National Park Service
U.S. Department of the Interior

Natural Resource Stewardship and Science

Shoreline Change at Cape Hatteras National Seashore

2018–2019 Data Summary

Natural Resource Data Series NPS/SECN/NRDS—2020/1281



ON THE COVER
Picture taken during the spring 2019 high tide line data collection on Hatteras Island, North Carolina.
NPS Photo / SECN

Shoreline Change at Cape Hatteras National Seashore
2018–2019 Data Summary

Natural Resource Data Series NPS/SECN/NRDS—2020/1281

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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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Contents

Page

Figures iv
Tables xii
Acknowledgments xiii
Summary and Key Findings xiv
Introduction 1
Study Area 3
Methods 4
    Standard Operating Procedures 4
    Shoreline Data Collection 4
    Shoreline Change Analysis 4
    Water Levels 5
Results 9
    Shoreline Data 9
    Shoreline Change Analysis 9
        Annual Shoreline Change 9
        Seasonal Shoreline Change 10
Literature Cited 13
Appendix A. Shoreline Data and Annual Shoreline Change Distance Maps 14
Appendix B. Seasonal Shoreline Change Distance Maps 76

Figures

Page

Figure 1. Map showing the section of beach, highlighted in red (study area) where data is collected for the long-term shoreline monitoring project. . . . 2

Figure 2. Plot of predicted (blue) and verified (red) tides at the Oregon Inlet Marina, North Carolina (Station ID: 8652587) tide gauge during the spring 2018 shoreline data collection. . . . 6

Figure 3. Plot of predicted (blue) and verified (red) tides at the USCG Station Hatteras, North Carolina (Station ID: 8654467) tide gauge during the spring 2018 shoreline data collection. . . . 6

Figure 4. Plot of predicted (blue) and verified (red) tides at the Oregon Inlet Marina, North Carolina (Station ID: 8652587) tide gauge during the fall 2018 shoreline data collection. . . . 7

Figure 5. Plot of predicted (blue) and verified (red) tides at the USCG Hatteras, North Carolina (Station ID: 8654467) tide gauge during the fall 2018 shoreline data collection. . . . 7

Figure 6. Plot of predicted (blue) and verified (red) tides at the Oregon Inlet Marina, North Carolina (Station ID: 8652587) tide gauge during the spring 2019 shoreline data collection. . . . 8

Figure 7. Plot of predicted (blue) and verified (red) tides at the USCG Hatteras, North Carolina (Station ID: 8654467) tide gauge during the spring 2019 shoreline data collection. . . . 8

Figure 8. Histogram of transect shoreline change distances from spring 2018 to spring 2019. . . . 10

Figure 9. Histogram of transect shoreline change distances from spring 2018 to fall 2018. . . . 11

Figure 10. Histogram of transect shoreline change distances from fall 2018 to spring 2019. . . . 12

Figure A-1. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 0 and 1. . . . 15

Figure A-2. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 2 and 3. . . . 16

Figure A-3. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 3 and 4. . . . 17

Figure A-4. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 4 and 5. . . . 18

Figure A-5. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at the north end of Hatteras Island within Pea Island National Wildlife Refuge near Oregon Inlet. . . . 19

Figure A-6. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at the north end of Hatteras Island within Pea Island National Wildlife Refuge, second section. . . . 20

Figure A-7. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at the north end of Hatteras Island within Pea Island National Wildlife Refuge, third section. . . . 21

Figure A-8. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at the north end of Hatteras Island within Pea Island National Wildlife Refuge, fourth section. . . . 22

Figure A-9. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at the north end of Hatteras Island within Pea Island National Wildlife Refuge, fifth section. . . . 23

Figure A-10. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at the north end of Hatteras Island within Pea Island National Wildlife Refuge, sixth section. 24

Figure A-11. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at the north end of Hatteras Island within Pea Island National Wildlife Refuge, seventh section. 25

Figure A-12. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at the north end of Hatteras Island within Pea Island National Wildlife Refuge, eighth section. 26

Figure A-13. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 19. 27

Figure A-14. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 20 and 21. 28

Figure A-15. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 21 and 22. 29

Figure A-16. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 22 and 23. 30

Figure A-17. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 24 and 25. 31

Figure A-18. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 25 and 26. 32

Figure A-19. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 26 and 27. 33

Figure A-20. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 27 and 28. 34

Figure A-21. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 29 and 30. 35

Figure A-22. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 30 and 31. 36

Figure A-23. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 31 and 32. 37

Figure A-24. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 33 and 34. 38

Figure A-25. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 34 and 35. 39

Figure A-26. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 35 and 36. 40

Figure A-27. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 37. 41

Figure A-28. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 38 and 39. 42

Figure A-29. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 39 and 40. 43

Figure A-30. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 40 and 41. 44

Figure A-31. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 42 and 43. 45

Figure A-32. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 43 and 44. 46

Figure A-33. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 44 through 46. 47

Figure A-34. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 45 and 46. 48

Figure A-35. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 47. 49

Figure A-36. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 48. 50

Figure A-37. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 49. 51

Figure A-38. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 50. 52

Figure A-39. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 51. 53

Figure A-40. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 52. 54

Figure A-41. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 53. 55

Figure A-42. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 54. 56

Figure A-43. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 55. 57

Figure A-44. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 56. 58

Figure A-45. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 57. 59

Figure A-46. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 58. 60

Figure A-47. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 60. 61

Figure A-48. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 61. 62

Figure A-49. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 62. 63

Figure A-50. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 63. 64

Figure A-51. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 64. . . . 65

Figure A-52. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 65. . . . 66

Figure A-53. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 66. . . . 67

Figure A-54. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 67. . . . 68

Figure A-55. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 68. . . . 69

Figure A-56. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 69. . . . 70

Figure A-57. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 70. . . . 71

Figure A-58. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 71. . . . 72

Figure A-59. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (m) at Cape Hatteras National Seashore at mile marker 72 and 73. . . . 73

Figure A-60. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (m) at Cape Hatteras National Seashore at mile marker 74. . . . 74

Figure A-61. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (m) at Cape Hatteras National Seashore east of mile marker 74. . . . 75

Figure B-1. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 0 and 1. . . . 77

Figure B-2. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 2 and 3. . . . 78

Figure B-3. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 3 and 4. . . . 79

Figure B-4. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 4 and 5. . . . 80

Figure B-5. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys at the north end of Hatteras Island within Pea Island National Wildlife Refuge near Oregon Inlet. . . . 81

Figure B-6. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys at the north end of Hatteras Island within Pea Island National Wildlife Refuge, second section. . . . 82

Figure B-7. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys at the north end of Hatteras Island within Pea Island National Wildlife Refuge, third section. . . . 83

Figure B-8. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys at the north end of Hatteras Island within Pea Island National Wildlife Refuge, fourth section. . . . 84

Figure B-9. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys at the north end of Hatteras Island within Pea Island National Wildlife Refuge, fifth section. . . . 85

Figure B-10. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys at the north end of Hatteras Island within Pea Island National Wildlife Refuge, sixth section. . . . 86

Figure B-11. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys at the north end of Hatteras Island within Pea Island National Wildlife Refuge, seventh section. . . . 87

Figure B-12. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys at the north end of Hatteras Island within Pea Island National Wildlife Refuge, eighth section. . . . 88

Figure B-13. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 19. . . . 89

Figure B-14. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 20 and 21. . . . 90

Figure B-15. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 21 and 22. . . . 91

Figure B-16. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 22 and 23. . . . 92

Figure B-17. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 24 and 25. . . . 93

Figure B-18. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 25 and 26. . . . 94

Figure B-19. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 26 and 27. . . . 95

Figure B-20. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 27 and 28. . . . 96

Figure B-21. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 29 and 30. . . . 97

Figure B-22. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 30 and 31. . . . 98

Figure B-23. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 31 and 32. . . . 99

Figure B-24. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 33 and 34. . . . 100

Figure B-25. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 34 and 35. . . . 101

Figure B-26. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 35 and 36. . . . 102

Figure B-27. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 37. . . . 103

Figure B-28. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 38 and 39. . . . 104

Figure B-29. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 39 and 40. . . . 105

Figure B-30. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 40 and 41. . . . 106

Figure B-31. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 42 and 43. . . . 107

Figure B-32. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 43 and 44. . . . 108

Figure B-33. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 44 through 46. . . . 109

Figure B-34. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 45 and 46. . . . 110

Figure B-35. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 47. . . . 111

Figure B-36. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 48. . . . 112

Figure B-37. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 49. . . . 113

Figure B-38. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 50. . . . 114

Figure B-39. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 51. . . . 115

Figure B-40. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 52. . . . 116

Figure B-41. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 53. . . . 117

Figure B-42. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 54. . . . 118

Figure B-43. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 55. . . . 119

Figure B-44. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 56. . . . 120

Figure B-45. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 57. . . . 121

Figure B-46. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 58. . . . 122

Figure B-47. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 60. . . . 123

Figure B-48. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 61. . . . 124

Figure B-49. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 62. . . . 125

Figure B-50. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 63. . . . 126

Figure B-51. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 64. . . . 127

Figure B-52. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 65. . . . 128

Figure B-53. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 66. . . . 129

Figure B-54. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 67. . . . 130

Figure B-55. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 68. . . . 131

Figure B-56. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 69. . . . 132

Figure B-57. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 70. . . . 133

Figure B-58. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 71. . . . 134

Figure B-59. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 72 and 73. . . . 135

Figure B-60. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 74. . . . 136

Figure B-61. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore east of mile marker 74. . . . 137

Tables

Page

Table 1. SOPs used for shoreline position data collection, processing, and reporting 4

Table 2. High tide levels surveyed for the Cape Hatteras National Seashore shoreline monitoring. 5

Table 3. Table listing the length and horizontal precision of the shorelines collected during 2018 and 2019 with the mean length and horizontal precision calculated by averaging the entire shoreline feature. 9

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Summary and Key Findings

In 2018 and 2019 the Southeast Coast Network, with assistance from park staff, collected shoreline data at Cape Hatteras 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:

- In 2018 and 2019 the Southeast Coast Network collected shoreline data at Cape Hatteras National Seashore as a part of the NPS Vital Signs Monitoring Program. High tide line data were collected in spring 2018, fall 2018, and spring 2019.
- A mean of 121.85 kilometers (75.71 miles [mi]) of shoreline were mapped from 2018 to 2019 with a mean horizontal precision of 10.49 centimeters (4.13 inches [in]).
- The mean shoreline change distance from spring 2018 to fall 2018 was 9.62 meters (31.56 feet [ft]) with a standard deviation of 17.59 meters (57.71 ft). The shoreline change distance ranged from -140.50 to 152.08 meters (-460.96 to 498.95 ft).
- The mean shoreline change distance from fall 2018 to spring 2019 was -10.89 meters (-35.73 ft) with a standard deviation of 15.59 meters (51.14 ft). The shoreline change distance ranged from -95.58 to 71.98 meters (-313.58 to 236.15 ft).
- The mean shoreline change distance from spring 2018 to spring 2019 was -1.46 meters (-4.79 ft) with a standard deviation of 21.76 meters (71.39 ft). The shoreline change distance ranged from -172.52 to 85.38 meters (-566.01 to 280.12 ft).
- High erosion areas were present in the spring 2018 to fall 2018 shoreline survey analysis. 7.88 % of the transects were located in areas of erosion beyond the uncertainty range of the data (± 10 meters [32.8 ft]).
- High erosion areas were present in the fall 2018 to spring 2019 shoreline survey analysis. 46.43 % of the transects were located in areas of erosion beyond the uncertainty range of the data (± 10 meters [32.8 ft]).
- High erosion areas were present in the spring 2018 to spring 2019 shoreline survey analysis. 26.75 % of the transects were located in areas of erosion beyond the uncertainty range of the data (± 10 meters [32.8 ft]).
- High accretion areas were present in the spring 2018 to fall 2018 shoreline survey analysis. 47.06 % of the transects were located in areas of accretion beyond the uncertainty range of the data (± 10 meters [32.8 ft]).
- High accretion areas were present in the fall 2018 to spring 2019 shoreline survey analysis. 4.49 % of the transects were located in areas of accretion beyond the uncertainty range of the data (± 10 meters [32.8 ft]).
- High accretion areas were present in the spring 2018 to spring 2019 shoreline survey analysis. 24.51 % of the transects were located in areas of accretion beyond the uncertainty range of the data (± 10 meters [32.8 ft]).

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 Cape Hatteras National Seashore (CAHA) 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 long-term shoreline monitoring project. Data is collected along the sandy beaches of Bodie Island, Hatteras Island (including Pea Island National Wildlife refuge), and Ocracoke Island.

Study Area

Cape Hatteras National Seashore is a series of barrier islands that make up the northern portion of the Outer Banks of North Carolina. The seashore consists of 74 miles (119 kilometers [km]) of shoreline. The islands are made up of both east and south facing beaches and are very close to the Gulf Stream and Labrador oceanic currents. They encompass many points, spits and inlets, making for an extremely dynamic area.

The seashore is made up of three separate islands; Bodie Island, Hatteras Island, and Ocracoke Island. The northern boundary is bordered by the Village of Nags Head, and the southern boundary ends at Ocracoke Inlet. Two other major inlets play a role in the seashore's makeup and they are Oregon Inlet and Hatteras Inlet.

There is local interest in the protection of roadways and property on the island, which are under constant threat from storm surges, high winds and sand deposition and erosion. The seashore surrounds nine villages where most of this sensitive property is located, and also where much of the development pressure originates. A constructed dune line put into place by the Civilian Conservation Corps in the late 1930s has offered protection in the past, but is now in need of continuous maintenance due to erosion from storms and sea-level rise. Additionally, various beach nourishment projects have been completed over the years at these sensitive areas in attempts to thwart rising sea level and storm impacts.

Historic sites such as the Cape Hatteras Lighthouse, which was moved in 1999 due to threats from shoreline erosion, and several Coast Guard life-saving stations are constantly threatened from sea-level rise and the island's dynamic nature. The seashore is comprised of a variety of different habitats such as maritime forest, salt marsh, bog, back dune, and ocean shoreline, which allow for an array of wildlife to inhabit the area. The seashore has been designated as a Globally Important Bird Area by the American Bird Conservancy because of the importance of the habitats to avian breeding, migration, and wintering (DeVivo et. al 2015). Several threatened and endangered species—such as the Loggerhead sea turtle and Piping Plover—use the island for nesting and overwintering. Preferred nesting and overwintering areas change as shorelines change over time. Knowledge of shoreline dynamics may help with future planning for wildlife protection at the seashore.

Long-term monitoring of shoreline position is useful for park managers in making critical decisions about the protection and preservation of the islands resources. The purpose of this document is to report 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 Cape Hatteras 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 three shoreline data collections were analyzed using DSAS. The annual shoreline change was performed by analyzing the 2018 and 2019 shoreline data collected. The spring 2018 shoreline was collected during April 2018, the fall 2018 shoreline data was collected during October 2018, and the spring 2019 shoreline was collected during March 2019 (Table 2). The three shorelines were analyzed by calculating the distance the high-tide lines of two shorelines moved, along cross-shore transects spaced approximately 10 meters (32.8 ft) apart. This analysis is termed Net Shoreline Movement in DSAS. For this report the seasonal shoreline change was analyzed from spring 2018 to fall 2018 and from fall 2018 to spring 2019. Additionally, the annual shoreline change was analyzed from spring 2018 to spring 2019.

High erosion areas were 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

Three shoreline surveys of the high tide swash line included in this report were conducted during neap tide windows. The survey window was chosen based on the predicted tides using the closest NOAA tide gage with predicted tides (Oregon Inlet Marina, NC—Station ID: 8652587 or UCGS Station Hatteras, NC—Station IS: 8654467; National Ocean and Atmospheric Administration, 2019). The actual tide heights that occurred before the surveys included in this annual report are listed in Table 2 and plots of the predicted and verified tidal heights are shown in Figures 2 through 7. The high tides prior to the shoreline survey data collections were predicted to have similar water levels, but as shown in Figures 2-7, the actual tidal heights can vary. The Oregon Inlet tide station is used for the Bodie Island and northern Hatteras Island sections, including Pea Island National Wildlife Refuge. The USCG Station Hatteras tide station is used for the southern Hatteras Island and Ocracoke Island sections.

Table 2. High tide levels surveyed for the Cape Hatteras National Seashore shoreline monitoring.

Season	Survey Collection Date (YYYYMMDDHH)	Previous High Tide Height* (meters)	Previous High Tide Time (military time)
Spring 2018	2018042107**	0.22	0118
	2018042206*	0.30	0136
	2018042307**	0.14	0342
	2018042508*	0.54	0454
	2018042607**	0.31	0624
Fall 2018	2018102007**	0.20	0618
	2018102207*	0.37	0706
	2018102208**	0.27	0742
	2018102307*	0.36	0812
	2018102410**	0.33	0912
Spring 2019	2019032807**	0.38	0318
	2019032907**	0.26	0418
	2019033006**	0.20	0512
	2019033107*	0.42	0536
	2019033107*	0.42	0536

* Tide heights are relative to Mean Lower Low Water, Oregon Inlet Marina, North Carolina—Station ID 8652587; ** Tide heights are relative to Mean Lower Low Water, USGS Station Hatteras, North Carolina—Station ID 8654467

During the spring 2018 shoreline data collection, there was a weather event on April 25, 2018 that increased the morning and afternoon tides at the Oregon Inlet tide station (Figure 2). Additionally, this weather event also slightly increased the April 26, 2018 morning tide. This weather event caused lower than anticipated tides at the USCG Station Hatteras tide gauge (Figure 3). However, this weather event did not create tides that were considered storm events, i.e. actual tide greater than 1 foot above the predicted tide.

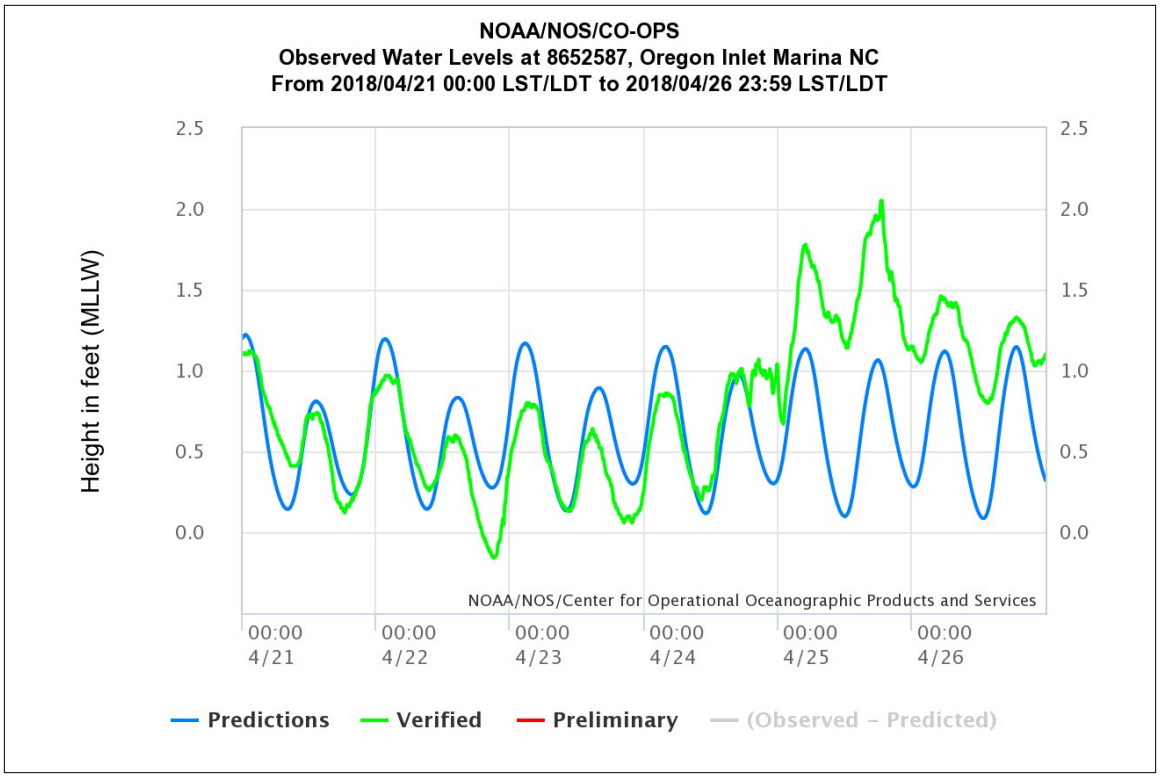


Figure 2. Plot of predicted (blue) and verified (green) tides at the Oregon Inlet Marina, North Carolina (Station ID: 8652587) tide gauge during the spring 2018 shoreline data collection.

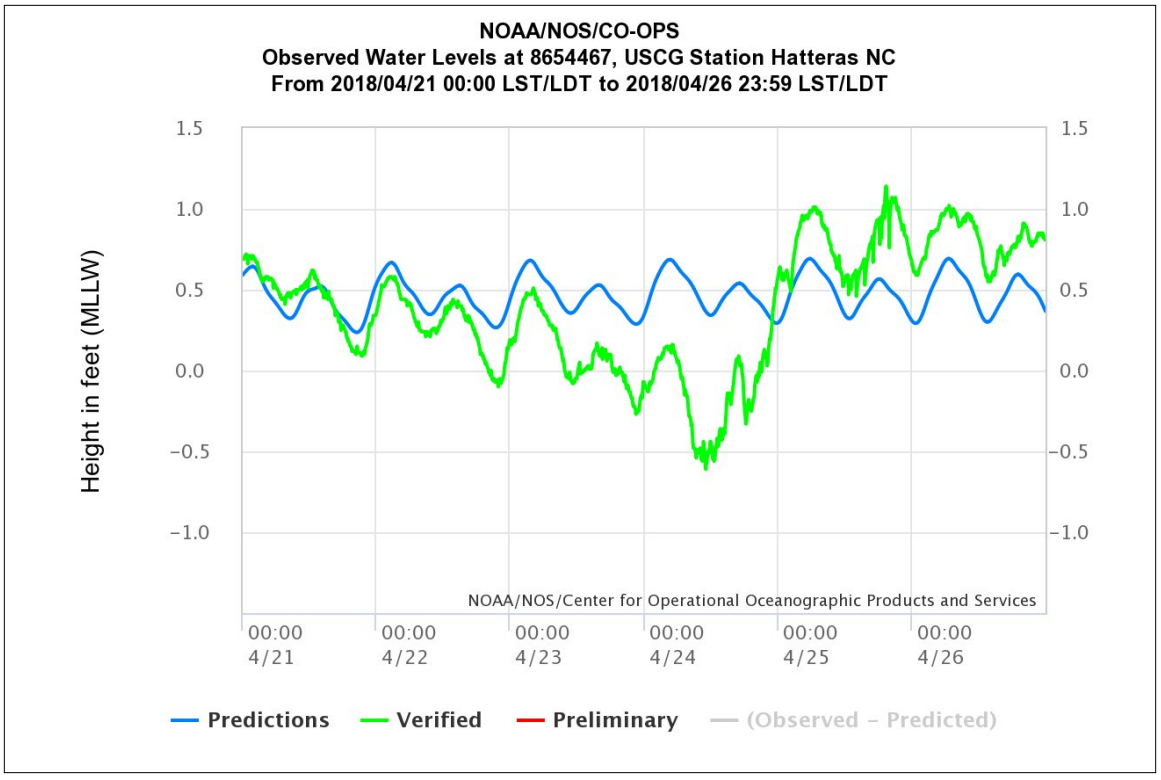


Figure 3. Plot of predicted (blue) and verified (green) tides at the USCG Station Hatteras, North Carolina (Station ID: 8654467) tide gauge during the spring 2018 shoreline data collection.

During the fall 2018 shoreline data collection no weather events occurred that created storm tides or affected data collection according to the Oregon Inlet tide gauge (Figure 4). However, the USCG Station Hatteras tide gauge exhibited a weather event on October 21, 2018 (Figure 5). Shoreline data was not collected on this day. Data collection resumed October 22, 2018 because the tides for those days were not considered storm tides and were within 1 foot of the predicted tide for that day.

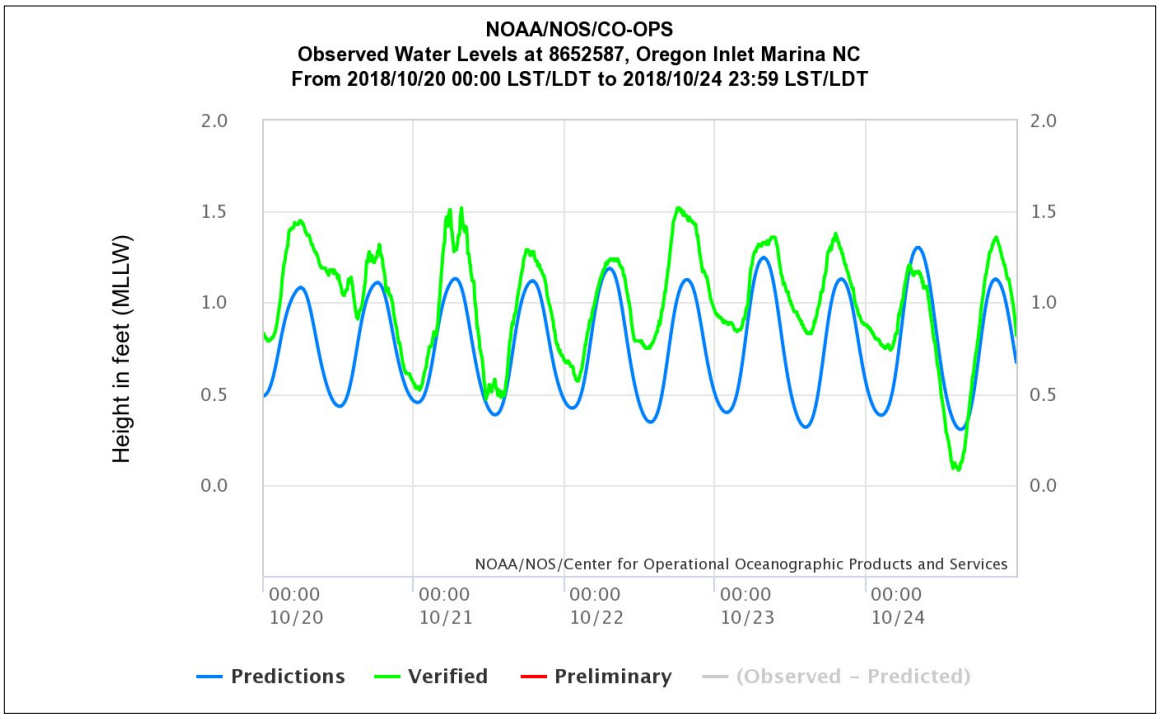


Figure 4. Plot of predicted (blue) and verified (green) tides at the Oregon Inlet Marina, North Carolina (Station ID: 8652587) tide gauge during the fall 2018 shoreline data collection.

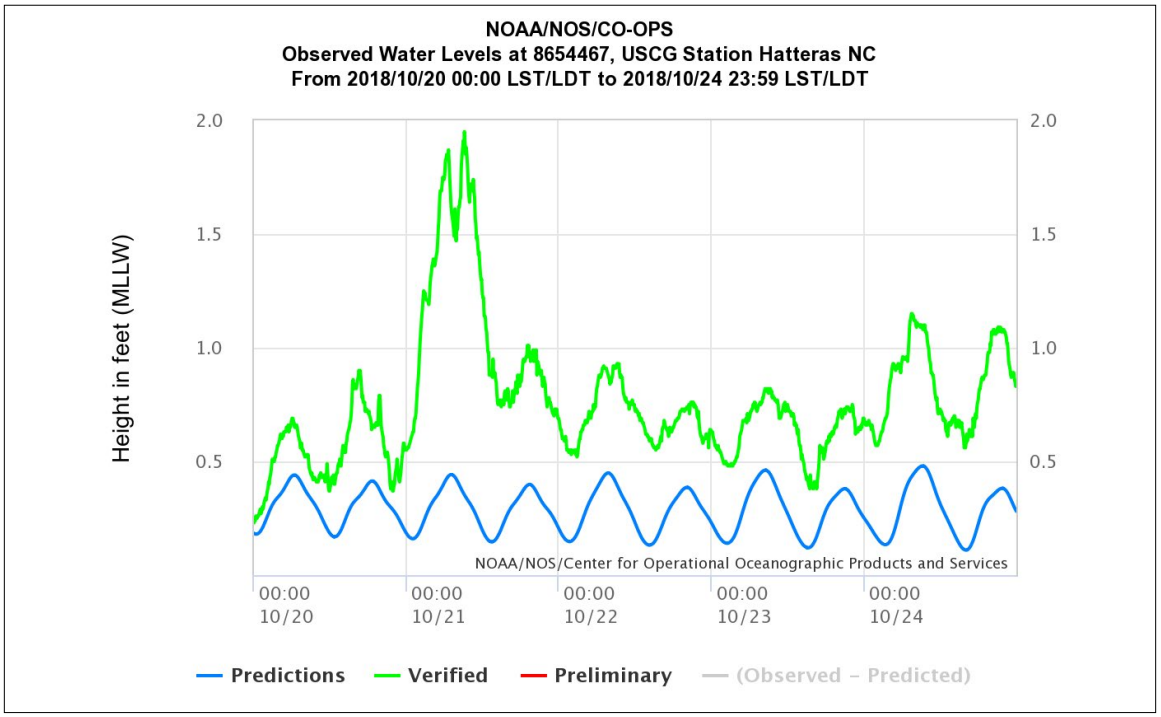


Figure 5. Plot of predicted (blue) and verified (green) tides at the USCG Hatteras, North Carolina (Station ID: 8654467) tide gauge during the fall 2018 shoreline data collection.

During the spring 2019 shoreline data collection the actual high tides were higher than predicted at the Oregon Inlet and USCG Station tide gauges, but were still within the non storm tide threshold (Figures 6 and 7).

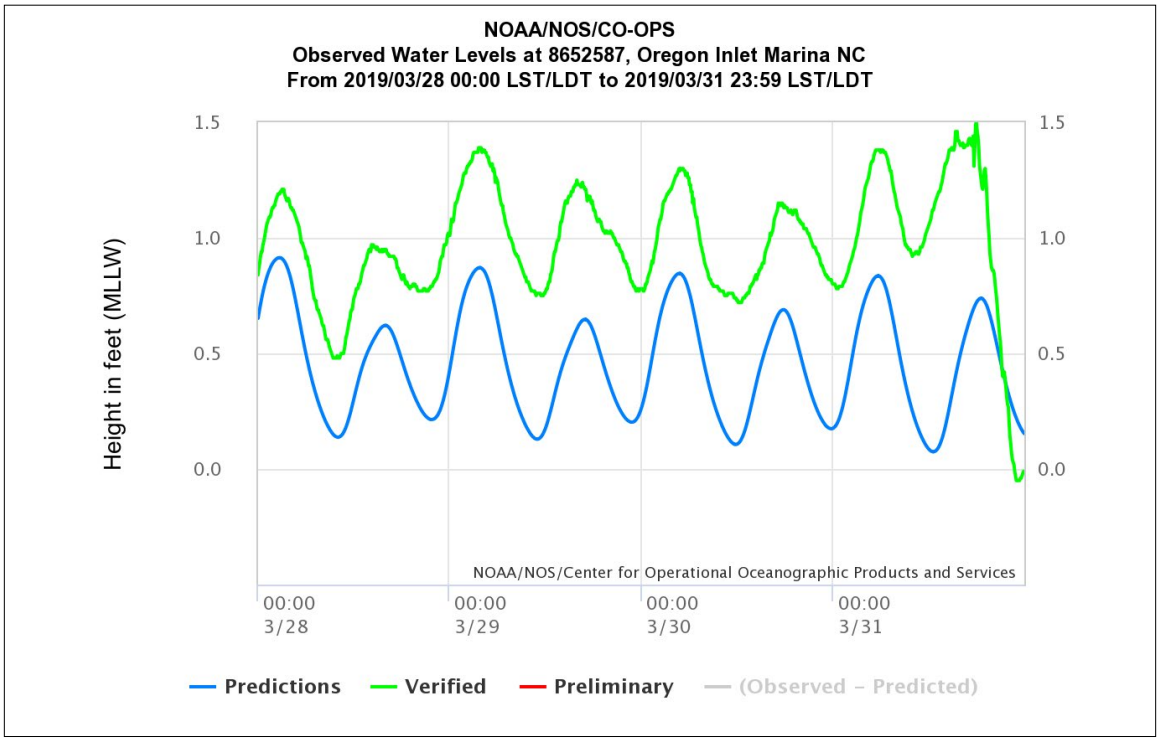


Figure 6. Plot of predicted (blue) and verified (green) tides at the Oregon Inlet Marina, North Carolina (Station ID: 8652587) tide gauge during the spring 2019 shoreline data collection.

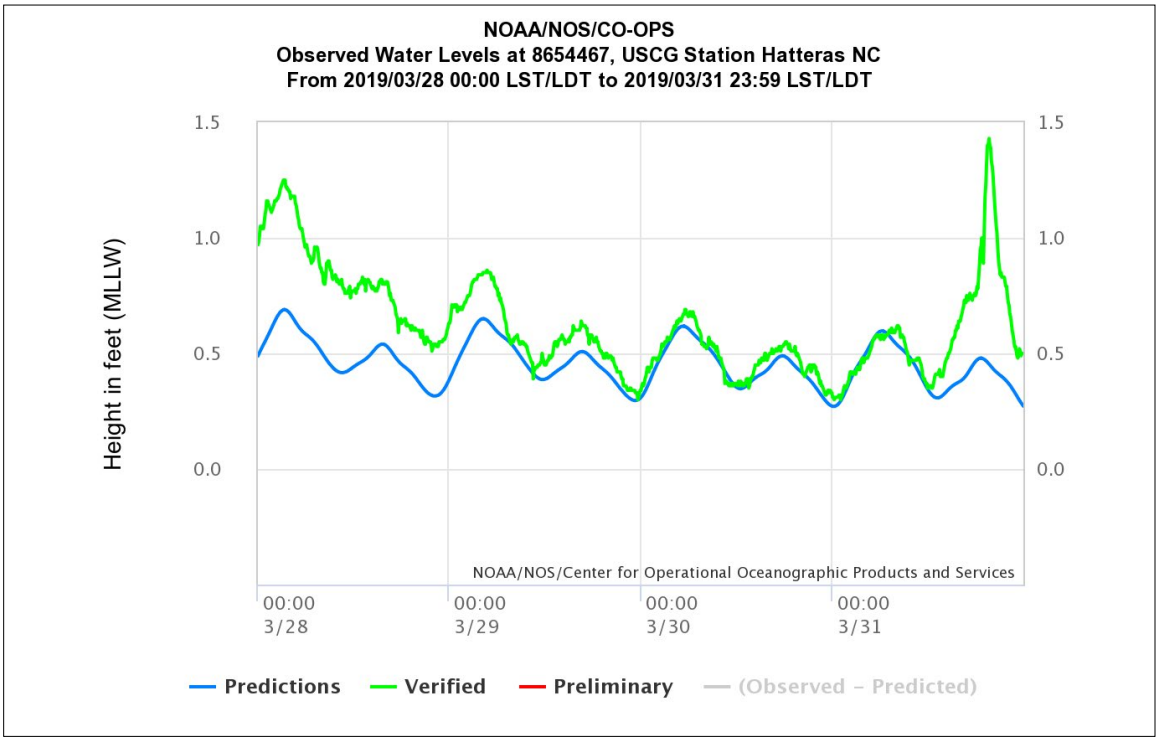


Figure 7. Plot of predicted (blue) and verified (green) tides at the USCG Hatteras, North Carolina (Station ID: 8654467) tide gauge during the spring 2019 shoreline data collection.

Results

Shoreline Data

Shoreline data was collected in 2018 and 2019. On average, 121.85 kilometers (75.71 mi) of shoreline was mapped during the three data collection efforts with a mean horizontal error of 10.49 centimeters (4.13 inches; Table 3).

Shoreline Change Analysis

Annual Shoreline Change

A mean of 121.98 kilometers (75.79 mi) of shoreline was mapped during the spring 2018 and spring 2019 data collection efforts (Table 3). Appendix A contains maps of the spring 2018 to spring 2019 shoreline change distances calculated for the 2018 and 2019 shoreline data collected. The annual shoreline change distance is displayed by the transects between two shorelines, which are clipped to the extent of shoreline change envelope and colored according to the shoreline change distance. A negative shoreline change distance denotes erosion. Positive shoreline change distance is depicting accretion. The shoreline change distance ranged from -172.52 to 85.38 meters (-566.01 to 280.12 ft;). The mean shoreline distance change for the area mapped was -1.46 meters (-4.79 ft) with a standard deviation of 21.76 meters.

High erosion areas were present in the study area, represented as light orange, dark orange, and red transects in the maps in Appendix A. High erosion was identified for 26.75% of the transects (3,140 of 11,740) in the analysis (Figure 8). Because the transects are located approximately every 10 meters (32.8 ft) along the baseline, it can be inferred that high erosions occurred along a cumulative 31.40 kilometers (19.51 mi) of the study area surveyed.

High accretion occurred within the study area, represented as green, teal, light blue, and dark blue transects in the maps in Appendix A. High accretion was identified for 24.51% of the transects (2,878 of 11,740) in the analysis (Figure 8). Because the transects are located approximately every 10 meters (32.8 ft) along the baseline, it can be inferred that high accretion occurred along a cumulative 28.78 kilometers (17.88 mi) of the study area surveyed.

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

A spreadsheet containing annual shoreline change distances for Cape Hatteras NS is available along with this report at https://irma.nps.gov/DataStore/Reference/Profile/2275649.

Table 3. Table listing the length and horizontal precision of the shorelines collected during 2018 and 2019 with the mean length and horizontal precision calculated by averaging the entire shoreline feature. Note: 'YYYY' denotes the four digit year, 'MM' denotes the two digit month, 'DD' denotes the two digit day, and 'HH' denotes the two digit hour in military time. [cm—centimeters; km—kilometers].

Collection Date (YYYYMMDDHH)	Area Mapped	Mean Horizontal Precision (cm)	Length (km)
2018042107	Hatteras Island from the north end of Pea Island National Wildlife Refuge down to just past mile marker 19	10.00	19.82
2018042206	Ocracoke Island	10.00	26.13
2018042307	Hatteras Island from mile marker 19 down to just north of mile marker 39	10.07	32.45
2018042508	Hatteras Island just north of mile marker 39 down to Hatteras Inlet	9.23	34.49
2018042607	Bodie Island	10.00	9.52
2018102007	Bodie Island	10.00	9.30
2018102207	Hatteras Island from the jetty at Buxton up to the Rodanthe Pier	6.66	25.28
2018102208	Hatteras Island from the jetty at Buxton up to the north end of the park boundary	10.52	37.56
2018102307	Ocracoke Island	10.01	27.49
2018102410	Hatteras Island from the north end of Pea Island National Wildlife Refuge down to Rodanthe Pier	10.34	21.95
2019032807	Bodie Island	10.05	9.40
2019032907	Hatteras Island from the north end of Pea Island National Wildlife Refuge down to just past mile marker 19	10.00	19.93
2019033006	Hatteras Island from mile marker 19 down to jetty in Buxton	21.27	40.03
2019033107	Hatteras Island from the jetty at Buxton south to Hatteras Inlet	9.19	24.61
2019033107	Ocracoke Island	10.03	27.59

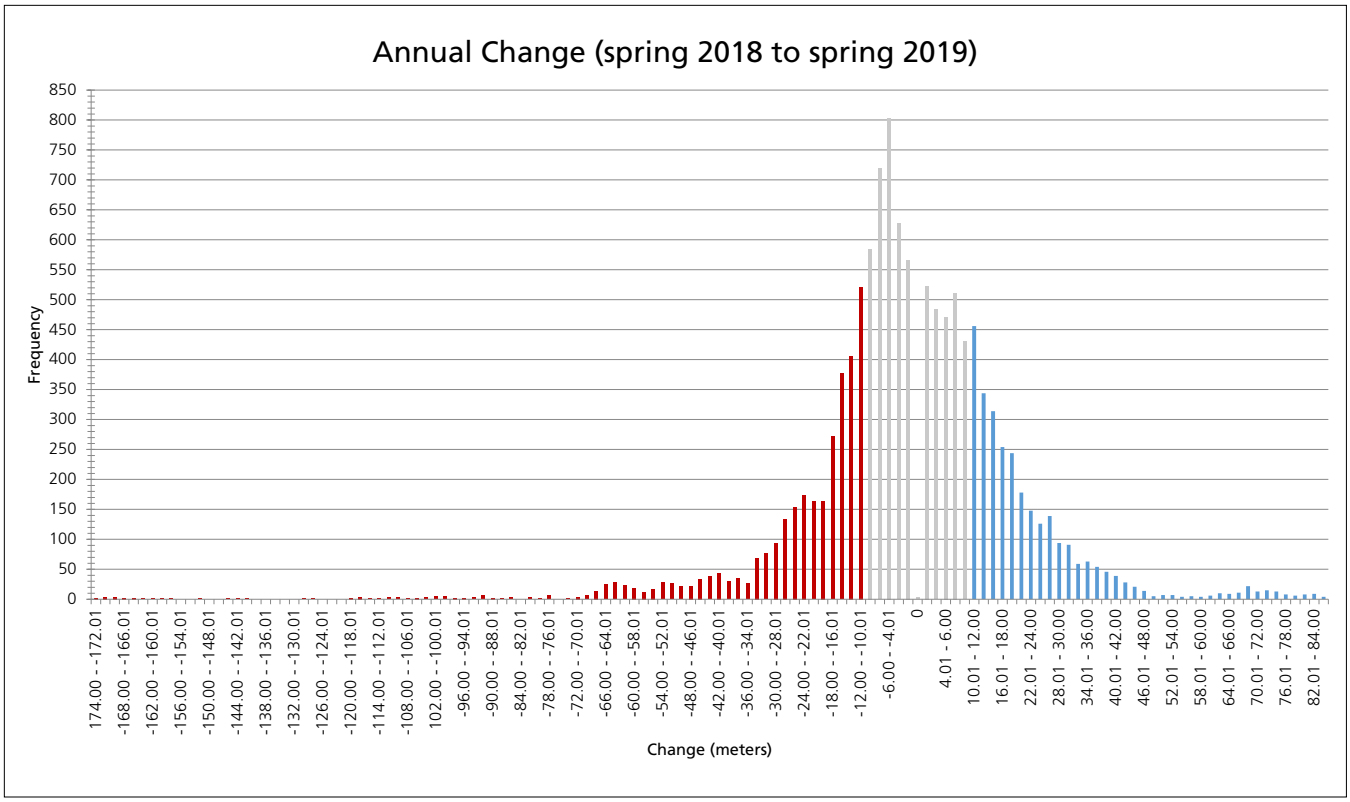


Figure 8. Histogram of transect shoreline change distances from spring 2018 to spring 2019. The shoreline change distance is binned by 2-meter (6.6 ft) increments. The bars are colored red denoting high erosion, grey denoting transect within the uncertainty range of ±10 meters (32.8 ft), and blue denoting high accretion.

Seasonal Shoreline Change

Appendix B contains maps of the spring 2018 to fall 2018 and fall 2018 to spring 2019 shoreline change distances calculated for the 2018 and 2019 shoreline data collected. The annual shoreline change distance is displayed by the transects between two shorelines, which are clipped to the extent of shoreline change and colored according to the shoreline change distance. A negative shoreline change distance denotes erosion. Positive shoreline change distance depicts accretion.

Spring 2018 to Fall 2018 Shoreline Change

A mean of 122 kilometers (75.8 mi) of shoreline were mapped during the spring 2018 and fall 2018 data collection efforts (Table 3). The shoreline change distance from spring 2018 to fall 2018 ranged from -140.50 to 152.08 meters (-460.96 to 498.95 ft;). The mean shoreline distance change from spring 2018 to fall 2018 was 9.62 meters (31.56 ft) with a standard deviation of 17.59.

High erosion areas were present in the study area, represented as light orange, dark orange, and red transects in the maps in Appendix B. High erosion was identified for 7.88% of the transects (929 of 11,783) in the analysis (Figure 9). Because the transects are located approximately every 10 meters (32.8 ft) along the baseline, it can be inferred that high erosions occurred along a cumulative 9.29 kilometers (5.77 mi) of the study area surveyed.

High accretion occurred within the study area, represented as green, teal, light blue, and dark blue transects in the maps in Appendix B. High accretion was identified for 47.06% of the transects (5,545 of 11,783) in the analysis (Figure 9). Because the transects are located approximately every 10 meters (32.8 ft) along the baseline, it can be inferred that high accretion occurred along a cumulative 55.45 kilometers (34.46 mi) of the study area surveyed.

A spreadsheet containing seasonal shoreline change distances for Cape Hatteras NS is available along with this report at https://irma.nps.gov/DataStore/Reference/Profile/2275649.

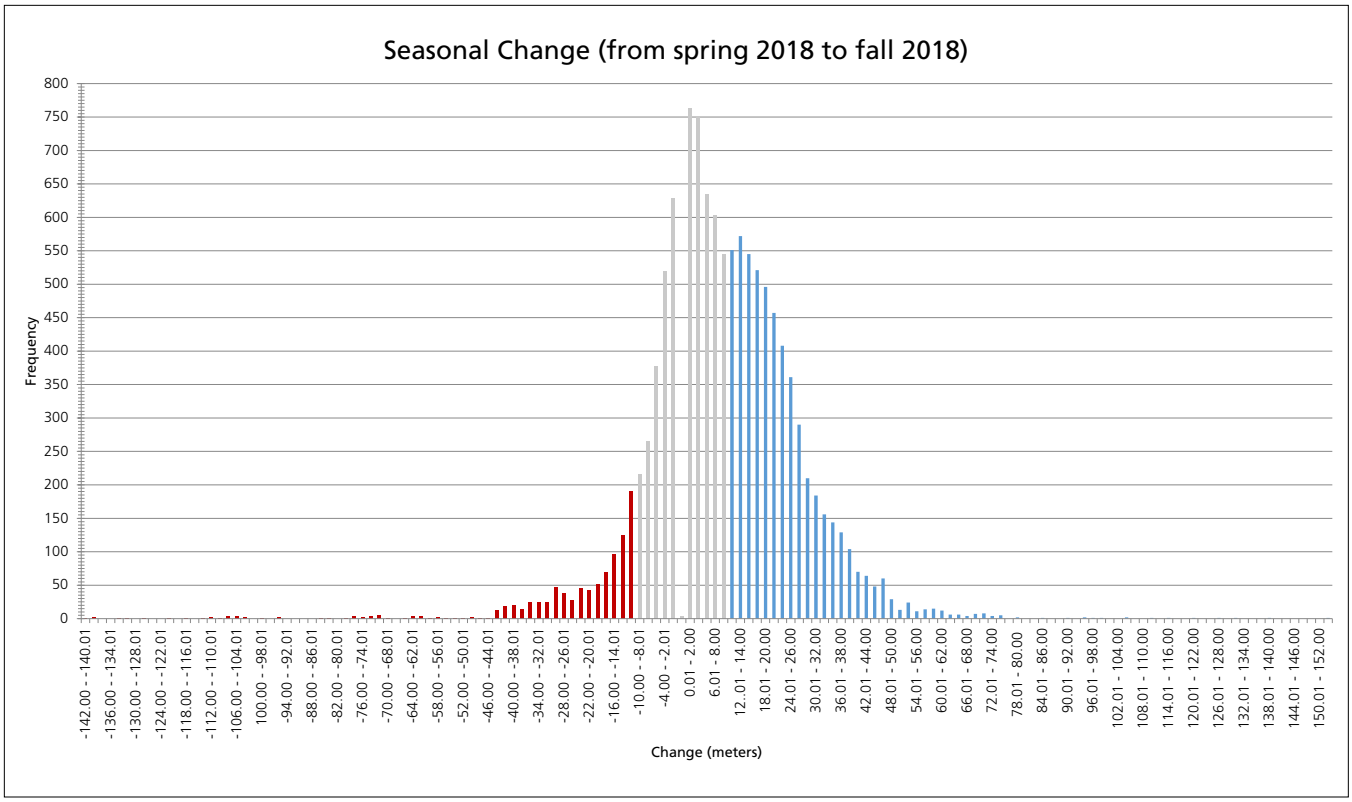


Figure 9. Histogram of transect shoreline change distances from spring 2018 to fall 2018. The shoreline change distance is binned by 2-meter (6.6 ft) increments. The bars are colored red denoting high erosion, grey denoting transect within the uncertainty range of ±10 meters (32.8 ft), and blue denoting high accretion.

Fall 2018 to Spring 2019 Shoreline Change

A mean of 121.57 kilometers (75.54 mi) of shoreline were mapped during the fall 2018 and spring 2019 data collection efforts (Table 3). The shoreline change distance from fall 2018 to spring 2019 ranged from -95.58 to 71.98 meters (-313.58 to 236.15 ft; Appendix D). The mean shoreline distance change from fall 2018 to spring 2019 was -10.89 meters (-35.73 ft) with a standard deviation of 15.59.

High erosion areas were present in the study area, represented as light orange, dark orange, and red transects in the maps in Appendix B. High erosion was identified for 46.43% of the transects (5,542 of 11,935) in the analysis (Figure 10). Because the transects are located approximately every 10 meters (32.8 ft) along the baseline, it can be inferred that high erosions occurred along a cumulative 55.42 kilometers (34.44 mi) of the study area surveyed.

High accretion occurred within the study area, represented as green, teal, light blue, and dark blue transects in the maps in Appendix B. High accretion was identified for 4.49 % of the transects (536 of 11,935) in the analysis (Figure 10). Because the transects are located approximately every 10 meters (32.8 ft) along the baseline, it can be inferred that high accretion occurred along a cumulative 5.36 kilometers (3.33 mi) of the study area surveyed.

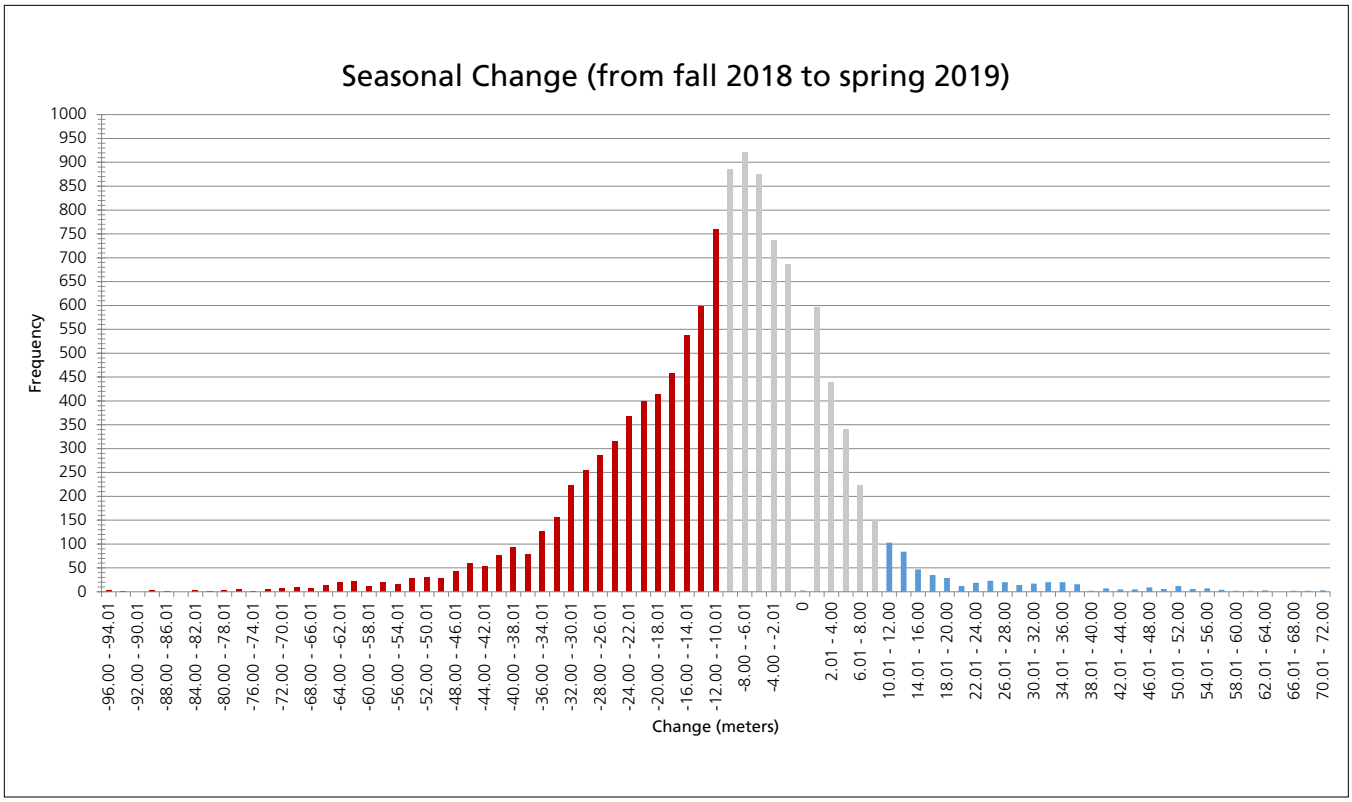


Figure 10. Histogram of transect shoreline change distances from fall 2018 to spring 2019. The shoreline change distance is binned by 2-meter (6.6 ft) increments. The bars are colored red denoting high erosion, grey denoting transect within the uncertainty range of ±10 meters (32.8 ft), and blue denoting high accretion.

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Appendix A. Shoreline Data and Annual Shoreline Change Distance Maps

Maps of the shoreline surveys collected from 2018 to 2019 at Cape Hatteras National Seashore. The shoreline data collected in spring 2018 is shown as a solid black line, the fall 2018 shoreline is shown as a hatched line, and the spring 2019 shoreline is shown as a dotted black line. Maps of net shoreline movement (NSM), also known as shoreline change distance (meters), for the spring 2018 to spring 2019 surveys collected are also shown on the same map. 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 are 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]).

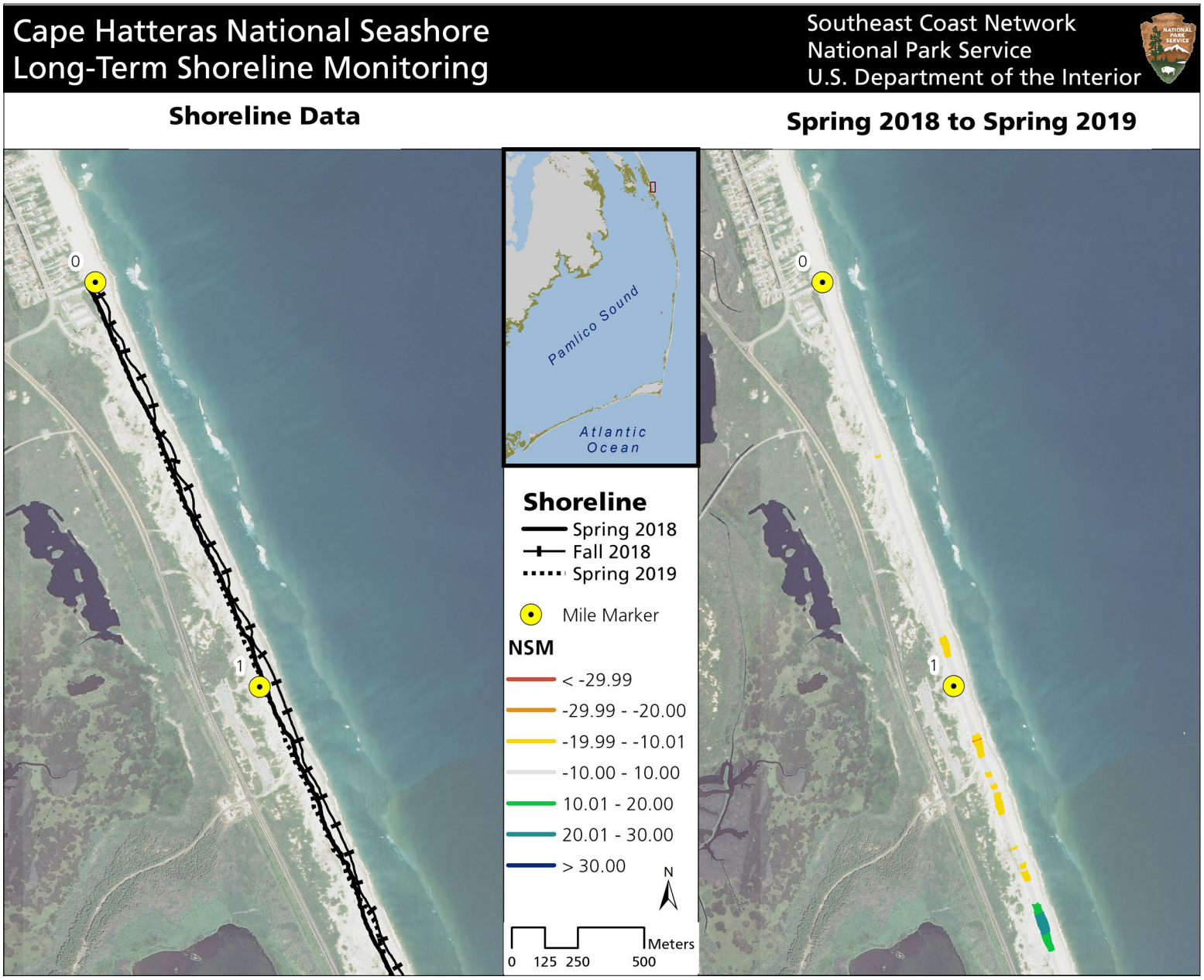


Figure A-1. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 0 and 1.

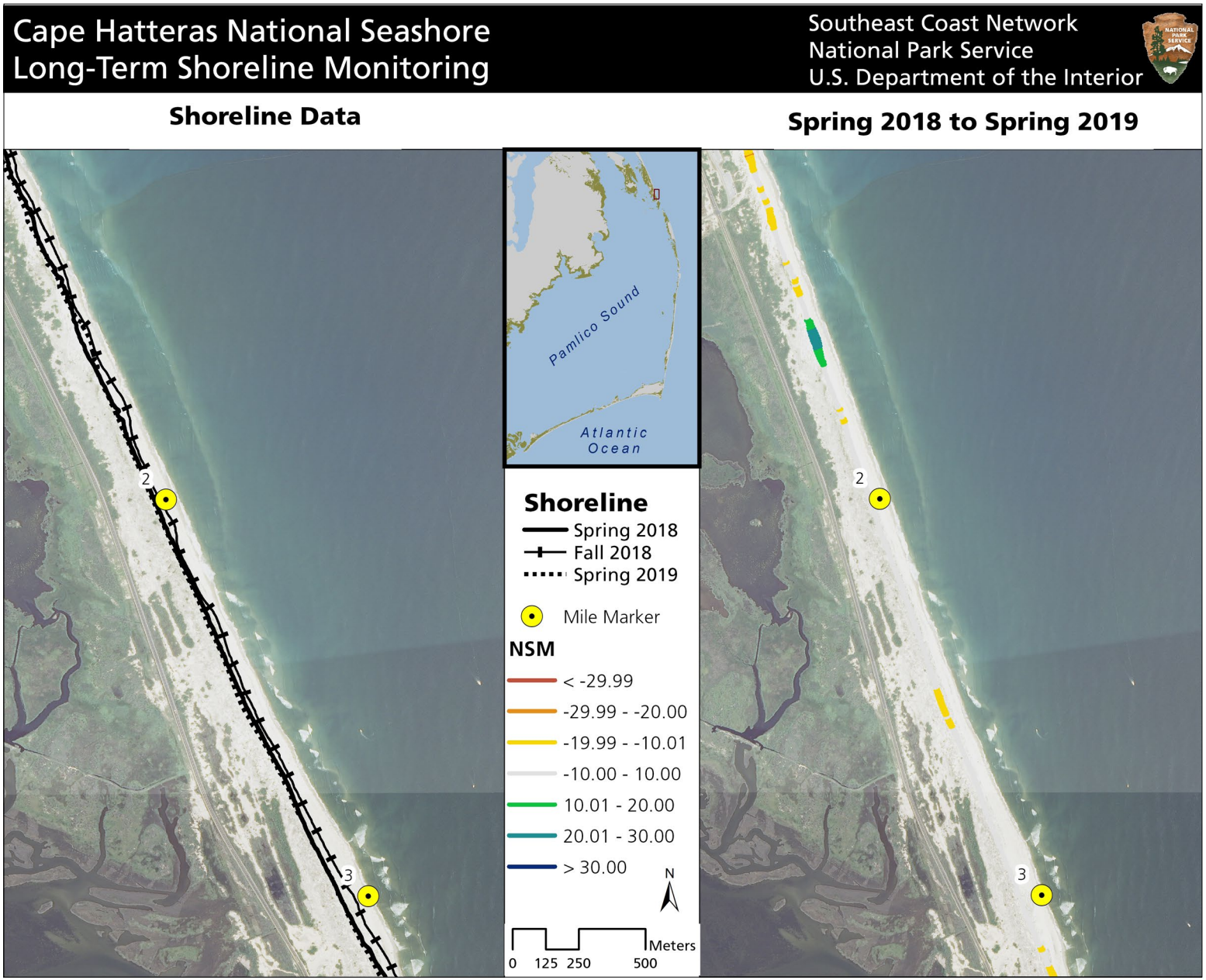


Figure A-2. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 2 and 3.

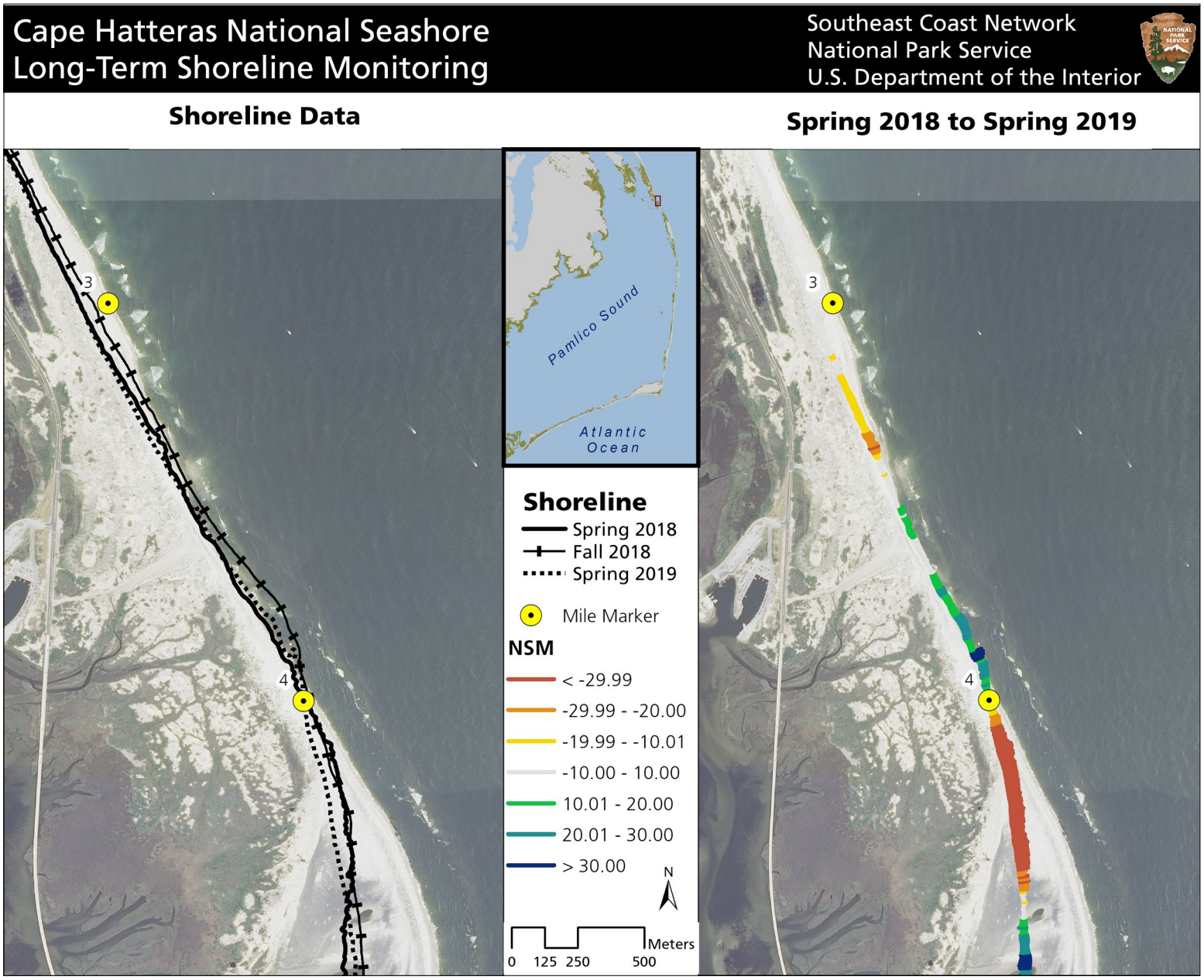


Figure A-3. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 3 and 4.

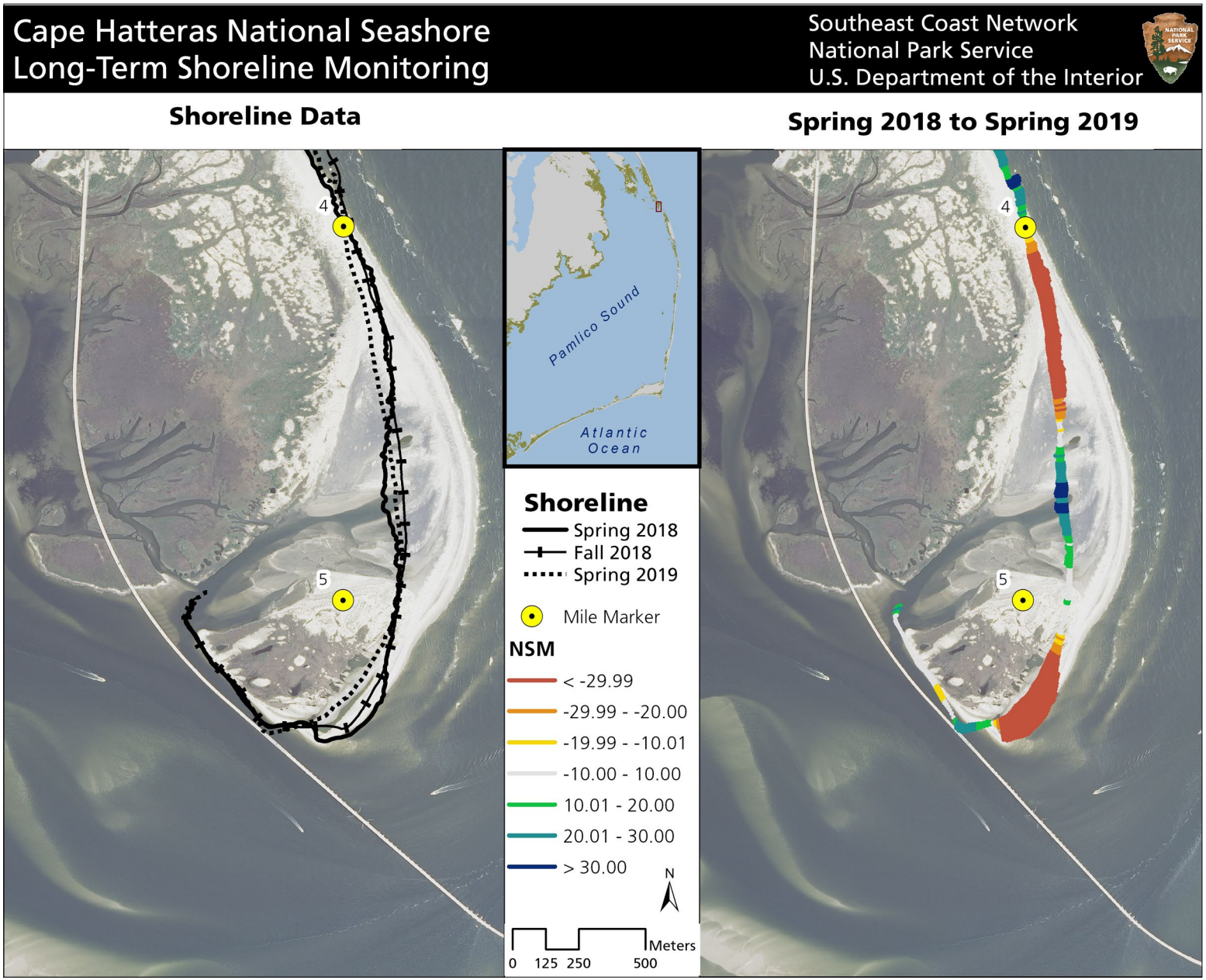


Figure A-4. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 4 and 5.

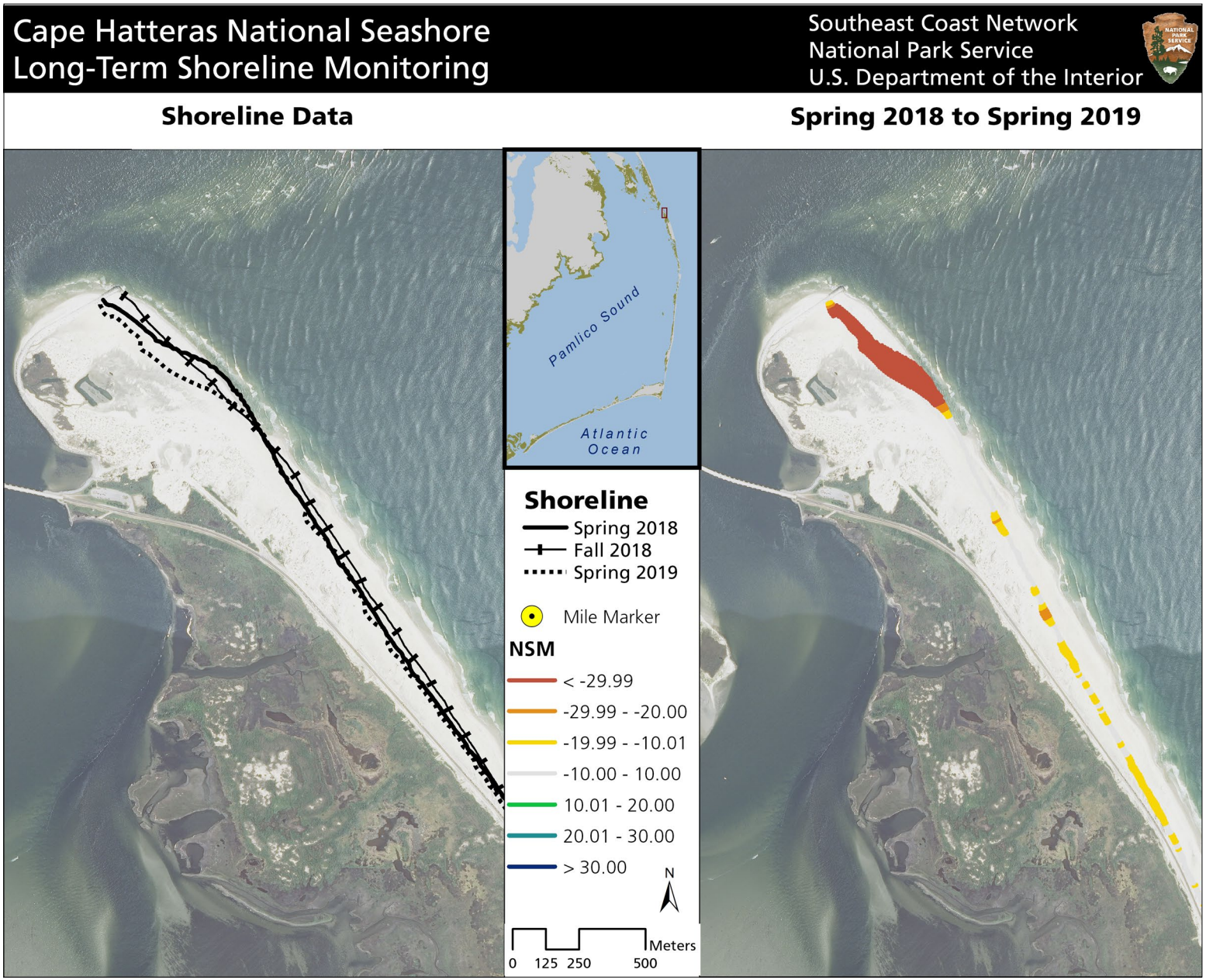


Figure A-5. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at the north end of Hatteras Island within Pea Island National Wildlife Refuge near Oregon Inlet.

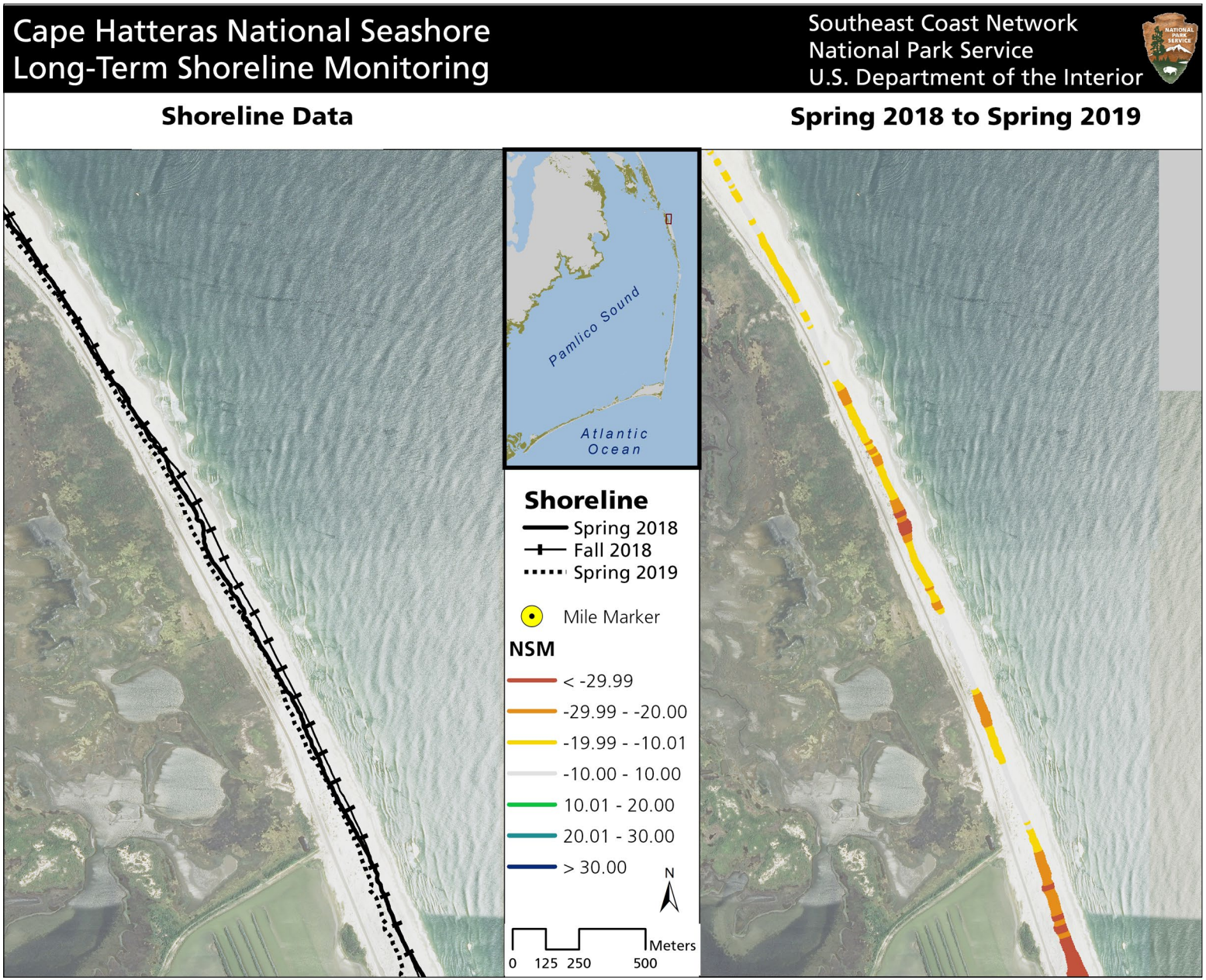


Figure A-6. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at the north end of Hatteras Island within Pea Island National Wildlife Refuge, second section.

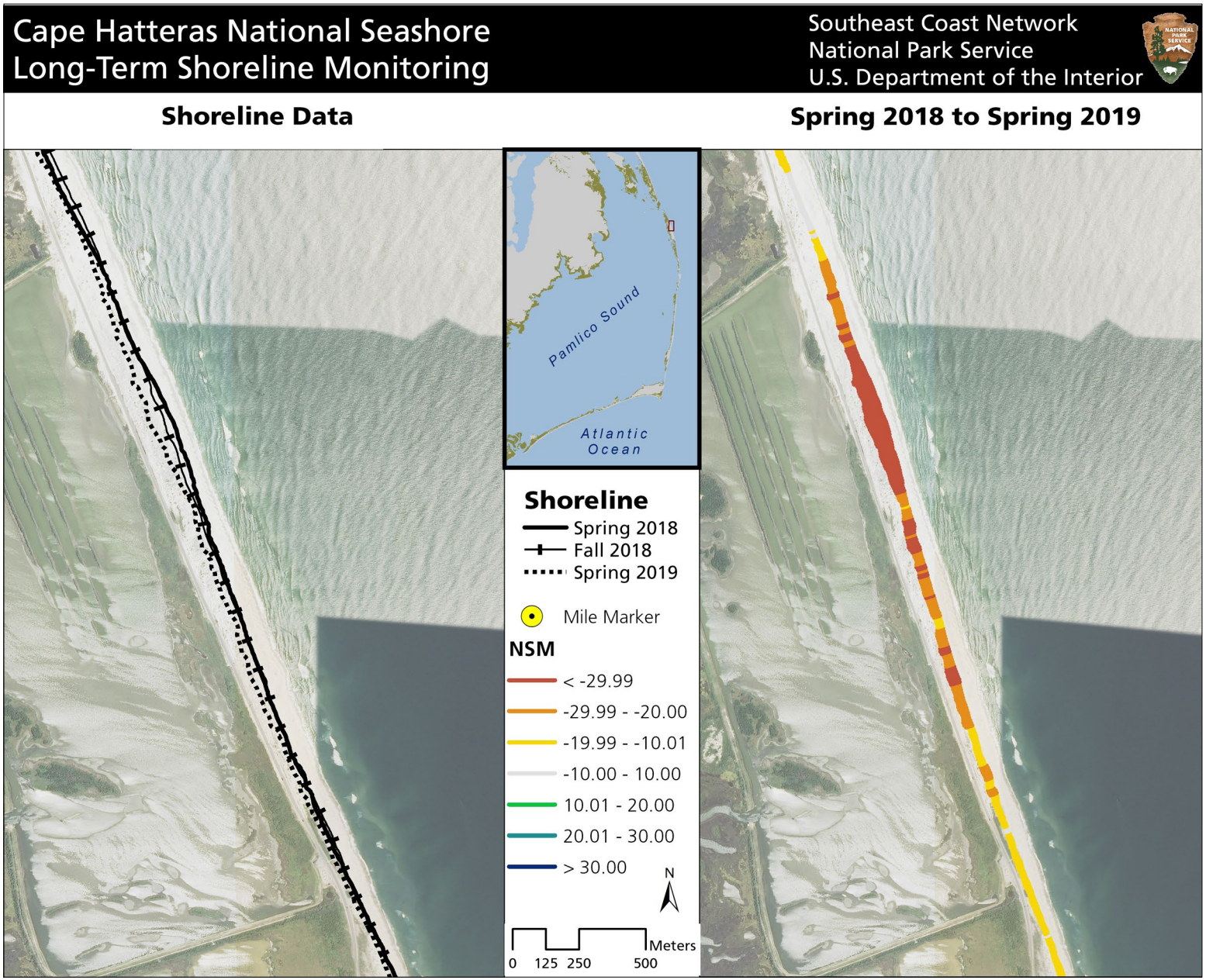


Figure A-7. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at the north end of Hatteras Island within Pea Island National Wildlife Refuge, third section.

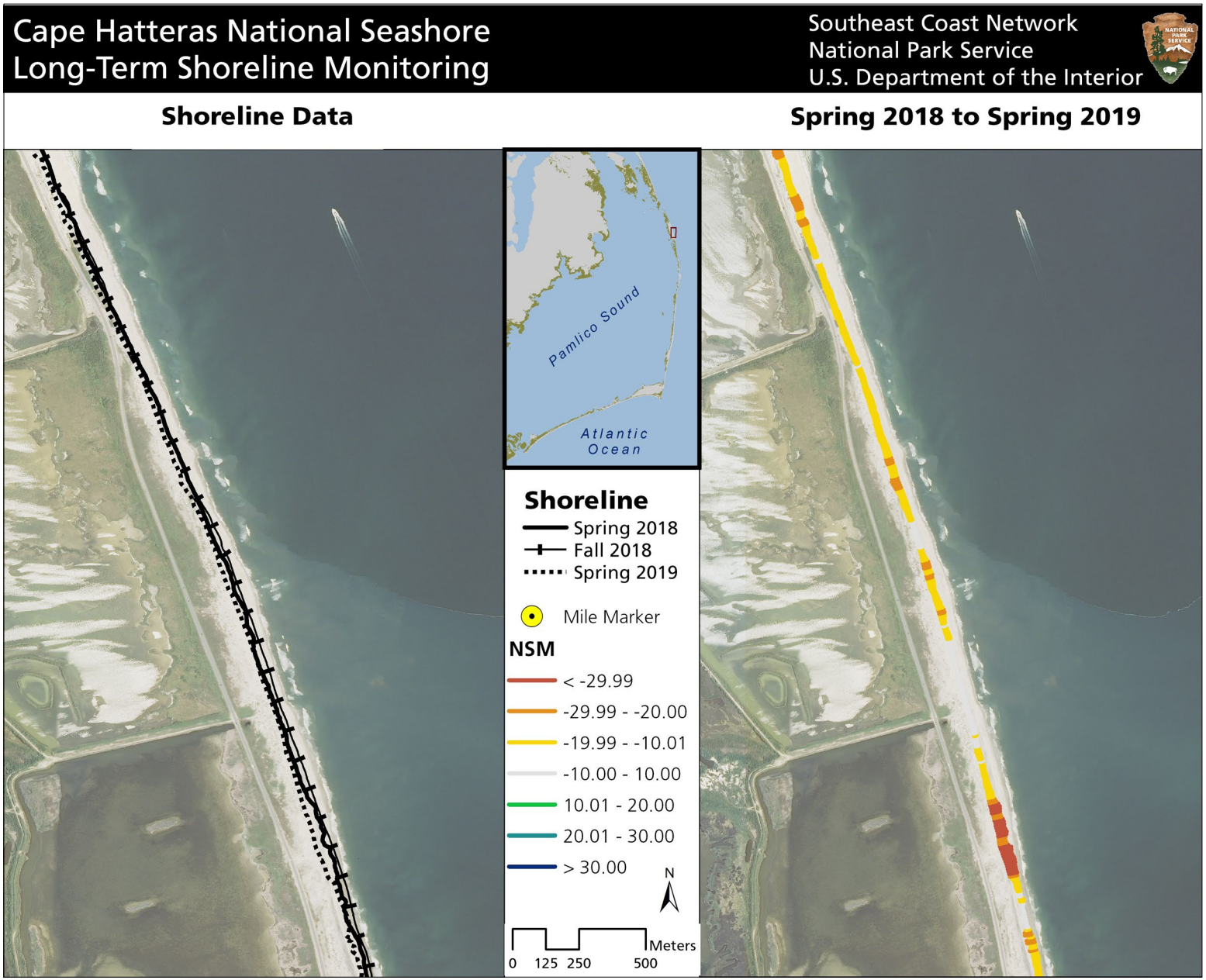


Figure A-8. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at the north end of Hatteras Island within Pea Island National Wildlife Refuge, fourth section.

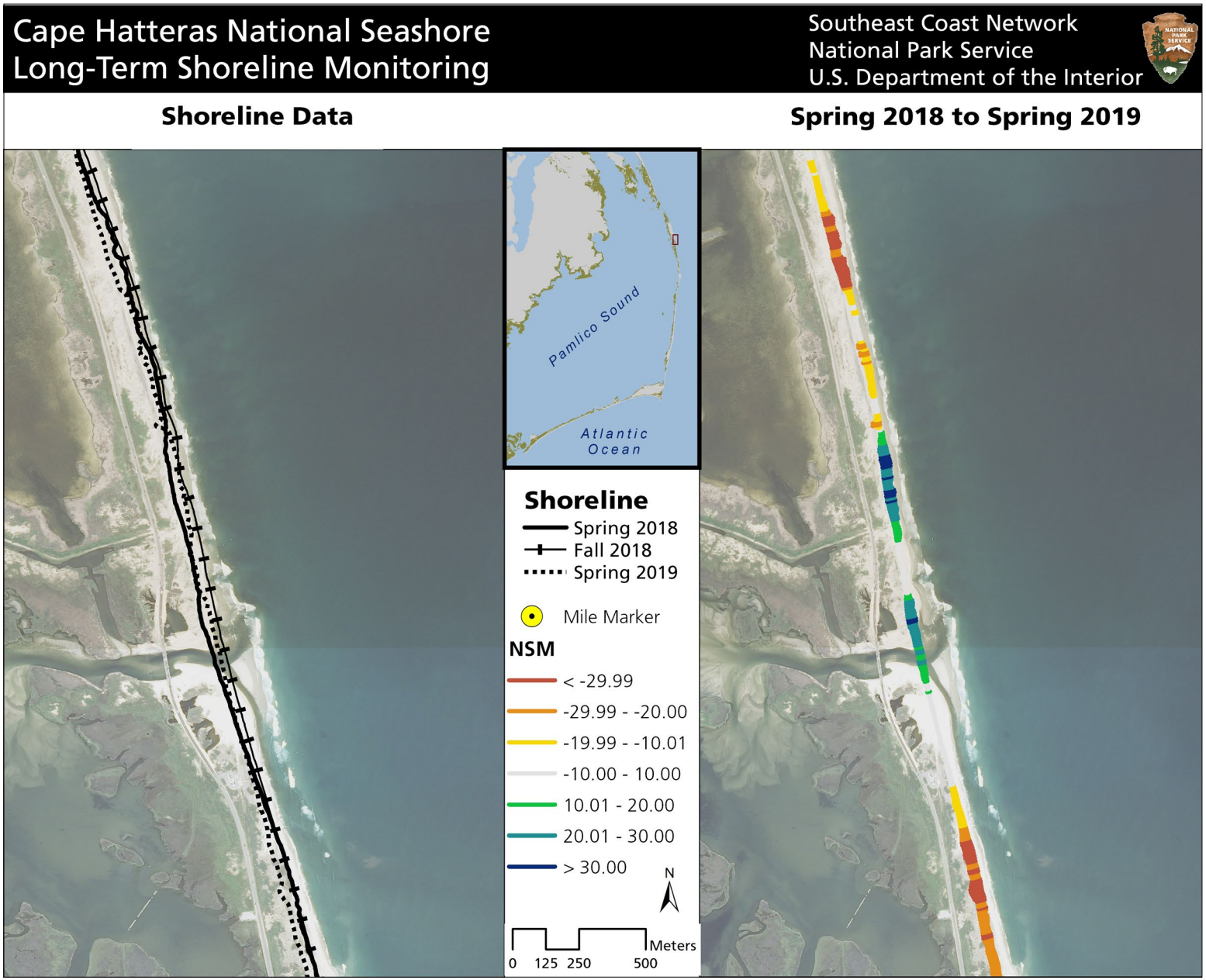


Figure A-9. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at the north end of Hatteras Island within Pea Island National Wildlife Refuge, fifth section.

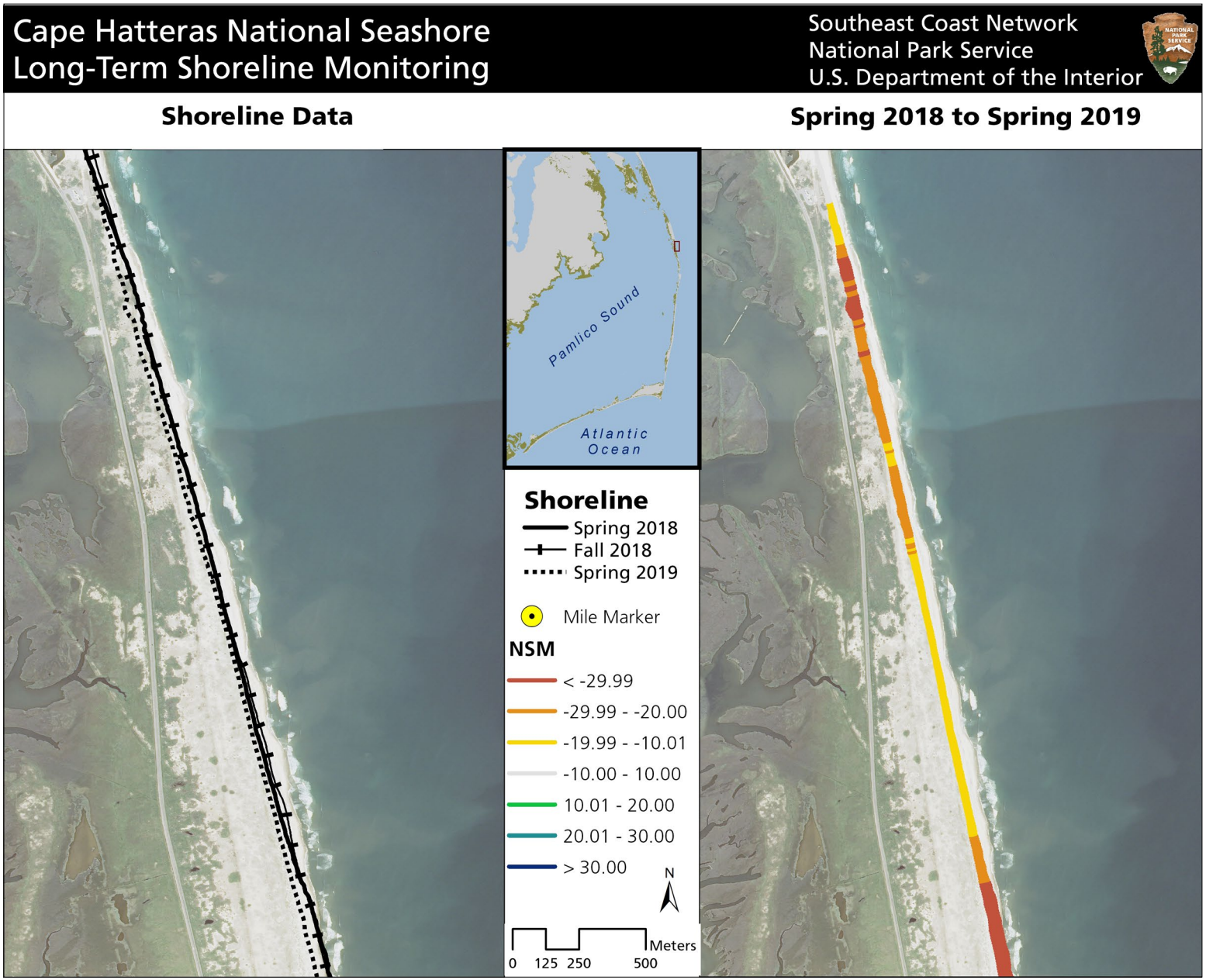


Figure A-10. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at the north end of Hatteras Island within Pea Island National Wildlife Refuge, sixth section.

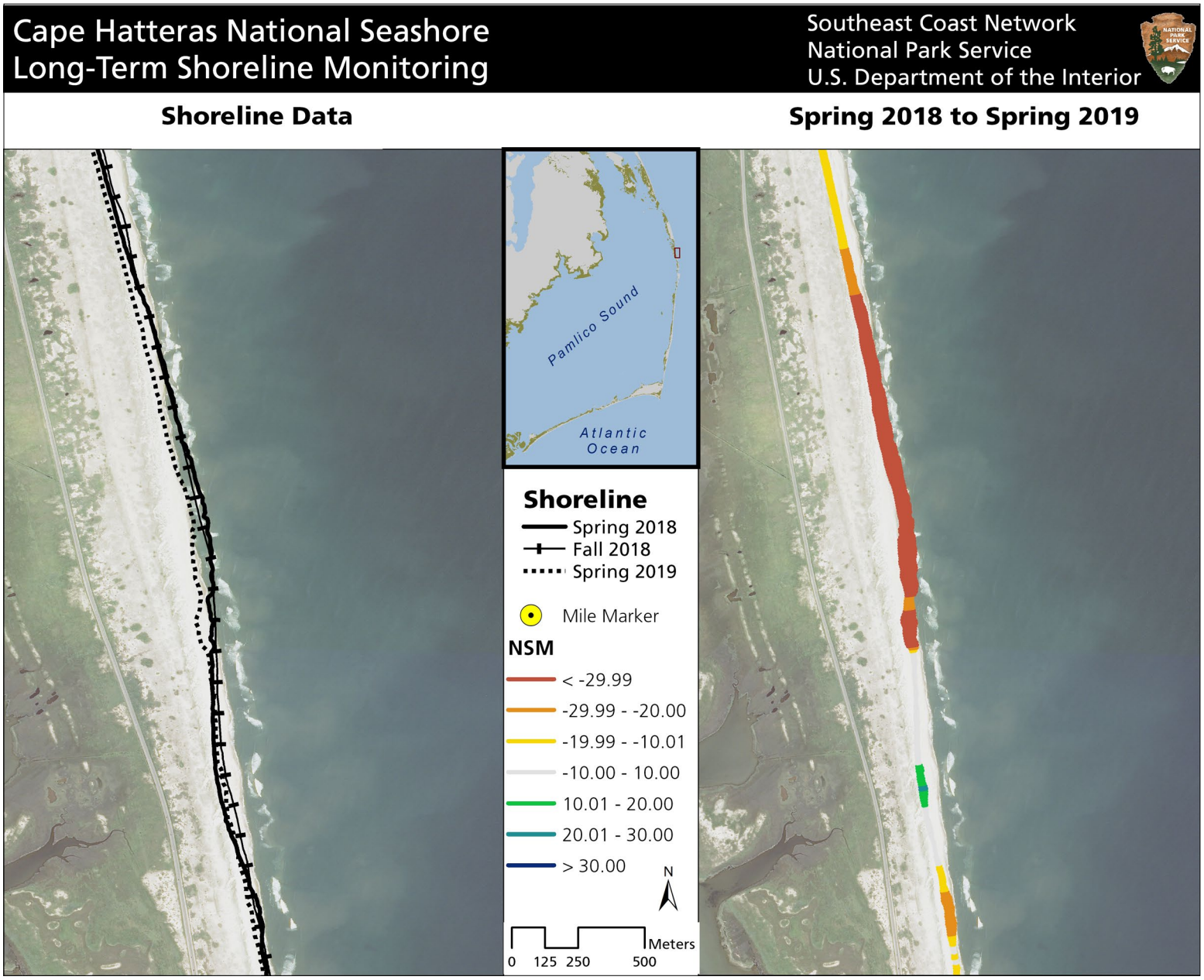


Figure A-11. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at the north end of Hatteras Island within Pea Island National Wildlife Refuge, seventh section.

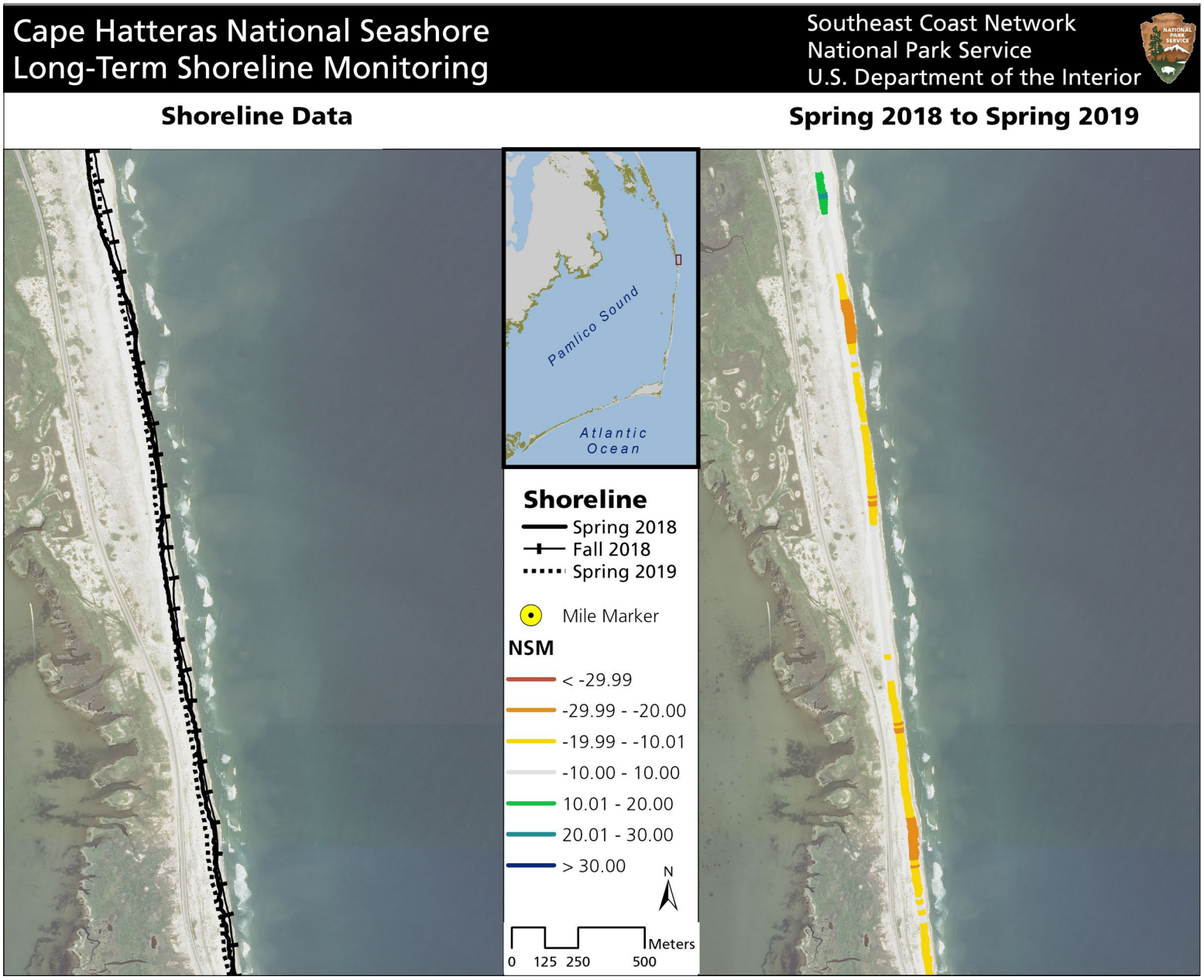


Figure A-12. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at the north end of Hatteras Island within Pea Island National Wildlife Refuge, eighth section.

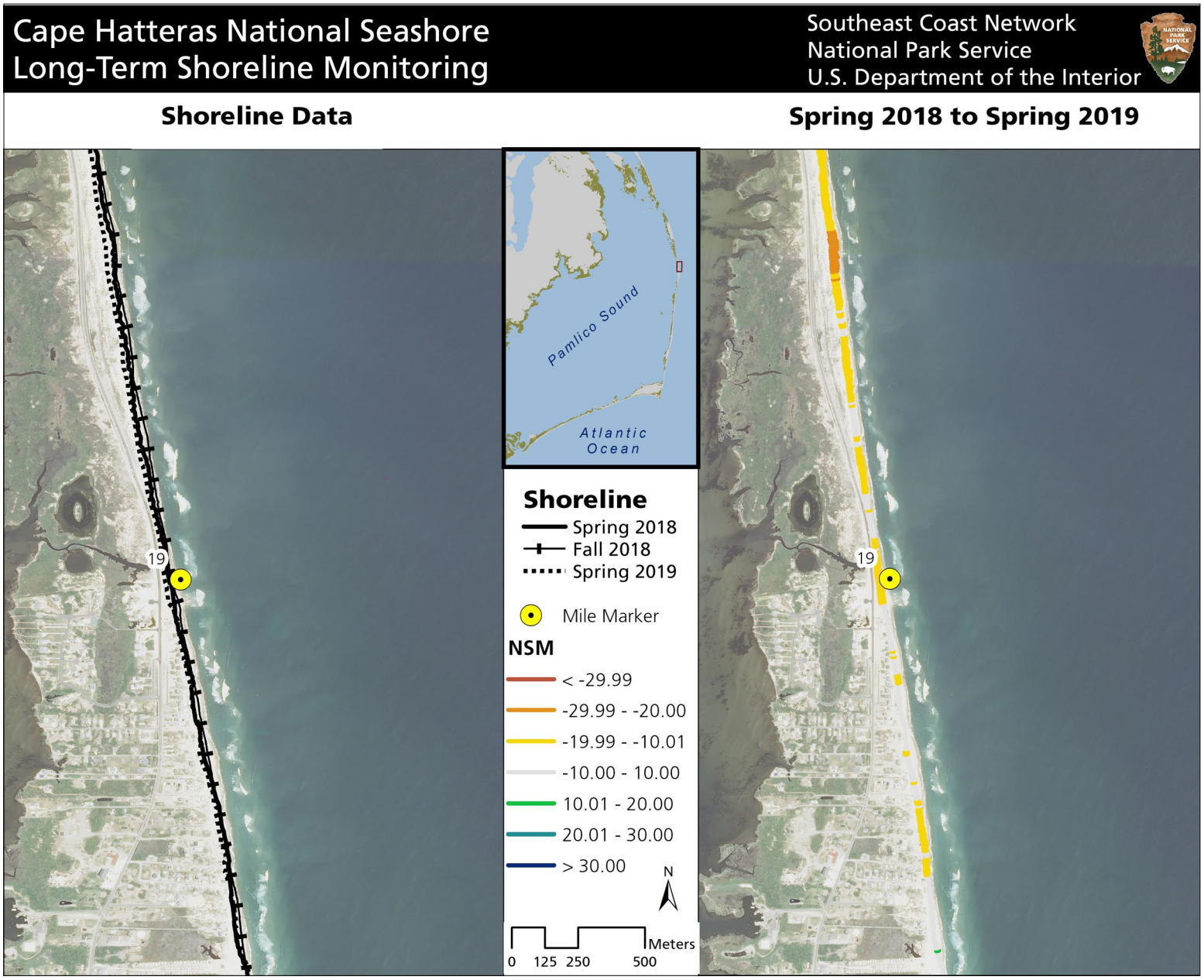


Figure A-13. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 19.

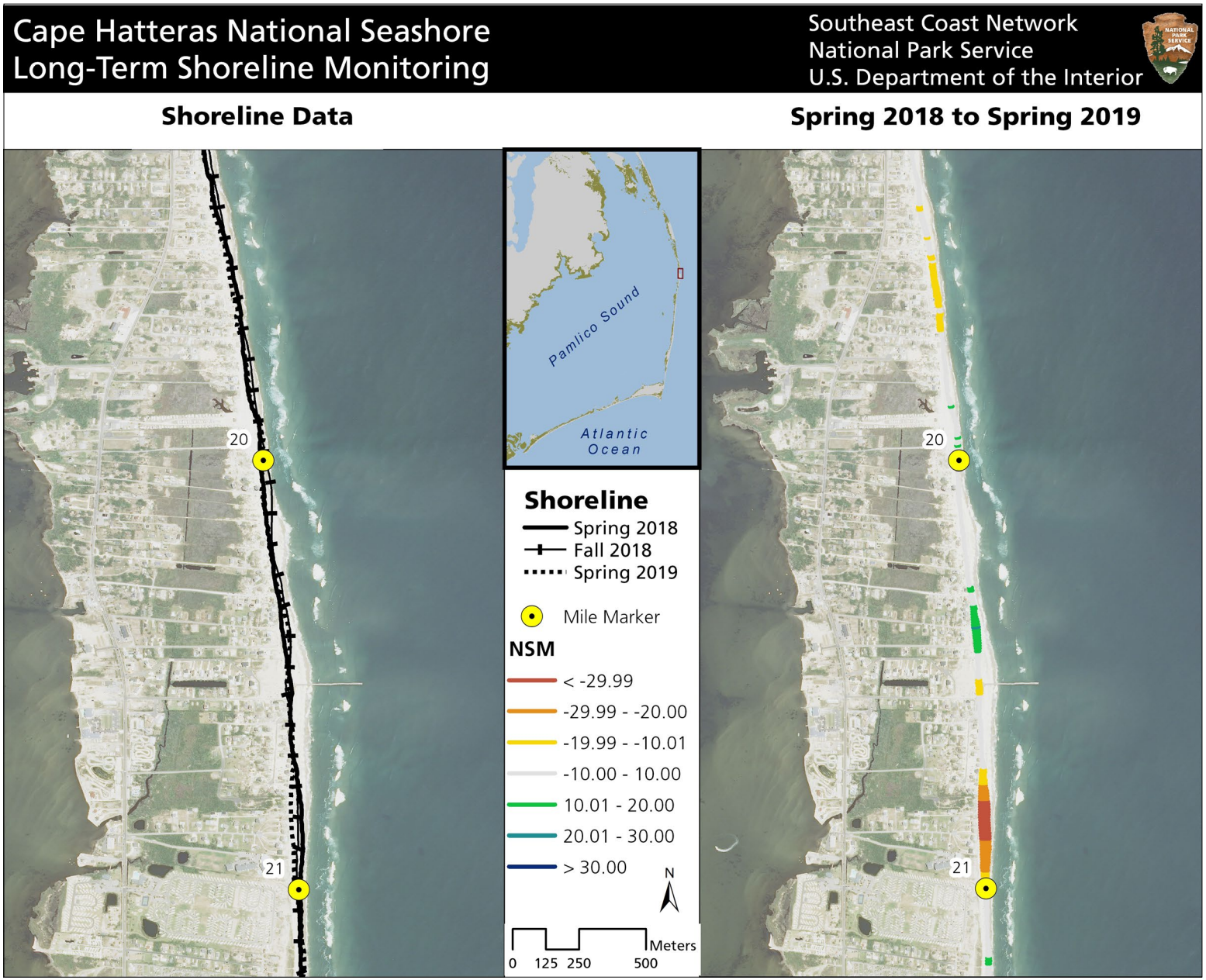


Figure A-14. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 20 and 21.

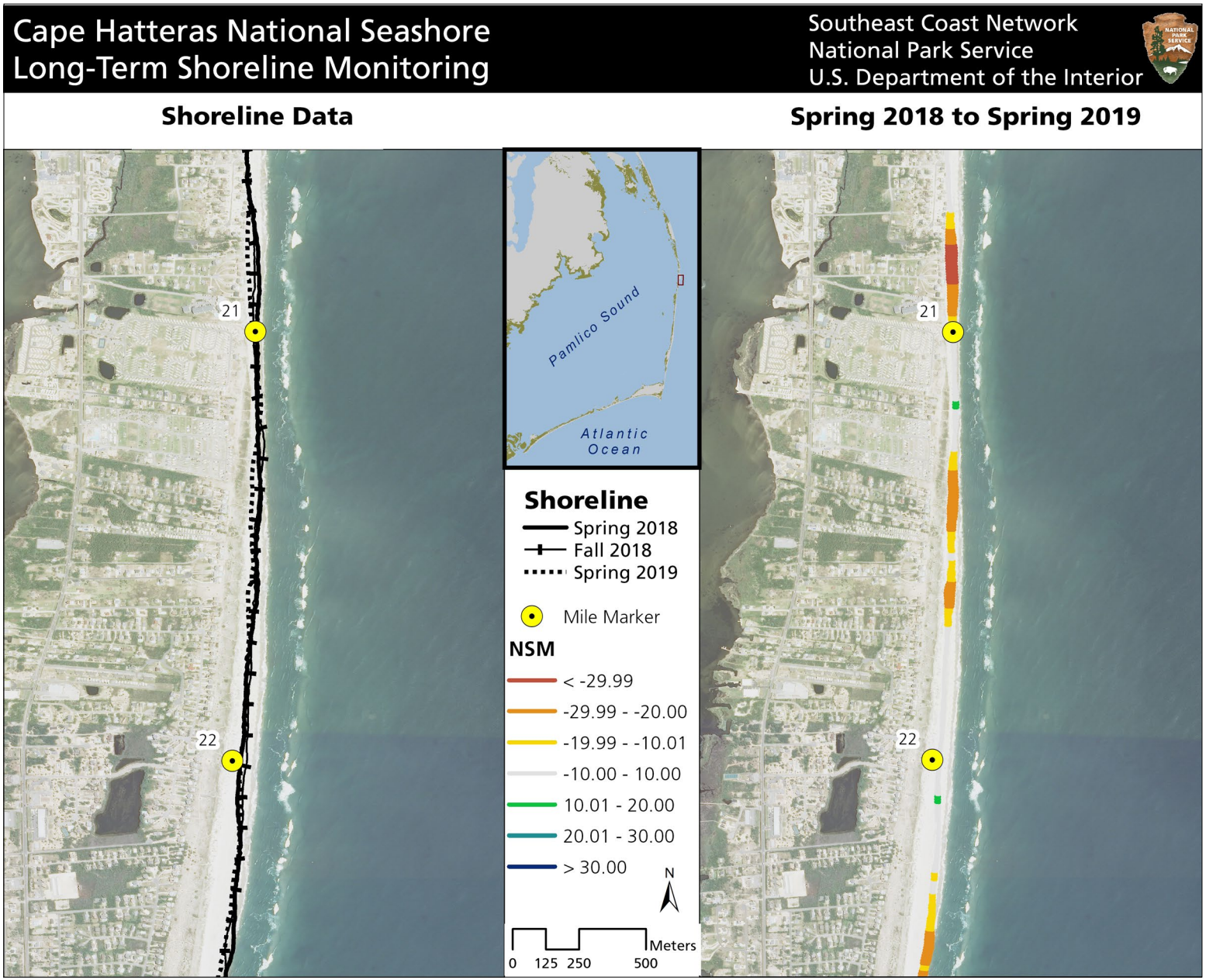


Figure A-15. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 21 and 22.

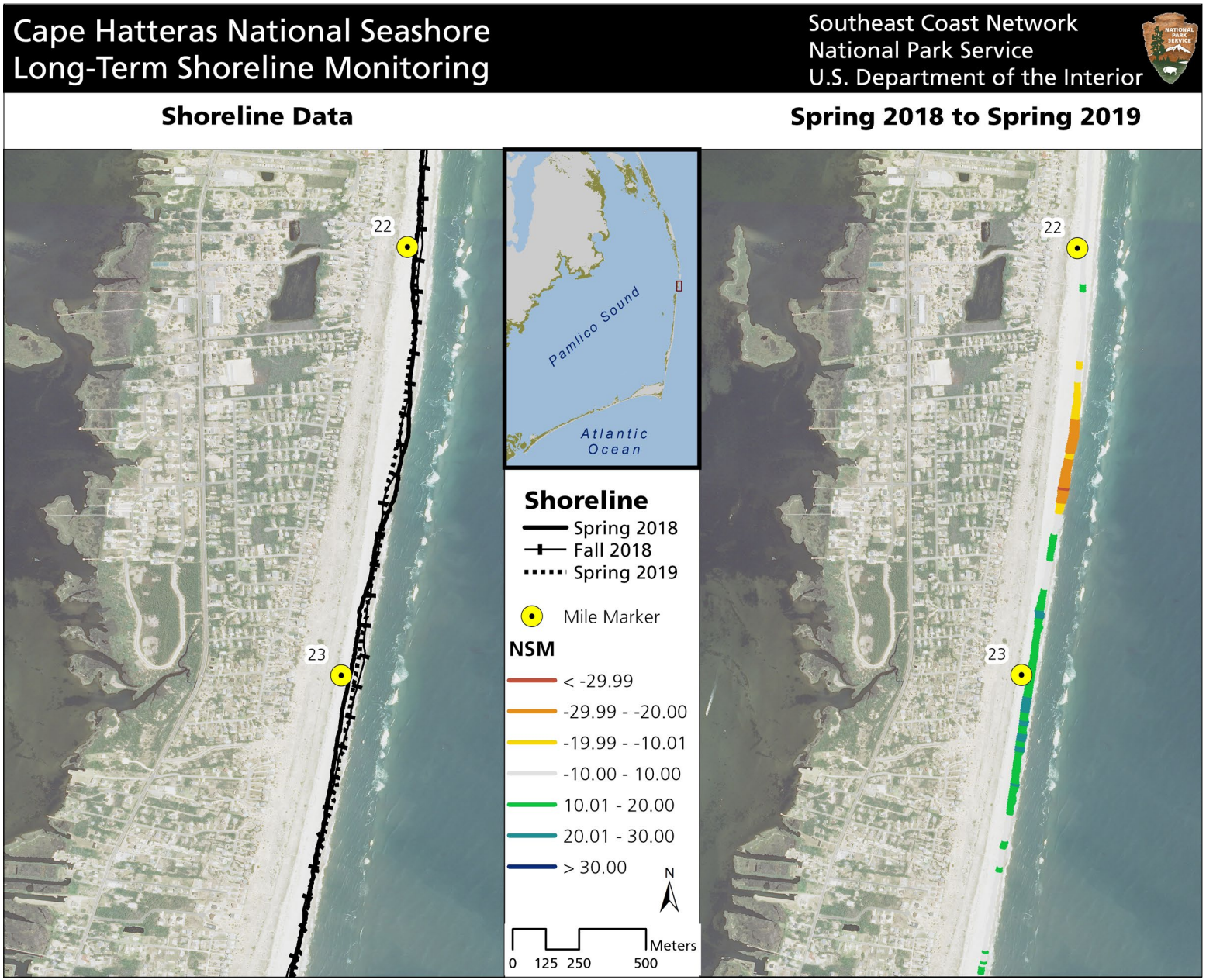


Figure A-16. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 22 and 23.

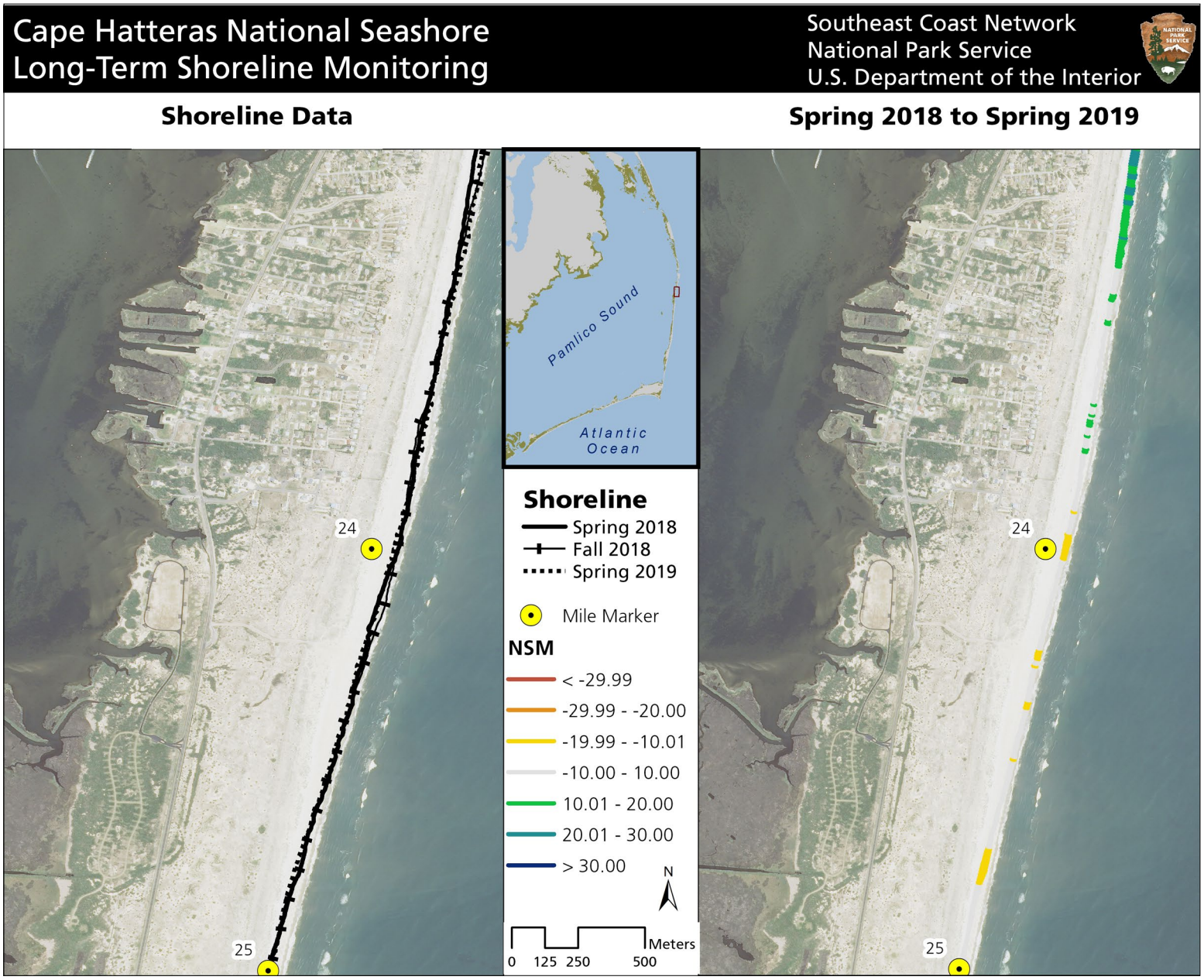


Figure A-17. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 24 and 25.

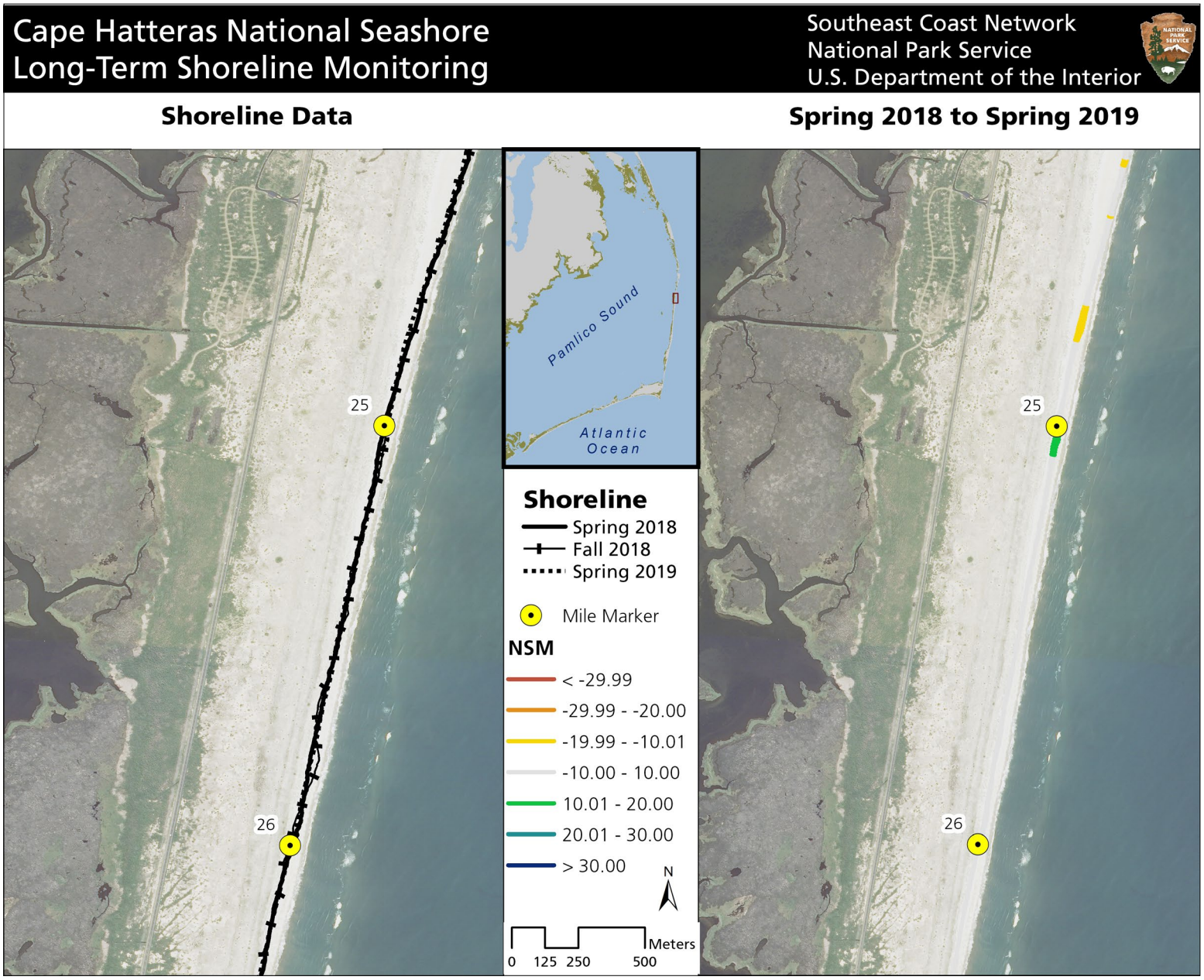


Figure A-18. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 25 and 26.

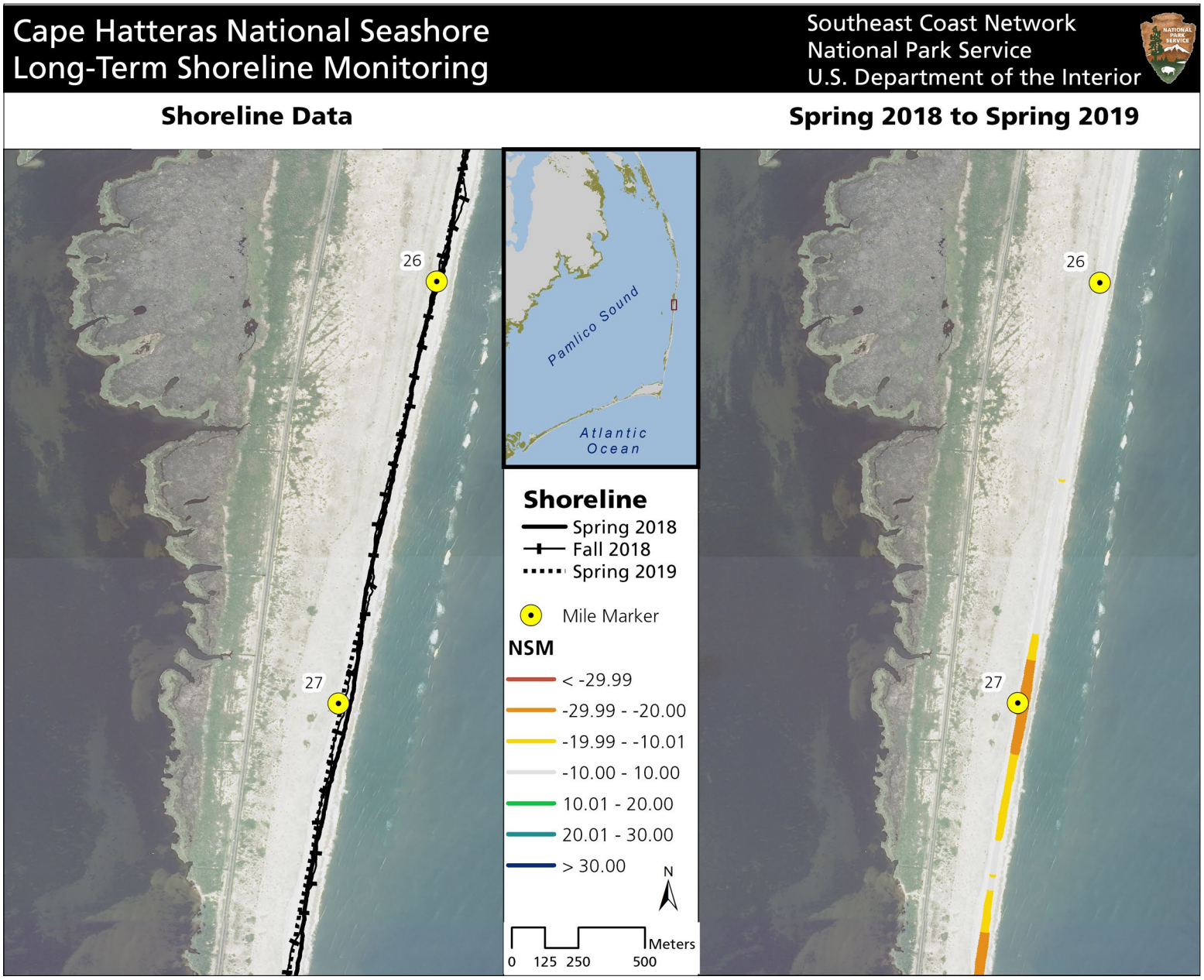


Figure A-19. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 26 and 27.

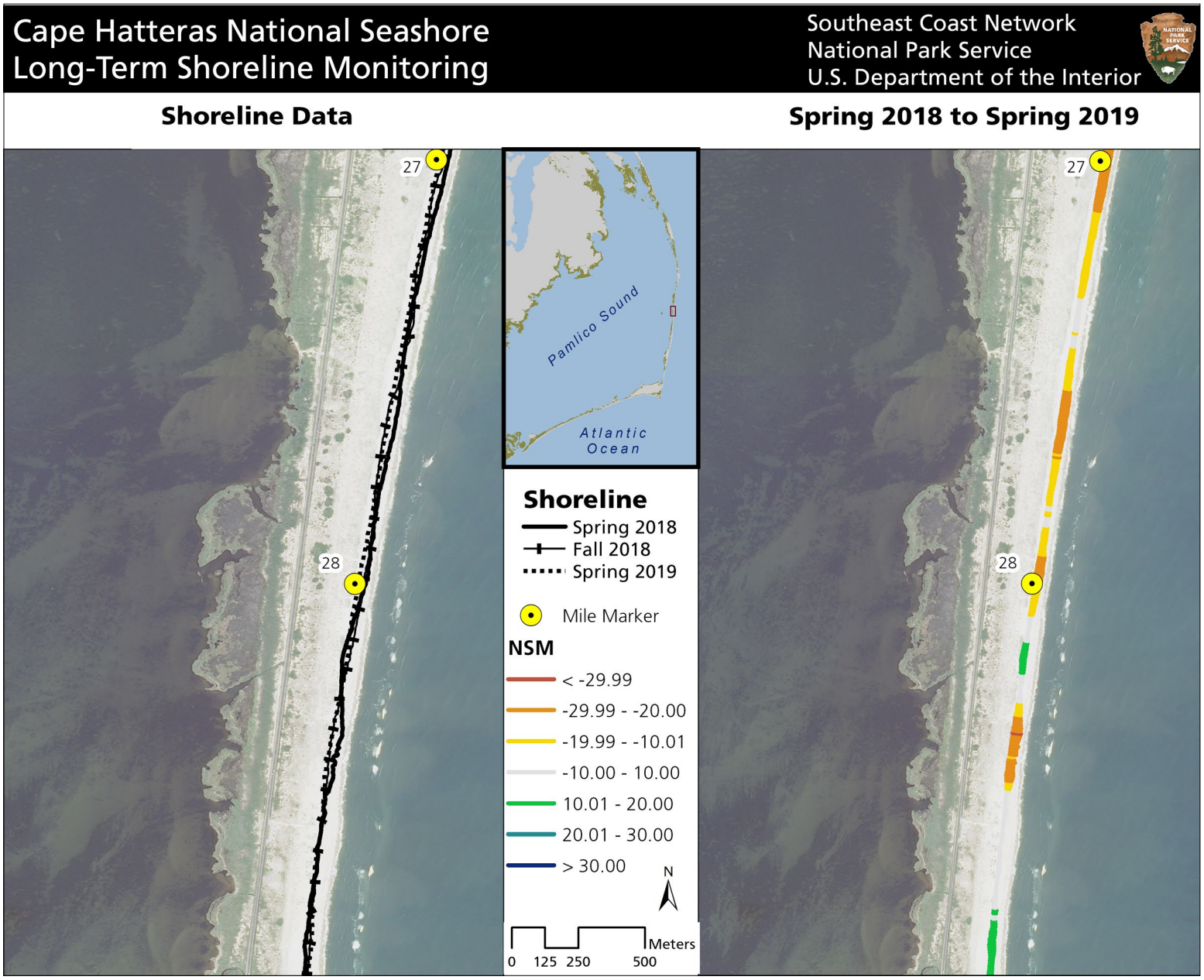


Figure A-20. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 27 and 28.

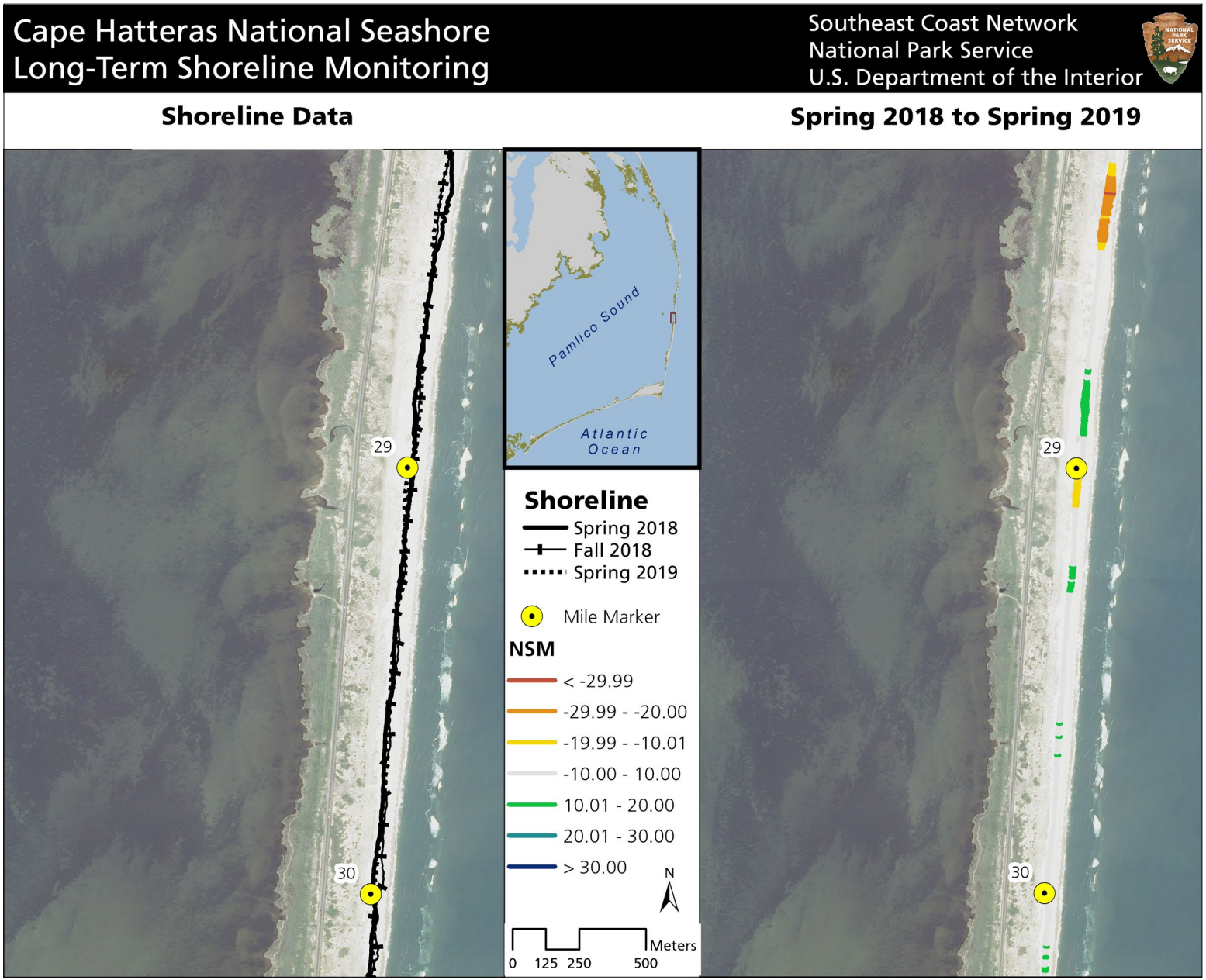


Figure A-21. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 29 and 30.

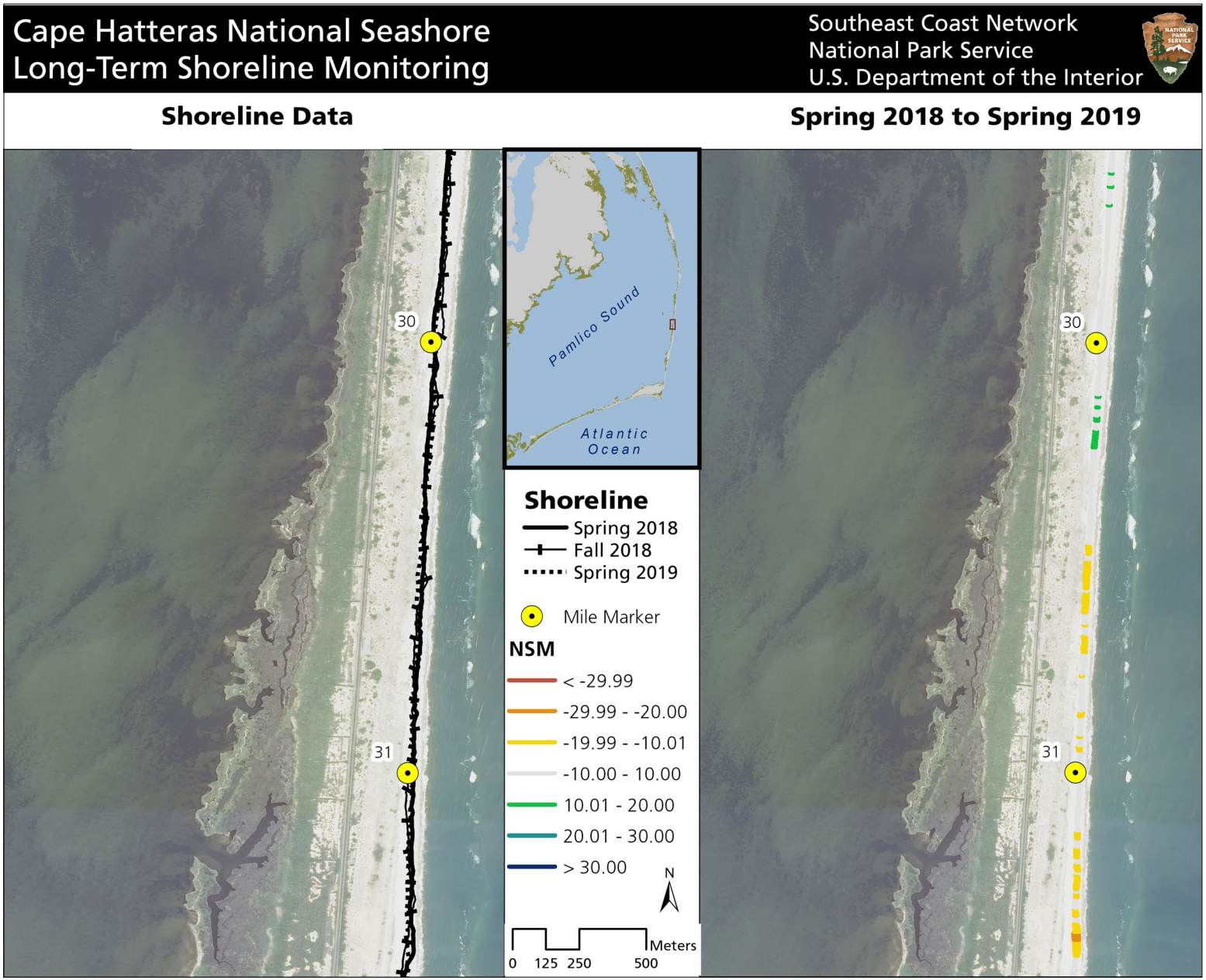


Figure A-22. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 30 and 31.

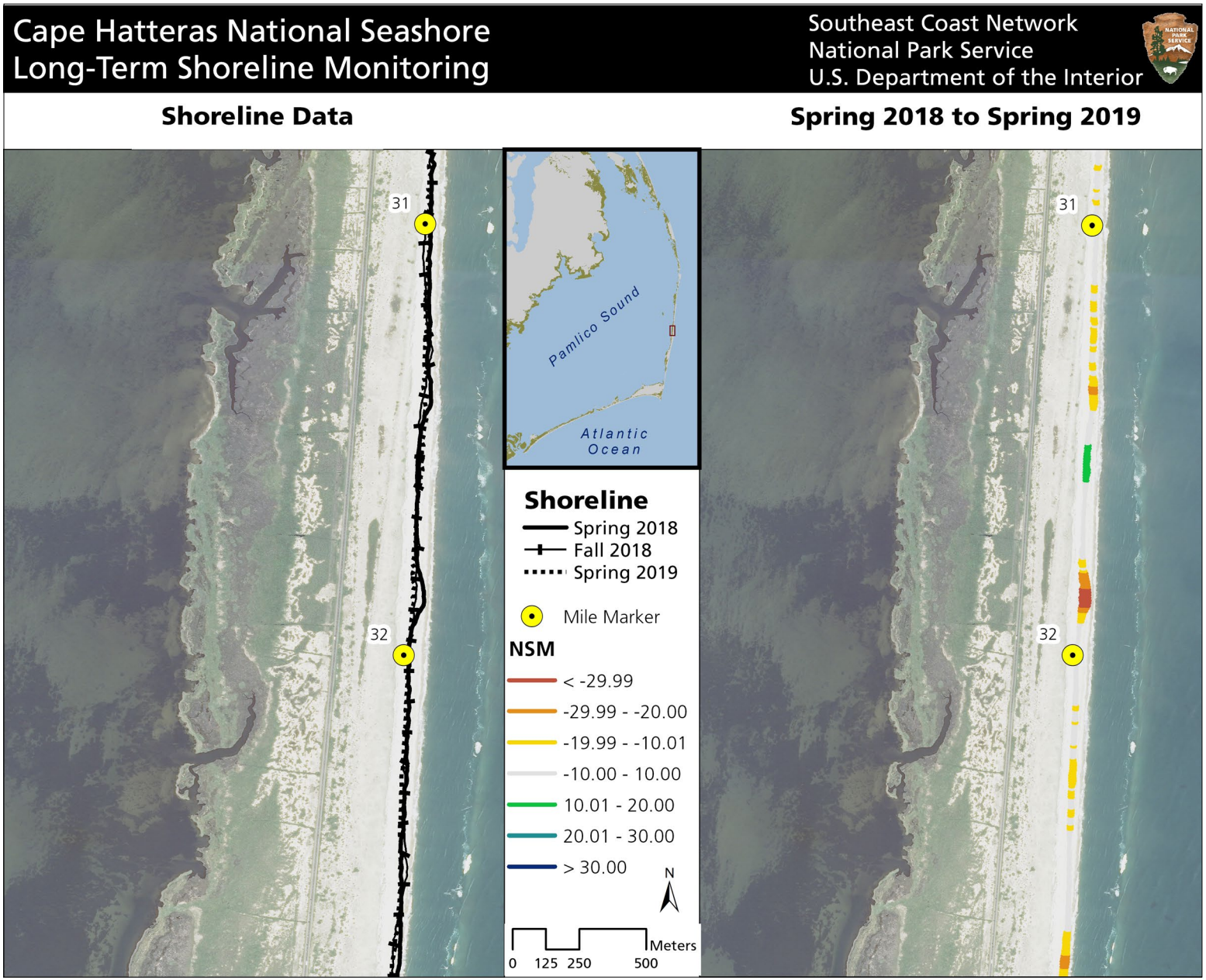


Figure A-23. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 31 and 32.

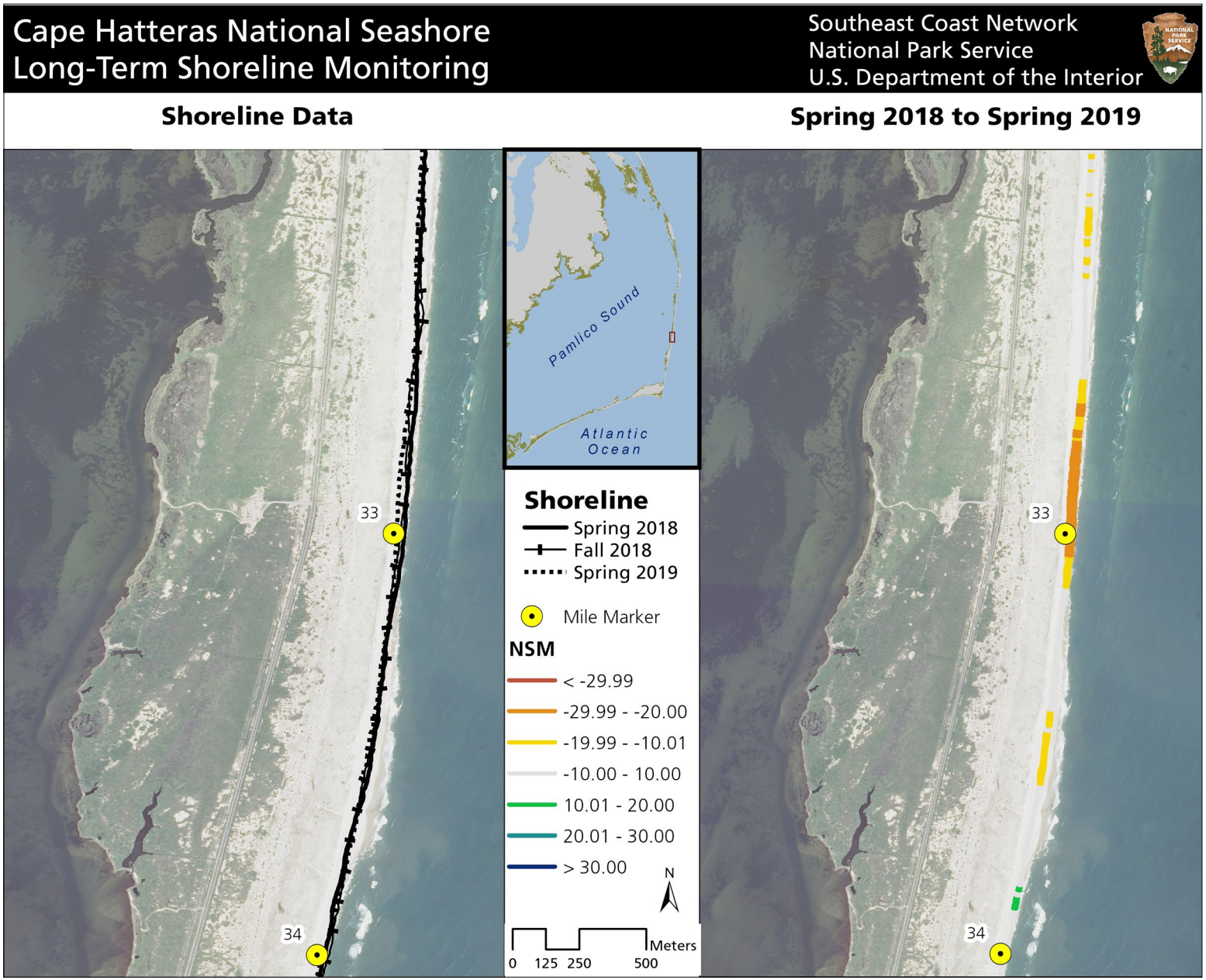


Figure A-24. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 33 and 34.

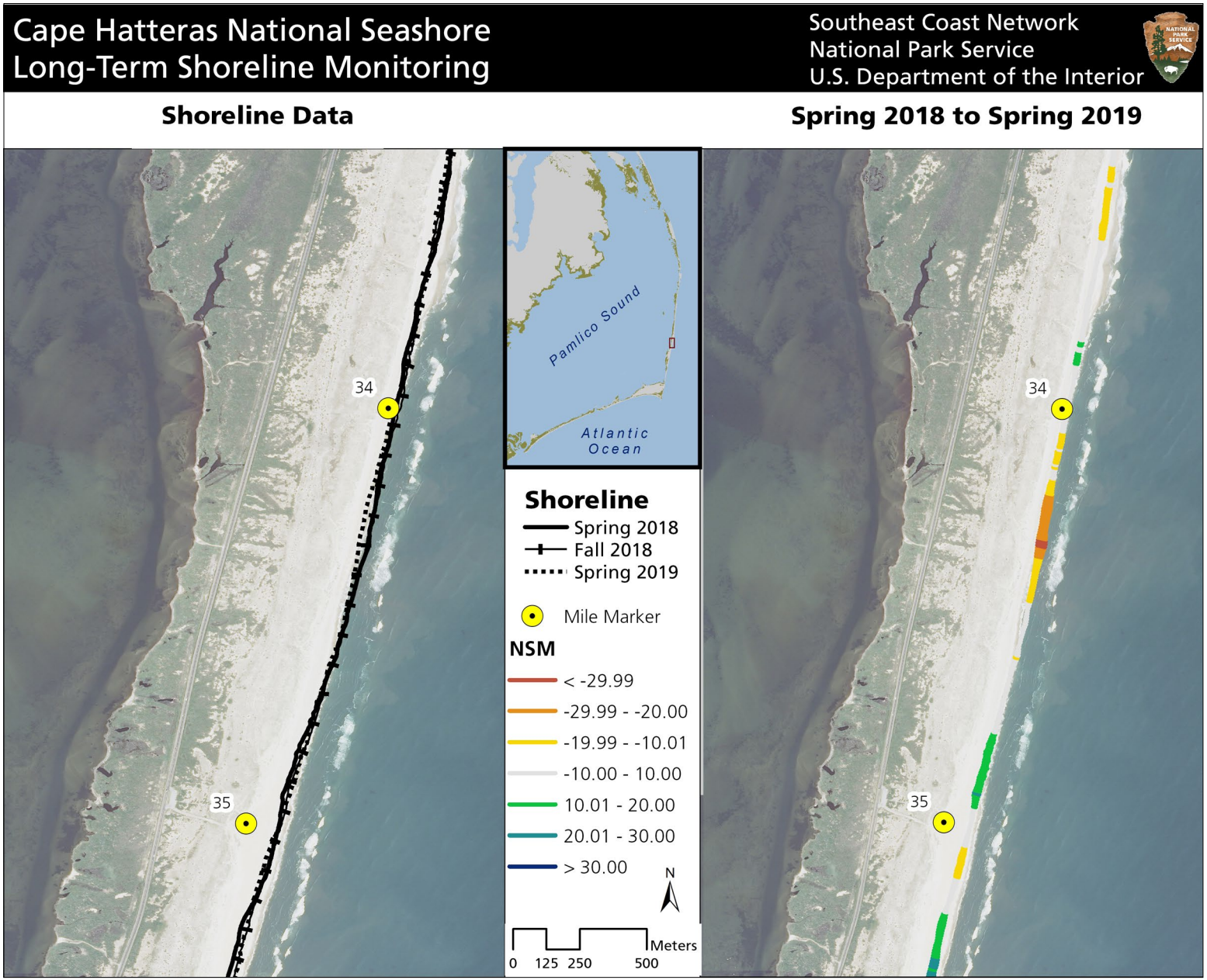


Figure A-25. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 34 and 35.

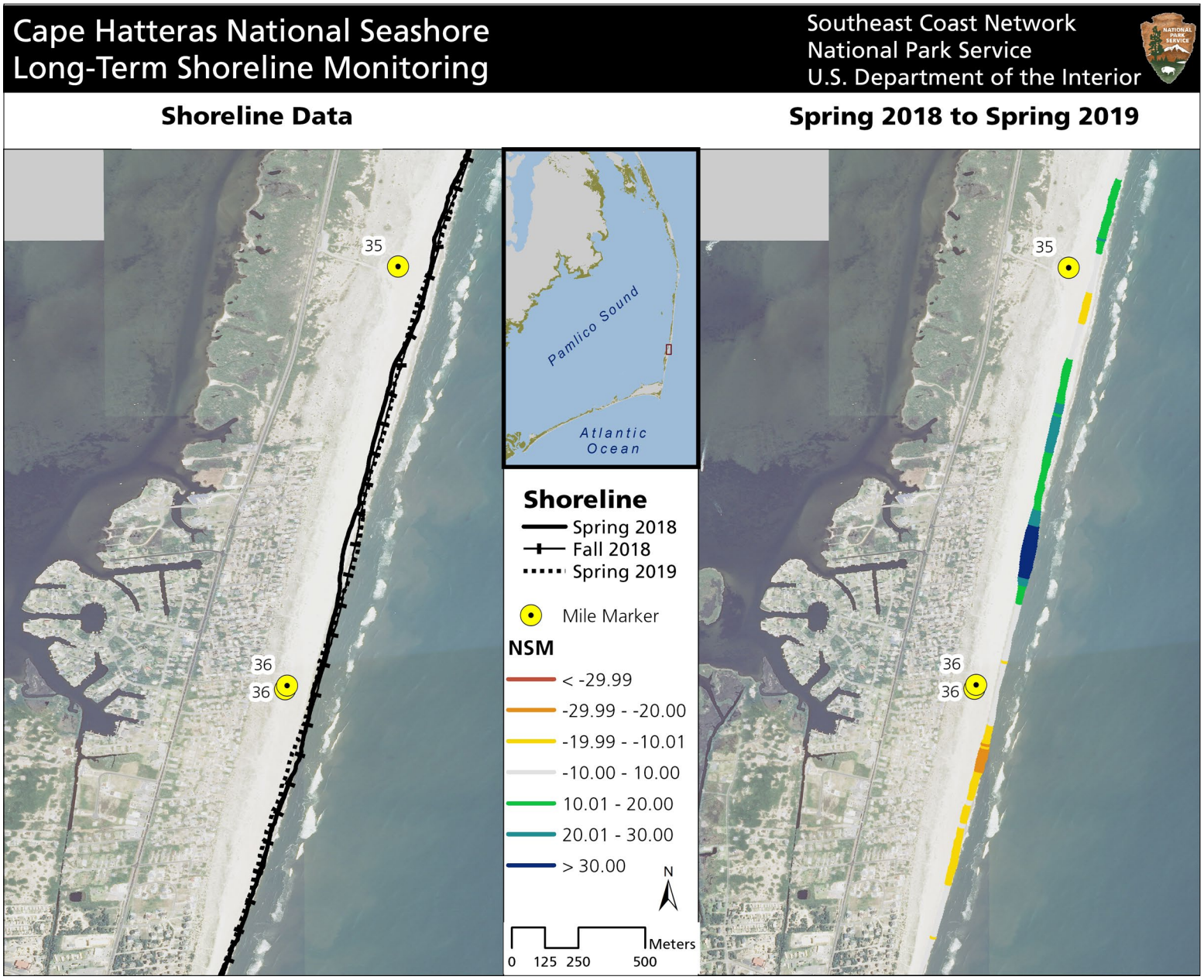


Figure A-26. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 35 and 36.

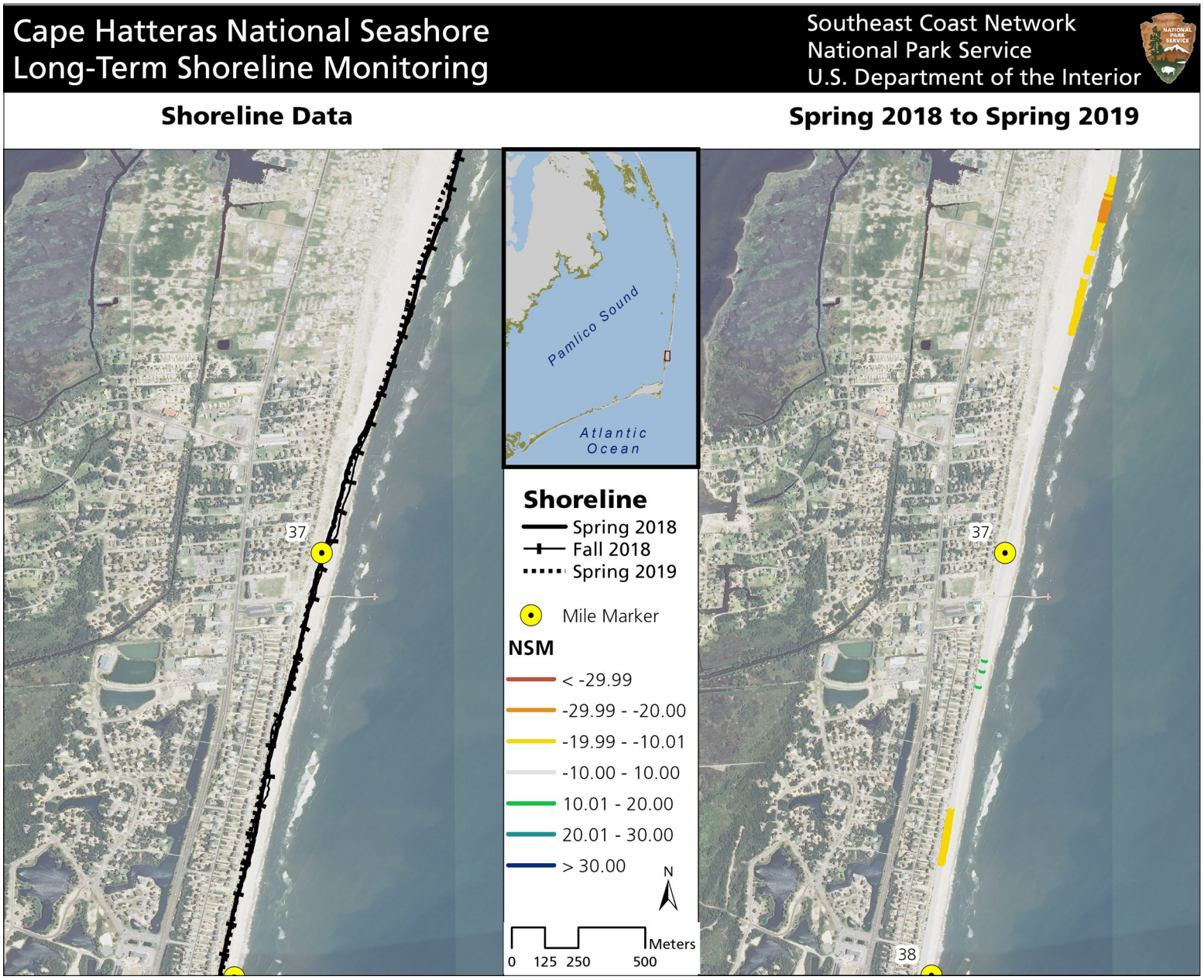


Figure A-27. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 37.

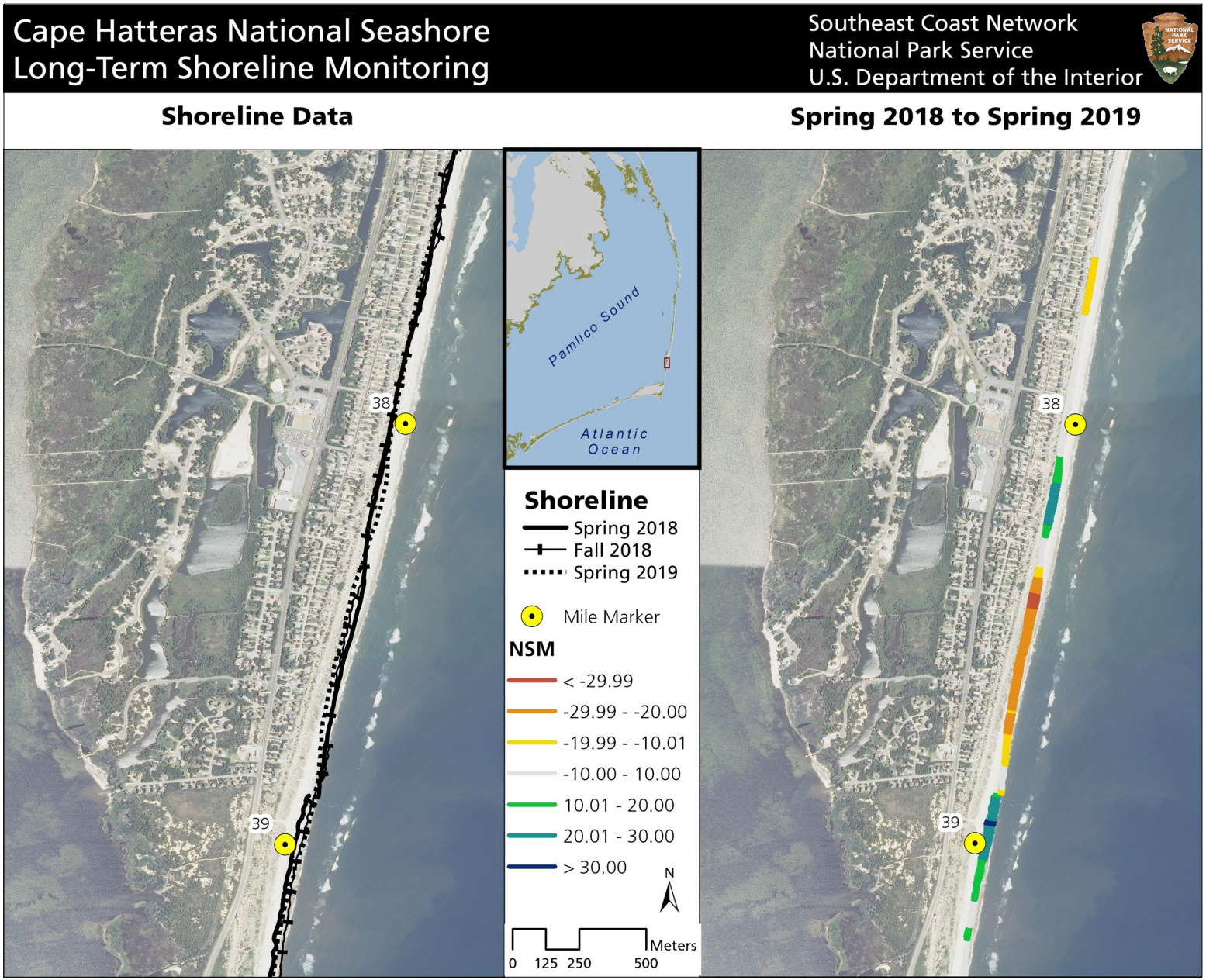


Figure A-28. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 38 and 39.

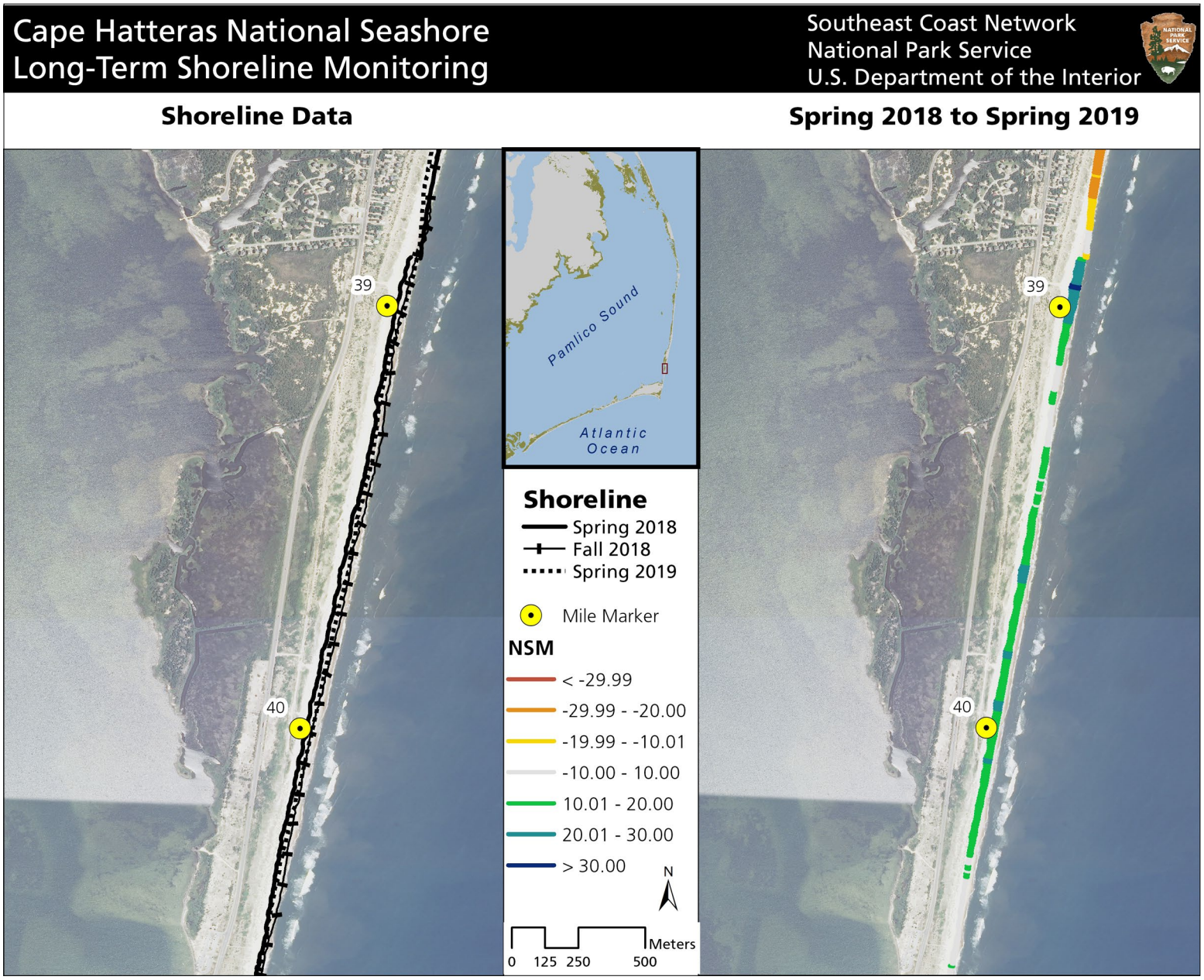


Figure A-29. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 39 and 40.

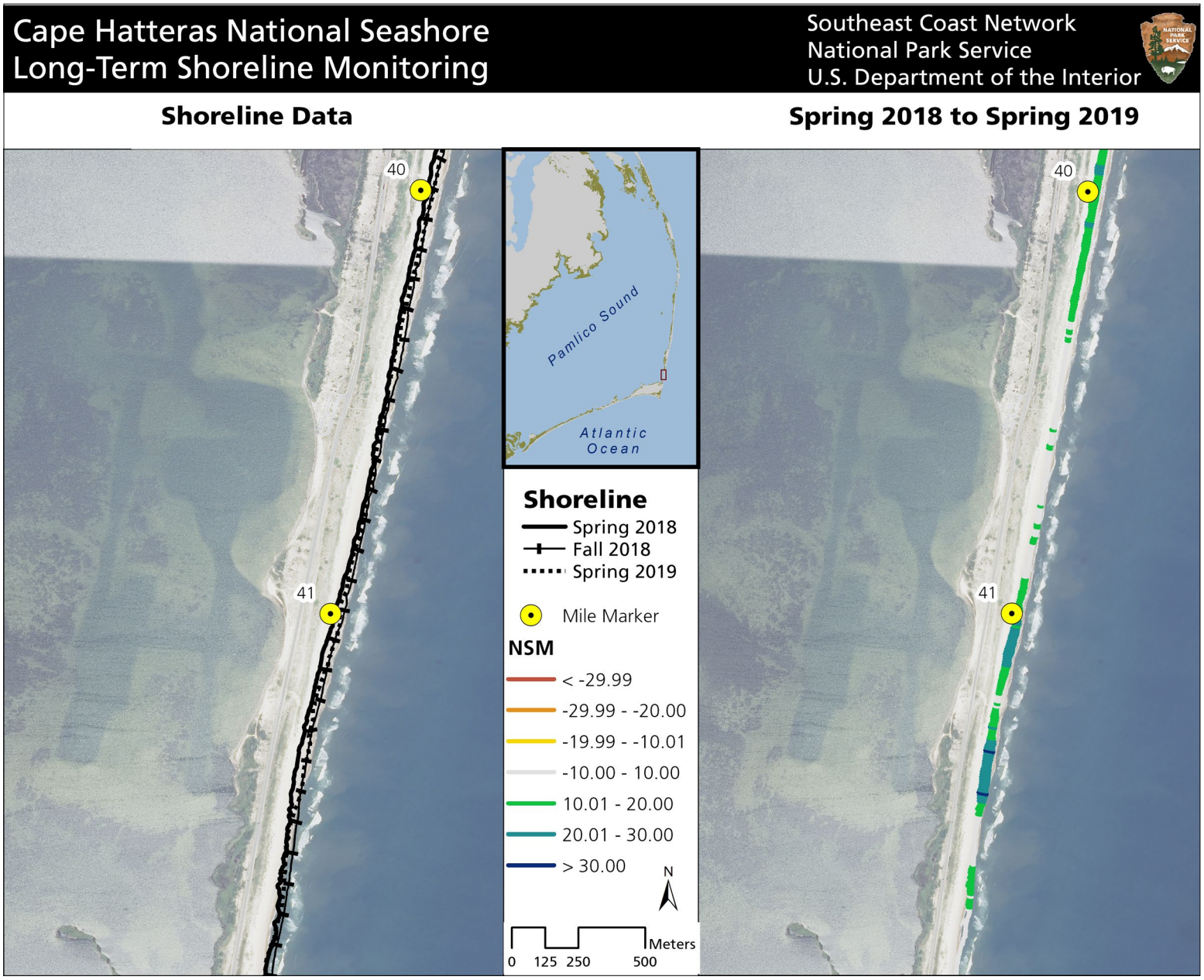


Figure A-30. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 40 and 41.

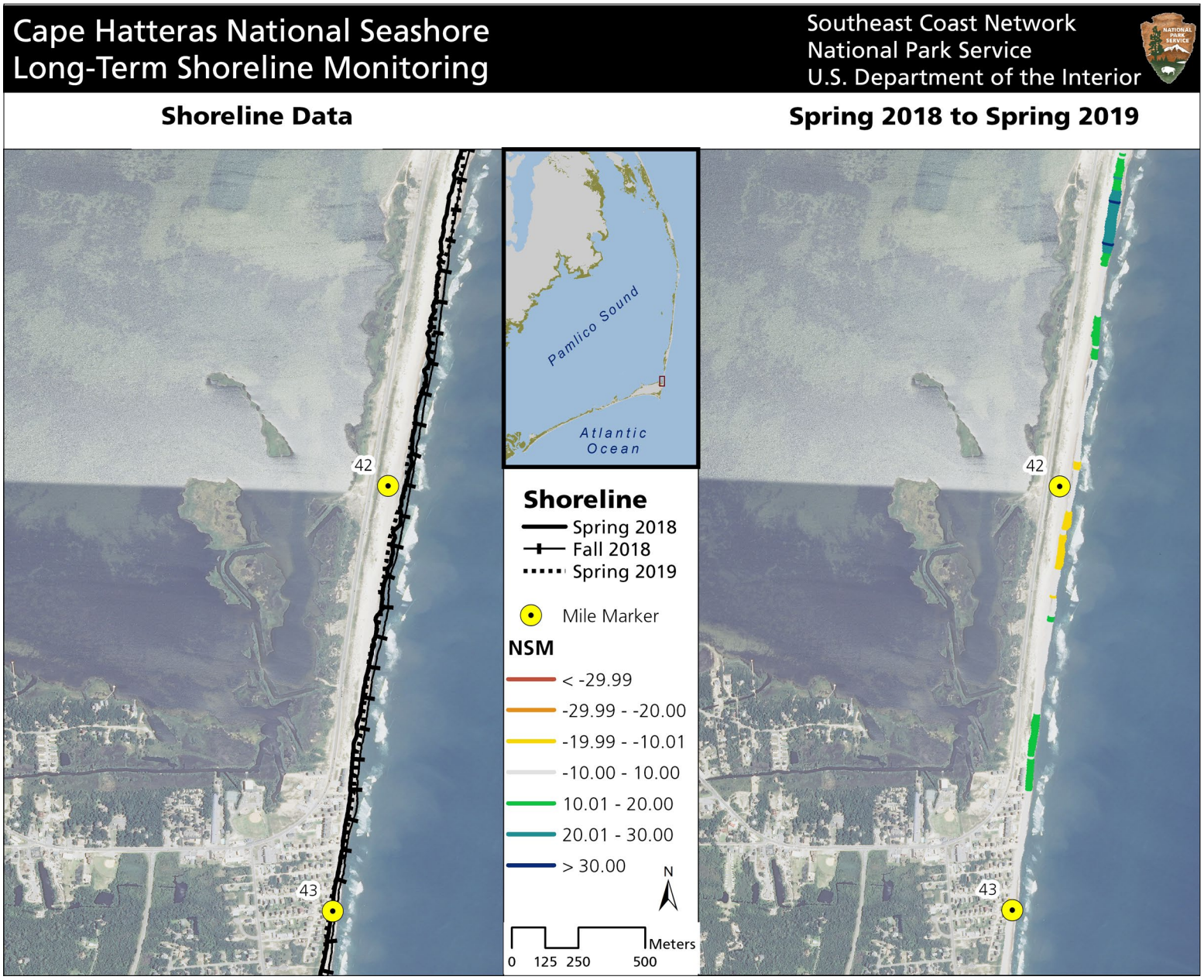


Figure A-31. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 42 and 43.

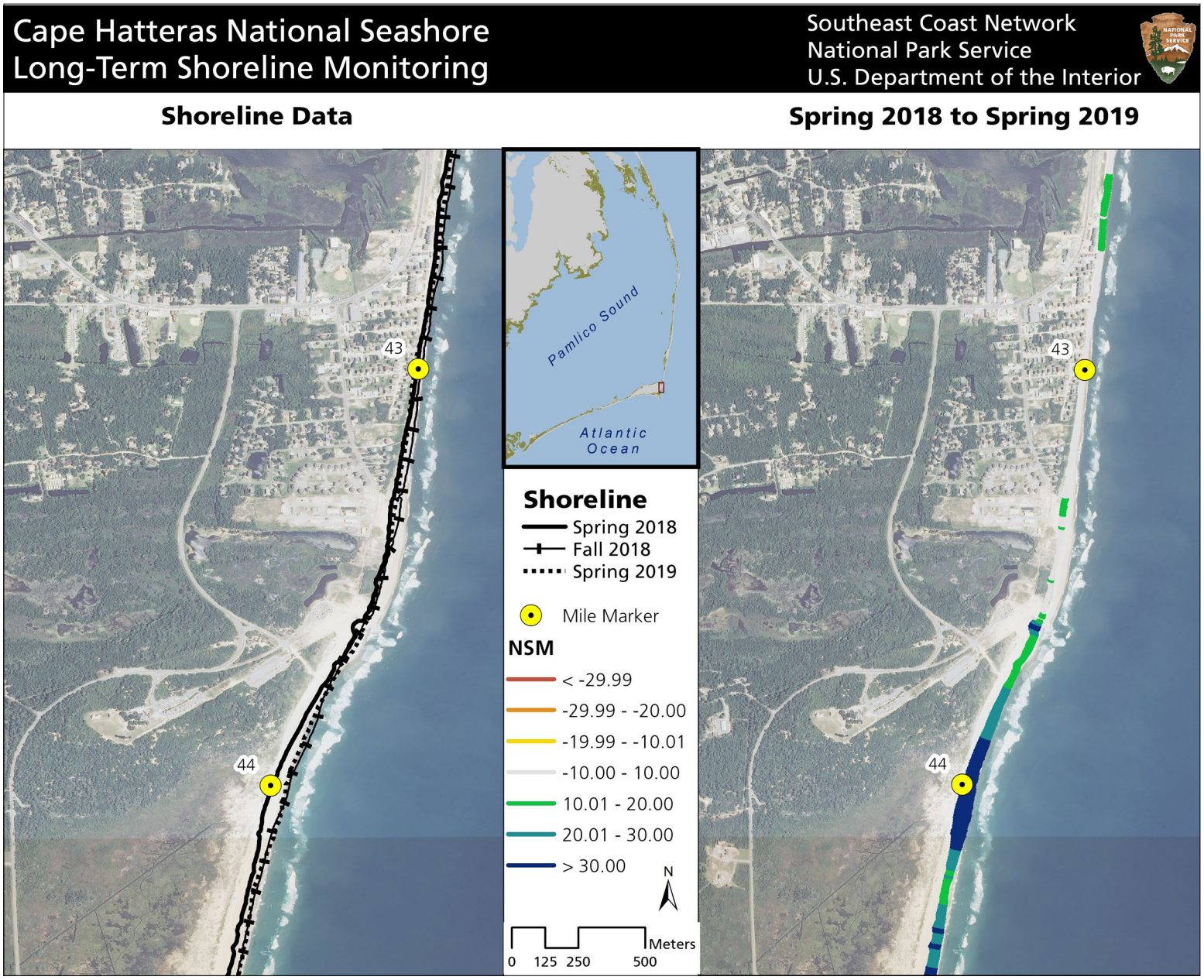


Figure A-32. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 43 and 44.

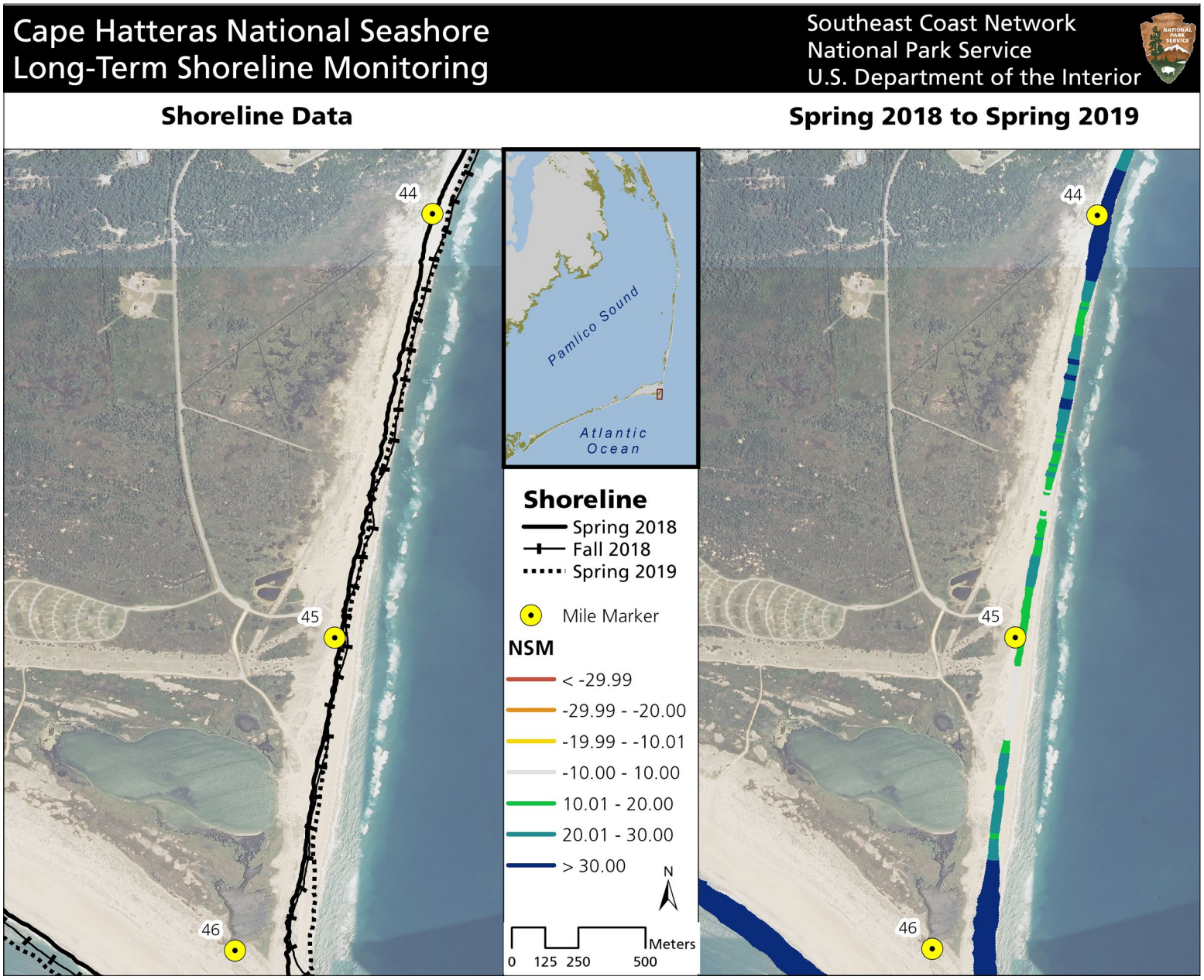


Figure A-33. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 44 through 46.

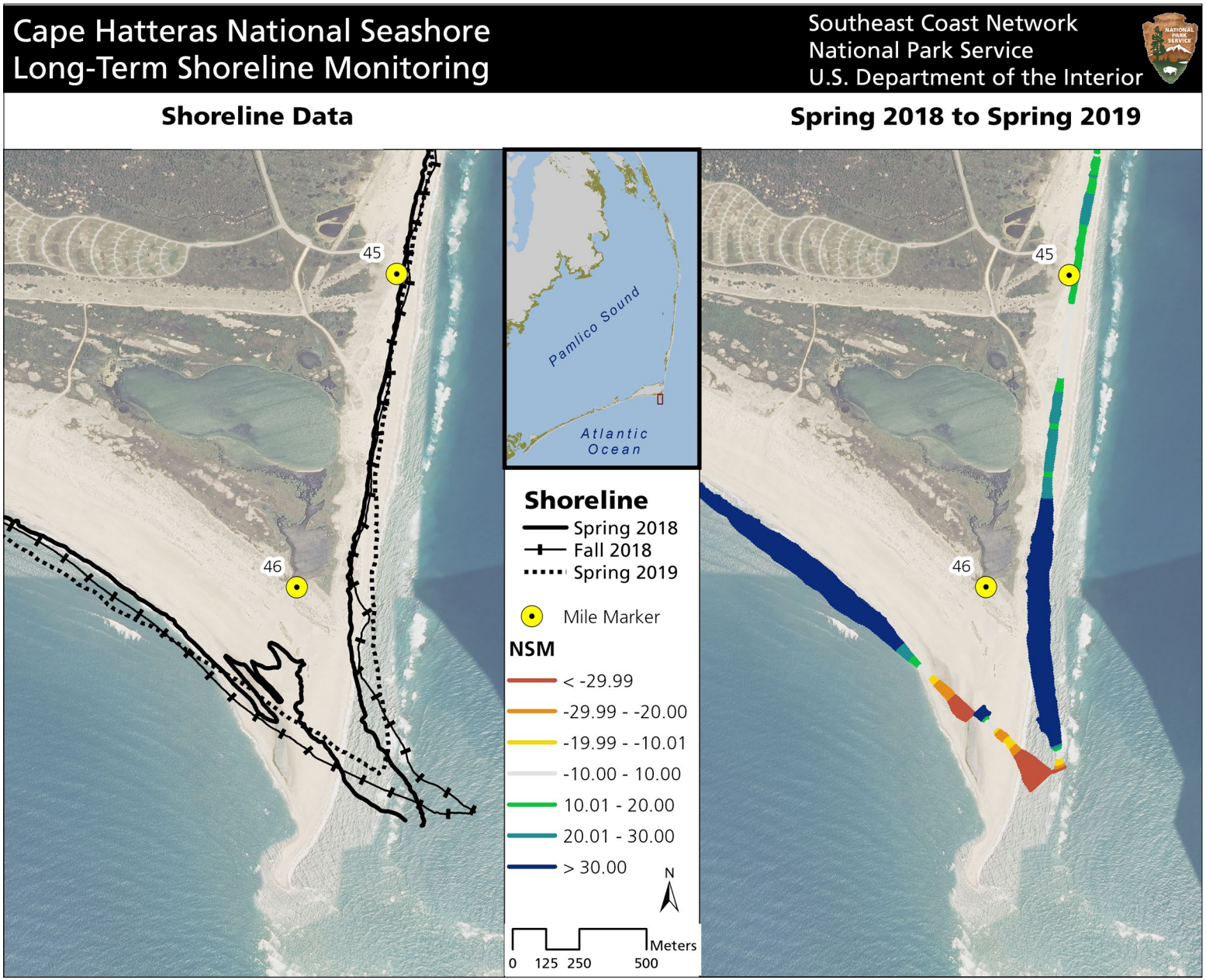


Figure A-34. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 45 and 46.

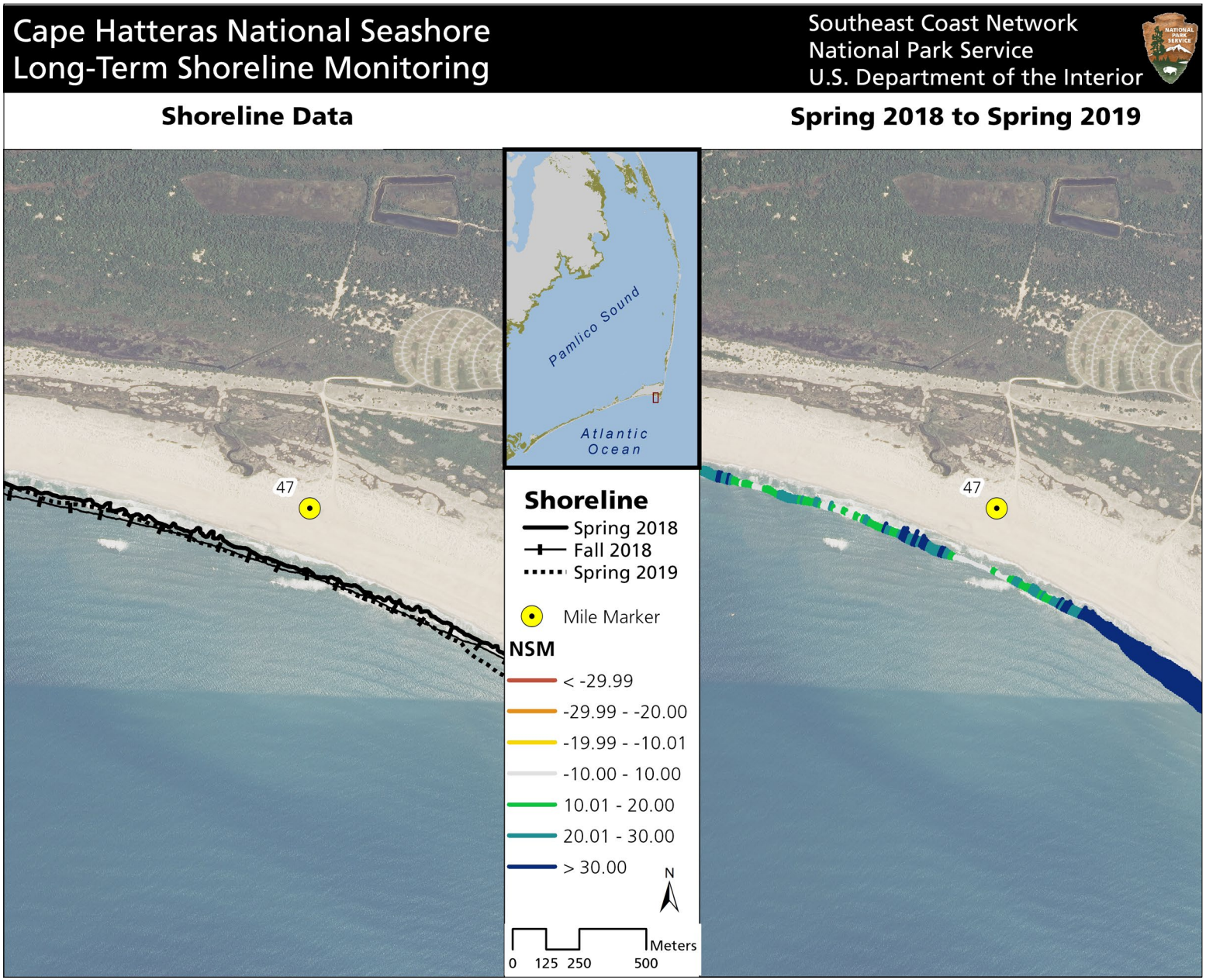


Figure A-35. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 47.

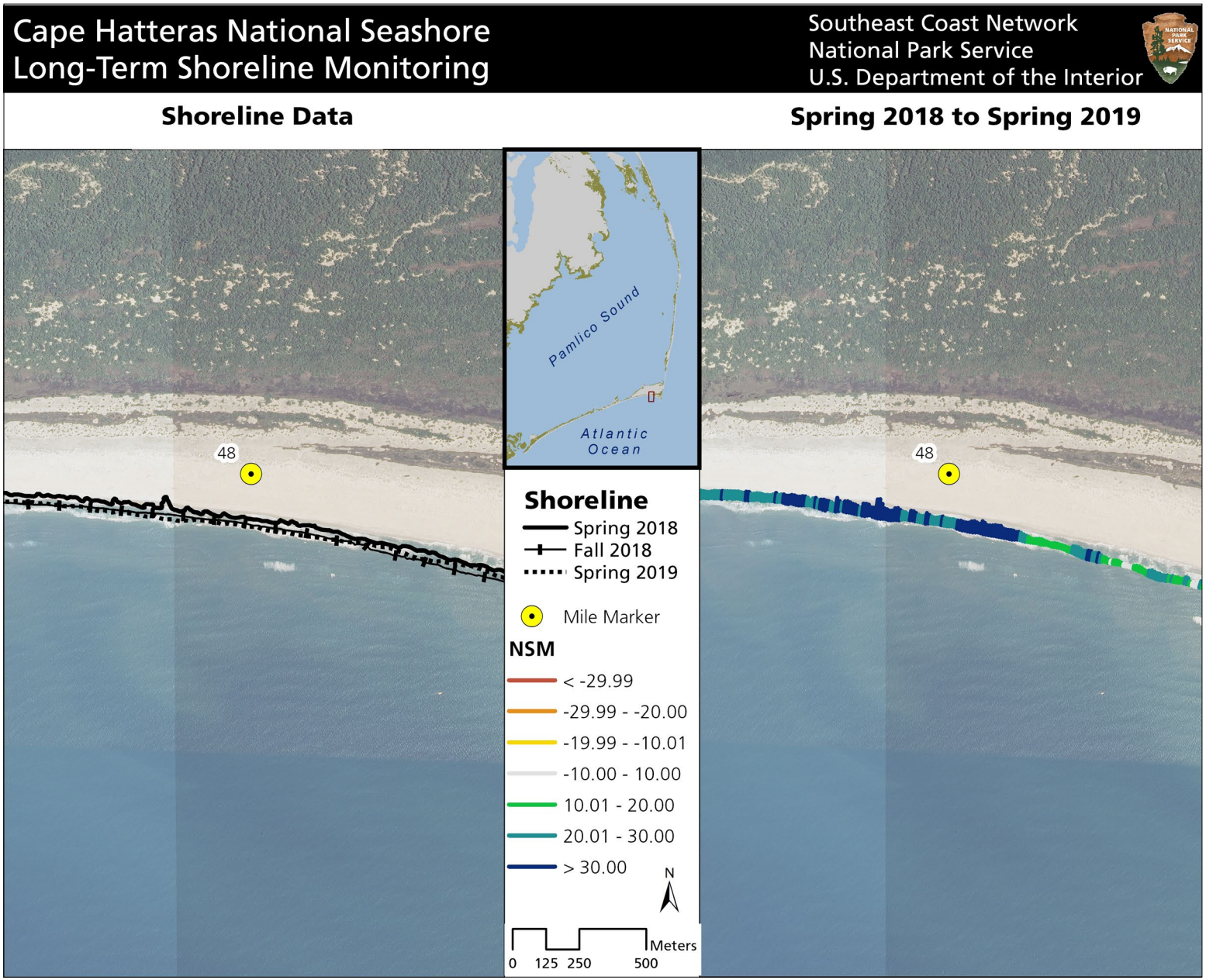


Figure A-36. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 48.

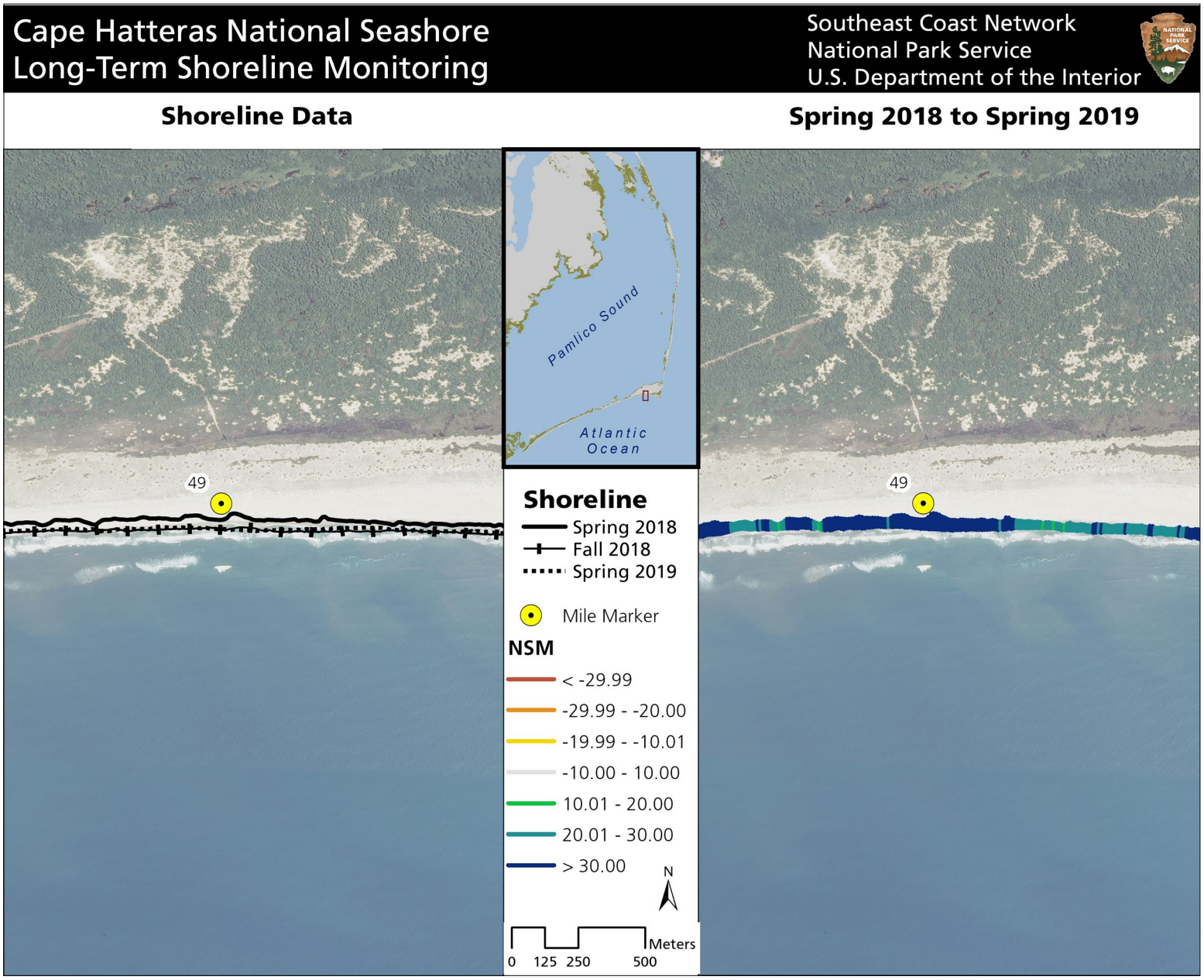


Figure A-37. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 49.

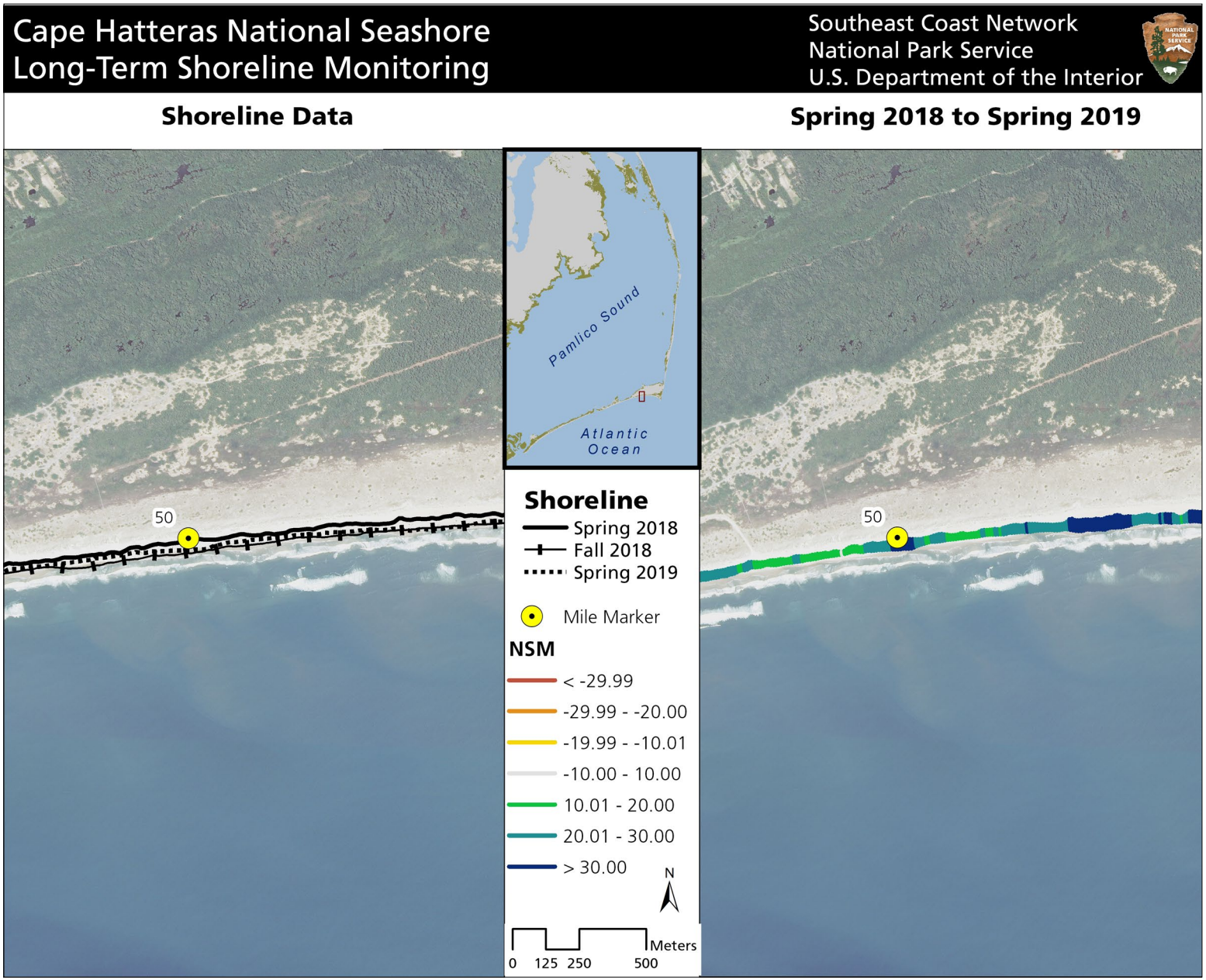


Figure A-38. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 50.

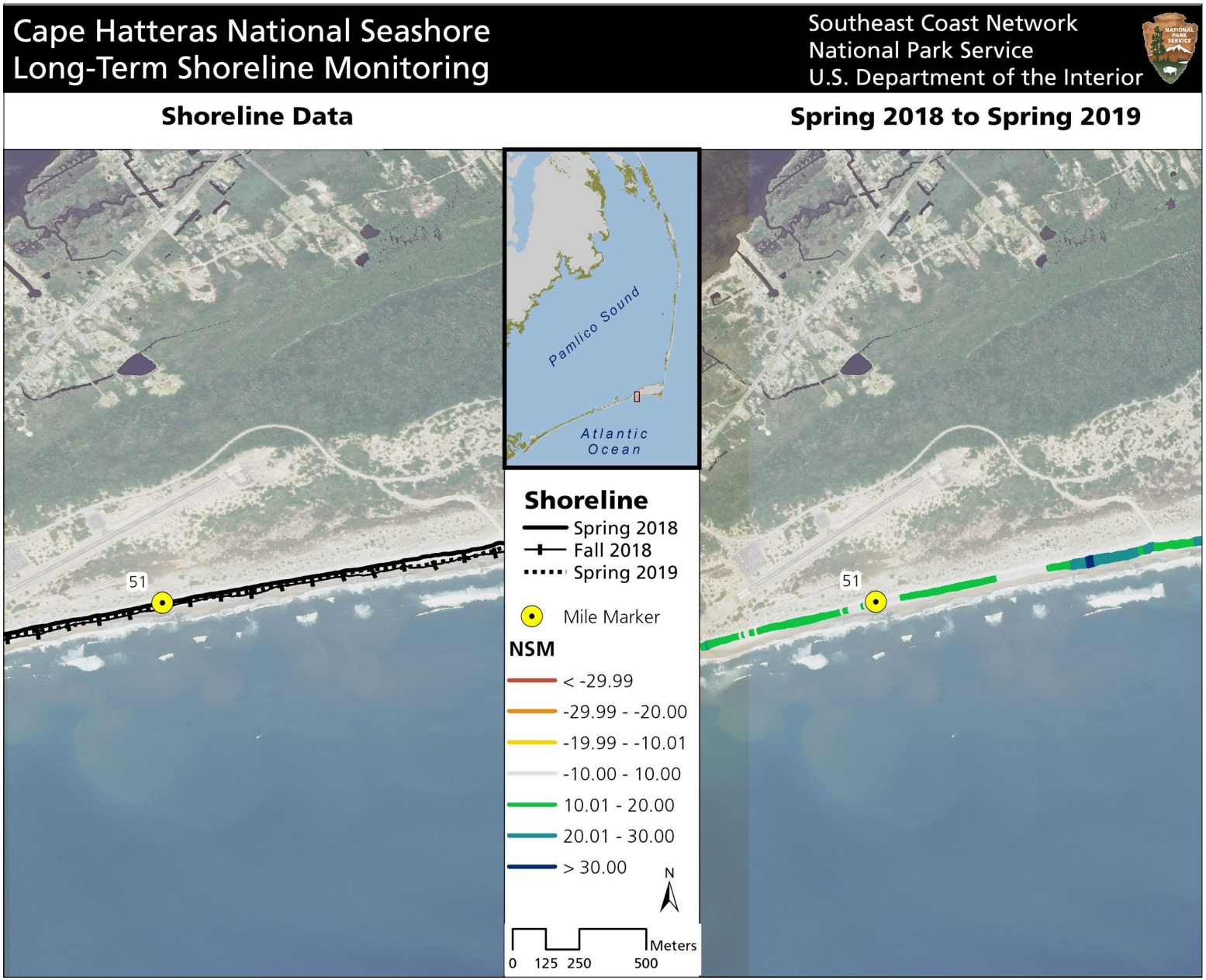


Figure A-39. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 51.

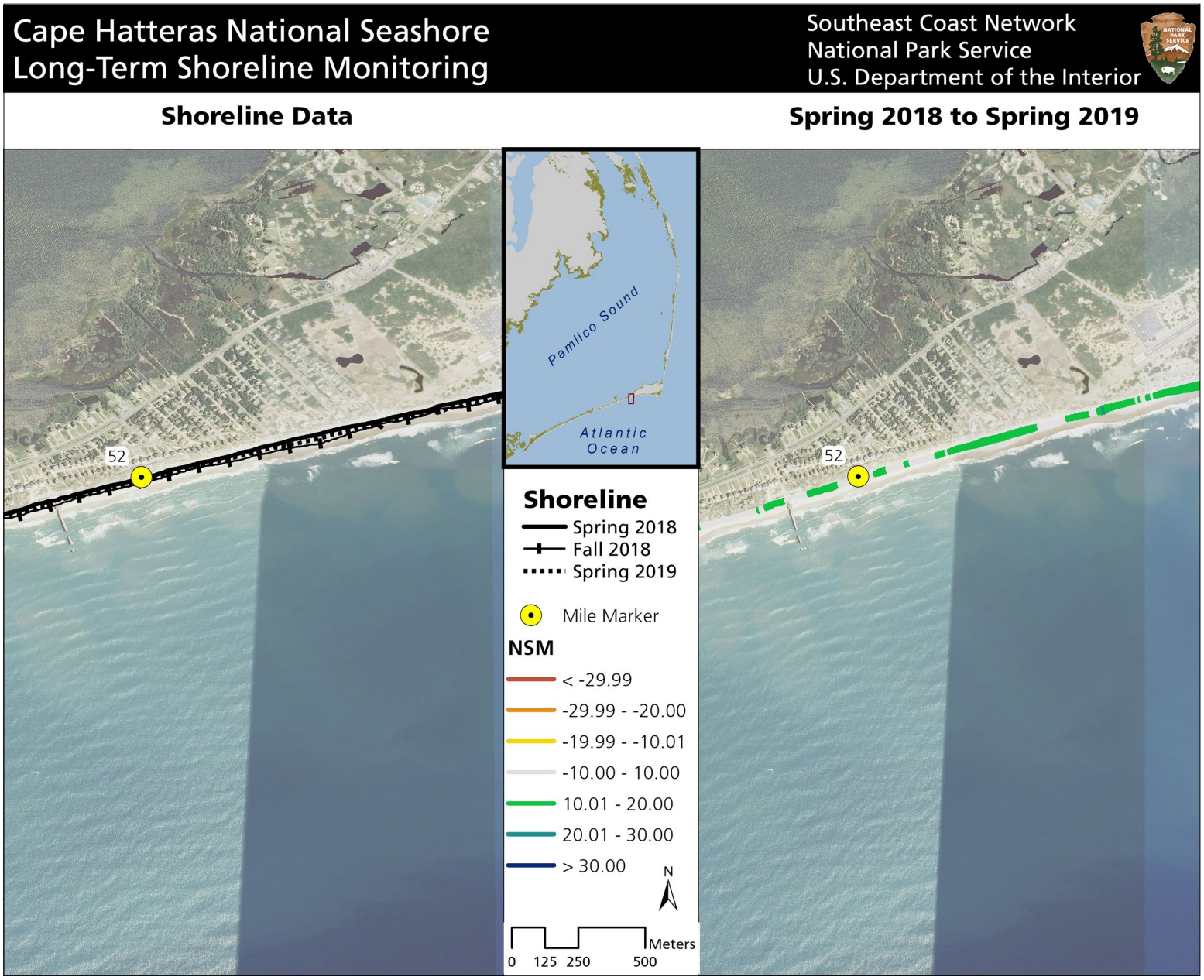


Figure A-40. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 52.

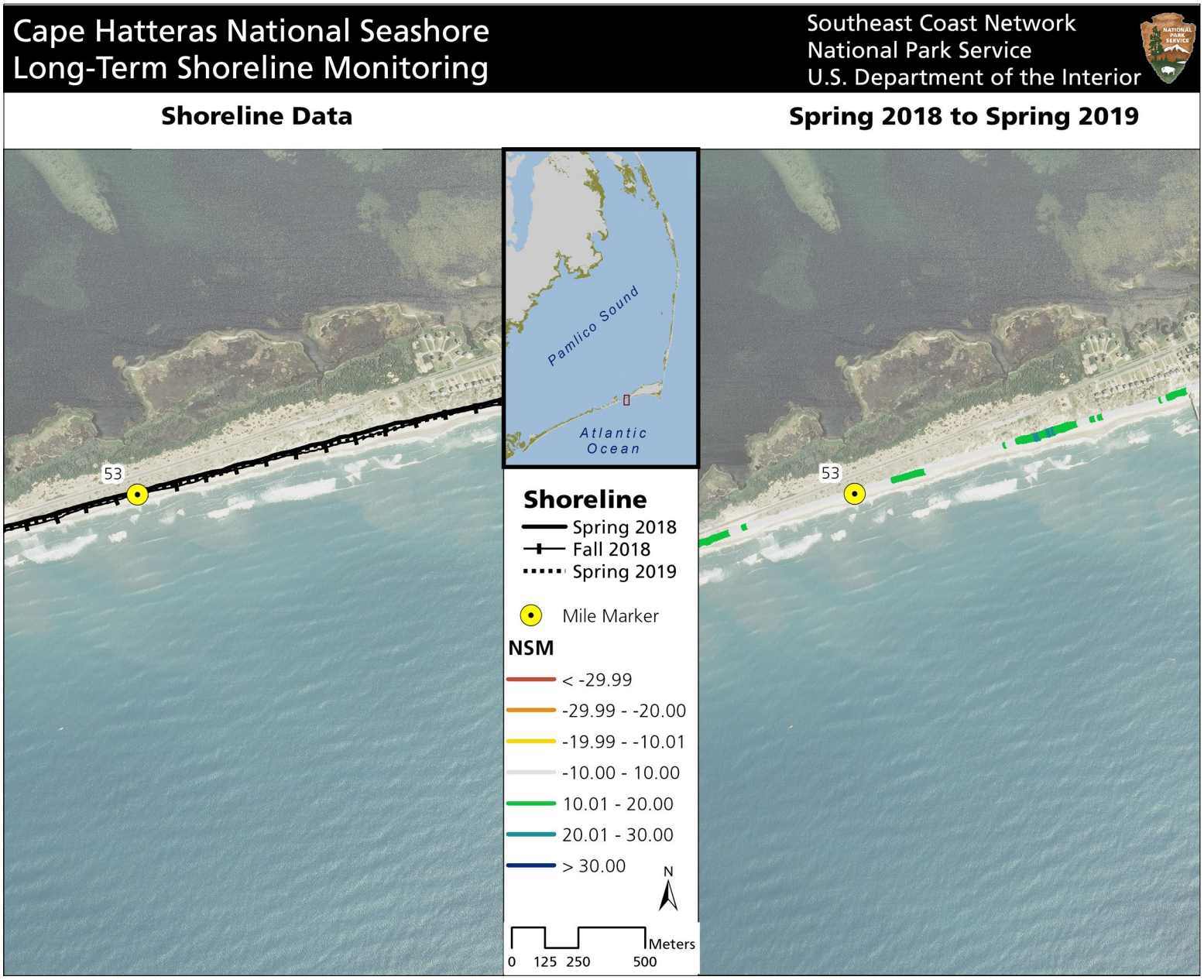


Figure A-41. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 53.

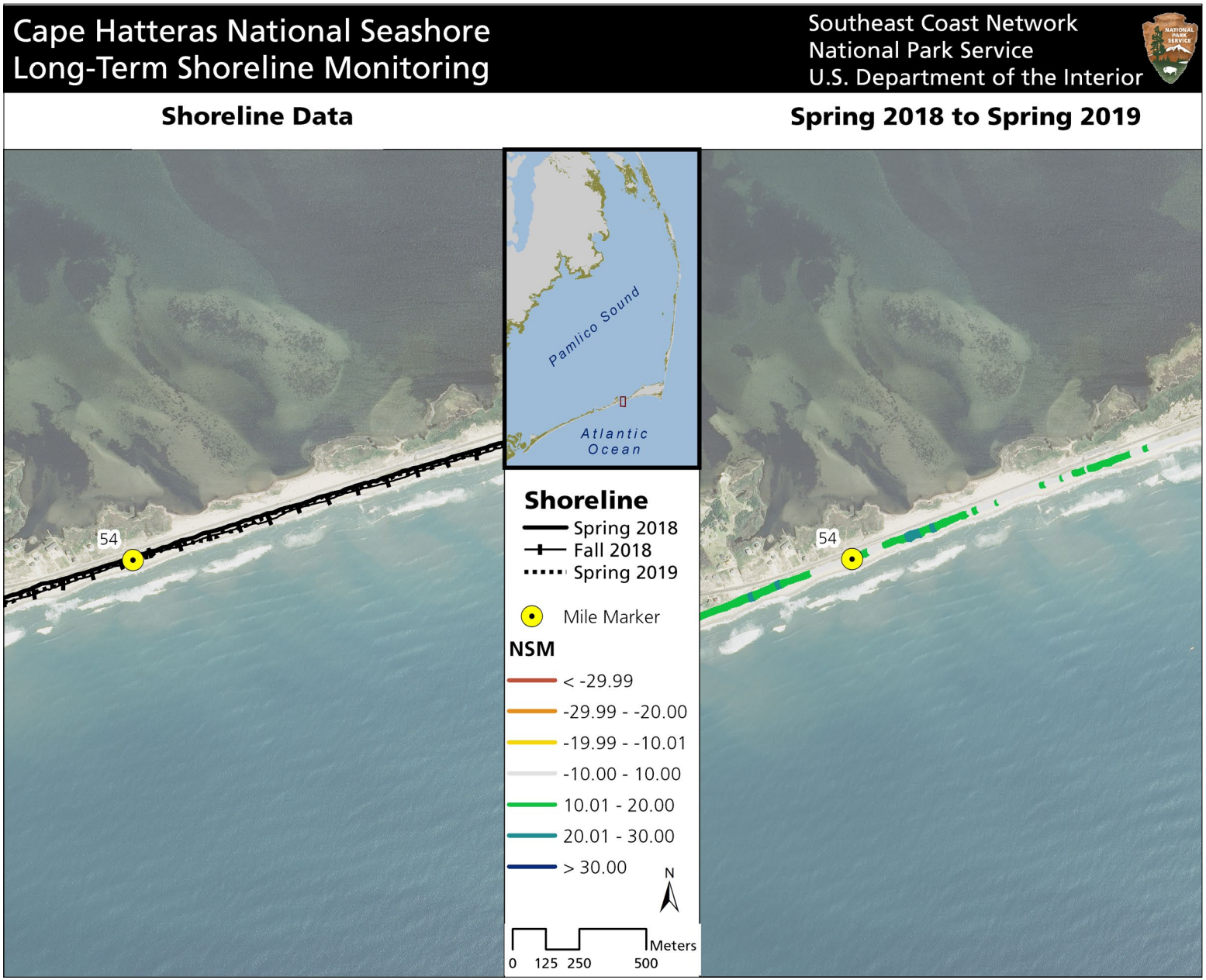


Figure A-42. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 54.

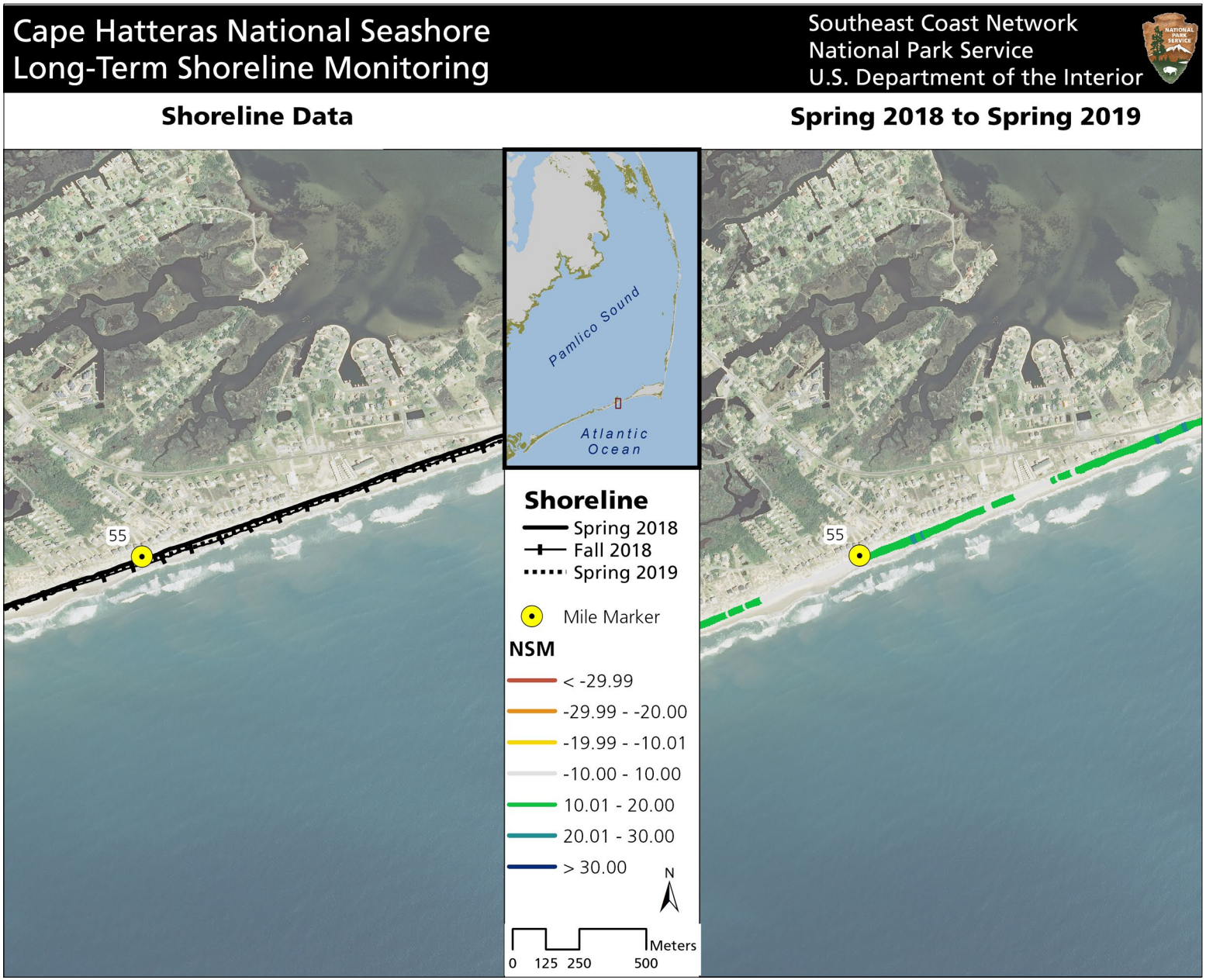


Figure A-43. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 55.

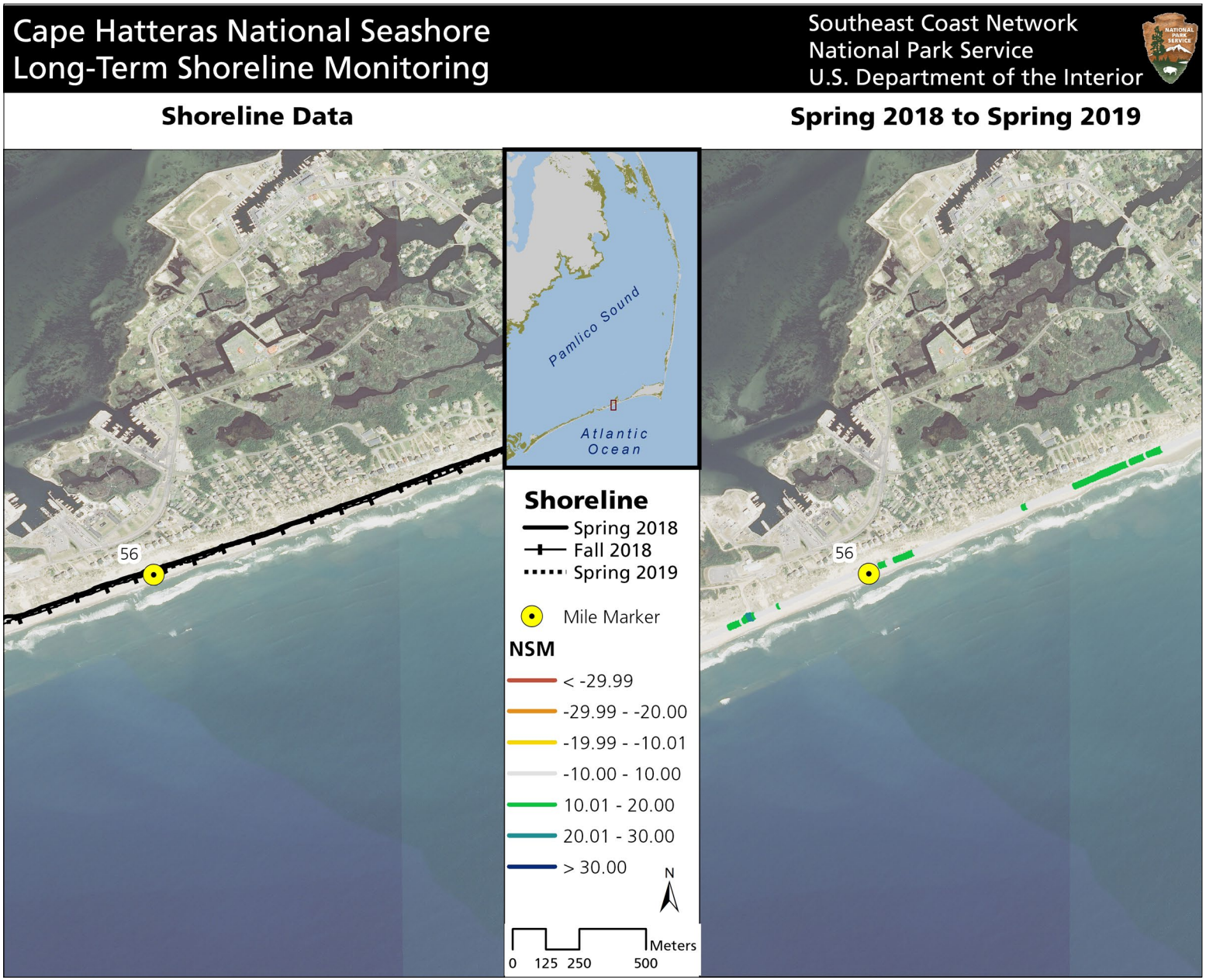


Figure A-44. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 56.

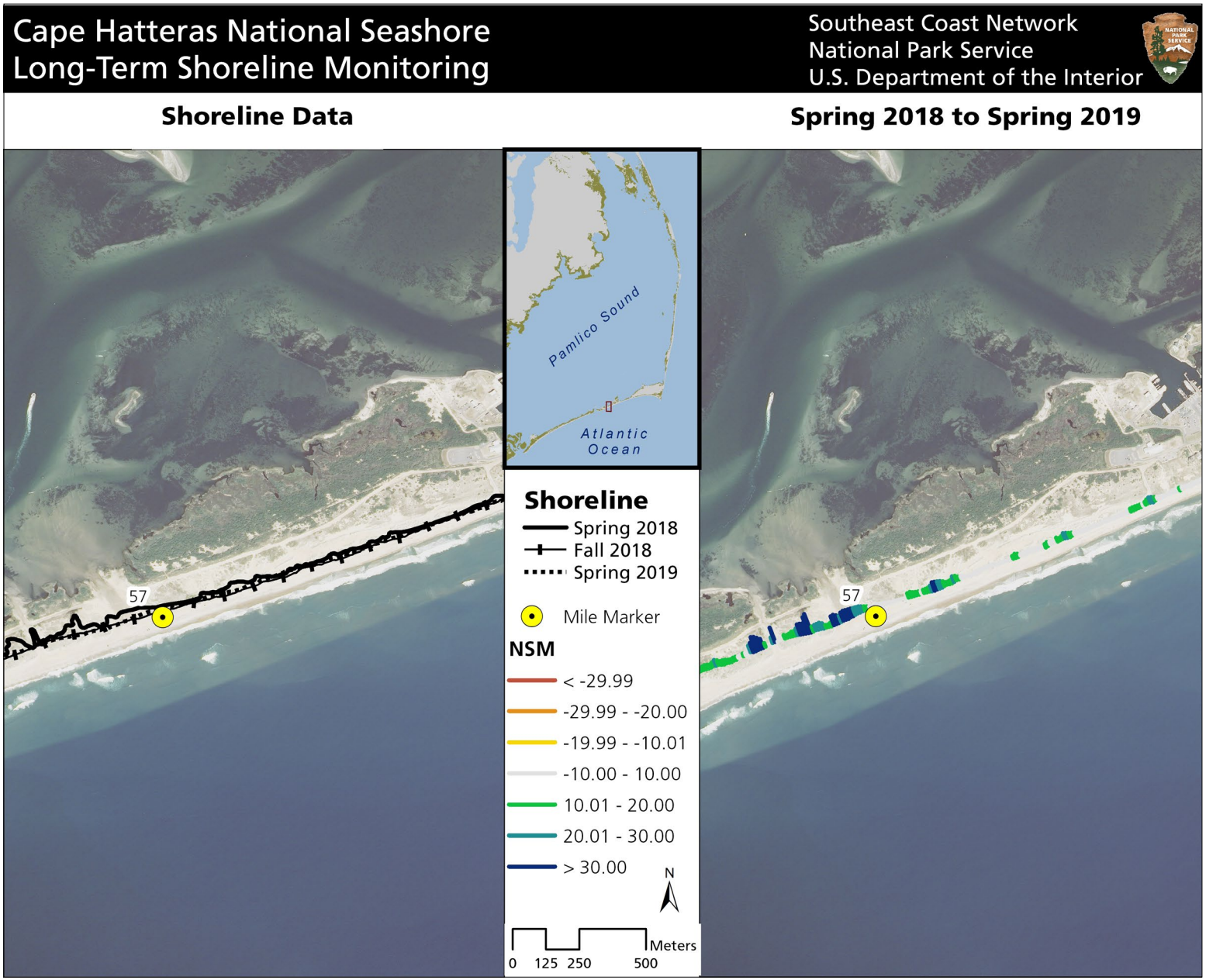


Figure A-45. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 57.

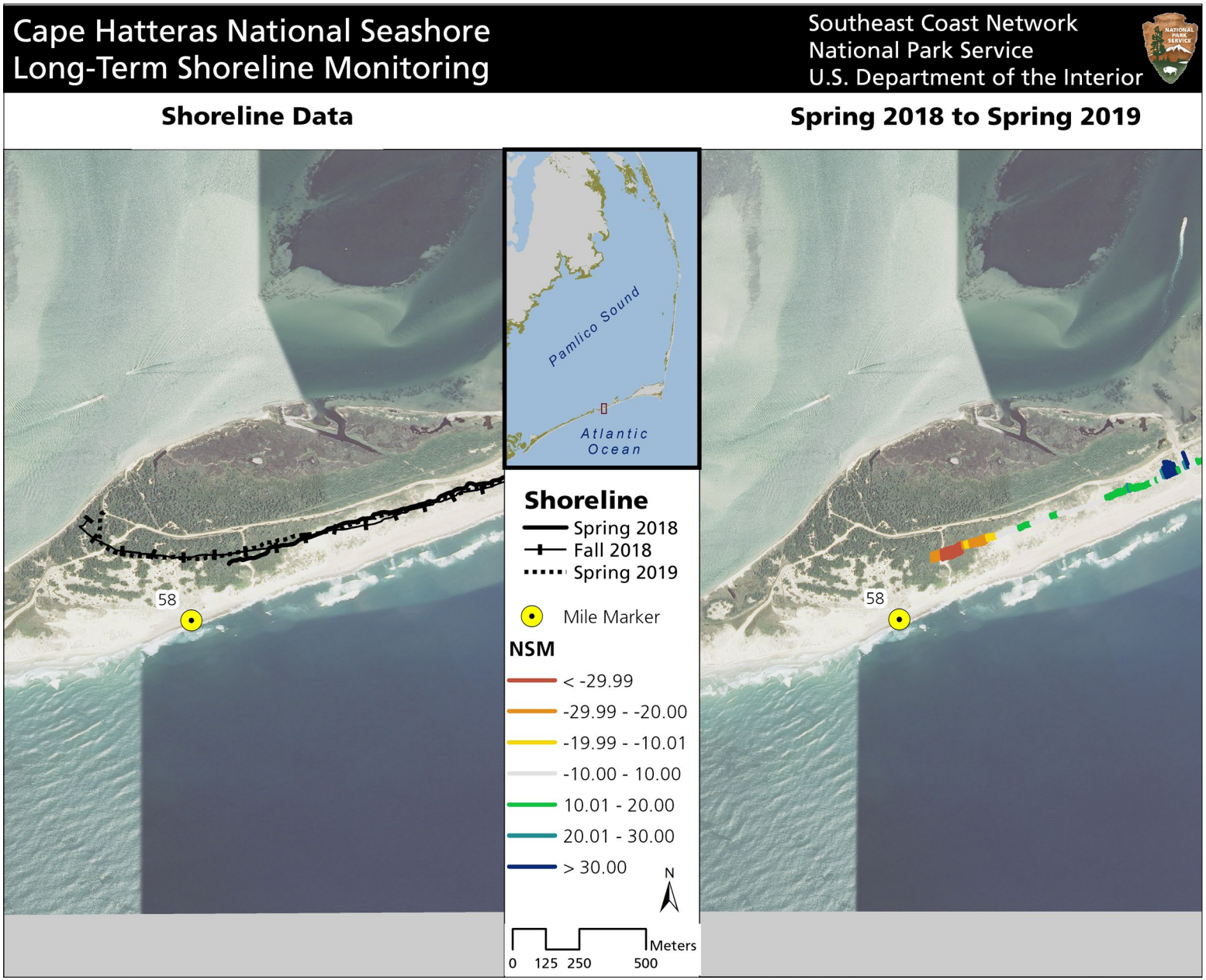


Figure A-46. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 58.

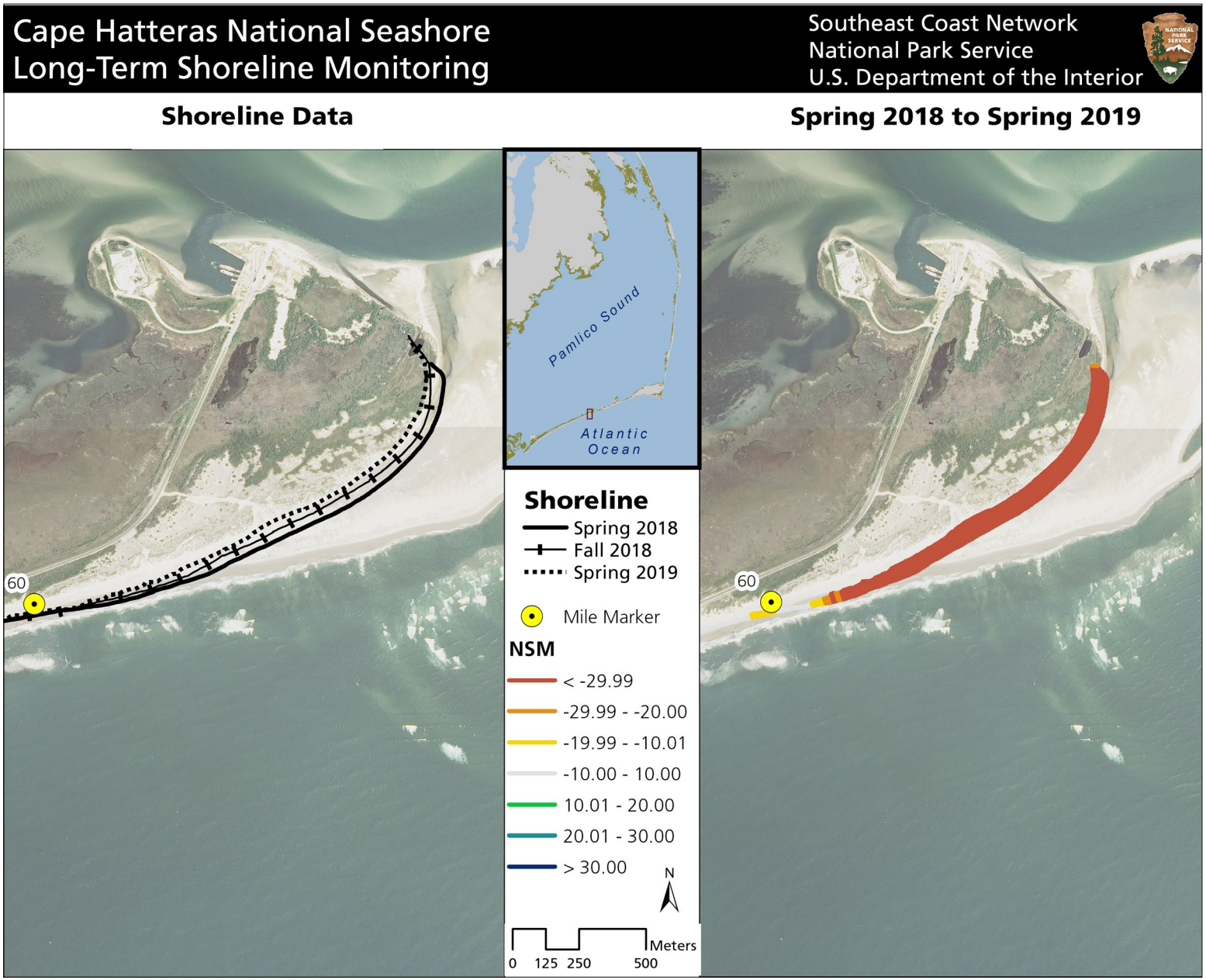


Figure A-47. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 60.

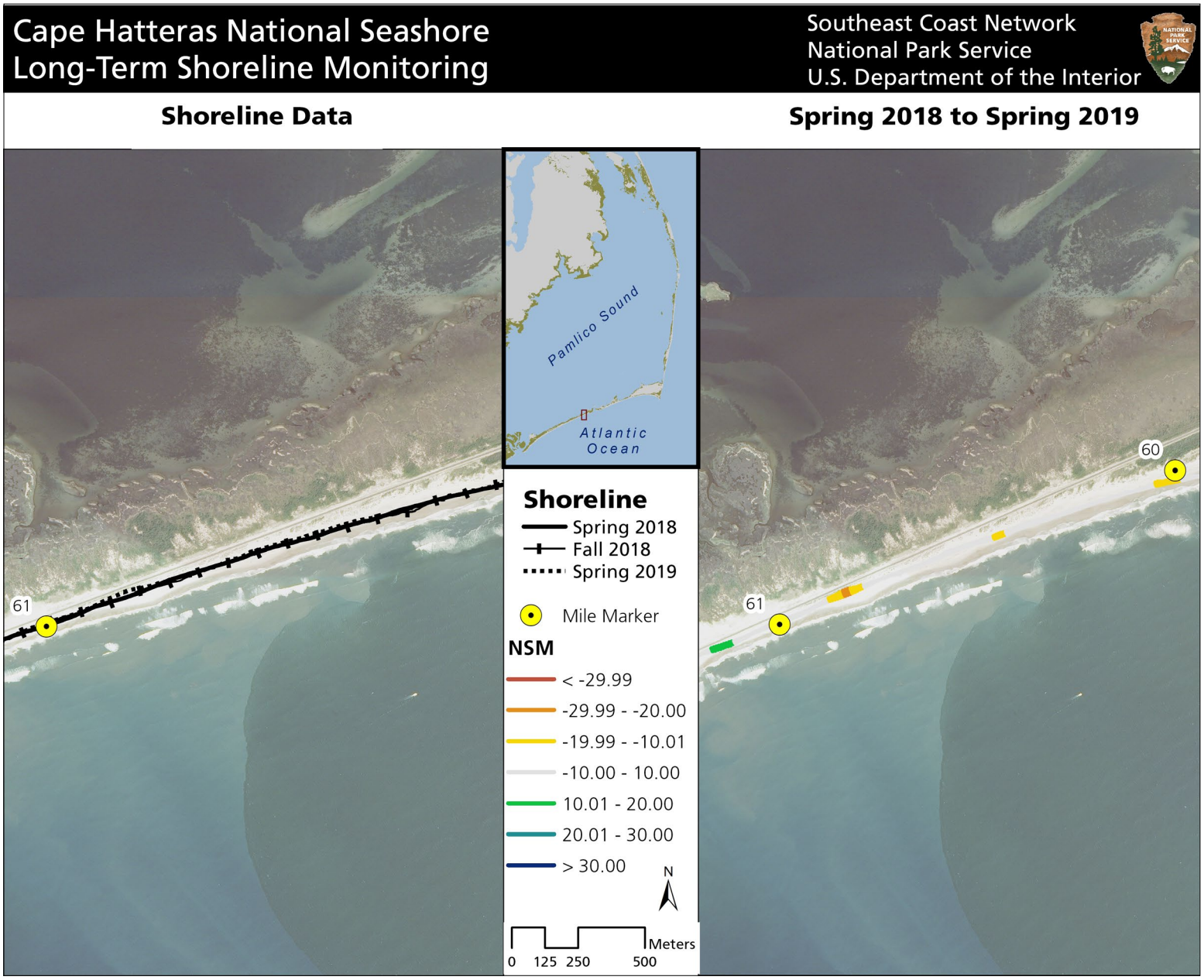


Figure A-48. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 61.

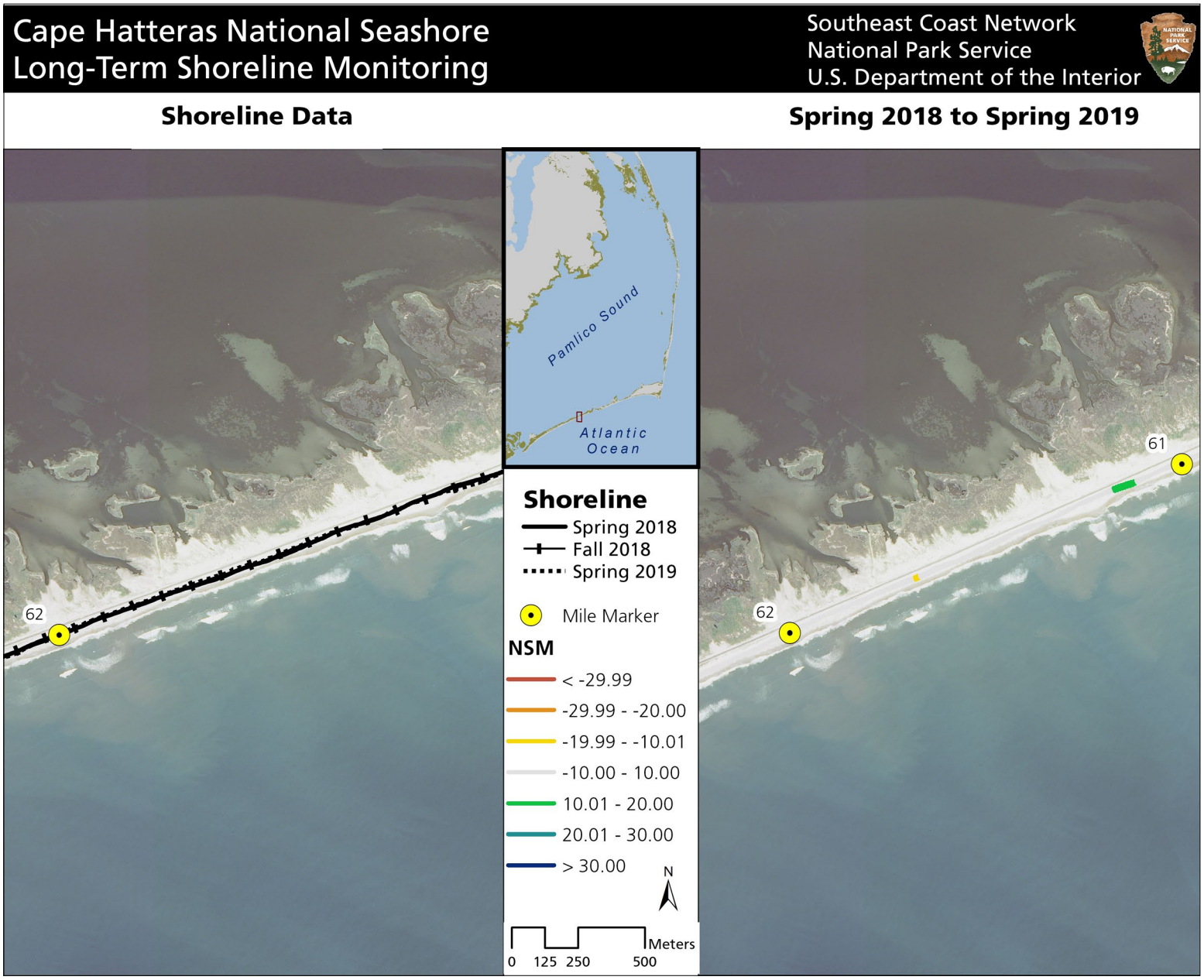


Figure A-49. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 62.

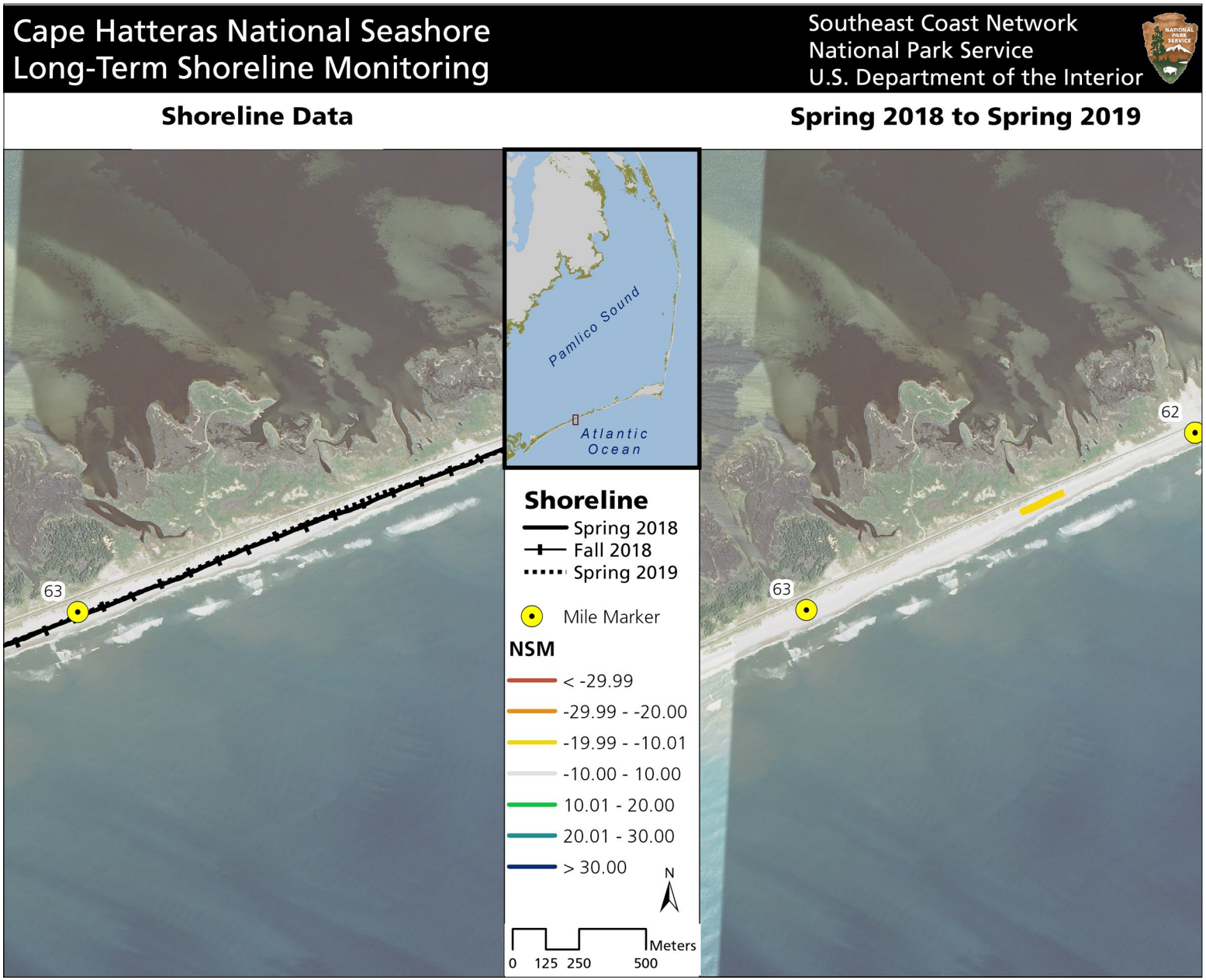


Figure A-50. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 63.

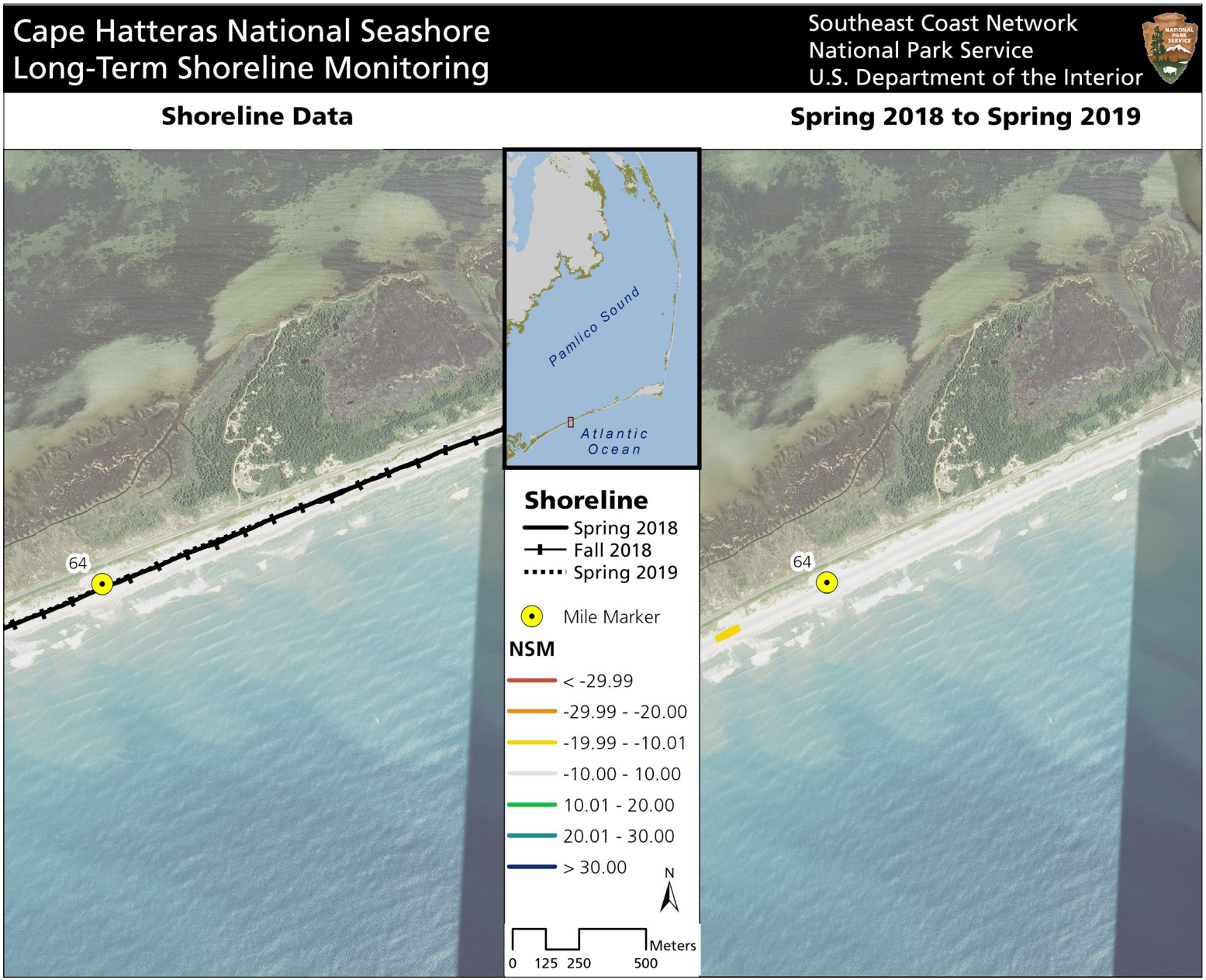


Figure A-51. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 64.

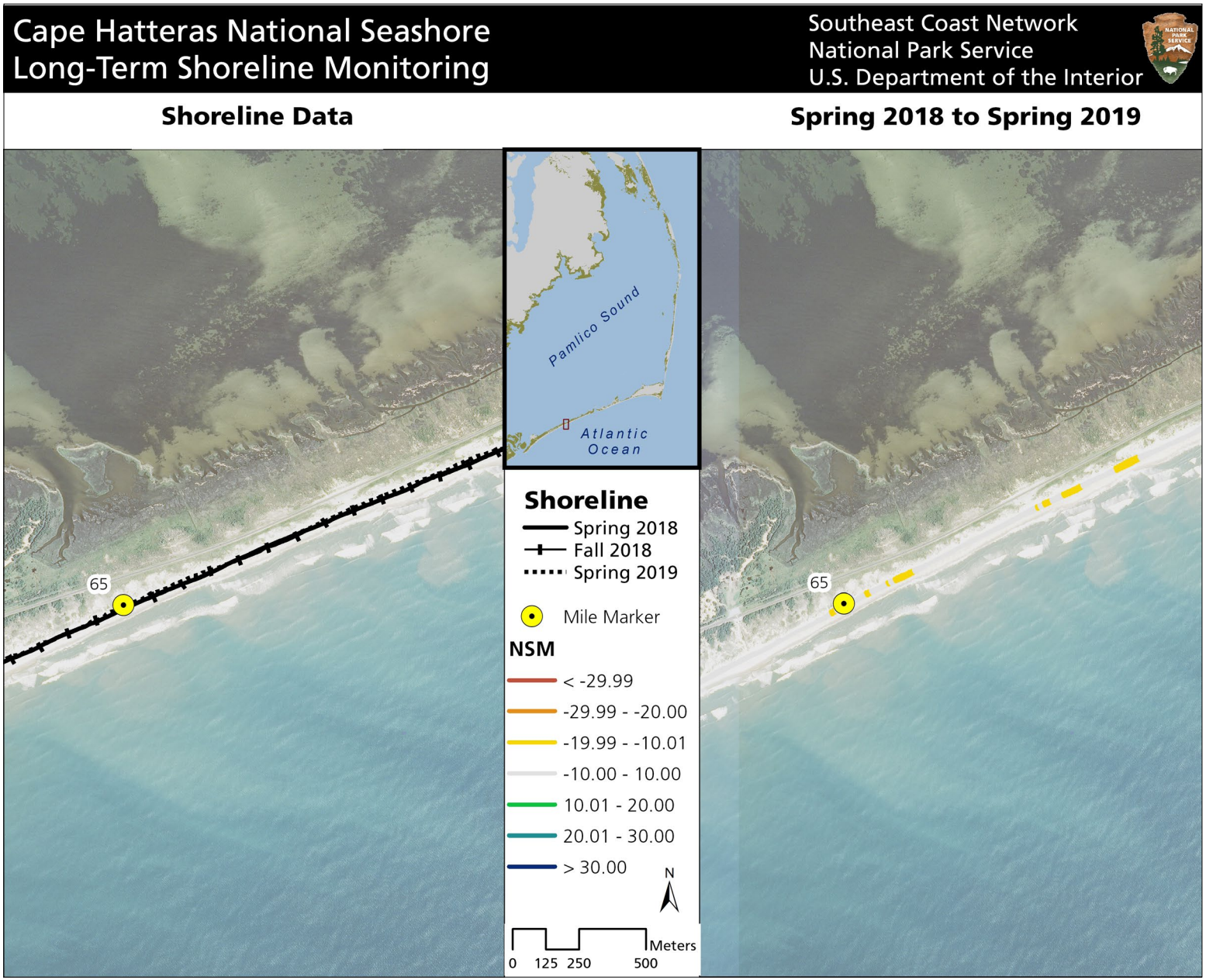


Figure A-52. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 65.

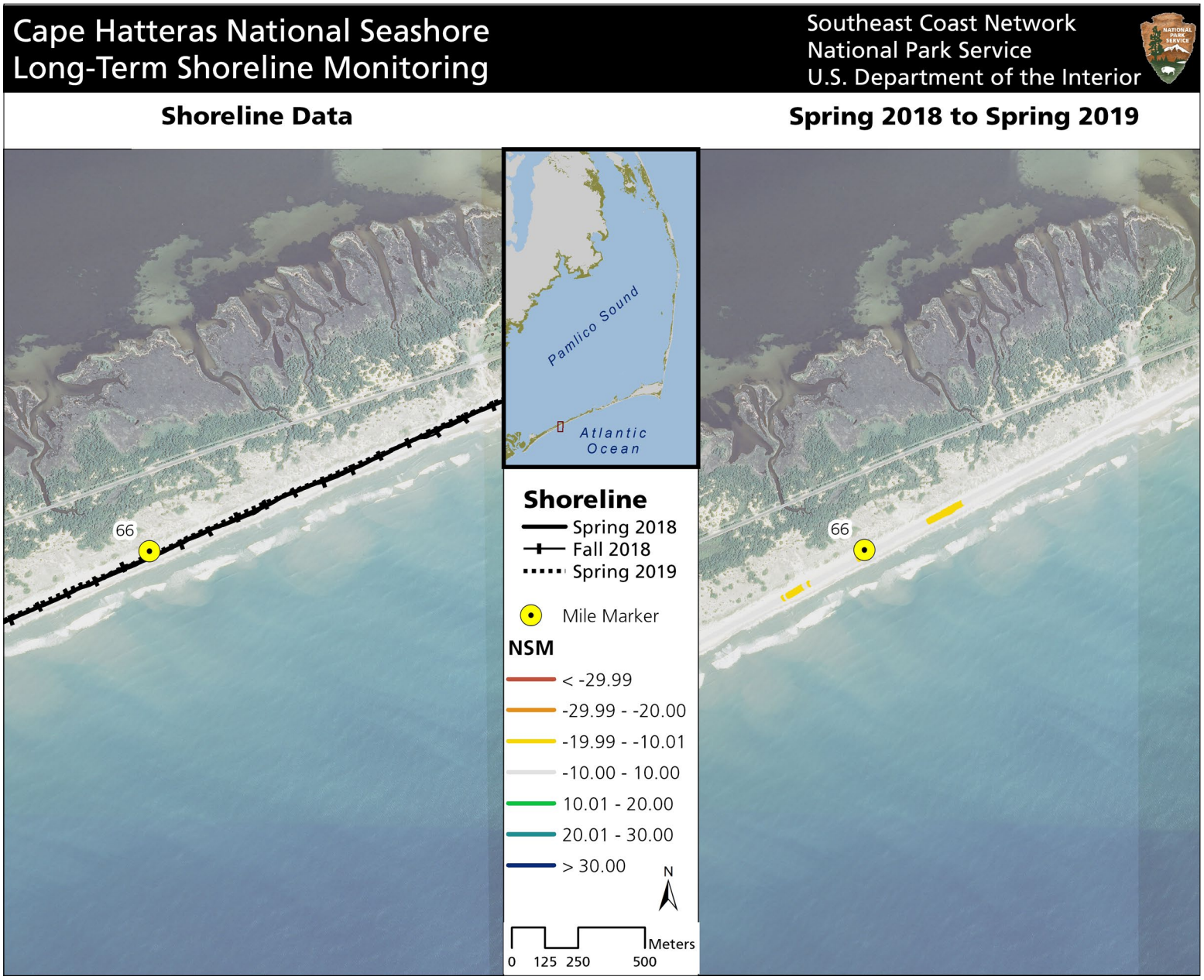


Figure A-53. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 66.

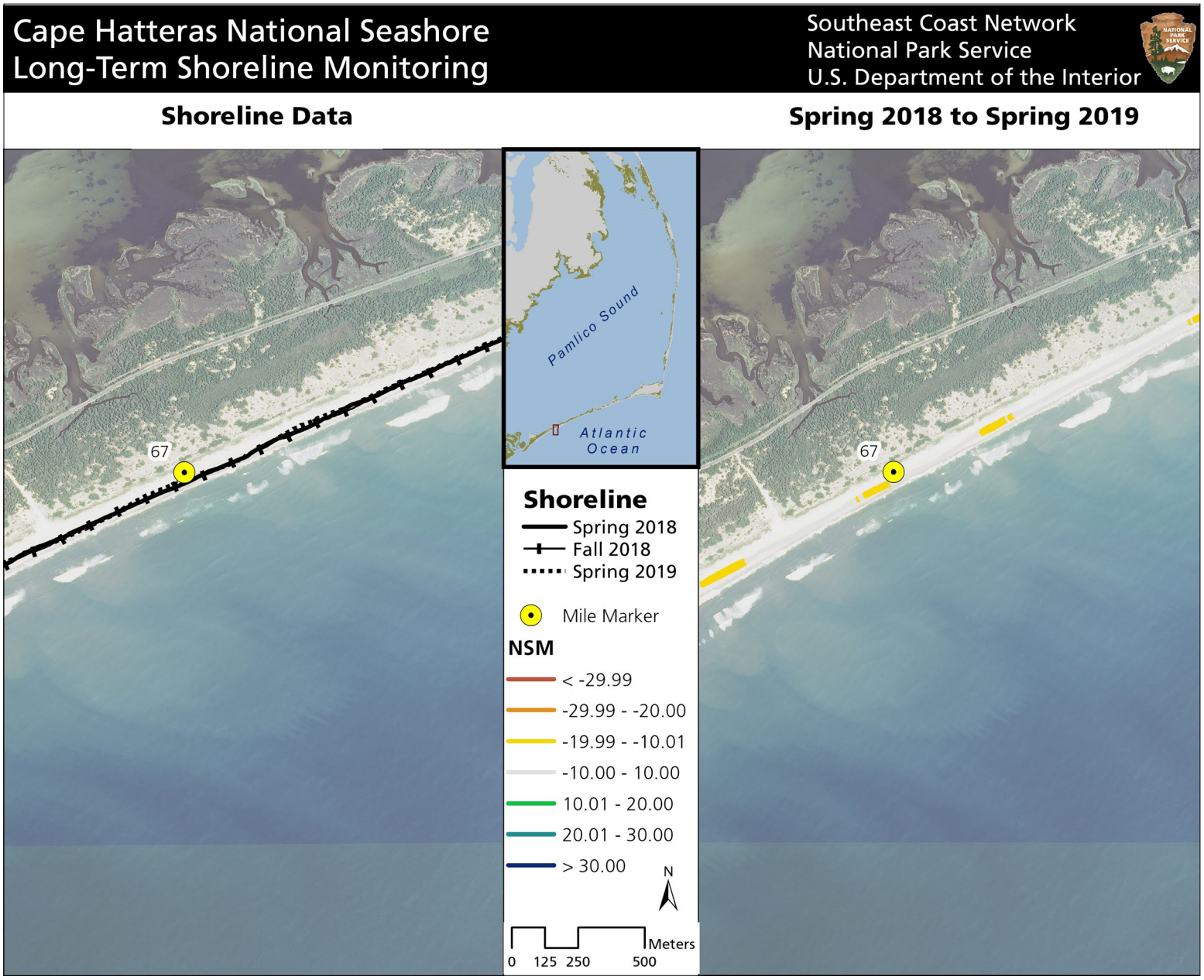


Figure A-54. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 67.

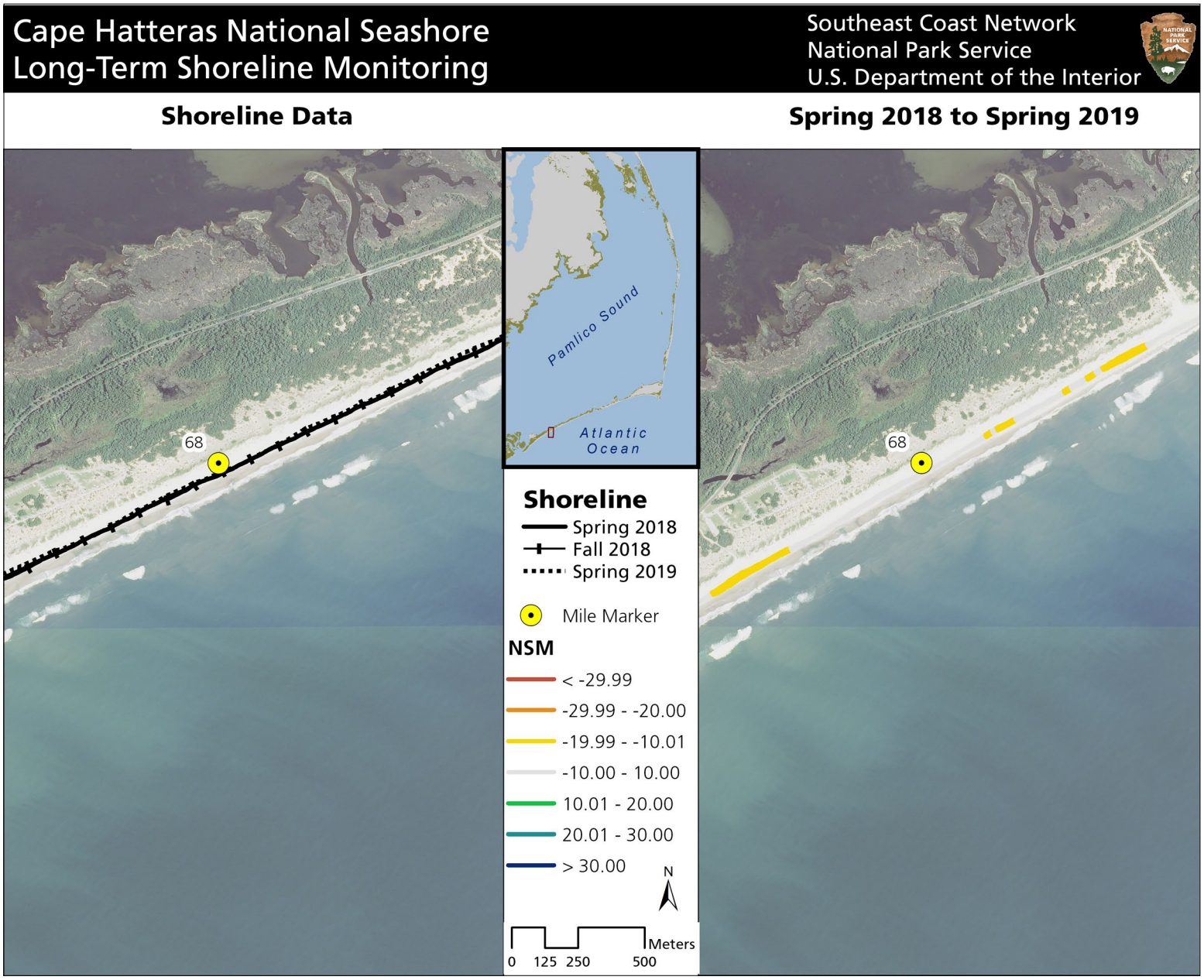


Figure A-55. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 68.

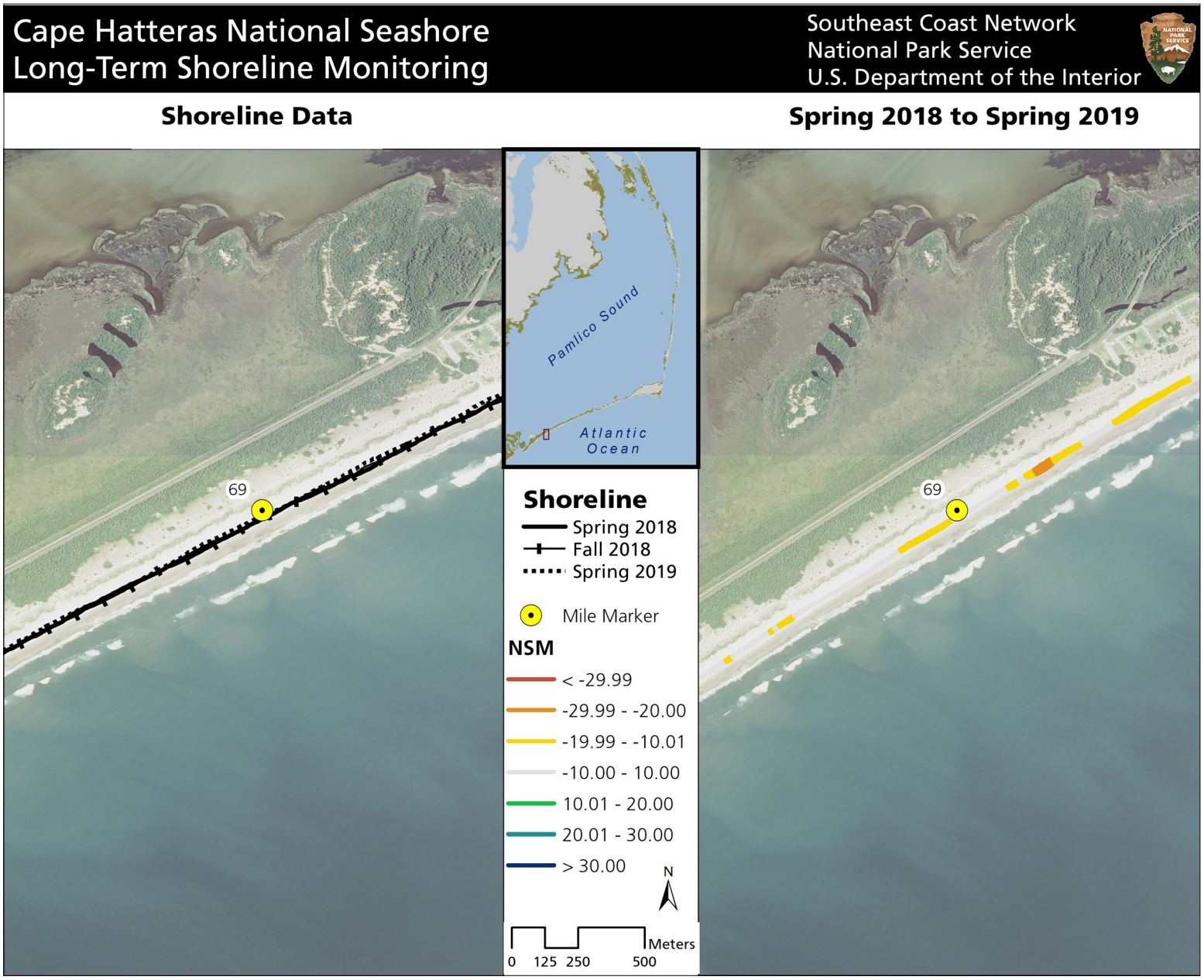


Figure A-56. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 69.

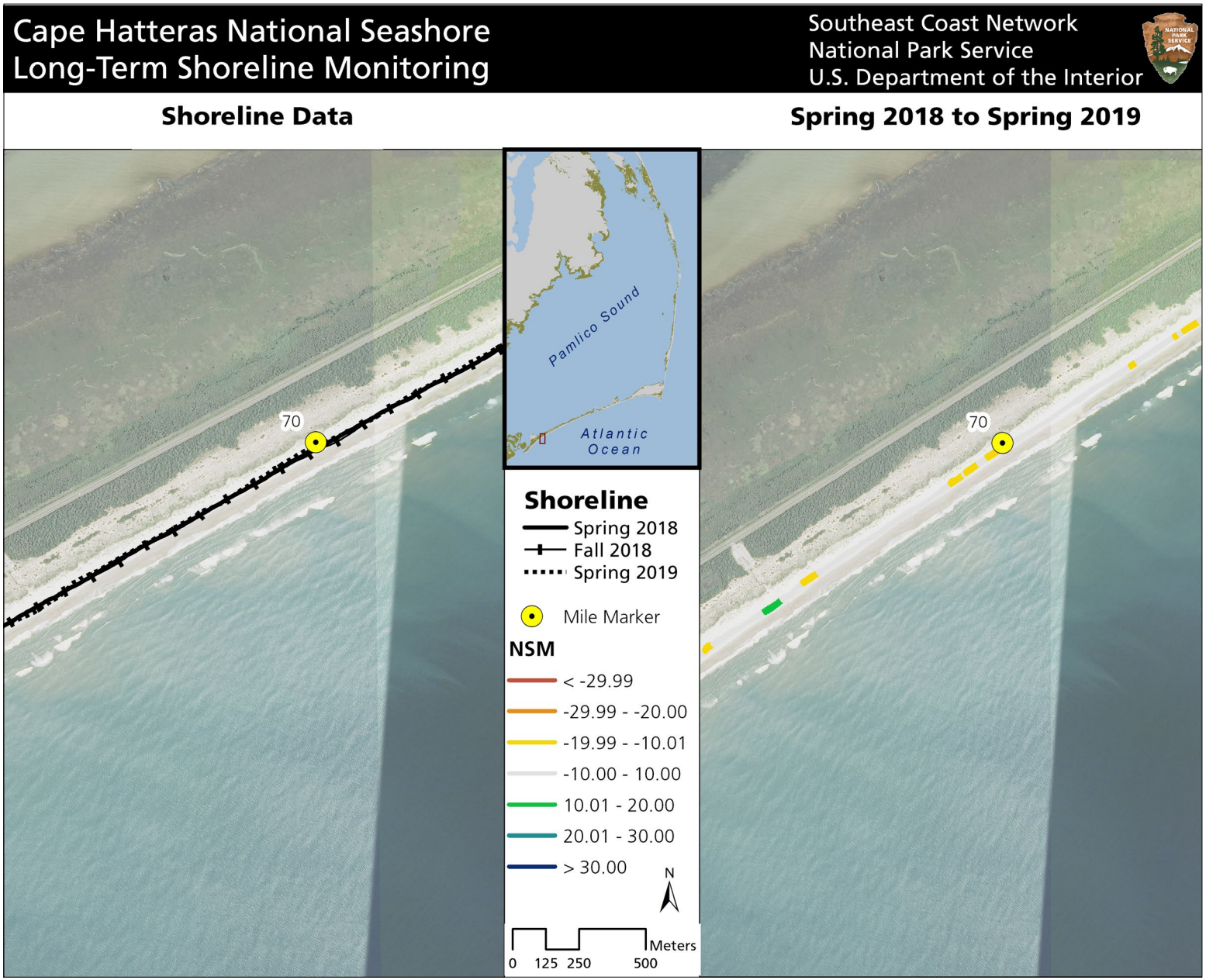


Figure A-57. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 70.

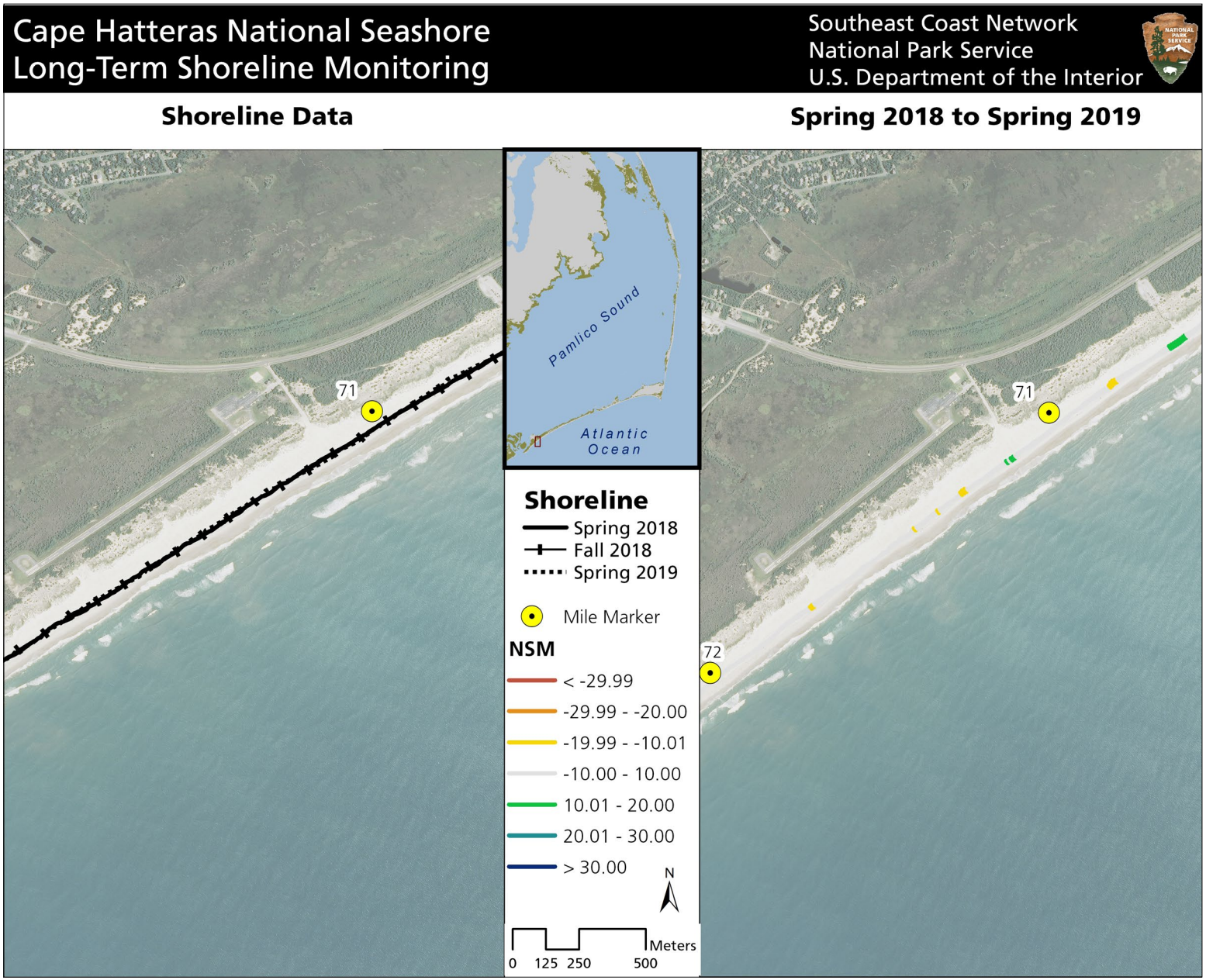


Figure A-58. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (meters) at Cape Hatteras National Seashore at mile marker 71.

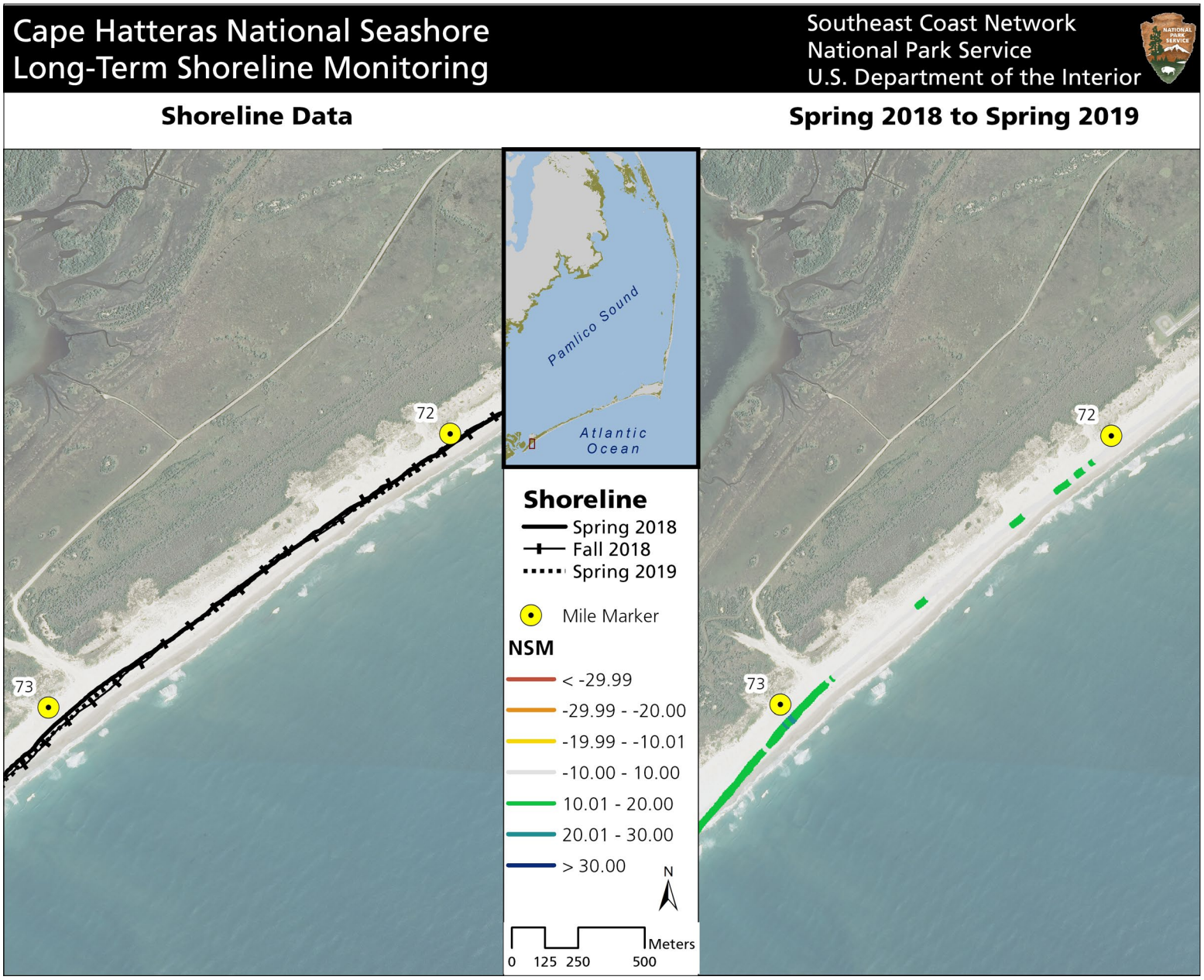


Figure A-59. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (m) at Cape Hatteras National Seashore at mile marker 72 and 73.

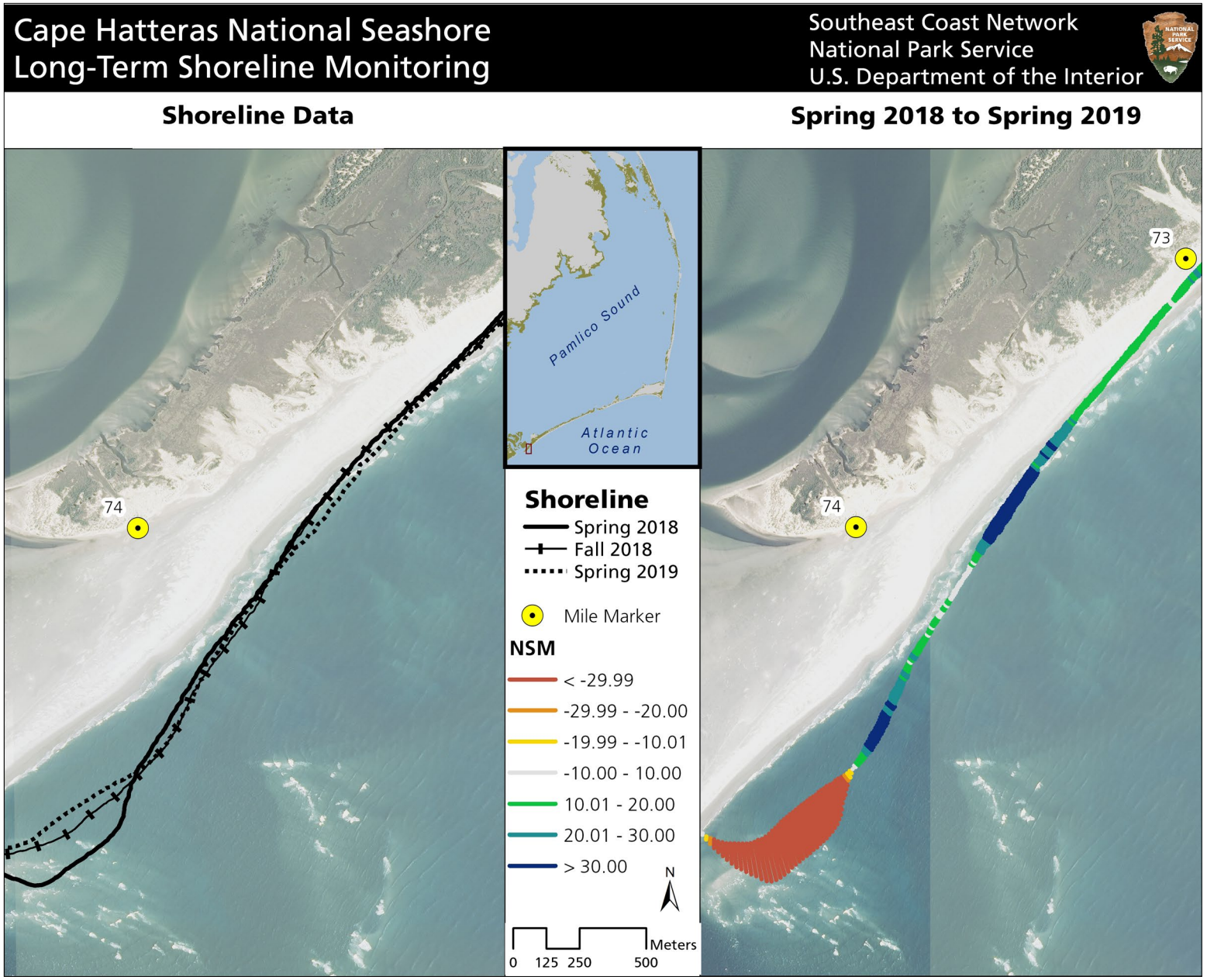


Figure A-60. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (m) at Cape Hatteras National Seashore at mile marker 74.

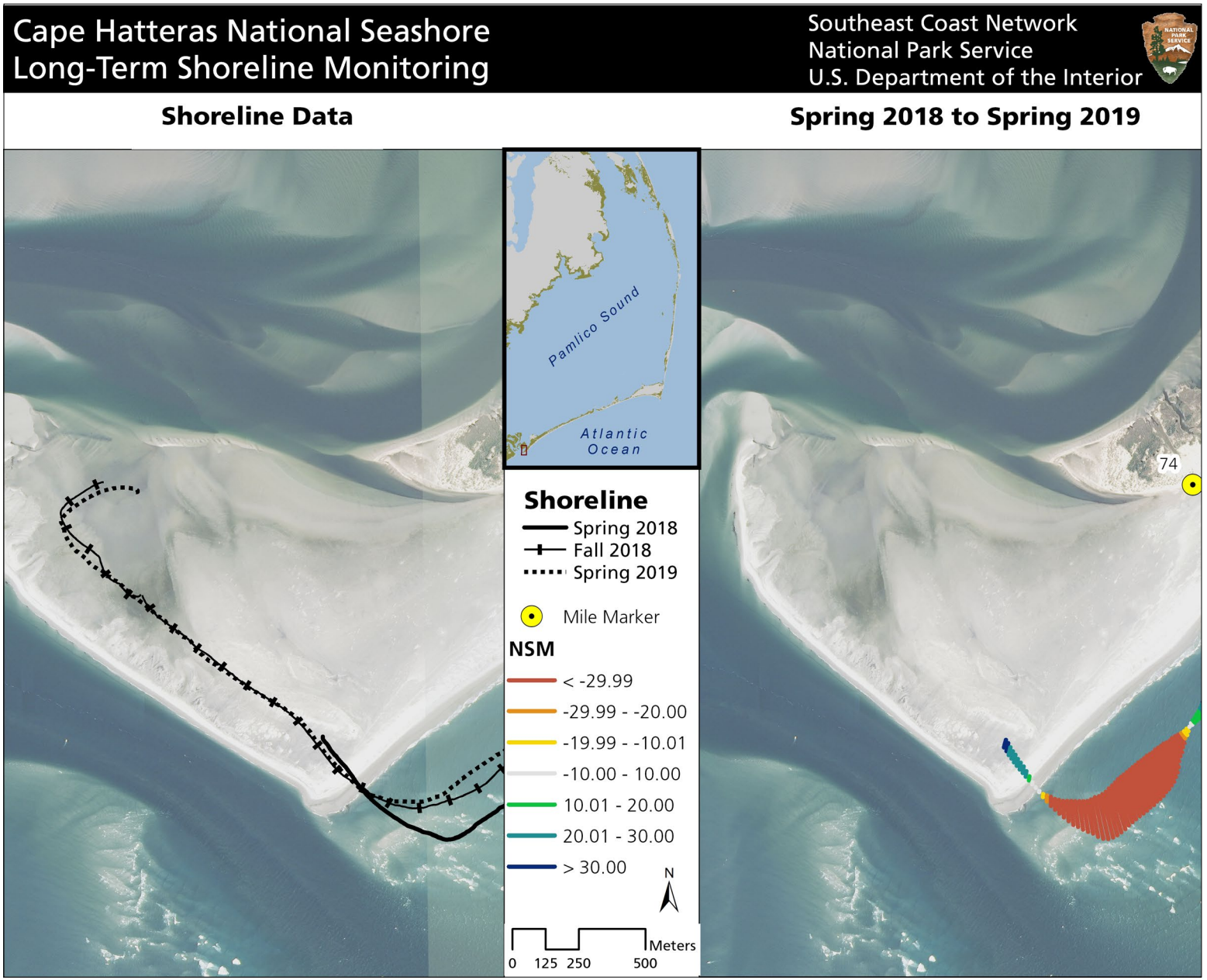


Figure A-61. Maps of the shoreline data and spring 2018 to spring 2019 shoreline change distance (m) at Cape Hatteras National Seashore east of mile marker 74.

Appendix B. Seasonal Shoreline Change Distance Maps

Maps of the seasonal shoreline surveys collected from 2018 to 2019 at Cape Hatteras National Seashore. The net shoreline movement (NSM) is also known as shoreline change distance (meters [m]). The more negative shoreline change distance denotes more erosion and is shown in warmer colors. The less negative shoreline change distance denotes less erosion and in some cases can represent accretion (when positive). The grey transects denote shoreline change distance within the error range of the data (±10 meters [32.8 ft]).

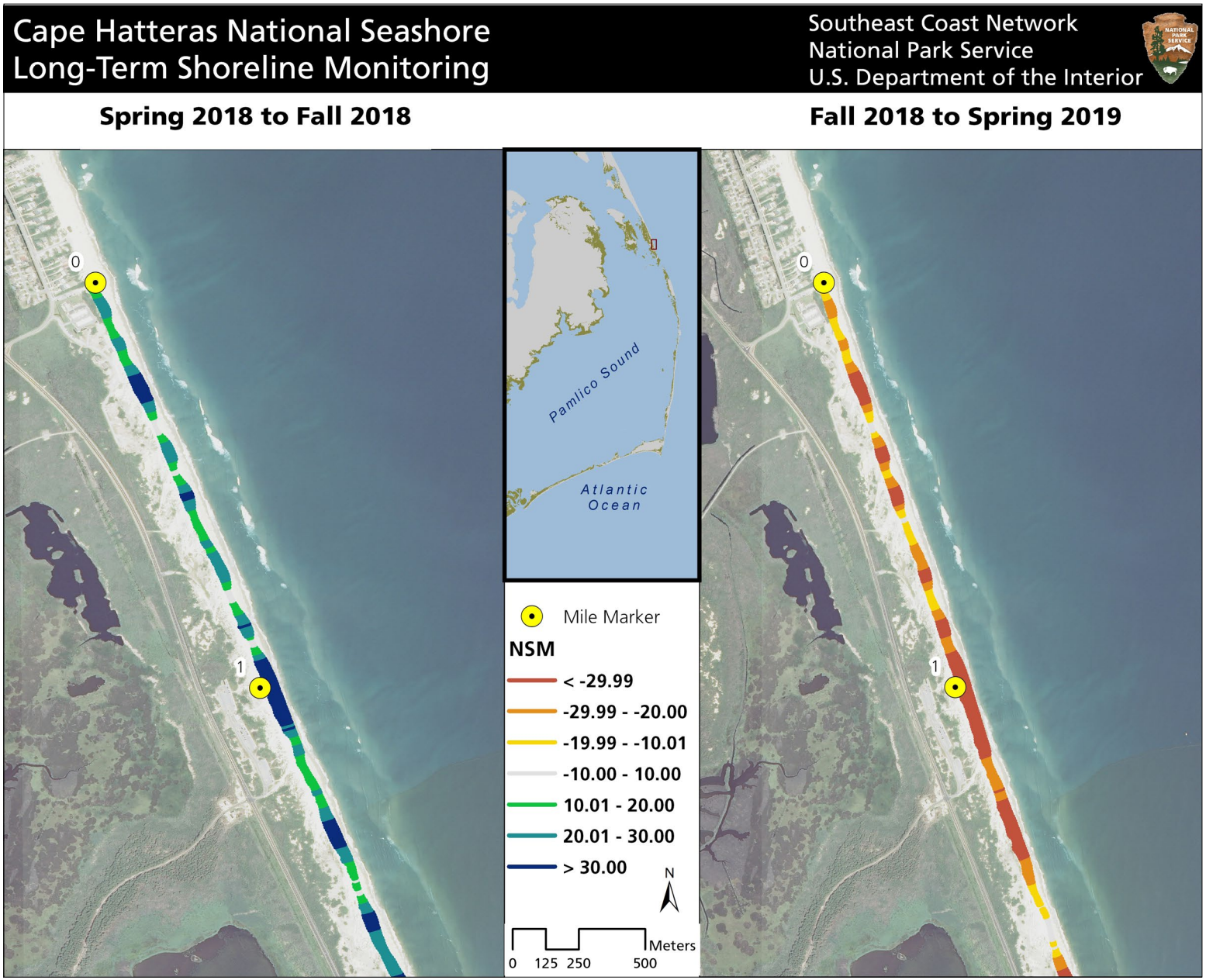


Figure B-1. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 0 and 1.

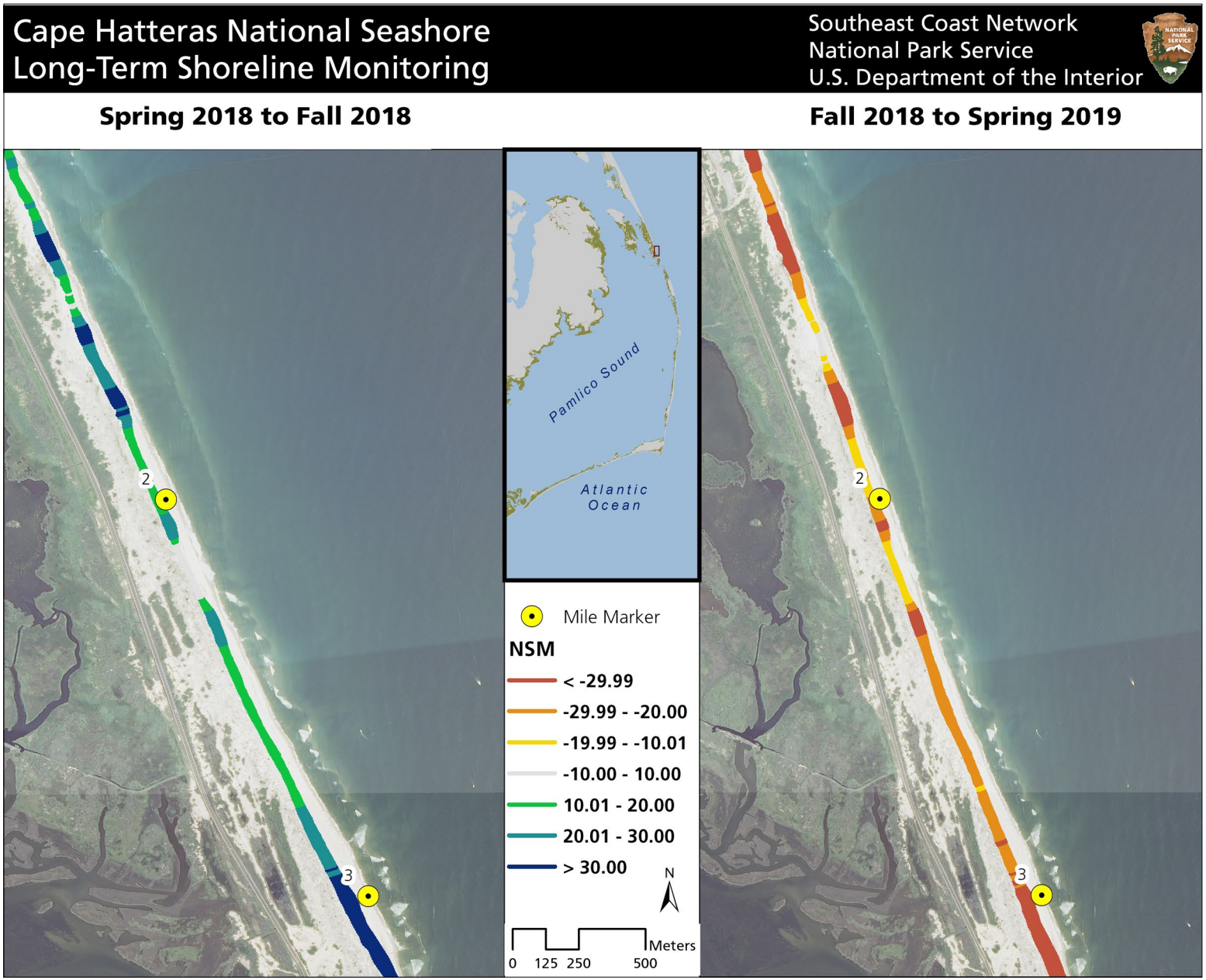


Figure B-2. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 2 and 3.

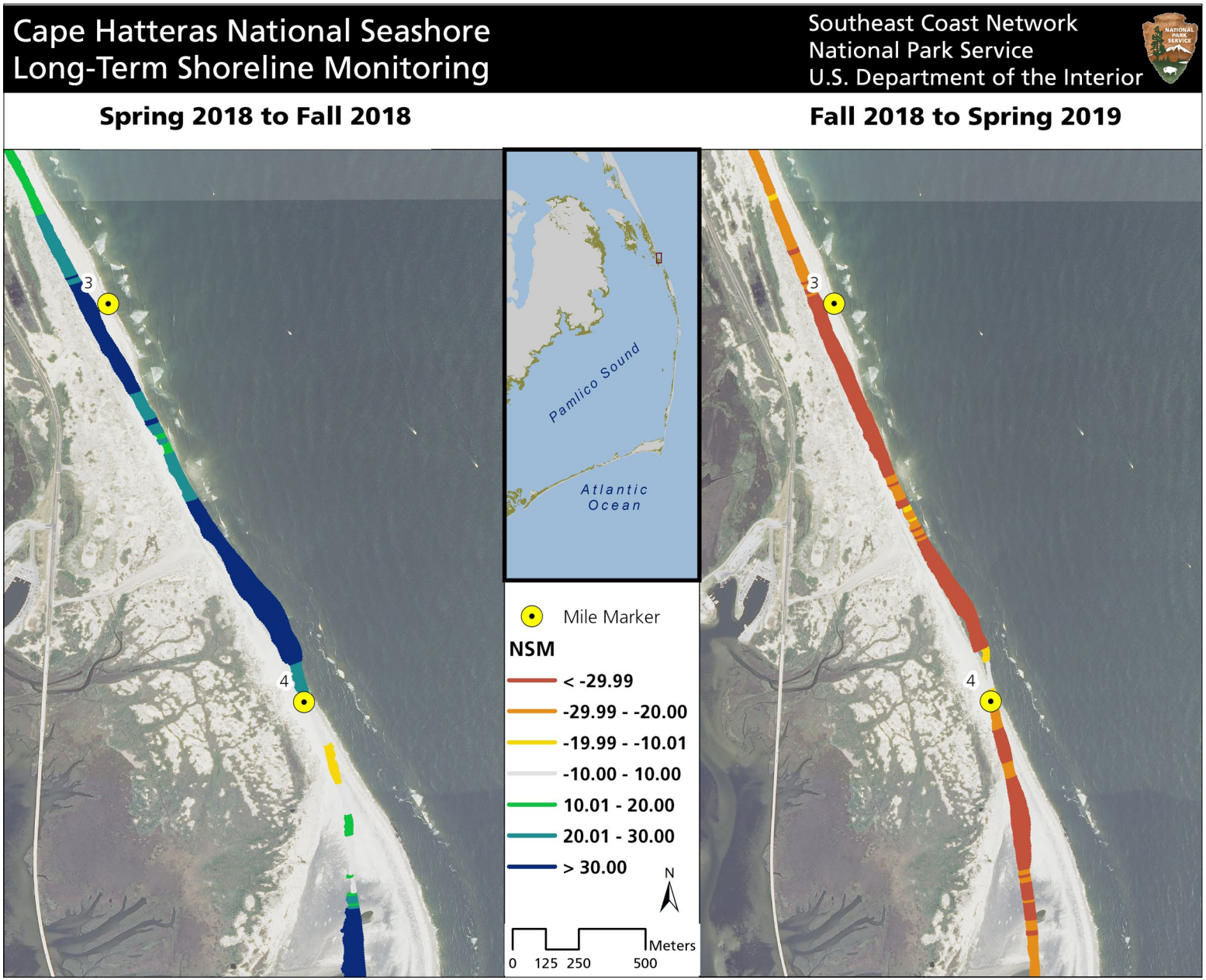


Figure B-3. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 3 and 4.

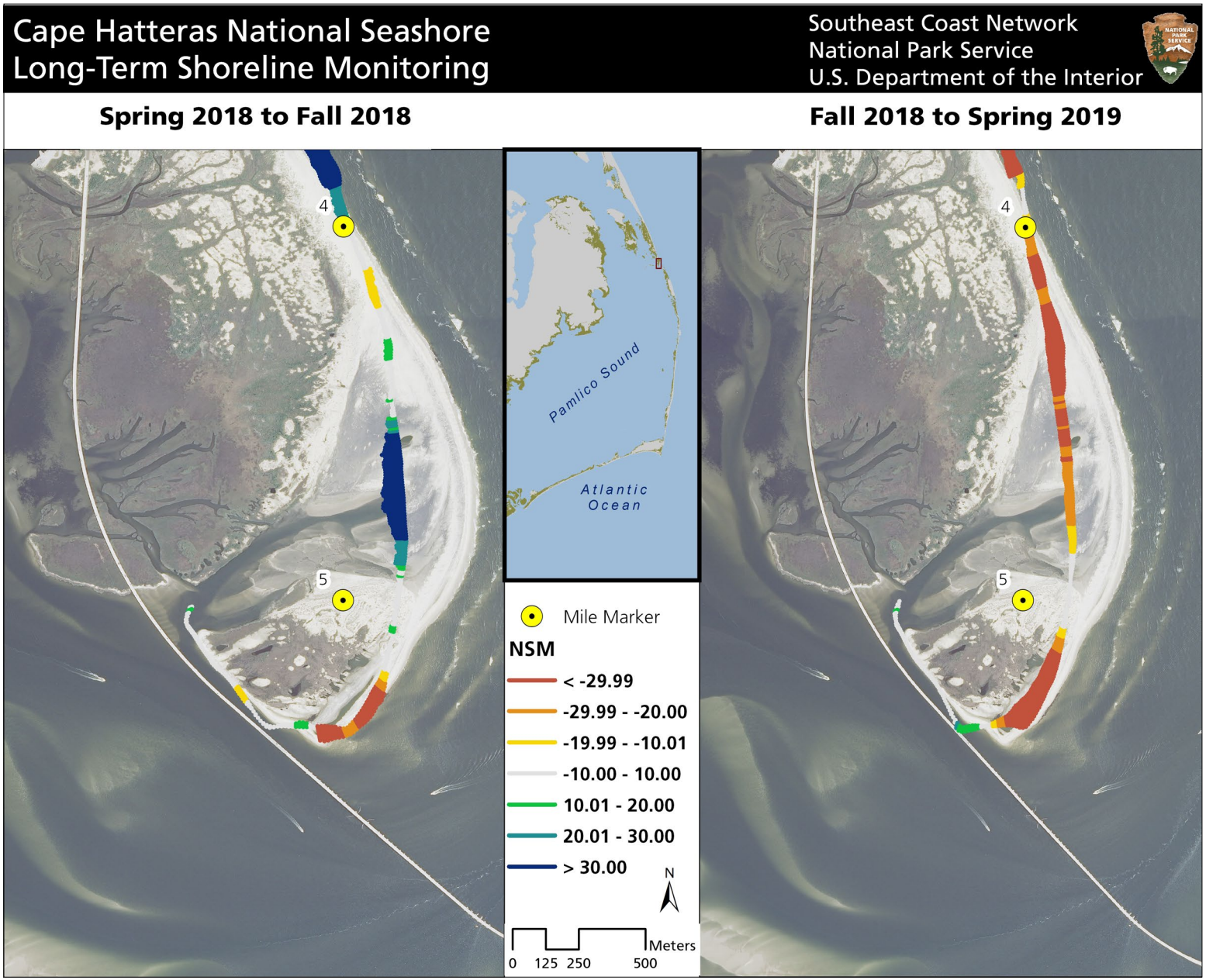


Figure B-4. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 4 and 5.

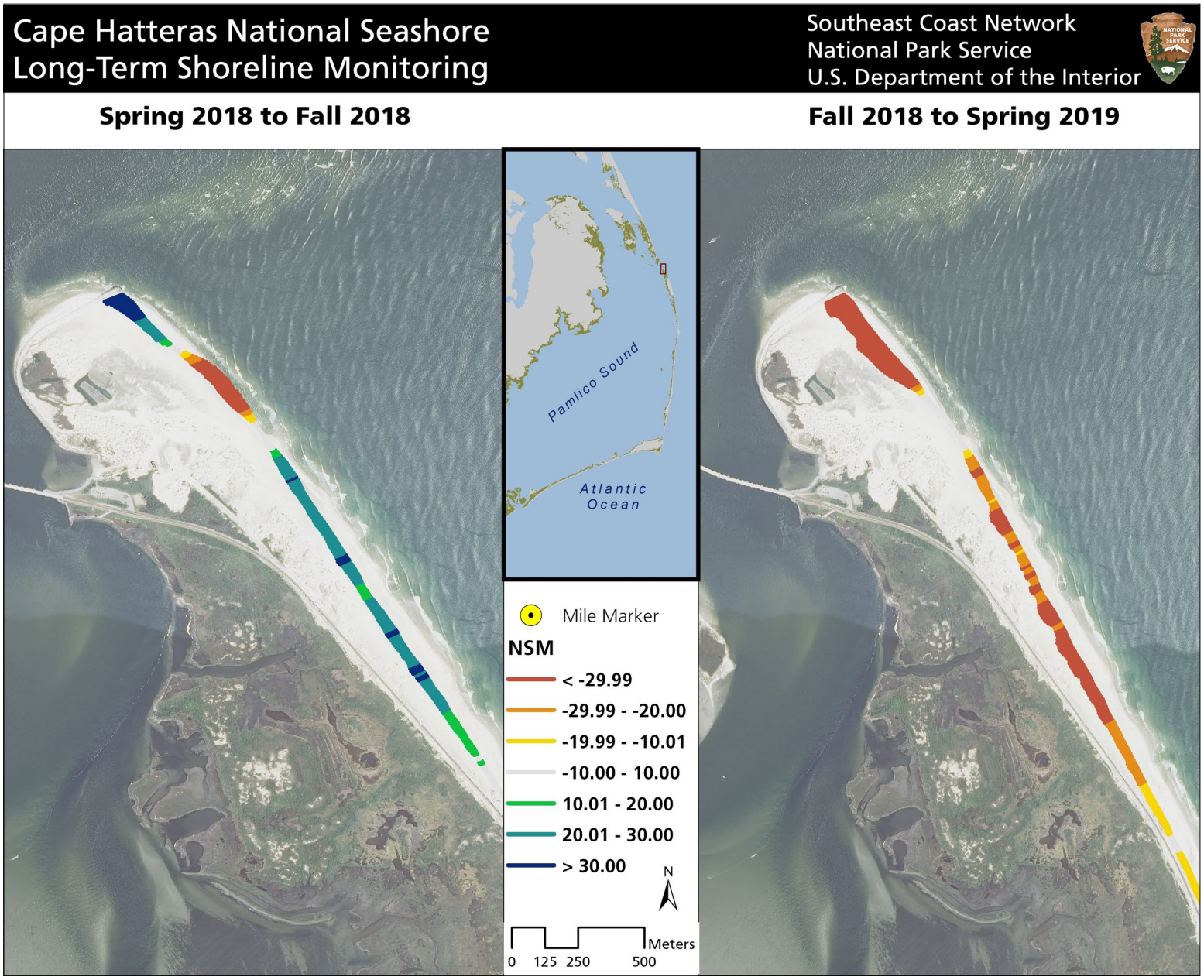


Figure B-5. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys at the north end of Hatteras Island within Pea Island National Wildlife Refuge near Oregon Inlet.

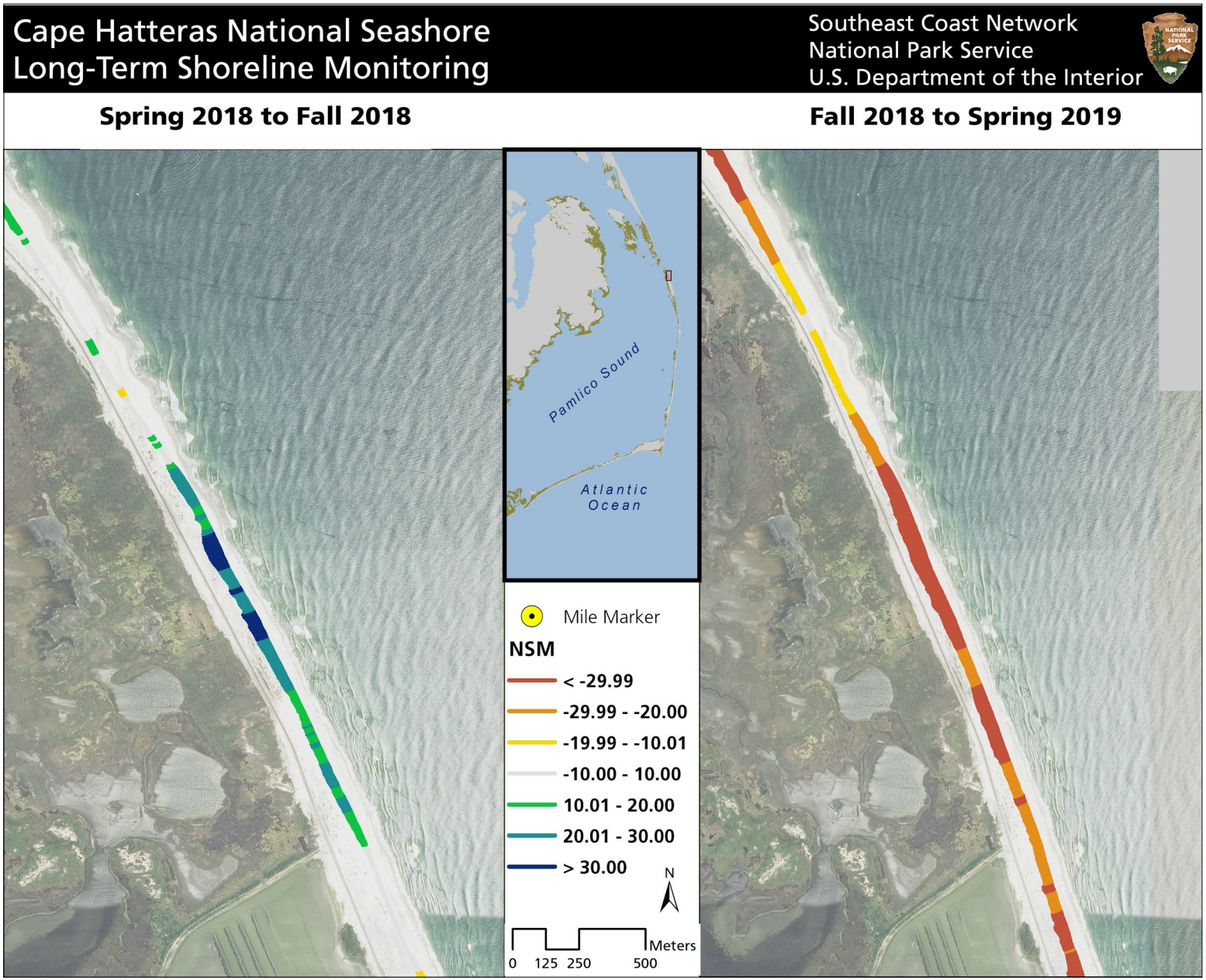


Figure B-6. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys at the north end of Hatteras Island within Pea Island National Wildlife Refuge, second section.

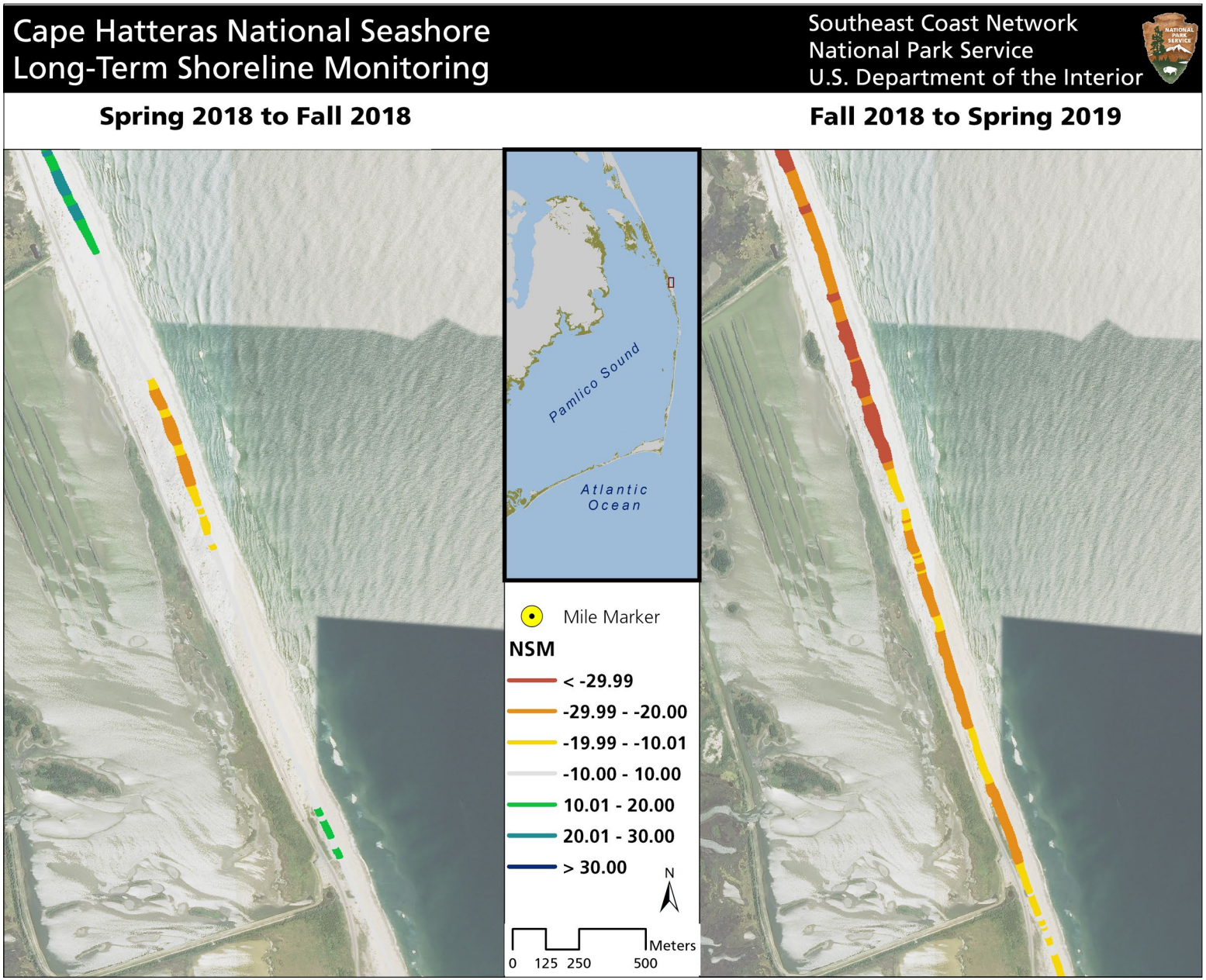


Figure B-7. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys at the north end of Hatteras Island within Pea Island National Wildlife Refuge, third section.

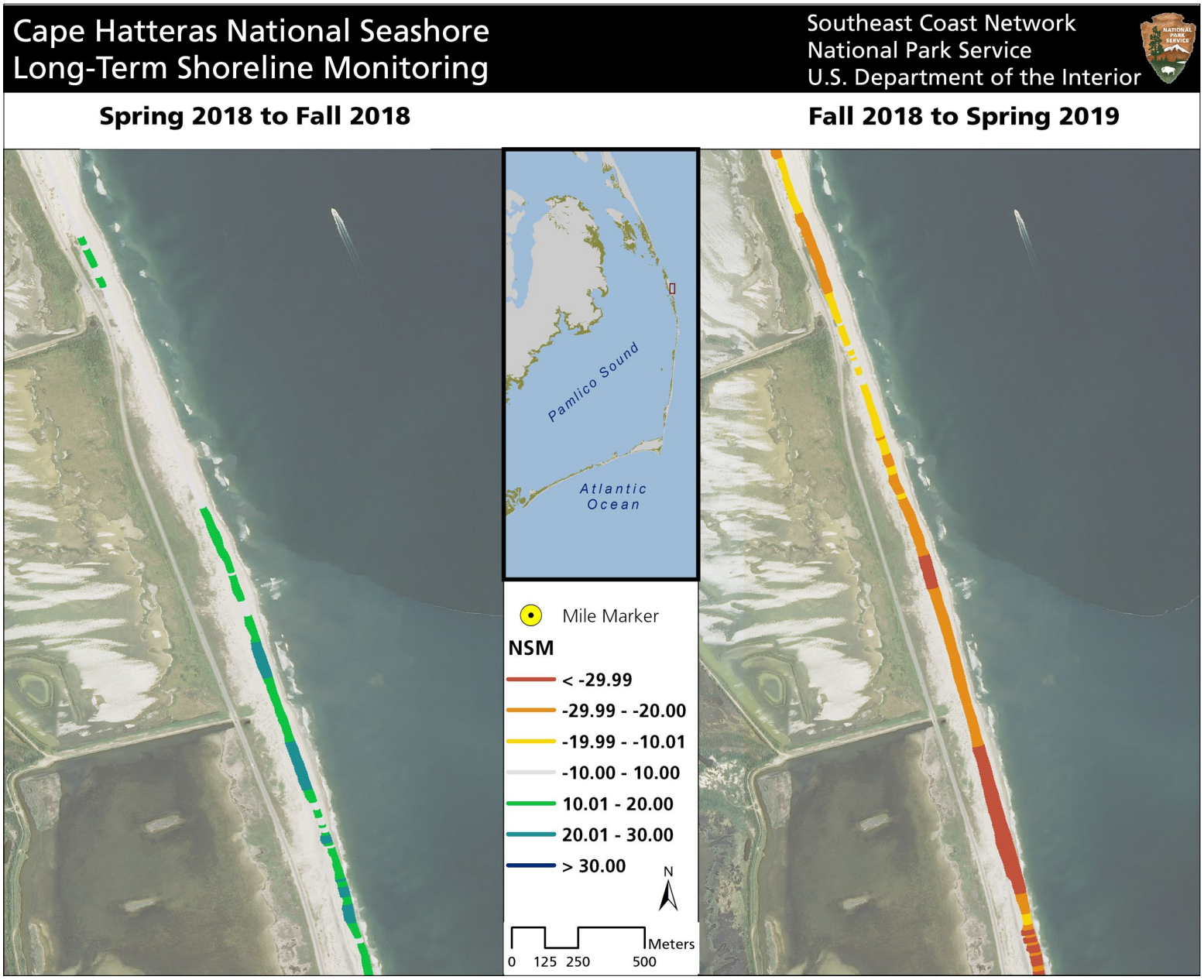


Figure B-8. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys at the north end of Hatteras Island within Pea Island National Wildlife Refuge, fourth section.

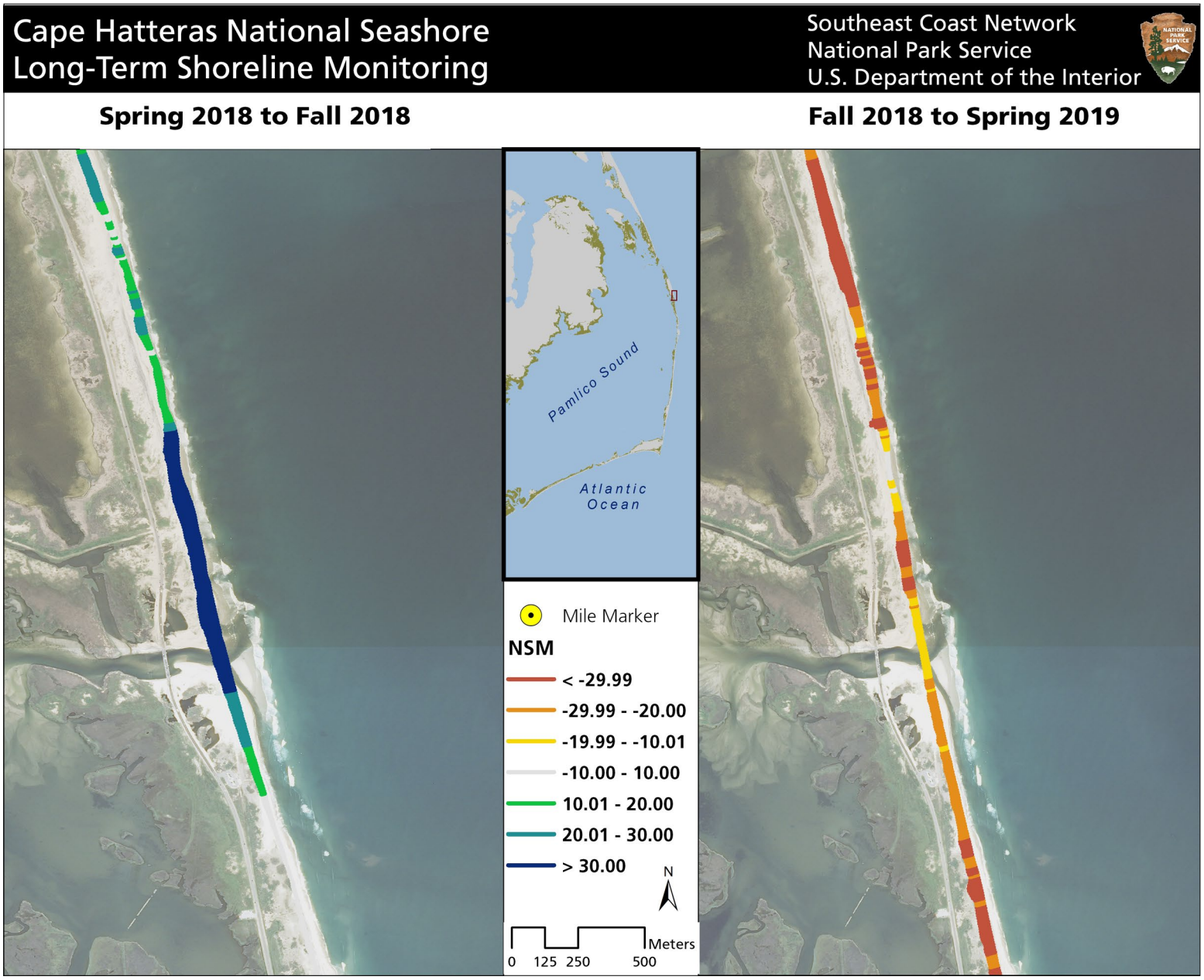


Figure B-9. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys at the north end of Hatteras Island within Pea Island National Wildlife Refuge, fifth section.

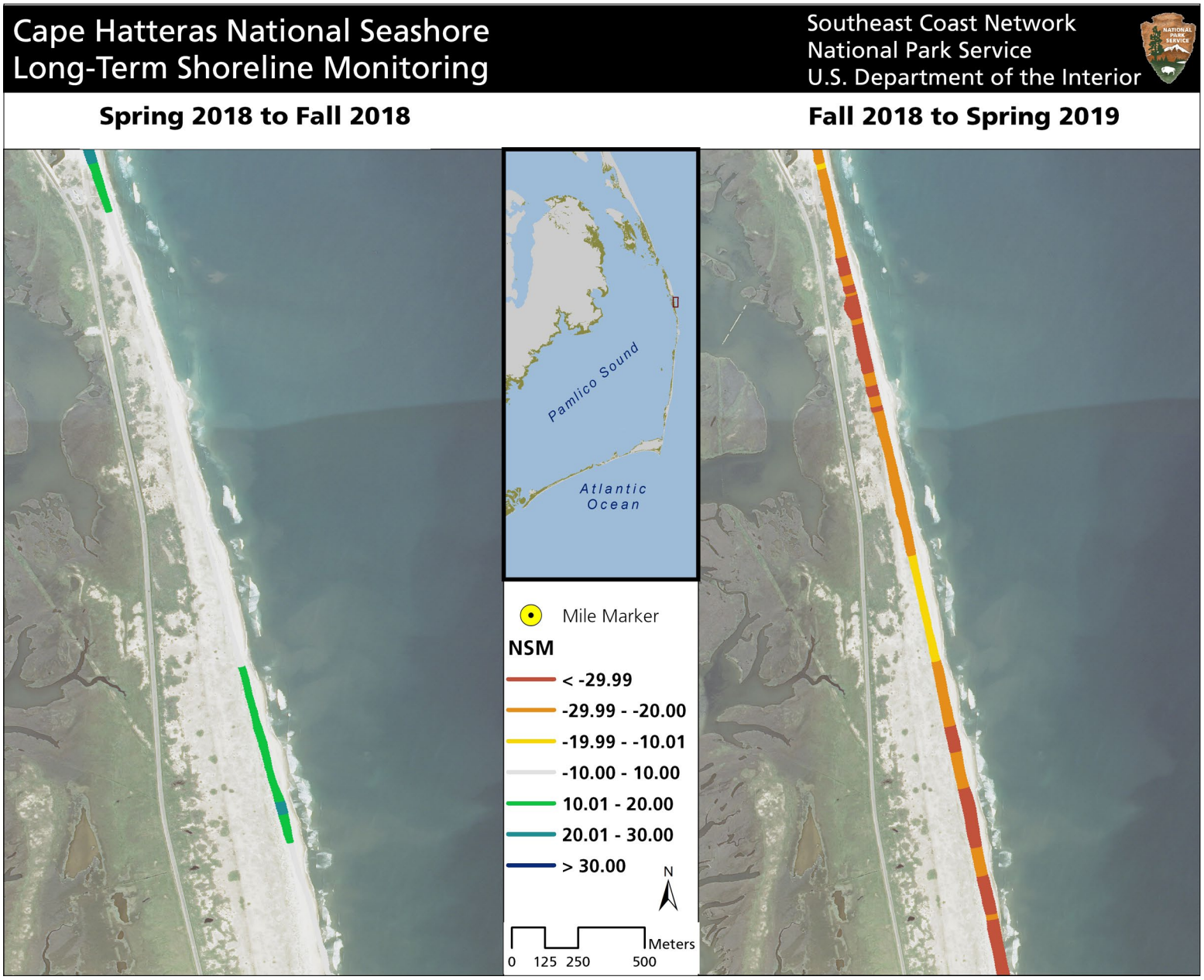


Figure B-10. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys at the north end of Hatteras Island within Pea Island National Wildlife Refuge, sixth section.

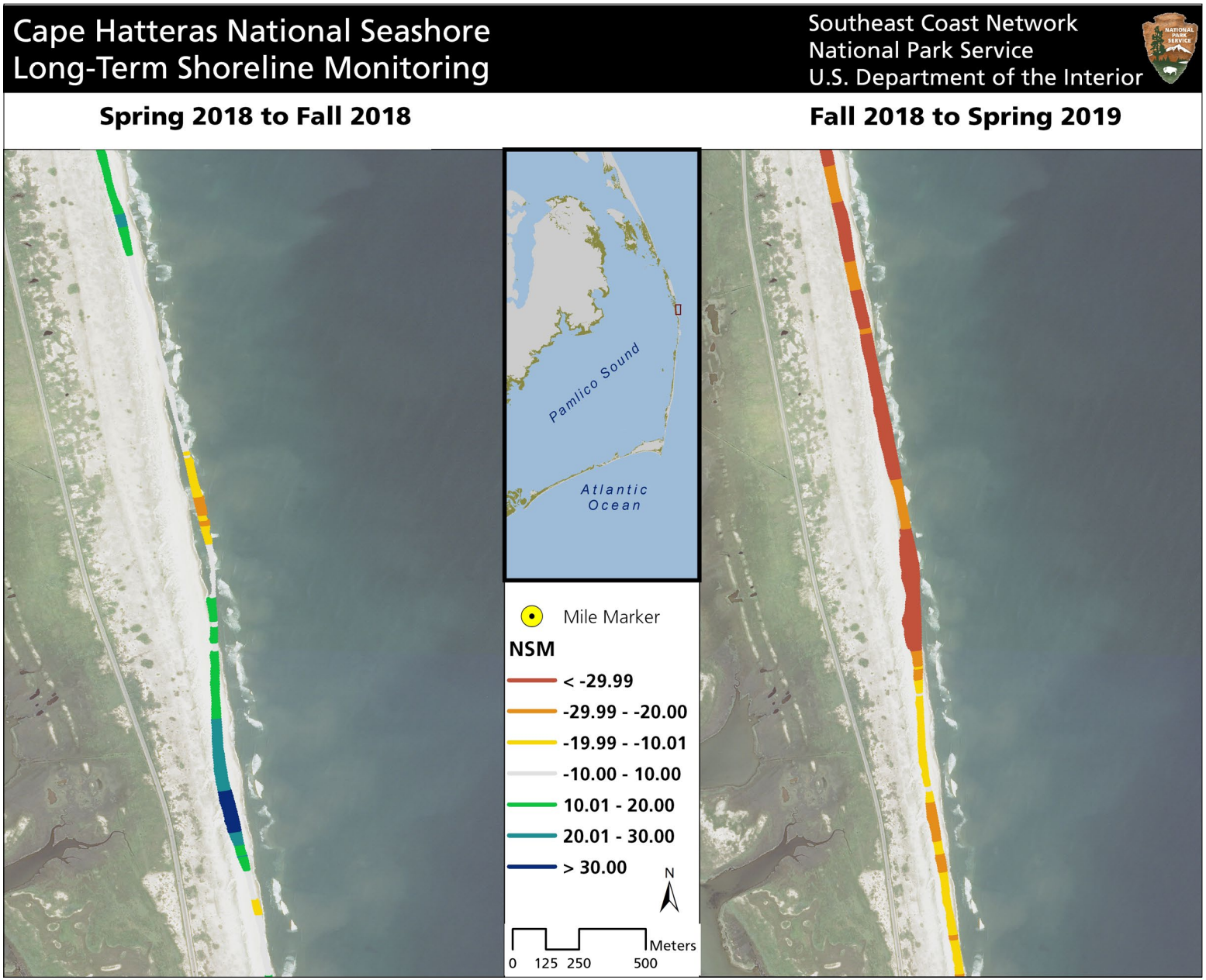


Figure B-11. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys at the north end of Hatteras Island within Pea Island National Wildlife Refuge, seventh section.

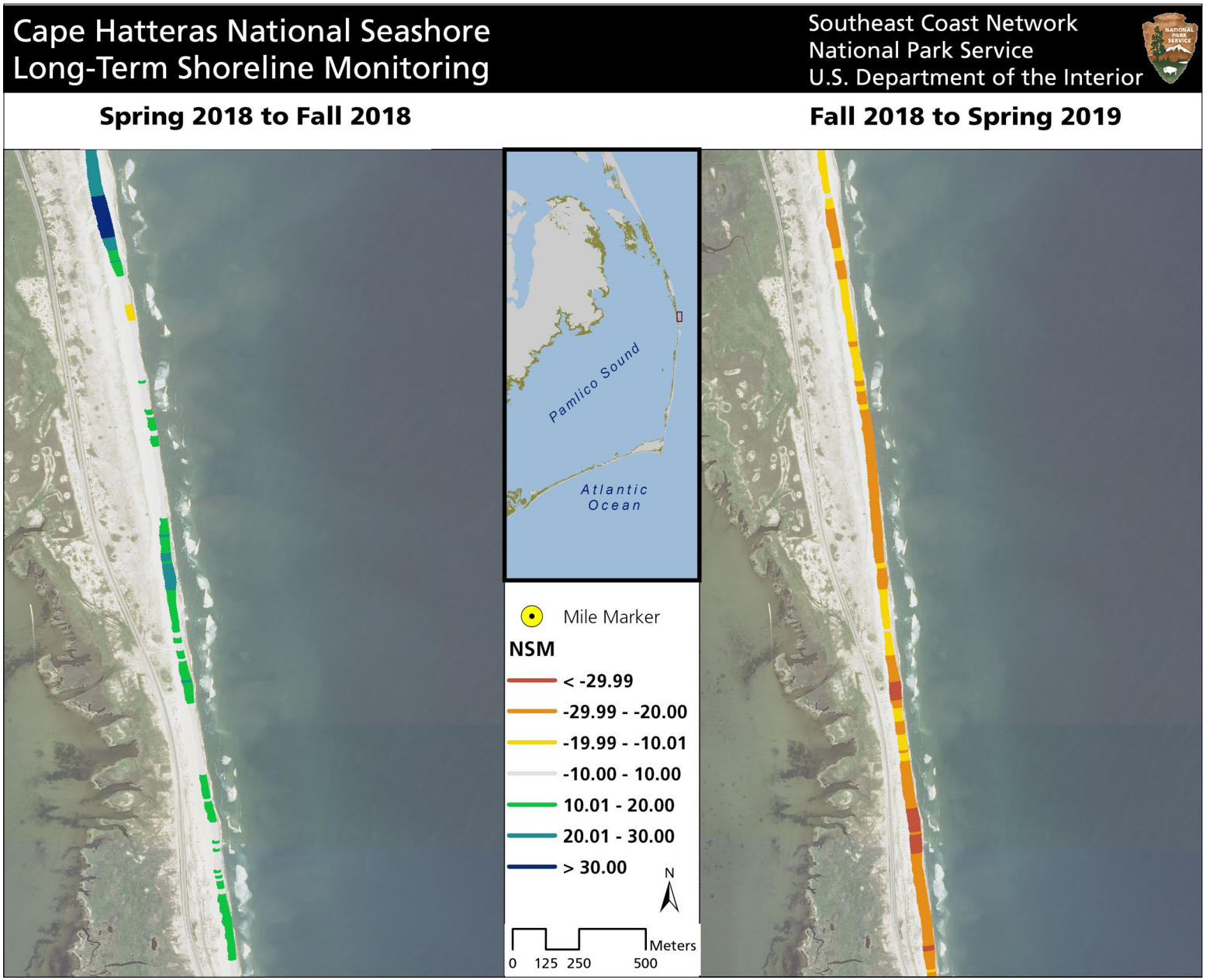


Figure B-12. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys at the north end of Hatteras Island within Pea Island National Wildlife Refuge, eighth section.

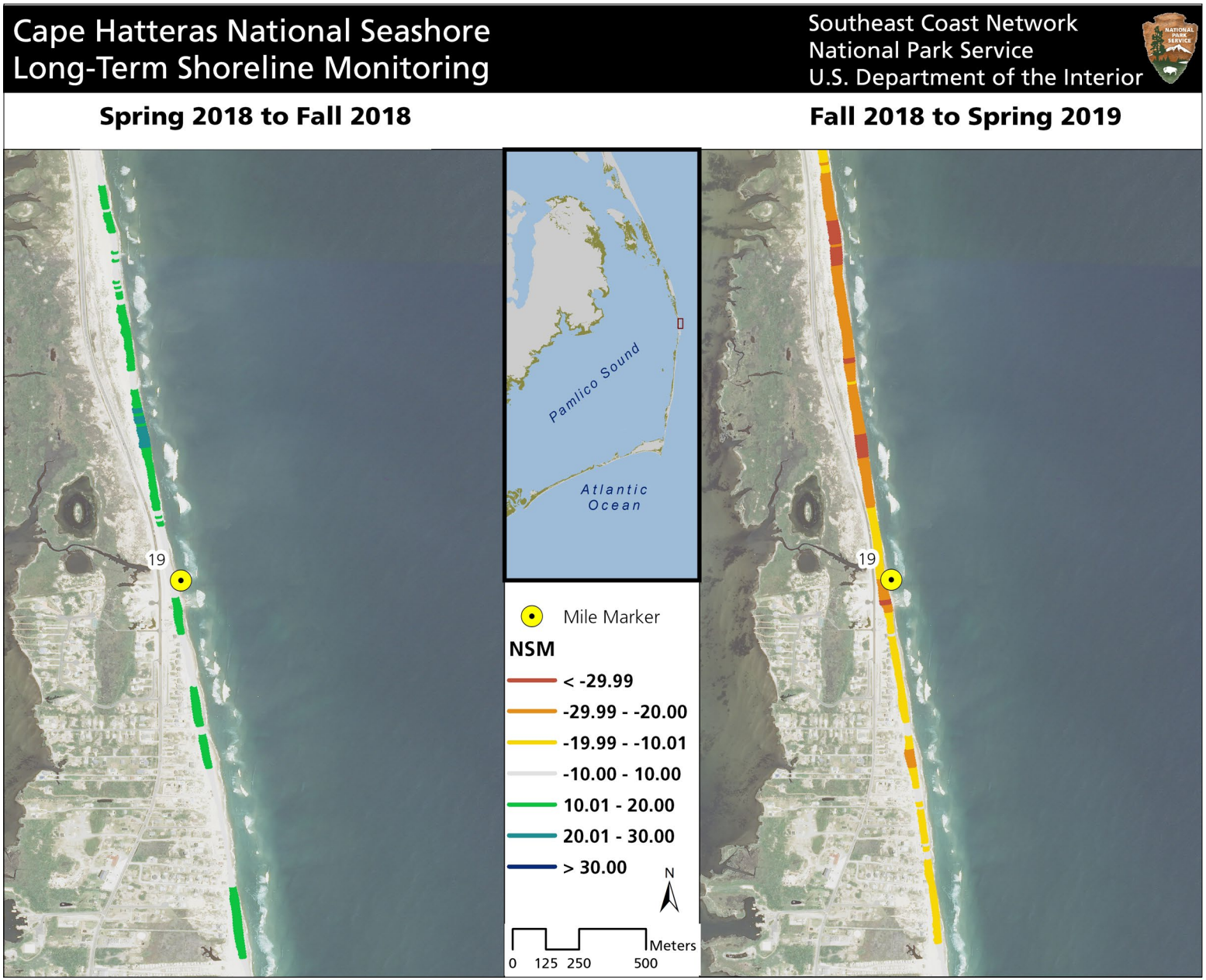


Figure B-13. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 19.

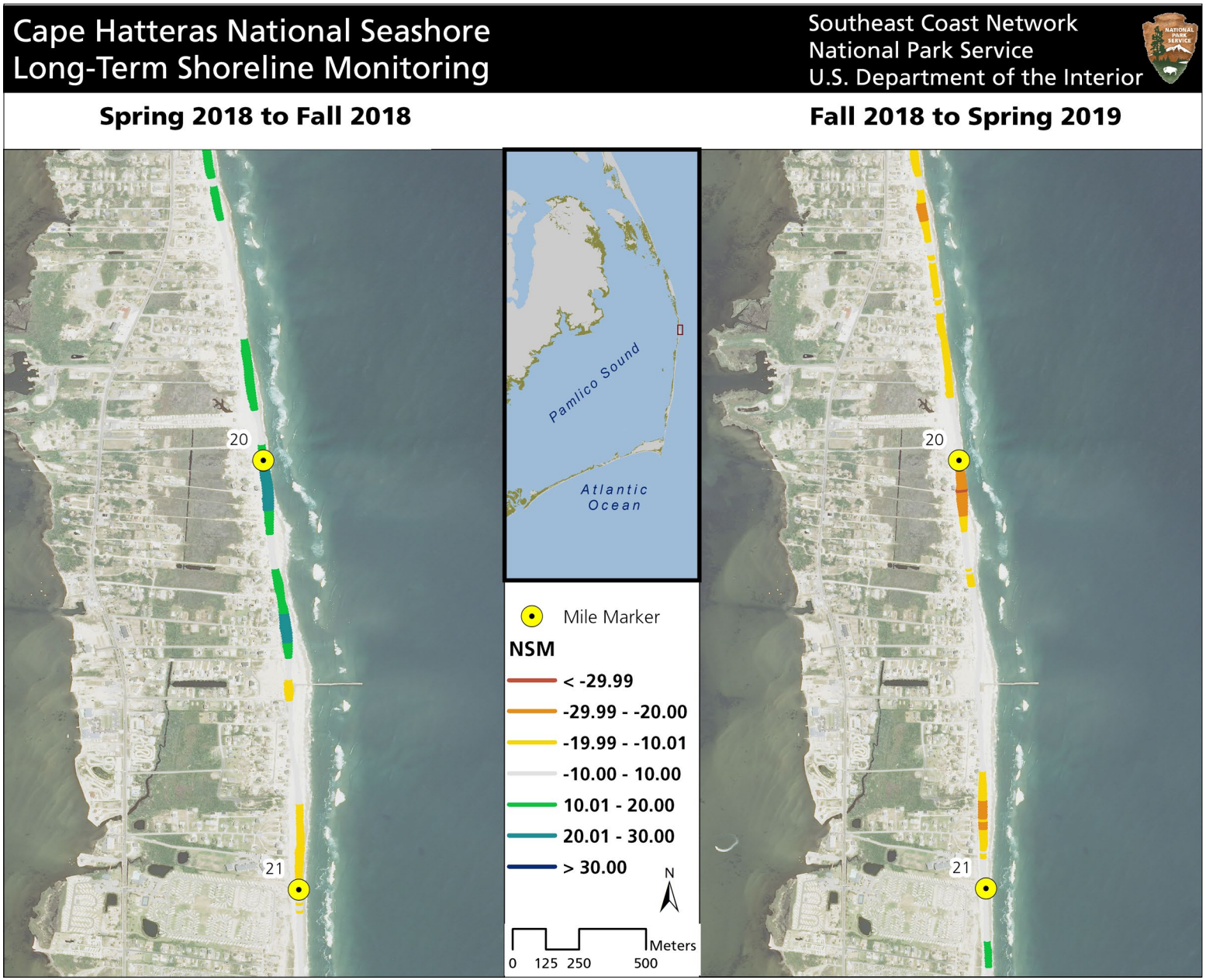


Figure B-14. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 20 and 21.

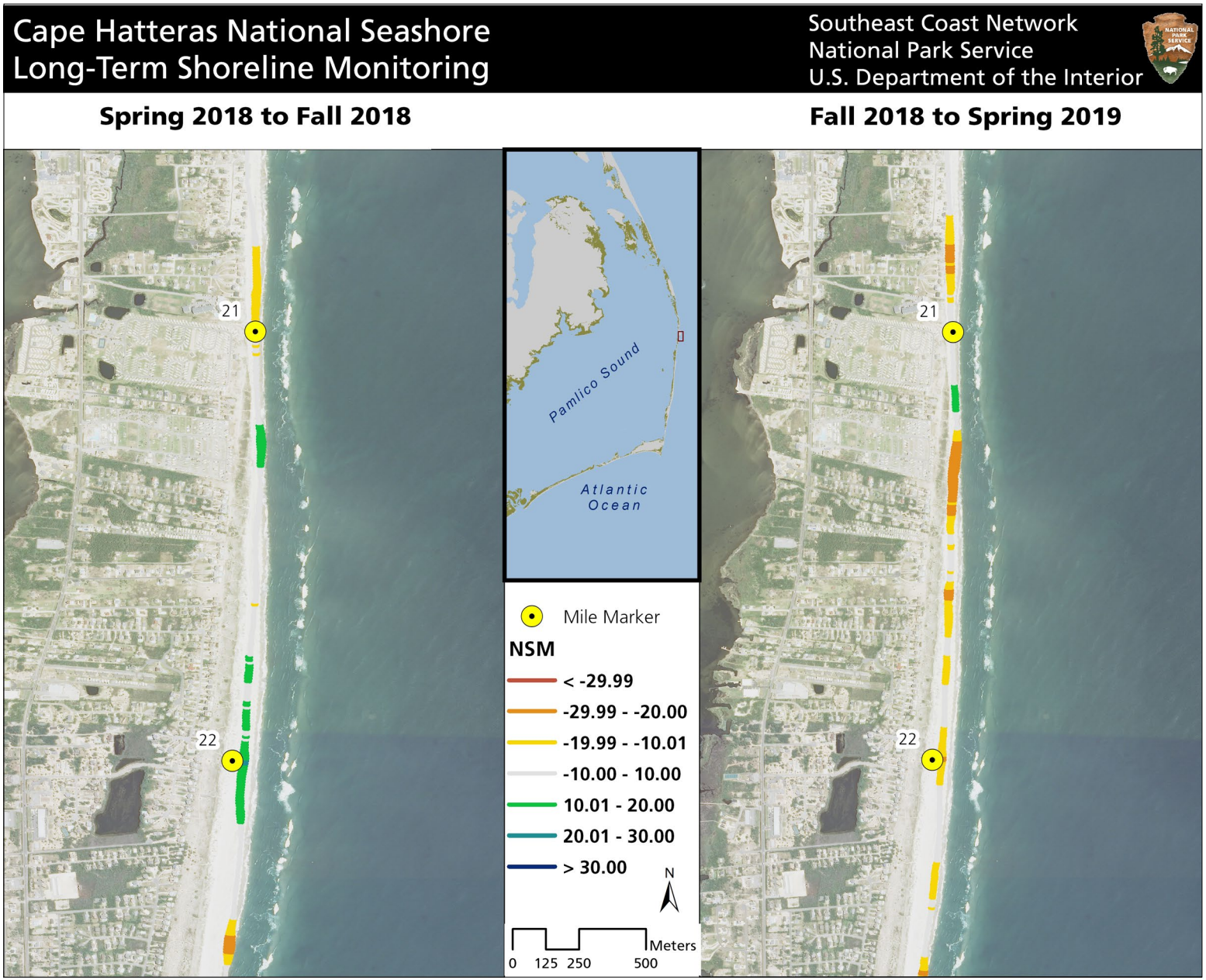


Figure B-15. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 21 and 22.

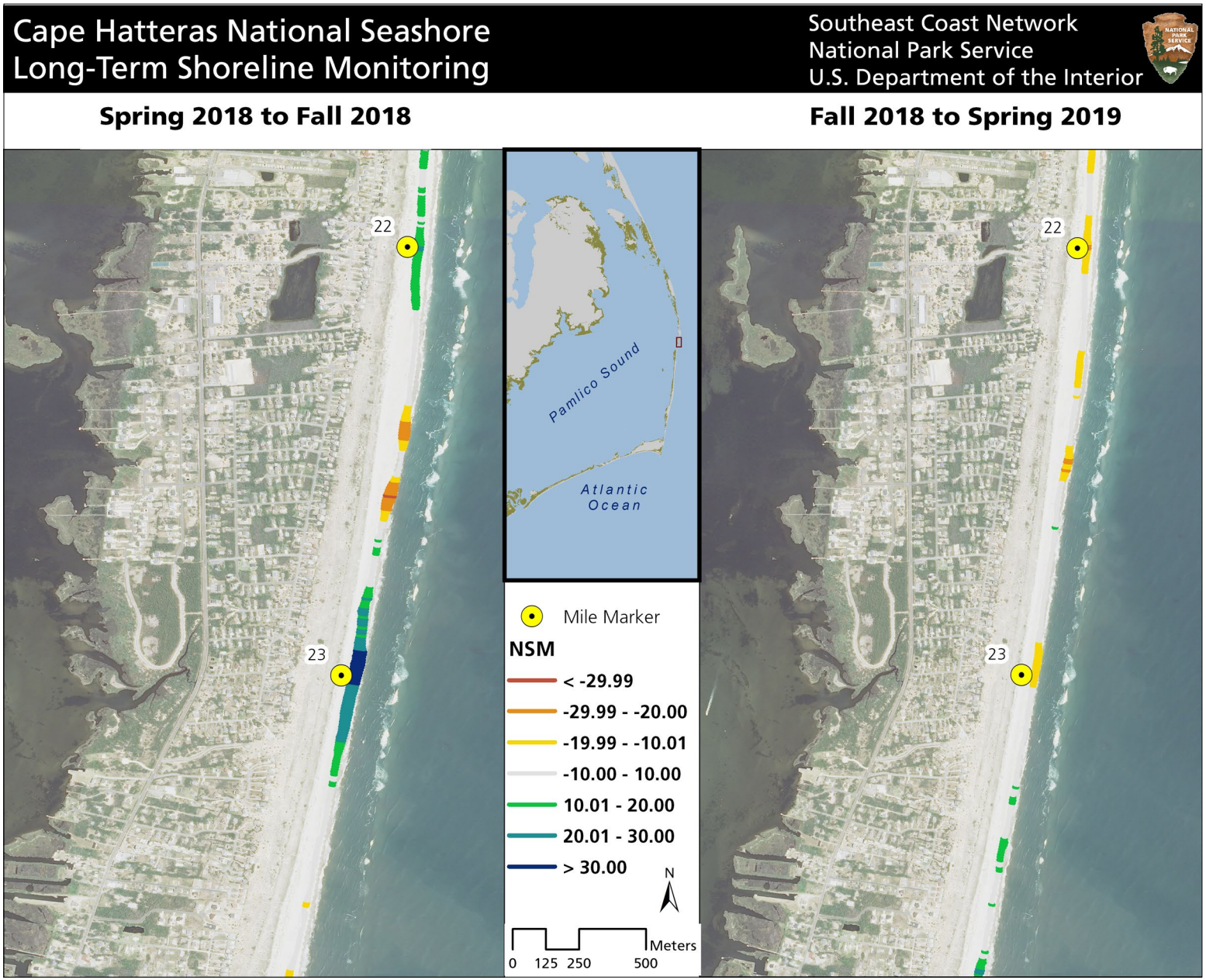


Figure B-16. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 22 and 23.

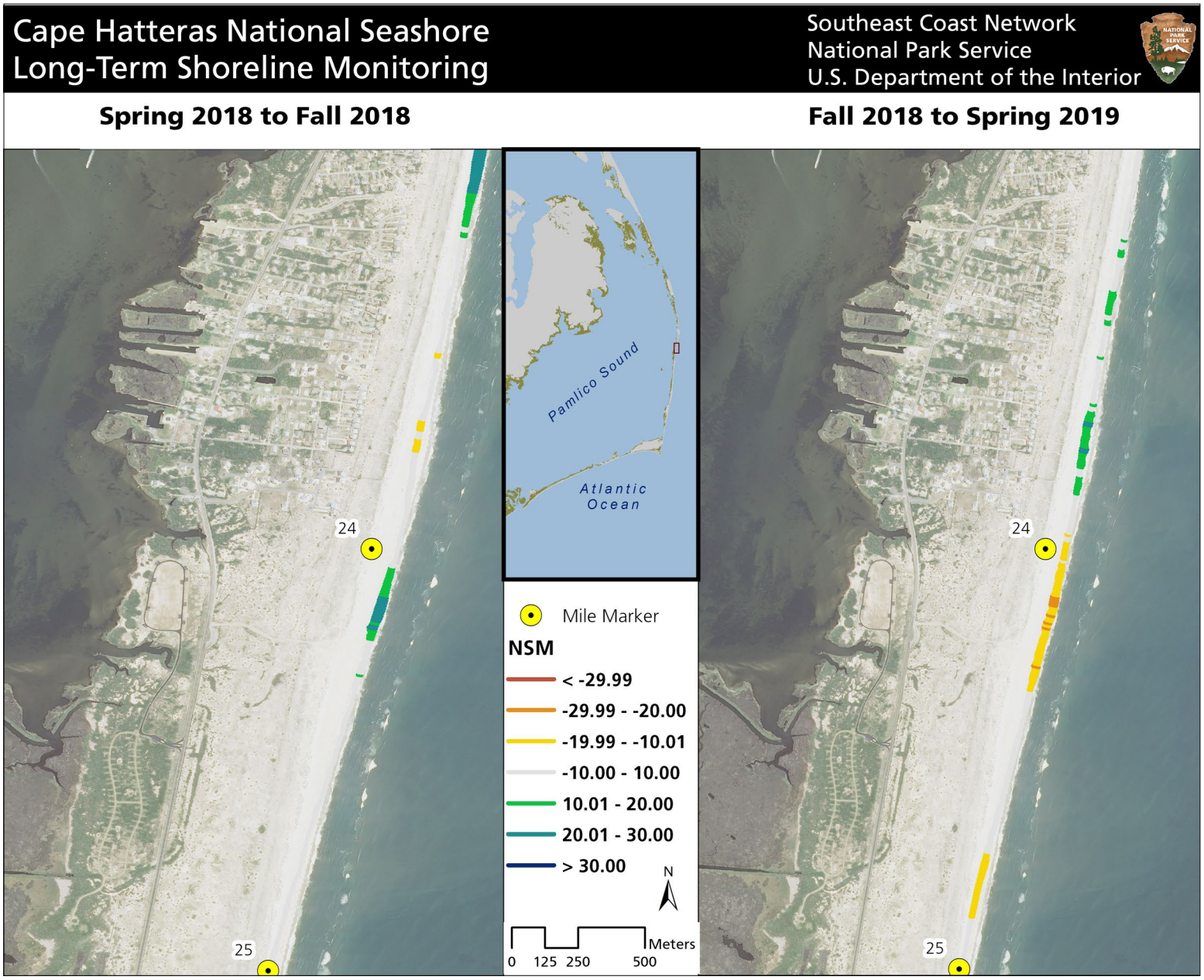


Figure B-17. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 24 and 25.

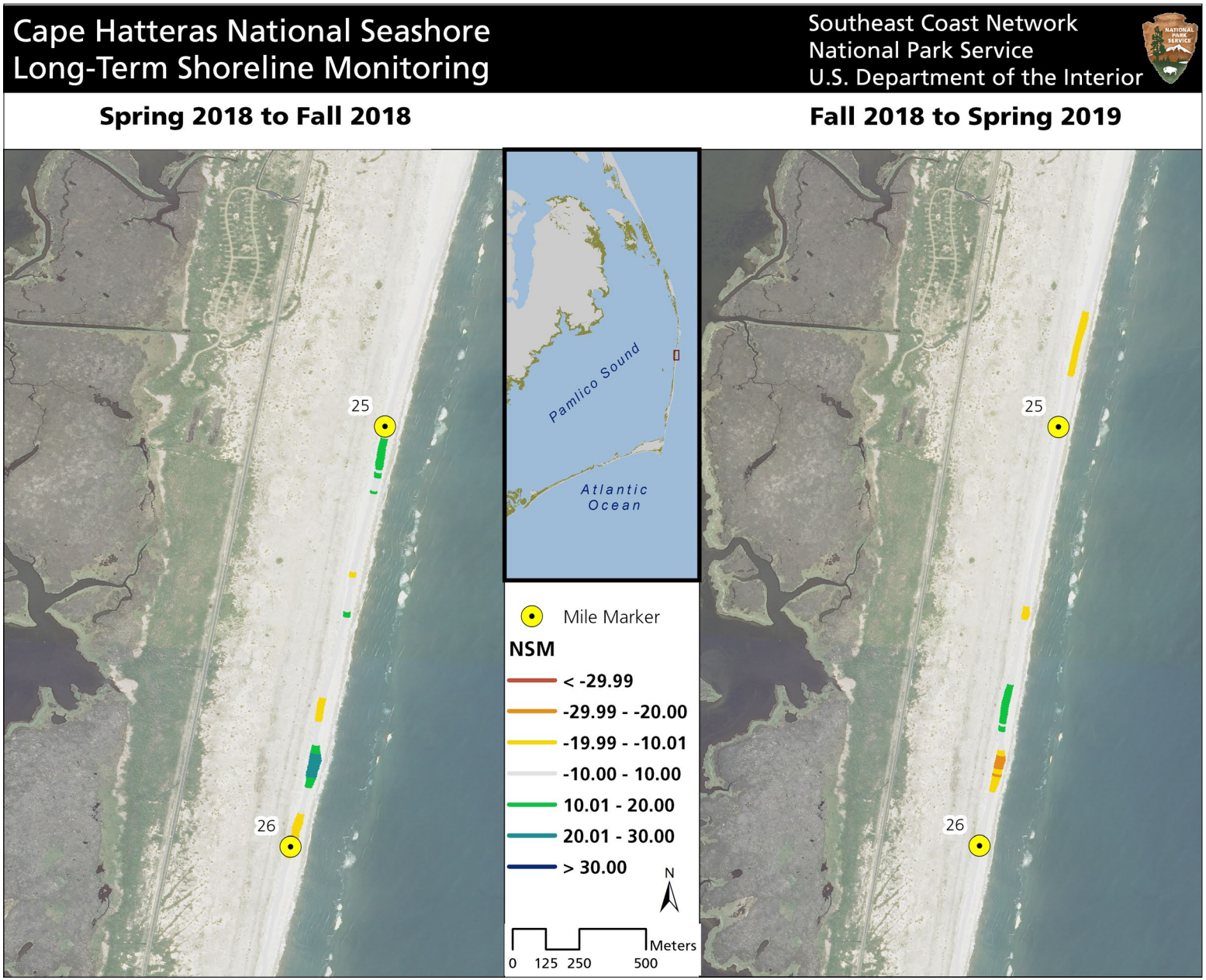


Figure B-18. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 25 and 26.

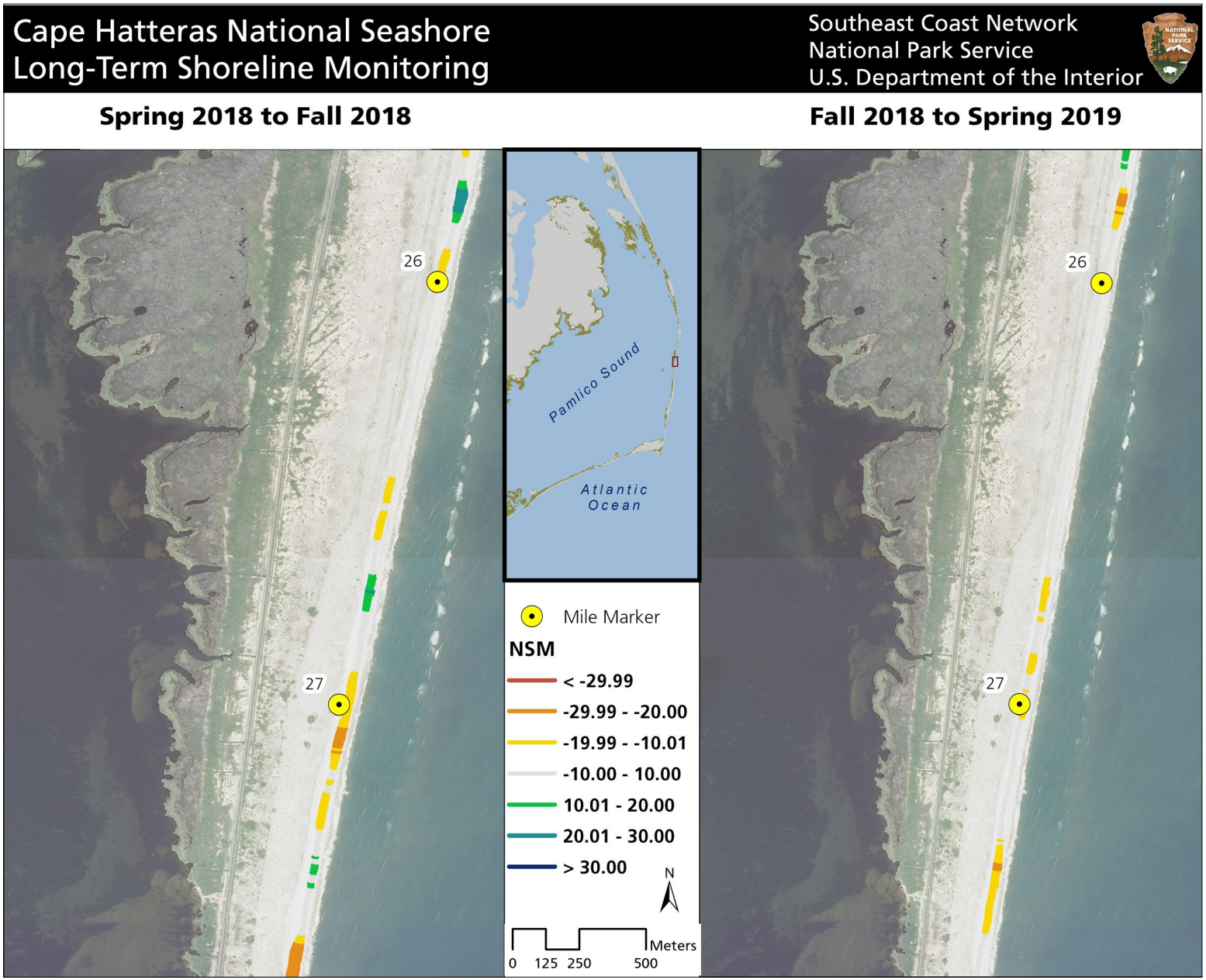


Figure B-19. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 26 and 27.

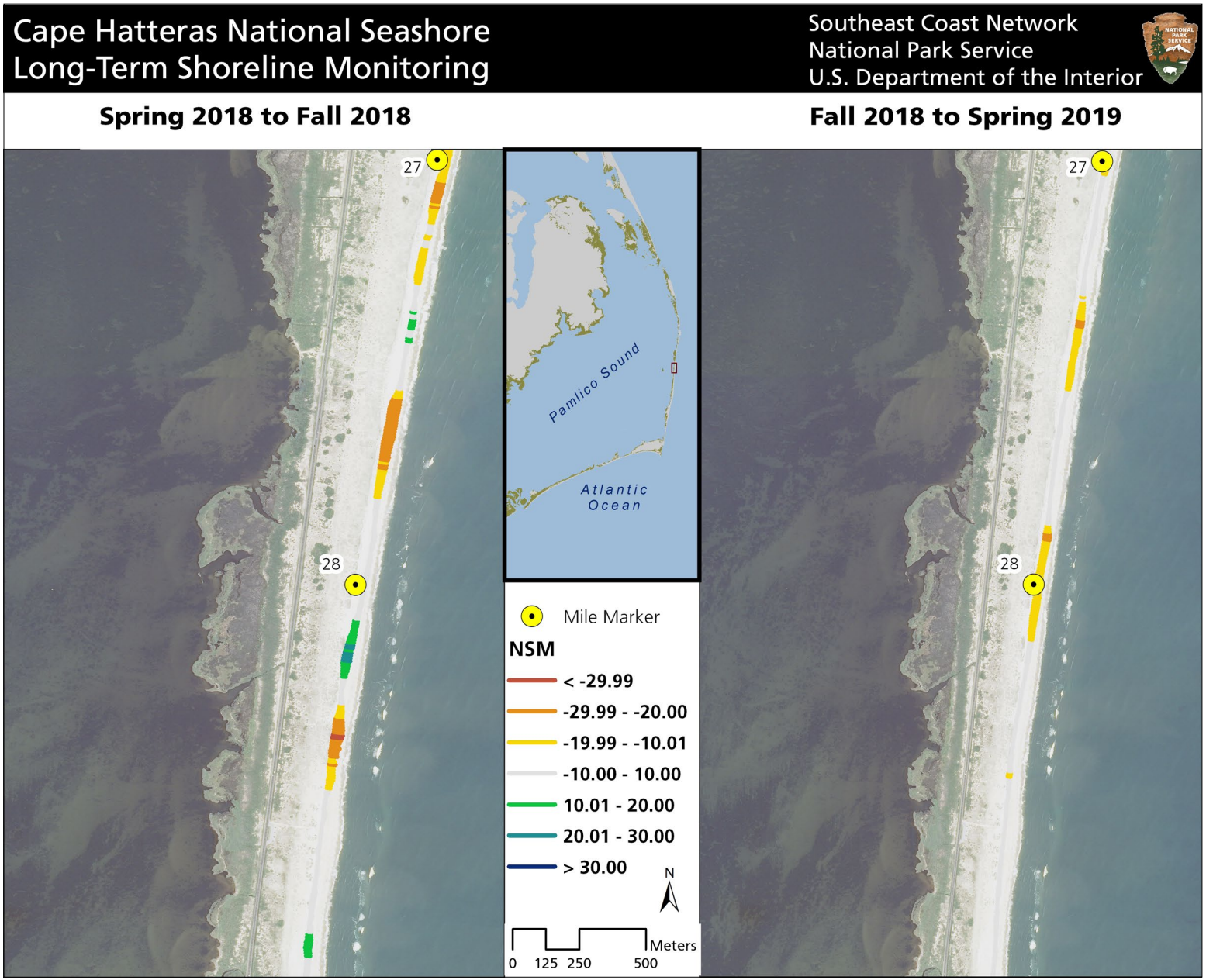


Figure B-20. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 27 and 28.

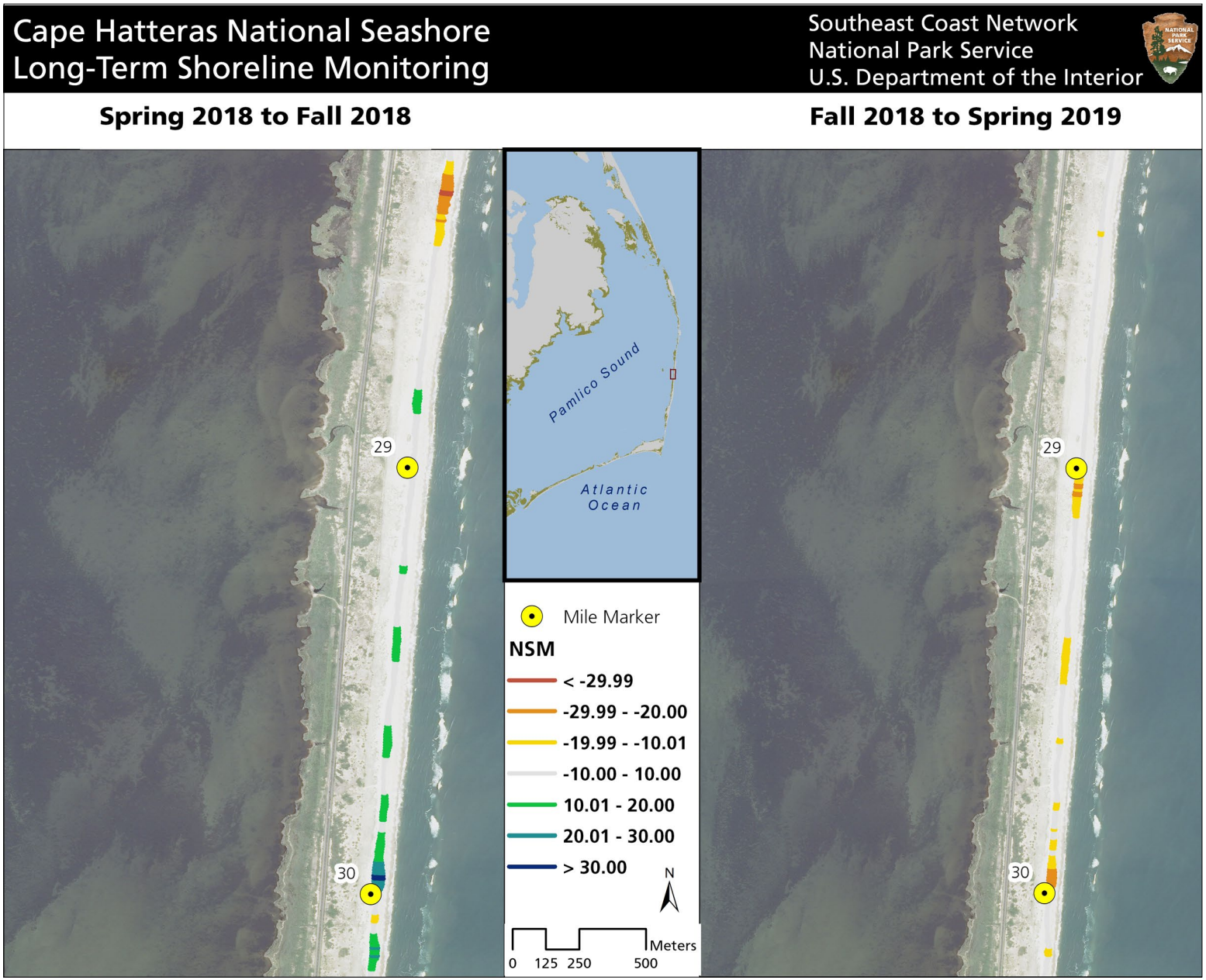


Figure B-21. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 29 and 30.

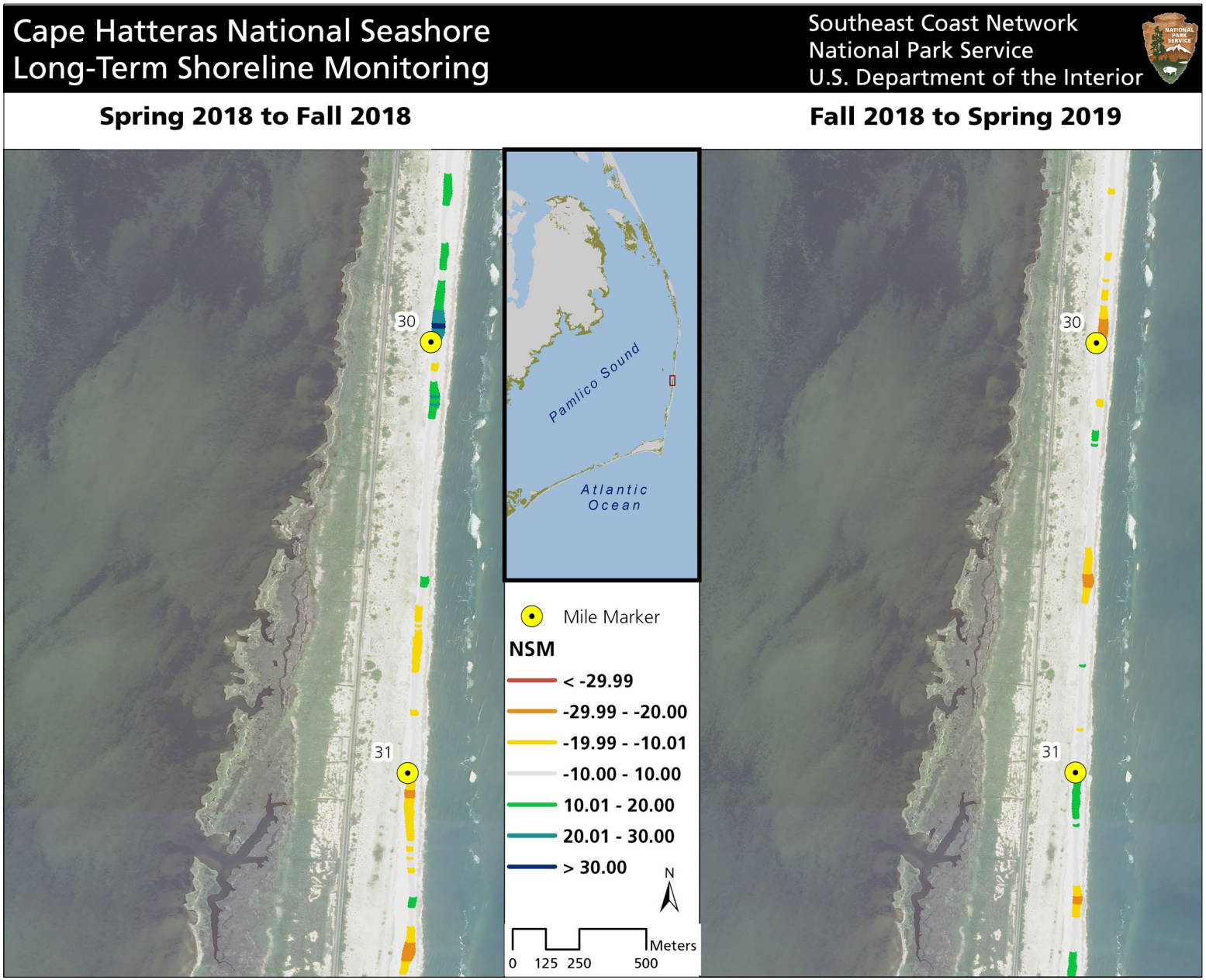


Figure B-22. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 30 and 31.

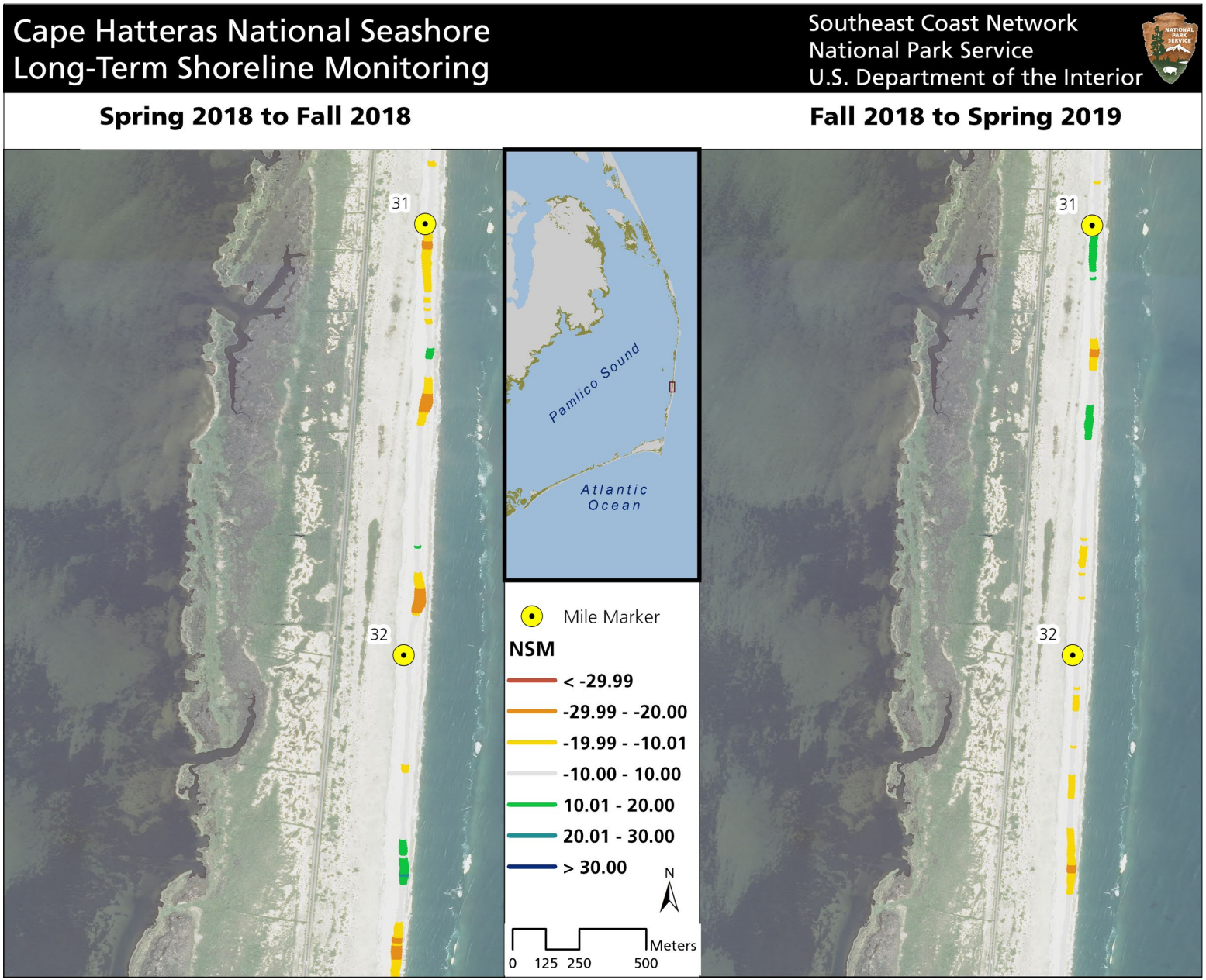


Figure B-23. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 31 and 32.

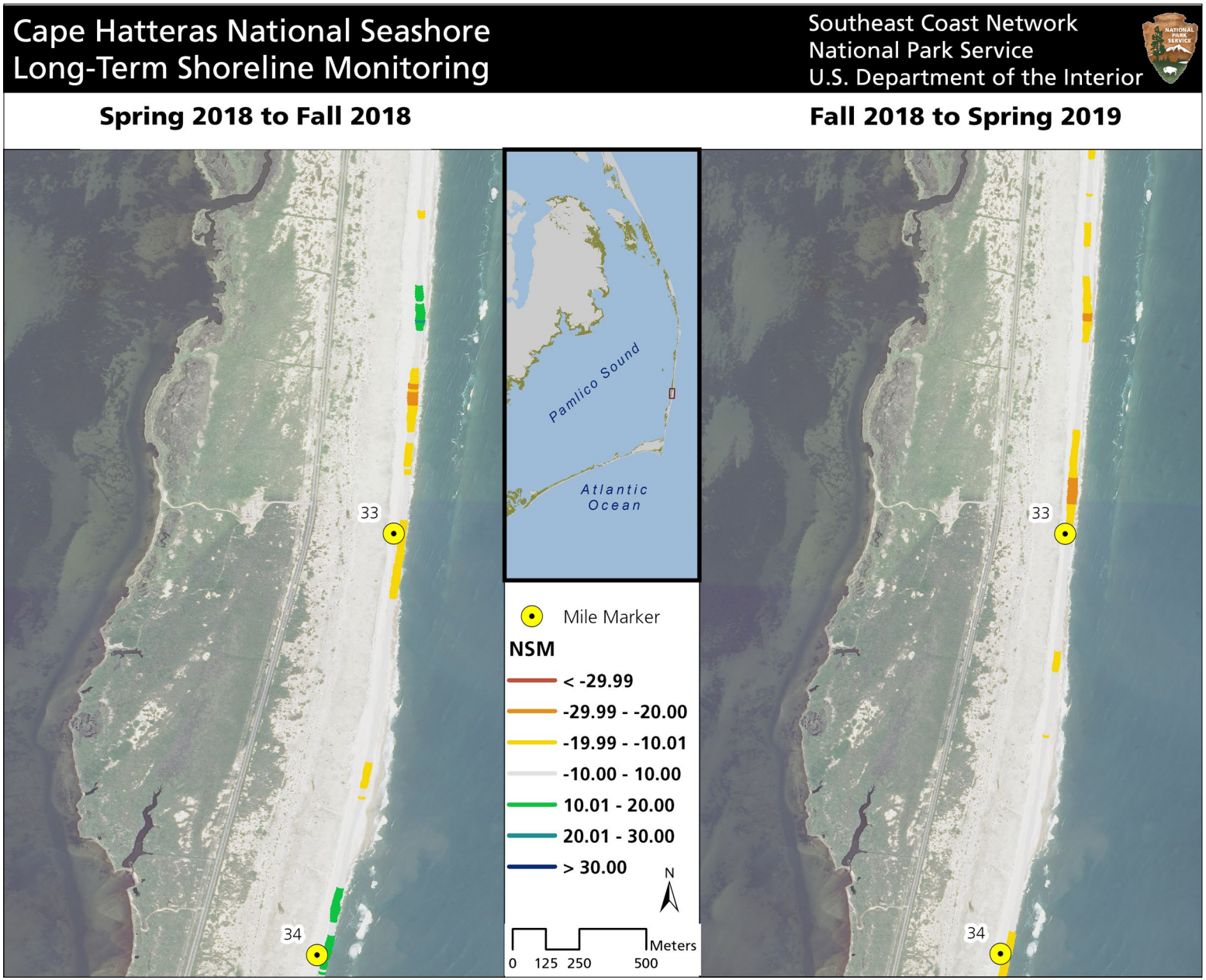


Figure B-24. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 33 and 34.

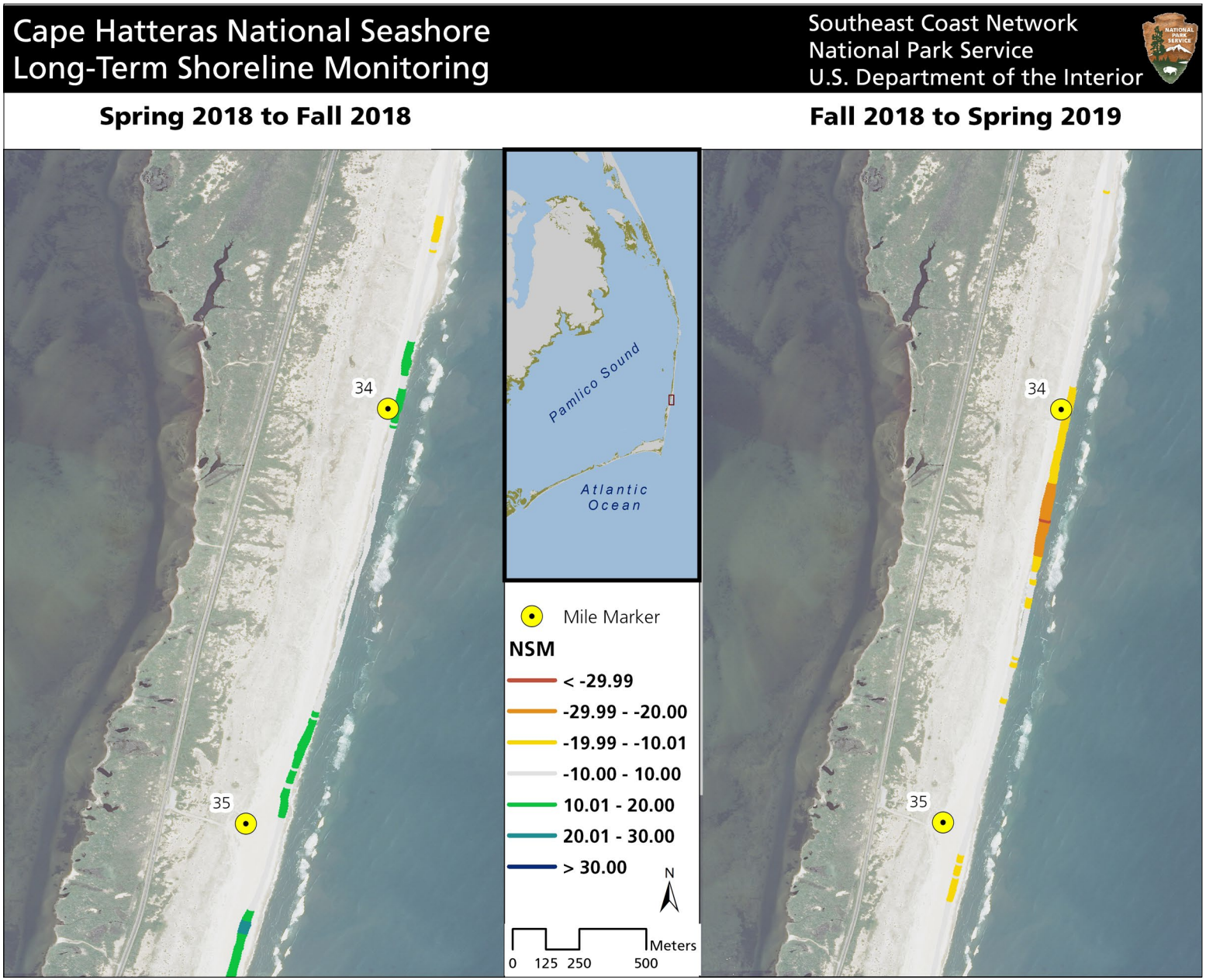


Figure B-25. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 34 and 35.

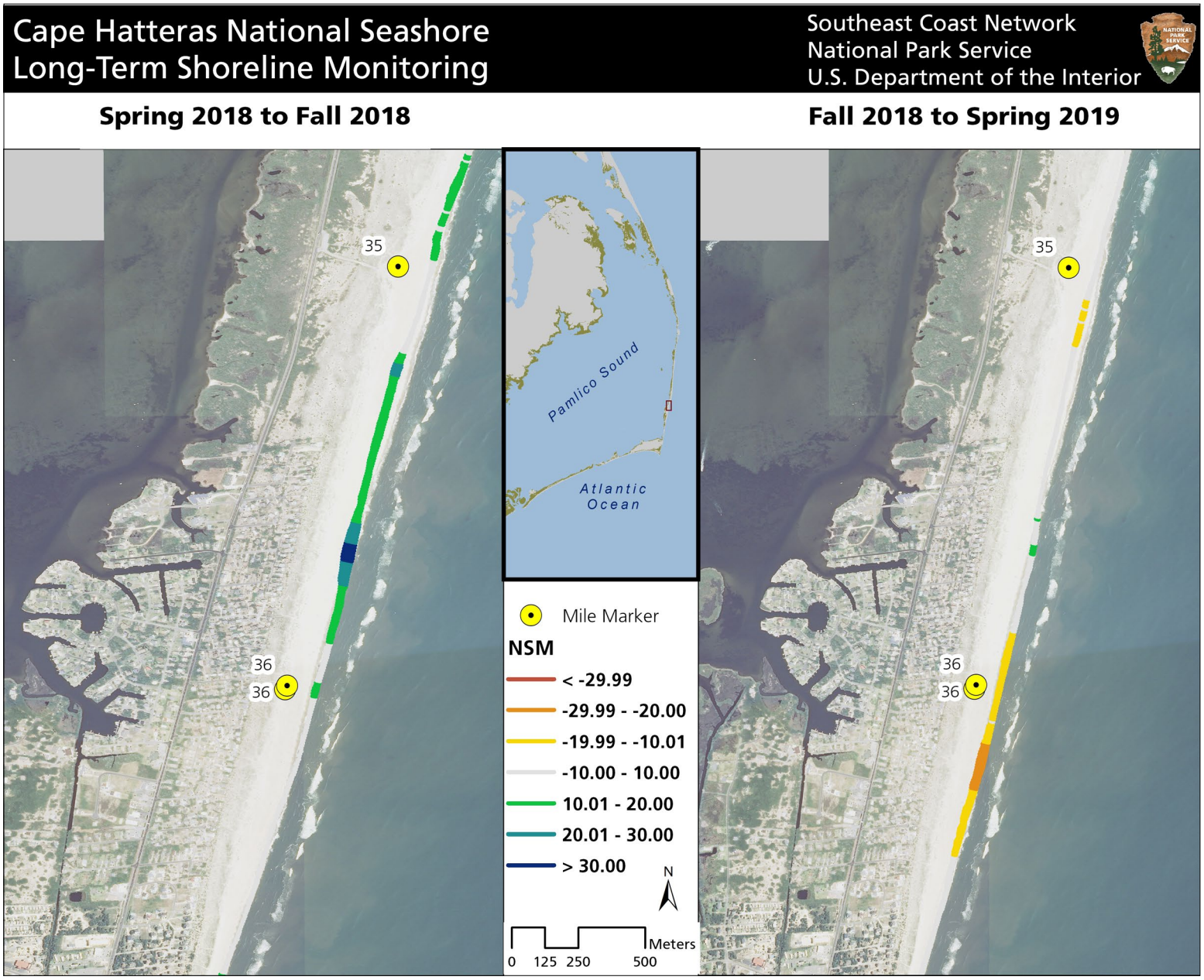


Figure B-26. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 35 and 36.

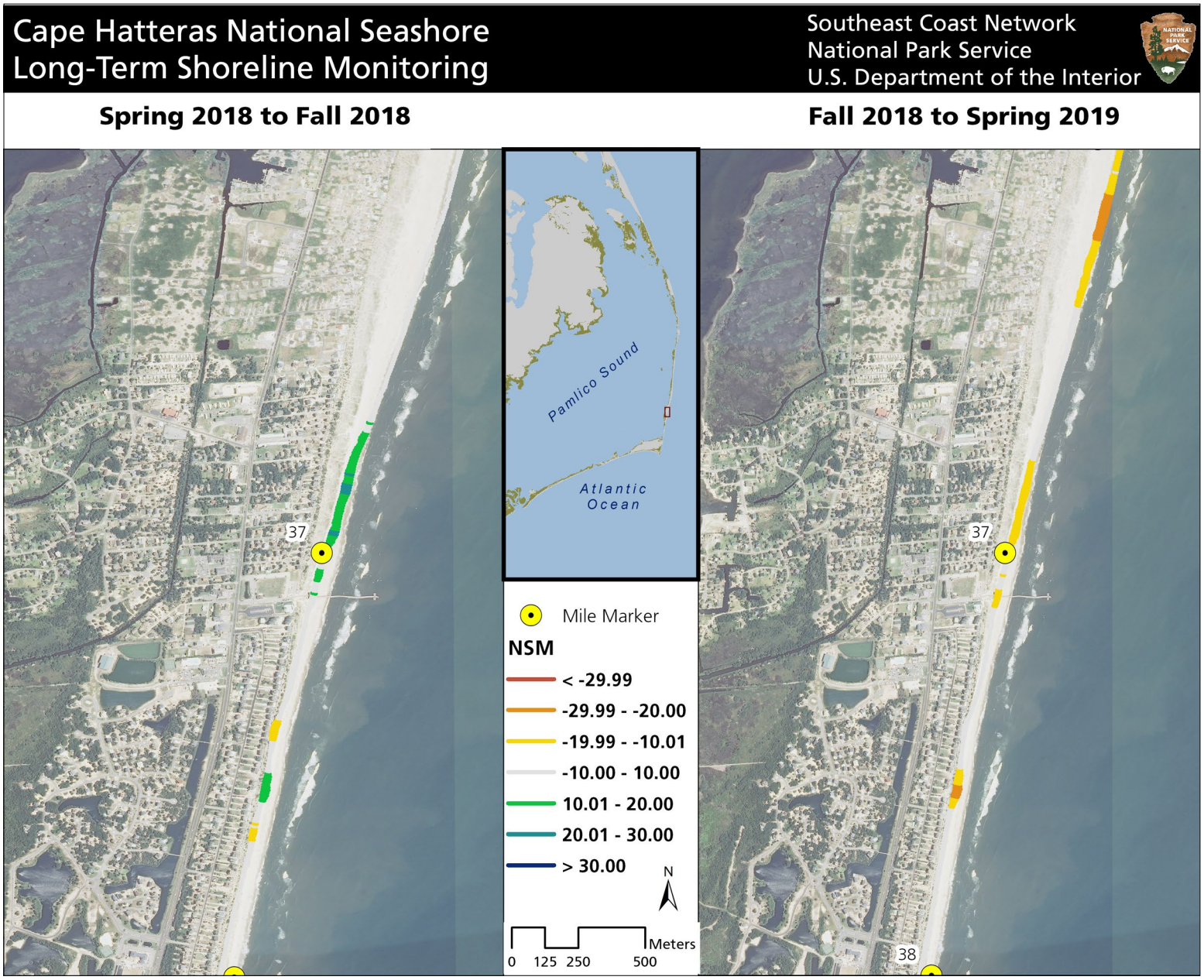


Figure B-27. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 37.

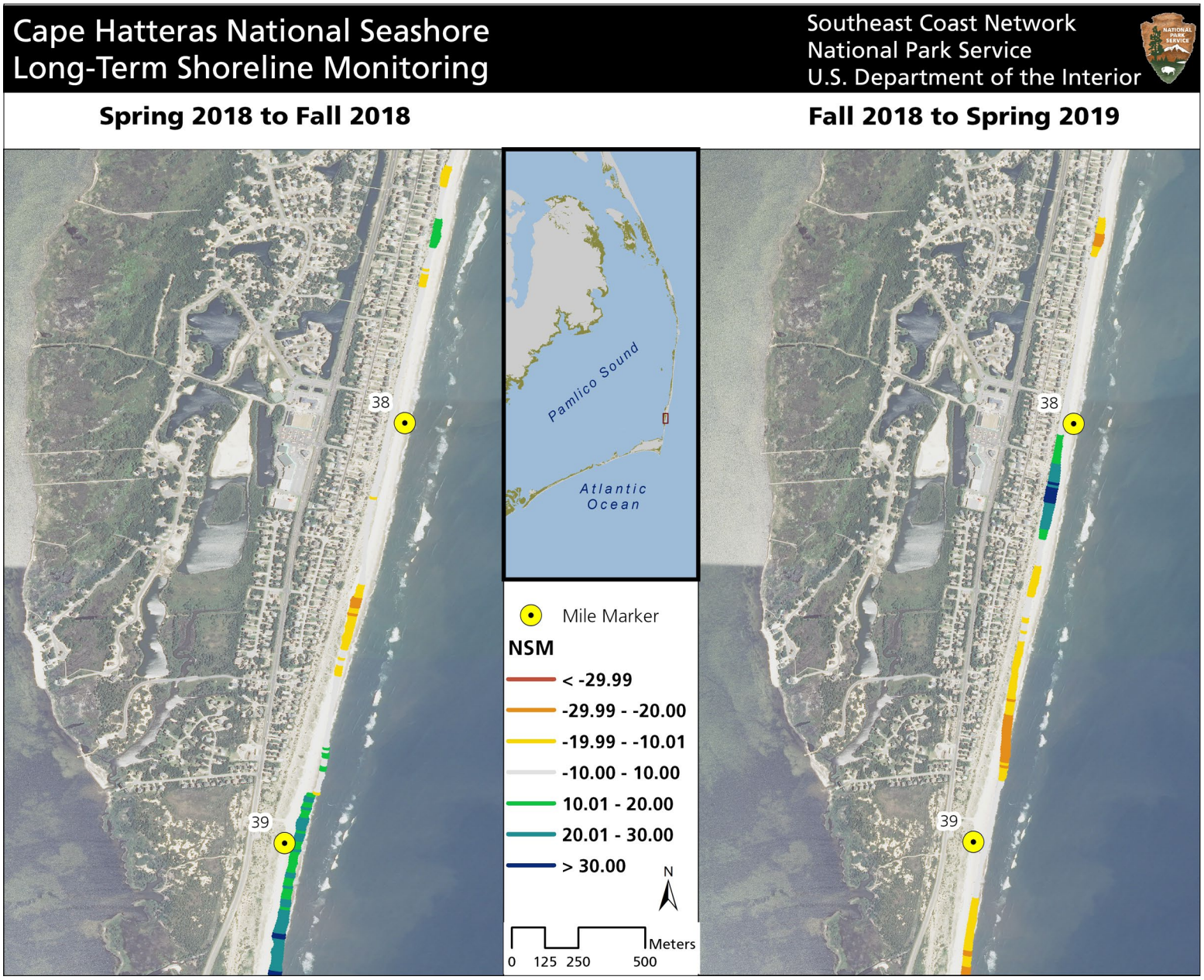


Figure B-28. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 38 and 39.

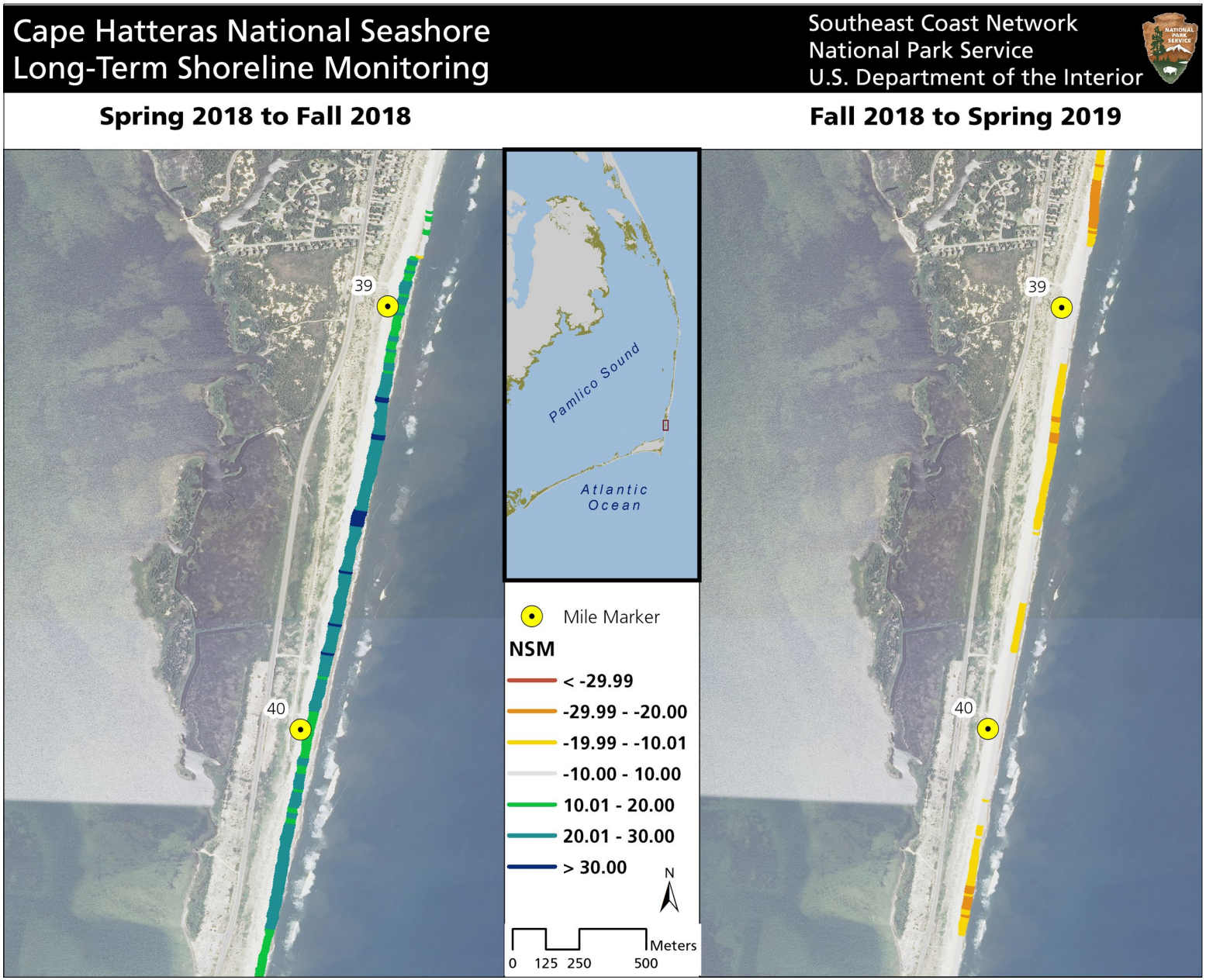


Figure B-29. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 39 and 40.

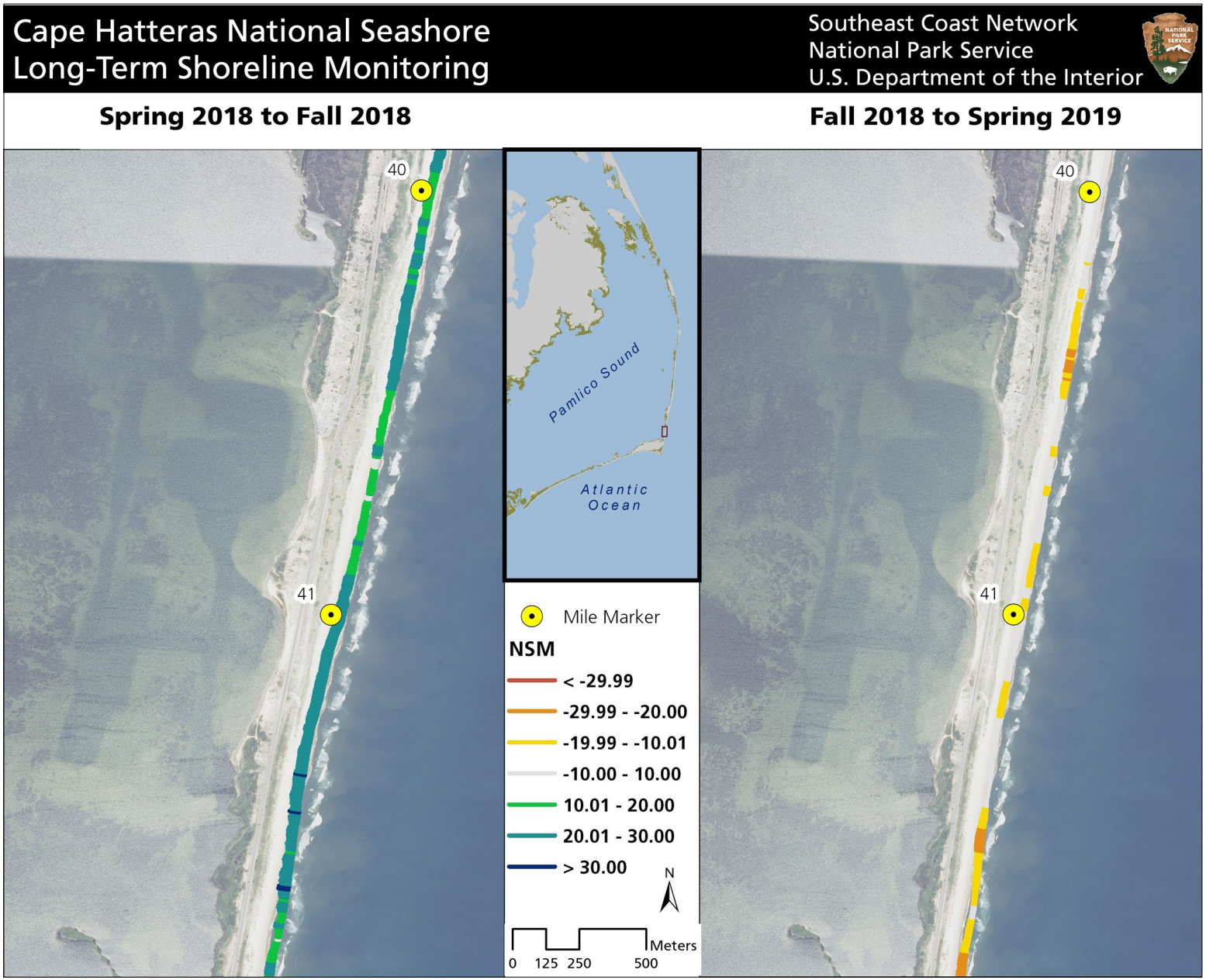


Figure B-30. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 40 and 41.

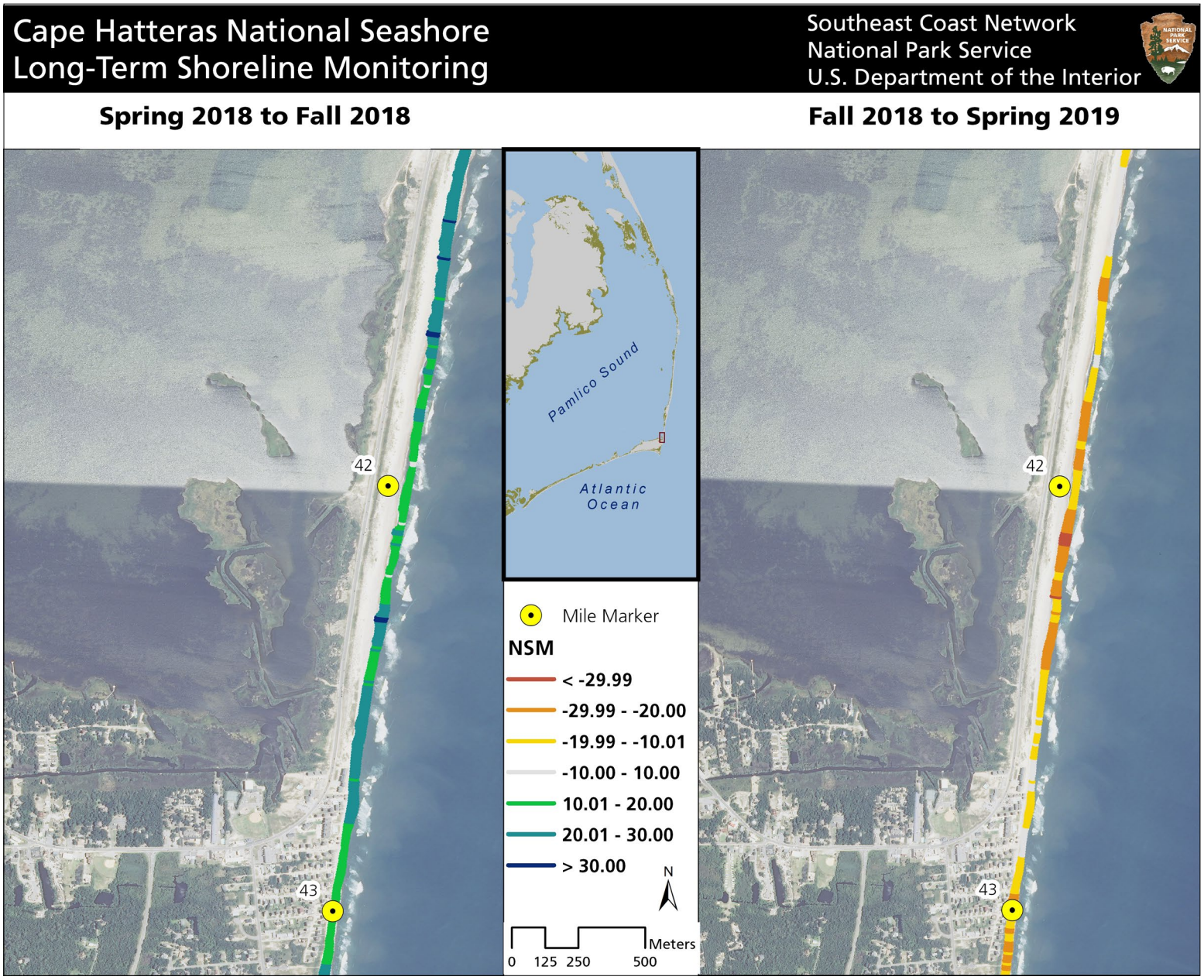


Figure B-31. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 42 and 43.

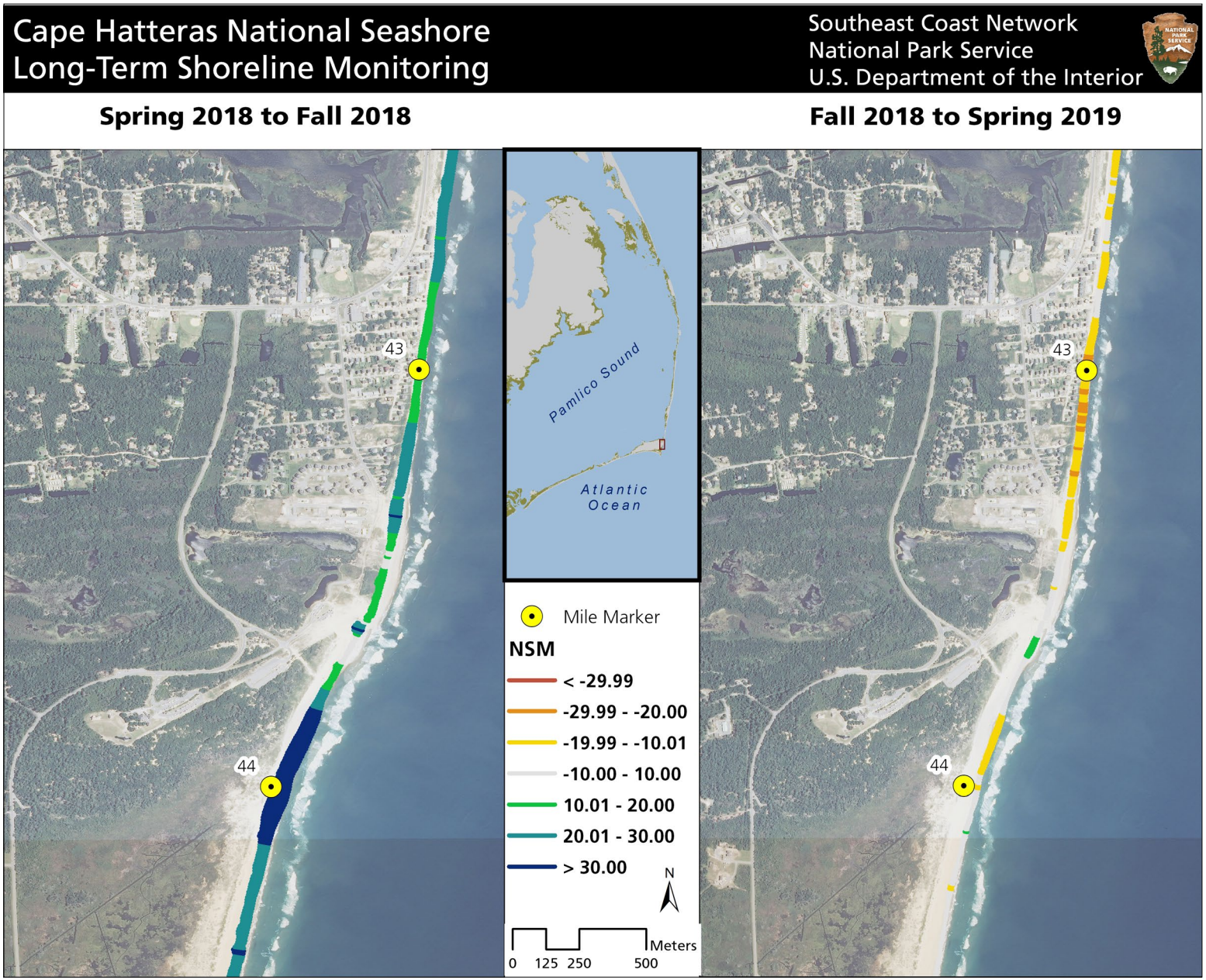


Figure B-32. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 43 and 44.

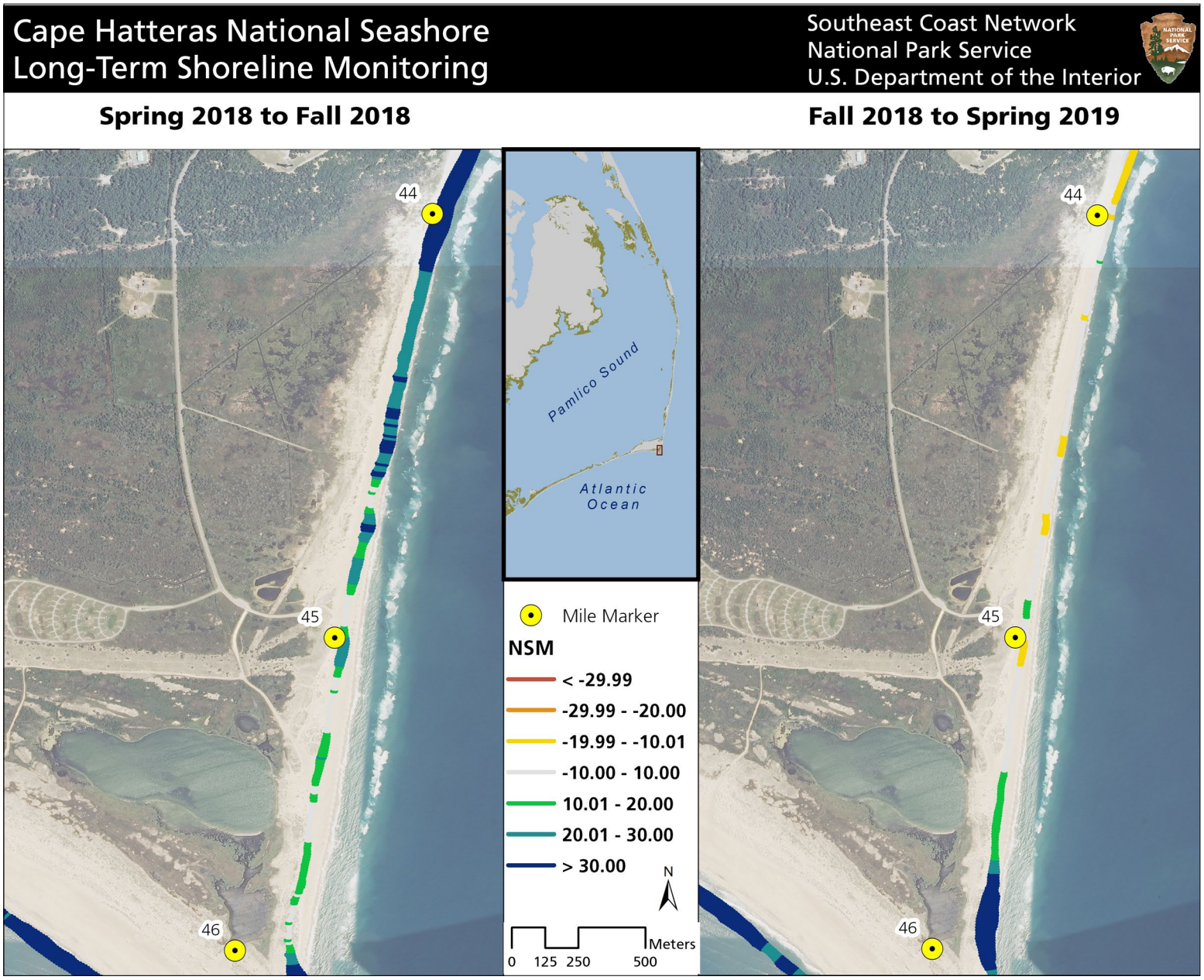


Figure B-33. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 44 through 46.

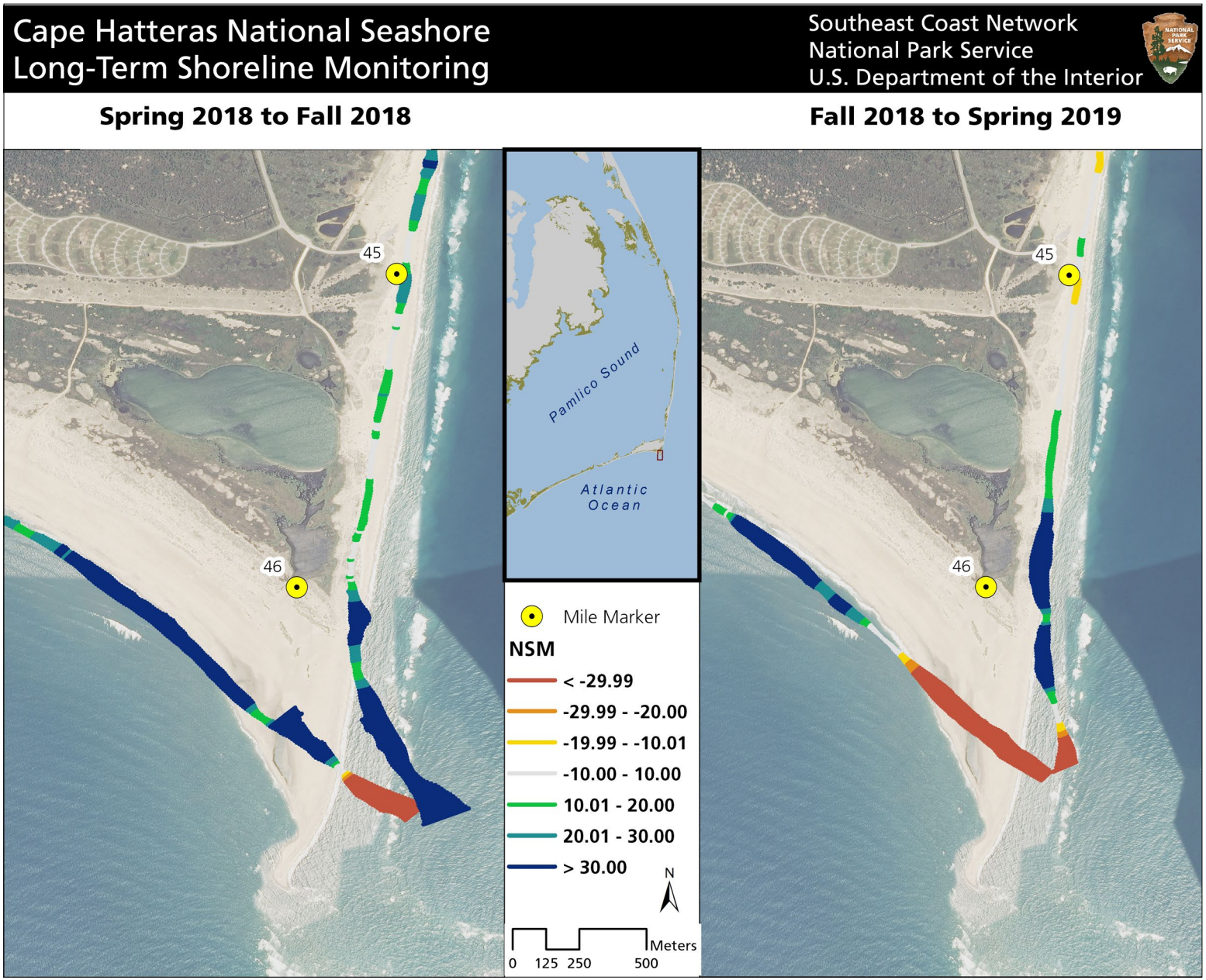


Figure B-34. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 45 and 46.

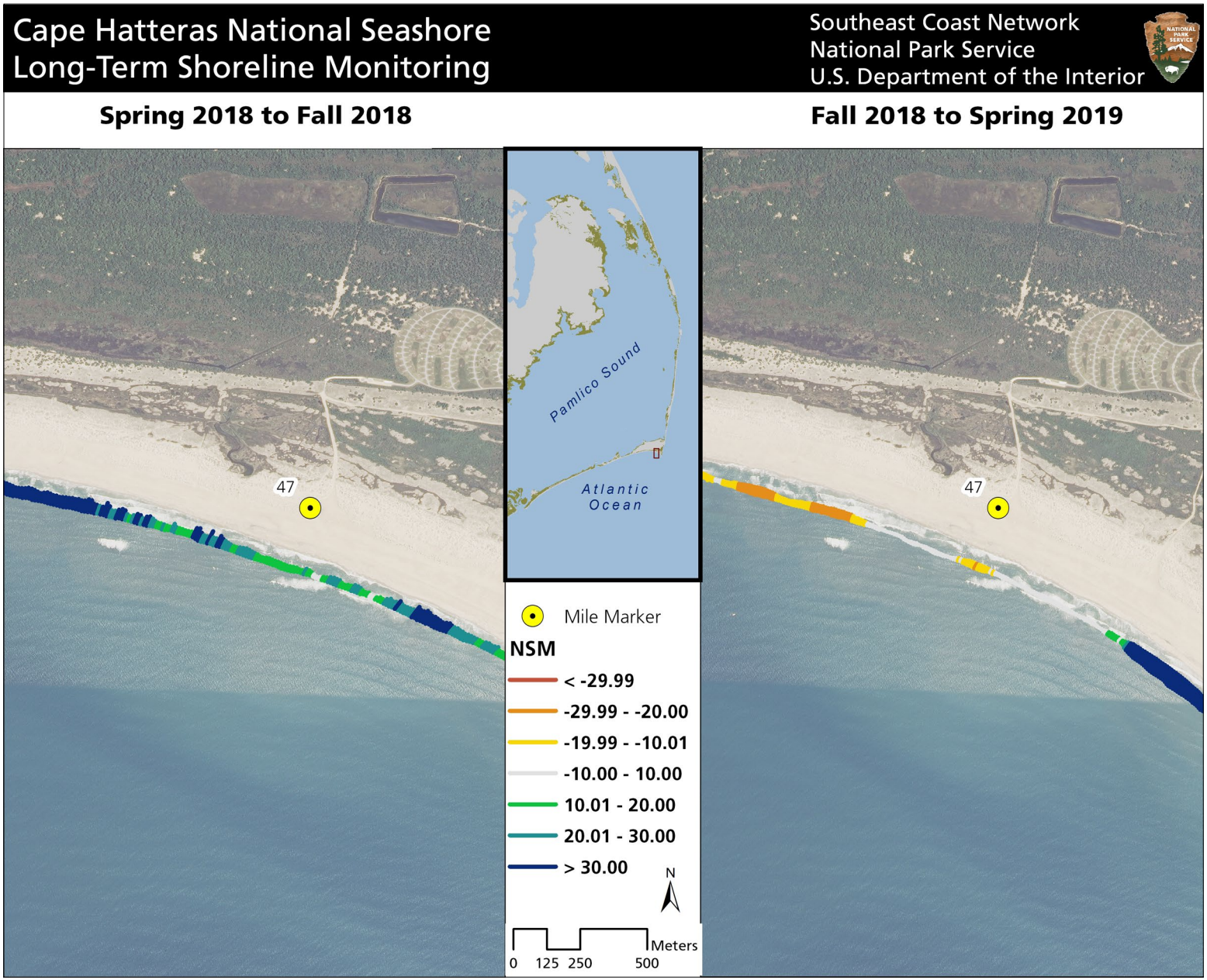


Figure B-35. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 47.

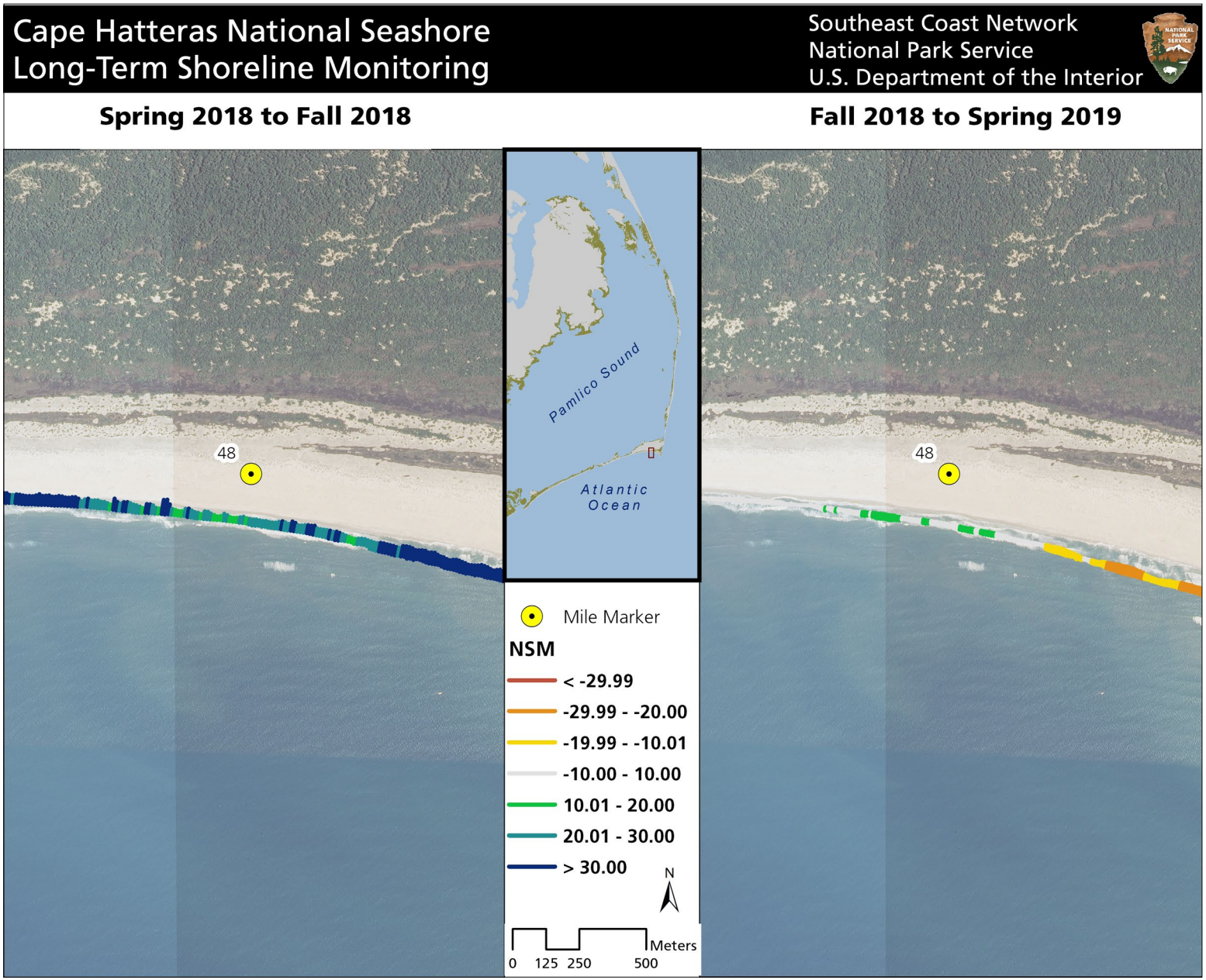


Figure B-36. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 48.

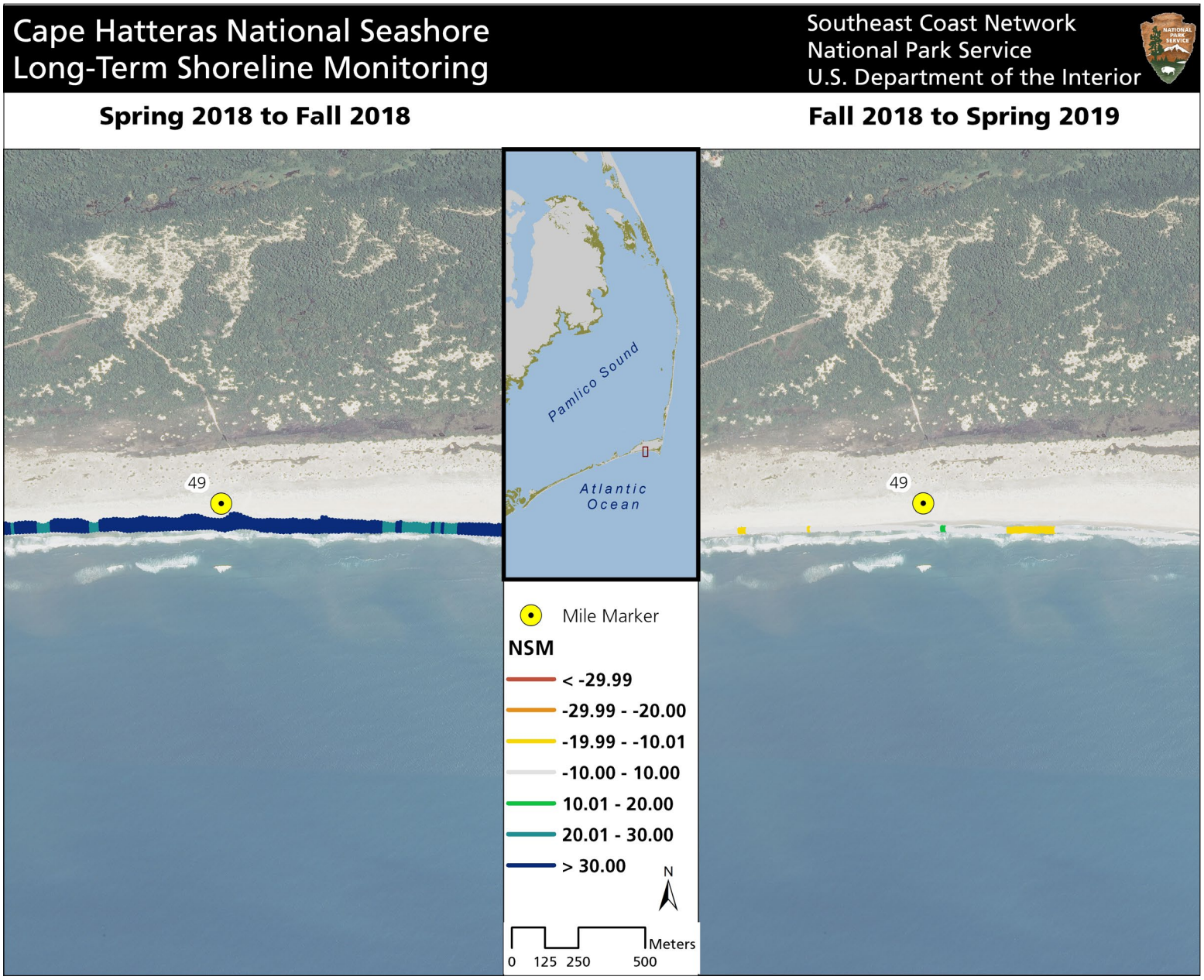


Figure B-37. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 49.

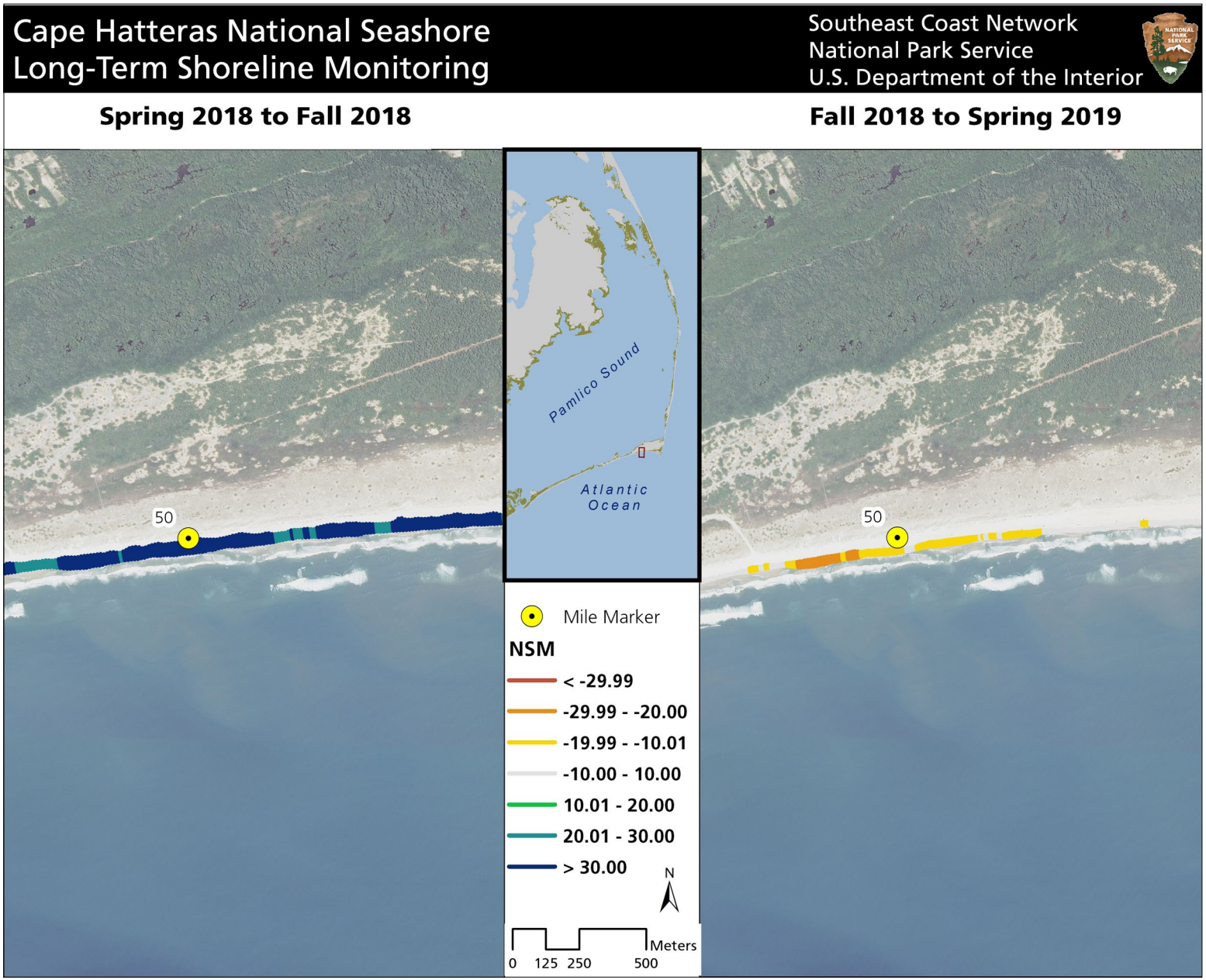


Figure B-38. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 50.

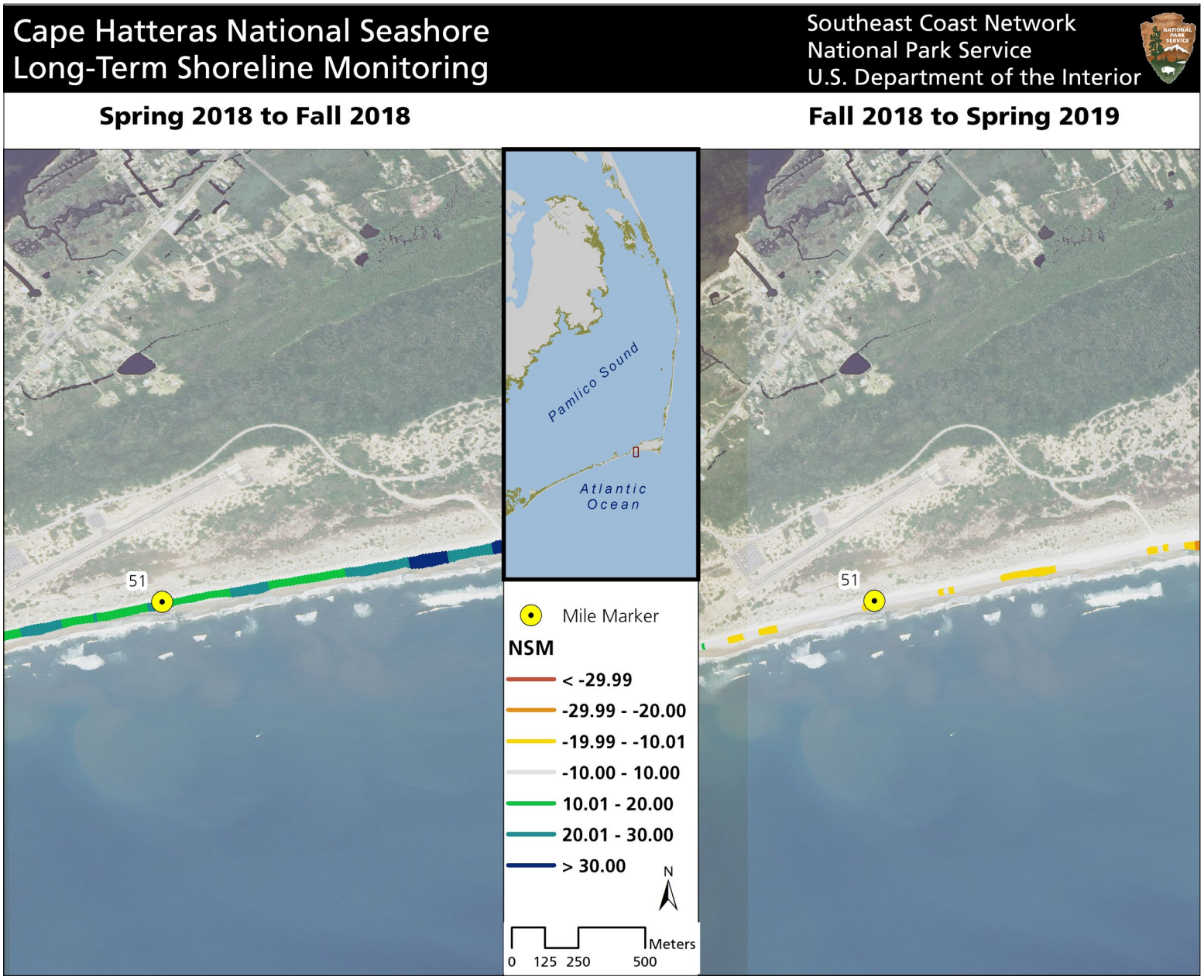


Figure B-39. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 51.

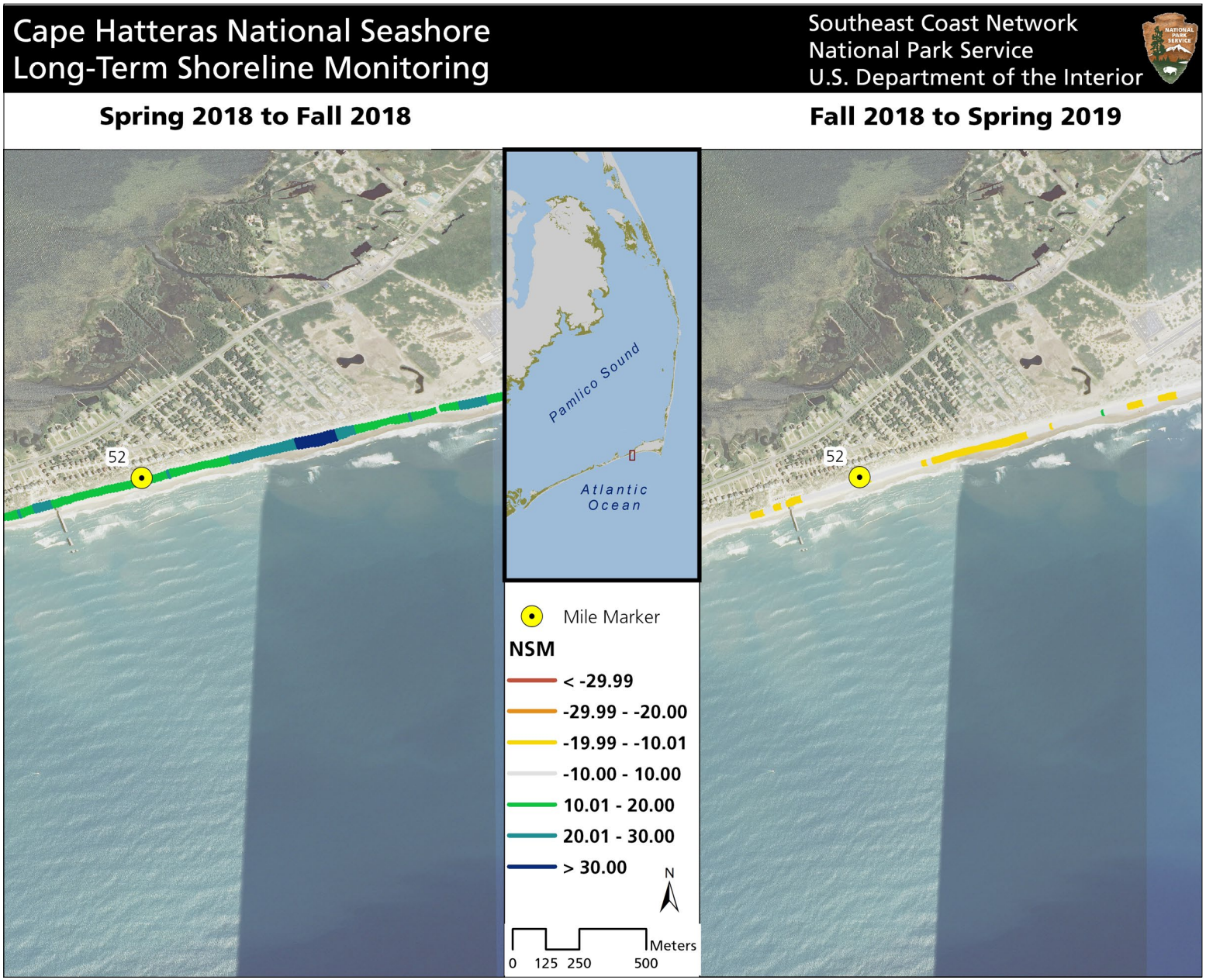


Figure B-40. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 52.

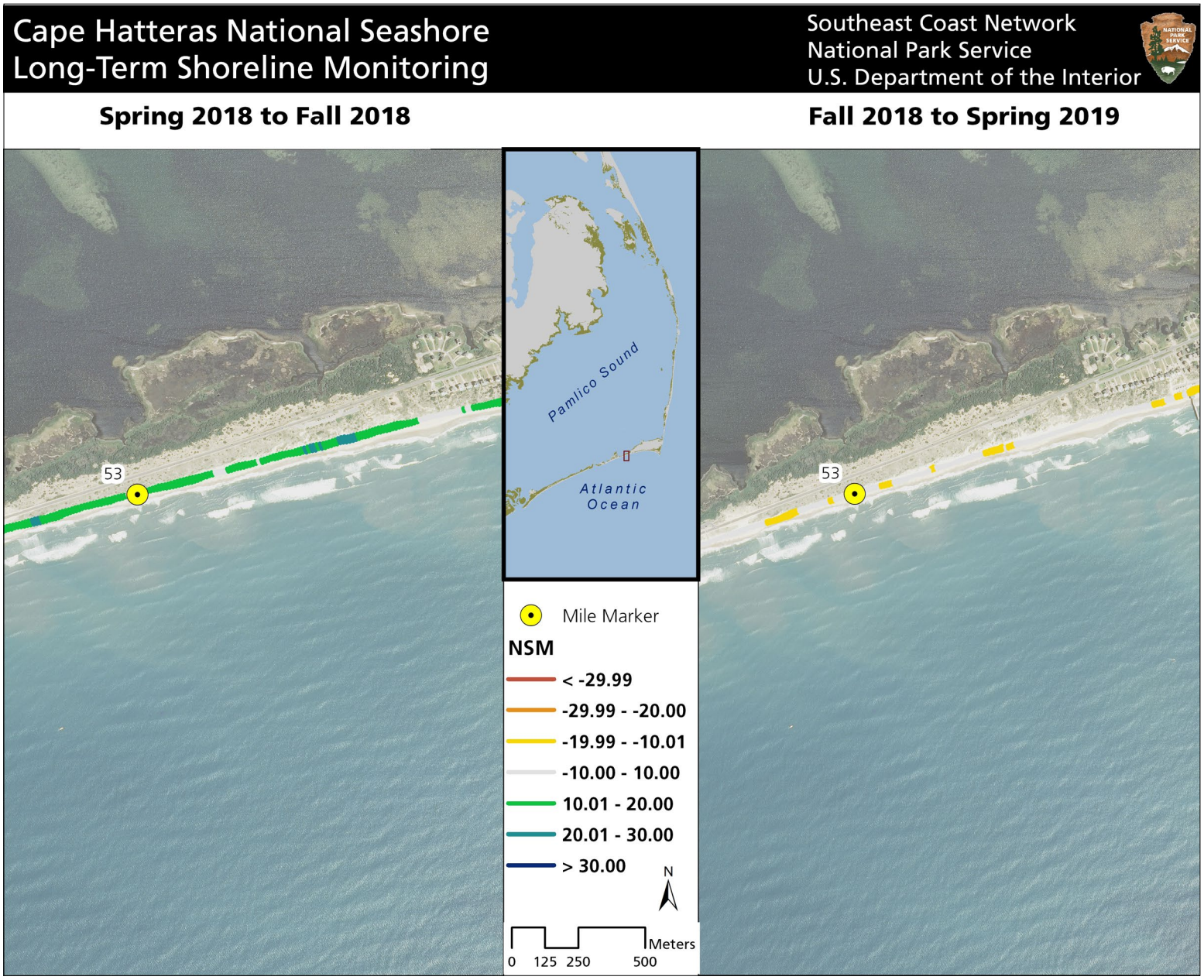


Figure B-41. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 53.

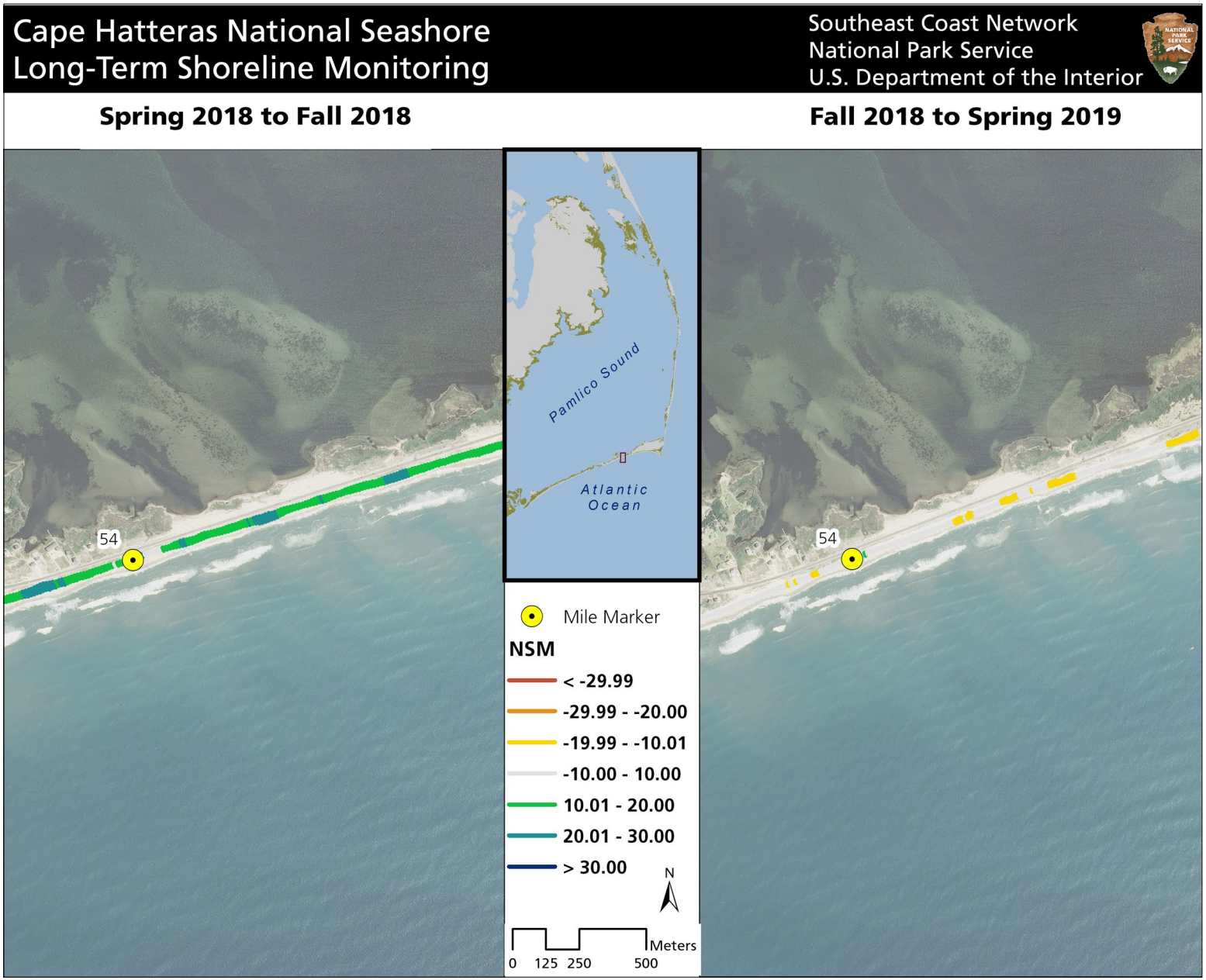


Figure B-42. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 54.

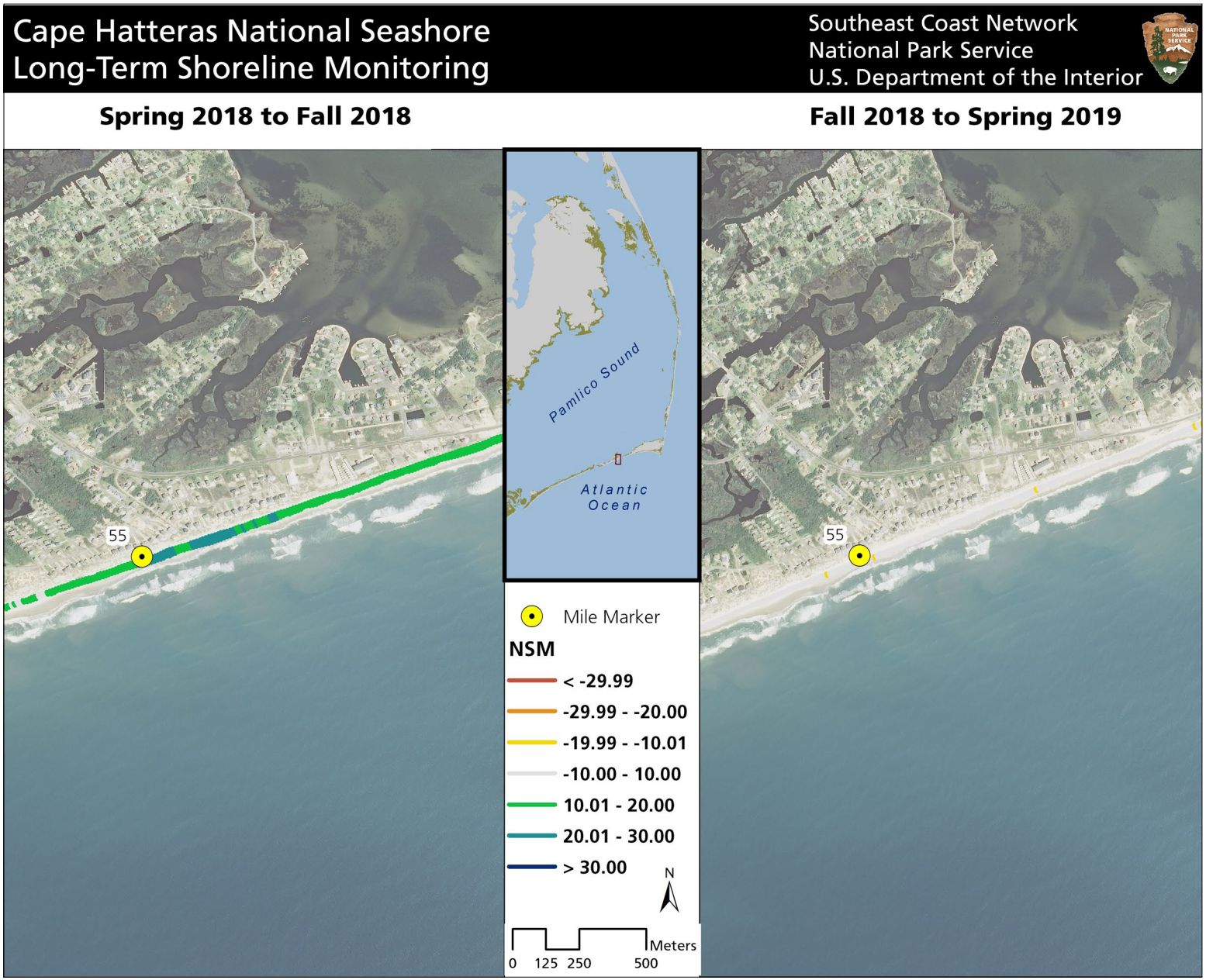


Figure B-43. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 55.

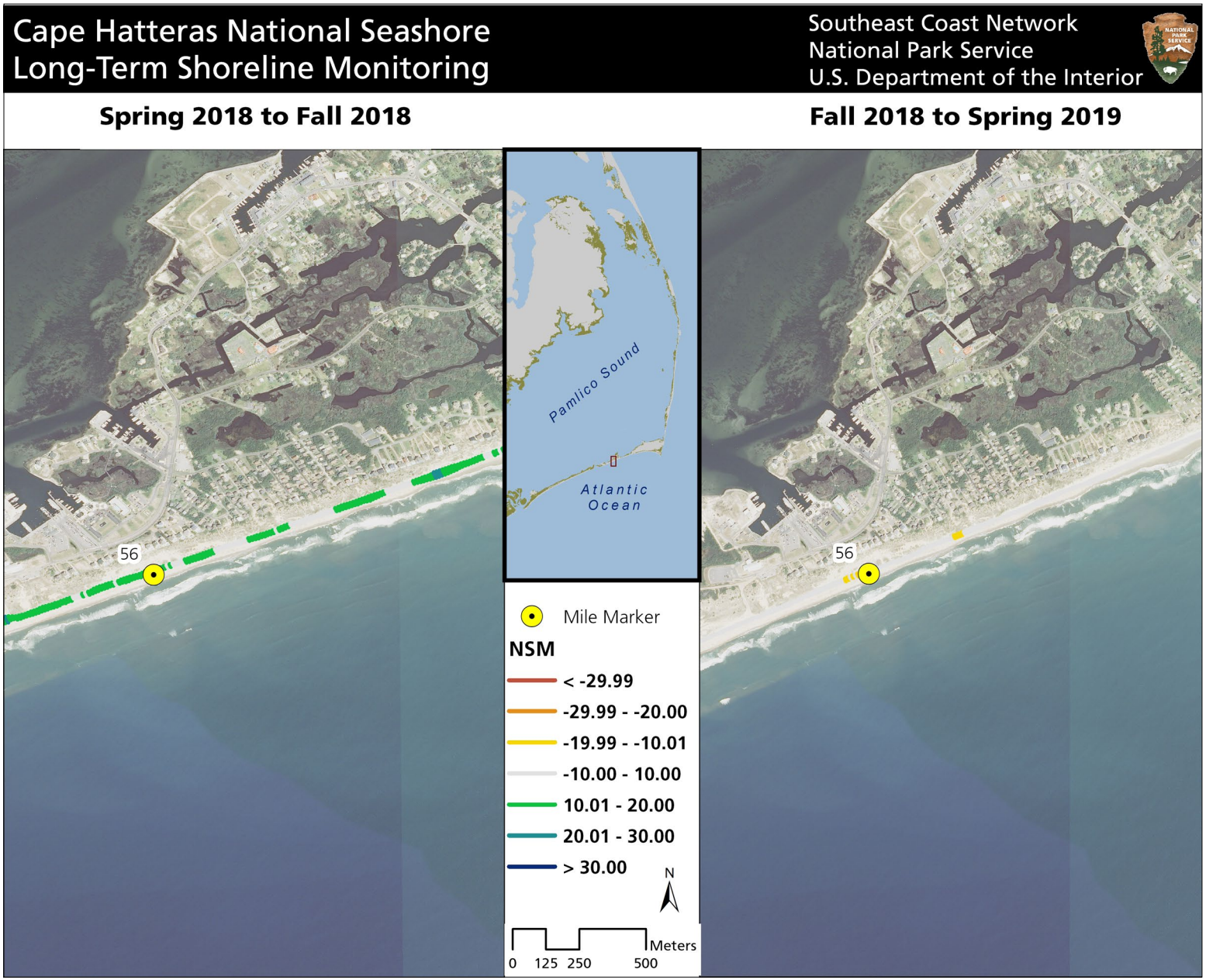


Figure B-44. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 56.

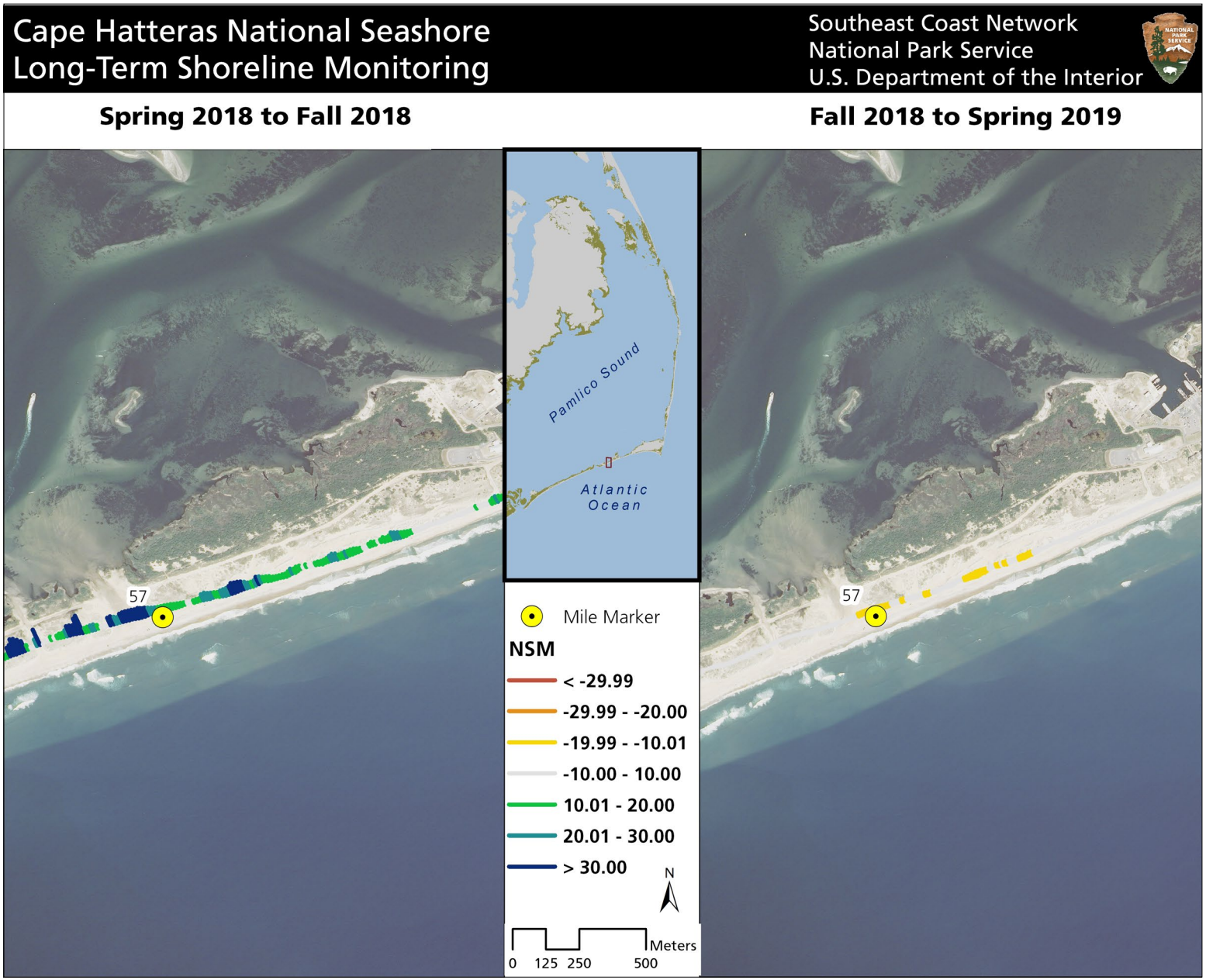


Figure B-45. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 57.

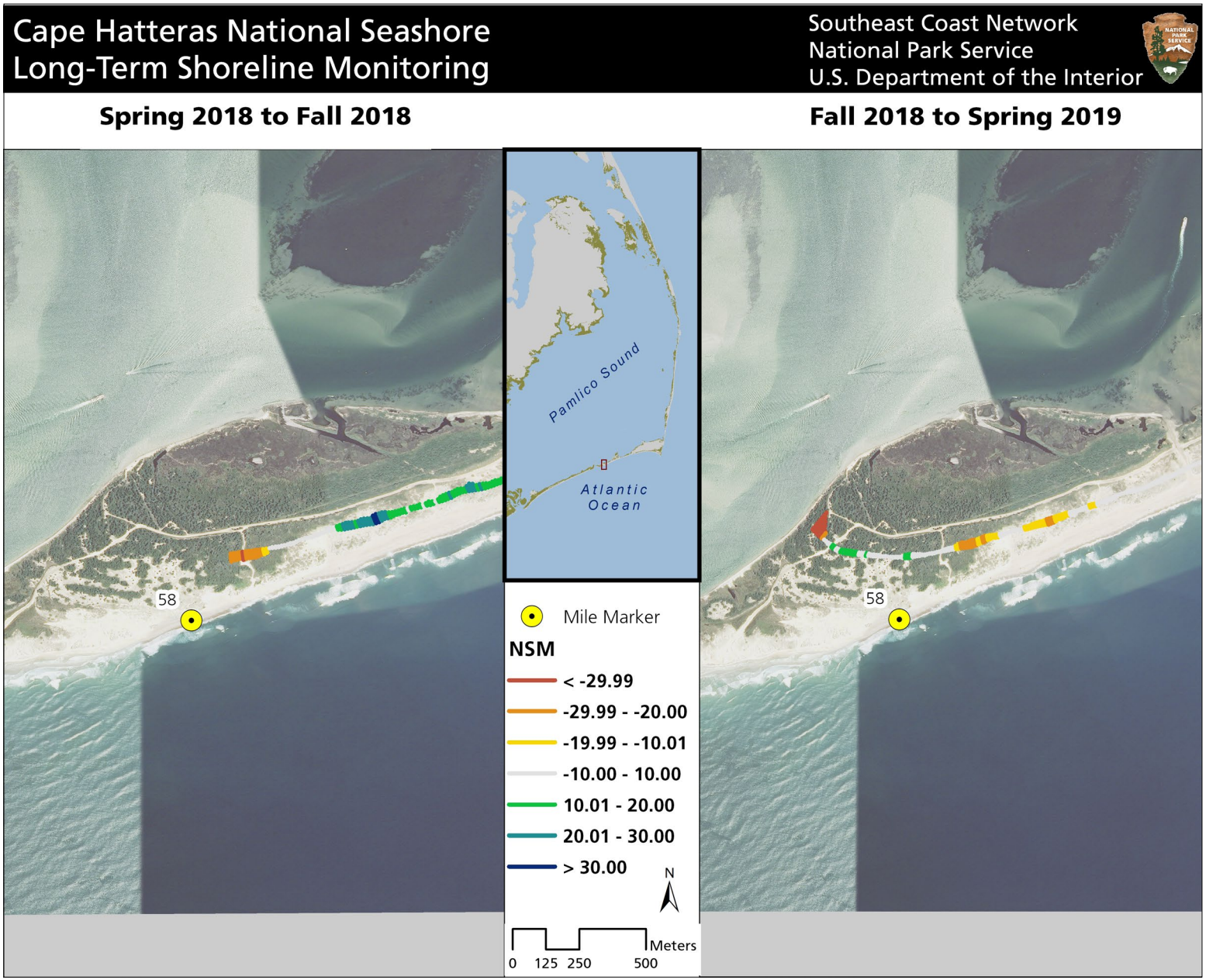


Figure B-46. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 58.

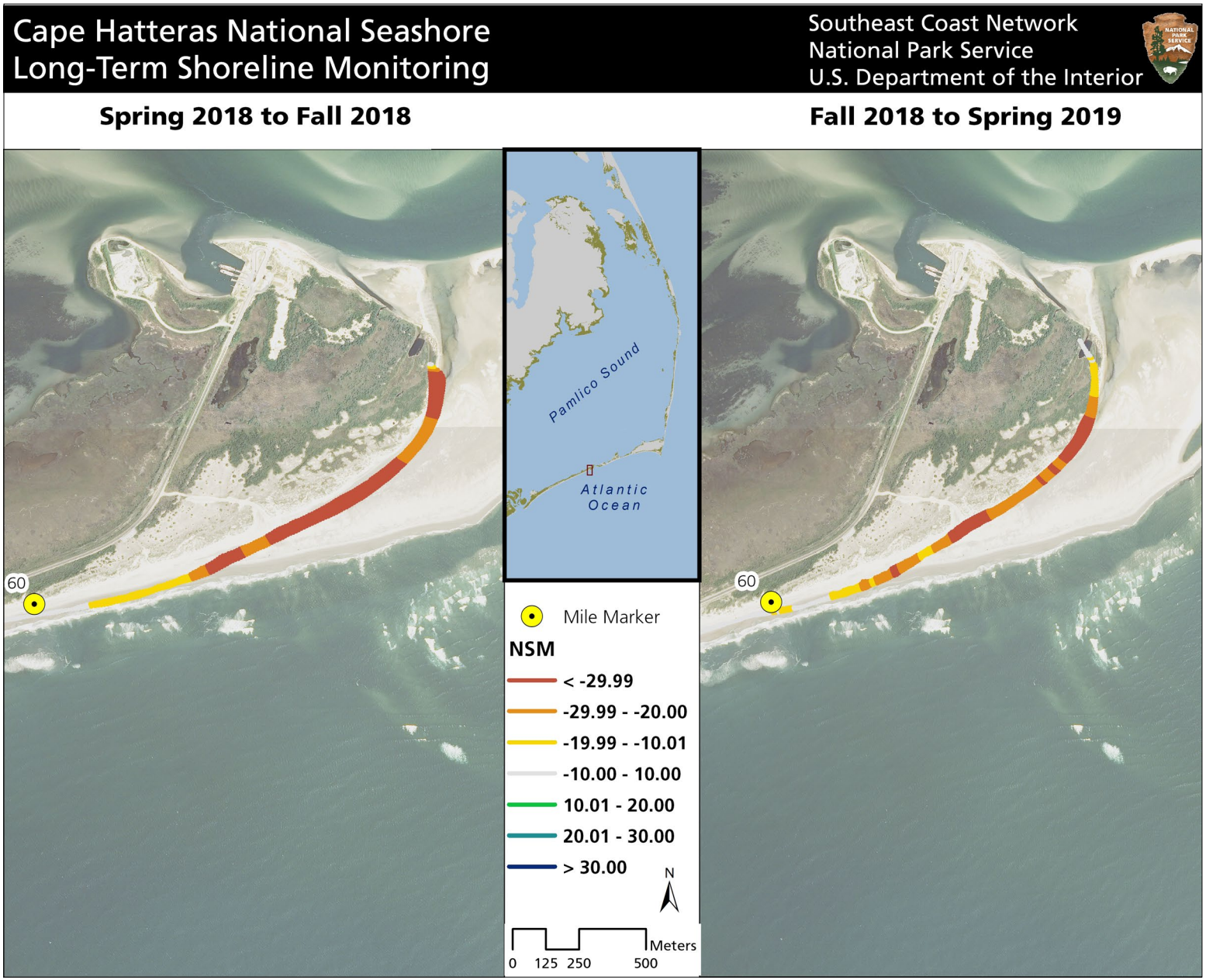


Figure B-47. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 60.

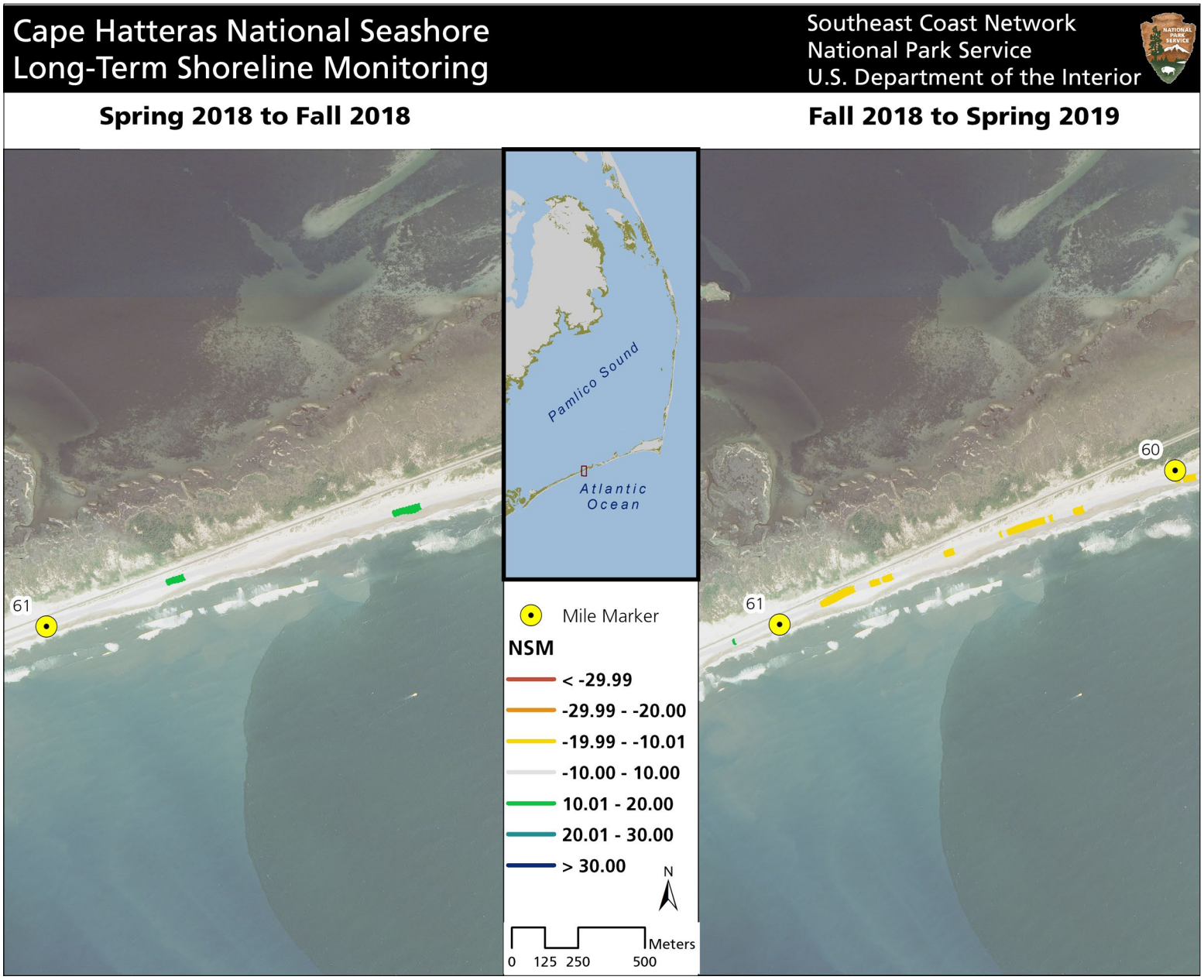


Figure B-48. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 61.

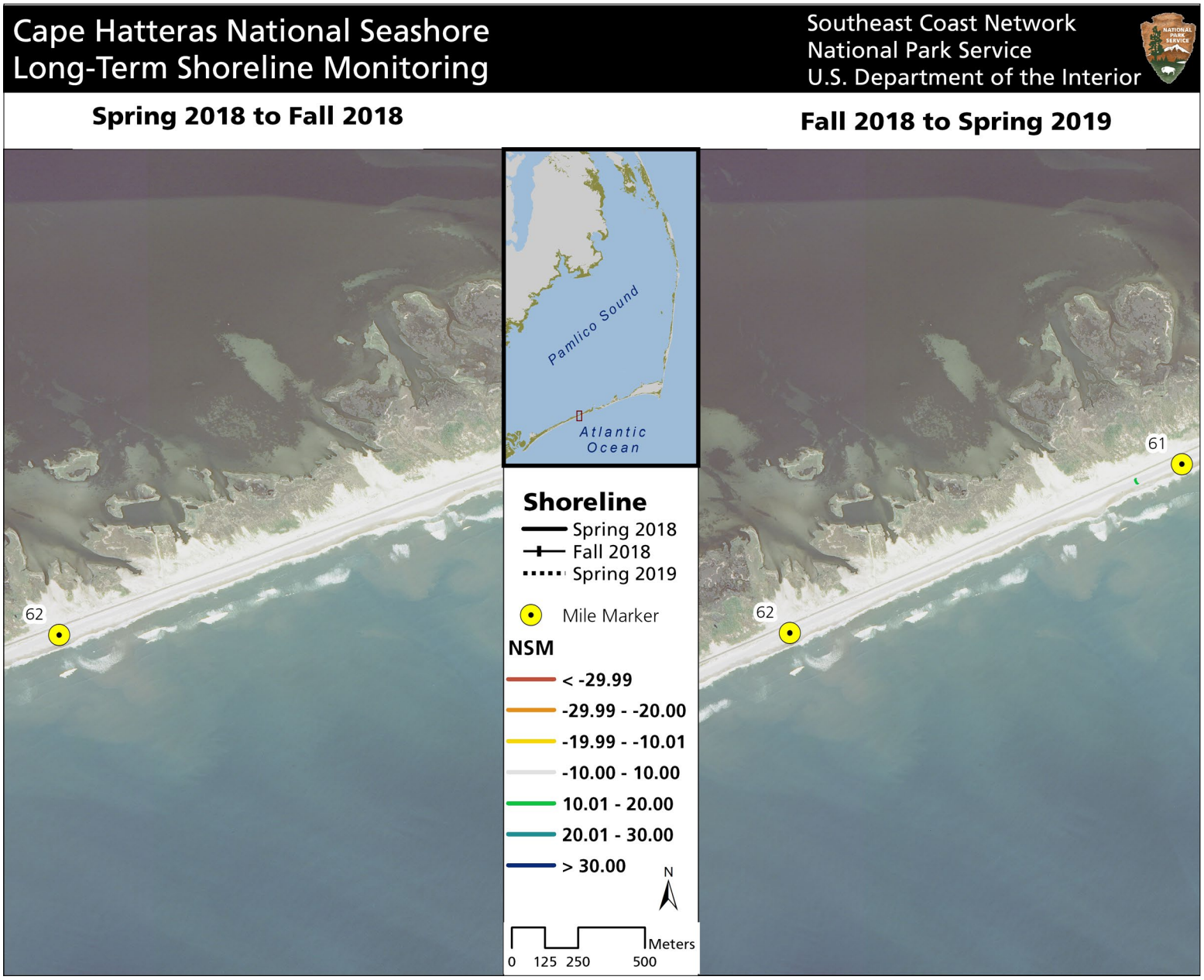


Figure B-49. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 62.

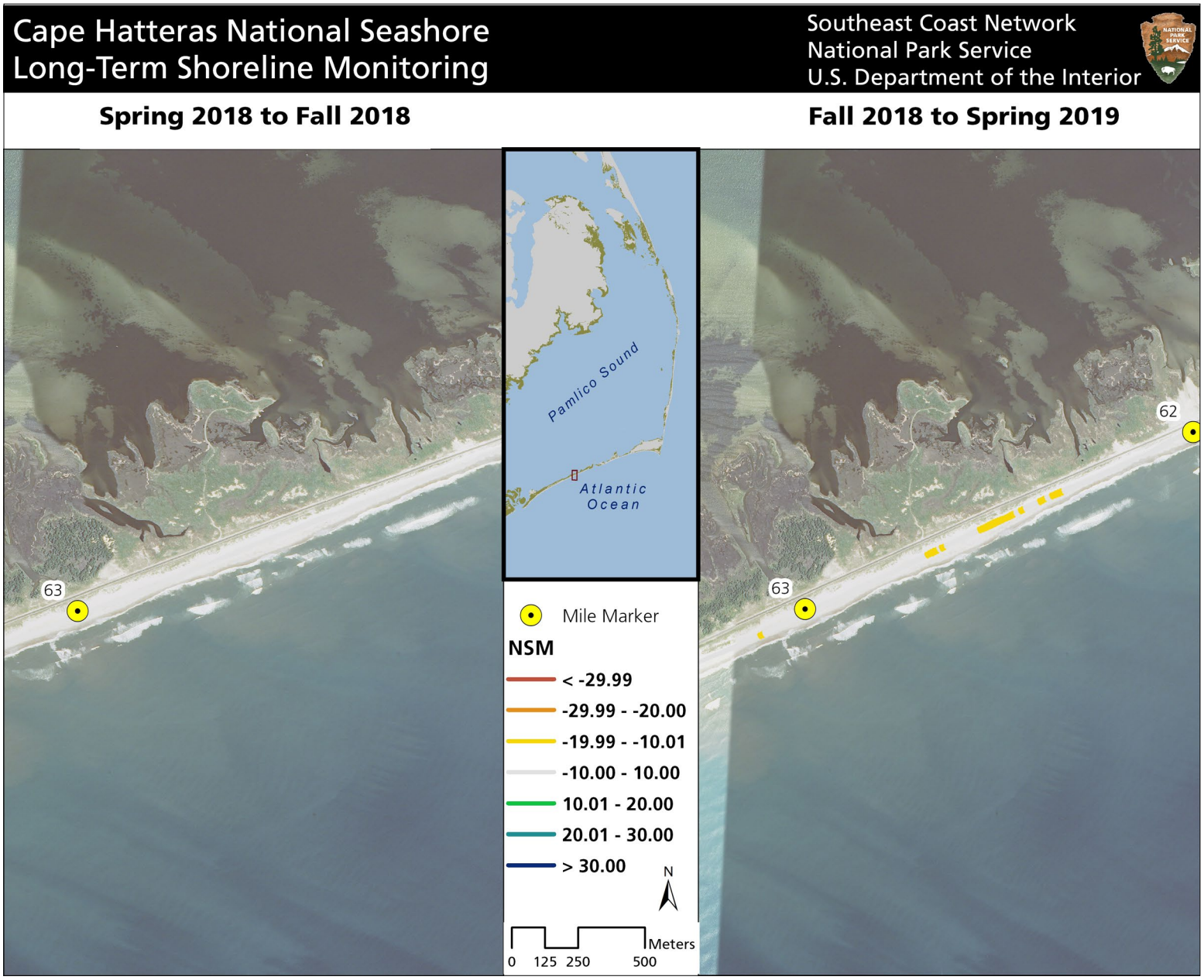


Figure B-50. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 63.

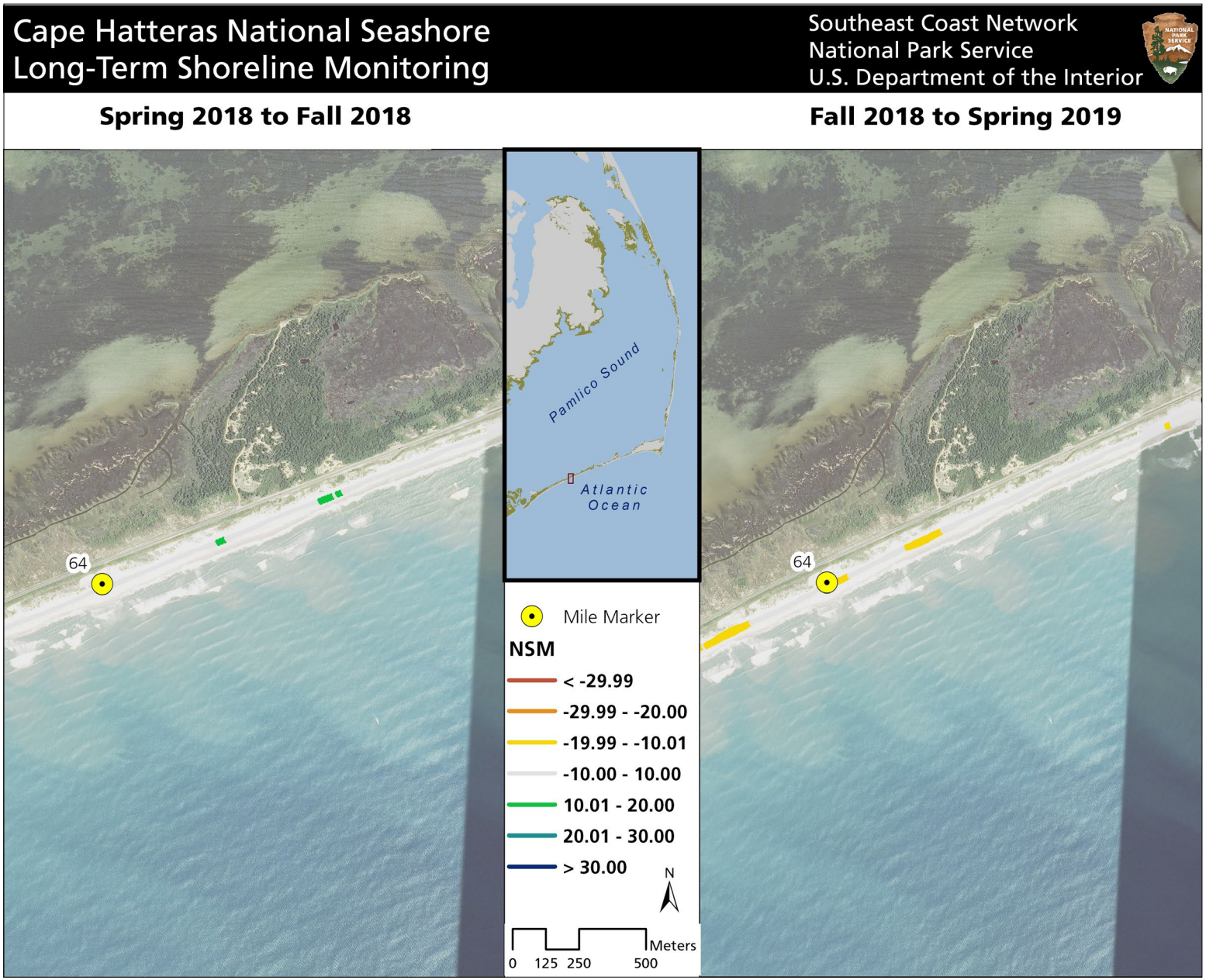


Figure B-51. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 64.

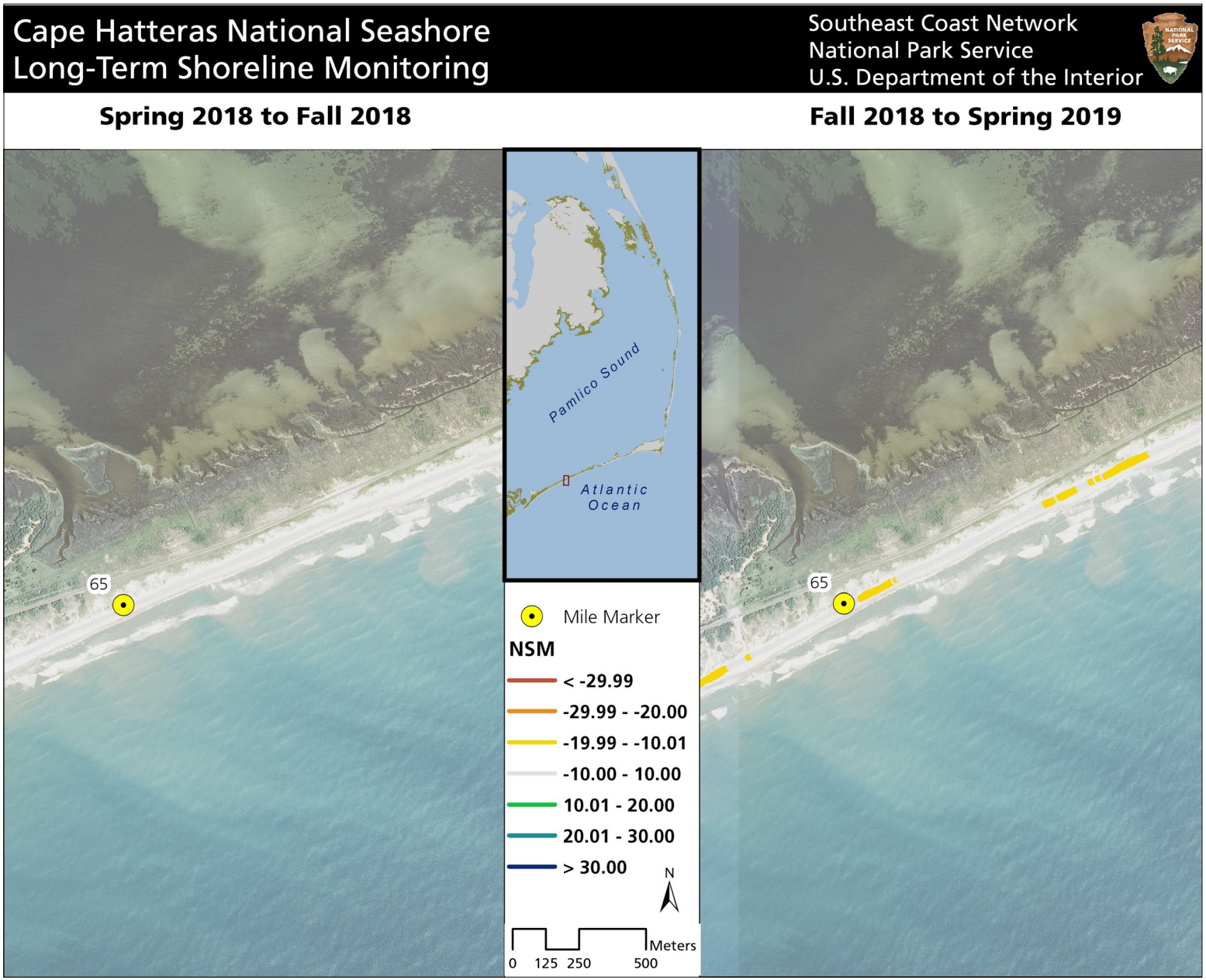


Figure B-52. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 65.

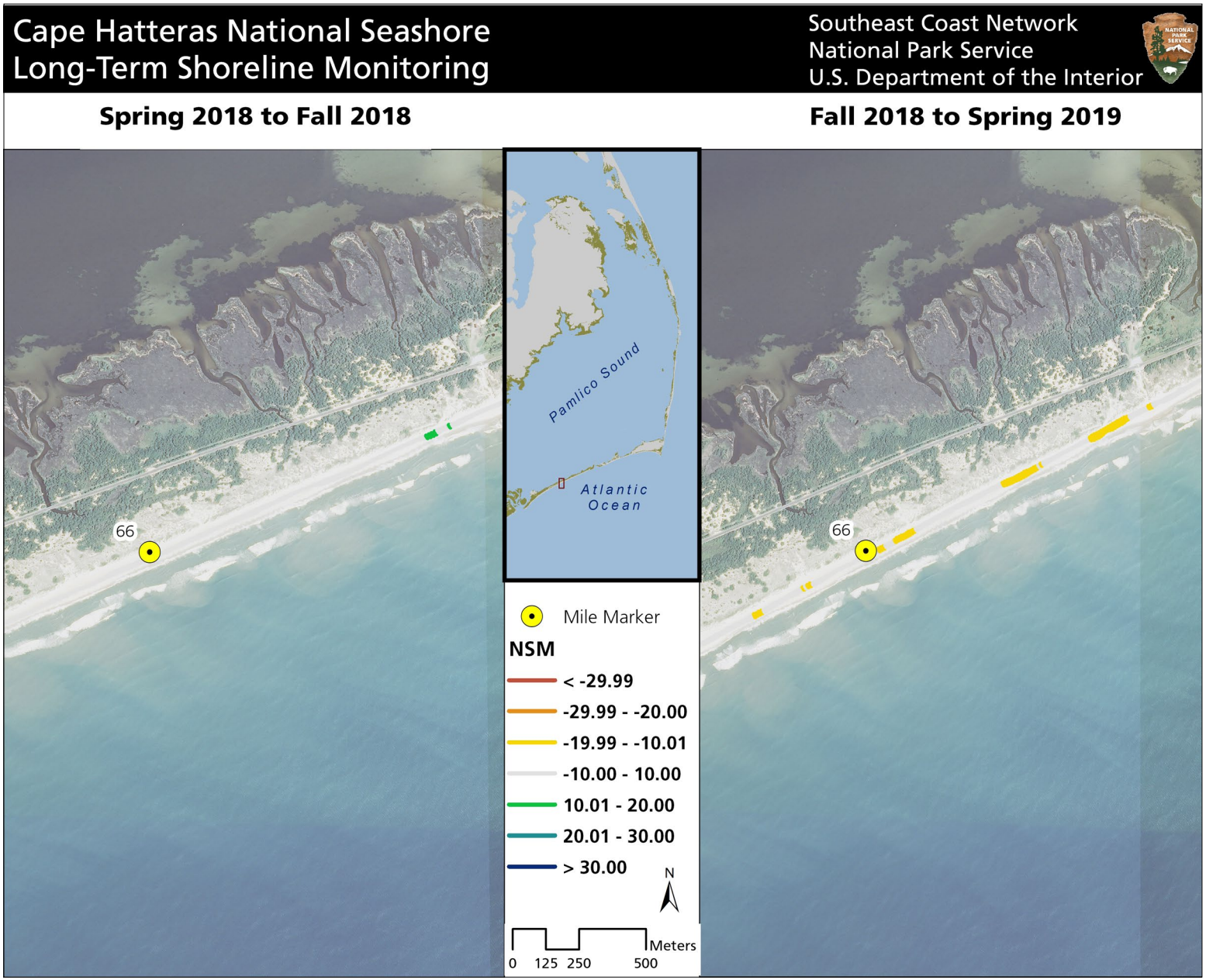


Figure B-53. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 66.

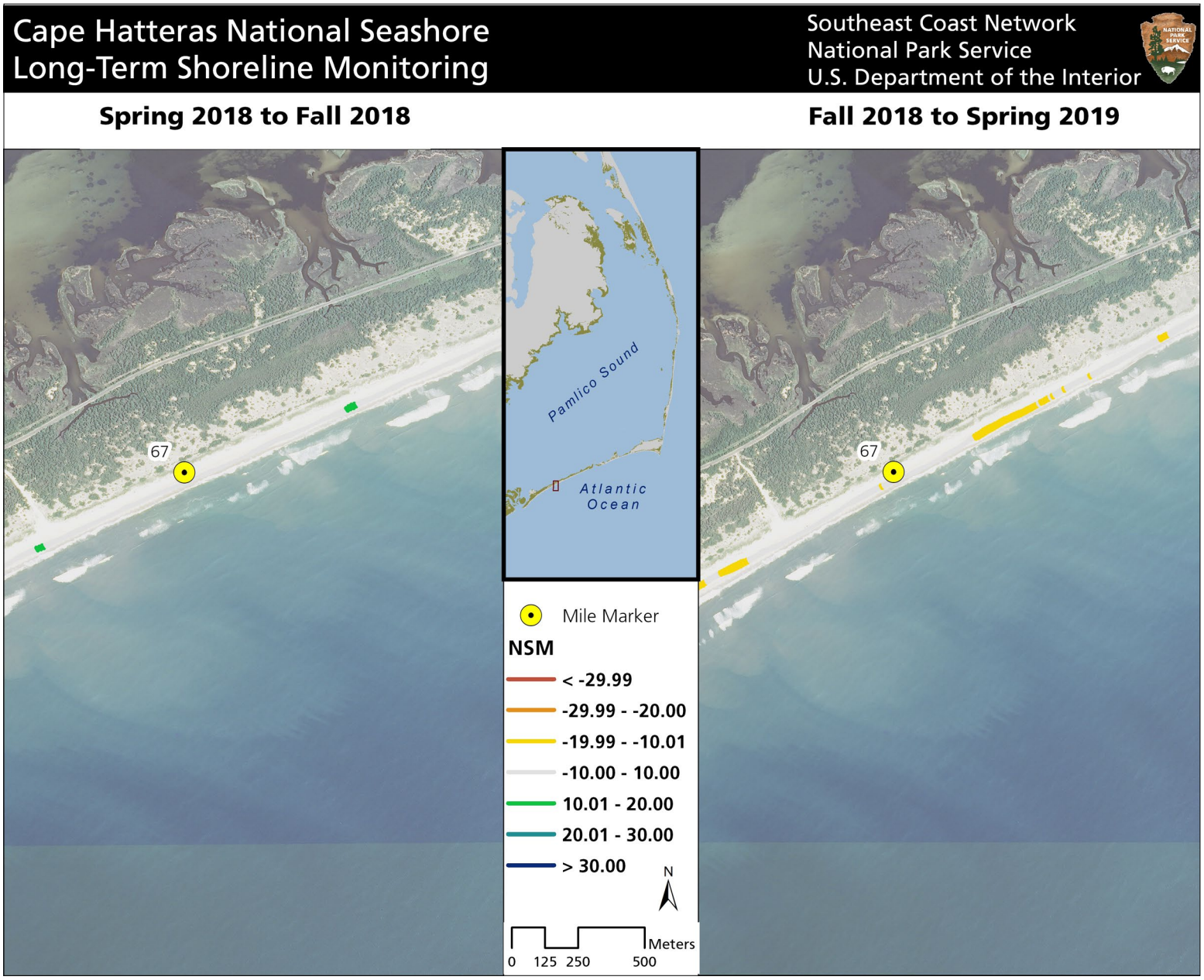


Figure B-54. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 67.

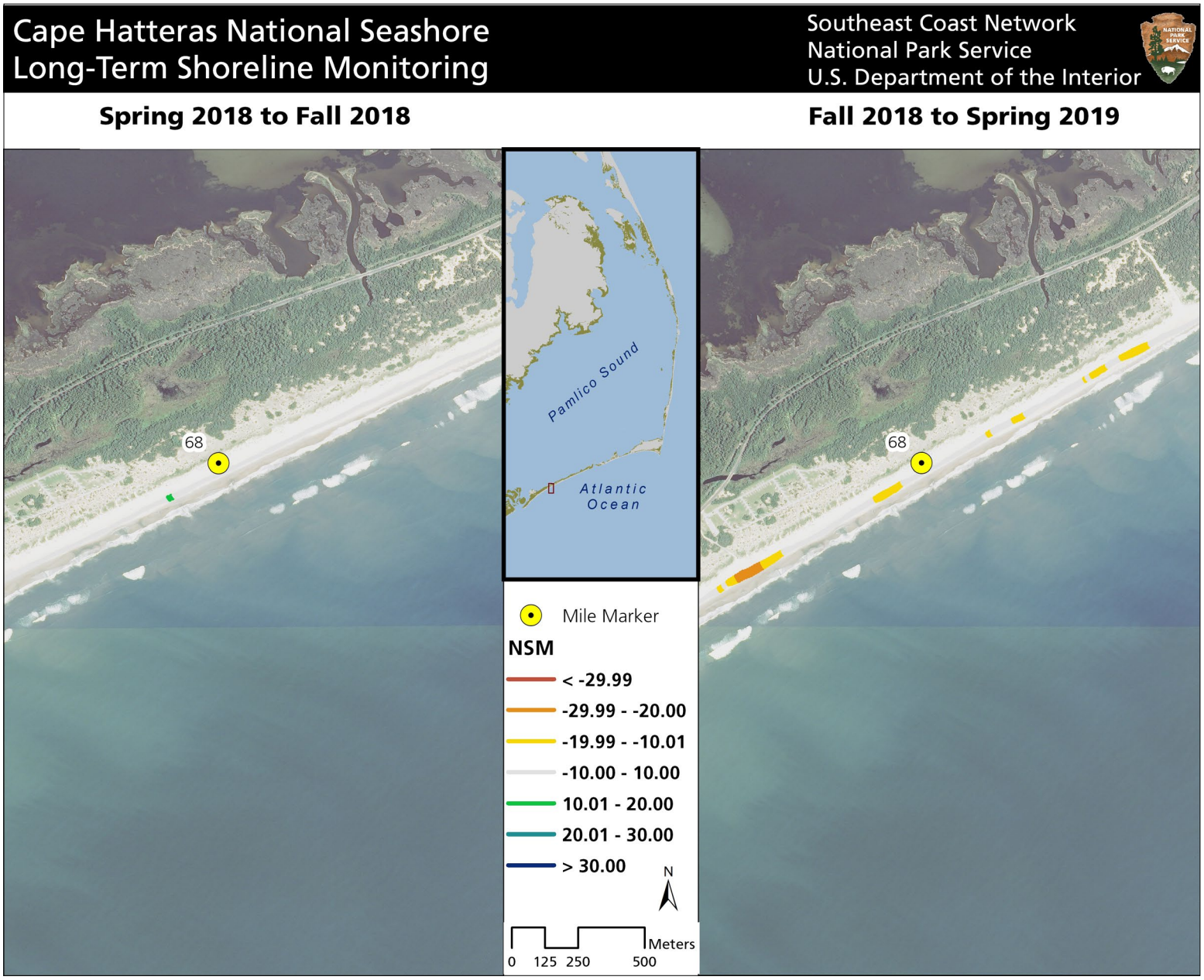


Figure B-55. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 68.

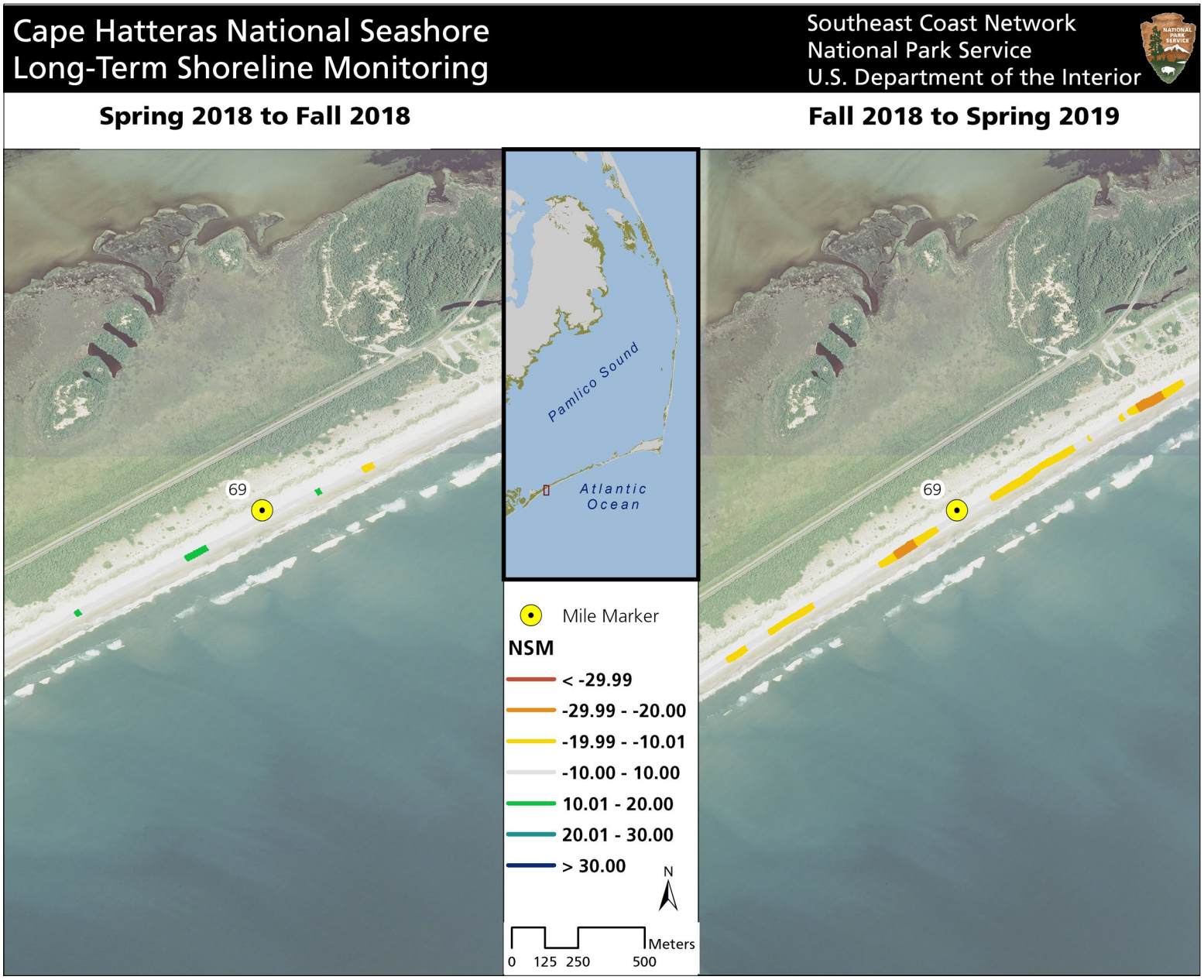


Figure B-56. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 69.

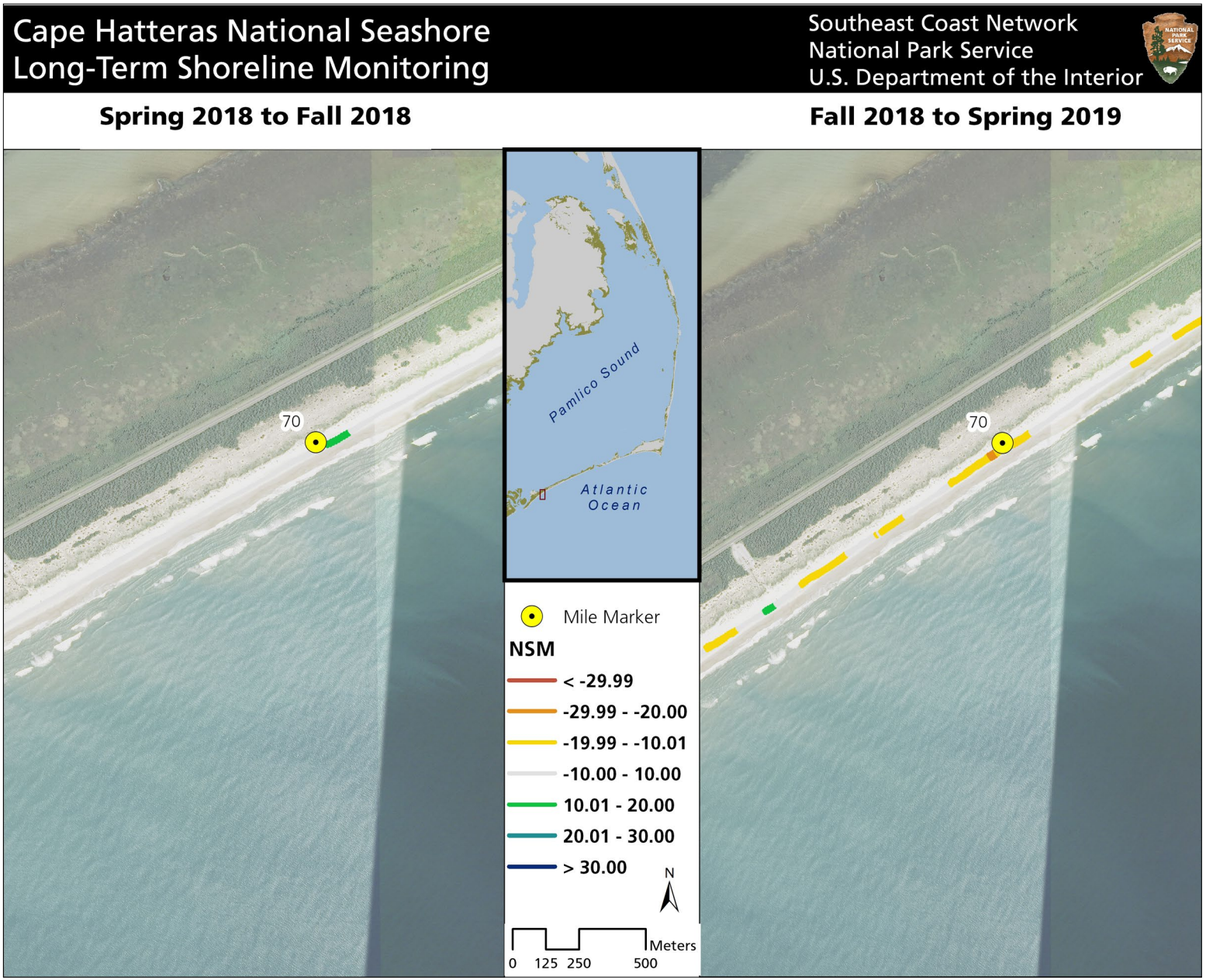


Figure B-57. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 70.

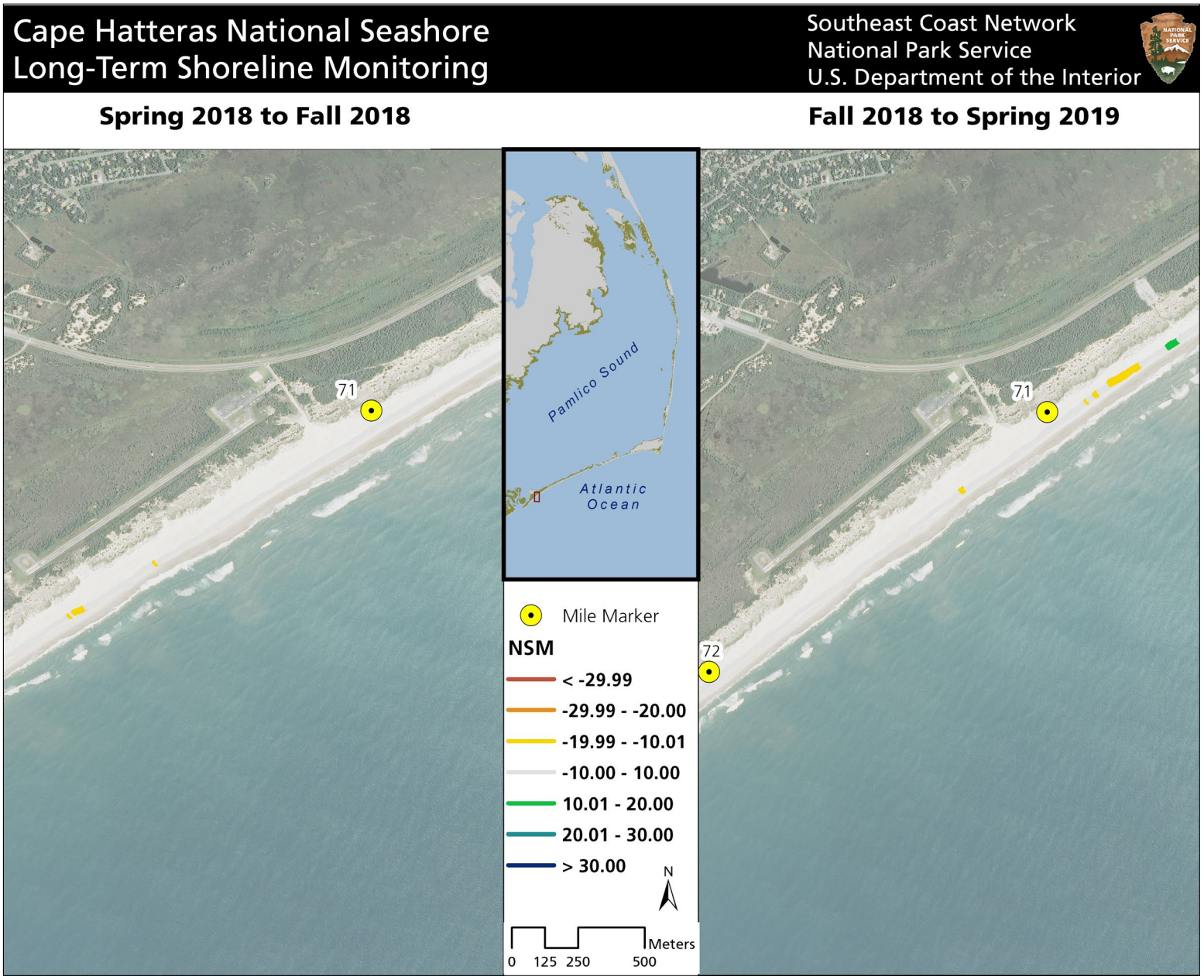


Figure B-58. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 71.

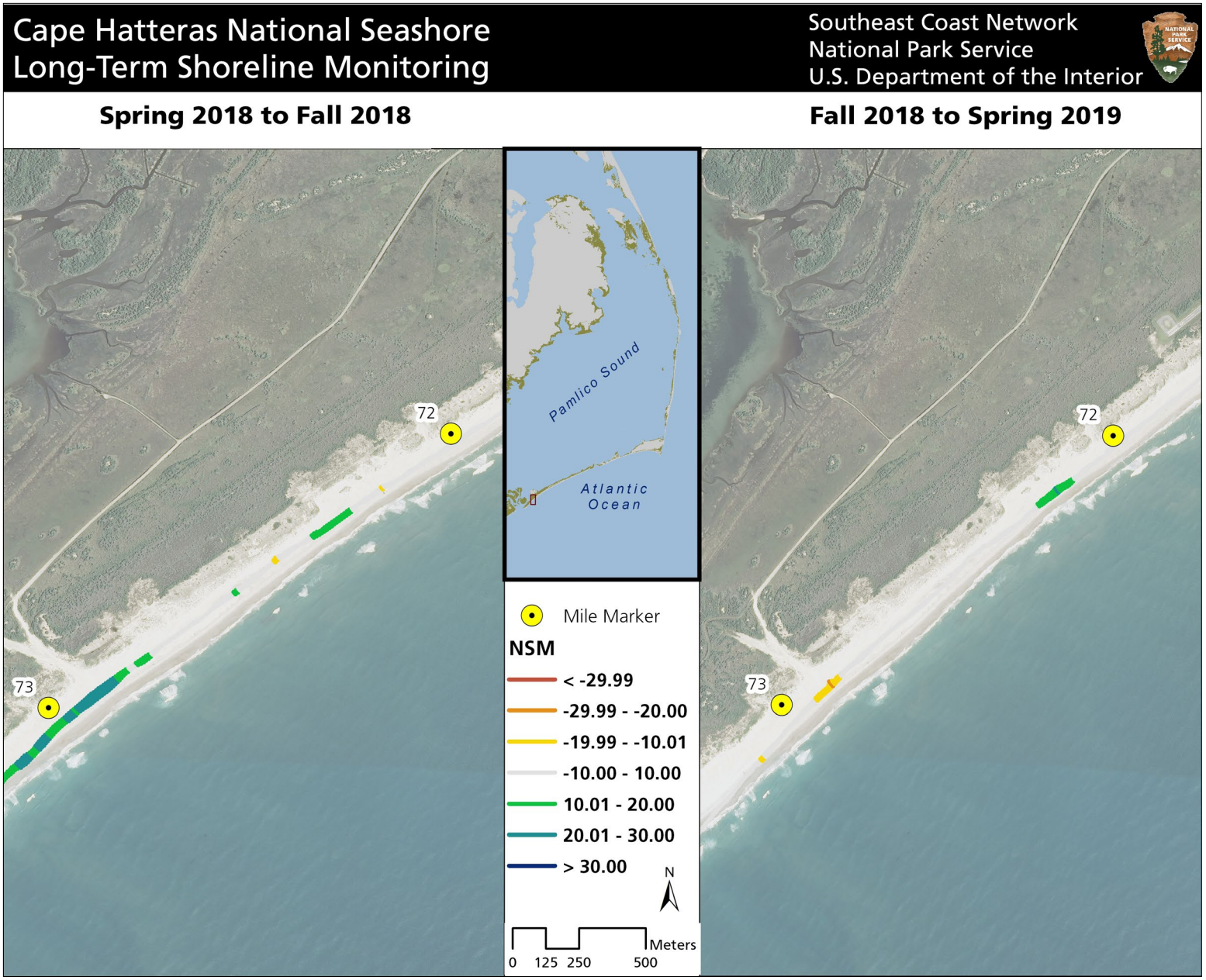


Figure B-59. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 72 and 73.

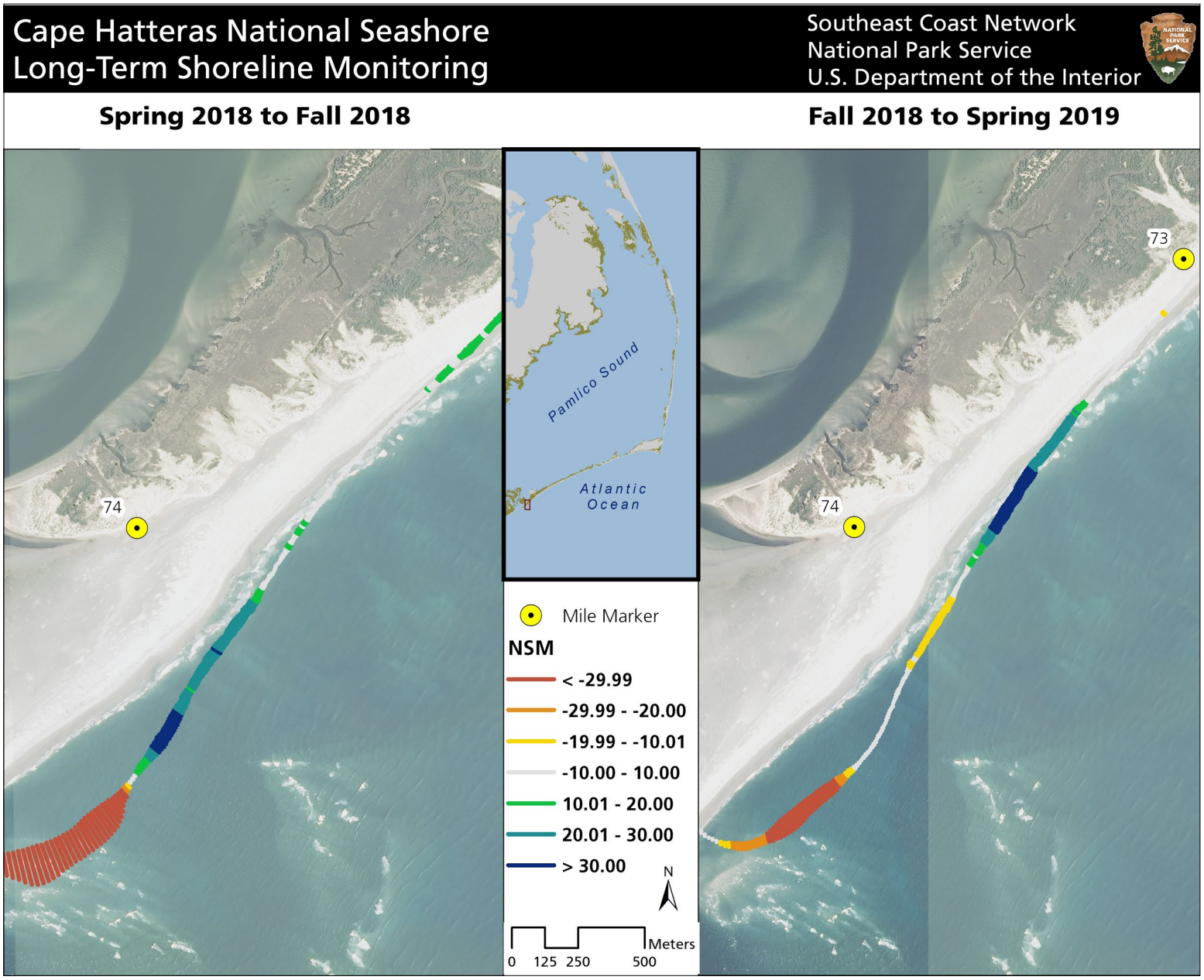


Figure B-60. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore at mile marker 74.

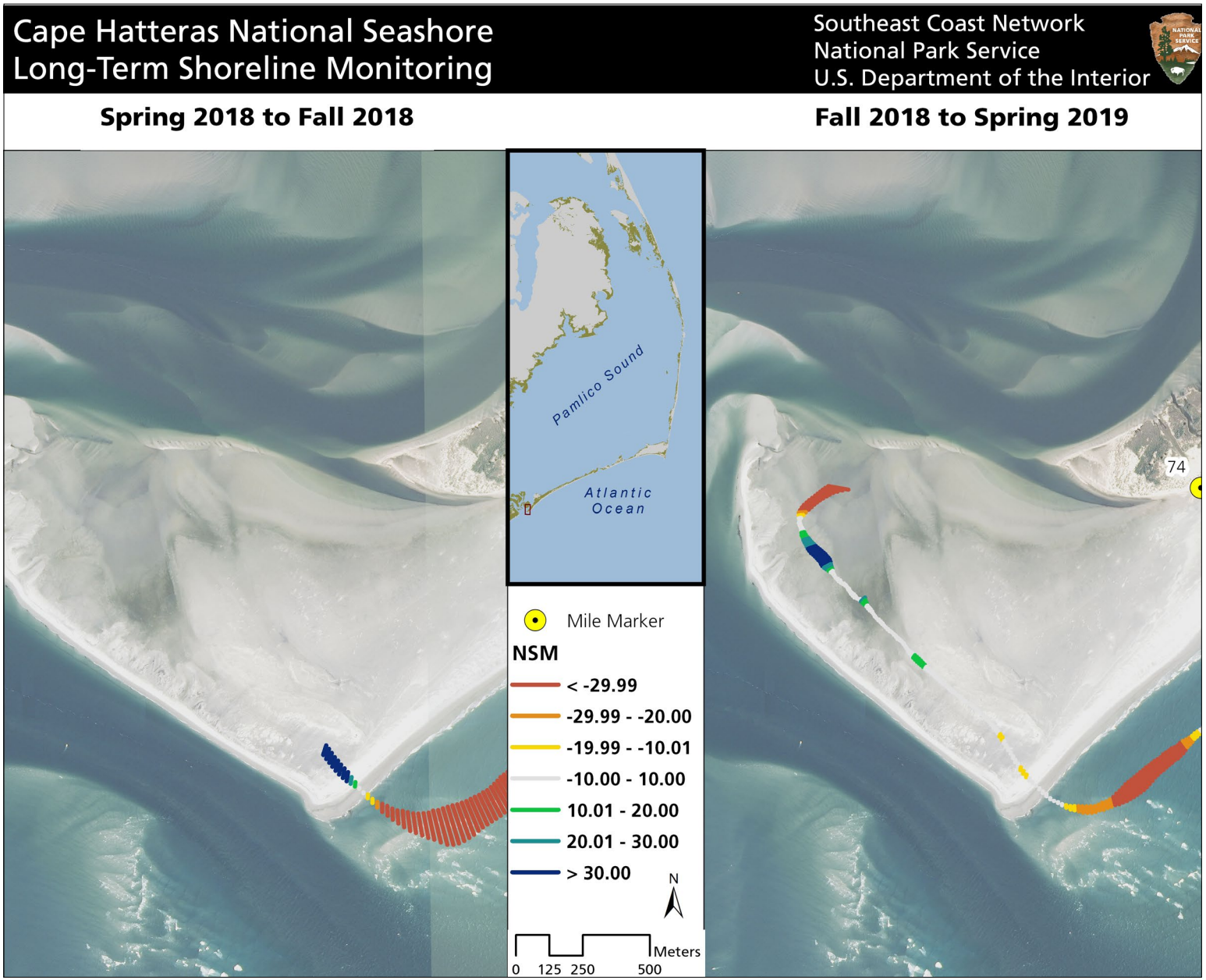


Figure B-61. Map of seasonal shoreline change distance (meters) for the spring 2018 to fall 2018 and fall 2018 to spring 2019 surveys collected at Cape Hatteras National Seashore east of mile marker 74.

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.

NPS 603/170749, June 2020

National Park Service
U.S. Department of the Interior

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