

Probabilistic Flood Forecasting, Hazard Assessment and Adaptation Studies for the US Northeast

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Acknowledged: CCRUN partners at Columbia CIESIN, Columbia CCSR

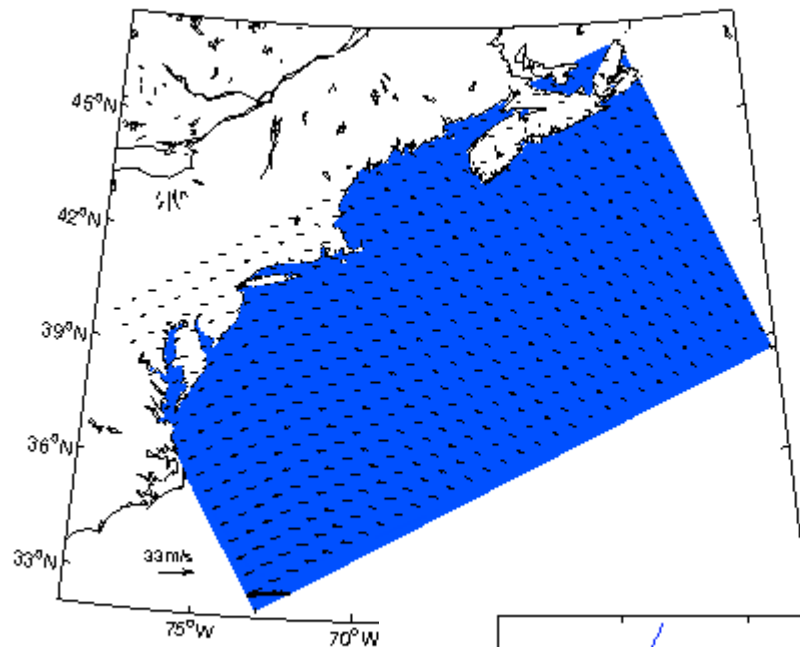
Funding: Port Authority of NY/NJ, NOAA-RISA, NOAA-COCA, NASA



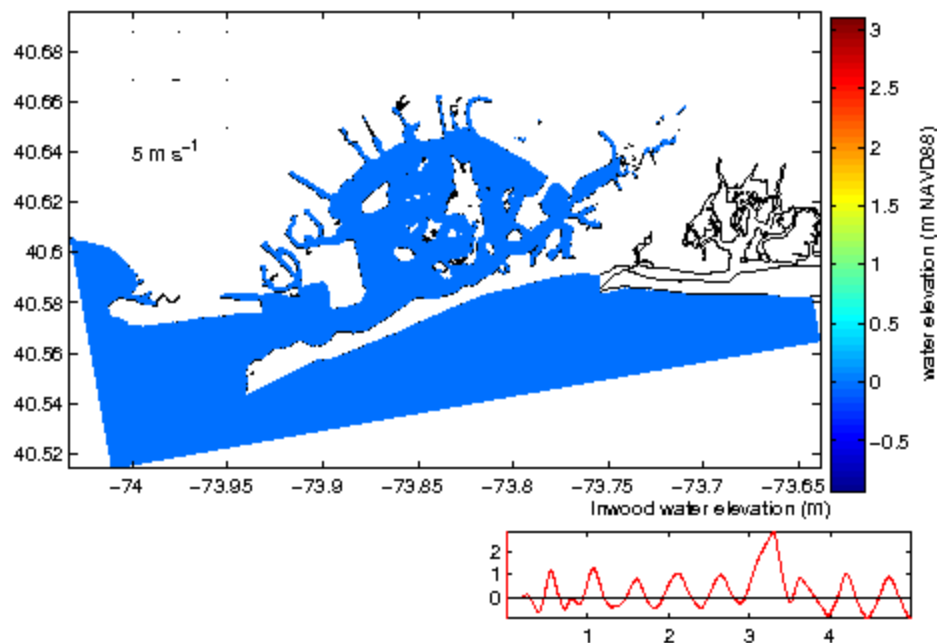
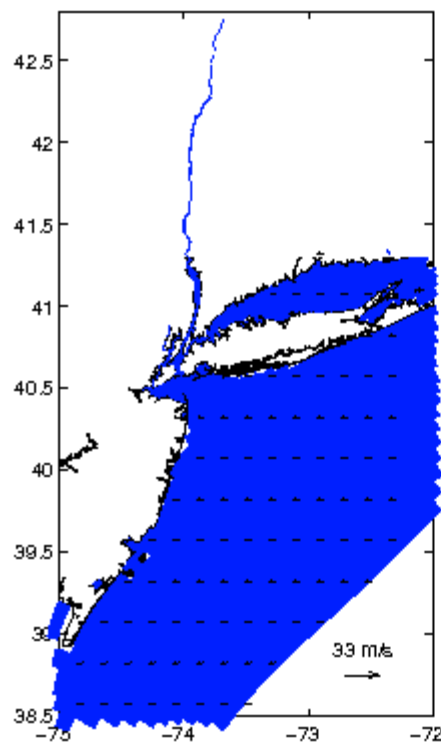
Summary

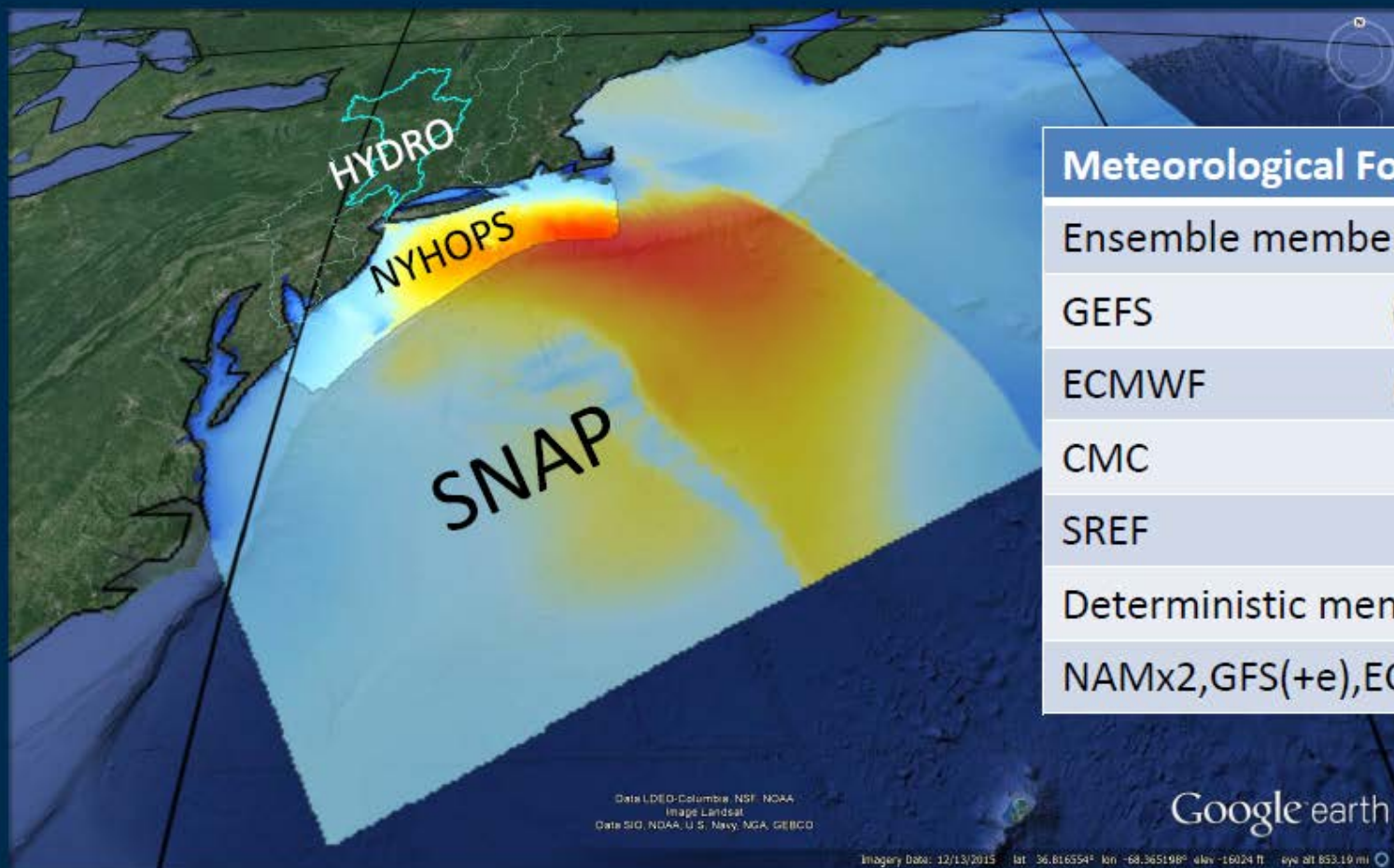
- Climate and flood-related services for the US Northeast:
 - Coastal flood forecasting
 - what is the 5% chance flood Friday?
 - Flood/sea level hazard assessment
 - what is the 100-year flood in the 2050s?
 - Quantitative analysis of nature-based flood adaptations
 - what are the annualized benefits via damage reduction?
- Probabilistic products - address user needs!

05-Sep-1977 05:50:36 UTC



- Stevens ECOM hydrodynamic model (e.g. Blumberg et al. 1999; Georgas and Blumberg, 2010; Orton et al. 2012; 2015) <http://stevens.edu/NYHOPS>
- **Computationally tractable** to run many (probabilistic) simulations on a supercomputer





Meteorological Forcing

Ensemble members

GEFS (21)

ECMWF (51)

CMC (21)

SREF (26)

Deterministic members

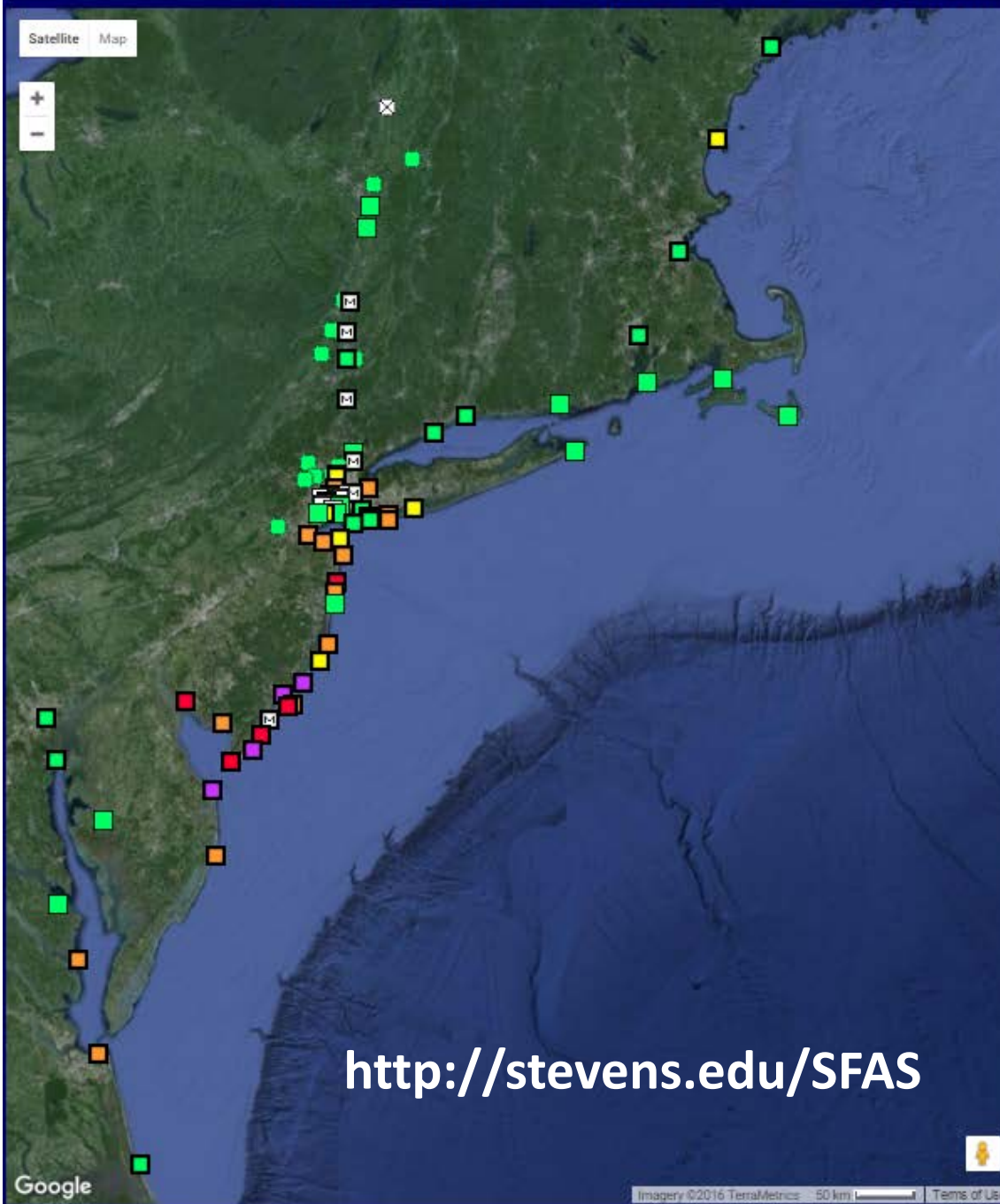
NAMx2, GFS(+e), ECMWF.

NYHOPS 3D 125-member Ensemble linked to offshore SNAP & HYDRO-river ensembles



Stevens Flood Advisory System

Forecast Period: 2016-01-23 10:00 AM through 2016-01-26 10:00 AM ET



SFAS Stations

Station:

Major Flood

Moderate Flood

Minor Flood

Near Flood

Normal Levels

Blowout

☐ Model Predictions Only, Currently ☐

Marker color indicates current water level.
Blinking markers indicate predicted flooding.

Page auto-refresh in: **4:27**

To register for email flooding notifications, or to
update registration information, enter
your primary email and click the Manage... button:

[Manage Email Notifications](#)

If you have questions or comments, please contact:

[Dr. Nickitas Georgas](#)

[Latest News about SFAS as of
December 08, 2015](#)

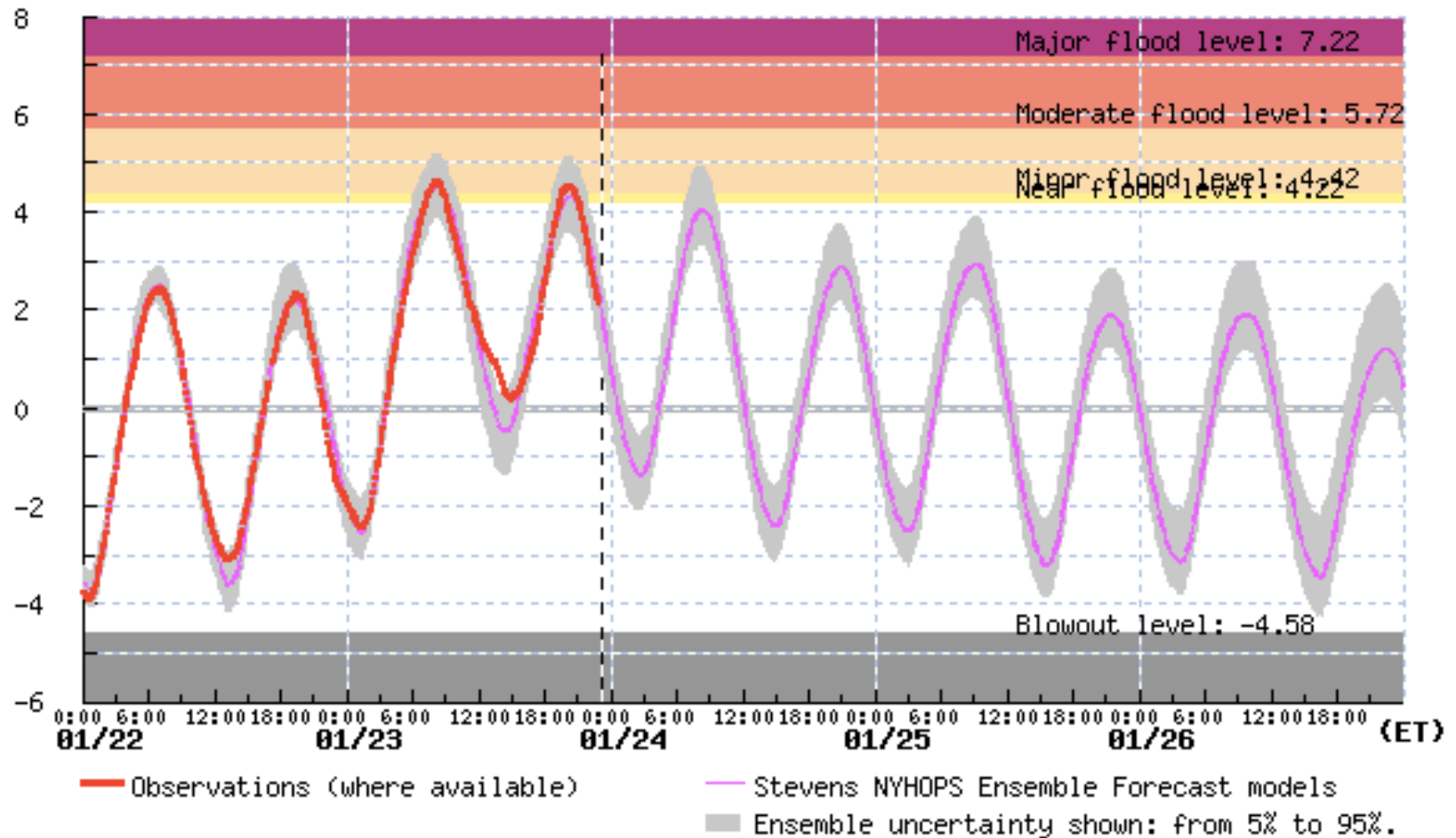
The Stevens FAS is a collaboration among
[Stevens Institute of Technology](#)
[Stony Brook University](#)
[NOAA Meteorological Development Lab](#)
[NJ Meadowlands Environmental Research
Institute](#)

Funding has been provided by
[The Port Authority of New York and New Jersey](#),
[New York Sea Grant](#), and other sponsors.

DISCLAIMER: Stevens FAS is supported by the NOAA IOOS program and adheres
to NOAA standards and guidelines for use and reliability of our forecasts. Click
[here](#) to view.

<http://stevens.edu/SFAS>

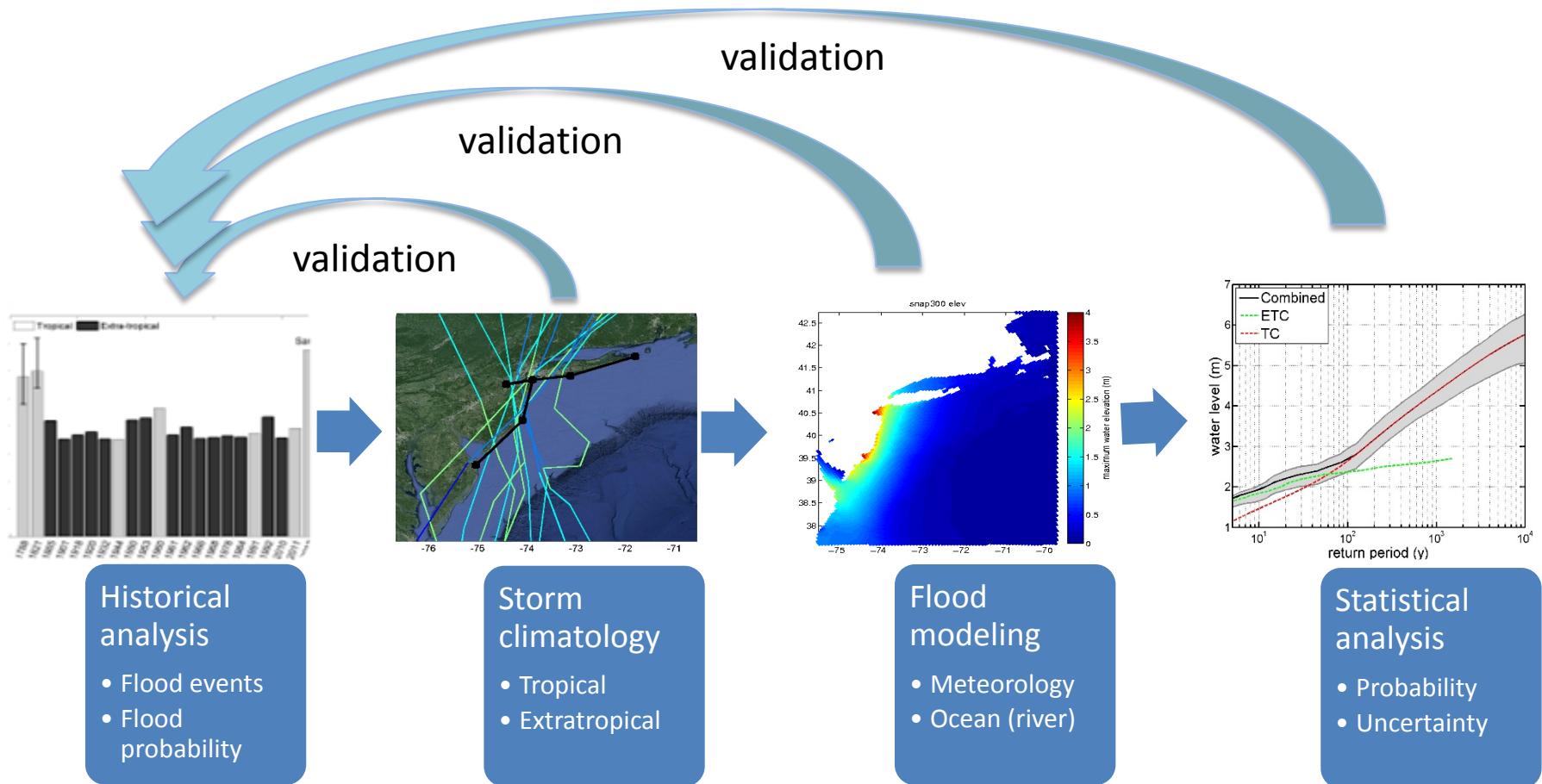
The Battery NY - Water level relative to NAVD88 (ft)



Gray areas are 90% confidence intervals

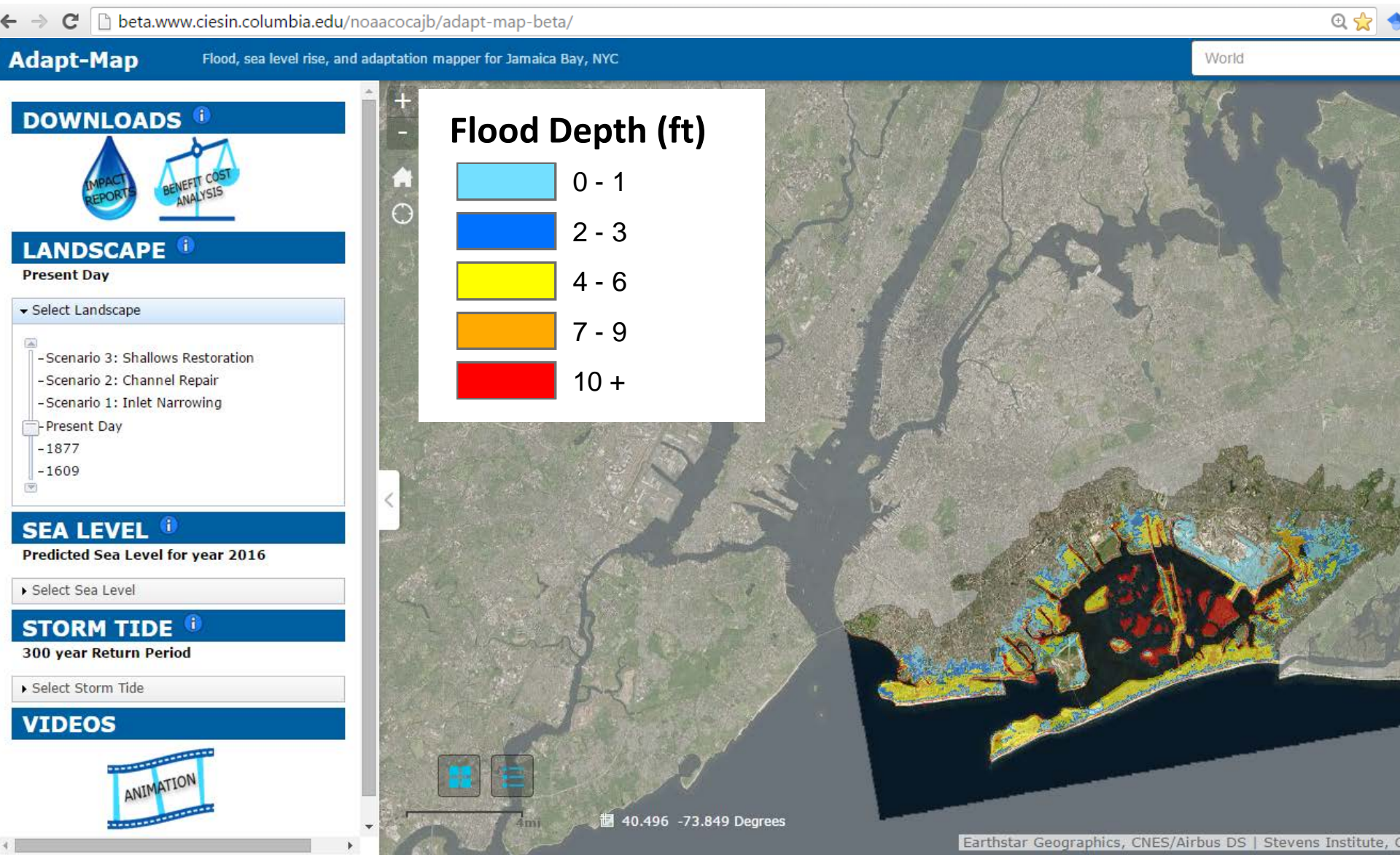
<http://stevens.edu/SFAS>

Methods: Flood Hazard Assessment



Orton et al. (submitted to *J. Geophys. Res.*, 1/25/2016), A Validated Tropical-Extratropical Flood Hazard Assessment for New York Harbor.



AdaptMAP Dynamic Flood Mapper





AdaptMAP Dynamic Flood Mapper


← → ↻ beta.www.ciesin.columbia.edu/noaacocajb/adapt-map-beta/ World


Adapt-Map Flood, sea level rise, and adaptation mapper for Jamaica Bay, NYC

DOWNLOADS  

LANDSCAPE 
Present Day
▼ Select Landscape
- Scenario 3: Shallows Restoration
- Scenario 2: Channel Repair
- Scenario 1: Inlet Narrowing
- Present Day
- 1877
- 1609

SEA LEVEL 
Predicted Sea Level for year 2016
▶ Select Sea Level

STORM TIDE 
300 year Return Period
▶ Select Storm Tide

VIDEOS


Slider Controls Allow Users to Select Landscape, Sea Level, and Storm Tide

4mi 40.496 -73.849 Degrees

Earthstar Geographics, CNES/Airbus DS | Stevens Institute, C


Many Scenarios to Choose From

LANDSCAPE ?

Present Day

Sample Landscape Current Description

▼ Show/Hide Controls

- 
- Sand Replenishment Scenario
 - Channel Repair Scenario
 - Shallows Restoration Scenario
 - Present Day
 - 1882
 - 1609


SEA LEVEL ?

Predicted Sea Level for year 2016

Sample Predicted Sea Level for year 2016

Description

▼ Show/Hide Controls


- 
- 2055-90th Percentile
 - 2055-50th Percentile
 - 2055-10th Percentile
 - 2016

STORM TIDE ?

1,000 year Return Period

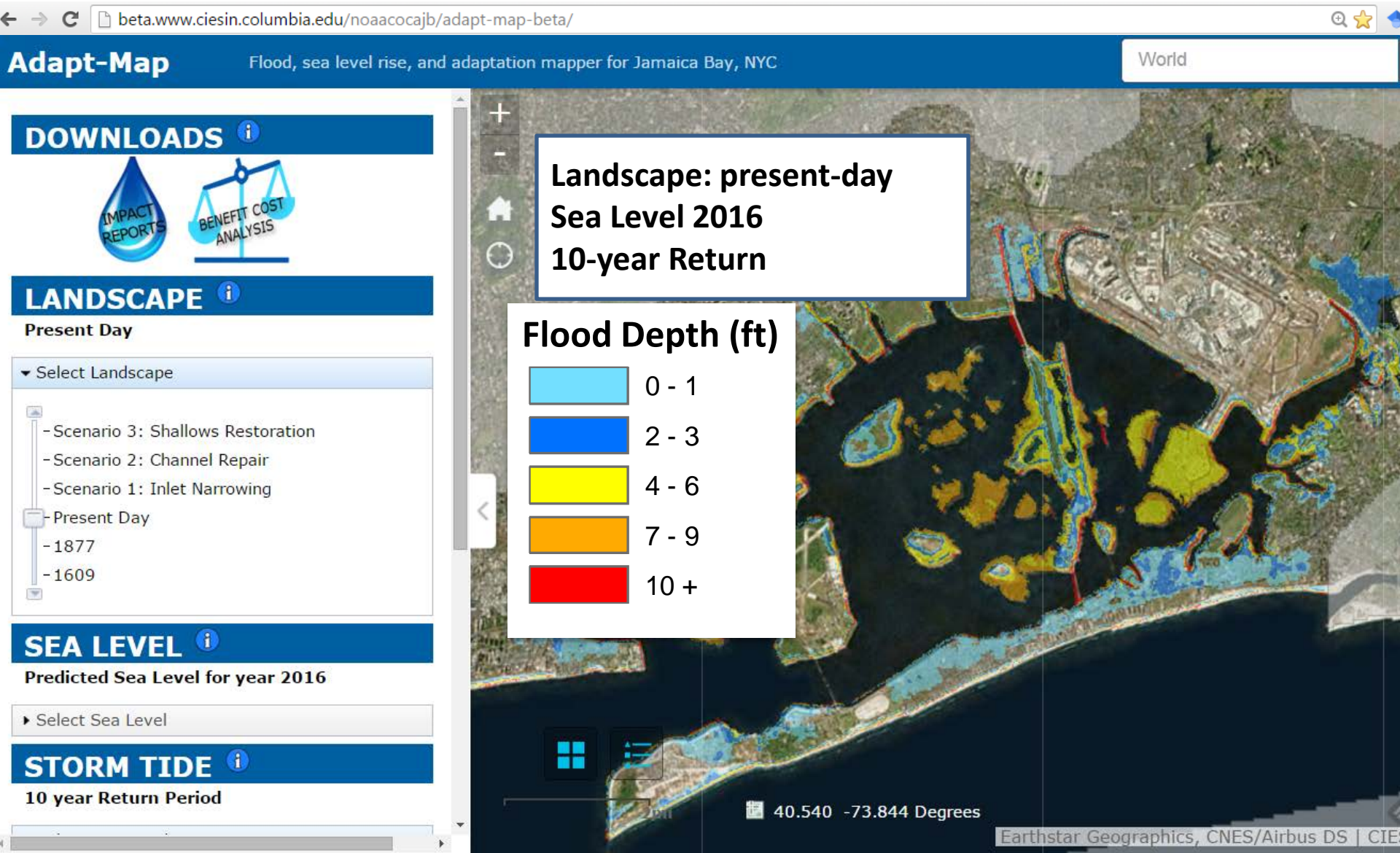
Sample 1,000 year Return Period Description

▼ Show/Hide Controls

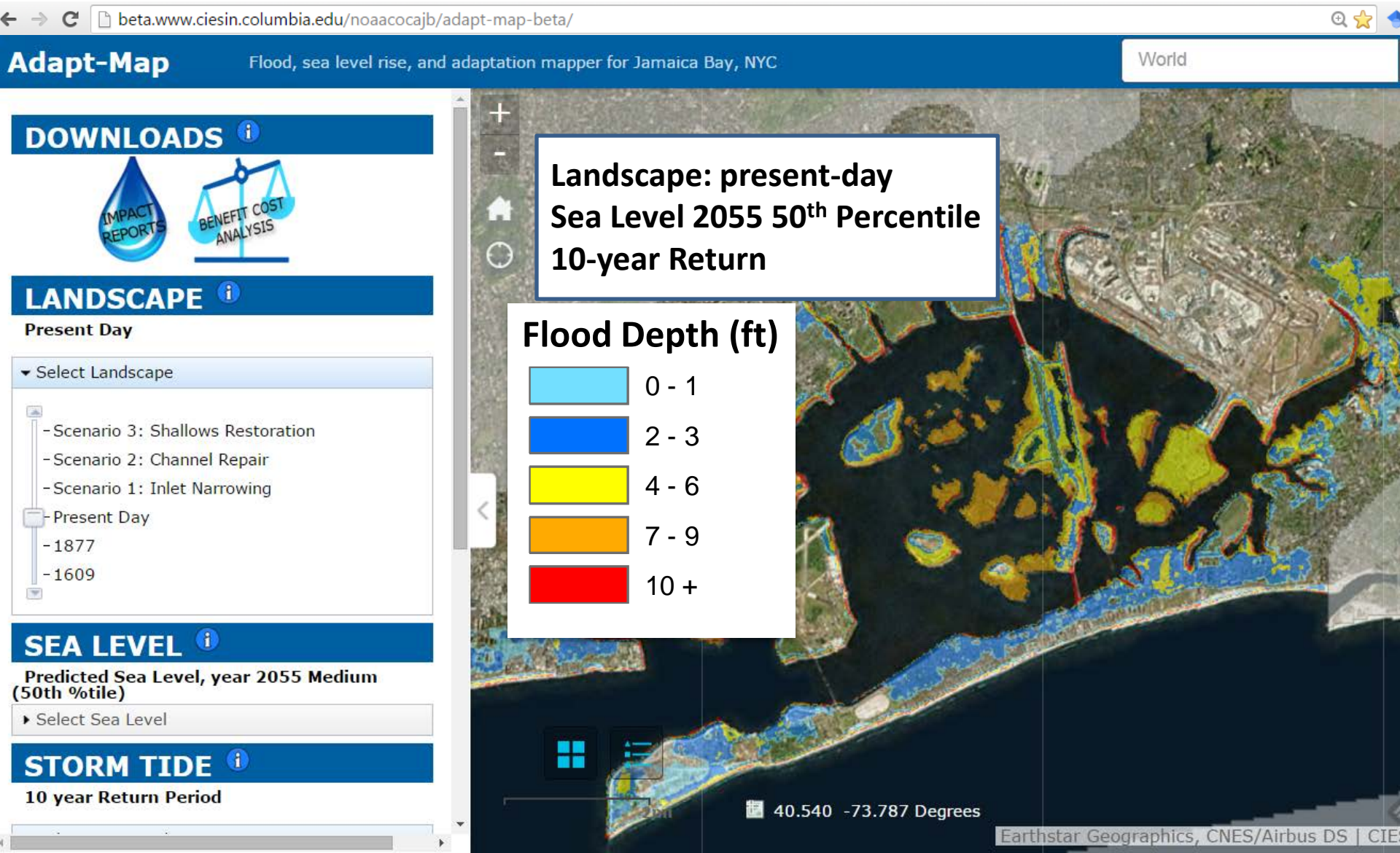
- 
- 1000-year (0.1% annual chance)
 - 500-year (0.2% annual chance)
 - 300-year (0.33% annual chance)
 - 100-year (1% annual chance)
 - 50-year (2% annual chance)
 - 30-year (3.3% annual chance)
 - 10-year (10% annual chance)
 - 5-year (20% annual chance)

CCRUN/NYC Panel on Climate Change
projections (Horton et al. 2015)

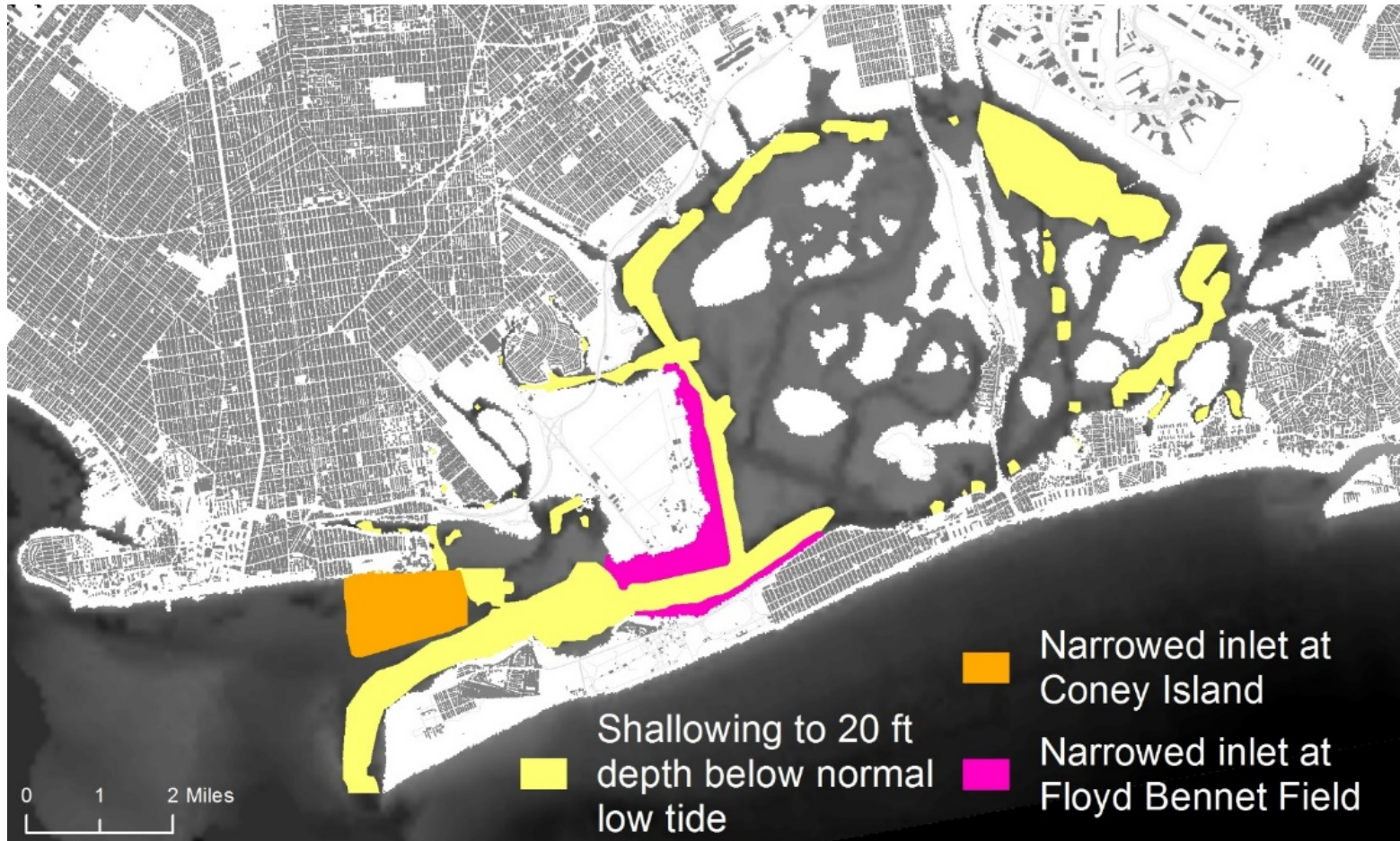
AdaptMAP Dynamic Flood Mapper



AdaptMAP Dynamic Flood Mapper

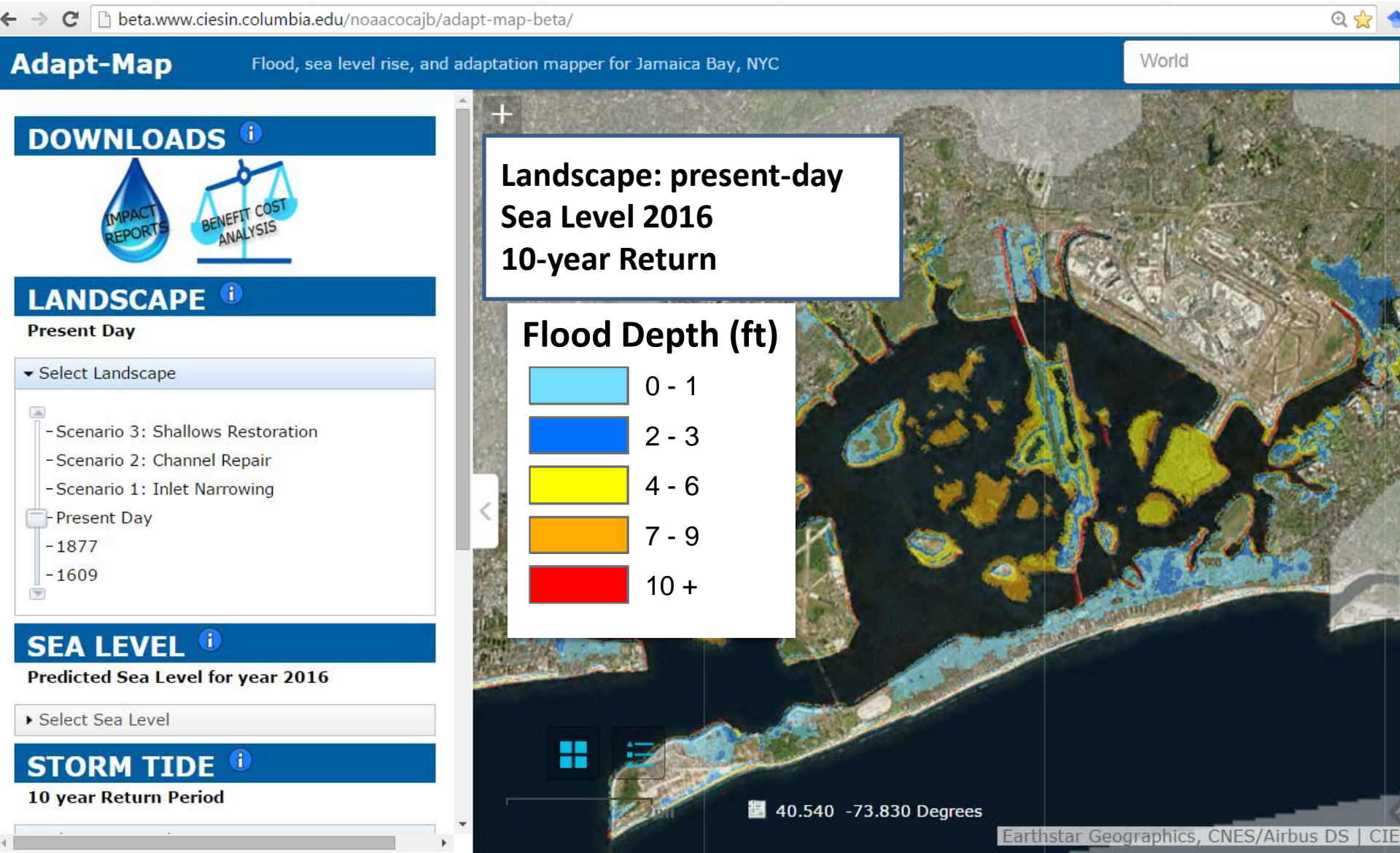


Adaptation Scenario 2: Channel Repair

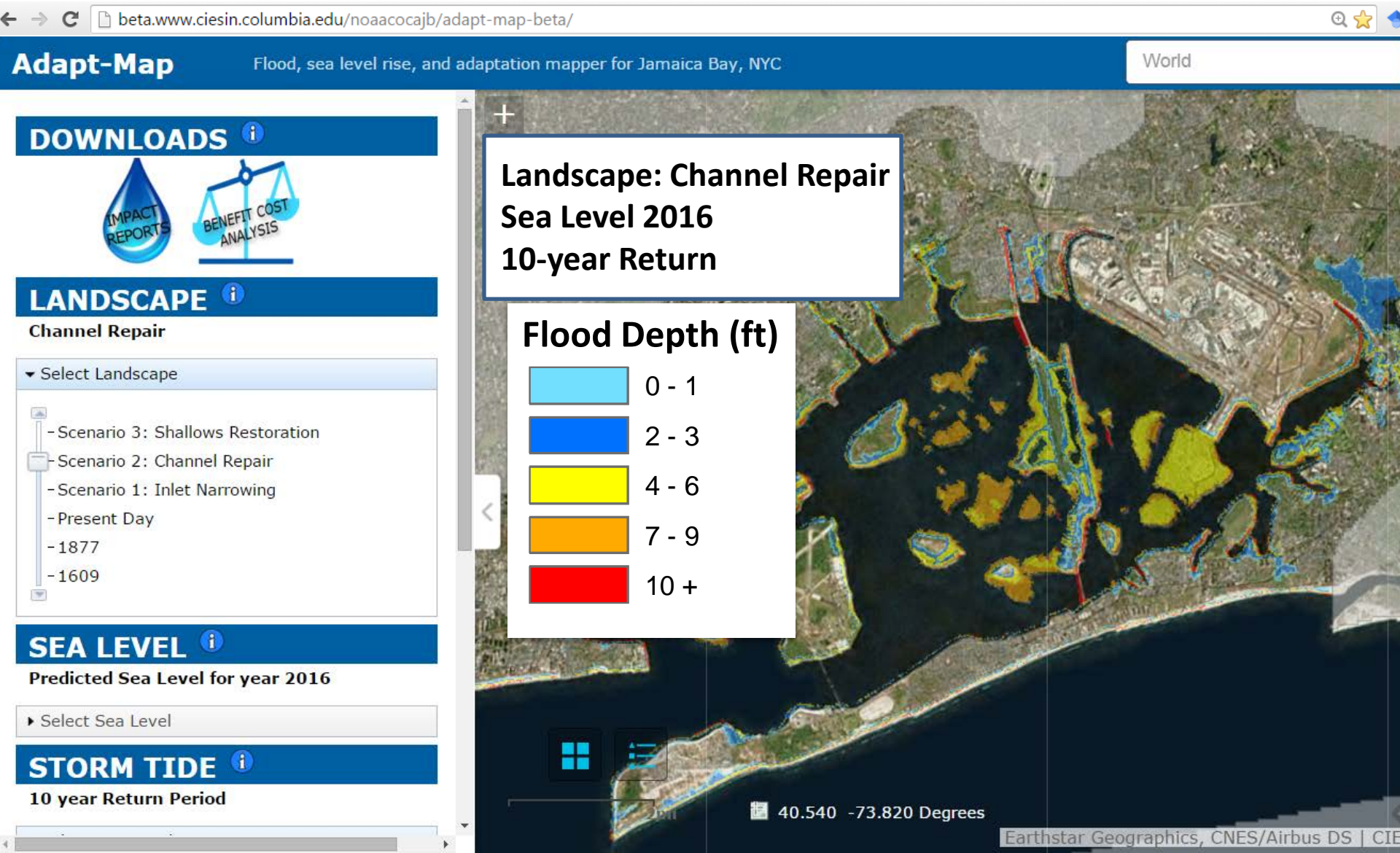


This scenario reverses the extreme historical over-dredging and widening of channels in the bay. The scenario constricts the flow of water entering Jamaica Bay during a coastal storm by narrowing the entrance to the bay and mildly shallowing the deep channels, thus reducing flooding.

AdaptMAP Dynamic Flood Mapper



AdaptMAP Dynamic Flood Mapper



Current/Ongoing Work

- Benefit-Cost-Analysis for flood adaptations
- Jamaica Bay Master Plan –
 - water quality impacts of flood protection
 - evolving landscape under sea level rise
- Expanding hazard assessment, adaptation work to Boston
- Using these tools to evaluate broader metrics of resilience

Conclusions

- Probabilistic products form the basis for satisfying many user needs
- They require us to NOT run the most computationally expensive wave models
- Our products are being used widely
 - National Weather Service WFO
 - Constant interactions with stakeholders

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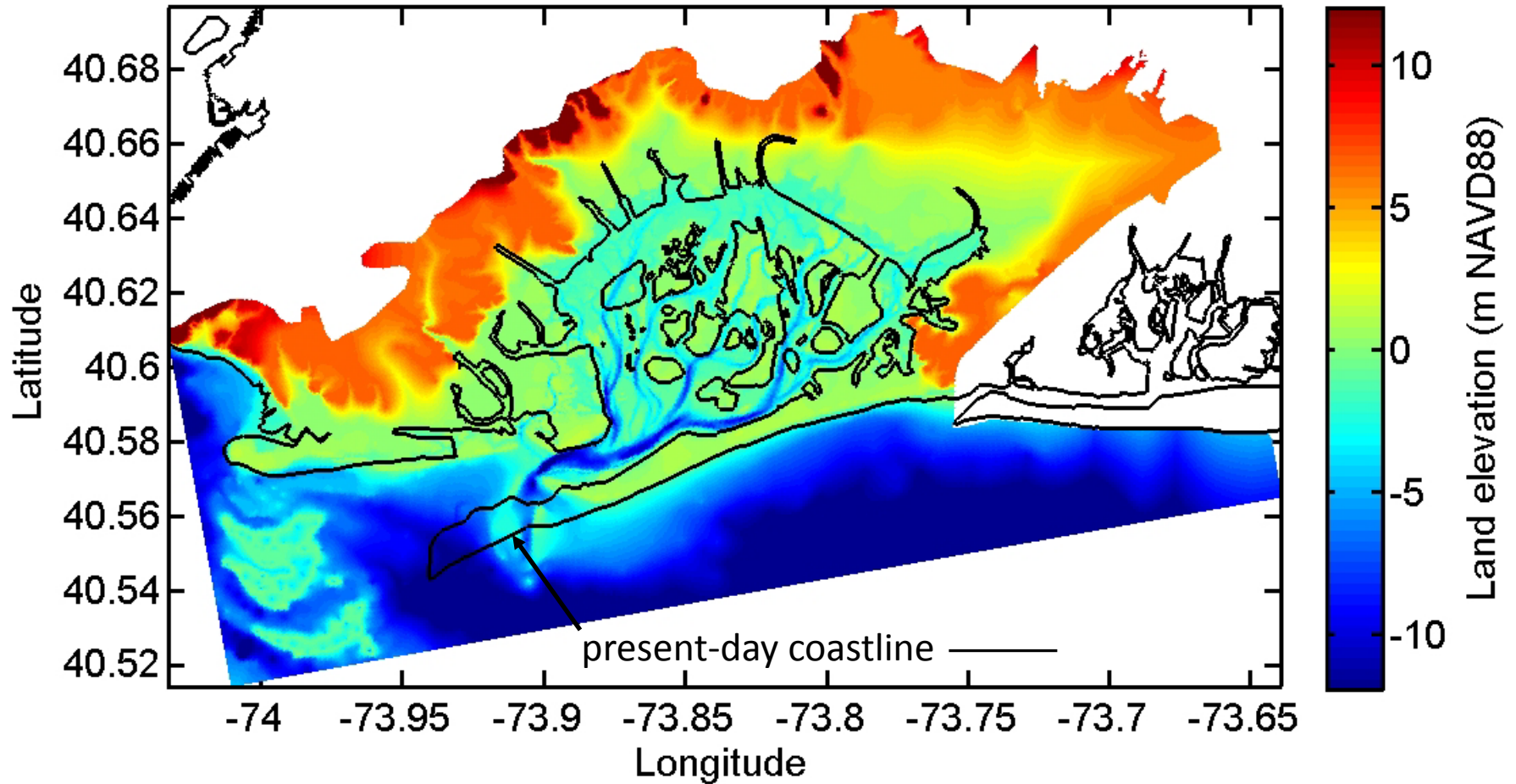
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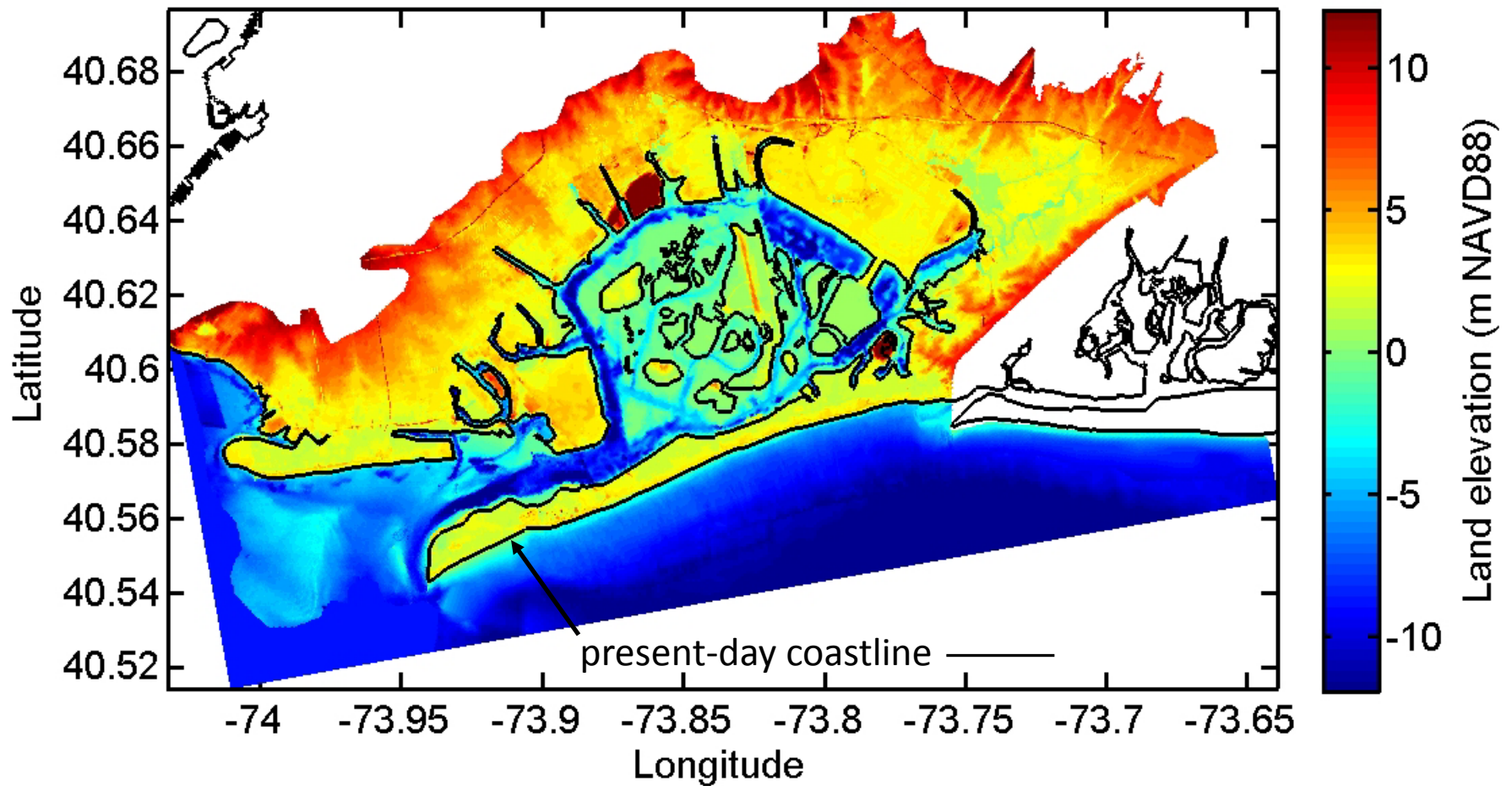


Extra Slides

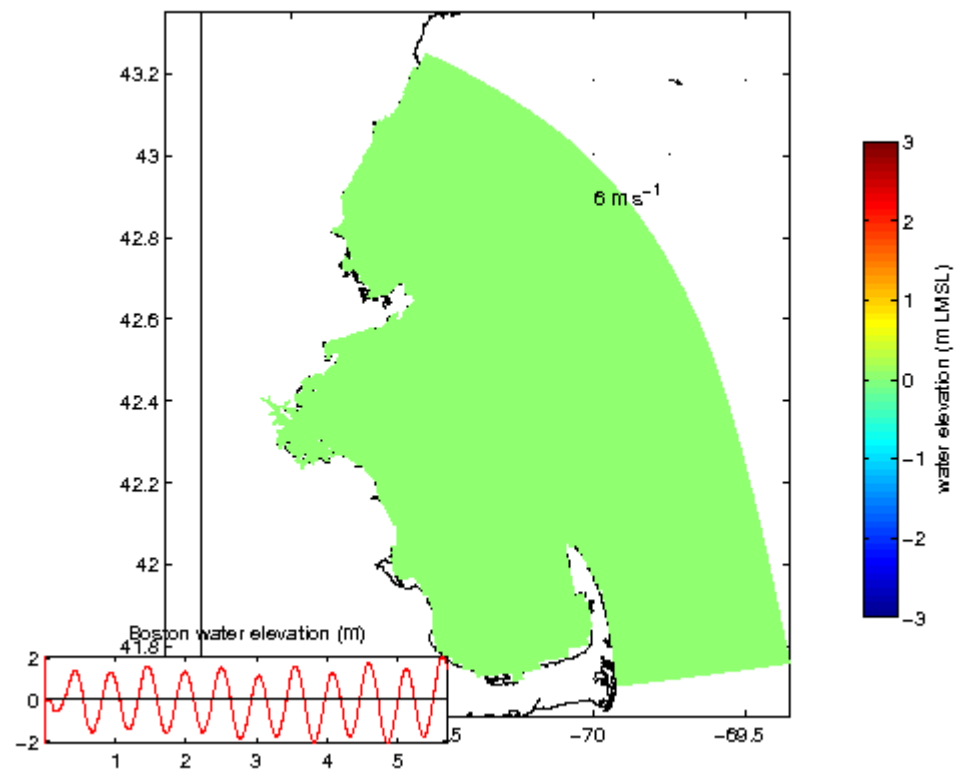
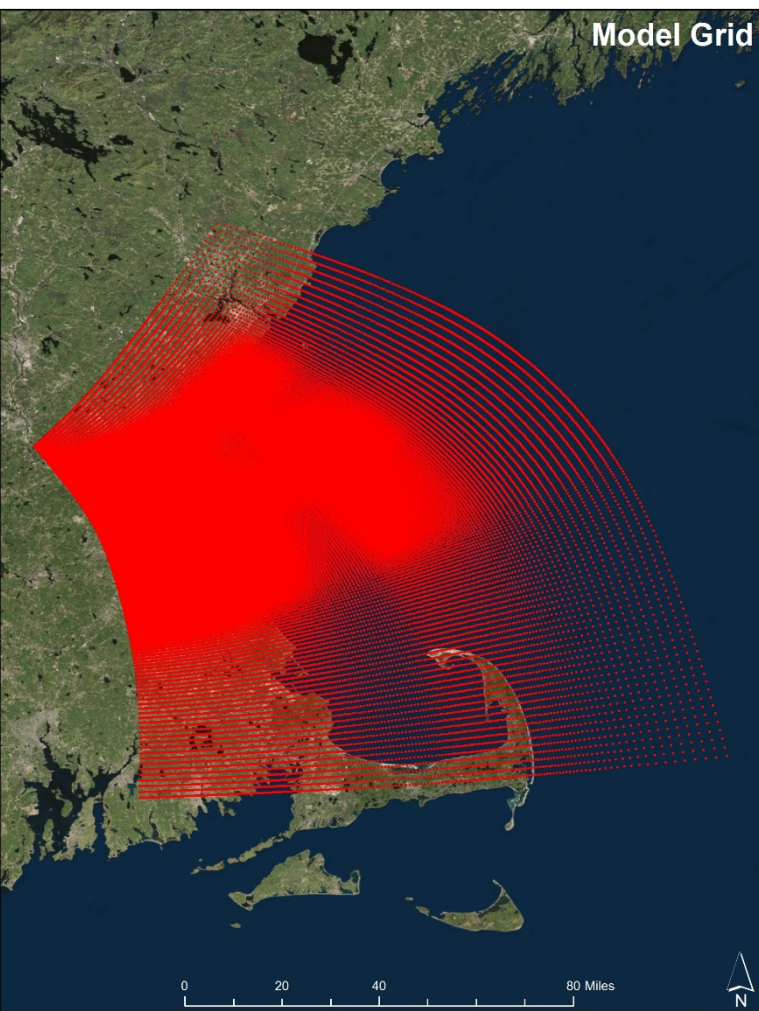
Jamaica Bay 1877 Land Elevation



Jamaica Bay 2010 Land Elevation

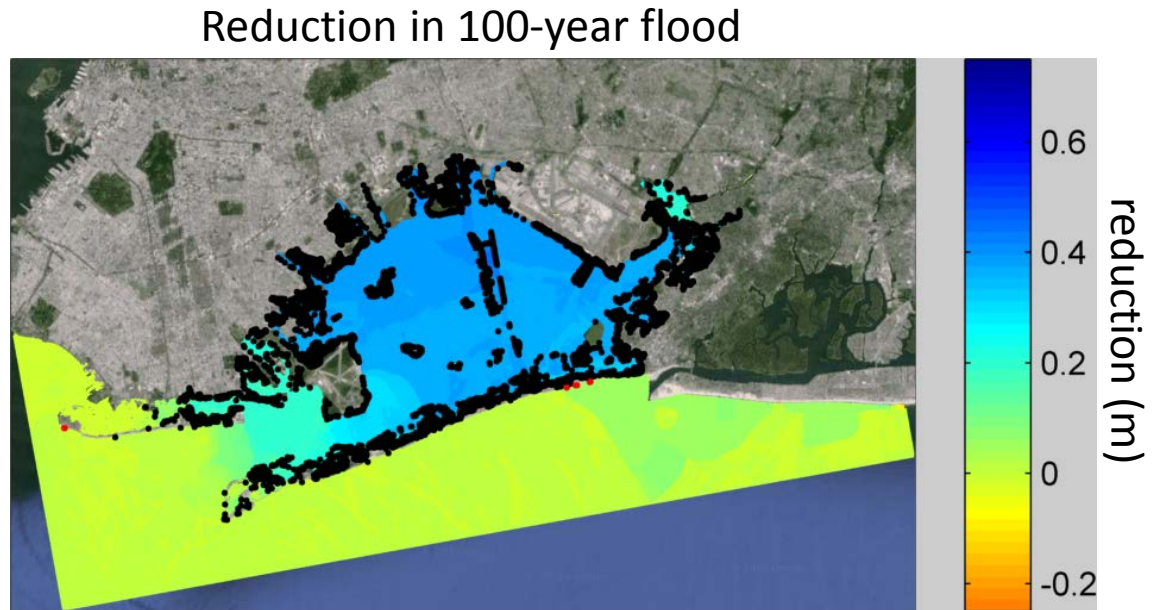


Boston/MA-Bay Model Grid



Adaptation Scenario: "Channel Repair"

- Reduced flood levels by 30-35 cm
- Reduced upland flood area by 10.1 km²
- No chance of overtopping; always provides "risk reduction"
- Does not reduce tide range



- flooding prevented
- flooding initiated