Documentation for the New Jersey Coastal Marsh Change Maps (2019 version)

Richard Lathrop, July 2019

To project future marsh change under projected sea level rise (SLR), a marsh change data product provided by the NOAA Office for Coastal Management that was developed for the US Digital Coast Sea Level Rise Viewer (https://coast.noaa.gov/digitalcoast/tools/slr.html) was employed. This NOAA product was used, rather than a more site/state-specific implementation as this NOAA product is being used in New Jersey but also nationally for state to local scale planning and decision-making.

The NOAA marsh change product, based on SLAMM, identifies coastal marsh areas (includes estuarine and brackish marsh areas dominated by *Spartina alterniflora, Spartina patens* and *Phragmites australis)* that may be vulnerable for conversion to either non-vegetated or open water. The NOAA implementation employs a "modified bathtub" approach that incorporates local and regional tidal variation of mean higher high water (MHHW) (NOAA, 2017). Marsh areas that are predicted to be submerged below Mean Tide Level are classed as converting to unconsolidated shore (i.e., non-vegetated mud/peat/sand flat). When the marsh elevation dips below the Mean Low Water threshold, the marsh is classed as converting to open water.

The Digital Coast implementation did not explicitly incorporate marsh shoreline erosion as a separate modeled process nor does the adjacent estuary/bay morphology change. Three scenarios of sea level rise out to the Year 2050 were examined (1', 2' and 3'). Based on the consensus SLR estimates determined for New Jersey (Lathrop, Kopp and Kaplan, 2014), 2.5', 5 and 7' Year 2100 SLR scenarios were employed. These levels were then scaled to the Year 2050, equating to 1', 2' and 3' of SLR (at 2050) using the NOAA guidance 2017 document. A 'moderate' vertical accretion rate of 4mm yr^{-1} (i.e., 4mm yr^{-1} over a 50yr time frame from 2000 to 2050) was chosen based on best available information as to present rates of marsh accretion over the broader MidAtlantic region (Titus *et al.,* 2009). This single accretion rate was applied over the entire state. This 2019 version of the New Jersey Marsh Retreat Change Maps replaces an earlier version produced in 2013. This new version predicts significantly higher conversion and loss in New Jersey's Atlantic Coast's tidal marshes than the prior 2013 version.

As the NOAA-predicted marsh change product does not explicitly model marsh shoreline edge erosion, estimated past shoreline erosion rates to project future shoreline location. Shoreline erosion rates were determined by comparing the shoreline position changes between a baseline year during the 1970s and a contemporary year in the 2010s. The baseline shoreline was defined by the 1977 New Jersey Tidelands Claimed line. The NJDEP Tidelands claims map (http://www.nj.gov/dep/gis/tidelandsshp.html**)** depicts areas formerly water covered at or below mean high tide as of 1977. The contemporary shoreline for both Delaware and New Jersey was defined as the mean tide level (MTL) shoreline from V-Datum-corrected LiDAR-derived bathymetric/elevation data for the year 2010. VDatum is a software tool designed to vertically transform geospatial data among a variety of tidal, orthometric and ellipsoidal vertical datums (NOAA 2018). The historical shoreline data were rasterized at a grid size of 10 m to match the spatial extent and resolution of the V-Datum corrected bathymetric/elevation data set. The perpendicular horizontal distance between the mapped baseline and contemporary shorelines was calculated for each contemporary shoreline grid cell and then converted to an average annual shoreline erosion rate in meters/year.

The shoreline erosion rate was projected from the 2010 MTL shoreline gridded map for each 10 m grid cell to establish an estimated 2050 shoreline location. This method extrapolates the shoreline erosion rate based on the rate measured at that location (i.e., each 10 m shoreline grid cell) and thereby incorporates the wave dynamics and substrate erodibility resident at that site. Recognizing that the past historical rate may not be entirely applicable to future rates due to varying conditions or characteristics of the marsh directly inland of the existing shoreline location, inclusion of degree of uncertainty is necessary. The vulnerability of the shoreline zone to future erosion was classed into three categories that incorporated a ‘grey zone’ or ‘likelihood confidence bounds’. Areas intervening between the 2010/2015 shoreline and 80% of the distance to the projected 2050 shoreline were classified as a High likelihood of erosion. Areas between 80% and 120% of the projected 2050 shoreline were classified as a Moderate likelihood of erosion. Areas beyond 120% of the projected 2050 shoreline location were classed as having a Lower likelihood of erosion.

The 1’, 2’ and 3’ SLR projected 2050 change maps were combined with the marsh shoreline erosion maps to create a composite projected 2050 change map. The categories in this map are defined in the table below.

Likelihood of Conversion	Marsh Platform Criteria (derived from SLAMM)	Marsh Edge Criteria
Highest Likelihood	Converts to open water or tidal flat under 1'SLR scenario	Within 80% threshold distance of 2050 projection - along exposed high wave energy coast
High Likelihood	Converts to open water or tidal flat under 2' SLR scenario	Within 80% threshold distance of 2050 projection
Moderate Likelihood	Converts to open water or tidal flat under 3' SLR scenario	Between 80% and 120% threshold distance of 2050 projection
Low Likelihood	All other existing marsh	Beyond 120% threshold distance of 2050 projection

References

Lathrop, R.; Kopp, R.E.; and Kaplan, M., 2014. Appendix A. Consensus Sea Level Rise Scenarios for the NJ Coastal Flood Exposure (CFE) Assessment. In: Lathrop, R.G., J. Bognar, E. Buenaventura, J. Rovito and J. Trimble. 2014. New Jersey Coastal Flood Exposure. http://nebula.wsimg.com/371031cafb163d05b7f380c712c8ed54?AccessKeyId=ACB457C88AE224CE0A00&disposition=0&alloworigin=1

NOAA, 2017. Detailed Method for Mapping Sea Level Rise Marsh Migration. https://coast.noaa.gov/data/digitalcoast/pdf/slr-marsh-migration-methods.pdf

Titus, J.G.; and Anderson, K.E., 2009. *Coastal sensitivity to sea-level rise: a focus on the mid-Atlantic region* (Vol. 4). Government Printing Office.

Documentation for NJ Tidal Marsh GIS layer

CRSSA file name (nj_naip_2017_coastalmarsh_cl_sieve.img)

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This data layer represents New Jersey tidal marshes. The data were extracted from the NJDEP 2012 Land Use/Land Cover GIS dataset, then further edited by the Center for Remote Sensing and Spatial Analysis (CRSSA), Rutgers University, using 2017 high resolution orthophotography for the purposes of the marsh impact/marsh retreat zone modeling and analysis. The data are gridded at a spatial resolution of 10 ft or 3+ m grid cell size.

The 2017 leaf-on National Agricultural Imagery Program (NIAP) digital orthophotography was employed in a supervised classification to map areas of “High Marsh” (i.e. *Spartina patens* and *Distichlis spicata* dominated saline marsh). Each county level mosaic was classified and then merged to create a state-wide data layer. The classified layer was then clumped and sieved, eliminating clumps smaller than 4 pixels (<400 ft^2). Only High Marsh was separately classified; the other categories are derived from the NJDEP 2012 LU/LC data.

The resulting map was compared with nearly 3000 survey ground points where the dominant coastal marsh vegetation type was observed and recorded during the summers of 2017 and 2018. High Marsh was classified as where *Spartina patens* and *Distichlis spicata* was recorded as dominant. There was a 79% agreement. There was a high omission error with 559 out of 1166 points (48%) recorded as *Sp paten/Di spicata* dominated but not mapped as such. This discrepancy can be partly attributed to the difference in spatial scales between the 100 ft^2 grid cells and the < 1 ft^2 survey point. Conversely, there was very low commission error (9%) i.e., if the map says that there is high marsh at a specific grid cell location, the map user can be quite confident that high marsh can be found there. The end result is that the 7210 acres of High Marsh that was mapped is likely an underestimate.