

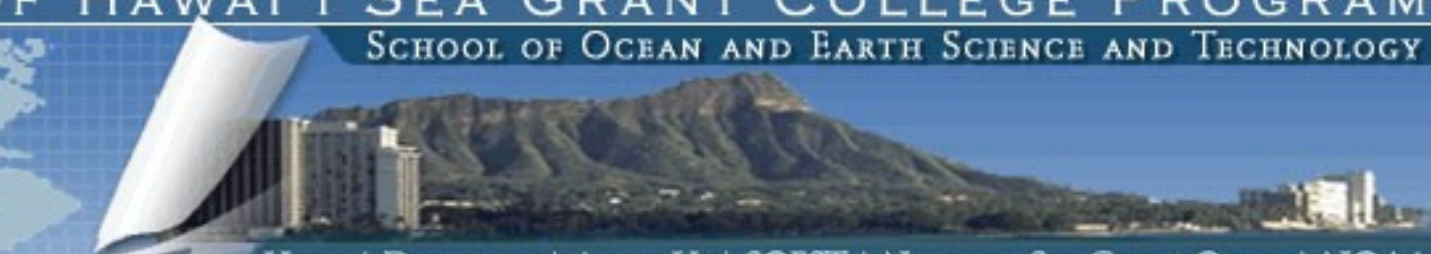
Framework for Climate Change Adaptation in Hawaii

Center for Island Climate Adaptation and Policy

Dolan Eversole- Coastal Geologist
University of Hawaii Sea Grant Program



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The Case for Adaptation Planning

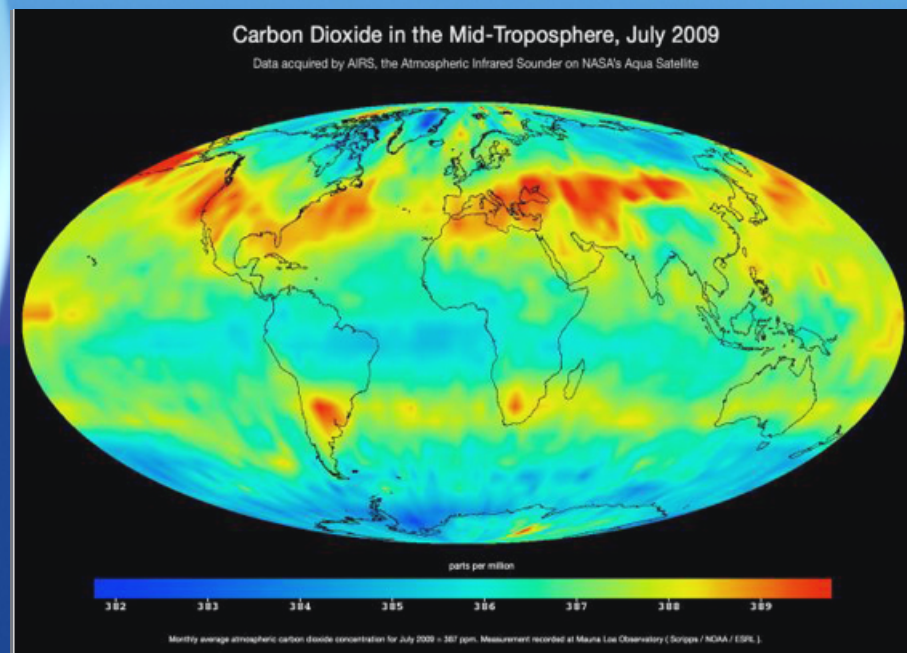


- **We cannot assume that our climate will be the same as in the past.**
- **GHG concentrations will result in unavoidable changes to our climate for several centuries.**
- **Goal: is to minimize the unavoidable impacts/cost of climate change.**
- **Adaptation Planning is risk management.**
- **Strong, focused leadership essential for effective response.**

Climate Change Response Approach: Adaption vs. Mitigation

Adaptation: Adjustment in natural or human systems in response to actual or expected climatic changes or their impacts, so as to reduce harm or exploit beneficial opportunities.

Mitigation: Within a climate change context, mitigation is a human intervention to actively reduce the production of greenhouse gas emissions (reducing energy consumption in transport, construction, at home, at work etc.), or to remove the gases from the atmosphere (sequestration).



Vulnerabilities

Climate change affects all sectors of the environment and economy. Virtually no one is immune.

THE GOOD NEWS: *The Sky is NOT falling.* We have time to prepare, adapt and/or mitigate.

ECONOMIC SECTORS:

- **Emergency/Disaster response systems**
- **Tourism/Economy**
- **Public Health Systems**
- **Public Infrastructure (e.g. roads, sewers, water, electric)**

ENVIRONMENTAL SECTORS:

- **Freshwater Supply**
- **Coastal Resources**
- **Rainfall-Flooding**
- **Drought**
- **Ocean Acidification- reefs**

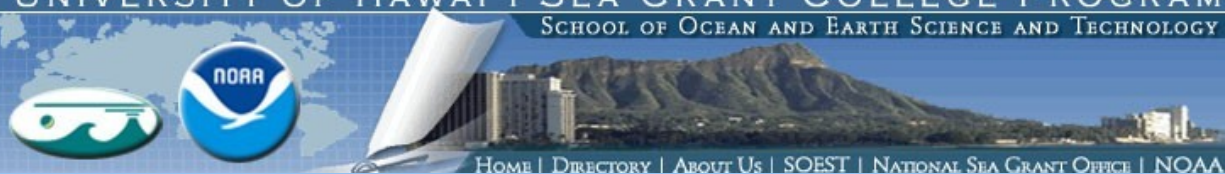

State of Hawaii's Role?

UH Centers Responding to Climate Change

1. Sustainable Tourism
2. ICAP
3. Smart growth and Community Design
4. Marine Science Education

Collaborative adaptation partnerships:

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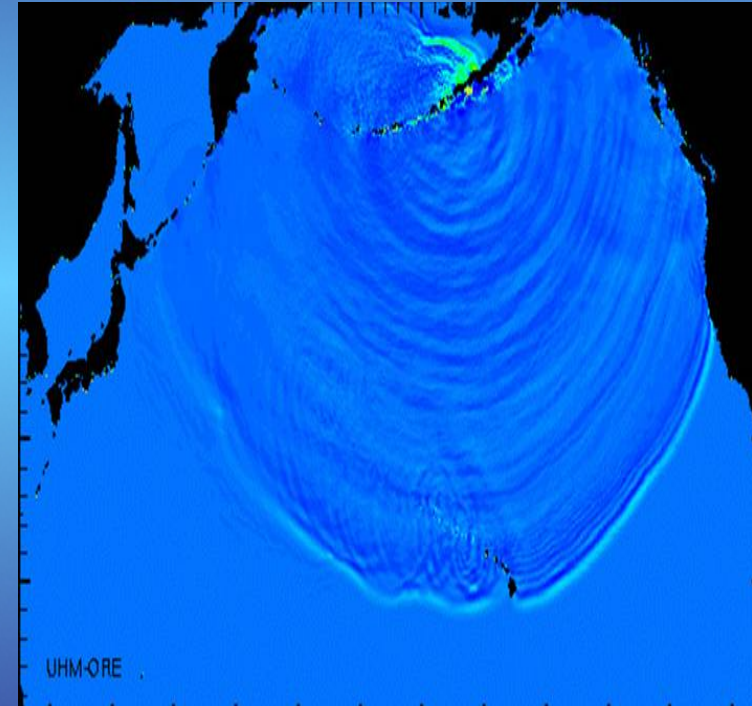
CENTER FOR SMART BUILDING AND COMMUNITY DESIGN



Coastal Hazard Mitigation Planning

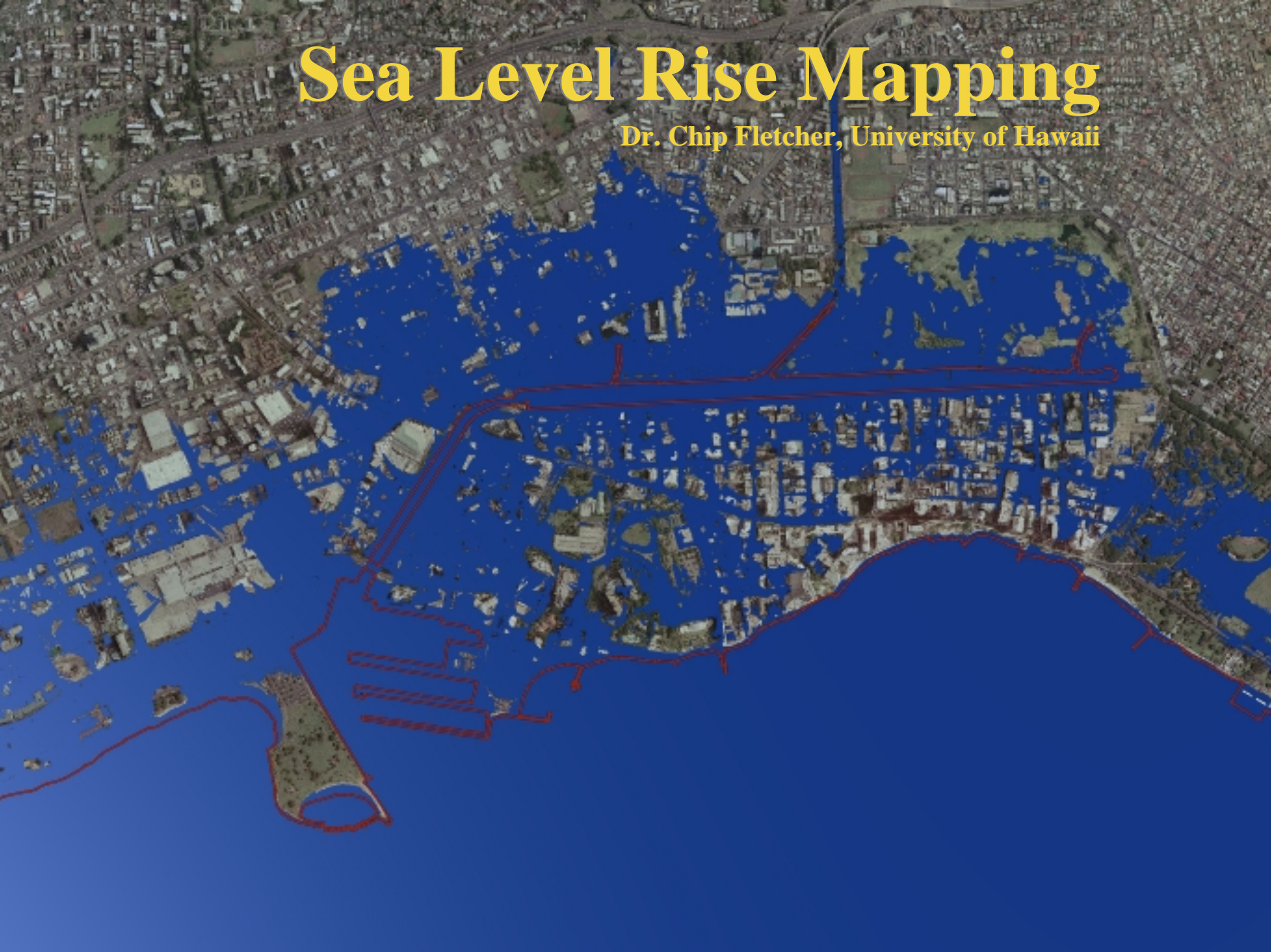
Proactive Climate Adaptation

- **Sea Level rise inundation research**
- **Shoreline erosion mapping**
- **Research and development for improved coastal construction setbacks.**
- **Development of the Hawaii Hazard Mitigation Plan**
- **Tsunami modeling and mapping**
- **Develop a Disaster Recovery Plan for the State of Hawaii**
- **Promote hazard mitigation in community development planning**



Sea Level Rise Mapping

Dr. Chip Fletcher, University of Hawaii



University of Hawaii Coastal Hazard Publications

Hawaii Coastal Hazard Mitigation Guidebook

Dennis J. Hwang

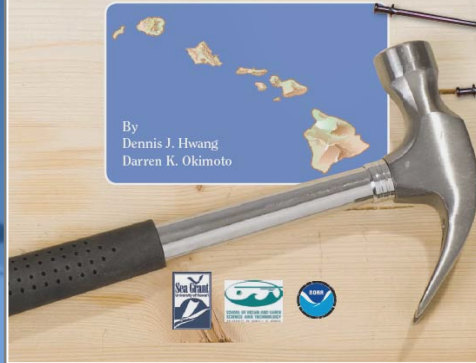


A Publication of the University of Hawai'i Sea Grant College Program

University of Hawai'i Sea Grant College Program

HOMEOWNER'S HANDBOOK TO PREPARE FOR NATURAL HAZARDS

By
Dennis J. Hwang
Darren K. Okimoto



NATURAL HAZARD CONSIDERATIONS FOR

PURCHASING COASTAL REAL ESTATE IN HAWAII



A PRACTICAL GUIDE OF COMMON QUESTIONS AND ANSWERS
AUGUST 2006



SHORELINE IMPACTS, SETBACK POLICY
&
SEA LEVEL RISE



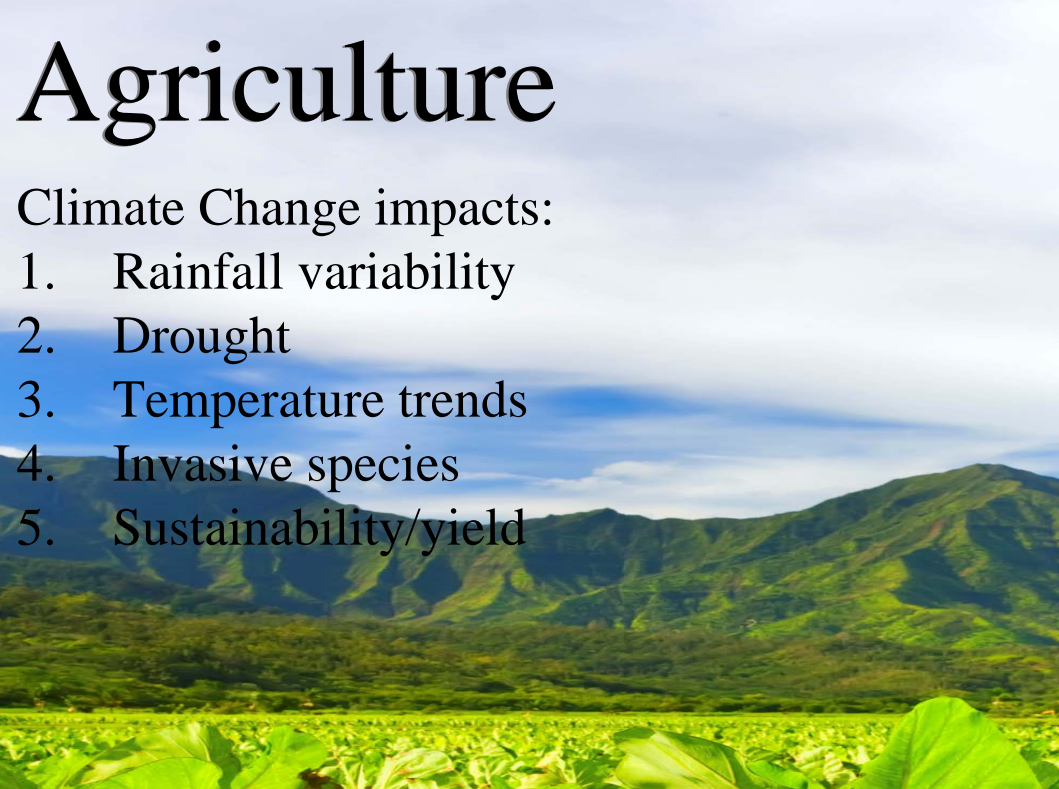
Center for
Island Climate Adaptation and Policy

- ✓ *Hawaii Coastal Hazard Mitigation,*
- ✓ *Development standards*
- ✓ *Erosion control & Shoreline Impacts*
- ✓ *Construction Setback Policy*
- ✓ *Sea Level Rise*

Agriculture

Climate Change impacts:

1. Rainfall variability
2. Drought
3. Temperature trends
4. Invasive species
5. Sustainability/yield

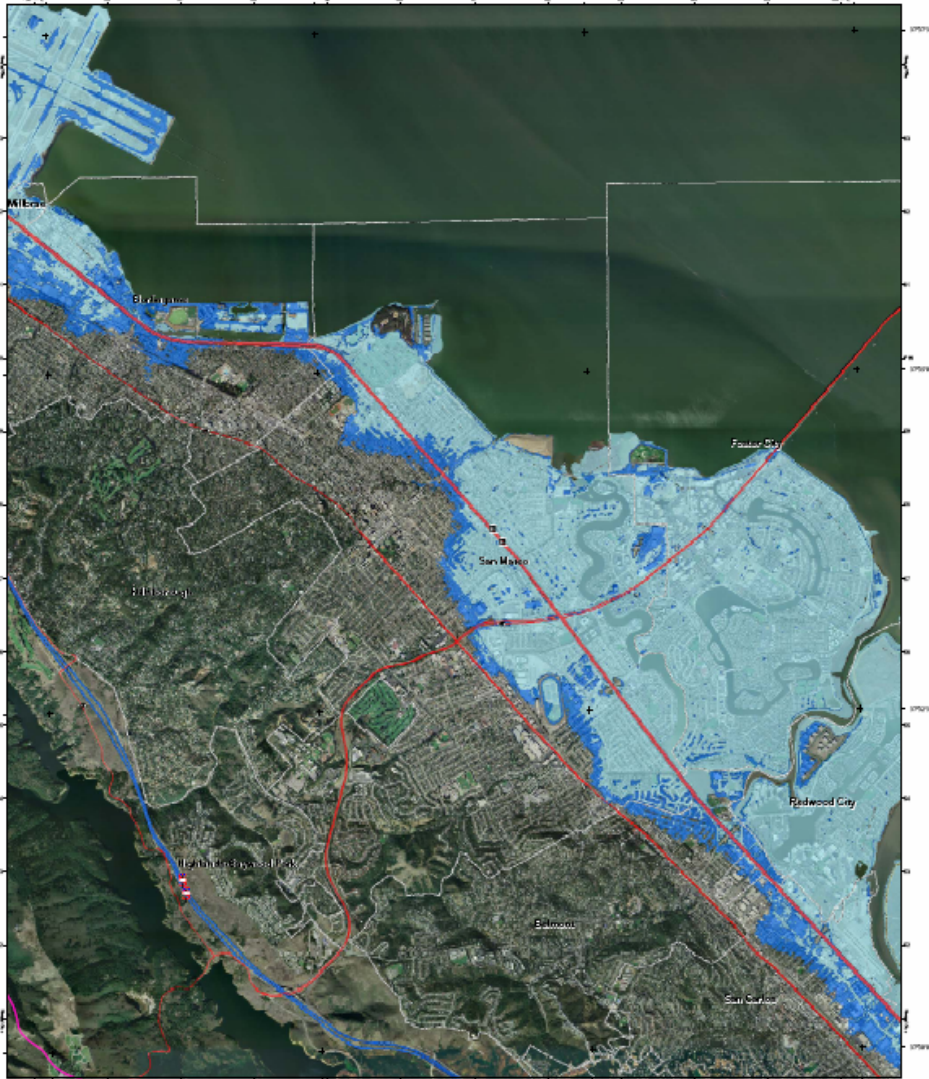


Transportation

Climate Change Impacts:

- Highways
- Airports
- Low elevation roadways
- Population and density
- Rail?





Legend

- Interstate
- State Highway
- County Highway
- Concurrent State Road (Supermarket 100 year flood extent)
- Bay Area Rapid Transit
- Lowland State Flood (1-4 meters (35 inches))
- Lowland State Flood (5-7 meters (20 inches))
- Lowland State Flood (8-10 meters (26 inches))
- Lowland State Flood (11-15 meters (36 inches))
- Lowland State Flood (16-20 meters (47 inches))
- Lowland State Flood (21-30 meters (69 inches))
- Lowland State Flood (31-40 meters (101 inches))
- Lowland State Flood (41-50 meters (133 inches))
- Lowland State Flood (51-60 meters (165 inches))
- Lowland State Flood (61-70 meters (197 inches))
- Lowland State Flood (71-80 meters (229 inches))
- Lowland State Flood (81-90 meters (261 inches))
- Lowland State Flood (91-100 meters (293 inches))
- Lowland State Flood (101-110 meters (325 inches))
- Lowland State Flood (111-120 meters (357 inches))
- Lowland State Flood (121-130 meters (389 inches))
- Lowland State Flood (131-140 meters (421 inches))
- Lowland State Flood (141-150 meters (453 inches))
- Lowland State Flood (151-160 meters (485 inches))
- Lowland State Flood (161-170 meters (517 inches))
- Lowland State Flood (171-180 meters (549 inches))
- Lowland State Flood (181-190 meters (581 inches))
- Lowland State Flood (191-200 meters (613 inches))
- Lowland State Flood (201-210 meters (645 inches))
- Lowland State Flood (211-220 meters (677 inches))
- Lowland State Flood (221-230 meters (709 inches))
- Lowland State Flood (231-240 meters (741 inches))
- Lowland State Flood (241-250 meters (773 inches))
- Lowland State Flood (251-260 meters (805 inches))
- Lowland State Flood (261-270 meters (837 inches))
- Lowland State Flood (271-280 meters (869 inches))
- Lowland State Flood (281-290 meters (901 inches))
- Lowland State Flood (291-300 meters (933 inches))
- Lowland State Flood (301-310 meters (965 inches))
- Lowland State Flood (311-320 meters (997 inches))
- Lowland State Flood (321-330 meters (1029 inches))
- Lowland State Flood (331-340 meters (1061 inches))
- Lowland State Flood (341-350 meters (1093 inches))
- Lowland State Flood (351-360 meters (1125 inches))
- Lowland State Flood (361-370 meters (1157 inches))
- Lowland State Flood (371-380 meters (1189 inches))
- Lowland State Flood (381-390 meters (1221 inches))
- Lowland State Flood (391-400 meters (1253 inches))
- Lowland State Flood (401-410 meters (1285 inches))
- Lowland State Flood (411-420 meters (1317 inches))
- Lowland State Flood (421-430 meters (1349 inches))
- Lowland State Flood (431-440 meters (1381 inches))
- Lowland State Flood (441-450 meters (1413 inches))
- Lowland State Flood (451-460 meters (1445 inches))
- Lowland State Flood (461-470 meters (1477 inches))
- Lowland State Flood (471-480 meters (1509 inches))
- Lowland State Flood (481-490 meters (1541 inches))
- Lowland State Flood (491-500 meters (1573 inches))
- Lowland State Flood (501-510 meters (1605 inches))
- Lowland State Flood (511-520 meters (1637 inches))
- Lowland State Flood (521-530 meters (1669 inches))
- Lowland State Flood (531-540 meters (1701 inches))
- Lowland State Flood (541-550 meters (1733 inches))
- Lowland State Flood (551-560 meters (1765 inches))
- Lowland State Flood (561-570 meters (1797 inches))
- Lowland State Flood (571-580 meters (1829 inches))
- Lowland State Flood (581-590 meters (1861 inches))
- Lowland State Flood (591-600 meters (1893 inches))
- Lowland State Flood (601-610 meters (1925 inches))
- Lowland State Flood (611-620 meters (1957 inches))
- Lowland State Flood (621-630 meters (1989 inches))
- Lowland State Flood (631-640 meters (2021 inches))
- Lowland State Flood (641-650 meters (2053 inches))
- Lowland State Flood (651-660 meters (2085 inches))
- Lowland State Flood (661-670 meters (2117 inches))
- Lowland State Flood (671-680 meters (2149 inches))
- Lowland State Flood (681-690 meters (2181 inches))
- Lowland State Flood (691-700 meters (2213 inches))
- Lowland State Flood (701-710 meters (2245 inches))
- Lowland State Flood (711-720 meters (2277 inches))
- Lowland State Flood (721-730 meters (2309 inches))
- Lowland State Flood (731-740 meters (2341 inches))
- Lowland State Flood (741-750 meters (2373 inches))
- Lowland State Flood (751-760 meters (2405 inches))
- Lowland State Flood (761-770 meters (2437 inches))
- Lowland State Flood (771-780 meters (2469 inches))
- Lowland State Flood (781-790 meters (2501 inches))
- Lowland State Flood (791-800 meters (2533 inches))
- Lowland State Flood (801-810 meters (2565 inches))
- Lowland State Flood (811-820 meters (2597 inches))
- Lowland State Flood (821-830 meters (2629 inches))
- Lowland State Flood (831-840 meters (2661 inches))
- Lowland State Flood (841-850 meters (2693 inches))
- Lowland State Flood (851-860 meters (2725 inches))
- Lowland State Flood (861-870 meters (2757 inches))
- Lowland State Flood (871-880 meters (2789 inches))
- Lowland State Flood (881-890 meters (2821 inches))
- Lowland State Flood (891-900 meters (2853 inches))
- Lowland State Flood (901-910 meters (2885 inches))
- Lowland State Flood (911-920 meters (2917 inches))
- Lowland State Flood (921-930 meters (2949 inches))
- Lowland State Flood (931-940 meters (2981 inches))
- Lowland State Flood (941-950 meters (3013 inches))
- Lowland State Flood (951-960 meters (3045 inches))
- Lowland State Flood (961-970 meters (3077 inches))
- Lowland State Flood (971-980 meters (3109 inches))
- Lowland State Flood (981-990 meters (3141 inches))
- Lowland State Flood (991-1000 meters (3173 inches))

Scale

0 0.25 0.5 1 1.5 2 Miles

0 0.25 0.5 1 1.5 2 Kilometers

Inset Map

Map of California showing the location of the San Mateo Quadrangle.

California

- State planning for 1.4 m SLR
- 480,000 people,
- \$100 billion in property
- 140 schools,
- 34 police and fire stations,
- 55 healthcare facilities,
- 330 EPA hazardous waste sites,
- 3500 miles of roads and highways,
- 280 miles of railroads,
- 30 power plants,
- 28 wastewater treatment plants.

Sea Level Rise- Waikiki High tide July, 2008



Economic Costs of Inaction

- Climate change will have wide ranging impacts on key resources.
- Hawaii must be positioned to meet these unavoidable challenges.
- Economic costs of these impacts are significant.
 - 1-5% of GDP (IPCC, 2007)
 - Federal climate adaptation funding opportunities
- The worst impacts can be avoided through proactive planning



Hawaii Strategic Planning

Each agency conduct:

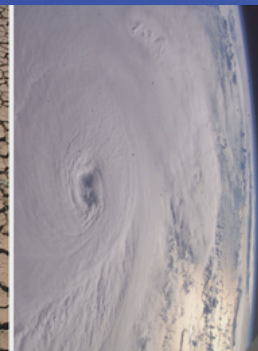
- Asses climate sensitive assets for each sector
- Engage key stakeholders
- Develop adaptation strategies
- Prioritize efforts
- Establish action plan
- Cross-jurisdictional collaboration



Sector-Specific Plans

Coordinate Multi-Agency Effort

- Water Resources
- Land Use
- Human Health
- Coastal Management
- Emergency Management
- **KEY PRIORITY IS TO IDENTIFY OVERLAPPING SECTORS**



Top Priorities

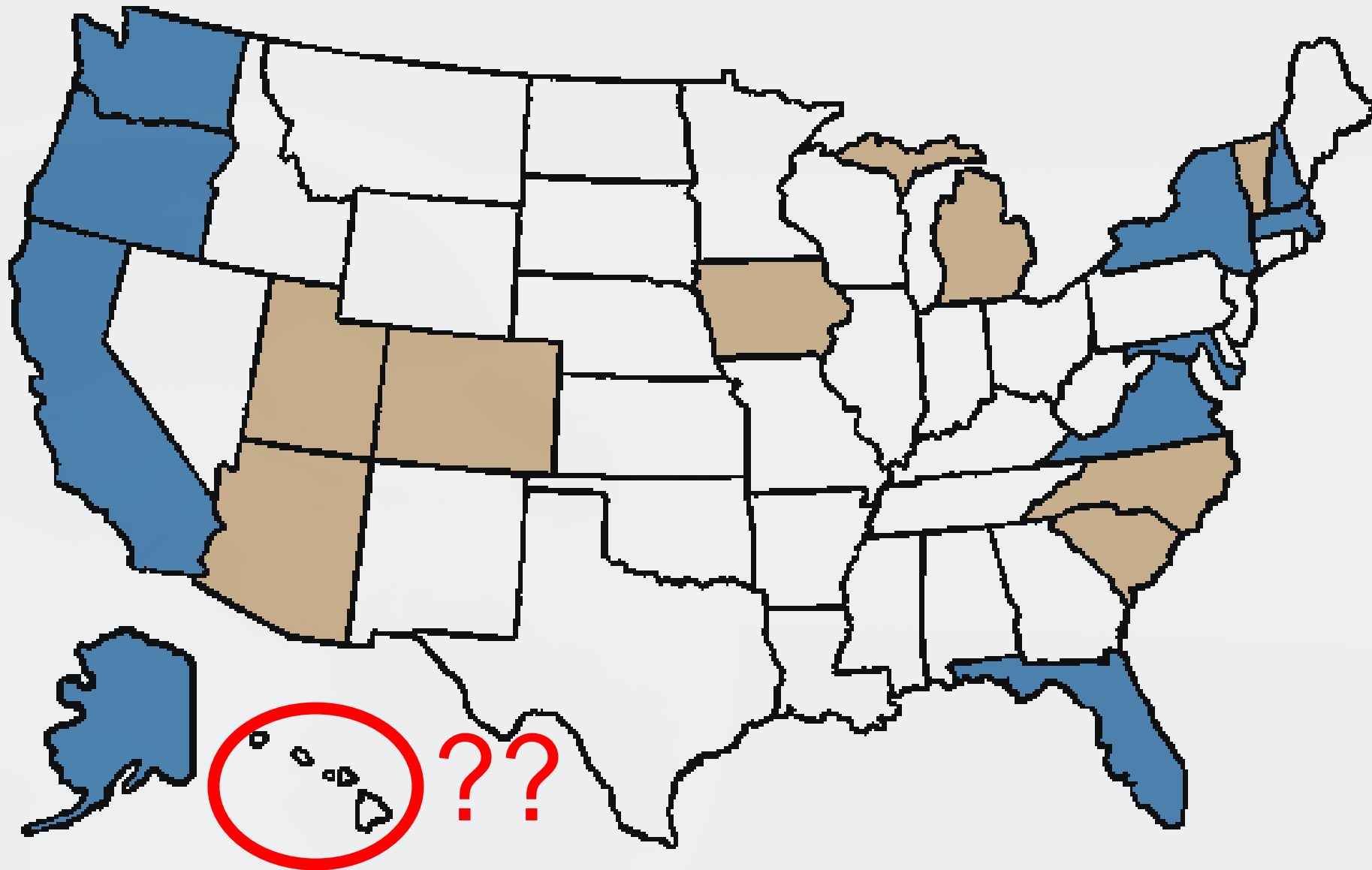
A satellite-style aerial photograph of a coastal region. The image shows a large body of water on the left, a large bay or inlet on the right, and several islands and peninsulas. The land is green with some brown patches, indicating vegetation and possibly urban or developed areas. The water is dark blue with some whitecaps. The overall scene is a top-down view of a coastal landscape.

- ✓ Inventory climate sensitive planning areas.
- ✓ Assess vulnerabilities and risks
- ✓ Develop long and short term adaptation strategies.
- ✓ Coordinate relevant stakeholders
- ✓ Identify opportunities for collaboration.

Federal Opportunities



- Waxman-Markey H.R. 2454 - American Clean Energy and Security Act of 2009
 - Passed in the House
 - Adaptation planning scaled funding 3% up to 12% of Cap and trade by 2050.
- Addresses domestic climate change adaptation
- Funding for State's with complete adaptation plans
 - States must have completed a climate adaptation plan to qualify



■ Adaptation Plan in Progress or Completed

■ Adaptation Plan Recommended in C.A.P.*

Hawaii Climate Change Framework

Framework for Climate Change Adaptation in Hawaii

Build Climate Adaptation Team ✓

Develop and Adopt a Long-Term Vision ?

Identify Planning Areas Relevant to Climate Change ✓

Scope Climate Change Impacts to Major Sectors ✓

Conduct a Vulnerability Assessment ?

Conduct Risk Assessment ?

Next Steps

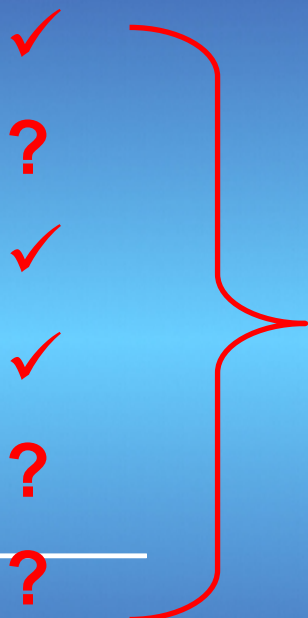
Prioritize Areas for Adaptation Planning

Set Preparedness Goals

Develop, Select, and Prioritize Preparedness Actions

Implement Preparedness Plan

Monitor and Update Plan

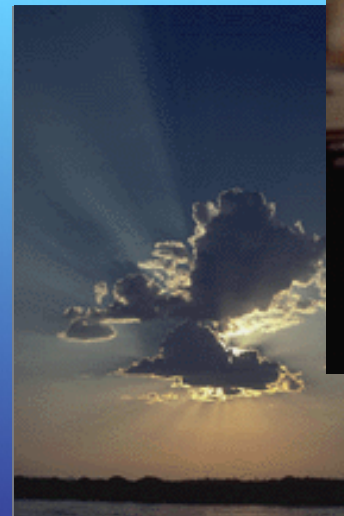


State Adaptation Planning stages to qualify for Federal funding

Timeframe

One year to produce long term and short term adaptation strategies for the State of Hawaii

- Assess risks and cost associated
- ID priority planning areas
- ID barriers to implementation



Stakeholders

Academic/Research

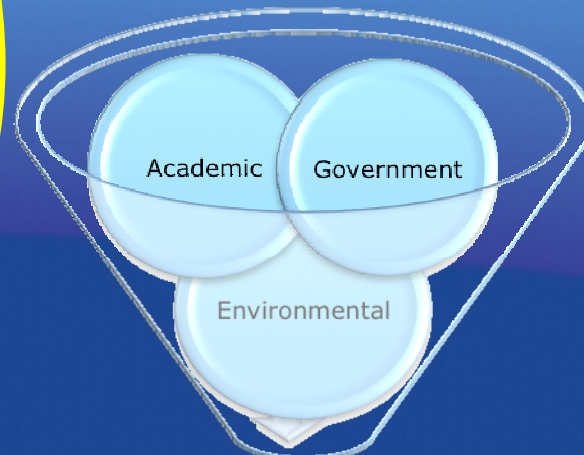
- University of Hawaii System
- UH Sea Grant -ICAP
- PRIMO
- Blue Planet Foundation

Government

- DLNR
- NOAA
- CZM/OP
- Civil Defense
- County Government
- OHA
- DOT (Harbors & Roads)
- Emergency Management Agencies
- Hawaii Hazard Mitigation Forum
- EMS-First Responders

NGO/Environmental

- Nature Conservancy
- Hawaii Conservation Alliance
- Kauai Land Trust
- Maui Coastal Land Trust
- North Shore Community Land Trust
- Sierra Club
- Surfrider Foundation
- Waikiki Improvement Association
- Waikiki Business Improvement District
- HTA



Sectoral Collaboration

Aloha and Mahalo!



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ICAP Accomplishments

- “A Framework for Addressing Climate Change in Hawaii”
- “Climate Update Hawaii”
- “Sea Level Rise in the Federated State of Micronesia; Food and Water Security, Risk Management, and Adaptive Strategies”
- “Climate Change Effects on Ocean and Coastal Resources”
- “Takings Law and Coastal Retreat”
- “Enhancing Hawaii’s Coastal Resiliency to Climate Change through Environmental Impact Assessments”
- “Shoreline Impacts, Setback Policy and Sea Level Rise”
- “Understanding Attitudes, Beliefs and Preparedness for Climate Change Impacts and Other Coastal Hazards”

ICAP Accomplishments

- Climate Adaptation Speaker Series
- PRiMO Public Perceptions of Climate Risk Workshop
- Successful Shoreline Model
- Hawaii Coastal Hazard Mitigation Guidebook
- Addressing Inundation Concerns to Wastewater Treatment Facility
- Technical Support Provided to the State Department of Land and Natural Resources
- Handbook Developed for Hawaii Residents on How to Prepare for Natural Hazards
- Review of the Hawaii State Hazard Mitigation Plan