NOAA/FDA Vibrio Predictive Models and Tools for the Northeast

Bob Daniels, IMSG@NOAA/NWS/OPC John Jacobs, NOAA/NOS/NCCOS

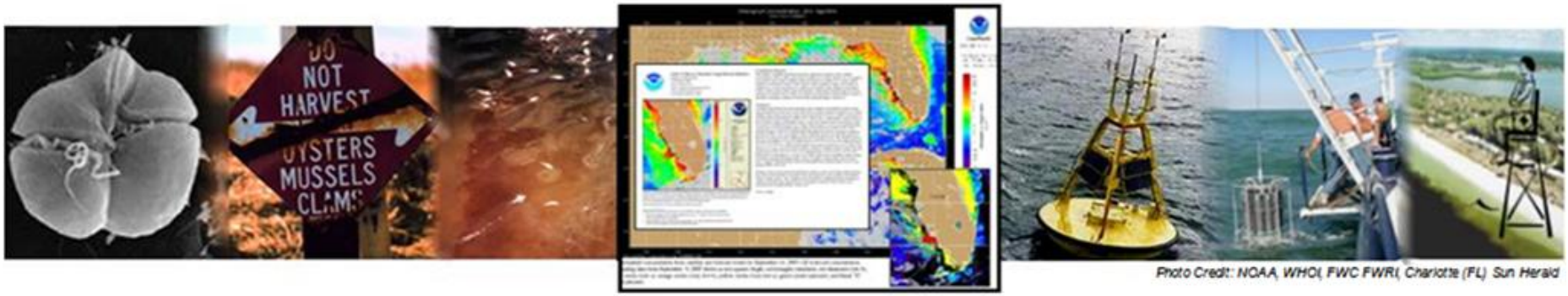


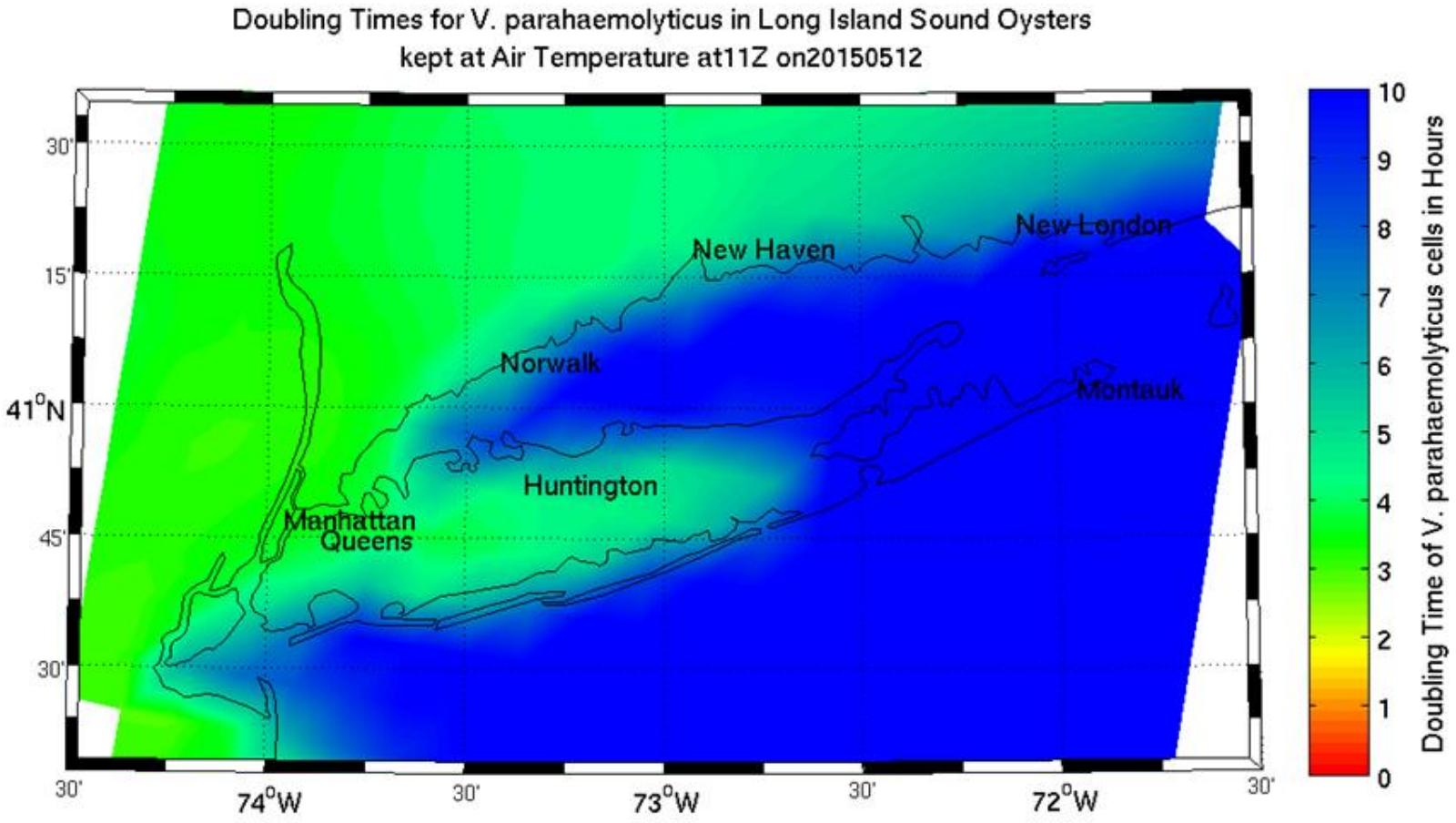
Photo Credit: NOAA, WHOI, FWC FWRI, Charlotte (FL) Sun Herald

Outline

- Vibrio in Oysters
  - *Vibrio parahaemolyticus (Vp)* Doubling Time and Best Harvest Models
  - Northeast Region: Currently Long Island Sound, Massachusetts, New Hampshire
  - Quantitative Precipitation Forecasts (QPF)
  - Seasonal forecasts
  - New Tools and Models

Doubling Time

- Number of hours to double from before Sunrise through next 6 days
- Empirical model derived from FDA risk assessment and John Bowers relating air temperature to *Vp* growth
- 2.5 km resolution, surface temperature from your local Weather Forecast Office (WFO) via the NDFD (NWS National Digital Forecast Database)


Doubling Times for V. parahaemolyticus in Long Island Sound Oysters
kept at Air Temperature at11Z on20150512
New Haven
New London
Norwalk
Montauk
Huntington
Manhattan
Queens
41°N
30'
15'
45'
30'
74°W
73°W
72°W
Doubling Time of V. parahaemolyticus cells in Hours
0
1
2
3
4
5
6
7
8
9
10

Vibrio Web Page

https://products.coastalscience.noaa.gov/vibrioforecast/

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Vibrio Predictive Models

Vibrio Background

What is *Vibrio*?

Vibrio spp. are bacteria that occur naturally in our coastal waters, but certain species and strains can also be harmful to human health. While rare, infection from water or foodborne exposure to *Vibrio vulnificus* is the most serious, often requiring hospitalization, and carries a high case fatality rate. The majority of the estimated 80,000 cases annually are associated with another member of the genus, *Vibrio parahaemolyticus*. Infection from this species is commonly associated with the consumption of raw or undercooked seafood, and usually results in self limiting gastroenteritis. To learn more about *Vibrio*, consult one of these pages from the Center for Disease Control or MD Healthy Beaches.

Why is this important?

Because of the human health consequences and association with consumption of raw seafood, state managers are responsible for regulating the shellfish industry to reduce consumer risk. Knowing where and when to expect elevated concentrations of Vibrio, and environmental conditions that promote rapid growth can inform both management and individual

SHELLFISH GUIDANCE

Vibrio parahaemolyticus

- Chesapeake Bay
- Delaware Bay
- Gulf of Mexico
- Northeast
- National
- Pacific Northwest
- Tampa Bay

WATER GUIDANCE

Vibrio vulnificus

- Chesapeake Bay

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SURVEY

Predictive Models

Click on a region to see available tools, or the center of the map for National level products.

An assortment of predictive models and weather related tools have been assembled, primarily related to issues surrounding safe harvest of shellfish around the nation. In partnership with the US Food and Drug Administration (USFDA), state and academic partners, *NOAA* is working continuously through the Ecological Forecasting Roadmap to verify and improve model accuracy and resolution, and transition them to a state of operations.

Vibrio in Oysters
Best Harvest Models

- Empirical model derived from FDA risk assessment and John Bowers relating air temperature to *Vp* growth
- Estimate of Vp doublings at given hour of harvest and following a specific cooling strategy
- Graphs for specific growing sites show current and next 3 days using NDFD surface air temperature

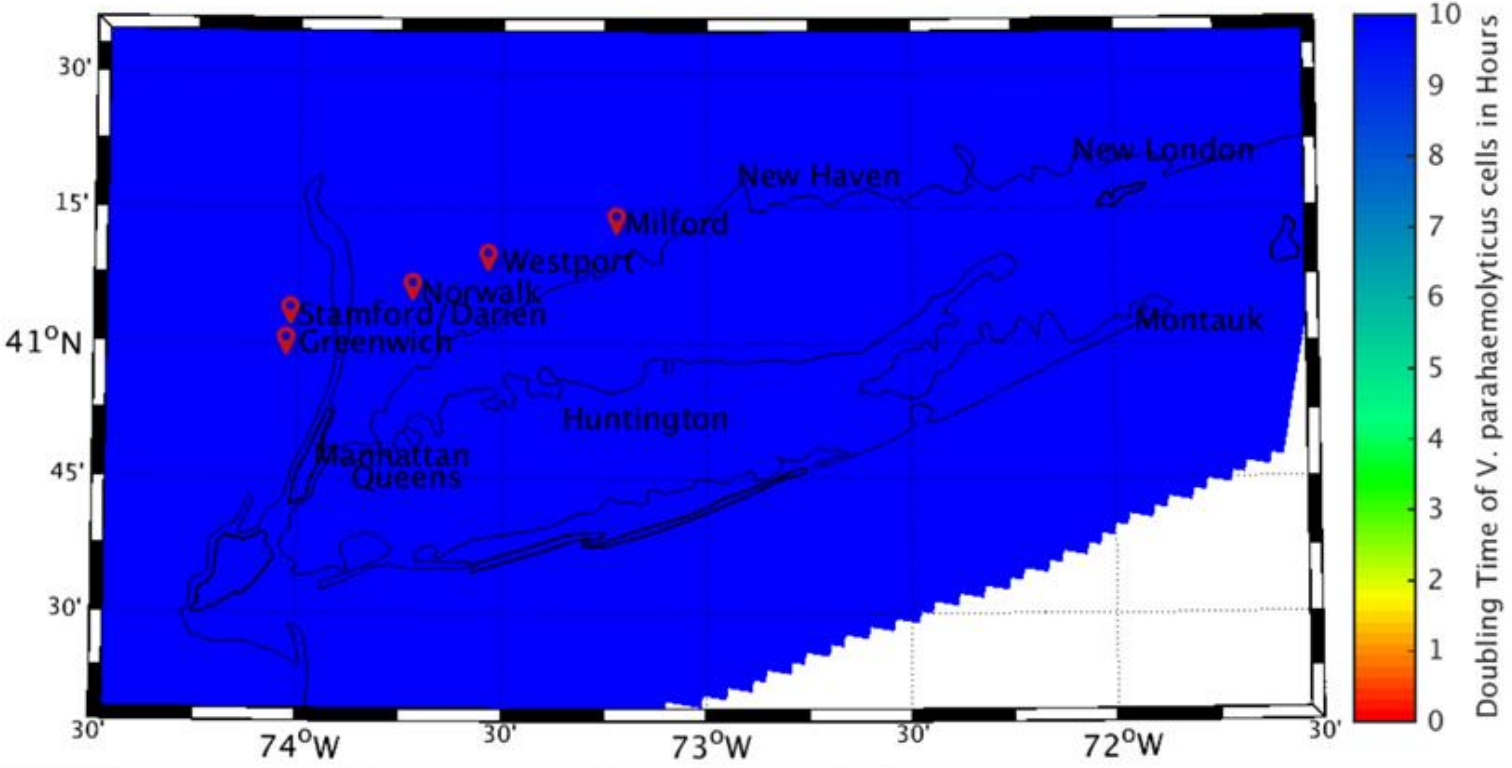
Long Island Sound Forecasts

Best Harvest Window Graphs

Click on a town name on the map to see a graph of Vp doublings in a growing area over the next 40 hours.

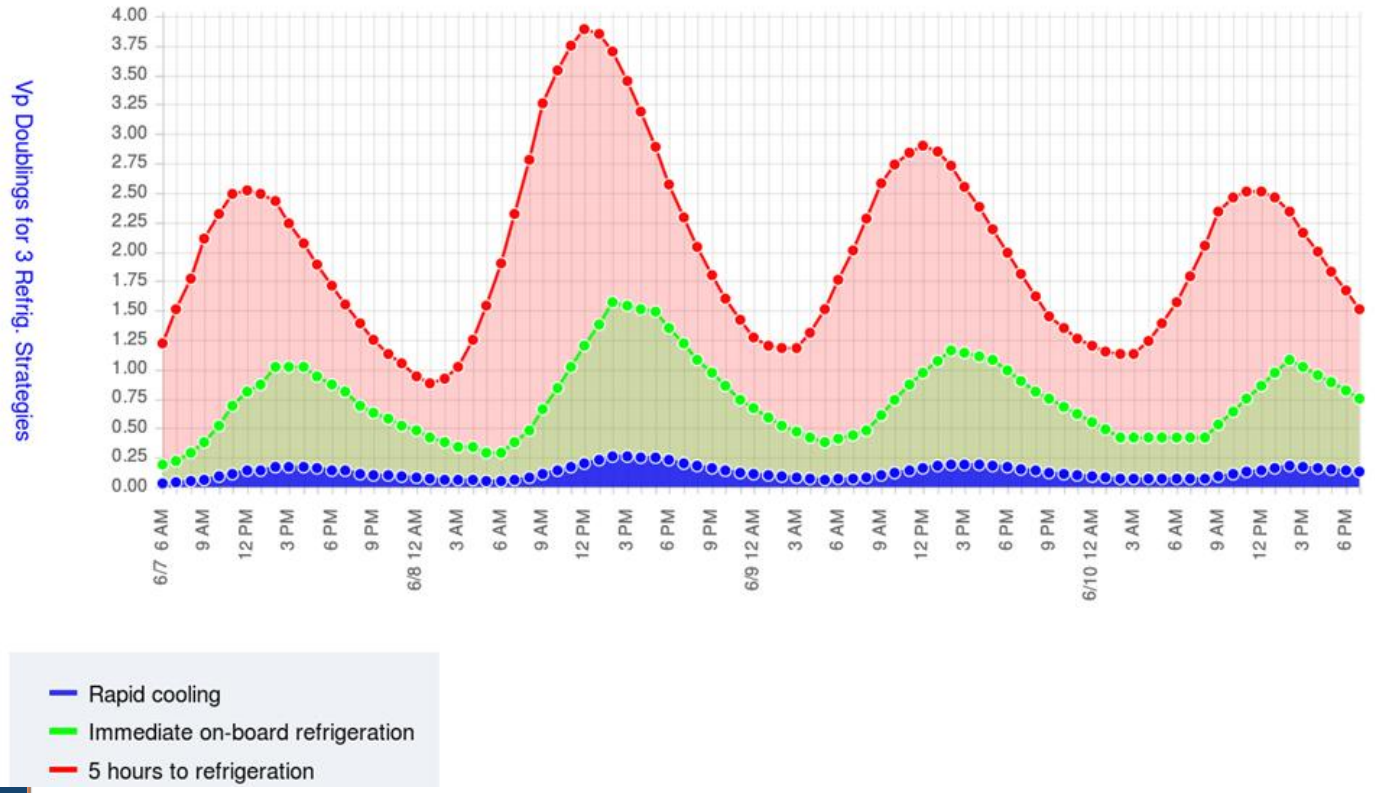
The *Vp* doublings given different cooling strategies are shown for growing areas in Long Island Sound. These graphs allow users to determine where and when the highest doubling times will occur in advance to plan harvest and cooling strategies.

View a Summer example of Milford



Best Harvesting Windows

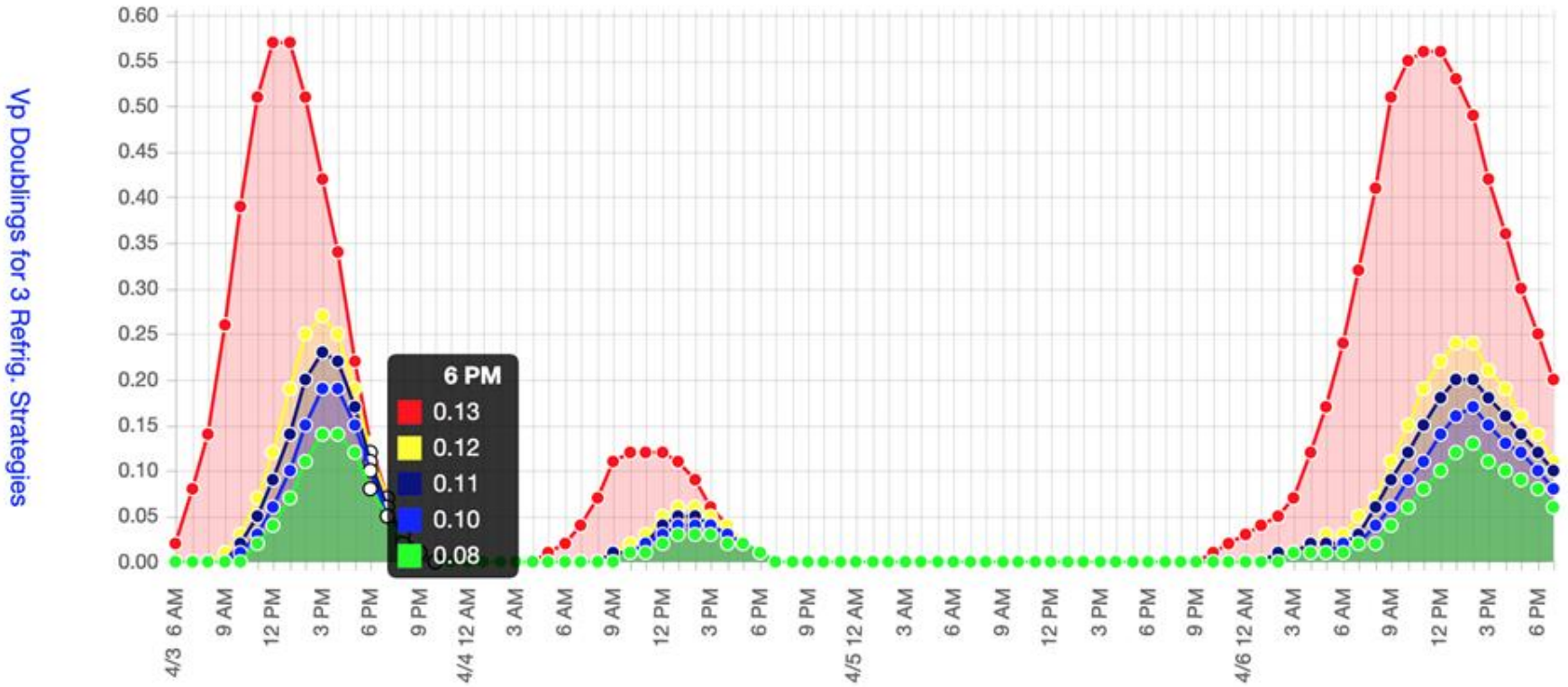
Westport, CT



Post-Harvest Cooling Strategies:

1) Blue line (Rapid cooling): Oysters placed into Ice Slurry on vessel within 0.5 hours of harvest start time; oysters are cooled to an internal temperature of 50°F within 1 hour of harvest.
2) Green line (Immediate On-board refrigeration): Oysters are placed into mechanical refrigeration unit on vessel within 0.5 hours of harvest time; oysters are cooled to 50°F within 5 hours of being placed under refrigeration.
3) Red Line (5 hours to refrigeration): Oysters are exposed to air temperature on the deck of the vessel for 5 hours and placed into mechanical refrigeration on shore; oysters are cooled to 50°F within 5 hours of being placed under refrigeration.

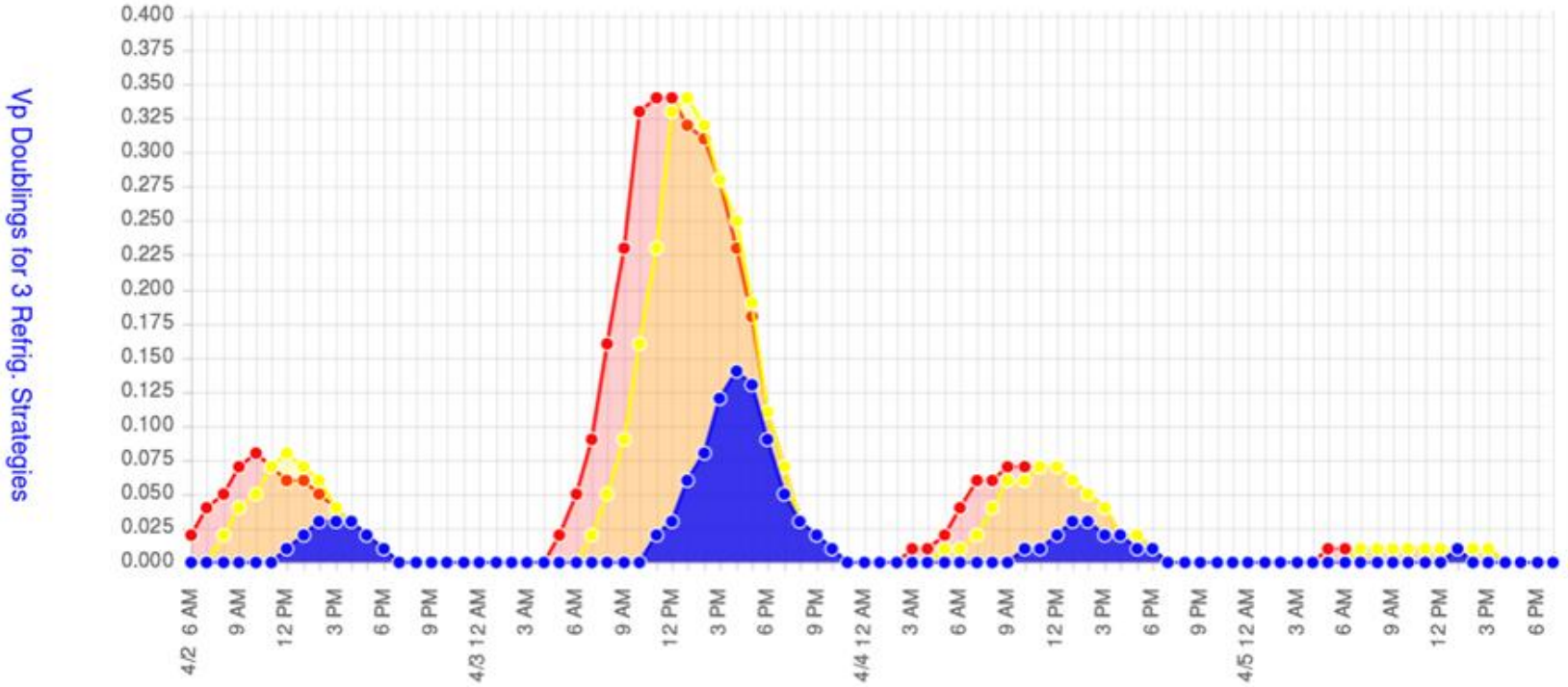
Duxbury, MA



- Rapid Cooling (Ice Slurry w/in 1 hour)
- Rapid Cooling (Direct Ice w/in 1 hour)
- Rapid Cooling (Ice Slurry w/in 2 hours)
- Rapid Cooling (Direct Ice w/in 2hours)
- 5 hours to refrigeration

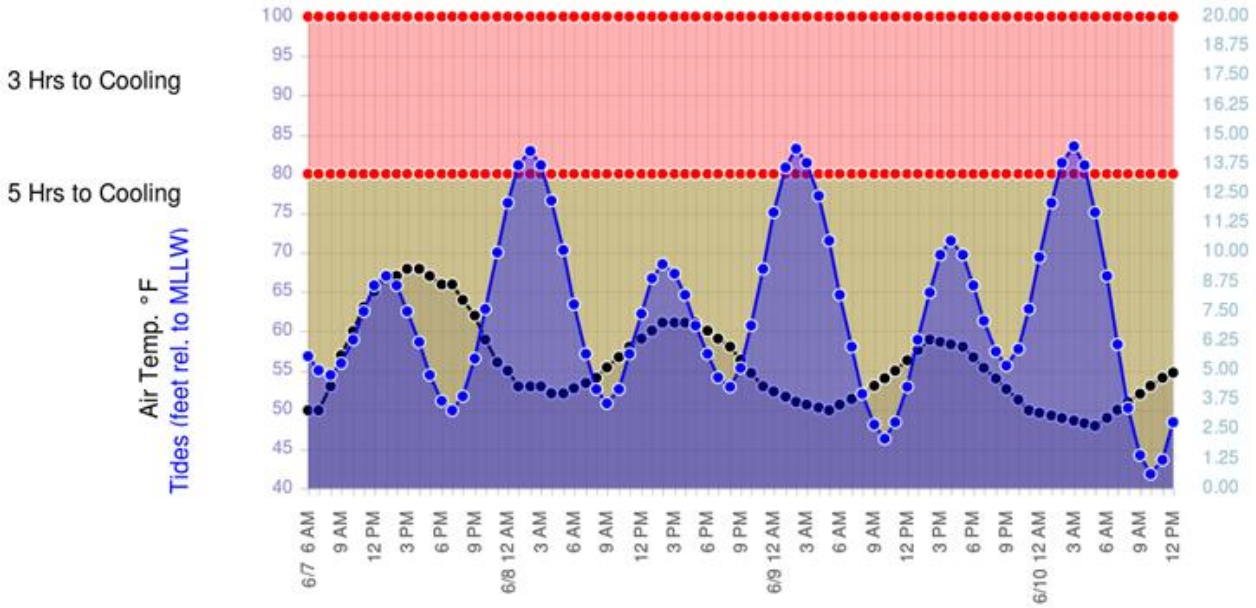
Best Harvesting Windows

Southwest Little Bay



Puget Sound Temperature Warnings

Pickering Passage Time to Cooling



Harvest Start Time

Graph illustrates the air temperature forecast(black line) and the tidal prediction(blue line) at the selected growing area plotted on top of temperature limits(red lines) for the required times to cooling of oysters from the Washington State *Vibrio parahaemolyticus* control plan. The air temperature plotted is the NWS/NDFD forecast and the tides are from the NOAA/NOS annual prediction. This tool is intended to assist oyster producers in choosing the optimal start time of harvest in order to achieve the lowest number of bacterial doublings.

National Shellfish Guidance

https://products.coastalscience.noaa.gov/vibrioforecast/

NCCOS | NATIONAL CENTERS FOR COASTAL OCEAN SCIENCE **Vibrio Predictive Models**

Vibrio Background > Shellfish Guidance - National Models

Shellfish Guidance - National Level Products

NWS Quantitative Precipitation Forecasts

Many states around the country use total rainfall in a 24hr period as a trigger for opening and closing shellfish harvest areas and for issuing warnings for swimming beaches. This product provides graphical guidance of expected, cumulative rainfall several days in advance through google earth. Follow these instructions (PDF) to download Google Earth™ and to learn how to work with the QPF kml files.

View Model

SHELLFISH GUIDANCE

Vibrio parahaemolyticus

- Chesapeake Bay
- Delaware Bay
- Gulf of Mexico
- Northeast
- National
- Pacific Northwest
- Tampa Bay

WATER GUIDANCE

Vibrio vulnificus

- Chesapeake Bay

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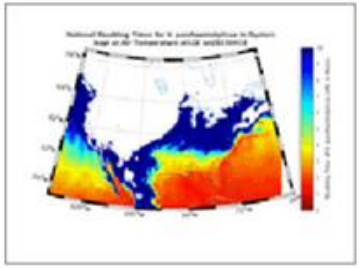
National Shellfish Guidance

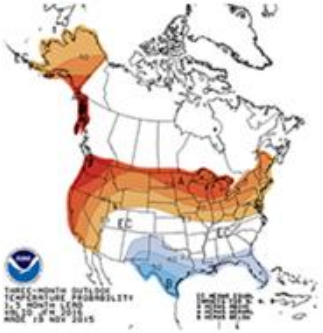
SURVEY



Doubling Time of *Vibro parahaemolyticus (Vp)* in oysters

Vibro parahaemolyticus has one of the fastest growth rates of all estuarine bacteria, and the population can replace itself, or double every hour at 90°C. This product uses modeled air temperature from the North American Mesoscale to force a statistical growth rate equation (USFDA 2005) for *Vp*. The spatially explicit graphical display allows users to determine where and when the highest doubling times will occur every hour, out to 72 hrs in advance to plan harvest and refrigeration strategies.

View Model



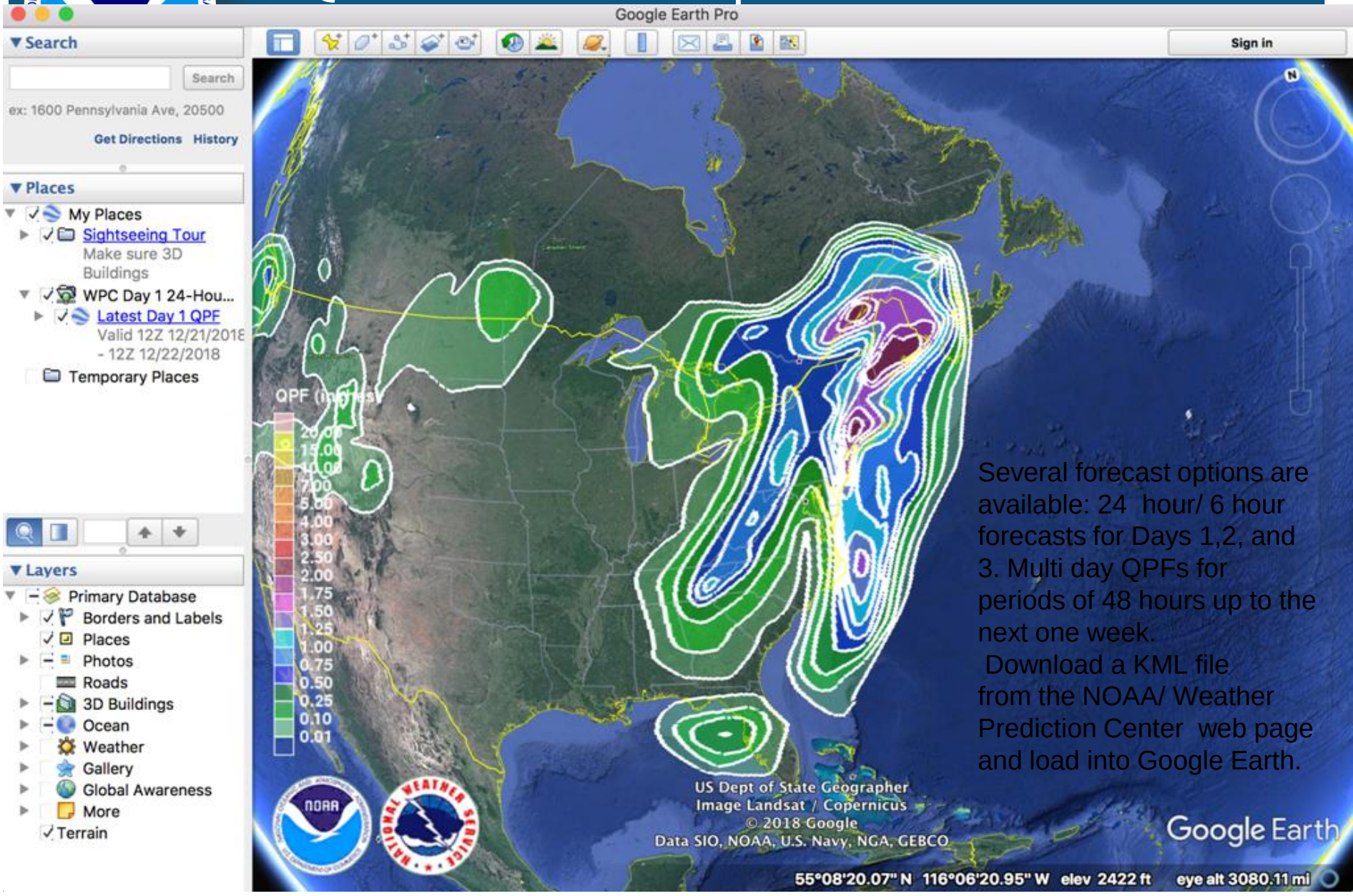
NWS Three Month Outlooks

For longer range planning for an upcoming growing or beach season, helpful forecasts are provided by the NWS Climate Prediction Center. These 3 month outlooks for temperature and precipitation, give probabilities of above average, normal or below average temperatures and rainfall with respect to a recent 30 year climatology.

View Model

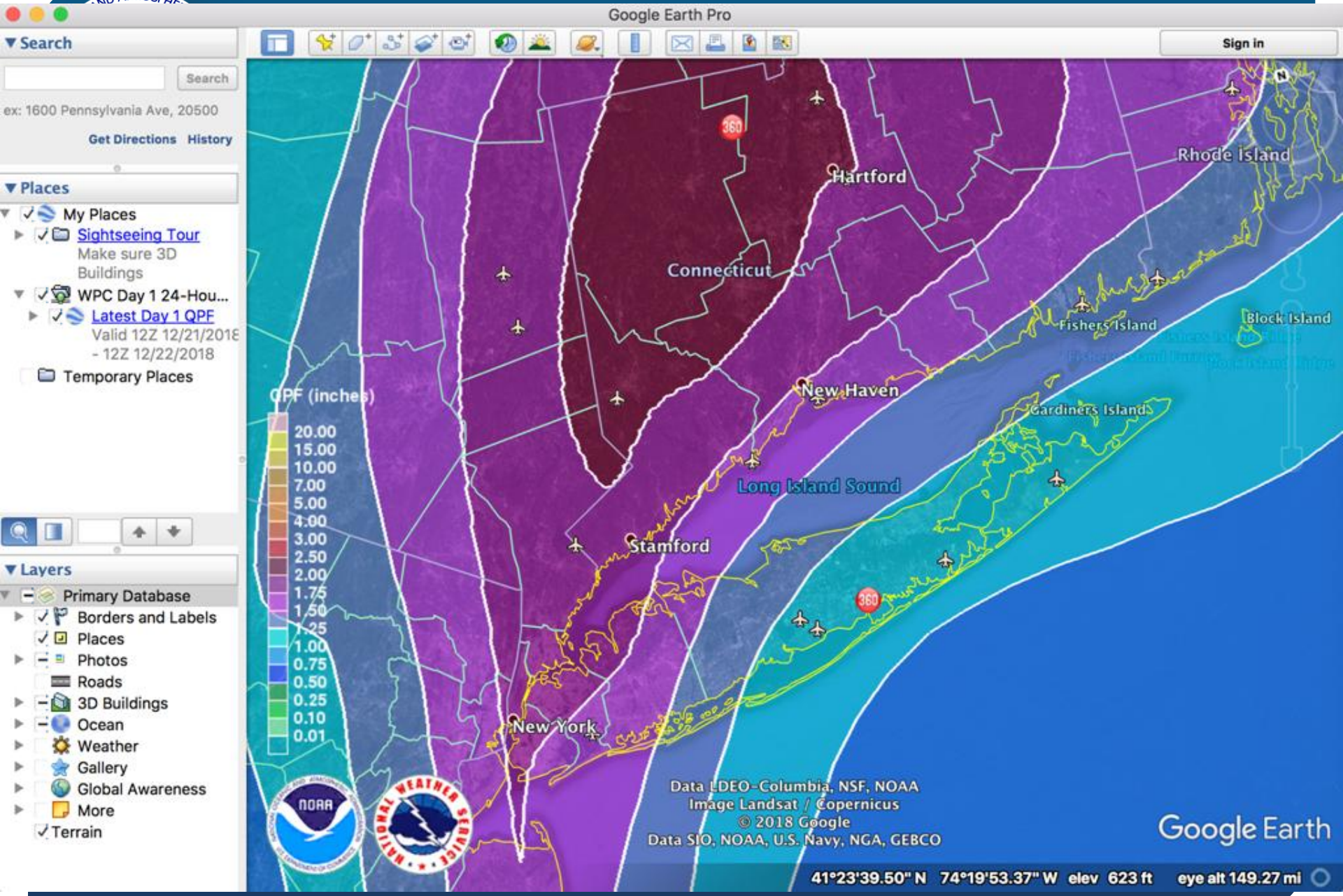
As a work in progress, current Vibrio models displayed here are considered experimental products, and thus NOAA will not be held liable from issues arising from their interpretation and use.

Quantitative Precipitation Forecast



Several forecast options are available: 24 hour/ 6 hour forecasts for Days 1,2, and 3. Multi day QPFs for periods of 48 hours up to the next one week.

Download a KML file from the NOAA/ Weather Prediction Center web page and load into Google Earth.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Hartford
Connecticut
Rhode Island
Fishers Island
Block Island
New Haven
Gardiners Island
Long Island Sound
Stamford
New York
Data LDEO-Columbia, NSF, NOAA
Image Landsat / Copernicus
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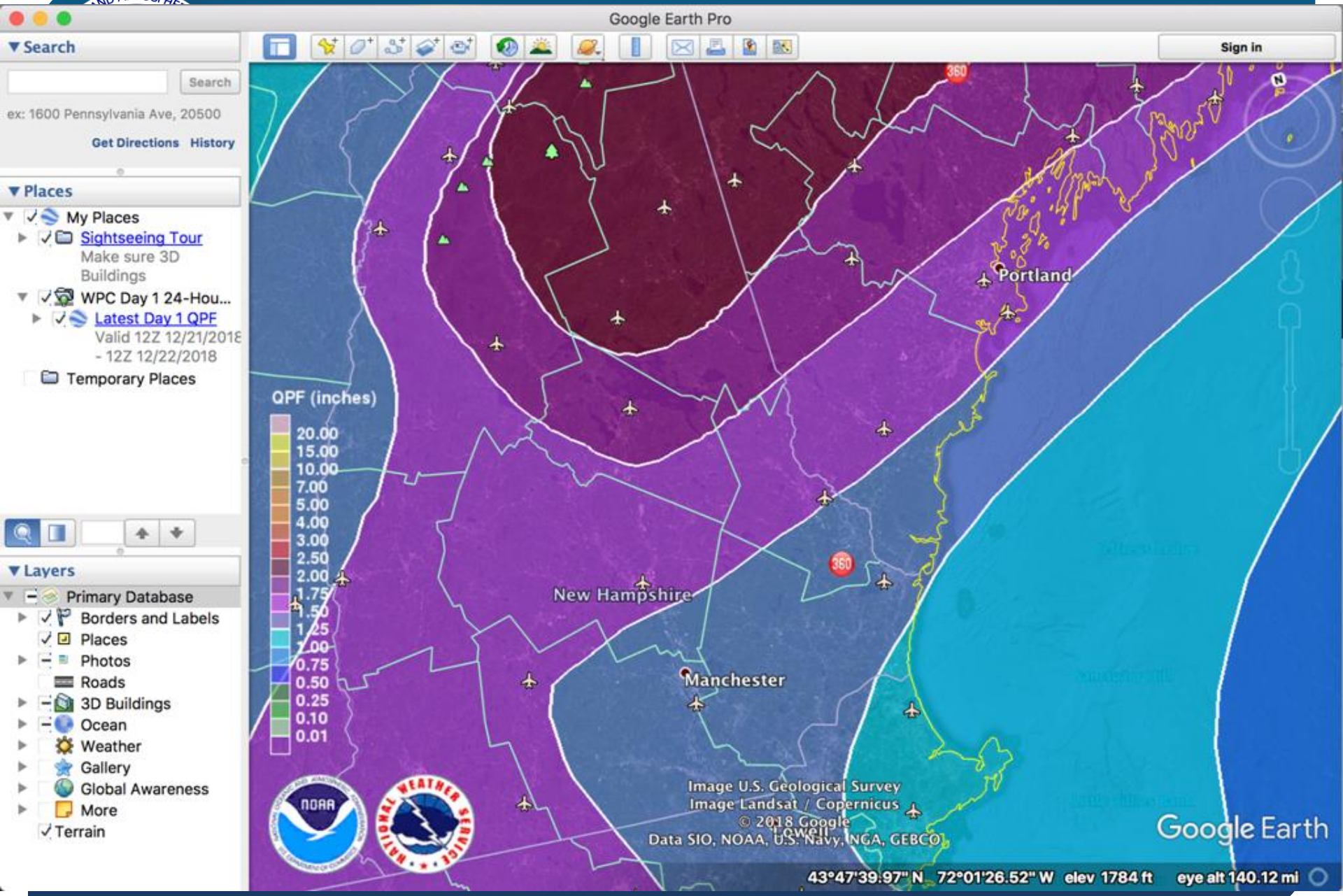
Google Earth
41°23'39.50" N 74°19'53.37" W elev 623 ft eye alt 149.27 mi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Portland
New Hampshire
Manchester
Lowell
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NOAA
NATIONAL WEATHER SERVICE
Image U.S. Geological Survey
Image Landsat / Copernicus
© 2018 Google
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
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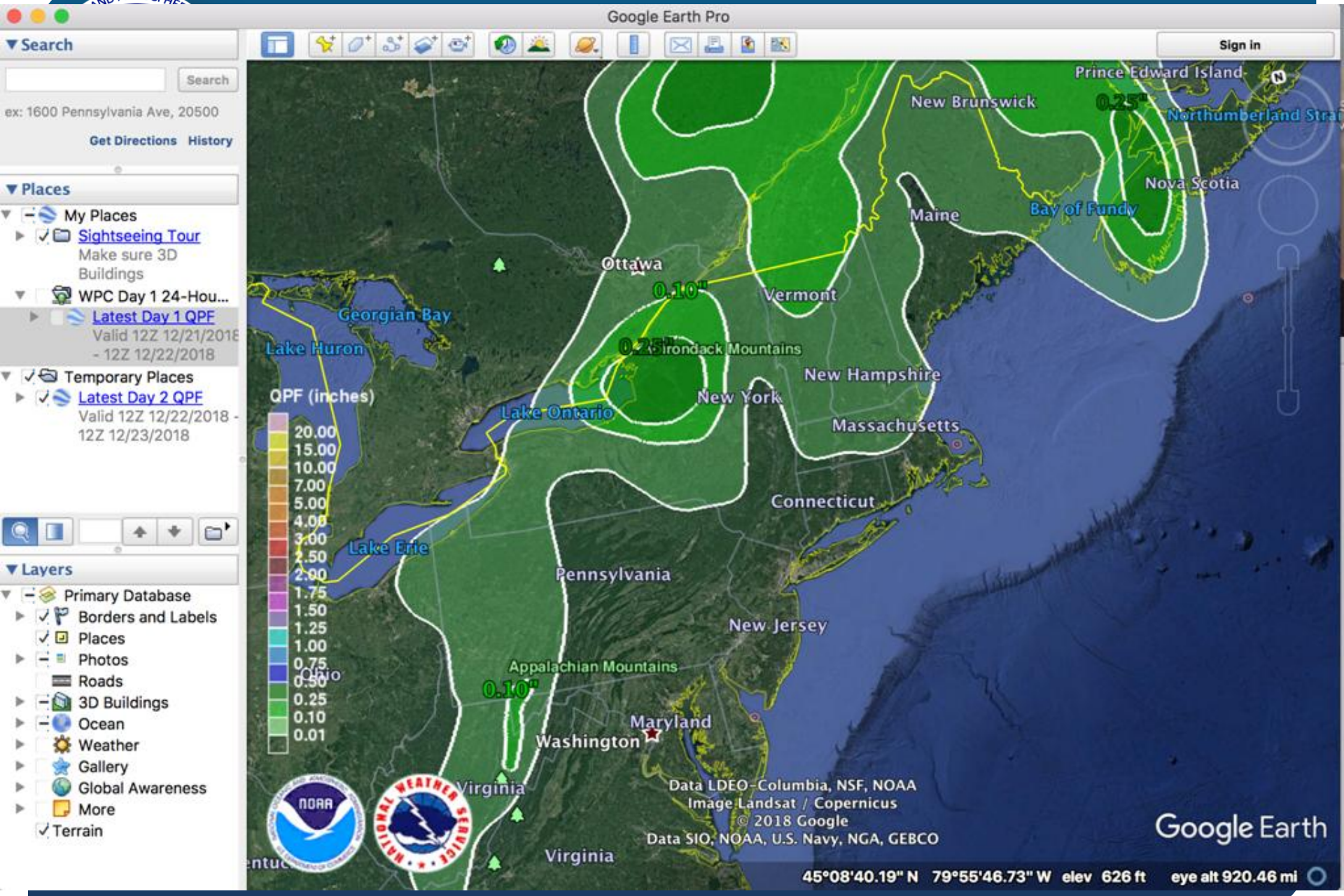
43°47'39.97" N 72°01'26.52" W elev 1784 ft eye alt 140.12 mi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Nova Scotia
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Ottawa
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Vermont
Georgian Bay
Lake Huron
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Adirondack Mountains
New Hampshire
New York
Lake Ontario
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QPF (inches)
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Virginia
Data LDEO-Columbia, NSF, NOAA
Image Landsat / Copernicus
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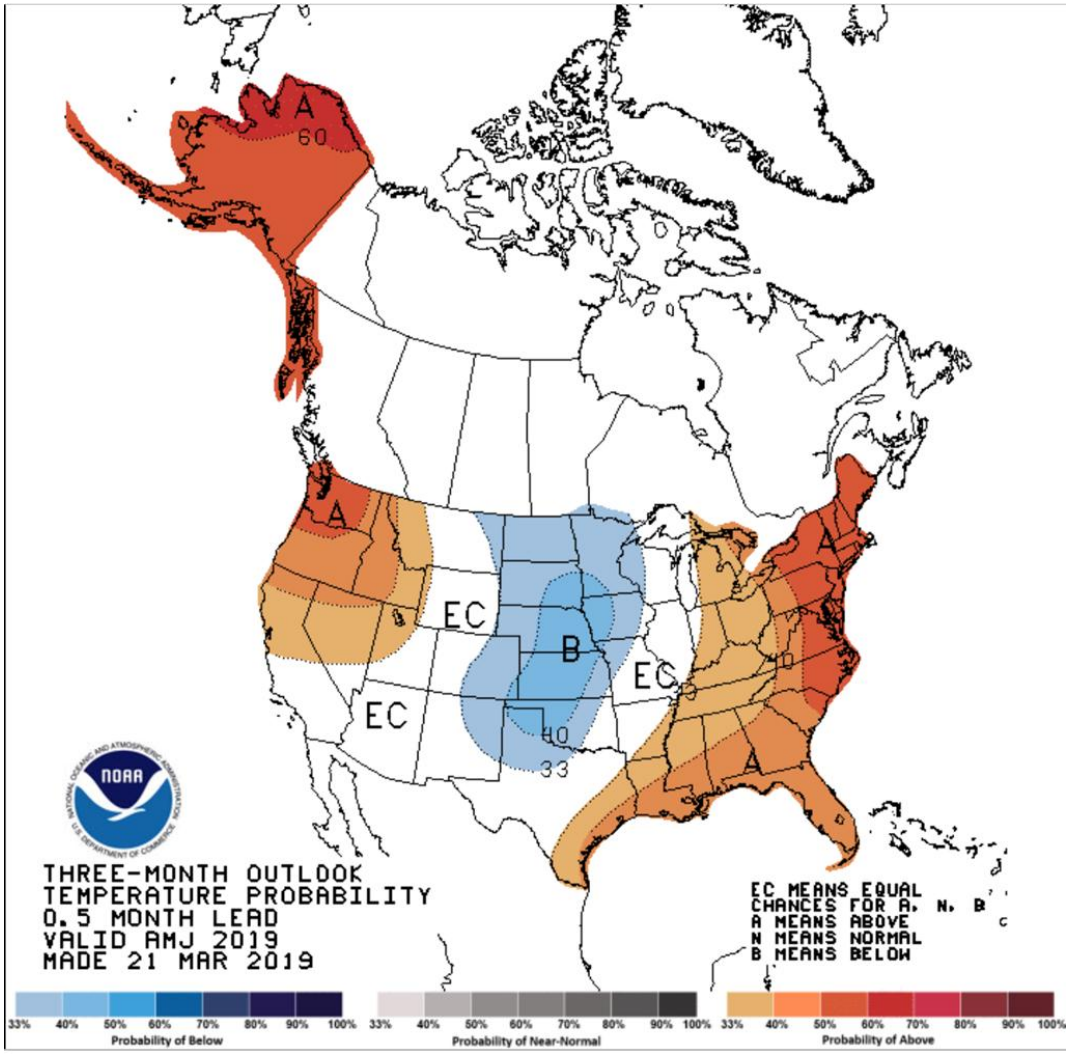
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Google Earth
45°08'40.19" N 79°55'46.73" W elev 626 ft eye alt 920.46 mi

Temperature Three Month Outlook



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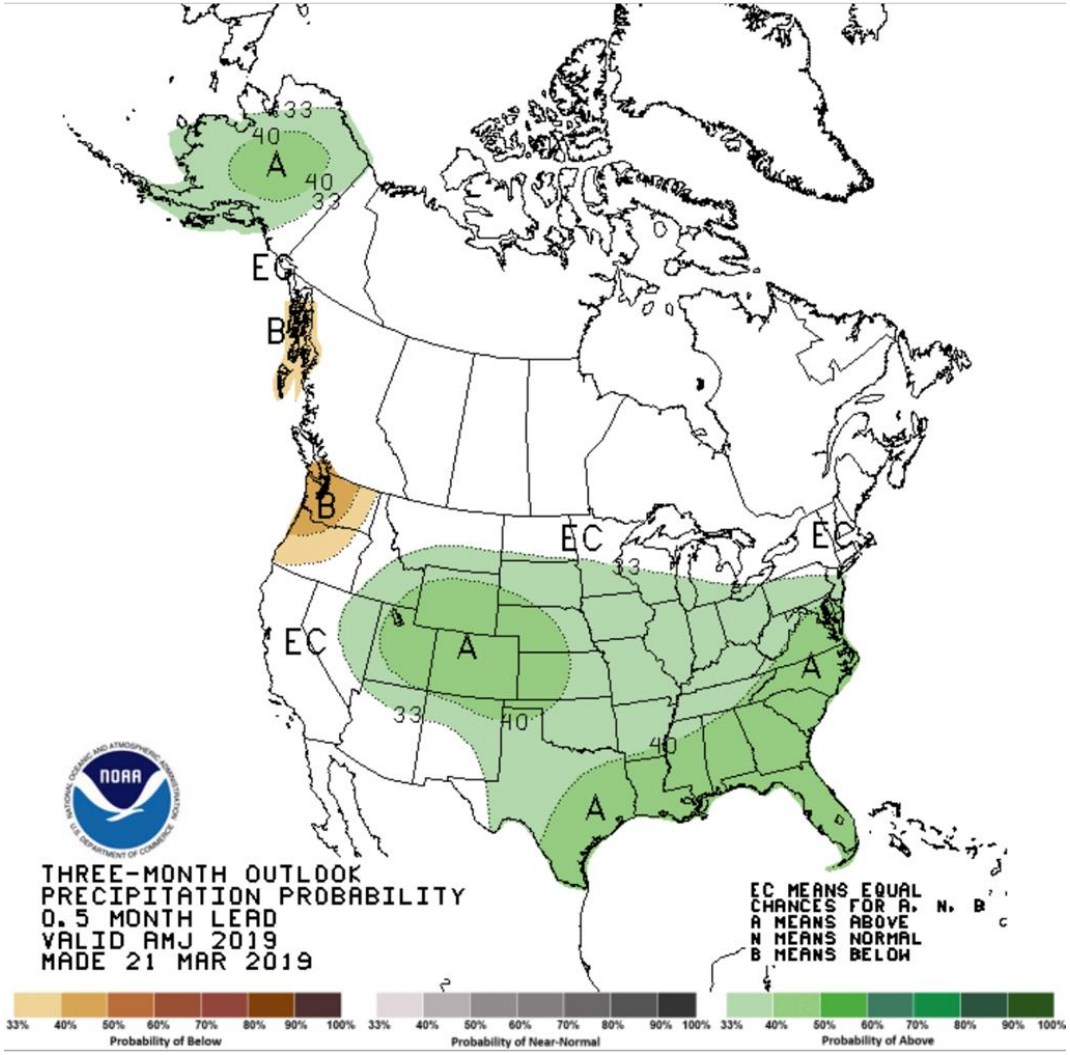
http://www.cpc.ncep.noaa.gov/products/predictions/long_range/seasonal.php?lead=1”

Precipitation Three Month Outlook



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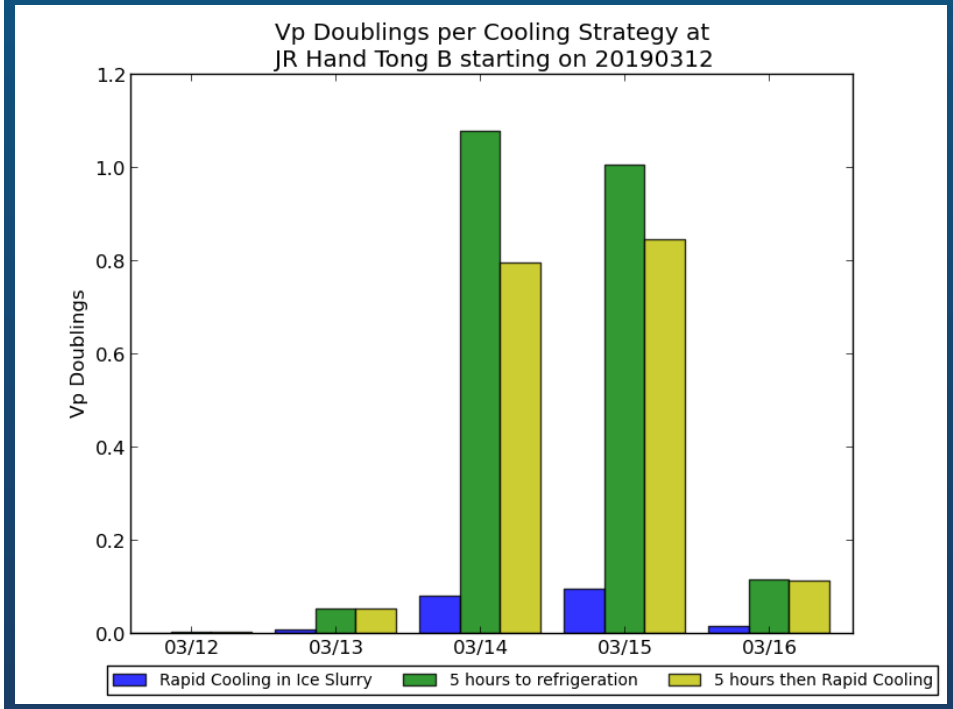
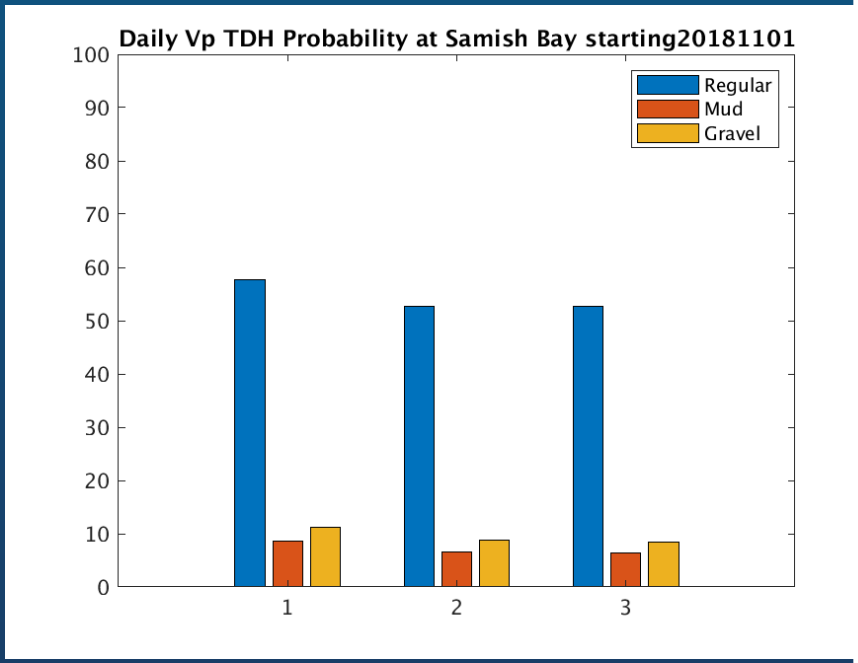
http://www.cpc.ncep.noaa.gov/products/predictions/long_range/seasonal.php?lead=1"

Future Tools and Projects

James River, Virginia *Vp* Best Harvest Tool





Puget Sound *Vp* Best Harvest Tool

Future Tools and Projects

- Resubmergence tools - Joint NOAA/FDA team is starting to address. Identifying reliable cool waters to resubmerge oysters for purging of *Vp* and guidance on timing.
- Best Harvest Graphs for more growing sites and revising for new control strategies
- Other new tools and Questions?

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