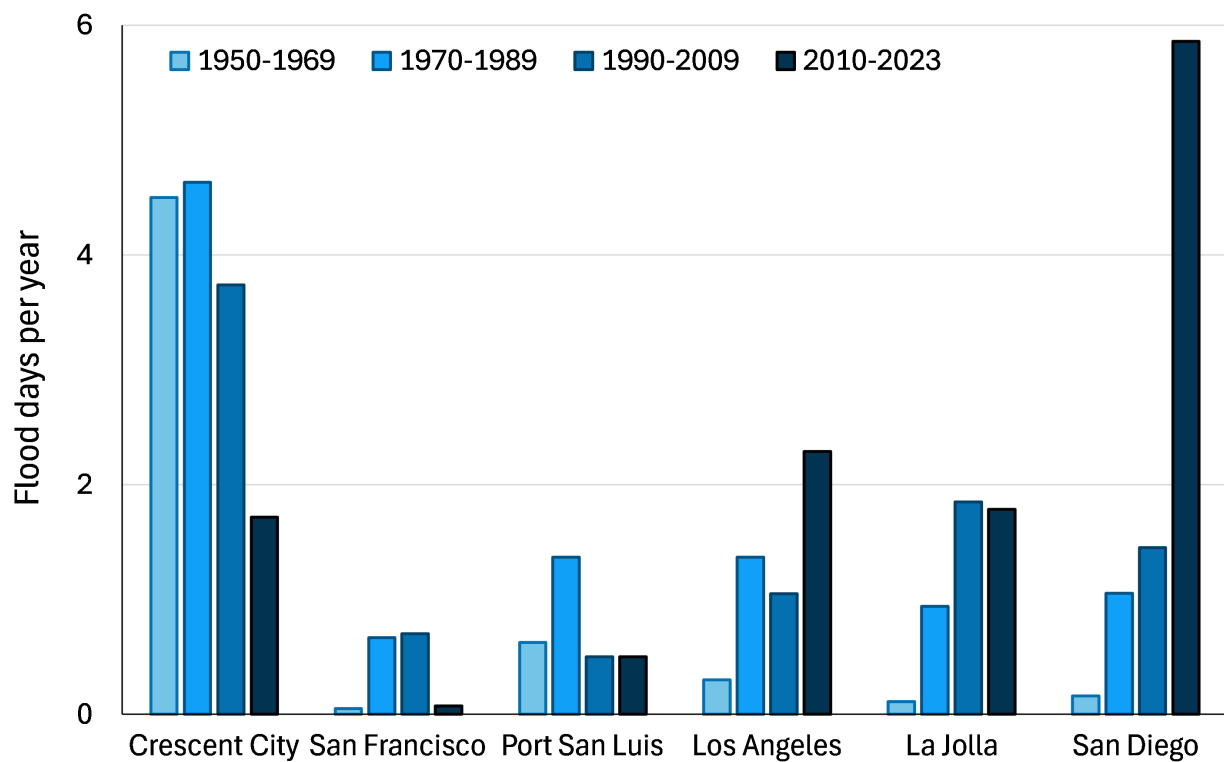


3.5 Coastal Flooding

Coastal flooding has become more frequent in multiple parts of the California coast in recent decades due to the rise in sea levels and the episodic occurrence of extreme storm events. Trends are expected to worsen. On the far north coast, where the land surface has risen due to the movement of the Earth's tectonic plates, there has been a small relative decline in sea level and a decrease in flooding frequency over time.

Figure 3.5.1. Average Number of Coastal Flood Events Per Year.



The average number of days per year in which coastal waters exceeded a local threshold for flooding at six sites along the California coast. While sea levels are rising along most of the coast, land uplift on parts of the north coast—such as at Crescent City—is outpacing sea level rise, resulting in reduced average days of coastal flooding.

Source: US EPA (2025)

What does the indicator show?

This indicator is a proxy for coastal flooding. A *flood day* is defined as any day when coastal water levels exceed a location-specific threshold, which is a water level



established for each tide gauge that corresponds to the onset of minor coastal flooding based on local conditions.

Coastal flooding is classified as minor, moderate, or major based on the potential severity of impacts. All location-specific thresholds used for this indicator correspond to minor coastal flooding and were developed by NOAA ([Table 3.5.1](#); also see Sweet et al., 2018).

Table 3.5.1. Local Minor Flood Thresholds.

Location	Minor flood threshold (m)
Crescent City	0.58
North Spit	0.58
Point Reyes	0.57
Alameda	0.58
San Francisco	0.57
Monterey	0.57
Port San Luis	0.57
Santa Monica	0.57
Los Angeles	0.57
La Jolla	0.57
San Diego	0.57

The table shows minor flood thresholds for stations along the California coast in meters (m) above mean higher high water (MHHW), i.e., the average daily highest tide.

NOAA defines minor coastal floods as water levels approximately 0.5 m above the multi-year average of the daily highest water levels. These floods are expected to cause little to no property damage but create public inconvenience, often referred to as "nuisance flooding", and mostly affect low-lying and exposed assets or infrastructure, such as roads, harbors, beaches, public storm-, waste- and fresh-water systems and private and commercial properties (Sweet et al., 2018). Moderate and major floods (approximately 0.8 m and 1.2 m above the multi-year average of the daily highest water levels) are historically uncommon along California's coast but are expected to occur more often as sea level rise accelerates (see the *Sea Level Rise* chapter for metrics tracking increasing sea levels along California's coast). Overall, the indicator shows that



flood days occur more frequently at multiple stations along the California coast compared to previous years.

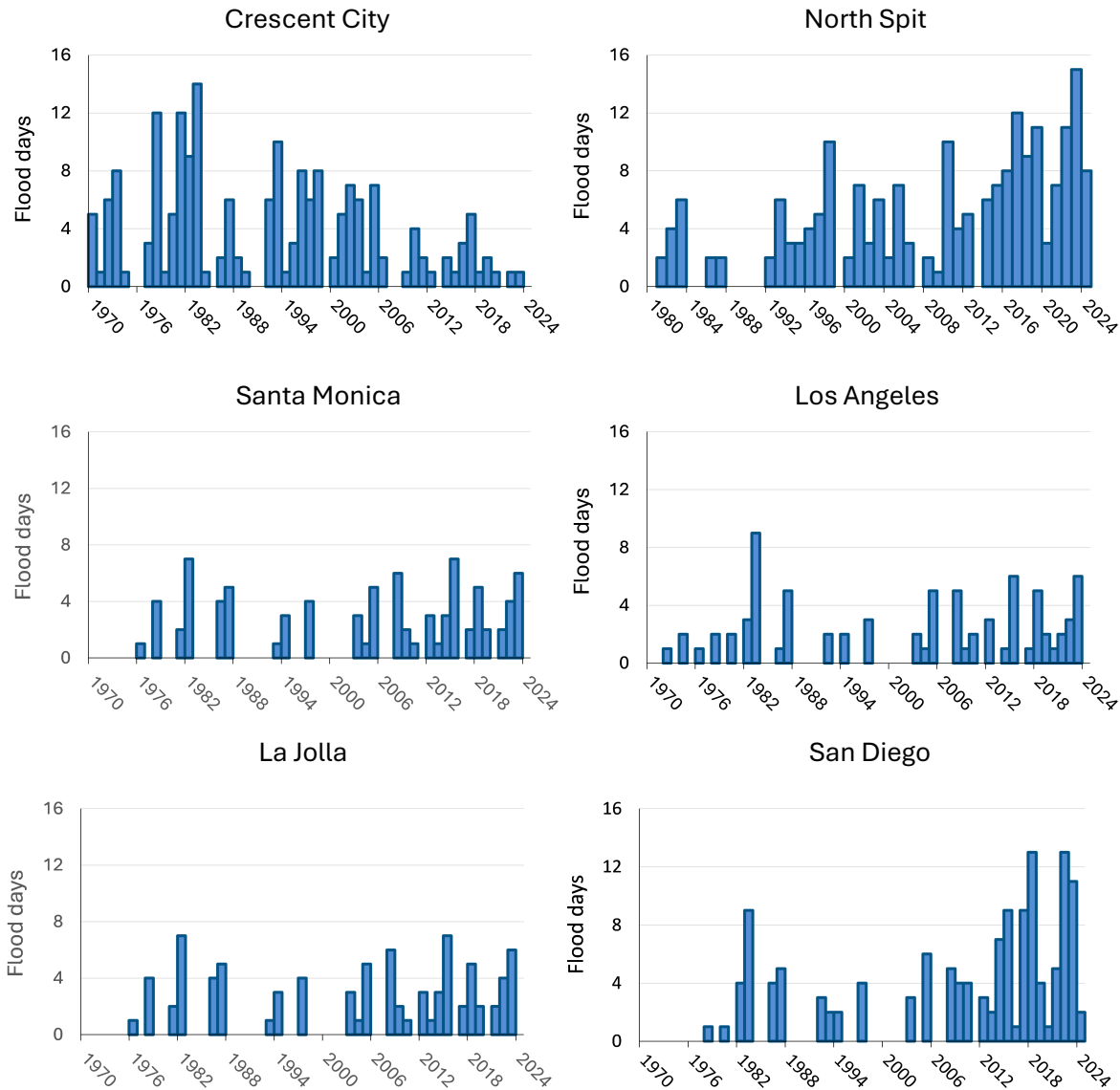
Figure 3.5.1 shows twenty-year averages of annual flood days since 1950 for selected stations where complete data for each period are available (except for the 2010–2023 period where only 14 years are available). Los Angeles and San Diego have experienced more frequent flood days in the more recent and shorter time period (2010–2023). Accelerating sea level rise and other factors that likely contribute to this trend are discussed below in “What factors influence this indicator?”.

Figure 3.5.2 presents time series data of annual flood days for selected stations along the California coast that were part of a larger NOAA analysis of past, present, and future impacts of floods along U.S. coasts, using data going back to the 1970s.

Flood days are increasing at North Spit at Humboldt Bay in Northern California, as well as Santa Monica, Los Angeles, La Jolla, and San Diego in Southern California. No long-term trend is observed for stations in the Bay Area (Point Reyes, Alameda, San Francisco). Parts of the north coast (e.g., Crescent City) are experiencing significant land uplift, exceeding sea level rise and resulting in fewer coastal flood days.



Figure 3.5.2. Number of Minor Flood Days.



The following graphs show the number of days per year in which coastal waters exceeded a local flooding threshold at multiple stations along the coast.

Source: USGCRP (2025). These data, curated and processed by the US Interagency Taskforce on Sea Level Change (2024), were obtained from the [National Sea Level Explorer](#).



Why is this indicator important?

Recurrent coastal flooding can cause significant impacts, including:

- Property damage to both public infrastructure and private development;
- Frequent transportation disruptions, including road and rail corridor closures;
- Reduced stormwater drainage capacity;
- Limitations or reduction in coastal access; and
- Deterioration of habitat and infrastructure not designed to withstand frequent inundation or exposure to saltwater.

These impacts are of particular concern because close to 70% of Californians live near the coast, with millions more who visit each year, and \$250 billion of property is at risk of flooding this century (Barnard et al., 2019; California Sea Level Rise Guidance, 2024).

Critical infrastructure in many locations lies less than 4 feet above the high tide, including two international airports – Oakland and San Francisco – and approximately 172,000 homes (DWR, 2016). International airports at San Diego and San Jose are also low lying. Rising sea levels place these airports at greater risk of floods (Griggs, 2020). Loss of service at either airport would result in major economic consequences regionally, nationally, and internationally (San Francisco Bay Conservation and Development Commission, 2012). Other critical infrastructure will also become more vulnerable to storms and flooding (Caldwell et al., 2013; CEC, 2017; Hummel et al., 2018), such as:

- Ports and harbors;
- Natural gas lines, water, electric, fiber optic and sewer lines; and
- Wastewater treatment plants and their outfalls

Extreme coastal flooding once projected for the future is already here, impacting California's coastal cities and counties. Repeated storms over the past three winters have damaged infrastructure, homes, businesses, and vital community resources—causing an estimated \$4.7 billion in losses between December 2022 and March 2023 alone (NOAA, 2025a; also see the *Precipitation* chapter). The growing intensity and



frequency of these storms, and the scale of their social and economic impacts, underscore the urgent need to strengthen and accelerate coastal management strategies (Griggs and Davar, 2025).

On January 5, 2023, for example, a major coastal flood event occurred along the northern Monterey Bay coastline, where offshore wave heights reached 28 feet coinciding with seven foot high tides and strong onshore winds (California Sea Level Rise Guidance, 2024). The event caused severe bluff erosion along West Cliff Drive in Santa Cruz, destruction of the historic wooden pier at Seacliff State Beach, flooding of coastal streets and roads in Capitola and Rio del Mar ([Figure 3.5.3](#)), and damage to both private development and public infrastructure along the northern Monterey Bay shoreline.

In early January 2026, communities along California’s coast and around San Francisco Bay experienced exceptionally high tides known as “King Tides”, which are the regularly occurring highest tides of the year. When King Tides coincide with floods or storms, water levels can rise higher, potentially causing significant damage to the coastline and coastal property. Some of the King Tide levels in early January were among the highest seen in decades, leading to flooding in streets, parks, and public spaces. Although King Tides themselves are not related to climate change, the kinds of flooding seen during King Tides are an excellent indicator of what more frequent high tide flooding will look like as sea levels continue to rise in the coming decades. Flooding that historically occurred only few times per century could become an annual or even daily occurrence in some communities by mid-century if coastlines are not prepared (CCC, 2025; OPC, 2026; Taherkhani et al., 2020; Thompson et al., 2021).



Figure 3.5.3. Flooding of the Esplanade Parking Area at Rio Del Mar in January 2024.



Coastal flooding can also impact human health by increasing the risk of wastewater infrastructure failures, potentially exposing people to pathogens and harmful chemicals. Many sites that use, store, or emit hazardous substances—including power plants, refineries, industrial facilities, former military sites, dry cleaners and service stations - are additionally located along California's coast (Lasky et al., 2026). Flooding at these sites can result in both intentional and unintentional releases of hazardous materials, exposing surrounding communities due to damaged infrastructure, power outages that disable monitoring and control systems, and impediments to operator access that limit the ability to safely operate, shut down, or respond to emergencies (Radke et al., 2016; Young et al., 2004). For example, flooding from Hurricane Harvey in Houston in 2017 resulted in widespread boil-water notices, millions of pounds of excess air pollutant



emissions, and an explosion and controlled burn at a chemical plant necessitating resident evacuations (Berberian et al., 2024; Cardinal and Xie, 2018; CSB, 2018).

In California, over 400 hazardous coastal sites are projected to face increased risk of coastal flooding by 2100 due to sea level rise under a scenario of continued high greenhouse gas emissions, more than all other U.S. states except Louisiana, Florida, New Jersey, and Texas (Cushing et al., 2023). San Francisco Bay alone is surrounded by over 5,000 sites with buried contaminants, including active and closed landfills, as well as “brownfields” that are undergoing or require cleanup, all of which are at risk from surface and groundwater flooding. Sea level rise poses risks for such facilities, which can experience flooding events that potentially expose nearby residents to hazardous substances (Hill et al., 2023). Rising seas will result in shallower coastal groundwater, leading to emergent groundwater (when groundwater rises to or above the surface of the ground) in some areas. Across California, shallow and emerging groundwater is expected to impact ~480 billion in property with 1 m of SLR, 6 times more than high tide overland flooding (Befus et al., 2020; Lasky et al., 2026; Wood et al., 2020). Coastal floods and elevated groundwater levels driven by sea level rise can interact, compounding flood impacts and risks to coastal communities (Rahimi et al., 2020).

Coastal flooding can also occur alongside other types of floods (such as heavy rainfall), to create a larger and more impactful compound flood event. This amplified flooding can lead to longer flood durations, wider geographic areas affected, and greater risks to people and property (Green et al., 2025; Wang et al., 2025). As sea level rise accelerates, and coincides with other climate change occurrences (e.g., frequent periods of heavier rainfall), more frequent and severe compound flooding events may emerge as one of the most noticeable and damaging impacts of climate change in California.

Climate-driven coastal hazards can amplify social inequities. In California, low-income communities are often located in areas with aging infrastructure and limited drainage capacity, which increases their vulnerability to coastal flooding and its impacts (Rahimi et al., 2020). Flood-related hazards disproportionately affect communities that are least able to prepare for or recover from disasters. For example, hazardous facilities at risk of

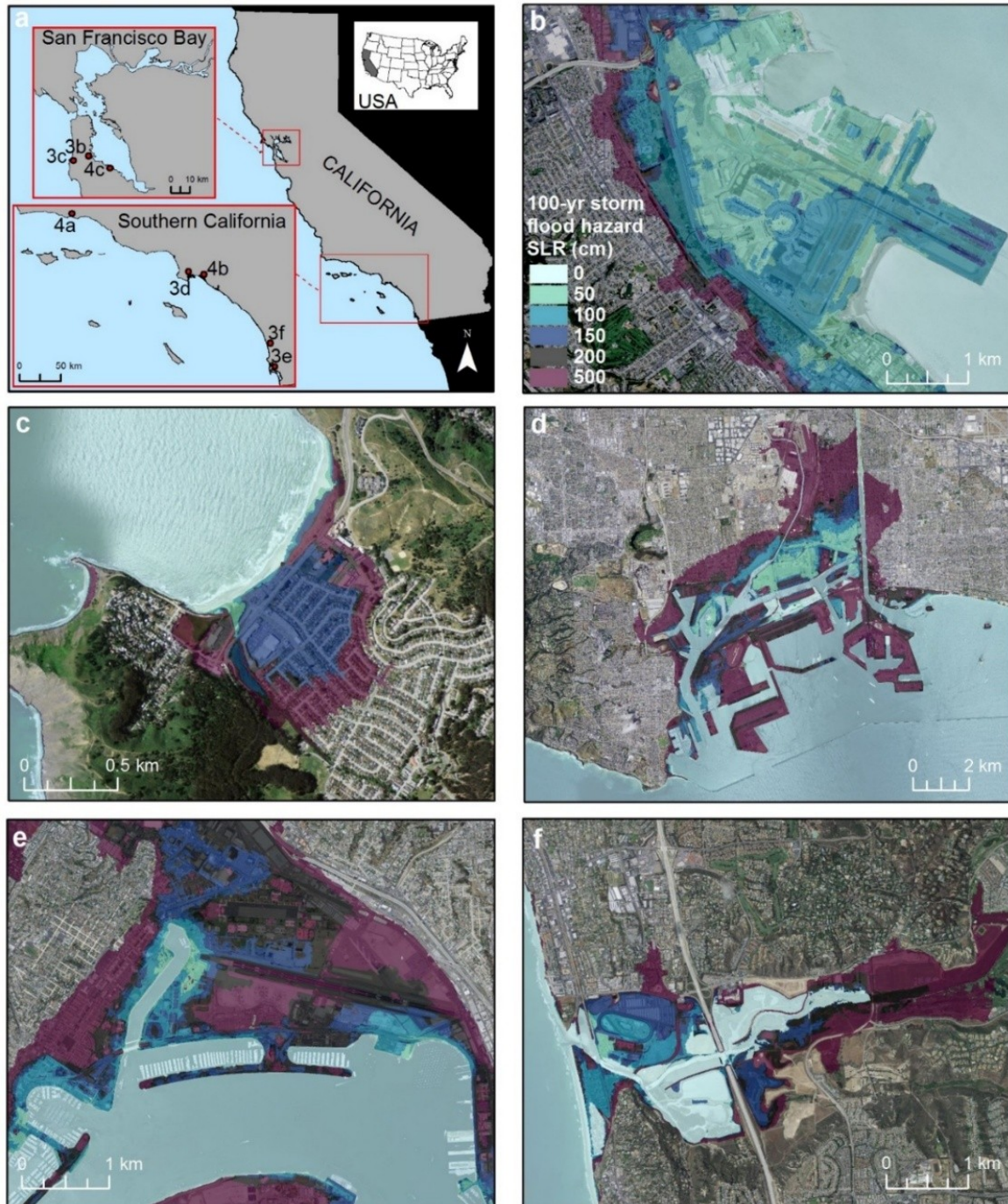


flooding are disproportionately located in low-income communities and communities of color (Cushing et al., 2023; Hill et al., 2023). Disadvantaged communities are over five times more likely to be located within 1 kilometer (km) of one or more hazardous facilities at risk of flooding by 2050, and over six times as likely by 2100 (Cushing et al., 2023). Compared to higher-income communities and property owners, people with lower incomes and residents of rental units face disproportionately greater impacts from coastal floods (CCC, 2015; LAO, 2020). They are more likely to be displaced by flooding or related impacts because they cannot relocate, rebuild or are less able to prepare their residences for floods; face barriers to evacuation that reduce control over safety; and lack adequate resources and insurance to replace lost or damaged property. Using a dynamic model (the Coastal Storm Modeling System or CoSMoS) that incorporates the effects of coastal storms in addition to estimates of sea level rise, projected areas of coastal flooding could impact over 600,000 people and \$200 billion in property statewide over the next century (**Figure 3.5.4**; Barnard et al., 2019).

Low-lying coastal areas are important to many California tribes such as the Wiyot, Yurok, and Amah Mutsun Tribal Band. Flooding can damage or erase sacred sites, traditional gathering areas, and fishing grounds that are integral to Tribal identity and practices.



Figure 3.5.4. Projected Overland Flood Exposure in Select Locations.



Projected overland flood exposure over the next century based on results from the Coastal Storm Modeling System (CoSMoS: Barnard et al., 2019). (a) Study locations in the San Francisco Bay Area and Southern California; (b) San Francisco International Airport, point 3b on



the map in panel A, legend showing 0, 0.50, 1.00, 1.50, 2.00, and 5.00 meters of SLR; (c) City of Pacifica, point 3c on panel A's map; (d) Port of Los Angeles and Port of Long Beach, point 3d on panel A's map; (e) Port of San Diego and San Diego International Airport, point 3e on panel A's map; and (f) City of Del Mar, point 3f on panel A's map.

*Figure generated using ArcGIS v. 10.4.2, by Esri. Local base maps from [ArcGIS Online](#), World_Terrain_Base, and ESRI_Imagery_World_2D, accessed 2 Oct 2018. Projections can be viewed [interactively](#) and translated into [socioeconomic exposure](#).

Source: Barnard et al. (2019).

What factors influence this indicator?

Coastal flooding is becoming increasingly common due to sea level rise, changing storm patterns, sinking land, and the loss of natural coastal barriers (Henny and Kim, 2025). Human influence on the climate was very likely the main driver of global sea level rise since at least 1971 (IPCC, 2023), and the current rate of global sea level rise is three times higher than the 20th century rate (May et al., 2023). Sea level rise rates vary by location but are generally rising along the California coast (see the *Sea Level Rise* chapter). During very high tides, like King tides, higher sea levels can cause a larger land area to be flooded to greater depths, amplifying impacts (NOAA, 2025b).

Along with global sea level rise, storm surges (short-term rises in sea levels due to prevailing onshore winds and low atmospheric pressure), wave runup (the rise in coastal water levels as waves break and rush up the beach), astronomical tides (the regular rise and fall of the sea surface in response to the gravitational pull of the moon and sun on the ocean), and El Niño events and seasonal variations (California Sea Level Rise Guidance, 2024) all contribute to coastal water levels in California. Storm events caused by atmospheric rivers (long corridors of atmospheric moisture that are common in California) are becoming stronger and happening more often (Henny and Kim, 2025).

Damage observed along California's shoreline over recent decades is due to higher sea levels, and the co-occurrence of high tides along with storm surge and very large waves, which are gradually becoming larger and more energetic in certain locations (Griggs, 2025). They are expected to intensify in the coming decades (California Sea Level Rise Guidance, 2024). Short-term increases coastal water levels during storms



will likely result in the greatest damages to infrastructure and coastal development along the coast of California over the next several decades (Barnard et al., 2019; Griggs et al., 2017; Griggs, 2025). In addition, as sea levels rise, many coastal sites will experience more frequent and widespread flooding during high tides and storms. Sea level rise is raising coastal water levels and driving shoreline further inland, closing the gap between the ocean and coastal infrastructure (coastal squeeze), meaning that more typical, less extreme tides and storms may cause flooding, and that flooding will likely become more widespread, deeper, and more severe over time (USGCRP, 2025).

Technical considerations

Data characteristics

The coastal flooding indicator is based on water level measurements from [NOAA tide gauges](#), which record sea level relative to the land surface. As a result, the indicator reflects both changes in flood frequency occurring from changes in ocean water levels and local land level motion, providing a measure of relative sea level rise rather than absolute sea surface height.

Flood days are defined as days when observed water levels exceed location-specific flood thresholds established by NOAA National Weather Service in coordination with local emergency managers. These thresholds are designed to signal the onset of minor coastal flooding and trigger public notification of impending flood risks.

The data for **Figure 3.5.1** were downloaded from the [Climate Change Indicators in the United States website](#) (US EPA, 2025). The data set for **Figure 3.5.2** was downloaded from the [National Sea Level Explorer](#) (USGCRP, 2025). Local flood thresholds for each station in **Figure 3.5.1** and **Figure 3.5.2** are presented in **Table 3.5.1** above.

The number of flood days reported for each station reflects observed exceedances of local thresholds and is used to characterize changes in the frequency of coastal flooding over time at each location.

Strengths and limitations of the data

The methodology to calculate flood thresholds used to determine flood days is useful because it enables scientists to calculate a flood threshold for any location along the coast, provided sufficient years of data have been collected. However, these flood



thresholds are a proxy for flooding, and do not necessarily correspond to a specific level of observed disruption or damage. Every location is unique in terms of land cover, topography, locations of roads and other infrastructure (how close they are to sea level), and the presence of flood defenses such as seawalls or levees. As a result of these differences, flooding that reaches the threshold in one location might only cause a minor inconvenience for a small population, while waters that reach the threshold in another city may flood large sections of a low-lying downtown area. For this reason, when considering the impacts of flooding, it is more useful to compare changes over time at a single location than it is to compare patterns across different locations (US EPA, 2025). In addition, shifts in the frequency of rare but damaging extreme floods may be masked.

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