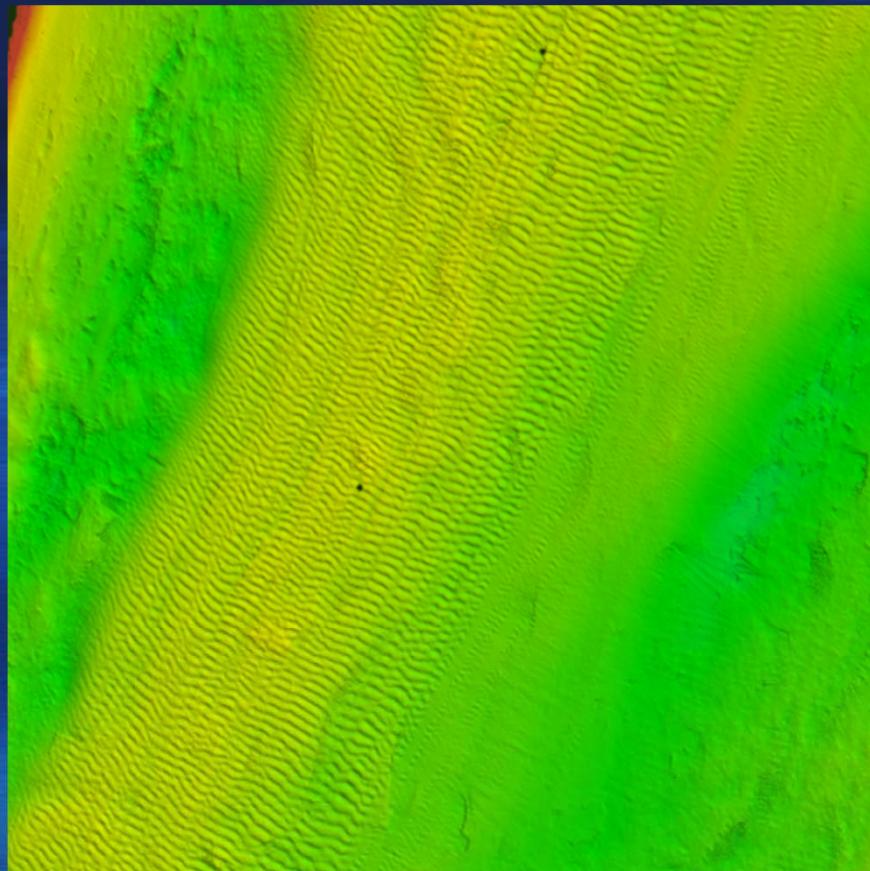
2. Since 2000 there has been no net change in the bathymetry.

3. There is a limited bed mobility (bed forms) but no net change.

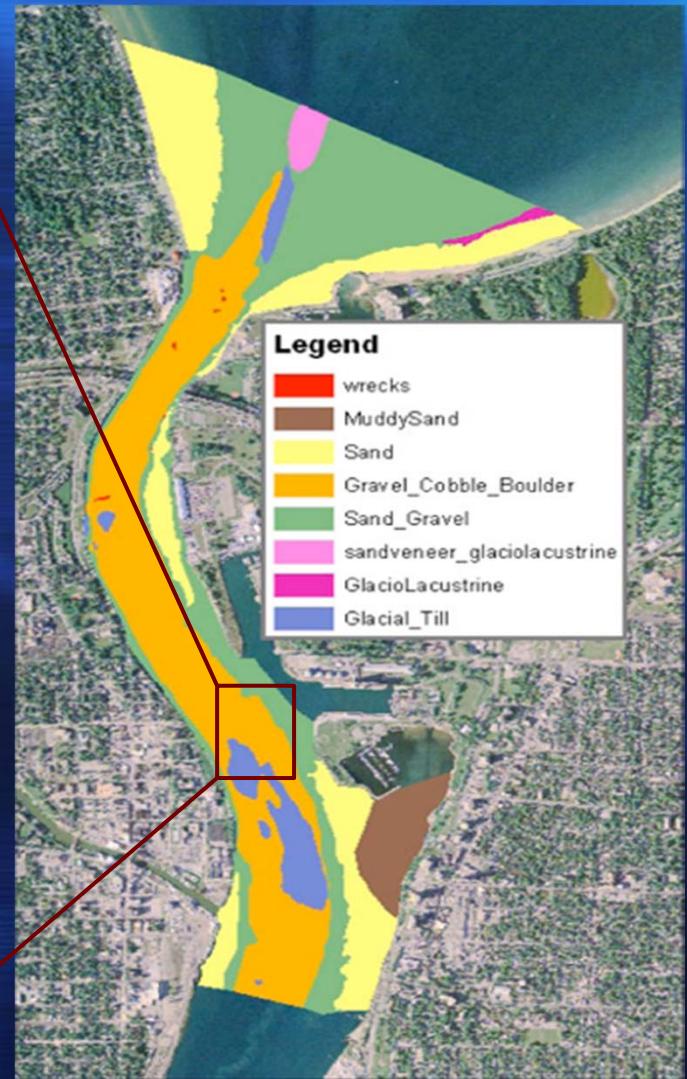
4. Shear stresses along entire river are insufficient to erode the bed.

5. Shipping, ice jams can increase shear stress and may result in sediment movement.

Bed Morphology



Mobile Bed
(flow transverse bedforms)



Hydraulic

- Science Questions:

What is causing the declining head difference between Lake Michigan-Huron and Lake Erie?

- a) *Has the conveyance capacity of the St. Clair River changed since 1962?*
- b) *If the conveyance capacity has changed what were the causes?*

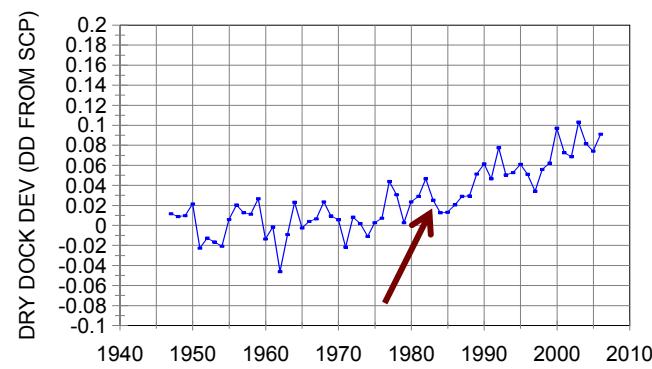
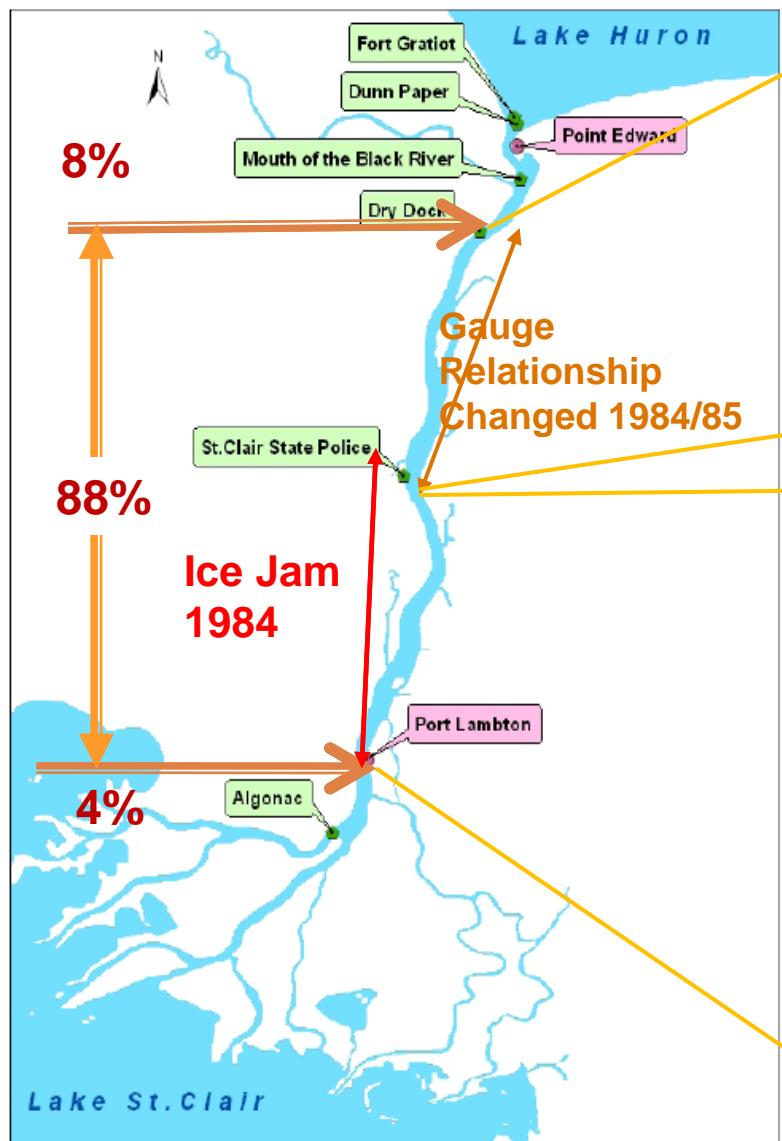
1. Increase in conveyance capacity accounts for about 8 to 13 cm (3.2 to 5.1 in.) decrease in Lake Huron level between 1971 and 2007. The river is stable since 2000.
2. Conveyance capacity increased by 5% and the flow by about $270 \text{ m}^3/\text{s}$ ($9,500 \text{ ft}^3/\text{s}$), less than 5% of the mean flow, for a brief period in the mid 1980s.
3. About 88% of the change in conveyance has occurred in the lower river. The mouth of the river is not a control section.
4. Conveyance changed in mid 1980s, probably due to ice jam (1984) and/or high flows.

Impact of Conveyance Capacity on Head Drop*

Projects		cm.	in.
Hydraulic - Sediment Modelling	1-D HEC-RAS	9	4
	2-D RMA	12	5
	2-D Telemac ¹	13	5
	2-D Telemac ²	8	3
	HydroSed 2D	10	4
Data Analysis	Flow	13	5
	Lake-to-Lake Fall	8	3
	Rating Curve	8	3
	Gauge-to-Gauge	7	3
Hydro- Climatic Modelling	Mid-lakes Routing	13	5
	Coordinated Routing - Component	8	3
	Coordinated Routing - Residual	7	3

* from 1971 to 2007

St. Clair River Gauge Stations



Ice Jam Highlights

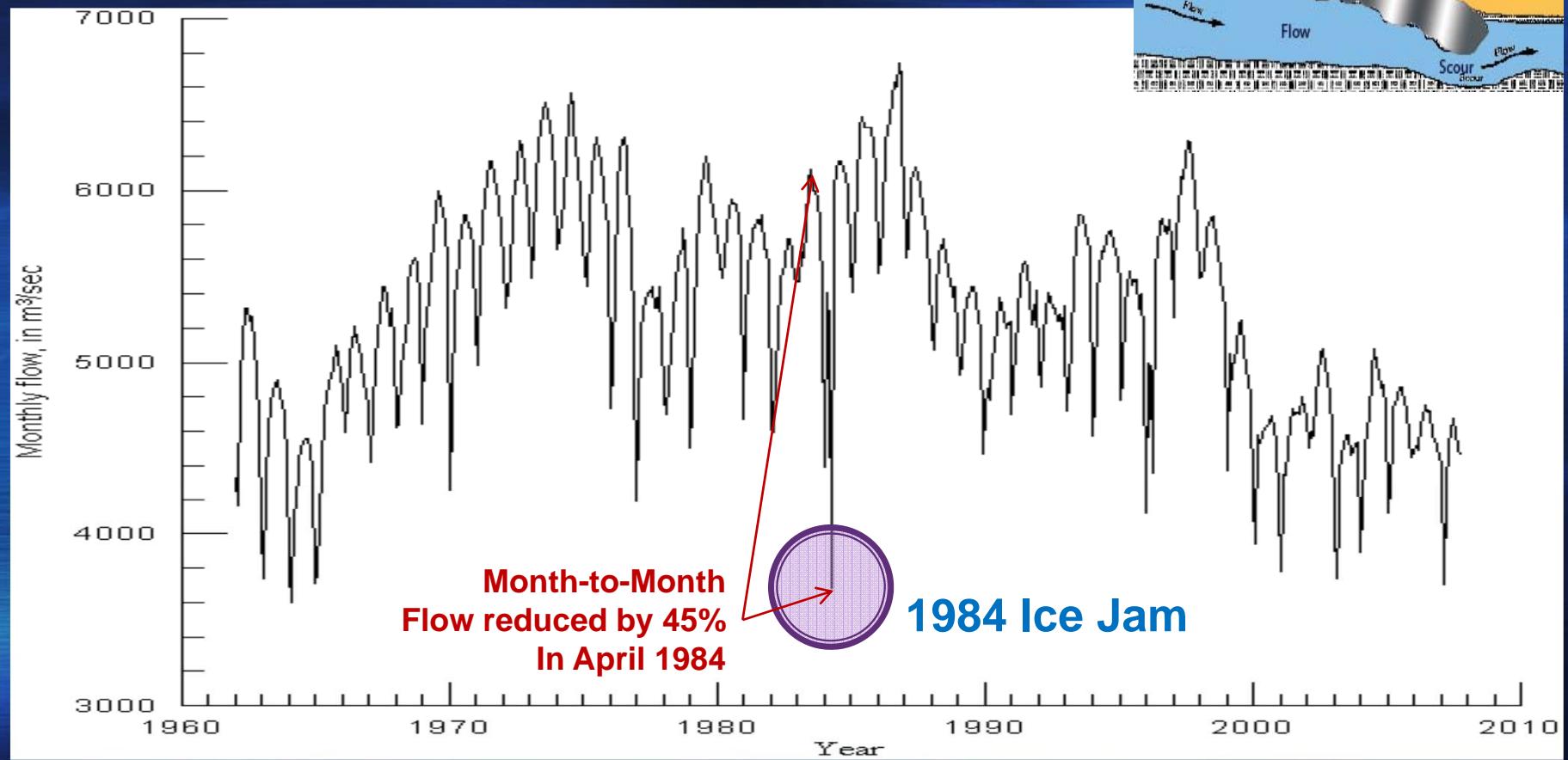
Locked up the river in April 1984.

Worst ice jam on record.

Doubled the water level difference between Port Lambton & St. Clair State Police backing water into the Lake Huron-Michigan and increasing velocities.

Could be source of increased bottom shear and of conveyance change.

St. Clair River Flows



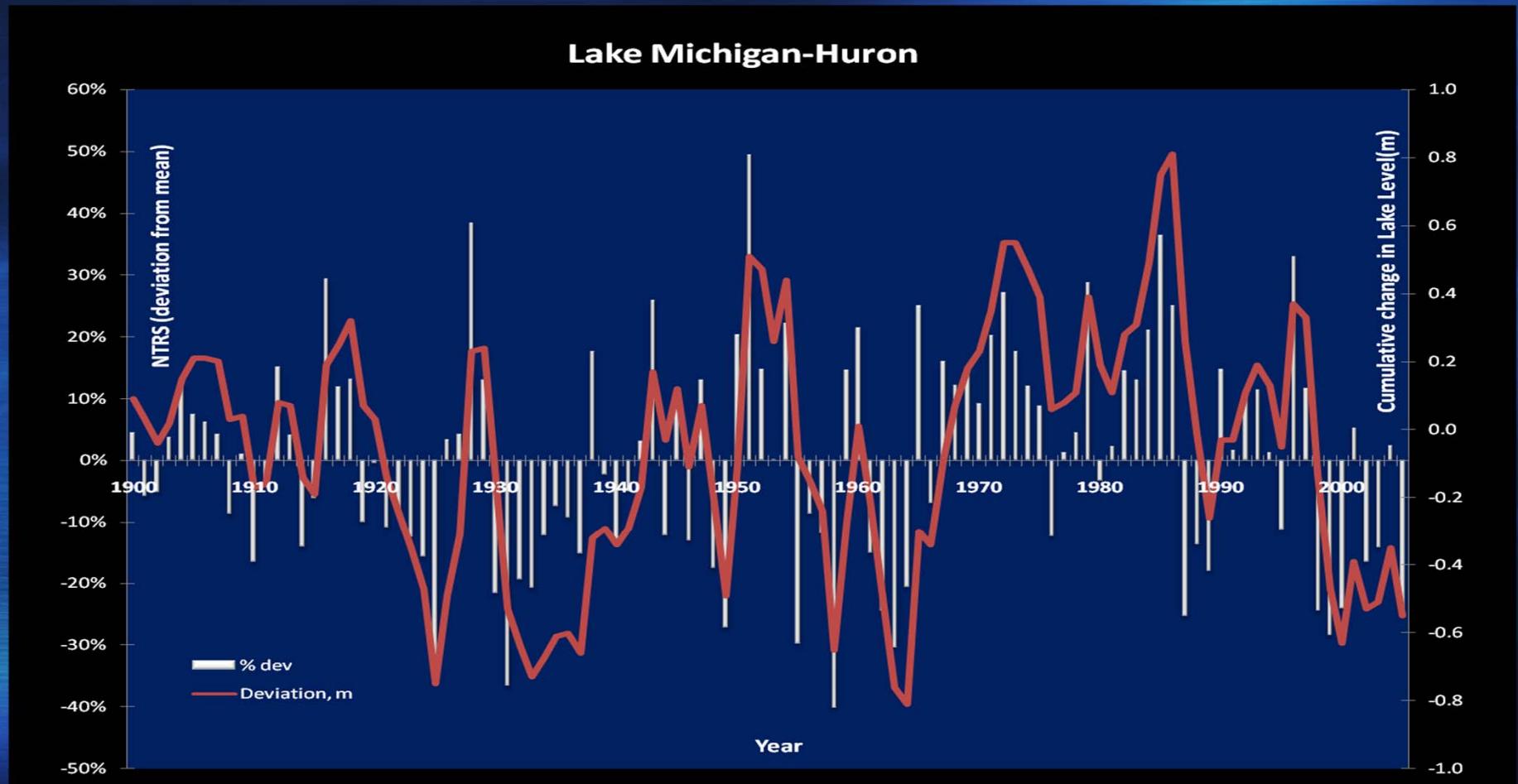
Hydroclimatic

- **Science Question:**

How has climate affected the change in lake level relationship between Lake Michigan-Huron and Lake Erie?

1. Hydroclimatic models suggest that increased conveyance capacity (8 to 9 cm/3.5 in) and climatic factors (9 to 27 cm/3.5 to 10.5 in) account for a drop of Lake Michigan-Huron between 1986-2005.
2. From 1962 to 1986, climate and conveyance were major factors.
3. Climate was by far the major factor for 1996 to 2005 period.

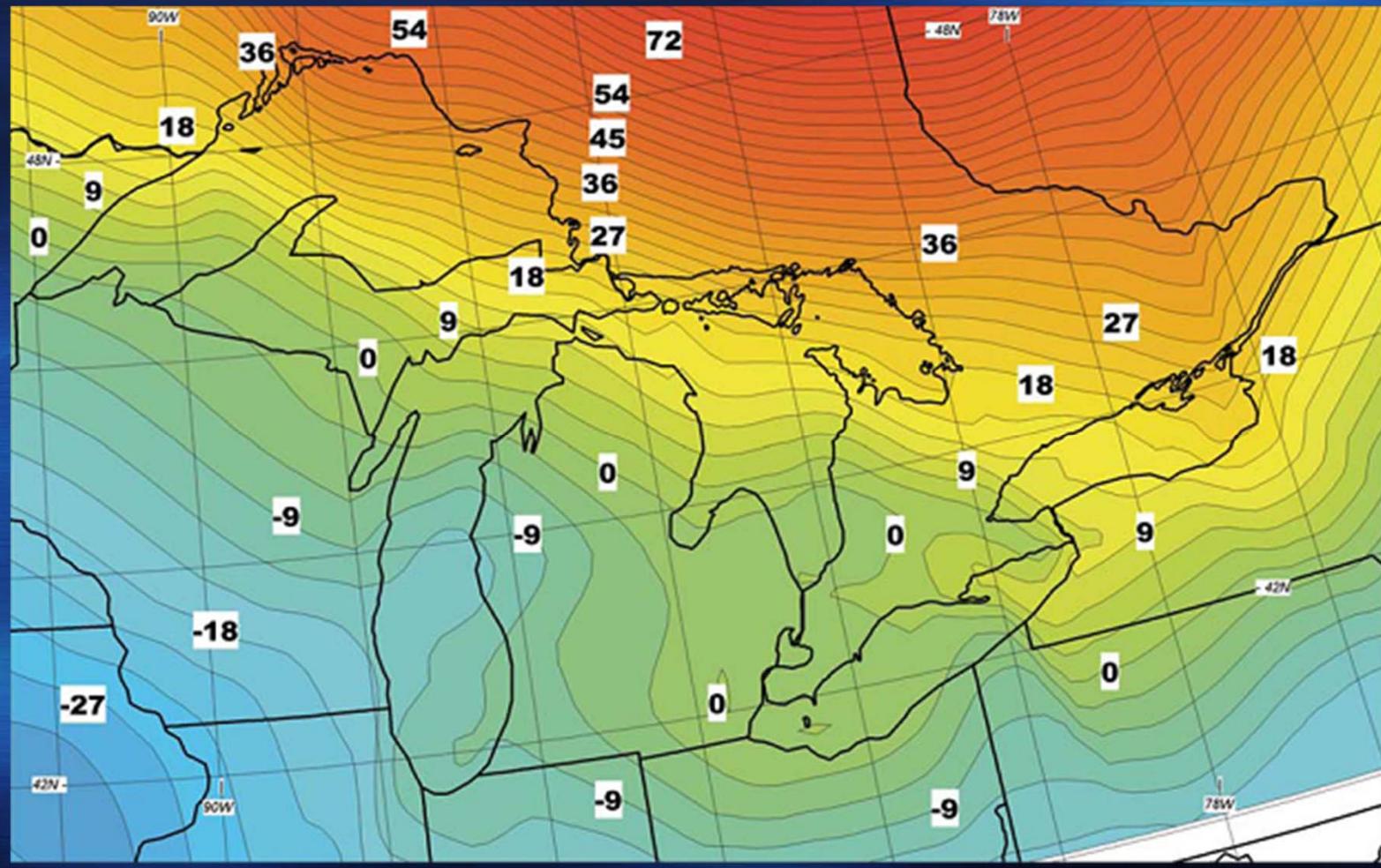
Water Supply Deficit & Lake Levels



Lakes Michigan-Huron Lake-wide Average Monthly Mean Water Levels



Impact of Glacial Isostatic Adjustment



Impact of Glacial Isostatic Adjustment Around Lake Michigan-Huron

GIA Relative Change since 1963 (based on longer term rates)*	cm./in
Georgian Bay area (Parry Sound)	+11 cm/4.3 in
Lake Huron Outlet	0
Milwaukee	-6 cm/2.4 in

ΔGIA accounts for ≈ 4 cm (1.5 in) of fall between Michigan-Huron & Erie of the ≈ 23 cm (9 in) difference between 1963 and 2006.

Synthesis

23* cm
9 in

Components of the Fall	
Change in fall from hydraulic property change	8 – 13 cm 3.2 to 5.1 in
Change in lake-wide surplus or deficit from Net Total Supplies (NTS)	9 – 27 cm 3.5 to 10.6 in
Change in fall due to difference in NTS between Erie & Michigan-Huron	
Change in fall from Glacial Isostatic Adjustment	4 cm/1.6 in
Change in fall between Erie & Michigan Huron from Niagara/Detroit	Small – included in NTS
Rounding errors & unknowns	Small

* As high as 51 cm/20 in from 1986 to 2006

Study Board Deliberations

Science

- Conveyance capacity did increase between 1971-2000, but since 2000 has actually decreased.
- There are concerns related to quality of the 1971 survey and impacts on the results.
- More confidence in surveys after 2000, which show little change.
- Analysis from multiple approaches show a range of 7-13 cm (2.7-5.1 in) and therefore the uncertainty in the findings.

Study Board Deliberations

- IJC Directive

- The Study has determined that there is no “ongoing” erosion.
- The 1962 dredging was not the trigger, instead it appears to be the result of natural causes (ice jam and/or high water levels and flows in the mid-1980s).
- Unclear whether “remedial options” (term used) applies to natural causes.

Interim Board Recommendations

1. *Remedial measures not be undertaken on the St. Clair River at this time.*
2. *The need for mitigative measures in the St. Clair River be examined as part of the comprehensive assessment of the future effects of climate change on water supplies in the upper Great Lakes basin in Report 2 of the Study, on Lake Superior regulation.*

Recommendations for Government Action

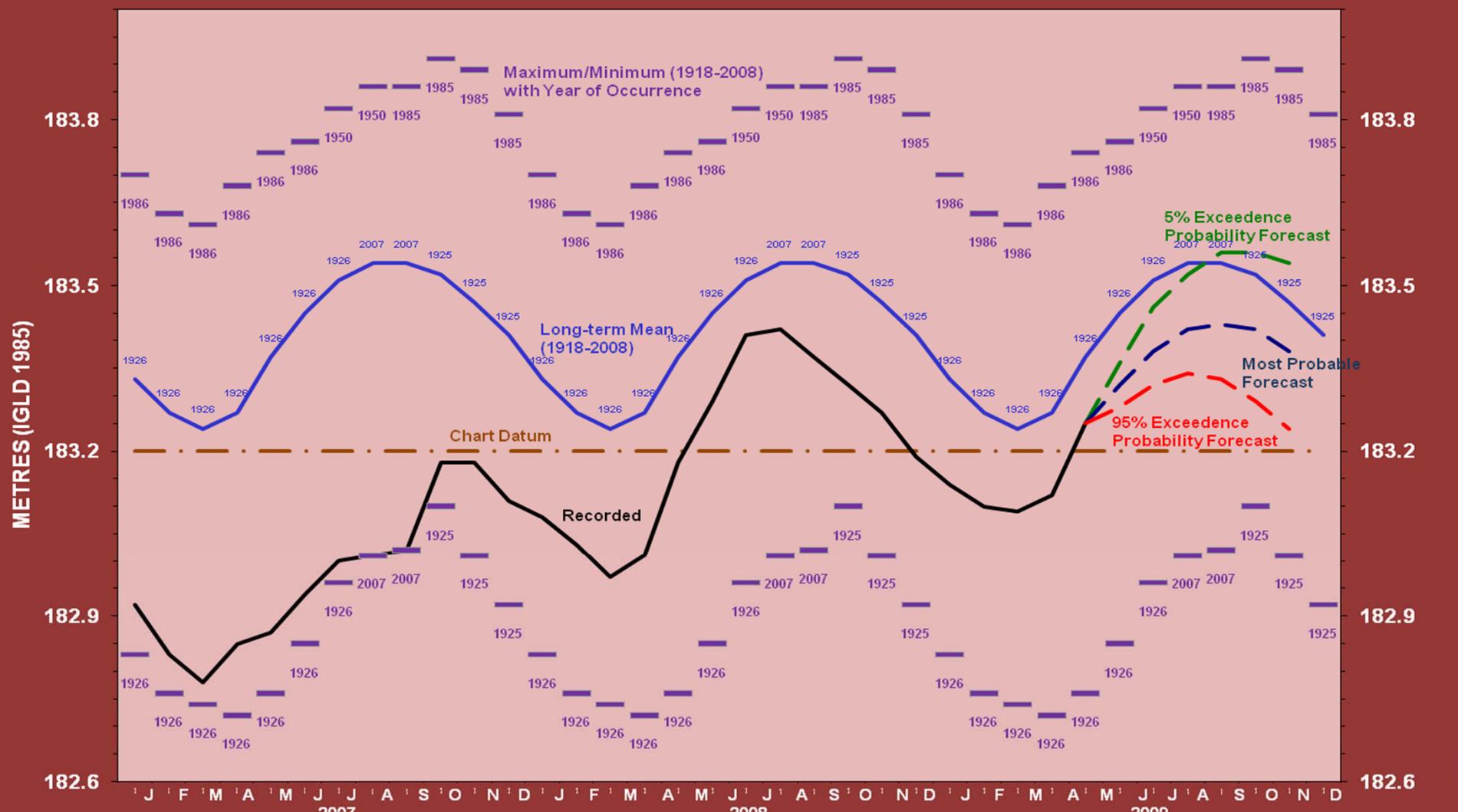
- *Support and maintain key monitoring programs*
- *Implement new models and methods into the government programs*
- *Establish a formal mechanism for accountability*

Next Steps

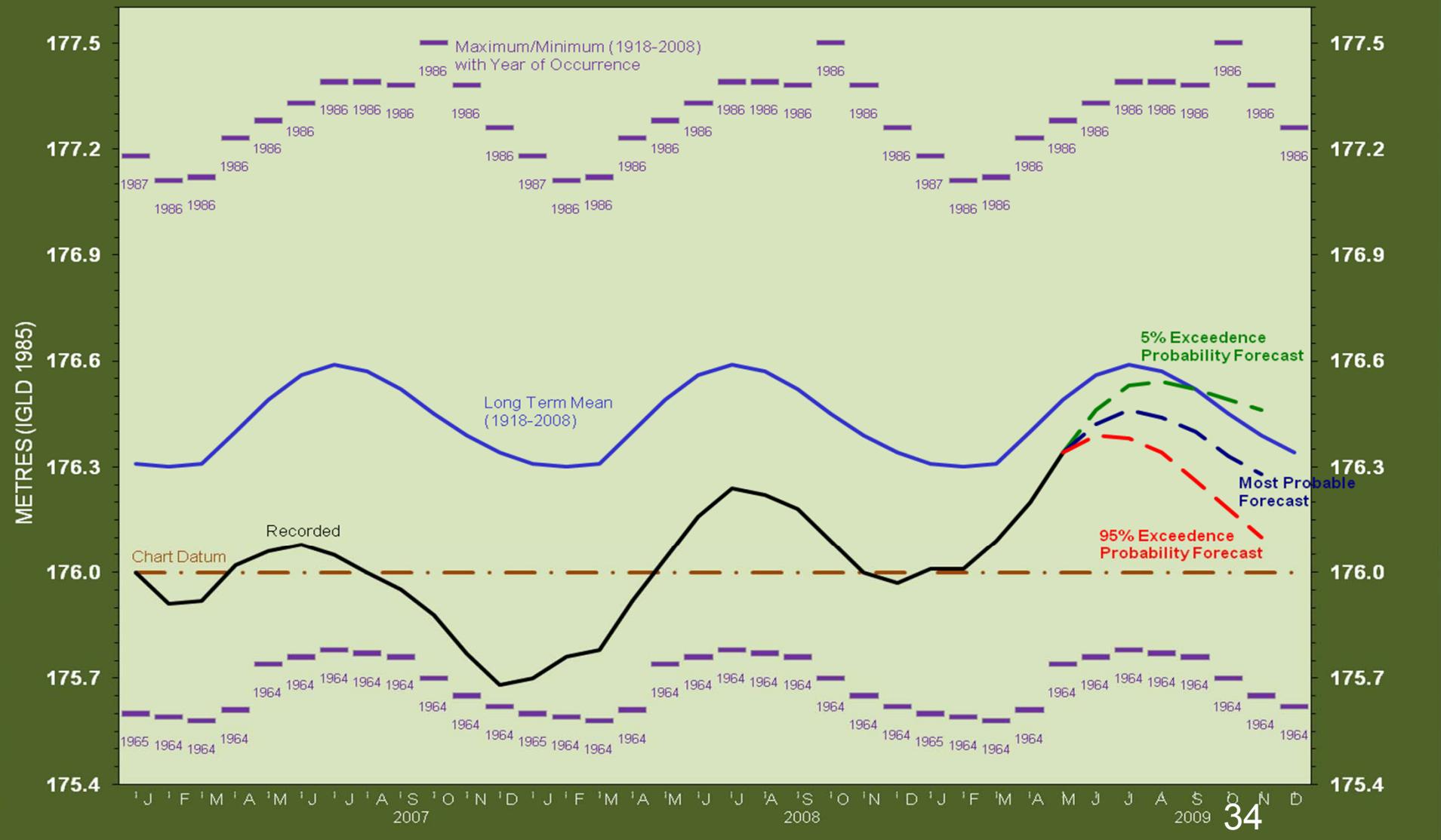
- ✓ Peer review of study findings
- ✓ Public review and comments period
- ✓ Public meetings throughout the upper Great Lakes
- ✓ Further analyses:
 - ✓ Navigation and shipping impacts
 - ✓ Investigations of ice jam impacts
 - ✓ Maintenance dredging impacts
 - ✓ Scientific uncertainty analysis
- ✓ Incorporate comments from the public and external peer review and any additional findings
- ✓ Submit final report to the International Joint Commission on October 1, 2009.

Animation

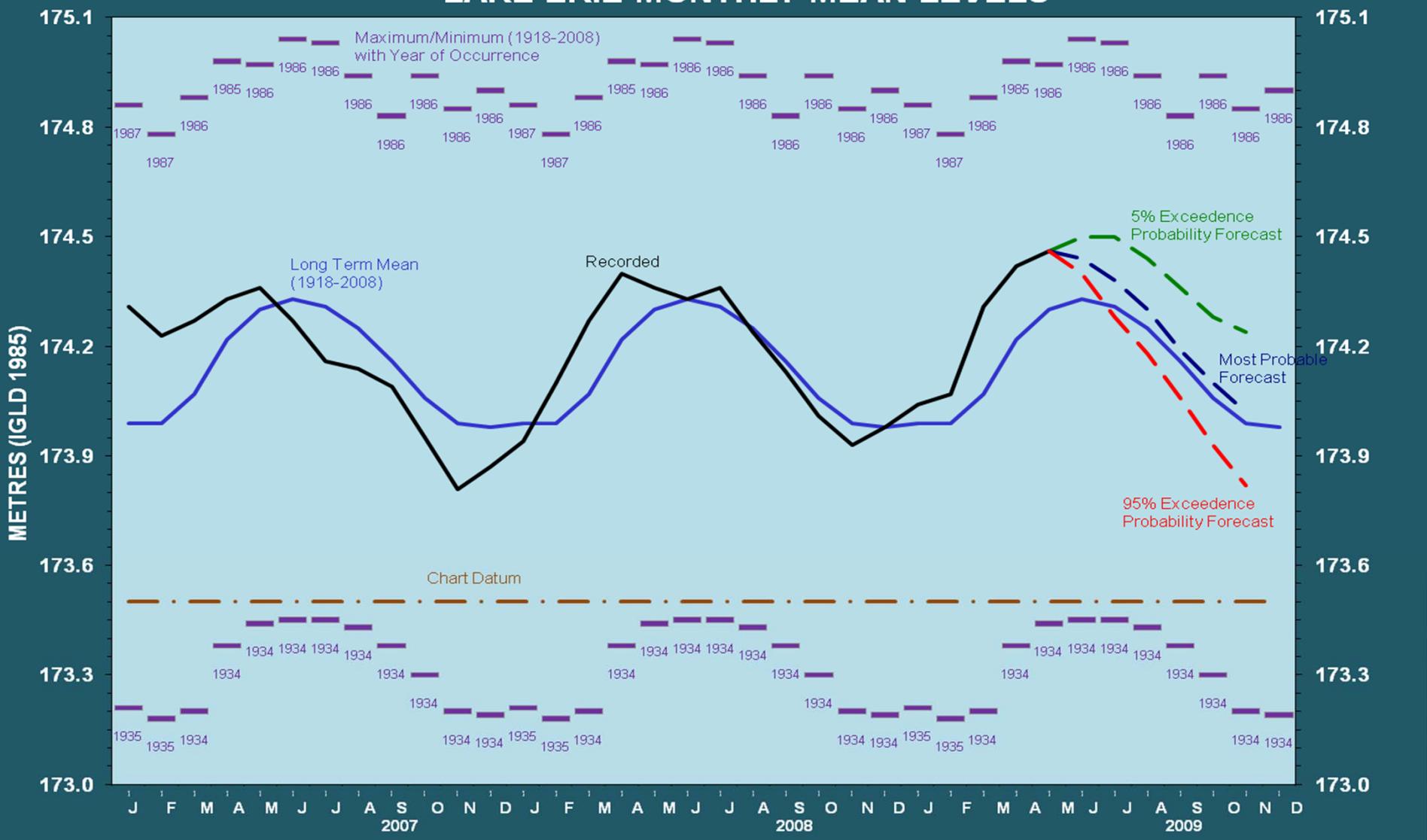
LAKE SUPERIOR MONTHLY MEAN LEVELS



LAKES MICHIGAN-HURON MONTHLY MEAN LEVELS



LAKE ERIE MONTHLY MEAN LEVELS



Great Lakes Water Levels

Lake	May Monthly Mean Level		Beginning-of-June Level	
	Compared to Monthly Average (1918-2008)	Compared to One Year Ago	Compared to Beginning-of-Month Average (1918-2008)	Compared to One Year Ago
Superior	12 cm below	7 cm above	13 cm below	6 cm above
Michigan-Huron	15 cm below	30 cm above	14 cm below	30 cm above
St. Clair	8 cm above	20 cm above	9 cm above	24 cm above
Erie	16 cm above	11 cm above	16 cm above	17 cm above
Ontario	18 cm above	11 cm below	16 cm above	2 cm below

Public Meeting Date	Location
May 19, 2009	Sarnia, ON (Live) - Hub
May 19, 2009	Grosse Pointe Farms, MI (Satellite)
May 19, 2009	Owen Sound, ON (Satellite)
May 20, 2009	Cleveland, OH (Live) - Hub
May 20, 2009	Manitoulin Island, ON (Satellite)
May 20, 2009	Evanston, IL (Satellite)
May 20, 2009	Thunder Bay, ON (Satellite)
June 9, 2009	Muskegon, MI (Live) - Hub
June 9, 2009	Parry Sound, ON (Satellite)
June 9, 2009	Sault Ste. Marie, ON (Satellite)
June 11, 2009	Midland, ON (Live) - Hub
June 11, 2009	Traverse City, MI (Satellite)
June 11, 2009	Superior, WI (Satellite)
June 11, 2009	Bay City, MI (Satellite)

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Questions

