SEA CHANGE
SAN MATEO COUNTY

Frequently Asked Questions (FAQ)

SEA LEVEL RISE SCIENCE

1. What is sea level rise?
(Answer provided by Climate Central)

Over the past century or so, oceans all over the world have been sneaking imperceptibly but steadily higher — about eight inches higher, on average, since around 1900. And the rate of sea level rise appears to be accelerating. The reason, scientists almost universally agree, is climate change; and climate change is triggered by the increase of heat-trapping greenhouse gases pumped into the atmosphere, especially carbon dioxide (CO2) from the burning of fossil fuels.

2. What causes sea level rise?
(Answer provided by the National Oceanic and Atmospheric Administration)

The two primary processes that lead to sea level rise are the increase of ocean temperature, which leads to thermal expansion, and the melting of glaciers and large land-based ice sheets, which add fresh water to the ocean.

3. How is sea level rise related to climate change?
(Answer provided by Climate Central)

Thanks to heat-trapping greenhouse gases - especially carbon dioxide (CO2) pumped into the atmosphere by the burning of fossil fuels - global temperatures are more than one degree F higher than they were 100 years ago. Since water expands as it warms, the oceans take up more space than they once did, and the only direction they can expand are up and out.

Warmer temperatures also make glaciers and land-based ice sheets melt, and make tidewater glaciers — glaciers that reach the ocean — slide more rapidly into the sea and calve more icebergs. In both cases, water that had been trapped on land enters the ocean, in either solid or liquid form, making sea level rise even more.

All of this has been thoroughly documented. Scientists understand the expansion of water very well; they have watched many hundreds of glaciers around the world retreat over the past century; and careful measurements from the ground, air and space show that Greenland and Antarctica have been losing ice at an accelerating rate over the past two decades, at least.

Scientists have also watched levels of greenhouse gases in the atmosphere rise steadily, thanks largely to the growing worldwide demand for energy. The increase in temperature is what you'd expect from the rise in greenhouse gases; the rise in sea level is what you'd expect from the rise in temperature; and the acceleration of sea level rise in recent decades is what you'd expect from the fact that there are more greenhouse gases like CO2 in the atmosphere now, trapping more heat, than there were at the beginning of the 20th century.

4. How are high tides and storm surges related to sea level?

Tides are caused by the gravitational pull of the sun and the moon, and are always rising and falling. There are several very high tides every year, which can cause minor flooding around coastal areas. As seas slowly rise, the highest high tides of the year will slowly reach further and further inland, resulting in more frequent flooding during those high tide events.

In addition to high tides, storms also push water up onto the shore through what is known as "storm surge". Sea level sets the baseline for storm surge - as sea level rises, so does that baseline. This means that, with higher seas as the baseline, storm surge will reach further inland. The picture below shows how storms, high tides, and sea level rise can combine to create potential future flood risks.

5. How much and how fast are seas rising?

In San Francisco, sea levels have risen by 8 inches since 1900, according to records from the San Francisco tide gage. Sea levels in California could rise by approximately ½ a foot by 2030, 1 foot by 2050, and 3 feet by 2100, according to the best available science on sea level rise in California (National Research Council 2012). By the end of the century, sea levels could rise by up to 5 ½ feet. The exact amount of sea level rise is uncertain, because we don't know the amount of future greenhouse gas emissions, and the rate of future ice sheet melt. The table below shows the range of possible sea level rise amounts.

Time Period*	NRC 2012	
	Range	**Projection**
By 2030	2 – 12 in	6 in (± 2in)
By 2050	5 –24 in	11 in (± 4 in)
By 2100	17 – 66 in	36 in (± 10 in)

*Relative to the year 2000

Info from: Sea level rise projections based on the National Research Council's 2012 report, Sea-Level Rise for the Coasts of California, Oregon, and Washington: Past, Present, and Future for south of Cape Mendocino.

6. Are sea levels rising at the same rate everywhere?
(Answer provided by Climate Central)

No. The rate of sea level rise in any given area depends on all sorts of factors. In some coastal areas, land is literally rising, still rebounding from the enormous weight of the glaciers that melted 10,000 years ago. While the land right under the glaciers was pushed down by the weight of the ice, land nearby was squeezed upward to compensate; those places are now falling slowly back. In still other areas, the land is falling because large amounts of oil, gas, or groundwater have been pumped from underground. The land is essentially deflating. Whatever the reason, if the land is slowly falling, then local sea level rises faster than average; if the land is rising (the rarer case), the seas may barely keep pace, or even fall behind.

That's not all. If the water right offshore warms faster than the ocean as a whole (due to local currents, for example), the water will expand faster, and sea level rise will outpace the global average. If a current that normally draws water away from a stretch of shoreline slows as the climate warms — which may well happen — the water can pile up behind it, like traffic on a partially blocked highway, driving up sea level.

SEA LEVEL RISE IMPACTS

7. What types of impacts will sea level rise cause?
(Answer from Coastal Commission)

The physical effects of sea level rise include the following:

- **Flooding and inundation:** Low lying coastal areas may experience more frequent flooding (temporary wetting) or inundation (permanent wetting), and the inland extents of 100-year floods may increase. Riverine and coastal waters come together at river mouths, coastal lagoons, and estuaries, and higher water levels at the coast may cause water to back up and increase upstream flooding (Heberger et al. 2009). Drainage systems that discharge close to sea level could have similar problems, and inland areas may become flooded if outfall pipes back up with salt water. In addition, other climate change impacts such as increases in the amount of precipitation falling as rain rather than snow will add to river flooding in some areas.

- **Wave impacts:** Wave impacts can cause some of the more long-lasting consequences of coastal storms, resulting in high amounts of erosion and damage or destruction of structures. The increase in the extent and elevation of flood waters from sea level rise will also increase wave impacts and move the wave impacts farther inland. Erosion rates of coastal cliffs, beaches, and dunes will increase with rising sea level and are likely to further increase if waves become larger or more frequent (NRC 2012).

- **Erosion:** Large sections of the California coast consist of oceanfront bluffs that are often highly susceptible to erosion. With higher sea levels, the amount of time that bluffs are pounded by waves would increase, causing greater erosion (NRC 2012). This erosion could lead to landslides and loss of structural and geologic stability of bluff top development such as homes, infrastructure, the California Coastal Trail, Highway 1, and other roads and public utilities. The Pacific Institute (Heberger et al. 2009) estimated that 41 square miles (106 square km) of coastal land from the California-Oregon border through Santa Barbara County could be lost due to increased erosion with 4.6 ft (1.4 m) of sea level rise by the year 2100, and approximately 14,000 people now live in those vulnerable areas. Increased erosion will not occur uniformly throughout the state. Mendocino and Humboldt Counties have the greatest areas projected to be lost by erosion. For example, dunes in Humboldt County could erode a distance of approximately 2000 ft (nearly 600 m) by the year 2100 (Heberger et al. 2009; Revell et al. 2011). Man-made structures like dikes and levees may also be impacted by erosion, increasing flooding risk of the areas protected by those structures, such as low-lying agricultural land. Over the long term, rising sea levels will also cause landward migration of beaches due to the combined effects of inundation and loss of sediment due to erosion (NRC 2012).

- **Changes in sediment supply and movement:** Sediment is important to coastal systems in, for example, forming beaches and mudflats and as the substrate for wetlands. Sea level rise will result in changes to sediment availability. Higher water levels and changing precipitation patterns could change erosion and deposition patterns. Loss of sediment could worsen beach erosion and possibly increase the need for beach nourishment projects (adding sand to a beach or other coastal area), as well as decrease the effectiveness and long-term viability of beach nourishment if sand is quickly washed away after being placed on a beach (Griggs 2010). Sediment supplies in wetland areas will also be important for long-term marsh survival. Higher water levels due to sea level rise, however, may outpace the ability of wetlands to trap sediment and grow vertically (Titus 1988; Ranasinghe et al. 2012; Van Dyke 2012).

- **Saltwater intrusion:** An increase in sea level could cause saltwater to enter into groundwater resources, or aquifers. Existing research suggests that rising sea level is likely to degrade fresh groundwater resources in certain areas, but the degree of impact will vary greatly due to local hydrogeological conditions. Generally, the most vulnerable hydrogeological systems are unconfined aquifers along low-lying coasts, or aquifers that have already experienced overdraft and saline intrusion. In California, saline intrusion into groundwater resources is a problem in multiple areas, including but not limited to the Pajaro Valley (Hanson 2003), Salinas Valley (Hanson et al. 2002a; MCWRA 2012), Oxnard Plain (Izbicki 1996; Hanson et al. 2002b), and the heavily urbanized coastal plains of Los Angeles and Orange Counties (Edwards and Evans 2002; Ponti et al. 2007; Nishikawa et al. 2009; Barlow and Reichard 2010). Groundwater sources for coastal agricultural lands may also be susceptible to saltwater intrusion. Additional research is needed to understand the

site-specific consequences of sea level rise and saltwater intrusion to these and other coastal aquifers in California.

8. What kinds of infrastructure, habitats, and other coastal resources might rising sea level affect?

(Answer from Coastal Commission)

The Bay Area is among the top 10 hot spots for sea level rise impacts across the country. Some of the different types of infrastructure and coastal resources that could be at risk include:

- **Public infrastructure:** Low-lying roads, wastewater treatment facilities, energy facilities, stormwater infrastructure, and utility infrastructure such as potable water systems and electricity transfer systems.
- **Ports:** Port infrastructure, piers, and marina facilities
- **Industrial development, refineries, and petrochemical facilities**
- **Public access and recreation:** Beaches, recreational areas, or trails
- **Coastal Habitats:** Beaches, dunes, intertidal, and wetlands
- **Coastal Agriculture**
- **Cultural resources:** Historic buildings and areas, archeological and paleontological resources

9. I don't live near the water. Why should I care about sea level rise?

Even if your house isn't in danger of flooding or erosion from sea level rise, your life could be impacted. Many of the Bay Area's roads and airports are at risk of future flooding, which could add traffic to your commute or impact your vacation plans. Wastewater treatment facilities and power stations which serve your home might be located in a flood-risk area. Some of your favorite parks, beaches, hiking trails, recreation areas, and wildlife sanctuaries may be in areas of potential flooding. Finally, if businesses are lost or need to move, this may also impact the local economy and lead to job losses or relocations.

10. Are there health risks from sea level rise?

Yes. The Bay has many closed landfills and other contaminated sites that could become flooded, and thereafter release toxins into the environment and local neighborhoods.

Also, risk of vector borne disease and wound infection could increase during floods and permanent inundation as contact with contaminated water could become more prevalent.

11. Are the impacts the same along the coast side as they are along the bay side?

No. Along the coastal side of San Mateo County, erosion is one of the major concerns. Along the Bay shoreline, temporary or permanent flooding is the biggest concern.

12. Will buildings along the shoreline have to move?

That depends on the adaptation measures that agencies put into place. Adaptation is the process of deciding among alternatives to address sea level rise risks. There are many different adaptation options, each of which will be best suited to particular situations or conditions. For example, levees, wetlands, and seawalls all provide a barrier between flood waters and buildings that are located near the shore. Agencies can use levees, wetlands and seawalls to protect certain buildings in certain areas. Other buildings which aren't easy to protect with these measures may need to be removed, or moved elsewhere.

13. Will Highway 101 be underwater?

Sections of Highway 101 are already at risk today from a big storm (a 1% annual chance storm). With sea level rise, the risk of flooding increases.

14. What will happen to coastal wetlands and beaches, and to the wildlife that live there?

As sea level slowly rises, the beaches, wetlands, and other natural areas near the water will slowly shrink. Wetlands and beaches in the County are surrounded by roads, houses, and other human infrastructure that prevent these areas from retreating as the seas advance. Smaller natural areas mean that there is less room for the wildlife species that make their home in those areas.

15. Will I need to get flood insurance for sea level rise?

Flood insurance is regulated by the Federal Emergency Management Agency. For more information on whether and how to purchase flood insurance for your home, visit: https://www.floodsmart.gov. The current regulations do not include considerations of sea level rise.

SEA LEVEL RISE RESPONSES

16. What is being done about sea level rise?

Sea level rise is being addressed at many different levels by national governments, federal and state agencies, local jurisdictions, non-profits, and the private sector. While each group works with many of the others and may be involved in several activities, here is a short summary of the primary ways in which each sector is addressing sea level rise:

- National governments work with each other on high-level policy issues, and have primarily focused on mitigation, or reducing greenhouse gas emissions in order to try to limit the impacts of climate change. The Paris Climate Talks are an example of national governments' work.
- The U.S. government funds scientific research, conducts long-term monitoring of change, and provides funding and technical assistance to local governments and citizens. Some of the federal agencies that are most involved with sea level rise work include NOAA, NASA, the Department of Energy (DOE), the Environmental Protection Agency (EPA), the Department of Housing and Urban Development (HUD), the Department of the Interior (DOI), and the Federal Emergency Management Agency (FEMA).
- California state agencies set policies that govern what activities may take place in the coastal zone (the area within 3,000 feet of the shoreline), and provide funding and technical assistance to local governments. The California coastal agencies are the Coastal Commission, the Coastal Conservancy, and the Bay Conservation and Development Commission.
- Local governments assess risks and set local land use policy, including where buildings can be constructed. San Mateo County is currently undertaking a vulnerability assessment called Sea Change SMC. More information is provided below.
- Private businesses develop land and sell flood insurance to homeowners.

17. Can we just build a big tide gate under the Golden Gate Bridge?

A large dam or gate to manage the flow of water in and out of San Francisco Bay was first proposed in the mid-19th Century. The vision for such an approach would be to create a single construction project that could protect the entire SF Bay shoreline, and all of the communities that live along it. The potential disadvantages of this approach are the high cost, the risk of a single point of catastrophic failure, and the transformation of the landscape and ecological functions of our region. Because of the cost, alteration of the landscape, and significant engineering and scientific uncertainties, the idea has not yet been tested or scoped.

18. Can we just build a levee or a seawall?

Sea level rise is a regional problem, and will need to be addressed at a regional scale. If one town (or one property owner) builds a levee or a seawall to protect their own area, flood waters could simply enter at the point where the levee or seawall ends, and cause greater damage to the unprotected area than the damage that would have been caused if no protective structure were built. In addition, levees or seawalls can lead to increased erosion on properties adjacent to the end of the structure. They also can lead to a loss of beach and other impacts to habitat and recreation.

19. Do wetlands provide flood protection benefits?

Wetlands restoration is certainly part of what we can and should do to prepare for sea level rise. Wetlands make communities more resilient by providing flood storage, storm surge buffers, erosion control, water quality improvements, and wildlife habitat. However, many of the Bay Area's historic wetlands were filled to make way for homes, bridges, roads, and other infrastructure, and it is now very difficult and expensive to move. If we continue to restore the region's remaining wetlands, we will buy ourselves some more time and space for other adaptation measures which will be necessary.

20. How much is it going to cost to prepare for sea level rise?

Preparing for sea level rise will not be cheap. Some roads, bridges, homes, and businesses may need to be modified or moved entirely in order to reduce risks. Significant investments in public infrastructure and possibly even private property will need to be made to ensure that adaptation is equitable and successful, and that the Bay Area continues to be an attractive place to live, work, and play. In coastal development regions, strong evidence to suggest that the costs of inaction are 4 to 10 times greater than the costs associated with proactive adaptation and hazard mitigation (Moser et al. 2014). Projected national costs to flooding and sea level range as high as $200 billion by 2100 with 1 foot of sea level rise.

21. Who is going to pay for all this?

Funding will come from a variety of sources. Many federal and state agencies are already committing resources to pay for research, assessments, and action. Several major charitable foundations are also providing funding and technical assistance to local government agencies in particular, because most land use planning is conducted at the local and regional level. In coming years, voters will likely need to consider a variety of

funding mechanisms - such as parcel taxes and bond measures - to pay for facilities and infrastructure to make our region resilient.

22. Why are we still building in areas that are vulnerable to sea level rise?

Many people value living near the shore, and in the Bay Area, options for development are limited and expensive. Living near the water offers recreation opportunities and beautiful scenery. As long as there is demand for development in areas at risk from flooding and erosion, pressure exists to develop housing that meets the demand. Land use policies exist to ensure that developments are safe, equitable, and in line with community values. As our shorelines change, our local land use policies may need to change as well.

SEA CHANGE SMC

23. What is Sea Change SMC?

SeaChange SMC is a County-wide sea level rise preparedness program. This program has included a SFO, San Bruno, and Colma Creek Resilience Study and a Sea Level Rise Vulnerability Assessment.

24. Who is it for?

The informational products that the project develops are primarily geared towards the cities, towns, and unincorporated areas of San Mateo County so that they can conduct better planning processes.

25. What is the timeline for Sea Change SMC?

Phase I of the initiative includes the completion of a San Francisco International Airport, San Bruno, and Colma Creek study and a county-wide sea level rise vulnerability assessment.

The County of San Mateo partnered with SFO and the California Coastal Conservancy to obtain a Climate Ready Grant to develop a sea level rise vulnerability assessment and adaptation plan for the shoreline area northwest of the airport, where San Bruno and Colma Creeks meet the Bay. The study complements the Shoreline Protection Study that SFO recently completed to assess the vulnerability of the airport perimeter system and evaluate adaptation options for both 1%-annual-chance floods and sea level rise.

The county-wide sea level rise vulnerability assessment will be complete in August 2016. Phase II will begin in September 2016 and will identify near, mid-, and long-term solutions, develop governance structures, and implement pilot projects.

26. Who is paying for this project?

The San Mateo County Sea Level Rise Vulnerability Assessment is grant funded through the California State Coastal Conservancy. Additional funds were provided by the County of San Mateo to complete the Assessment.

With the creation of San Mateo County's Office of Sustainability, the County has also dedicated funds to create the position of *Climate Resiliency Specialist,* to ensure climate change mitigation and adaptation are being considered holistically.

27. Who is involved?

This is a multi-stakeholder effort which includes members of the community, businesses, cities and many regional agencies.

For San Mateo County's Sea Level Rise Vulnerability Assessment, the County has convened 3 stakeholder groups:

- Policy Advisory Committee consisting of elected officials, high level city and agency staff, and representatives from businesses and community organizations.
- Technical Working Group consisting primarily of city staff and asset managers.
- Community Task Force, which represents the views of the residents and supports the County's outreach efforts.

28. What is currently being done in San Mateo County to address the impacts of sea level rise?

Below are flood protection and improvement projects being completed in San Mateo County.

- SFO Airport Shoreline Protection Project: SFO completed an Airport Shoreline Protection Feasibility Study to better understand the deficiencies in its existing shoreline protection system. The study also provides recommendations on improvements needed to protect the Airport from a 100-year flood and sea level rise. Started working on developing concept design.
- Coyote Point Park Eastern Promenade Rejuvenation Project: An improvement project that brings the living coastline back to the park. These improvements

include a new sandy beach, new sand dunes, a re-located restroom building and a re-configured parking area. The Eastern Promenade is being designed with climate change adaptations, including 2 feet of SLR.

- Coyote Point Levee Improvement and Pump Station Replacement Project: The purpose of the project is to provide flood protection to the North Shoreview Neighborhood located in San Mateo, CA.
- Foster City Levee Protection Planning and Improvements Project: Project to raise the levee to meet FEMA accreditation standards and prepare for sea level rise. FEMA has recently conducted a coastal flood hazard study which has determined that roughly 85% of Foster City's levee system does not meet FEMA requirements. Therefore, the levee will not retain accreditation status when the Flood Insurance Rate Map is updated in mid-2016.
- Redwood City Blue Harbor: Development of 402 unit multi-family residential project, including a 45-65 slip commercial marina, and associated parking and amenities at 1 Uccelli Blvd. Incorporated sea level rise into the design.
- SAFER Bay Project: Levee and tidal restoration from San Francisquito Creek to border of Menlo Park and Redwood City. The San Francisquito Creek Joint Powers Authority (SFCJPA) seeks to improve existing or construct new flood protection facilities that consider the current tidal floodplain and projected Sea Level Rise over a 50-year period in a manner that conforms to the requirements of FEMA. Will explore cost-effective and innovative designs that can adapt to our changing climate, enable the enhancement of historic marshlands, including those that are part of the South Bay Salt Pond Restoration Project, and expand opportunities for recreation and community connectivity provided by the San Francisco Bay Trail.
- San Francisquito Creek Improvements: Multiple improvement projects to increase capacity, reduce flooding, includes sea level rise in design.
- Look Ahead – San Mateo: Through a grant with FEMA and Climate Access, SMC will be getting 2 OWL viewfinders that show SLR and adaptation strategies in place. The OWL is a virtual reality kiosk that shows visitors the future or history of a place and collects public input.

INDIVIDUAL ACTION

29. What can I do to flood-proof my property from sea level rise?

Some options for property owners in the near term include using sandbags during storms and king tides, and in the long term many are considering elevating their homes.
In the coming months, San Mateo County planners will be exploring many different adaptation options to help protect homes, businesses, and natural areas from future flooding. The County will work with other regional and federal government agencies to

identify solutions for property owners. Sign up for our mailing list or join our Facebook group to get more information.

30. What can I / we / residents do now to help prevent the worst effects of sea level rise?

Scientists believe that some amount of sea level rise is already inevitable, due to the amount of warming that is already "baked in" to the equation from the last century of greenhouse gas emissions. Collectively, we have the ability to reduce global greenhouse gas emissions and slow the pace of climate change. Some ways that you can have an impact:

- Enroll in San Mateo County's Peninsula Clean Energy (PCE) program and power your home with renewable energy at competitive rates. For more information, visit Peninsula Clean Energy.
- Help restore wetlands. Wetlands can provide natural protection to flooding by reducing wave action. Volunteer with local organizations like Grassroots Ecology's program which hosts a number of habitat restorations sites throughout the Counties of San Mateo and Santa Clara. For more information visit, Grassroots Ecology.
- Get informed. Stay in touch with the Sea Change SMC project to find out what we're discovering about our risks and opportunities for adaptation.
- Support local, state, and federal action. Attend community meetings about sea level rise, write to your representatives expressing support for action, and find out political candidates' positions on sea level rise.

GLOSSARY OF TERMS

(Synthesized from Climate Central, National Oceanic and Atmospheric Administration, Our Coast, Our Future, and the California Coastal Commission)

- **5, 20, 100-year storm:** How often a storm of that magnitude is expected to occur (i.e., once in 5 years, once in 20 years, once in 100 years, etc).
- **100 year tide**: Maximum high tide level that has occurred over a period of 100 years.
- **Adaptation:** Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which minimizes harm or takes advantage of beneficial opportunities.
- **Armor**: To fortify a topographical feature to protect it from erosion (e.g., constructing a wall to armor the base of a sea cliff), or to construct a feature (e.g., a seawall, dike, or levee) to protect other resources (e.g., development or agricultural land) from flooding, erosion, or other hazards.
- **Bluff top retreat (or Cliff top retreat):** The landward migration of the bluff or cliff edge, caused by marine erosion of the bluff or cliff toe and subaerial erosion of the bluff or cliff face.
- **Erosion:** The wearing away of land by natural forces; on a beach, the carrying away of beach material by wave action, currents, or the wind. Development and other non-natural forces (e.g., water leaking from pipes or scour caused by wave action against a seawall) may create or worse erosion problems.
- **Feasible** (as used in "least environmentally damaging feasible alternative"): Capable of being accomplished in a successful manner within a reasonable period of time, taking into account economic, environmental, social, and technological factors.
- **Flood (or Flooding):** Refers to normally dry land becoming temporarily covered in water, either periodically (e.g., tidal flooding) or episodically (e.g., storm or tsunami flooding).
- **Green infrastructure:** Refers to the use of vegetative planting, dune management, beach nourishment or other methods that mimic natural systems to capitalize on the ability of these systems to provide flood and erosion protection, stormwater management, and other ecosystem services while also contributing to the enhancement or creation of natural habitat areas.
- **Greenhouse gases (GHGs):** Any gas that absorbs infrared radiation in the atmosphere. Greenhouse gases include, carbon dioxide, methane, nitrous oxide, ozone, chlorofluorocarbons, hydrochlorofluorocarbons, hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride.

- **Inundation:** The process of dry land becoming permanently drowned or submerged, such as from dam construction or from sea level rise.
- **Local Coastal Program (LCP):** A local government's (a) land use plans, (b) zoning ordinances, (c) zoning district maps, and (d) within sensitive coastal resources areas, other implementing actions, which, when taken together, meet the requirements of, and implement the provisions and policies of, this division at the local level.
- **Mean Higher High Water (MHHW):** The average of the elevations of the higher of the two daily high tides over a specific 19-year period.
- **Mean sea level:** The average relative sea level over a period, such as a month or a year, long enough to average out transients such as waves and tides. Relative sea level is sea level measured by a tide gauge with respect to the land upon which it is situated.
- **Revetment:** A sloped retaining wall; a facing of stone, concrete, blocks, rip-rap, etc. built to protect an embankment, bluff, or development against erosion by wave action and currents.
- **Risk:** Commonly considered to be the combination of the likelihood of an event and its consequences – i.e., risk equals the probability of climate hazard occurring multiplied the consequences a given system may experience.
- **Sea level:** The height of the ocean relative to land; tides, wind, atmospheric pressure changes, heating, cooling, and other factors cause sea level changes.
- **Sea level change/sea level rise:** Sea level can change, both globally and locally, due to (a) changes in the shape of the ocean basins, (b) changes in the total mass of water and (c) changes in water density. Factors leading to sea level rise under global warming include both increases in the total mass of water from the melting of land-based snow and ice, and changes in water density from an increase in ocean water temperatures and salinity changes. Relative sea level rise occurs where there is a local increase in the level of the ocean relative to the land, which might be due to ocean rise and/or land level subsidence. (See also Mean sea level, Thermal expansion).
- **Seawall:** A structure separating land and water areas, primarily designed to prevent erosion and other damage due to wave action. It is usually a vertical wood or concrete wall as opposed to a sloped revetment.
- **Sensitivity:** The degree to which a system is affected, either adversely or beneficially, by climate-related stimuli. The effect may be direct (e.g., a change in crop yield in response to a change in the mean, range, or variability of temperature) or indirect (e.g., climatic or nonclimatic stressors may cause people to be more sensitive to additional extreme conditions from climate change than they would be in the absence of these stressors).

- **Subsidence:** Sinking or down-warping of a part of the earth's surface; can result from seismic activity, changes in loadings on the earth's surface, fluid extraction, or soil settlement.
- **Storm surge:** A temporary increase in ocean and estuary water levels associated with storm conditions that are caused by the combination of low barometric pressure and winds blowing onshore or alongshore, causing water to 'pile up' against the coast.
- **Thermal expansion:** An increase in water volume in response to an increase in temperature, through heat transfer.
- **Vulnerability:** The extent to which a species, habitat, ecosystem, or human system is susceptible to harm from climate change impacts. More specifically, the degree to which a system is exposed to, susceptible to, and unable to cope with, the adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed, as well as of non-climatic characteristics of the system, including its sensitivity, and its coping and adaptive capacity.
- **Vulnerability assessment:** An activity to identify who and what is exposed and sensitive to change and how able a given system is to cope with extremes and change. A vulnerability assessment considers the factors that expose and make people or the environment susceptible to harm, as well as access to natural and financial resources available to cope and adapt, including the ability to self-protect, external coping mechanisms, support networks, etc.