York-Cumberland FEMA appeal Phase I Update

Wells Town Hall
May 22, 2018

Prepared For:

Town of Kittery
Town of Wells
Town of Kennebunkport
City of Biddeford
Town of Old Orchard Beach
City of Portland
Town of Harpswell

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Consulting
Engineers
and Scientists

Overview

- Basis for Appeal
- What FEMA did
- What we did
- Implications
- Next Steps
- Grayson Results

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§ 67.6 Basis of appeal.

(a) The sole basis of appeal under this part shall be the possession of knowledge or information indicating that the elevations proposed by FEMA are scientifically or technically incorrect. Because scientific and technical correctness is often a matter of degree rather than absolute (except where mathematical or measurement error or changed physical conditions can be demonstrated), appellants are required to demonstrate that alternative methods or applications result in more correct estimates of base flood elevations, thus demonstrating that FEMA's estimates are incorrect.

Code of Federal Regulations
Title 44, Part 67.6

Phase I Basis is Scientifically Incorrect Total Stillwater Levels (TWL)

Phase II may have additional Technical Bases

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Scientific Basis

(3) If any appellant believes the proposed base flood elevations are scientifically incorrect, the appeal must demonstrate scientific incorrectness by:

(i) Identifying the methods, or assumptions purported to be scientifically incorrect.

(ii) Supporting why the methods, or assumptions are scientifically incorrect.

(iii) Providing an alternative analysis utilizing methods, or assumptions purported to be correct.

(iv) Providing technical support indicating why the appellant's methods should be accepted as more correct and

(v) Providing documentation of all locations where the appellant's base flood elevations are different from FEMA's.

Phase I :

i. **Identify scientifically incorrect methods**
ii. **Explain why they are incorrect**
iii. **Provide alternative analyses**
iv. **Explain why the alternative analysis is more correct**

Phase II:

i. **Provide Documentation of where BFE is different**

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Scientific Basis

The appeal is based, in part, on the use of more correct **hydrologic information** for determination of the coastal BFE

Hydrologic information = Total stillWater level (TWL) and incident wave conditions associated with the 1% annual chance flood

Total stillWater Level = Stillwater Level (SWL) + Wave Setup

Incident Wave Conditions = Wave Height and Wave Period at the shoreline

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Scientific Basis - TWL

FEMA assumes TWL can be separated into SWL and Wave Setup

- This simplifying assumption is scientifically incorrect because alternative methods more correctly consider the physics that cause storm surge and wave setup.

- FEMA has computed Wave Setup from a single representative event and added it a SWL that is based on a statistical analysis of many events. This is statistically inconsistent.

- FEMA's Wave Setup calculations have not been validated.
- FEMA's SWL contains an unquantified amount of Wave Setup that is present in the gauge data.

- Our alternative methods are demonstrably more correct through model validation procedures that compare modeled TWL to observed water levels. Inherently validating both the wave setup and SWL.

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Scientific Basis - Waves

FEMA assumes wave conditions result from a single event based on 1% wind conditions and 1% water level

- More correctly, the 1% Base Flood may be caused by a number of possible events.
- Our analysis considers many possible events, consistent with the estimation of the 1% TWL, in order to derive the wave conditions that may cause the 1% Base Flood.

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FEMA's Existing Stillwater level

- From the late 1970's – early 1980's
- Based on 2D numerical modeling of storm surge
- e.g. from Kittery 1984 FIS:

> The flood elevations associated with historical storms were simulated using a modified version of the FEMA storm surge model (References 9 and 10). Input to the model consisted of wind and pressure fields generated either by the synthetic northeaster model or a hurricane wind and pressure field model for each historical storm selected. The study area, which included Kittery, was modeled with a 4-nautical-mile-square grid which provided sufficient resolution to accurately represent the topography. Output from the model included the time history of storm-induced surge heights in the study area. These elevations were combined with the predicted astronomical tide for the same time period to produce a total stillwater elevation for each community in the study area. The total stillwater elevation was calibrated using historic tide elevation data at Portland, Maine, and Portsmouth, New Hampshire. Thus, the historic storm-induced flood elevations in Kittery were simulated for each storm considered in the analysis.

- Wave setup was not considered at the time
- 4 nautical mile grid resolution
- Otherwise we are using similar methods!

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FEMA's Proposed Stillwater Level

- Circuitous path of references leads to 2007 summary reports by Ocean and Coastal Consultants, Inc. (OCC)
- OCC performed updated gauge data analysis at Portland and Seavey Island
- OCC's analysis has many errors:
  - Incorrect/unnecessary conversion for tidal epoch
  - Did not use full record at Portland
  - Incorrect storm rate used for Seavey Island
  - Did not account for historic sea level change
- OCC recommended using 1988 USACE tidal flood profiles instead of their updated analysis
  - FEMA provided no backup data for 1988 tidal flood profiles
  - Likely included subjective use of 1978 blizzards highwater mark data so that it may include unknown component of wave setup
  - Did account for historic sea level change up to 1988.

Bottom Line:

FEMA's Proposed SWL is based on Data/Analysis that is 30 years old!

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Our Proposed SWL

- Using same basic methods as FEMA (e.g. gauge data analysis like OCC did)
- Correct error's in FEMA's analysis
  - Use complete records at Seavey Island and Portland
  - Correct for historic sea level change up to 2017
  - All elevations are in feet-NAVD88

Community	Current Effective FIS	2017 Preliminary FIS (i.e. USACE 1988 Tidal Flood Profiles)	OCC incorrect	Corrected/Updated
Kittery	8.0	9.2	7.8 – 8.0	8.0 – 8.1
Wells	8.9	8.9	NA	NA
Kennebunkport	8.3	8.9	NA	NA
Biddeford	8.2	8.9	NA	NA
Old Orchard Beach	8.3	8.9	NA	NA
Portland	8.6 – 8.9	8.9	8.6 – 9.0	8.4 - 8.6
Harpswell	8.7 - 9.1	9.1	NA	NA

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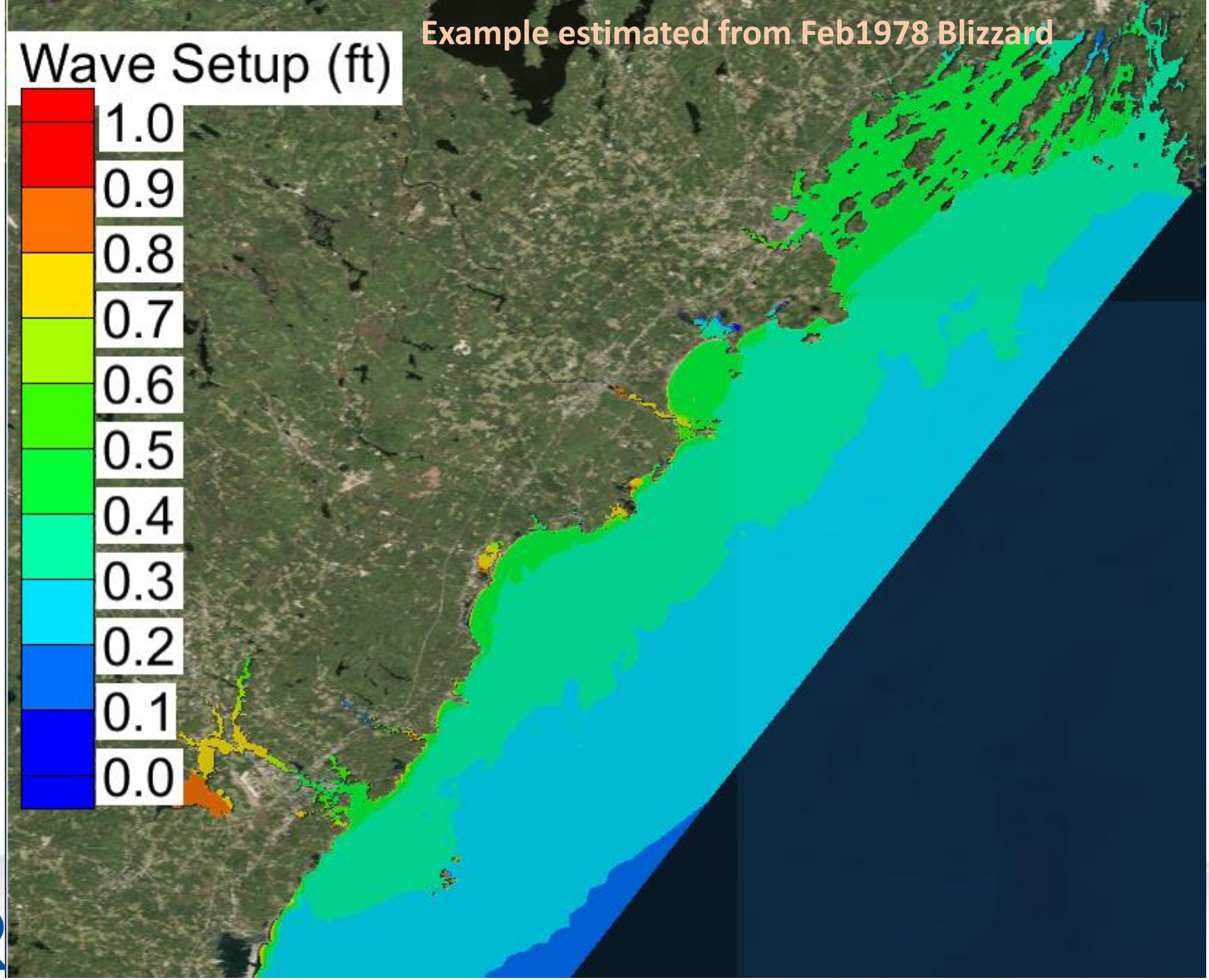
Example estimated from Feb1978 Blizzard
Wave Setup (ft)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0

Our Proposed TWL

- Does not use our SWL (because SWL is gauge specific and include unquantified Wave Setup at the gauges)
- Based on numerical modeling that directly computes TWL everywhere
- Is validated with historic data (i.e. matches gauge data at gauges)

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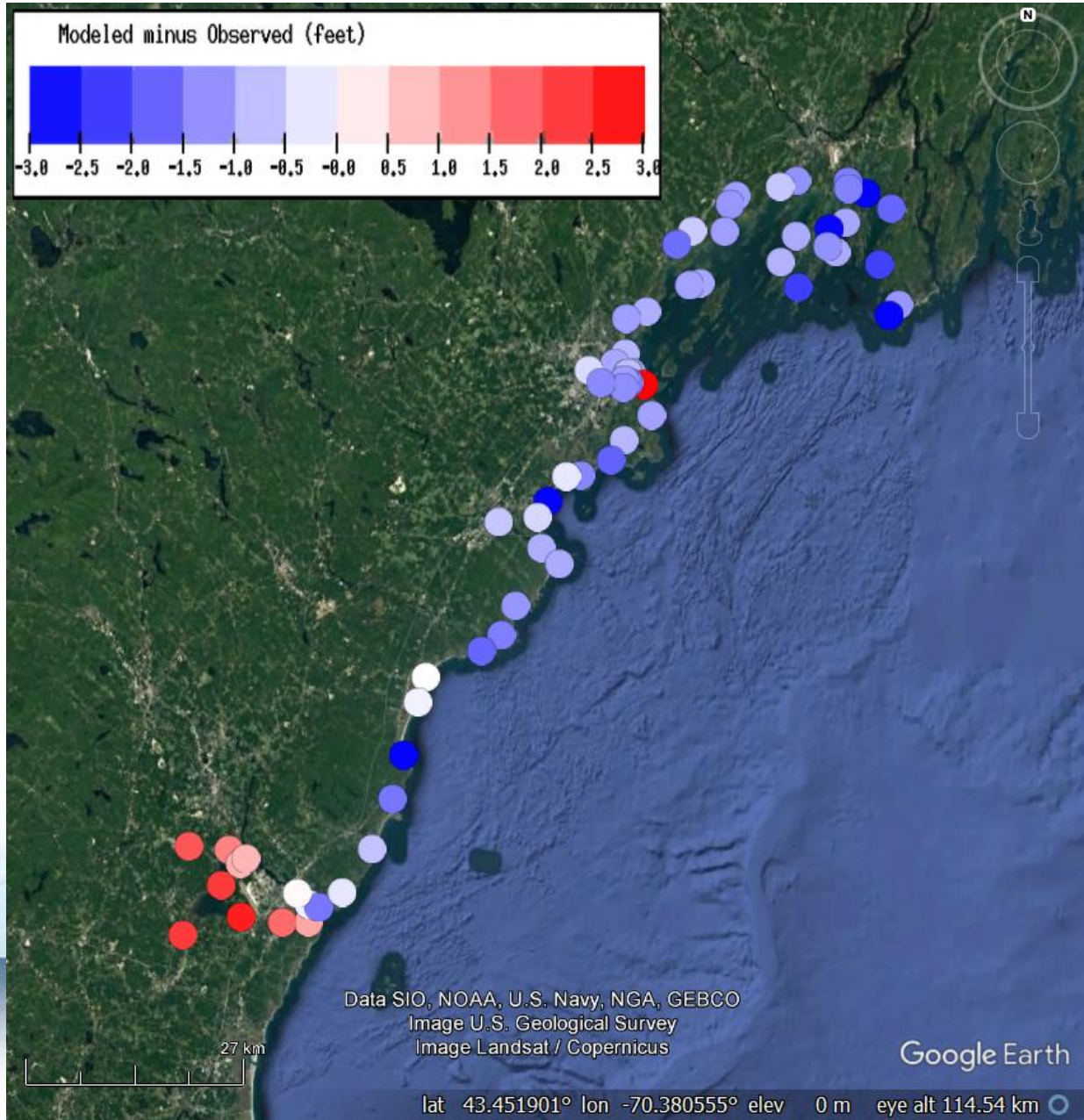
TWL Validation

February 1978 Blizzard



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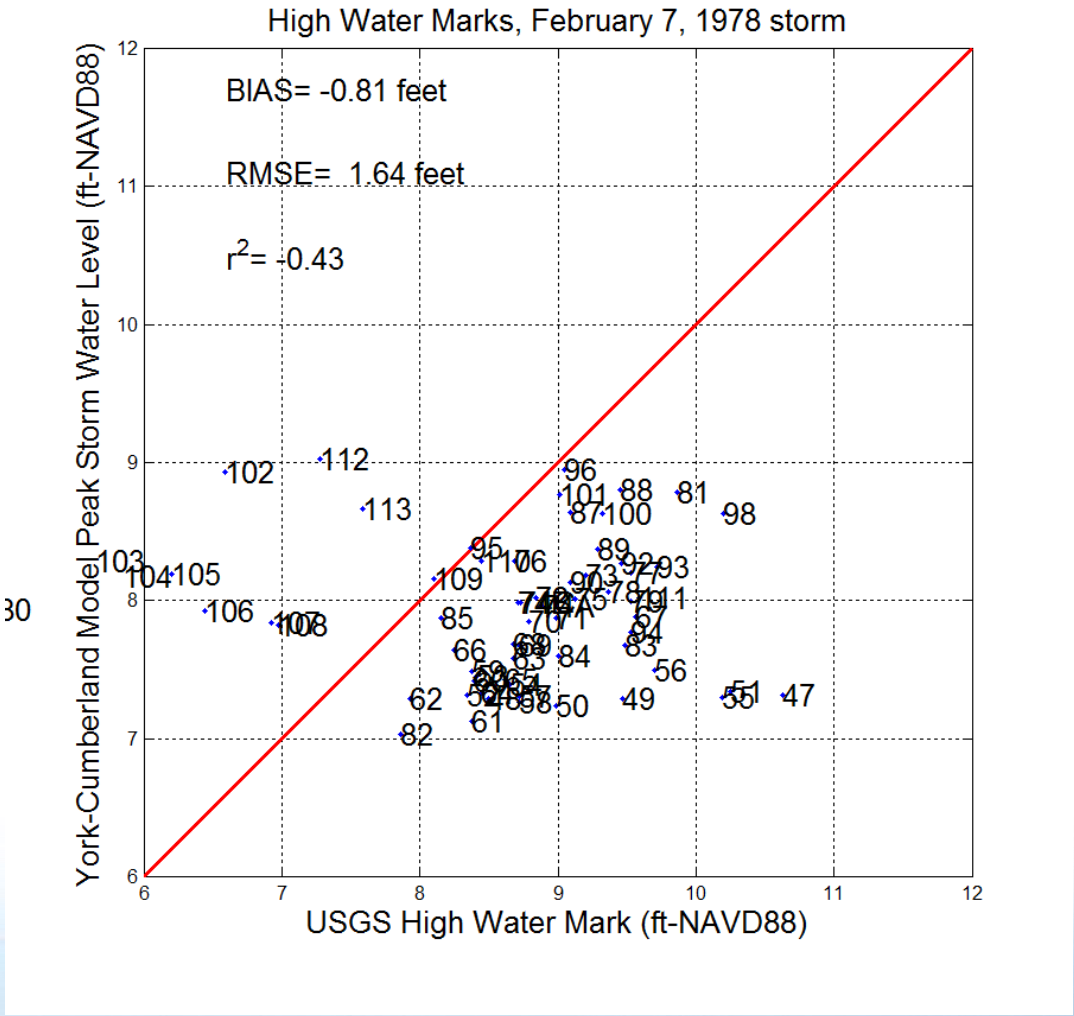
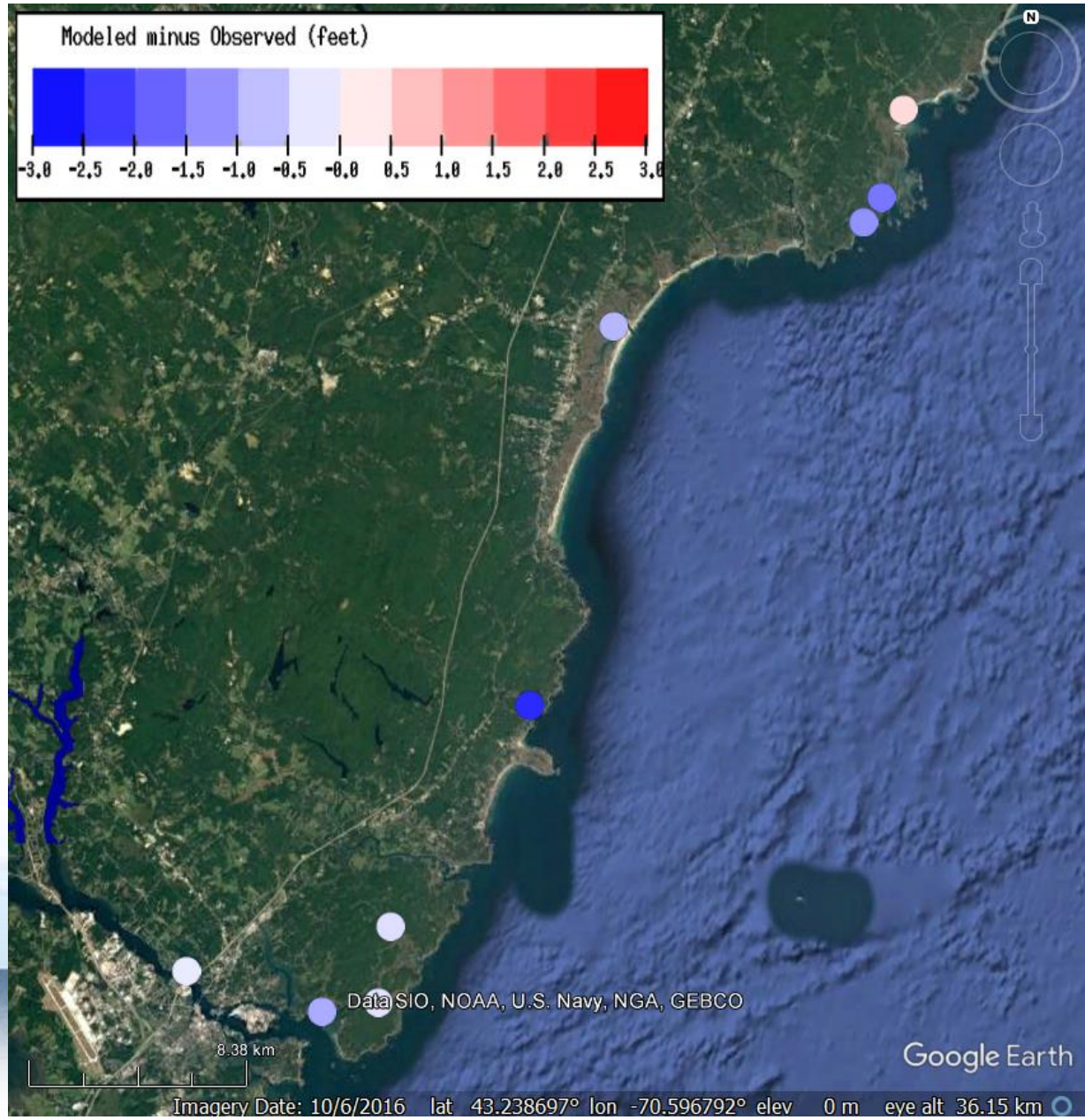
TWL Validation

February 1978 Blizzard



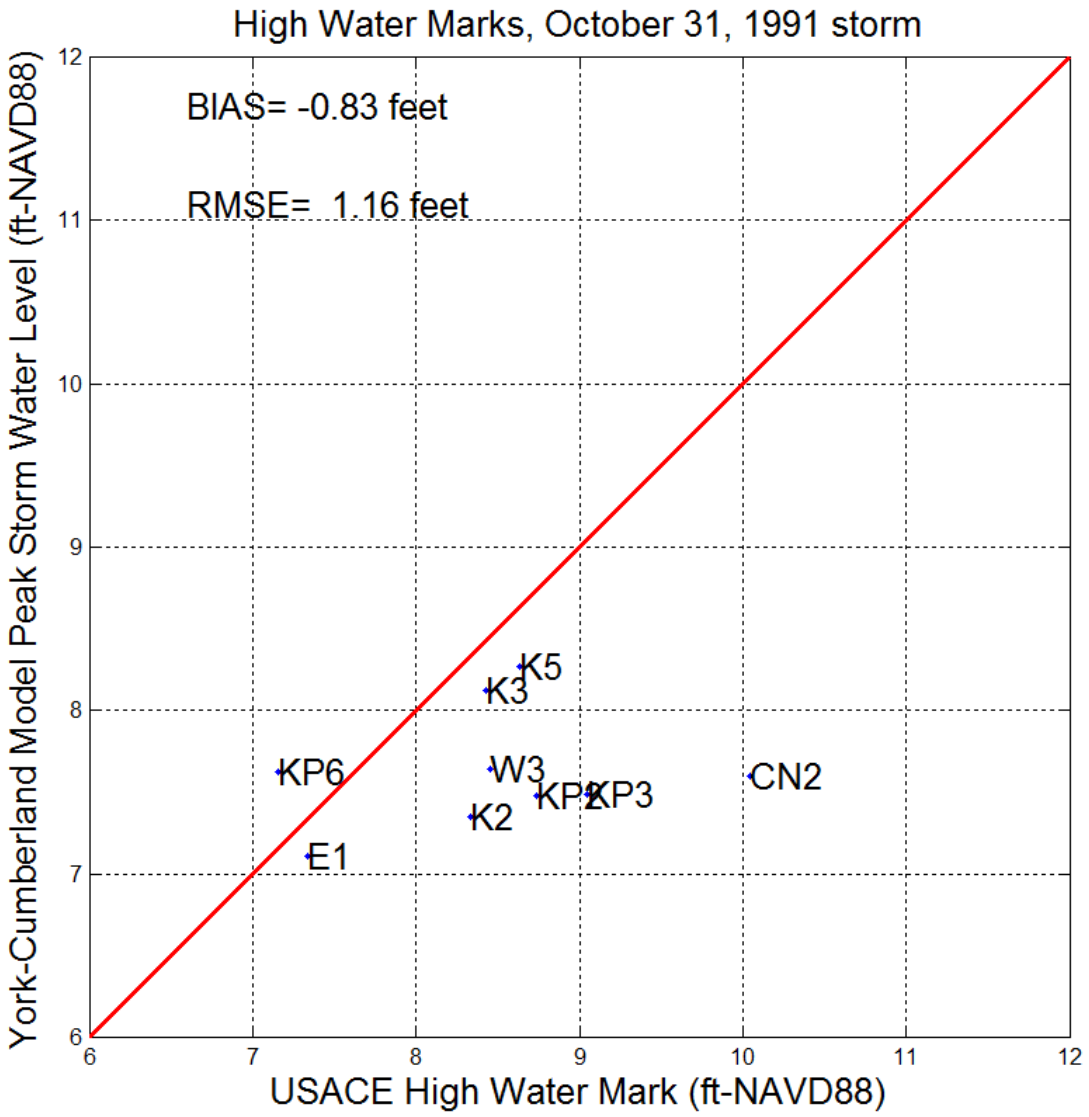
TWL Validation

Halloween 1991



TWL Validation

Halloween 1991



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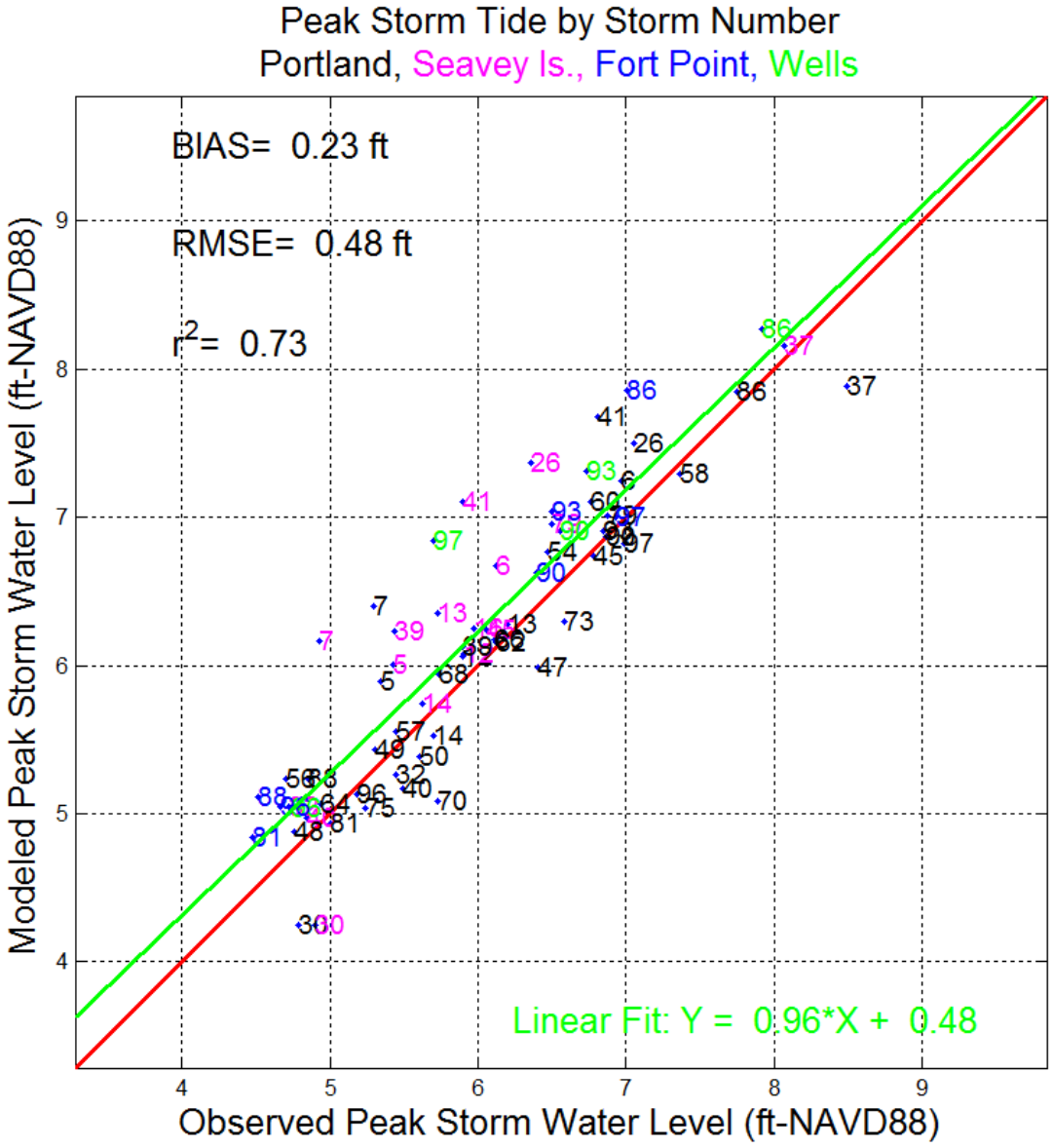
TWL Validation

All Historic ET Storms
Peak TWL at Tide Stations



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Kittery 1% annual chance TWL

FEMA SWL = 9.2’

Wave Setup = 0.5’ to 7.7’

FEMA TWL = 9.7’ to 16.9’

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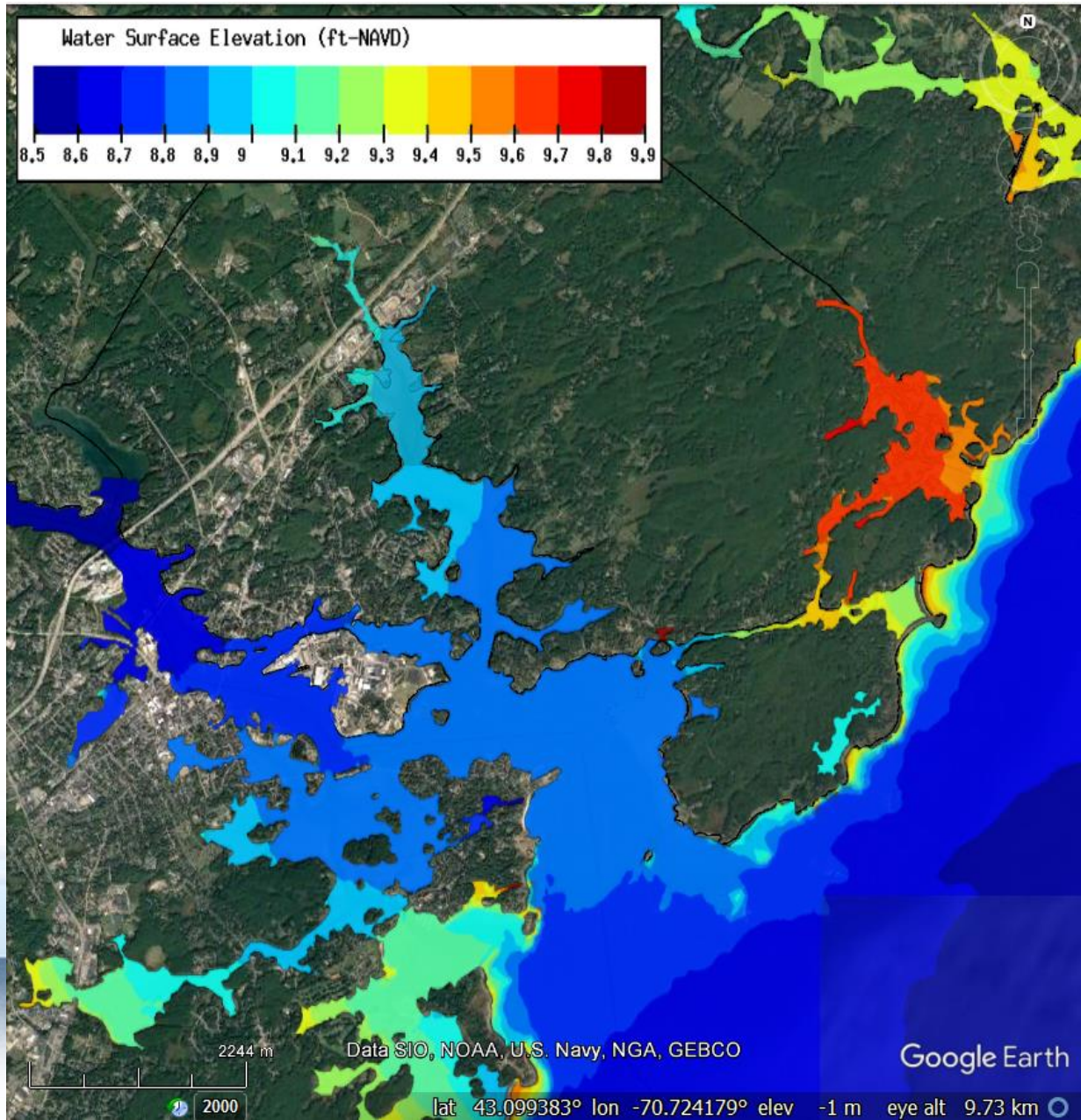

Wells 1% annual chance TWL

FEMA SWL = 8.9’

Wave Setup = 3.9’ to 4.8’

FEMA TWL = 12.8’ to 13.7’

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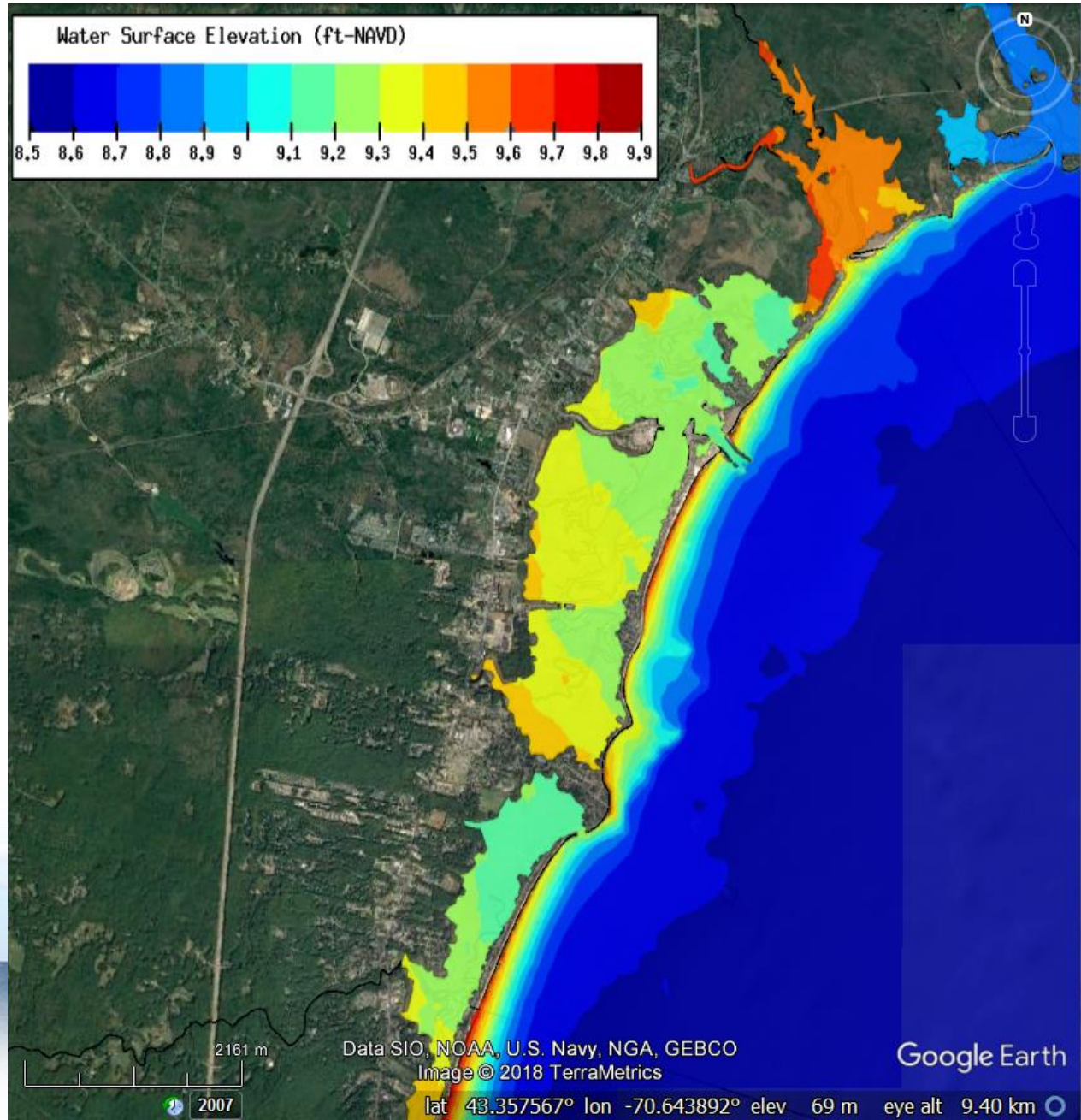

Kennebunkport 1% annual chance TWL

FEMA SWL = 8.9’

Wave Setup = 0.9’ to 4.2’

FEMA TWL = 9.8’ to 13.1’

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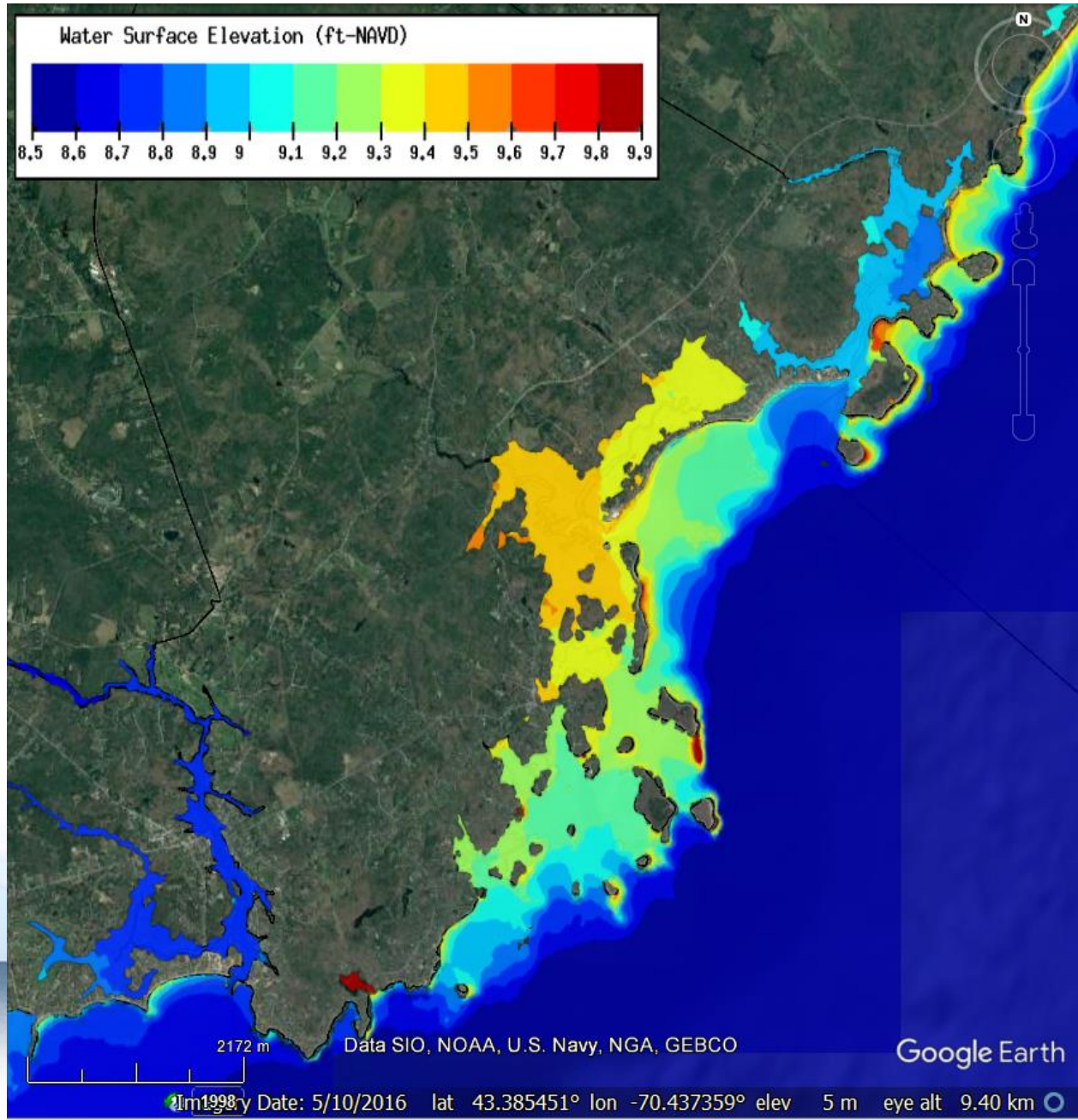

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Biddeford 1% annual chance TWL

FEMA SWL = 8.9’

Wave Setup = 0.6’ to 3.9’

FEMA TWL = 9.5’ to 12.8’

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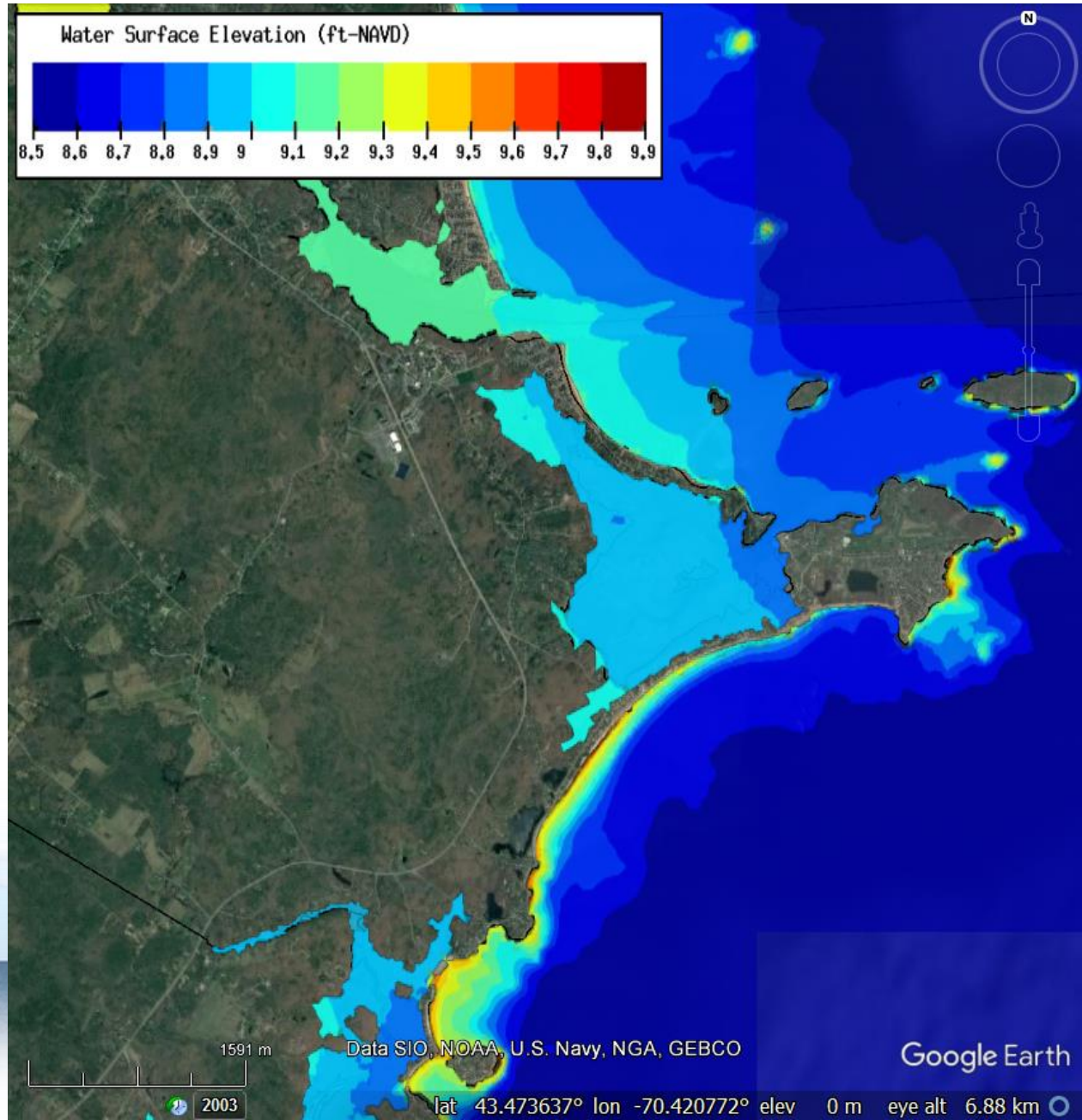

Old Orchard Beach 1% annual chance TWL

FEMA SWL = 8.9’

Wave Setup = 3.6’ to 4.2’

FEMA TWL = 12.5’ to 13.1’

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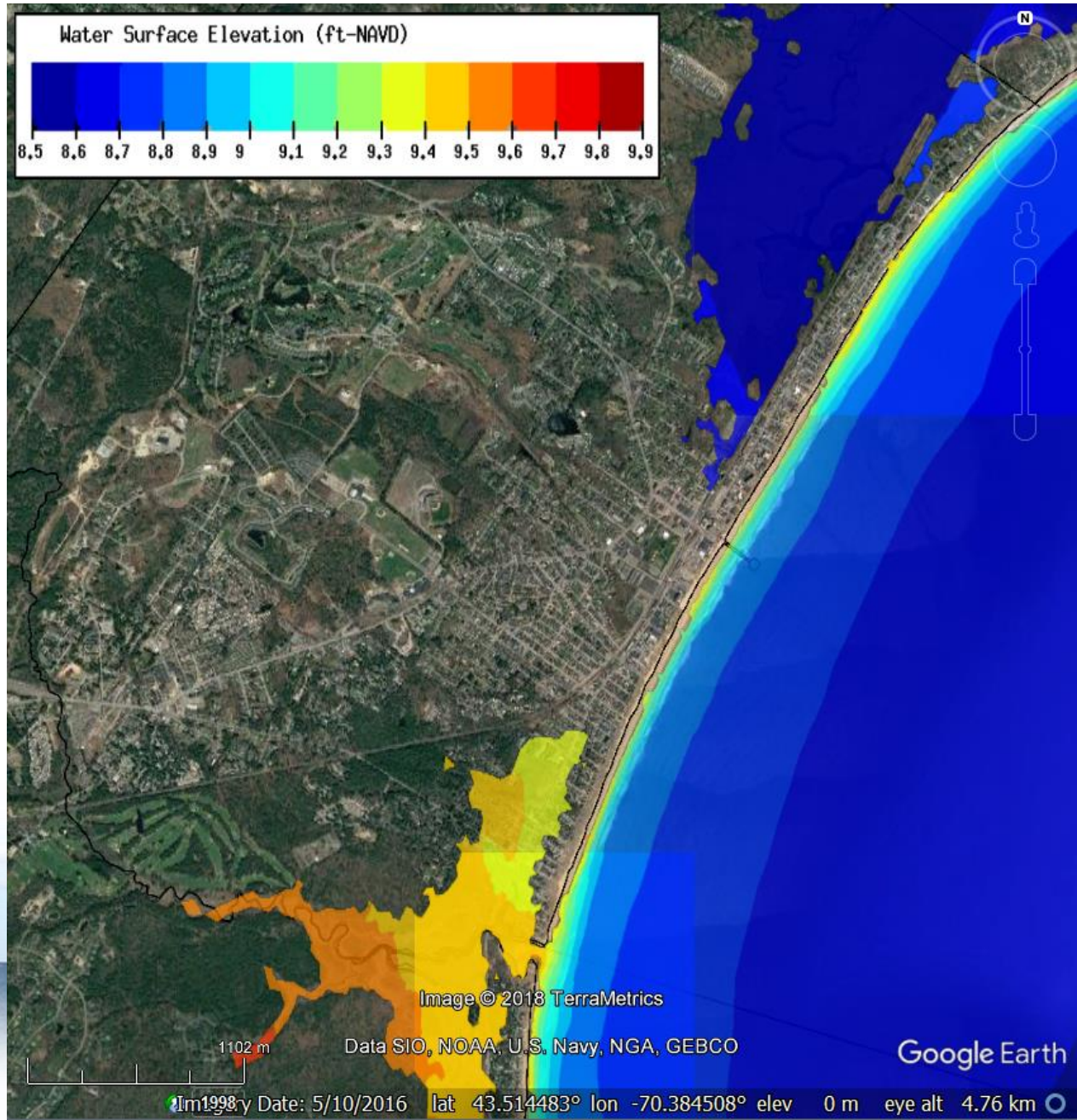

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Portland 1% annual chance TWL

FEMA SWL = 8.9’

Wave Setup = 0.6’ to 5’

FEMA TWL = 9.5’ to 13.9’

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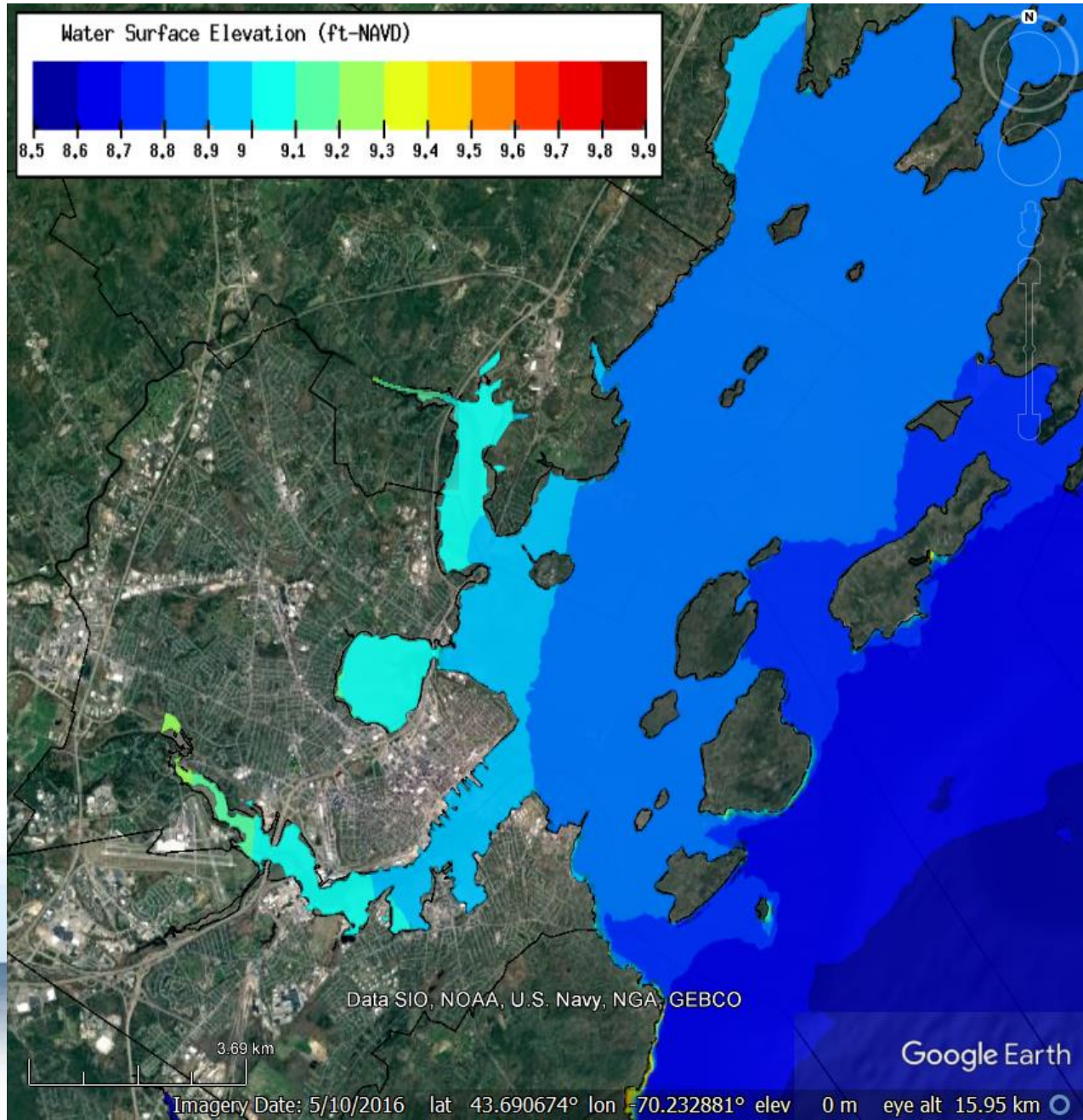

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Harpswell 1% annual chance TWL

FEMA SWL = 9.1’

Wave Setup = 1’ to 5’

FEMA TWL = 10.1’ to 14.1’

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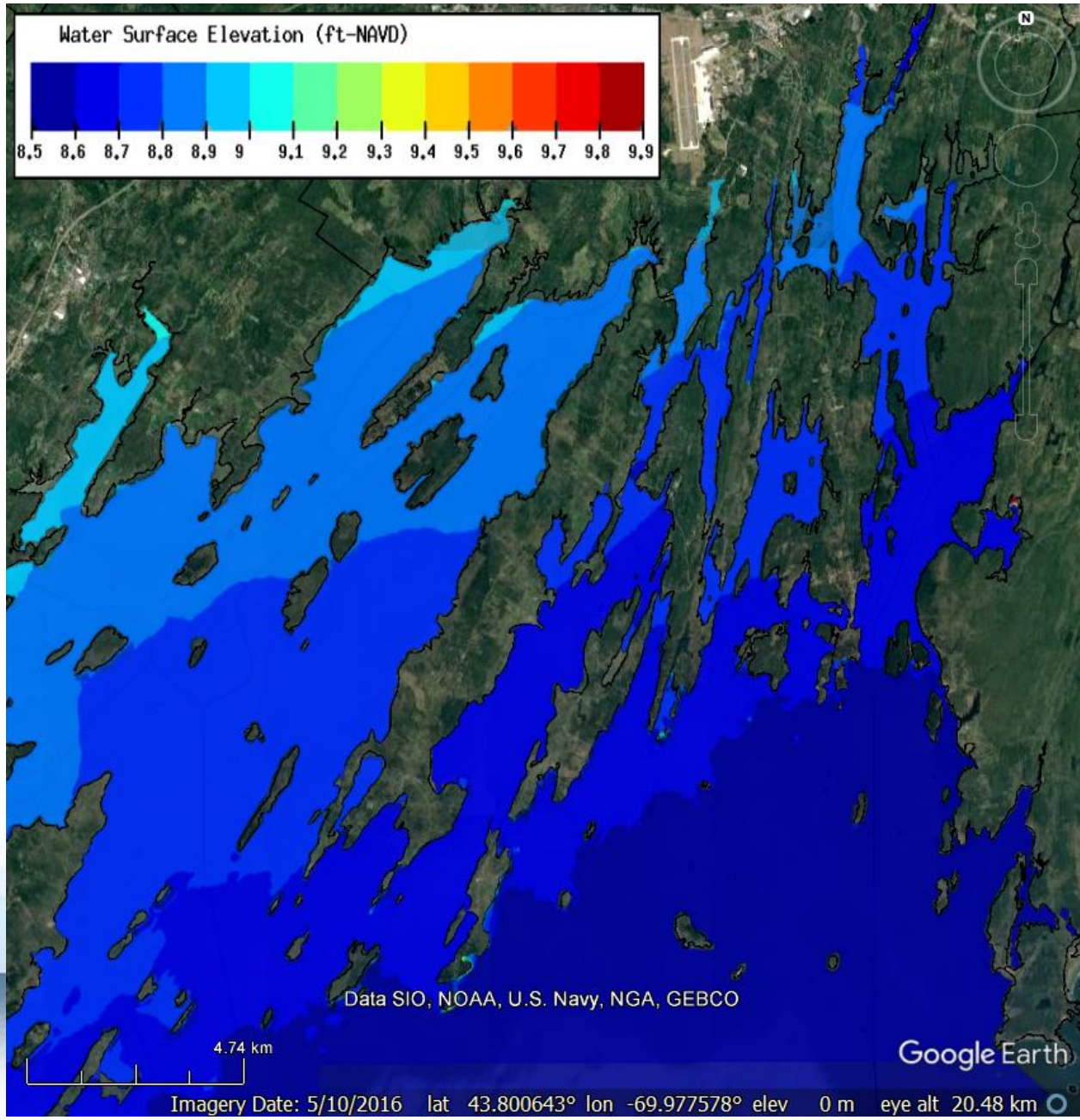

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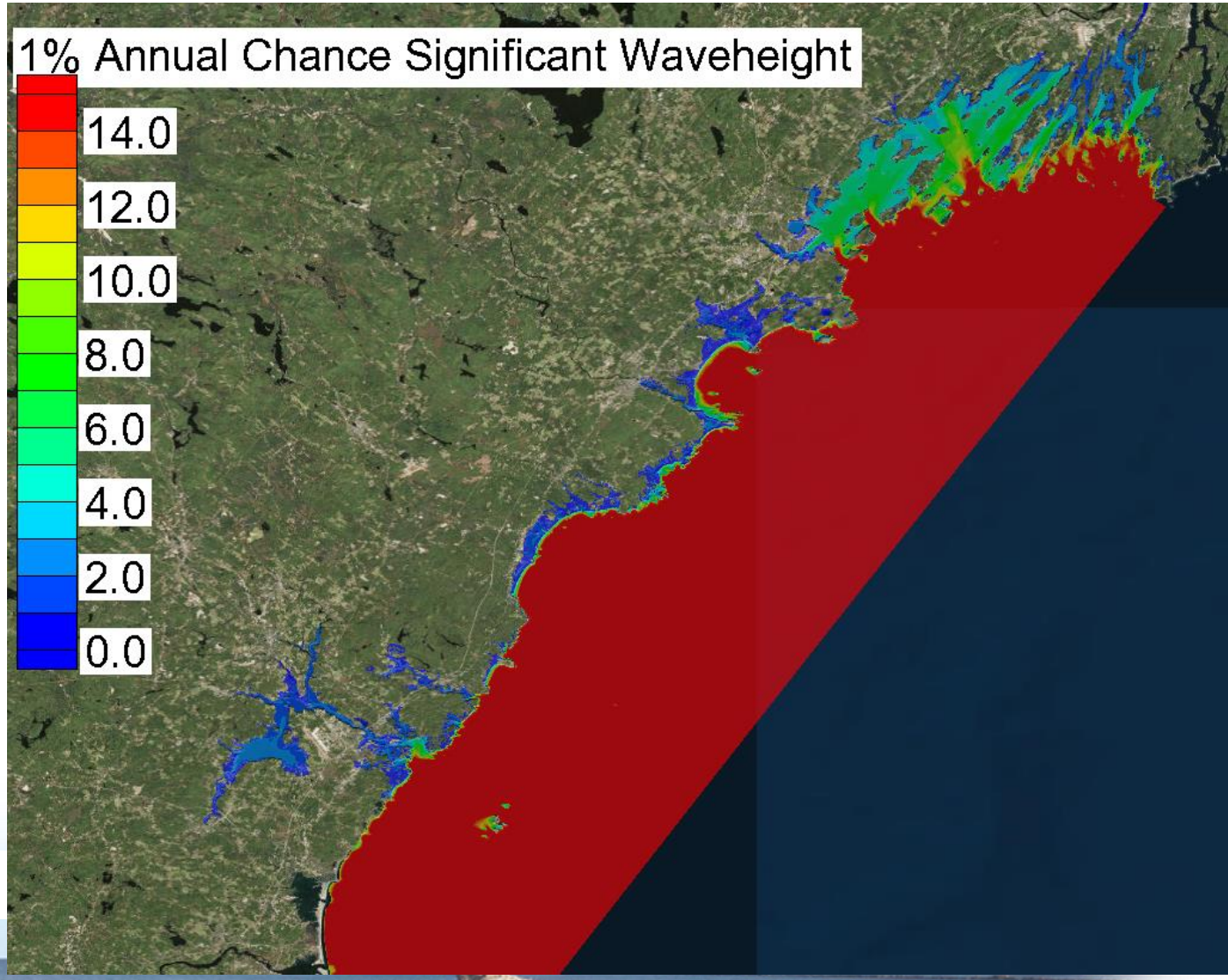
Our Proposed Wave Conditions

Wave Period based on site specific constant wave steepness assumption



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Next Steps
Phase II – Transect Specific

- Wave Run-up and Wave Crest elevation
- Determing BFE
- Draw revised flood zones

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