National Park Service
U.S. Department of the Interior

Natural Resource Stewardship and Science

Shoreline Change at Canaveral National Seashore

2018–2019 Data Summary

Natural Resource Data Series NPS/SECN/NRDS—2020/1255



ON THE COVER
Picture taken at the south end of Playa Linda, facing north, during the spring 2018 shoreline data collection effort.
NPS Photo / SECN

Shoreline Change at Canaveral National Seashore
2018–2019 Data Summary

Natural Resource Data Series NPS/SECN/NRDS—2020/1255

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U.S. Department of the Interior
National Park Service
Natural Resource Stewardship and Science
Fort Collins, Colorado

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All manuscripts in the series receive the appropriate level of peer review to ensure that the information is scientifically credible, technically accurate, appropriately written for the intended audience, and designed and published in a professional manner. Data in this report were collected and analyzed using methods based on established, peer-reviewed protocols and were analyzed and interpreted within the guidelines of the protocols.

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Acknowledgments

This report was completed with the assistance of Kelsey Mack (SECN Coastal Monitoring Intern) and previous work performed by Jason Gardner (previous Coastal Monitoring Technician). Mike Cooper (previous Canaveral National Seashore Biotech) and CANA VIPs, Ed Link and Joe Barolet, assisted in data collection efforts of the 2018 and 2019 data collection. Thank you for your assistance and efforts that facilitated the creation of this report.

Summary and Key Findings

In 2018 and 2019 the Southeast Coast Network collected shoreline data at Canaveral National Seashore as a part of the NPS Vital Signs Monitoring Program.

Monitoring was conducted following methods developed by the National Park Service Northeast Barrier Coast Network and consisted of mapping the high tide swash line using a global positioning system (GPS) unit in the spring of each year (Psuty et al. 2010). Shoreline change was calculated using the Digital Shoreline Analysis System developed by USGS (Theiler et al. 2008).

Key findings from this effort are as follows:

- A mean of 39.02 kilometers (24.25 miles [mi])of shoreline were mapped from 2018 to 2019 with a mean horizontal accuracy of 10.10 centimeters (3.98 inches [in]).
- The mean shoreline distance change from 2018 to 2019 was 7.30 meters (23.95 feet [ft]) with a standard deviation of 3.32 meters (10.89 ft). The shoreline change distance ranged from -2.59 meters to 21.03 meters (-8.50 to 69.00 ft).
- No high erosion areas were identified in the study area because no transects were located in areas where the shoreline distance change was beyond the uncertainty range of the data (± 10 meters [32.8 ft]).
- Accretion was present in the 2018 to 2019 shoreline survey analysis. 20.6 % of the transects were located in areas of accretion beyond the uncertainty range of the data (± 10 meters [32.8 ft]), which can be inferred that accretion occurred along a cumulative 7.92 kilometers (4.92 mi) of the study area surveyed.

Introduction

The problem of land loss and gain and landscape alteration at the marine edge is fundamental to the many issues facing coastal park resource stewards. Shoreline change is a prime geoindicator of coastal environmental resource threats within parks. Change in shoreline position drives the alteration and replacement of established natural habitats, and shoreline retreat may destroy cultural resources, facilities, and other infrastructure. Geomorphologic change is a basic concern because it also influences change in other natural resource areas of interest within the National Park Service such as estuarine and subsurface water quality, species and habitats of concern, recreational visitor use, and even resource extraction. Spatial variability is inherent in shoreline change. Early identification of changes in past trends, along with an understanding of normal variability, is key to recognizing ecological problems in coastal parks. For managers, an understanding of the spatial and temporal patterns of geomorphologic change is important for optimal management of any coastal park because: (1) the interface of marine and land systems is very dynamic and is driven by multiple forcing mechanisms, (2) it results in alterations to resource patterns and dynamics at habitat and ecosystem level, and (3) it will eventually result in the loss of static resources. Developing an understanding of these effects will benefit from the establishment of local long-term monitoring programs.

To effectively monitor diverse and dynamic coastal resources, the Southeast Coast Network has implemented a monitoring approach which consists of mapping the high tide swash line along the oceanfront beaches using GPS equipment. The data collected is post-processed to attain higher accuracy data and analyzed using the Digital Shoreline Analysis System (DSAS) created by USGS (Theiler et al. 2008). This approach is modeled after the *Northeast Coastal Barrier Network Geomorphological Protocol: Part 1—Ocean Shoreline Position* (Psuty et al. 2010).

The monitoring objectives for which data are collected and analyzed as part of this effort are (Baron 2018a):

1. Determine inter-annual changes in mean high-water shoreline position (average and standard deviation of change in position at fixed transects, and cumulatively within management units).

2. Determine the magnitude, direction, and spatial distribution of observed shoreline change including the identification of areas of highly dynamic shorelines, and areas of accretion versus erosion.

This report provides a summary of shoreline monitoring data collected by the network to address these objectives at Canaveral National Seashore (CANA) from 2018 through 2019 (Figure 1). Data used in this report are available at https://irma.nps.gov/DataStore/Reference/Profile/2267045.

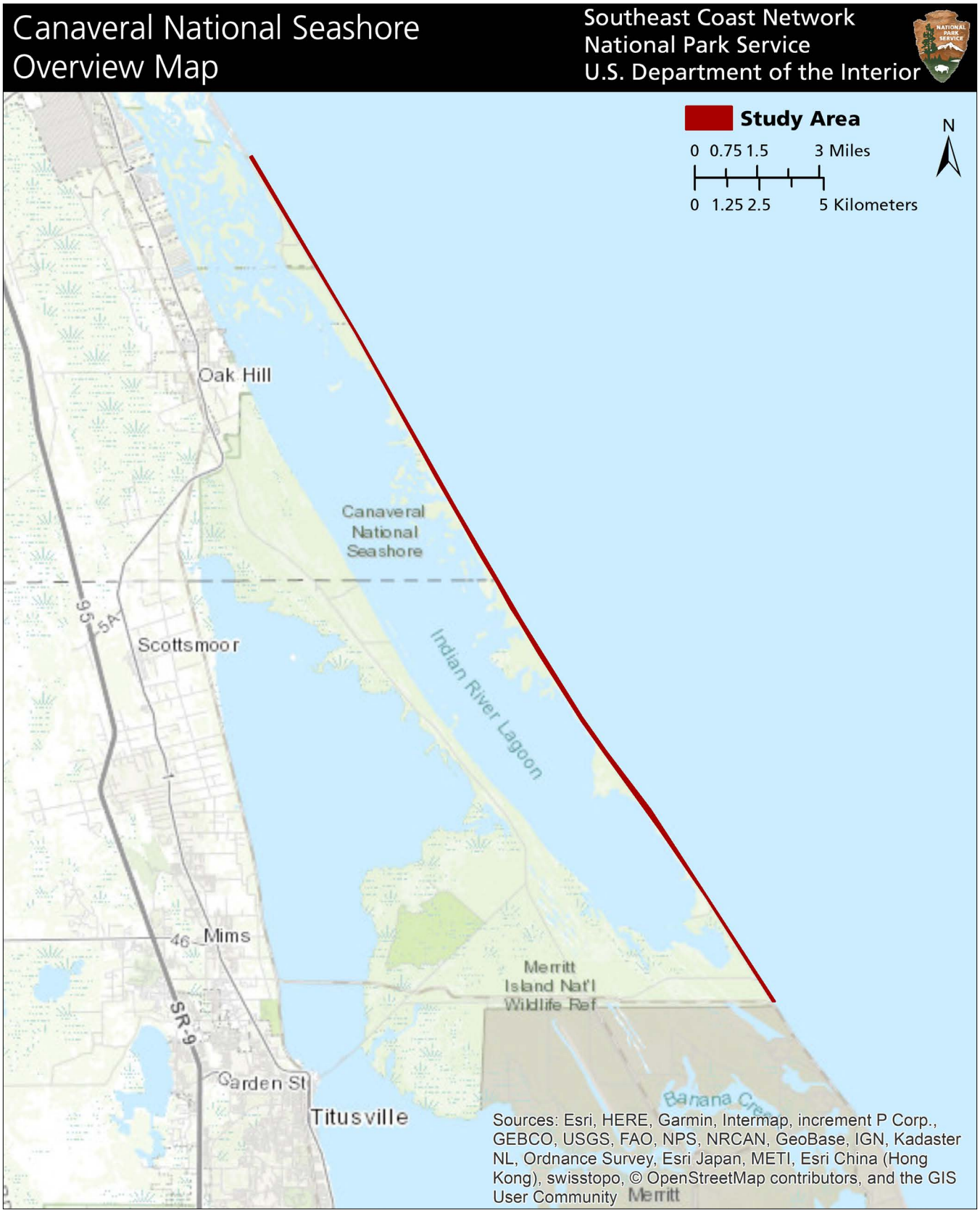


Figure 1. Map showing the section of beach, highlighted in red (study area) where data is collected for the shoreline monitoring project. The entire shoreline of Canaveral NS, from the north park boundary to the south park boundary, is monitored.

Study Area

Canaveral National Seashore is a 24-mile (38.6-kilometer) stretch of shoreline. Unlike many other barrier islands, CANA has only a single dune ridge, averaging approximately 12 ft (3.7 m) in height. For the vast majority of its length the dune is quite stable, backed by a dense growth of saw palmetto (Serenoa repens) and several other species of hardy shrubs and grasses (DeVivo et. al 2015). Being directly in the track of Hurricane Alley—a section of warm water that runs from the northwest coast of Africa into the Gulf of Mexico and the east coast of the United States—Canaveral National Seashore is exposed to many strong storms each year, which make for a very dynamic and ever changing area.

The seashore supports a dense population of nesting sea turtles every summer and is an important area for migratory and nesting birds, many of which are threatened or endangered. Also, scattered throughout the seashore are cultural resources such sensitive Native American sites like Turtle Mound, historic buildings such as the Eldora house and surrounding structures that could potentially be affected with a rise in sea level. Since important lands such as NASA's Kennedy Space Center and Merritt Island NWR and many communities like New Smyrna, Edgewater, and Titusville surround the Seashore, it is important that the island's lands and resources are monitored closely. Even the slightest change could affect many nearby regions.

The purpose of this report is to deliver the most recently-collected data from within the park as part of an ongoing long-term shoreline-change monitoring program.

Methods

Standard Operating Procedures

Table 1 lists the Standard Operating Procedures (SOPs) utilized in the long-term shoreline monitoring data collection, processing, and reporting. These SOPs are critical to maintaining continuity between data sets across many surveys to ensure comparable results. The version numbers in the table apply to both 2018 and 2019 data sets.

The shoreline was mapped along the oceanfront sandy shoreline of Canaveral National Seashore following the methods developed by the National Park Service Northeast Coast Barrier Network (Psuty et al. 2010). The Digital Shoreline Analysis System (DSAS; Theiler et al. 2008) was used to analyze the shoreline change. Annual shoreline change distances were calculated by determining the distance between two shorelines. Shoreline surveys were collected in 2018 and 2019; therefore, the shoreline change that occurred between those two time periods is analyzed in this report (Appendix A).

As stated in SOP 2.3.11 *Coastal Shoreline Monitoring Annual Change Analysis—Version 1.0* (Baron 2018b), the uncertainty of the individual shoreline survey is ± 5 meters (16.4 ft]). This value is derived from the: (1) GPS accuracy, (2) differential tide position, (3) meteorological effects–wave dimension and run-up, and (4) interpretation of the line (Psuty et al. 2010). The annual comparisons deduced using two individual shoreline surveys will have an uncertainty of ± 10 meters (32.8 ft; Psuty et al. 2010). Refer to Psuty et al. 2010 for additional information regarding shoreline survey uncertainty.

Shoreline Data Collection

Shoreline data is collected according to SOP 1.3.22 *Conducting the Shoreline Survey—Version 1.0* (Baron 2018c). The high tide swash line is mapped using a Trimble® GPS unit. The data collected is post-processed according to SOP 2.3.10 *Post survey GPS data processing—Version 1.0* (Baron 2018d) using Pathfinder Office software to obtain higher accuracy data. The corrected data is exported as an ESRI shapefile. The ESRI shapefile is then edited, formatted, and uploaded to a personal geodatabase to analyze using DSAS.

Shoreline Change Analysis

The two shorelines were analyzed using DSAS. The annual shoreline change was performed by analyzing the 2018 and 2019 shoreline data collected. The 2018 shoreline was collected on 26 March 2018 and the 2019 shoreline was collected on 29 April 2019. The two shorelines were analyzed by calculating the distance the high tide line has moved from 2018 to 2019, along cross-shore transects spaced 10 meters (32.8 ft) apart. This analysis is termed "net shoreline movement" in DSAS.

High erosion areas were determined as areas having negative shoreline change distance less than the uncertainty range of the data (± 10 meters [32.8 ft]). Accretion areas were determined as locations with positive shoreline change distances greater than the uncertainty range (± 10 meters [32.8 ft]).

Table 1. SOPs used for shoreline position data collection, processing, and reporting

SOP number	SOP title	SOP version
1.3.21	Survey timing and GPS mission planning	1.0
1.3.22	Conducting the GPS shoreline survey	1.0
2.3.10	Post survey GPS data processing	1.0
2.3.11	Coastal shoreline monitoring annual change analysis	1.0
2.3.09	Coastal shoreline monitoring annual reporting	1.0

Water Levels

Two shoreline surveys of the high tide swash line included in this report were conducted during neap tides. The survey window was chosen based on the predicted tides using the closest NOAA tide gage with predicted tides (Trident Pier, FL - Station ID: 8721604; National Ocean and Atmospheric Administration, 2013). The actual tide heights that occurred before the surveys included in this annual report are listed in Table 2. The two previous high tides prior to the shoreline surveys conducted have similar water levels. The 2018 high tide line height is 0.34 meters (1.11 ft) higher than the 2019 high tide line height. This tidal difference can influence the position of the high tide line along the beach, based on the topography of the beach.

Table 2. High tide levels surveyed for the spring CANA shoreline monitoring (m—meters).

Season	Survey collection date	Previous high tide height* (m)	Previous high tide time
Spring 2018	3/26/2018	1.33	0400
Spring 2019	4/29/2019	0.99	0438

* Tide heights are relative to Mean Lower Low Water, Trident Pier, FL—Station ID 8721604

Results

Shoreline Data

Shoreline data was collected in 2018 and 2019. On average, 39.02 kilometers (24.3 miles [mi]) of shoreline were mapped during the time period analyzed with a mean horizontal error of 10.10 centimeters (3.98 in; Table 3).

Annual Shoreline Change

Appendix B contains maps of the Spring shoreline change distances calculated for the 2018 and 2019 shoreline data collected. The annual shoreline change distance is displayed by the transects between the two shorelines, which are clipped to the extent of shoreline change envelope and colored according to the shoreline change rate. A negative shoreline change distance denotes erosion, shown in warmer colors (if present). Positive shoreline change distance is depicting accretion, and is shown in cooler colors (if present). Shoreline change distance ranged from -2.59 meters (-8.50 ft) to 21.03 meters (69.00 ft). The mean shoreline distance change for the area mapped was 7.30 meters (23.95 ft) with a standard deviation of 3.32 meters (10.89 ft).

No high erosion areas were present in the study area. High accretion occurred within the study area, represented as orange, green, teal, and blue transects in the maps in Appendix B. High accretion was identified for 20.58 % of the transects (792 of 3849) in the analysis (Figure 2). Because the transects are located every 10 meters (32.8 ft) along the baseline, it can be inferred that high accretion occurred along a cumulative 7.92 kilometers (4.92 mi) of the study area surveyed.

Data used in this report are available at https://irma.nps.gov/DataStore/Reference/Profile/2267045.

Table 3. Table listing the length and positional error of the shorelines collected during 2018 and 2019 with the mean length and horizontal precision calculated by averaging across the entire shoreline feature [cm—centimeters; km—kilometers].

Collection Date	Mean Horizontal Accuracy (cm)	Length (km)
3/26/2018	10.05	39.09
4/29/2019	10.15	38.95

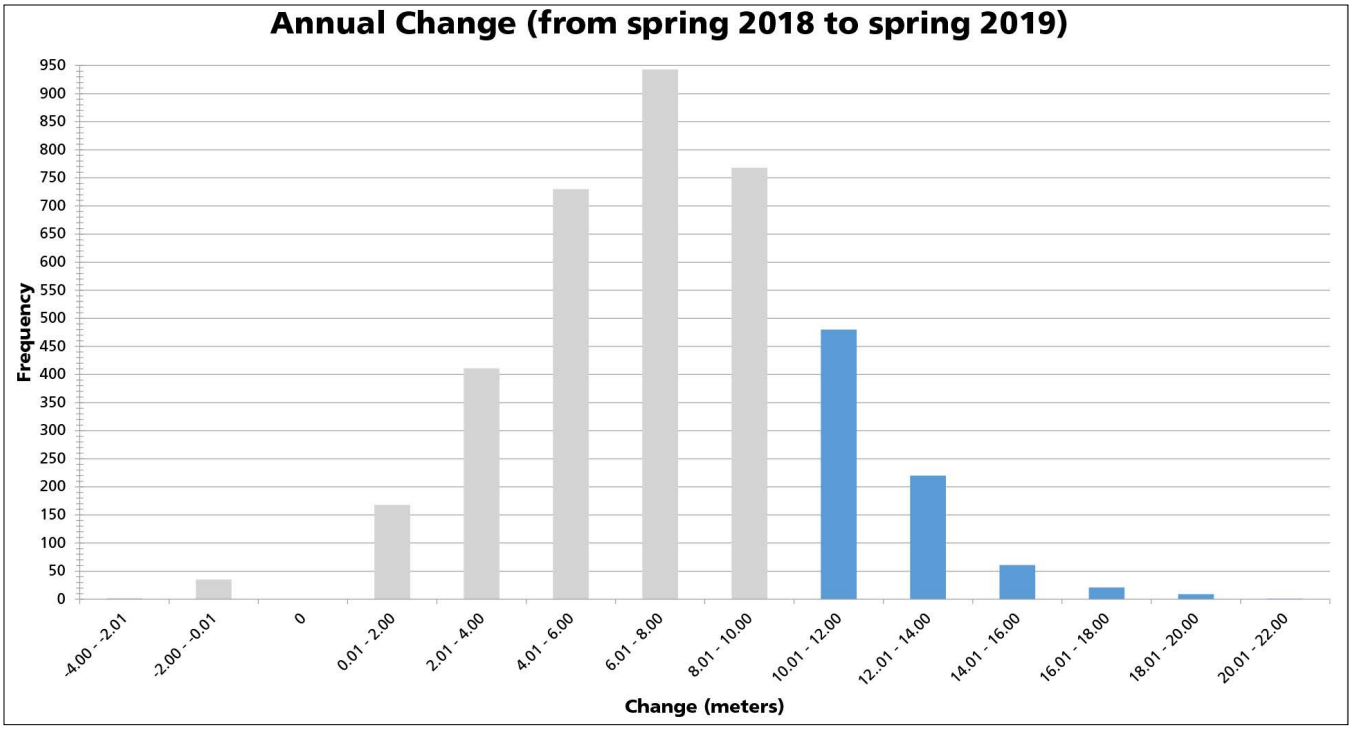


Figure 2. Histogram of transect shoreline change distances. The shoreline change distance is binned by 2-meter (6.56 ft) increments. The values along the x-axis represent the bin range. High erosion transects are presented as red (if present), transects that fall within the uncertainty range of the data (± 10 meters [32.8 ft]) are represented as grey, and the high accretion transects are represented as blue.

Literature Cited

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Appendix A. Shoreline Data Collection Maps

Maps of the shoreline surveys collected from 2018 to 2019 at Canaveral National Seashore. The shoreline survey collected in 2018 is shown as a solid black line and the shoreline survey collected in 2019 is shown as a dotted black line.



Figure A-1. Map of the shoreline surveys from mile marker 0 to 4.



Figure A-2. Map of the shoreline surveys from mile marker 4 to 7.



Figure A-3. Map of the shoreline surveys from mile marker 7 to 10



Figure A-4. Map of the shoreline surveys from mile marker 10 to 13



Figure A-5. Map of the shoreline surveys from mile marker 14 to 17



Figure A-6. Map of the shoreline surveys from mile marker 17 to 20



Figure A-7. Map of the shoreline surveys from mile marker 21 to 24



Figure A-8. Map of the shoreline surveys from mile marker 24 to 27



Figure A-9. Map of the shoreline surveys from mile marker 28 to 31

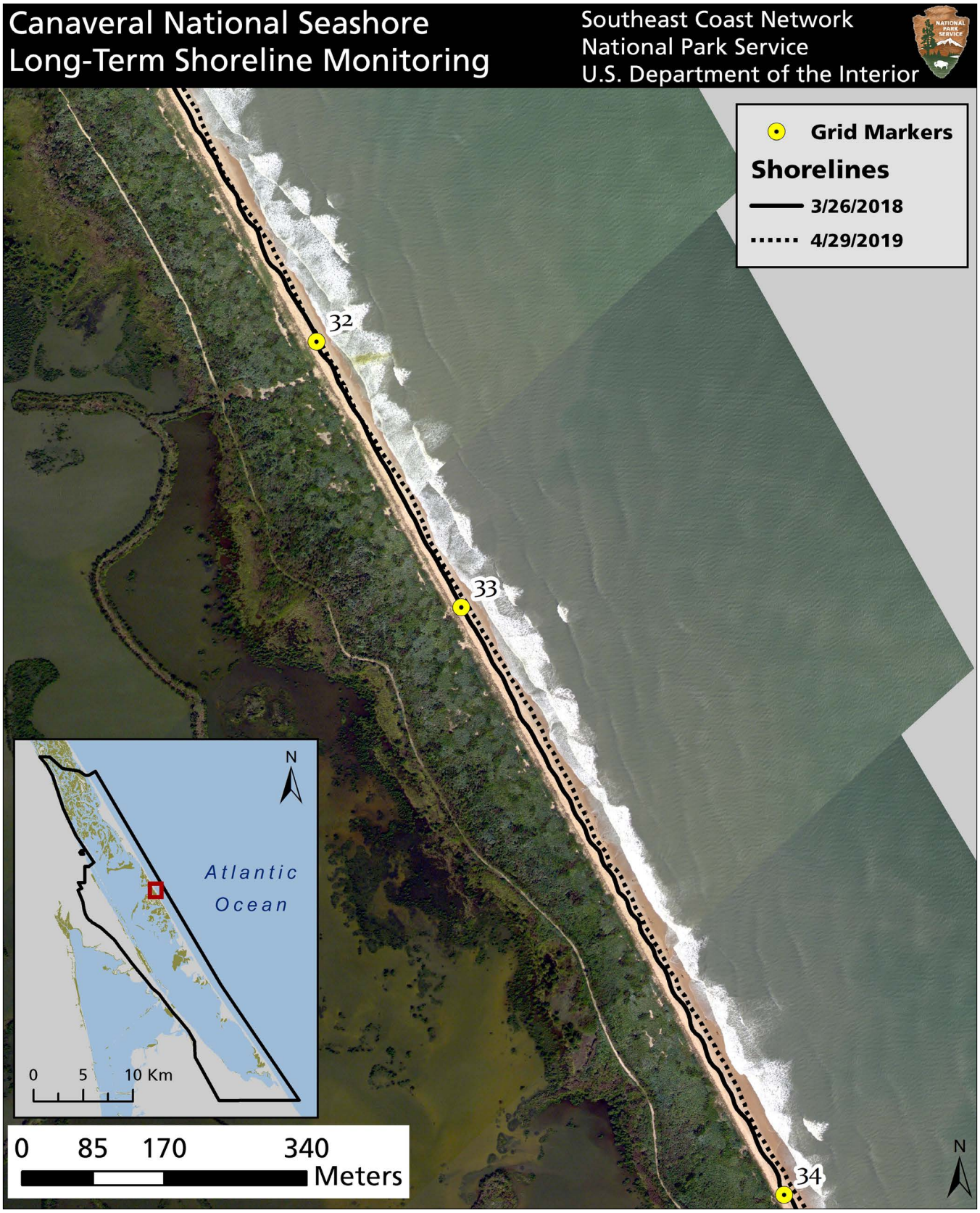


Figure A-10. Map of the shoreline surveys from mile marker 32 to 34



Figure A-11. Map of the shoreline surveys from mile marker 34 to 37



Figure A-12. Map of the shoreline surveys from mile marker 38 to 41

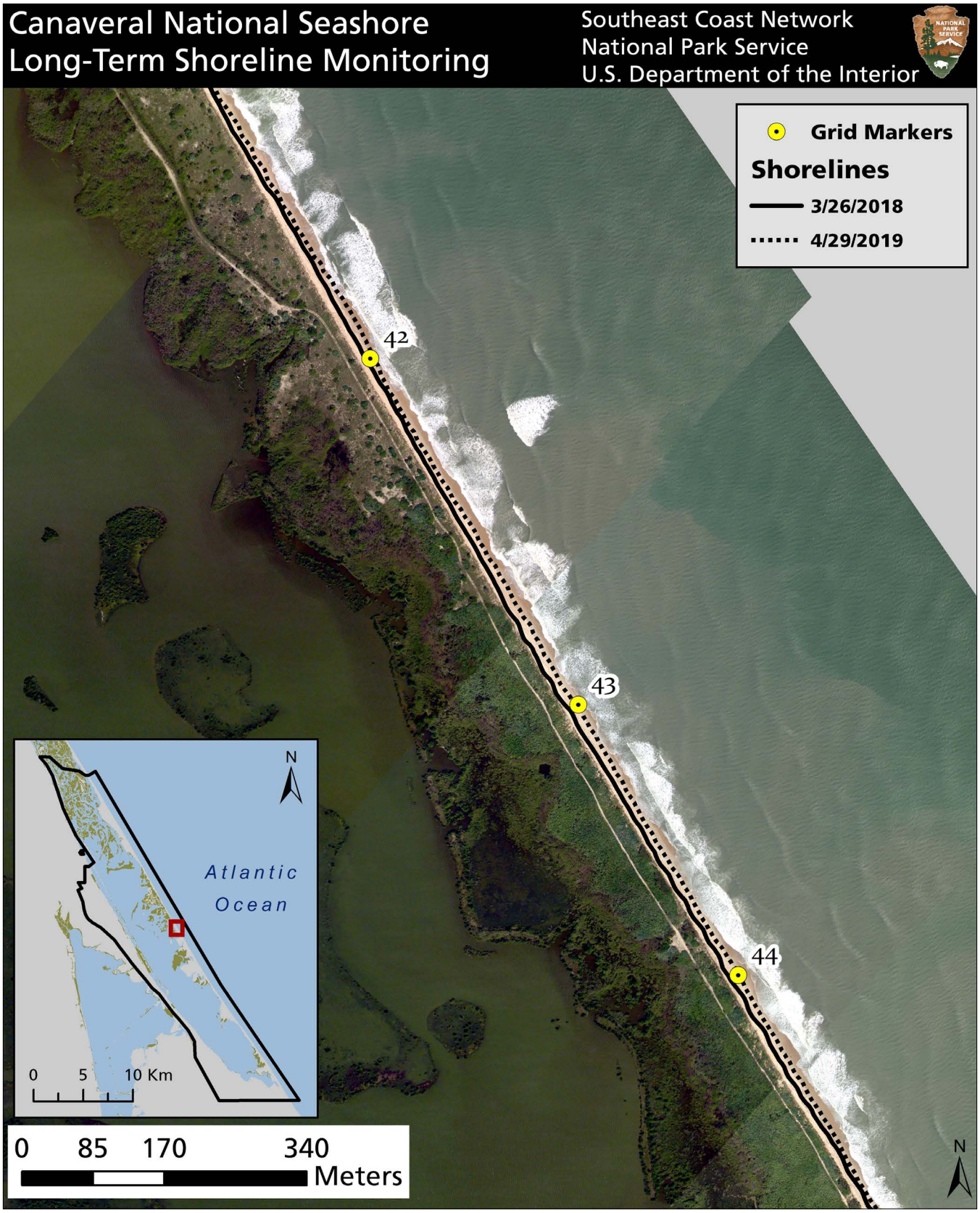


Figure A-13. Map of the shoreline surveys from mile marker 42 to 44



Figure A-14. Map of the shoreline surveys from mile marker 45 to 48

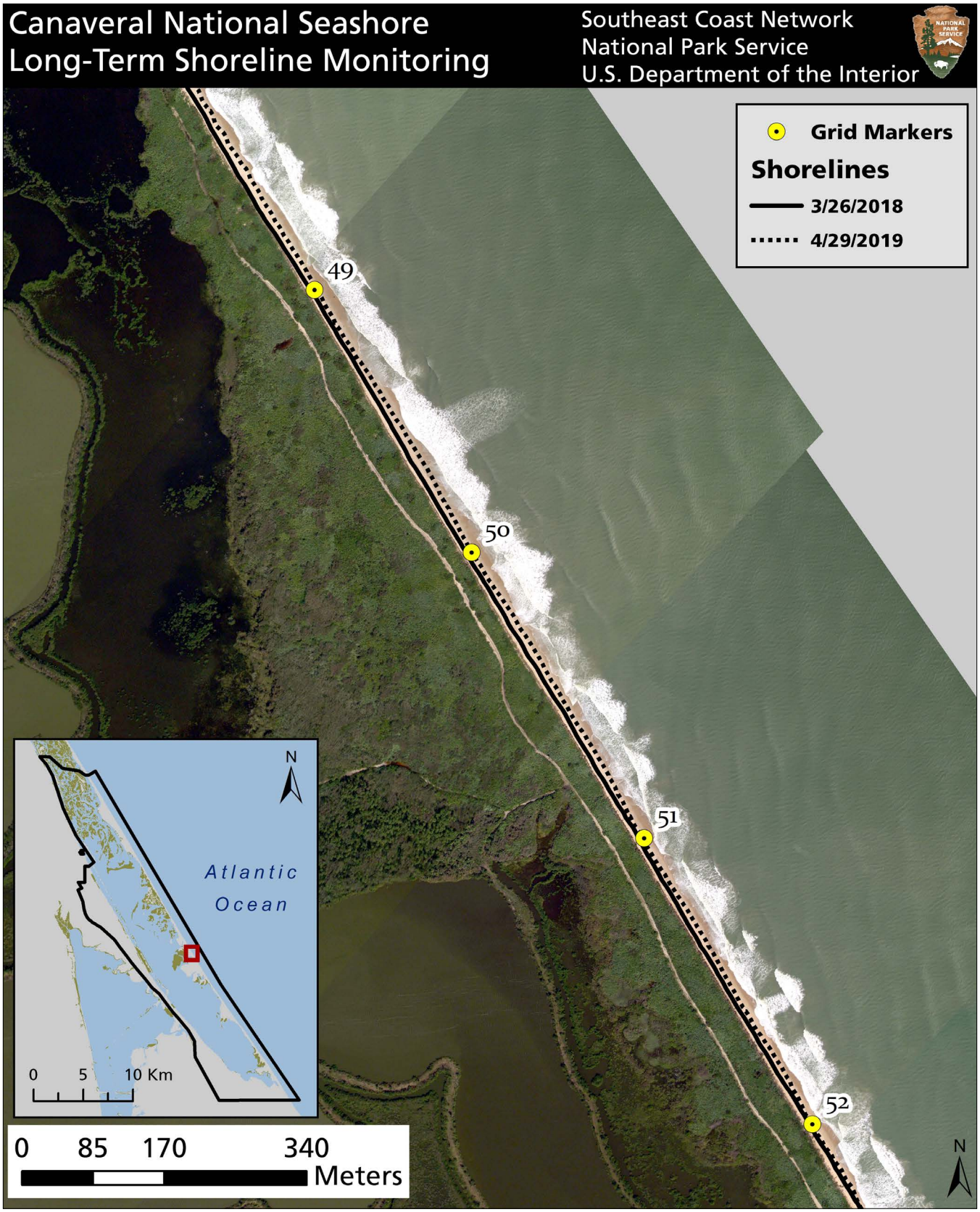


Figure A-15. Map of the shoreline surveys from mile marker 49 to 52

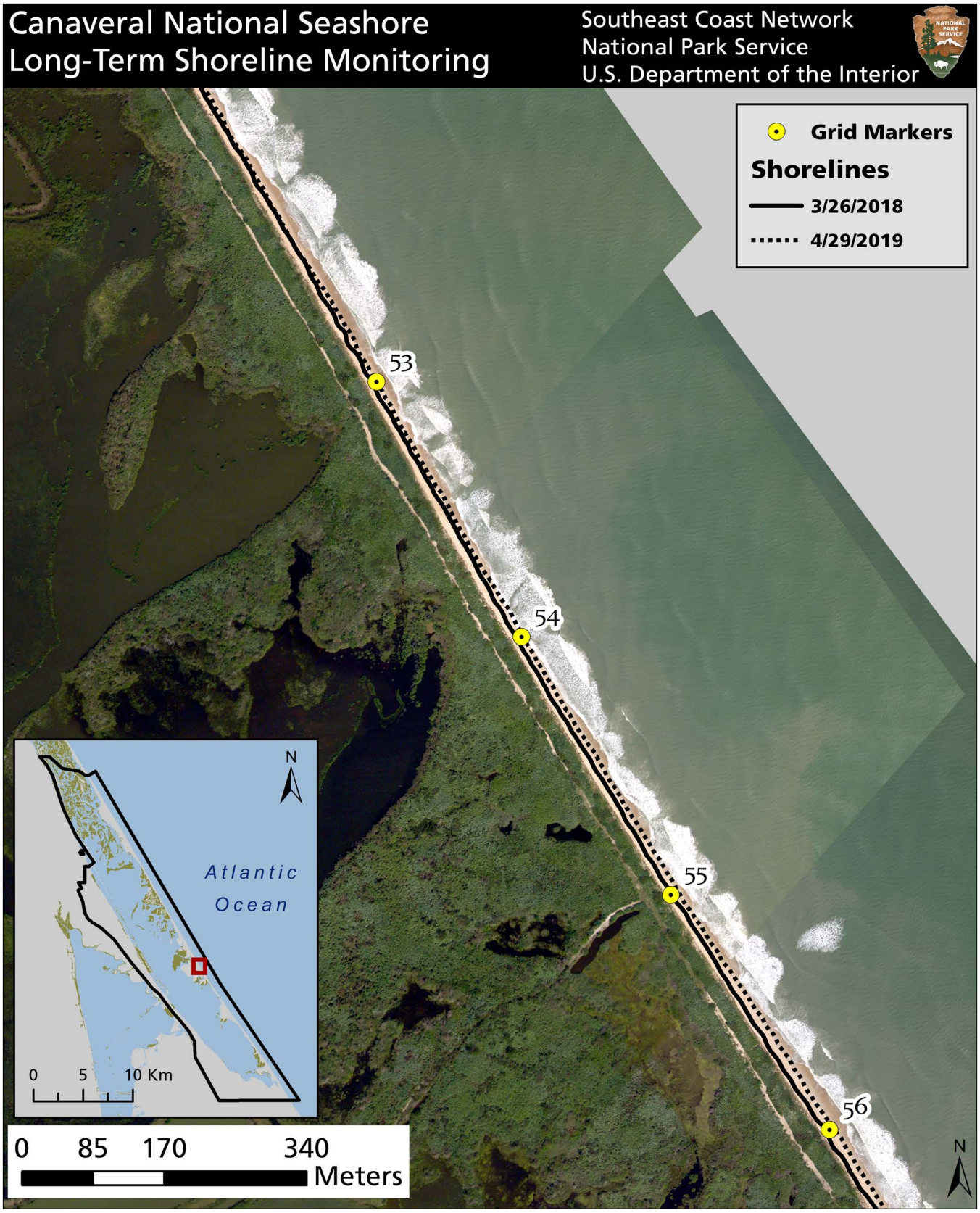


Figure A-16. Map of the shoreline surveys from mile marker 53 to 56

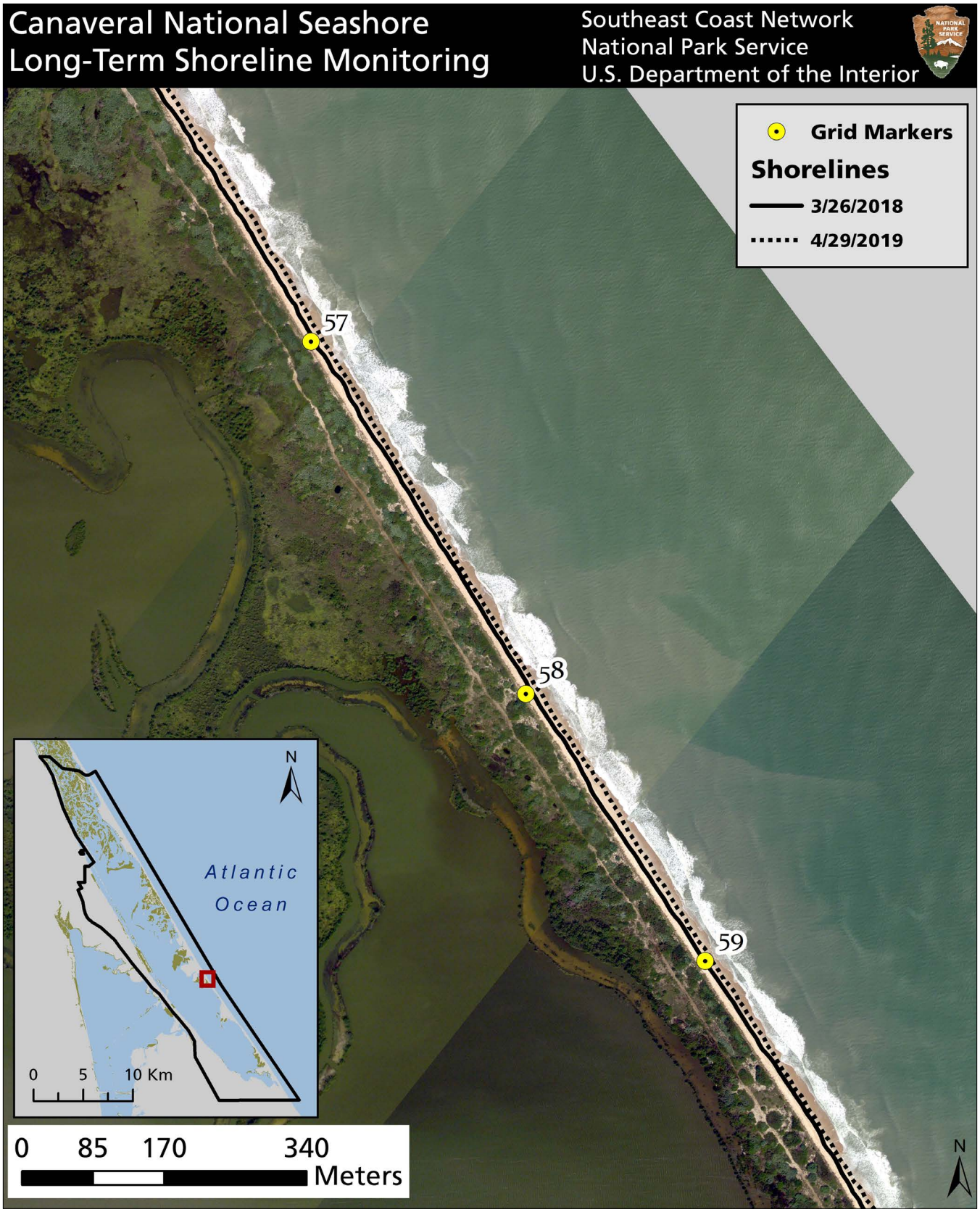


Figure A-17. Map of the shoreline surveys from mile marker 57 to 59



Figure A-18. Map of the shoreline surveys from mile marker 60 to 63

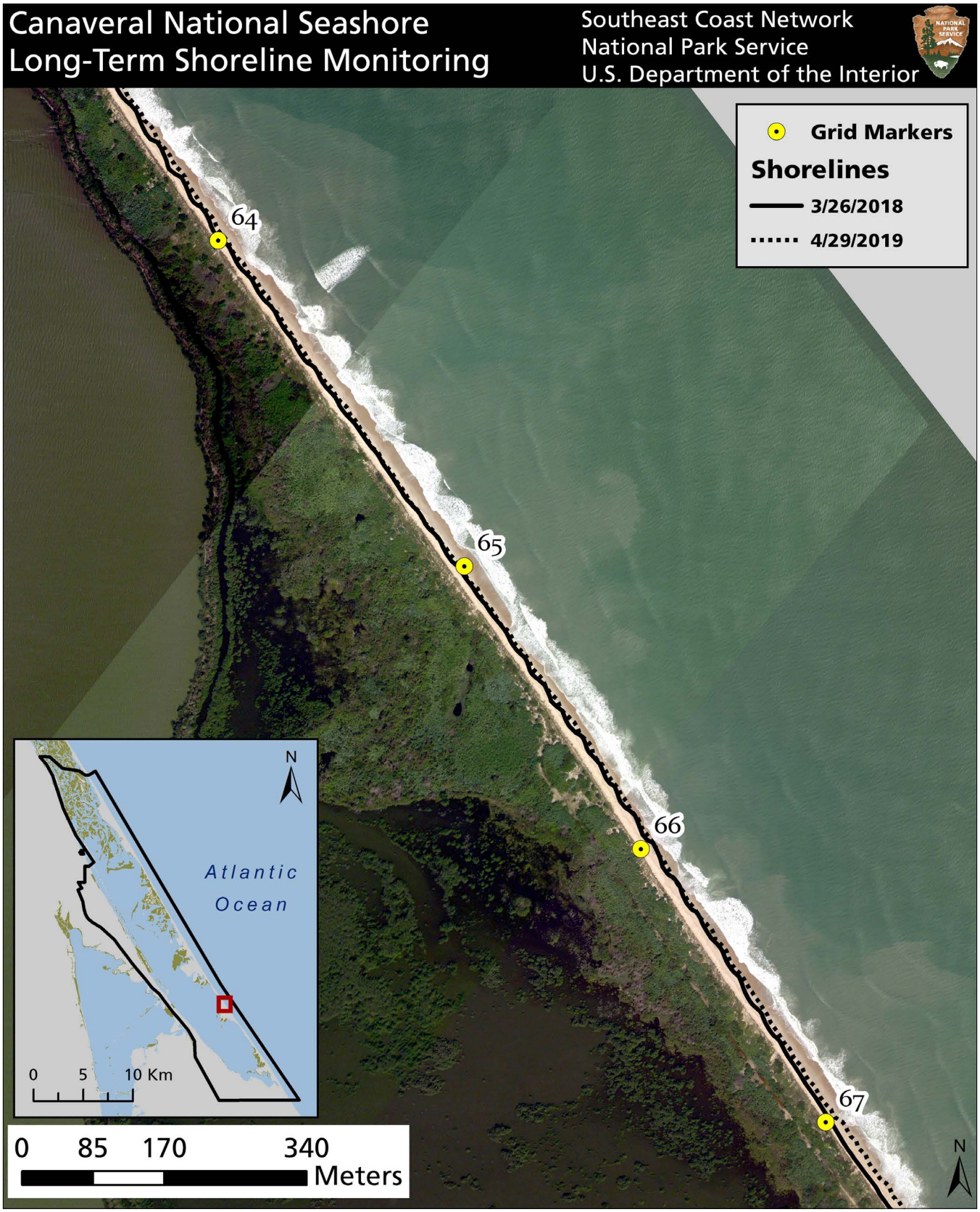


Figure A-19. Map of the shoreline surveys from mile marker 64 to 67



Figure A-20. Map of the shoreline surveys from mile marker 68 to 71

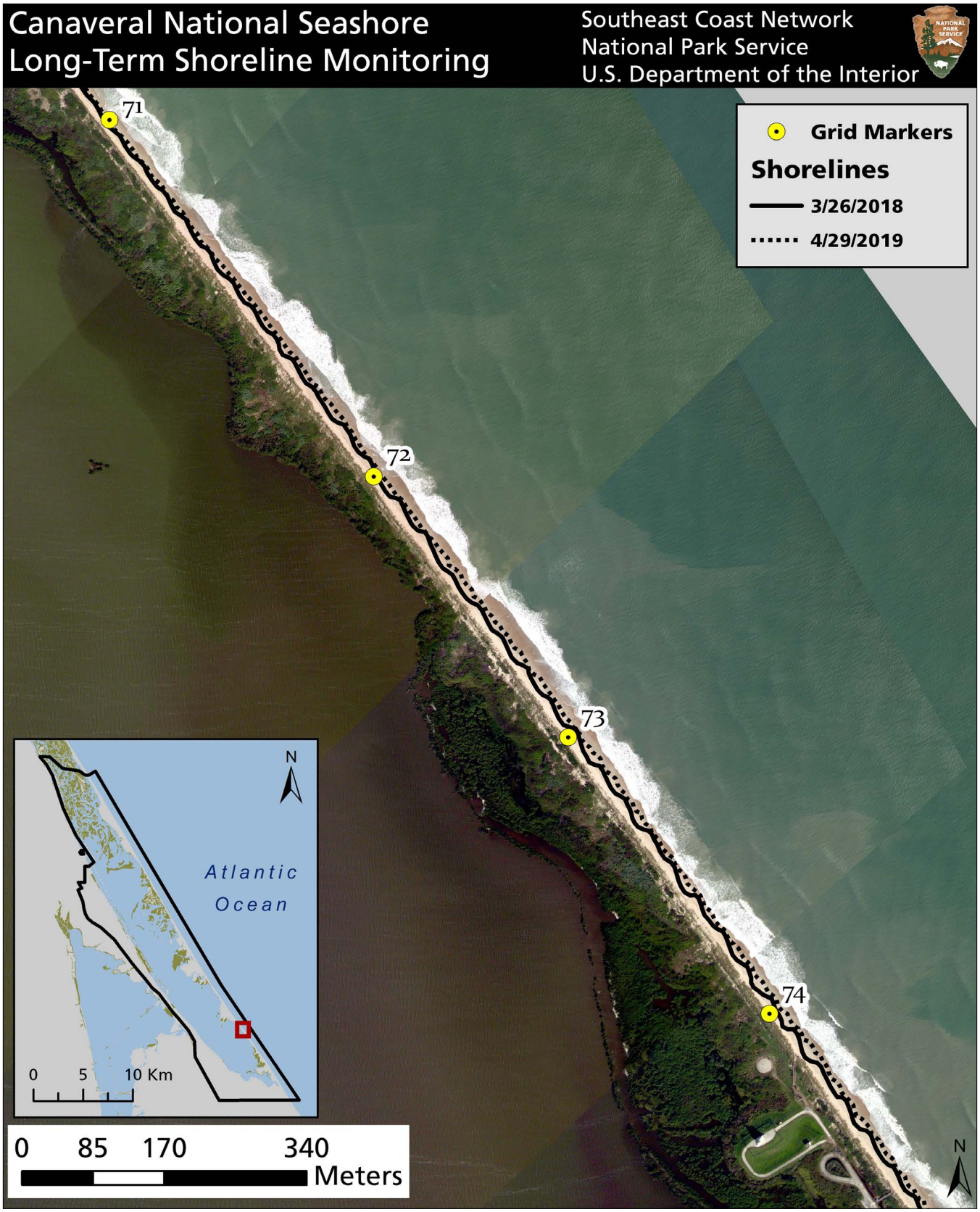


Figure A-21. Map of the shoreline surveys from mile marker 71 to 74

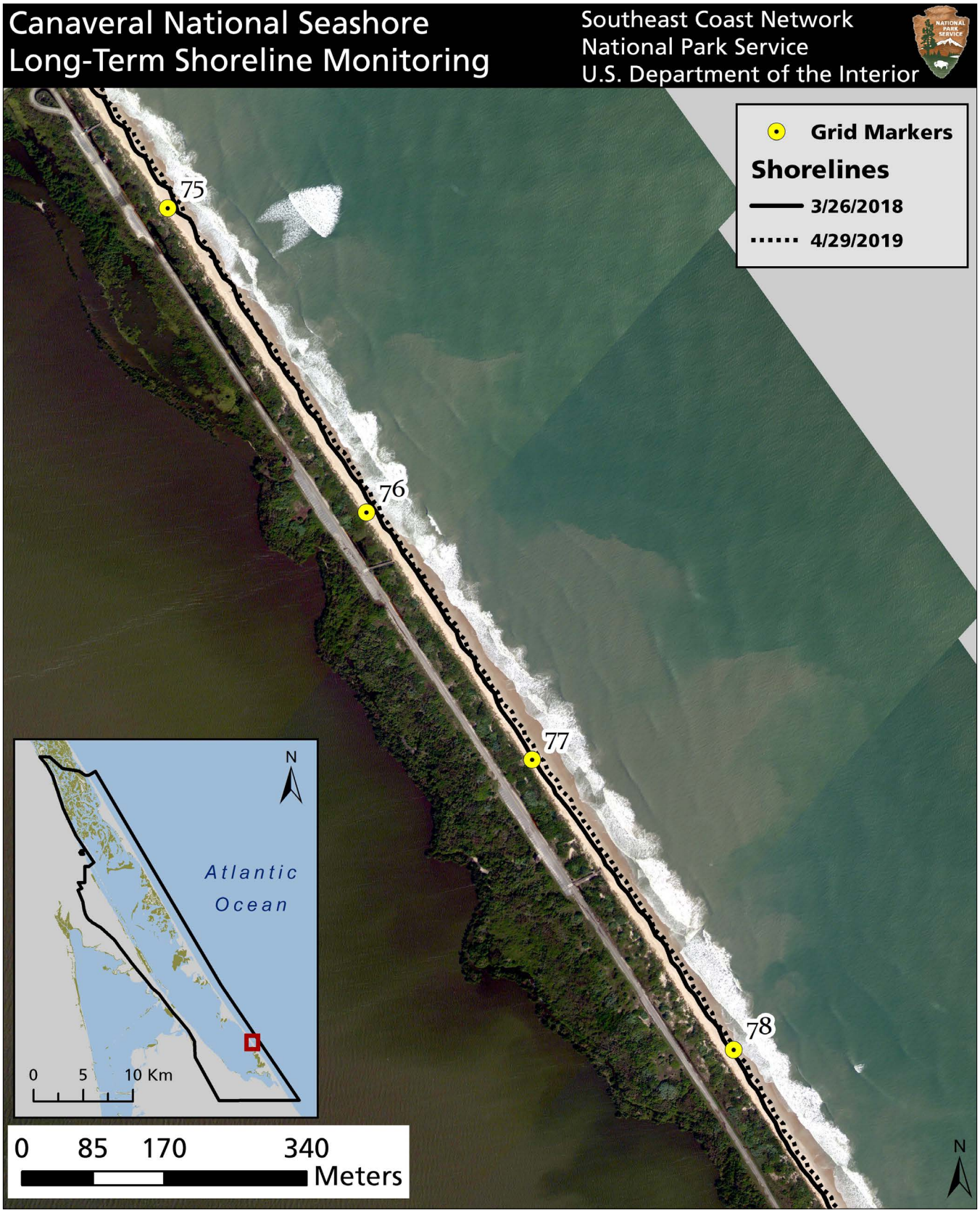


Figure A-22. Map of the shoreline surveys from mile marker 75 to 78



Figure A-23. Map of the shoreline surveys from mile marker 79 to 82



Figure A-24. Map of the shoreline surveys from mile marker 83 to 86



Figure A-25. Map of the shoreline surveys from mile marker 87 to 90



Figure A-26. Map of the shoreline surveys from mile marker 91 to 94

Appendix B. Shoreline Change Distance Maps

Maps of shoreline change distance (meters) for the 2018 and 2019 surveys collected. The more negative shoreline change denotes more erosion and is shown in warmer colors (if present). The less negative shoreline change denotes less erosion and in some cases can represent accretion (when positive), and is displayed as cooler colors (green, light blue, and dark blue). The grey transects denote shoreline change distance within the error range of the data (±10 meters [32.8 ft]).

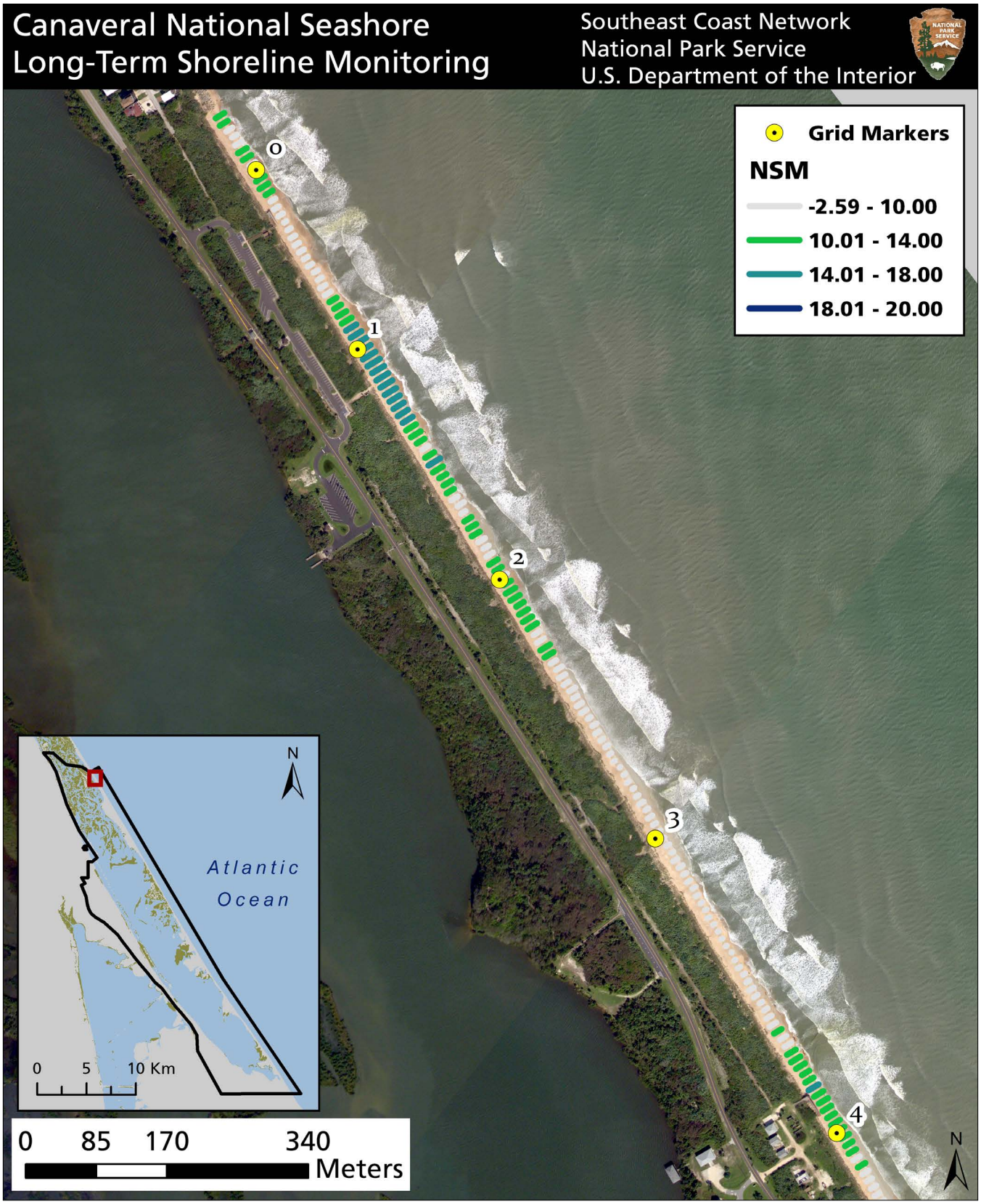


Figure B-1. Map of shoreline change distance (meters) for mile markers 0 to 4.

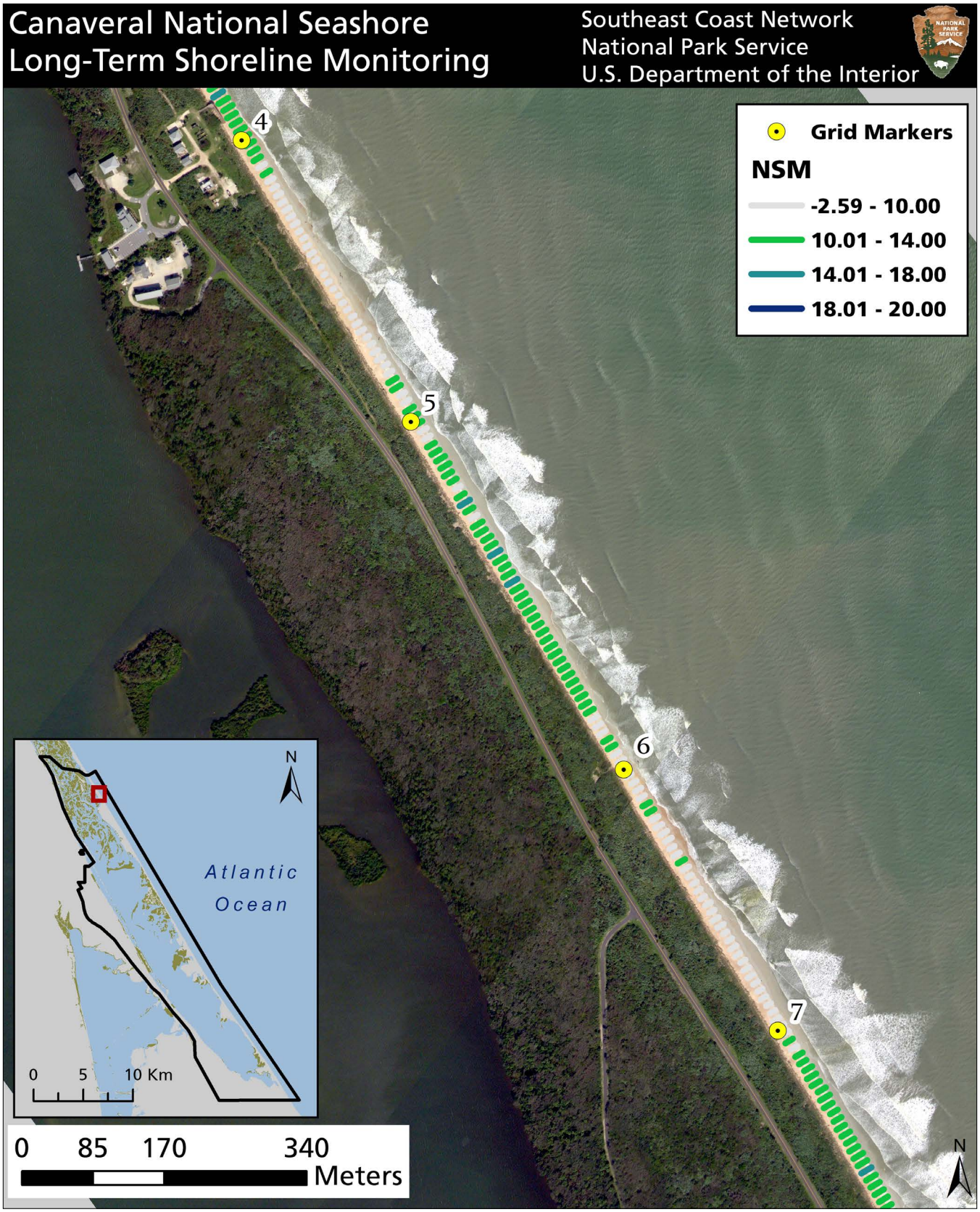


Figure B-2. Map of shoreline change distance (meters) for mile markers 4 to 7.

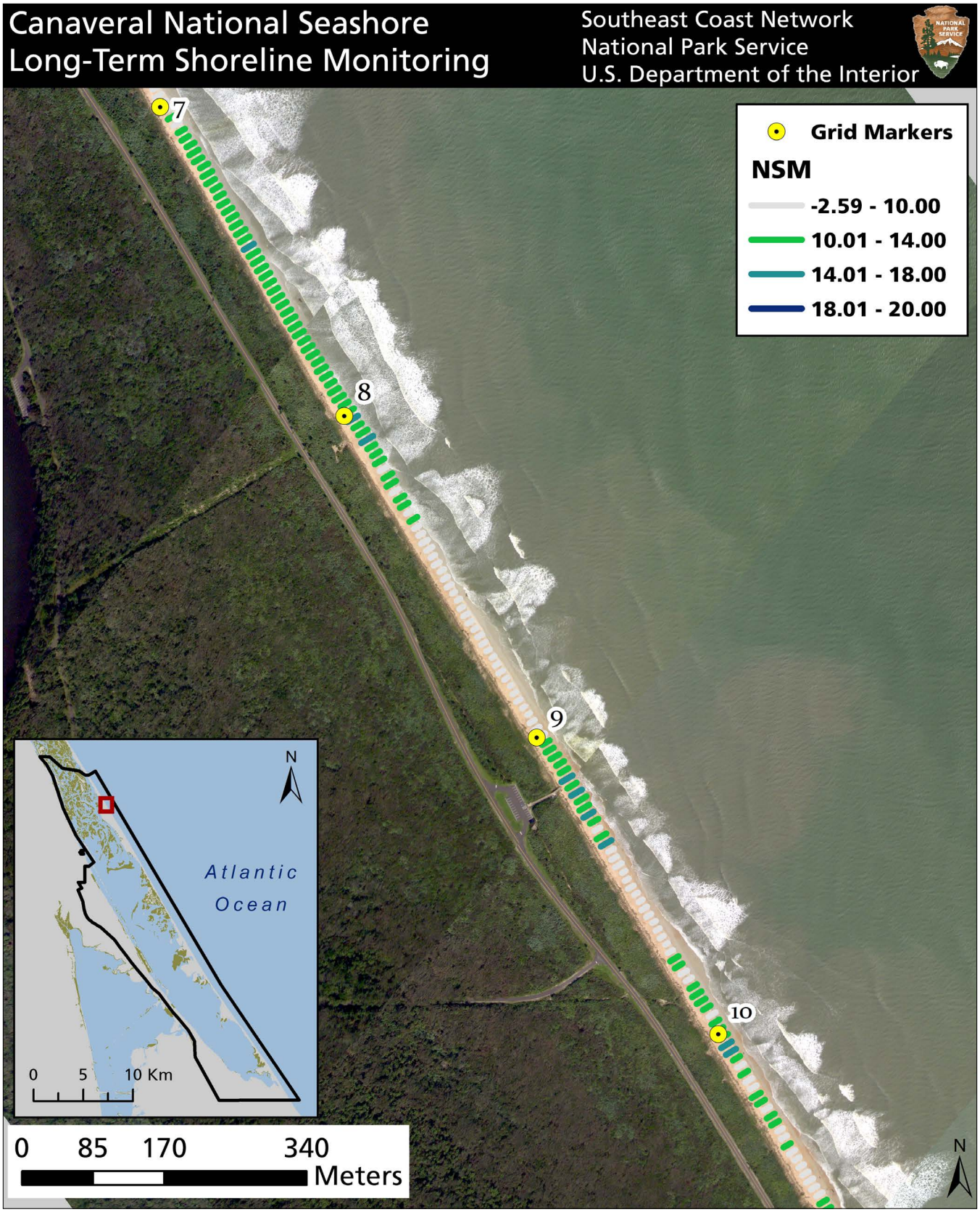


Figure B-3. Map of shoreline change distance (meters) for mile markers 7 to 10.

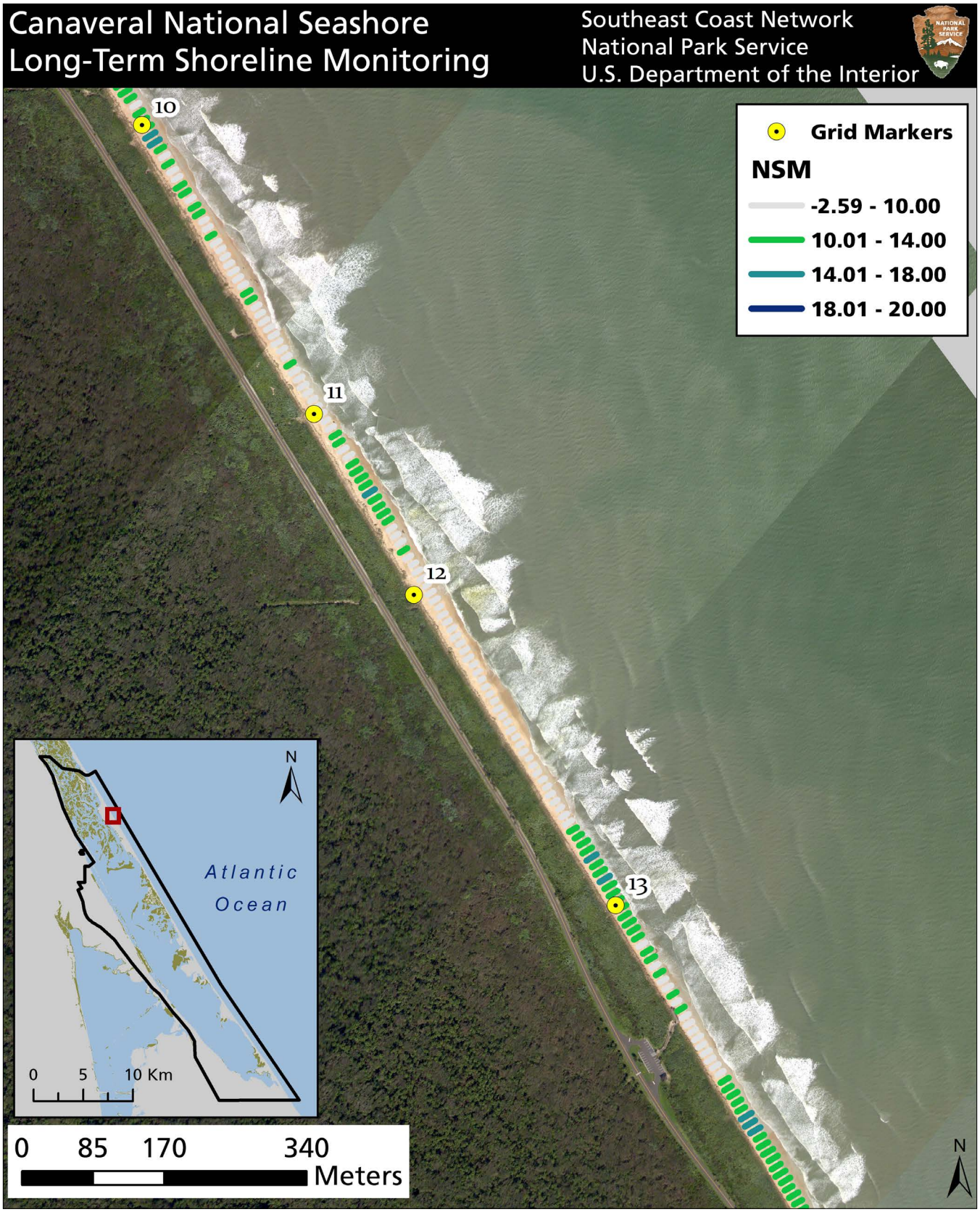


Figure B-4. Map of shoreline change distance (meters) for mile markers 10 to 13.

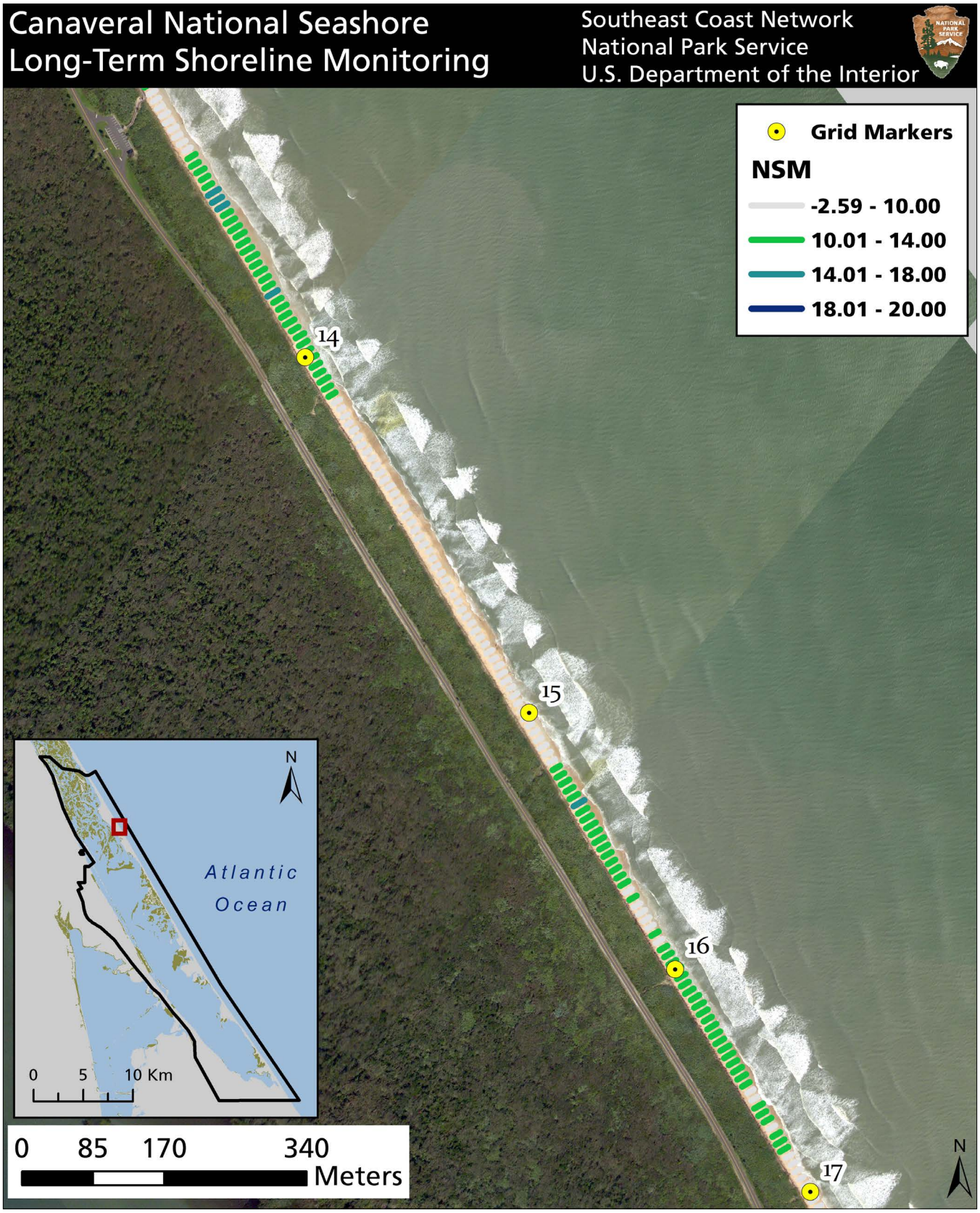


Figure B-5. Map of shoreline change distance (meters) for mile markers 14 to 17.

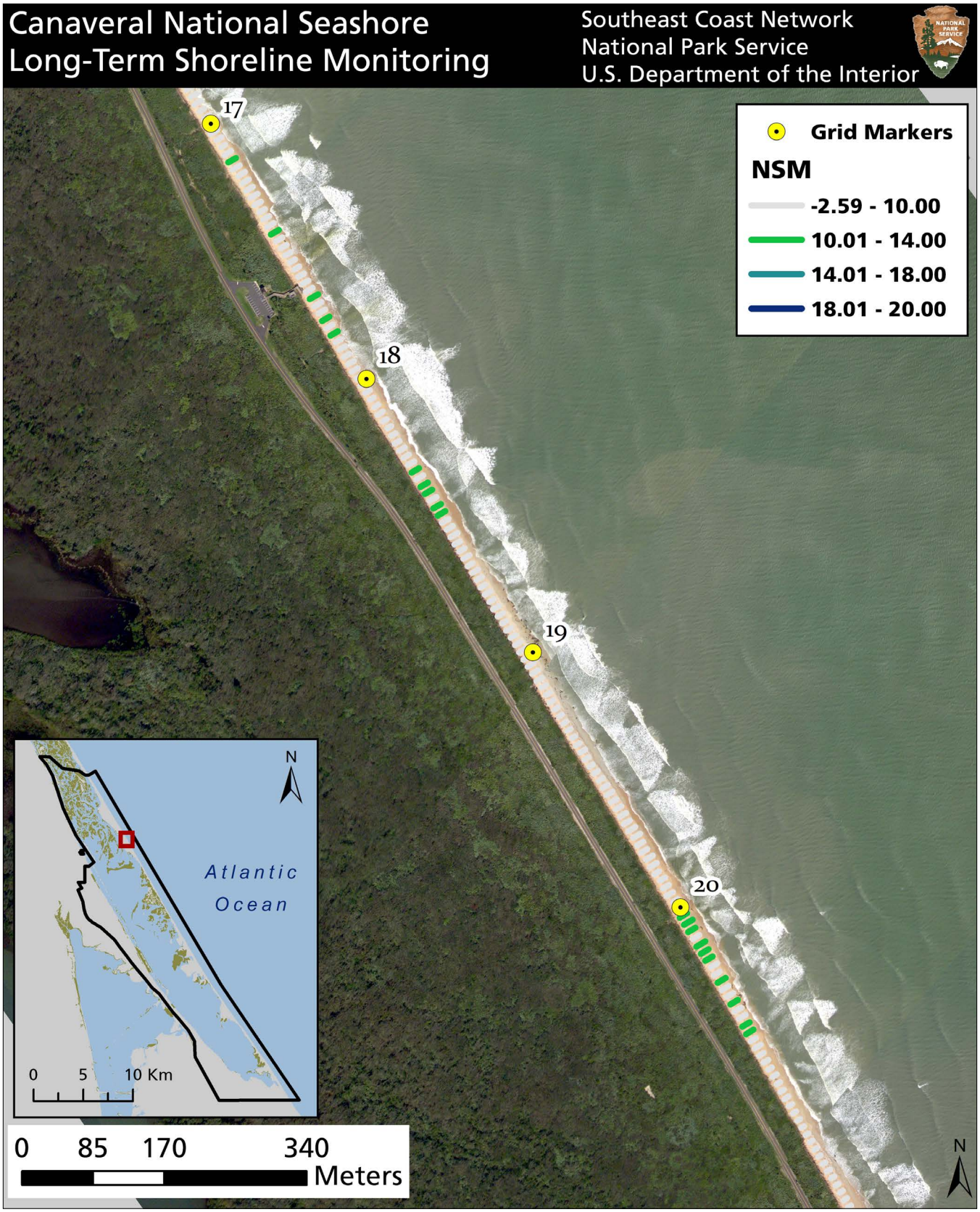


Figure B-6. Map of shoreline change distance (meters) for mile markers 17 to 20.

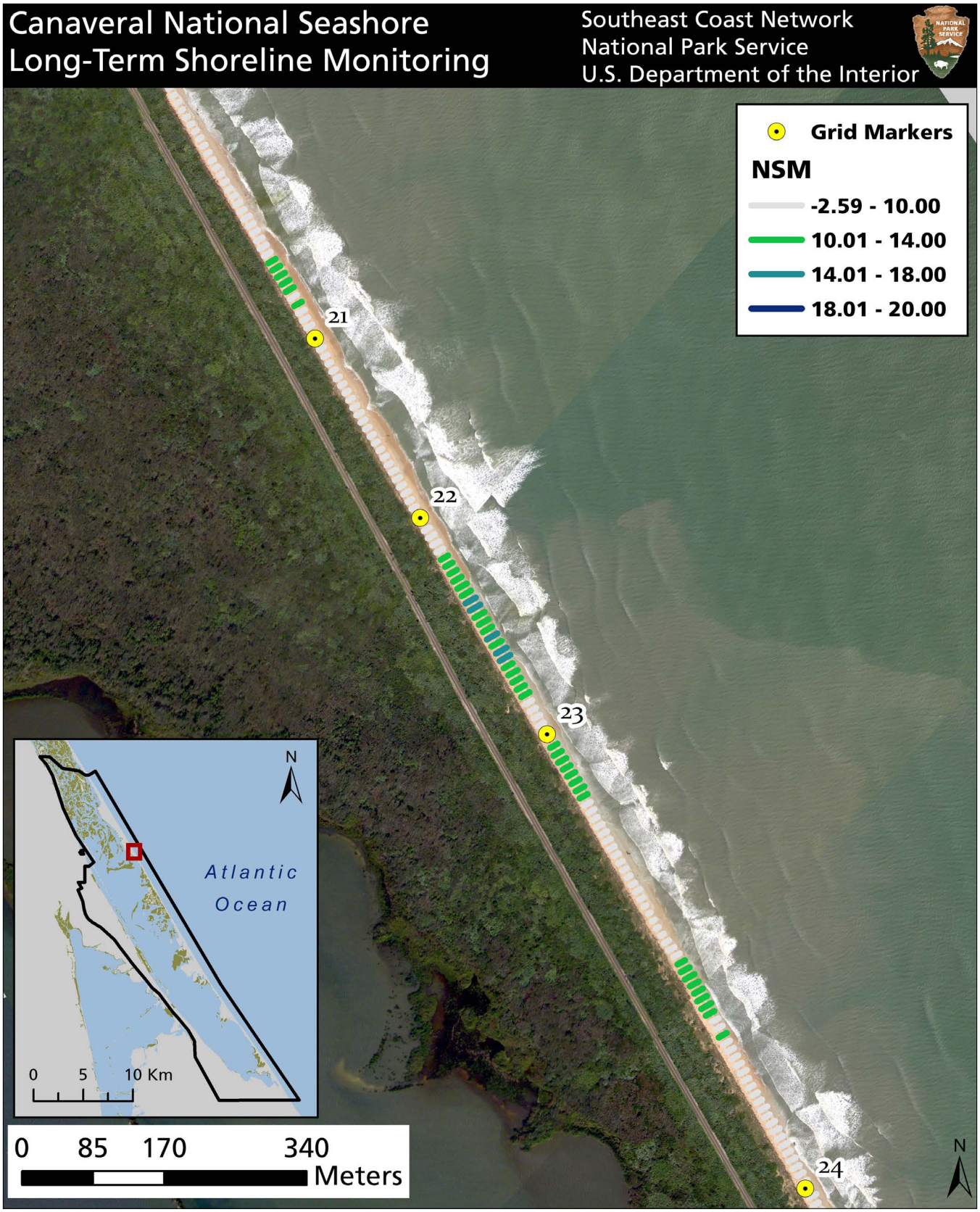


Figure B-7. Map of shoreline change distance (meters) for mile markers 21 to 24.

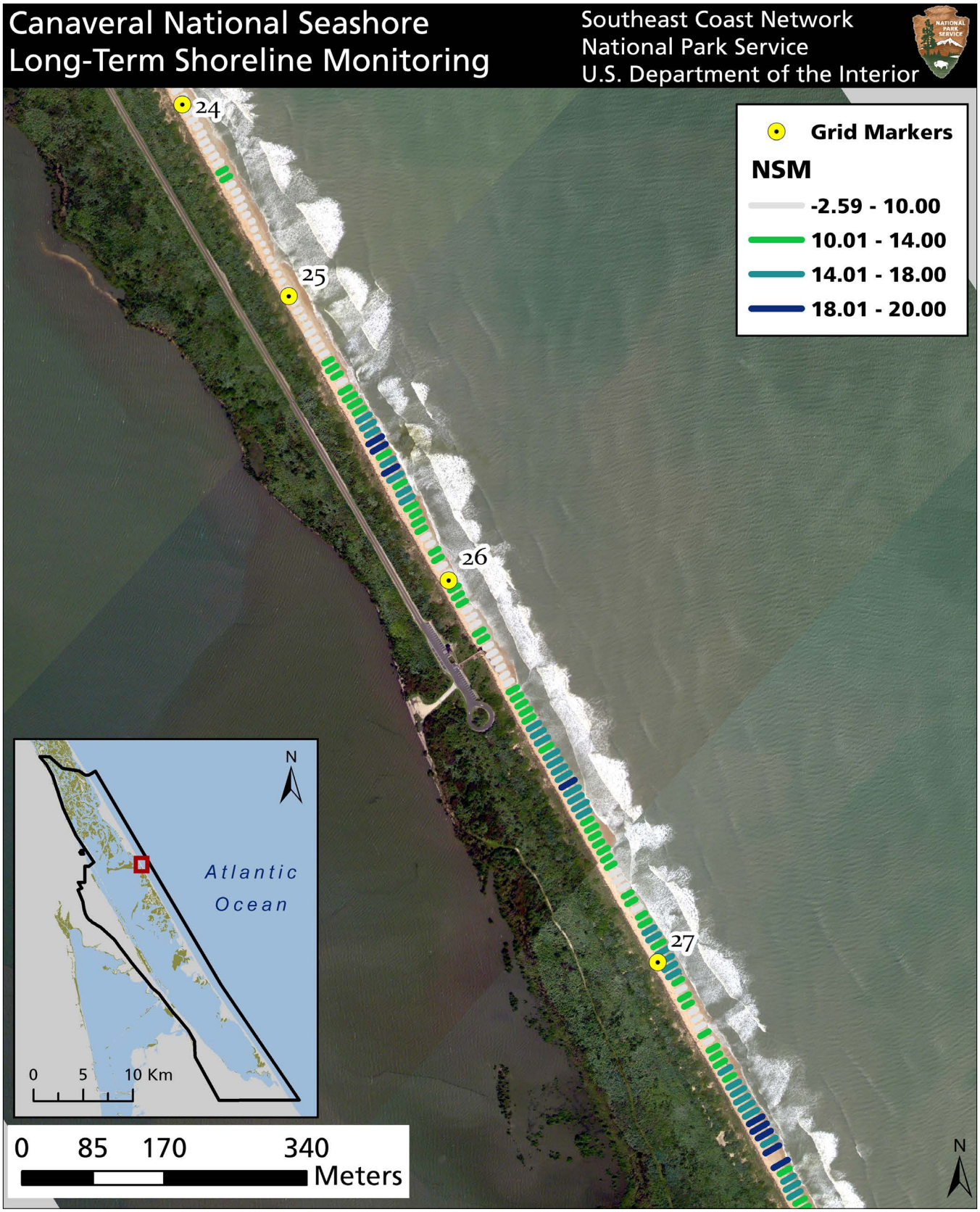


Figure B-8. Map of shoreline change distance (meters) for mile markers 24 to 27.

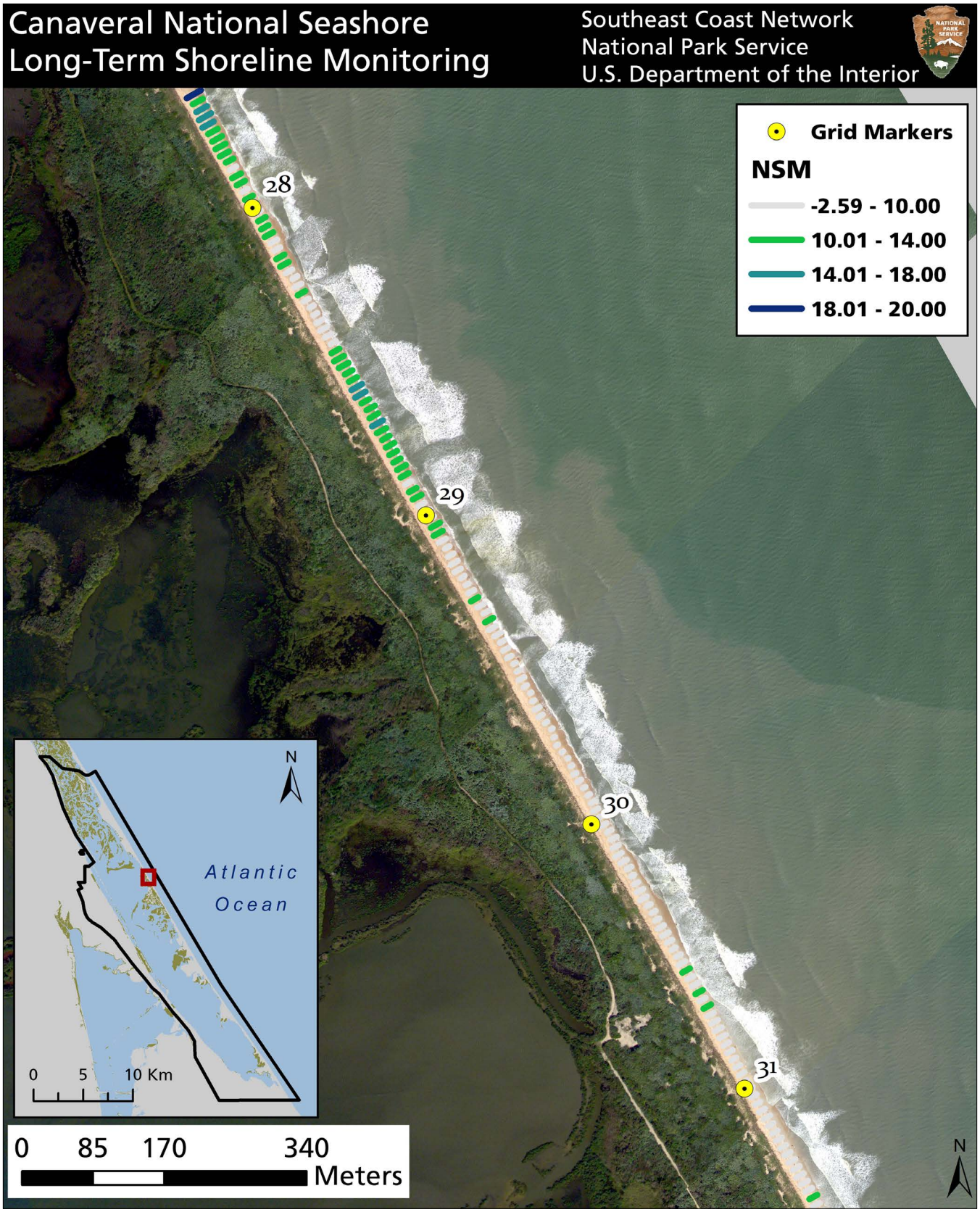


Figure B-9. Map of shoreline change distance (meters) for mile markers 28 to 31.

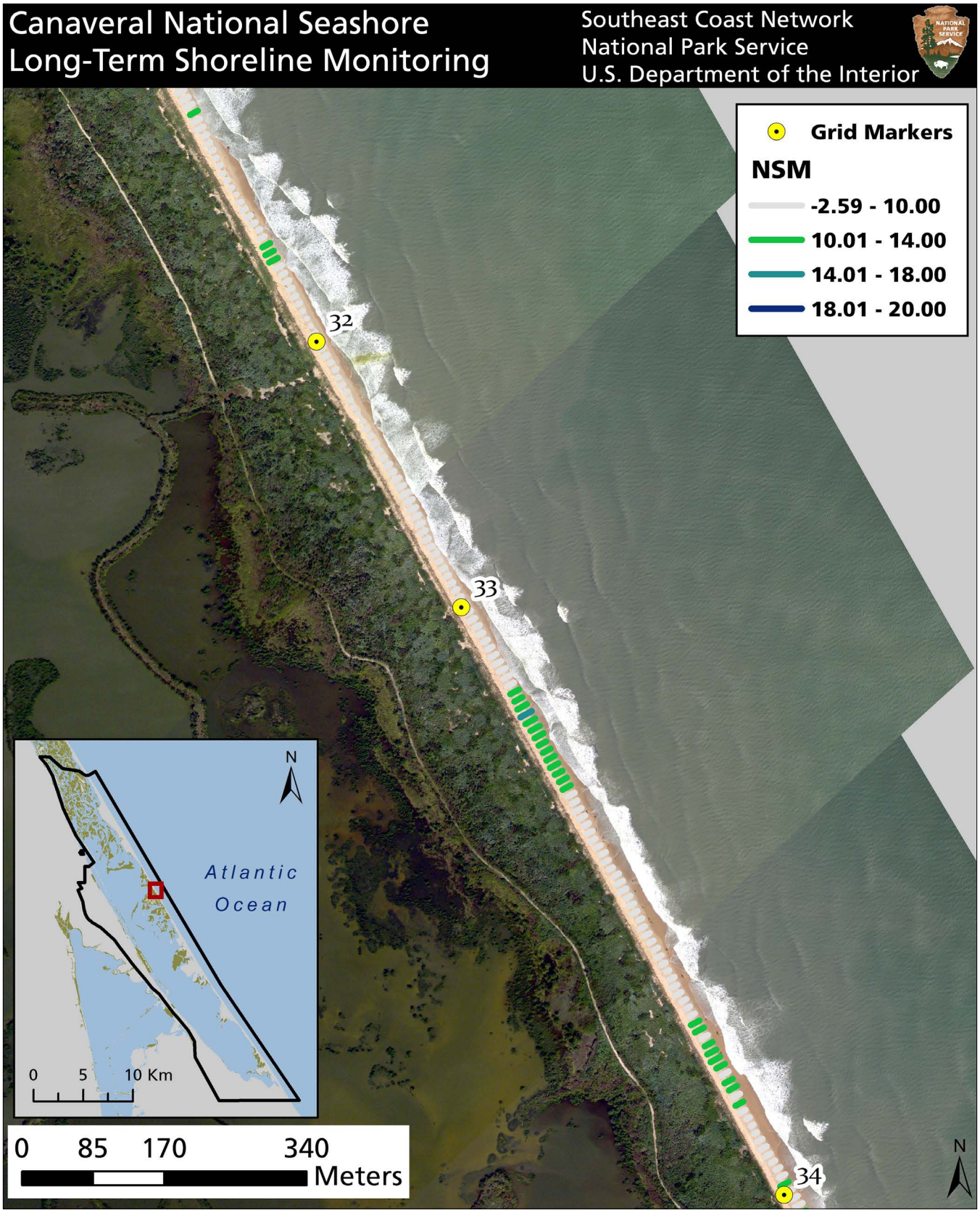


Figure B-10. Map of shoreline change distance (meters) for mile markers 32 to 34.

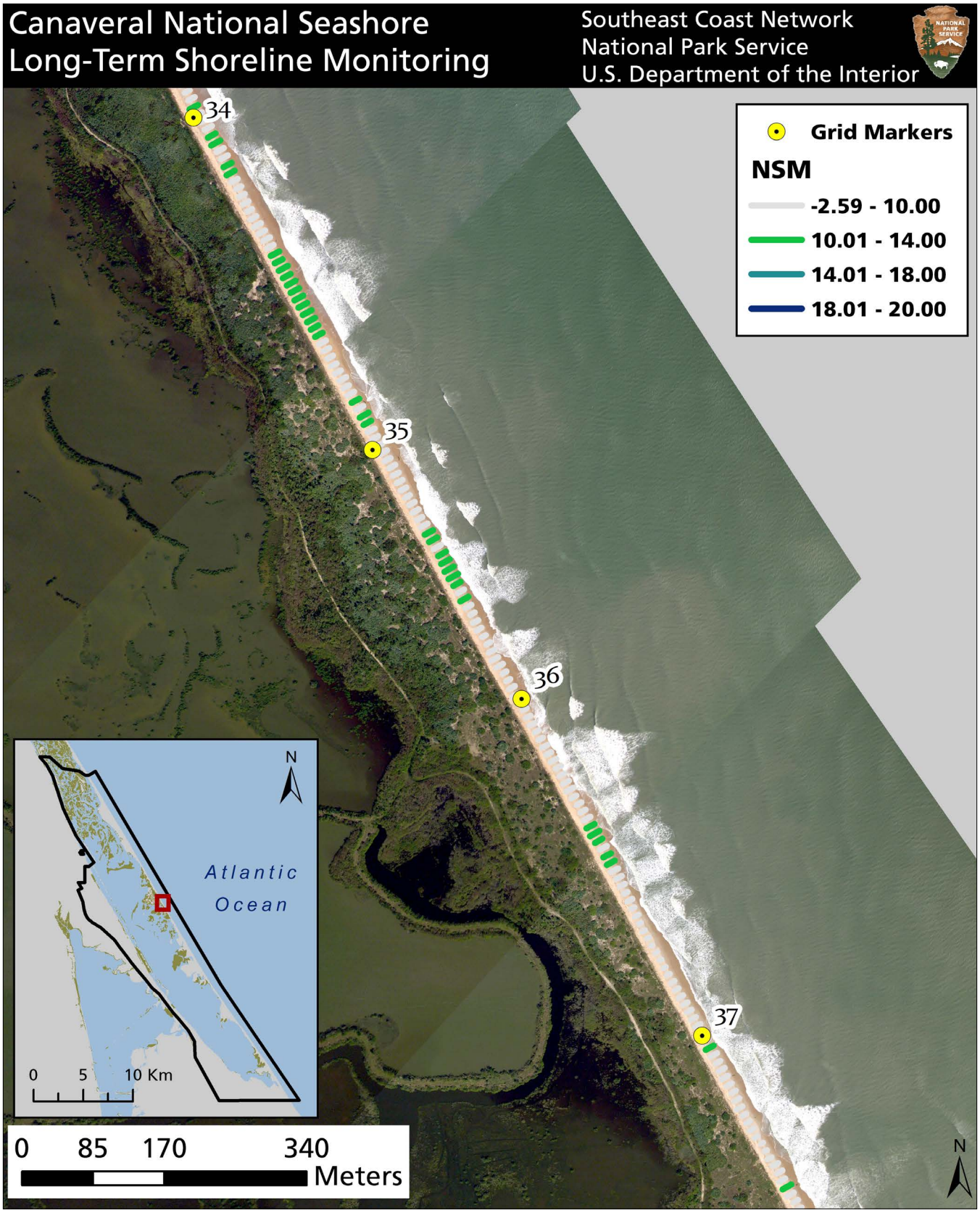


Figure B-11. Map of shoreline change distance (meters) for mile markers 34 to 37.

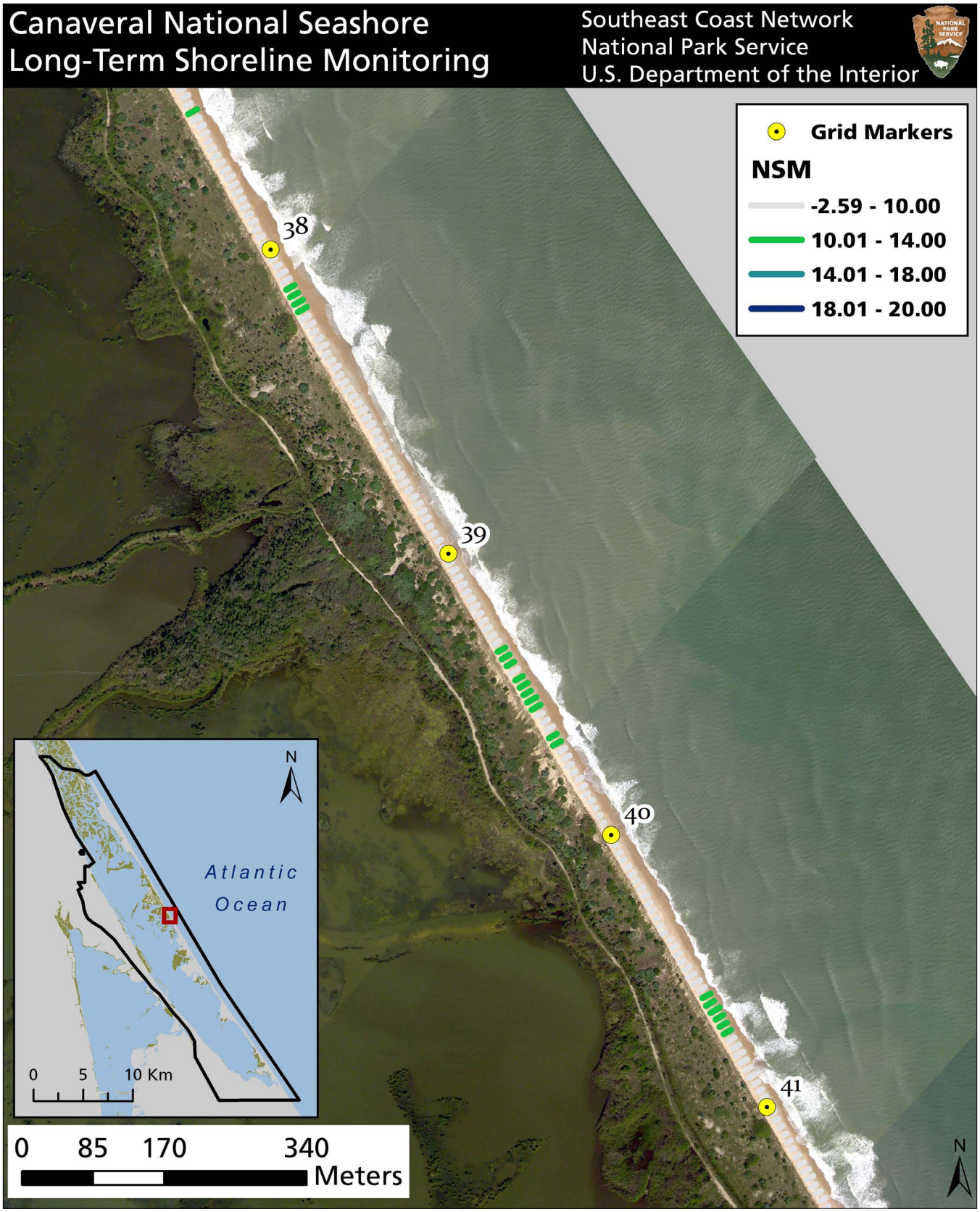


Figure B-12. Map of shoreline change distance (meters) for mile markers 38 to 41.

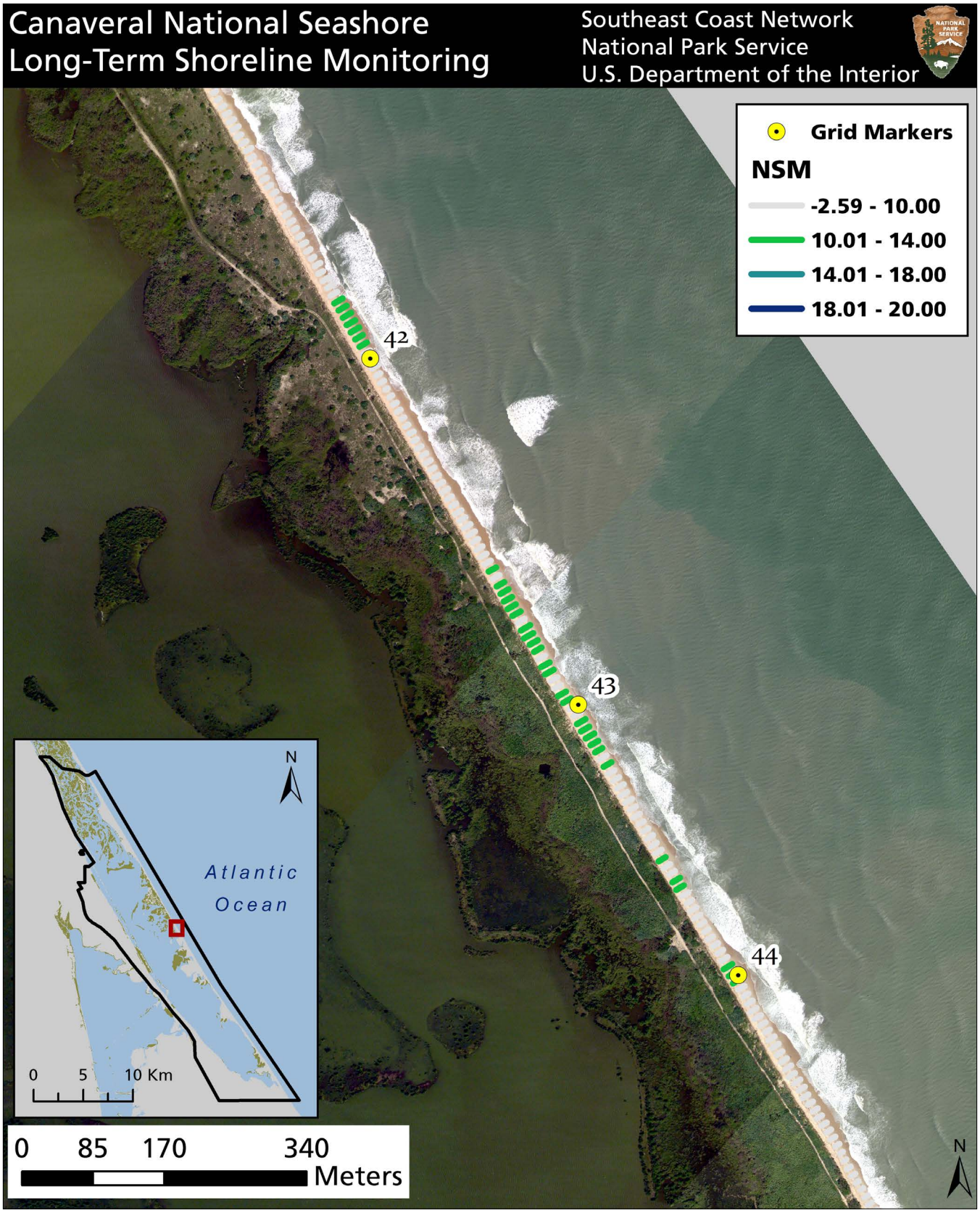


Figure B-13. Map of shoreline change distance (meters) for mile markers 42 to 44.

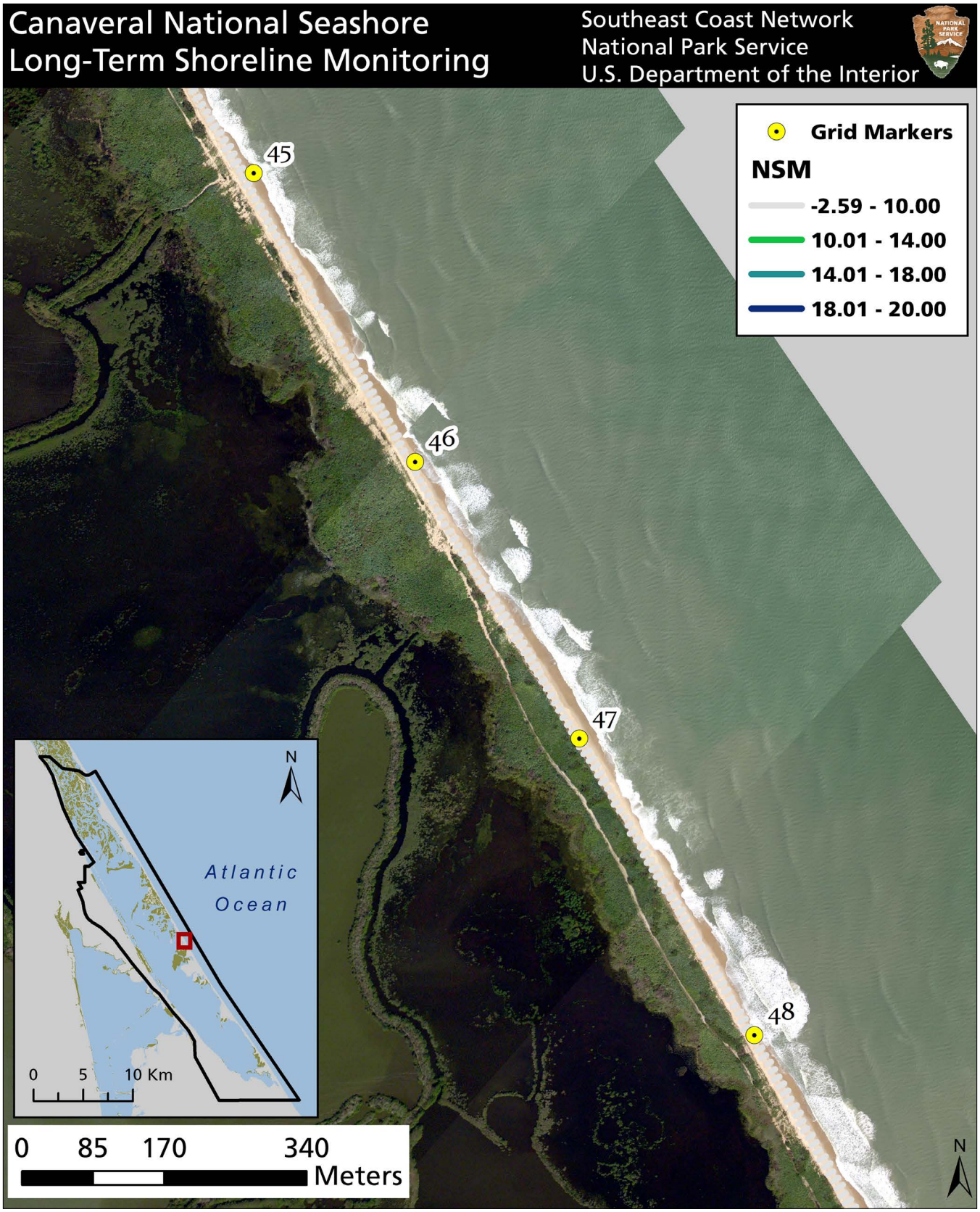


Figure B-14. Map of shoreline change distance (meters) for mile markers 45 to 48.

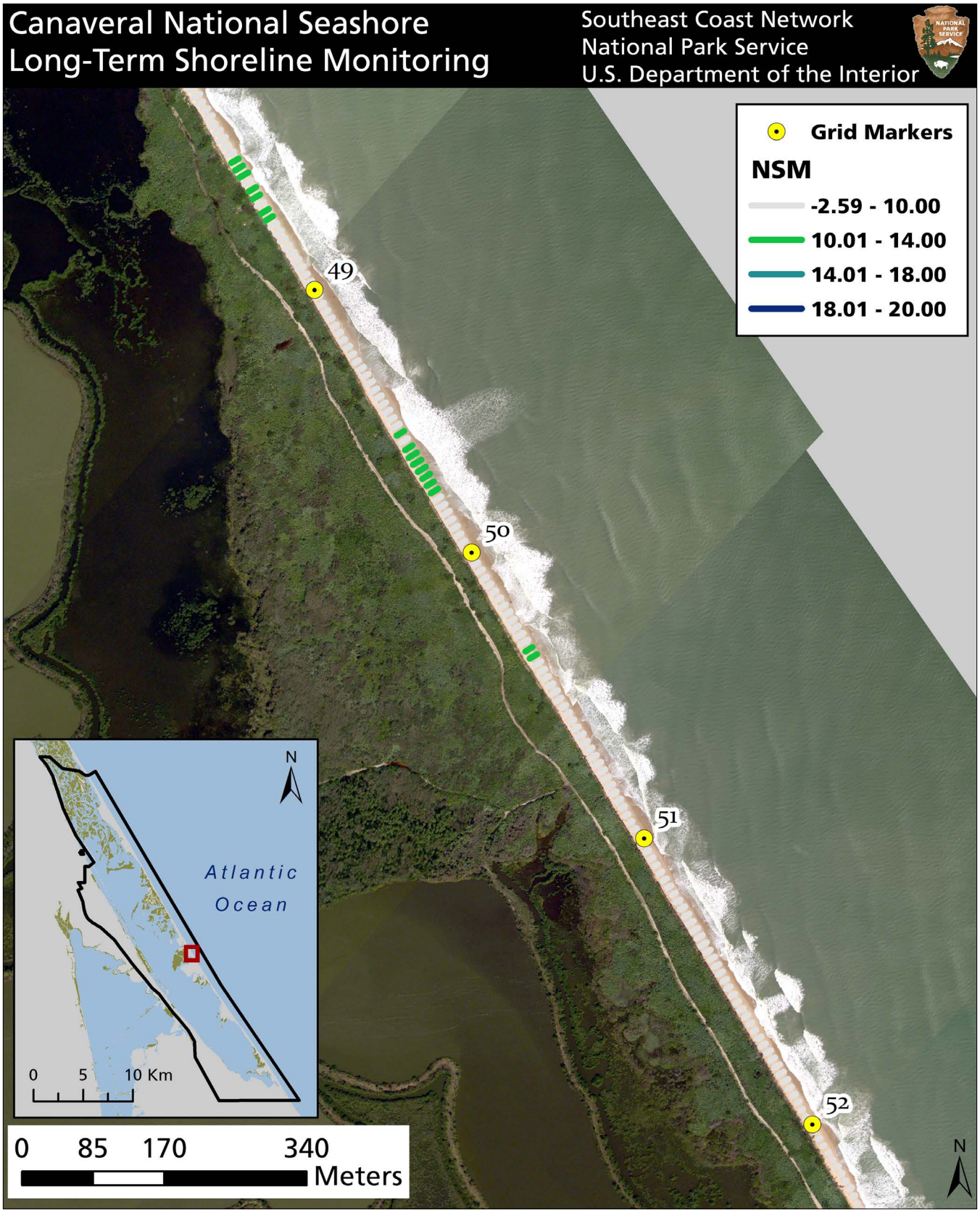


Figure B-15. Map of shoreline change distance (meters) for mile markers 49 to 52.

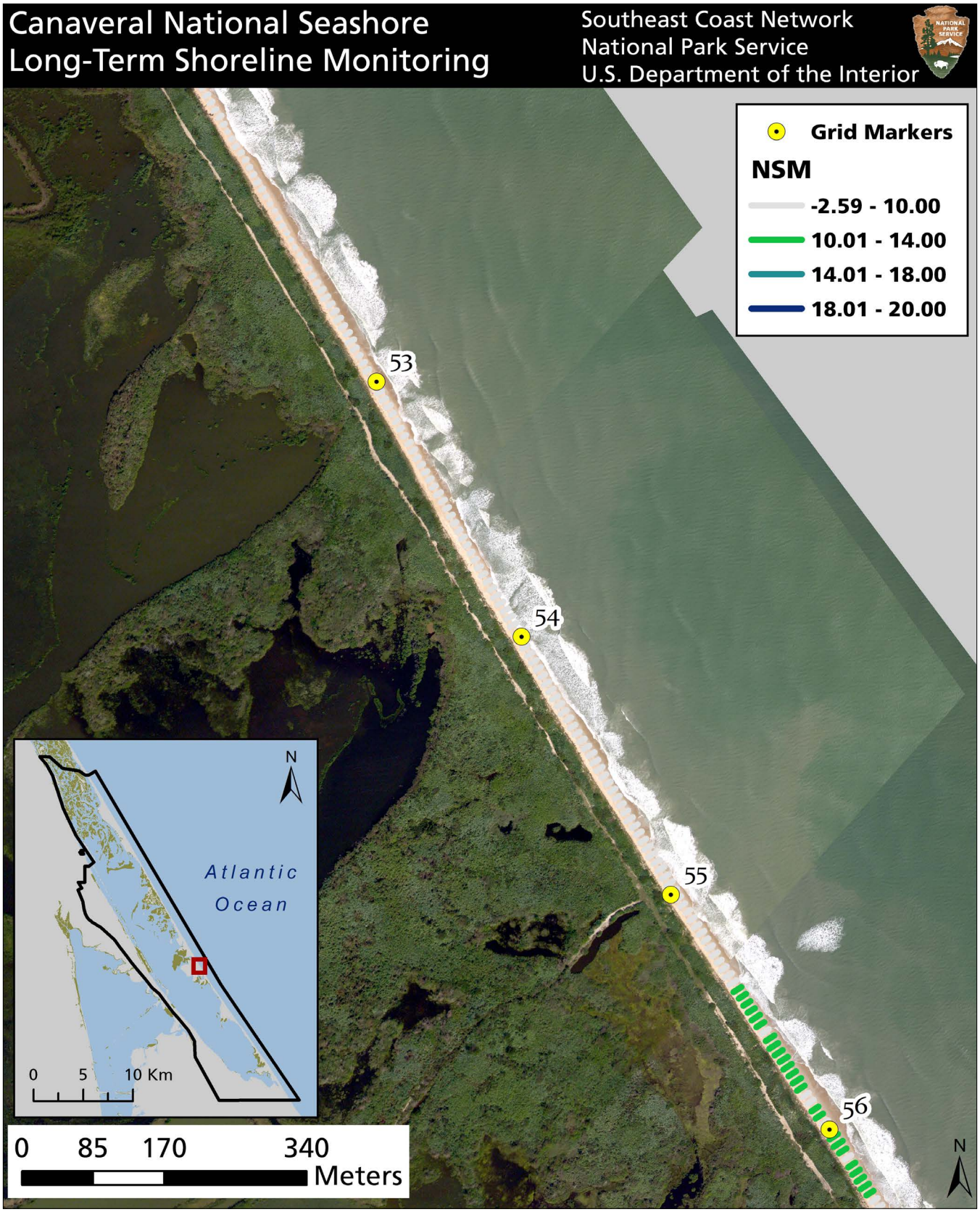


Figure B-16. Map of shoreline change distance (meters) for mile markers 53 to 56.

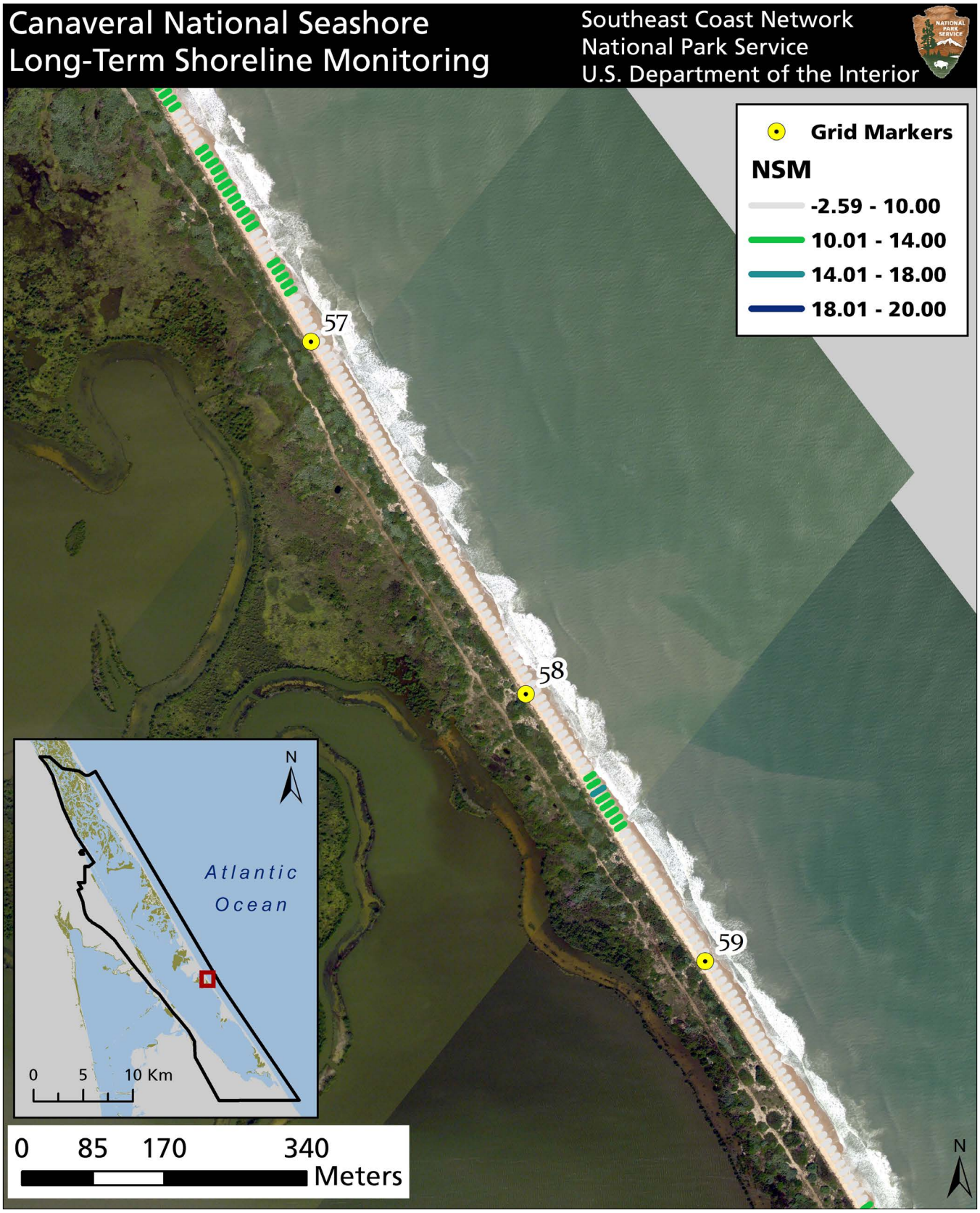


Figure B-17. Map of shoreline change distance (meters) for mile markers 57 to 59.

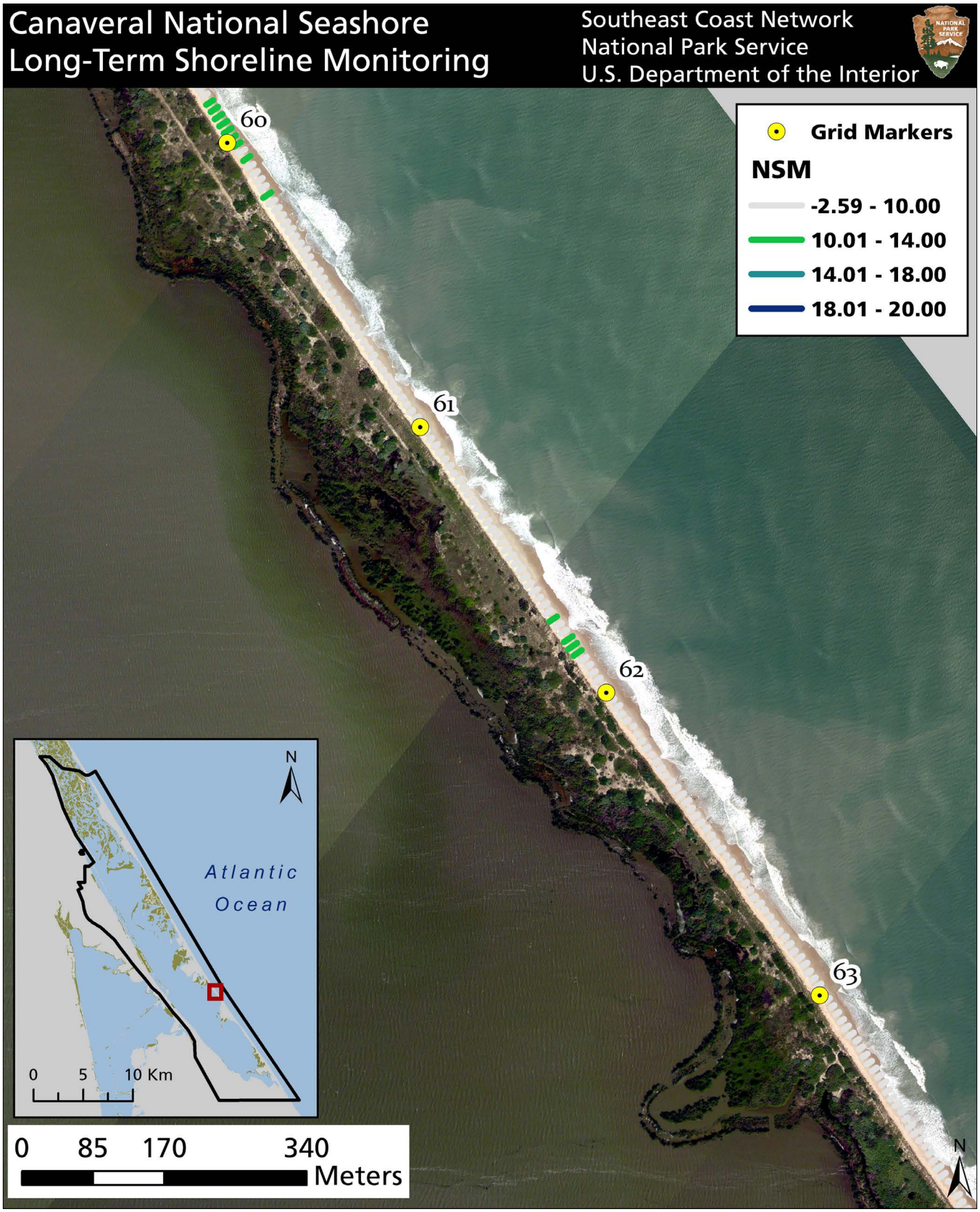


Figure B-18. Map of shoreline change distance (meters) for mile markers 60 to 63.

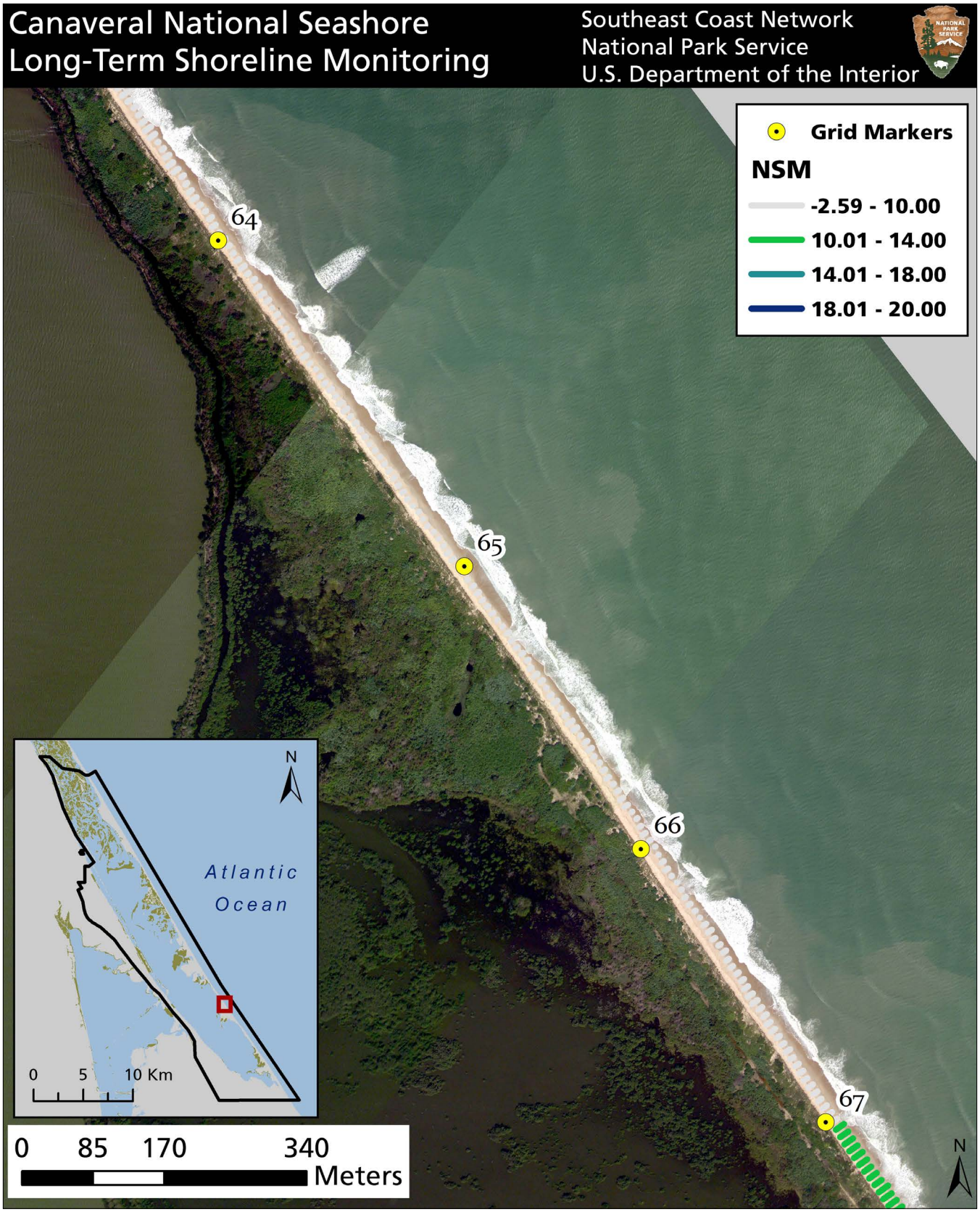


Figure B-19. Map of shoreline change distance (meters) for mile markers 64 to 67.

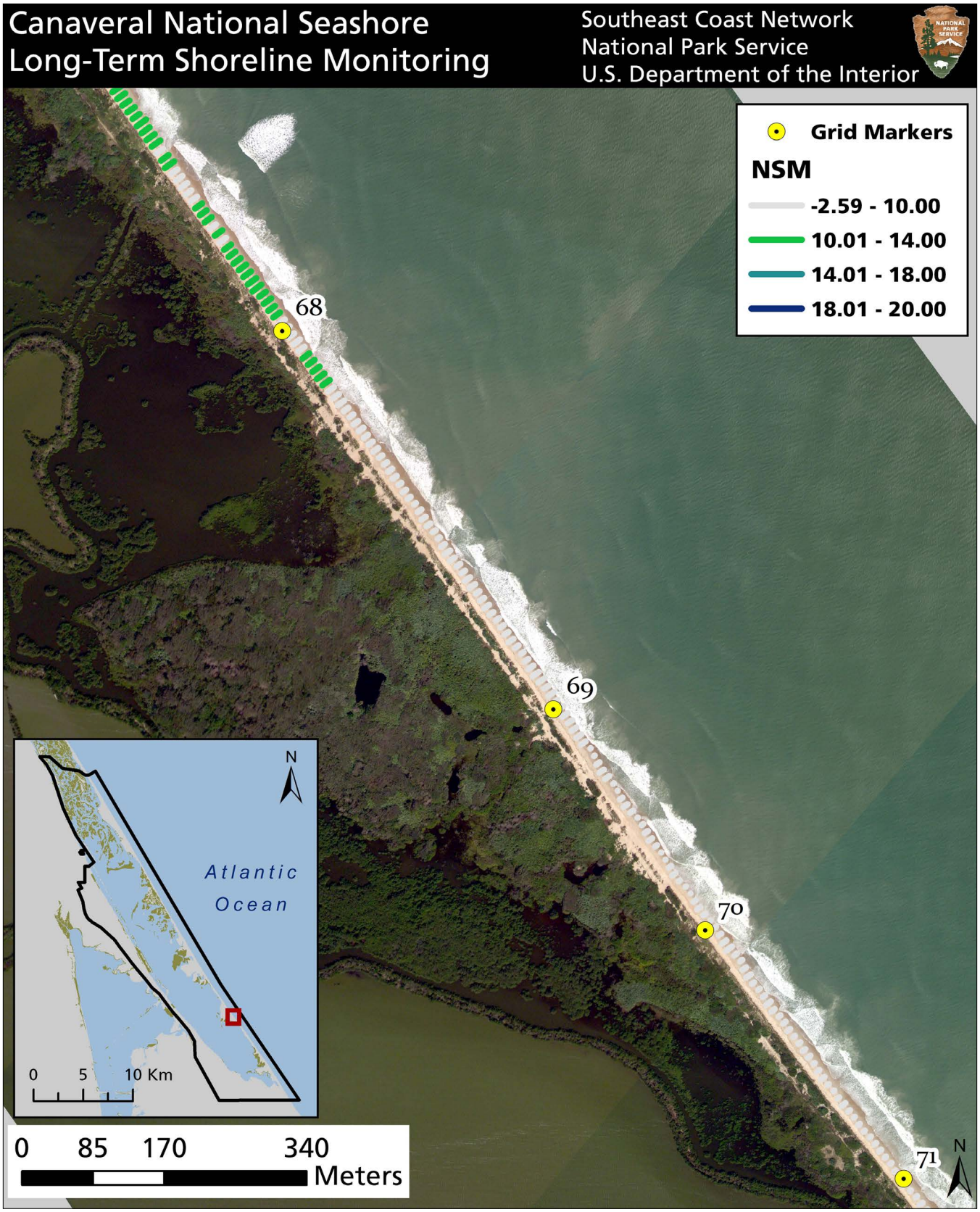


Figure B-20. Map of shoreline change distance (meters) for mile markers 68 to 71.

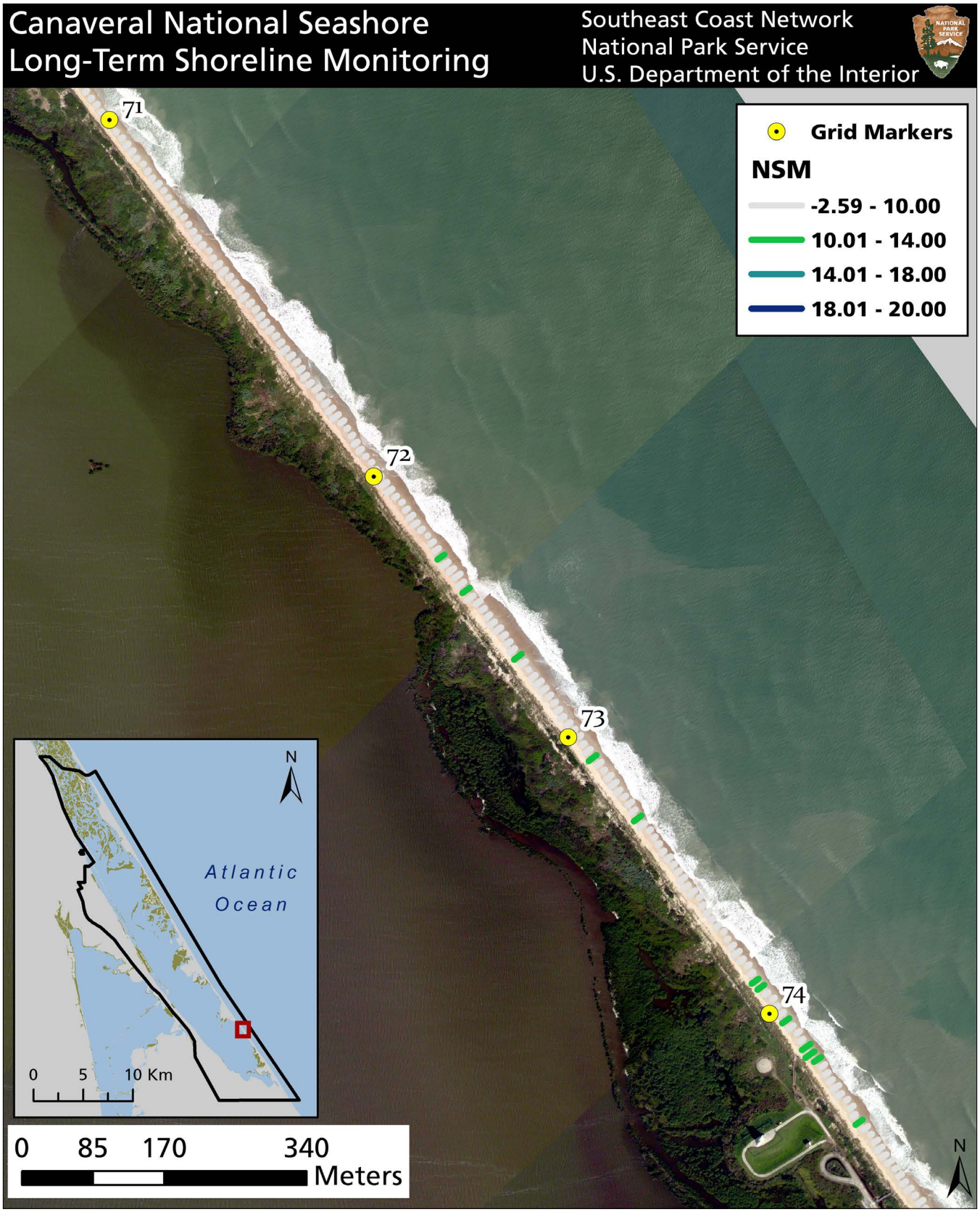


Figure B-21. Map of shoreline change distance (meters) for mile markers 71 to 74.

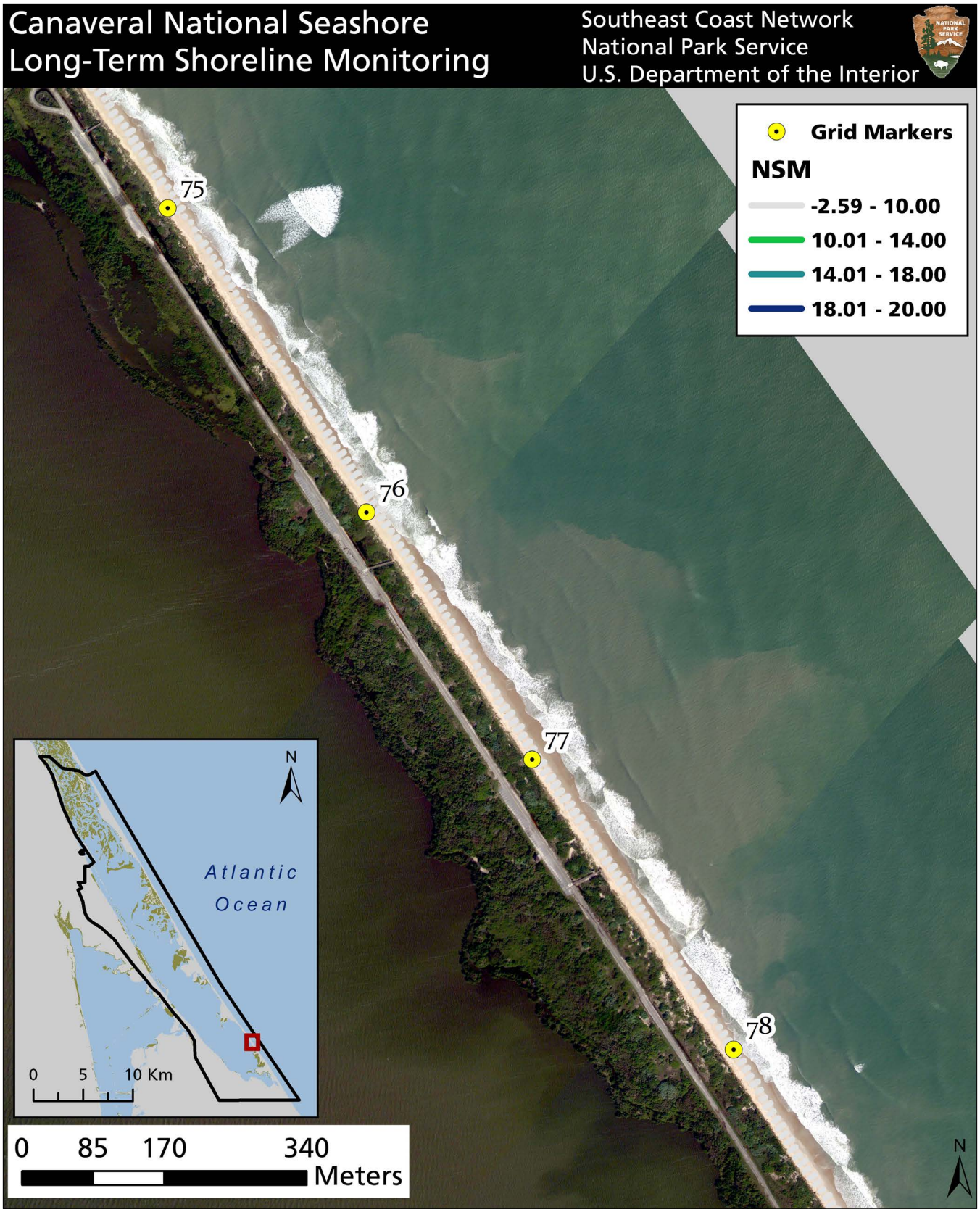


Figure B-22. Map of shoreline change distance (meters) for mile markers 75 to 78.

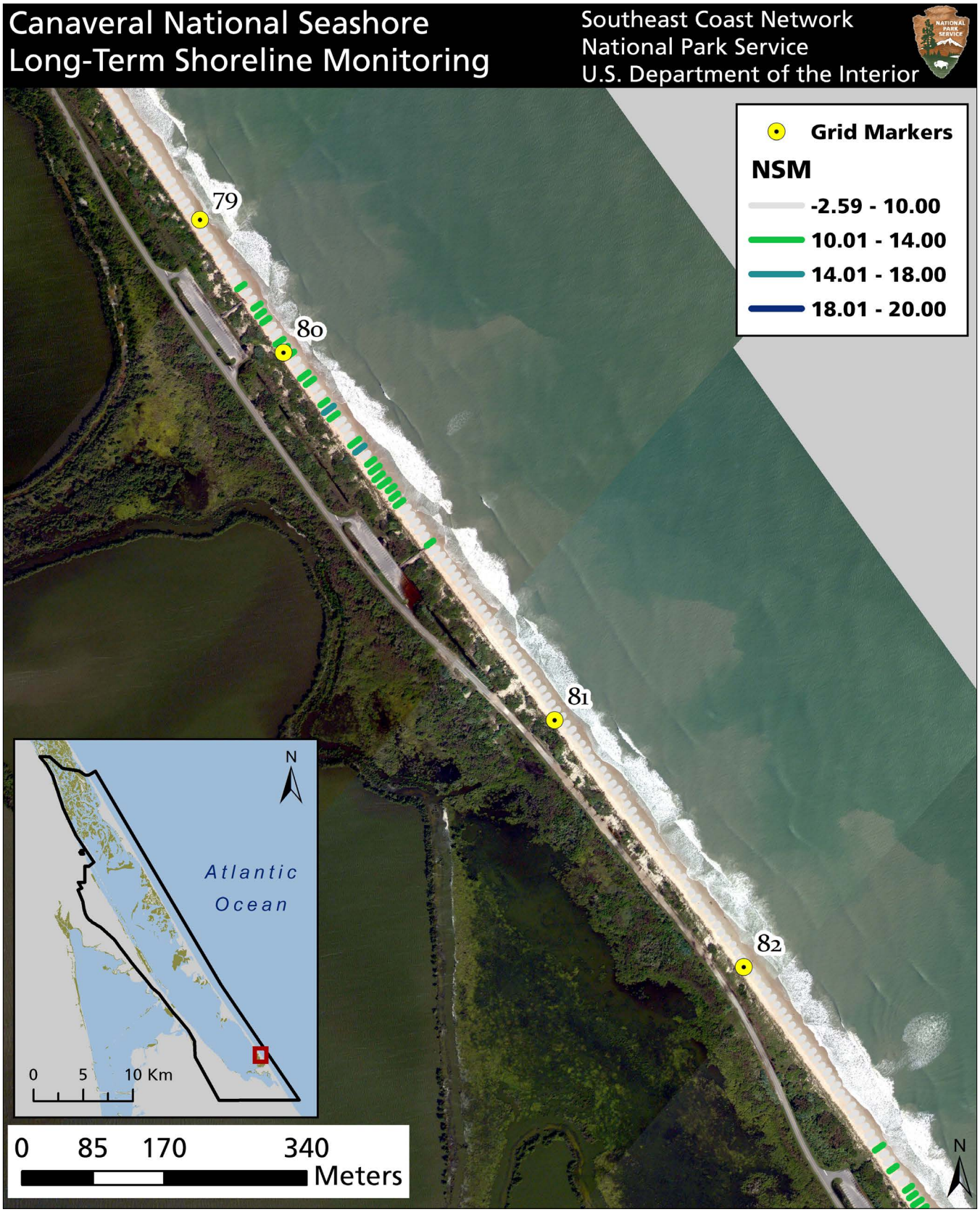


Figure B-23. Map of shoreline change distance (meters) for mile markers 79 to 82.

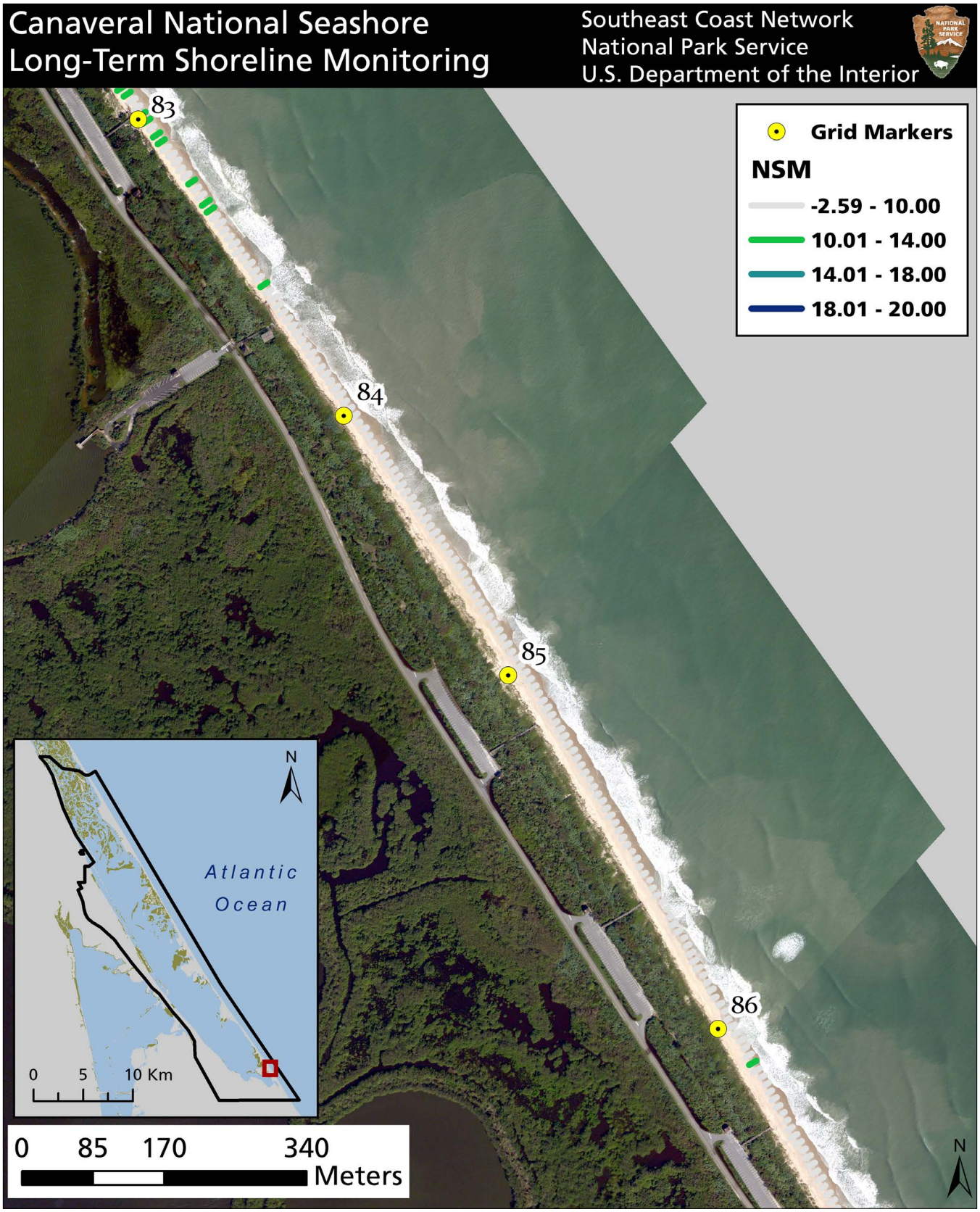


Figure B-24. Map of shoreline change distance (meters) for mile markers 83 to 86.

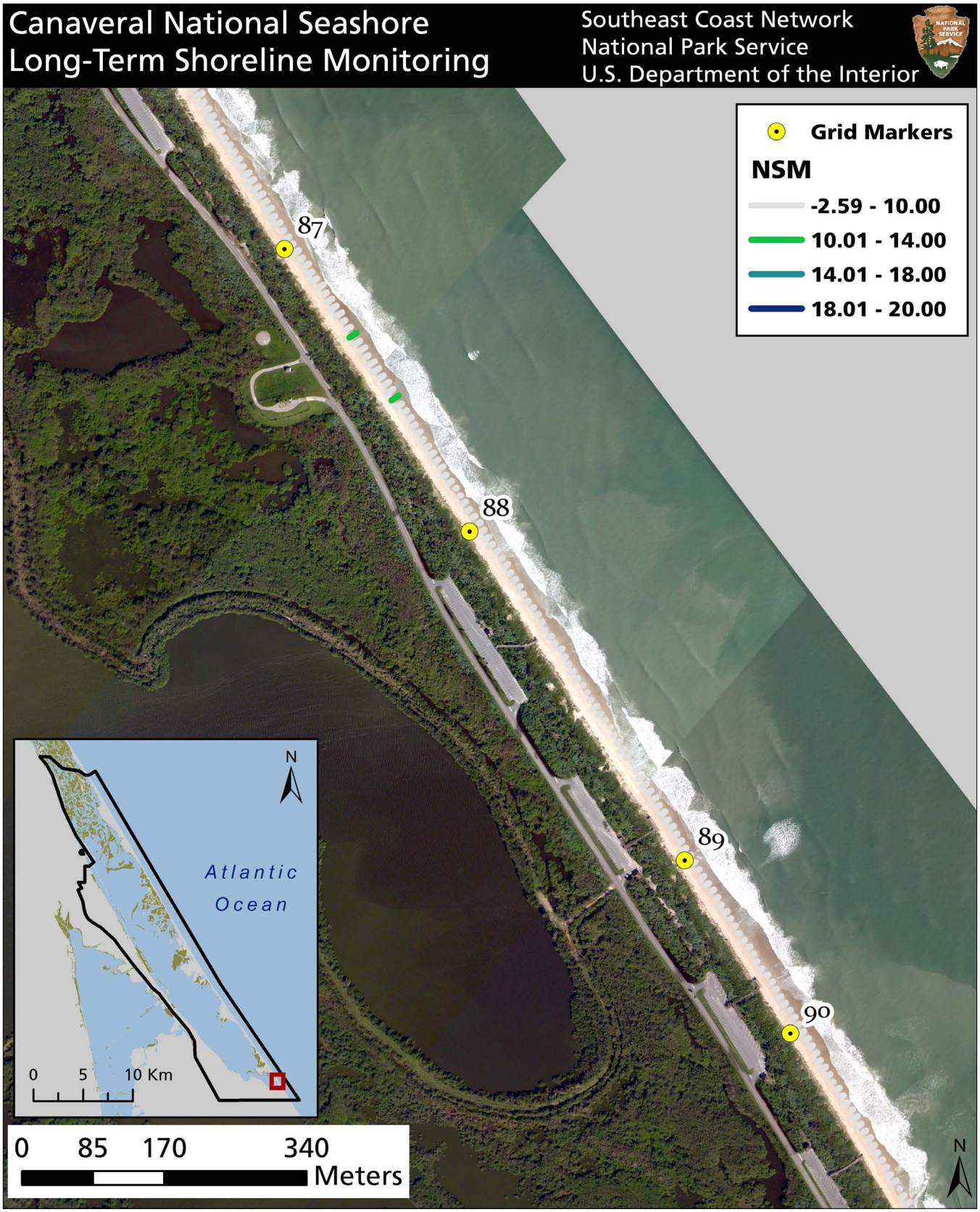


Figure B-25. Map of shoreline change distance (meters) for mile markers 87 to 90.

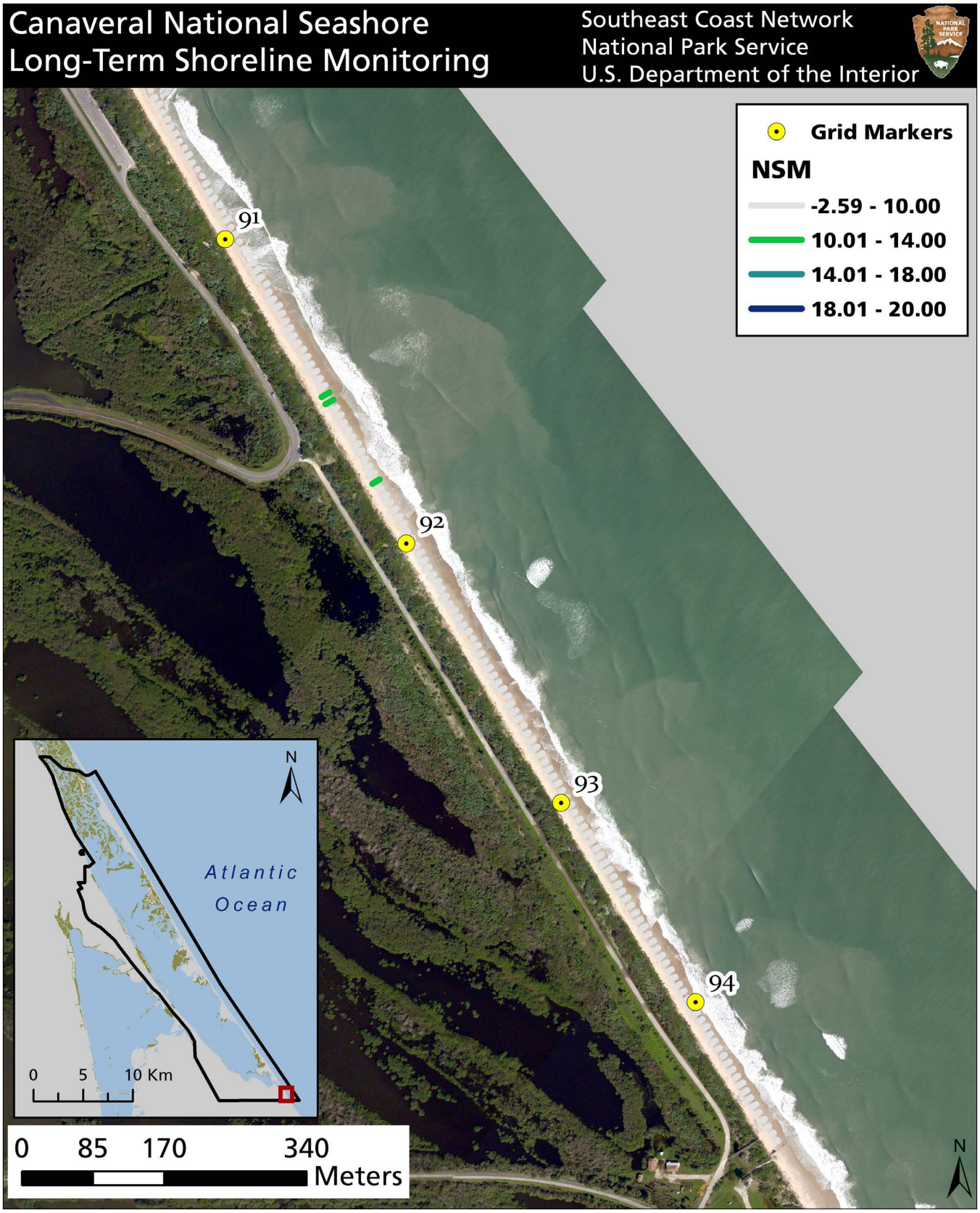


Figure B-26. Map of shoreline change distance (meters) for mile markers 91 to 94.

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

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National Park Service
U.S. Department of the Interior

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