iCoast—Did the Coast Change?
Appendix to Supporting Statement A

Figure 1. Welcome Page for iCoast. This is the first page any user sees. He or she can register for iCoast or log in if they have previously registered. If users have not yet registered with iCoast, they will register through Google, an OpenID provider to the Federal Government. **Please Note**. All pages have the footer and feedback button shown, however on some figures this is omitted in the interest of space.

Figure 2. Profile Page for iCoast. On this page, the first time user completes his or her registration. The iCoast software will compare the email address that is returned by Google to the iCoast database of encrypted user email addresses. If the email is not found, the user is identified as a new user and the system will request the user's time zone and crowd type. The pick list of crowd types is shown in Figure 3. The user can also insert a crowd type of their own choosing in the space provided and optionally supply their affiliation (eg. name of organization such as university).

Figure 3. Registration Page for iCoast. This screen is identical to Figure 2, except that the possible crowd types that the user may select are shown.

Figure 4. Welcome Page seen by first-time users. This page appears when a first-time user has successfully registered for iCoast. Note that the user email address, which is stored in the database in encrypted form, is obscured. The page indicates the project available for tagging. At the moment the only project available is for Hurricane Sandy. The user can begin tagging photographs by pressing the button.

Figure 5. Welcome Back Page. This page is for users who have previously registered but have not yet tagged photographs. Users are ranked by statistics kept in the iCoast database anonymously. This is an element of gamification to help boost participation.

USGS iCoast - Did the Coast Change?

Home | Welcome | Classify | Profile | Help | About | Logout

Welcome Back to USGS iCoast

You are logged in as bs***re@usgs.gov
If this is not you, logout then login with your Google Account.

Your USGS iCoast Statistics

Leaderboard Position:	Joint 24th Place
# of Photos Tagged:	2
# of Photos to Move up a Position:	1
# of Photos to Reach 1st Place:	103
# of Tags in Total:	9
Last Project Annotated:	Hurricane Sandy
Last Annotation:	May 2, 2014 at 1:30 PM

Start Tagging Photos

Rodanthe, NC. Hurricane Sandy caused this section of coastline to experience inundation with resulting damage to housing and infrastructure.

Figure 6. Welcome Back Page. This page is seen by users who have previously registered and tagged photographs. The anonymized statistics in the iCoast database reflect the ranking of the user among all other users, how many photographs the user has tagged, how many photographs the user would need to tag to move up on the leaderboard or reach first place, the total number of photographs the user has tagged, and the date and time of the user's last session.

Figure 7. **Profile and Tagging History**. Once a user has established a profile he or she can access it by clicking on the *Profile* button along the top of the page. This page reflects the choices shown in figure 2 as well as providing access to the user's tagging history, either their complete history or their history for a specific project only Hurricane Sandy is currently available.) This screen can be used to change the user's profile.

Figure 8. Tagging History. This page appears if the user clicks the *Complete History* button. The chart shows where and when a user's tags were made. The locations previously tagged can are indicated on the map.

USGS iCoast - Did the Coast Change?

| Home | Profile | Classify | Help | About | Logout |

USGS iCoast Help and FAQs

FAQs

Click any question to reveal the answer

[Reveal All FAQs]   [Hide All FAQs]

Logging Into USGS iCoast

[+] Why do I have to sign in with a Google account? Can I sign in with other accounts?

[+] I don't have a Google Account. How do I get one? Can I register with Google using an existing non-Google email address?

[+] What information is shared between Google and the USGS iCoast system?

[+] Can I make changes to the information I provided when I first created an iCoast account?

Using the USGS iCoast System

[+] What is the best screen resolution for using iCoast?

[+] Can the magnifier tool zoom in and out?

[+] What are the pop-up boxes that appear next to the tags?

[+] What is the purpose of the map in the middle of the classification page?

Coastal Aerial Photos

[+] What is the difference between selecting a photo with the *Random* button versus the *Map* button?

[+] Can I change and update post-storm photos that I already annotated?

[+] Why do some pre-storm photos show more change and damage than the post-storm photos?

[+] Why is the location information above each photograph not always accurate?

[+] Can you put a scale bar on each aerial photograph?

Figure 9. Help Page. This page is accessed by pressing the *Help* button at the top of the page. The Help consists of frequently asked questions (FAQ). The questions and answers are detailed in the next three figures.

Logging Into USGS iCoast

☐ **Why do I have to sign in with a Google account? Can I sign in with other accounts?**

USGS has chosen to use OpenID authentication and Google based credentials to lighten the burden on the public of creating multiple user names and passwords. Using externally issued credentials in this manner also increases user security by reducing the number of places in which sensitive information such as IDs and Passwords is stored.

☐ **I don't have a Google Account. How do I get one? Can I register with Google using an existing non-Google email address?**

By clicking the *Login or Register with Google* button on the iCoast *Login* page you will be redirected to a Google server which handles the login process. Below the Email and Password boxes is a link to create a new account with Google. You can use any email address to create a Google account by selecting the option to use your own address when asked to choose your username. If you have problems logging into iCoast, please contact the iCoast administrators at icoast@usgs.gov.

☐ **What information is shared between Google and the USGS iCoast system?**

After iCoast has successfully authenticated the user via a Google server, the iCoast system only stores the user's Google username, which is the email used to login to Google Accounts. USGS does not share any information about you or your actions within the iCoast system with Google. Google is primarily used as a secure authentication medium. If you have any security questions or other concerns, please contact icoast@usgs.gov.

☐ **Can I make changes to the information I provided when I first created an iCoast account?**

Yes, go to the *Profile* page and you can update your account information there. We may request other optional information in the future here.

Figure 10. Questions and Answers about Logging into iCoast.

Using the USGS iCoast System

What is the best screen resolution for using iCoast?

iCoast is designed to dynamically adapt to the size of your screen but it requires a minimum resolution of 1280 pixels wide and 786 pixels high. Screens or windows smaller than this resolution may require the user to excessively scroll and may find it difficult to use iCoast.

Can the magnifier tool zoom in and out?

Yes, you can zoom in and out with the magnifier tool by using the scroll wheel on a mouse or touchpad. The magnifier tool is only visible when your cursor is over the aerial photographs.

What are the pop-up boxes that appear next to the tags?

The pop-up boxes provide textual and pictorial information about each tag containing pre-defined keywords on the buttons. The boxes appear when the cursor is inside of the tag button for a few seconds and will disappear when the cursor is outside of the tag button.

What is the purpose of the map in the middle of the classification page?

This interactive map allows you to see the location of the post-storm photo. The geographic features and place names may help you to orient yourself along the coast. You can also zoom in and out to better determine whether the coastline is a barrier island.

Figure 11. Questions and Answers about using the iCoast system.

Coastal Aerial Photos

What is the difference between selecting a photo with the *Random* button versus the *Map* button?

If you select the button, iCoast will find a random post-storm photo that you have not yet annotated. The *Map* button allows you to select a post-storm photo through a map interface. You can also use the search box at the top of the map to zoom into a specific location to search for post-storm photos in that area. To find the images you have already annotated, go to your *Profile* page.

Can I change and update post-storm photos that I already annotated?

Yes, you can find all the post-storm photos you annotated in the *Profile* page. It provides a table and map view of your annotated photos as well as a *Tag* button to allow you to edit the tags you selected.

Why do some pre-storm photos show more change and damage than the post-storm photos?

Some pre-storm photos were taken after a previous storm in that area. This may be why the pre-storm photo shows more damage than the post-storm one.

Why is the location information above each photograph not always accurate?

The aerial photographs are geocoded based on the location of the aircraft. Because these images were taken from the water, the geographic tag may not accurately reflect the location visible in the photograph. iCoast shows an estimated location of the nearest populated place or city.

Can you put a scale bar on each aerial photograph?

No, it is difficult to provide an accurate scale bar for every photograph because of the variability in altitude, distance offshore, and field of view of each flight.

Figure 12. Questions and Answers about Coastal Aerial Photographs

USGS iCoast - Did the Coast Change?

Administration | Home | Classify | Profile | Help | About | Logout

About "USGS iCoast - Did the Coast Change?"

Purpose of USGS iCoast

Since 1995, the U.S. Geological Survey (USGS) has collected over 140,000 aerial photographs of the Atlantic and Gulf coasts before and after 24 extreme storms in order to assess coastal damages. The USGS has not been able to use these images to the fullest extent due to a lack of the information processing capacity and personnel needed to analyze the thousands of images they collect after each storm. Computers cannot yet automatically identify coastal changes adequately. Human perception is still needed. "USGS iCoast - Did the Coast Change?" is a USGS research project to construct and deploy a citizen science web application that asks volunteers to compare pre- and post-storm aerial photographs and identify coastal changes using predefined tags. This crowdsourced data will help USGS improve predictive models of coastal change and educate the public about coastal vulnerability to extreme storms.

USGS Oblique Aerial Photographs

The USGS acquires high-resolution oblique aerial photography after extreme storms and compares them to baseline imagery collected before the storms. These aerial photographs are taken at a low altitude to capture a small area of the coast. Aerial imagery helps USGS scientists qualitatively classify the geomorphic change and infrastructure damage from extreme storms that may not be easily recognizable in the quantitative topographic data. The photography can be uploaded quickly to the web to help provide damage assessments in the immediate aftermath of a storm. These digital photographs are also geocoded with the location of the aircraft to easily plot them on a map. Learn more at the USGS Aerial Photography web page.

USGS Predictive Models of Storm-Induced Coastal Changes

Sandy beaches provide a natural barrier between the ocean and inland communities, ecosystems, and resources. These dynamic environments move and change in response to winds, waves, and currents. During a hurricane, these changes can be large and sometimes catastrophic. High waves and storm surge act together to erode beaches and inundate low-lying lands, putting inland communities at risk. Research on storm-induced coastal change hazards has provided the data and modeling capabilities to allow the USGS to identify areas of the US coastline that are likely to experience extreme and potentially hazardous erosion during hurricanes or other extreme storms.

To assess coastal vulnerability to extreme storms, the USGS has developed a Storm-Impact Scale to produce Coastal Change Probability estimates. Hurricane-induced water levels, due to both storm surge and waves, are compared to beach and dune elevations to determine the probabilities of three types of coastal change processes: (1) Dune Erosion, where the base or toe of the dune is eroded by waves and surge, (2) Overwash, where sand is transported and deposited landward over the beach and dune by waves and surge, and (3) Inundation, where the beach and dune are completely and continuously submerged by surge and wave runup.

Benefits and Broader Impact of USGS iCoast

There are scientific, technological, and societal benefits to the iCoast project. The crowdsourced data produced from users like you in iCoast will enhance predictive modeling of coastal erosion to better inform emergency managers, coastal planners, and coastal residents of coastal vulnerabilities in their region. iCoast also serves the cause of open government and open data, by sharing USGS aerial imagery with the public. Lastly, iCoast educates the public and particularly coastal residents about the vulnerabilities to the coastline resulting from extreme erosion during storms. iCoast can also be used by marine science educators to further science, technology, engineering, and math (STEM) education.

The USGS iCoast Team

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The USGS iCoast project is funded by the Coastal and Marine Geology Program (CMGP) and the National Geospatial Program (NGP) through the Center of Excellence for Geospatial Information Science (CEGIS).

Attributions

References to or use of non-U.S. Department of the Interior (DOI) products does not constitute an endorsement by the DOI.

Geocoding: Location names derived using the GeoNames Gazetteer. Creative Commons Attribution 3.0 License
ToolTips: TipTip. MIT and GPL Licenses
Zoom Tool: Elevate Zoom. Dual licensed: MIT and GPL Licenses
Map Marker Clustering: Leaflet.markercluster. MIT License
Map Search: Leaflet.GeoSearch. License
Form Validation: jQuery Validation Plugin. MIT License
OpenId Validation: lightopenid. MIT License
Map Icon: Created by Simple Icon. License
Dice Icon: Created by VisualPharm. License
Map Markers: Map icons Collection. Creative Commons Attribution-Share Alike 3.0 Unported License

Figure 13. About Page. Accessed by clicking *About* in the menu bar on top of the page.

Figure 14. Choose a Project and Photo. This screen is the first screen the user sees when tagging a project. It shows the help text that appears when the user hovers the mouse over the random button. iCoast was tested with photos from Hurricane Sandy (2012). In subsequent years, each storm will constitute a new project.

Figure 15. Choose a Project and Photo. Shows the help text associated with the map button.

Figure 16. iCoast Map Navigator. The iCoast system will choose a random photograph for tagging. The user can see which photo was chosen on the map and either accept the random photo, be shown another random photo, or use the map to navigate to a particular area and zoom in to the clustered photos to chose a photo to tag.

17
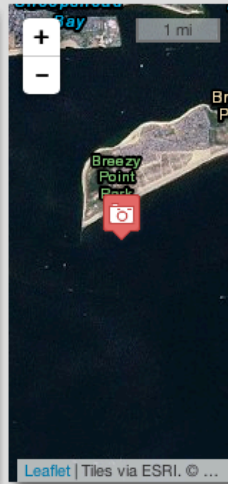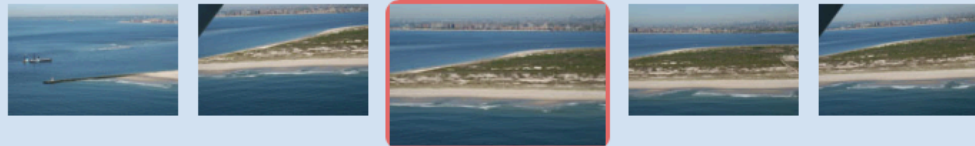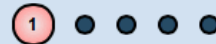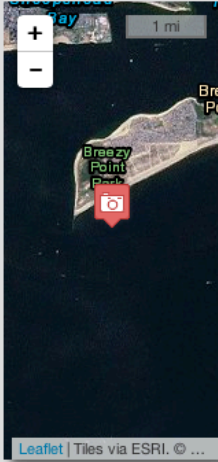
Figure 17. Task 1: Match Coastal Photos. The user may accept the computer-generated matching photograph or move along the coast in either direction to find a better match.
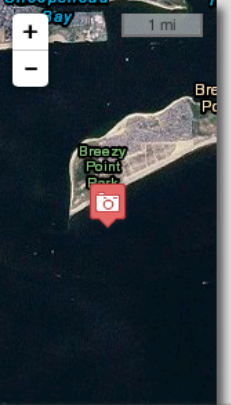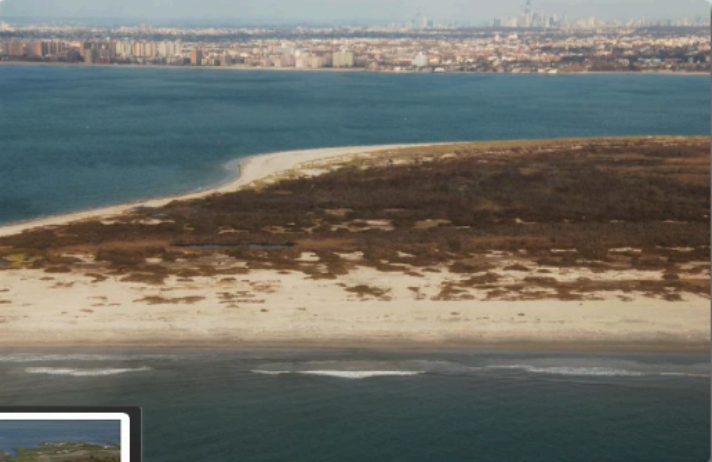
Figure 18. Task 2: Identify Coastal Landscape. Users can select a type of coastline and the level of development. The help associated with each button consists of a picture and description. An example of a picture is shown in Fig 19, page 20.

Figure 19. Task 2: This is an example of the picture and description for "Undeveloped." The help text for each button in Task 2 is given on pages 21 and 22.

Help Texts for Task 2: Identify Coastal Landscape

What type of coastline do you see in the PRE-storm photo? (choose any)

- **Barrier Island**: Elongated narrow islands with sandy beaches that run parallel to the mainland separated by a body of water like a marsh, bay or lagoon (use map above to look for water behind the coast).

- **Mainland:** Sandy beaches connected to the mainland and often backed by dunes, marshes, or human infrastructure.

- **Bluff-Backed**: A beach backed by steep cliffs or bluffs often made up of loose sediment.

- **Inlet:** An opening or gap in the coastline that leads to an enclosed body of water.

Help Text for Task 2: Identify Level of Development

What is the level of development? Choose multiple levels if necessary. (choose any)
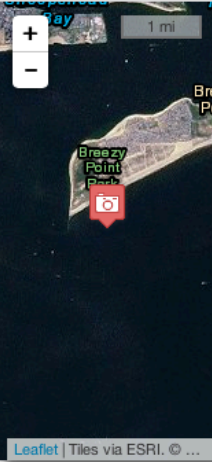
- **Undeveloped**: Natural coastal ecosystems like dunes, coastal vegetation, and marshes are more prominent with little or no human infrastructure visible

- **Moderate**: Moderately developed coast with sparse concentration of houses, residential complexes, and/or hotels; some commercial development and tourism infrastructure may be visible

- **Heavy**: Heavily developed area with a dense concentration of houses, residential complexes, and/or hotels; extensive commercial development; substantial tourism infrastructure

Figure 20: Task 3: Determine Impacts to Coastal Infrastructure. Users can select type of infrastructure and indicate damage using the buttons. Help text is shown on' Pages 24 and 25).

Help Text for Task 3: Determine Impacts to Coastal Infrastructure

What types of infrastructure do you see? (choose any)

- **None**
- **Seawall:** An artificial wall or protective structure built parallel to the shoreline to prevent the sea from eroding the coast
- **Jetty / Groin:** Coastal engineering structures built perpendicular to the coast to interrupt water flow or trap migrating sand
- **Roadway:** Paved roads and parking lots
- **Buildings:** Houses, residential complexes, tourism and commercial infrastructure
- **Bridge**: A transportation infrastructure built to create a passageway over a body of water
- **Pier:** A raised platform supported by pilings or stilts built perpendicular to the coast
- **Walkway:** A boardwalk built parallel to the beach, or a walkover with a raised path for walking over dunes to access the beach
- **Sand Fence:** A fence used to force windblown sand to accumulate in a certain area and stabilize dunes
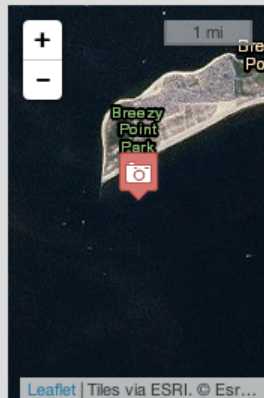-

Help Text for Task 3: Determine Impacts to Coastal Infrastructure

Which ones are damaged or missing from the storm? (choose any)

- **None**
- **Seawall:** The wall is damaged or exposed
- **Jetty / Groin:** Coastal engineering structures are more exposed or eroding
- **Roadway:** Inaccessible roads or parking lots covered by sand or damaged by storm surge waters
- **Buildings:** Damaged or missing houses, residential complexes, tourism and commercial infrastructures; they may be buried by sand or pilings might be exposed
- **Bridge:** Damaged or impassable bridge that may affect transportation
- **Pier:** Damaged or missing platform exposing the pilings or stilts of the pier
- **Walkway:** Damaged, missing, or shorter boardwalks or walkovers covered by sand
- **Sand Fence:** Missing or destroyed fence where posts from fence are more exposed

Figure 21. Task 4: Specify Changes to Coastal Landforms. Figure 7 shows an example of beach erosion, pages 28, 28, and 30 show help text.

Figure 7. Task 4: Showing help image for "Beach Erosion".

Help text for Task 4: Specify Changes to Coastal Landforms

What storm-driven changes do you see for each coastal change process? (choose any)
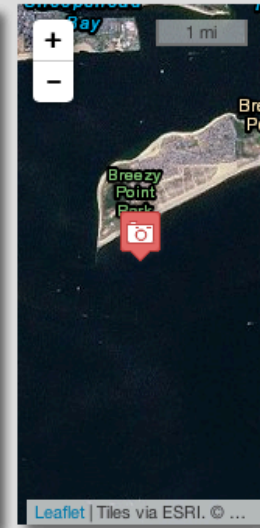
- **Beach Erosion**
  - **Less Sand:** Less sand creating a narrower beach
  - **Dark Sand:** Darker sand made up of coarser, heavier, or wet sediment on the beach
  - **Beach Scarp**: A steep perpendicular slope of sand on beach

- **Dune Erosion**
  - **Dune Scarp**: A steep perpendicular slope of sand along the base of dunes
  - **Leveled Dune**: Flattened dunes or mounds of sand wiped out
  - **Less Vegetation**: Vegetation on dunes is missing or buried, but vegetation change may be seasonal

-

Help Text for Task 4 Contd.

- **Overwash**
  - **Sand Deposit Inland**: Sand deposited onshore landward overtopping dunes or in low lying areas
  - **Sand on Roads**: Sand covering roadways and parking lots
  - **Sand in Marsh**: Sand deposited in marsh or back bay behind barrier island

- **Inundation**
  - **Breach:** A new channel of water creating an inlet or gap in the barrier island
  - **Standing Water**: A pool of water inland in areas that are typically dry or new pools of water in marshes
  - **Dead Vegetation:** Brown, damaged, or stripped vegetation from high winds or storm surge, but vegetation change may be seasonal

Help text for Task 4 Contd.

Which coastal change process is most dominant in the POST-storm photo? (choose one)

- **No Change:** No significant change is visible. PRE-storm photo may show more storm-driven changes than POST-storm photo.
- **Beach Erosion**: Beach erosion is a process that occurs when there are scarps along the beach, dark or heavier sediment on the beach, or less sand creating narrower beaches.
- **Dune Erosion**: Dune erosion is a process that occurs when waves and storm surge flow higher than the base of dunes along the coast erode resulting in smaller dunes, scarps along the base of the dune, or less vegetation.
- **Overwash**: Overwash is a process that occurs when waves and storm surge overtop or go around dunes or low lying areas depositing sand inland from beaches onto roads or in marshes.
- **Inundation**: Inundation is a process that occurs when storm water floods the beach and areas that are normally dry causing breaches, standing water inland, and brown vegetation

Figure 22. Task 5: Indicate Other Changes. Users can choose any additional changes they see or add comments in the free text box. Help texts are given On page 32.
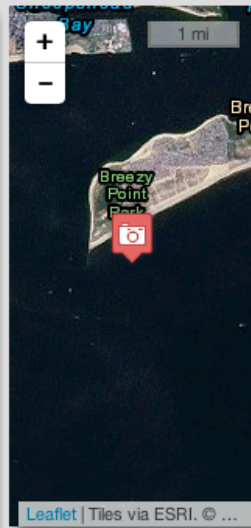
Help Text for Task 5: Indicate other Changes

Do you see any of these other features?

- **NONE**

- **More Sand**: More sand, wider beaches, or higher dunes in POST-storm photo. Sand eroded during the storm may also return and attach itself along the beach after storms creating tidal pools on the beach.

- **More Vegetation**: Vegetation appears to be more dense in the POST-storm photo

- **Marsh Erosion**: Typically occurs on wetland coastlines exposed to an open body of water causing erosion of wetland soil and standing water in marsh

- **Backwash**: Storm surge water receded from backside of narrow barrier islands depositing sand and water seaward or widening channels in marshes

- **More Development**: New infrastructure in POST-storm photo that is not in PRE-storm photo

- **Construction Activity**: Tractors or bulldozers on the beach and near roads moving sand and debris

- **Piles of Sand**: Piles of sand removed from roadways or for replenishing beaches

- **Piles of Debris**: Cleanup efforts are visible through organized piles of rubble

- **Are there any other visual changes or information you know about this coast? [Comment Box]**

Annotation Complete

Congratulations!

This is the 4th photo you have tagged in iCoast for the Hurricane Sandy Project.
Statistics of the last photo you tagged are below.

Leaderboard Position:	Joint 18th Place
# of Photos to be 1st:	101
# of Tags Selected:	8
Time Spent Tagging Photo:	0 min(s) 4 sec(s)
Location of Photo:	Rockaway Point, Coney Island, NY

Select Another Photo

**Here is a random photo near
Bog Opening, Avon, NC**

**Tag This
Random Photo**

OR

Select an Option Below

Find a New Random Photo

Find a Photo from the Map

Traverse the Coast

You are annotating the only project currently available in iCoast. Other selections are not available at this time.

Figure 23. **Annotation Complete Page**. This page appears after each session of annotation. The user can select another nearby photo to tag or select a new random photo, find a photo from the map, or traverse the coast.