

The Value of **PORTS**[®] to the Nation



How Real-time Observations Improve Safety and Economic Efficiency of Maritime Commerce

National Oceanic and Atmospheric Administration
U.S. Department of Commerce



*Cover: Large container vessel transiting under the Gerald Desmond Bridge in Los Angeles, California. Credit: Warren Krug, NOAA
Inside cover: Air gap installation on Dames Point Bridge in Jacksonville, Florida. Credit: Steve O'Malley, Ocean Tech Services, LLC*



Did you know that the majority of products that Americans find on store shelves come to us by way of the United States marine transportation system? It is the backbone for the movement of goods, services, and people throughout the nation and abroad. Like most infrastructure systems, the nation's network of waterways and seaports is challenged by ever increasing demand. Continually larger ships are pushing the limits of existing navigation channels and bridge heights at seaports. In addition, the volume of traffic at U.S. seaports is expected to double by 2021, and double again shortly after 2030.

Bigger vessels and greater traffic means increased potential for accidents. Over 600 commercial vessels annually are involved in accidents on the nation's waterways and major seaports. Real-time observations from PORTS[®], or the Physical Oceanographic Real-Time System, when combined with up-to-date nautical charts and precise positioning, can greatly increase the safety and efficiency of maritime commerce. For example, there has been a nearly 60 percent reduction in groundings at some seaports currently served by PORTS[®].

This document communicates the results of an economic valuation conducted by NOAA that estimated as much as a \$300 million annual benefit from an expanded PORTS[®] system serving the nation's 175 major seaports; the potential ten-year net present value of this investment could be as much as \$2.5 billion. PORTS[®] is a key element of the informational infrastructure that improves the safety and efficiency of the U.S. marine transportation system, and our continuing ability to successfully compete in the expanding global economy.

Sincerely,



Richard Edwing
Director, Center for Operational Oceanographic Products and Services (CO-OPS)
NOAA National Ocean Service

<http://tidesandcurrents.noaa.gov/ports.html>

Our lives depend on maritime commerce

The following statistics show the importance of U.S. waterborne transport in recent years:

76%

Percent of all trade involving some form of marine transportation

\$740 billion

In 2008, approximate dollars contributed to our gross domestic product from marine transportation

13 million

Jobs supported by marine transportation

15,000

Miles of waterways, seaports, and other commercially navigable waters

3,700+

Number of marine terminals

Why PORTS®?

A tragic bridge collapse



Scene from the Sunshine Skyway Bridge collapse in May, 1980.
Credit: St. Petersburg Times

On the morning of May 9, 1980, a freighter ship, the *Summit Venture*, was heading from the Gulf of Mexico up Tampa Bay to the Port of Tampa. The weather conditions on this particular day were treacherous, with tropical storm force winds and heavy rain.

With near zero visibility, the ship lost its radar, rendering it essentially blind as it approached a critical bend in the route leading between the two main piers of the Sunshine Skyway Bridge.

High winds and currents pushed the 20,000 ton freighter out of the channel, and when the freighter hit the bridge's main support pier, the suspended roadway above fell 150 feet into the water. Six cars, a truck, and a Greyhound Bus fell, killing 35 people. Only one person that fell from the bridge survived.

U.S. Coast Guard inquiries following this tragedy determined that the use of real-time oceanographic and meteorological information may have helped to avoid this accident. In 1991, in response to this incident and other maritime accidents, the Physical Oceanographic Real Time System, or PORTS®, was established to provide accurate and reliable real-time information about environmental conditions in seaports. Today, PORTS® serves about one-third of all major seaports in the United States.

What if one major accident is avoided?

One maritime accident can cost tens of millions of dollars

Many maritime accidents have minor impacts, but others have been catastrophic. For these catastrophic events, avoiding just one accident can save tens or even hundreds of millions of dollars in property damage, oil spill response, injuries to our coastal environment, port facility closures, and the potential for loss of life. The trend towards bigger vessels and greater port traffic will result in increased potential for accidents. An investment in PORTS® provides the real-time data and decision-support tools that can help mariners and port operators avoid maritime accidents.

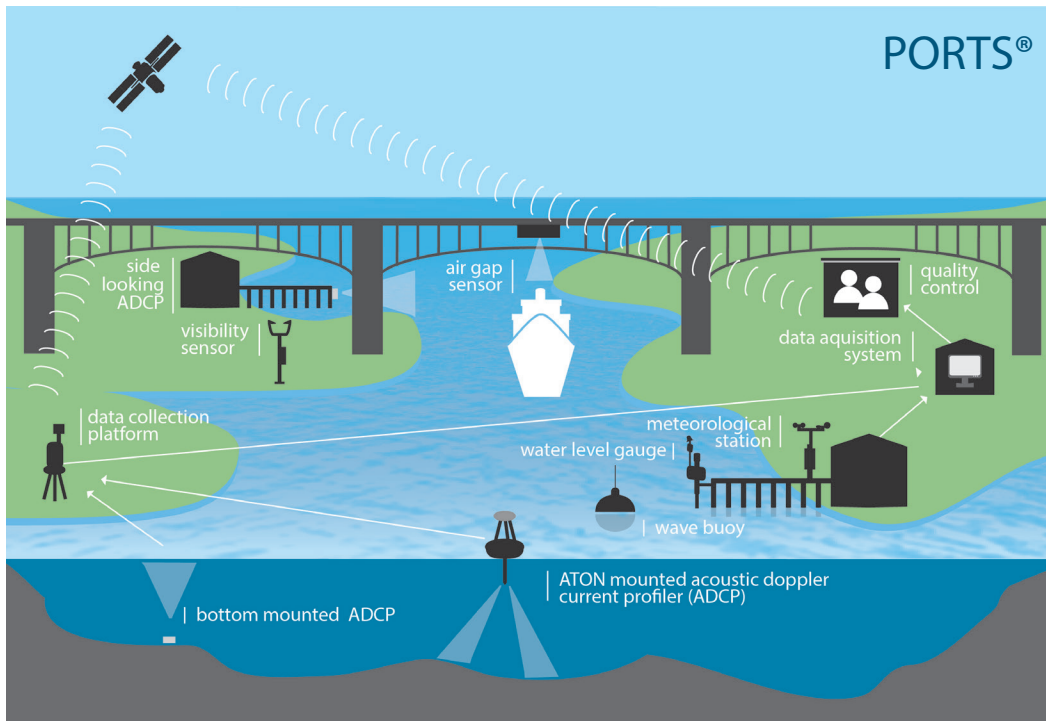


Ship entering Tampa Bay under the Sunshine Skyway Bridge. Credit: Mike Henderson



Ship entering a berth at Tampa Bay harbor. Credit: Mike Henderson

What is PORTS®?



Real-time, accurate, and reliable

PORTS® is an integrated system of oceanographic and meteorological sensors that provide mariners with accurate and reliable real-time information about environmental conditions in seaports. In concert with nautical charts and other navigational aids, this “coastal intelligence” helps mariners make better safety and economic decisions.

With PORTS®, mariners can access observations and predictions of water levels, currents, waves, salinity, water temperature, bridge heights, winds, visibility, atmospheric pressure, and air temperature – information that is critical to safe navigation. All PORTS® observations and predictions are quality controlled by NOAA 24 hours a day, 365 days a year.

Systems come in a variety of sizes and configurations, each specifically designed to meet local user requirements. The largest existing PORTS® installation is comprised of over 100 individual sensors, while the smallest consists of a single water level sensor and associated meteorological sensors. Regardless of its size, each PORTS® provides real-time information to improve both the safety and efficiency of maritime commerce based on needs identified by local users.



Elevated tide station with wind sensors.
Credit: CO-OPS



Visibility sensor at Pinto Island on Mobile Bay is primarily used to determine fog on the waterway. Credit: CO-OPS

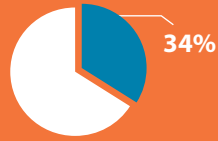
“I can’t imagine doing my job without PORTS®!”

- Captain Jon Kemmerley, Delaware Bay and River Pilot

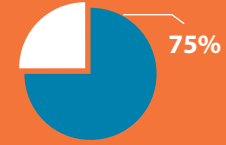
Where is PORTS®?

PORTS® currently serves about one-third of the 175 major seaports in the U.S.

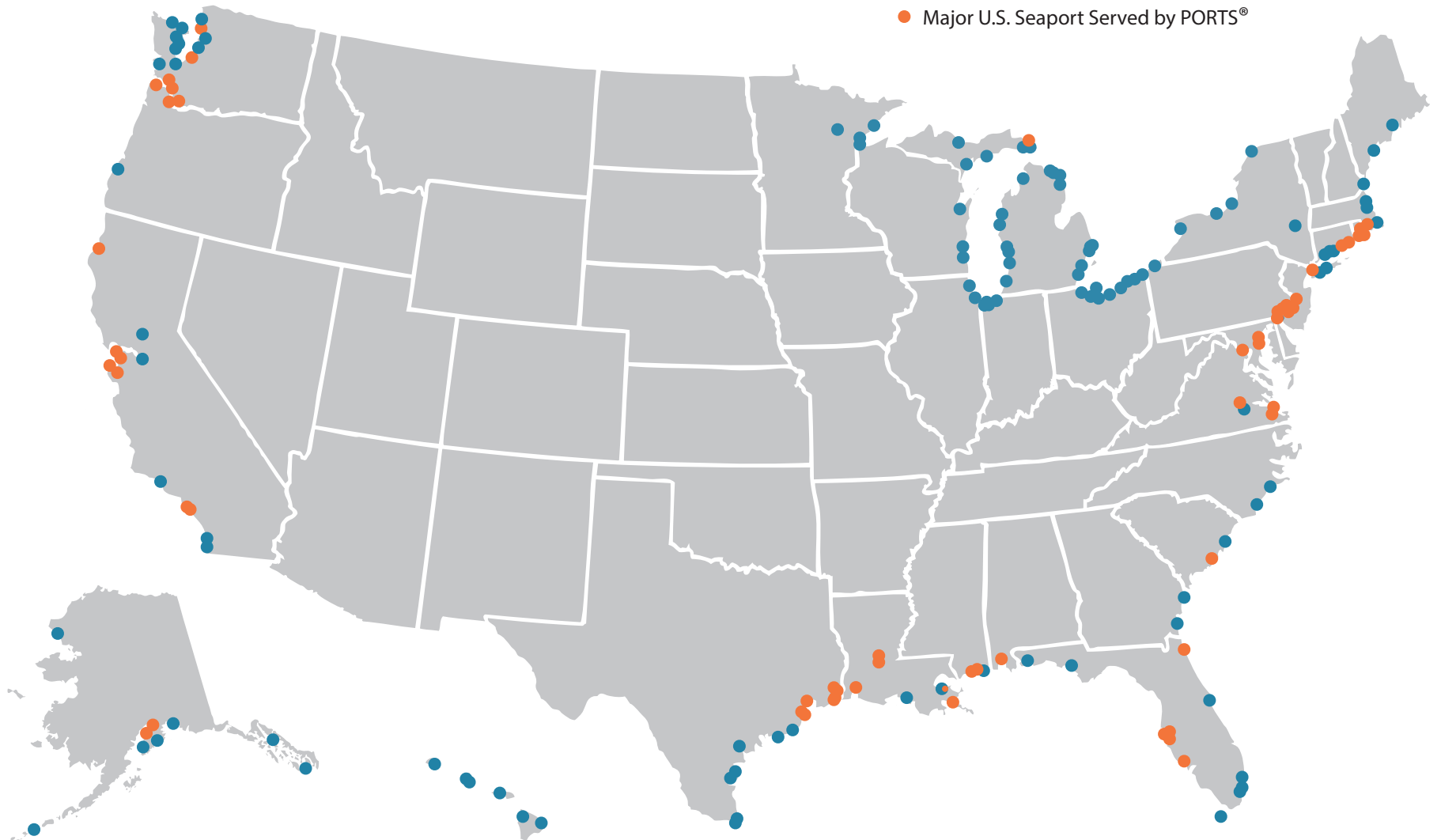
Percent of 175 major seaports currently served by PORTS®.



Percent of depth constrained total tonnage that passes through seaports currently served by PORTS®.



- Major U.S. Seaport
- Major U.S. Seaport Served by PORTS®



How does PORTS® help mariners?

Real-time data available anytime, anywhere

PORTS® real-time observations are updated at six-minute intervals and are available via the Internet and via toll-free phone calls. PORTS® information is also available on mobile devices, making it even more convenient for both commercial and recreational users to access real-time data anytime, anywhere.

A safer seaport is a more efficient seaport

Both mariners and seaport operators use PORTS® real-time information to maintain an adequate margin of safety for increasingly larger vessels in more congested seaports. **Safety and efficiency are inextricably linked and a safer seaport is a more efficient seaport.** Both mariners and seaport operators use PORTS® to maximize seaport throughput. Real-time observations help to optimize use of the available water column and to plan the most efficient transit scheduling and loading operations. One additional inch of draft may account for several millions of dollars in cargo value per transit.

"It's very, very valuable information. We run a lot of deep-draft vessels in and out of here. Having that accurate information also enables ships to put on just a little bit more cargo if we do have a good positive tide."

- James Lyon, Director and Chief Executive Officer at the Port of Mobile, on PORTS®

Other essential uses of PORTS® information

PORTS® provides benefits beyond the maritime community. When hurricanes strike or there is an oil spill, local emergency response personnel use wind and currents data from PORTS® to inform decision-making. Water level data from PORTS® also supports local decision-making, as in the case of the Domino Sugar Plant in Baltimore, where PORTS® is monitored to help decide when to shut the plant down due to risk of flooding. Similarly, New York City monitors PORTS® data to help decide when to shut down certain subway air intakes due to risk of flooding. PORTS® data has also been used to improve local habitat restoration efforts by providing tidal datums, frequency of inundation projections, and sea level trends.

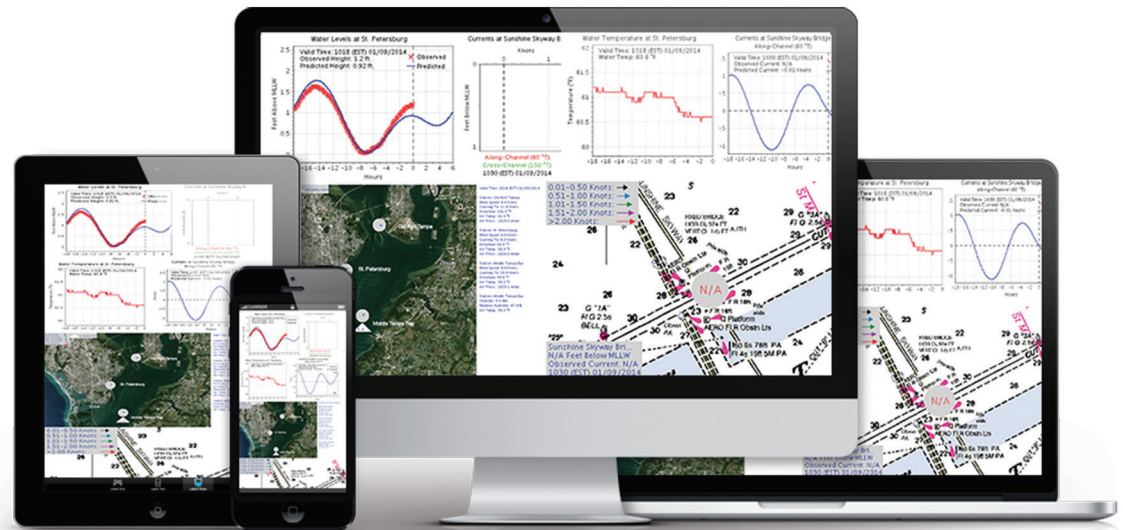
"We are convinced that, because of the PORTS® system, a potential grounding was avoided."

- Ted Lee,
NSA Agencies, Inc.



NOAA monitors the quality of PORTS® data 24 hours a day, seven days a week, 365 days a year. Credit: CO-OPS

<http://tidesandcurrents.noaa.gov/ports.html>



Improving safety through air gap technology

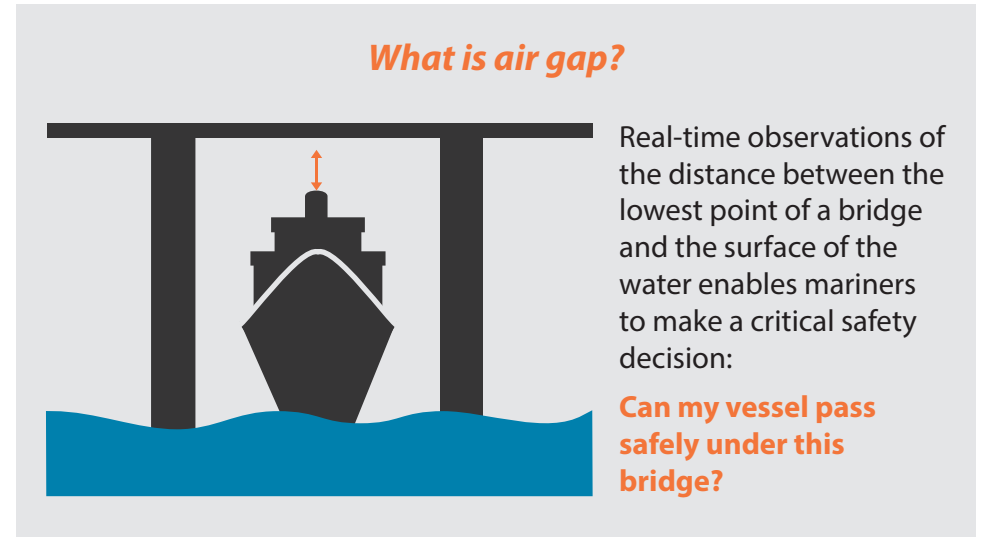
PORTS® can readily evolve to address emerging safety issues

As commercial vessels have grown in size, bridge clearance at our nation's seaports has become a more significant safety concern and can limit seaport operations. In response, NOAA researched, tested, and installed the first air gap sensor in 2004, on the Reedy Point Bridge in Maryland, to provide real-time information on bridge clearance. Since then, at the request of mariners and seaport operators, this technology has been successfully deployed at PORTS® serving nearly a dozen seaports.

The integration of air gap sensors into PORTS® demonstrates NOAA's ability to adapt to emerging issues, and evolve PORTS® to meet specific needs of users for improved safety. As part of its larger PORTS® program, NOAA is continually testing and evaluating new technologies, in order to make existing services more accurate and reliable, but also to provide new services that will improve the safety of vessel traffic and seaport operations. In support of the ports of Los Angeles and Long Beach, NOAA quickly installed an air gap sensor to allow the first of a new super class vessel to access the seaport.

"We use air gap data from the Bayonne Bridge and water level data from the Bergen Point water level gauge to bring vessels within two feet of the bridge and two feet from the bottom at the same time!"

- NY Metro Pilots



Air gap installation on Dames Point Bridge in Jacksonville, Florida.
Credit: Steve O'Malley, Ocean Tech Services, LLC

What if PORTS® served all major U.S. seaports?



Improved safety

Real-time observations from PORTS® can greatly increase safety. At seaports currently served by PORTS®, there has been a significant reduction in maritime accidents.

Increased efficiency

PORTS® enables mariners to safely use every inch of available channel depth, thereby increasing the amount of cargo moved per transit. One additional inch of draft may account for several millions of dollars in cargo value per transit.

Potential value of a fully-built PORTS® system

PORTS® currently serves about one-third of the 175 major U.S. seaports, and NOAA has identified and estimated the value of specific safety and efficiency benefits realized at several of these operational PORTS®. Building on these case studies of actual benefits, **NOAA has estimated as much as a \$300 million annual benefit from an expanded PORTS® system serving all 175 major U.S. seaports.**

Potential Value of an Expanded PORTS® System Serving 175 Major U.S. Seaports

Benefit Area	Potential Annual Value	Potential Ten-Year Net Present Value
Improved Safety		
Reduced Commercial Marine Transportation Accidents <i>Property Damages</i> <i>Injuries and Deaths</i>	\$7.7 \$19.1	\$64.4 \$156.3
Reduced Recreational Boating Accidents <i>Property Damages</i> <i>Injuries and Deaths</i>	<\$0.1 \$0.4	<\$0.1 \$3.1
Reduced Oil Spill Remediation	\$5.2	\$42.3
Increased Efficiency		
More Efficient Commercial Marine Transportation	\$265.5	\$2,172.3
Enhanced Fishing Productivity <i>Commercial Fishing</i> <i>Recreational Fishing</i>	\$1.8 \$0.3	\$15.1 \$2.5
Total	\$300.0	\$2,456.0

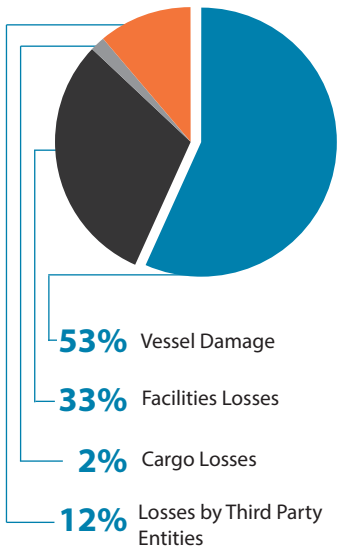
(Millions of 2010 dollars)

(Ten-Year Net Present Value is the sum of discounted benefit values for the next 10 years.)

Reduced Commercial Marine Transportation Accidents

Commercial Marine Transportation in the U.S.	Existing PORTS® Have Improved Commercial Marine Transportation Safety	Potential Value of an Expanded PORTS® System
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Distribution of Property Damage for all Accident Types



Safety is paramount to the maritime community. As the number and size of cargo vessels, cruise ships, and other commercial vessels visiting U.S. seaports increases, so does the risk of accidents. In locations where PORTS® real-time observations have been available to mariners and seaport operators, collisions and groundings have been reduced.

Accidents have been reduced at seaports currently served by PORTS®.



Improved Commercial Marine Transportation Safety

“The MAC uses PORTS® data to help prevent and/or recover from damage to our port complex. In 2011’s Hurricane Irene, the Coast Guard and MAC used PORTS® information to manage shipping traffic in the river above Philadelphia during the post storm period when tides were running far above normal, preventing the possibility of hitting bridges or causing damage to other critical infrastructure.”

- Captain Steve Roberts, Chairman, Mariners Advisory Committee for the Bay and River Delaware (MAC)

Potential value of reduced commercial marine transportation accidents from PORTS® serving 175 major U.S. seaports.





Benefit Area	Potential Annual Value (million)
Property Damages	\$7.7
Injuries and Deaths	\$19.1
Total	\$26.8
10 Year Net Present Value	\$220.7





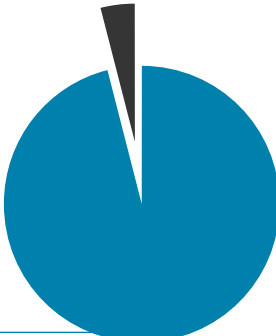

Cranes use PORTS® air gap information while passing under the Crescent City Bridge in New Orleans, Louisiana. Credit: Port of New Orleans

Improved Safety

Reduced Recreational Boating Accidents

Recreational Boating in the U.S.	PORTS® Can Be Used to Reduce Recreational Boating Accidents	Potential Value of an Expanded PORTS® System												
<p>32% Percent of adults in the United States that participate in recreational boating.</p> <p>12.2 million Approximate number of recreational boats in the United States in 2011. This is greater than the population of the state of Ohio.</p>  <p>54% Percent of recreational boaters in coastal states.</p>  <p>45% Percent of recreational boaters operating out of one of the 175 major seaports.</p> 	<p>Real-time observations and predictions provided by PORTS® can be used by recreational boaters to better understand environmental conditions prior to and during their trip. Specifically, PORTS® can be used to gain a good understanding of timing and magnitude of tides, currents, and winds, thereby reducing accidents caused by weather and groundings.</p> <p>There were 850 recreational boating accidents from 2005 to 2012 that were caused by weather and groundings. Conservative estimates show that PORTS® serving 175 major U.S. seaports could help to reduce the property damage, injuries, and deaths resulting from such accidents.</p> <table border="0"> <tr> <td data-bbox="567 824 682 941"></td> <td data-bbox="693 824 1018 998"> <p>Weather</p> <p>\$2.5 mil Property Damage</p> <p>120 Injuries</p> <p>32 Deaths</p> </td> <td data-bbox="1039 824 1155 941"></td> <td data-bbox="1165 824 1501 998"> <p>Groundings</p> <p>\$14 mil Property Damage</p> <p>336 Injuries</p> <p>17 Deaths</p> </td> </tr> </table> <p>Improved Recreational Boating Safety</p> <p>Both the recreational boating community and the recreational fishing community use PORTS® before leaving the dock to check weather, times of high and low water, and timing and velocity of currents. This helps mariners ensure a safe boating experience. Sailboat and yacht clubs use PORTS® to help ensure the safety of their water-based events.</p>		<p>Weather</p> <p>\$2.5 mil Property Damage</p> <p>120 Injuries</p> <p>32 Deaths</p>		<p>Groundings</p> <p>\$14 mil Property Damage</p> <p>336 Injuries</p> <p>17 Deaths</p>	<p>Potential value of reduced recreational boating accidents from PORTS® serving 175 major U.S. seaports.</p> <table border="1"> <thead> <tr> <th data-bbox="1596 581 1791 686">Benefit Area</th> <th data-bbox="1791 581 1980 686">Potential Annual Value</th> </tr> </thead> <tbody> <tr> <td data-bbox="1596 703 1791 808">Reduced Groundings</td> <td data-bbox="1791 703 1980 808">\$40,000</td> </tr> <tr> <td data-bbox="1596 824 1791 930">Reduced Weather Losses</td> <td data-bbox="1791 824 1980 930">\$339,000</td> </tr> <tr> <td data-bbox="1596 946 1791 995">Total</td> <td data-bbox="1791 946 1980 995">\$380,000</td> </tr> </tbody> </table> <p>10 Year Net Present Value \$3.1 million</p>  <p>A NOAA water level gauge is used to measure tides. Credit: CO-OPS</p>	Benefit Area	Potential Annual Value	Reduced Groundings	\$40,000	Reduced Weather Losses	\$339,000	Total	\$380,000
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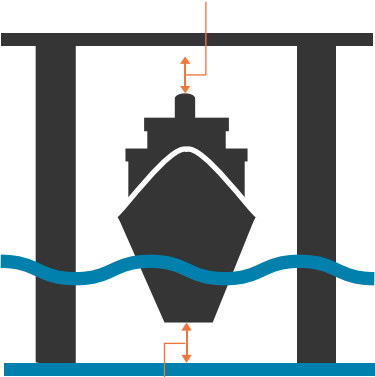




Reduced Oil Pollution Remediation

Pollution Spills in the U.S.	Existing PORTS® Reduced Accidents and Associated Oil Spills	Potential Value of an Expanded PORTS® System						
<p>All Pollution Spills</p>  <p>46% Percent of spill occurrences involving the release of any pollutant that are greater than one gallon.</p>	<p>In locations where PORTS® real-time observations have been available, oil releases due to collisions and groundings have been reduced by 21 percent. Oil spill remediation is a costly endeavor. Oil spill events can cause long disruptions in seaport and waterway operations and cause environmental damage.</p> <p>Oil spills have been reduced at seaports currently served by PORTS®.</p> <p> Oil Spills ↓ 21% Reduction in oil releases due to collisions and groundings at seaports currently served by PORTS®.</p>	<p>Potential value of reduced oil spill remediation at PORTS® serving 175 major U.S. seaports.</p> <table border="1"> <thead> <tr> <th data-bbox="1596 571 1780 678">Benefit Area</th> <th data-bbox="1787 571 1976 678">Potential Annual Value (million)</th> </tr> </thead> <tbody> <tr> <td data-bbox="1596 695 1780 802">Property Damages</td> <td data-bbox="1787 695 1976 802">\$5.2</td> </tr> <tr> <td data-bbox="1596 818 1780 868">Total</td> <td data-bbox="1787 818 1976 868">\$5.2</td> </tr> </tbody> </table>	Benefit Area	Potential Annual Value (million)	Property Damages	\$5.2	Total	\$5.2
Benefit Area	Potential Annual Value (million)							
Property Damages	\$5.2							
Total	\$5.2							
<p>Petroleum Spills</p>  <p>96% Percent of spill occurrences involving the release of more than one gallon of petroleum products.</p>	<div style="border: 1px solid orange; padding: 5px;"> <p>Spill Prevention</p> <p>"... in 1993, a 634-foot tanker, <i>Potomac Trader</i>, while maneuvering in the New York harbor using "predicted Tides Tables" ran aground in Hells Gate. Had the tanker had access to a real-time NOAA PORTS®, this near-disaster could have been averted. The vessel master would have obtained information about an abnormally large tidal range that caused the actual tide to be three feet lower than the predicted tide. Fortunately, the vessel was a double-hull tanker and none of its cargo of over seven million gallons of crude oil spilled."</p> <p style="text-align: right;">- United States Coast Guard</p> </div> <div style="border: 1px solid orange; padding: 5px; margin-top: 10px;"> <p>Spill Containment and Clean-up</p> <p>NOAA's Office of Response and Restoration (OR&R) uses real-time information on winds, currents, visibility, water levels, waves, and salinity when responding to spill events. This information is used for the containment and clean-up as well as to plan for restoration efforts. In other words, PORTS® information can help OR&R locate and remediate such spills. NOAA responds to about 104 of the largest spill events annually.</p> <p style="text-align: right;">- NOAA's Office of Response and Restoration</p> </div>	<p>10 Year Net Present Value \$42</p>  <p>Vessels waiting for the Mississippi River to reopen after a collision of two barges caused an oil spill. Credit: NOAA</p>						



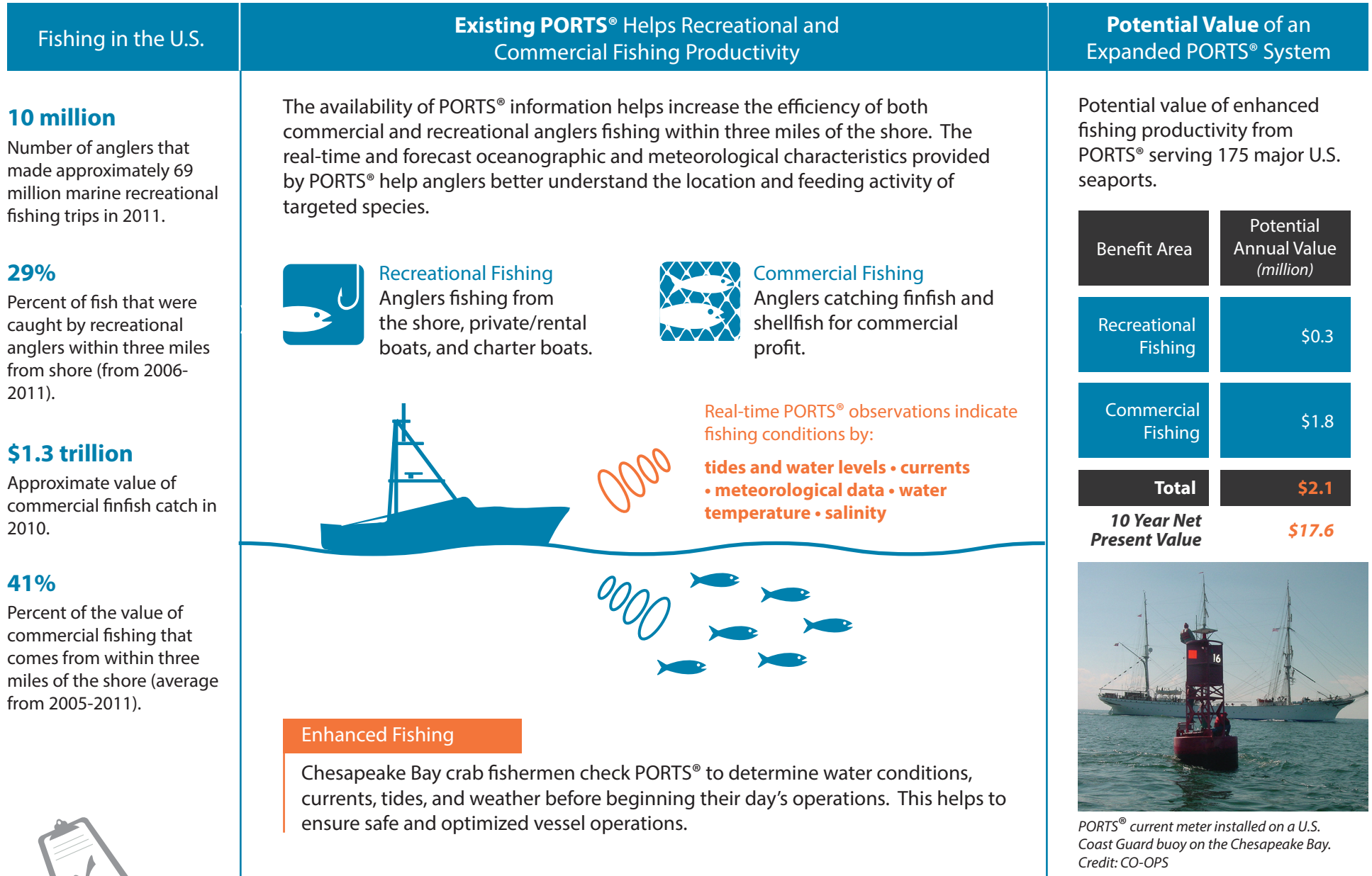
Increased Efficiency

More Efficient Commercial Marine Transportation

Clearance Parameters when Entering a Seaport	Existing PORTS® Increase the Efficiency of Marine Transportation	Potential Value of an Expanded PORTS® System												
<p>Air Gap Clearance</p> <p>The distance between the top of the ship and the lowest point of a bridge.</p>  <p>Under Keel Clearance</p> <p>The distance between the ship's keel and the bottom of the channel.</p> <p><i>Why is this important?</i></p> <p>Smaller safety margins for under keel clearance and air gap clearance.</p> <p style="text-align: center;">=</p> <p>Greater safety and efficiency of marine transportation.</p> 	<p>PORTS® real-time observations and forecasts allow mariners to optimize use of available water depth by adjusting cargo load and/or transit schedules. More cargo carried per transit means lower transportation cost per ton. Similarly, reducing vessel transit delays can lower transportation costs per ton.</p> <p> Reducing Under Keel Clearance Restrictions ~1,400 Estimated fewer number of vessel transits by reducing under keel clearance restrictions from four feet to two feet by using real-time information from the existing PORTS® System.</p> <p> Improved Transit Times \$1,800 Estimated average savings per vessel transit by using real-time information from the existing PORTS® System.</p> <p>Improved Efficiency</p> <p>"When we load, we call the voice system to see what the water level is doing. Every inch of draft is equal to 237 long tons (on the Lake Carrier <i>Edgar B. Spear</i>). When we get closer to the Soo (locks) we call again. We use it (PORTS® at Sault Ste. Marie, Michigan) a lot and it's been invaluable."</p> <p style="text-align: right;">- <i>Master of the Edgar B. Spear</i></p>	<p>Potential value of more efficient commercial marine transportation from PORTS® serving 175 major U.S. seaports.</p> <table border="1" data-bbox="1585 576 1974 1242"> <thead> <tr> <th>Benefit Area</th> <th>Potential Annual Value (million)</th> </tr> </thead> <tbody> <tr> <td>Added Shipping Costs</td> <td>\$117.4</td> </tr> <tr> <td>Extra Handling</td> <td>\$36.5</td> </tr> <tr> <td>Injury and Death</td> <td>\$6.4</td> </tr> <tr> <td>Reduced Delays in Transit</td> <td>\$105.2</td> </tr> <tr> <td>Total</td> <td>\$265.5</td> </tr> </tbody> </table> <p>10 Year Net Present Value \$2,172.3</p>  <p><i>A liquefied natural gas vessel entering Sabine, Texas. Credit: NOAA</i></p>	Benefit Area	Potential Annual Value (million)	Added Shipping Costs	\$117.4	Extra Handling	\$36.5	Injury and Death	\$6.4	Reduced Delays in Transit	\$105.2	Total	\$265.5
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Increased Efficiency

Enhanced Fishing Productivity



About the Data

This document communicates the results of an economic valuation conducted by NOAA to estimate the potential value of safety and efficiency benefits provided by a fully-built PORTS® system serving all of the nation's 175 major seaports. Economic valuation is not an exact science, and NOAA made many assumptions; however, in all cases NOAA made conservative assumptions. The table below conveys NOAA's overall confidence level for each of the five major benefit areas in this economic valuation. The single reference for this document is the economic valuation report, which can be downloaded here:

<http://tidesandcurrents.noaa.gov/pub.html>

Benefit Area	Confidence Level of Valuation
Improved Safety	
Reduced Commercial Marine Transportation Accidents	Medium-High
Reduced Recreational Boating Accidents	Medium-High
Reduced Oil Spill Remediation	Medium
Increased Efficiency	
More Efficient Commercial Marine Transportation	High
Enhanced Fishing Productivity	Low

Other Potential PORTS® Benefits not yet Quantified

The NOAA economic valuation report identified many potential benefit areas associated with PORTS®, however, NOAA quantified estimated values for only five major benefit areas due to limited data for analysis. Other potential benefit areas associated with PORTS® include:

- Recreation** - beach , diving, surfing and kite boarding conditions
- Recreational Boating** - reduced distress calls, sail conditions
- Weather** - improved storm surge forecasts
- Environmental Restoration** - improved habitat restoration planning
- Industry** - improved marine construction and facility operations
- Government** - improved public services
- Research** - additional data for scientific analysis

Data Sources

Data analyzed in the NOAA economic valuation report came from public, semi-public, and private sources.

- NOAA Coastal Services Center's Digital Coast, Economics: National Ocean Watch
- National Ocean Economics Program
- U.S. Army Corps of Engineers' National Navigation Operation Management Performance Evaluation & Assessment System (NNOMPEAS) and Channel Portfolio Tool (CPT)
- Department of Labor
- Bureau of Labor Statistics
- U.S. Coast Guard
- U.S. Department of Transportation
- Census Bureau's U.S.A. Trade Online

Reference

Wolfe, K. Eric and David MacFarland. 2013. An Assessment of the Value of the Physical Real-Time System to the U.S. Economy (PORTS®). National Oceanic and Atmospheric Administration. Available from <http://tidesandcurrents.noaa.gov/pub.html>.

Report design, layout, and graphical illustrations by the National Ocean Service's Communication and Education Division.

<http://tidesandcurrents.noaa.gov/ports.html>

