Announcement M13AS00014: Hurricane Sandy Coastal Recovery and Resiliency - Resource Identification, Delineation and Management Practices

Agreement: M14AC00006 Massachusetts Geological Survey/University of Massachusetts; Sand Resource Assessment at Critical Beaches on the Massachusetts Coast

Lead Agency:
Massachusetts Geological Survey/University of Massachusetts

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Summary Report (7/22/2016)

Cooperative Agreement Outputs including Project Deliverables:

(1)Venti, N., Mabee, S.B., Woodruff, J.D., 2016, Sand Resource Assessment at Critical Beaches on the Massachusetts Coast, Bureau of Ocean Energy Management Cooperative Agreement M14AC00006 with the Massachusetts Geological Survey/University of Massachusetts Amherst – Technical Report, 18p.
ftp://eclogite.geo.umass.edu/pub/stategeologist/BOEMData/DRAFT_BOEM_Technical_Report.docx

Abstract:

Topographic profiles and grain size analyses performed on sediment samples collected at 18 Massachusetts beaches that are currently experiencing erosion were taken during the summer and winter to evaluate seasonal and spatial variability (Figure 1). This information will be used primarily to match native-beach material with compatible offshore sand resources for beach nourishment projects. Results suggest that nearly all beaches lose a veneer of sand size particles in the winter but that initial beach grain size distribution and seasonal profile changes are

partially a function of surficial geology. Beaches derived from till or moraines are coarser initially, often become coarser in the intertidal zone during winter but show 2.5 meters or less of retreat in the winter. In contrast, beaches comprised exclusively of distal outwash deposits show significant (up to 10 to 20 meters) retreat in winter, depending on location, but no change in grain size with season. Beaches that are considered outwash but contain more fine gravel and gravel facies fall in between these extremes with some coarsening in the intertidal zone during the winter and some winter retreat. Results indicate that matching native-beach material with offshore sources spans a broad spectrum of grain size distributions that exhibit different seasonal behaviors. Cores obtained from Bartlett Pond in Plymouth reveal continuous long-term sediment records. Analysis of the Bartlett Pond cores show several major storm events that can be linked directly to historic storm events back to 1723. Furthermore, these large events appear more frequent prior to 1909 and are associated with extra-tropical storms, not hurricanes. This is in contrast to the south-facing shores of Massachusetts where storm tides appear to be a mixture of both nor'easters and tropical hurricanes. The implication is that perhaps more attention needs to be paid to understanding the frequency and likelihood of future extra-tropical storm events for Boston and all east-facing shores as these may be the greater flood hazard.

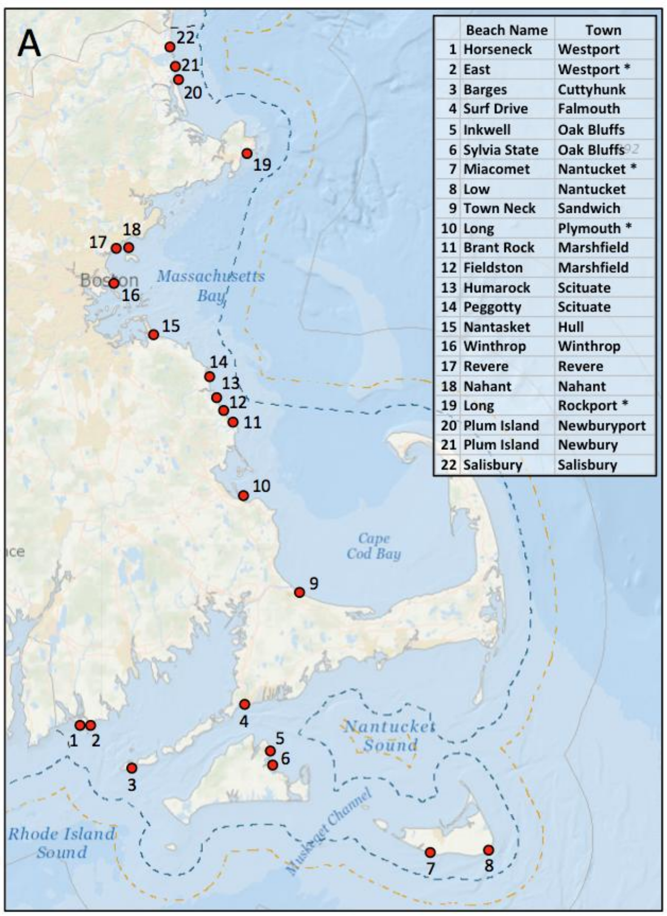


Figure 1. Location of beaches examined in this study. Note: Winthrop (16) and Town Neck in Sandwich are not part of this study. In addition, Brant Rock (11) and Fieldston (12) beaches are lumped as one beach called Marshfield in this study and Plum Island (20 and 21) is also lumped as one beach for the purposes of this study giving a total of 18 beaches. Inkwell Beach is synonymous with Town Beach, Oak Bluffs.

(2) Mabee, S.B., Woodruff, J.D., Venti, N., and Beach, D., 2016, ESRI Shapefiles Showing the Location of Beach Survey Points Used for Constructing Profiles at 18 Public Beaches on the Massachusetts Coast 2014 to 2016, Massachusetts Geological Survey Data Release. ftp://eclogite.geo.umass.edu/pub/stategeologist/BOEMData/Metadata/Beach_Shapefiles.xml

ftp://eclogite.geo.umass.edu/pub/stategeologist/BOEMData/Beach_Shapefiles/

Abstract:

This dataset contains all the shapefiles showing the location of survey points used to construct beach profiles at 18 public beaches on the Massachusetts coast. The dataset contains the feature identification number, transect label, survey or shot point number, latitude and longitude of each survey point, northing and easting (UTM Zone 19T), the elevation of the point in meters (NAVD88), day, month and year of the survey and information on sediment facies and sample locations. A total of 234 transects (Figure 1) were measured as follows: a) 43 transects in August/September 2014 and 43 transects in March, 2015 at Barges Beach, Gosnold, East and Horseneck Beaches, Westport, Low and Miacomet Beaches, Nantucket, Surf Beach, Falmouth, Town Beach, Oak Bluffs and Sylvia State Beach, Oak Bluffs and Edgartown, and, b) 74 transects in August/September, 2015 and 74 transects in March, 2016, at Humarock Beach, Scituate, Nahant Beach, Nahant, Nantasket Beach, Hull, Peggotty Beach, Scituate, Plum Island, Newbury and Newburyport, Long Beach, Plymouth, Revere Beach, Revere, Long Beach, Rockport, Fieldston/Brant Rock Beach, Marshfield and Salisbury Beach, Salisbury. Each beach has multiple transects. Shapefiles were created in ArcGIS Version 10.03. Dataset is used to compare summer and winter beach profiles and evaluate changes in seasonal sediment onlap and offlap. Data is also useful in determining fill volume for beach nourishment projects.

Figure 1. Transect E on Town Beach, Oak Bluffs, March 23, 2015. Flags indicate location of survey points along the beach profile used in the creation of shapefiles.

(3) Woodruff, J.D., Mabee, S.B., Venti, N., and Beach, D., 2016, Dataset Containing Beach Survey Points Collected at Transects for 18 Public Beaches on the Massachusetts Coast, 2014 - 2016, Massachusetts Geological Survey Data Release.
ftp://eclogite.geo.umass.edu/pub/stategeologist/BOEMData/Metadata/BeachProfileSurveyRawData.xml

ftp://eclogite.geo.umass.edu/pub/stategeologist/BOEMData/Beach_Profiles_RawData/

Abstract:

This dataset contains individual files of all the survey points collected for transects at 18 public beaches on the Massachusetts coast (Figures 1 and 2). A total of 234 transects were measured as follows: a) 43 transects in August/September 2014 and 43 transects in March, 2015 at Barges Beach, Gosnold, East and Horseneck Beaches, Westport, Low and Miacomet Beaches, Nantucket, Surf Beach, Falmouth, Town Beach, Oak Bluffs and Sylvia State Beach, Oak Bluffs and Edgartown, and, b) 74 transects in August/September, 2015 and 74 transects in March, 2016, at Humarock Beach, Scituate, Nahant Beach, Nahant, Nantasket Beach, Hull, Peggotty Beach, Scituate, Plum Island, Newbury and Newburyport, Long Beach, Plymouth, Revere Beach, Revere, Long Beach, Rockport, Fieldston/Brant Rock Beach, Marshfield and Salisbury Beach,

Figure 1. Jon Woodruff and Jen Jurnack measuring beach profiles with a Topcon GTS 210 total station on Miacomet Beach, Nantucket, March 2015.

Figure 2. Doug Beach measuring beach profiles on Plum Island in March 2016 with a Real Time Kinematic Trimble R8 Global Navigation Satellite System linked to the cellular phone network.

Salisbury. Each individual file contains the survey point or shot number, latitude, longitude, easting and northing (UTM Zone 19), elevation (NAVD88), and day, month and year survey was completed. Positional data was collected using two methods: a Topcon GTS 210 total station tied into UTM space with a Trimble GeoExplorer 2008 series GPS (±3 meter horizontal accuracy) and a Real Time Kinematic Trimble R8 Global Navigation Satellite System (GNSS) connected to the cellular phone network. Horizontal accuracy for locations measured with the total station position is within 1 meter and within 1 meter for the GNSS. Vertical accuracy is within 0.1 m for both methods. These data files were used to generate shapefiles or construct beach profiles.

(4) Mabee, S.B. and J. Jurnack, 2016, Dataset Containing Google Earth KMZ Files of Beach Profile Survey Points Collected at Transects for 18 Public Beaches on the Massachusetts Coast, Massachusetts Geological Survey Data Release. ftp://eclogite.geo.umass.edu/pub/stategeologist/BOEMData/Metadata/BeachProfileKMZ.xml

ftp://eclogite.geo.umass.edu/pub/stategeologist/BOEMData/Beach_Profiles_KMZ/

Abstract:

This dataset contains individual KMZ files of all the beach survey points collected for transects at 18 public beaches on the Massachusetts coast. Double clicking on these files opens the file in Google Earth and shows the location of transects and survey points on a Google earth image. Clicking on a point will bring up a table of attributes about that point including the feature identification number, transect label, survey point or shot point number, latitude, longitude, easting and northing (UTM Zone 19T), elevation in meters (NAVD88), day, month and year point was measured and information on sediment facies or sediment sample locations (Figure 1). A total of 234 transects were measured as follows: a) 43 transects in August/September 2014 and 43 transects in March, 2015 at Barges Beach, Gosnold, East and Horseneck Beaches, Westport, Low and Miacomet Beaches, Nantucket, Surf Beach, Falmouth, Town Beach, Oak Bluffs and Sylvia State Beach, Oak Bluffs and Edgartown, and, b) 74 transects in August/September, 2015 and 74 transects in March, 2016, at Humarock Beach, Scituate, Nahant Beach, Nahant, Nantasket Beach, Hull, Peggotty Beach, Scituate, Plum Island, Newbury and Newburyport, Long Beach, Plymouth, Revere Beach, Revere, Long Beach, Rockport, Fieldston/Brant Rock Beach, Marshfield and Salisbury Beach, Salisbury. Transects were measured at each beach once in the summer and once in the winter. Positional data was collected using two methods: a Topcon GTS 210 total station tied into UTM space with a Trimble GeoExplorer 2008 series GPS and a Real Time Kinematic Trimble R8 Global Navigation Satellite System (GNSS) connected to the cellular phone network. Horizontal accuracy of survey points measured with the total station is within 1 meter and within 1 meter for the GNSS. Vertical accuracy is within 0.1 m for both methods. These data files were generated by importing the raw beach profile data into ESRI ArcGIS 10.03, creating a shapefile for each transect and then exporting the shapefiles as KMZ files from within the ArcGIS environment. They can be used to quickly portray the data on a Google earth image.

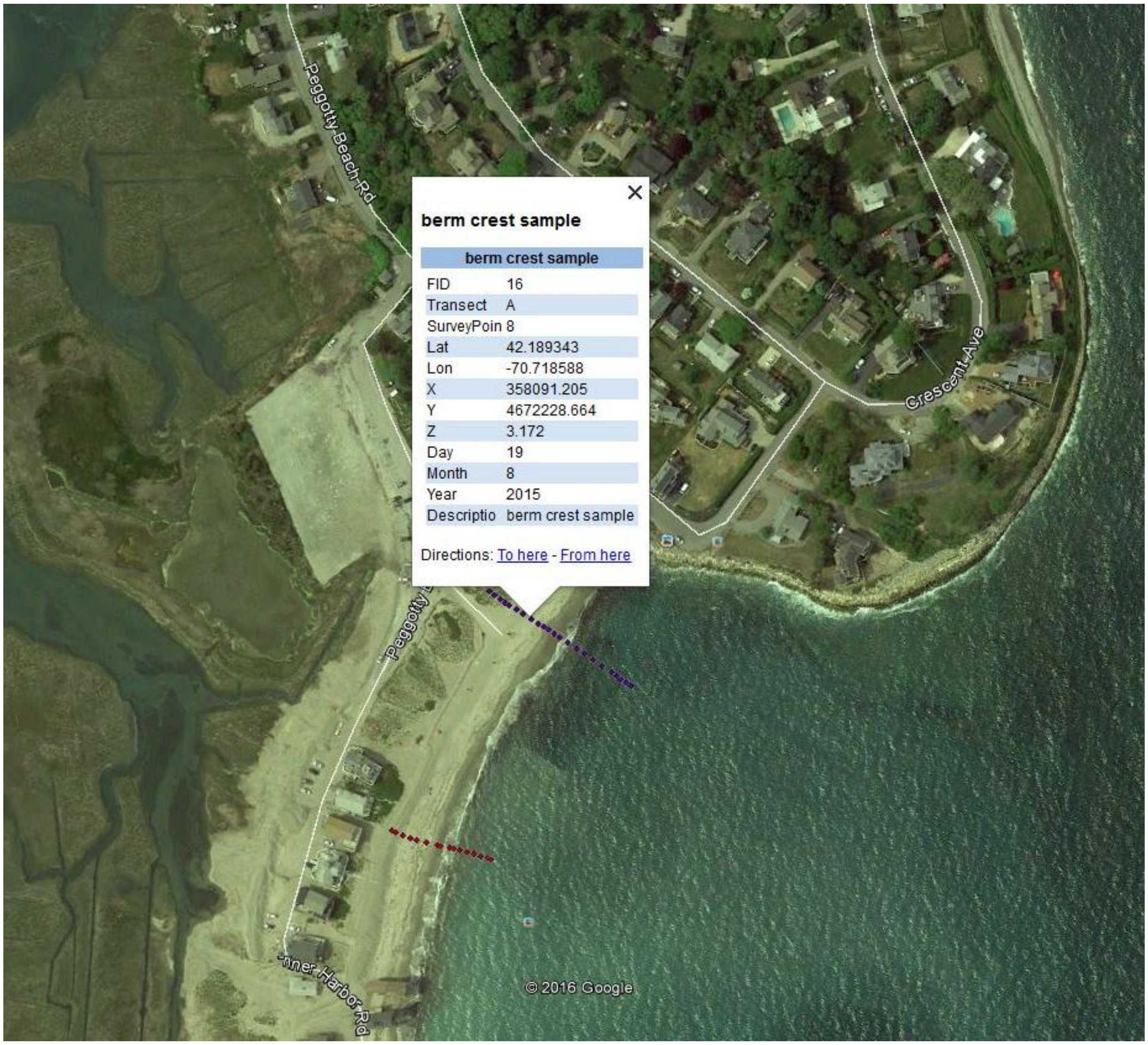


Figure 1. Example of Google image from Peggotty Beach, Scituate, showing the information for the berm crest sample location on Transect A.

(5) Venti, N., Mabee, S.B., Woodruff, J.D. and Beach, D., 2016, Dataset Containing the less than 4mm Grain Size Data Obtained from Samples Collected at Points Along Transects for 18 Public Beaches on the Massachusetts Coast 2014 to 2016, Massachusetts Geological Survey Data Release.

ftp://eclogite.geo.umass.edu/pub/stategeologist/BOEMData/Metadata/GrainSize_RawData.xml

ftp://eclogite.geo.umass.edu/pub/stategeologist/BOEMData/GrainSize_RawData/

Abstract:

This dataset contains the less than 4mm raw grain size data obtained from samples collected along transects at 18 public beaches on the Massachusetts coast (Figure 1). A total of 889 samples were collected along a total of 234 transects. The dataset includes samples collected: a) August/September 2014 and March, 2015 at Barges Beach, Gosnold, East and Horseneck Beaches, Westport, Low and Miacomet Beaches, Nantucket, Surf Beach, Falmouth, Town Beach, Oak Bluffs and Sylvia State Beach, Oak Bluffs and Edgartown, and, b) August/September, 2015 and March, 2016, at Humarock Beach, Scituate, Nahant Beach, Nahant, Nantasket Beach, Hull, Peggotty Beach, Scituate, Plum Island, Newbury and Newburyport, Long Beach, Plymouth, Revere Beach, Revere, Long Beach, Rockport, Fieldston/Brant Rock Beach, Marshfield and Salisbury Beach, Salisbury. Samples were collected at low tide, mid tide, high tide, the berm crest and in the dune(s), if present. A set of samples was taken at each transect in the summer and again in the winter. This dataset only includes analyses performed on the less than 4mm fraction. Grain size analyses were conducted on a Retsch Technology Camsizer. This instrument provides high resolution grain size and shape information on particles sizes ranging from 4 mm to 0.3 nm. Each file in the dataset provides the total mass of the greater than 4 mm fraction, total mass of the less than 4 mm fraction, percentage of sand fraction, number of splits to reduce size of less than 4mm fraction so it can be put into the Camsizer, D_{10}, D_{50}, D_{90}, cumulative distribution, sphericity, symmetry, aspect ratio, proportion (%) of samples with sphericity less than 0.9, proportion (%) of samples with symmetry less than 0.9, proportion (%) of samples with aspect ratio less than 0.9, number of particle detections. Particle size data can be used to evaluate changes in sediment character between winter and summer and for matching off-shore sand resources with native beach characteristics for beach nourishment projects.

Figure 1. Example of sample collection. This sample collected at mid tide at Revere Beach in March 2016. Taking a gallon size sample.

(6) Woodruff, J.D., Beach, D., Venti, N., and Mabee, S.B., 2016, Table Summarizing Winter and Summer Grain Size Statistics (Percentages, Masses and Pebble Counts) in Samples Collected from Points Along Transects for 18 Public Beaches on the Massachusetts Coast between 2014 and 2016, Massachusetts Geological Survey Data Release.
ftp://eclogite.geo.umass.edu/pub/stategeologist/BOEMData/Metadata/GrainSize_Summary.xml

ftp://eclogite.geo.umass.edu/pub/stategeologist/BOEMData/GrainSize_Summary/

Abstract:

This table summarizes all the results of the greater than 4 mm fractions and pebble counts from samples collected along transects at 18 public beaches on the Massachusetts coast (Figures 1, 2, and 3). A total of 889 samples were collected and 86 pebble counts were conducted along a total of 234 transects. The dataset includes samples collected and pebble counts performed in: a) August/September 2014 and March, 2015 at Barges Beach, Gosnold, East and Horseneck Beaches, Westport, Low and Miacomet Beaches, Nantucket, Surf Beach, Falmouth, Town Beach, Oak Bluffs and Sylvia State Beach, Oak Bluffs and Edgartown, and, b) August/September, 2015 and March, 2016, at Humarock Beach, Scituate, Nahant Beach, Nahant, Nantasket Beach, Hull, Peggotty Beach, Scituate, Plum Island, Newbury and Newburyport, Long Beach, Plymouth, Revere Beach, Revere, Long Beach, Rockport, Fieldston/Brant Rock Beach, Marshfield and Salisbury Beach, Salisbury. Samples were collected at low tide, mid tide, high tide, the berm crest and in the dune(s), if present. A set of samples was taken or pebble counts performed at each transect in the summer and again in the winter. For beaches comprised of >80% gravel, cobbles or small boulders, pebble counts were conducted using the method of Wolman (1954) http://onlinelibrary.wiley.com/doi/10.1029/TR035i006p00951/epdf. Beaches containing both sand and some gravel, cobbles or small boulders were collected in 5 gallon buckets, washed, dried and then sieved to separate the less than 4 mm fraction from the greater than 4 mm fraction. The large fraction was sieved into gravel, cobble and boulder categories and the less than 4 mm fraction put through the Retsch Technology Camsizer. Beaches comprised of 100% or nearly 100% sand were bagged (quart or gallon size), washed, dried, weighed, split, and put through the Camsizer. The Camsizer provides high resolution grain size and shape information on particles sizes ranging from 4 mm to 0.3 nm. The summary table provides the Beach, Transect, facies (low tide, mid-tide, high tide, berm, etc.), survey shot point at which the sample was collected on the transect, sample type (bag, bucket, pebble count), date of collection, D_{10}, D_{50}, and D_{90} of the less than 4mm fraction, % less than 4mm, % gravel, % cobble, and % small boulders, if present, and absolute masses of the greater than 4mm fractions (gravel, cobbles, small boulders for bucket samples) or pebble count tallies. These data can be used for comparing the proportion of sand, gravel, cobbles and boulders between transects and among beaches and evaluating the seasonal change in these proportions. The data can also be used for matching onshore beach characteristics with offsite resources proposed for beach nourishment.

Figure 1. Picture from the University of Massachusetts Amherst sedimentology lab showing samples in pans in preparation for weighing and sieving for the greater than 4 mm fraction.

Figure 2. Conducting pebble count on Humarock Beach, Scituate, Massachusetts, March 2016.

Figure 3. Loading 5-gallon buckets containing samples collected from Town Beach and Sylvia State Beach, Martha's Vineyard, March 2015.

(7) Woodruff, J.D, 2016, Cumulative Percent Passing Grain Size Distribution Plots and Data Tables for Sediment Samples Collected at Discrete Points Along Transects for 18 Public Beaches on the Massachusetts Coast Between 2014 and 2016, Massachusetts Geological Survey Data Release.
ftp://eclogite.geo.umass.edu/pub/stategeologist/BOEMData/Metadata/GrainSizePlotsandTables.xml

ftp://eclogite.geo.umass.edu/pub/stategeologist/BOEMData/GrainSizePlotsandTables/

Abstract

This dataset contains individual plots and data tables of the cumulative percent passing for all sediment samples collected at transects for 18 public beaches on the Massachusetts coast (Figure 1). A total of 889 sediment samples were analyzed and 86 pebble counts conducted. A total of 234 transects were measured as follows: a) 43 transects in August/September 2014 and 43 transects in March, 2015 at Barges Beach, Gosnold, East and Horseneck Beaches, Westport, Low and Miacomet Beaches, Nantucket, Surf Beach, Falmouth, Town Beach, Oak Bluffs and Sylvia State Beach, Oak Bluffs and Edgartown, and, b) 74 transects in August/September, 2015 and 74 transects in March, 2016, at Humarock Beach, Scituate, Nahant Beach, Nahant, Nantasket Beach, Hull, Peggotty Beach, Scituate, Plum Island, Newbury and Newburyport, Long Beach, Plymouth, Revere Beach, Revere, Long Beach, Rockport, Fieldston/Brant Rock Beach, Marshfield and Salisbury Beach, Salisbury. Samples were collected at low tide, mid tide, high tide, the berm crest and in the dune(s), if present. A set of samples was taken or pebble counts performed at each transect in the summer and again in the winter. For beaches comprised of greater than 80% gravel, cobbles or small boulders, pebble counts were conducted using the method of Wolman (1954) http://onlinelibrary.wiley.com/doi/10.1029/TR035i006p00951/epdf. Beaches containing both sand and some gravel, cobbles or small boulders were collected in 5 gallon buckets, washed, dried and then sieved to separate the less than 4 mm fraction from the greater than 4 mm fraction. The large fraction was sieved into gravel, cobble and boulder categories and the less than 4 mm fraction put through the Retsch Technology Camsizer. Beaches comprised of 100% or nearly 100% sand were bagged (quart or gallon size), washed, dried, weighed, split, and put through the Camsizer. The Camsizer provides high resolution grain size and shape information on particles sizes ranging from 4 mm to 0.3 nm. Camsizer data were then combined with the distribution of the plus 4mm fraction and plotted using a script in Matlab. The data tables in this dataset contain the name of the beach and town, date sample was collected, transect identifier, survey shot point number, facies (low tide, high tide, mid tide, berm or dune), the sieve size opening in mm, and the percent passing a particular sieve size. The data plots contain three items: a cumulative percent passing plot (percent passing vs. grain size, in mm), a Google image showing the transect and location along the transect where the sample was taken including the latitude and longitude of the point, and a profile (cross section) of the beach showing the elevation position of the sample along the transect. The plots also provide the percent sand, gravel, cobbles, boulders and the median grain size, in mm. These data can be used for comparing the proportion of sand, gravel, cobbles and boulders between transects and among beaches and evaluating the seasonal change in these proportions. The data can also be used for matching onshore beach characteristics with offsite resources proposed for beach nourishment.

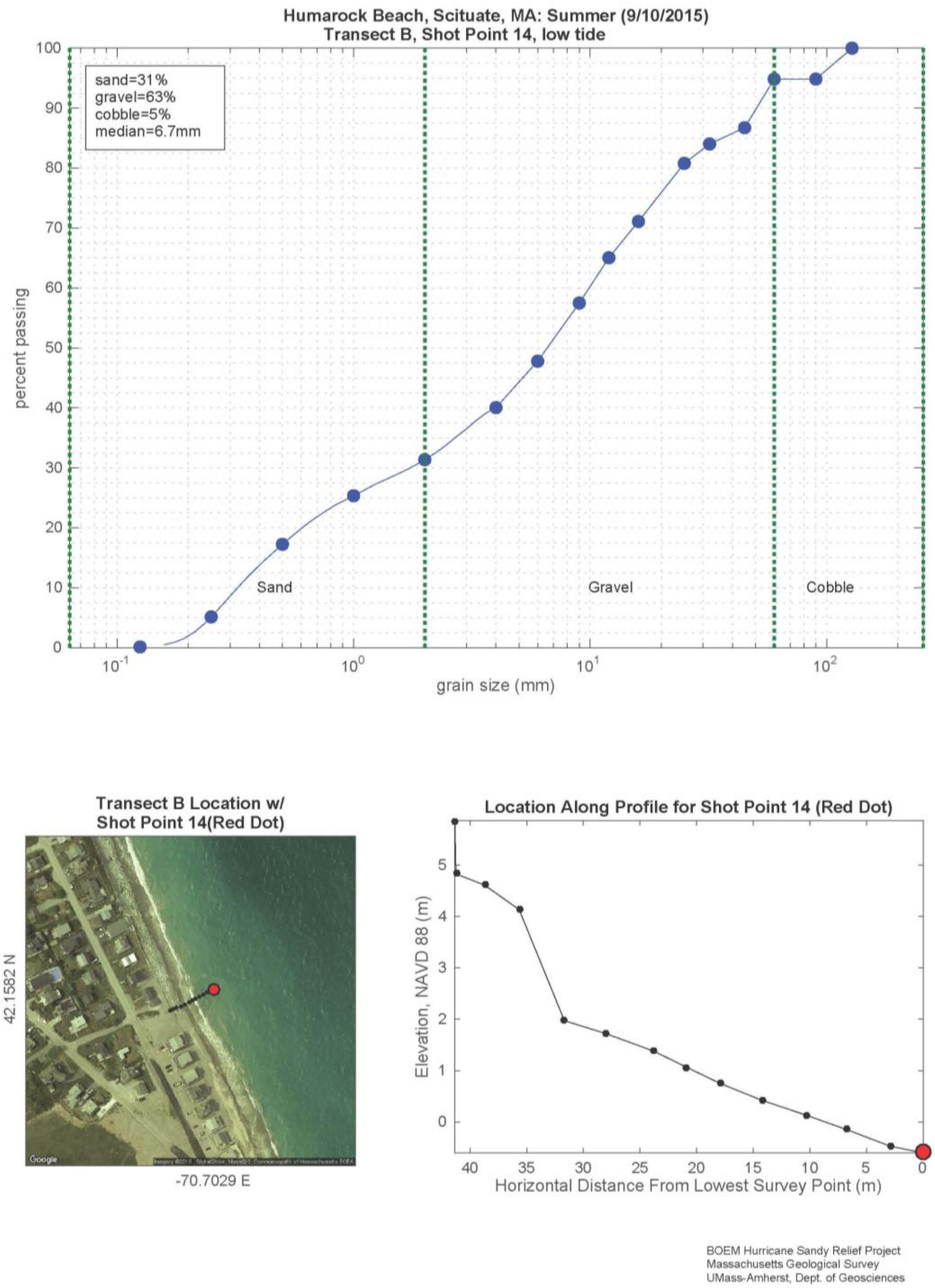


Figure 1. Example of grain size distribution plot (top) from Transect B, low tide sample in summer 2015 collected at Humarock Beach, Scituate, Massachusetts. Also shown is the location of the sample on the transect (lower left) and location of sample along beach profile (lower right).

(8) Stromer, Z. and Woodruff, J.D., 2016, ESRI shapefile showing the location of sediment cores taken at Bartlett Pond, Plymouth, Massachusetts, October 2014, Massachusetts Geological Survey Data Release.
ftp://eclogite.geo.umass.edu/pub/stategeologist/BOEMData/Metadata/BartlettPond_Shapefile.xml

ftp://eclogite.geo.umass.edu/pub/stategeologist/BOEMData/BartlettPond_Shapefiles/

Abstract:

This dataset contains an ESRI ArcMap shapefile showing the location of five sediment cores (BAP5, BAP6, BAP7, BAP8 and BAP9) taken at Bartlett Pond in Plymouth, Massachusetts in October, 2014. Prior to coring, a bathymetric survey of the pond was conducted to determine optimal sites for coring. Core locations were determined using a hand-held Garmin GPSmap 76S. Horizontal accuracy is less than 15 meters. Cores were collected using a modified Vohnout/Colinvaux piston corer mounted on a twin canoe coring platform. Cores were taken in overlapping ~2 meter sections (ie., D1, D2, etc.). These sections were later cut into 150 cm lengths or less for ease of analysis (ie., 1 of 2, 2 of 2). Cores were collected to a maximum depth of 5 meters. Once collected, core sections were transported to the University of Massachusetts and refrigerated until analysis. Core sections were then split horizontally into working and archive halves. These sections were analyzed on a Cox Analytical Systems Itrax XRF core scanner to determine elemental composition and to obtain x-radiographs. Based on the x-radiographs, BAP6 was determined to contain the best record of sand overwash deposits. Therefore, additional analyses were performed on core BAP6 to determine the characteristics of the sandy overwash layers. BAP6 was subsampled at a minimum of every 3 cm at 1 cm resolution and sieved for coarse percentage (greater than 32 microns and 63 microns). Coarse percentages greater than 63 microns of sandy deposits were analyzed on a Retsch Technology camsizer to determine grain size distribution. Additional subsamples were taken from BAP6 to determine organic content via loss on ignition. In order to determine timing of these deposits, subsamples from BAP6 were taken for carbon 14 dating and activities of Cs-137 and Pb-210. Results indicate that these sandy deposits correspond to large coastal flood events up to 1000 years in the past. Historic coastal flood events recorded in the core, among others, include the Blizzard 1978, the Christmas Storm of 1909, the 1851 Minot Light storm, Benjamin Franklin's eclipse storm of 1743, and a particularly large storm in 1723 recorded by the Reverend Cotton Mather. These flood events were driven in large part by extra-tropical storms. This record of coastal flood events near Boston extends our knowledge of extreme events back at least 300 years. These events suggest an under-assessment of risk of flooding if that risk is based solely on the instrumental record.

(9) Stromer, Z. and Woodruff, J.D., 2016, X-Radiographs of five sediment cores taken at Bartlett Pond, Plymouth, Massachusetts, October 2014, Massachusetts Geological Survey Data Release.
ftp://eclogite.geo.umass.edu/pub/stategeologist/BOEMData/Metadata/BartlettPond_xradiographs.xml

ftp://eclogite.geo.umass.edu/pub/stategeologist/BOEMData/BartlettPond_xradiographs/

Abstract:

This dataset contains x-radiographs of five sediment cores (BAP5, BAP6, BAP7, BAP8 and BAP9) taken at Bartlett Pond in Plymouth, Massachusetts in October, 2014. Prior to coring, a bathymetric survey of the pond was conducted to determine optimal sites for coring. Core locations were determined using a hand-held Garmin GPSmap 76S. Horizontal accuracy is less than 15 meters. Cores were collected using a modified Vohnout/Colinvaux piston corer mounted on a twin canoe coring platform. Cores were taken in overlapping ~2 meter sections (ie., D1, D2, etc.). These sections were later cut into 150 cm lengths or less for ease of analysis (ie., 1 of 2, 2 of 2). Cores were collected to a maximum depth of 5 meters. Once collected, core sections were transported to the University of Massachusetts and refrigerated until analysis. Core sections were then split horizontally into working and archive halves. These sections were analyzed on a Cox Analytical Systems Itrax XRF core scanner to determine elemental composition and to obtain x-radiographs. X-radiographs provide a means of identifying sandy layers within the core at high resolution. The sand layers indicate individual storm events, which when linked with an age model, extend the coastal storm flood record back in time beyond the instrumental and historic record. Results indicate that these sandy deposits correspond to large coastal flood events up to 1000 years in the past. Historic coastal flood events recorded in the core, among others, include the Blizzard 1978, the Christmas Storm of 1909, the 1851 Minot Light storm, Benjamin Franklin's eclipse storm of 1743, and a particularly large storm in 1723 recorded by the Reverend Cotton Mather. These flood events were driven in large part by extra-tropical storms. This record of coastal flood events near Boston extends our knowledge of extreme events back at least 300 years. These events suggest an under-assessment of risk of flooding if that risk is based solely on the instrumental record.

(10) Stromer, Z. and Woodruff, J.D., 2016, Dataset Summarizing Elemental X-ray Fluorescence (XRF) Data Obtained from five Sediment Cores Taken at Bartlett Pond, Plymouth, Massachusetts, October 2014, Massachusetts Geological Survey Data Release.
ftp://eclogite.geo.umass.edu/pub/stategeologist/BOEMData/Metadata/BartlettPond_XRFData.xml

ftp://eclogite.geo.umass.edu/pub/stategeologist/BOEMData/BartlettPond_XRFData/

Abstract:

This dataset contains the results of X-ray Fluorescence (XRF) analyses obtained from five sediment cores (BAP5, BAP6, BAP7, BAP8 and BAP9) taken at Bartlett Pond in Plymouth, Massachusetts in October, 2014. Prior to coring, a bathymetric survey of the pond was conducted to determine optimal sites for coring. Core locations were determined using a hand-held Garmin GPSmap 76S. Horizontal accuracy is less than 15 meters. Cores were collected using a modified Vohnout/Colinvaux piston corer mounted on a twin canoe coring platform. Cores were taken in overlapping ~2 meter sections (ie., D1, D2, etc.). These sections were later cut into 150 cm lengths or less for ease of analysis (ie., 1 of 2, 2 of 2). Cores were collected to a maximum depth of 5 meters. Once collected, core sections were transported to the University of Massachusetts and refrigerated until analysis. Core sections were then split horizontally into working and archive halves. These sections were analyzed on a Cox Analytical Systems Itrax XRF core scanner to determine elemental composition and to obtain x-radiographs. The XRF scan provides relative abundances of 33 elements. The elemental analyses are used as proxies to look for changes in lithology, onset of industrialization, changes in energy regime and changes in the rate of deposition. At Bartlett Pond, lead was helpful in distinguishing the industrial horizon and rubidium corresponded well with sand deposits because of the higher feldspar content. These results constrained the age of horizons and identified horizons for grain size analysis.

(11) Stromer, Z. and Woodruff, J.D., 2016, Dataset Summarizing Grain Size, Organic Content, 14C Age Dating and Cesium and Lead Activities for Core BAP6 Collected at Bartlett Pond, Plymouth, Massachusetts, October 2014, Massachusetts Geological Survey Data Release.
ftp://eclogite.geo.umass.edu/pub/stategeologist/BOEMData/Metadata/BartlettPond_BAP6Data.xml

ftp://eclogite.geo.umass.edu/pub/stategeologist/BOEMData/BartlettPond_BAP6Data/

Abstract:

This dataset contains the results of grain size analyses, carbon 14 age dating and Cesium-137 and Lead-210 activities obtained on core BAP6 collected at Bartlett Pond, Plymouth, Massachusetts in October 2014. Core BAP6 is one of 5 cores taken at Bartlett Pond to better understand the frequency of major coastal erosion and overwash events along the east facing coast of Massachusetts. The core was collected using a modified Vohnout/Colinvaux piston corer mounted on a twin canoe coring platform. The core was taken in overlapping ~2 meter sections (ie., D1, D2, etc.). These sections were later cut into 150 cm lengths or less for ease of analysis (ie., 1 of 2, 2 of 2). BAP6 is 5 meters in length. Once collected, core sections were transported to the University of Massachusetts and refrigerated until analysis. Core sections were then split horizontally into working and archive halves. These sections were analyzed on a Cox Analytical Systems Itrax XRF core scanner to determine elemental composition and to obtain x-radiographs. Based on the x-radiographs, BAP6 was determined to contain the best record of sand overwash deposits. Therefore, additional analyses were performed on core BAP6 to determine the characteristics of the sandy overwash layers. BAP6 was subsampled at a minimum of every 3 cm at 1 cm resolution and sieved for coarse percentage (greater than 32 microns and 63 microns). Coarse percentages greater than 63 microns of sandy deposits were analyzed on a Retsch Technology camsizer to determine grain size distribution. Additional subsamples were taken from the core to determine organic content via loss on ignition. In order to determine timing of these deposits, subsamples from BAP6 were taken for carbon 14 dating and activities of Cs-137 and Pb-210. Results indicate that these sandy deposits correspond to large coastal flood events up to 1000 years in the past. Historic coastal flood events recorded in the core, among others, include the Blizzard 1978, the Christmas Storm of 1909, the 1851 Minot Light storm, Benjamin Franklin's eclipse storm of 1743, and a particularly large storm in 1723 recorded by the Reverend Cotton Mather. These flood events were driven in large part by extra-tropical storms. This record of coastal flood events near Boston extends our knowledge of extreme events back at least 300 years. These events suggest an under-assessment of risk of flooding if that risk is based solely on the instrumental record.

(12) Stromer, Z. and Woodruff, J.D., 2016, Bathymetry Data for Bartlett Pond, Plymouth, Massachusetts, Collected October 2014, Massachusetts Geological Survey Data Release. ftp://eclogite.geo.umass.edu/pub/stategeologist/BOEMData/Metadata/BartlettPond_Bathymetry.xml

ftp://eclogite.geo.umass.edu/pub/stategeologist/BOEMData/BartlettPond_Bathymetry/

Abstract:

This dataset contains latitude, longitude and depth information along five traverses across Bartlett Pond, Plymouth, Massachusetts, collected in October 2014. The purpose of this bathymetric survey was to locate potential depositional centers and identify the best locations for acquiring sediment core. Based on this information five sites were selected for coring (BAP5, BAP6, BAP7, BAP8 and BAP9). Bathymetric data was collected in a canoe using a fish finder attached to a hand-held GPS unit. Horizontal accuracy is less than 15 meters. Vertical accuracy is approximately 0.1 meters. Cores were collected using a modified Vohnout/Colinvaux piston corer mounted on a twin canoe coring platform. Of the five cores taken, BAP6 contained the best record of sand overwash deposits indicating multiple coastal flood events. Analysis of BAP6 indicated flood events up to 1000 years in the past. This is well beyond the historic and instrumental record.

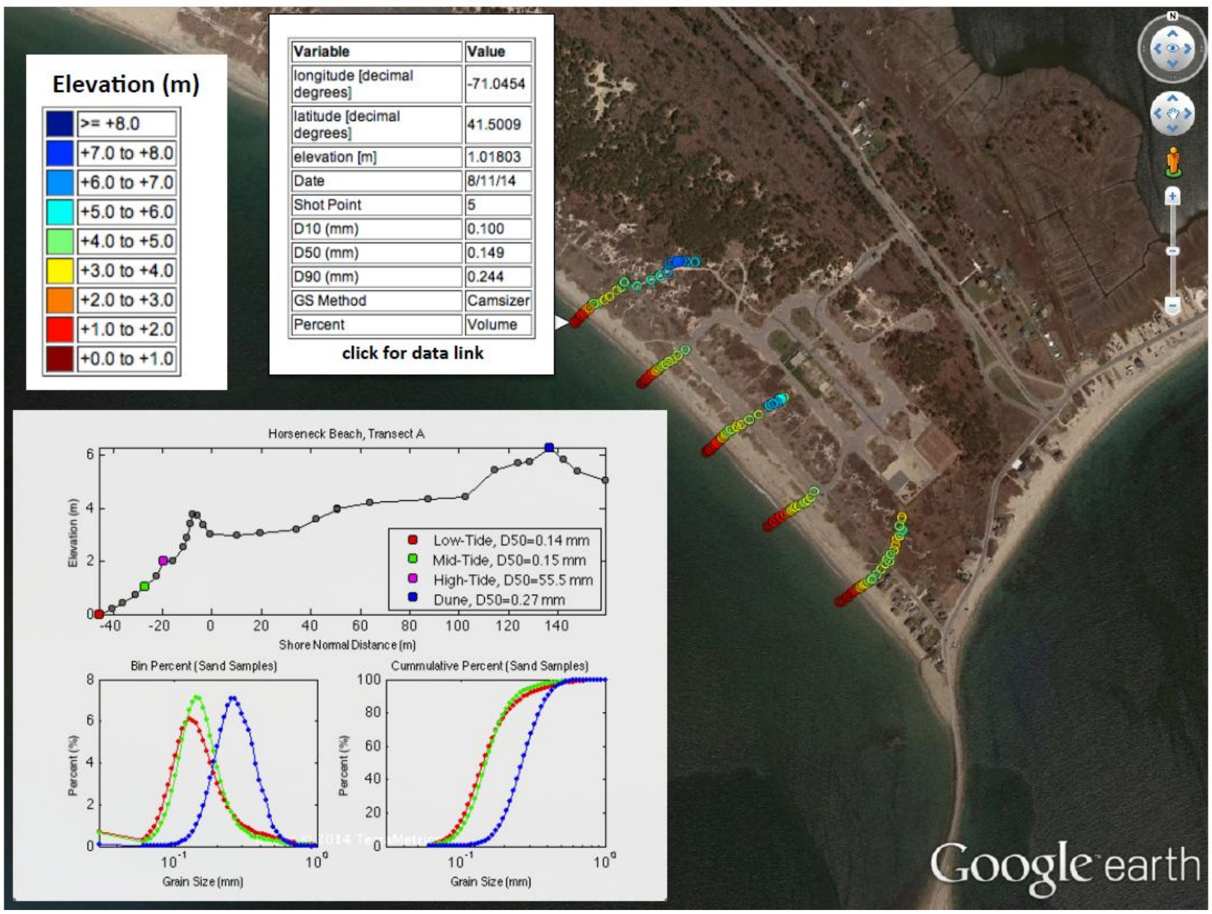
Associated Cooperative Agreement Outputs:

(1)Woodruff, J.D., Mabee, S., Venti, N., Mansfield, M., 2014 (Sept. 17), Sand Resource Needs Assessment at Critical Beaches on the Massachusetts Coast, Northeast Shore & Beach Preservation Association Conference on New England Coastal Issues

ftp://eclogite.geo.umass.edu/pub/stategeologist/BOEMData/Presentations/Woodruff_NSBPA2014.pdf

Abstract:

This is a presentation given at the Northeast Shore & Beach Preservation Association Conference held in Taunton, MA to discuss New England coastal issues. The presentation was given on September 17, 2014 to members of the association and other interested parties. The presentation provided an opportunity to inform Association members and other interested parties about the Bureau of Ocean Energy Management (BOEM) Cooperative Agreement with the Commonwealth of Massachusetts. The purpose of this two-year agreement with BOEM is to evaluate sand resources for coastal resilience and restoration planning. Under this agreement, the University of Massachusetts (Amherst) will obtain baseline onshore coastal geologic data for 18 public beaches in critical need of assessment. The three main objectives of this cooperative agreement are: (1) characterize the native beach sediment such that beach-compatible material can be identified in off-shore borrow areas, (2) determine the historical frequency of major erosion and overwash events at selected beaches by coring and dating the individual storm event layers within overwash fans thereby determining inundation frequency, sensitivity to recent sea-level rise, and capacity of coastal resiliency for these critical areas, (3) coordinate with the Massachusetts Office of Coastal Zone Management to determine areas to be studied for future OCS geophysical and geological surveys to locate suitable offshore sand resources. The most important factor for beach nourishment projects is sediment compatibility, that is, the grain size distribution of the source material as compared to the native beach material. Presently, information on the grain size and character of native beach material at 18 public beaches in Massachusetts does not exist. This project will fill this data gap.



Example showing how the BOEM cooperative project will address characterization of native beach material. This example is from Horseneck Beach, Westport, MA.

(2) Woodruff, J.D., Mabee, S., Venti, N., Mansfield, M., 2014 (Oct. 31), Sand Resource Needs Assessment at Critical Beaches on the Massachusetts Coast, Environmental Business Council's Ocean and Coastal Resources Program - Shoreline Resilience in New England - Sand & Gravel Mining

ftp://eclogite.geo.umass.edu/pub/stategeologist/BOEMData/Presentations/Woodruff_EBC2014.pdf

Abstract:

This presentation was an invited talk given at a meeting of the Environmental Business Council of New England on behalf of the Oceans and Coastal Resources Committee. The meeting was held at Nutter McClennen and Fish, LLP in Boston on October 31, 2014. The presentation provided an opportunity to inform a broad cross section of business council members (consultants, energy providers, attorneys, non-profits, construction contractors, etc.) about the Bureau of Ocean Energy Management (BOEM) Cooperative Agreement with the Commonwealth of Massachusetts. The purpose of this two-year agreement with BOEM is to evaluate sand resources for coastal resilience and restoration planning. Under this agreement, the University of Massachusetts (Amherst) will obtain baseline onshore coastal geologic data for 18 public beaches in critical need of assessment. The three main objectives of this cooperative agreement are: (1) characterize the native beach sediment such that beach-compatible material can be identified in off-shore borrow areas, (2) determine the historical frequency of major erosion and overwash events at selected beaches by coring and dating the individual storm event layers within overwash fans thereby determining inundation frequency, sensitivity to recent sea-level rise, and capacity of coastal resiliency for these critical areas, (3) coordinate with the Massachusetts Office of Coastal Zone Management to determine areas to be studied for future OCS geophysical and geological surveys to locate suitable offshore sand resources. Two important messages from the talk are: 1) Beach nourishment projects require sediment compatibility, that is, the grain size distribution of the source material must be similar to the native beach material, and, 2) it is prudent to have some understanding of the frequency of major inundation events before investing heavily in a beach nourishment project. The proposed BOEM project addresses these issues.

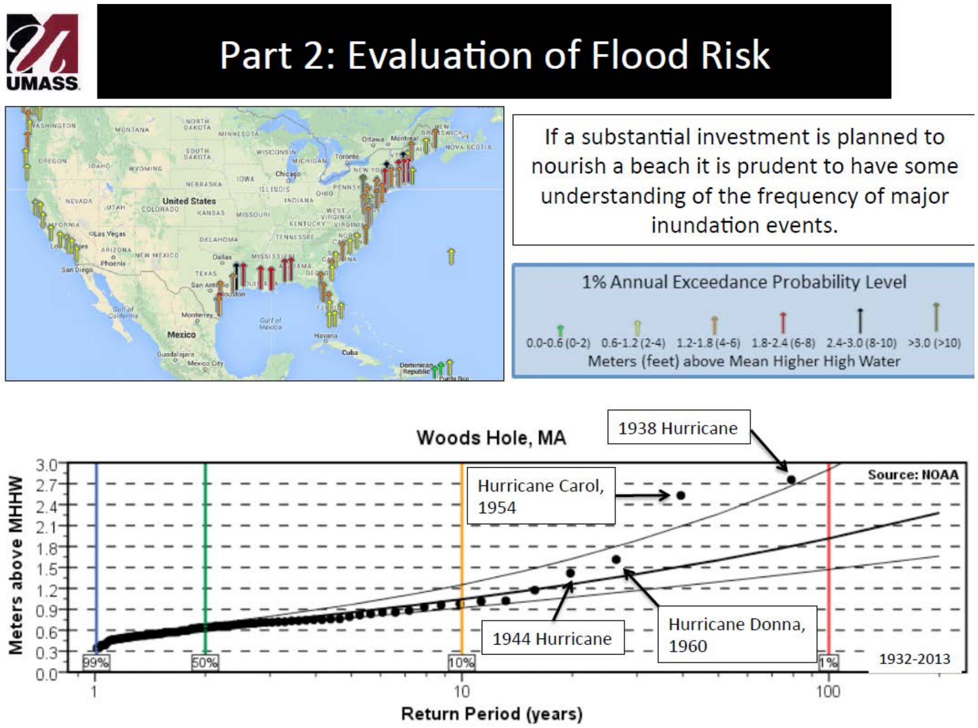


Figure showing how the magnitude of low frequency inundation events seemingly produces higher storm surges than expected.

(3) Venti, N.L., Gessay, S., Southard, P, Beach, D. Mansfield, M, Mabee, S.B., Woodruff, J.D., 2015, Subtle Modification of Glacially Derived Materials Along Massachusetts' Southern Coast by Passing Summer Storms, Paper No. 73-2, Geological Society of America Northeast Section, Abstracts with Programs, v. 47, no., 3, p. 136.

https://gsa.confex.com/gsa/2015NE/webprogram/Paper252510.html
ftp://eclogite.geo.umass.edu/pub/stategeologist/BOEMData/Presentations/Venti_NEGSA2015.pdf

Abstract:

Engineered resupply of sand to coastal environments, i.e. nourishment, offers an attractive short-term strategy to address beach erosion in Massachusetts. For efficient nourishment, site-specific knowledge of seasonal grain size and sediment volume variability at eroding beaches is essential. In this project, we measured grain size and beach profiles at Massachusetts beaches, using a total station and real time kinematic GPS equipment, capturing summer and winter conditions at each site through four to nine representative transects perpendicular to the shore and spaced 100-500 meters apart. Samples for grain size analysis were also collected along each transect for low tide, mid-tide, high tide, berm and dune facies. Profiles and sampling for the quarter of the project were completed August/September 2014 at 8 beaches along Massachusetts' south coast from Rhode Island to Nantucket. These environments should reflect regional glacial history and a

summer interval of reduced storm activity. Where unstratified surficial materials characterize the coast, erosion of glacial till (Horseneck and East beaches, Westport) and end moraine (Barges Beach, Cuttyhunk Island; Town and Sylvia State beaches, Oak Bluffs/Edgartown) yields cobble berms capping steep intertidal zones. We noted that increased wave activity during storms strips a thin (inches-thick) layer of intertidal sand to reveal gravel and cobble below, while leaving the beach profile essentially unchanged. In contrast, where (cobble-free) glacial outwash intersects the coast (Surf Beach, Falmouth; Miacomet and Low beaches, Nantucket) sand and gravel are distributed more evenly across the berm and intertidal zone. Here passing summer storms modify the beach profile but not grain size: high surf cuts sandy berms, shifting steepened intertidal zones landward. We will reoccupy these sites at the end of winter in 2015 to examine effects of the seasonally related increase in storm (and wave) activity. Results of this preliminary work provide a valuable baseline for both seasonal and long-term changes in beach profile, position and grain size characteristics. In addition, surficial geology plays a first order role in determining the grain size of the beach. All grain size data will be added to the Massachusetts Office of Coastal Zone Management's extensive grain-size database.

(4) Healey, J., Koerth, M., Gessay, S., Southard, P., Jurnack, J., Beach, D., Mansfield, M., Mabee, S.B., Venti, N.L., Woodruff, J., 2015 (April 23), Seasonal Variability of Massachusetts' Southern Coast: Influence of Grain Size on Berm Resilience, Five College Geology Undergraduate Symposium, Amherst College, April 23, 2015.

ftp://eclogite.geo.umass.edu/pub/stategeologist/BOEMData/Presentations/Healey_FCGUS2015.pdf

Abstract:

Increased storm frequency in the winter should lead to increased rates of erosion and a narrower berm and steeper intertidal zone. To examine this generalized conceptual model, we measured change between summer (August-September2014) and winter (March 2015) beach profiles at 8 beaches along the southern coast of Massachusetts and Nantucket sound. We surveyed elevation along identical transects using a Trimble R8 self-contained kinematic real time GPS and total station. Combined with qualitative observations of grain size, these surveys reveal seasonal patterns of beach character. As expected, loss of berm is generally observed at Miacomet Beach and Low Beach on Nantucket during winter, systems dominated almost exclusively by sand-sized outwash material year-round. We noted a lesser degree of berm erosion at Surf Beach in Falmouth, Town Beach in Oak Bluffs, and Sylvia State Beach in Martha's Vineyard. Grain sizes at these three beaches increase during winter, particularly through the intertidal zone. In addition, profiles at Barges Beach on Cuttyhunk, East Beach and Horseneck Beach (both in Westport) show no appreciable seasonal change. At the remaining 6 beaches we did not observe the expected change between summer and winter profiles. Grain size observations would suggest that larger grain sizes preserve the summer profile by exceeding the erosive forces of winter storms.

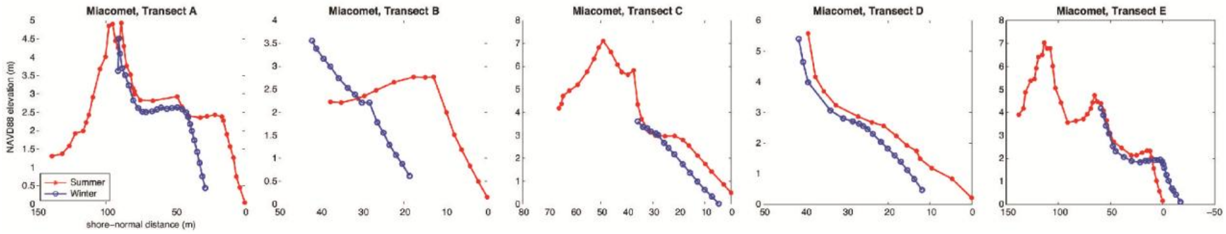


Figure showing the landward retreat Miacomet Beach, Nantucket between August 2014 and March 2015.

(5) Stromer, Z.D, Woodruff, J.D., Donnelly, J.P., 2015 (Nov. 1), The Great Colonial Hurricane of 1635 - Reassessing Extreme Flood Vulnerability for the Southern Coast of Massachusetts, Geological Society of America Annual Meeting, Baltimore, MD, Abstracts with Programs, v. 47, no. 7, p.360.

https://gsa.confex.com/gsa/2015AM/webprogram/Paper265839.html
ftp://eclogite.geo.umass.edu/pub/stategeologist/BOEMData/Presentations/Stromer_GSA2015.pdf

Abstract:

Prior to Hurricane Sandy, the return period for a flood of that magnitude in New York City, calculated using instrumental tide gage data was 10,000 years. It is now becoming clear that the true return period was likely closer to 100 years. This two-order of magnitude underassessment of risk for New York City highlights the inability of short instrumental data sets in estimating the risk of extreme flooding to the region. Hurricane Sandy now provides a modern and more accurate representation of flood risk for the New York City region. However, such an event is still not available for locations further to the north where Hurricane Sandy had less of an impact. The Great Colonial Hurricane of 1635, considered by many to be the historical event of record for many locations in New England, may provide such an event. Early colonial records provide documentation for storm tides as high as 6 m in Buzzards Bay and 4 m in Narragansett Bay during the storm. Historical accounts of the 1635 event may be prone to exaggeration, and significant questions have been raised regarding the occurrence and true intensity of this legendary storm. To provide further insight we present a large number of geographically spaced sedimentologically derived records combined with NOAA's SLOSH (Sea, Lake, and Overland Surge from Hurricanes) storm surge model to estimate the maximum flooding surge at locations along the Massachusetts coastline. By adding this modeled storm surge data to commonly used flood return period models which use Generalized Extreme Value (GEV) theory, we show that GEV may be greatly over-estimating the return period (i.e. under-assessing risk), for larger flood events on the southern facing coastline of Massachusetts. Results emphasize the inability of short instrumental data sets for assessing flood risk by 100 yr or greater events, as well as the value in combining sedimentological, modeled and historical records of early historical floods for improving these assessments.

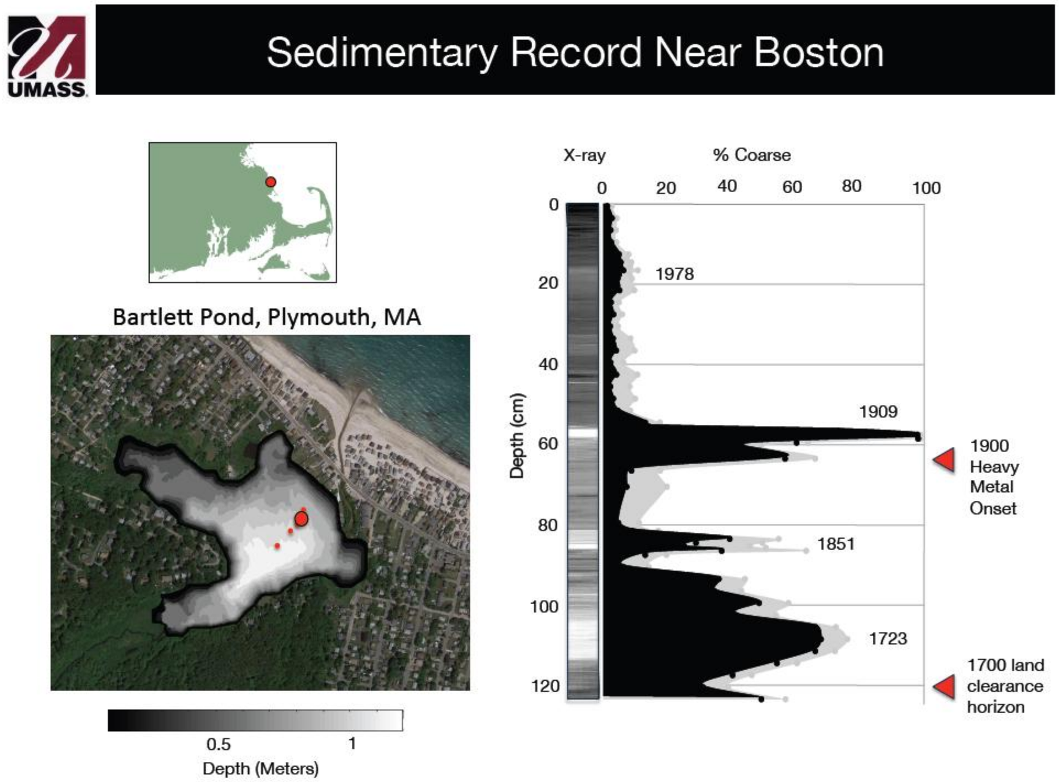


Figure showing results of x-ray scan and % coarse sand on BAP6 from Bartlett Pond, Plymouth, MA. Percent coarse sand on core BAP6 (left) showing sand peaks associated with storm events. Lead and onset of land clearing help constrain the age model for each core. Bright sections in x-ray scan represent sandier storm event layers (from Woodruff et al., 2015).

(6) Woodruff, J.D., Stromer, Z., Talke, S., and Orton, P., 2015, (Dec. 17) Improving Coastal Flood Risk Assessments for the Northeastern United States: New York City to Boston, Paper No. NH44A-01, American Geophysical Union Fall Meeting, San Francisco, CA

https://agu.confex.com/agu/fm15/meetingapp.cgi/Paper/82654
ftp://eclogite.geo.umass.edu/pub/stategeologist/BOEMData/Presentations/Woodruff_AGU2015.pdf

Abstract:

Interest in extreme flood vulnerability in the Northeastern U.S. has increased significantly since Hurricane Sandy caused more than $50 billion dollars in damages. Despite increased focus there is still no overall consensus regarding the true return period in the region for flood events of Sandy's magnitude. The application of Generalized Extreme Value (GEV) theory to water level data is one of the most common techniques for estimating the return period for these rare events. Here we assess the skill of this popular technique by combining modeled, instrumental and sedimentologically derived records of flooding for the region. We show that GEV derived return

periods greatly and consistently underappreciate risk for sites from New York City east to southern Cape Cod. This is in part because at these locations maximum annual flood data represents a mixture of two very different populations of storms, i.e. tropically derived disturbances and extratropical Nor'easters. Nor'easters comprise a majority of floods with 10-yr return periods and shorter, hurricanes for 100-yr floods or longer, and a combination in between. In contrast, the GEV technique functions better in estimating the 100-yr flood for points north of Cape Cod including Boston. At these locations flooding occurs more often from just one type of disturbance, i.e. Nor'easters. However, modeled and sedimentary reconstructions of storms indicate hurricanes likely still dominate flood distribution at northern location like Boston for 500 yr or greater events. Results stress the need for separating storm populations before applying the GEV technique, especially where flood behavior can vary depending on the type of disturbance.

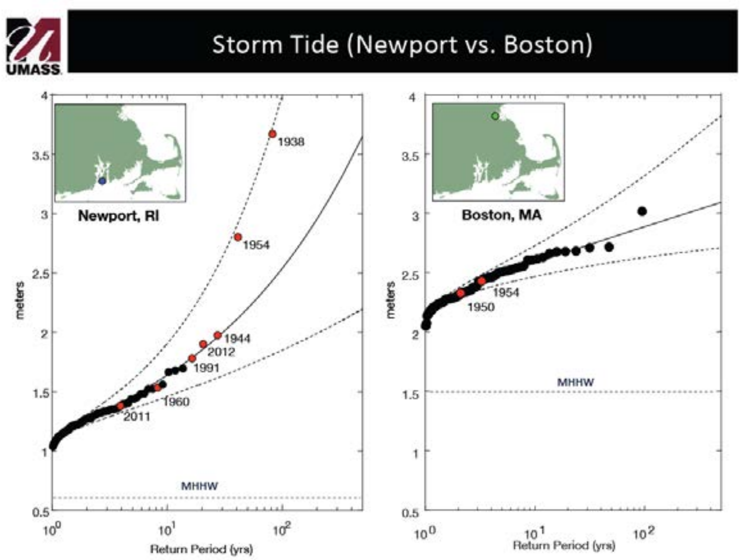


Figure comparing storm tides at Newport and Boston (from Woodruff et al., 2015)