NOAA Navigation Services

Alaska and U.S. Arctic Regional Report

Office of Coast Survey, Center for Operational Oceanographic Products & Services, National Geodetic Survey

July 2018

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Contents

Alaska and U.S. Arctic Region

This report covers the capabilities, assets, and gaps of NOAA's navigation services in the state of Alaska and U.S. Arctic region as defined by the Arctic Research and Policy Act of 1984. This definition includes four large marine ecosystems (West Bering Sea, East Bering Sea, Chukchi Sea, and Beaufort Sea), the terrestrial portions of northern and western Alaska, and the region located above the Arctic Circle.

The U.S. Arctic Research and Policy Act of 1984 defines the U.S. Arctic as the area north of the Arctic Circle, Yukon River, and Aleutian Islands through the Bering Strait and Chukchi and Beaufort Seas.

Alaska is the largest U.S. state geographically, occupying the northwestern part of the North American continent. Canada borders Alaska to the east and south and the Pacific and Arctic oceans border the state on the west and north, respectively. The northernmost point of Alaska is Point Barrow (71°23'N., 156°28'W.); the westernmost point is Cape Wrangell (52°55'N., 172°26'E.) on Attu Island; and the southernmost point is Nitrof Point (51°13.0'N., 179°07.7'W.) on Amatignak Island. Cape Muzon (54°40'N., 132°41'W.) is on the historic parallel, which is the coastal boundary between Alaska and Canada's British Columbia. Cape Muzon is on the north side of Dixon Entrance and is 480 miles northwest of Cape Flattery, Washington. Between the two United States capes is the coastal area of British Columbia.[1] Alaska has a general ocean coastline of 5,770 nautical miles, a tidal shoreline of 29,462 miles, and a surface area of 665,384 square miles.

The Arctic Ocean coastline of Alaska runs from the Bering Strait to Demarcation Point, at the boundary between the United States and Canada, and the waters of Kotzebue Sound and Prudhoe Bay. Also included are

[1] Available from https://nauticalcharts.noaa.gov/publications/coast-pilot/index.html

the Diomede Islands, Barter Island and many of the off-lying coastal islands. The more important towns and communities in this area include Wales, Kotzebue, Wainwright and Utqiagvik.[2]

Comparison of Alaska and lower 48 "navigationally significant" area. Sixty-eight percent of U.S. navigationally significant waters are in Alaska.

The U.S. purchased Alaska from Russia in 1867 and the area became an organized territory in 1912. By Presidential proclamation of January 3, 1959, Alaska officially became the 49th state in the United States. Alaska is the most sparsely populated state with an estimated population of 739,795 in 2017. Alaska's largest city, Anchorage, has an estimated population of 294,356.[3] Principal resources within the state include oil, timber, fish, and coal.[4] Alaska has a diverse terrain of open spaces, mountains, forests with abundant wildlife, and many small vibrant communities. Outdoor activities such as skiing, mountain biking, and kayaking are incredibly popular with residents and visitors. Denali National Park is larger than the state of Massachusetts and is home to Denali (formerly called Mount McKinley), North America's highest peak.

Alaska and the U.S. Arctic, particularly the maritime transportation sector, face many challenges due to the harsh natural environment. From the wooded and rocky shorelines of Southeast Alaska to the treeless and exposed Arctic Slope, all regions regularly see extreme weather and experience strong, localized weather phenomena. Furthermore, there is a persistent lack of observational infrastructure such as tide, global positioning systems (GPS), or weather stations across much of the state and particularly along Western Alaska. This makes for large data gaps, which hinder effective decision-making. With the ever-increasing size of ships

[2] Available from https://nauticalcharts.noaa.gov/publications/coast-pilot/index.html
[3] Available from https://www.census.gov/quickfacts/AK
[4] Available from https://nauticalcharts.noaa.gov/publications/coast-pilot/index.html

and increase in vessel traffic, particularly of cruise ships, to Alaska and the Arctic, there is growing reliance on accurate charts, tidal data, and weather forecasts to support communities and commerce across the state. Because of this demand and due to the scope of the challenge there is a renewed call for the fostering of partnerships inside and outside of NOAA to address these challenges.

Principal ports in northern and southeastern Alaska

The principal commercial port in Alaska is the Port of Alaska in Anchorage, as it handles the majority of consumer goods for Alaskans across the state. Alaska also has two major oil terminals located in Valdez (Prince William Sound) and Nikiski (Cook Inlet). Those ports, in addition to the zinc and lead from Red Dog Mine and processed fish from Unalaska Island, represent the majority of goods (in tons) transported through Alaskan ports.

With a limited road system, however, all ports are critical for their respective communities. Other deep-draft commercial ports such as Cordova, Valdez, Whittier, Seward, Homer, Kenai, Kodiak, Sand Point, Nome, and Adak are critical to the economies of Western and Southcentral Alaska. Similarly, in Southeast Alaska, local ports of Ketchikan, Sitka, Wrangell, Skagway, Juneau, Metlakatla, Lutak Inlet, Skagway, Petersburg, and Port Chilkoot are critical for their respective communities.

National Ocean Service (NOS) in the U.S. Arctic

Observation gaps in the U.S. Arctic

Creating nautical charts goes beyond just conducting hydrographic surveys. This region currently lacks the other data and components needed to build a chart - a geospatial framework to determine the exact location of depth measurements, and water level data to correct depth measurements for the effects of weather and tides.

Creating charts and other tools that depict geographic relationships requires a system that describes the location of everything. This system is the National Spatial Reference System (NSRS), and it includes NOAA's Continuously Operating Reference Stations (CORS), a network of more than 1,800 stationary GPS receivers, which are critical for enabling precise positioning. NOAA is working with partners to fill gaps that exist in Arctic coverage, to improve both the precision of survey positions and the measurement of land movement.

Additionally, there is insufficient data to define tidal datums relative to land or predict tides and currents for many locations in the U.S. Arctic. In these, no tide and current predictions or products are available. For other locations that may have data, these tide and current predictions may be inaccurate as they were calculated using scant data and have not been updated since the early 1950s. Modern data and techniques are needed, as NOAA now uses at least 30 days of continuous data collection to calculate accurate predictions.

Ensign Christopher Wood, Ensign Samuel (Woodrow) McKay, and Ensign Dylan Kosten establish a horizontal control station on a U.S. Coast Guard day marker in the Arctic.

NOAA currently operates 10 long-term National Water Level Observation Network (NWLON) tide stations in the Arctic region of Alaska and operates 27 total NWLON stations statewide. NOAA's Center for Operational Products and Services (CO-OPS) has also identified 32 NWLON gaps throughout the state that are preventing NOAA from fulfilling its stated mission and goals. Furthermore, only 40% of Alaska's operational ports and harbors have access to real-time water level observations.

Gaps in these data do not just affect safe navigation, it is also critical information for maritime accidents, oil spills, and for modeling, flooding, and inundation associated with powerful weather systems. This geospatial framework is the critical infrastructure that needs to be in place to enable the effective use, exploration, and development of a region.

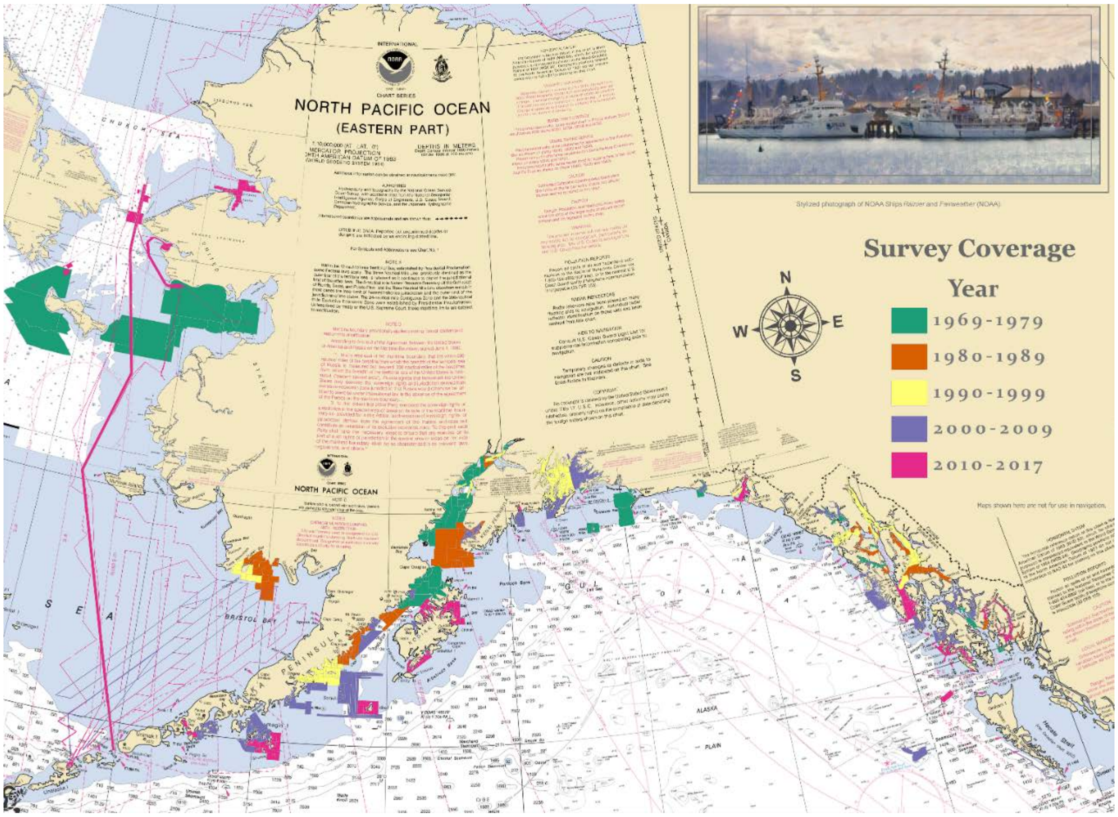
Charting the U.S. Arctic

As sea ice continues to melt earlier in the spring and form later in the fall, Arctic vessel traffic is on the rise. This is leading to new maritime concerns, especially with regard to potential conflicts in these emerging areas used by the offshore oil and gas industry, cruise liners, tugs and barges, and fishing vessels. Keeping all of this new ocean traffic moving smoothly and safely is a growing concern. Addressing this concern moving forward will be vital to the U.S. economy, environment, and national security.

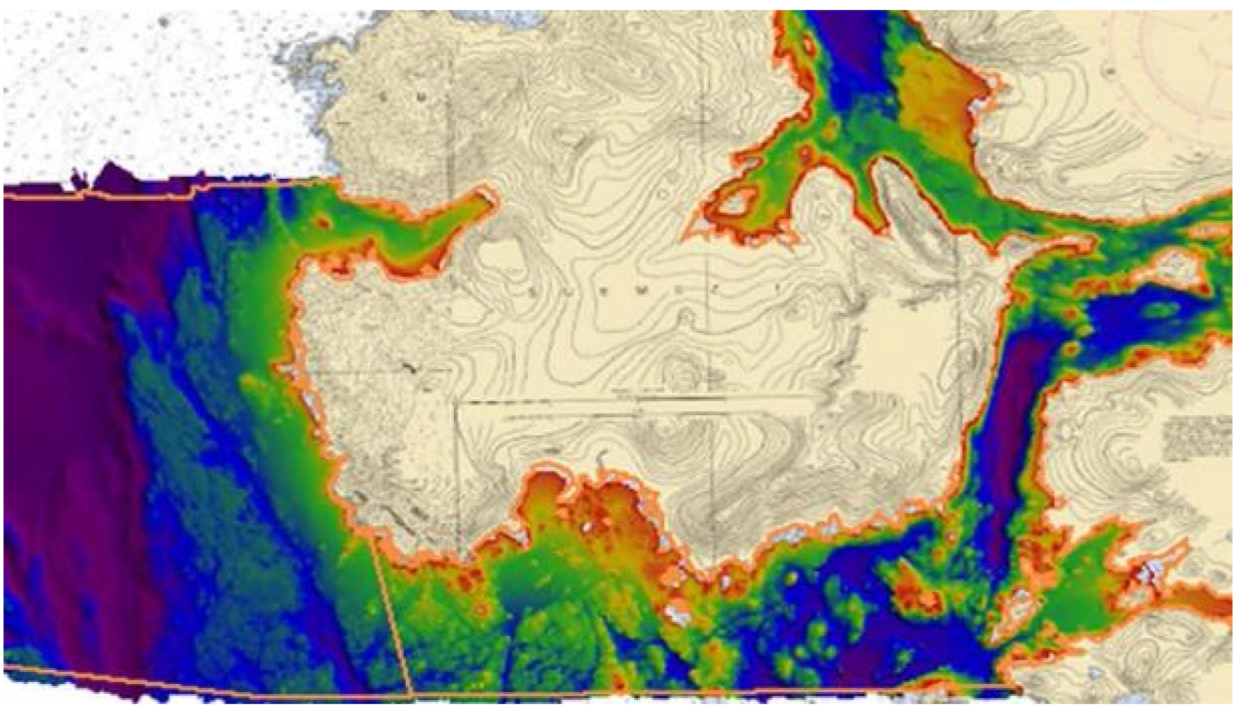
Commercial and recreational vessels depend on NOAA to provide nautical charts and the U.S. Coast Pilot. However, many of NOAA's charts and publications of the U.S. Arctic are inadequate. Until recently, most of this region was relatively inaccessible by ship due to sea ice. Data that exists in the region was acquired using early lead line technology[GD1] in the 1800s, even before the region was part of the United States. Much of the shoreline along Alaska's northern and western coasts, which are subject to drastic changes due to melting permafrost and strong winter storms, have not been mapped since 1960. As a result, mariners operating in the region lack confidence in the nautical charts and are increasingly requesting updated data.

Of the 426,000 square nautical miles in the U.S. Arctic Exclusive Economic Zone, NOAA considers 242,000 square nautical miles to be "navigationally significant." NOAA ships *Rainier* and *Fairweather* have been conducting hydrographic survey operations in large sections of the maritime routes along the west coast of Alaska since their commissioning in 1968. However, given the scale of the area, surveying this area with NOAA's hydrographic ships would take decades, so NOAA is exploring the use of partnerships and emerging technology to address the challenge. For example, the combined effort of NOAA ships, the U.S. Coast Guard (USCG) Cutter *Healy*, and private contractors has resulted in numerous hydrographic surveys that have significantly improved the charts. In many cases, this new data directly replaced historic data dating back to the lead-line surveys of early explorers like Capt. James Cook.[5]

[5] Available from http://www.noaa.gov/explainers/arctic-charting-mapping-new-frontier



Extent of NOAA ships *Rainier* and *Fairweather's* combined survey coverage from 1969 to 2017.



Hydrographic survey coverage overlaid on a nautical chart around West Prince of Wales Island, Alaska.

NOAA is evaluating other ways to update and improve U.S. Arctic charts, including the use of satellite imagery. While these images cannot measure exact depths, they may indicate seafloor change and identify shallow areas. NOAA is also leading the establishment of an international database for collecting crowd-sourced data for evaluation and potential nautical charting. Additionally, NOAA continues to rely on mariners to report observed hazards and chart discrepancies. To date, NOAA has charted more than 2,000 of these reports nationally, improving the safety of all maritime traffic.

NOAA issued the third version of the U.S. Arctic Nautical Charting Plan, August 10, 2016, after continued consultations with maritime interests and the public, as well as with other federal, state, and local governments. In accordance with the plan, NOAA completed several new hydrographic surveys and published three new charts (Chart 16145, Chart 16161 and Chart 16190). Moving forward, NOAA has recently released the National Charting Plan, November 1, 2017, which includes plans for rescheming of charts, including the Arctic, for the future.

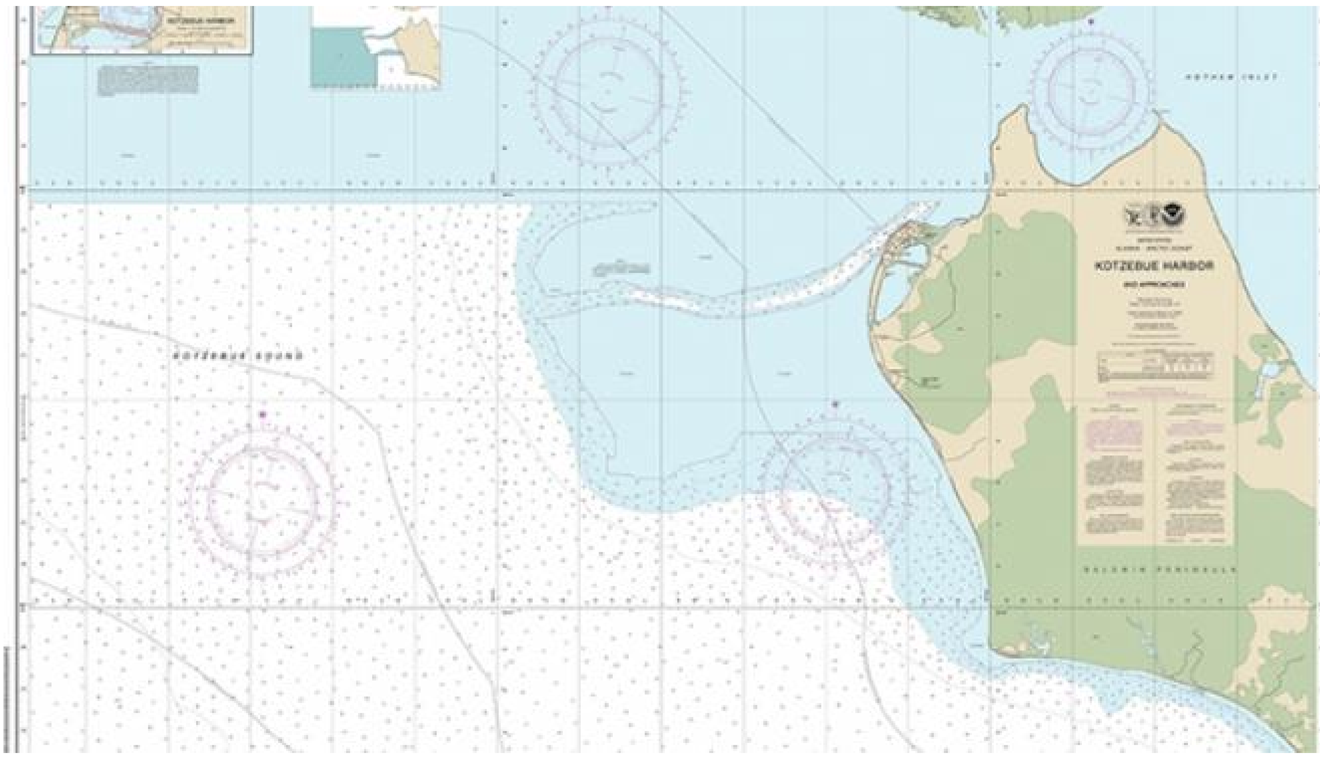


Chart 16161 of Kotzebue Harbor and surrounding waters was one of the first charts completed as part of the U.S. Arctic Charting Plan.

The Arctic is an International Effort

In October 2010, NOAA led a U.S. delegation that formally established a new Arctic Regional Hydrographic Commission with four other Arctic nations. The commission, which includes Canada, Denmark, Norway, and the Russian Federation, promotes cooperation in hydrographic surveying and nautical charting. The commission provides a forum for better collaboration to ensure safety of life at sea, protect the increasingly fragile Arctic ecosystem, and support the maritime economy. The commission's efforts focus on data sharing, new technologies for improved hydrography, resolving duplicative efforts such as overlapping electronic charts, and the development of an Arctic voyage planning guide to aid mariners who plan to transit Arctic waters.

FACT: 4.1 Percent of the U.S. Arctic has been surveyed with modern methods and technology

Arctic boundary as defined by the Arctic Research and Policy Act.

UN Convention on Law of the Sea and the U.S. UNCLOS Bathymetry Project

University of New Hampshire, Center for Coastal Ocean Mapping and UNH-NOAA Joint Hydrographic Center (CCOM/JHC) collected multibeam bathymetry and acoustic backscatter data for areas in the Arctic Ocean and the Gulf of Alaska that will support an extended continental shelf under Article 76 of the United Nations Convention of the Law of the Sea (UNCLOS). The extensive seafloor mapping project grew out of an exhaustive desktop study of the U.S. bathymetry data holdings and identified several regions where new bathymetric surveys are needed. The report emphasized that multibeam echo sounder data are needed to rigorously define (1) the foot of the slope, a parameter of both UNCLOS formula lines, and (2) the 2500-m isobath, a parameter of a UNCLOS cutoff line. Both of these features, the former a geomorphic feature and the latter a geodetic position, can be used to define an extended continental shelf claim.

For more information about the national effort to establish the full extent of the continental shelf of the United States, visit the U.S. Extended Continental Shelf Project website.

Law of the Sea Survey Sites in Alaska from CCOM/JHC include:

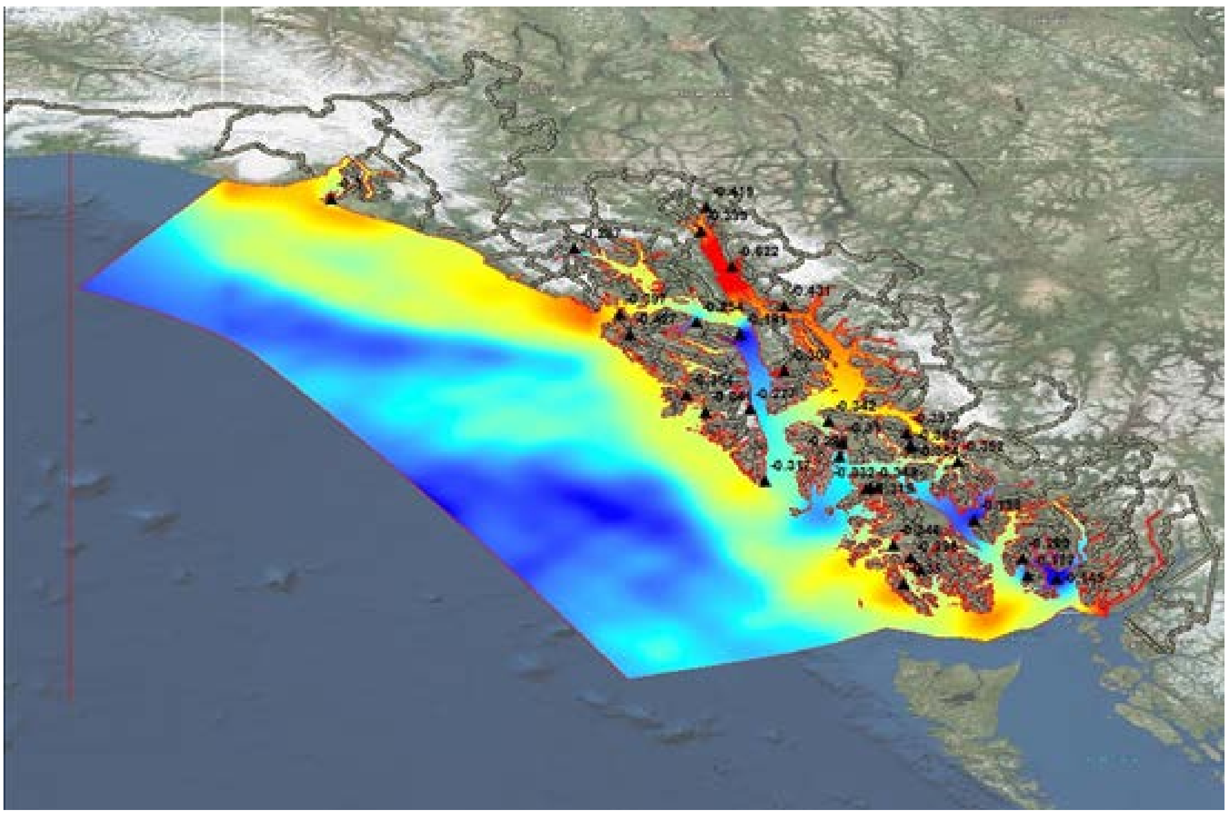
- Arctic Ocean
- Bering Sea - Beringian Margin
- Bering Sea - Bowers Ridge
- Gulf of Alaska Margin

NGS, CO-OPS, and OCS "Tri-Office" Activities in Alaska

VDatum and grid updates for Alaska

The VDatum tool transforms geospatial data among a variety of tidal, orthometric, and ellipsoidal vertical datums. NOAA is updating model grids around the country to lower the uncertainty within the models for broader usage.

In line with those efforts, the team is developing an exploratory model for Southeast Alaska utilizing the xGEOID17b and next-generation Topography of the Sea Surface to relate geodetic to tidal datums. Anticipated release for the Southeast Alaska model is the summer of 2018.

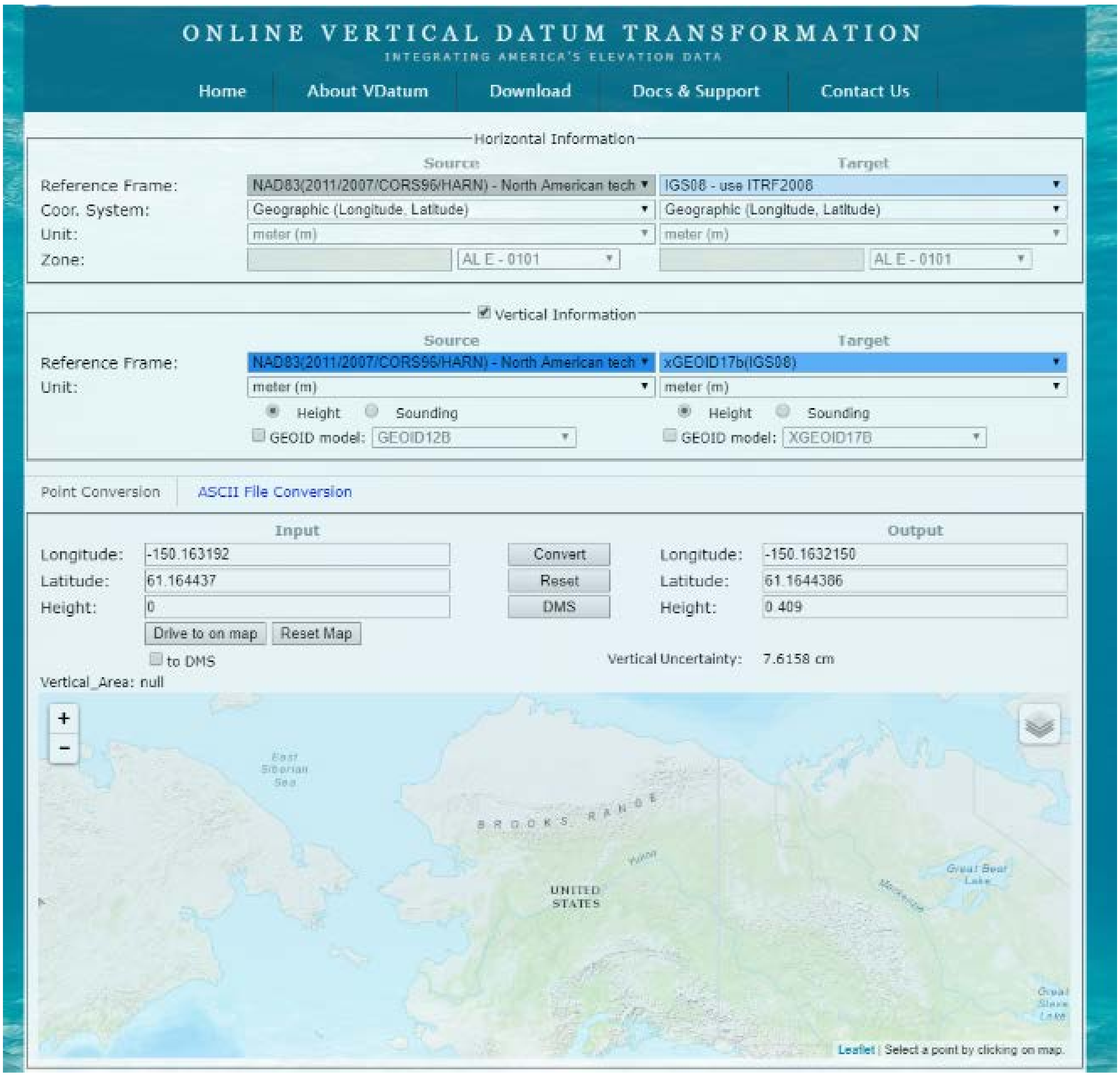


Geographic extent of Exploratory VDatum model for southeast Alaska.

In an effort to make the VDatum tool more readily accessible to users, without the need to download software and install it on a computer, the VDatum team released an initial online version. The online version provides a similar user interface and transformation functionality as the standalone application, but has reduced input/output format capabilities since it is web-based. The team plans to release the updated version (3.8) in winter of 2018 with the following updates and improvements:

- Enhanced GeoTIFF input/output format support

- LAS 1.4 and LAZ input/output format support
- LAS Classification support
- HTDP Functionality
- Regional model grid versioning and reporting
- xGEOID16b/xGEOID17b support
- Bug fixes: (HTDP enhancements,3D shapefile fix, IGLD85 grid point fix, exit code implementation)



User interface of the online version of VDatum.

Office of Coast Survey

Personnel and products in Alaska and the U.S. Arctic

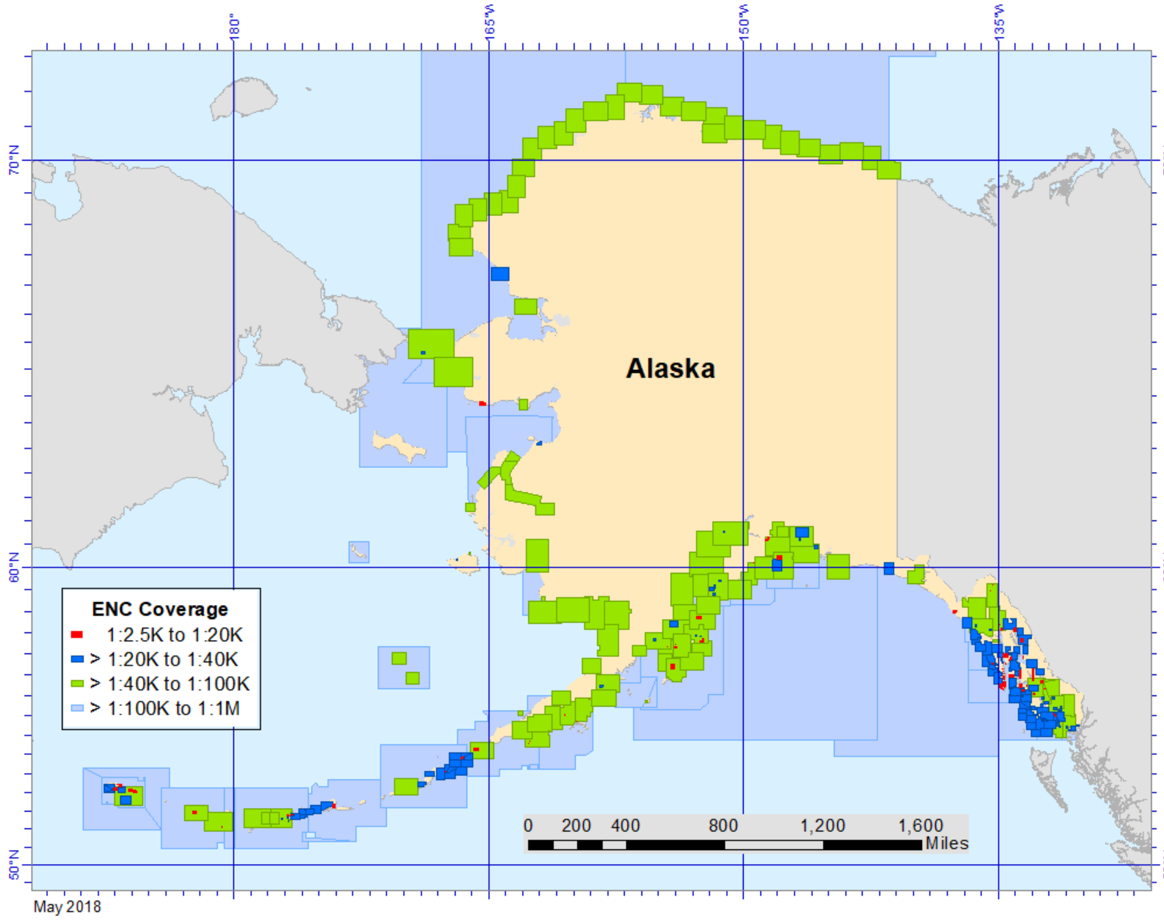
Coast Survey regional navigation managers

Coast Survey's navigation managers, stationed strategically in port areas along U.S. coasts and Great Lakes, work directly with the U.S. Coast Guard, pilots, mariners, port authorities, and recreational boaters. They help identify navigational challenges facing the marine transportation system, and provide the resources and services that promote safe and efficient navigation. Coast Survey has one Alaska navigation manager position in this region.

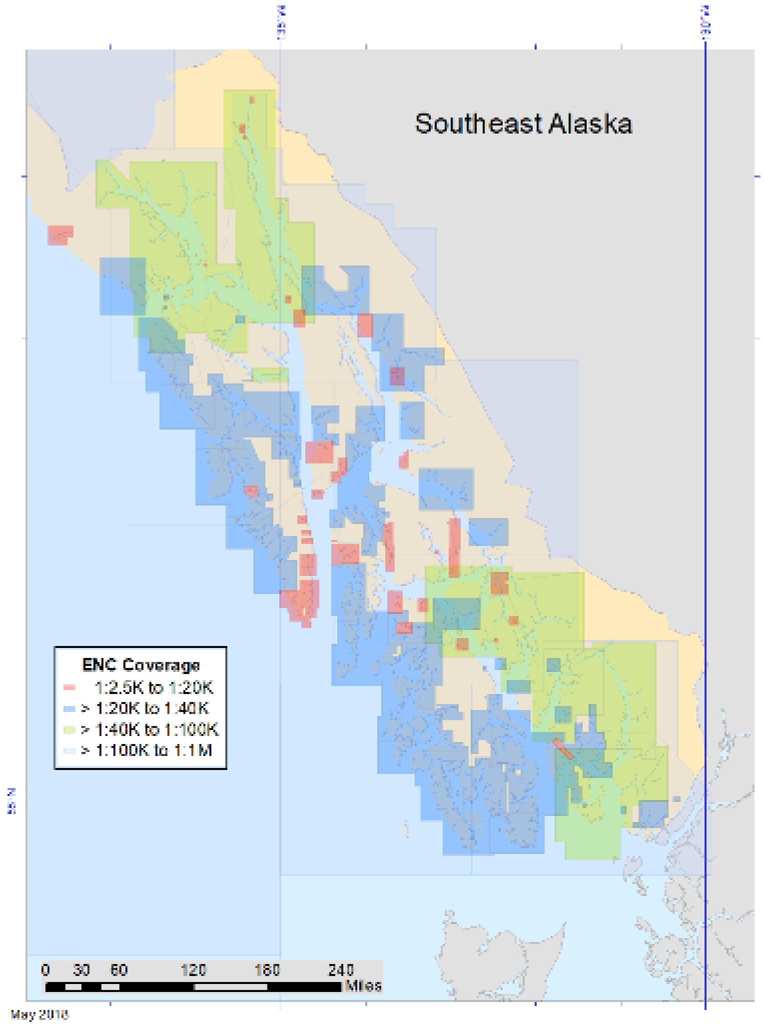
Region	Navigation manager (base of operations)	Contact information
Alaska Navigation Manager	Bart Buesseler Anchorage, Alaska	Phone: 907.271.3327 Bart.O.Buesseler@noaa.gov

Chart coverage

Coast Survey is transitioning nautical chart production from two databases into a single database—the Nautical Information System (NIS). The two original databases were built separately, one for raster charts (NOAA paper nautical charts and NOAA raster navigational charts (NOAA RNC®)), and one for vector charts (NOAA electronic navigational charts (NOAA ENC®)). The transition allows faster, more efficient updates of all NOAA chart products. As cartographers receive new source information, they update the affected ENC and RNC products. They apply critical corrections to both raster and vector products quickly and publish the updates weekly. They apply non-critical (or routine) source updates to ENCs first and on raster products later. This allows Coast Survey to keep both ENC and RNC products in agreement with regard to critical updates required for safe navigation.

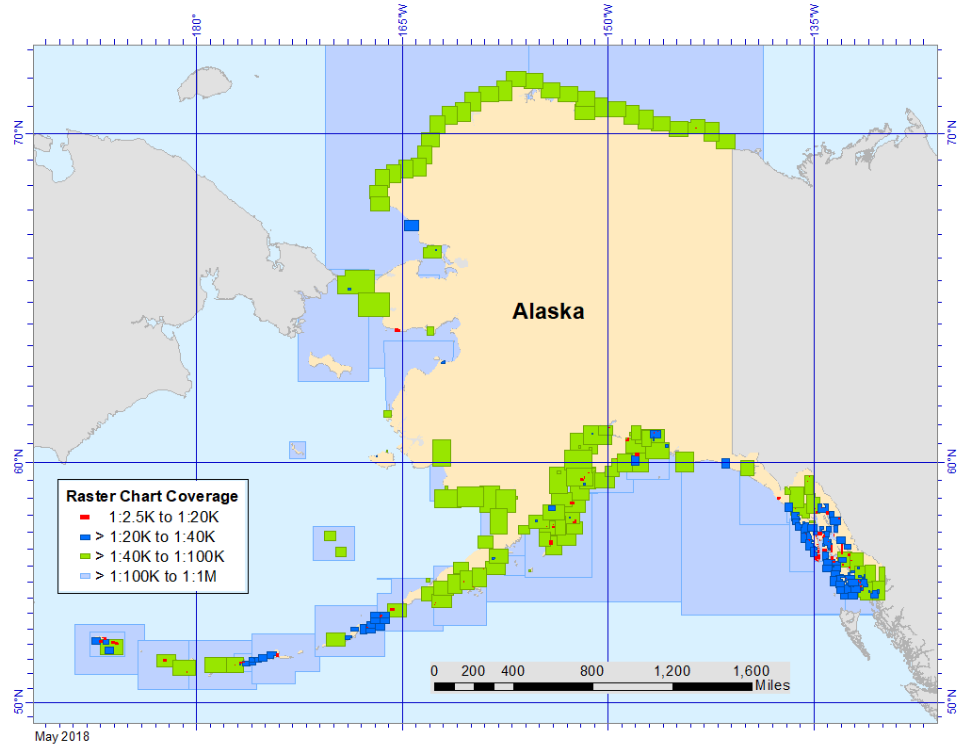


Electronic Navigational Chart coverage - an overview of coverage for Alaska.

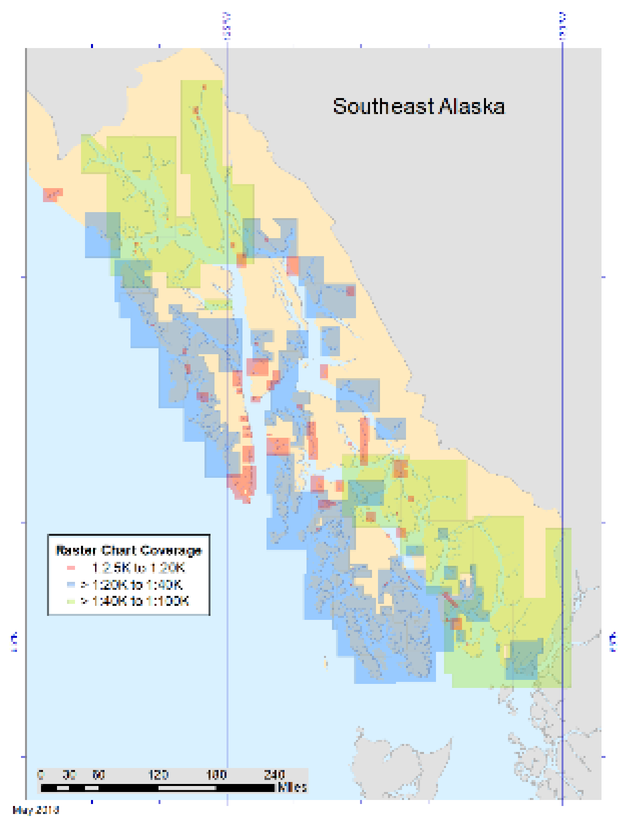


ENC coverage for Southeast Alaska.

In the past, Coast Survey did not release large applications of routine source data on vector products until the publication of a new edition. Coast Survey now releases routine source applications as part of weekly ENC and vector product updates, meaning that mariners will see shoreline and hydrographic updates more quickly, without having to wait years for a new edition. Above is the ENC coverage for Alaska and for Southeast Alaska. Graphics of the raster charts overview and for Southeast Alaska are below.



Raster navigational chart coverage - an overview of coverage for Alaska.

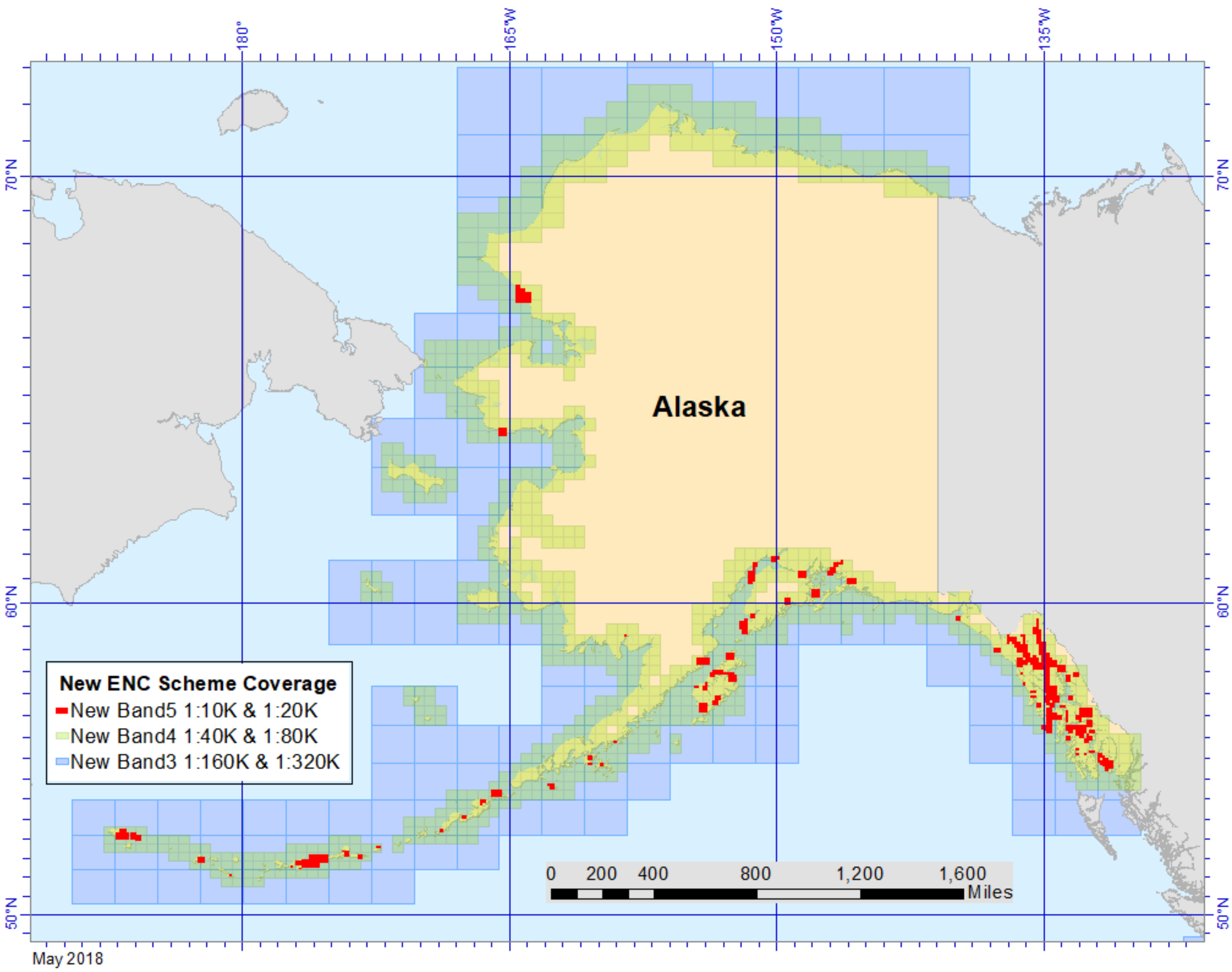


Alaska Raster chart coverage for Southeast Alaska.

New ENC scheme coverage for the U.S.

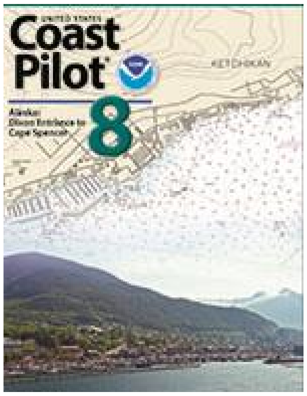
As outlined in the National Charting Plan, Coast Survey's Marine Chart Division (MCD) is creating a new ENC scheme that provides an orderly layout for all NOAA ENCs nationwide. ENC limits will be based on a tiled grid following lines of longitude and latitude, rather than the legacy raster chart boundaries. MCD is standardizing ENCs to only 11 scales, a great reduction from the 131 current ENC scales. MCD will then grid sizes and depth contours to whole meter values. For example, the 5-meter contour will be standard for all ENCs up to 1:80,000, the 10-meter contour for all ENCs up to 1:160,000, and so on. This new scheme will provide a seamless user experience and increase usability of the product.

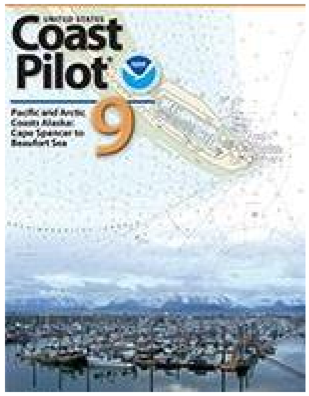
The image below shows a proposed ENC scheme for Alaska.



Proposal for new ENC scheme coverage in Alaska.

United States Coast Pilot®





The United States Coast Pilot® provides information important to navigators of coastal and intracoastal waters and contains supplemental information that is difficult to portray on a nautical chart. Topics in the Coast Pilot include channel descriptions, anchorages, bridge and cable clearances, currents, tide and water levels, prominent features, pilotage, towage, weather, ice conditions, wharf descriptions, dangers, routes, traffic separation schemes, and federal regulations applicable to navigation.

Coast Survey provides two Coast Pilot volumes that cover Alaska:

Coast Pilot 8 (39th Edition) : Alaska: Dixon Entrance to Cape Spencer

Coast Pilot 9 (35th Edition): Alaska: Cape Spencer to Beaufort Sea

Weekly updates to these editions are available from the Coast Pilot webpage and are also published in the National Geospatial-Intelligence Agency (NGA) U.S. Notice to Mariners.

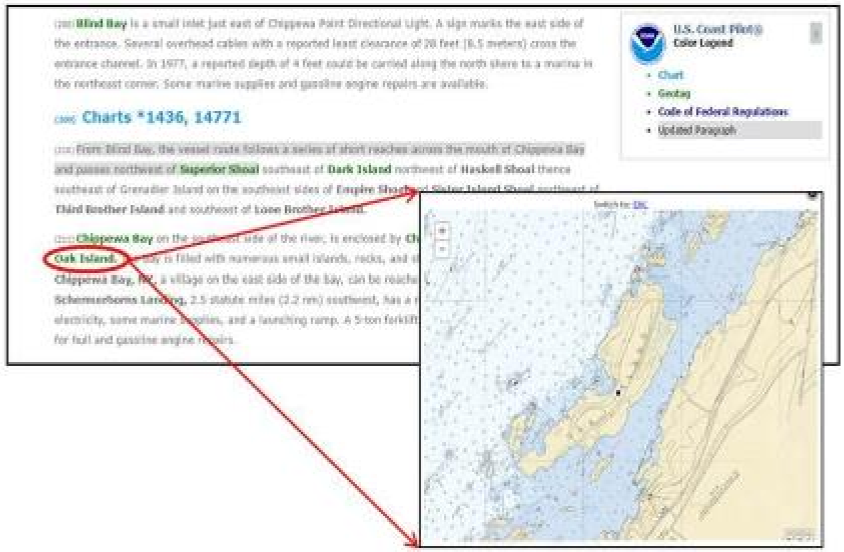
All nine volumes of the Coast Pilot are updated and available for download weekly, and usable on mobile devices such as smart phones and tablets.

The digital version of *Coast Pilot* provides geotagged reference points that assist mariners with landmark positions and displays the associated nautical chart inset (A geotag is a geographical location information assigned to a type of media.) In the online versions of *Coast Pilot*, certain place names and objects, (highlighted in green) are now viewable on a nautical chart and linked to entries in the official U.S. Geographic Names database.

Other features include:

- images that become larger when clicked
- an interactive table of contents for each book
- links to raster navigational chart, highlighted in light blue
- weekly changes, highlighted in gray, which are retained until the next annual version is published

Alaska waterways safety groups who value and use the Coast Pilot are soliciting feedback and are interested in providing updates. Coast Survey accepts update requests via the general email address coast.pilot@noaa.gov or NOAA's Nautical Inquiry & Comment System.



Clicking on the geotagged place name in the online xml versions of Coast Pilot, launches a chartlet of the area.

Recent activities

Alaska stakeholder engagement

One of the primary ways Coast Survey engages stakeholders and partners is through interactions with the navigation manager at regional meetings and events across the state. By traveling throughout the state, the navigation manager compiles stakeholder feedback specific to each region. Coast Survey wishes to interact with all stakeholders including the USCG, U.S. Army Corps of Engineers (USACE), pilots associations, recreational boaters, commercial fishermen, state and local governments, academia and others.

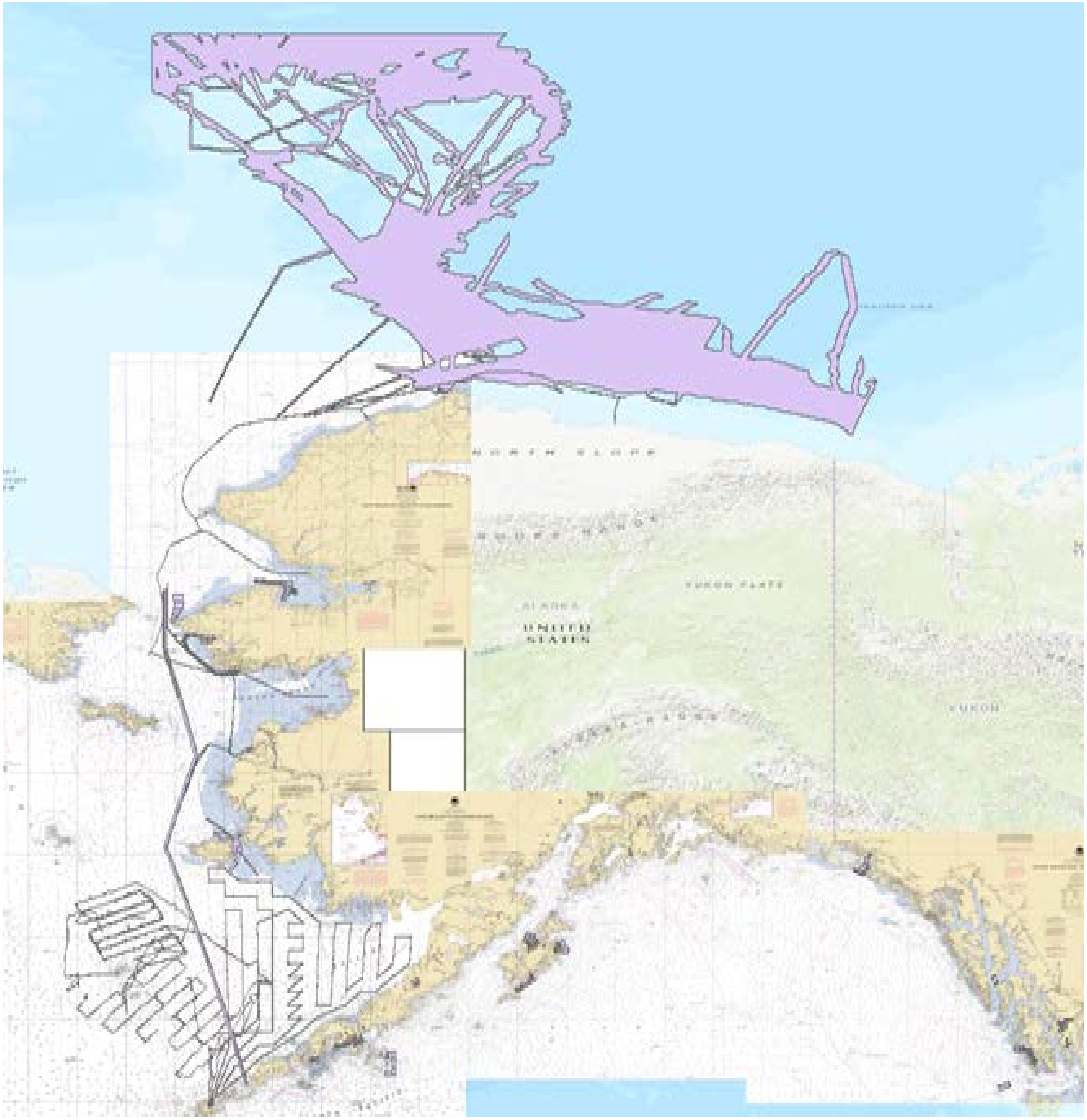
In August 2017, LT Bart Buesseler started in the role of Alaskan navigation manager after a gap in representation. He is building relationships and partnerships as described below:

- Upon arrival to Anchorage, Lt. Buesseler worked with a previous navigation manager, Lt. Cmdr. Matthew Forney, to meet with partners in Anchorage including USCG, USACE, Alaskan Ocean Observing System (AOOS), Bearing Watch, Fugro, National Weather Service (NWS), and the Port of Alaska in Anchorage.
- Participated in multiple board meetings of the Cook Inlet Regional Citizens' Advisory Council (CIRCAC) and Prince William Sound Regional Citizens' Advisory Council (PWSRCAC) to listen to feedback from a wide range of stakeholders for their respective areas of responsibility.
- Attended the fall, winter, and spring meetings of the Alaskan Board of Marine Pilots. Provided a presentation on the National Charting Plan during the spring 2018 meeting and solicited feedback.
- Attended the annual Alaskan Association of Harbormasters and Port Administrators (AAHPA) meeting in Petersburg, Alaska, to learn more about how local ports and harbors utilize NOAA's navigation services.
- Presented at the OCEANS'17 conference held in Anchorage, showing how Coast Survey data is available to the scientific community to support research in the state.

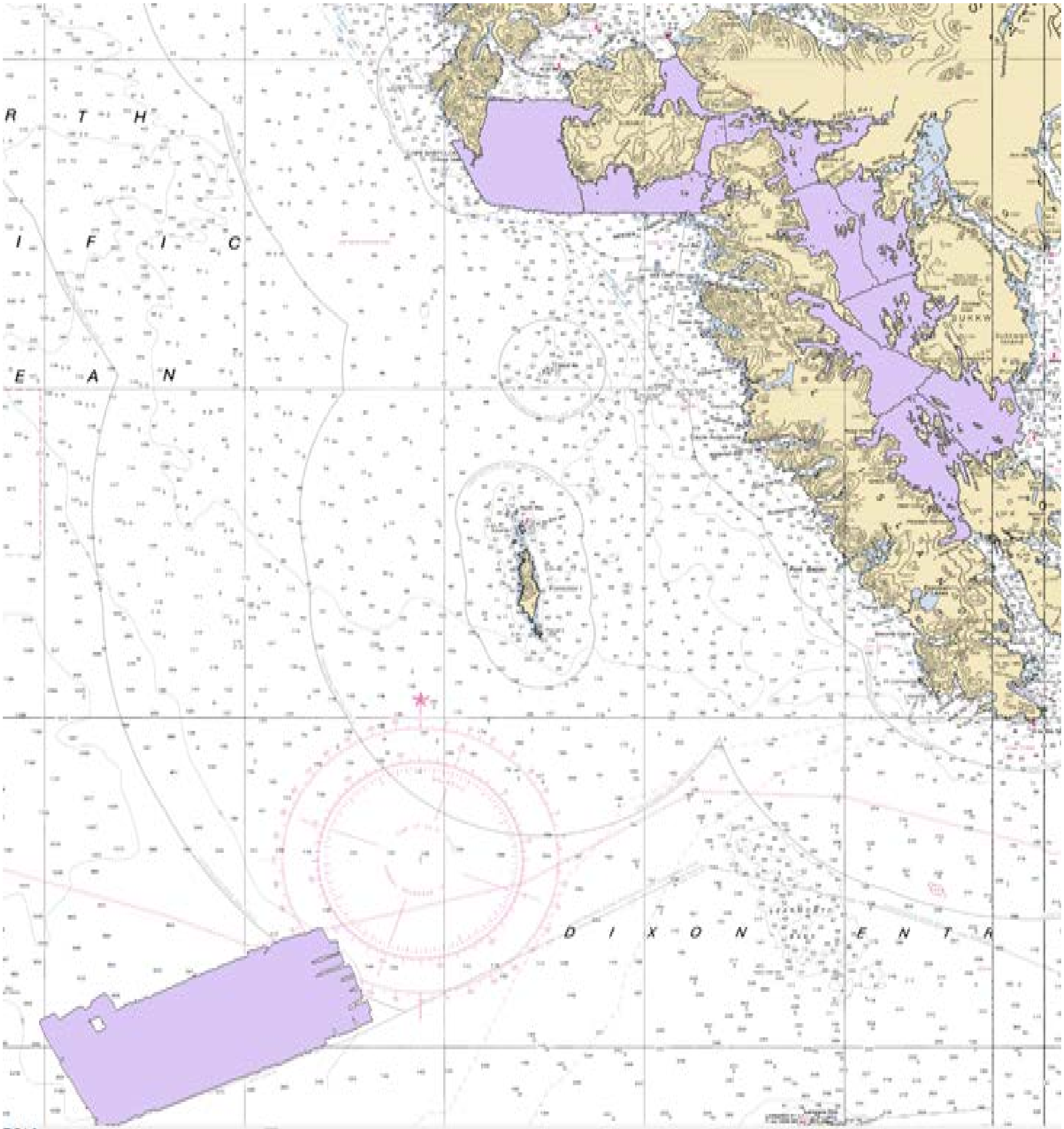
- Active participant with regional safety committees, including Cook Inlet Harbor Safety Committee (CIHSC), Arctic Waterways Safety Committee (AWSC), and the newly formed Aleutian Islands Waterways Safety Committee (AIWSC).
- Attended the Alaska Eskimo Whaling Commission (AEWC) Mini-Convention in Utqiagvik, to build relationships with native communities and learn from them regarding their traditional knowledge and navigation service needs.
- Presented "Charting 101" in conjunction with Alaska Vocational Technical Center (AVTEC) to a local tour boat captains operating out of Seward. This included general background and information on the National Charting Plan and the hydrographic surveying process.
- Participated in multiple outreach events with the public such as the Alaska State Fair, Alaska Federation of Natives (AFN), and the Alaska Boat Show in cooperation with other NOAA line offices.
- Participated and presented at the 2018 Alaskan Water Level Meeting, a local stakeholder meeting for users of water level data in the state.

Survey operations in Alaska and the U.S. Arctic since 2014

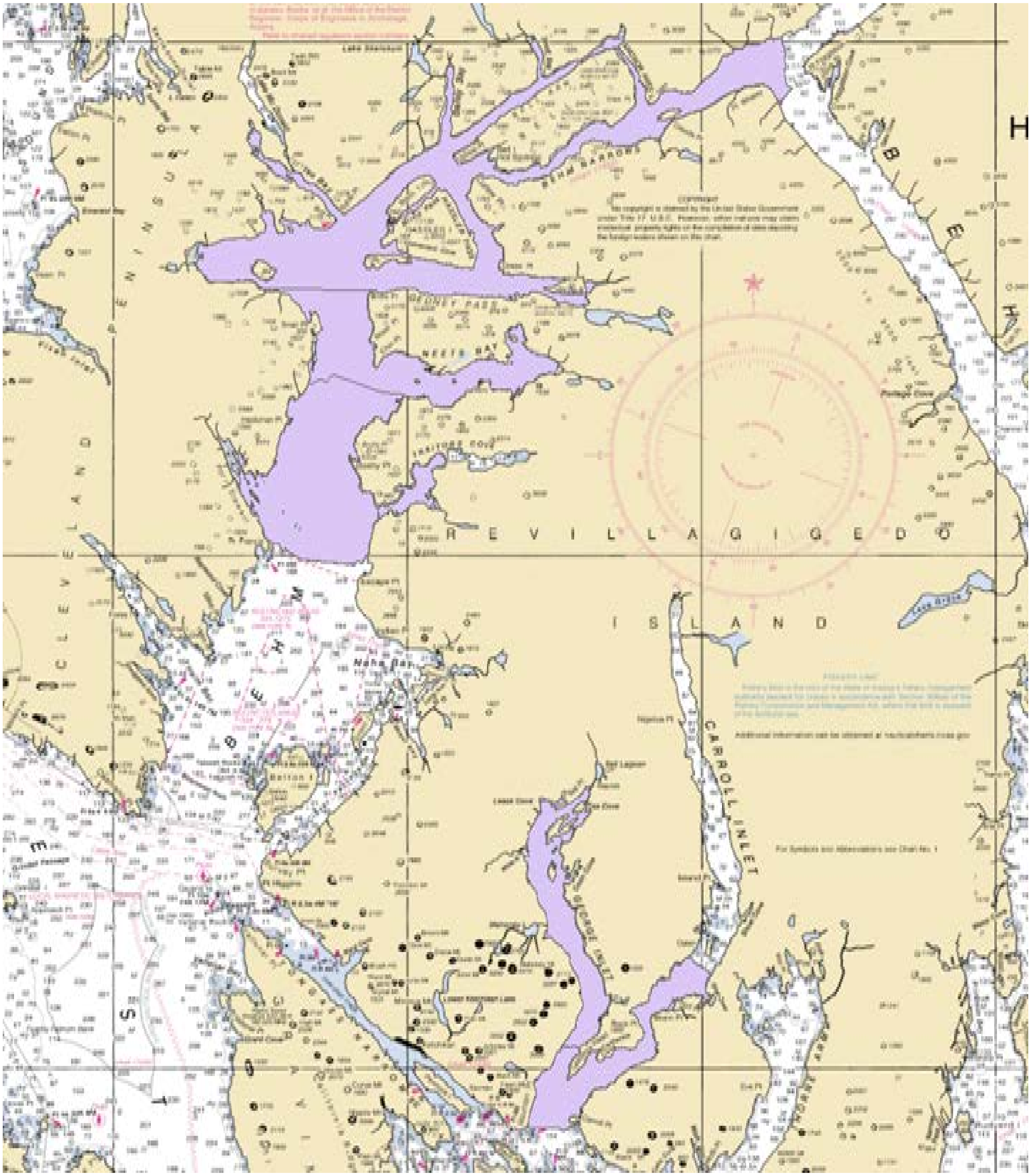
From 2014 to 2017, NOAA completed 105 hydrographic surveys in Alaska, including 47 by NOAA Ship *Fairweather*, 37 by NOAA Ship *Rainier*, and 18 by contractor field units. NOAA also accepted delivery of three outside source surveys from partners.



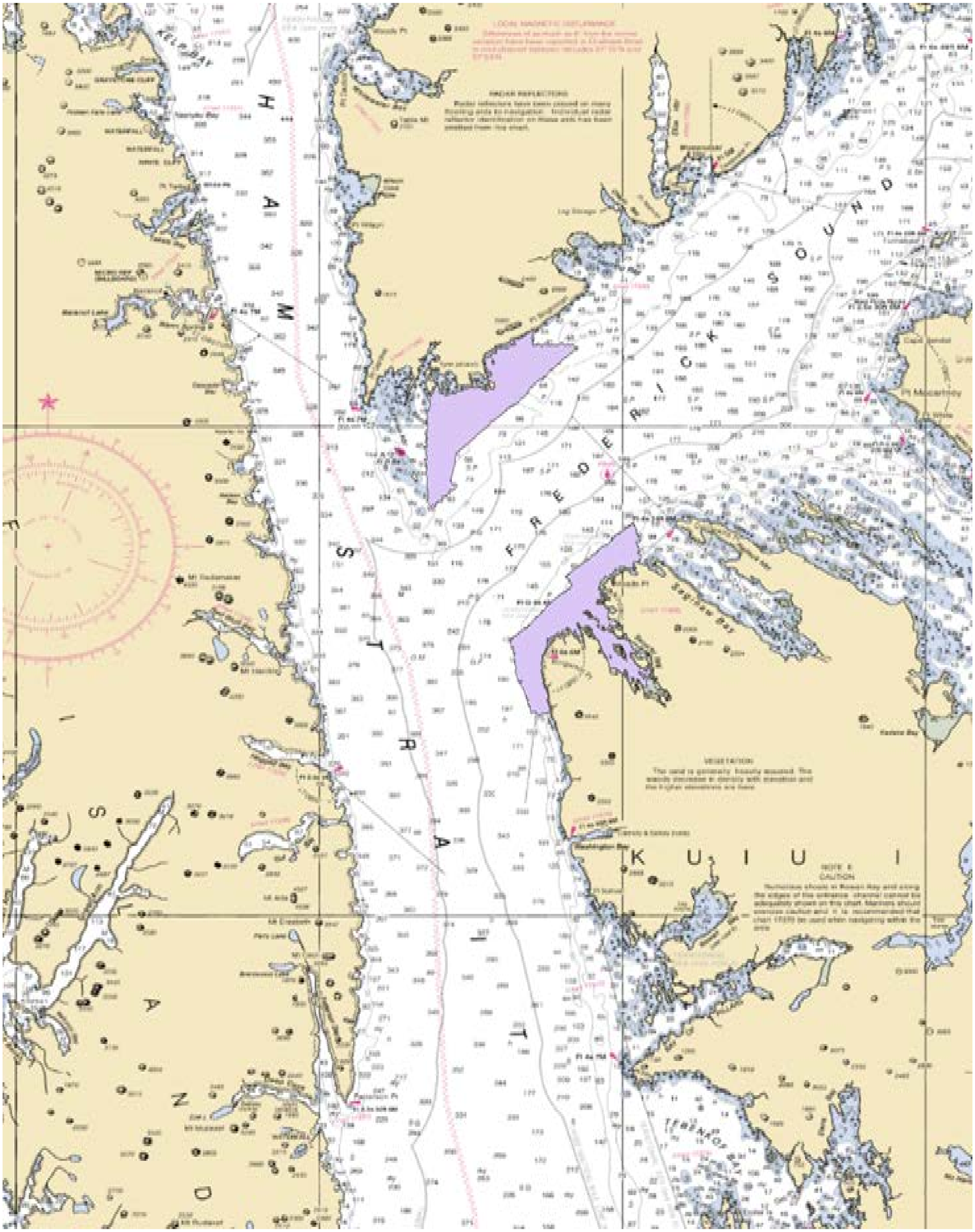
Surveys completed throughout Alaska, 2014-2017.



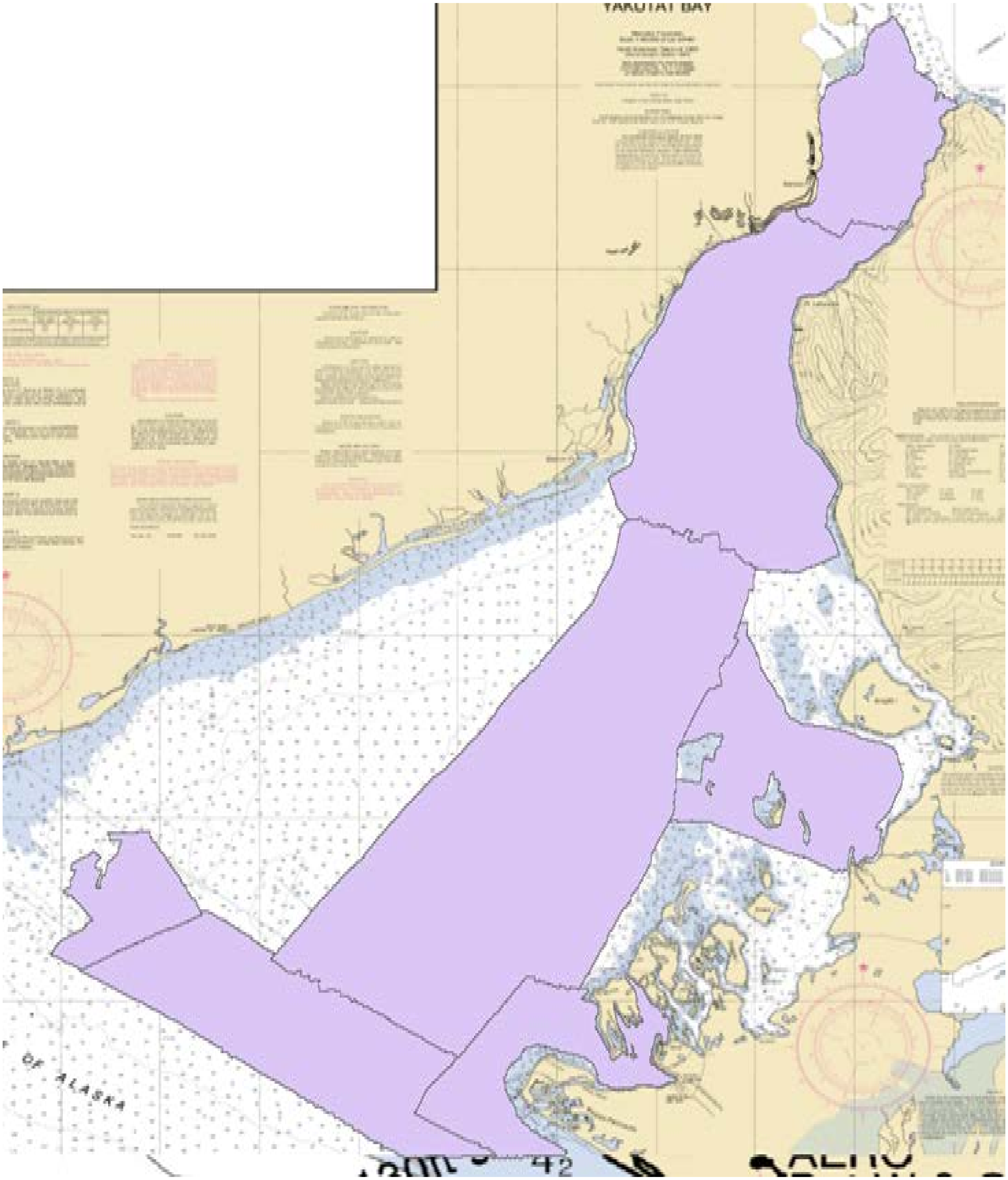
Surveys completed near Prince of Wales Island, Southeast Alaska, 2014-2017.



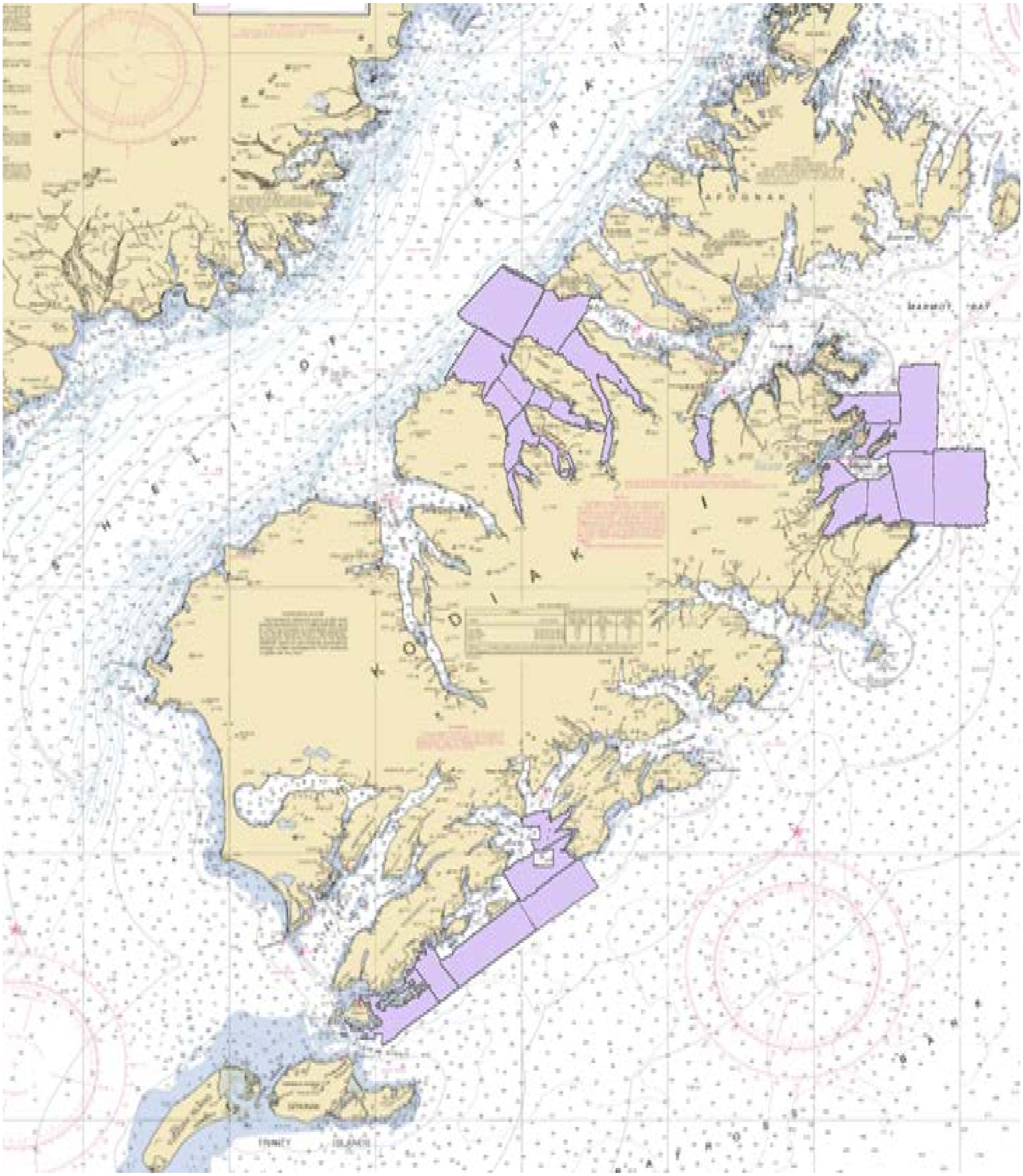
Surveys completed near Revillagigedo Island, Southeast Alaska, 2014-2017.



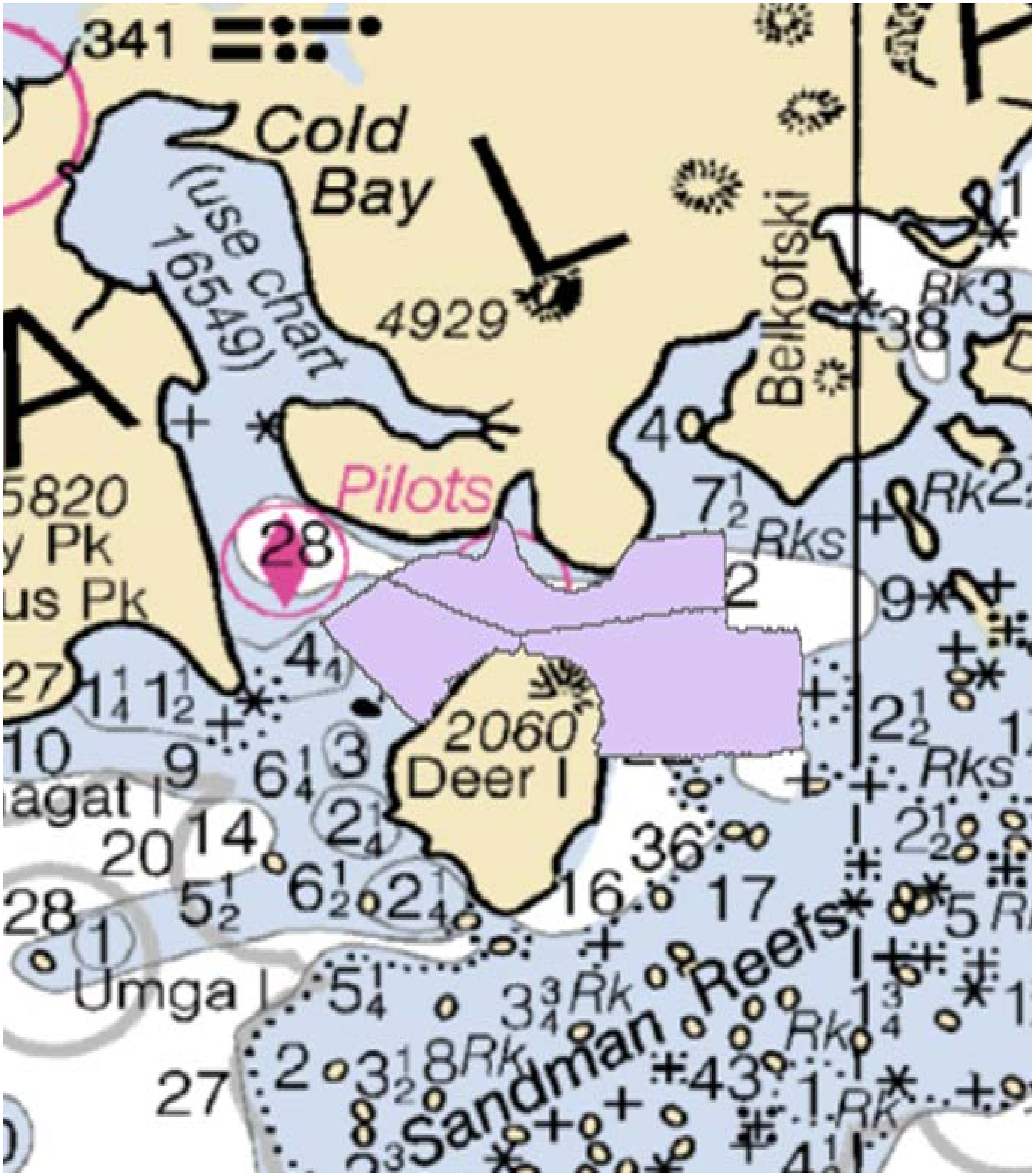
Surveys completed near Chatham Strait, Southeast Alaska, 2014-2017.



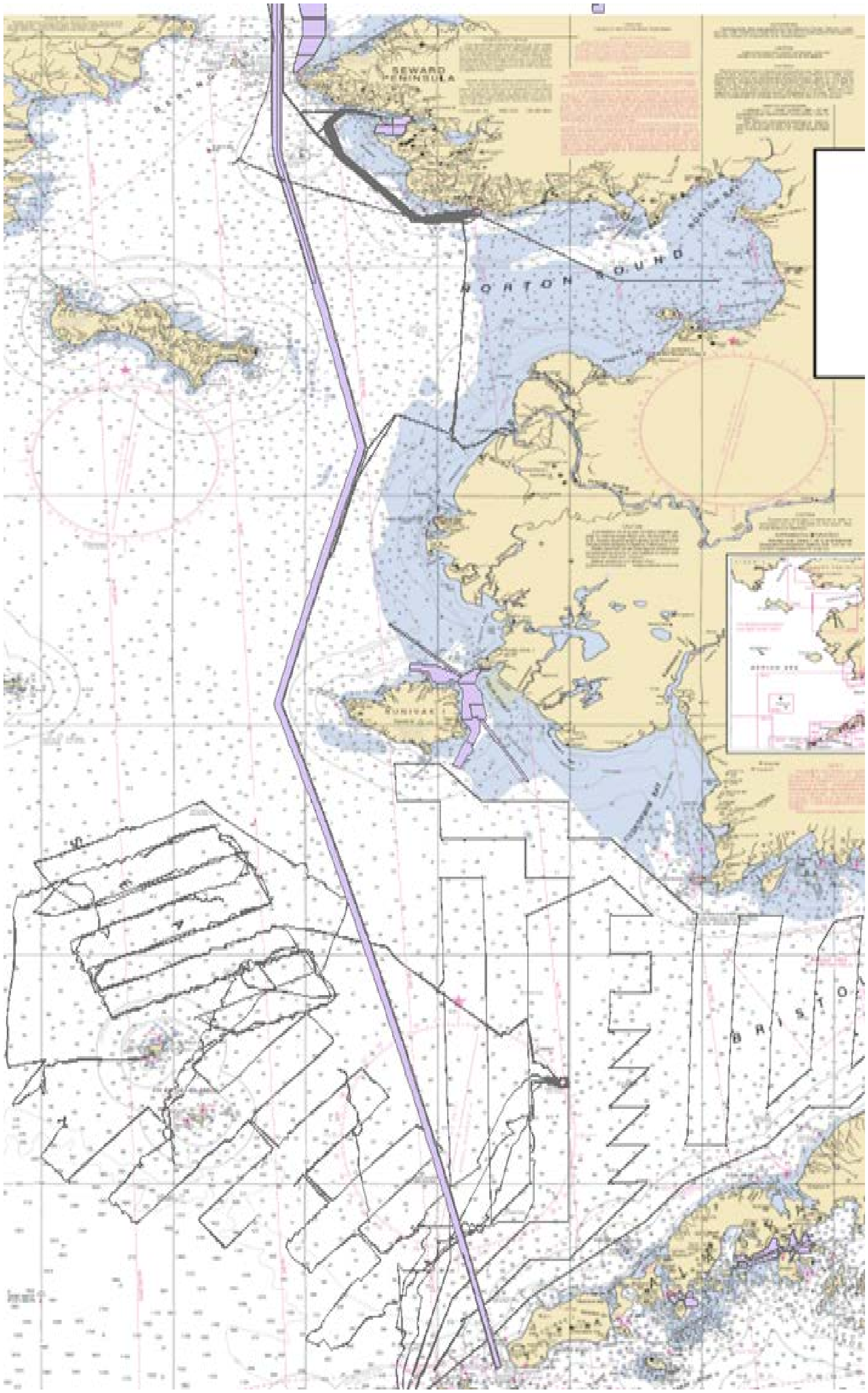
Surveys completed in Yakutat Bay, Southeast Alaska, 2017[GD2].



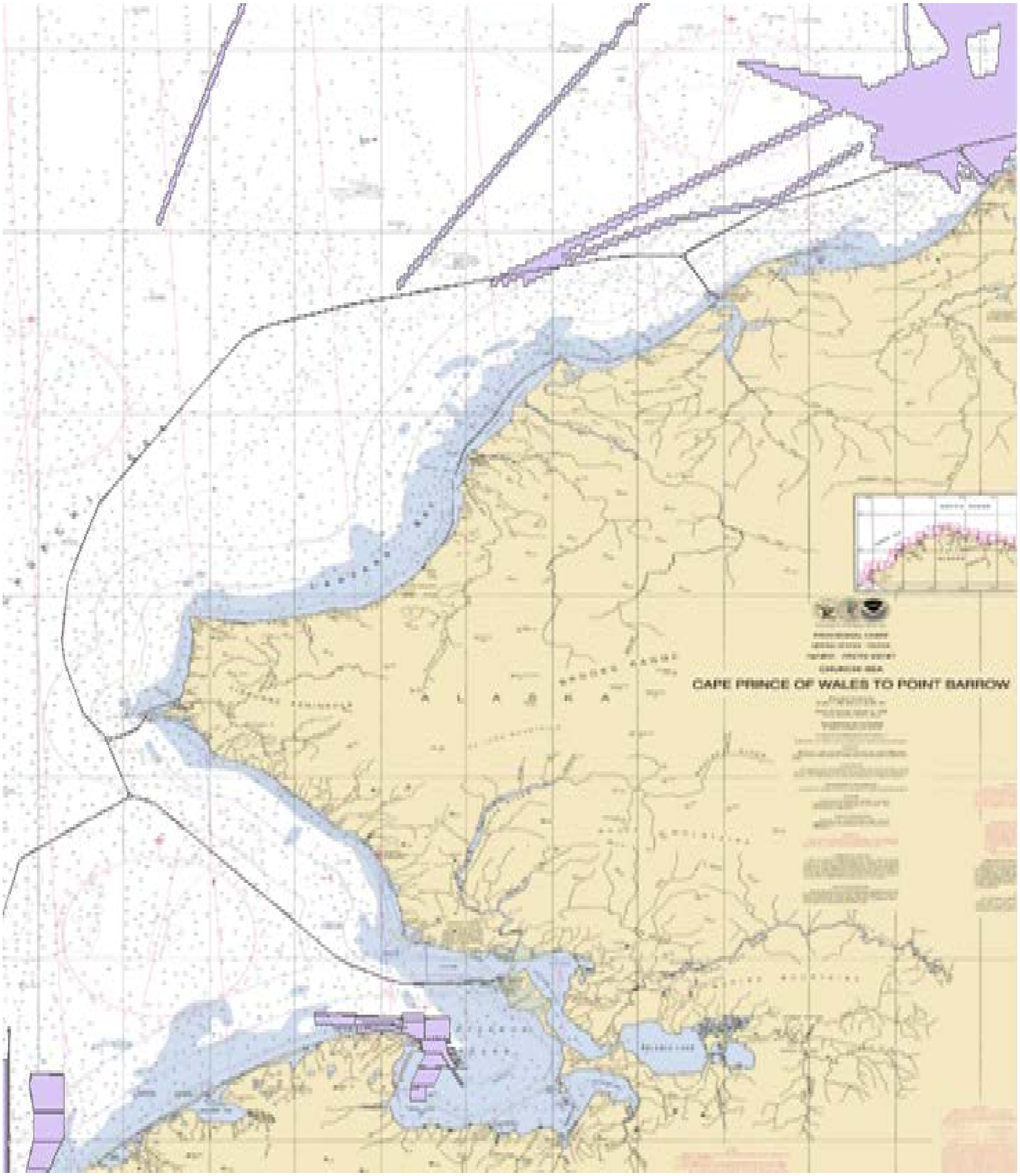
Surveys completed near Kodiak Island, Alaska, 2014-2017.



Surveys completed near Cold Bay, 2014-2017.



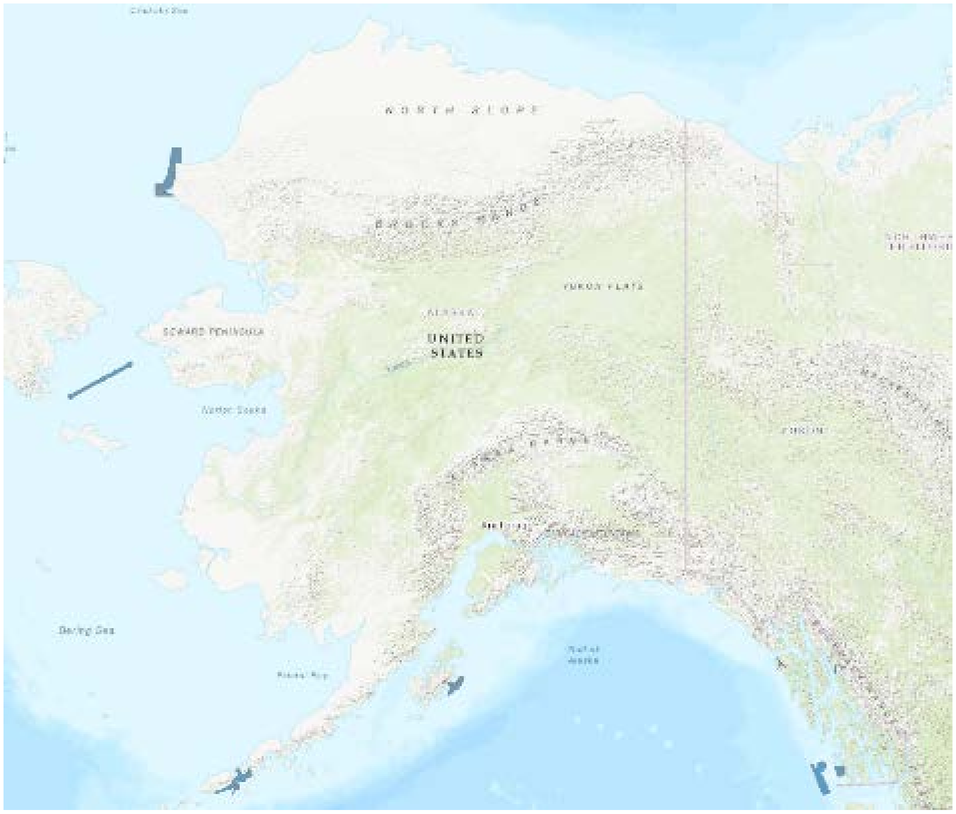
Surveys completed in the Bering Sea, 2014-2017.



Surveys completed in the Arctic, 2014-2017.

Alaska and Arctic survey priorities

In 2018, Coast Survey is conducting surveys around Southeast Alaska, Kodiak Island, Unimak Island, and Point Hope, as shown below. NOAA has 51 surveys planned for 2018 to 2020, throughout all parts of Alaska.



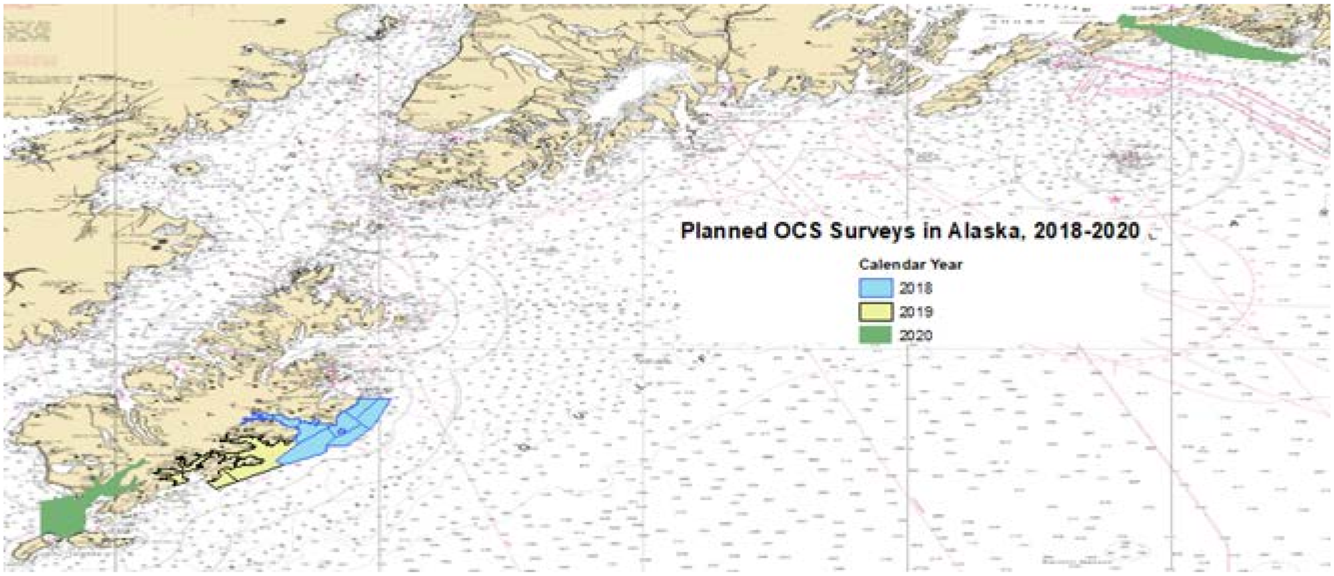
Coast Survey's 2018 survey plans in Alaska.

Given the highly dynamic nature of the Arctic and the expanding maritime commerce in Alaska, future survey priorities in the region are constantly redefined. Utilizing new tools such as vessel Automatic Identification Systems (AIS), Coast Survey is getting a clearer understanding of where contemporary surveys are most needed. These new insights, in conjunction with the upcoming "Hydro Health" model are providing Coast Survey with the tools needed to create survey plans that truly reflect the navigation needs in Alaska.

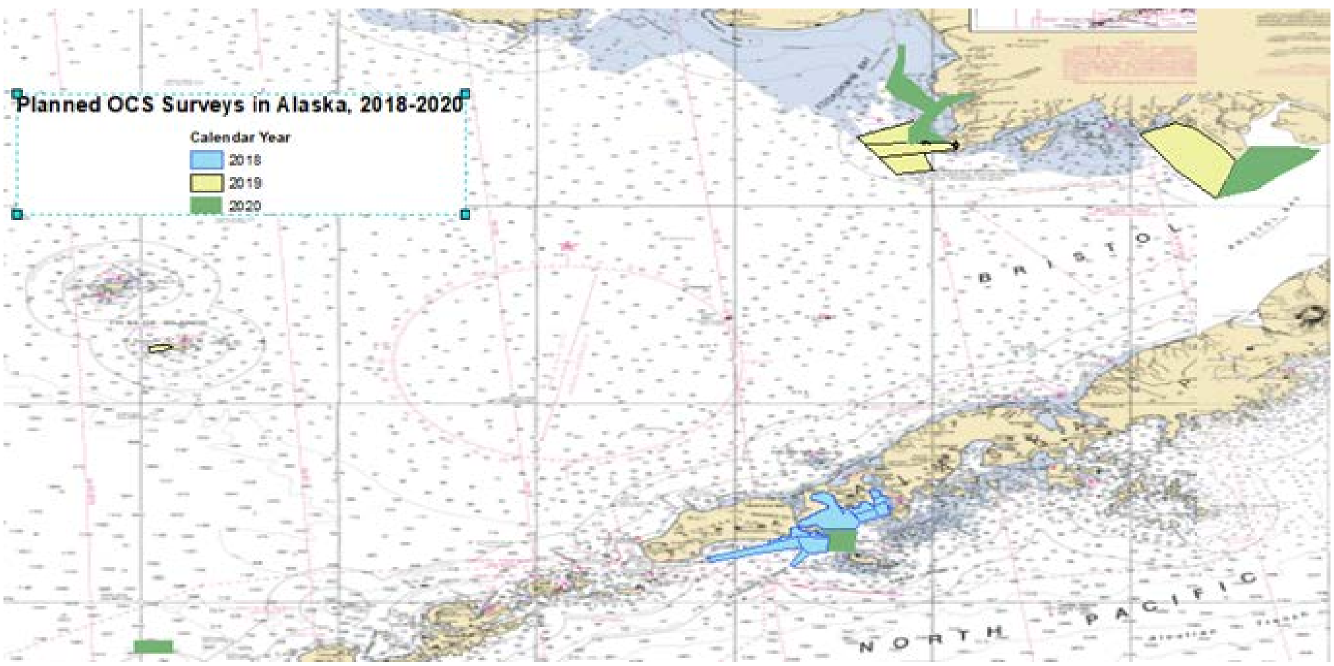
While future projects are subject to outside factors such as budget, weather, ship maintenance, and are subject to change, below are the proposed survey projects for Alaska for 2018 to 2020.

Planned surveys in southern Southeast Alaska, 2018-2020.

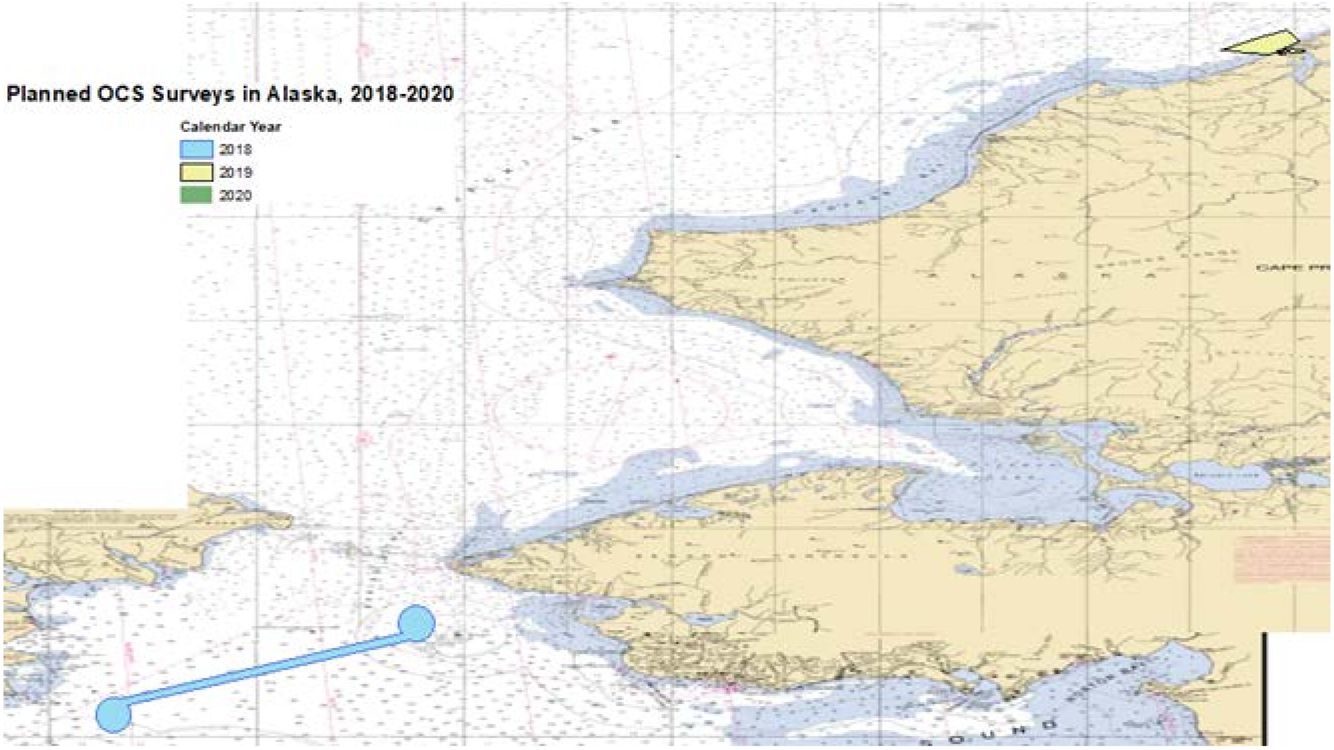
Planned surveys in northern Southeast Alaska, 2018-2020.



Planned surveys in Prince William Sound and Kodiak Island, 2018-2020.



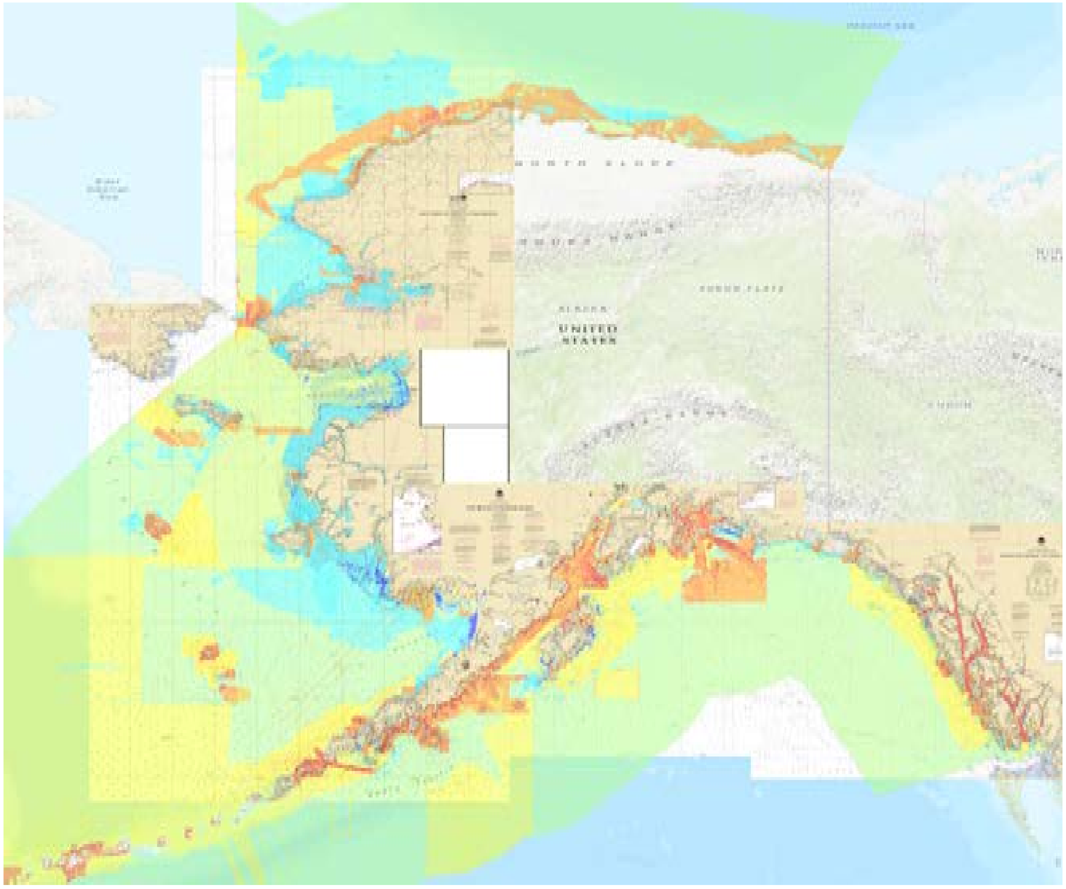
Planned surveys on the Alaska Peninsula, Bristol Bay, and the southern Bering Sea, 2018-2020.



Planned surveys in the northern Bering Sea and Arctic, 2018-2020.

“Hydrographic Health” approach

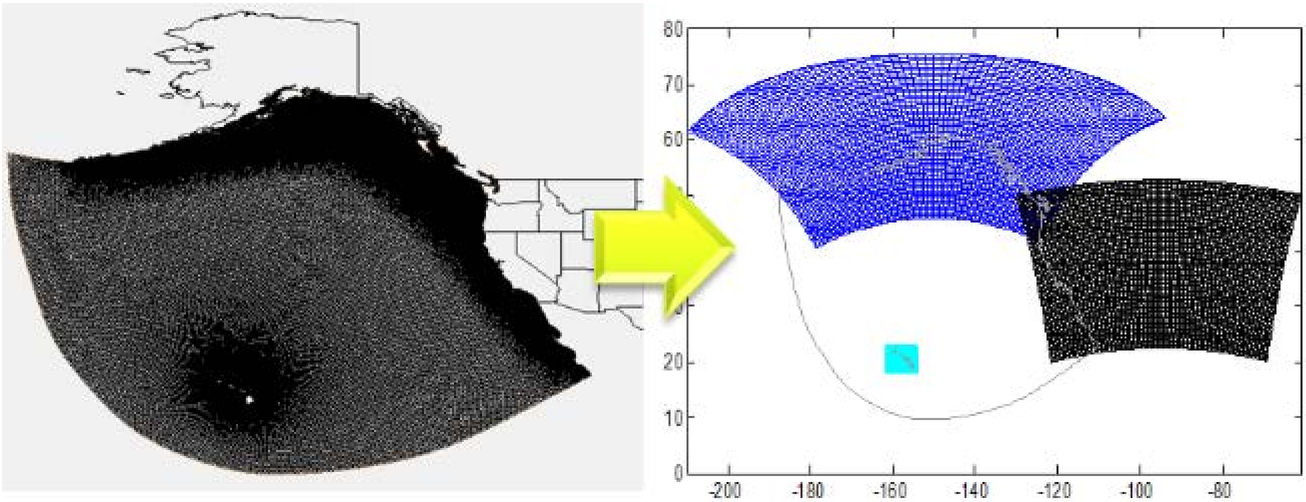
It is important to note that Coast Survey is in the process of developing new methodology for evaluating survey priorities, by modeling the “hydrographic health” for a given survey area. With the completion of the initial run of the Hydro Health model, Coast Survey will have better tools to assess the urgency of navigational needs in an area. This new model is still being quality controlled and input datasets are being verified. Consult the Hydro Health team if drawing conclusions about model output. The following image is a sample of one potential visualization option applied to Alaska.



A Hydro Health Model visualization of Alaska.

Extra-Tropical Storm Surge and Tide Operational Forecasting System (ESTOFS) for Alaska

The Coast Survey Development Laboratory developed and currently maintains the Extra-Tropical Storm Surge and Tide Operational Forecasting System (ESTOFS) to provide operational guidance on storm surge and tidal water levels. ESTOFS is operational for the Atlantic and Gulf of Mexico, Pacific, and Micronesia. The ESTOFS-Pacific domain covers Alaska from the Aleutian Islands to the Southeast portion of the state, as displayed in the figure below. There is a geographic gap in Alaska coverage of ESTOFS for the Bering Sea and Arctic Sea coastal regions of Alaska. NOAA Central Operations (NCO) runs and operates the ESTOFS systems on the high-performance Weather & Climate Operational Supercomputing System. Every 6 hours it provides 7-days surge and tide guidance for the U.S. coastal zone. The ESTOFS framework uses a state-of-the-art advanced ocean circulation model, ADCIRC, and is part of the NOAA/NWS/National Centers for Environmental Prediction (NCEP) production suite. Local and regional forecasters, as well as other NOAA modeling components such as Nearshore Wave Prediction System actively use ESTOFS guidance.



ESTOFS-Pacific model grid and coverage. Water level forecasts are available on the model grid (left) and are interpolated onto the National Digital Forecast Database (NDFD) grids (Alaska-6km, CONUS-2.5km, Hawaii-2.5km).

Unmanned systems for maritime mapping

Coast Survey continues to adopt unmanned systems as complementary technology to its maritime mapping capabilities, where the unmanned systems can provide a meaningful benefit by either expanding capabilities or making more effective use of manned resources.

In 2017, Coast Survey approved a formal Unmanned Systems (UxS) Roadmap and Strategy that defines four goals to enable the development and use of unmanned and autonomous technology:

- Develop Enabling Technologies - Support the development and adoption of enabling technologies, such as high bandwidth data radios and automated processing, to advance unmanned systems and benefit conventional manned survey.
- Maintain Operational Expertise - Develop and maintain operational expertise with unmanned systems through training and the use of Coast Survey's current suite of unmanned systems.
- Operational Innovation - Support the development and transfer-to-operations of unmanned systems that benefit Coast Survey and NOAA missions.
- Collaborate - Collaborate with government, academic, and industry partners to share expertise and resources and to direct and expedite system development.

Current and planned activities to address those goals include:

- Coast Survey UxS Operational Team – Stand-up, train, and fully resource a team at Stennis Space Center to manage and operate the suite of Coast Survey's unmanned systems on navigation safety and interdisciplinary surveys. Coast Survey's current suite of unmanned system's include:
    - Small Autonomous Underwater Vehicle (AUV) – Equipped to provide object detection and sonar imagery in depths up to 100 meters. Able to operate from shore, small boat, or ship. Primarily used for post-storm and navigation safety response surveys.

- Large AUV – Equipped to provide high-resolution bathymetric data in depths up to 550 meters. Operations require a vessel with suitable deck space and handling systems. Primarily used for interdisciplinary seafloor mapping in support of NOAA scientists.
- Small Unmanned Surface Vessels (USV) – Equipped to provide object detection, sonar imagery, and bathymetry in shallow coastal water. Able to operate from shore, small boat, or ship. Primarily used for hydrographic surveys and navigation response surveys.


Small AUV deployed for post-storm survey in Galveston Harbor.


Large AUV on NOAA Ship *Ferdinand R Hassler*.


Small USV on NOAA Ship *Thomas Jefferson*.

- Unmanned Launch Conversion – Coast Survey has awarded a contract to convert two existing hydrographic survey launches converted aboard the NOAA Ship *Rainier* to operate in either manned or unmanned modes. This will allow Coast Survey and NOAA's hydrographic survey fleet to incrementally, but rapidly, evaluate unmanned systems and operational concepts while maximizes the use of existing vessels, support infrastructure, and expertise. Following successful operational testing and development of standard operating procedures, additional launch conversions may be undertaken, which could be used to enhance the capabilities of NOAA's hydrographic vessels operating in Alaska and the Arctic region.
- Vessel-to-Vessel Data Telemetry – Coast Survey is conducting operational testing of high-bandwidth data radios and protocols for survey control and data transfer between ship and manned survey launches. The same technology can improve communication for the command and control of unmanned systems.
- Automated Data Processing and Workflow Improvement – Coast Survey has multiple projects underway to automate data processing and streamline the data processing workflow. These efforts will improve traditional efforts and support the development of more autonomous unmanned systems. The goal is a 75% reduction of current shipboard data processing person-hours per acquisition hour by 2020.

Upcoming unmanned system activities in Alaska and the Arctic:

- Coast Survey is collaborating with NOAA's Pacific Marine Environmental Laboratory (PMEL) on the continuing work to use wind-powered unmanned surface vehicles (saildrone) on Arctic surveys in 2018. Coast Survey intends to identify areas near PMEL's planned surveys where bathymetric data can be extracted from the saildrone to benefit Coast Survey's charting efforts.
- Coast Survey, NOAA Ship *Fairweather*, and CCOM/JHC are collaborating to deploy UNH's C-Worker 4 unmanned surface vehicle aboard the *Fairweather* in late July 2018 in support of hydrographic surveys near Point Hope, Alaska. The goals of the operations are to: 1) explore and develop new operational methods; 2) identify, and where possible solve, technological shortcomings; 3) identify particular points of risk in using unmanned systems; 4) develop shipboard experience in operations and support. Additionally, bathymetric data will collected within the project area with the intention to submit for charting purposes.

Coast Survey and CO-OPS Operational Forecast Systems (OFS) and Cook Inlet OFS

Please see the joint program information on page 42.

NOAA's Integrated Ocean and Coastal Mapping Program (IOCM) and Alaska

NOAA's IOCM program is engaged in a number of ways with Alaska and the U.S. Arctic. The NOAA IOCM coordinator participates in NOAA's Arctic Action Team and co-chairs with USCG the Committee on Marine Transportation System's Arctic Integrated Action Team.

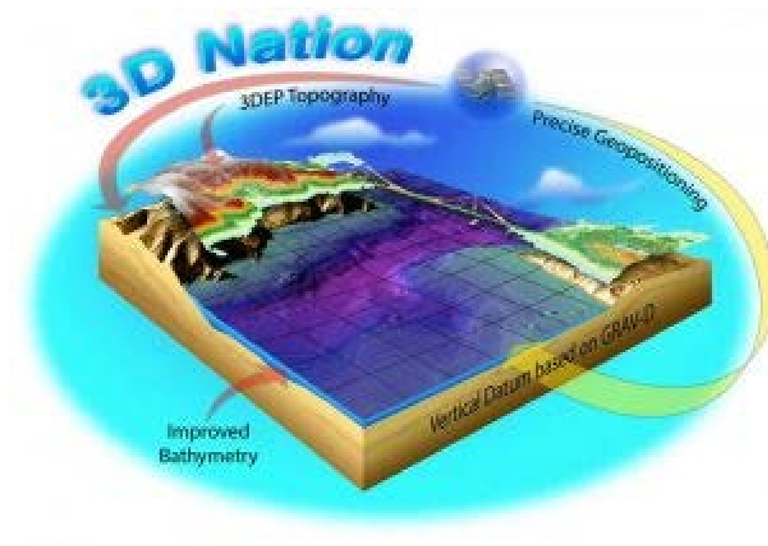
Under the banner of the Interagency Working Group on Ocean and Coastal Mapping, NOAA hosted a second Alaska Coastal Mapping Summit in February 2018 with the Alaska Ocean Observing System (AOOS) and the state Department of Natural Resources. On February 9, 2018, more than 100 subject matter experts gathered in Anchorage for the second Alaska Coastal Mapping Summit. This event provided a forum to discuss the next steps for a coordinated approach to coastal mapping in Alaska. Numerous real-world stories and planning scenarios made it apparent that reliable geospatial data underpins all responsible and economic decision-making for Alaska's coastal environments. Examples illustrated how coastal mapping is critical to the safety and livelihoods of residents, responsible resource extraction (mining, oil, gas, and timber), tourism, commercial fishing, subsistence, land and habitat management, and the development of local and international marine shipping routes. More than 30 of these detailed examples are included in the body and appendices of the summit report and the specific applications identified at the summit will drive development of the state's Coastal Mapping Strategic Plan.

To ensure that the substantive discussion from this meeting becomes a roadmap for coastal data acquisition in Alaska, NOAA, AOOS, and the Alaska Geospatial Council have jointly funded a one-year coastal mapping strategist position to spearhead compilation of an Alaska Coastal Mapping Strategic Plan. This plan will incorporate many of the more than two dozen recommendations from this summit, including priorities and refresh rates for bathymetry, terrestrial elevation and imagery data; tiered, technology-neutral data specifications for different coastal environments; a data inventory with appropriate metrics; and an emphasis on demonstrated region-specific applications and anticipated future uses. Widespread and continued participation in the development of the Alaska Coastal Mapping Strategic Plan—scheduled for draft release by December 2018—will be required to achieve an executable strategy that will include Alaska's many coastal mapping needs.

IOCM update on 3D Nation

IOCM continues to advance the 3D Nation's requirements and benefits study, as briefed at the Portsmouth, New Hampshire, HSRP meeting in September 2017. NOAA Office of Coast Survey and USGS are working to improve the technology, systems, data, and services that provide information about 3D elevation data and related applications within the United States. By learning more about business uses and associated benefits that would be realized from improved 3D elevation data, the agencies will be able to prioritize and direct investments that will best serve user needs.

Elevation data is essential to put actionable geospatial data in the hands of decision-makers to inform decisions in high-risk areas such as emergency planning, climate adaptation and resilience, economic investment, infrastructure development and habitat protection. Elevation data are also critical inputs for modeling to prepare for and respond to hazards such as hazardous weather, flooding, storm surge, and landslides. Accurate elevation data can foster understanding and help people mitigate the negative effects of these challenges, protect biodiversity and habitats, and characterize areas of the United States that have never been well mapped, such as the Arctic. Mapping to acquire high quality terrestrial, coastal, ocean and Great Lakes elevation data – from the mountains to our shorelines to the nearshore and bathymetric depths of our oceans – is more essential today than ever before. People must have accurate and up-to-date elevation data in order to make informed choices on land and off, whether for the safety of residents, environmental protection, security, or economic decisions.



Update on the Committee on the Marine Transportation System (CMTS) Arctic Integrated Action Team (IAT)

The IOCM program coordinator represents NOAA on the CMTS Arctic IAT, co-chairing this team with USCG and the Maritime Administration. The IAT is working on an update to its assessment of Arctic MTS infrastructure capabilities and gaps. NOAA's navigation services components fall into two elements of the Arctic MTS: physical infrastructure (geodetic/positioning and water level stations) and information infrastructure (surveying, mapping, charting, weather, and related products and services).

University of New Hampshire and NOAA's Joint Hydrographic Center and the Center for Coastal Ocean Mapping

Seabed 2030

The University of New Hampshire (UNH) Center for Coastal and Ocean Mapping (CCOM) is one of Seabed 2030 program's four Regional Centers. The Regional Centers will be responsible for championing mapping activities, assembling and compiling bathymetric information and collaborating with existing mapping initiatives within their regions. The Global Center in the United Kingdom will be responsible for producing and delivering global GEBCO products.

NOAA supports the Seabed 2030 project. Seafloor mapping is integral to many NOAA products that are vital to our nation's commerce, from nautical charts to accurate assessments of fish and their habitats. It is used to model inputs that enable better weather forecasts and climate predictions for agriculture, transportation and insurance industry decisions, for earlier warnings of costly natural disasters, and for a greater understanding of how our oceans drive life as we know it on Earth. Knowing the depth of the seafloor is not only vital to navigation and coastal management, but is also a fundamental parameter for understanding ocean circulation and tides, wave action, sediment transport, subsea dynamic processes, environmental change, underwater hazards, pipeline routing, for ground truthing research and commercial satellite observations. NOAA's preliminary data gap assessment shows that there is significant work to be done in the U.S. EEZ.[6]

The recent article, *The Nippon Foundation—GEBCO Seabed 2030 Project: The Quest to See the World's Oceans Completely Mapped by 2030*, explains the Seabed 2030 Project in detail, including the strategy, objectives, processes for collecting and sharing data. [7]

[6] https://www.hydro-international.com/content/article/seabed-2030-a-call-to-action

[7] Mayer, L.; Jakobsson, M.; Allen, G.; Dorschel, B.; Falconer, R.; Ferrini, V.; Lamarche, G.; Snaith, H.; Weatherall, P. The Nippon Foundation—GEBCO Seabed 2030 Project: The Quest to See the World's Oceans Completely Mapped by 2030. Geosciences 2018, 8, 63. Available from http://www.mdpi.com/2076-3263/8/2/63.

Center for Operational Oceanographic Products & Services

Personnel and products in Alaska

CO-OPS personnel

The Pacific Regional Field Office, with 11 federal and 3 contract employees, operates and maintains about 100 oceanographic and meteorological observing system sensors in the West Coast, Pacific Islands and Alaska regions, supporting the National Water Level Observation Network, National Current Observation Program (NCOP), and Physical Oceanographic Real-time Systems (PORTS®). These personnel are divided into two complementary teams. The field team executes CO-OPS requirements in the field including installation, preventative maintenance, repairs, and upgrades, providing contract oversight and providing field training for CO-OPS' partners. Members of the field team have oversight of smaller regions within the overall area of responsibility. The Seattle Instrument Lab team focuses on supporting that fieldwork and CO-OPS technology advancements in the Lab. This includes remote diagnostics and repair from the lab, providing in-lab training to CO-OPS' personnel and CO-OPS' partners, preparing equipment for field deployment, and troubleshooting and repairing equipment. The Seattle Instrument Lab also works with other parts of CO-OPS to advance its technologies to support the development of new products, improve data quality, and continuity.

National Water Level Observation Network

CO-OPS operates and maintains the National Water Level Observation Network, which is a network of 210 continuously operating water-level stations throughout the U.S., including its island possessions and territories. NWLON is the "go to" source for government and commercial sector navigation, recreation, and coastal ecosystem management. The NWLON provides the national standards for tide and water level reference datums used for nautical charting, coastal engineering, international treaty regulation, and boundary determination. NWLON supports storm surge and tsunami warnings and provides relative sea level trends. Approximately one quarter of the NWLON is located in the Great Lakes (non-tidal), providing water level data for the international management of those water resources. The NWLON is also widely recognized as the key federal component of the Integrated Ocean Observing System (IOOS).

There are 27 NWLON stations in Alaska. Water level stations contain water level sensors and data collection platforms. Real-time data are transmitted every six minutes via geostationary orbiting environmental satellite. Telephone modems or cellular gateways provide backup communications at most locations. In addition to a primary and backup water level sensor, most stations also acquire meteorological data including wind speed and direction, air temperature, and water temperature.

CO-OPS operates the following NWLON stations in Alaska: Adak Island, Alitak, Anchorage, Atka, Cordova, Elfin Cove, Juneau, Ketchikan, King Cove, Kodiak Island, Nikiski, Nikolski, Nome (Norton Sound), Port Alexander, Port Moller, Prudhoe Bay, Red Dog Dock, Sand Point, Seldovia, Seward, Sitka, Skagway, Unalakleet, Unalaska, Valdez, Village Cove (St. Paul Island), and Yakutat Bay. Please note that fire destroyed the Port Moller station in August 2017.

Filling the NWLON gaps with partners

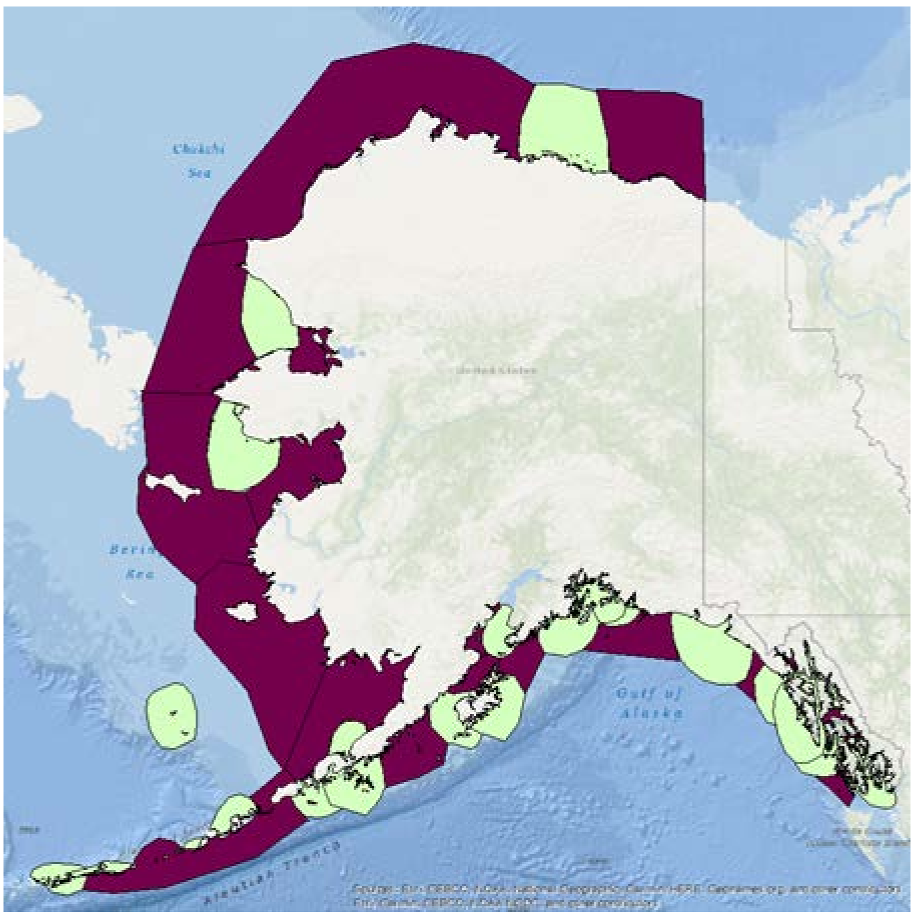
Presently, CO-OPS operates 27 long-term NWLON tide stations in Alaska, with only 10 of these located in the Arctic. CO-OPS identified more than 30 gaps in NWLON coverage for Alaska, with the majority being in the

Arctic. CO-OPS recently collaborated to fill NWLON gaps. The 27th NWLON station, Unalakleet, was installed in 2016 under a partnership between CO-OPS and the NWS.

Another partner, National Park Service, will be installing and maintaining a long-term permanent tide gauge and tsunami warning station in FY 2018 at Chisik Island, in Lake Clark National Park. Plans include water level monitoring infrastructure in an NWLON gap that will consist of the latest measurement technology (microwave radar sensors) while supporting tsunami warning and eventually a long-term sea level trend.

CO-OPS also collaborates with AOOS and the Alaska Department of Natural Resources on topics concerning water levels measurements in Alaska. CO-OPS participated in workshops to determine water level needs and priorities, and exchange information about measurement technologies.

Recently CO-OPS partnered with NOAA's Office for Coastal Management and will provide water level processing and datum support for several short-term stations in Arctic gap locations with multiple stakeholder interest.



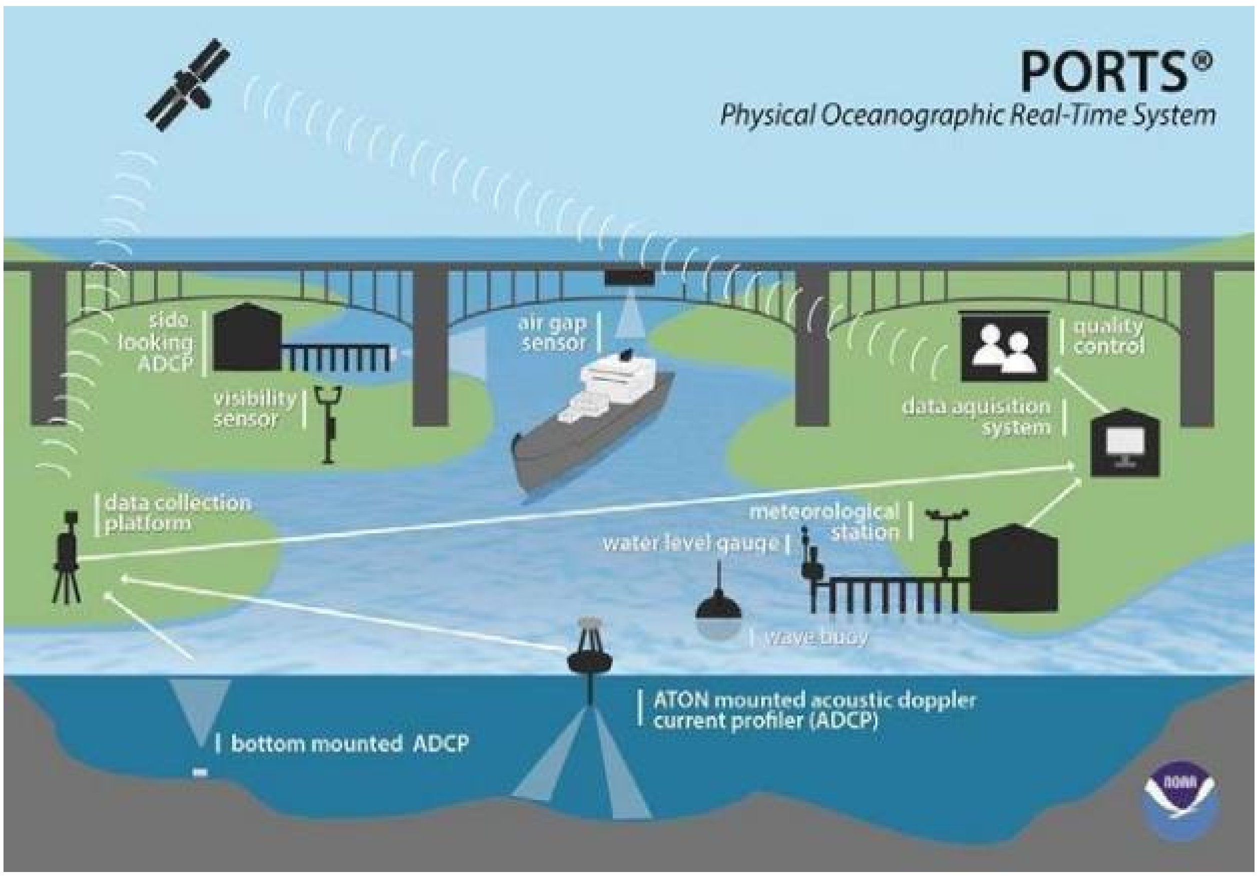
Locations of NWLON tidal datum coverage (green) and gaps in NWLON coverage (purple).

Upgrade in water level technology

CO-OPS is upgrading the NWLON using microwave water level sensors (MWWL) instead of traditional acoustic sensors. With a MWWL system, the sensors sit up out of the water, requiring less maintenance, resulting in lower costs. It is also more accurate in high-energy conditions and has the potential to provide information on waves. In order to ensure accuracy of the data, CO-OPS leaves both the MWWL and acoustic sensors in place for one year for comparison. As of May 1, 2018, CO-OPS installed MWWL sensors at 57 NWLON stations across the country, and 27 of those stations use MWWL as the primary sensor. Two locations in Alaska are transitioned (Adak and Prudhoe Bay) while two are in the process of being transitioned (Ketchikan and Skagway). CO-OPS will install Seldovia and Sand Point MWWL sensors by October 1, 2018. Additionally, MWWL sensors have also been installed at 29 non-NWLON locations (PORTS, Texas Coastal Ocean Observation Network, Global Sea Level Observing System, etc.), 26 of which are fully operational.

Physical Oceanographic Real-Time System (PORTS®)

PORTS® is a decision-support tool that improves the safety and efficiency of maritime commerce and coastal resource management through the integration of real-time environmental observations, forecasts, and other geospatial information. PORTS® measures and disseminates observations and predictions of water levels, currents, salinity, waves, and meteorological parameters (e.g., winds, atmospheric pressure, visibility, and air and water temperatures) that mariners need to navigate safely. NOS operates 31 PORTS®, one of which operates in Cook Inlet supporting the Port of Anchorage.



Port of Anchorage PORTS®

CO-OPS initiated Port of Anchorage PORTS® in July 2002 as part of an agreement with the Port of Anchorage. Currently, this PORTS® network comprises two NOS NWLON gauges, so there is no longer a supporting partnership for this location. The Port of Anchorage PORTS® provides real-time data quality-controlled and disseminated to local users for safe and efficient navigation. Real-time data is available for two water level stations with meteorological data.

Current surveys in Alaska

Recently, CO-OPS conducted several current surveys in Alaska to update the tidal current tables with modern predictions. CO-OPS spent an entire decade updating current predictions in Alaska from 2000-2010. In 2008, CO-OPS deployed 51 stations in Southeast Alaska, and two in Cook Inlet specifically, to obtain a more accurate prediction for the docking of oil tankers at Tesoro pier. In 2009, CO-OPS deployed 44 stations around Kodiak Island. In 2010, CO-OPS did a detailed study of Glacier Bay and Cross Sound Alaska with 10 current meters and deployed 24 stations around Unimak Pass to capture one of the most dynamic shipping channels in the world. In 2012, funded by the Alaska Energy Authority, CO-OPS deployed nine more stations in Cook Inlet to support a model developed to identify key areas for tidal kinetic energy.

Looking ahead, CO-OPS will partner on a circulation study of Kachemak Bay with NOAA's Kasitsna Bay Laboratory set to begin in FY19, deploy a current meter to update predictions at North Inian Pass, and finally, deploy current meters in the Aleutian Passes in FY23.

With the improvements in measurement and computing technology available today, the accuracy of these modern predictions are significantly improved from past observations. Data and predictions are available to partners, stakeholders, and the public in the NOAA tidal current tables and through NOAA Current Predictions website.

CO-OPS and OCS Joint Operational Forecast Systems (OFS) and the Cook Inlet OFS (CIOF)

Operational nowcast and forecast hydrodynamic model systems support NOAA's mission goals and priorities by providing automated integration of observing system data streams, hydrodynamic model predictions, product dissemination**,** and continuous quality-control monitoring. State-of-the-art numerical hydrodynamic models driven by real-time data and meteorological, oceanographic, and/or river flow rate forecasts, form the core of these end-to-end systems. The operational forecast system provides nowcast and short-term (0 hour – 48 hour) forecast guidance of pertinent parameters (e.g., water levels, currents, salinity, temperature, and waves) and disseminates them to users.

NOAA’s National Ocean Service recently developed a new three-dimensional Cook Inlet Operational Forecast System (CIOFS) in a joint project of Coast Survey, CO-OPS, and the NWS National Centers for Environmental Protection Central Operations (NCEP NCO) using Rutgers University's Regional Ocean Modeling System (ROMS). CIOFS will be implemented on the NOAA’s Weather Climate Operational Supercomputing System (WCOSS) and provides the maritime community with nowcasts (i.e. analysis) and short-term (48 hours) forecast guidance of water levels, currents, water temperature, and salinity. NOS intends to collaborate with NWS NCEP NCO to operationalize this OFS. Operational implementation of CIOFS is scheduled for late December of 2018.

CIOFS uses an orthogonal grid with horizontal dimension of 1132 x 777[GD3]. Its horizontal resolution ranges from 10 m within the upper bay/estuaries and navigational channels to 3.5 km near offshore waters. The vertical grid follows the terrain and consists of 30 sigma levels. The bathymetry on the Cook Inlet model grids is populated from the best available data that include NOS sounding data, National Geodetic Data Center (NGDC) and NGS shoreline data, and the USGS topography gridded product. Digital Elevation Maps (DEM) capture the wetting/drying process.

Time series graphics at specific locations (locations of observation stations or navigationally strategic locations, for example) and aerial animations over the entire domain of all five parameters (wind, water levels, surface currents, surface water temperature and surface salinity) are displayed on the CO-OPS developmental website.

CIOFS runs four times per day at 00, 06, 12, and 18 UTC. CIOFS outputs are available in Network Common Data Form (NetCDF) on CO-OPS THREDDS server. CIOFS is in the developmental and testing phases, the user may experience outage or delay to access CIOFS web products due to WCOSS unavailability for developer users.

National Geodetic Survey

Regional Mission Summary for Activities in Alaska

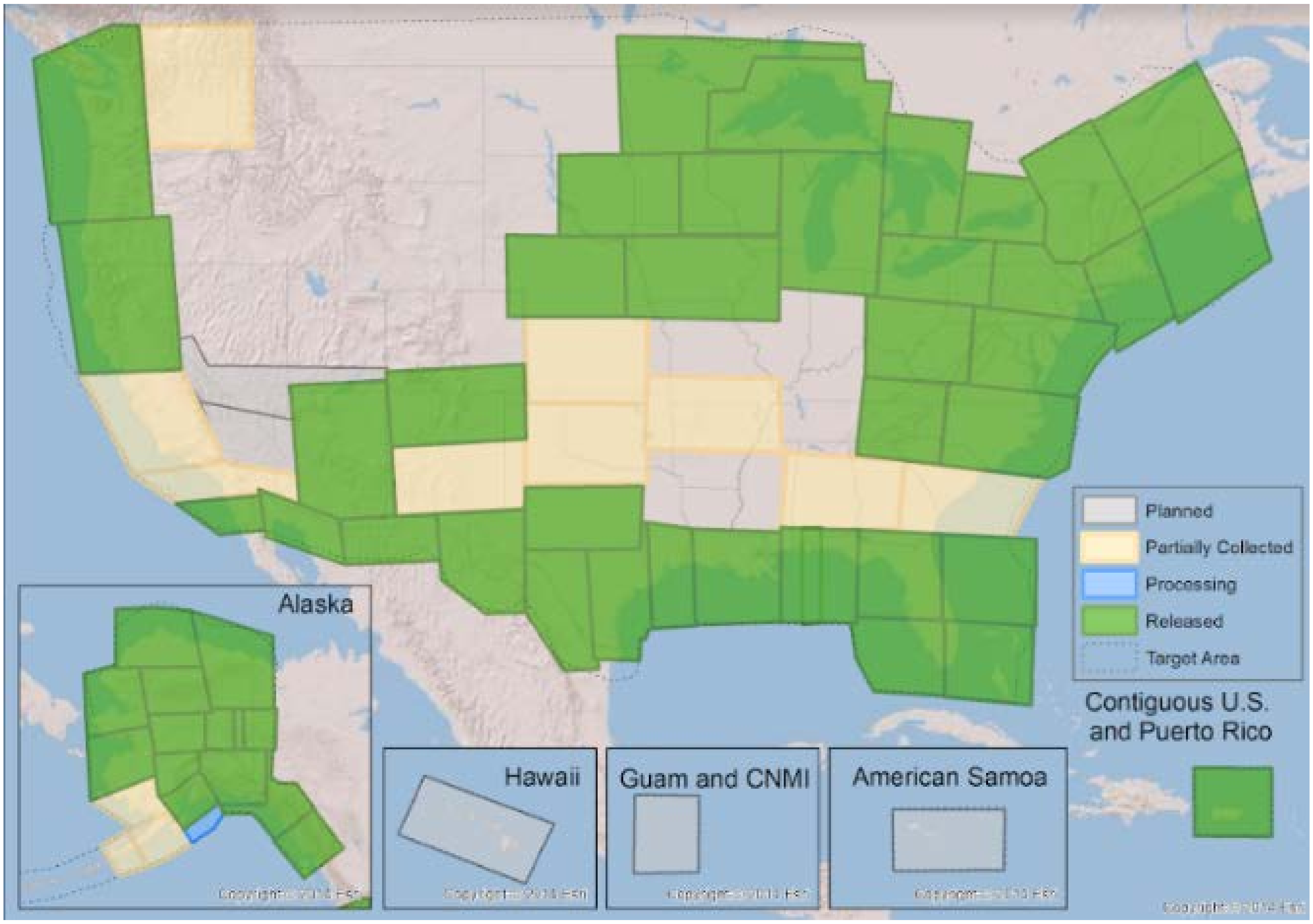
NGS supports a wide variety of programs and activities in Alaska and the U.S. Arctic focused on improving the accuracy of and access to the National Spatial Reference System, producing a gravity-based vertical datum, and updating the national shoreline. The NGS regional geodetic advisor program provides subject matter experts in geodesy and regional geodetic issues and collaborates internally across NGS and NOAA to further the organization's missions. These advisors maintain awareness of current developments in geodetic science and technology, updates and improvements to geodetic reference systems, and application to geospatial activities. NGS regional geodetic advisor for Alaska is Nicole Kinsman (nicole.kinsman@noaa.gov).

NSRS modernization will significantly improve the quality of positioning and geospatial products nationwide, but will be of particular utility in remote and geophysically complex places such as Alaska, where existing NGS products, tools, and services have historically struggled to perform at a nationally consistent level. The upcoming NSRS changes will be a boon in Alaska because:

- time-dependency improves assessment of mark stability, which enables the monitoring of gradual changes such as permafrost subsidence or tectonic motion;
- the new vertical datum aligns with international neighbors such as Canada, facilitating data-sharing in the Arctic;
- GPS-based positioning opens the door to consistent NSRS access in remote and isolated parts of the United States, including offshore;
- systematic ties between geodetic and tidal datums will improve the quality of geospatial data in coastal environments experiencing sea level change; and
- direct relationships between the NSRS and global reference frames improve the spatial framework for UAS operations and precision navigation.

GRAV-D update for Alaska

The Gravity for the Redefinition of the American Vertical Datum (GRAV-D) program is producing a gravity-based vertical datum that will be accurate at the ~2 cm level where possible. GRAV-D is expected to complete 95% of data collection for mainland Alaska in the summer of 2018. NGS anticipates that the entire state will have airborne gravity data collected by the end of 2020. This new information will be included in revised gravity models for the region and will culminate in a new national vertical reference system. This system will result in an estimated $522 million in nationwide annual economic benefits once implemented, allowing users to determine more precise elevations using GPS, with approximately $240 million saved from improved floodplain management alone. For more information go to the NGS GRAV-D web page or contact Monica Youngman (monica.youngman@noaa.gov).



Status of GRAV-D data collection, processing, and release as of May 2018.

Geodetic activities in Alaska

Regional coordination on NSRS modernization preparedness

To advance Alaska geodetic activities in a coordinated fashion, the Alaska Geospatial Council approved the charter of a Geodetic Technical Working Group in December 2016. The NGS regional advisor co-chairs this working group in conjunction with a state or Alaska university subject matter expert and meets quarterly to discuss geodetic priorities such as NSRS modernization, preparedness, and the regional emergence of GPS real-time networks.

In February 2018, the Alaska Geodetic Technical Working Group facilitated a half-day session at the 2018 Alaska Surveying and Mapping Conference entitled "Alaska Preparedness for National Spatial Reference System Modernization in 2022: Evaluating Impacts and Planning for a Smooth Transition." Partner presentations focused on anticipated impacts, preparations to-date, concerns, and outstanding requirements such as necessary changes to Alaska Statute, Continuously Operating Reference Station, and GPS field campaigns to support the development of reliable NSRS transformation tools. Speakers were present from the following stakeholders

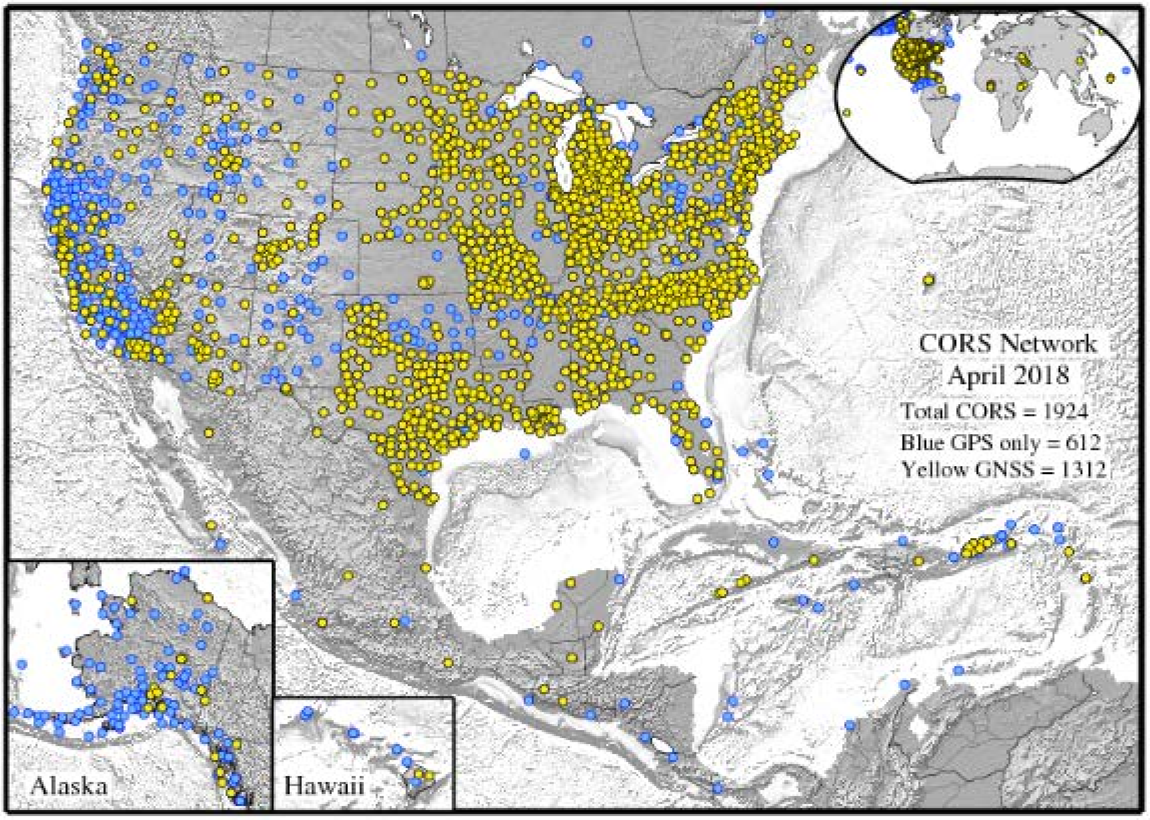
- Alaska Dept. of Natural Resources (GIS Section of Geological & Geophysical Surveys)
- Alaska Dept. of Natural Resources (Survey Section of Mining, Land, and Water)
- Alaska Dept. of Transportation & Public Facilities (Northern, Central, and Southcoast[GD4] Regions)
- U.S. Army Corps of Engineers, Alaska District
- Bureau of Land Management, Alaska Region
- National Park Service Alaska Region Headquarters
- GNSS equipment retailer and commercial RTN operator Frontier Precision
- Private geospatial and surveying companies (TerraSond and CMJV Surveying)

Alaska Department of Transportation & Public Facilities presents at 2018 NGS-led meeting on regional preparedness for NSRS modernization.

As NGS moves forward with developing new products and tools to support GPS-based geodetic control in the modernized NSRS, Alaska will serve an important role as a critical test-bed for ensuring functional GPS-based positioning services in remote, offshore, and tectonically active environments. For more information about regional geodetic coordination, contact Nicole Kinsman (nicole.kinsman@noaa.gov).

Continuously Operating Reference Stations

NGS manages a network of CORS that provide Global Navigation Satellite System (GNSS) data consisting of carrier phase and code range measurements to define, and provide access to, the NSRS. The CORS network in Alaska consists of 116 stations that contribute GPS and GNSS data to the NSRS. As shown in the graphic below, the majority of stations in Alaska are GPS-only, with only 16 with GNSS capability (seven sites include GLONASS signals, and nine sites include both GLONASS and Galileo signals).



NGS owns and operates two sites in Alaska, one located in Seward and one in Sitka. Eight other CORS data providers contribute to the region. These providers consist of UNAVCO (contributes 86 sites), the U.S. Coast Guard (contributes 14 sites), the Federal Aviation Administration (FAA) (contributes 7 sites), the Alaska Department of Transportation & Public Facilities (AKDT) (contributes 2 sites), BP (BPEXAK) (contributes 2 sites), Surveyors Exchange (SUREX) (contributes 2) sites, and JPL (contributes 1 site).

The USCG is in the process of gradually decommissioning all stations in its Nationwide Differential GPS (DGPS) service, including the 14 stations in Alaska, to culminate in full discontinuance of DGPS by 2020.

Upcoming NGS foundation CORS in Alaska

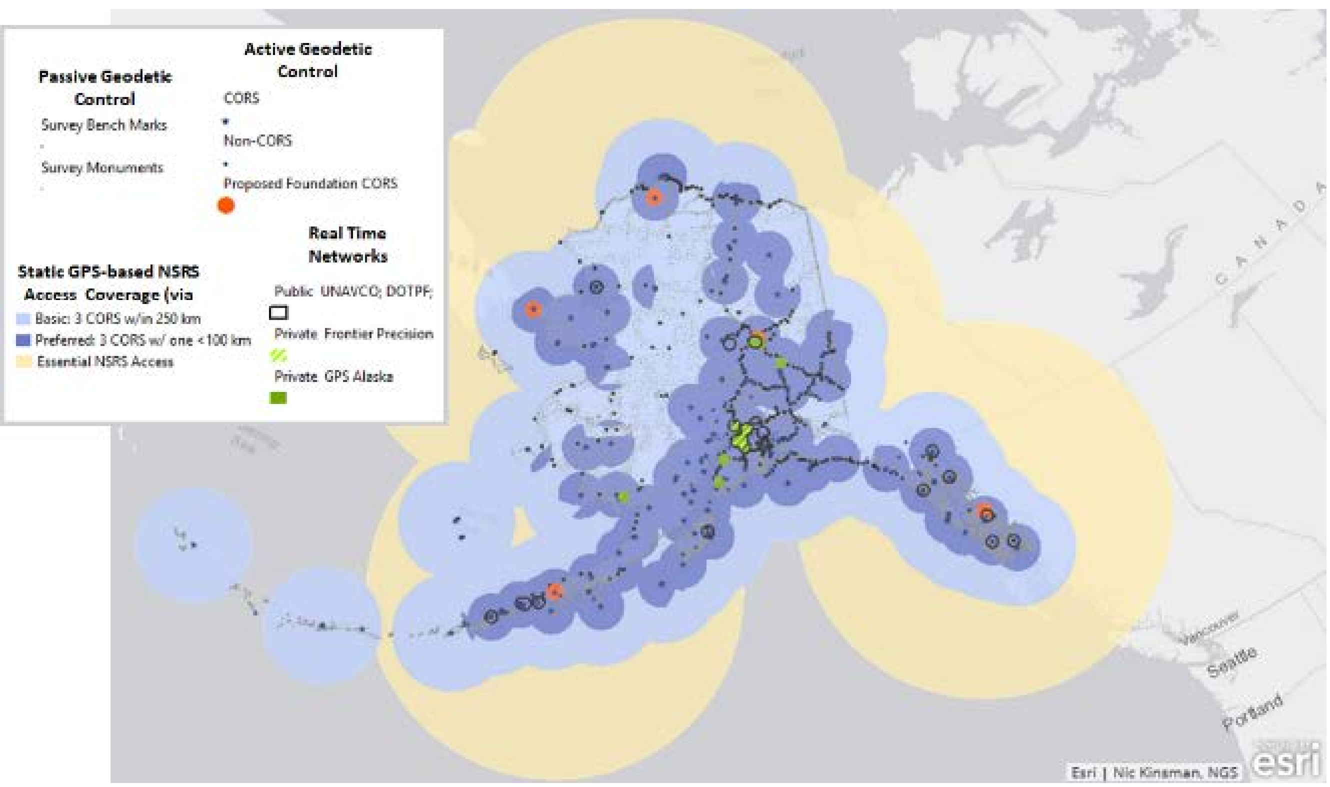
Satellite geodesy contributes to the global frame realization with accurate coordinates computed using continuously observed GPS data and satellite orbits. The GPS-based reference systems depend on physically stable ground-based GNSS networks as their primary foundations. NGS manages the CORS network to define, and provide access to, the NSRS. A planned modernization of the NSRS places greater importance on ties to the International Terrestrial Reference Frame (ITRF). NGS will support a healthy U.S. contribution to ITRF by installing or upgrading a subset of the current CORS network to the highest operational standards. To meet this need, NGS is working with key partners to identify, upgrade, and protect "Foundation" CORS stations, and with international scientific groups to designate these as global reference stations based on scientific merit such as collocation with other geodetic techniques, geographic distribution, and monument stability.

For more information about the CORS network in Alaska, contact NGS Kevin Choi (kevin.choi@noaa.gov).

Online Positioning User Service (OPUS)

The Online Positioning User Service (OPUS) provides simplified access to GPS-based NSRS coordinates on points of interest. OPUS requires minimal user input and uses software which computes coordinates using data from NGS CORS in combination with the user's survey-grade static GPS data from static observations of 15 minutes to 48 hours in duration. This NGS precise positioning service is presently used more than 8,000 times per year in Alaska, with more than 90% of users collecting data on points of interest for a minimum of two hours to generate an NSRS position.

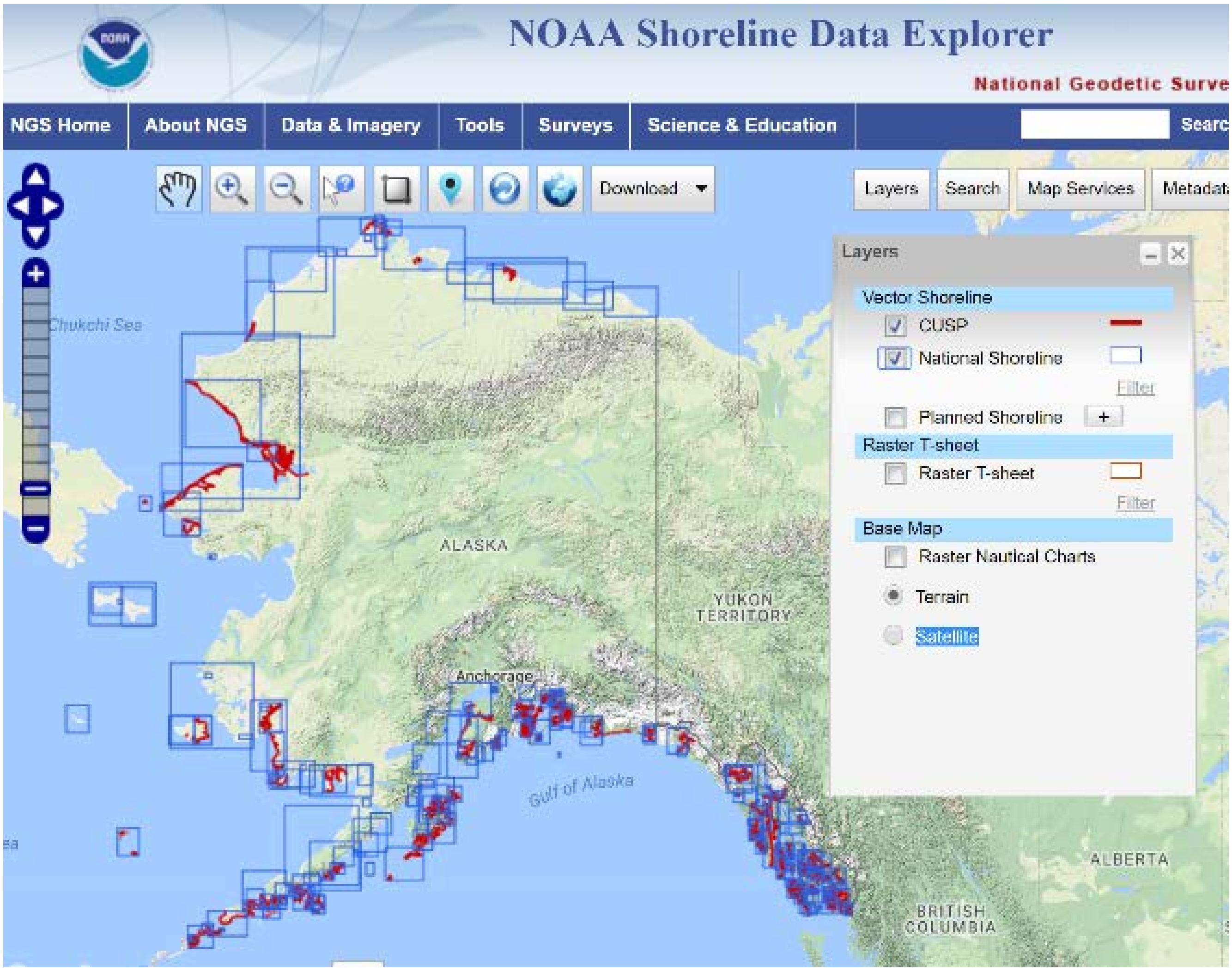
As NSRS access shifts from the passive network of geodetic control marks to GPS, the establishment of precise NSRS positions in remote parts of Alaska has become increasingly feasible. The blue regions on the map below illustrate user-assessed NSRS access in Alaska based on the existing CORS network; light blue areas require extended GPS occupation times of 4 or more hours to achieve the NSRS positional accuracies desired for typical surveying activities, whereas dark blue areas that are more proximal to CORS generally require GPS occupation times of less than 2 hours. For more information about OPUS NSRS access, contact NGS Joe Evjen (joe.evjen@noaa.gov).



Map of passive (monuments and benchmarks), active (continuous GPS and CORS sites), and real time (continuous GPS sites with broadcasting capabilities) geodetic control in Alaska. A higher resolution online version of this map is available from the Alaska Geospatial Council.

Shoreline coverages for Alaska

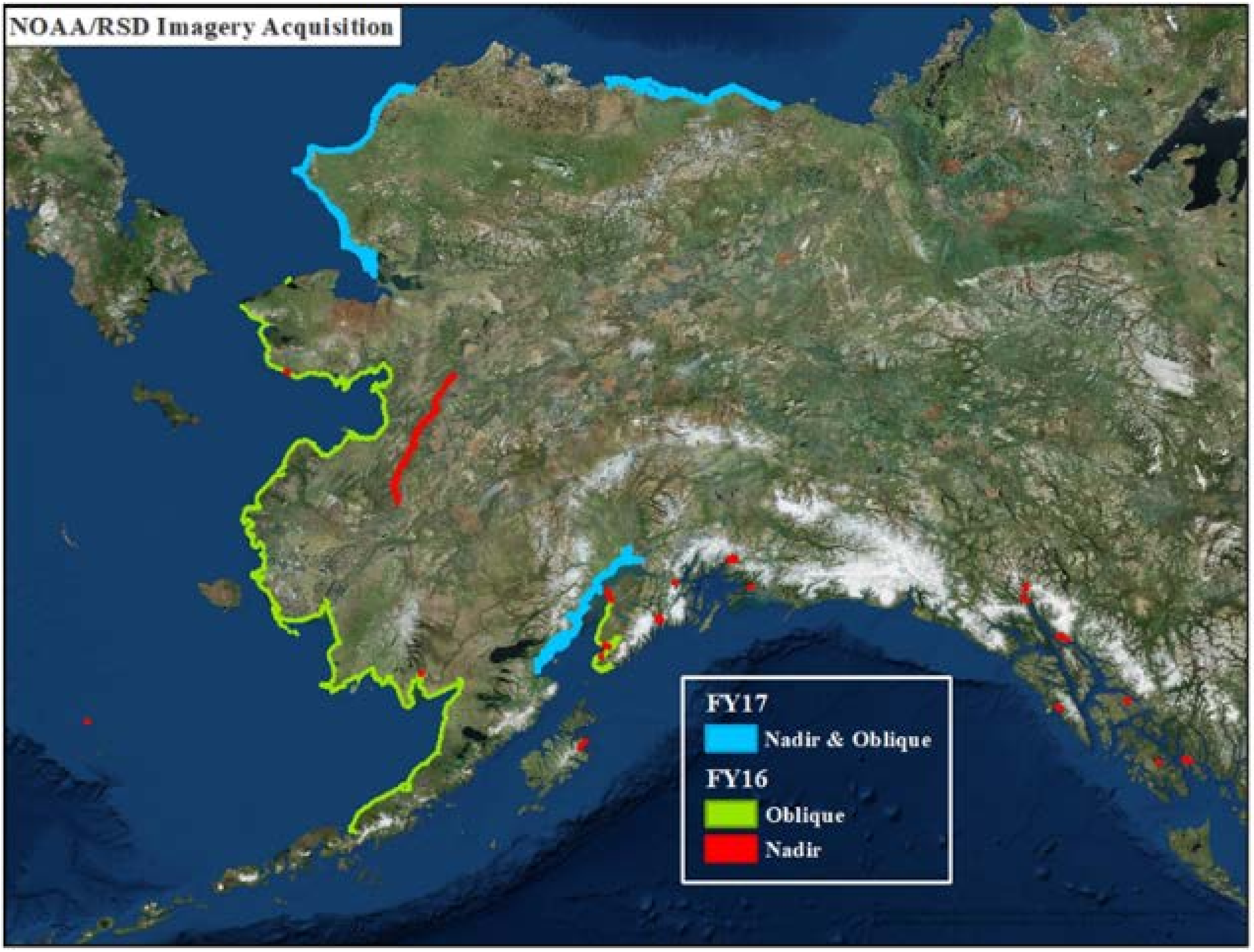
NOAA produces the national shoreline that provides critical baseline data for updating nautical charts; defining our nation's territorial limits, including the Exclusive Economic Zone; and managing our coastal resources.



NOAA NGS Shoreline Data Explorer.

NOAA's National Shoreline Geographic Cells (GCs) are displayed in blue boxes (above) and these GCs are in direct support of NOAA hydrographic operations both internal and contract. NOAA's continually updated shoreline product (CUSP) provides the most current shoreline representation of the U.S. and its territories. CUSP is built upon NGS national shoreline data and uses both NOAA and non-NOAA contemporary sources to replace vintage shoreline areas. The goal of CUSP is to represent the dynamic interface between land and water; therefore, CUSP is designed to deliver continuous shoreline with frequent updates.

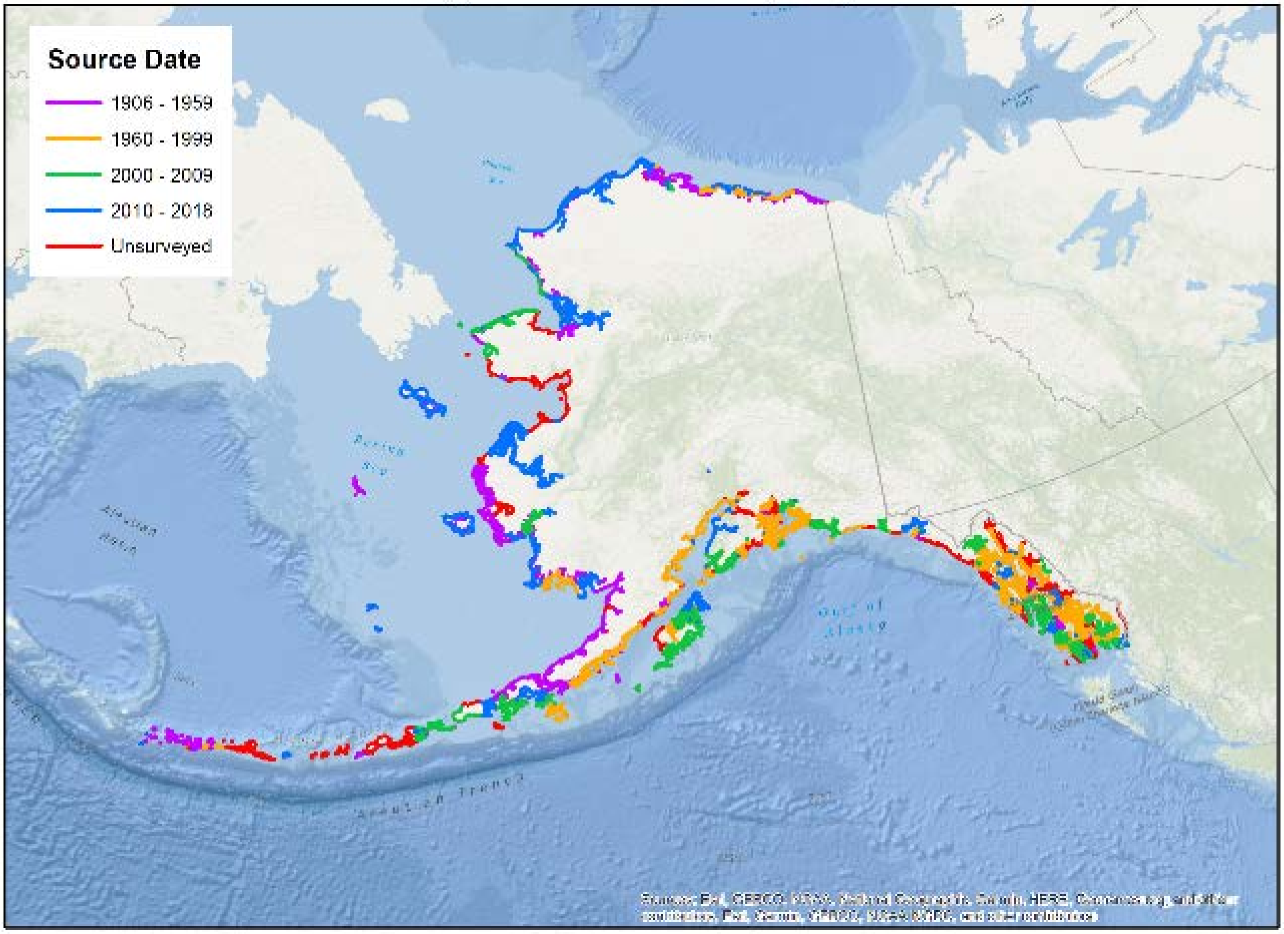
NOAA acquired oblique and nadir imagery in Alaska in 2016 and in 2017 but has no current plans for additional acquisition in FY18. Only the nadir imagery is being used for updating the national shoreline. The oblique imagery is used as baseline to assess damage from coastal storms and other coastal natural events.



NGS nadir and oblique imagery status.

Nadir and Oblique imagery are available on the NOAA AK Imagery website:
https://geodesy.noaa.gov/storm_archive/alaska/index.html.

Age of Shoreline in Alaska (2018)



Age of shoreline surveys in Alaska.

Emergency response imagery

NGS conducts flights to collect imagery after natural (hurricane, earthquake, tsunami, flood, and tornado) and man-made (oil spill) disasters. The high-resolution, geo-referenced airborne imagery, which support NGS' coastal mapping program, also support homeland security and Federal Emergency Management Agency (FEMA) requirements, as well as state and local interests. NGS posts the images on the web, often within hours, to make them available to the public.

NGS has been called on to collect emergency response imagery following many different types of disasters in 2016-2017, including the aftermath of Hurricanes Matthew, Harvey, Irma, and Maria. At the end of FY17, NGS calculated 64,848 images, 24,279 sq km, and 198.8 flight hours for these four hurricanes. NGS conducts surveys as requested by FEMA or a state, territory, or tribe in coordination with FEMA.

NGS collected emergency response imagery for all major hurricanes since 2003. From the imagery, those in charge of response and restoration can determine the effect of disasters on the land. For example, they can determine where flooding has wiped out parts of barrier islands and affected their formation. In 2013, NGS enhanced its imagery collection by developing hardware, software, and processes to allow for the collection of oblique aerial imagery. In 2015, NGS began collecting pre-event imagery along most of the U.S. shoreline using oblique imagery. Currently, NGS has collected pre-event imagery for the majority of the contiguous United States outer coast. While NGS has not had emergency requirements in Alaska, the oblique imagery NGS collected in 2016 and 2017 serves as a baseline to assess damage and impacts from coastal storms and other natural coastal events.