Assessing Sea Level Rise and Future Storm Surge Exposure for the Port of Virginia NIT-South Marine Terminal

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Problem

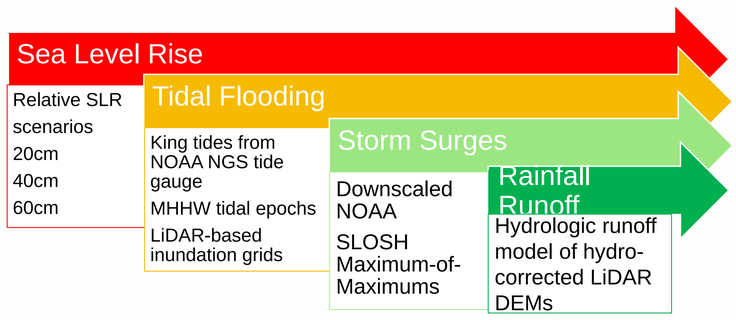
Marine terminal capital improvement investments in the form of new and updated equipment must include planning for potential exposure to relative sea level rise and storm surge. Estimate the risk of flood water exposure for selected structural assets at Norfolk International Marine Terminal South. Estimate the risks of exposure under current conditions as well as under projected relative sea level rise and coastal storm surge scenarios.

Objectives

- Integrate marine terminal structural assets into hazard simulations to assess current and future risk stemming from flood water inundation.
- Generate 3D representations of potential inundation under storm surges with relative sea level rise.
- Assess the relative and absolute vertical and spatial dimensions of exposure at fixed thresholds of sea level and storm surges.
- Evaluate interacting and cumulative risk as sea level and tidal inundation evolve.

Data & Scenarios

DEM inundation models draw upon NOAA SLOSH surge models, LiDAR DEMs, and tide gauge datum. All spatial data are co-registered to a common horizontal and vertical reference. Storm surges are simulated using NOAA SLOSH Maximum of Maximums (MOM) grids for slow-moving storms (Category 1-3) at each of 5 sea level reference frames (baseline today, +20cm, +40cm, +60cm, and +80cm relative SLR.) Increased tidal flooding was also estimated using projection of high tides for exposure across the terminal.

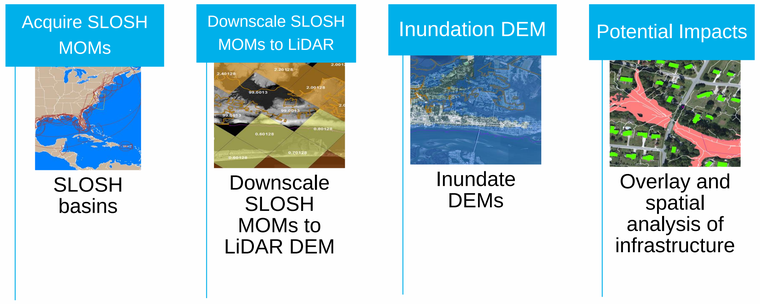


Approach & Methodology

The approach deploys a multi-hazard methodology for vulnerability assessment of the marine terminal's structural assets. The assessment entails drawing upon the NOAA SLOSH model, superposition of SLOSH on landforms and developed surfaces with relative SLR, mapping surge inundation zones for storm severity, and estimating freeboard or potential depth of inundation structures. NOAA 2017 and USACE intermediate-high sea level calculations are used. Flooding depths are compared to freeboard elevation of structural assets. Risk analysis is informed by: (1) Exposure, (2) Susceptibility, (3) Potential Impacts

Asset Susceptibility

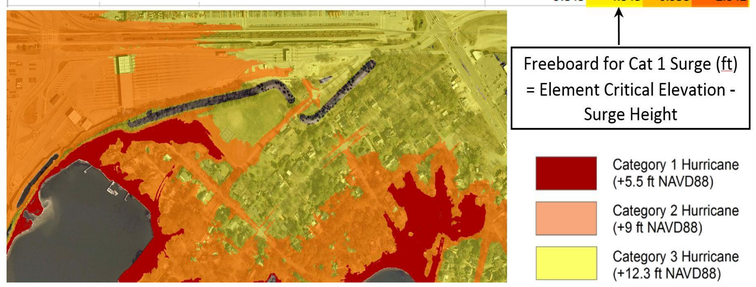
Asset susceptibility is evaluated using recent down-scaled Norfolk SLOSH basin MOMs, flood LiDAR DEMs, and intersected vertical separation distances.



Asset Exposure

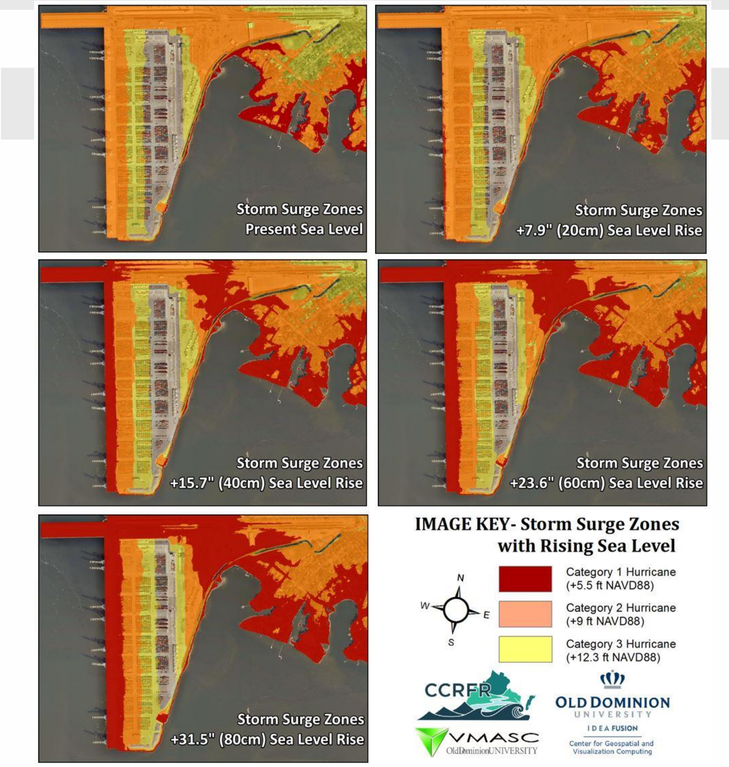
Infrastructure risk tables detail the freeboard elevation between the surge and the structure's critical elevation. Positive values indicate critical elevation is not submerged and negative values indicate potential inundation depth.

Crit_Infrastr_#	Infrastr_Type	Crit_Infrastr_Name	Crit_NAVD88_ft	FB_c1	FB_c2	FB_c3
			9.848	4.348	0.958	-2.342



Results

With sea level rise, assets already exposed to storm surges today may be impacted by less severe storms in the future



Recommendations

Risk to structural assets quantified, thus allowing for recommendations:

- The Port should prepare for Relative Sea Level Rise of 15"+ in the 2030s. more rapid acceleration beyond.
- Tidal flooding poses a creeping threat, affecting storm water, pipes, and tailwater and subsurface drainage.
- Disconnected depressions may be susceptible if barriers are breached or flooding intrudes subsurface.
- Continued systemic monitoring of sea level rise projections and other climate-sensitive hazards.

References

Sweet et al. 2014. Sea Level Rise and Nuisance Flood Frequency Changes around the United States. NOAA Tech. Rpt. NOS CO-OPS 073

McLeod, G. M., Allen, T. R., & Behr, J. G. (2018). Geospatial Risk Assessment of Marine Terminal Infrastructure to Storm Surge Inundation and Sea Level Rise. Transportation Research Record. https://doi.org/10.1177/0361198118774234