RUTGERS
School of Environmental
and Biological Sciences

Grant F. Walton Center for Remote Sensing and Spatial Analysis
Rutgers, The State University of New Jersey
14 College Farm Road
New Brunswick, New Jersey 08901-8551

http://crssa.rutgers.edu

Tel: 848-932-1582
Fax: 732-932-2587

Documentation for the New Jersey Coastal Marsh Change Maps (2020 version)
Richard Lathrop, January, 2020

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 (1', 2' and 3') out to the Year 2050 were examined. 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 data (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 marsh shoreline erosion rate was projected from the 2010 MTL shoreline gridded map for each 10 m grid cell to establish an estimated 2050 marsh shoreline location. This method extrapolates the marsh 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 grid cells determined to have the Highest Likelihood of future erosion were those cells intervening between the 2010/2015 shoreline and 120% of the distance to the projected 2050 shoreline. 120% of the projected distance, rather than 100%, was used to account for a degree of uncertainty in the estimated erosion rate, as well as partially accommodate the expected increase in the rate of sea level rise (which is expected to lead to enhanced erosion rates). The actual relationship between rising sea levels and increasing the rates of marsh edge shoreline erosion has not been quantified. If a grid cell was classed as either likely to convert at 1’ SLR or within the projected erosion zone (i.e. 120% threshold distance of projected 2050 marsh shoreline), then it was classed as the Highest Likelihood of conversion.

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 1. Using geospatial analysis software, future marsh retreat zones were modeled for these same 1-3’ sea level rise scenarios. Those portions of New Jersey’s coastal wetland complex that are free to retreat inland as part of the natural landward migration process were mapped and labeled as **unimpeded marsh retreat zones**. Areas where future tidal marsh retreat are blocked by developed uplands, other coastal protection structures or roads were mapped and labeled as **impeded marsh retreat zones**. The marsh retreat zone maps were combined with the marsh change maps to provide a composite view of predicted salt marsh change as of the year 2050 (Table 1). Roads were masked out based on the NJ 2012 Land Use/Land Cover

Table 1. Area of predicted marsh change in acres and hectares.

Class Type	**Area (ac)**	**Area (ha)**
1 upland		
2 open water		
3 tidal flat	9,506	3,847
4 Lowest vulnerability: remains salt marsh	70,322	28,458
5 Low Vulnerability: salt marsh converts to tidal flat/open water at 3’ SLR	59,915	24,247
6 Moderate vulnerability: salt marsh converts to tidal flat/open water at 2’ SLR	41,008	16,595
7 High vulnerability: salt marsh converts to tidal flat/open water at 1’ SLR	19,236	7,785
8 Highest Vulnerability: salt marsh converts to tidal flat/open water from shoreline erosion	24,798	10,035
9 freshwater tidal/interior marsh converts to salt marsh	6,664	2,697
10 unimpeded marsh migration at 1’ SLR	34,287	13,876
11 unimpeded marsh migration at 2’ SLR	16,045	6,493
12 unimpeded marsh migration at 3’ SLR	16,011	6,479
13 impeded marsh migration	4,543	1,838

References

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