

War in the Pacific National Historical Park

Sea Level Rise

National Park Service
U.S. Department of the Interior

Natural Resource Stewardship & Science
Ocean and Coastal Resources Program

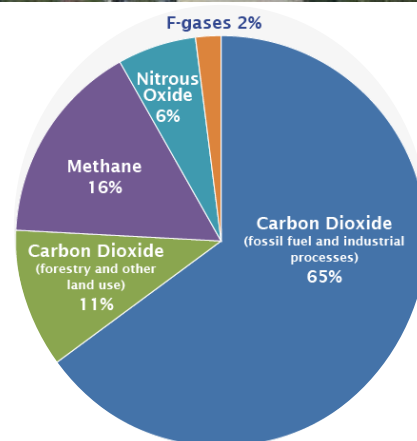


Sea levels are rising.

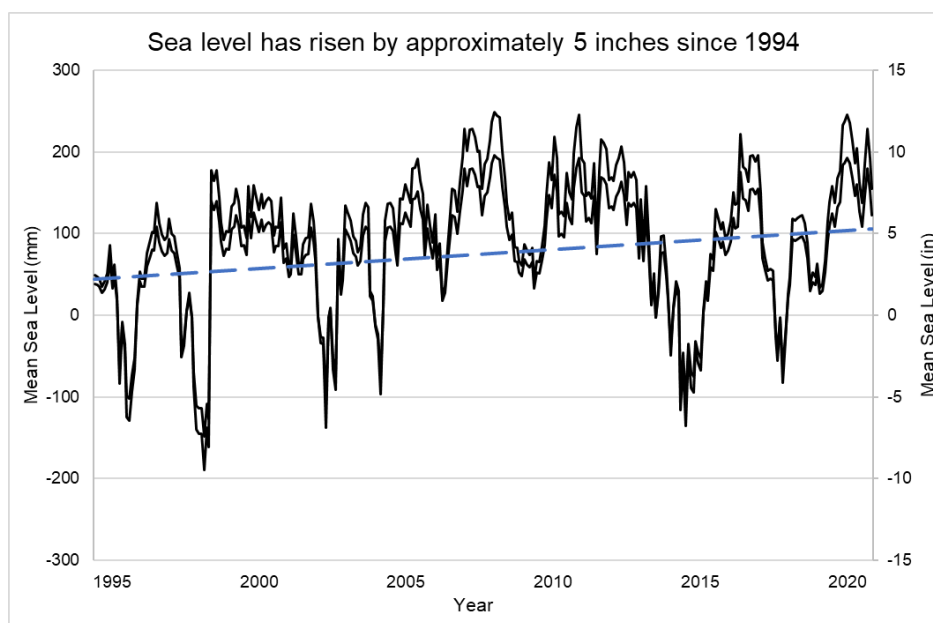
Two phenomena related to climate change contribute to accelerated global sea level rise:

- Thermal expansion: global atmospheric and ocean temperatures are rising, and water expands as it absorbs heat.
- Ice melt: melting glaciers and ice sheets increase freshwater runoff into oceans.

Greenhouse gases trap heat in our atmosphere resulting in rising ocean temperatures. Sources of greenhouse gases include the use of fossil fuels such as coal, oil, and natural gas to power our societies, which releases carbon dioxide and methane into the atmosphere. Other methane sources include emissions from landfills and agriculture.



Greenhouse Gas Emissions by Gas



Since 1994, sea level has risen by about 5 inches at War in the Pacific National Historical Park based on data from the Apra Harbor tide gauge in Guam,* which is operated by the National Oceanic and Atmospheric Administration (NOAA). Sea level could rise by as much as 5.48 feet by 2100.

**The Apra Harbor record is short due to a major earthquake in 1993 that caused vertical land motion and an abrupt change in sea level elevations. Therefore, only post-earthquake measurements are included here.*

What is the future of sea level rise at War in the Pacific National Historical Park?

NOAA Projections ¹	2050	2100
Intermediate Low	+0.72 ft	+1.87 ft
Intermediate	+0.89 ft	+3.51 ft
Intermediate High	+1.12 ft	+5.48 ft

This table shows projected sea level heights at the park compared to today's mean sea level. These projections were developed by NOAA in 2022 based on different climate change scenarios. Projections are a way of visualizing a range of possible futures. They can aid in park planning by helping managers determine which resources are most threatened by sea level rise.



From left to right, these images show the Asan Beach unit of War in the Pacific National Historical Park at current sea level, with three feet of sea level rise, and with five feet of sea level rise. Parts of the parking lot would be inundated with five feet of sea level rise.



How is sea level rise impacting War in the Pacific National Historical Park?

War in the Pacific National Historical Park comprises seven park units. It was founded to commemorate those who fought in the Pacific during World War II and to conserve the natural and historic values of the island of Guam. The park's natural resources include beaches, coral reefs, seagrass beds, mangrove forests, and unique plant and animal species. Historical resources include World War II fortifications and commemorative monuments. These resources are being impacted by flooding, erosion, storm damage, and saltwater intrusion resulting from rising sea levels. Frequent flooding of park infrastructure also impacts the park's ability to provide learning and recreation opportunities for visitors.

- A recent vulnerability assessment found that by 2050, 59% of the park's infrastructure is likely to be exposed to coastal hazards such as flooding, shoreline change, and sea level rise.
- A small rise in sea level can greatly increase the frequency of high-water days, which result when high tides combine with high wave activity. Flooding during high-water days impacts low-lying infrastructure, such as the parking lot at Asan Beach, as well as natural resources like beaches and mangroves.
- World War II pillboxes, fortifications, and commemorative monuments located near the ocean at the Asan Beach and Agat units will be impacted by increased flooding during storm events. The park implements an adaptive management philosophy to guide their response when a resource is threatened.



Flooding at the Asan Beach unit parking lot [NPS]

The Apolinario Mabini historical marker at the Asan Beach unit [NPS]



How is the park responding to sea level rise?

- The park's coral reefs protect the coast by reducing wave energy during storms. However, corals are being damaged by coral bleaching events, ocean acidification, and crown-of-thorns starfish predation. To combat this, the park is planning to grow corals that have survived past bleaching events to then transplant them to the reef.
- Mangrove forests play an important role in stabilizing coastlines and providing nursery habitat for fish and other marine species. However, mangroves could "drown" if they are unable to migrate landward to combat rising waters. To maintain this essential coastal resource, the park is beginning to explore options for mangrove restoration.



Coral bleaching off the coast of Guam [NPS]

What can you do to help?

- Reduce your carbon footprint: power down electronics or reduce your thermostat. Go to carbonfootprint.com to calculate your carbon footprint and find ways to make changes.
- Volunteer with organizations working to protect coastal habitats that provide natural defenses against sea level rise.
- Support climate mitigation and adaptation policies. Contact your representatives in Congress to let them know you care.
- Visit coastal areas and support the parks and communities that are taking actions to prepare for sea level rise.

Additional Resources

1. <https://coast.noaa.gov/slr/>: A NOAA SLR viewer tool to access local sea level rise projections at tide gauges and visualize sea level rise scenarios.
2. <https://tidesandcurrents.noaa.gov/>: Access water levels, tide predictions, and other conditions along coasts.
3. [NOAA Coastal Flood Exposure Mapper](#): A tool to visualize coastal hazards as well as societal, infrastructure, and ecosystems exposure to those hazards
4. [War in the Pacific National Historical Park Asset Vulnerability Assessment](#): A 2017 report on the coastal hazards at War in the Pacific.

Note: The sea level rise projections, storm surge projections, and other information presented here are for general educational and awareness purposes only. They should not be used for site-specific analysis, navigation, permitting, or legally binding activities.