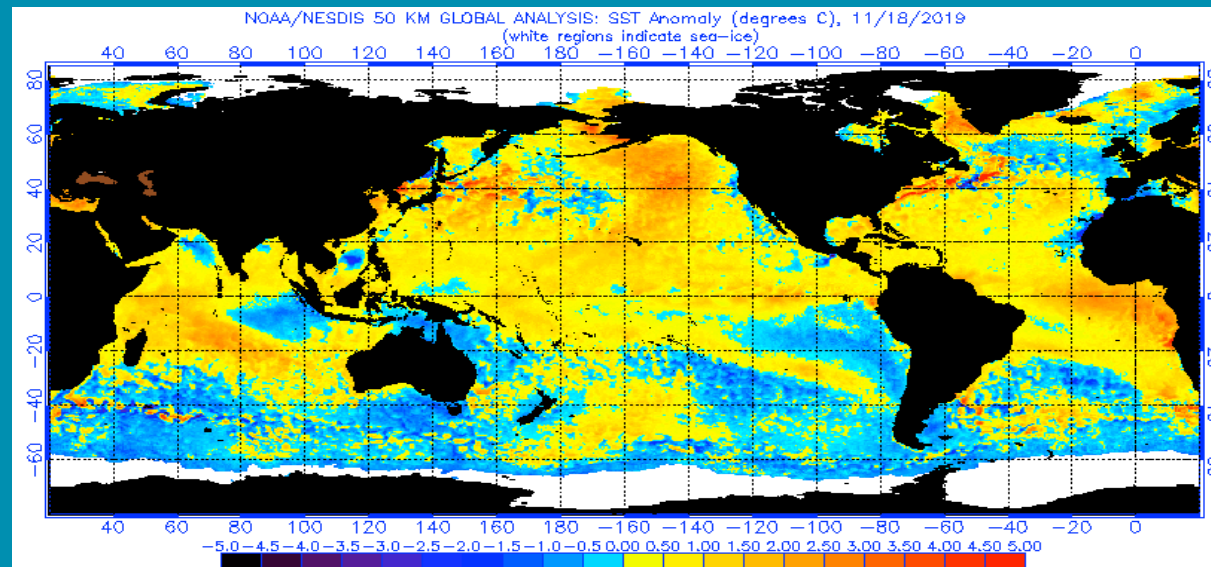


# Managing National Marine Sanctuaries in a Changing Ocean

Dr. Zachary Cannizzo

Sea Grant Knauss Fellow

MPA Climate Change and Interagency Coordinator







- Olympic Coast
- Thunder Bay
- Wisconsin-Lake Michigan
- Lake Ontario
- Stellwagen Bank
- Mallows Bay-Potomac River
- Monitor
- Gray's Reef
- Flower Garden Banks
- Florida Keys
- Greater Farallones
- Cordell Bank
- Monterey Bay
- Channel Islands
- Papahānaumokuākea
- Hawaiian Islands Humpback Whale
- American Samoa (U.S.)
- Rose Atoll

Legend:

- National Marine Sanctuary
- Marine National Monument
- Proposed National Marine Sanctuary

Bathymetric Tints (Depths are in corrected meters below mean sea level)

Image reproduced from the GEBCO world map, <http://www.gebco.net/>  
Customized by NOAA's Office of National Marine Sanctuaries



# Ocean Acidification

- Human-released Carbon-dioxide ( $\text{CO}_2$ ) is causing the ocean to become more acidic
- Acidic water makes it difficult for animals to make and maintain shells



# Ocean Acidification at Olympic Coast NMS



# Ocean Acidification at Olympic Coast NMS

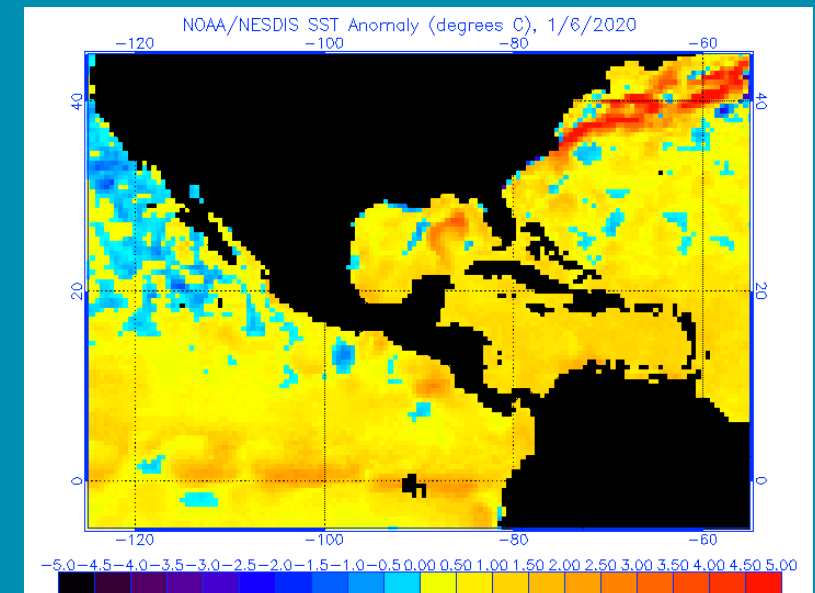
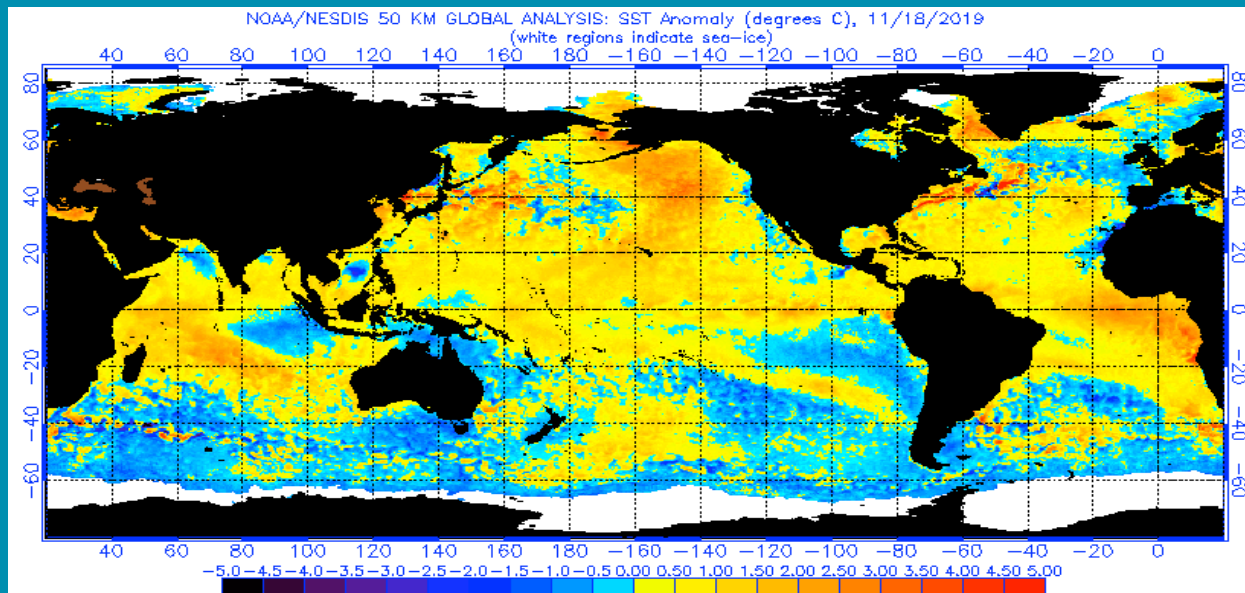
- Waters in the region are particularly susceptible to acidification
- Waters are projected to increase in acidity up to 50% by 2100.
- Potential impacts:
  - larval shortages of mussels and oysters
  - regional disappearance of pteropods





# Rising Ocean Temperatures

- As global temperatures rise, the ocean has taken up more than 90% of the excess heat
- Ocean temperatures are rising world-wide



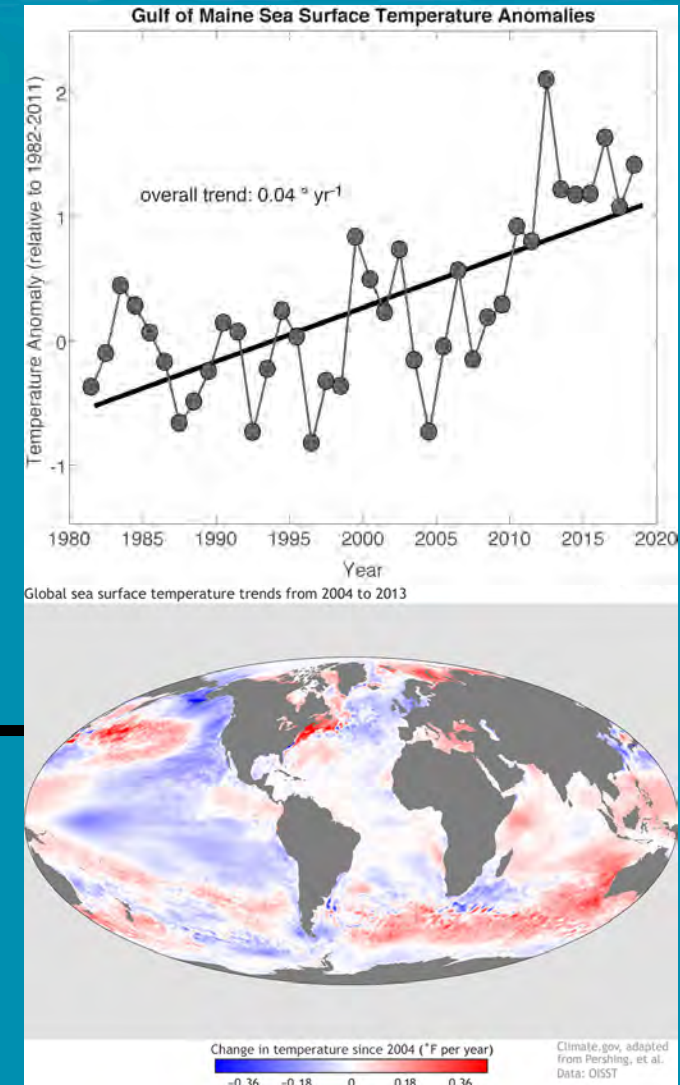
# Rising Ocean Temperatures at Stellwagen Bank NMS





# Rising Ocean Temperatures at Stellwagen Bank NMS

- Ocean temperatures in the region rising faster than 99% of the ocean
- Due, in part, to shifting Gulf Stream
- Potential Impacts:
  - Shifting fish
  - Increased lobster disease
  - Shifts in prey important to endangered North Atlantic right whales





# Sea Level Rise

- Relative sea level is rising (or falling) at different rates in different places
- Melting glaciers and land ice contribute water to the ocean
- Warming expands, which is responsible for about 1/3 of sea level rise



# Sea Level Rise at Papahānaumokuākea MNM





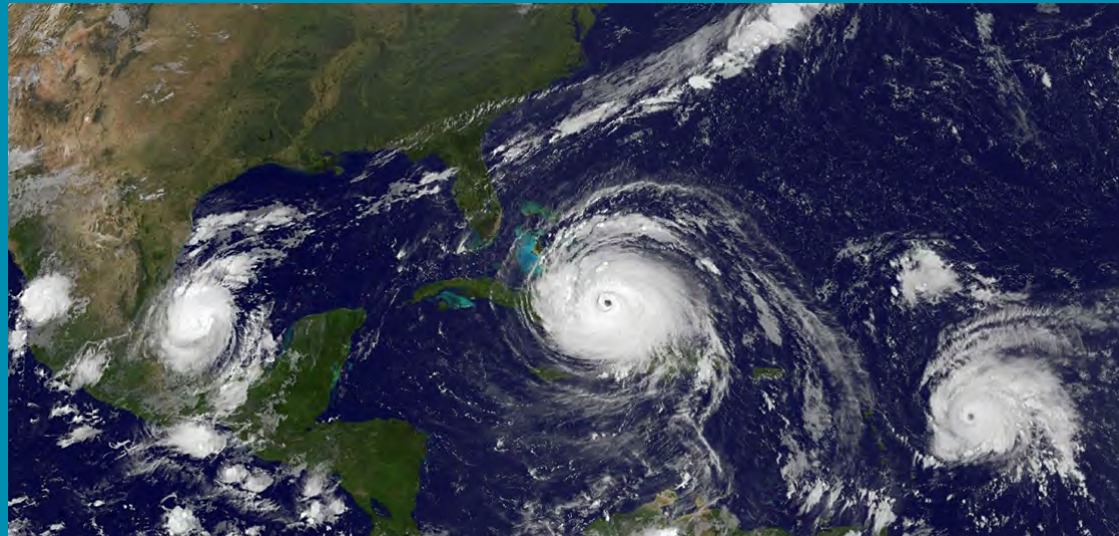
# Sea Level Rise at Papahānaumokuākea MNM

- Sea level rise in the region is expected to be higher than the global average
- Many islands in the monument could be submerged in the next 50-100 years
- Potential impacts:
  - Loss of nesting and pupping habitat for seabirds, sea turtles, and Hawaiian monk seals



# Changing Storm Patterns

- Higher water temperatures fuel stronger storms while changing circulation alters their paths
- Some locations are expected to experience storms while others are expected to be impacted less frequently.





# Changing Storms at Papahānaumokuākea MNM



# Changing Storms at Papahānaumokuākea MNM

- Projections of stronger tropical storms tracking closer
- Hurricane Walaka (2018)
  - Caused extensive damage to a diverse coral reef
  - Caused East Islet to lose over 95% of its emergent land overnight





# Changing Ecological Communities

- Climate impacts can interact with physical and biological factors to produce unexpected changes to ecological communities
- Changing conditions encourage range shifts and alter ecological communities



# Changing Communities at Greater Farallones NMS





# Changing Communities at Greater Farallones NMS

- High temperatures between 2012 and 2016
  - Triggered a cascade of events leading to the loss of 90% of the area's kelp canopy cover
- Resulted in shift from kelp forest to urchin barren



# How can we possibly address climate change?



Credit: *ParabolStudio/Shutterstock*



# Climate-Smart

## SMART

Specific

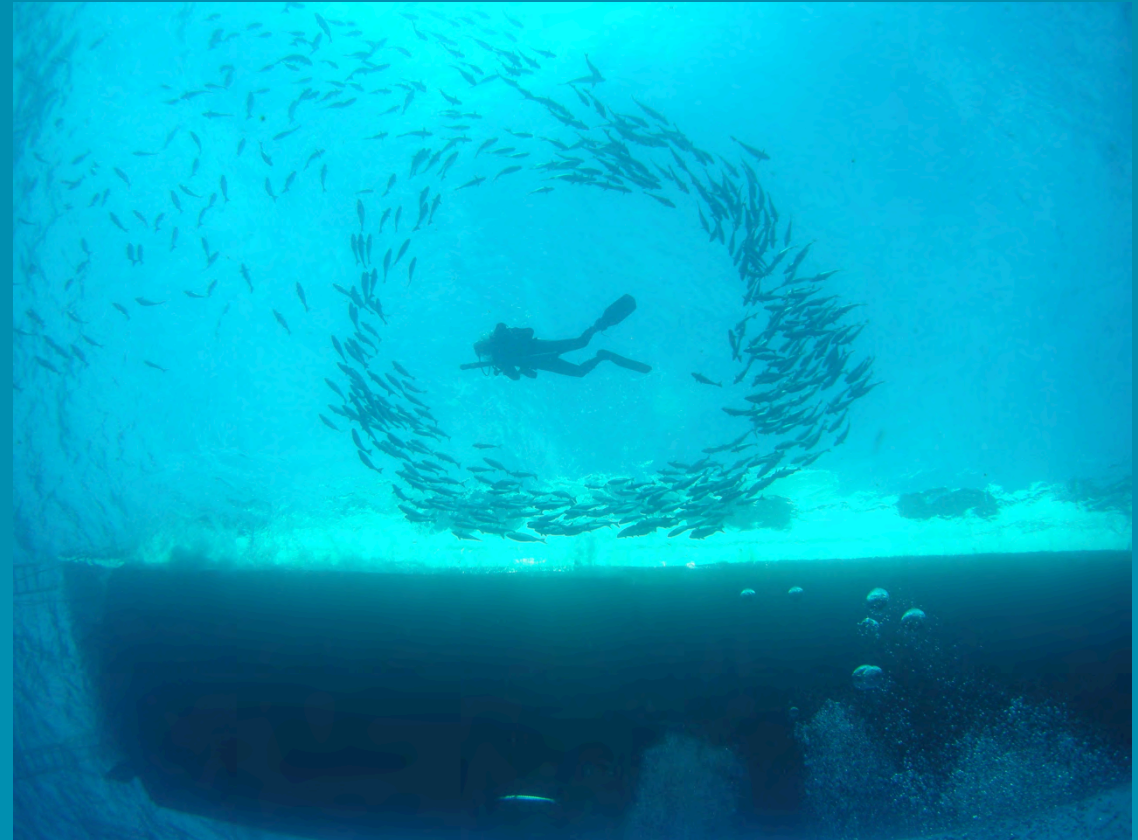
Measurable

Achievable

Results-oriented

Time-fixed

- Management objectives and goals should be climate-SMART



# Climate-smart planning cycle



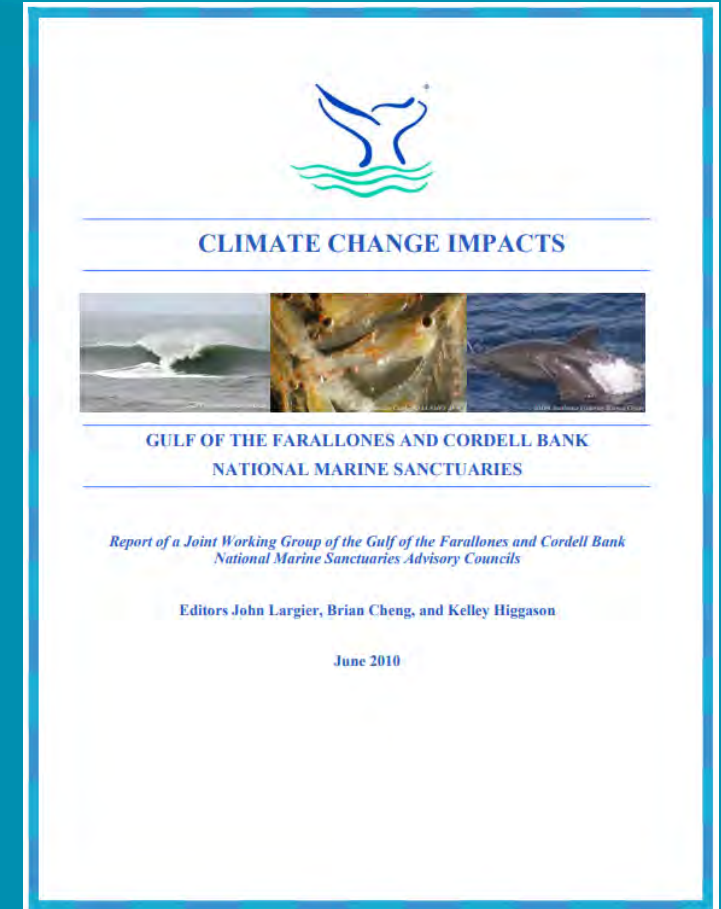


# Understand



# Understand


- Gathering and synthesizing relevant climate data
- Greater Farallones NNMS' Climate Change Impacts Report.

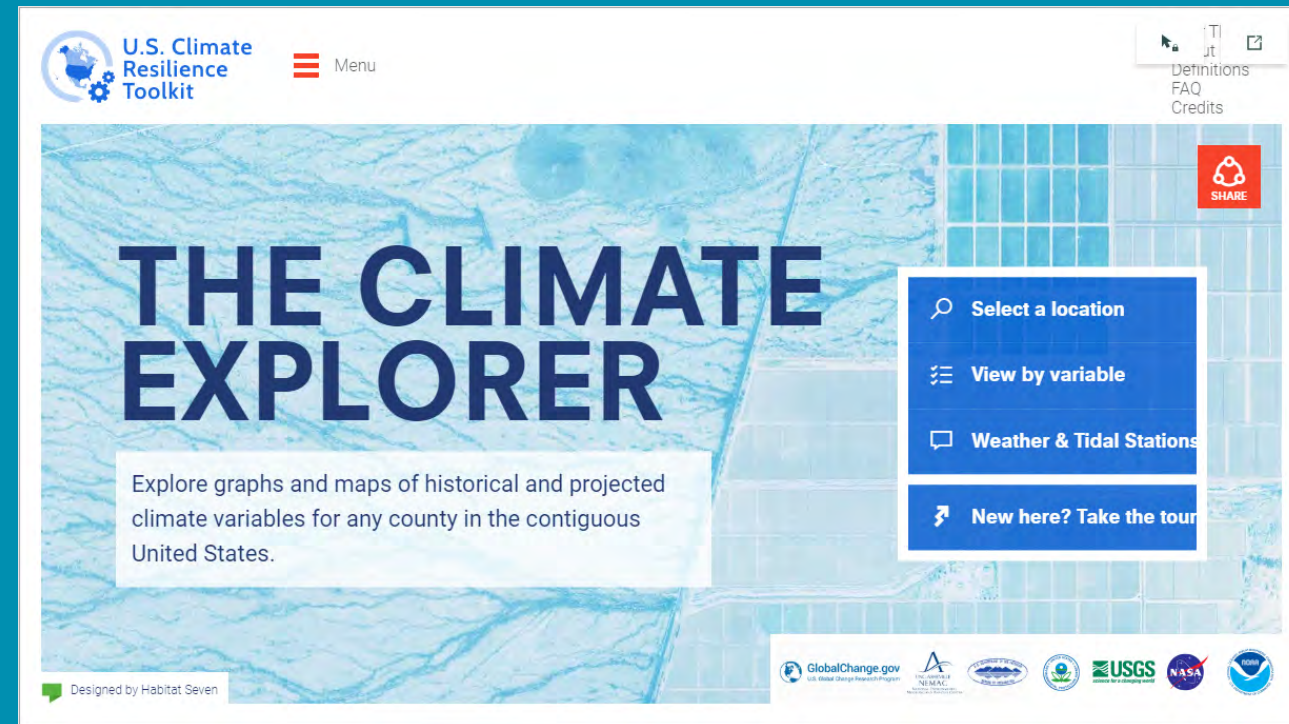


[!\[\]\(99f58673407353e96a019fbca558fd72\_img.jpg\) Click to download!](#)



# Tools to Understand

- NOAA's [climate.gov](https://climate.gov)
  - Science and information for a climate-smart nation
- [Our Coast Our Future](#)
  - Tools to help understand, visualize and anticipate vulnerabilities to sea level rise and storms
- The Climate Explorer 



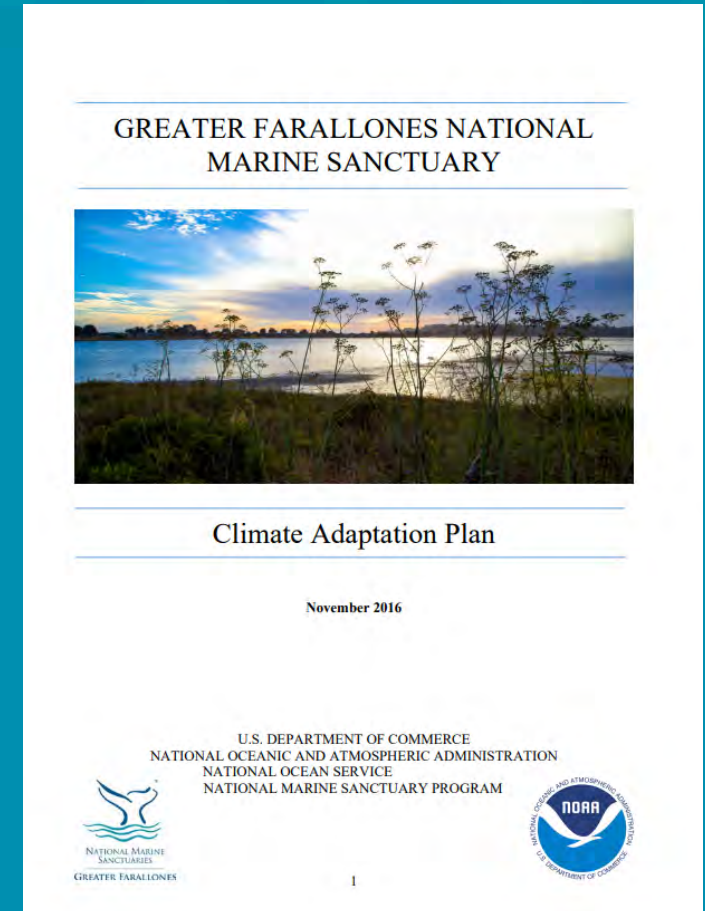
# Plan





# Plan

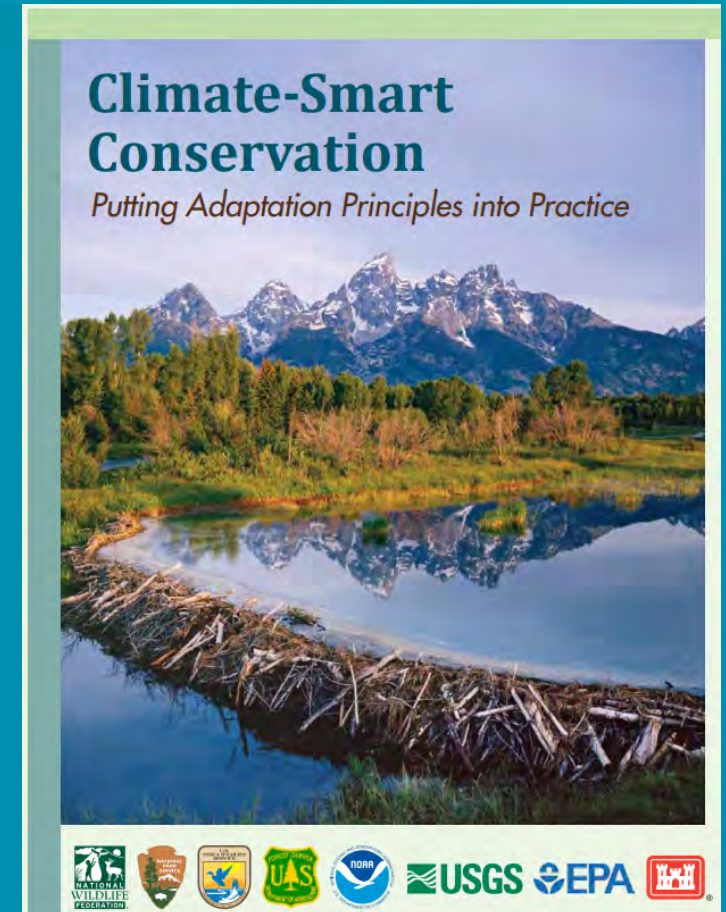
- Develop plan for accomplishing goals
  - Goals should be climate-smart!
- Strong guidance documents lead to a robust adaptation plan
- Greater Farallones NMS' 2016 Climate Adaptation Plan



[!\[\]\(666e09182d4cd268646ea700ea60dcdf\_img.jpg\) Click to download!](#)

# Tools for Planning

- [Climate Smart Conservation](#)
- [Guide for Planners and Managers to Design Resilient Marine Protected Area Networks in a Changing Climate](#)
- [Scientific Guidelines for Designing Resilient Marine Protected Area Networks in a Changing Climate](#)

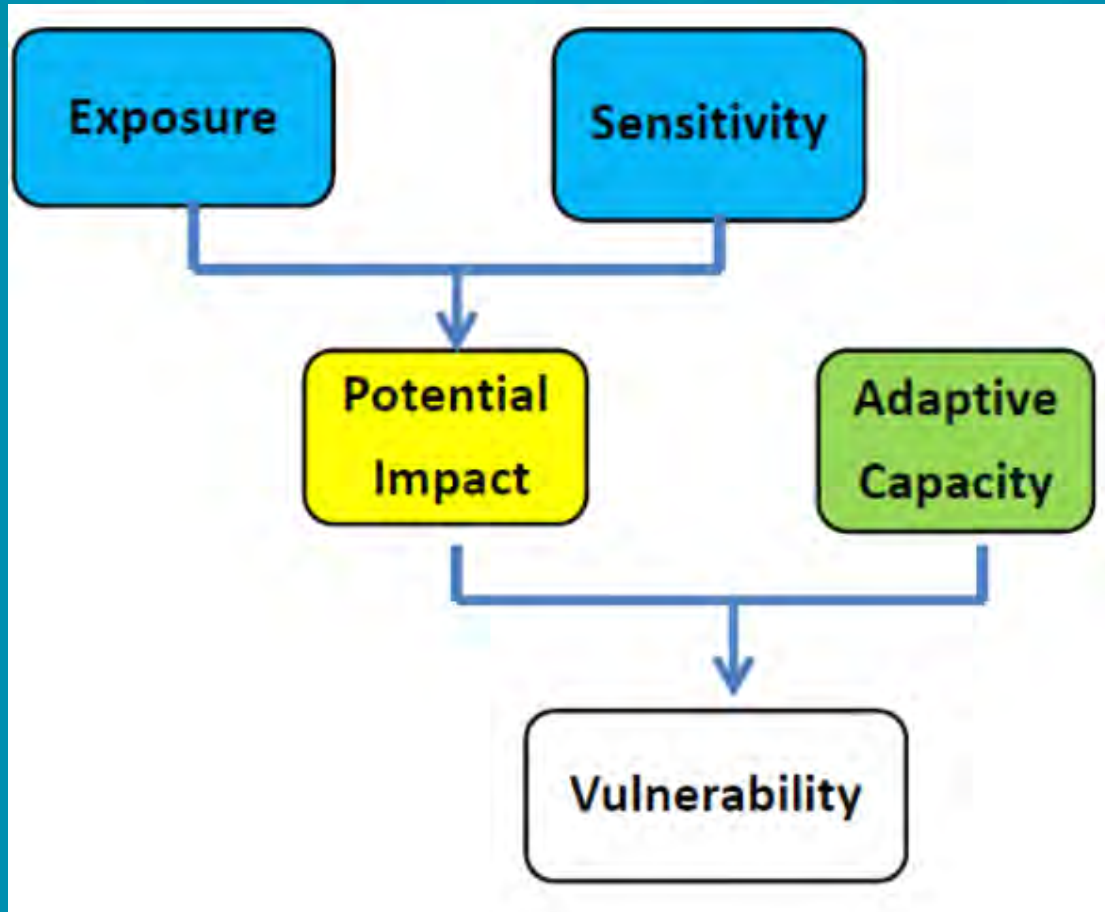




# Assess



# Assess Climate Vulnerability



What is most vulnerable and why?

1. Select a resource
2. Answer questions about the resource regarding climate vulnerability
3. Compare relative vulnerabilities of resources



# Climate Vulnerability Assessments

- Can and should inform planning and vice-versa
- Often the biggest step towards successful climate adaptation management



## Rapid Vulnerability Assessment and Adaptation Strategies for the National Marine Sanctuary and Territory of American Samoa



2017

# Climate Vulnerability Assessments

Many Sanctuaries have done this

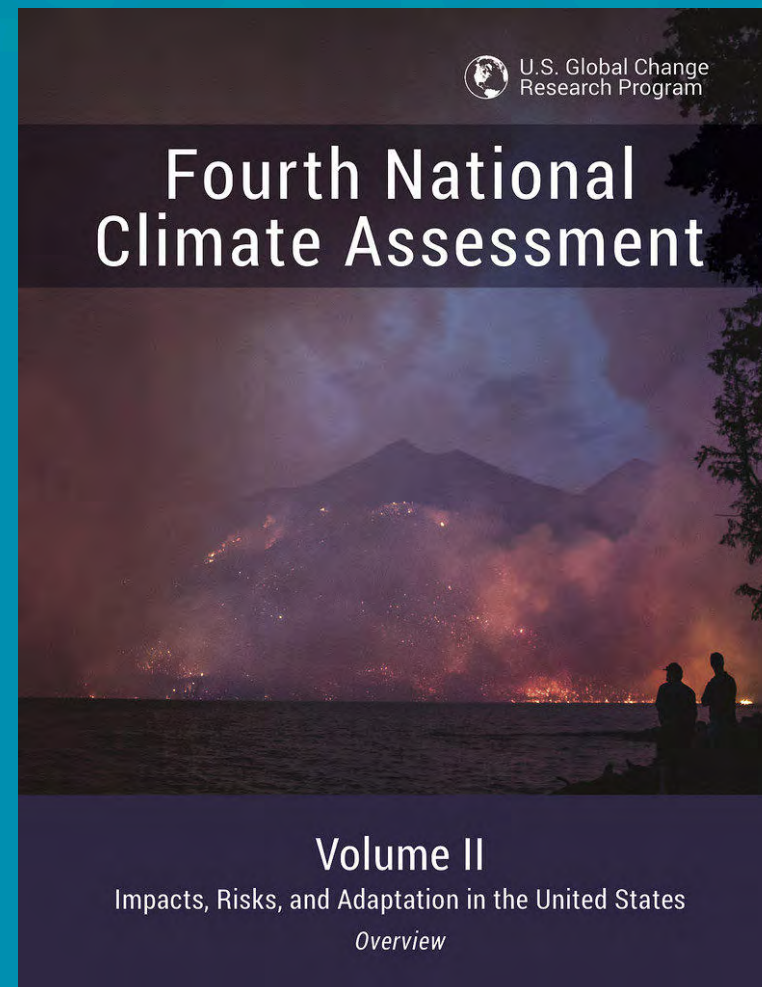
- Gray's Reef NMS: 17-person 1.5-day vulnerability workshop
- Greater Farallones NMS: 60-person 3-day vulnerability workshop
- Papahānaumokuākea MNM: series of workshops and interviews
- Olympic Coast NMS: plan to test a new strategy
- NMS American Samoa: workshops including local stakeholders and village leaders in addition to experts





# Tools for Assessing Climate Vulnerabilities

- North American Marine Protected Area [Rapid Vulnerability Assessment Tool](#)
- Fourth National Climate Assessment Volume II: [Impacts, Risks and Adaptation](#)



# Adapt





# Adapt

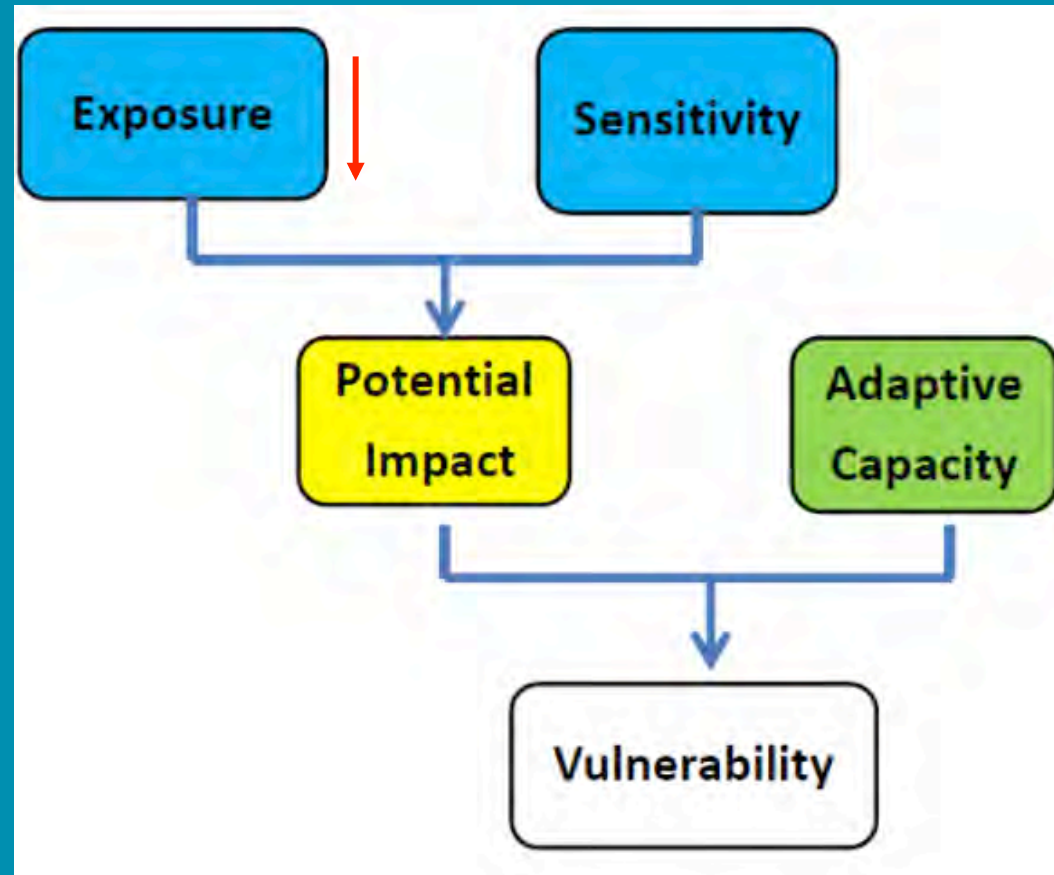
## Take Action!

- Develop and implement management actions to reduce climate vulnerabilities
- Greater Farallones NMS develops management actions as a result of the 2016 Climate Adaptation Plan



# How to identify strategies and actions

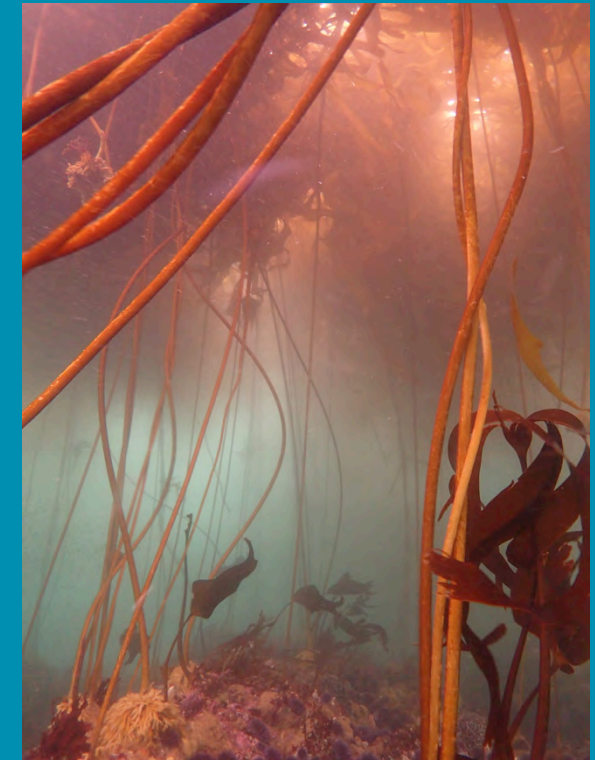
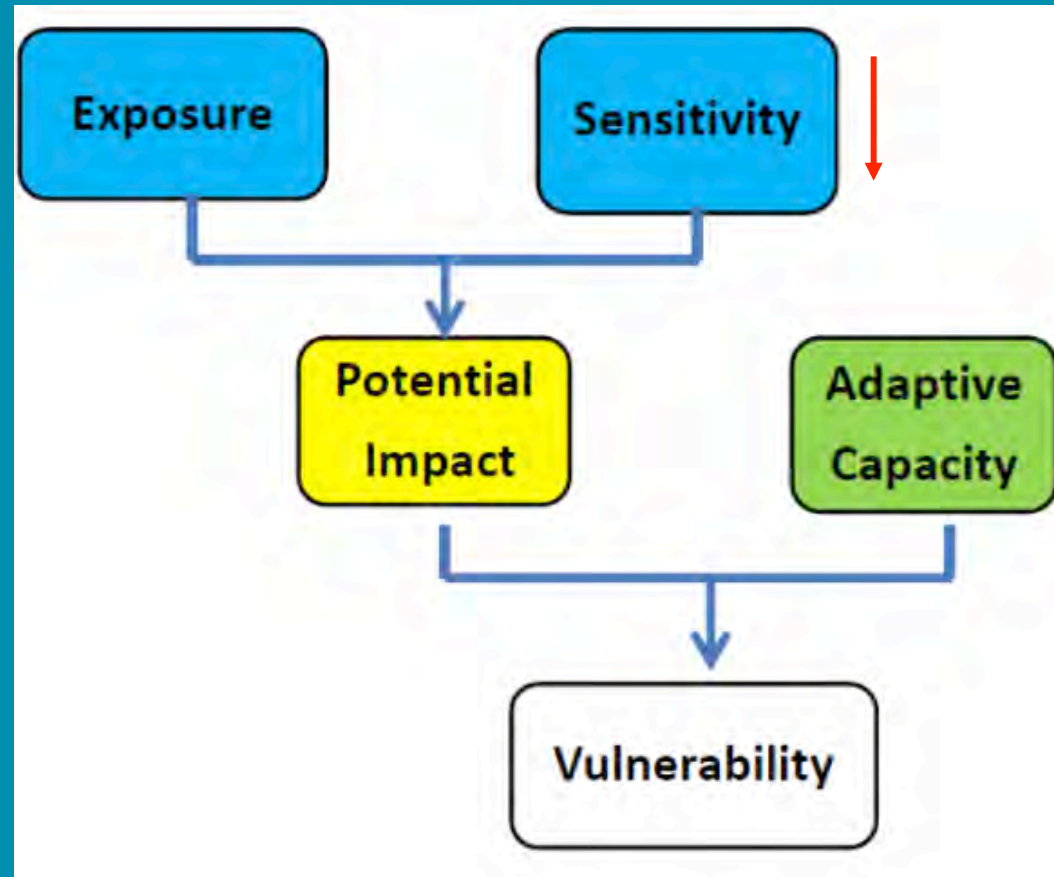
Use the components of vulnerability as a framework





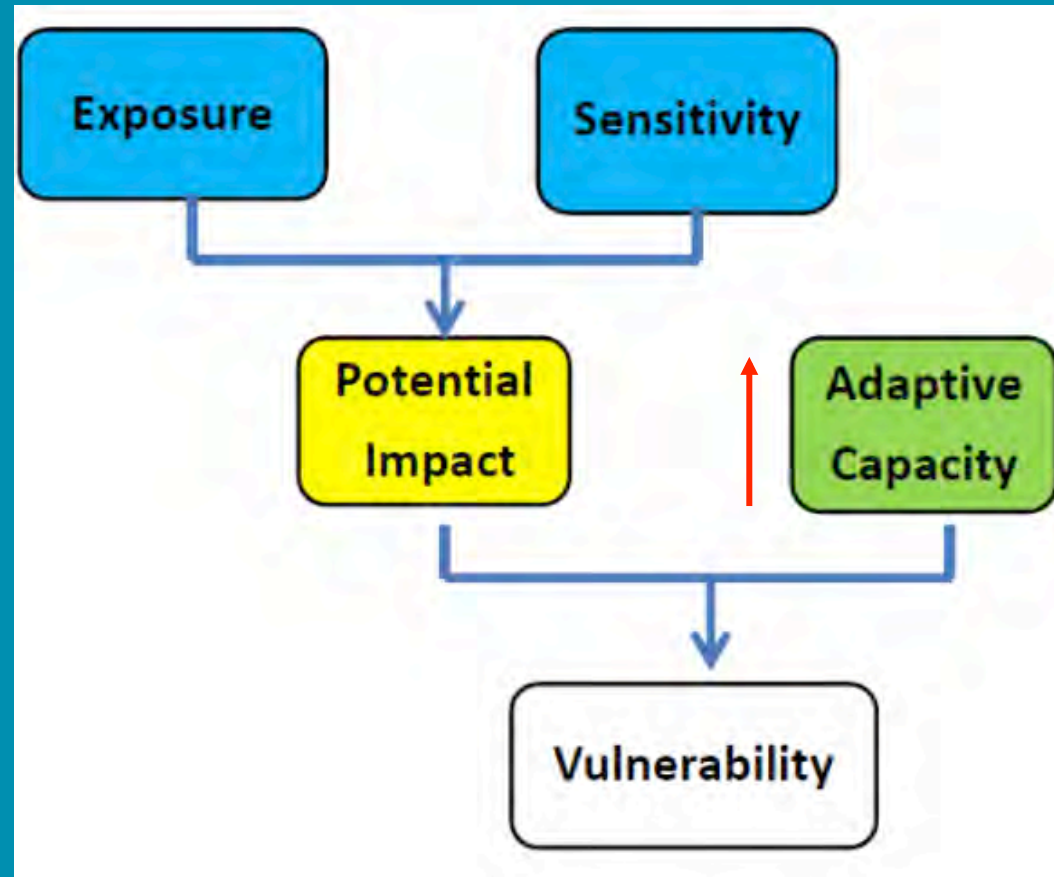
# How to identify strategies and actions

Use the components of vulnerability as a framework



# How to identify strategies and actions

Use the components of vulnerability as a framework

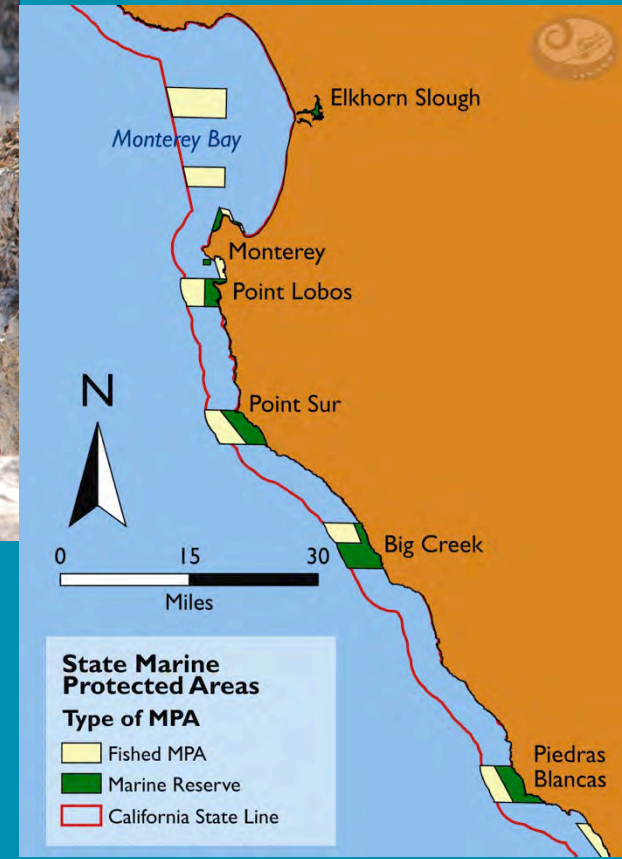




# How to identify strategies and actions

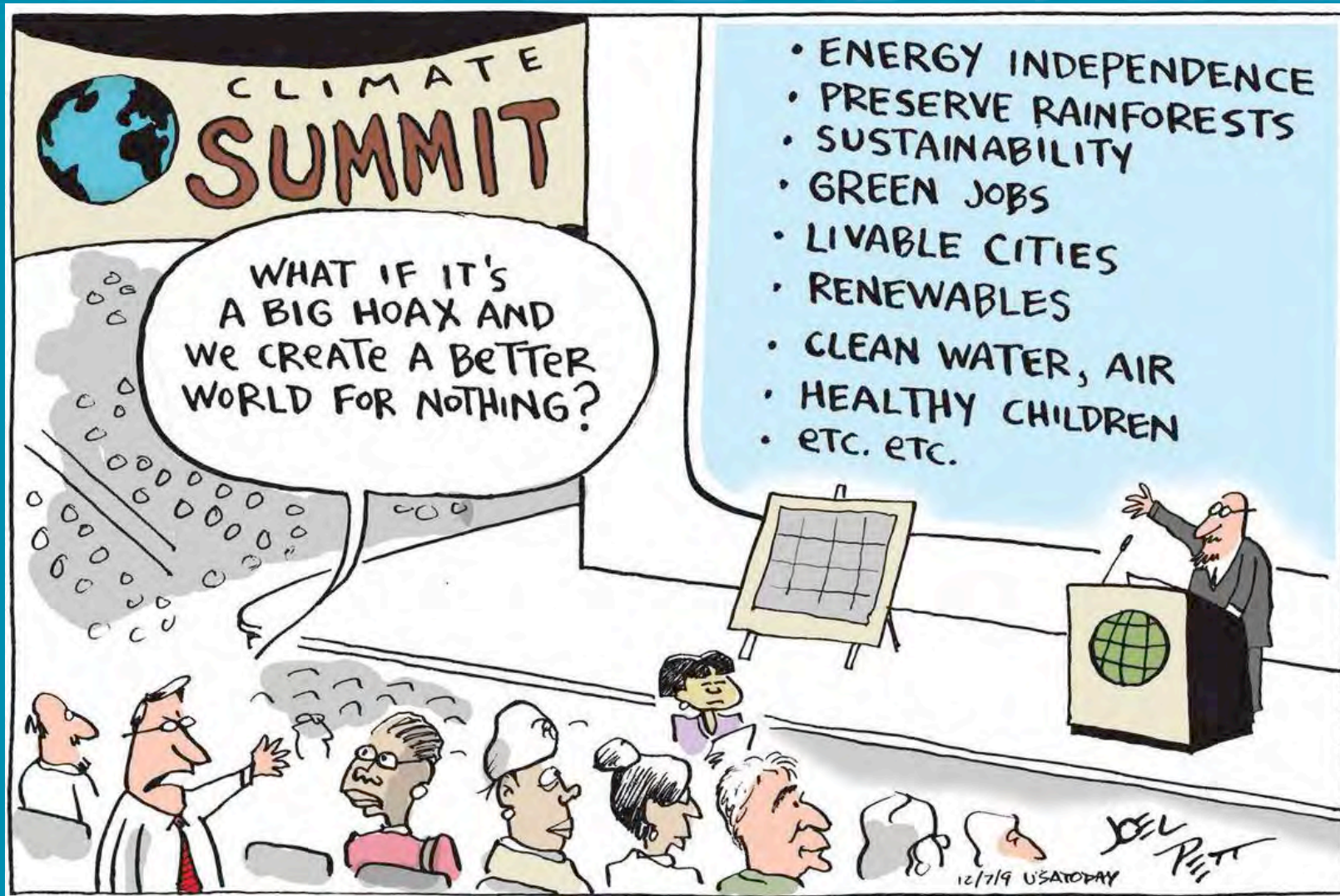
## A few other ideas:

- Reduce non-climate stressors
- Enhance connectivity
- Protect refugia
- Promote education/outreach
- No active intervention





# No Regrets



# Tools for Adapting

- CEC/EcoAdapt  
[Climate Adaptation Tool Kit](#)
- Panorama: Solutions for a  
Healthy Planet  
[Marine and Coastal Solutions](#)





# Monitor



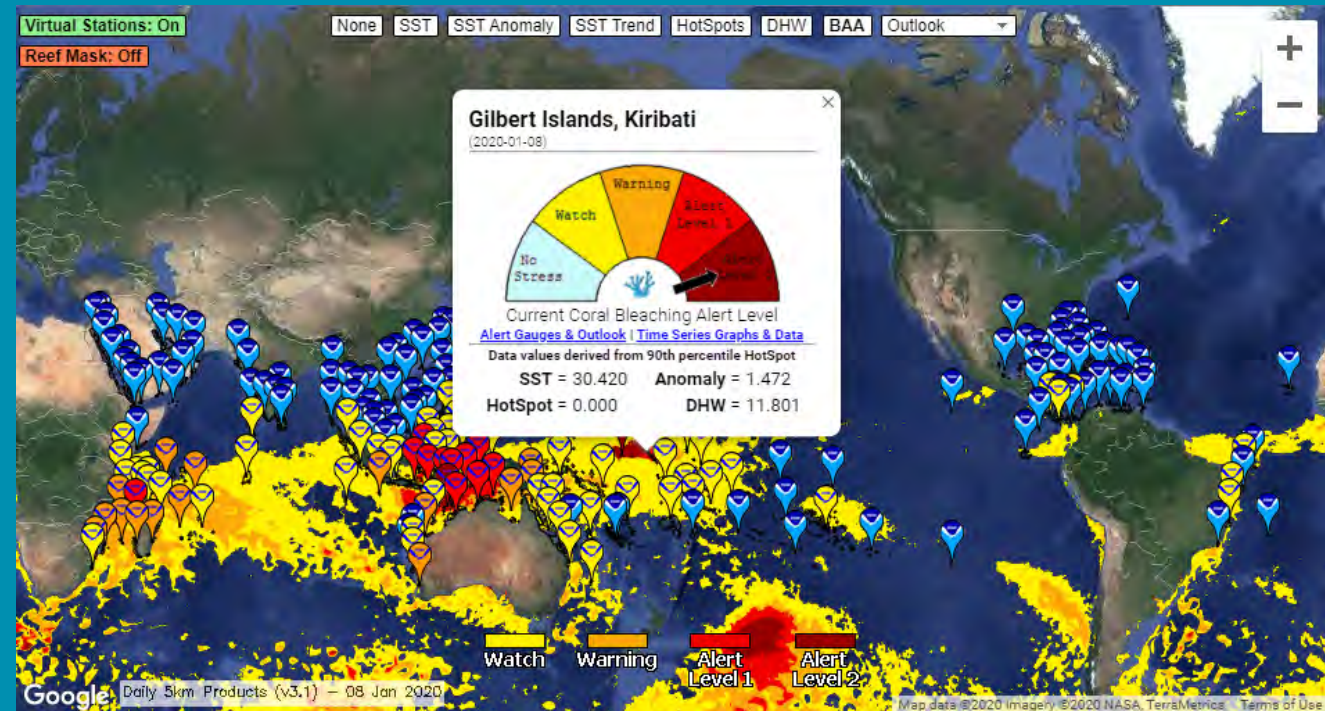
# Monitor

- Monitor to track the efficacy of the management actions, as well as the response of the resources
- Sanctuaries monitor the efficacy of their climate management actions
- Olympic Coast NMS as an Ocean Acidification Sentinel Site



# Tools for Monitoring

- [CoastAdapt](#): Monitoring and Evaluation in Climate Change Adaptation
- [Sentinel Sites](#)
- NOAA [Coral Reef Watch](#)





# Evaluate



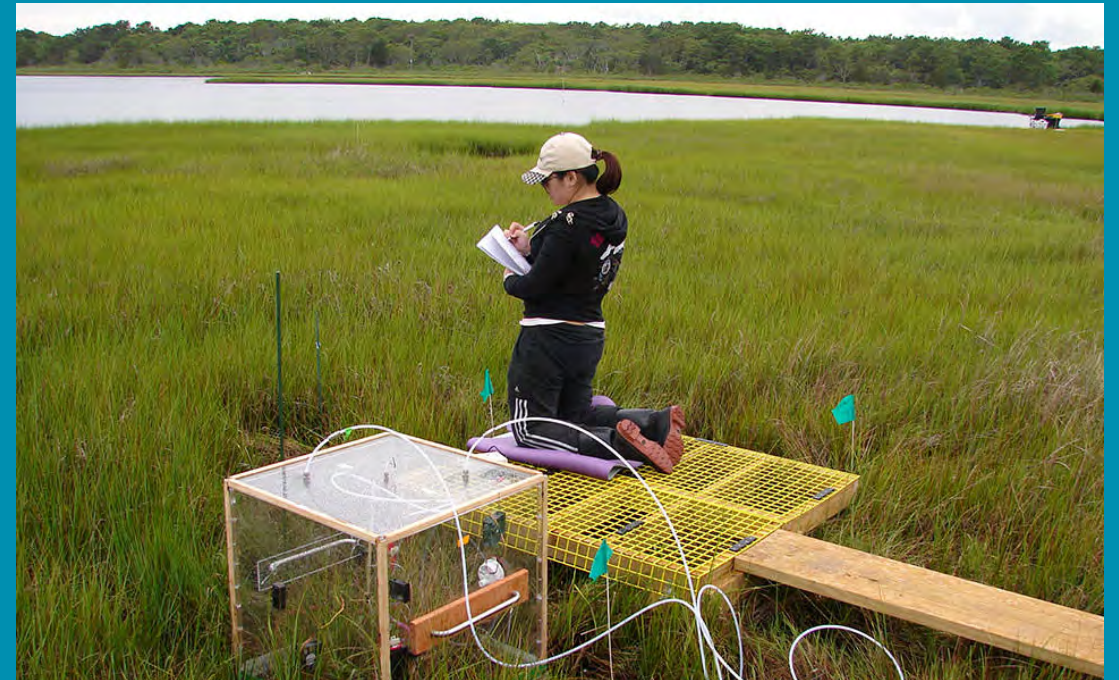
# Evaluate

- Important to evaluate the effectiveness of the climate adaptation and mitigation
- Adapt management actions as necessary to improve resilience of the resources



# Tools for Evaluation

- European Climate Adaptation Platform:  
[Monitoring and Evaluation](#)





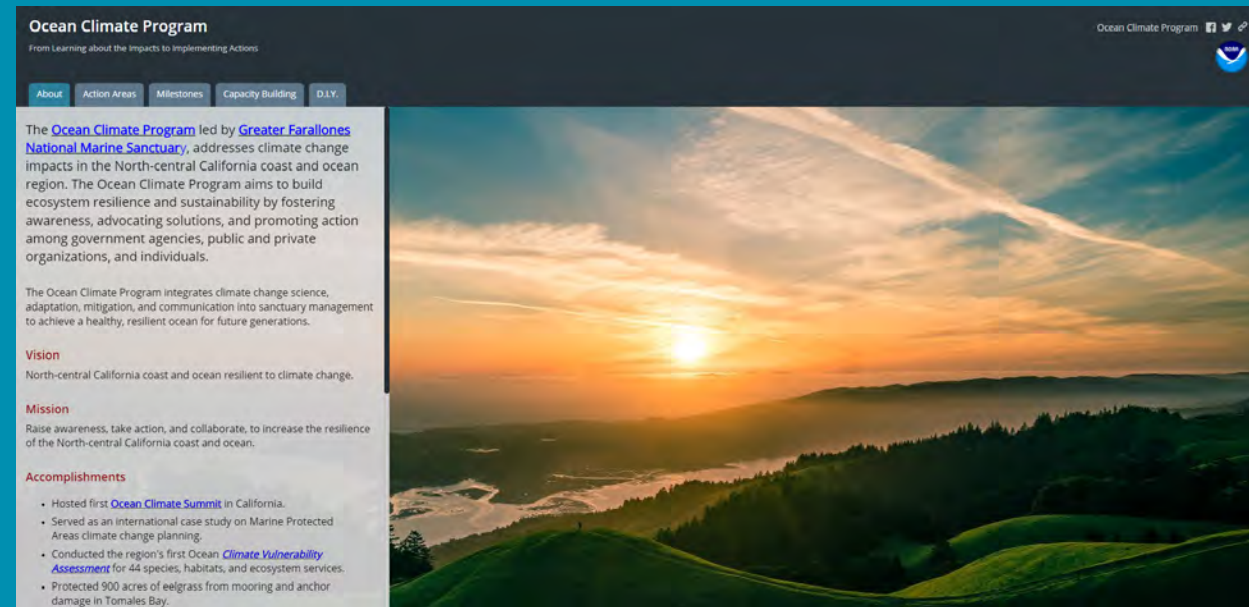
# Communicate



# Communicate

## Present at every step

- Sanctuaries integrate climate messaging across all programs
- Sanctuaries work with partners to commute local effects of climate change and actions we can take
- Greater Farallones NMS Ocean Climate Program Story map



↑ Click to visit!

# Communicate - Dungeness Crab Case Study

An online toolkit designed for educators and communicators to teach about the impact of ocean acidification on Dungeness crab

## ECOLOGICALLY:

Dungeness crab, especially during their larval stage, are a major food source for many fish species



Salmon, rockfish, herring, and other fish species



Dungeness crab

## CULTURALLY:

West Coast tribal Dungeness crab fisheries provide food, income, and communal activity for many Native Americans



## ECONOMICALLY:

Dungeness crab U.S. fishery is valued at over \$200M annually, and supports the jobs and livelihood of many fishermen, restaurant workers, and seafood retailers

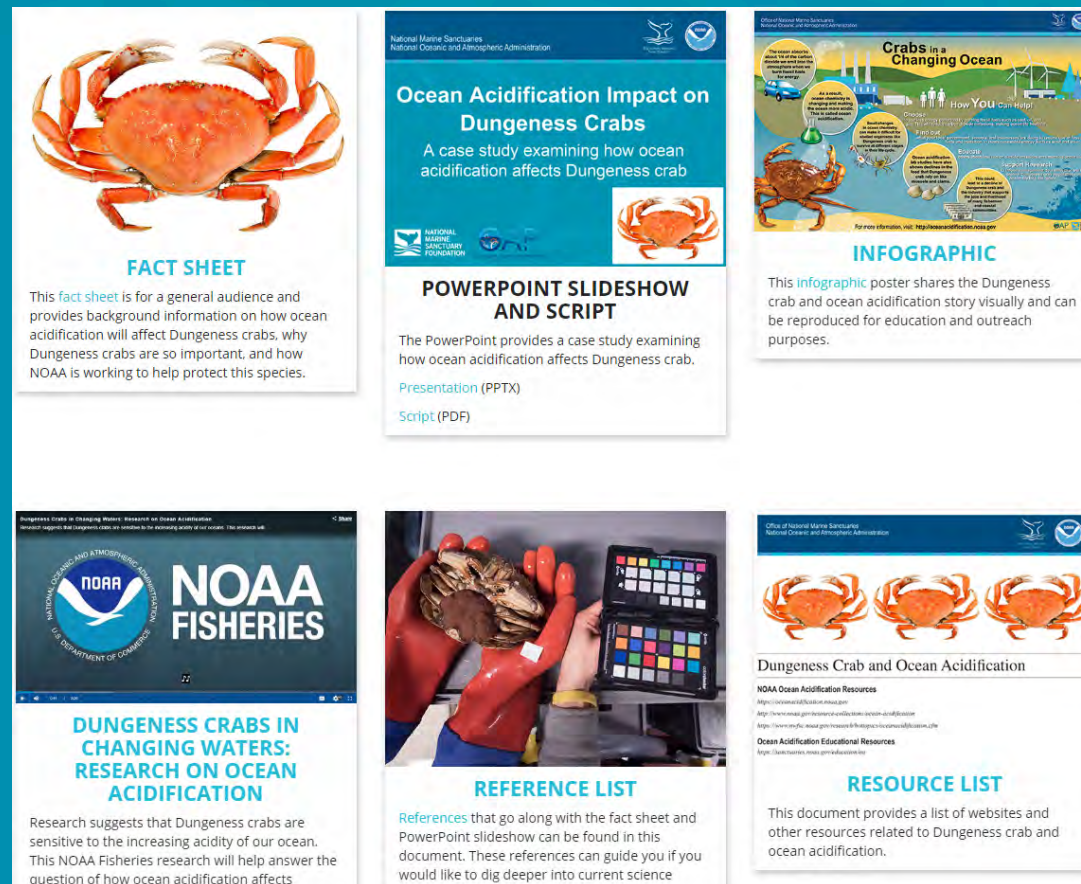




# Communicate - Dungeness Crab Case Study

## Partners in Development:

- NOAA National Marine Fisheries Service: *Paul McElhany, Shalin Busch, Shelley Trigg*
- NOAA Ocean Acidification Program
- National Marine Sanctuary Foundation
- USC Sea Grant
- NOAA Office of National Marine Sanctuaries



**FACT SHEET**

This fact sheet is for a general audience and provides background information on how ocean acidification will affect Dungeness crabs, why Dungeness crabs are so important, and how NOAA is working to help protect this species.

**Ocean Acidification Impact on Dungeness Crabs**

A case study examining how ocean acidification affects Dungeness crab

**POWERPOINT SLIDESHOW AND SCRIPT**

The PowerPoint provides a case study examining how ocean acidification affects Dungeness crab.

Presentation (PPTX)

Script (PDF)

**Crabs in a Changing Ocean**

**INFOGRAPHIC**

This infographic poster shares the Dungeness crab and ocean acidification story visually and can be reproduced for education and outreach purposes.

**NOAA FISHERIES**

**DUNGENESS CRABS IN CHANGING WATERS: RESEARCH ON OCEAN ACIDIFICATION**

Research suggests that Dungeness crabs are sensitive to the increasing acidity of our ocean. This NOAA Fisheries research will help answer the question of how ocean acidification affects

**REFERENCE LIST**

References that go along with the fact sheet and PowerPoint slideshow can be found in this document. These references can guide you if you would like to dig deeper into current science

**Dungeness Crab and Ocean Acidification**

**NOAA Ocean Acidification Resources**

**Resource List**

This document provides a list of websites and other resources related to Dungeness crab and ocean acidification.

↑ Click to visit!

# Sanctuary Advisory Councils

- Advise on many aspects of Sanctuary management
- Diverse areas of expertise
- Represent diverse community interests and help build partnerships





# Partnerships

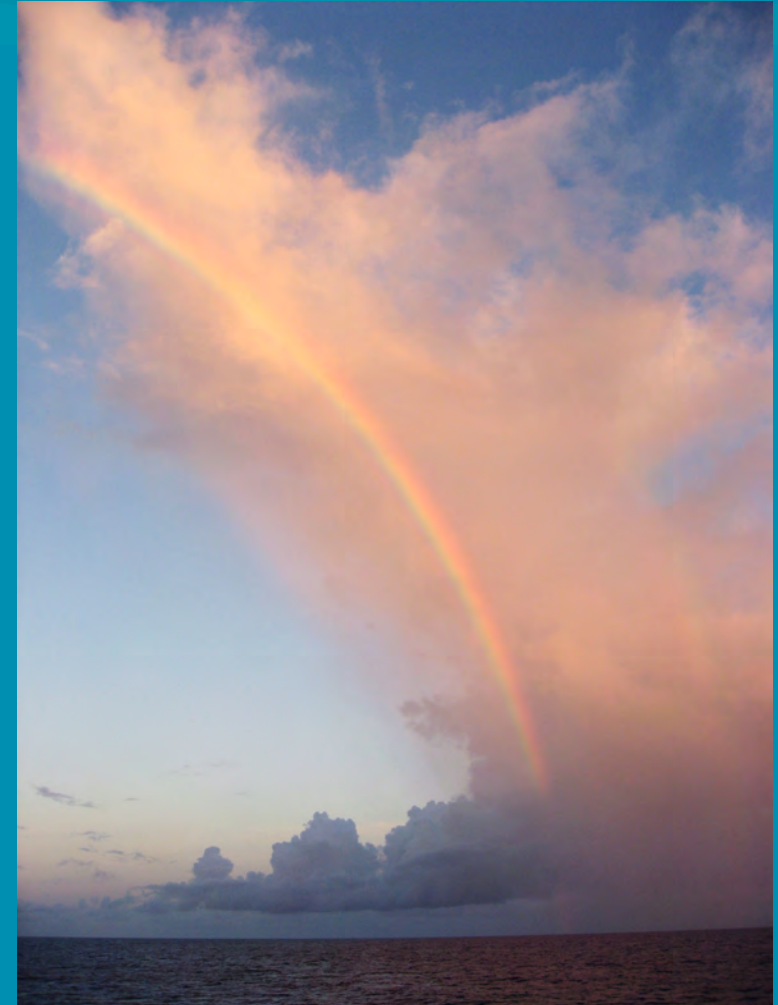
- Sanctuaries are always interested in climate change partnerships





# What about climate mitigation?

- Growing level of interest within Sanctuaries
- Greater Farallones NMS conducted an Emissions Inventory



# How does it all fit?

Condition Reports: **Assess** current conditions



Management Plans: set **management** strategies



# How does it all fit?

Condition Reports: **Assess** current conditions



Management Plans: set **management** strategies



Climate Vulnerability Assessments:  
**Assess climate** vulnerabilities



We *can* manage our national marine treasures in the face of climate change



# Questions?



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[zac.Cannizzo@noaa.gov](mailto:zac.Cannizzo@noaa.gov)