Identification and Extraction of the Seaward Edge of Terrestrial Vegetation using Digital Aerial Photography

Open-File Report 2006–1092

U.S. Department of the Interior
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Identification and Extraction of the Seaward Edge of Terrestrial Vegetation using Digital Aerial Photography

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SECTION ONE

Project Overview

1.1 Introduction

This report is created as part of the Aerial Data Collection and Creation of Products for Park Vital Signs Monitoring within the Northeast Region Coastal and Barrier Network project, which is a joint project between the National Park Service Inventory and Monitoring Program (NPS-IM), the National Aeronautics and Space Administration (NASA) Observational Sciences Branch, and the U.S. Geological Survey (USGS) Center for Coastal and Watershed Studies (CCWS). This report is one of a series that discusses methods for extracting topographic features from aerial survey data. It details step-by-step methods used to extract a spatially referenced digital line from aerial photography that represents the seaward edge of terrestrial vegetation along the coast of Assateague Island National Seashore (ASIS). One component of the NPS-IM/USGS/NASA project includes the collection of NASA aerial surveys over various NPS barrier islands and coastal parks throughout the National Park Serviceís Northeast Region. These aerial surveys consist of collecting optical remote sensing data from a variety of sensors, including the NASA Airborne Topographic Mapper (ATM), the NASA Experimental Advanced Airborne Research Lidar (EAARL), and down-looking digital mapping cameras.

Information is presented in two main sections. Section One describes the study area and discusses the scientific rationale behind the project with a brief description of the sensors used and initial data-processing techniques. References for papers providing detailed discussions of the topics mentioned are included. Section Two presents detailed step-by-step instructions for extracting the seaward edge of vegetation from aerial photography, as performed with ESRI ArcGIS 8.3 software. Although ESRI software was utilized for this project, similar techniques may be applied with other GIS or image-processing software. Imagery is spatially referenced to the Universal Transverse Mercator (UTM) coordinate system, Zone 18, referenced to the North American Datum 1983.

1.2 Study Area

Assateague Island National Seashore (ASIS) is located on the eastern seaboard along the coasts of Maryland and Virginia (Figure 1). Park boundaries encompass the entire island; management of the island is a partnership between the National Park Service, Assateague State Park, and Chincoteague National Wildlife Refuge.

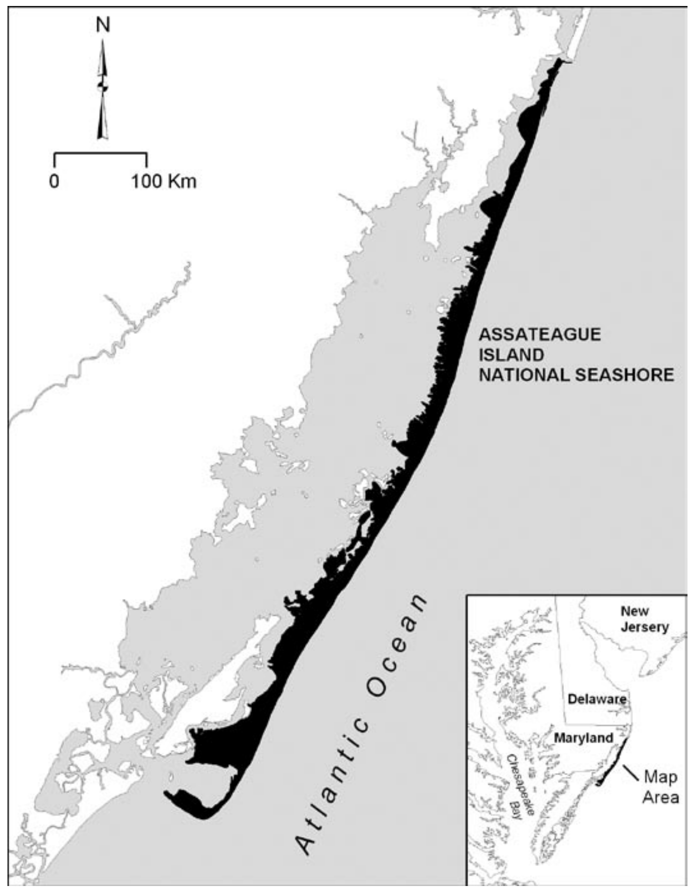


Figure 1. Assateague Island National Seashore.

Given its proximity to the NASA Wallops Flight Facility as well as NPS interest in using the resulting datasets for ongoing resource management activities, Assateague Island has been a focus of data collection and applications-development activity. NASA Wallops Flight Facility, located on Wallops Island, Va, has been collecting aerial survey data over ASIS since 1995, beginning with topographic lidar (light detection and ranging) surveys (Krabill and others, 2000; Brock and Sallenger, 2001) and expanding to include digital aerial photography acquisition and additional development of innovative lidar sensors that integrate bathymetric and topographic surveys (Nayegandhi and others, 2005). Lidar surveys provide point ground elevations that are used to construct a three dimensional representation of the island landscape (Brock and others, 1999; Brock and others, 2003). At ASIS, pilot efforts to use NASA aerial survey data in resource management and monitoring have already resulted in significant practical contributions to park resource management (Nayegandhi, 2002; Nayegandhi and others, 2005).

1.3 Scientific Significance and Rationale for Project

Tracking changes in terrain along barrier island beaches has long been problematic because of a lack of accurate high-resolution topographic data. Traditional products, such as available contour maps or low-resolution digital elevation models (DEMs), could not provide the level of detail or the update frequency necessary to monitor barrier island parks. To address this need, the NPS and NASA initiated an experimental beach-mapping program using topographic lidar surveys at ASIS (Brock and others, 1999; Brock and others, 2001).

NASA began collecting airborne laser surveys over Assateague Island in 1995 using the NASA ATM sensor. Initially, the ATM carried a single-return green wavelength lidar; a down-looking camera was added in 2001 (Brock and Sallenger, 2001). Further enhanced sensor development resulted in a new waveform-resolving red-wavelength lidar (NASA EAARL). The EAARL is a cross-environment sensor, capable of surveying both terrestrial and aquatic environments (Brock and Wright, 2002). As a result, sensor survey data provides a wide range of information, including but not limited to: (1) bare earth digital elevation models, (2) first return DEMs, and (3) vegetation canopy height and distribution. Currently, both sensors incorporate down-looking cameras for collecting digital photography in concordance with the lidar survey data.

Data collected by the sensors are referenced to the ground using kinematic differential global positioning system (GPS) methods, providing vertical accuracy to within 20 cm. In addition, orientation of the aircraft is measured using Inertial Navigation Systems (INS). Small laser spot size and high-pulse frequency result in DEM products being produced at a 1 m resolution (Nayegandhi and Brock, 2002). The ATM and EAARL sensors are mounted on small aircraft and can be commissioned as needed. Typical flight time required to complete surveys within the NPS Northeast Coastal and Barrier Island network have varied between 1 to 5 days. As a result, lidar surveys not only provide accurate, high-resolution datasets, but can be acquired frequently in order to meet resource-management and monitoring needs.

Over time, and with major cooperation from the USGS, the project has developed to the point where survey data is being used in a number of park programs, including change detection for shorelines and mapping high-resolution topography and bathymetry. Topographic lidar data and aerial photography acquired during NASA overflights of ASIS are being used in the Threatened and Endangered Species Recover Program[1]: Piping Plover and Sea Beach Amaranth, the Geomorphologic Monitoring Program[1] (elevation models, topographic profiles, and beach renourishment), and within the Wildlife Management Program[1]: Horse grazing effects on vegetation and natural dune evolution (DeStoppelaire and others, 2001).

The project has also revealed the importance of the USGS role in converting raw NASA remote-sensing datasets into GIS-compatible information layers of high relevance to the management needs of national seashores and parks. Lidar surveys result in very large datasets, which in their raw format are not compatible with most GIS software. The USGS has taken the lead role in developing methods for processing these data to a level that can be imported into widely used GIS software packages (Brock and others, 2001; Nayegandhi, 2001; Nayegandhi and Brock, 2002). Data is presented to the NPS in ESRI compatible formats. As a result, the NPS has been able to directly access these data for use in park natural resource management activities.

1.4 Aims and Objectives of Project

Over time, the seaward edge of barrier islands along the northeast U.S. coast has eroded. Periodically, major storms wash sand over the barrier island. Coastal erosion resulting from both natural and anthropogenic sources is one of the primary problems facing park management. Change in shoreline position, either through loss or accretion, can alter natural habitats. Shoreline retreat may destroy cultural resources, facilities, and other infrastructure. Upland resources can be adversely affected by coastal erosion because they are not mobile. Another basic concern on barrier islands is geomorphologic change. Changes in geomorphology drive change in other NPS natural resource areas of interest, including: water quality in ground and in estuaries, species and habitats of concern, recreational visitor use, and resource extraction.

The initial NPS/USGS/NASA cooperative project at ASIS has clearly demonstrated the value of NASA aerial surveys in meeting "on the ground" NPS resource management needs. Presently, lidar surveys are being incorporated in Vital Signs and Monitoring methods related to ocean beach features within the Northeast Barrier Island Park Network.[1] The NPS has identified shoreline, dune, and vegetation features as critical indicators of geomorphic change.

Over time, sand is transported inland onto dunes where it is trapped by vegetation and remains there until removed by storms. This movement of sand dissipates onshore wave energy and works to build dunes, which protect back island environments. During large storms, both the shoreline and dunes can erode, sometimes causing the base of the dune to collapse, sometimes completely destroying the dune. Dunes are also susceptible to wind erosion and depend upon beach grass for their protection. On the surface of the dunes, beach grass traps windblown sand. Under the surface, grass roots help to stabilize dunes. Changes in both shoreline and dunes may affect the location of the seaward edge of vegetation, hence its use as one of the indicators of change monitored by park resource managers at Assateague Island National Seashore. Using aerial surveys to periodically monitor changes in the seaward edge of vegetation enables park managers to assess management needs in a reasonable time frame and cost in the dynamic coastal environment. One component of the project is to develop a method for the detection and extraction of the seaward edge of terrestrial vegetation, or "vegetation line". The vegetation line is defined here as the first line of stable natural vegetation along the ocean beach side of the barrier island. This line represents the boundary between the normal dry-sand beach, which is subject to constant flux due to waves, tides, storms and wind, and the more stable upland areas. It is generally located at, or immediately oceanward of, the seaward toe of the frontal dune or erosion escarpment (Figure 2).

Figure 2. Coastal barrier island showing seaward edge of terrestrial vegetation.

1.5 Methodology Overview

The vegetation line was determined from digital aerial photography by using the ESRI software package. Photographs provide a qualitative, and potentially quantitative, record of the barrier island conditions (Figure 3). They can be used to document general conditions, storm events, development, or to assess resource conditions over time. Image-processing software allows for quantitative studies using various methods, such as classifying the image to create a thematic layer in which areal extents of classes may be calculated.

The aerial photography used for this project was collected coincident with the NASA topographic lidar surveys using a camera mounted on the sensor platform. The photography is true color with an image resolution of 1-meter. For the purpose of the vital signs monitoring project, digital photography collected with the lidar surveys is preferable to other aerial photography because it provides coincident data with the other critical indicators (dune and shoreline) derived from the lidar data. Additional types of aerial photography are available from Federal agencies; these are listed in Appendix I.

The methodology incorporated the use of ESRI ArcGIS 8.3 software. ArcMap extensions used included Spatial Analyst, XTools, and XClassif (downloaded from the ESRI website). The photography is classified using unsupervised classification. The classes are then aggregated into six classes. Afterward, the classified raster image is

Figure 3. False-color aerial photo of a portion of Assateague Island National Seashore; vegetation shows in shades of red; sand/non-vegetated is white; water is blue. Image courtesy of National Park Service.

converted to a feature (polygon) layer. An example showing the digital camera image and the two classifications is shown in Plate 1. Finally, the polygon representing sand is converted to a polyline layer. This polyline is edited in ArcMap to clip out the line that eventually represents the edge of vegetation (Figure 4). Detailed step-by-step instructions are presented in Section Two of this report.

1.6 Metadata Creation

Federal Geographic Data Committee (FGDC)-compliant metadata records are created for each "final" product. Examples of metadata included with products are shown in Appendix III.

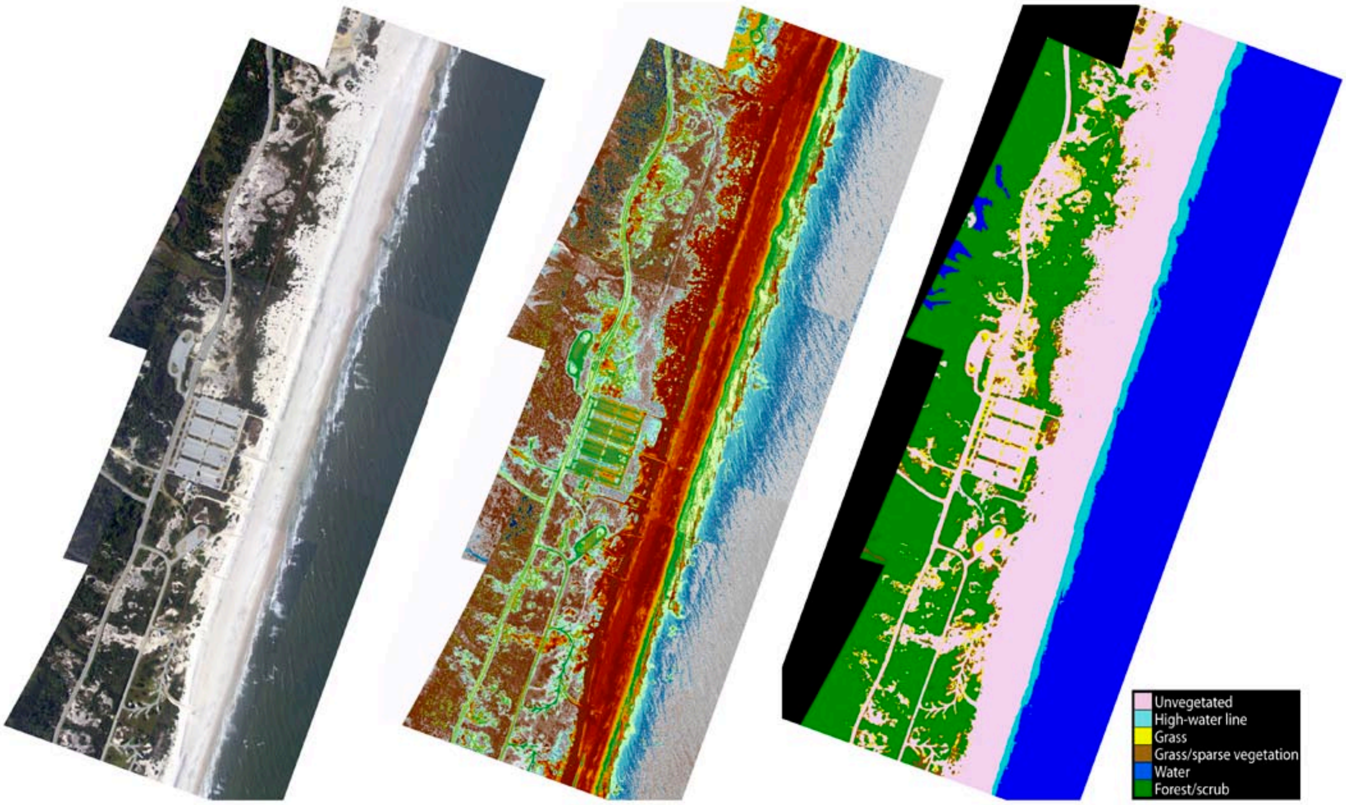


Plate 1. (A) Digital aerial photograph of a portion of Assateague Island National Seashore. (B) Classified image. (C) Classified image aggregated into six classes.

Figure 4. Extracted seaward edge of vegetation line overlaid on digital photo (left) and classified image (right).

SECTION TWO

Detailed Methods for Extracting Edge of Vegetation Line

Detailed Steps using ArcGIS 8.3

ESRI ArcGIS 8.3 software is used for the extraction of the edge of the vegetation line from digital aerial photography. Computer software requirements include: ArcGIS 8.2 or higher and a Spatial Analyst Extension License.

To extract a digital line from the imagery without manual digitization, the raster image was classified to create a thematic layer. The resulting thematic layer was then converted from a raster to polygon layer. The polygon layer was further converted to polylines, from which the vegetation line was extracted. In order to perform the classification, a Classification Analysis Tool script written for ESRI ArcGIS software was downloaded from the ESRI website. Follow the link to the ESRI arcscript download page to obtain the tool [URL:http://arcscripts.esri.com/details.asp?dbid=13784]. All the instructions for downloading and other pertinent information can be found there. Once the tool has been installed, proceed to the step-by-step procedure detailing the methodology used to extract the edge of vegetation line from the digital imagery as follows:

- Classify image
- Create signature file
- Perform image classification
- Load classified image
- Aggregate classes
- Final classes from aggregation
- Convert raster to polygon
- Convert polygon layer to polyline
- Extract vegetation line

2.1 Classify Image

Open ArcMap and Load image to classify. An example using a mosaic of digital camera images captured during a 2001 ATM survey is shown in Figure 5. The digital camera image is in Geotiff format (assateague.tif).

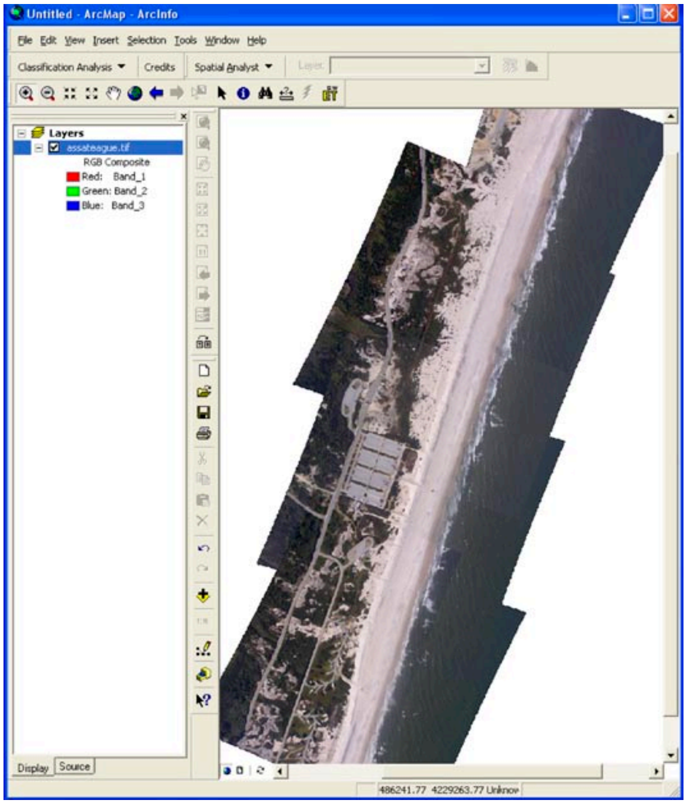


Figure 5. Add raster image to ArcMap dataframe.

The Classification Analysis Tool requires the raster to be an image format. Use the following steps to perform image conversion. If the file is already in image format, proceed to step 2.

Click on the Classification Analysis Tool (Figure 6).

Select Utilities.

Select Convert Raster to Image.

Select image file name from dropdown list.

Click OK.

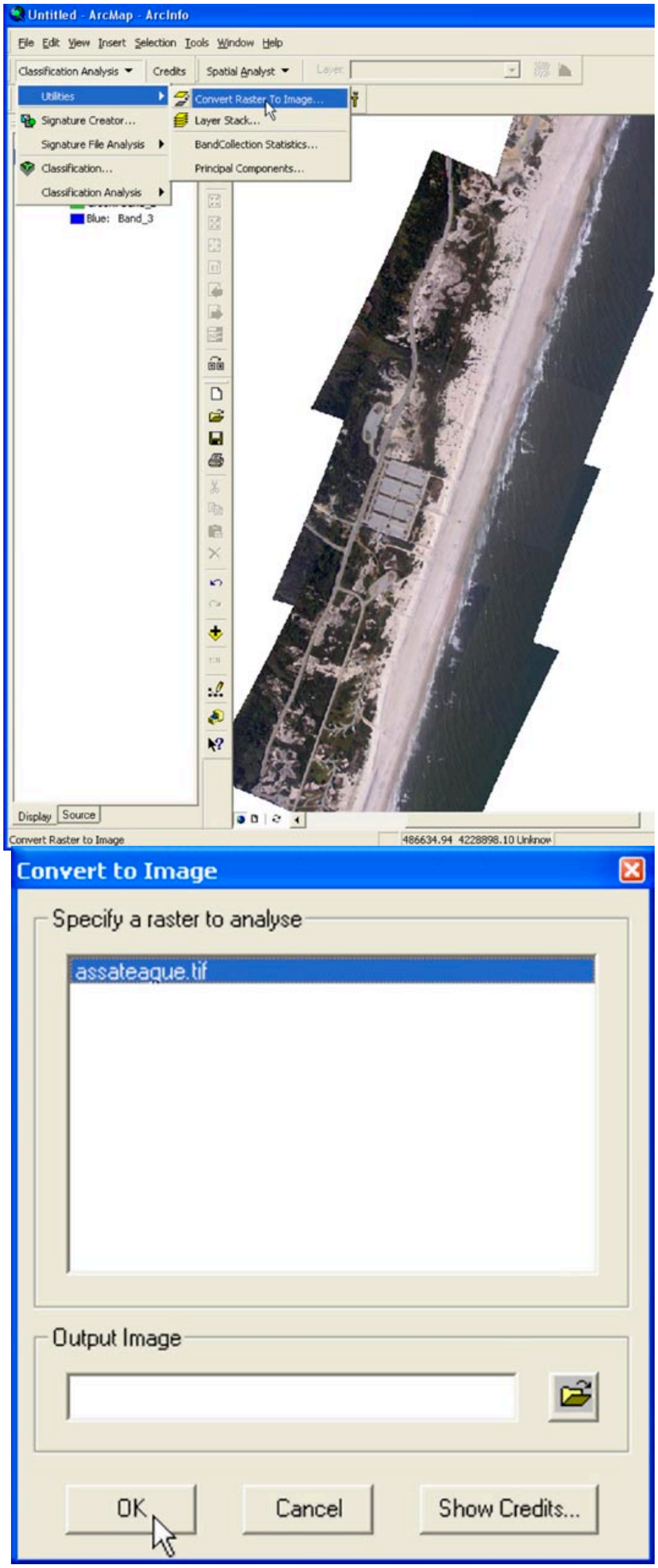


Figure 6. Convert raster to image using the Classification Analysis tool.

The new image will automatically load into the map dataframe. For this example, the new file is named assateague.img.

2.2 Create Signature File

The next step to perform is the image classification using the Classification Analysis Tool. First, a signature file must be created.

From the dropdown menu of the Classification Analysis Tool, select Signature Creator (Figure 7). Options for supervised or unsupervised classification are listed. Unsupervised classification was determined to be satisfactory for distinguishing between vegetation and sand, which is chiefly the edge of vegetation line on Assateague Island. A maximum of 25 classes was chosen, but this can be adjusted.

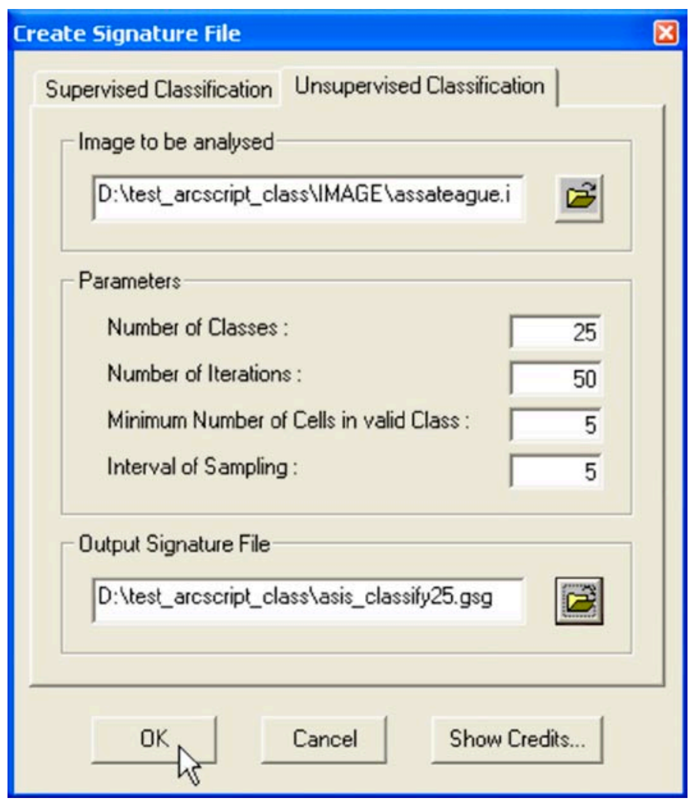


Figure 7. Dialog box used when creating signature file for image classification.

Select the Unsupervised Classification tab.

Select the Image File to be classified.

Input the Number of Classes.

Input the Number of Iterations.

Input the Minimum Number of Cells in Valid Class.

Input the Interval of Sampling.

Provide an output Signature File name (for this example: assateague_class.gsg).

Click OK.

2.3 Perform Image Classification

Once the signature file has been created from the image, perform the classification on the image (Figure 8).

Select Classification from the Classification Analysis Tool menu.

Select the Image to be Analyzed.

Select the Signature File that was just created.

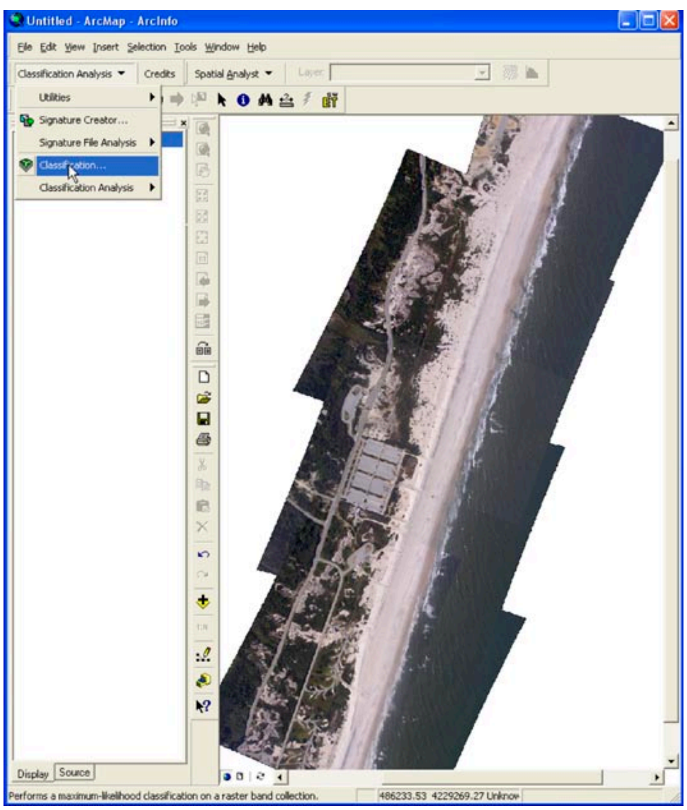
Select new location of Output File and provide a new name (assateague_class25.img).

Next, load new image into dataframe; see step 2.4.

2.4 Load Classified Image

The classified image will automatically load into the map dataframe. Note that only 15 of the maximum 25 classes for this image were created (Figure 9). Note, name changed to asis_class25.img)

The classes will be aggregated (reclassified) to create fewer classes using Spatial Analyst during the next step.



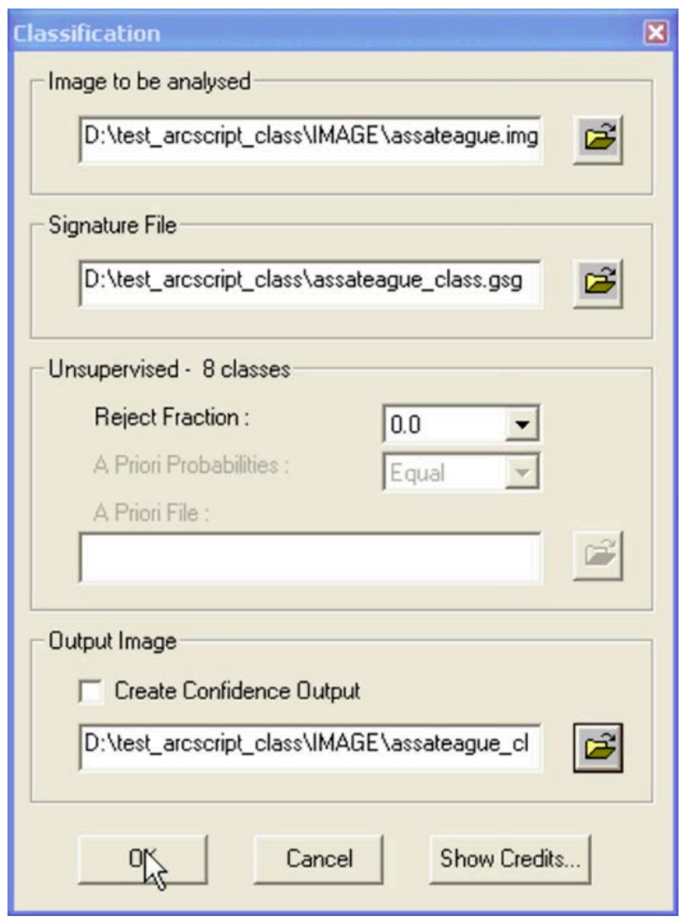


Figure 8. Use Classification Analysis Tool to perform classification; classification dialog box shown at right.

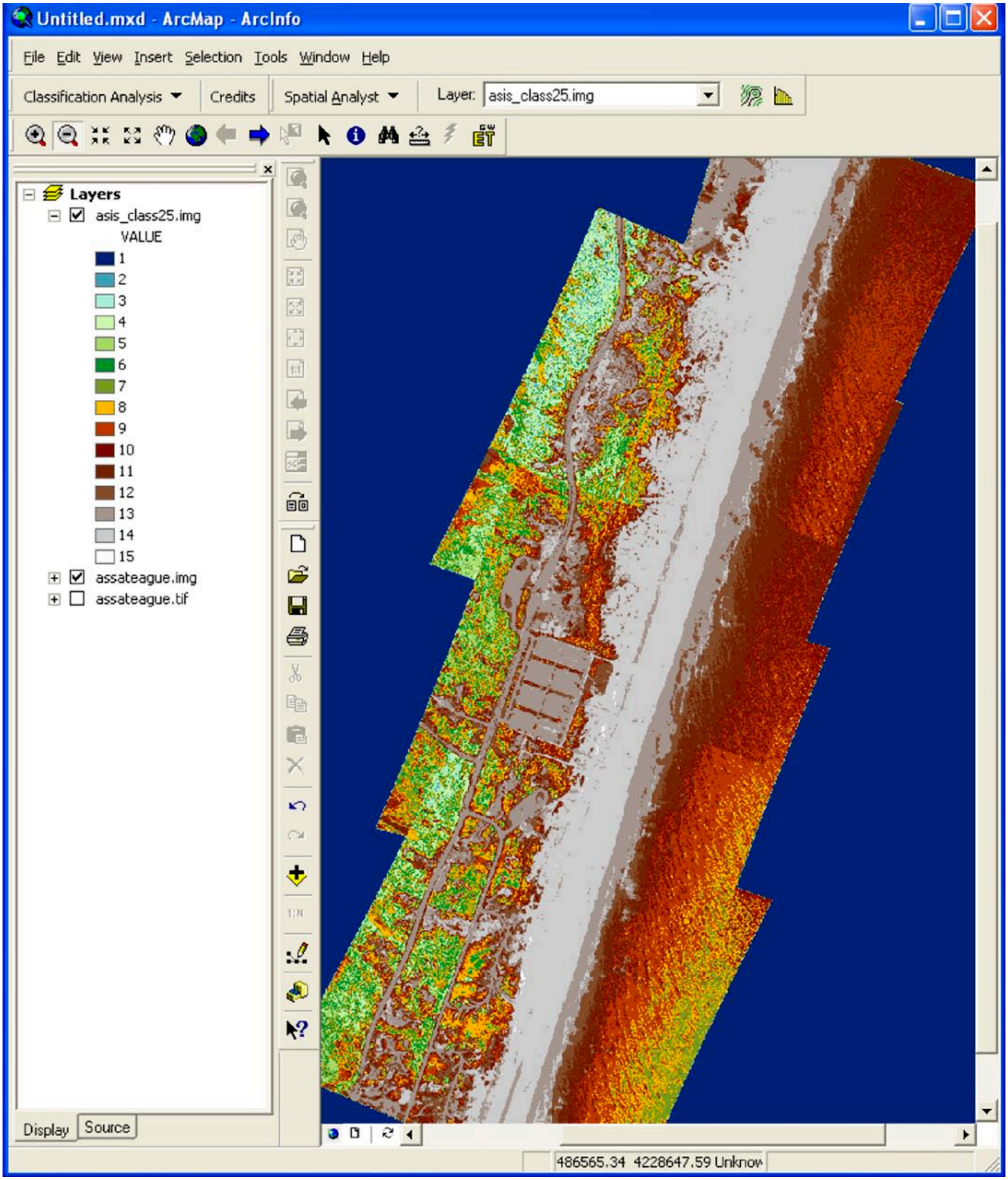


Figure 9. Resulting classified aerial photo (15 classes).

2.5 Aggregate Classes

Using Spatial Analyst, reclassify the image until the fewest number of classes necessary to allow for the capture of the seaward edge of vegetation have been created (Figure 10).

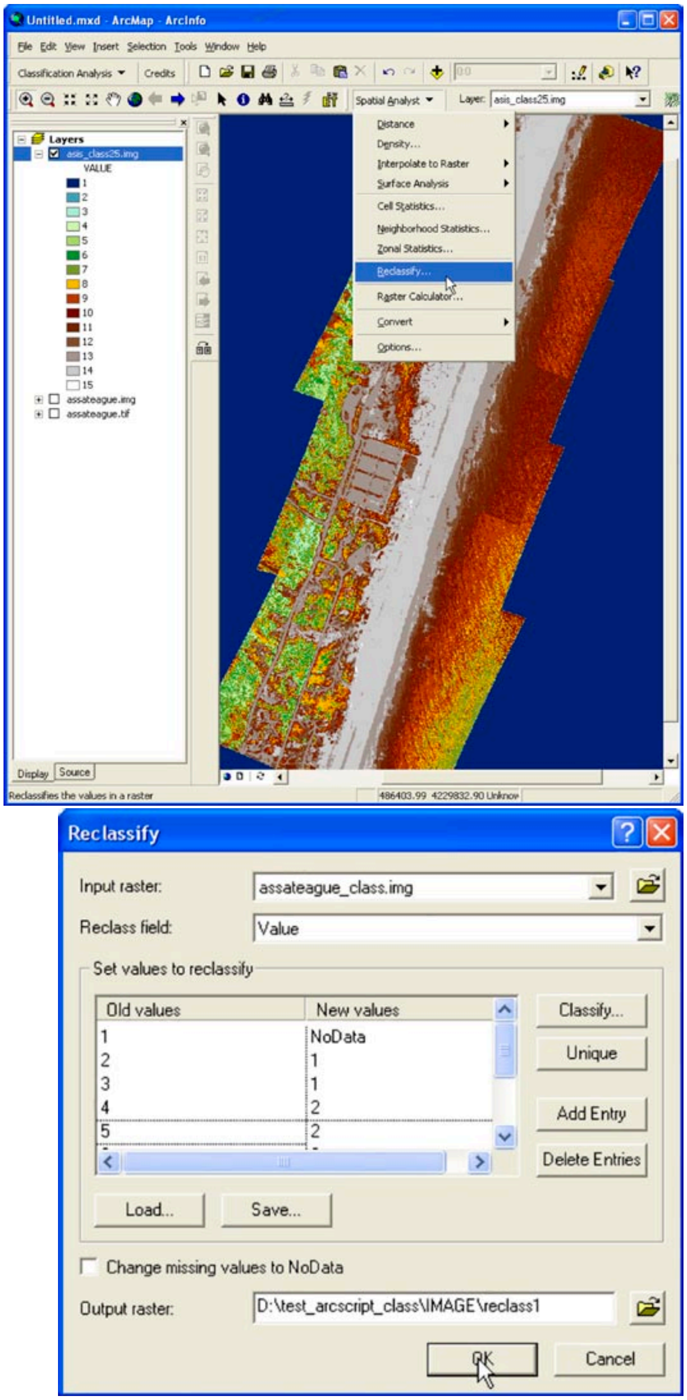


Figure 10. Aggregate existing classes into a smaller number of classes using Spatial Analyst. Reclassify dialog box shown above.

Select Reclass from the Spatial Analyst menu.

Select Input Raster and Reclass Field.

Provide New Values in order to aggregate the old classes into fewer new classes.

Select Output Raster location and enter name (asis_reclass.img).

2.6 Final Classes from Aggregation

For this example, the original 15 classes were aggregated until only two new classes remained (Figure 11). The two classes are:

sand (value 2), and

other (value1).

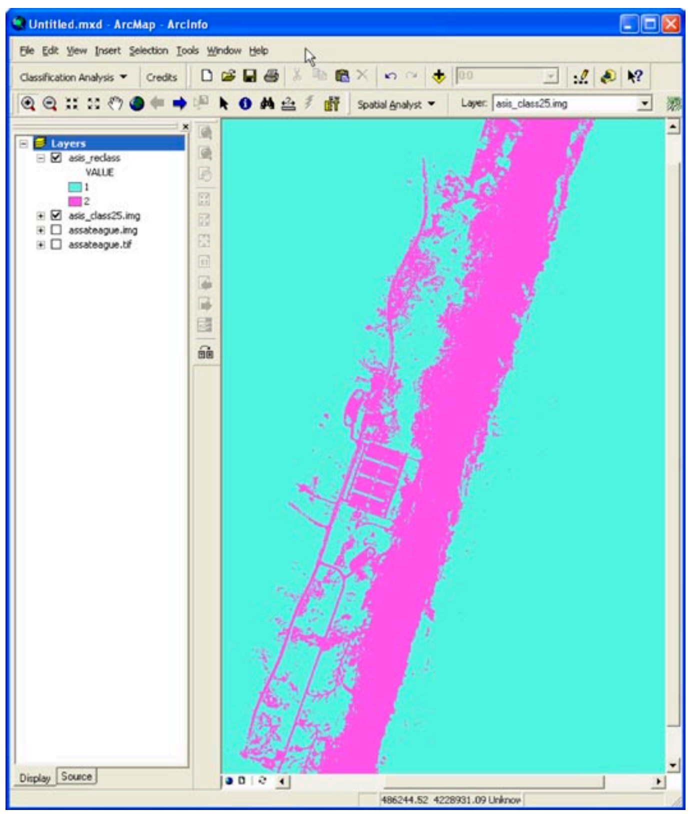


Figure 11. Final two classes resulting from reclassification are shown.

Next the raster is converted to a feature layer (polygons).

2.7 Convert Raster to Polygon

To extract the edge of vegetation Line, convert the raster to a feature (polygon) using Spatial Analyst (Figure 12).

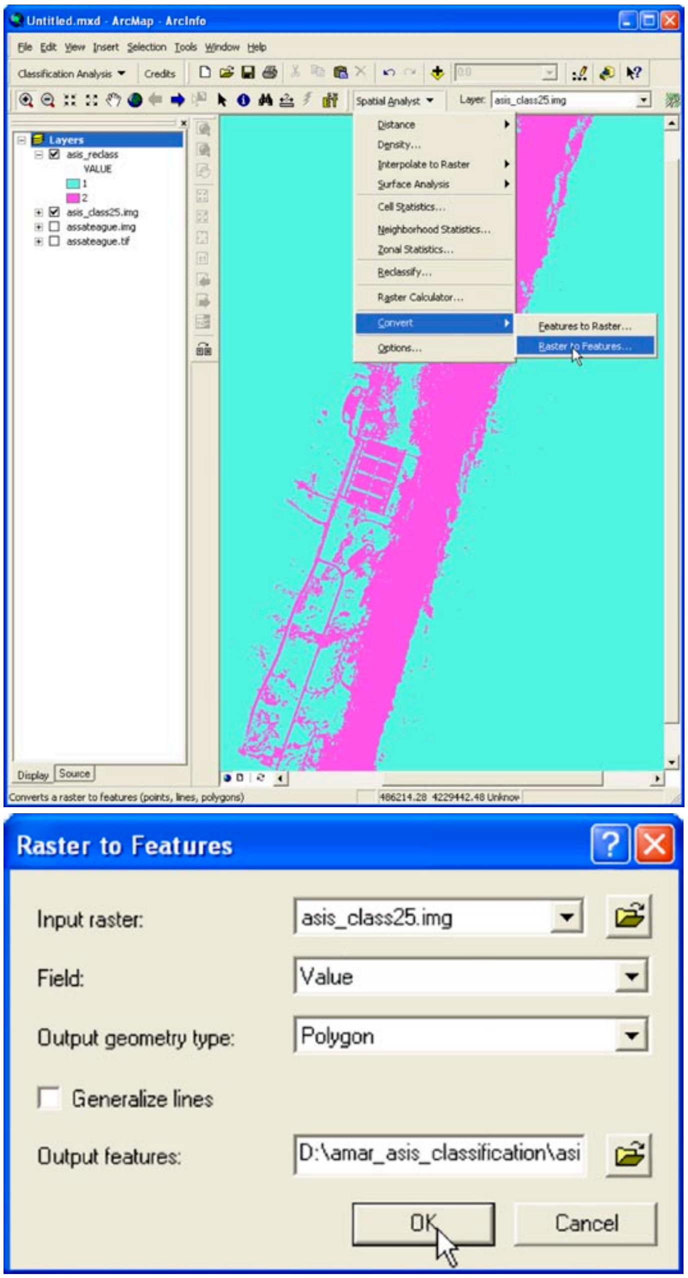


Figure 12. Using Spatial Analyst, convert raster layer to feature (polygon) layer; Raster to Features dialog box shown above.

Select Convert from the Spatial Analyst menu.

Select Raster to Feature.

From the Raster to Feature dialog, select Input Raster, Field, Output Geometry Type (Polygon).

Deselect Generalize Lines if selected.

Select Output Feature location and provide name for polygon layer.

Click OK.

2.8 Convert Polygon Layer to Polyline

To extract the edge of vegetation line, the polygon must be converted to a polyline. This can be accomplished using XTools Pro2.2, an extension for ArcGIS 8.x and 9.x downloaded from the ESRI webpage. The program was written by Maxim Chikinev and Igor Popov. The URL used to locate the download is: http://arcscripts.esri.com/details.asp?dbid=11731

First, select the polygon that will be edited to create the edge of vegetation line. Export to a new file and load into the dataframe.

From the ArcMap menu bar, click on Tools (Figure 13).

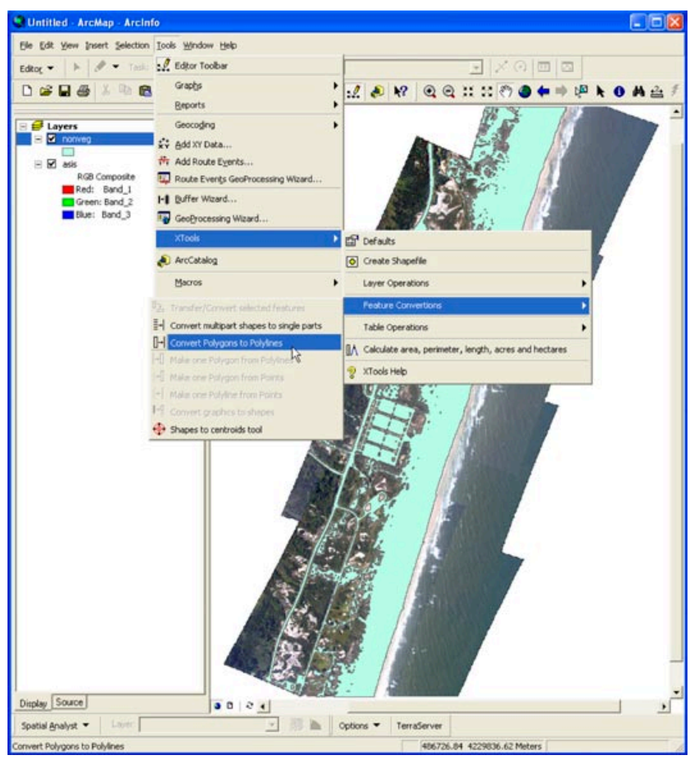


Figure 13. Using the XTools extension to convert a polygon to a polyline.

From the drop-down menu, select XTools.

Select Feature Conversions.

Select Convert Polygons to Polylines.

A pop-up will direct you to select the polygon layer to convert and select the directory to which the new file will be written with a new file name.

The new polyline will automatically be added to the dataframe in ArcMap (Figure 14).

Figure 14. Section of polyline/polygon zoomed in to show detail.

Next, the polyline will be edited to extract the edge of vegetation line.

2.9 Extract Vegetation Line

Edit the polyline to extract the vegetation line. Clip out line that runs between seaward edge of terrestrial vegetation and sand using the Editor tool in ArcGIS (Figure 15).

In areas where there is no stable natural vegetation present, this line shall be established by connecting or extending the lines from the nearest adjacent vegetation on either side of the site and by extrapolating (by either on-ground observation or by aerial photographic interpretation) to establish the line.

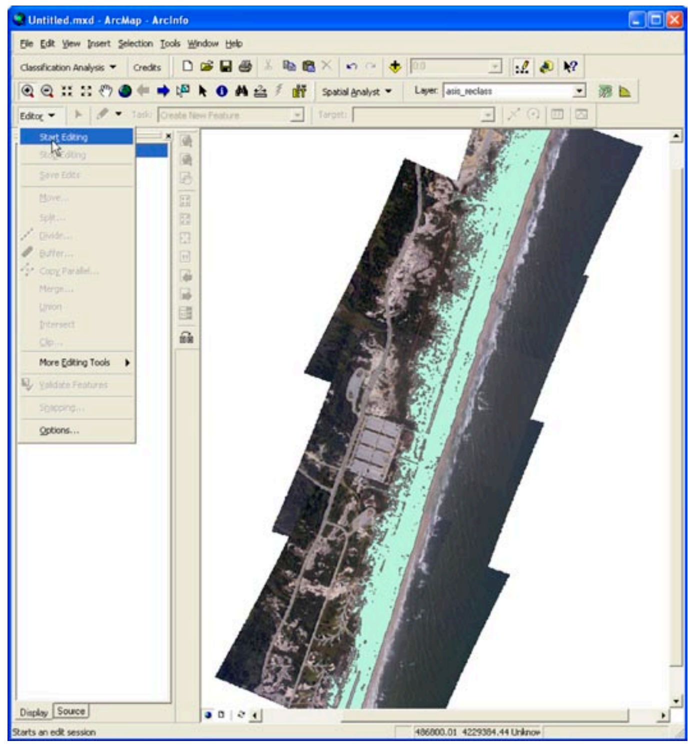


Figure 15. Begin Editing menu.

Click the Editor menu on the ArcMap toolbar.

From the drop-down menu, select Start Editing.

From the pop-up GUI, select the folder that contains the file to be edited.

Select the polyline to edit using the selection tool; this will activate the editing tools. Ensure that the file name is listed in the Target dialog box on the Editor toolbar.

From the Tasks menu, select Modify Feature.

To edit, the polyline may be clipped; open sections are closed by digitizing using the sketch tool, or if the gap is small enough, simply drag vertices together.

As edits are made, save using the Save Edits selection on the Editor drop-down menu.

When editing is complete, select Save Edits and Stop Editing from the Editor drop-down menu.

The resulting line is the edge of vegetation line (Figure 16).

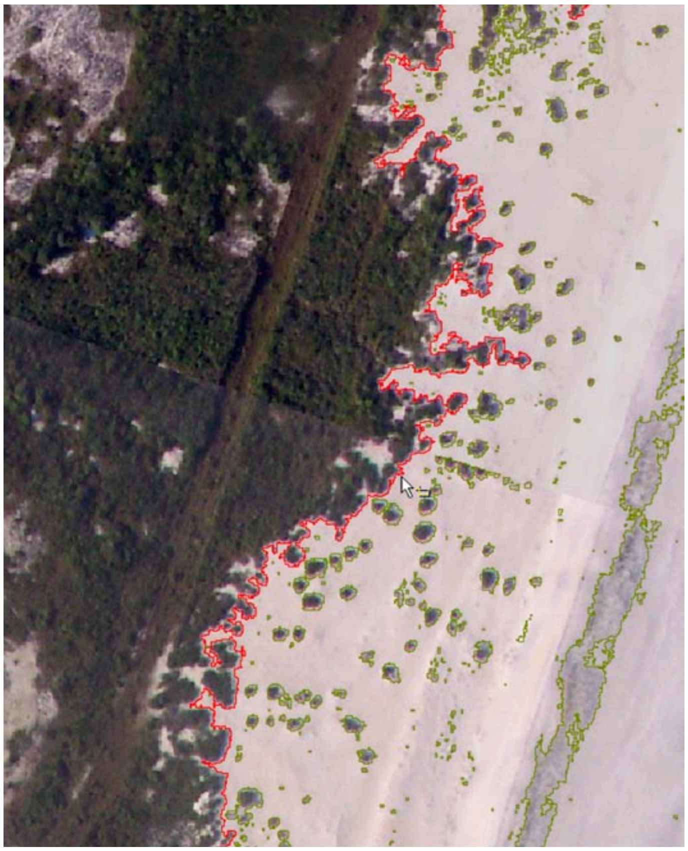


Figure 16. Resulting edge of vegetation line shown in red.

Appendix I

Obtaining Aerial Photography

Aerial photography may be obtained from the following agencies:

USGS Earth Science
Information Center
507 National Center
12201 Sunrise Valley Dr.
Reston, VA 22092
800-USA-MAPS

USDA Consolidated Farm
Service Agencies
Aerial Photography Field Office
222 West 2300 South
Salt Lake City, UT 84103-0010
801-524-5856

Cartographic and Architectural Branch
National Archives and Records Admin.
8601 Adelphi Road
College Park, MD 20740-6001
301-713-7040

Appendix II

List of Acronyms and Abbreviations

ASIS – Assateague Island National Seashore

ATM – Airborne Topographic Mapper

CCSW – Center for Coastal and Watershed Studies

DEM – Digital Elevation Model

EAARL – Experimental Advanced Airborne Research Lidar

ESRI – Environmental Systems Research Institute

FGDC – Federal Geographic Data Committee

GIS – Geographic Information System

GPS – Global Positioning System

IM – Inventory and Monitoring

INS – Inertial Navigation System

LIDAR – Light Detection and Ranging

NASA – National Aeronautic and Space Administration

NCBN – Northeast Coastal and Barrier Network

NPS – National Park Service

USDA – United States Department of Agriculture

USGS – United States Geological Survey

UTM – Universal Transverse Mercator

cm – centimeter

m – meter

Appendix III

Example Metadata for Digital Camera Image

ASIS Digital Camera Mosaic 2001

Metadata:

- Identification_Information
- Data_Quality_Information
- Spatial_Data_Organization_Information
- Spatial_Reference_Information
- Distribution_Information
- Metadata_Reference_Information

Identification_Information:
  Citation:
    Citation_Information:
      Originator: U.S. Geological Survey Center for Coastal and Watershed Studies 600 4th Street South St. Petersburg, FL 33701
      Publication_Date: 2001
      Title: ASIS Digital Camera Mosaic 2001
      Edition: First
      Geospatial_Data_Presentation_Form: raster digital data
      Other_Citation_Details: The USGS, in cooperation with the National Park Service (NPS) and the National Aeronautics and Space Administration (NASA), is to provide the coastal management community with usable, useful digital elevation products. The USGS processes aircraft lidar data (provided by NASA), develops software tools and algorithms to use and analyze the data and make products available to the coastal management community through a variety of media, including the internet, CD-ROMs and data reports.
      Online_Linkage: none
  Description:
    Abstract: Dataset contains mosaiced georeferenced digital camera images. These data were collected during the September 5, 2001, NASA ATM3 survey mission over Assateague Island National Seashore.

Purpose: The digital camera imagery is collected in conjunction with lidar elevation data in order to provide a more complete dataset to be used in resource management for National Seashores.
Time_Period_of_Content:
Time_Period_Information:
Single_Date/Time:
Calendar_Date: 20010905
Currentness_Reference: 20010905
Status:
Progress: Complete
Maintenance_and_Update_Frequency: Unknown
Spatial_Domain:
Bounding_Coordinates:
West_Bounding_Coordinate: -81.163032
East_Bounding_Coordinate: -81.140150
North_Bounding_Coordinate: 38.216397
South_Bounding_Coordinate: 38.198342
Keywords:
Theme:
Theme_Keyword: Airborne Topographic Mapper
Theme_Keyword: coastal management
Theme_Keyword: elevation change
Theme_Keyword: Digital Camera
Theme_Keyword: resource management
Place:
Place_Keyword: Assateague Island National Seashore
Place_Keyword: Atlantic Coast
Place_Keyword: Maryland
Place_Keyword: United States East Coast
Place_Keyword: Virginia
Access_Constraints: Any use of these data signifies a user's agreement to comprehension and compliance of the USGS Standard Disclaimer. Ensure all portions of metadata are read and clearly understood before using these data in order to protect both user and USGS interests. See section 6.3 Distribution Liability.
Use_Constraints: Although the USGS is making these datasets available to others who may find them valuable, USGS does not warrant, endorse, or recommend the use of these data for any given purpose. The user assumes the entire risk related to the use of these data. These datasets are not for navigational purposes. USGS is providing these data "as is," and USGS disclaims any and all warranties, whether expressed or implied, including (without limitation) any implied warranties of merchantability or fitness for a particular purpose. In no event will USGS be liable to you or to any third party for any direct, indirect, incidental, consequential, special, or exemplary damages or lost profits resulting from any use or misuse of these data.

Acknowledgement of the U.S. Geological Survey Center for Coastal and Watershed Studies as a data source would be appreciated in products developed from these data, and such acknowledgement as is standard for citation and legal practices for data source is expected by users of this data. Sharing new data layers developed directly from these data would also be appreciated by USGS staff. Users should be aware that comparisons with other datasets for the same area from other time periods may be inaccurate due to inconsistencies resulting from changes in photo interpretation, mapping conventions, and digital processes over time. These data are not legal documents and are not to be used as such.

Point_of_Contact:
Contact_Information:
Contact_Organization_Primary:
Contact_Organization: U.S. Geological Survey, Center for Coastal and Watershed Studies
Contact_Person: Dr. John C. Brock
Contact_Address:
Address_Type: mailing and physical address
Address: 600 4th Street South
City: St. Petersburg
State_or_Province: FL
Postal_Code: 33701
Country: USA
Contact_Voice_Telephone: (727)803-8747
Contact_Electronic_Mail_Address: jbrock@usgs.gov
Hours_of_Service: Monday-Friday, 8-5, EST
Data_Set_Credit:
The USGS Center for Coastal and Watershed Studies would like to acknowledge NASA Wallops Flight Facility for their cooperation and assistance in the development of the data.
Native_Data_Set_Environment:
Microsoft Windows 2000 Version 5.1 (Build 2600) Service Pack 2; ESRI ArcCatalog 8.3.0.800
Cross_Reference:
Citation_Information:
Originator: John Brock and Asbury Sallenger, U.S. Geological Survey
Publication_Date: 2001
Title: Airborne Topographic Lidar Mapping for Coastal Science and Resource Management
Geospatial_Data_Presentation_Form: USGS Open-File Report
Publication_Information:
Publication_Place: St. Petersburg, FL
Publisher: U.S. Geological Survey
Citation_Information:
Originator: Brock, J.C.; Wright, C.W.; Sallenger, A.H.; Krabill, W.B.; and Swift, R.N.
Publication_Date: 2003
Title: Basis and Methods of NASA Airborne Topographic Mapper Lidar Surveys for Coastal Studies
Geospatial_Data_Presentation_Form: journal article
Publication_Information:
Publication_Place: West Palm Beach, FL
Publisher: Journal of Coastal Research

Spatial_Data_Organization_Information:
Direct_Spatial_Reference_Method: Raster
Raster_Object_Type: Pixel
Row_Count: 4000
Column_Count: 4000
Vertical_Count: 1

Spatial_Reference_Information:
Horizontal_Coordinate_System_Definition:
Planar:
Grid_Coordinate_System:
Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:
UTM_Zone_Number: 17
Transverse_Mercator:
Scale_Factor_at_Central_Meridian: 0.999600
Longitude_of_Central_Meridian: -81.000000
Latitude_of_Projection_Origin: 0.000000
False_Easting: 500000.000000
False_Northing: 0.000000
Planar_Coordinate_Information:
Planar_Coordinate_Encoding_Method: row and column
Coordinate_Representation:
Abscissa_Resolution: 0.500000
Ordinate_Resolution: 0.500000
Planar_Distance_Units: meters
Geodetic_Model:
Horizontal_Datum_Name: D_WGS_1984
Ellipsoid_Name: WGS_1984
Semi-major_Axis: 6378137.000000
Denominator_of_Flattening_Ratio: 298.257224

Distribution_Information:
Distributor:
Contact_Information:
Contact_Organization_Primary:
Contact_Organization: U.S. Geological Survey
Contact_Position: GIS Specialist
Contact_Address:
Address_Type: Mailing Address
Address: 600 4th Street South
City: St. Petersburg
State_or_Province: FL
Postal_Code: 33701
Country: USA
Contact_Voice_Telephone: 727-803-8747
Contact_Instructions: Call Office for Details
Resource_Description: Call Office for Details
Distribution_Liability:
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Standard_Order_Process:
  Custom_Order_Process: Call USGS for Details

Metadata_Reference_Information:
  Metadata_Date: 20050629
    Metadata_Contact:
      Contact_Information:
        Contact_Organization_Primary:
          Contact_Organization: U.S. Geological Survey
          Contact_Person: Melanie Harris
        Contact_Position: GIS Specialist
        Contact_Address:
          Address_Type: Mailing
          Address: 600 4th Street South
          City: St. Petersburg
          State_or_Province: FL
          Postal_Code: 33701
          Country: USA
        Contact_Voice_Telephone: 727-803-8747
        Contact_Instructions: Call Survey for Details
  Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata
  Metadata_Standard_Version: FGDC-STD-001-1998
  Metadata_Time_Convention: local time
  Metadata_Extensions:
    Profile_Name: ESRI Metadata Profile

Example Metadata for Edge of Vegetation Line

Edge of Vegetation - ASIS 2001

Metadata:

Identification_Information:
  Citation:
    Citation_Information:
      Originator:
        U.S. Geological Survey Center for Coastal and Watershed Studies 600 4th Street South St. Petersburg, FL 33701
      Publication_Date: 2004
      Title: Edge of Vegetation - ASIS 2001
      Edition: First
      Geospatial_Data_Presentation_Form: vector digital data
      Other_Citation_Details:
        The USGS, in cooperation with the National Park Service (NPS) and the National Aeronautics and Space Administration (NASA), is to provide the coastal management community with usable, useful digital elevation products. The USGS processes aircraft lidar data (provided by NASA), develops software tools and algorithms to use and analyze the data and make products available to the coastal management community through a variety of media, including the internet, CD-ROMs and data reports.
      Online_Linkage: none
  Description:
    Abstract:
      Dataset contains edge of vegetation line derived from mosaiced georeferenced digital camera images. These data were collected during the September 5, 2001, NASA ATM3 survey mission over Assateague Island National Seashore.
    Purpose:
      The digital camera imagery is collected in conjunction with lidar elevation data in order to provide a more complete dataset to be used in resource management for National Seashores.
  Time_Period_of_Content:
    Time_Period_Information:
      Single_Date/Time:
      Calendar_Date: 20010905
    Currentness_Reference: 20010905

Status:
Progress: Complete
Maintenance_and_Update_Frequency: Unknown

Spatial_Domain:
Bounding_Coordinates:
West_Bounding_Coordinate: -81.154681
East_Bounding_Coordinate: -81.147511
North_Bounding_Coordinate: 38.213517
South_Bounding_Coordinate: 38.199864
Keywords:
Theme:
Theme_Keyword: Airborne Topographic Mapper
Theme_Keyword: coastal management
Theme_Keyword: edge of vegetation
Theme_Keyword: digital camera
Theme_Keyword: resource management
Place:
Place_Keyword: Assateague Island National Seashore
Place_Keyword: Atlantic Coast
Place_Keyword: Maryland
Place_Keyword: United States East Coast
Place_Keyword: Virginia
Access_Constraints:
Any use of these data signifies a user's agreement to comprehension and compliance of the USGS Standard Disclaimer. Ensure all portions of metadata are read and clearly understood before using these data in order to protect both user and USGS interests. See section 6.3 Distribution Liability.
Use_Constraints:
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Acknowledgement of the U.S. Geological Survey Center for Coastal and Watershed Studies as a data source would be appreciated in products developed from these data, and such acknowledgement as is standard for citation and legal practices for data source is expected by users of this data. Sharing new data layers developed directly from these data would also be appreciated by USGS staff. Users should be aware that comparisons with other datasets for the same area from other time periods may be inaccurate due to inconsistencies resulting from changes in photo interpretation, mapping conventions, and digital processes over time. These data are not legal documents and are not to be used as such.
Point_of_Contact:
Contact_Information:
Contact_Organization_Primary:
Contact_Organization: U.S. Geological Survey, Center for Coastal and Watershed Studies
Contact_Person: Dr. John C. Brock
Contact_Position: National Coastal Assessment Project Chief

Contact_Address:
Address_Type: mailing and physical address
Address: 600 4th Street South
City: St. Petersburg
State_or_Province: FL
Postal_Code: 33701
Country: USA

Contact_Voice_Telephone: (727)803-8747
Contact_Electronic_Mail_Address: jbrock@usgs.gov
Hours_of_Service: Monday-Friday, 8-5, EST
Data_Set_Credit:
The USGS Center for Coastal and Watershed Studies would like to acknowledge NASA Wallops Flight Facility for their cooperation and assistance in the development of the data.
Native_Data_Set_Environment:
Microsoft Windows 2000 Version 5.1 (Build 2600) Service Pack 2; ESRI ArcCatalog 8.3.0.800
Cross_Reference:
Citation_Information:
Originator: John Brock and Asbury Sallenger, U.S. Geological Survey
Publication_Date: 2001
Title:
Airborne Topographic Lidar Mapping for Coastal Science and Resource Management
Geospatial_Data_Presentation_Form: USGS Open-File Report
Publication_Information:
Publication_Place: St. Petersburg, FL
Publisher: U.S. Geological Survey
Citation_Information:
Originator:
Brock, J.C.; Wright, C.W.; Sallenger, A.H.; Krabill, W.B.; and Swift, R.N.
Publication_Date: 2003
Title:
Basis and Methods of NASA Airborne Topographic Mapper Lidar Surveys for Coastal Studies
Geospatial_Data_Presentation_Form: journal article
Publication_Information:
Publication_Place: West Palm Beach, FL
Publisher: Journal of Coastal Research

Spatial_Data_Organization_Information:
Direct_Spatial_Reference_Method: Vector
Point_and_Vector_Object_Information:
SDTS_Terms_Description:
SDTS_Point_and_Vector_Object_Type: String
Point_and_Vector_Object_Count: 83

Spatial_Reference_Information:
Horizontal_Coordinate_System_Definition:
Planar:
Grid_Coordinate_System:
Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:
UTM_Zone_Number: 18
Transverse_Mercator:
Scale_Factor_at_Central_Meridian: 0.999600
Longitude_of_Central_Meridian: -75.000000
Latitude_of_Projection_Origin: 0.000000
False_Easting: 500000.000000
False_Northing: 0.000000
Planar_Coordinate_Information:
Planar_Coordinate_Encoding_Method: coordinate pair
Coordinate_Representation:
Abscissa_Resolution: 0.000001
Ordinate_Resolution: 0.000001
Planar_Distance_Units: meters
Geodetic_Model:
Horizontal_Datum_Name: North American Datum of 1983
Ellipsoid_Name: Geodetic Reference System 80
Semi-major_Axis: 6378137.000000
Denominator_of_Flattening_Ratio: 298.257222

Entity_and_Attribute_Information:
Detailed_Description:
Entity_Type:
Entity_Type_Label: asis2001_edgeveg
Attribute:
Attribute_Label: FID
Attribute_Definition: Internal feature number.
Attribute_Definition_Source: ESRI
Attribute_Domain_Values:
Unrepresentable_Domain: Sequential unique whole numbers that are automatically generated.
Attribute:
Attribute_Label: Shape
Attribute_Definition: Feature geometry.
Attribute_Definition_Source: ESRI
Attribute_Domain_Values:
Unrepresentable_Domain: Coordinates defining the features.
Attribute:
Attribute_Label: ParkID
Attribute:
Attribute_Label: Year
Attribute:
Attribute_Label: Sensor
Attribute:
Attribute_Label: Date_

Distribution_Information:
Distributor:
Contact_Information:
Contact_Organization_Primary:
Contact_Organization: U.S. Geological Survey
Contact_Address:
Address_Type: Mailing Address
Address: 600 4th Street South
City: St. Petersburg
State_or_Province: FL
Postal_Code: 33701
Country: USA
Contact_Voice_Telephone: 727-803-8747
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Standard_Order_Process:
Custom_Order_Process: Call USGS for Details

Metadata_Reference_Information:
Metadata_Date: 20050630
Metadata_Contact:
Contact_Information:
Contact_Organization_Primary:
Contact_Organization: U.S. Geological Survey
Contact_Person: Melanie Harris
Contact_Position: GIS Specialist
Contact_Address:
Address_Type: Mailing
Address: 600 4th Street South
City: St. Petersburg
State_or_Province: FL
Postal_Code: 33701
Country: USA

Contact_Voice_Telephone: 727-803-8747
Contact_Instructions: Call Survey for Details
Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata
Metadata_Standard_Version: FGDC-STD-001-1998
Metadata_Time_Convention: local time
Profile_Name: ESRI Metadata Profile

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Brock, J.C., Wright, C.W., Sallenger, A.H., Krabill, W.B., and Swift, R.N., 2003, Basis and methods of NASA Airborne Topographic Mapper lidar surveys for coastal studies: Journal of Coastal Research, v. 18, no. 1, p. 1-13.

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Notes

[1]National Park Service Inventory and Monitoring Program: Northeast Coastal and Barrier Network Vital Signs Monitoring Plan Documents [URL:http://www1.nature.nps.gov/im/units/ncbn/m_plan.html]