OceanGrafix
Accurate Charts. Confident Boating.

# The Creation of Accurate, Precise Charts

## Understanding U.S. Nautical Chart Updates and Their Distribution

No doubt, a photo of a grounded vessel is intriguing. *A sailboat trapped cockeyed in warm, teal waters. A proud yacht caught by undetected rocks.* To see a seemingly seaworthy vessel stuck at sea is perplexing to the mind's eye; one instinctively wants to know what happened, what went wrong. More specifically, one wants to know if the ship's captain could have avoided it or not.

This is not always an easy question to answer. A violent storm can ground a ship just as easily as a short-cut-seeking captain can. But in the absence of weather-related issues or blatant navigational negligence, groundings and other nautical mishaps can sometimes be attributed to one simple but significant fact: waterways are always changing.

### Why Waterways Change: Manmade and Natural Events

As the Greek philosopher Heraclitus put it in roughly 400 B.C., "You cannot step into the same river twice." This truly is the ever-changing and interconnected nature of water. Tides rise and fall. Shoals shift and adapt. These changes can be large or small, visible or invisible. Sometimes mankind initiates these water-based alterations; other times, Mother Nature does.

On March 11, 2011, an ocean's worth of water was affected by a natural event: a 9.0 earthquake off the coast of Japan. Clearly, the people of Japan are at the center of this tsunami story and its subsequent relief efforts; however, it is worth noting that the event was powerful enough to travel across the entire Pacific Ocean and ultimately alter ports and seaways along the West Coast of the United States.

According to a March 15, 2011, press release issued by the National Oceanic and Atmospheric Administration (NOAA), the tsunami that followed the earthquake near Japan "left the port at Crescent City, Calif., in shambles, with marine debris and wreckage above and below the waterline." That same release reported that waterways near Santa Cruz, Calif., were also significantly affected.

Just as underwater earthquakes affect coastlines, so, too, do hurricanes and other major storms. A NOAA-generated press release issued before the 2010 hurricane season warned

mariners that "port navigation after a hurricane is just as deadly as the hurricane itself if debris and changes in the ocean floor go undetected."

These spectacular natural events change waterways and make headlines. But manmade activities such as dredging and reconstruction efforts change waterways as well, though they garner much less media attention.

Take, for example, the St. Lucie Inlet, a small opening into the Indian River Lagoon, located between Hutchinson Island and Jupiter Island in western Florida. Martin County officials worked to cobble together the funding needed to keep the inlet open through emergency dredging, lest the inlet close. Fortunately, the officials succeeded and the inlet remains open after 470,000 cubic yards of sand were dredged since early March.

This is one of countless examples of little-known, local projects that can change a waterway and, ultimately, the safety of mariners. This is precisely the kind of change (as well as changes in buoy markings, channel depths, lights, bridge heights, new harbor approaches, wrecks, regulations, and obstructions) that is a part of NOAA-generated updates to mariners.

One might argue that the aforementioned waterway changes are negligible, and that updates containing information about them are, therefore, not worth a recreational boater's time. But as any mariner worth his or her salt knows, navigation demands precision. And precision involves knowledge of changes—both large and small.

## Hassler's Solution: The Creation of Accurate, Precise Charts

The importance of precision when navigating on the sea has been known for centuries. As such, the United States founded the Survey of the Coast in February of 1807. It was the first scientific agency in the federal government. The agency's mission was to provide nautical charts to the American maritime community for safe passage into American ports and along the nation's extensive coastline.

Ferdinand Hassler, a native of Switzerland, was the agency's first superintendent. Hassler's vision was one of extreme accuracy, precision, and scientific integrity. Hassler was skilled in mathematics, physics, metrology (the science of measurement), geodesy (precise land surveying that accounts for the shape of the Earth), topography, hydrography, and cartography. Additionally, Hassler trained and recruited engravers, artists, and printers to aid in the production of exceptional nautical charts.

Today, Hassler's precision-based Coast Survey is the oldest ancestor agency within NOAA. While Hassler endeavored to create the *first* accurate charts of the nation's coasts and waterways, it is NOAA that today *keeps* nautical charts accurate—a task with no end, given the breadth and volatility of so many U.S. waterways.

## How Chart Updates Are Discovered

True to Hassler's vision, NOAA and its partners—from the U.S. Coast Guard to the National Geospatial-Intelligence Agency (NGA) to the U.S. Power Squadrons to the Army Corps of Engineers—continue to go the extra mile when it comes to surveying U.S. waterways.

This is no easy task. There are nearly 3.5 million square nautical miles of water in the United States. Some 500,000 are deemed navigationally significant and are subsequently evaluated by the Office of Coast Survey. Additionally, hydrographic parties survey sections of the 43,000 square nautical miles deemed critical by the Coast Survey's evaluation each year. On behalf of the mariner, NOAA yearly publishes more than 11,000 critical chart updates.

There was a time when chart information was unearthed using lead lines: ropes with graduated depth-markings and a lead weight attached to the end. To obtain a sounding, a leadsman would heave the lead weight ahead of a vessel so it would have time to sink to the ocean bottom just before the leadsman was over that point.

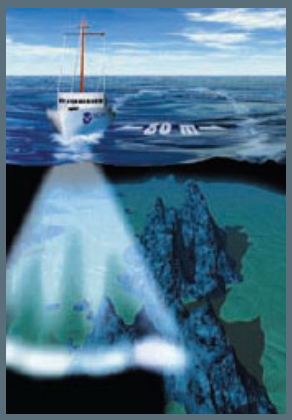
Needless to say, much has changed—especially since the advent of satellites and global positioning systems (GPS) in the 1970s. Through use of satellites, sonar, LIDAR (see sidebar Today's Hydrographic Tool Set), and other technologies, NOAA develops the highest quality, most accurate charts in the world.

# TODAY'S HYDROGRAPHIC TOOL SET

### MAPPING THE SEAFLOOR WITH MULTI-BEAM & SIDE SCAN SONAR

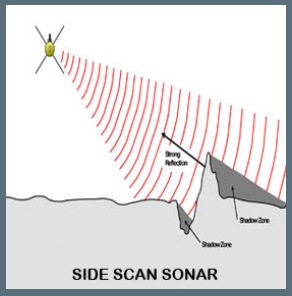
Survey crews use multi-beam sonar to measure the depth of the sea floor by analyzing the time it takes for sound waves to travel from a boat to the sea floor and back. Multi-beam sonar provides amazing detail of the sea floor, especially in rocky and rough terrains.

Similarly, survey crews use side scan sonar to find obstructions in shallow waters. Though side scan sonar cannot always measure depth, it can create useful images of the sea floor that could not otherwise have been obtained from above with multi-beam sonar.



### DETERMINING POSITION THROUGH GPS

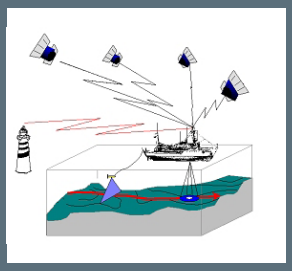
Charting and mapping the sea floor via vessel-mounted sonar devices demands accurate knowledge of the vessel's position. GPS provides exact information on a two-dimensional scale (the vessel's latitude and longitude) as well as information regarding the vessel's vertical position.



SIDE SCAN SONAR

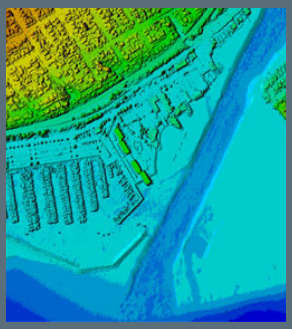
### MEASURING REAL-TIME TIDES AND CURRENTS

Many vessels that enter and exit U.S. ports do so with mere inches of clearance; this is why the measurement of tides and currents is so important. Long-term, continuously operating water-level stations, known as the National Water Level Observation Network, detect and record changes in water levels through air acoustic and pressure systems.



### SHORELINE MAPPING FROM THE AIR

Today, aerial photographs are useful in the development of charts and maps, as the photos themselves are linked to GPS coordinates. Additionally, aircraft-mounted Light Detection and Ranging (LIDAR) is used by NOAA's contractors to measure elevation or depth.
LIDAR analyzes pulses of laser light reflected off objects above or below sea level. Depending on water clarity, these systems are accurate 50 meters below the surface.



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## How Chart Updates Are Distributed to Mariners

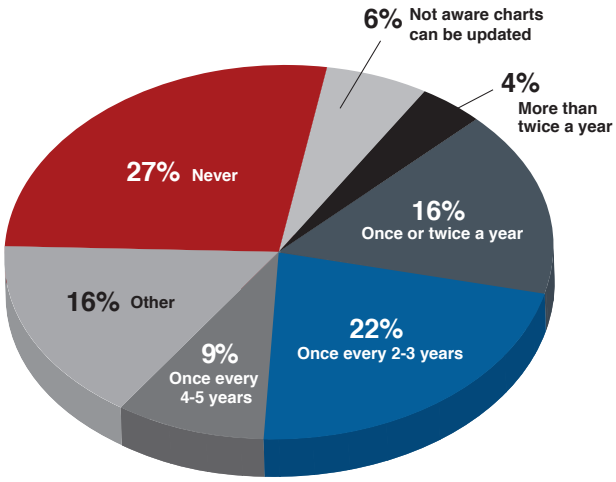
Each time a critical update is unearthed, mariners are made aware through several notices. The NGA issues a Notice to Mariners (NMs) every week. These notices contain important information for deep draft vessels that mariners can manually add to their paper charts to bring them up-to-date. In addition, the nine district U.S. Coast Guard offices issue a Local Notice to Mariners (LNMs) each week. LNMs provide timely marine safety information and chart corrections meant to keep boaters informed about recent changes—such as a relocated navigation aid, a missing light, even a new obstruction or wreck.

Both notices let boaters know it's time to update or replace their existing chart. Downloads are made available for users of electronic charts. Naturally, owners of paper charts can manually update them by hand or replace them.

NOAA also provides another option for mariners: print-on-demand charts. These charts are printed digitally at the time they are ordered; as such, they always contain the latest NMs, LNMs, and any new edition corrections applied by NOAA's professional nautical cartographers. These print-on-demand charts are available through OceanGrafix (and its agents), a chart publisher that works directly with NOAA's cartographers.

Unfortunately, the majority of recreational mariners do not follow best practices when it comes to chart updates. This fact, in part, led to the creation of the Alliance for Safe Navigation (ASN), a group of industry leaders, including and sponsored by NOAA, that all share a commitment to boating safety. A major goal of the alliance is to raise the boating community's understanding of and appreciation for using up-to-date navigational information.

This awareness couldn't come at a better time. In July 2011, the ASN surveyed 2,040 recreational boaters (see pie chart). The survey results suggest that while most boaters use aids such as GPS, electronic and/or paper charts, most do not routinely purchase current charts that reflect weekly updates issued by the U.S. Coast Guard. In fact, 27% of the respondents who use electronic charts said that they have never downloaded any updates to their charts.




In a NOAA press release dated March 2011, Capt. John Lowell, director of NOAA's Office of Coast Survey said, "Recreational boaters, unlike commercial mariners, are not required to carry nautical charts. But as more demands are put on our waterways, busy coasts mean more risk for accidents. By using charts that are current, people have a better chance of avoiding potential groundings and other accidents."

## Conclusion

Being on the water is a relatively safe activity. Still, if boaters do not have access to—and record—the latest chart updates, they increase their odds of mishaps. And boaters do get into trouble. According to a U.S. Coast Guard report of recreation boating accidents in 2010, groundings resulted in $3.3 million in damages and, more importantly, 11 deaths. Recreational boats, as opposed to commercial vessels, account for the vast majority of these groundings. Of the 313 groundings recorded in 2010, 199 of them (almost two-thirds) involved vessels 26 feet and under.

How can recreational boaters stay out of trouble? In part, by staying updated. This involves an understanding of U.S. chart updates and their distribution. As more recreational vessels compete for space on U.S. waterways, it becomes imperative that recreational boaters use accurate charts as a key component in navigating safely.

## RESOURCES TO STAY CURRENT

**OCEANGRAFIX**
Be notified via email about new NOAA chart editions. Boaters can update charts manually, or purchase new editions that contain the latest updates.

**ALLIANCE FOR SAFE NAVIGATION**
Anticipate waterway changes. Use these resources to ensure that your electronic or paper charts are up-to-date.