



Climate Change Vulnerability in the Coasts and Oceans of the Mid-Atlantic Region: A Closer Look at Maryland



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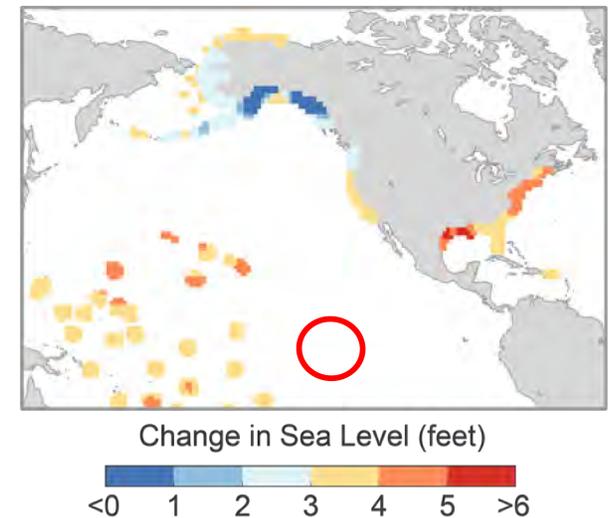
Current Research on Climate Change in Coastal and Marine Mid-Atlantic

- Reviewed 83 Studies:

Regional:	34	- Delaware:	11
New York:	14	- Maryland:	7
New Jersey:	7	- Virginia:	10

- Threats arising from changes in ocean temperatures, land ice melt, and chemistry (compounded with non-climatic threats)
- Changing Views of Sea Level Rise
 - Better observations
 - Better understanding of underlying processes, especially land-based sources
 - Better models:
 - Unevenly used across the region at the moment

Projected Relative Sea Level Change for 2100 under the Intermediate Scenario



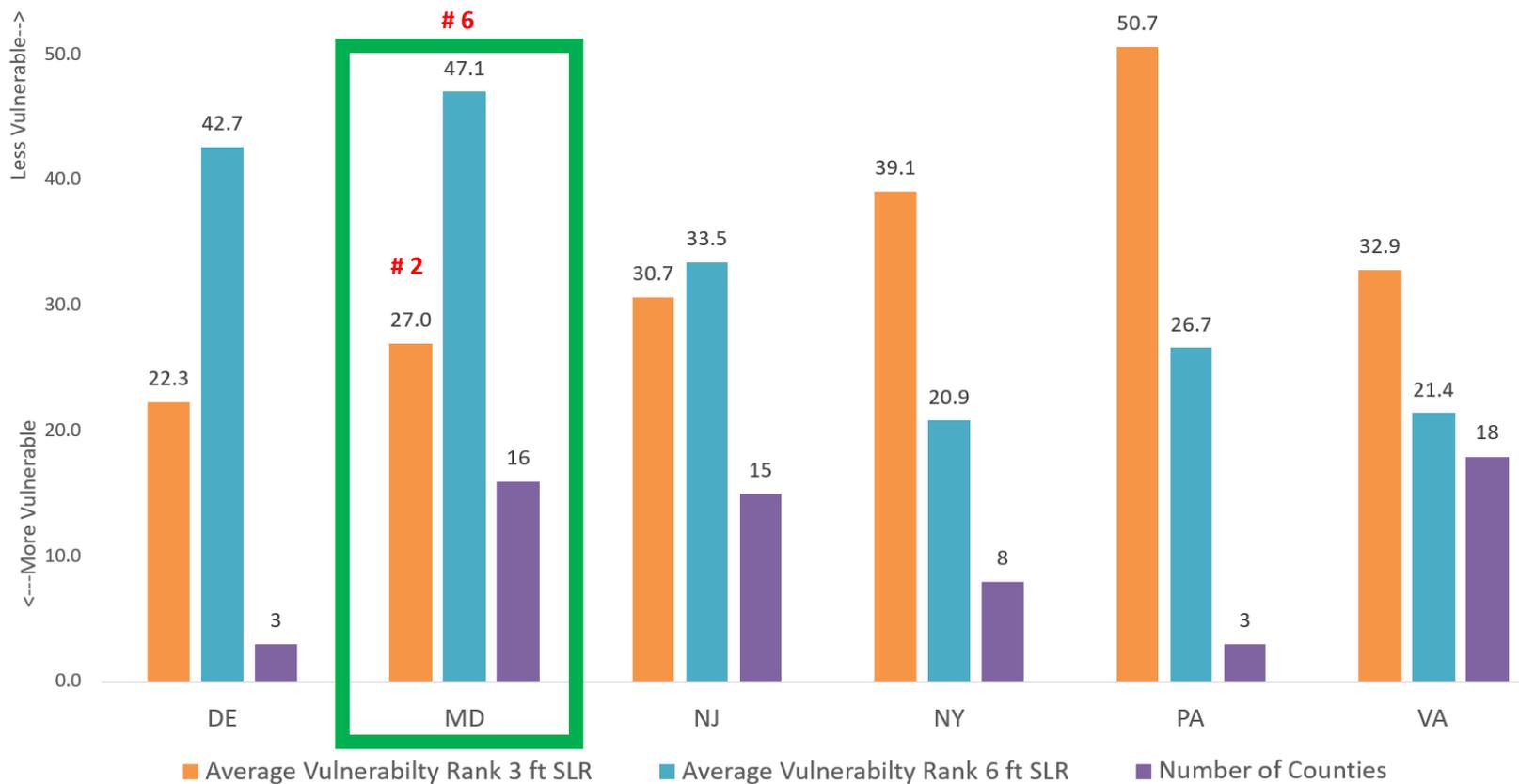
2. Estimating Sea Level Rise Vulnerabilities

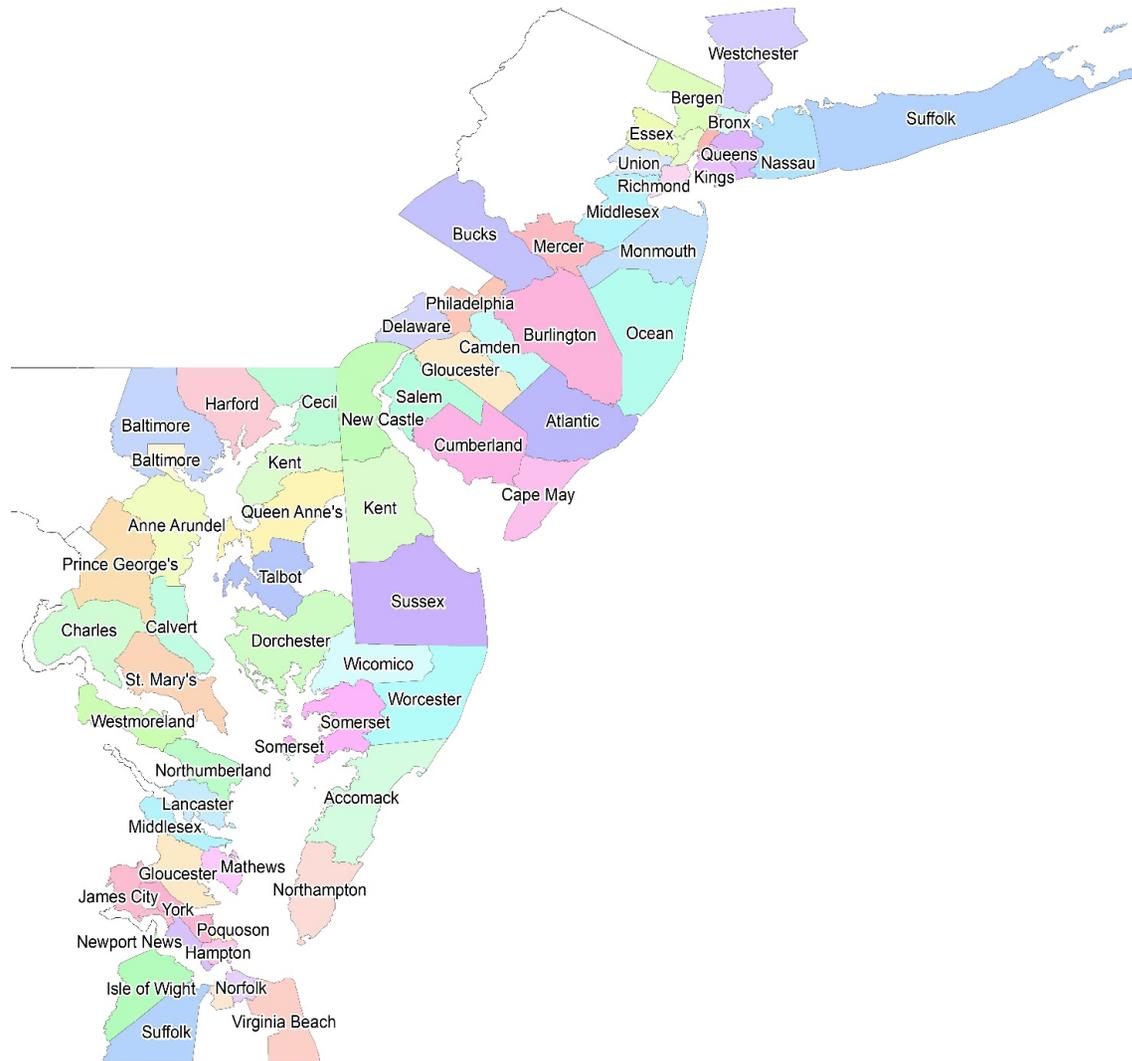
- SLR Model Used: NOAA Sea Level Rise Viewer (updated August 2016, based on Post-Sandy lidar).
 - 3 Feet and 6 Feet

Relationship to Current State Practice:

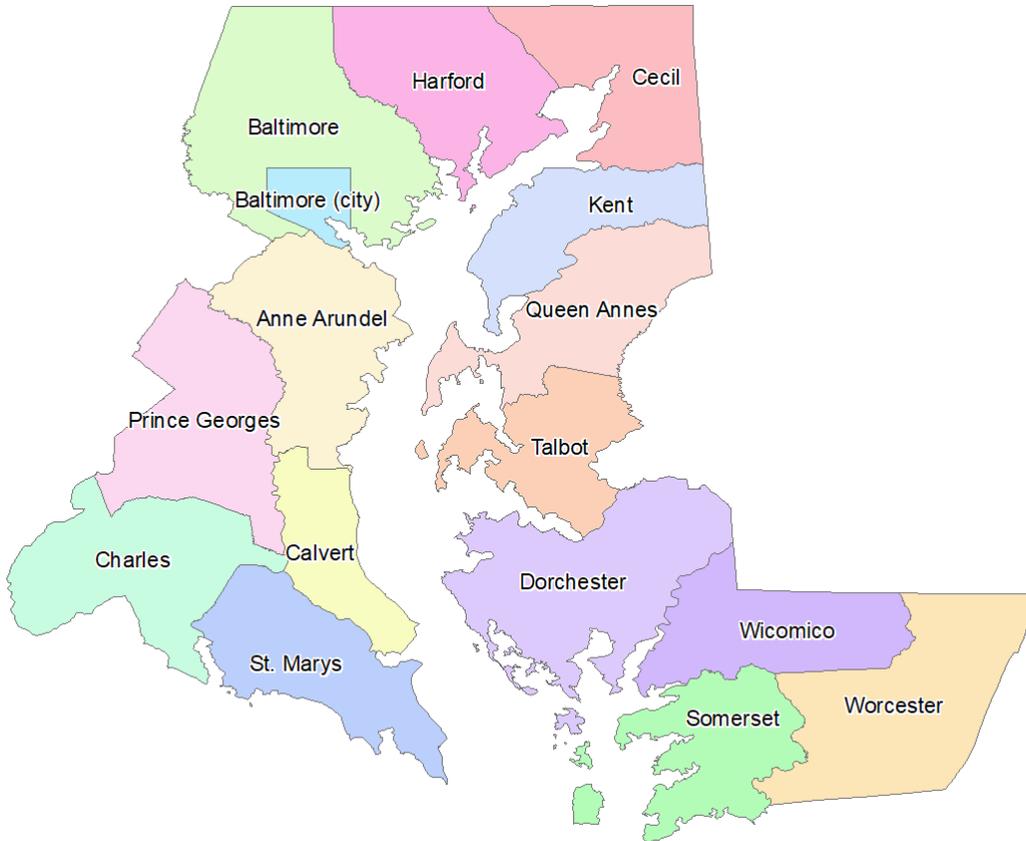
	CBE Recommended Scenarios	Fourth National Climate Assessment (2017)	NOAA (2017)	NY (2014)	NJ (2014)	DE (2017)	MD (2013)	VA (ADAPTVA, Norfolk, VA, 2017)	MEAN	IPCC (2013)
MEDIUM	3	3.3	3.28	3	N/A	3.3	3.7	4.2	3.5	1.5
HIGH	6	6.6	6.56	6.25	4.5	4.9	5.7	7.5	6.0	2.1

Mean Ranking of 63 counties on 11 vulnerability factors (Lower Scores = Higher Vulnerability)





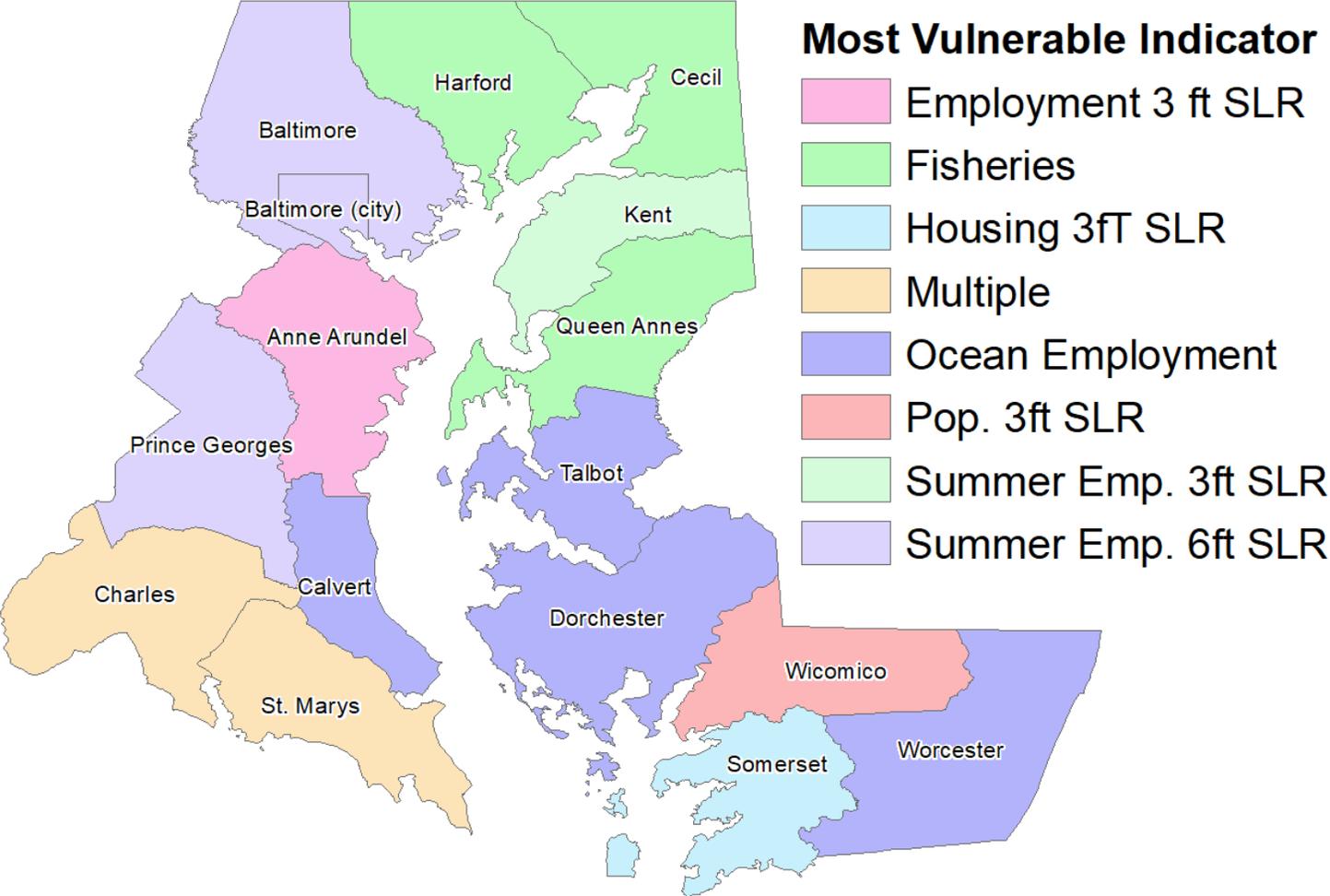
Maryland Counties Included



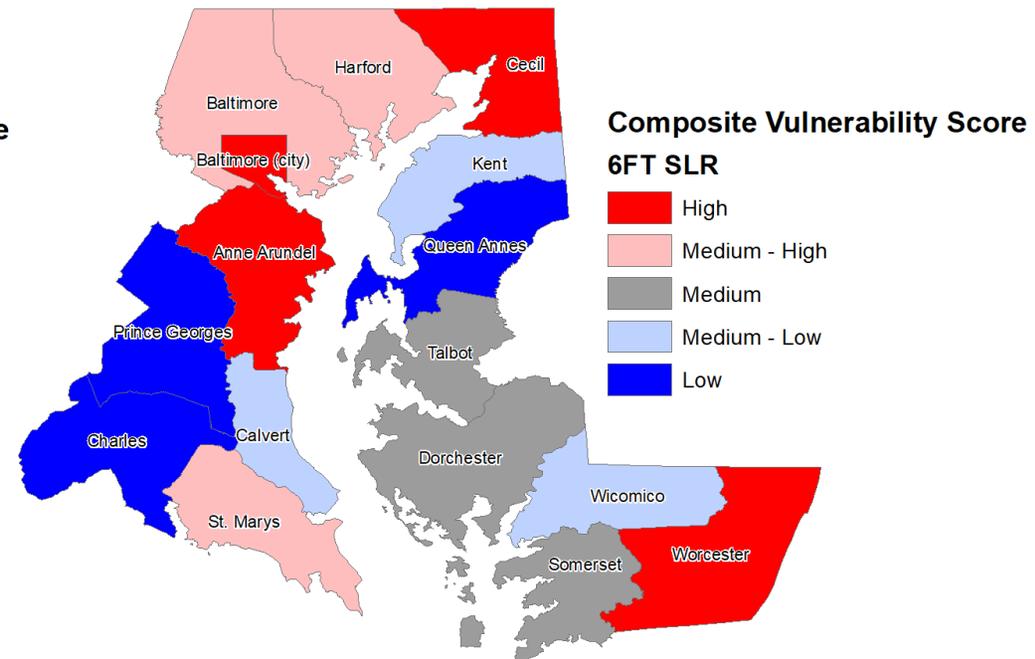
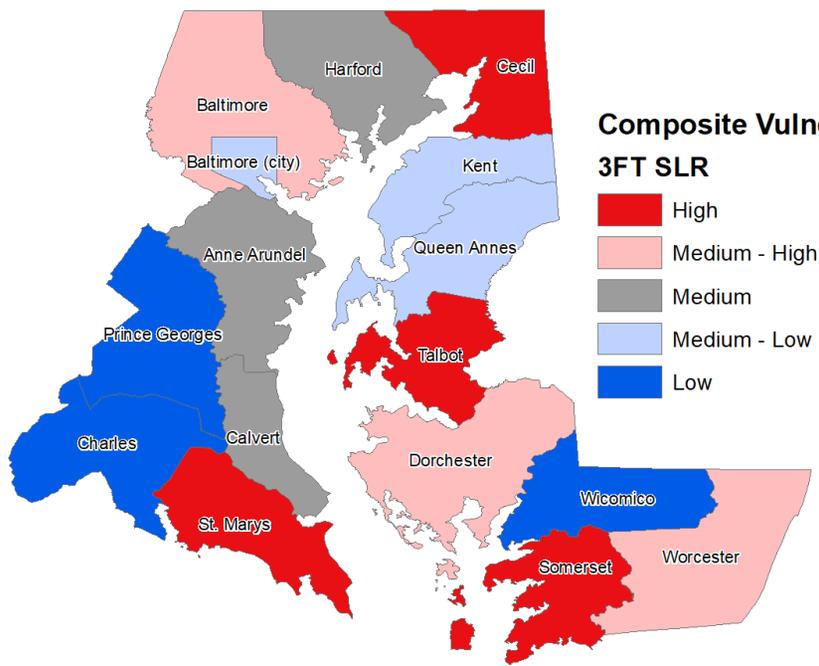
Major Factors

- Population
- Total Employment
- Summer Tourism & Recreation
- Infrastructure
- Fishing Communities
- Social Vulnerability

Highest Vulnerability Factor by County

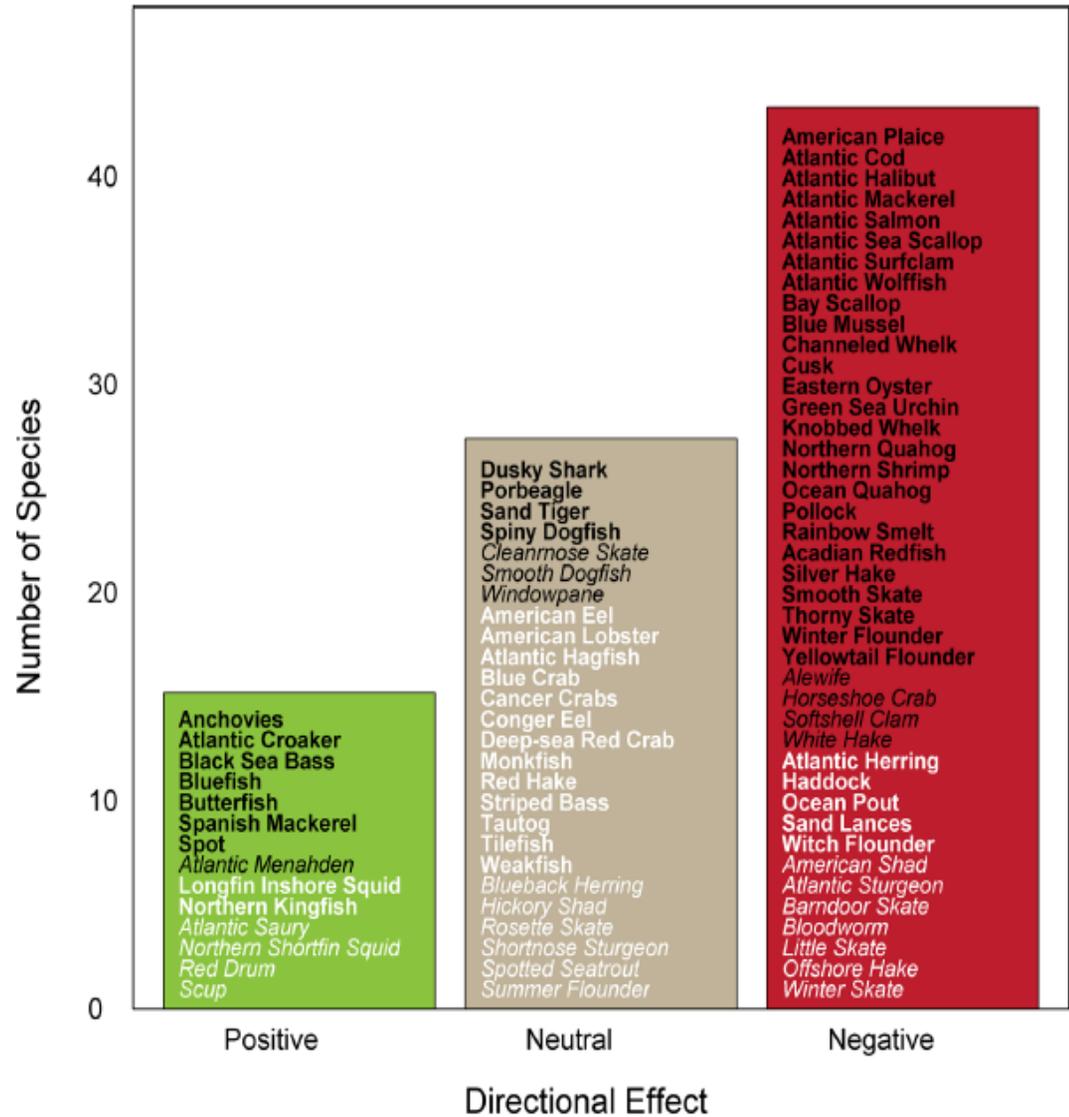


Composite Vulnerability Scores (Regional Ranking)



Number of Seafood Businesses Affected by Sea Level Rise

State	City	3 ft SLR	6 ft SLR
MD	Cambridge		1
MD	Chesapeake Beach		1
MD	Churchton		1
MD	Crisfield	3	3
MD	Deale		1
MD	Fishing Creek	1	1
MD	Grasonville	1	1
MD	Middle River	2	3
MD	Ocean City		1
MD	Piney Point	1	1
MD	Ridge		1
MD	Rock Hall	1	2
MD	Sherwood		1
MD	Tilghman		1
MD	Westover	2	2



Ecosystem Services (ES) related to Wetlands

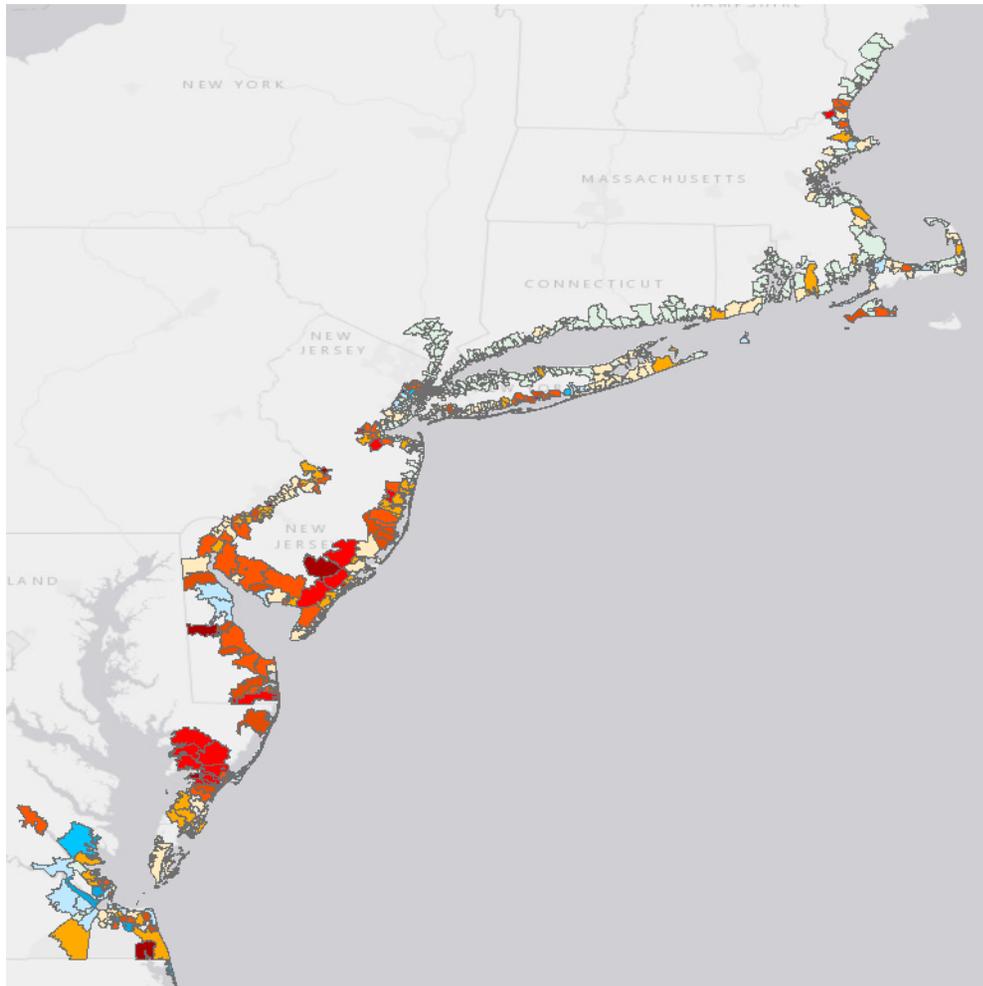
Provisioning	Regulating	Cultural	Supporting
<ul style="list-style-type: none">■ Floodplain recession agriculture■ Fresh water supply■ Food source (fishery, birds, wildlife)■ Grazing area for cattle	<ul style="list-style-type: none">■ Flood attenuation and protection■ River flow regulation■ Improvement of water quality■ Nutrient cycling and sediment retention	<ul style="list-style-type: none">■ Ecotourism■ Services meeting aesthetic, emotional, ethnic or spiritual needs	<ul style="list-style-type: none">■ Biodiversity■ Carbon sequestration and storage■ Groundwater recharge



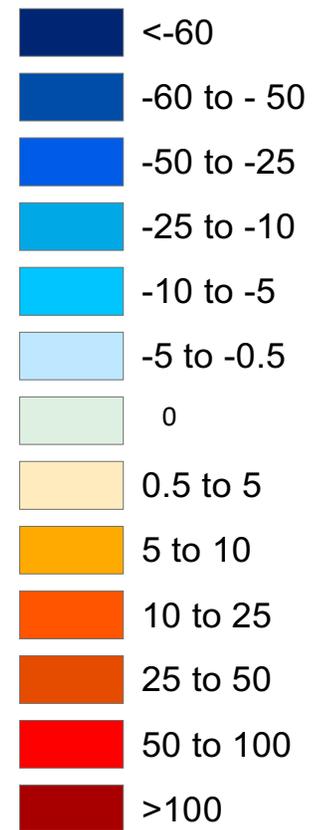
Protected Area Certificates + Management Plan for Development



Benefit sharing, Conservation of Nature and Sustainable Use of Resources

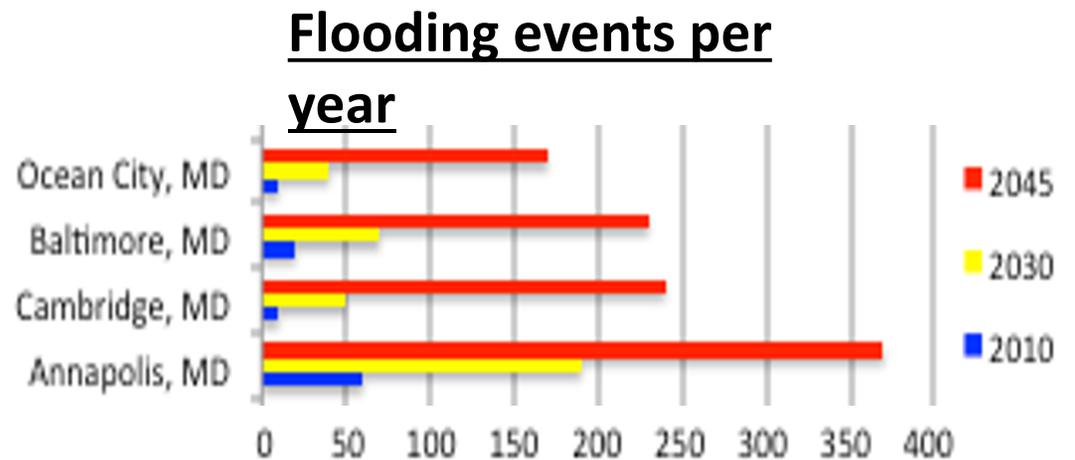


Difference in Losses (%)



6. Maritime Transportation Impacts

	Maritime Transportation		
	Employment	Wages (\$billion)	GDP (\$billion)
New York	22,963	1.70	3.81
New Jersey	31,757	2.26	4.29
Delaware	4,846	0.21	0.35
Maryland	21,834	1.87	3.90
Virginia	15,657	1.12	2.23
MARCO Total	97,057	7.16	14.58



Conclusions

- Every part of coastal Maryland is vulnerable to climate change, but the source of vulnerability differs across the state.
- Vulnerability analysis is a first stage to planning.
 - Broad assessment followed by increased precision
 - Checklist for planning
 - Better models:
 - SLR
 - Economic/Demographic Forecasts to Match
- Start with the Swiss Army Knives of Adaptation Planning
 - Wetlands
 - Public infrastructure (ports)