# Future Habitat application: modeling approach used to project future salt marsh and marsh/upland edge change

Richard Lathrop January 6, 2016

Tidal marsh areas that can't keep up with sea level rise are vulnerable to submergence and conversion to mud/peat flat or open water. We undertook to model those areas of New Jersey's coastal marsh (as mapped in 2012) that were vulnerable for conversion to either mud/peat/sand flats (unconsolidated shore) or open water under 1 to 3 feet of sea level rise (i.e., brackets the range of the expected rates of sea level rise expected by 2050 with 1' of SLR have the highest probability of occurring as compared to 2' and 3') (Miller et al. 2013). The NOAA Coastal Services Center (CSC) provided a potential marsh change GIS map based on SLAMM (Sea Level Affecting Marsh Model; Ehman, 2012; USFWS, 2011) using a 'moderate' level of vertical accretion (4 mm/yr over a 40 yr time frame). Tidal marsh areas that are likely to be submerged and converted to unconsolidated shore (i.e., mud/peat/sand flat) or open water under rising sea levels were included as marsh conversion: unconsolidated shore and marsh conversion: open water, respectively (Table 1). The projected marsh data were rasterized at a grid size of 10m to match the New Jersey DEM (provided by NOAA CSC) spatial extent.

Table 1. Projected change in salt marsh area under different 2050 sea level rise scenarios. Note the baseline year is 2012; % change calculated vs. baseline year tidal salt marsh area.

| DESCRIPTION | Baseline | 1 ft SLR | | 2 ft SLR | | 3 ft SLR | |
|---|---|---|---|---|---|---|---|
| | acres | acres | % change | acres | % change | acres | % change |
| Tidal salt marsh | 213,844 | 204,212 | -4.5% | 204,068 | -4.6% | 184,172 | -13.9% |
| Marsh conversion: mud/peat | | 320 | +0.1% | 326 | +0.2% | 19,276 | +9.0% |
| Marsh conversion: open water | | 9,312 | +4.4% | 9,449 | +4.4% | 10,401 | +4.9% |

The baseline for the salt marsh shoreline erosion rate was determined by the change between the shoreline in 1977 vs. 2010. NJDEP Tidelands claims line (GIS file downloaded from NJGIN **http://www.nj.gov/dep/gis/tidelandsshp.html)** depicts areas now or formerly flowed at or below mean high tide as of 1977. The tidelands data were rasterized at a grid size of 10m to match the New Jersey DEM (provided by NOAA CSC) spatial extent. The Tidelands Claimed layer was buffered inland and compared with present day mapped land and water area to determine those areas where the shoreline eroded vs. areas where land accreted vs. No Change). Due to the 2010 baseline for the V-Datum MTL data and the 1977 year for the Tidelands data, there was a 33 year difference in time. Given a 10 m grid cell width, this equates to approximately 1 foot for year (10 m = approx. 33 feet; 33 ft/33 yr = 1 ft/yr).

This shoreline erosion rate was projected out to 2050 from the mean tide line (MTL) shoreline as of the baseline year of 2010 to establish an estimated 2050 shoreline location. The spatial

zone located between the 2010 shoreline and the projected 2050 shoreline was classified as a high likelihood of erosion. If these stretches of high erosion likelihood shoreline were along areas of open coast with a higher wind fetch and wave energy, these shorelines were classed as having the highest likelihood of shoreline erosion. The grid cells representing the projected 2050 shoreline were classed as a moderate likelihood of erosion as these were the furthest distance that shoreline edge erosion was expected to occur (and thus have a lower likelihood of erosion occurring).

The SLAMM-type sea level rise scenarios outlined above were combined with the Marsh shoreline erosion rate data into a composite probability of conversion map (Table 2).

Table 2. Composite Probability of Marsh Conversion for coastal marshes under SLR

| **Probability of Marsh Conversion class** | **Marsh Platform Criteria** | **Marsh Edge Criteria** | **Area Amount (acres)** |
|---|---|---|---|
| Highest Probability | Converts to open water or unconsolidated shore under 1 ft SLR by 2050 | High likelihood of shoreline erosion along open coast | 10,751 |
| High Probability | Converts to open water or unconsolidated shore under 2 ft SLR | High likelihood of erosion | 2,455 |
| Moderate Probability | Converts to open water or unconsolidated shore under 3 ft SLR | Moderate likelihood of erosion | 22,399 |
| Lower Probability | All other existing marsh | | 178,245 |

Inland areas adjacent to coastal marsh may be inundated under future sea level rise may convert to tidal marsh over time as part of the natural landward migration process (Titus 2008). Using geospatial analysis software, we also modeled future marsh retreat zones for these same sea level rise scenarios. Those portions of New Jersey's coastal zone adjacent to coastal marsh that will be inundated under sea level rise and expected to convert to emergent marsh 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 future marsh retreat zones under 1', 2' and 3' feet of sea level rise were composited together. Note that the acreage amounts under 2' and 3' of SLR enumerated in Table 3 represent additional acreages above and beyond that might be flooded under 1' of SLR (or in the case of 3' of SLR, in addition to 1' and 2' SLR).

Table 3. Area of Impeded and unimpeded marsh retreat zones under projected sea level rise.

| **Retreat Zone** | **Acres** |
|---|---|
| Unimpeded 1' SLR | 15,887 |
| Unimpeded 2' SLR | 11,381 |
| Unimpeded 3' SLR | 10,640 |
| Impeded (under all SLR) | 4,618 |
| Total | 45,526 |

We suggest using this modeled output as an initial coarse grain screening tool to identify those marsh areas that show the highest vulnerability to sea level rise and storm-driven wave erosion over the coming decades (out to 2050).

**References**

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