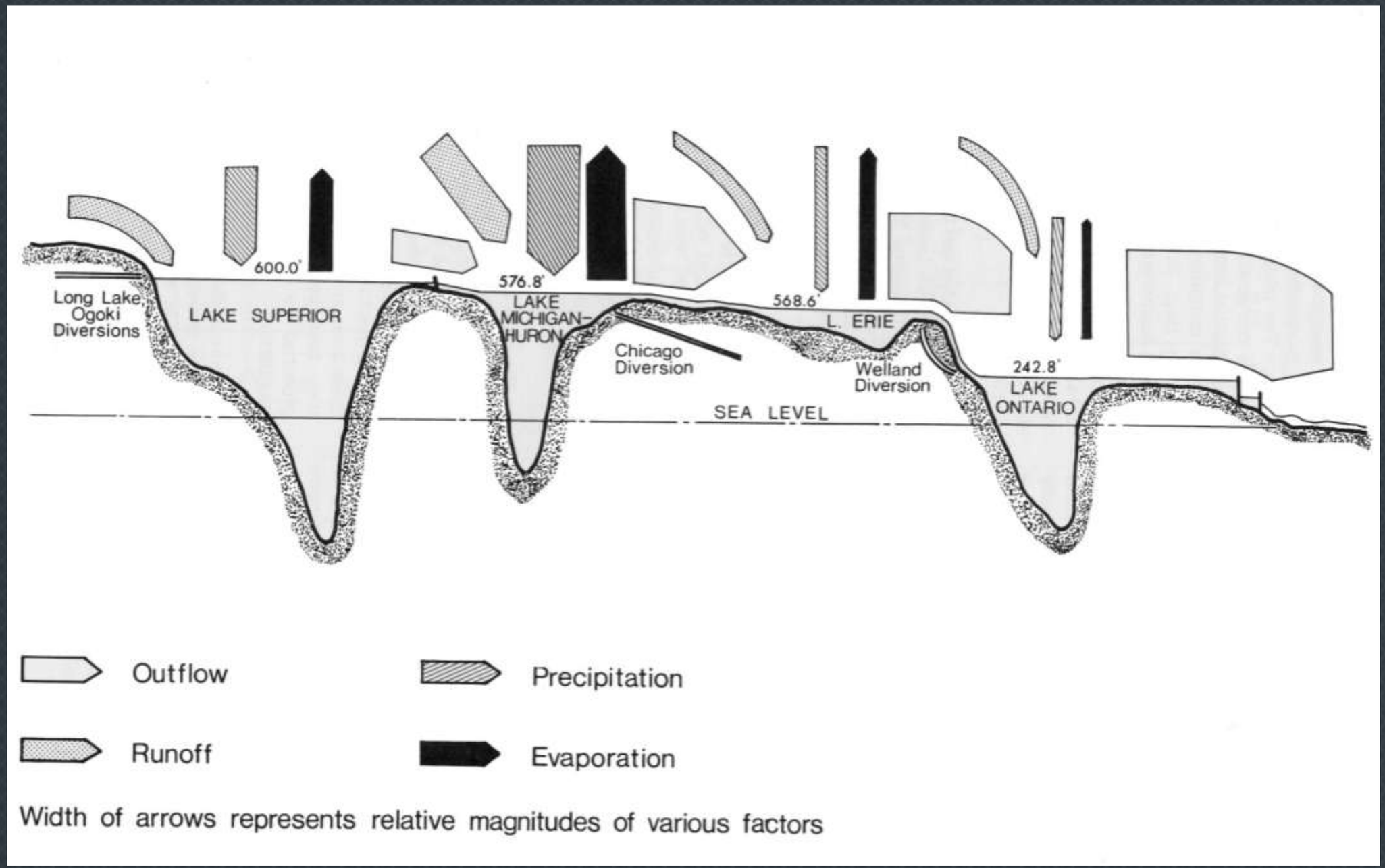
Update on Great Lakes Coastal Methodology

Event versus Response Approach

Pete Zuzek, MES, CFM, P.Geo.

Great Lakes Watershed



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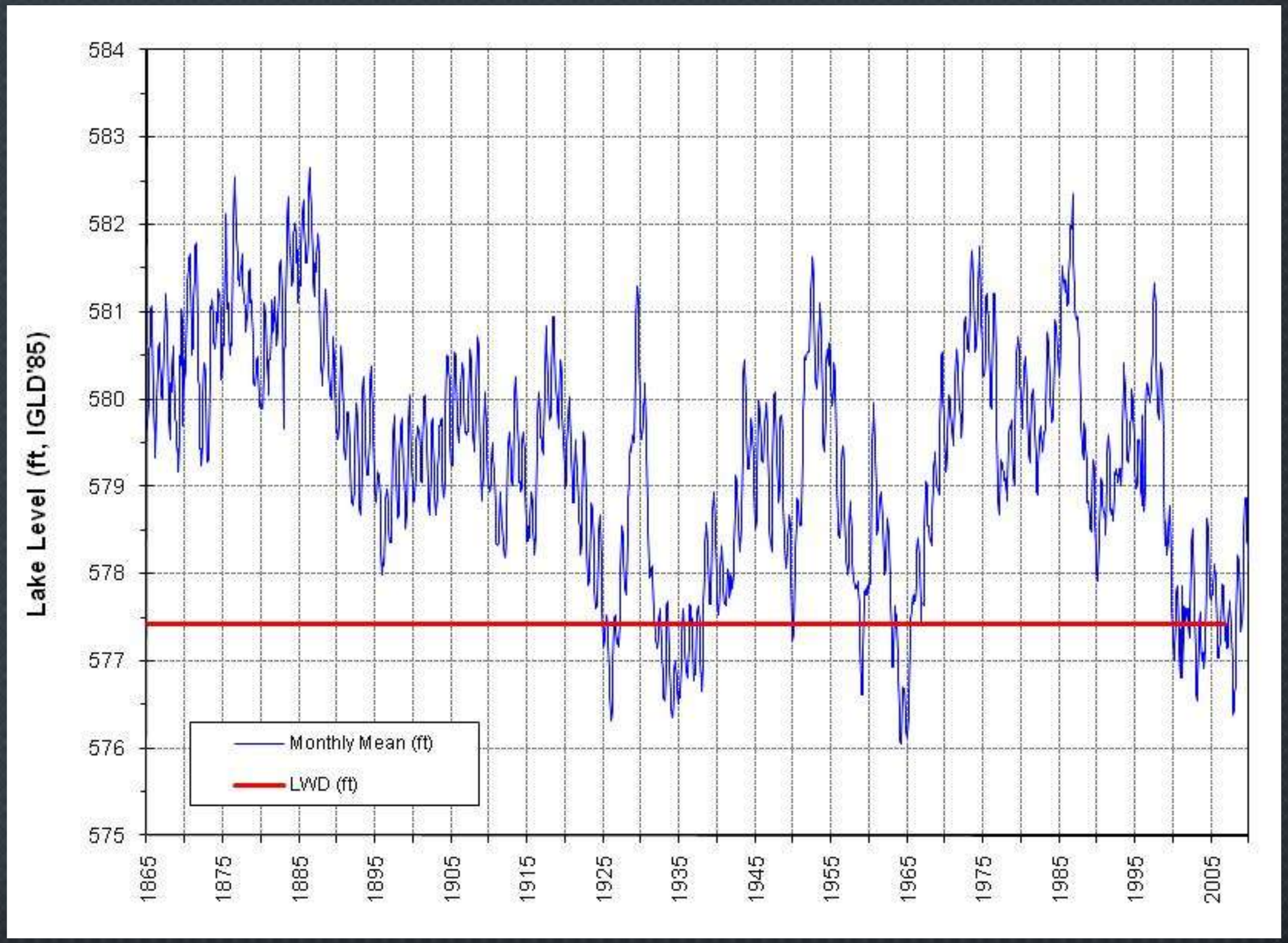
Lake Michigan Water Levels



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Presentation Overview

- I - Event vs. Response Approach
- II - Sheboygan County Runup Results
- III - Data Sensitivity Analysis
- IV – Shore Protection Sensitivity Analysis
- V – Lake Ontario Wave & Surge Modeling
- VI – Storm Selection Techniques

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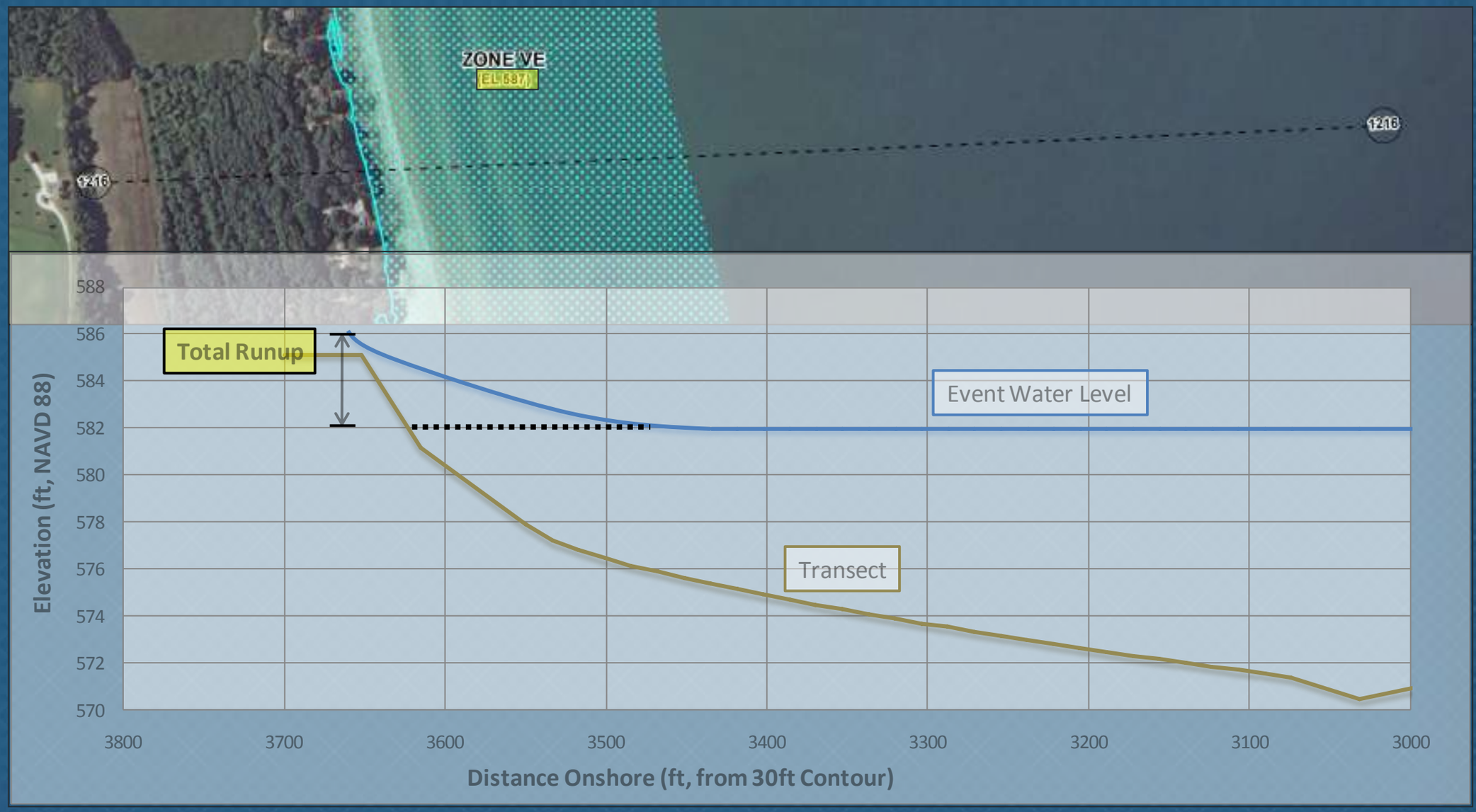
I – Event vs. Response for Runup



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Event Based (G&S, 2003)

- 1% SWEL and 3-yr wave height
  - Extreme value analysis (EVA) required for hourly wave data
- Single run-up calculation per transect
- $R_{2\%}$ defines spatial extent of floodplain
- VE/AE transition based on where runup profile is less than 3 ft above terrain

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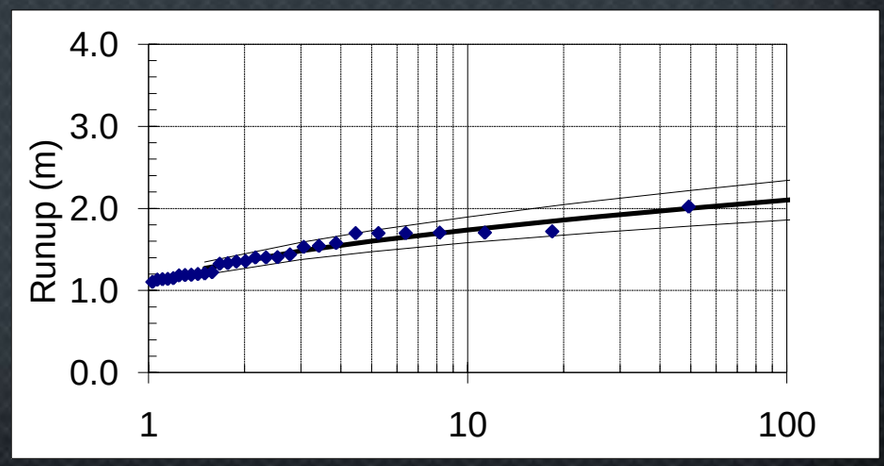
Modified Response (2010)

- Runup calculated for actual storms and hourly lake levels
- One event per year selected that produced the highest runup elevation
- EVA on annual maximum to determine the 1% Flood Elevation (BFE)
- POT approach in 2011



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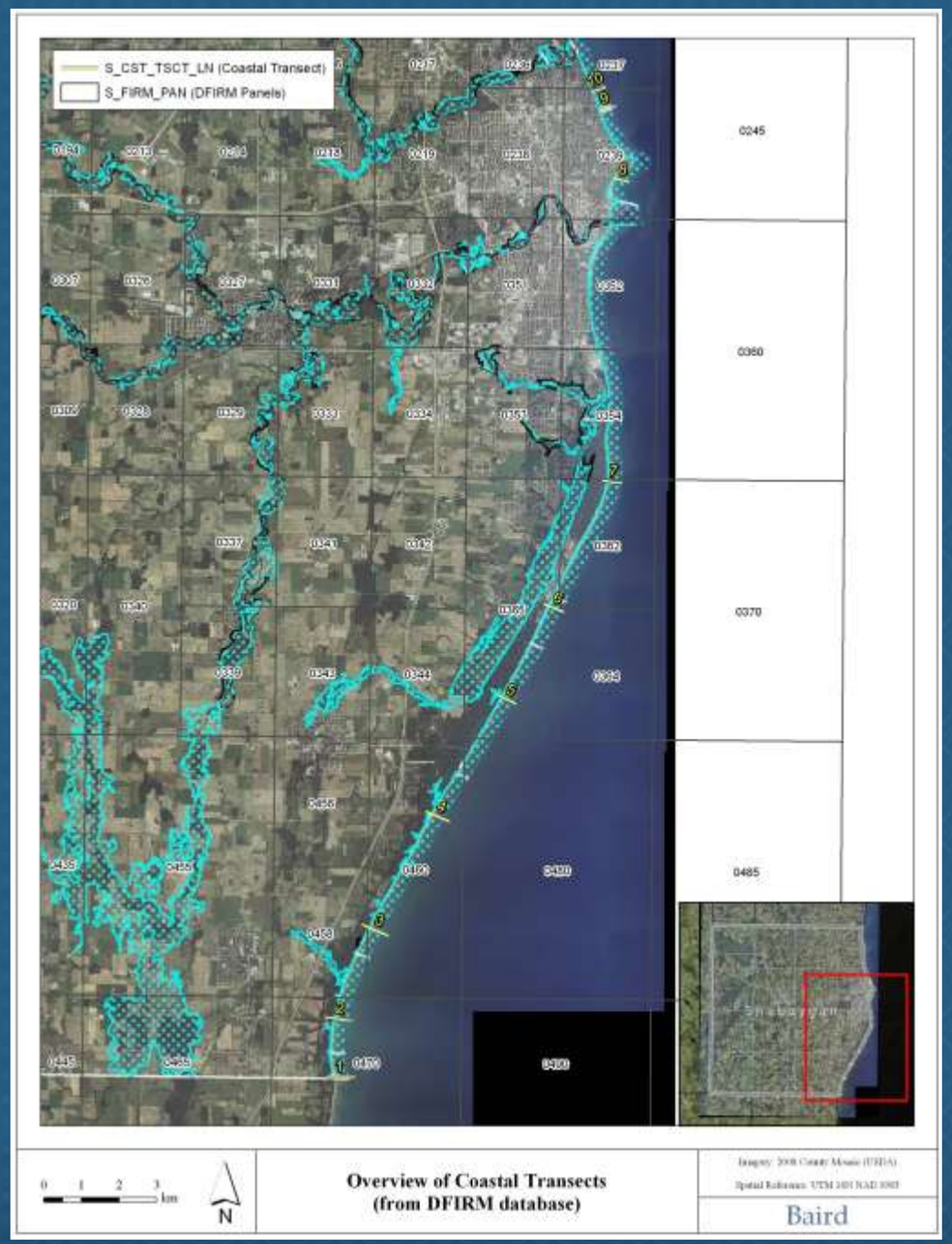
II – Sheboygan County Runup Results



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Sample Response Calculation

Combined waves (from hindcast) & WLs (NOAA) to create stormlisting

Year	Duration	Hs (m)	Tp (s)	Dir	Surge (m)
1998	15	2.92	8.61	22	0.22
1998	13	3.27	8.24	22	0.17
1998	23	3.65	9.44	22	0.16
1998	37	3.92	8.88	22	0.53
1998	23	2.96	7.07	112	0.25
1998	14	3.01	8.87	22	0.2
1998	49	4.24	9.74	22	0.35
1997	21	2.95	7.67	45	0.28
1997	7	2.55	7.16	22	0.33
1997	14	2.64	7.78	45	0.25
1997	3	2.5	7.82	135	0.21
1997	8	2.4	7.53	90	0.15
1996	2	2.47	7.23	158	0.1
1996	1	2.35	6.8	112	0.11
1996	5	2.68	7.67	135	0.15

Calculate $R_{2\%}$

$R_{2\%}$ (m)
0.914
0.875
1.002
0.943
0.751
0.942
1.034
0.814
0.760
0.826
0.830
0.799
0.768
0.722
0.814

Add $R_{2\%}$ to TWL from each storm

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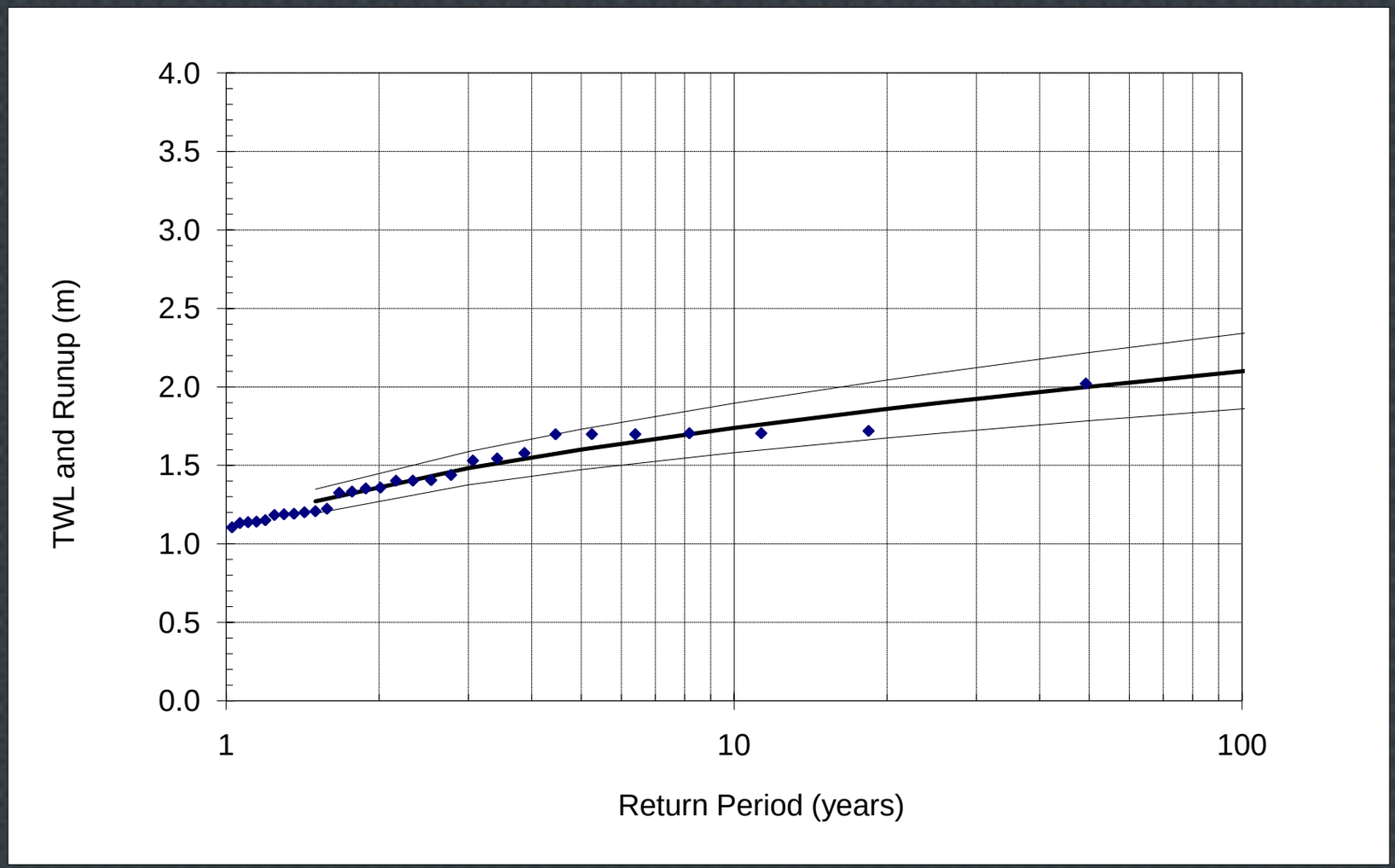
Extreme Value Analysis for ‘TWL plus Runup’



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Event vs Modified Response

- Old Event
  = $SWEL_{1\%} + R_{2\%}$
  = Transect 1224 BFE = 587 ft

- Modified Response
  = TWL (actual storms) + $R_{2\%}$
  Fit probability distribution to all runups
  = Transect 1224 BFE = 588 ft

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CORRECTED FIRM AUGUST 2010 - OLD METHOD
CORRECTED FIRM AUGUST 2010 - NEW METHOD
ZONE X
LEGEND
NFIP
NATIONAL FLOOD INSURANCE PROGRAM
FIRM
FLOOD INSURANCE RATE MAP
SHEBOYGAN COUNTY
MAP NUMBER
EFFECTIVE DATE
APRIL 2, 2009

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Summary

- Modified Response produces results ~1 ft higher than the Old Event Method
- Technically superior approach
- Detailed wave and surge modeling under way for ~150 storms per lake
- Results will be used for the Modified Response approach

III – Data Sensitivity Analysis

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Bathy/Topo Resolution

- High Resolution
- $R_{2\%}$ = 589 ft

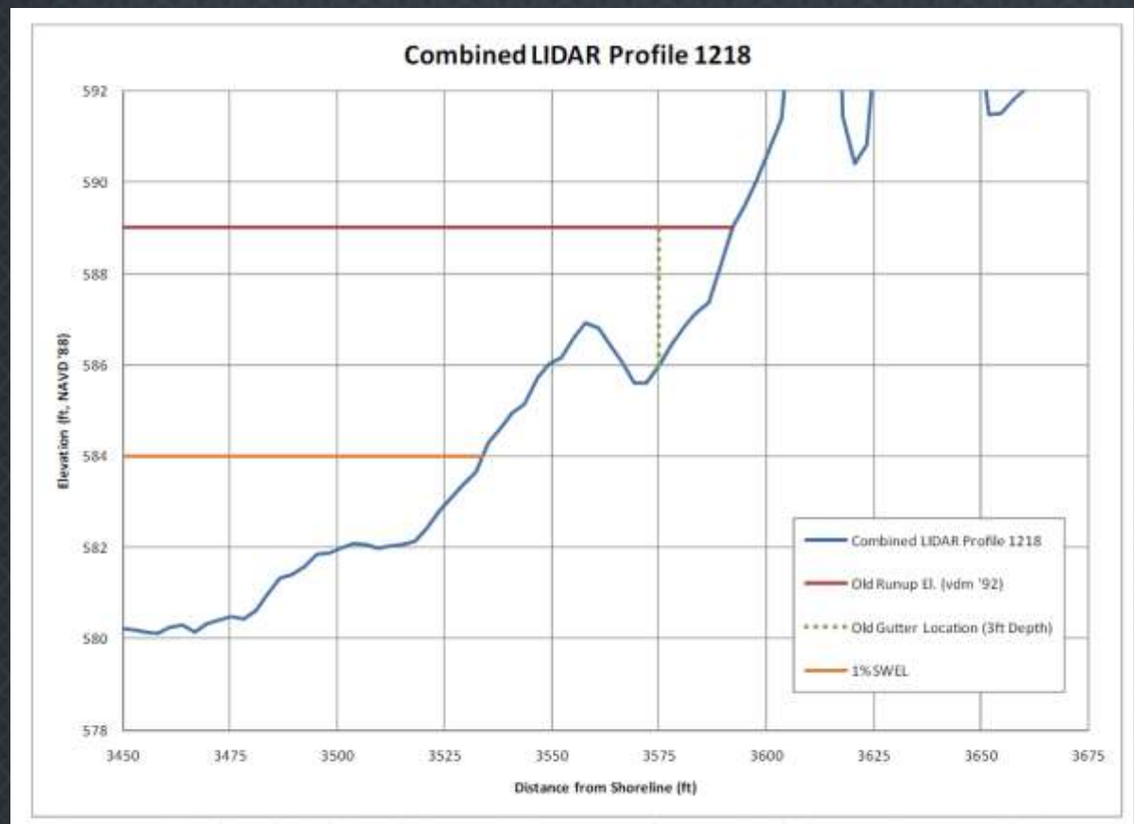

Figure 3.1 Combined High Resolution LIDAR Transect for 1218 in Sheboygan County with Runup

- Low Resolution
- $R_{2\%}$ = 587 ft

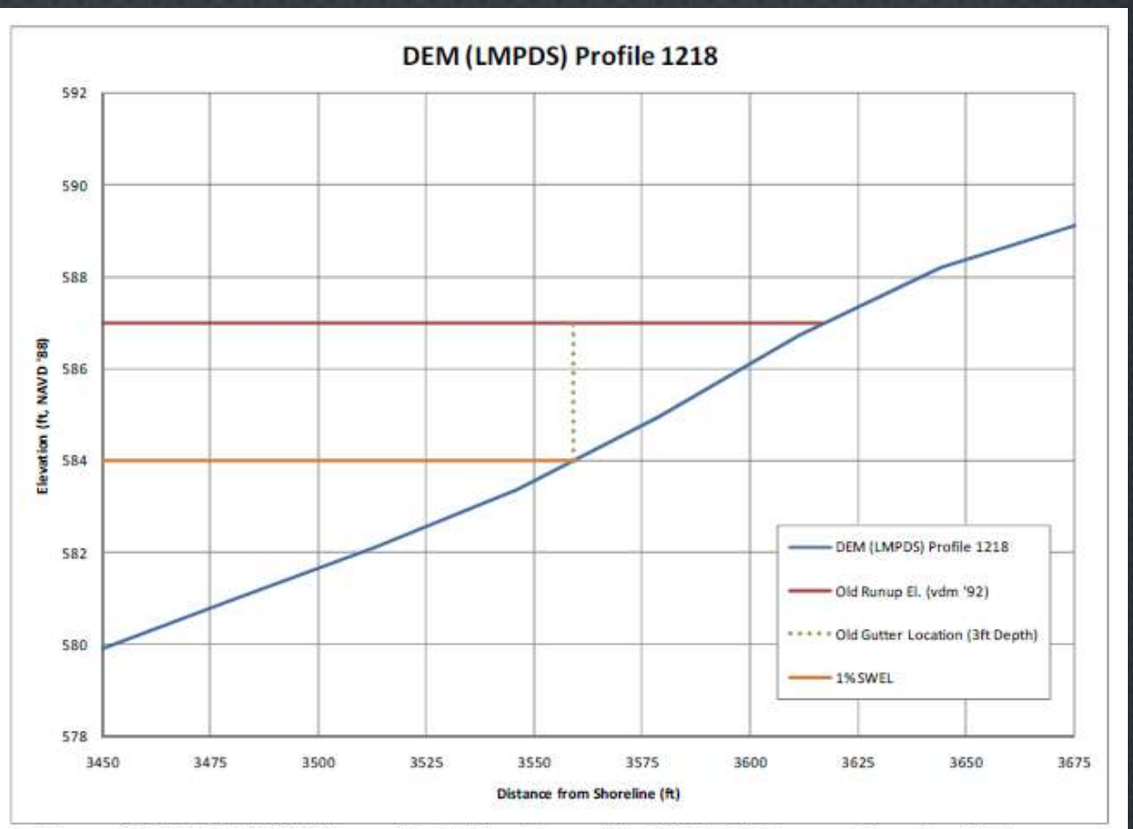

Figure 3.2 DEM/LMPDS Coarse Resolution Transect for 1218 in Sheboygan County with Runup

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Impact of Lake Level Trends on Beaches

- New LIDAR collected during low phase
- Flood events happen during high wls

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Spacing Resolution (Allegan)

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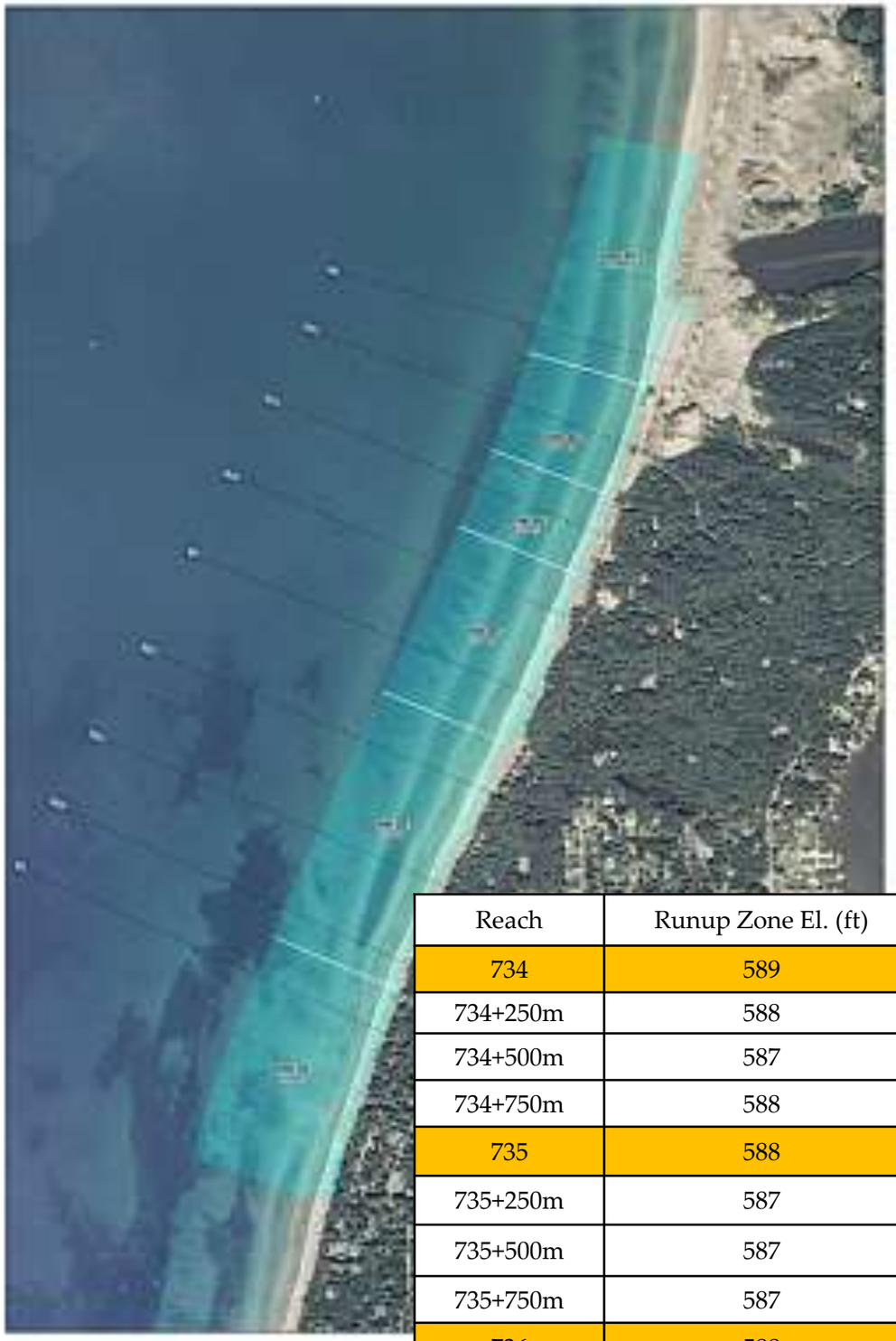
SENSITIVITY ANALYSIS - FEW COASTAL TRANSECTS

SENSITIVITY ANALYSIS - MANY COASTAL TRANSECTS



Reach	Runup Zone El. (ft)
734	589
734+250m	588
734+500m	587
734+750m	588
735	588
735+250m	587
735+500m	587
735+750m	587
736	588

LEGEND

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IV – Shore Protection Sensitivity Analysis

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Details for Structures

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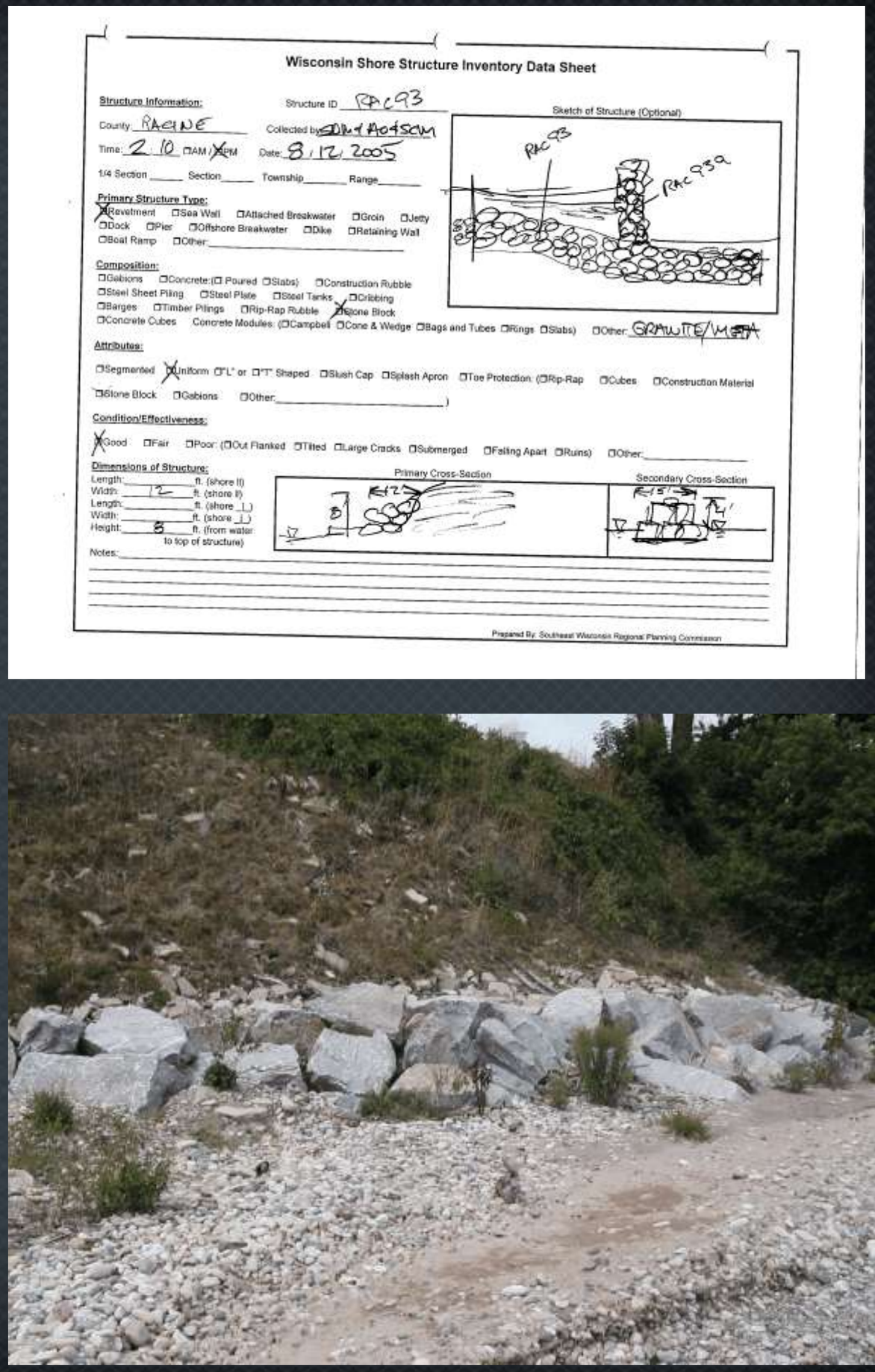

Wisconsin Shore Structure Inventory Data Sheet

Structure Information: Structure ID RAC93

County: RACINE Collected by: DMT AOTSCM

Time: 2:10 ☐AM/☒PM Date: 8/12/2005

1/4 Section ____ Section ____ Township ____ Range ____

Sketch of Structure (Optional)

Primary Structure Type:

☒Revetment ☐Sea Wall ☐Attached Breakwater ☐Groin ☐Jetty
☐Dock ☐Pier ☐Offshore Breakwater ☐Dike ☐Retaining Wall
☐Boat Ramp ☐Other: ____

Composition:

☐Gabions ☐Concrete:(☐ Poured ☐Slabs) ☐Construction Rubble
☐Steel Sheet Piling ☐Steel Plate ☐Steel Tanks ☐Cribbing
☐Barges ☐Timber Pilings ☐Rip-Rap Rubble ☒Stone Block
☐Concrete Cubes Concrete Modules: (☐Campbell ☐Cone & Wedge ☐Bags and Tubes ☐Rings ☐Slabs) ☐Other: GRAVITE/MORTA

Attributes:

☐Segmented ☒Uniform ☐"L" or ☐"T" Shaped ☐Slush Cap ☐Splash Apron ☐Toe Protection: (☐Rip-Rap ☐Cubes ☐Construction Material
☐Stone Block ☐Gabions ☐Other: ____)

Condition/Effectiveness:

☒Good ☐Fair ☐Poor: (☐Out Flanked ☐Tilted ☐Large Cracks ☐Submerged ☐Falling Apart ☐Ruins) ☐Other: ____

Dimensions of Structure:

Length: ____ ft. (shore ||)
Width: 12 ft. (shore ||)
Length: ____ ft. (shore ⊥)
Width: ____ ft. (shore ⊥)
Height: 5 ft. (from water to top of structure)

Primary Cross-Section

Secondary Cross-Section

Notes: ____

Prepared By: Southeast Wisconsin Regional Planning Commission

Structure Database

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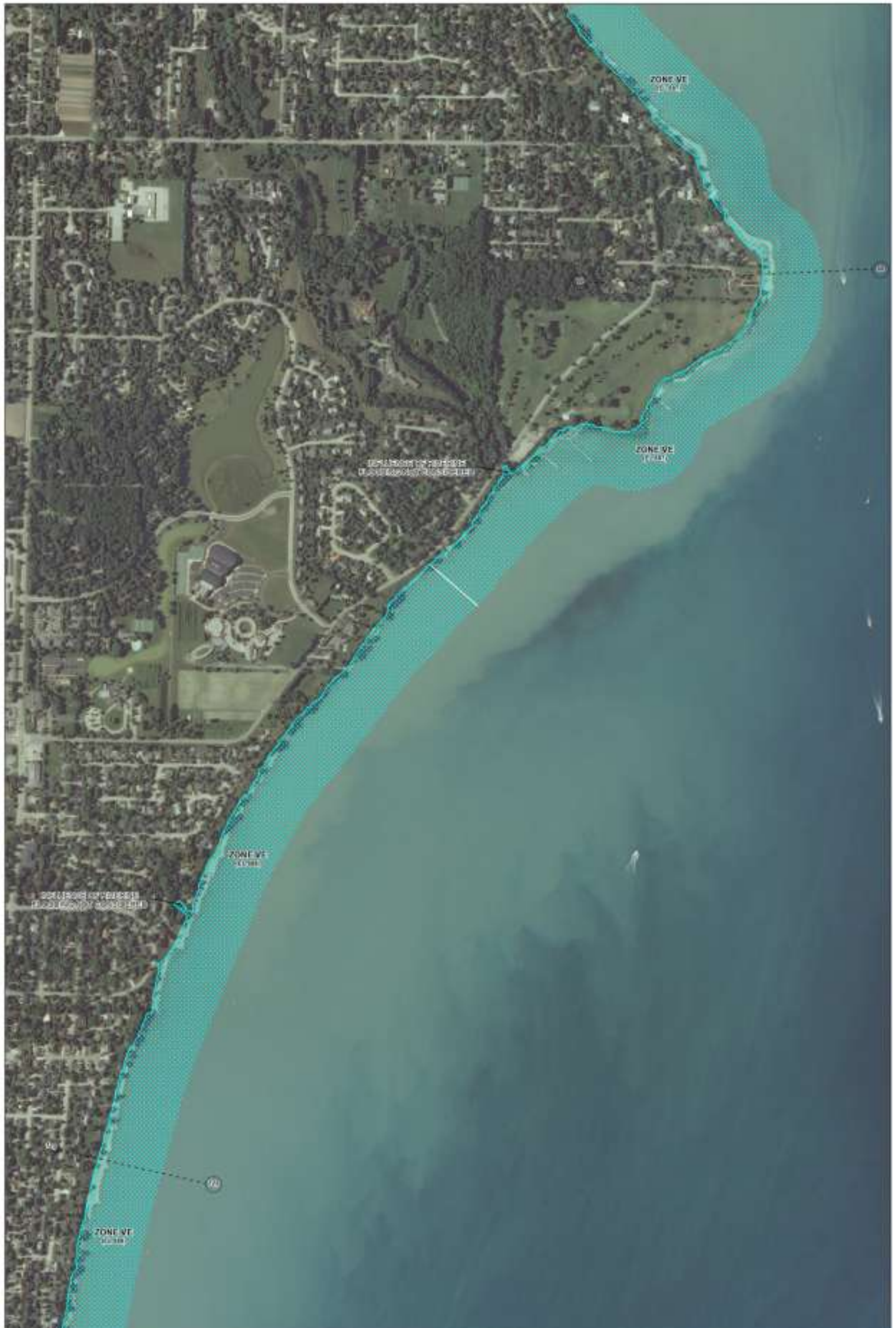
SENSITIVITY ANALYSIS - LOW RESOLUTION OF COASTAL STRUCTURES



SENSITIVITY ANALYSIS - HIGH RESOLUTION OF COASTAL STRUCTURES

ZONE VE
(EL 587)

69

ZONE VE
(EL 587)

INFLUENCE OF RIVERINE
FLOODING NOT CONSIDERED

ZONE VE
(EL 587)

ZONE VE
(EL 587)

ZONE VE
(EL 587)

ZONE VE
(EL 588)

ZONE VE
(EL 590)

ZONE VE
(EL 588)

ZONE VE
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(EL 587)

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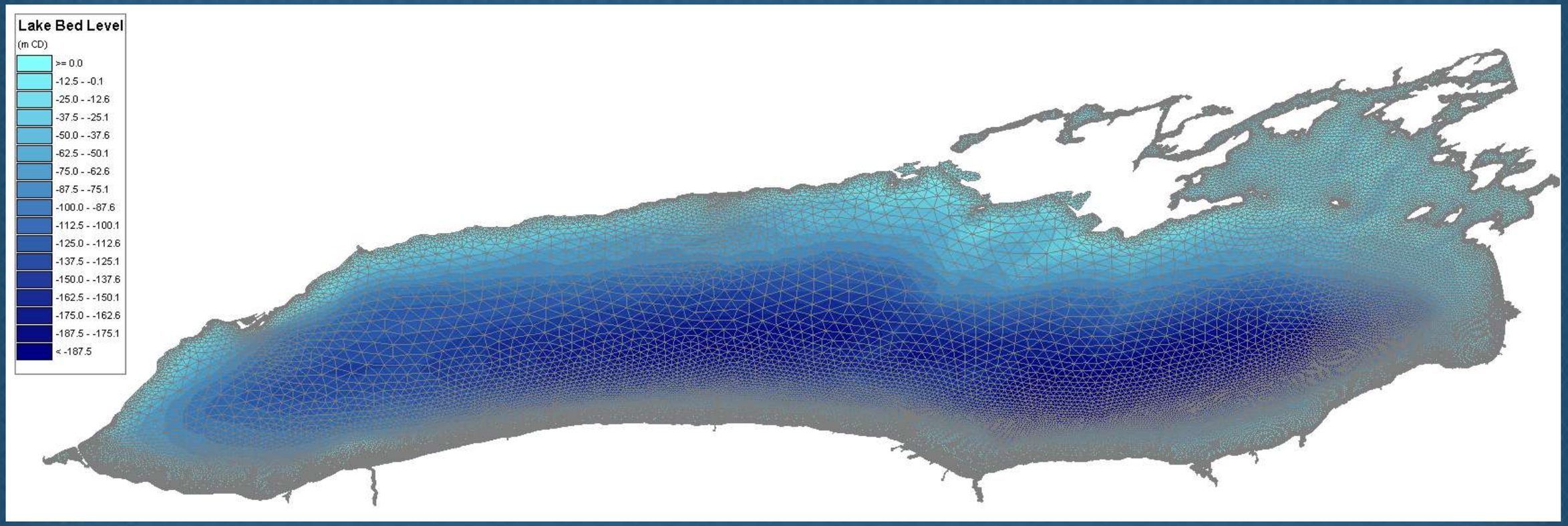
(EL 588)

ZONE VE

V – Lake Ontario Wave and Surge Modeling



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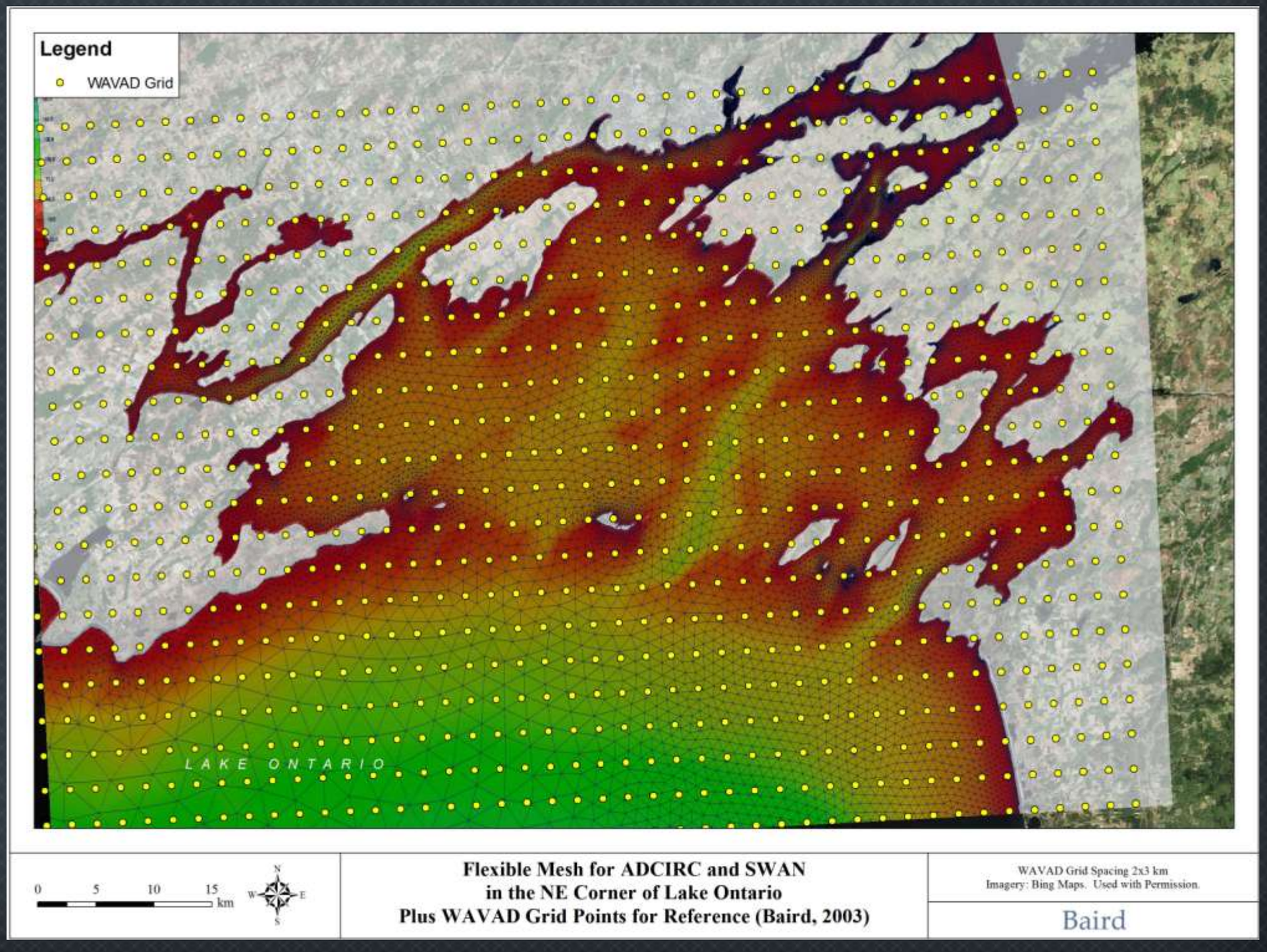
Model Selection



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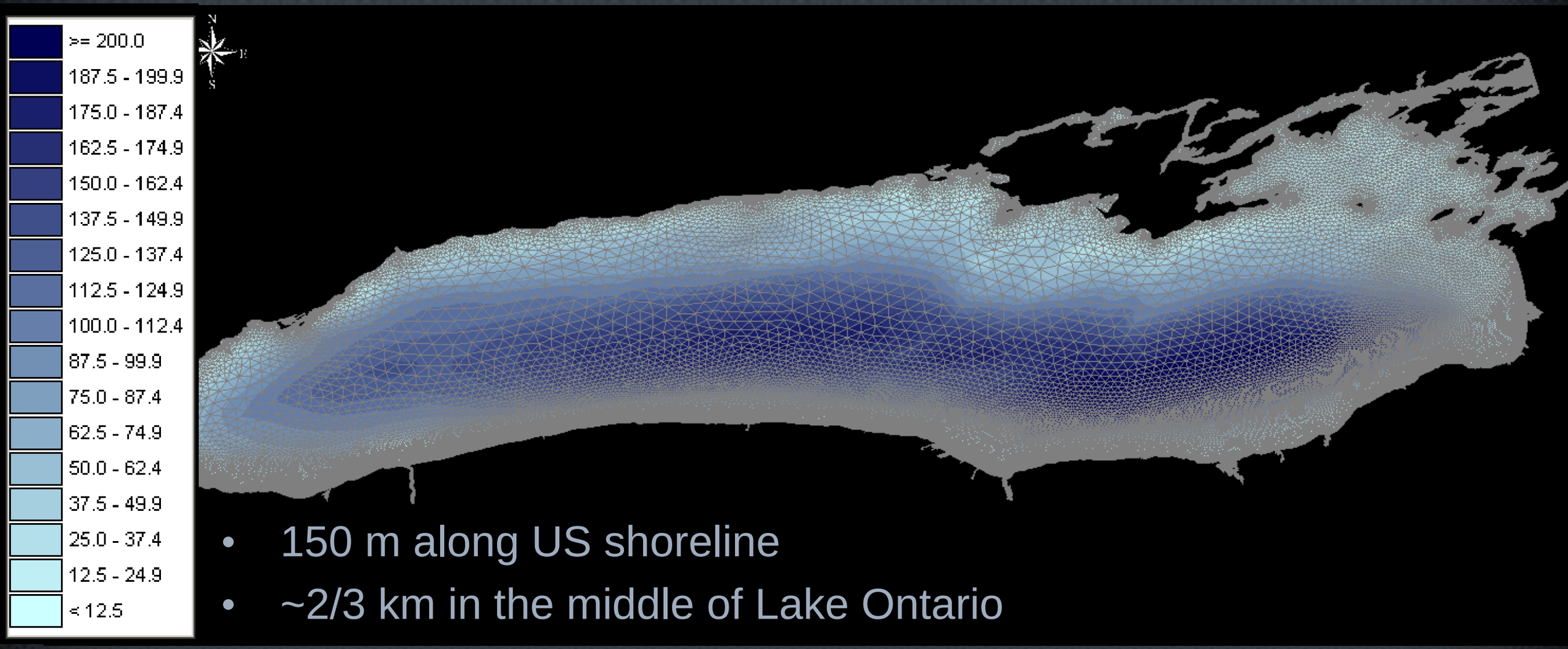
Mesh



- 150 m along US shoreline
- ~2/3 km in the middle of Lake Ontario

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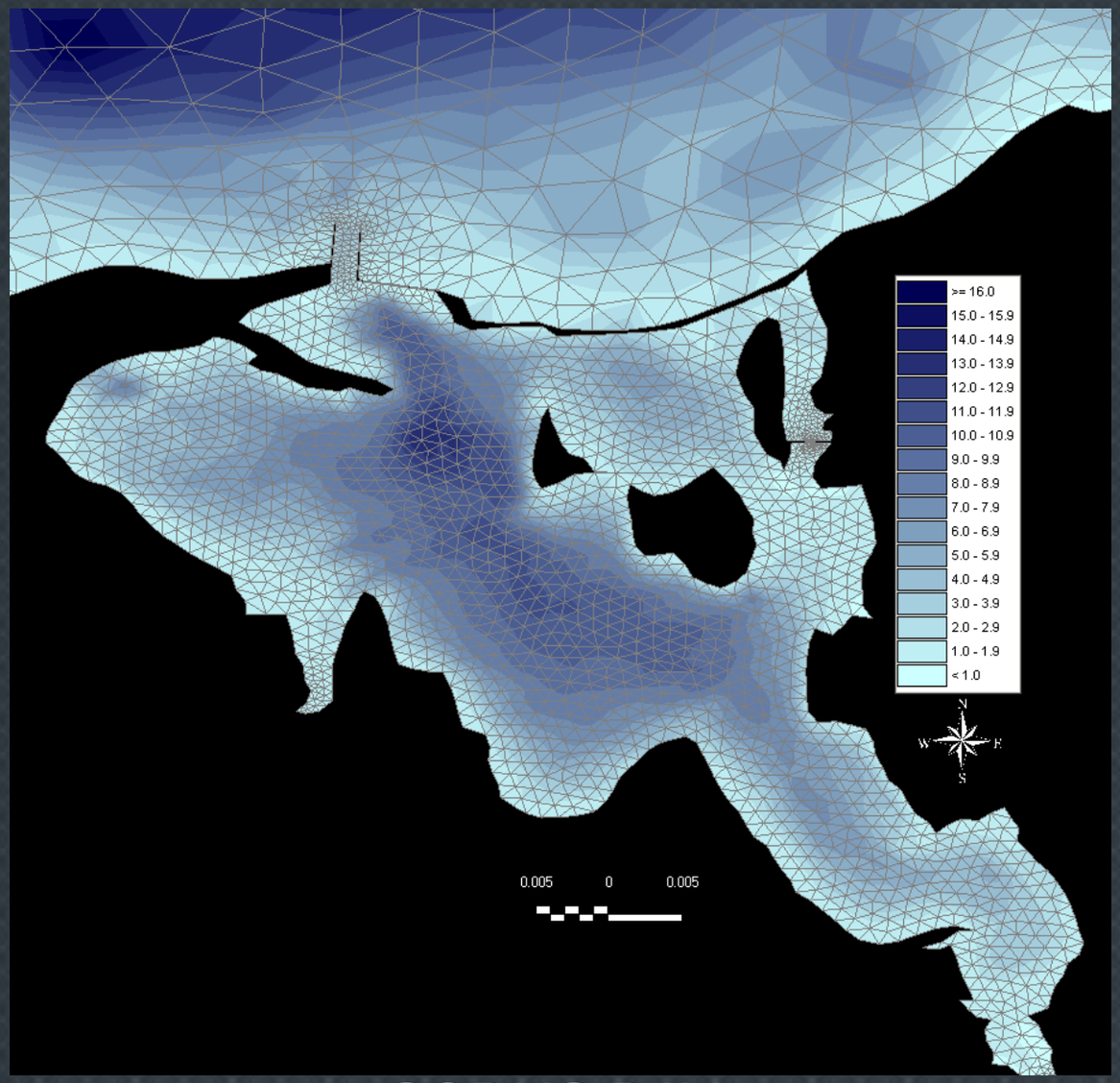
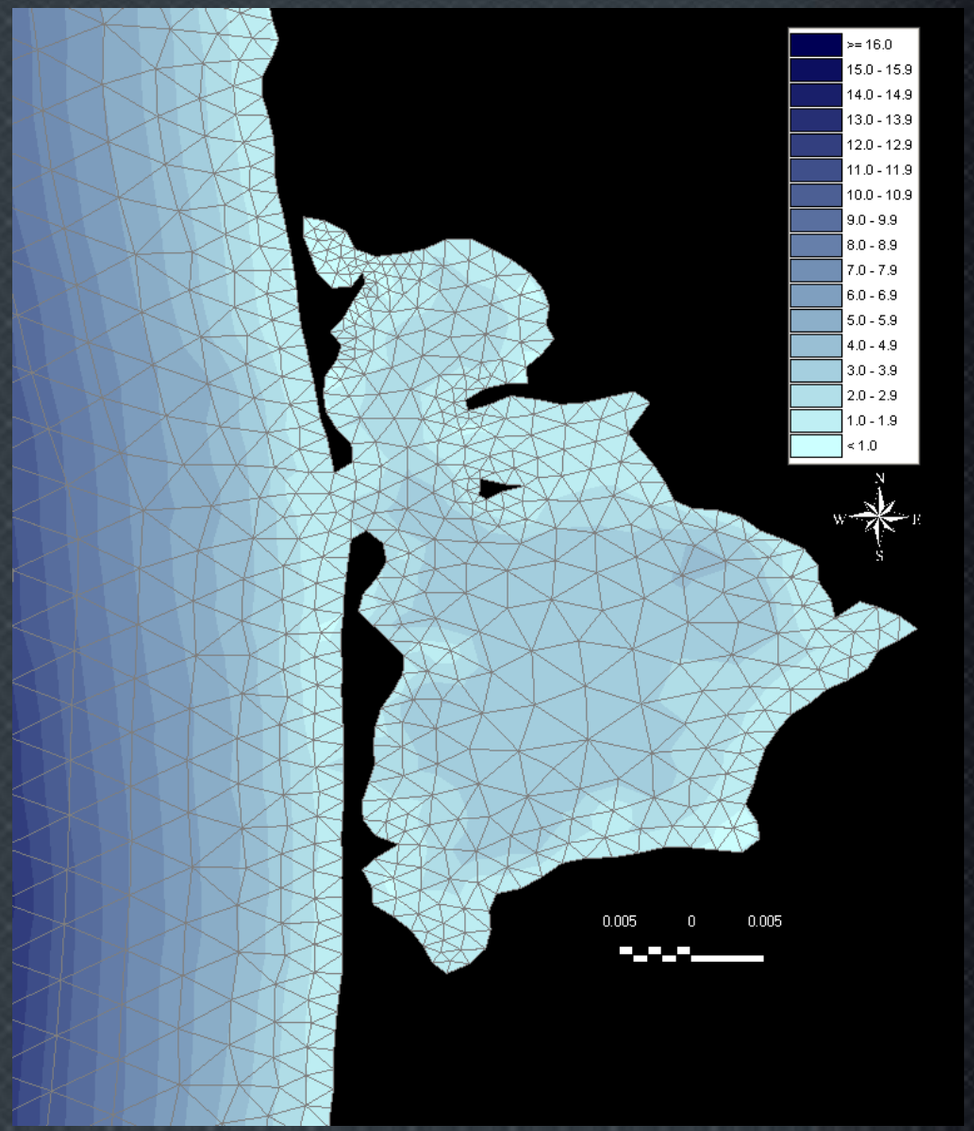
Mesh



SODUS BAY



NORTH POND

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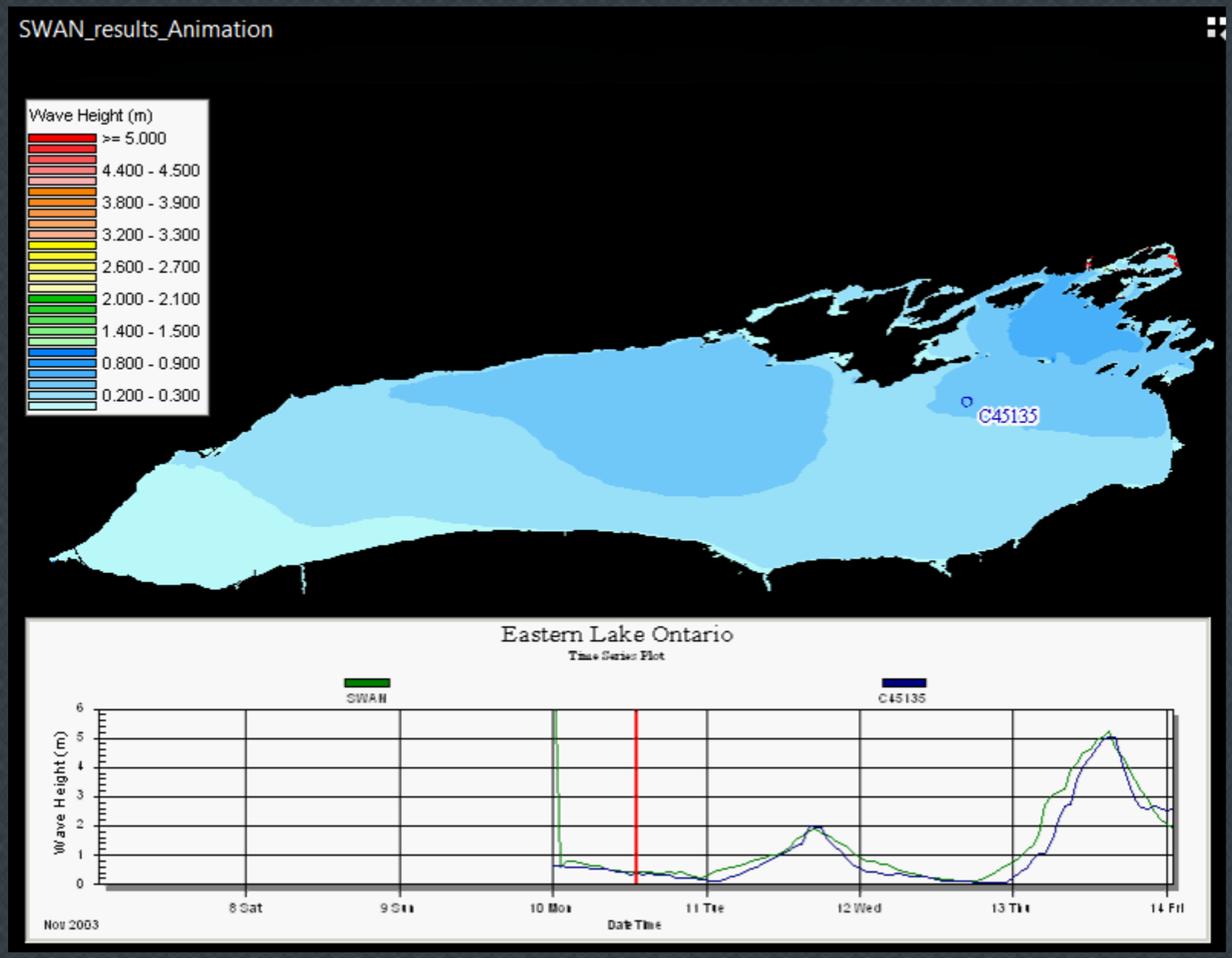
Preliminary Results



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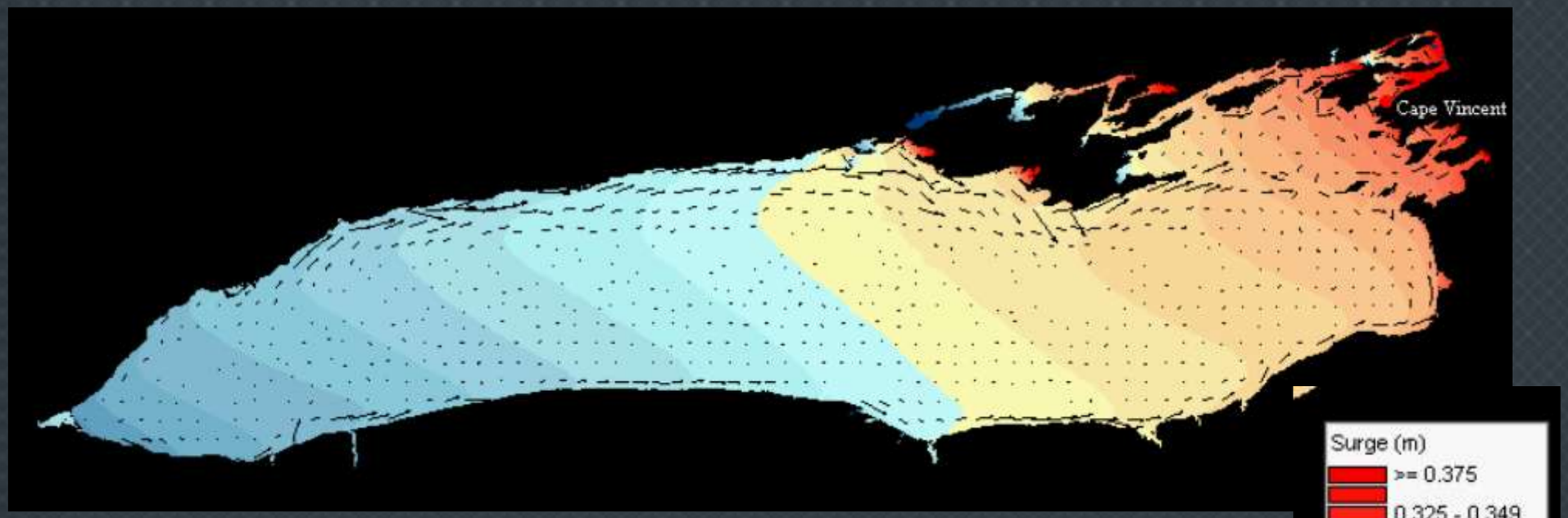
ADCIRC – Storm Surge Model



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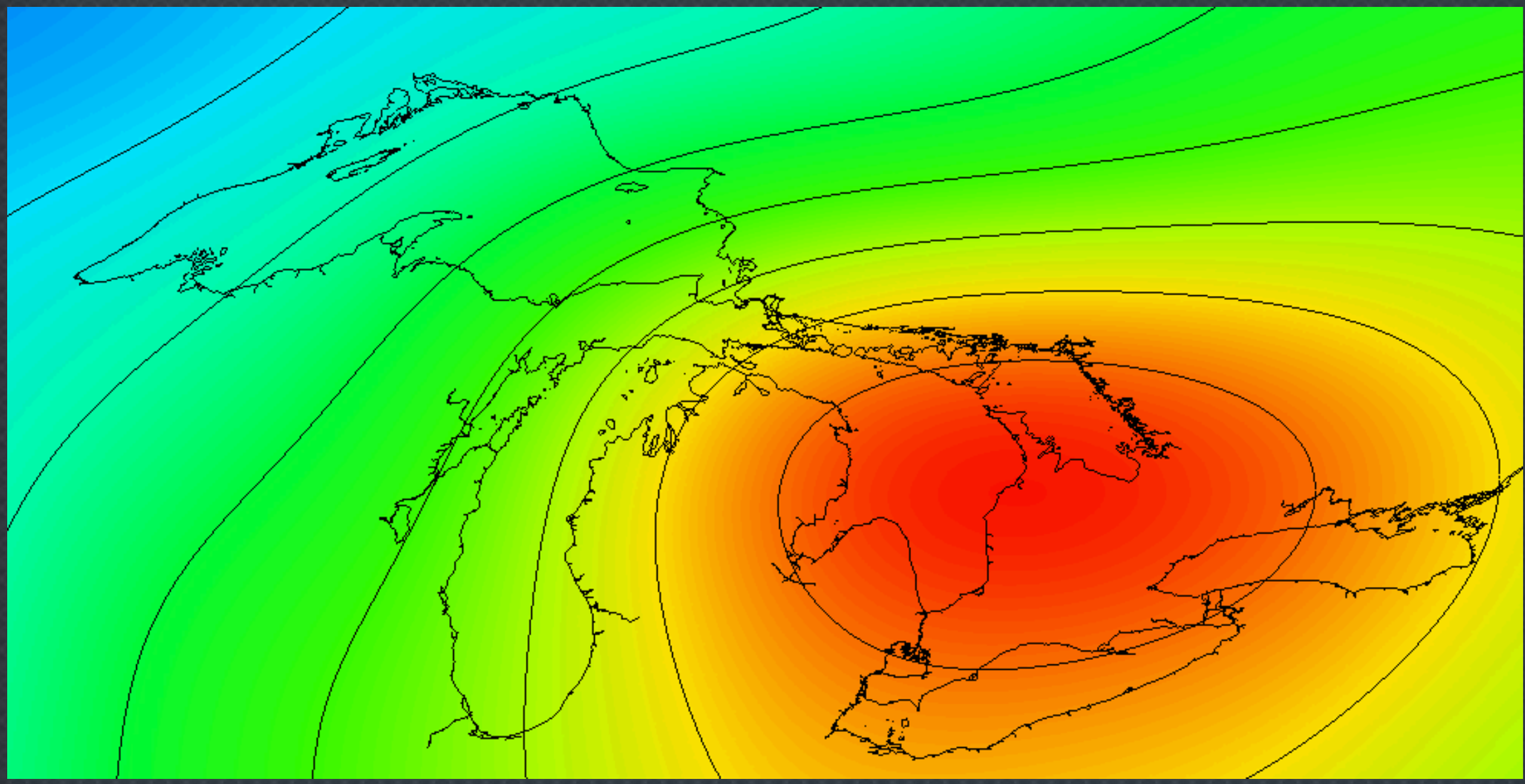
VI – Storm Selection



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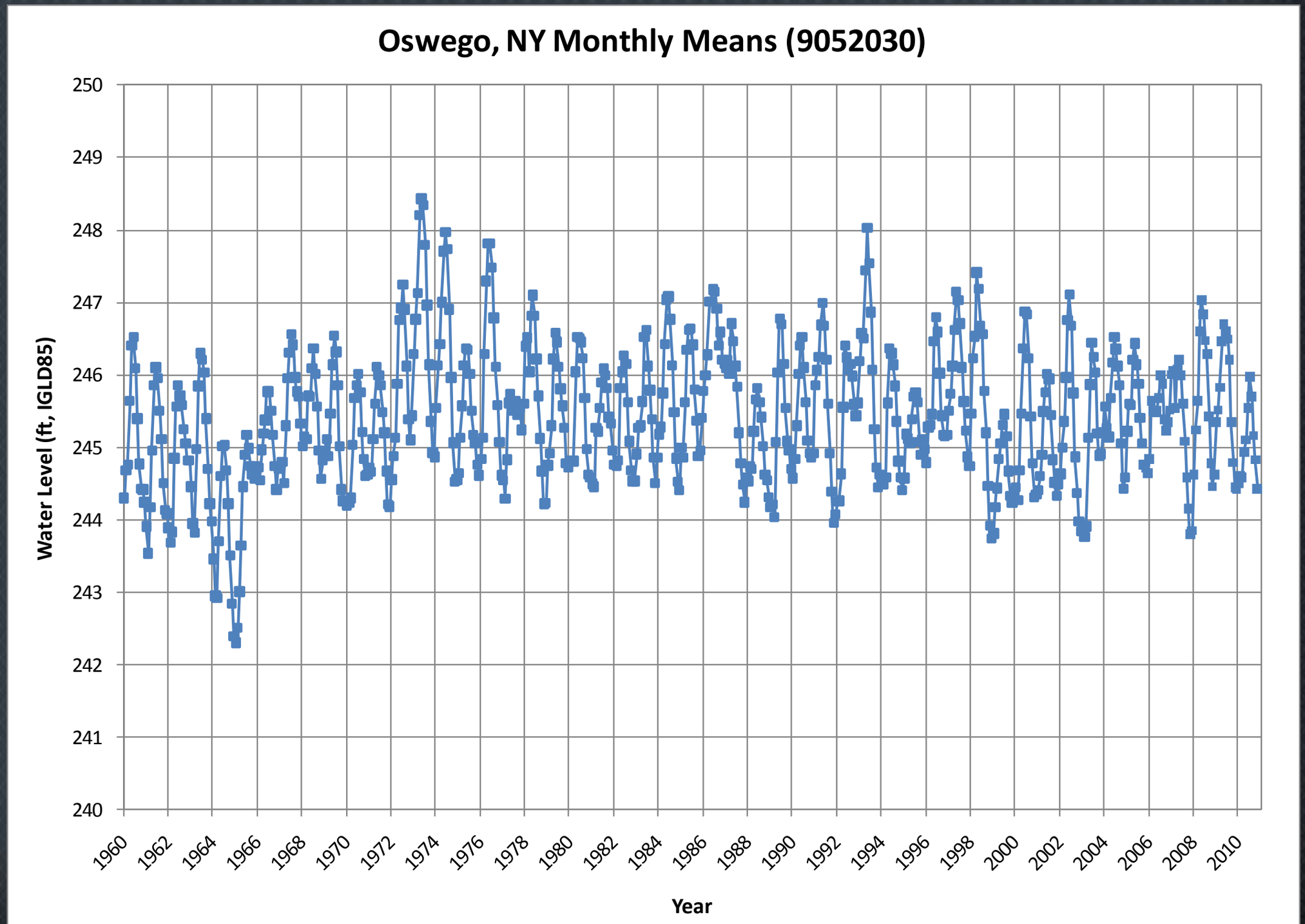
Monthly Means Oswego



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Lake Ontario Beaches

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Lake Ontario Bluffs

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Oswego 10/10

- Top 10 Surge

Rank	Maximum Time	Maximum Surge (ft)	Duration (hrs)	TWL (ft, IGLD'85)
1	1979/04/06 15:00	1.18	31	247.12
2	2006/02/17 09:00	1.16	43	246.76
3	1992/11/13 01:00	1.10	12	246.55
4	1991/12/14 18:00	0.97	18	245.03
5	1980/01/12 09:00	0.88	15	245.67
6	2005/09/29 09:00	0.83	13	245.74
7	2003/11/13 17:00	0.82	27	245.72
8	1974/01/31 17:00	0.81	8	246.67
9	1996/01/28 02:00	0.81	23	245.83
10	1976/03/05 12:00	0.80	17	246.65

- Waves

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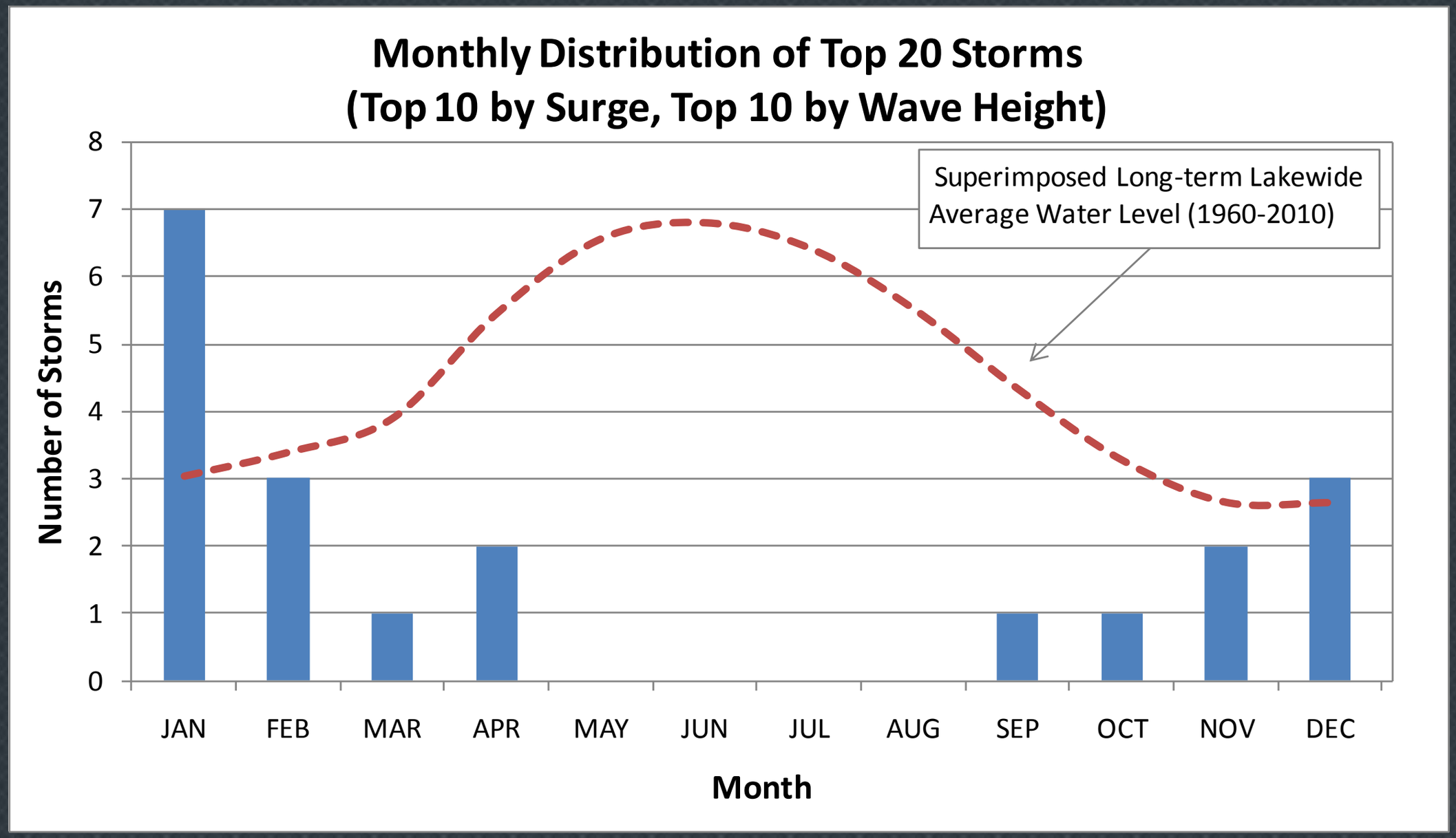
Rank	Maximum Time	Maximum H_o (ft)	Direction (deg)	Duration (hrs)
1	1972/01/25 20:00	20.08	280	19
2	1968/12/06 04:00	20.01	274	47
3	2003/02/05 06:00	19.85	273	26
4	1963/04/05 00:00	19.46	296	11
5	1985/12/03 01:00	19.23	278	19
6	1964/01/10 22:00	19.03	274	19
7	1963/01/24 18:00	18.96	275	35
8	1968/02/18 01:00	18.64	279	43
9	1963/01/21 20:00	18.60	274	35
10	2006/10/29 13:00	18.57	273	25

Oswego Monthly Distribution



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Oswego Total Water Level

Surge Rank	Maximum Time	Surge (ft)	Duration (hrs)	Maximum TWL (ft, IGLD'85)
95	1974/07/03 11:00	0.57	3	248.47
320	1973/04/11 17:00	0.40	16	248.47
120	1974/05/17 06:00	0.53	13	248.24
370	1976/05/19 16:00	0.37	2	248.21
338	1993/04/26 07:00	0.39	22	248.20
408	1973/07/14 06:00	0.35	5	248.20
139	1993/04/21 08:00	0.51	56	248.15
162	1998/04/17 14:00	0.49	11	247.85
150	1973/03/18 12:00	0.50	29	247.75
114	1997/06/24 08:00	0.54	8	247.50

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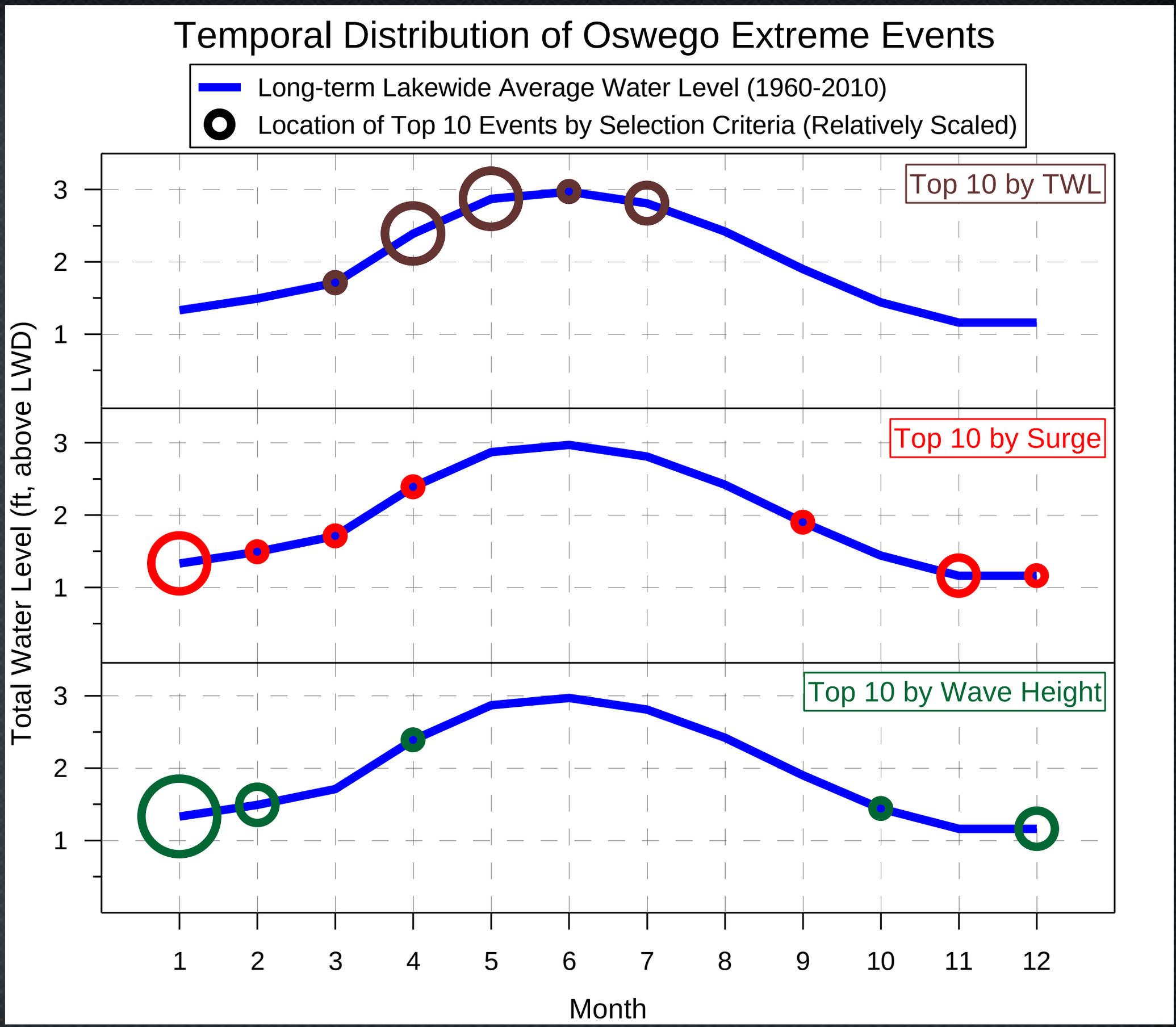
Temporal Distribution of Oswego Extreme Events



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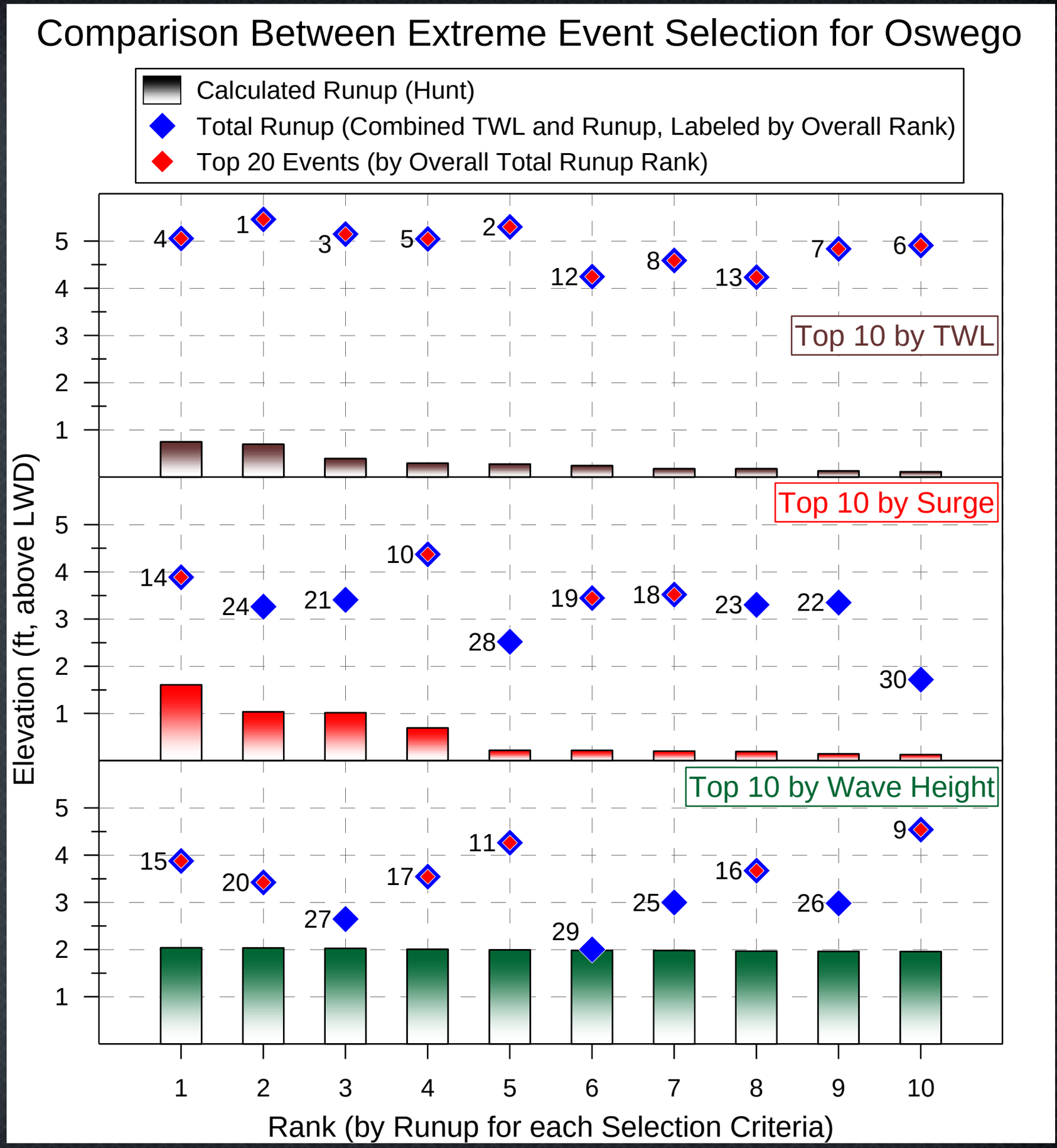
Hunt (1959) Runup



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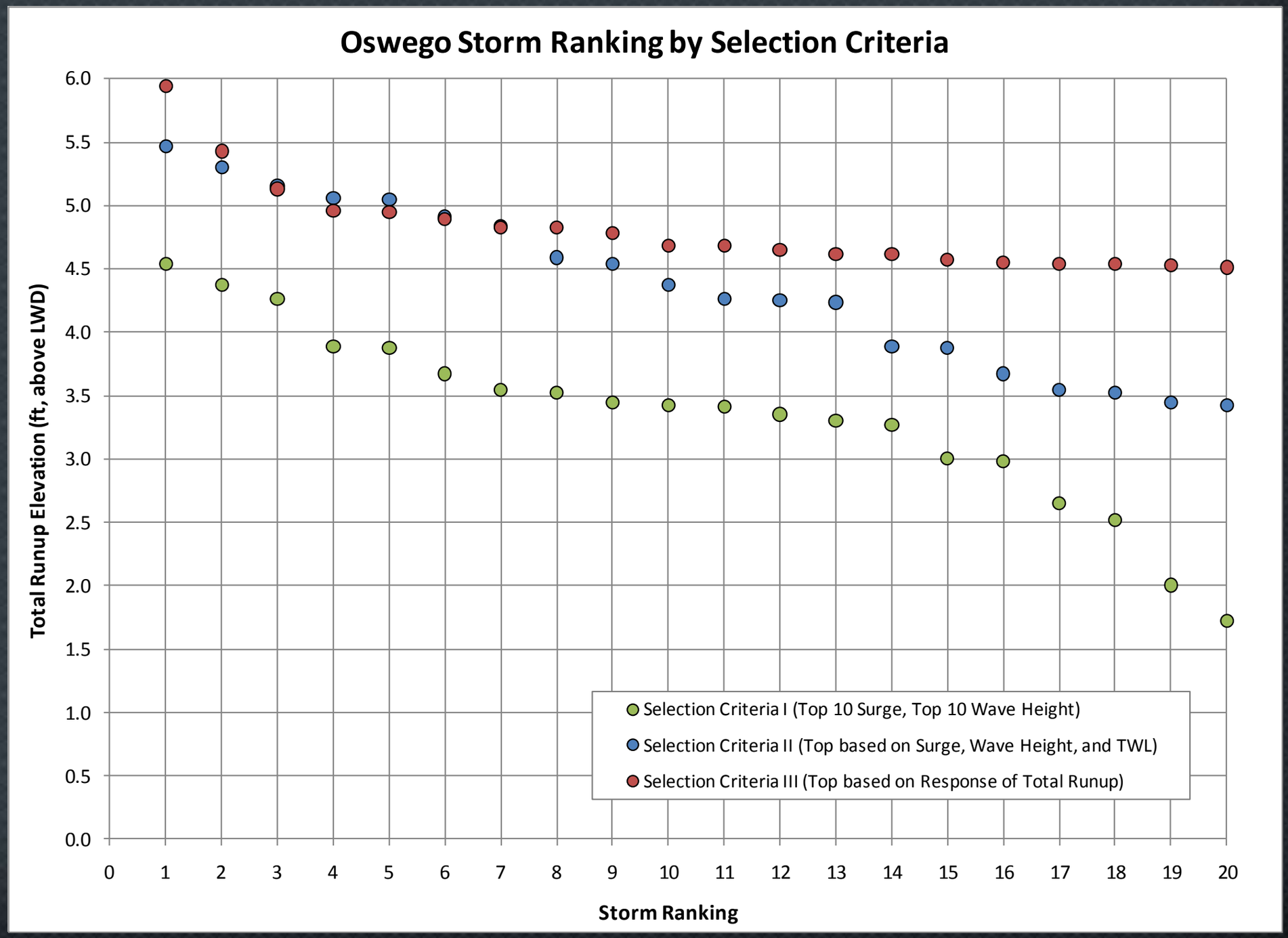
Selection Methods and Runup



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Questions