

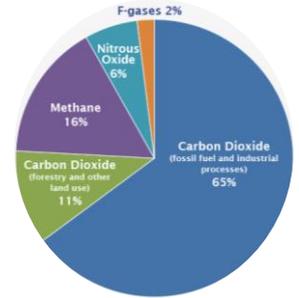


Sea levels are rising.

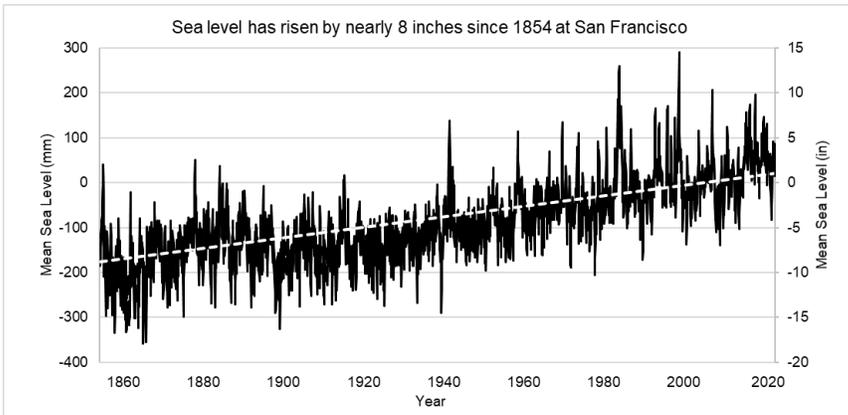
Two phenomena related to climate change contribute to accelerated global sea level rise:

- 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; methane sources also include emissions from landfills and agriculture.



Global Greenhouse Gas Emissions by Gas

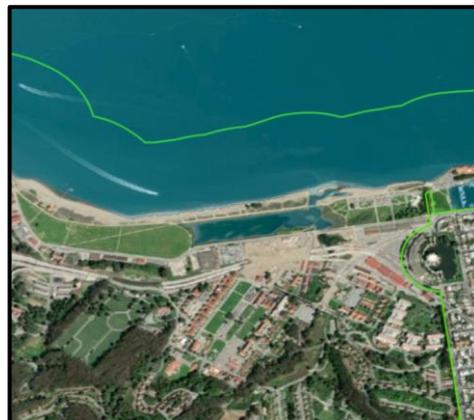
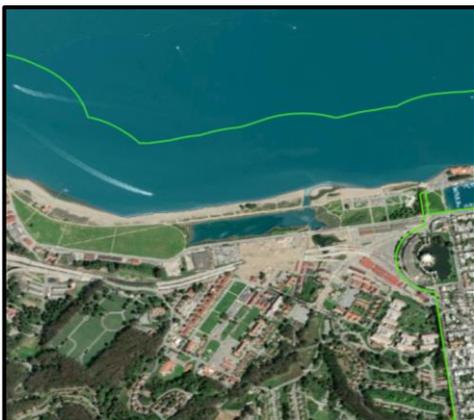


The San Francisco tide gauge, located at the end of a pier as seen in the image above, records water levels at Golden Gate National Recreation Area. It has recorded water levels since 1854 making it the oldest continually operating tidal gauge in the Western Hemisphere, one of the country's major scientific landmarks, and an important historical resource. Since 1854, it has recorded a sea level rise of nearly 8 inches at the park; sea level could rise by an additional 4.76 feet by 2100 (NOAA).

What is the future of sea level rise at Golden Gate National Recreation Area?

NOAA Projections ¹	2050	2100
Intermediate Low	+0.66 ft	+1.57 ft
Intermediate	+0.79 ft	+3.08 ft
Intermediate High	+1.02 ft	+4.76 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 Crissy Field and Marsh area of the park with its current water level, with 2 feet of sea level rise, and with 5 feet of sea level rise. Dramatic changes to the shoreline are visible with 5 feet of sea level rise, but there will only be subtle changes with 2 feet of sea level rise, such as slight inundation of the beach area and greater connectivity between the marsh and the bay.



How is sea level rise impacting Golden Gate National Recreation Area?

Golden Gate National Recreation Area preserves over 90 miles of shoreline along the coast of the San Francisco Bay area. Made up of several distinct park units, the bigger picture is one of interconnected pockets of nature, wildlife corridors, cultural resources, and places for recreation. Sprawling across so many miles of coastline means that rising sea levels and increased storm wave heights can have big impacts on the park. Challenges related to sea level rise, such as increases in storm wave height and frequent flooding, already impact some areas of the park, such as the Fort Point National Historic Site. This Civil War era fort located near Crissy Field is a place to experience the “pride of the Pacific,” an icon of American military history and architecture. The fort already experiences flooding and damage from high waves during strong storm events, and rising seas will cause more frequent flooding in the future.

- Natural resources – as sea level rise accelerates, water will inundate sandy beaches and coastal wetlands at the park. One area that is particularly vulnerable is the narrow strip of sand at Rodeo Beach. This beach is backed by Rodeo Lagoon, so as sea levels rise, water could eventually submerge the beach and spill over into the lagoon.
- Cultural resources – two shipwrecks listed on the National Register are located within the sandy coastline and are vulnerable to impacts related to climate change. The park also protects several Native American sites along the sandy shoreline and intertidal areas of the park, which could be damaged as flooding and erosion increase.
- Visitor access – two of the most popular visitor locations are Stinson Beach and Crissy Field. Stinson Beach is located north of the Golden Gate Bridge and provides opportunities for volleyball, hiking, picnicking, fishing, or surfing. Crissy Field is located south of the Golden Gate Bridge and provides access to the restored tidal marsh and beaches along the bay shore. Sea level rise could greatly impact these popular locations as water could flood much of the area available for visitor recreation.



A view of the narrow Rodeo Beach backed by Rodeo Lagoon [NPS]



A flooded parking lot at Stinson Beach, one of the most popular visitor locations [NPS]



One of the more delicate habitats in the park is the rocky intertidal zone, which exists in a balance between high and low tides. Species living in this zone are only adapted to a certain amount of inundation of water and exposure to air, and rising sea levels may cause longer periods of inundation that individual organisms cannot tolerate. The NPS Inventory and Monitoring program monitors rocky intertidal communities at several sites in the park, such as at Alcatraz Island in the photo above [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 your 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 (2022).
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

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.