# ECOSYSTEM SERVICES IN CLIMATE CHANGE ADAPTATION PLANNING

## OPTIMIZATION OF ECOSYSTEM SERVICES IN URBAN AND LANDSCAPE PLANNING

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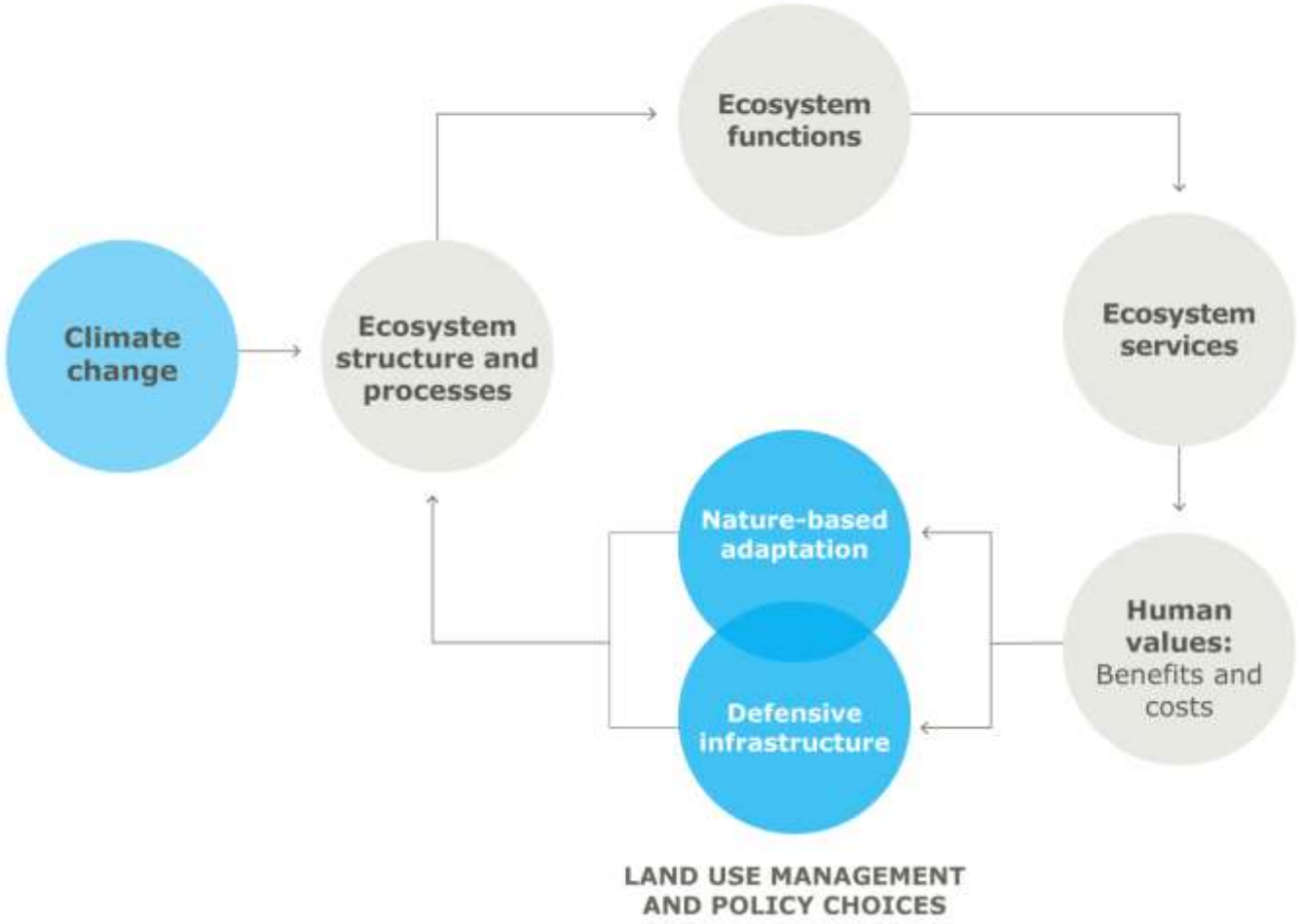
# ECOSYSTEM SERVICES AND ADAPTATION DECISIONS



# PRESENTATION TOPICS

1. Coastal Resilience in Ventura County, California
2. Economics of Adaptation Decisions
3. Ecosystem Services
4. Decision Making!
5. Conclusions and Next Steps

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# COASTAL RESILIENCE IN VENTURA COUNTY, CA

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# PARTNERSHIPS



ESA PWA


United Water Conservation District
Protecting Resources. Balancing Needs.


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Friends of the Santa Clara River

STATE OF CALIFORNIA
Coastal Conservancy



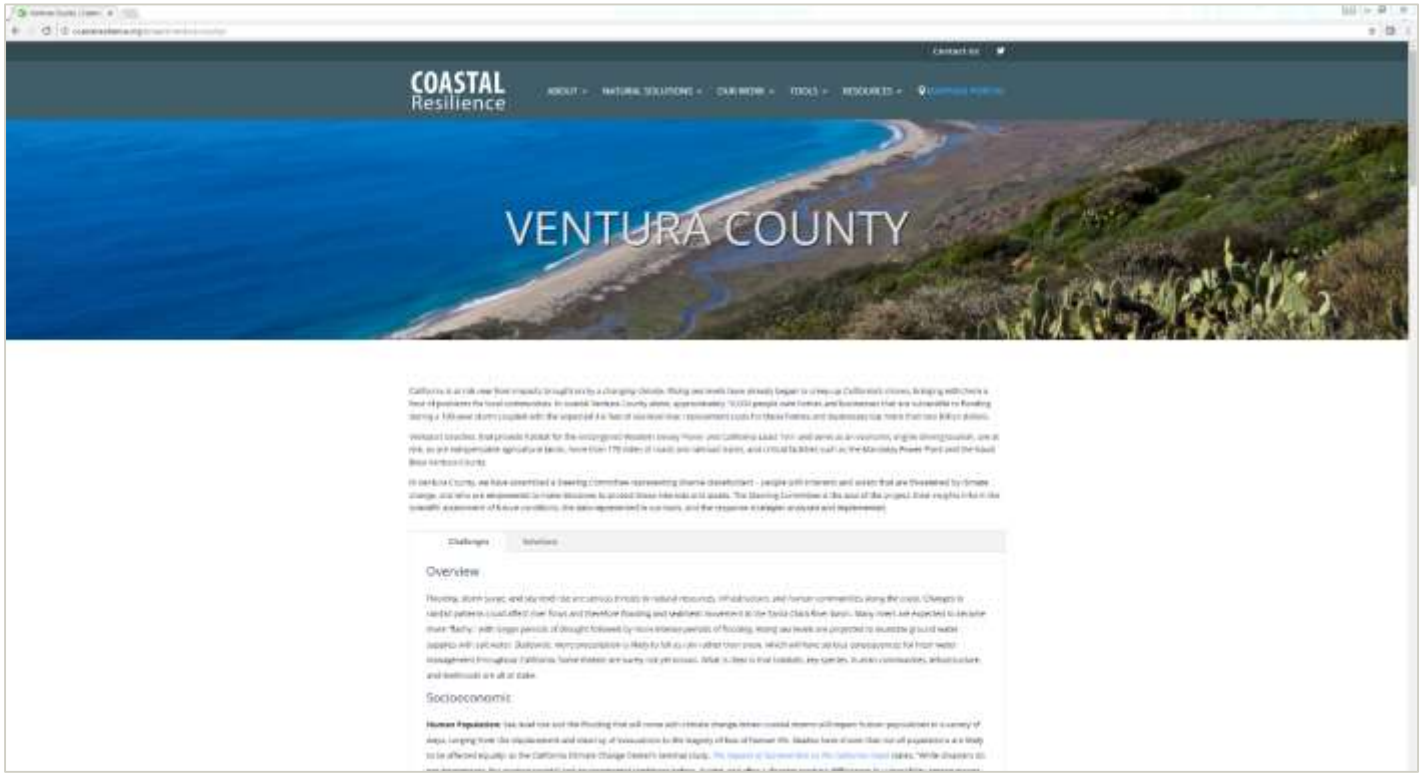




# OVERVIEW

## "Coastal Resilience"

- Provides tools and information to better inform stakeholders on climate change and disaster risk reduction
- Emphasizes important role of ecosystems in this process
- Focus on sea level rise (SLR)

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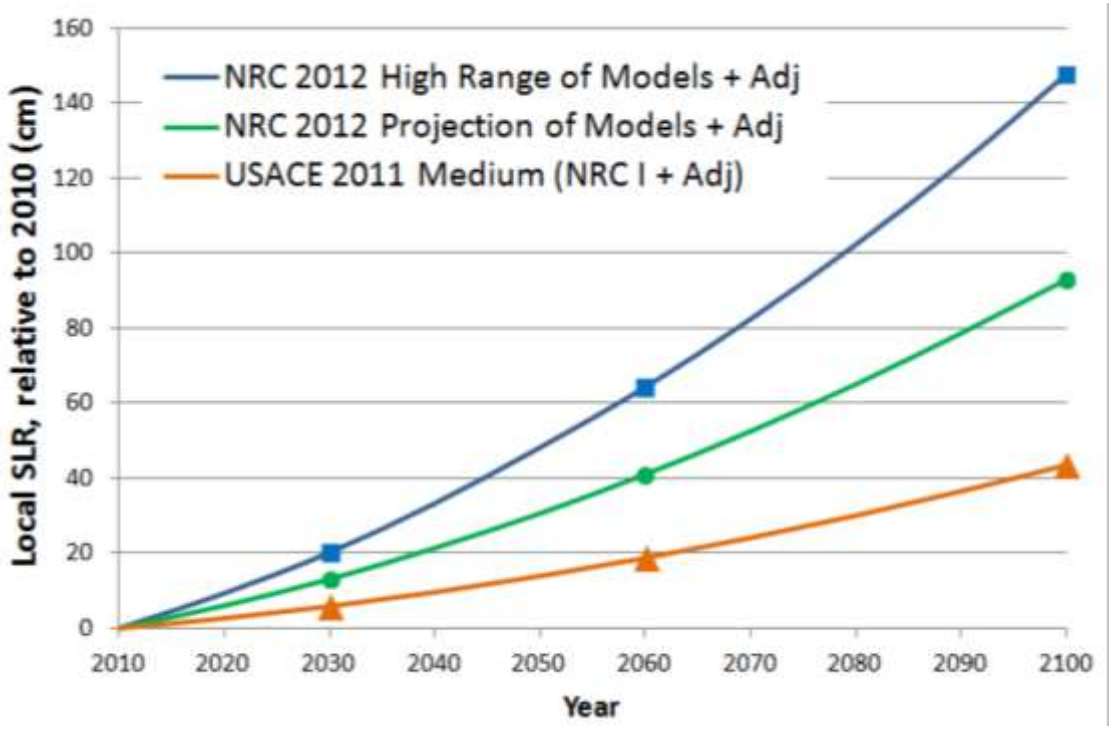
# COASTAL RESILIENCE IN VENTURA COUNTY

## COASTAL HAZARD MODELING

Effects of SLR modeled on three planning horizons and three climate change scenarios

Coastal resilience tool considers the following hazards:

Coastal erosions, rising tide inundation zones, coastal storm flooding, coastal storm flood combined storm flood hazard zones (waves)




Source: ESA PWA. 2013. Coastal Resilience Ventura, Technical Report for Coastal Hazards Mapping

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# COASTAL RESILIENCE IN VENTURA COUNTY, CALIFORNIA
## INUNDATION MODELING

**2030**

**2060**

**2100**

On-line results available at: http://maps.coastalresilience.org/ventura/#

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# COASTAL RESILIENCE IN VENTURA COUNTY, CALIFORNIA

- Stakeholder involvement in designing adaptation scenarios
- Maps for scribbling!
- Many different overlapping jurisdictions and perspectives – coordinated planning facilitated by Resilience Network activities
- Stakeholders involved in beta tests for online hazard mapping, and now
- Online results for economics

**TABLE 2: PARTICIPATING STAKEHOLDERS**

| Stakeholder | Representative | Title |
|---|---|---|
| Naval Base Ventura County | Anna Sheperd | Community Plans and Liaison Officer |
| Naval Base Ventura County | Jordan Young | Interdisciplinary Community Planner |
| Supervisor Long's Office | Lauren Bianchi-Klemann | Field Representative |
| California Coastal Commission | Jonna Engel | Ecologist |
| City of Ventura | Maggie Ide | Community Plan |
| City of Ventura | Dave Ward | Planning Manager |
| Office of Emergency Services | Kevin McGowan | Manager |
| California Coastal Conservancy | Peter Brand | Senior Project Manager |
| City of Oxnard | Chris Williamson | Principal Planner |
| City of Port Hueneme | Greg Brown | Community Development and Housing Authority |
| Surf Rider Foundation | Paul Jenkin | Environmental Coordinator |
| County of Ventura | Rosemary Rowen | Plans, Ordinances and Regional Planning Manager |
| County of Ventura | Jennifer Welch | Case Planner |

# ECONOMICS OF CLIMATE CHANGE ADAPTATION DECISIONS
## NATURE VS. ARMORING

- **NBA**: developed based on feasible engineering options, stakeholder comments and realistic options
  - Considers restoration of wetlands, dunes and other natural processes, and managed retreat
- **CAA**: developed based on feasible engineering options, stakeholder comments, and realistic implementation options and relative public acceptance
  - Considers construction of sea walls, levees and other armoring
  - Priority is to protect built property and infrastructure

# ECONOMICS OF ADAPTATION DECISIONS

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# ECONOMICS OF ADAPTATION DECISIONS

Risk is

Probability of an event or chance that it will occur in the future

X

Impacts of events in terms of structural damage, environmental harm, business interruptions

Likelihood of Events

Consequences of Events

"Chance favors the prepared mind"

Louis Pasteur, 1854

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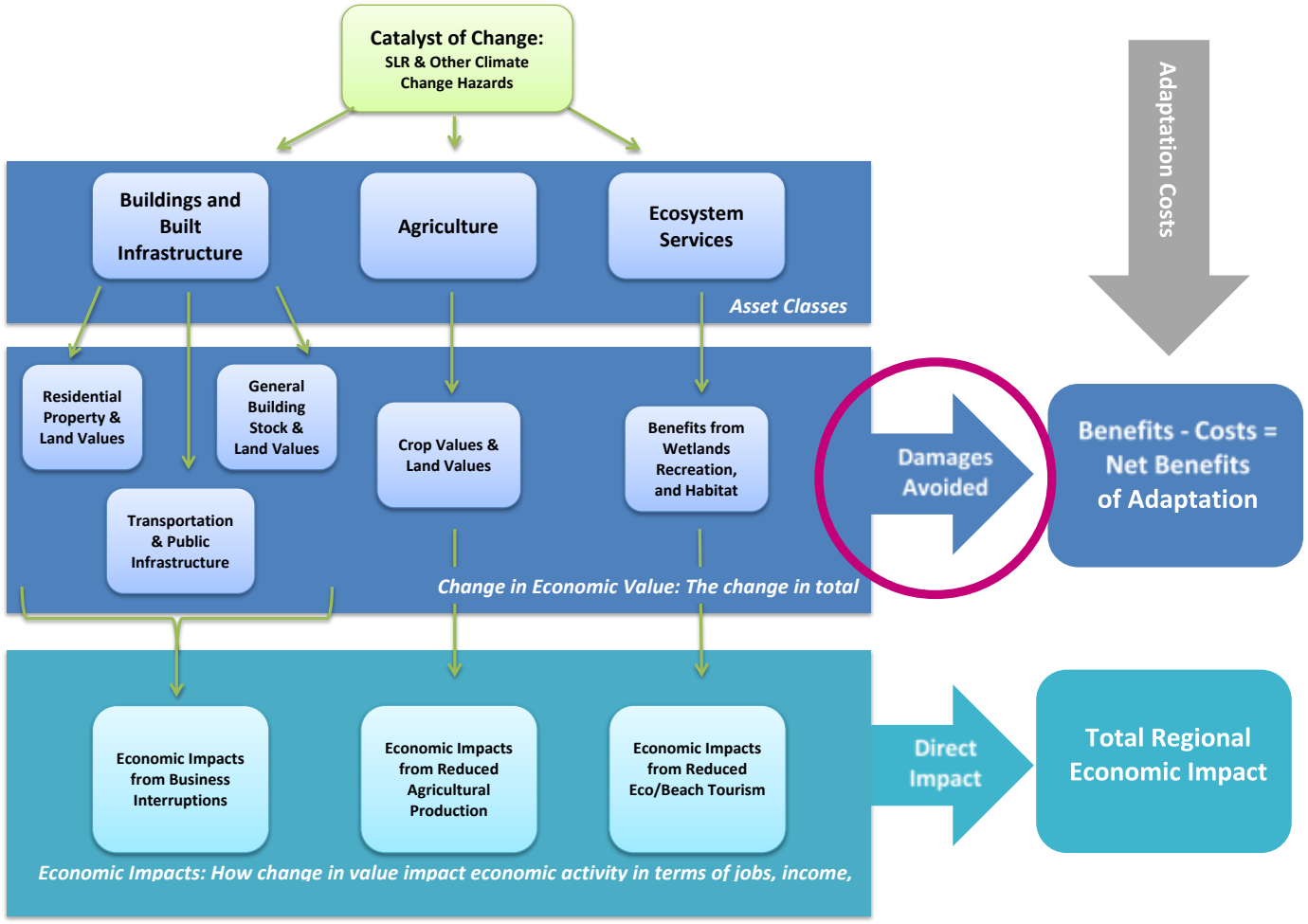
# ECONOMICS OF ADAPTATION DECISIONS




Analysis conducted for future in three scenarios:

1. No adaptation
2. Nature based adaptation
3. Coastal armoring adaptation

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# ECONOMICS OF CLIMATE CHANGE ADAPTATION DECISIONS

| DATA | SOURCE |
|---|---|
| Coastal hazard data | ESA PWA |
| Public infrastructure | Hazus |
| Parks and recreation<br><br>Parcel data | Multiple public sources<br><br>Ventra County Assessor's Office |
| Replacement cost of public infrastructure | Hazus |
| Market value of residential homes | DataQuick via LA Times |
| Recreational use data | Multiple public sources |
| Agricultural value | Ventura County Agricultural Commissioner's Office |
| Recreational value<br><br>Agricultural crop acreage<br><br>Road value | USFS database<br><br>Ventura County Agricultural Commissioner's Office<br><br>State of California Flood Rapid Assessment Model (F-RAM) Development |

# ECONOMICS OF CLIMATE CHANGE ADAPTATION DECISIONS

| ASSET CLASS | BASIC UNITS | # OF UNITS | VALUE (MILLIONS) |
|---|---|---|---|
| Private | Parcels with structures | 30,151 | $15,751 |
| Public | Parcels | 92 | $918.8 |
| Ag | Parcels | 408 | $936.5 |
| Recreational | Parcels | 236 | $115.8 |
| Roads | Miles impacted under current conditions | 234 | $12.7 |
| **Totals** | | **31,121** | **$17,735** |

# ECONOMICS OF CLIMATE CHANGE ADAPTATION DECISIONS

| HAZARD | DESCRIPTION | VARIABLE MEASUREMENT | ECONOMIC DAMAGE FUNCTION USED |
|---|---|---|---|
| Extreme monthly high water | EMHW, a high tidal water level reached approximately once per month. This represents areas that are regularly flooded by ocean tides. | Depth of flood used to estimate baseline | USACE depth damage functions based on number of stories, presence of basement and depth of water measured in feet |
| Flood depth of major coastal storms | This flood depth is based on a record storm in January 1983. Flood depths are only included for areas outside the wave hazard zone. | Mean flood depth of major coastal storm within parcel measured in meters | USACE depth damage functions based on number of stories, presence of basement and depth of water measured in feet |
| Wave zone area | Parcel is located in a wave zone area, dominates flood inundation | Presence of wave hazard in any part of parcel (YES/NO) | Loss of value based on USACE functions |
| Long-term erosion | Area of long-term, continued erosion due to SLR | Percent of parcel in long-term erosion hazard zone (%) | < 50% erosion = 50% loss in value<br>> 50% erosion = 100% loss in value |

# INCORPORATING ECOSYSTEM SERVICES

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# INCORPORATING OTHER ECOSYSTEM SERVICES

- NESA (net ecosystem services analysis)
  - Calculate net benefits/declines in services from the environment to humans
- HEA (habitat equivalency analysis) measures changes in ecosystem services
- Developed in natural resource damage assessment processes (and vetted through legal system!)
- Assumes level of ecosystem services is proportional to habitat quality
- HEA converts estimates into service acre-years (SAYs) – ecosystem services provided by one acre of saltwater wetland for one year
- These results can be discounted or turned into net gain or loss as per BCA

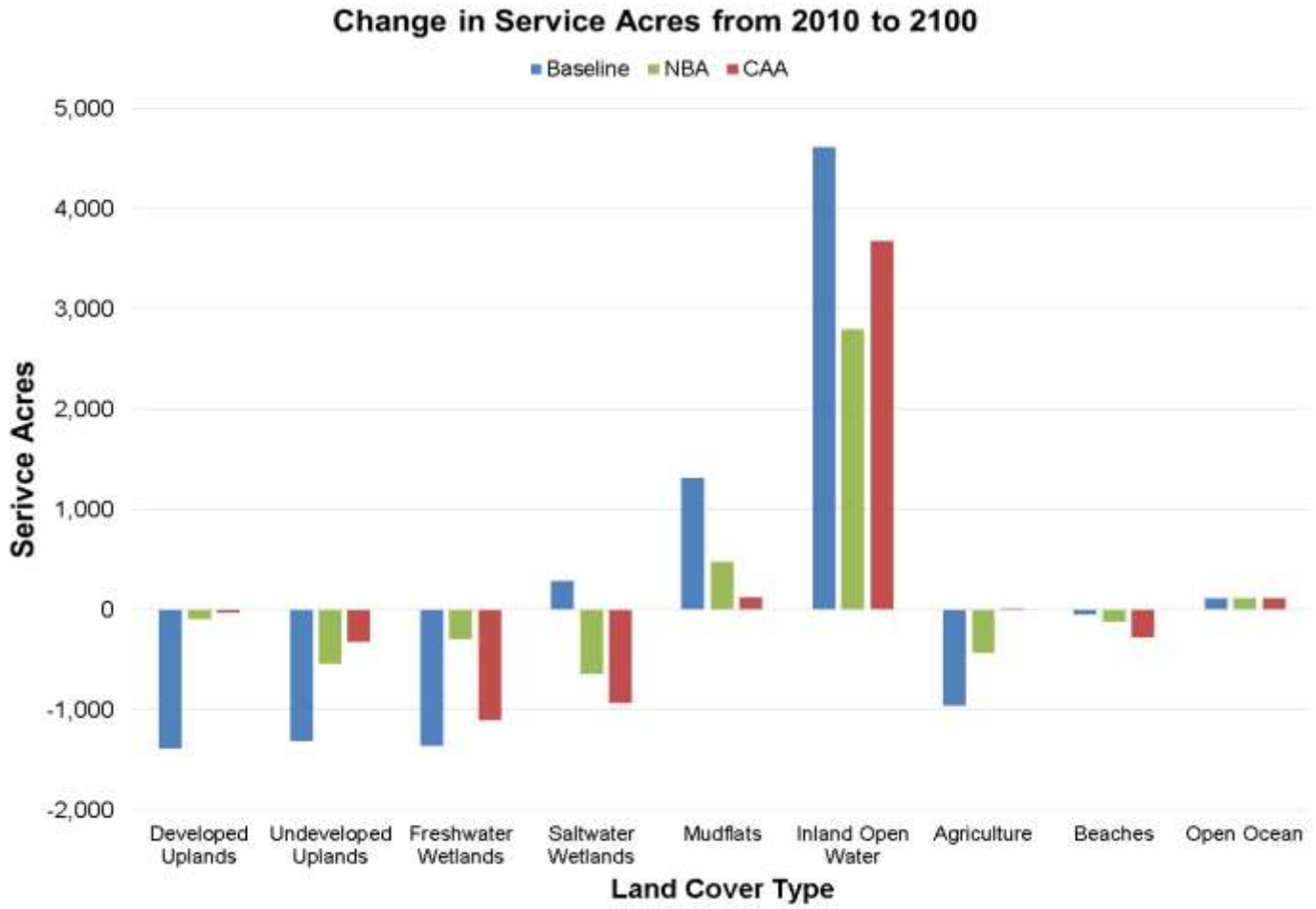
## SLAMM (SEA LEVEL AFFECTING MARSHES MODEL)

Simulates dominant processes involved in wetland conversions during long-term SLR, including inundation, erosion, overwash, saturation and accretion

**Input:**

High-res digital elevation model, map of wetland habitats, future SLR projections, marsh accretion rates, tide ranges and erosion rates

# INCORPORATING ECOSYSTEM SERVICES

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# RESULTS AND DECISION MAKING

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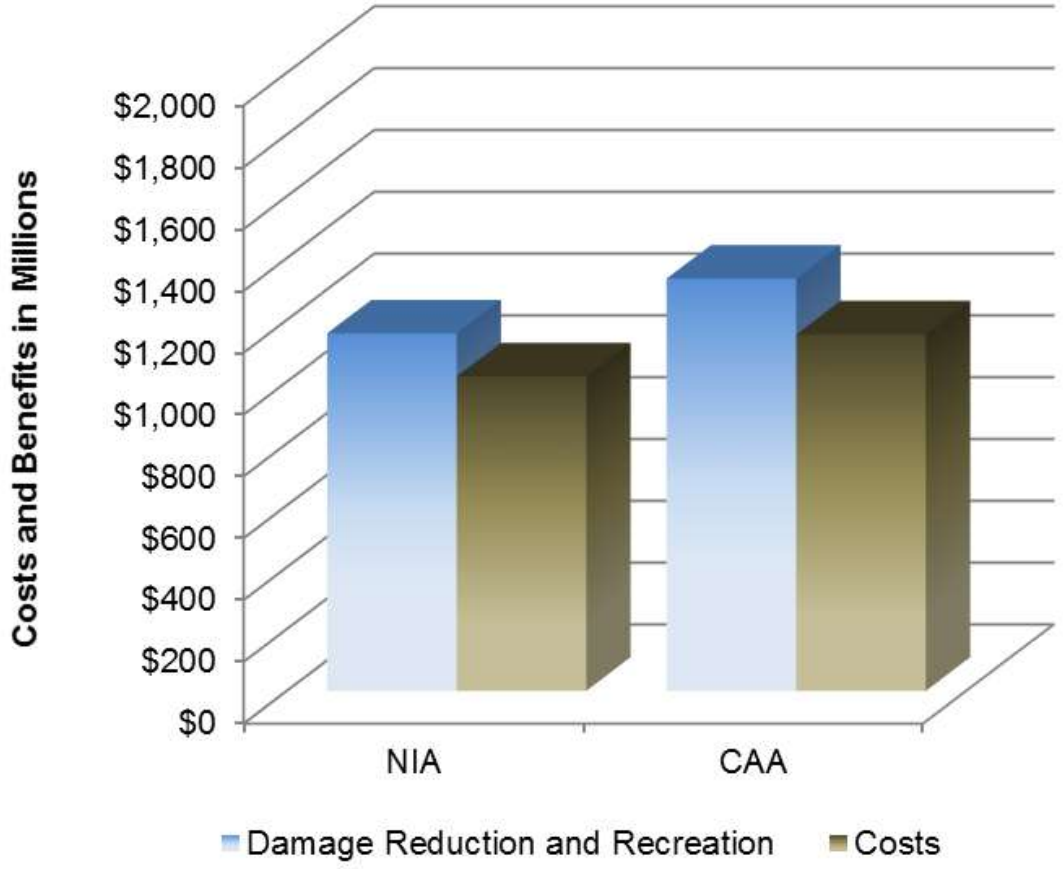
# RESULTS

- Coastal armoring and natural infrastructure are both cost effective in terms of mitigating sea-level rise damages as compared to the baseline
- Natural infrastructure reduces damages by 66%
- Coastal armoring by 76%

→ **Without including ecosystem services**

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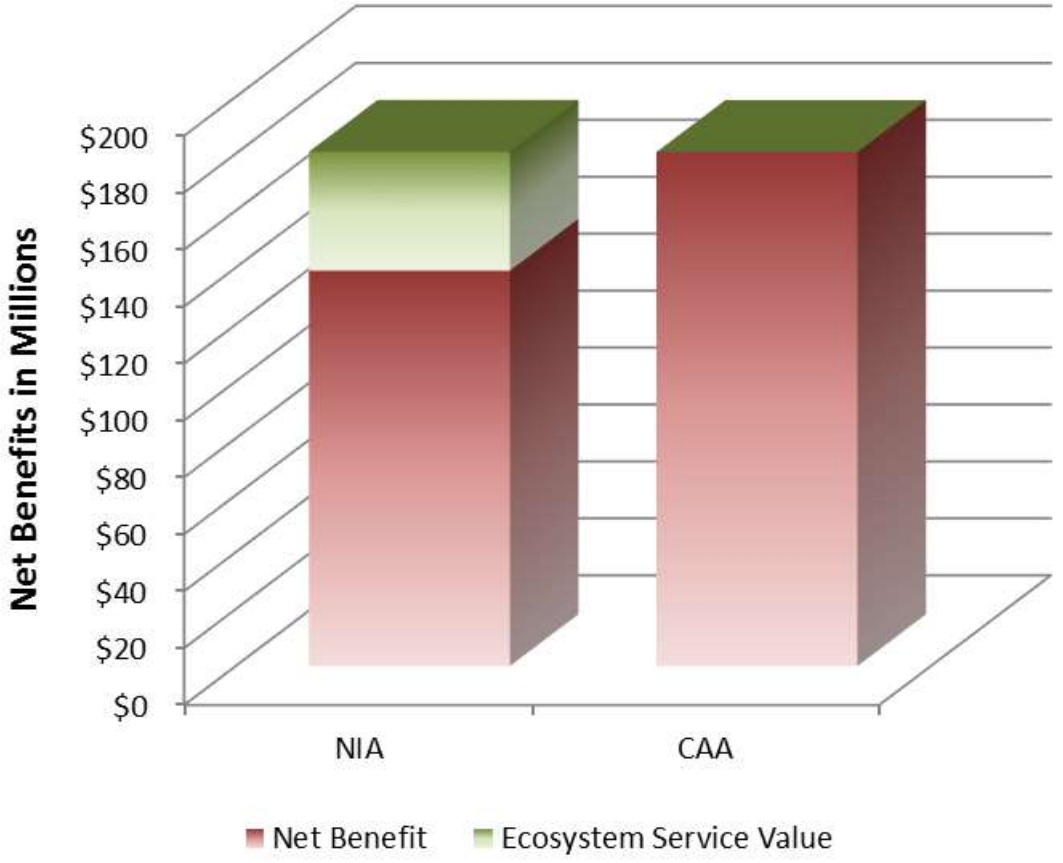
# RESULTS

- Valuing wetlands at $3,000/acre
- Natural infrastructure adaptation solution = greater net benefits

**→ With ecosystem services**

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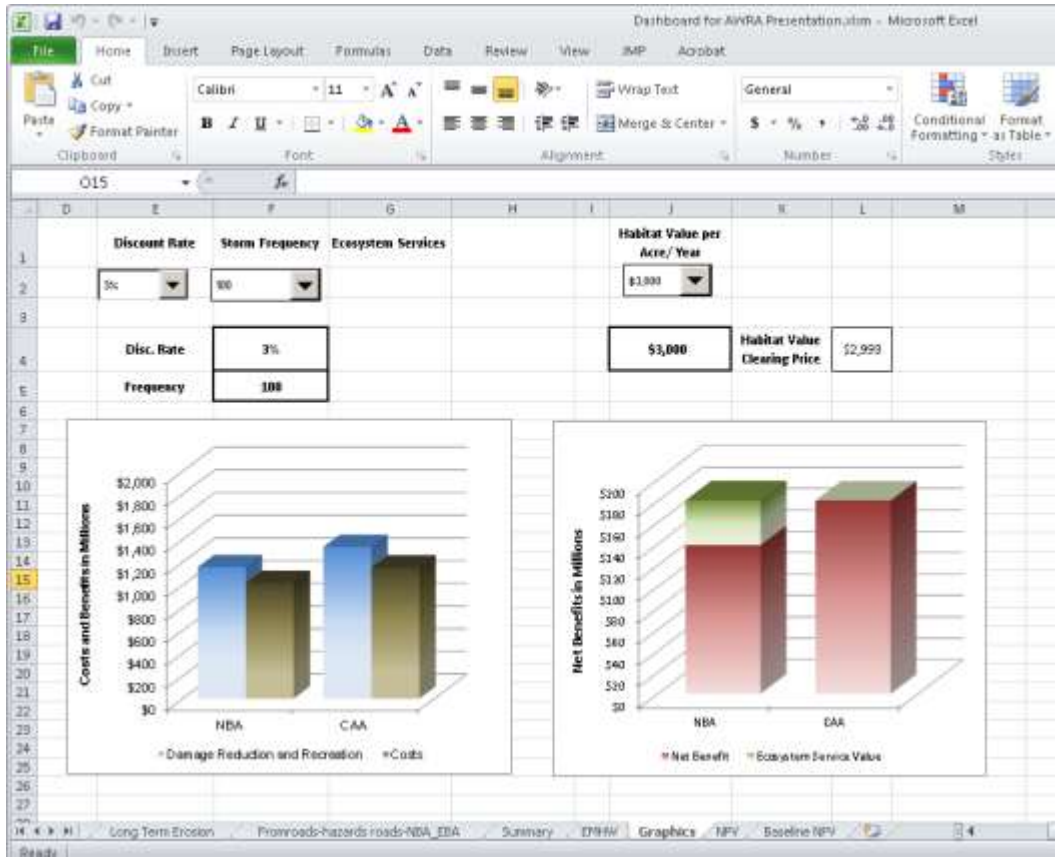
# RESULTS

- Two questions:
  - Do the benefits exceed the costs for the adaptation strategies?
  - Which strategy produces the greatest net benefits?
- Decision makers should explore how decision outcomes change over a variety of assumptions:
  - Frequency of storm
  - Value of ecosystem services
  - Discount rate
- **We do not need to know what will happen – we need to know the tipping points where decision would change!**

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# CONCLUSIONS AND NEXT STEPS

# CONCLUSIONS

- ✓ Suggest nature-based approaches to climate change adaptation can provide benefits
  - Can reduce damages comparable to coastal armoring/engineering approaches
- ✓ Value of saltwater wetlands and other ecosystem services (e.g. recreation and agriculture) interacts with benefits and costs
- ✓ Decision makers can use approach to inform decisions about climate change adaptation choices
  - Explore which alternatives perform best across a variety of assumptions
  - Priorities differ with context of decision
- ✓ Stakeholder input is critical
- ✓ Interdisciplinary collaboration is key

# NEXT STEPS

1. Site-specific decision making can build from existing effort
2. Need to include more formal probabilistic estimates of benefits and costs
3. Need to include more emergency, relocation and other costs
4. Ecosystem services analysis needs formal HEA

# THANK YOU
# CONTACT

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