

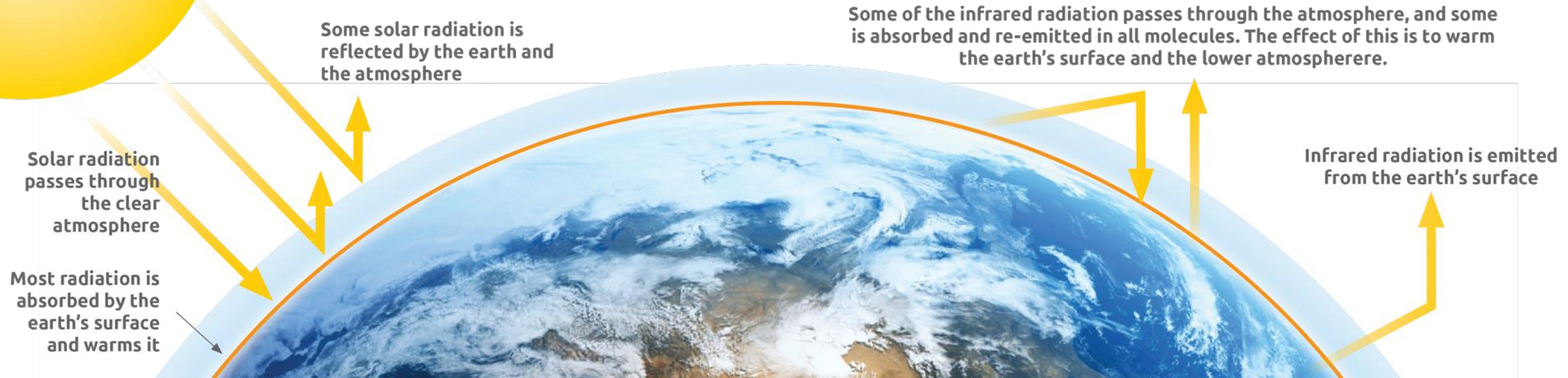


Global Climate Change and Mitigation

An introduction to Climate Change and possible mitigation opportunities on Maui

Anthony Joyce, PhD

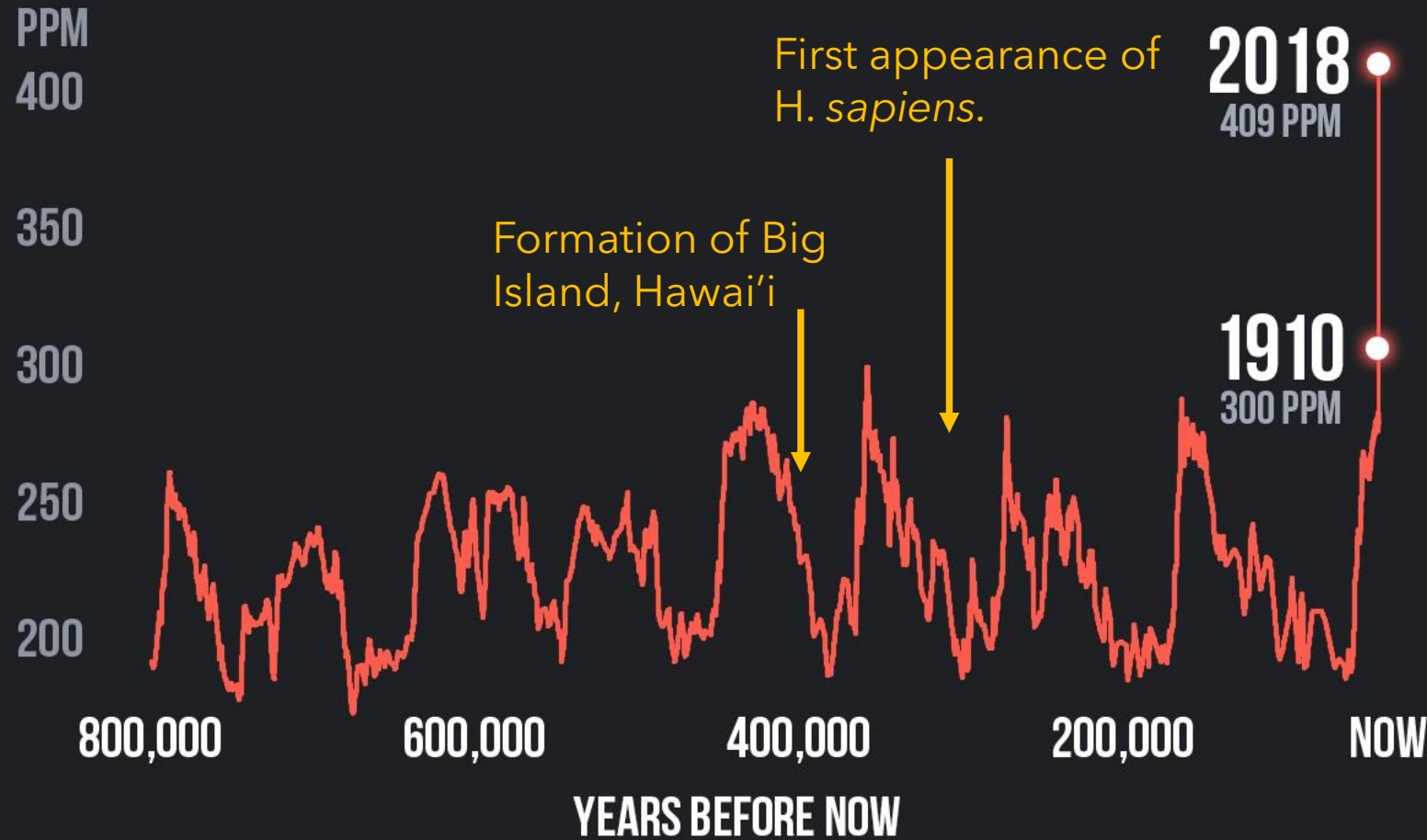
The Greenhouse Effect



1. Solar radiation pass through the atmosphere and is absorbed by the Earth's surface.
2. Infrared radiation is emitted from the Earth's surface back into space.
3. Some of this infrared radiation is absorbed by molecules (Greenhouse Gasses) and re-emitted back to the Earth's surface.
4. This allows us to have a habitable planet however, too much of a good can be bad.

CHANGING OUR ATMOSPHERE

800,000 Years of Carbon Dioxide

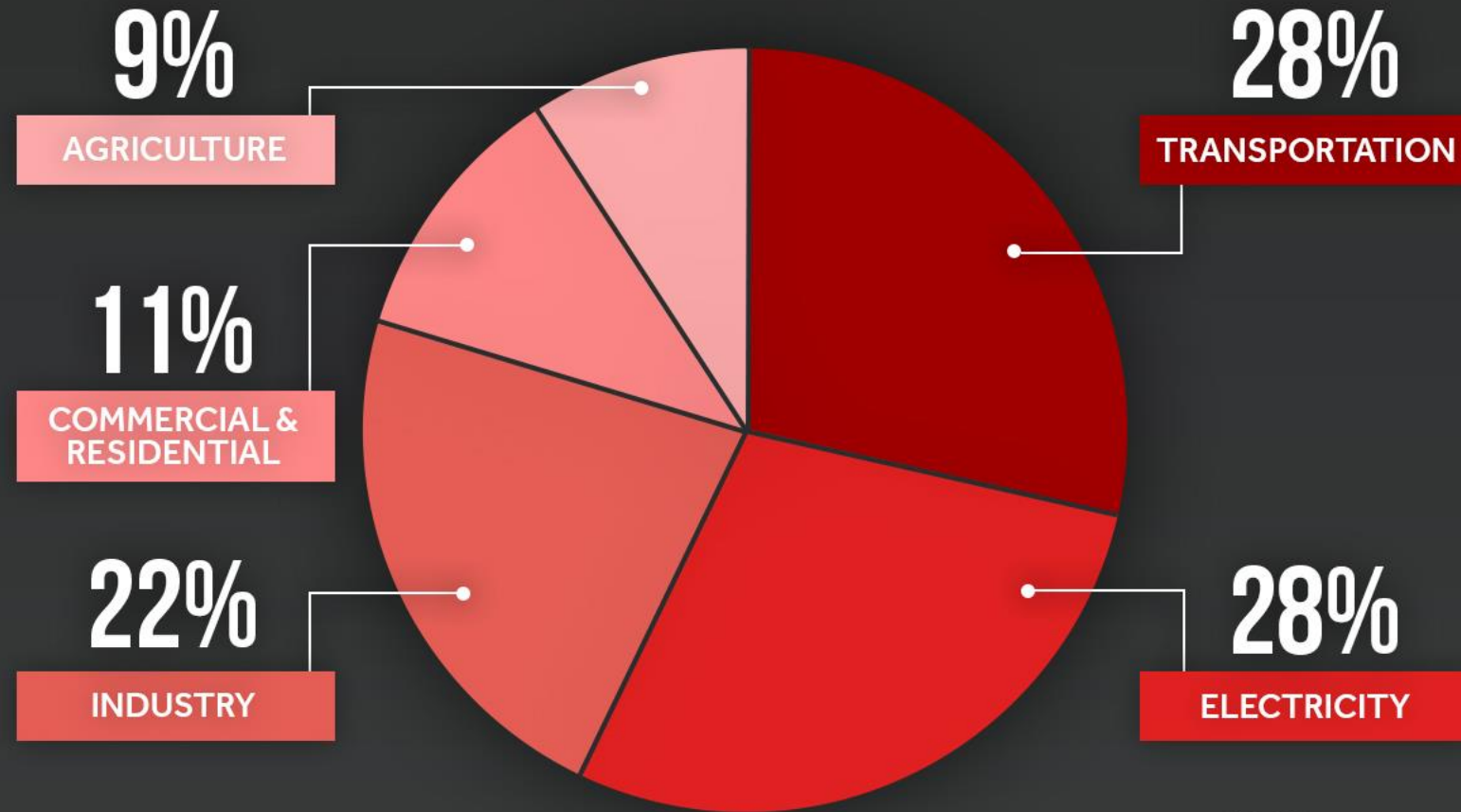


CO2 (ppm) (2008) (cdiac.ornl.gov) & NOAA ESRL (esrl.noaa.gov)

CLIMATE CENTRE

GREENHOUSE GAS SOURCES

United States Greenhouse Gas Emissions by Sector



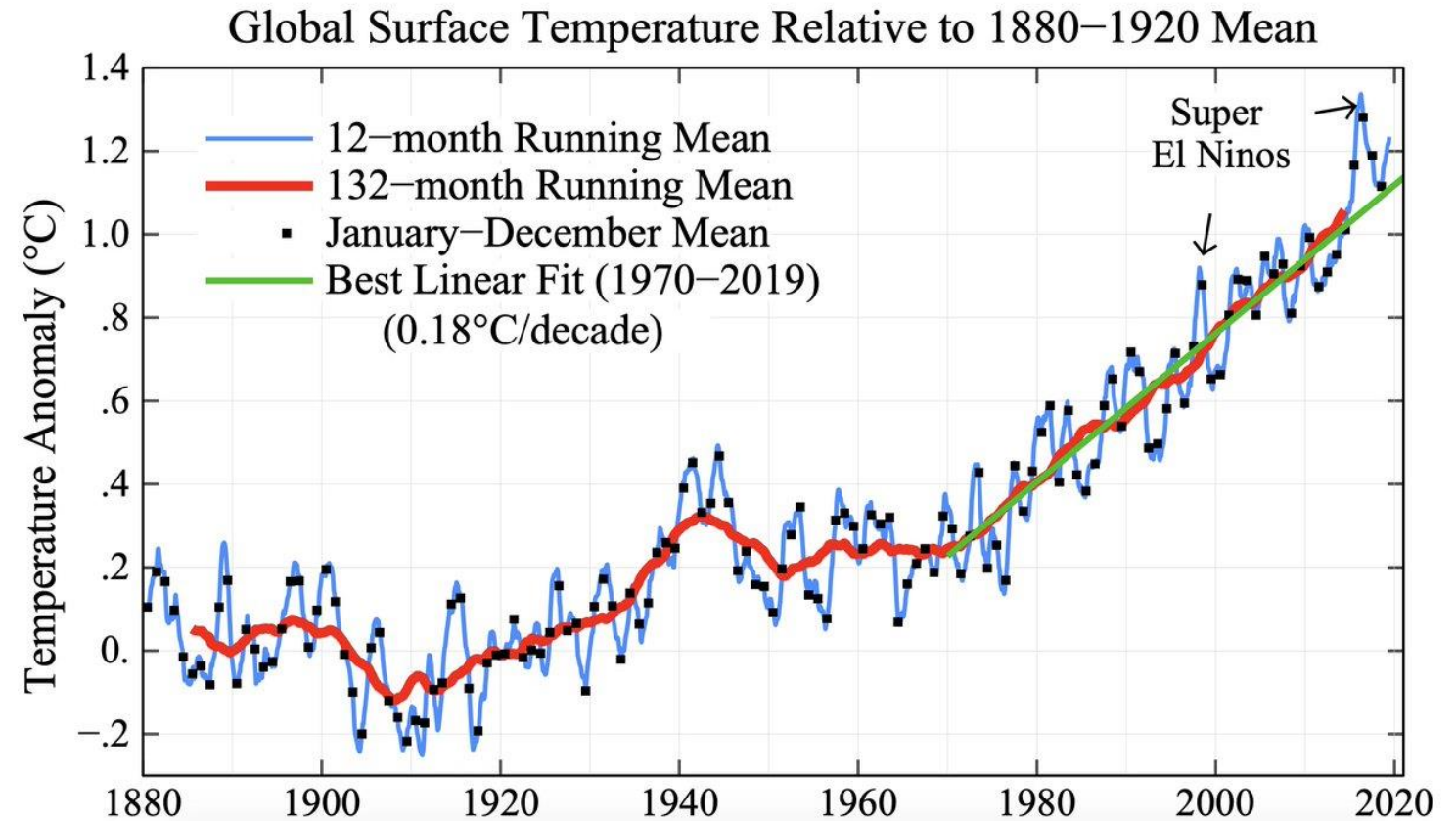
Source: US EPA

CLIMATE  CENTRAL

Data from: US EPA

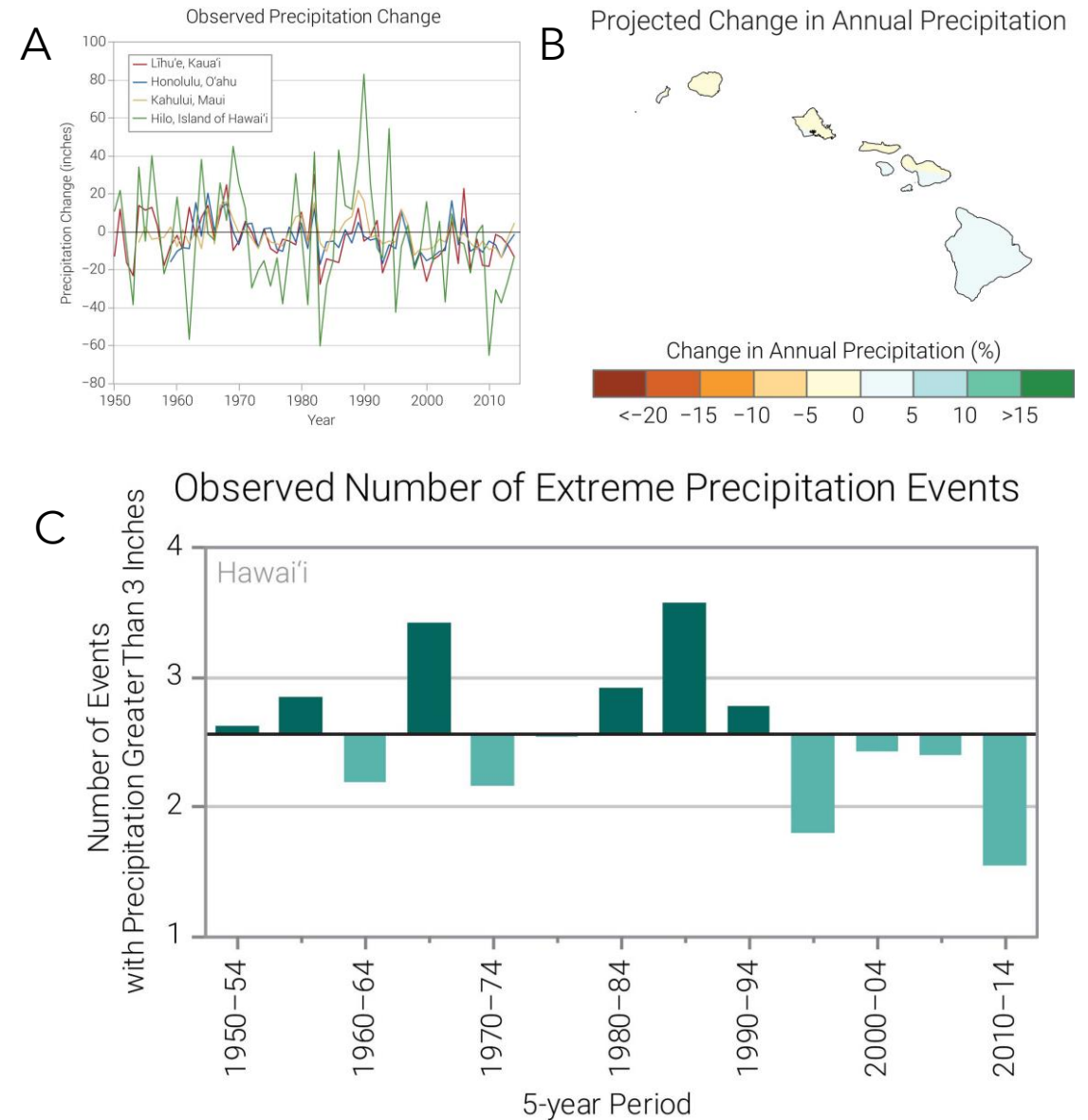
Global Surface Temperature Relative to 1880-1920

- The 5 warmest years on record have been the last 5 years.
- Since 1950, the temperature over the Hawaiian islands have risen 2 °F (NOAA).
- Current July global average temperature: 1.2 °C (2.2 °F)
- 2030: 1.5 °C (2.7 °F)
- 2050: >2.0 °C (3.6 °F)



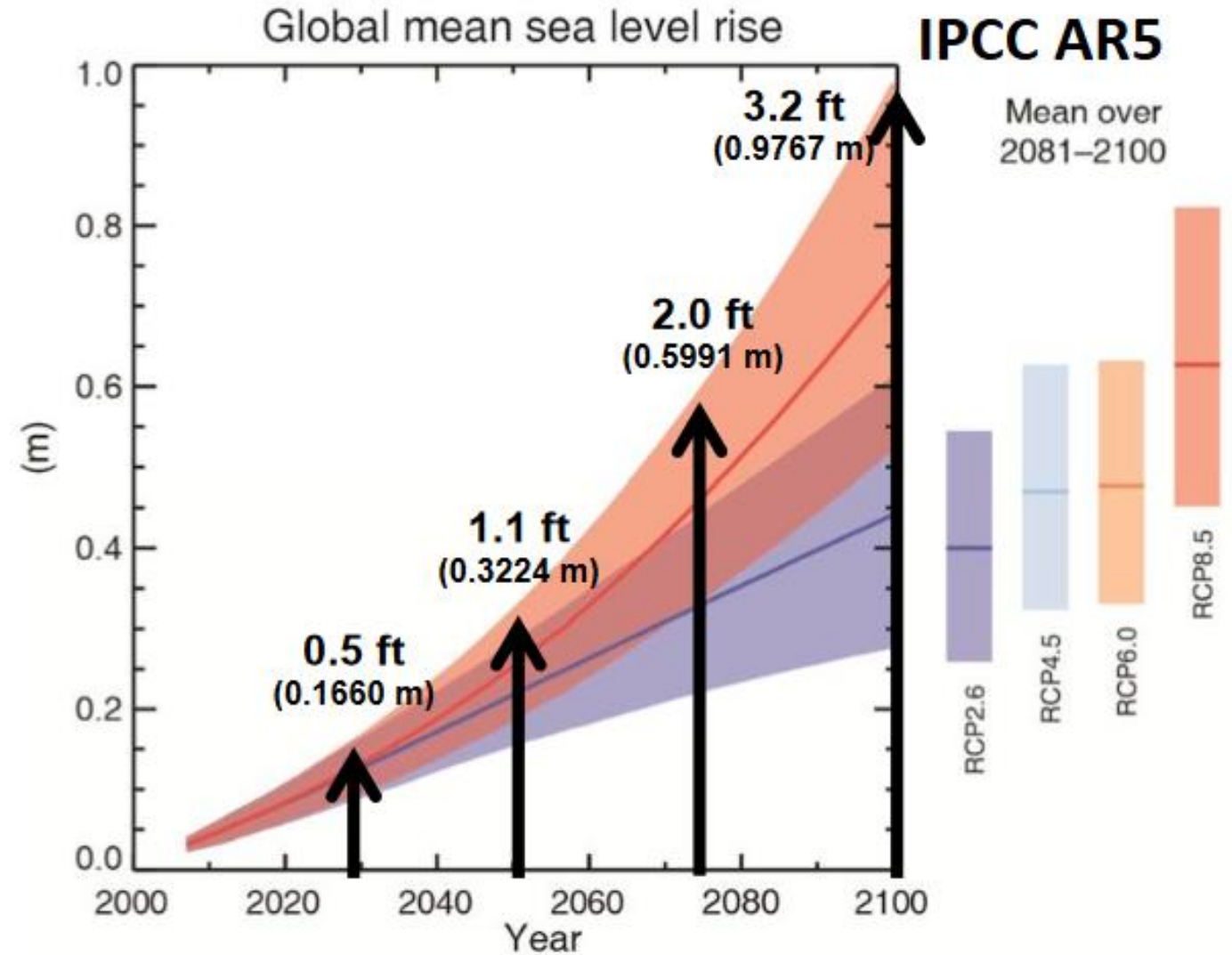
What does climate change mean for Maui?

- Decrease in annual precipitation since 1950 (A).
- A 5% reduction in annual rainfall is predicted (B).
- Decrease in extreme precipitation events (C).
- Decrease in stream base flow over the last 70 years - negative effects on aquifer recharge.

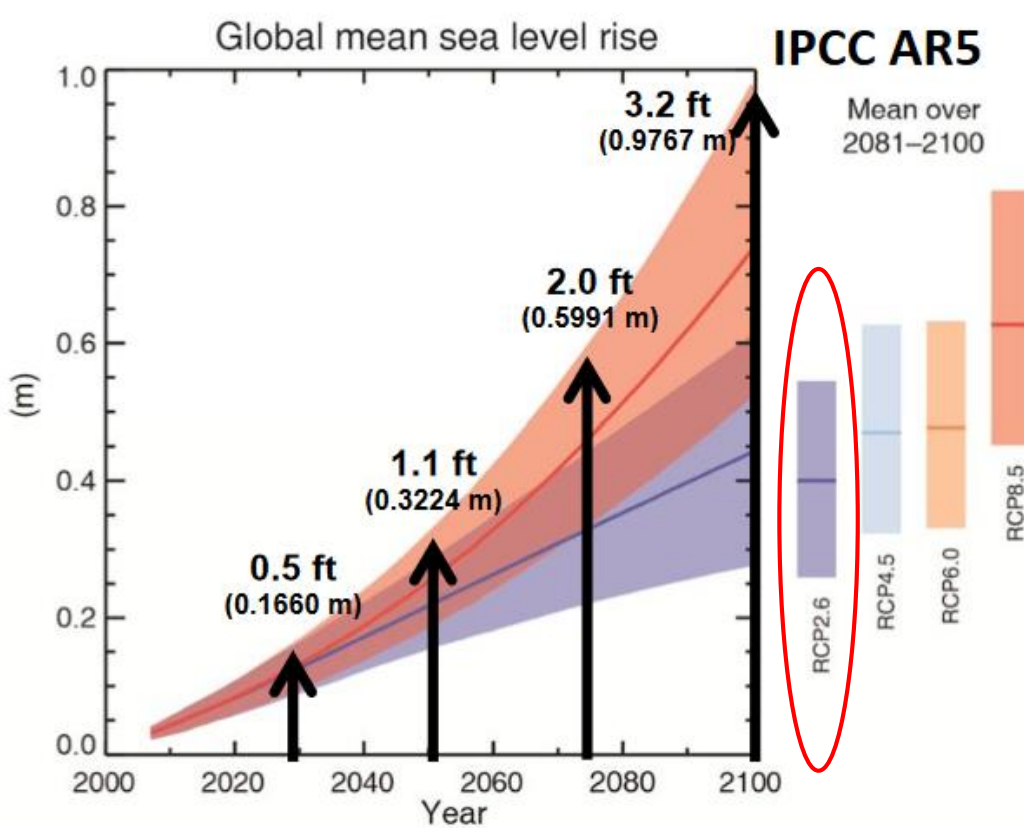


What does climate change mean for Maui?

- Sea level rise has been and will remain a major concern, and present challenges to shoreline planning.
- Representative Concentration Pathways (RCP):
 - RCP2.6 = 0.5 ft SLR
 - RCP4.5 = 1.1 ft SLR
 - RCP6.0 = 2.0 ft SLR
 - RCP8.5 = 3.2 ft SLR
- RCP8.5 = “business-as-usual” scenario

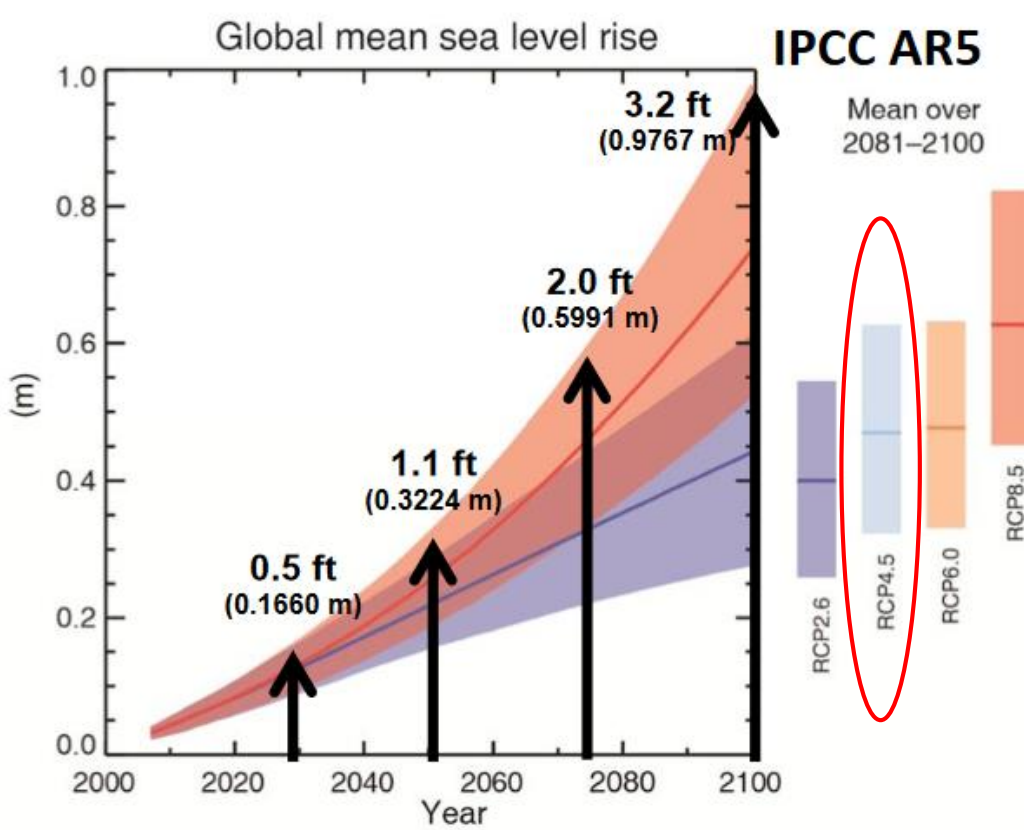


Data from: IPCC AR5 and PACIOOS SLR Interactive Map



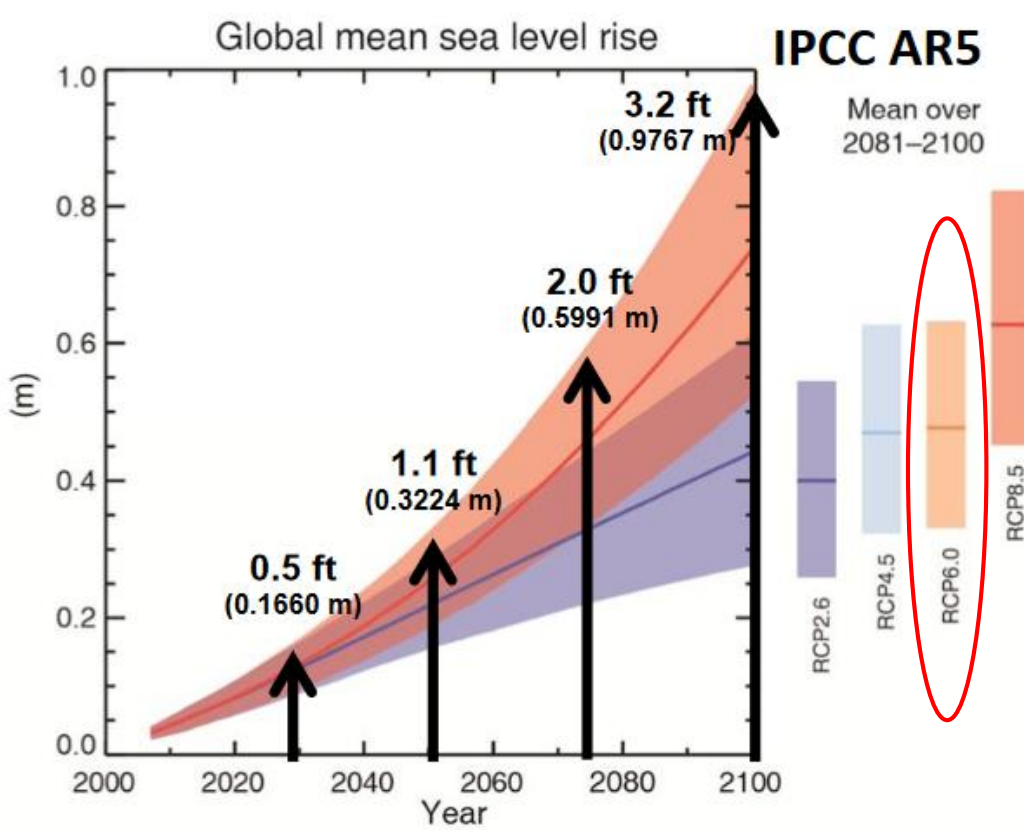
Sea Level Rise

- Sea level rise and coastal inundation for RCP2.6
- Data from: UH Sea Level Rise Viewer



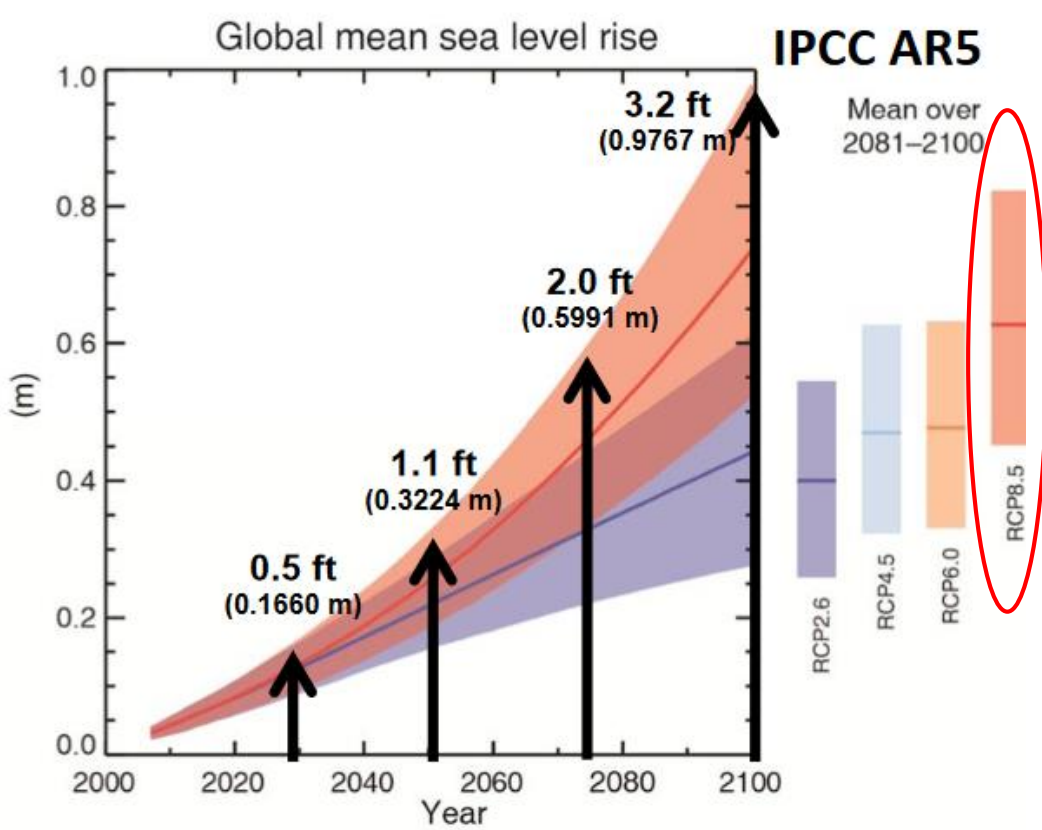
Sea Level Rise

- Sea level rise and coastal inundation for RCP4.5



Sea Level Rise

- Sea level rise and coastal inundation for RCP6.0

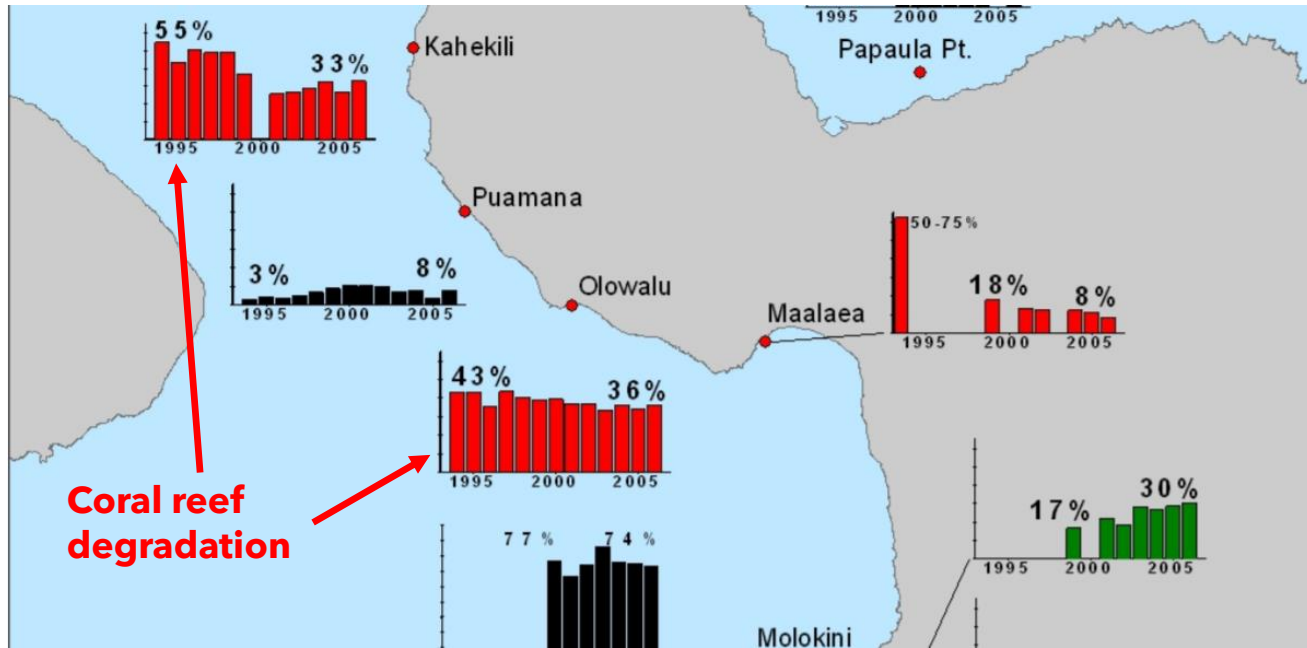


Sea Level Rise

- Sea level rise and coastal inundation for RCP8.5



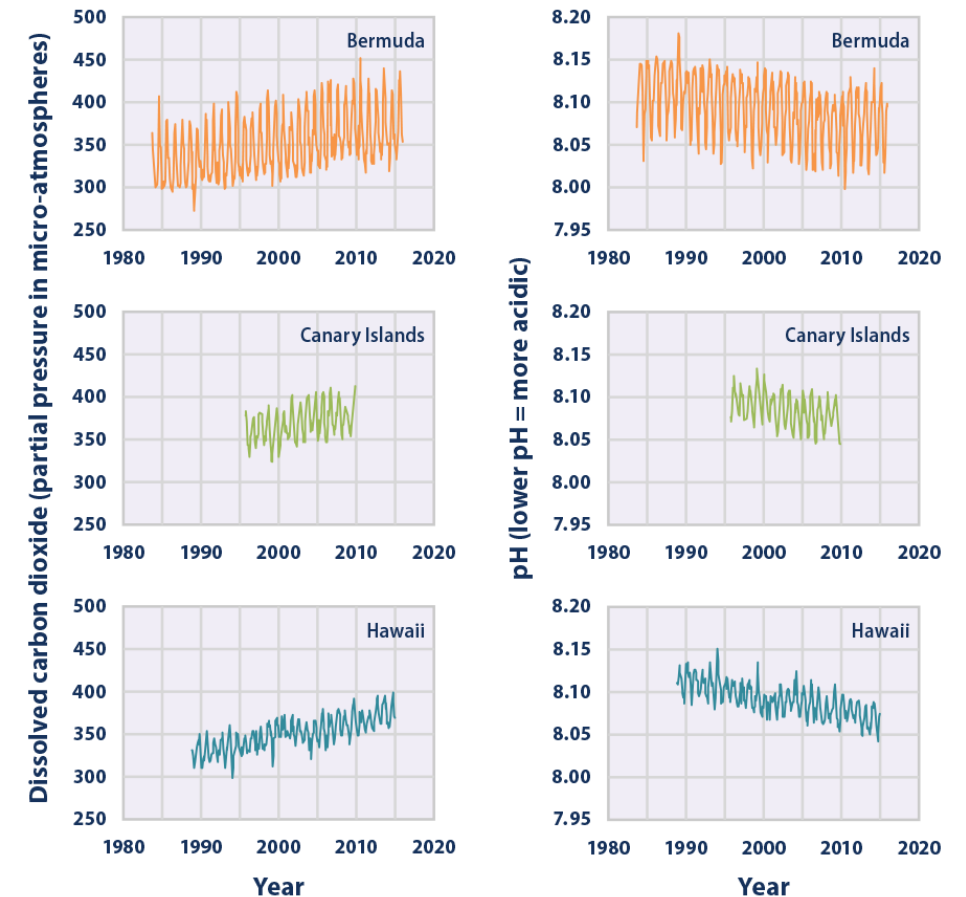
Coastal Erosion



Ocean acidification and Maui reefs

- The ocean absorbs one-third of the CO₂ in the atmosphere.
- Ocean acidity has increase 25% from pre-industrial and is the most acidic in over 2 million years.
- CO₂ + H₂O = H₂CO₃ (Carbonic Acid)
- Carbonic Acid steals carbonate ion from the water (shellfish, reefs use carbonate ion to make there shells)

Ocean Carbon Dioxide Levels and Acidity, 1983–2015



Data sources:

- Bates, N.R. 2016 update to data originally published in: Bates, N.R., M.H. Best, K. Neely, R. Garley, A.G. Dickson, and R.J. Johnson. 2012. Indicators of anthropogenic carbon dioxide uptake and ocean acidification in the North Atlantic Ocean. *Biogeosciences* 9:2509–2522.
- González-Dávila, M. 2012 update to data originally published in: González-Dávila, M., J.M. Santana-Casiano, M.J. Rueda, and O. Llinás. 2010. The water column distribution of carbonate system variables at the ESTOC site from 1995 to 2004. *Biogeosciences* 7:3067–3081.
- Dore, J. 2015 update to data originally published in: Dore, J.E., R. Lukas, D.W. Sadler, M.J. Church, and D.M. Karl. 2009. Physical and biogeochemical modulation of ocean acidification in the central North Pacific. *Proc. Natl. Acad. Sci. USA* 106:12235–12240.

For more information, visit U.S. EPA's "Climate Change Indicators in the United States" at www.epa.gov/climate-indicators.

Emergency Management's Role



Maui Emergency Management Agency's role is to mitigate and assess risks associated with the loss of life and property, prepare the community for disasters, respond to the disaster and aid in the recovery after a disaster.



As an emergency manager, you are not a scientist or engineer, rather the experience lies in reducing vulnerabilities...



Build partnerships for risk reduction involving government, non-gov't organizations, businesses and the public.



Hazard Mitigation Planning

The Maui County Hazard Mitigation Plan serves as an essential guide to reducing current and future risks to natural hazards and improving the emergency preparedness of the county's three islands.

Hazard Mitigation Plan Update



Maui County

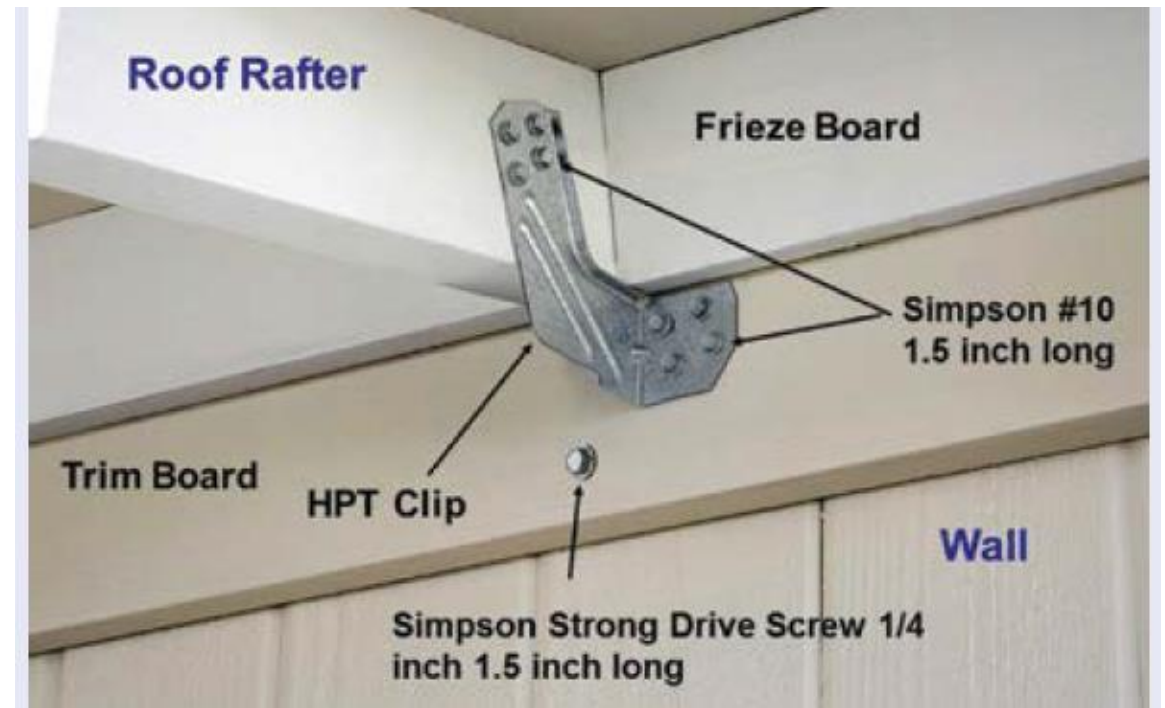
August 2015

Adaptation, Mitigation and Response

- In conjunction with the planning department, risk identification will identify and map vulnerable areas of Maui County that are susceptible to a disaster. Economic impacts will be modeled using FEMA's HAZUS model.
- Community meetings will be held to identify local hazards and public opinion on hazard mitigation, particularly in rural and under-represented areas.
- Update building codes* (Planning Dept., County), improving stormwater management (DPW, DEM), preserve areas that are designated as floodplain (DEM), and perform LiDAR studies (UH).
- Explore long term options for managed coastal retreat and elevation of major coastal highways.
- Create a hazard mitigation website to educate the public (will be incorporated to the hazard mitigation plan if we can secure funding).

Example: Hurricane Preparedness – Adaptation

- MEMA recommends hurricane clips if your home does not have any.
- MEMA actively recommends new developments be hurricane rated at least Cat. 3.
- On Maui, homes built after 1990 likely have hurricane clips and a complete load path if built after 1995.
- For single walled construction, Hawaii Plantation Tie (HPT) Clip will secure roof to home.



Example: Flood control - Mitigation

- Wailuku River flood control system





Conclusion

1. Climate Change hazard mitigation affects everyone and needs a multi-disciplinary approach with multiple groups of stakeholders.
2. Some climate change impacts are unavoidable and may not be affectively mitigated.
3. Some impacts are unavoidable but can be mitigated
 - Coastal erosion (preservation of dunes, change in zoning codes, streamline permitting, move to a less “reactionary management” situation)
4. Some impacts are unavoidable, but Hawaii will adapt
 - Changes in infrastructure may be needed to adapt to flooding
5. MEMA will work with all federal, state and local organizations to reduce the loss of life and property in Maui County.