San Francisco Bay – CoSMoS v2.x

Frequently Asked Questions

GEOGRAPHIC COVERAGE

What is the current geographic extent and resolution of the Digital Elevation Model and decision support tool?

The resolution is 2 m (a single elevation value is assigned to each 2 x 2 m grid cell) and it extends alongshore of the outer coast from Point Arena to just south of Pillar Point Harbor in Half Moon Bay. In the cross shore direction it extends from an elevation of +20 meters and offshore to at least the 3 nautical mile limit of state waters. Similarly, the San Francisco Bay digital elevation model is of the same resolution and extends from the Golden Gate all through the south and north bays and to just east of Antioch near the western portion of the Delta. The digital elevation model for San Francisco Bay is available at: http://topotools.cr.usgs.gov/topobathy_viewer/. Near all the land above MHW is based on aerial Lidar flights carried out in summer 2010. Therefore, any changes to the topography post-2010 is not captured by the DEM.

What is the timeline for expansion to the rest of the California coast?

The Products will be available for Southern California in 2018, the Central Coast in 2020, and the North Coast in 2022. New modeling components, such as shoreline evolution, were integrated beginning in Southern California.

DATA

Which LIDAR data do you use?

LIDAR data comes from three 2010 surveys: USGS, California State Ocean Protection Council (OPC), and the Golden Gate Lidar Project. See http://pubs.usgs.gov/ds/684/ for the spatial coverage of each survey.

The other primary data for the DEM are depth soundings recently collected using multibeam bathymetry as part of the California Seafloor Mapping Project, a collaborative, multi-institutional campaign (http://seafloor.csumb.edu/csmp/csmp.html).

What is the accuracy of the mapping used in this tool?

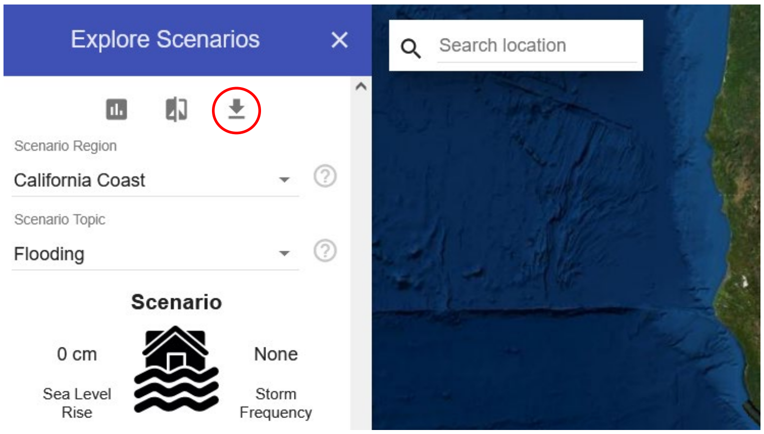
The DEM and all derived data layers have a horizontal resolution of 2 meters. The elevation data has a vertical accuracy of approximately 18 cm. The horizontal accuracy of the 2010 lidar (the bulk of the topography) has an RMSE of 1m.

How often is the mapping updated with new elevation data?

The DEM utilizes the latest and greatest topography and bathymetry available when the modeling was run (2010). There are no current plans to collect new data over this region.

How do I get a copy of the data layers for my own use?

You can download all data layers through the OCOF mapping tool.



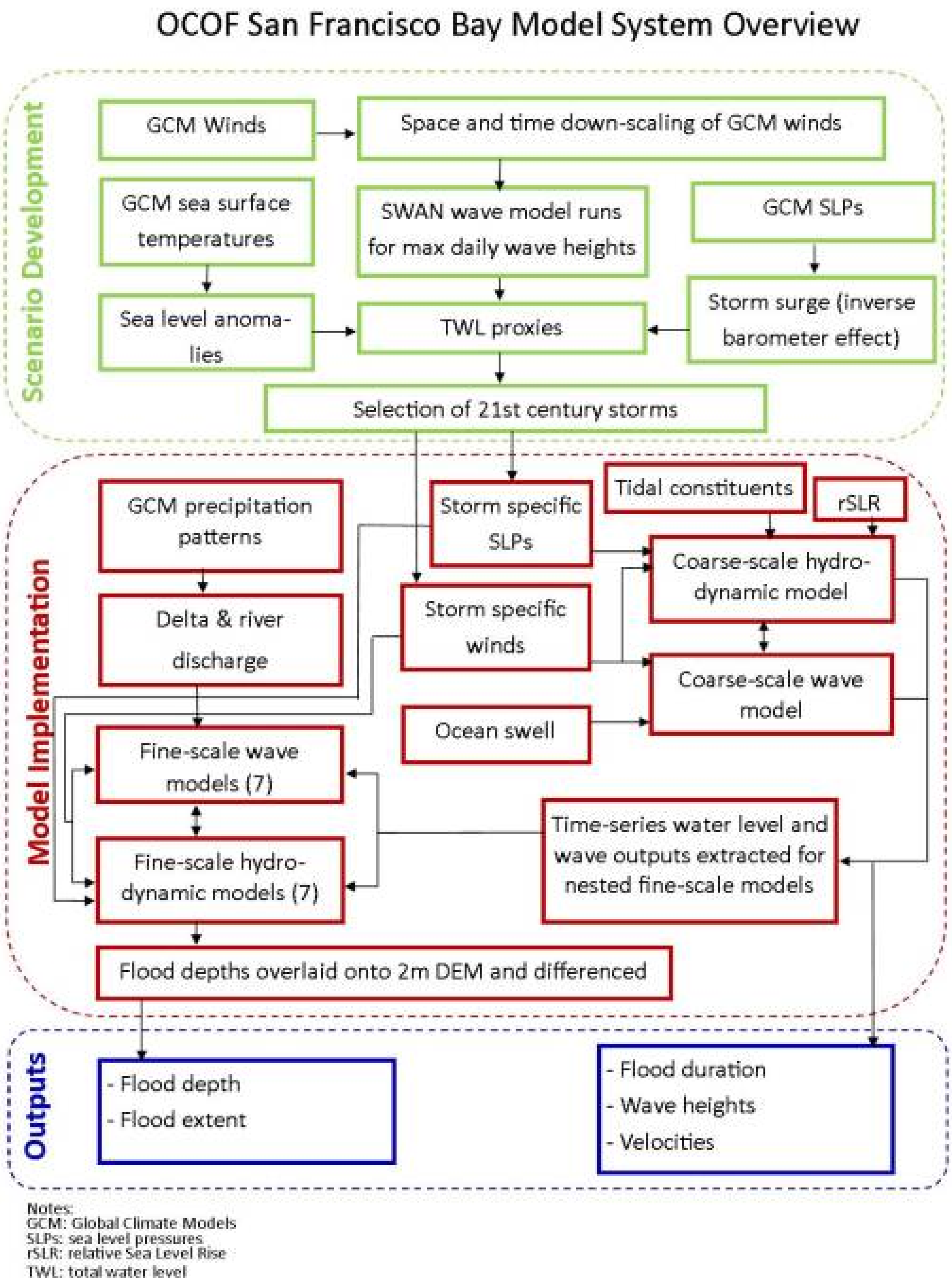
Select Hazard Map from the main menu to get to the mapping tool. Select the "download" button. You need to register as a user to access the download page. Please do provide a *description* of the project and/or purpose of the data, and any *contact info* to find out more about the project. It really helps us to keep track of user metrics and report on the broader impact of the modeling and web tool!

- e.g., who are you supporting and how are they planning to use the info from your analysis
- What is the geography of your analysis
- Any web links to a project or program are helpful as well.

MODELING - General

What are the components that go into the model results?

The following diagram outlines the components and workflow that drive creating the modeled estimates in this tool:



Which global climate models are used, and why did you choose them?

We use the latest and most sophisticated Global Climate Models from the Coupled Model Intercomparison Project Phase 5 (CMIP5: http://cmip-pcmdi.llnl.gov/cmip5/). These are a set of international climate models with a standard set of boundary conditions designed to collectively simulate the future climate for the 5th assessment report of the Intergovernmental Panel on Climate Change (AR5) , due in 2013. We chose the 4 of the 32 models (BCC-CSM1.1, INM-CM4, MIROC5, and GFDL-ESM2M) that have fine enough temporal resolution (3 hours) to adequately capture the maximum wind speeds so we can model the largest, most realistic waves. The remaining models only output our key parameters from storm modeling, wind and pressure fields, at 6-24 hour intervals, not adequate for resolving the peaks of coastal storms.

Is this based on a "bathtub" modeling approach?

No. Not only are we including both the static (i.e., tides and global sea level rise) and dynamic components of water levels (i.e., surge and wave-driven set-up and run-up), we are also explicitly modeling the flow of the flood waters as well.

Why does the tool show inundation starting at Mean High Water (MHW)?

Below the Mean High Water are elevations that are wet at some point every day due to expected tidal activity. Elevation alone is not enough to tell you whether you are expected to be flooded due to sea level rise and storm surge activity on top of tides.

Does this tool show timing of inundation levels (e.g., 3 feet by 2100)?

The OCOF mapping tool and underlying hazard data are provided for a wide variety of sea level rise and storm scenarios, but they are not explicitly time-bound. The latest sea level rise projections guidance from the State of California is provided on the "Science and Modeling" page, and can then be used to determine which of the OCOF scenarios to choose.

Does the model take into account future changes in geomorphology, shoreline change, etc.?

No, for the Bay Area it only models the changes during a single storm. However, the future shoreline position has been projected for 2030, 2050, and 2100 based on the historical rates of change reported in the USGS National Assessment of Shoreline Change for the California coast (http://pubs.usgs.gov/of/2006/1219/).

Shoreline evolution is, however, included in the product roll out in Southern and Central California, which includes the outer coast of San Mateo and San Francisco counties. It will eventually be included in the remaining outer coast geographies.

Are the cumulative impacts from sea level rise and storms modeled together?

Yes. Each simulation includes all the relevant components of each storm scenario, including sea level rise, tidal currents, surge (driven by wind and atmospheric pressure), and waves.

How do you model inputs such as rivers and stormwater?

Stormwater is not included in the simulations. Estimates of freshwater inflows from rivers and tributaries are included (the 'Delta', Napa River, Sonoma Creek, Petaluma River, Corte Madera

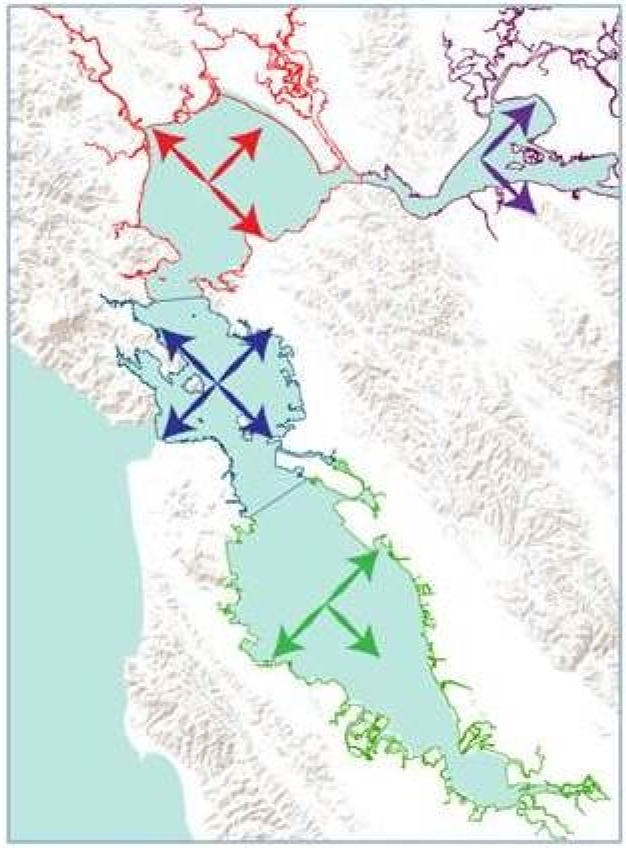
Creek, San Francisquito, Alameda Creek Coyote Creek, and Guadalupe River, Russian River, Gualala River).

Delta inflow estimates are based on projected discharge rates using a watershed model and precipitation patterns from the GFDL CMIP3 (AR3) model (see http://cascade.wr.usgs.gov/data/Task2-watershed/index.shtm for further explanation and data). Because the CoSMoS model employed atmospheric patterns from the later CMIP5 version of the GFDL model (http://www.gfdl.noaa.gov/cmip) it cannot be assumed that the timing of atmospheric conditions between the two models is the same. Therefore, times when spatial and temporal precipitation patterns over the Delta watershed were similar between the CMIP3 and CMIP5, were identified and used to better approximate Delta discharge rates commensurate with storm patterns in the CMIP5 model.

Discharge rates of the smaller rivers and tributaries (i.e., Napa, Sonoma, etc.) are estimated from quantile (percentage) plots relating historical discharge rates between the Delta and river or creek discharge rates.

What do storm event wave conditions represent in San Francisco Bay

With the exception of central San Francisco Bay where open ocean effects are included, ocean swell waves do not impact much of the interior of the Bay, and wind-driven waves, wind and atmospheric pressure are primary forces for coastal, storm-related flooding. The complex topography of the region greatly affects wind direction and strength, and in turn resulting storm waves, in the different areas of the Bay. Some locations in the Bay receive storm winds from many directions while other areas show storm-related impacts from a smaller range of waves and winds. Individual storm events may also vary in wind direction, strength, and pressure affecting sections of coastline, susceptible to particular directions of waves, currents and water levels, differently. Therefore, in order to capture the full extent of flooding possible with major storm events (20-year and 100-year storm events in 21st century climate models), storm scenarios for predominant wave and wind directions in the Bay's primary sub-regions are modeled (Suisun Bay, San Pablo Bay, Central Bay, and South Bay; see figure). The resultant flood projections are a combination of the maximum flooding for all predominant storm directions in each sub-region.



Predominant wave and wind directions which drive storm-related flooding modeled in regions of South Bay (green), Central Bay to include Richardson Bay (blue), San Pablo Bay including China Camp and Napa and Petaluma Rivers (red), and Suisun Bay (purple).

Annual storm (i.e., 1-year) scenarios are modeled from a single, 21st century storm event and do not include multiple storm directions as directional differences are not as significant throughout the Bay.

What does the term "wave runup" refer to?

Wave runup is the maximum vertical extent of wave uprush on a beach or structure above the still water level.

MODELING - Scenarios

What is *storm scenario frequency* and what do 0-year (i.e., no storm), 1-year, 20-year, 100-year storm event wave conditions represent?

Simply stated, a *storm scenario frequency* is an estimate of how long it will be between storms of a given magnitude. For example, the 20-year storm event is expected to occur once in 20 years. Equivalently, one can say that there is a 5% chance that a storm of that magnitude will occur in any one year.

It is important to remember that this is based on statistics - there is no guarantee that once such a storm has hit the coast it will not happen again for another 20 years. If you had measurements of wave heights covering 100 years, there would be five such storms in that data series (an *average* of once every 20 years). These storms could occur in consecutive years or several in a single year.

The 0-, 1-, 20-, and 100-year storm events used in this work for the outer coast were derived from numerically modeled wave heights using projected winds for the 21st century. Statistical analysis of the wave height record offshore of San Francisco indicates that the median wave height in deep water (0-year storm, i.e., average daily conditions) will be on the order of 2.4 m while offshore wave heights associated with a 100-year storm will exceed 9.8 m.

Similar to the outer coast, the 0-, 1-, 20-, and 100-year storm events used for San Francisco Bay were derived from numerically modeled wave heights using projected winds for the 21st century. However, storm identification for the Bay differed from the outer coast in three important ways: (1) in-Bay wave heights (as opposed to offshore wave heights) were computed, and only using the GFDL climate model (for the outer coast, winds from a total of four climate models were used (GFDL, INMCM, BCC, and MIROC5); (2) maximum wave heights oriented perpendicular to the major orientations of the shoreline within each basin (south, central, north and Suisun) were used to identify storm events; and (3) in addition to wave heights, estimates of elevated water levels from passing low pressure systems and longer term sea level anomalies related to, for example, El Niño were used to derive a proxy of total water levels. The 0-, 1-, 20-, and 100-year events were then identified from statistical analyses of the proximal total water level in each basin. These selected storm events were then modeled in detail with the full time-series of spatially and temporally varying winds, pressure fields, tides, offshore wave conditions, and freshwater inputs. It should be noted that no extreme events were identified in some basins and incident wave directions (e.g., northeasterly winds/waves in Suisun Bay),

What is the king tide scenario?

The king tide scenario depicts flooding extents expected inside San Francisco Bay with an extreme high tide, or king tide, and it was modeled using water level conditions from the 30 January 2014 king tide event. The flood projections are determined from a basic model accounting for tidal forcing only, and do not include atmospheric pressure, wind, waves, or other conditions included in average or storm wave scenarios.

These scenarios were modeled only for inside San Francisco Bay and are not available for the outer coastline. The king tide scenarios are available in the download packages, but are no longer displayed on the new OCOF viewer.

What does flood duration show?

Flood duration values represent the time an area is covered by flood waters for a given scenario during one spring tide cycle (24.84hrs). Spring tides are as much as 55 cm higher than neap tides and persist for about 2 weeks every month. Durations were calculated from a coarser grid than used for flooding, and thus fine-scale features (such as dikes and shore-armoring) may not be fully represented. As a consequence, duration times illustrate the estimated inundation time for a general area (~100 × 100 meters wide). Calculated duration data are not available some low-lying marsh regions (for example, small areas within Suisun Bay) where LiDAR offsets due to dense vegetation were particularly significant.

MODELING - Flood Extents

What goes into flooding potential? Why does the Minimum Inundation layer sometimes appear similar to projected flooding extents?

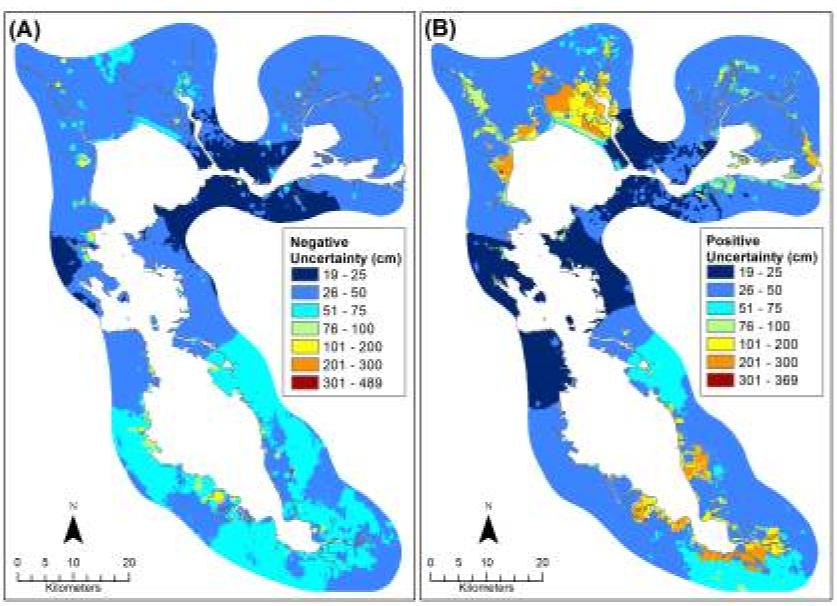
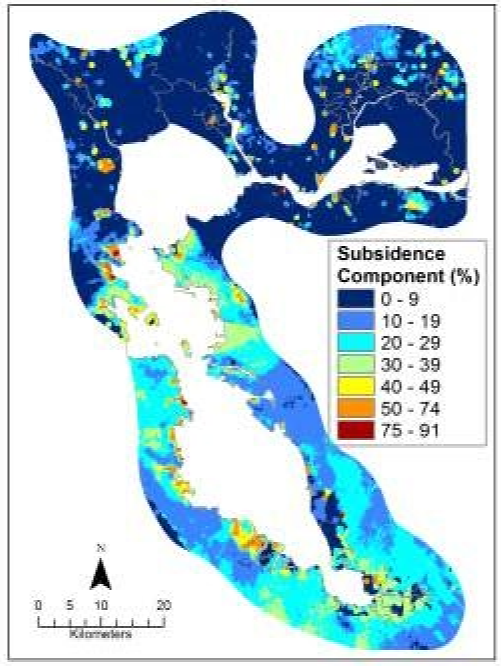


Illustration of total uncertainty for the 1m SLR scenarios; this uncertainty represents total possible elevation difference and resulting flooding potential. Uncertainty is derived from 1) estimated accuracy of the DEM (including vegetation offsets) and model calculations, and 2) vertical land motion associated with tectonics and subsidence as well as marsh accretion related to sea level rise. Negative uncertainty (A) is used to generate the most landward (expansive) extents of flood potential; positive uncertainty (B) is used for the most bay-ward flood potential.

Variations in the DEM, projected changes in marsh elevation, offsets in LiDAR data, and normal ranges in calculated flood projections can all result in changes to the modeled flood extent. Including these ranges of inputs, or uncertainty (figure left), yields an estimate of the potential minimum or maximum flood extent. Several processes and inputs were accounted for as components in San Francisco Bay's total uncertainty: overall accuracy of the DEM, average elevation offsets due to vegetation in 12 marsh areas, inherent variation in model calculations, projected marsh elevation changes, and vertical land motion. As most of these components varied by location and SLR, such as vertical land motion (figure right), total uncertainty is not uniform throughout the Bay (figure left).

The model used to compute flooding extent has a slightly larger resolution than the DEM on which its results are projected. Due to this difference, minimum flood potential closely resembles currently projected flood extents.



Proportion of the total negative uncertainty (used to generate maximum flood potential) attributed to subsidence for the 1m SLR scenario.

Why doesn't the flood extent reach the wet-dry line on the background image for the 0cm Sea Level Rise (SLR) with average wave conditions (0-year/no storm) in my study area?

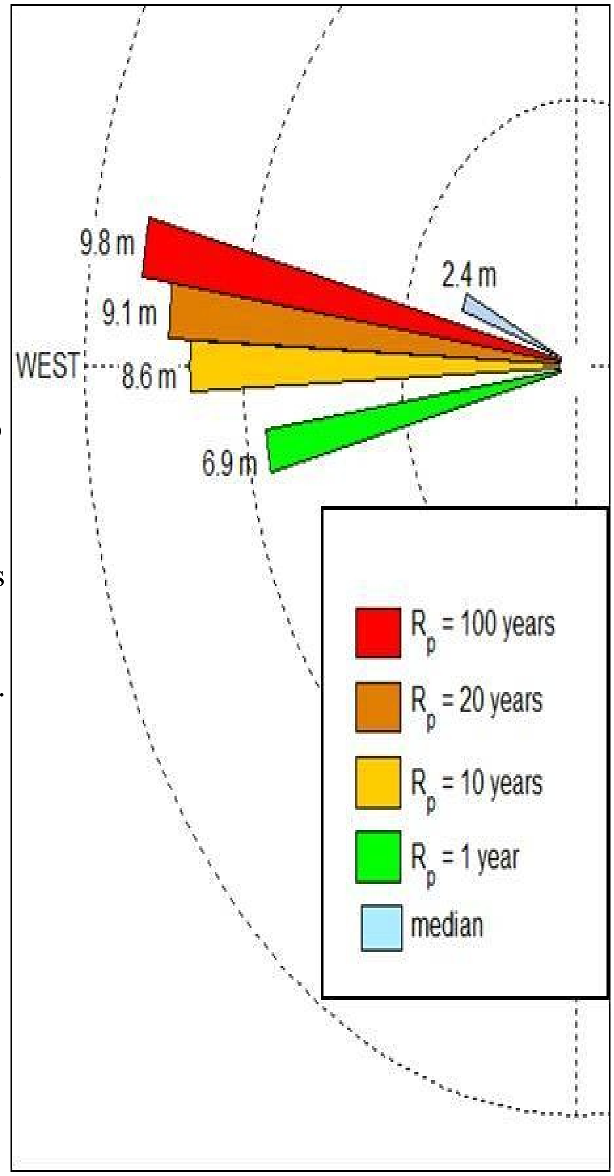
Projected flood extents are intended to represent the maximum landward extent where standing water is expected for the duration of several minutes or more. This is usually below the maximum wave run-up line, where intermittent wave uprush is expected to reach and recurrent wetting and drying occurs.

Beach profiles change frequently, both seasonally and from year to year. Although the digital elevation model (DEM) used in this study has the latest comprehensive data available, it does not capture any recent changes in beach profiles or necessarily coincide with profiles indicated in aerial imagery. Changes in beach profile can yield variations in flooding extent and maximum wave run-up that might be especially noticeable in relation to the visible wet/dry lines on beaches in the imagery. When viewing SLR 000 cm results, flood extents affected by such beach profile changes are observable in the DEM and in relation to the visible wet/dry line in many locations, particularly on sand spits such as at the mouth of Bodega Bay, Tomales Bay, Drakes Estero, entrance to Valley Ford, Bolinas, entrance to Rodeo Lagoon, and open beaches along Point Reyes Beach, Muir Beach, northern Pacifica, Pillar Point and Half Moon Bay State Beach.

Why does the flood extent for certain low SLR/storm scenarios sometimes seem to flood more than a higher SLR/storm scenario in my study area?

In certain locations, flooding does not progress in a consecutive manner with regard to SLR or storm event. There are two main reasons why this occurs:

- **Direction of incoming waves**: The first is due to changes in wave height as they approach the shore from different angles. Within the CoSMoS structure, each storm event generated waves of different heights and directions offshore central California (see above for more information). 100-year event waves approached from a northwest direction, while 20-year event waves approached from the west. As waves approach the shore, bathymetric variability along the coast causes waves to change direction and approach different locations at different angles resulting in focusing or de-focusing of wave energy relative to other locations. Additionally, as waves change direction to approach the shore nearly straight on, some energy is lost in the form of decreasing wave height. Differences in wave approach angles for particular locations can result, for example, in flooding extent from the 20-year storm event, when waves may approach an area of coast more directly, exceeding 100-year storm event extents, when the generated waves may be larger but approach from a more oblique angle (see Figure right). This is particularly noticeable along south and southwest-facing coastlines such as Drakes Estero, Stinson Beach, Muir Beach, Horseshoe Cove, Rodeo Lagoon, and Pillar Point.



Projected wave heights (in meters) and incidence angles (direction of approach) offshore of San Francisco for different return intervals.

- **Eroding shoreline**: The other reason that non-consecutive flooding occurs and small SLR/storm scenarios may have flooding extents greater than larger SLR/storm scenarios in limited areas is because of the complex nature of beach profile erosion simulated within the models. For each storm event, the same starting beach profile was used for a specific location along the coast. This profile was allowed to erode for the given storm within the model structure. Because of differences in wave height, length, and angle of wave approach, the erosion and deposition along the profile evolved in a nonprogressive fashion and subtle changes caused differences in the calculated extent of standing floodwater and maximum run-up. Most of this behavior is notable during stronger storm events (20-year and 100-year events) when there is considerable shoreline change.

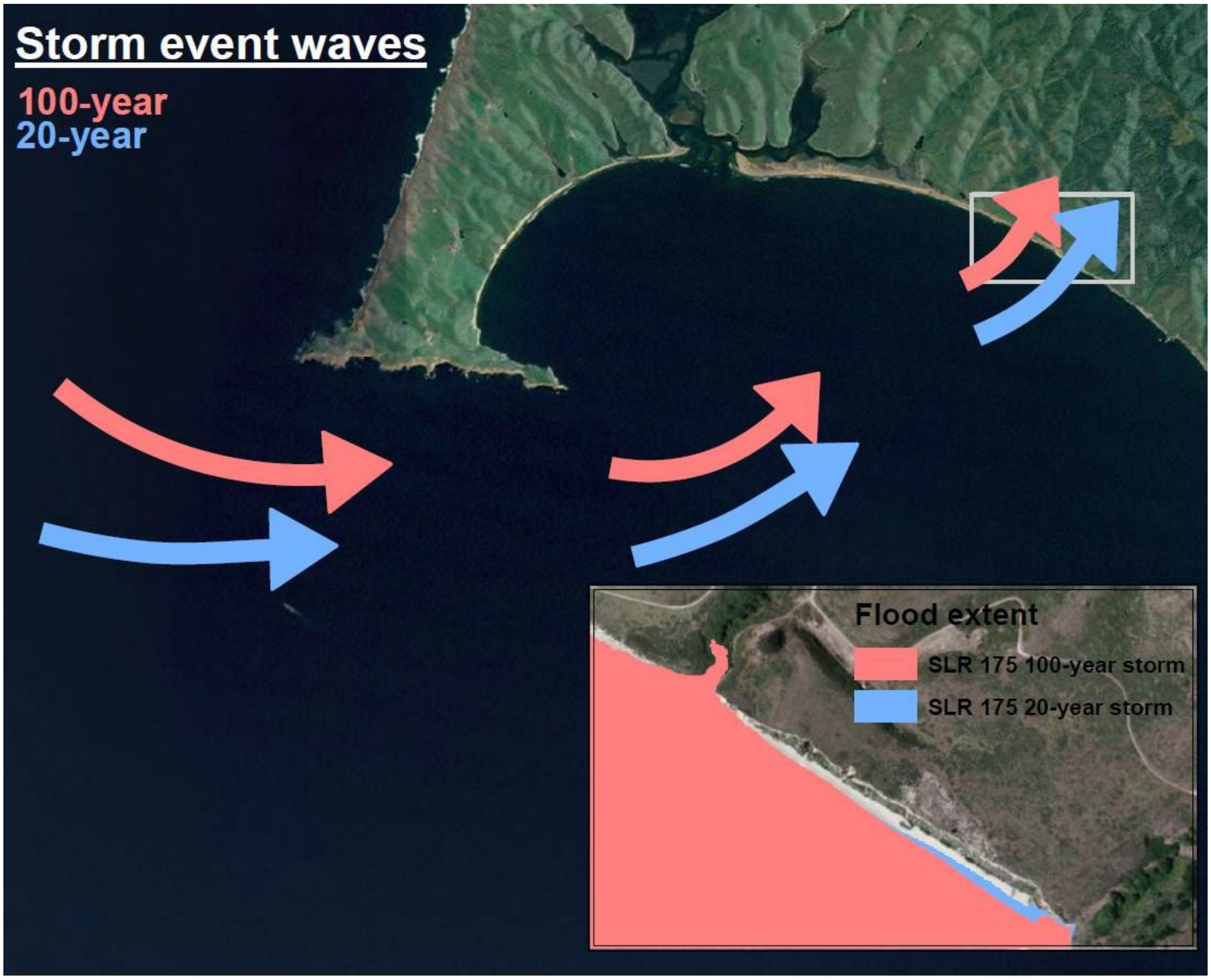


Illustration of waves generated by 20-year (blue arrows) and 100-year (red arrows) storm events, and corresponding flooding extents (for SLR 175 cm) at a section of coast east of Drakes Estero. The 100-year storm event waves are larger than the 20-year waves in the offshore region, but decrease in height and as they turn onto shore and interact with the seabed.

Why do flooding extents in some areas of San Francisco Bay look "scalloped"?

(see eastern South Bay near Hayward, Suisun Bay, ponds S/SW of Napa)

The curved, or "scalloped" (see figure), flood edge in some areas is a by-product of the method used to extract flood level data from the model and then project it on the DEM. Overall flooding extents and flood depth values are not affected. This artifact is most noticeable in lower-SLR scenarios and in low-elevation areas including portions of South Bay, small areas of Richmond, Suisun Bay, and marshes and ponds south of Napa.

Example of a flood extent's "scalloped" edge near Hayward.

Why does the flooded region for certain storm scenarios occasionally seem more extensive than a stronger storm scenario in my San Francisco Bay study area?

(see ponds and marshes N of San Pablo Bay, Suisun Bay, South Bay ponds N/NE of Moffett Field)

In certain locations inside San Francisco Bay, flooding does not progress in a sequential manner with respect to storm event. This effect is more common in areas with multiple pond structures or networks of levees. A primary reason may be direction of the storm event with regard to clustered levees and ponds. Individual levees, dikes, armoring, and portions thereof, can be susceptible to particular directions of storm currents, waves, or increased water levels. While predominant storm directions were modeled for different regions of the Bay, subtle differences in direction may result in associated flood waters circumventing particular sections of levees or armoring, allowing flooding into the interior. As the levees/dikes on the remaining borders may not be as robust as the primary structure encountered, flooding may migrate into neighboring ponds leading to larger sections ponds and marsh behind armoring to be flooded. Additionally, any recent or undocumented changes in structure to levees and dikes may not be accounted for in the model and can affect flood infiltration to these areas.

MODELING - Marshes and Wetlands

Why don't marshes appear flooded under the selected scenario?

In some cases, the LiDAR may not be penetrating the tall dense marsh vegetation and the resulting elevation is biased high, reflecting the height of the vegetation as opposed to bare earth. In this case, some marsh vegetation may still be exposed under the chosen scenario and thus the marsh does not appear to flood.

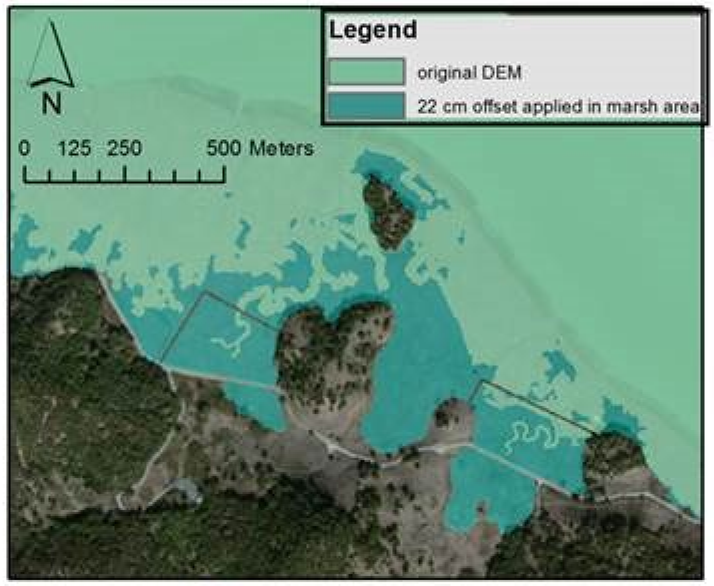
Another cause for marshes not appearing to flood could be due to the complexities of modeling water movement through networks of tidal sloughs and channels especially in areas where local tide gauge information is lacking or erroneous.

To better understand tidal marsh response to sea-level rise over time under different scenarios, please also visit the [Point Blue Future San Francisco Bay Tidal Marshes](www.pointblue.org/sfbayslr) tool (www.pointblue.org/sfbayslr).

Why do flood extents for particular marshes seem low?

(see ponds and marshes N of San Pablo Bay, upper Napa, Suisun Bay, China Camp, Corte Madera, marshes of east Palo Alto, marsh areas west of Hayward)

The DEM in this study primarily originates from LiDAR data collected in 2010. Recent work in a dozen, isolated locations throughout San Francisco Bay show that LiDAR was unable to penetrate thick vegetation, and resultant elevations are often higher than actual ground surfaces in these locations (http://pubs.usgs.gov/of/2013/1081/). On average across all 12 sites, LiDAR-derived DEM elevations within these marshes are offset 20 cm too high. Each study site showed variation within its respective marsh, with offsets ranging from -10 cm (DEM lower than measurements) to 29 cm (DEM higher than measurements), but site data also shows localized and inconsistent patterns, as the ability of LiDAR to penetrate vegetation is dependent on vegetation type, density, and season. To account for these elevation differences, a site-averaged offset was included in the estimates of maximum flooding potential at these survey locations. Without additional work to document comprehensive marsh vegetation variation and resultant offsets, credible modifications to DEM elevations could not be made throughout the Bay.



Example of flood extents in the marsh area of China Camp using the original DEM (elevations from LiDAR) and when a 22cm offset-correction is applied within the modeling framework. Solid lines denote areas where multiple model grids join.

As a consequence of this vegetation elevation offset, modeled flood levels in densely vegetated areas are likely too low and flood extents under-predicted. This is observable in several areas throughout the Bay, but most notably in marsh areas neighboring San Pablo Bay and surrounding ares. In these locations, the maximum flood potential is a more suitable illustration of probable flooding extent. Coincident flood depths and durations of these areas should be understood as under-predicted.

To demonstrate what type of influence this vegetation offset can have on flood extent, a separate study was conducted for the National Estuarine Research Reserve at China Camp. The measured vegetation offset at this location was accounted for with detailed modifications within the modeling framework. With the correction applied, flood extents expanded landward over 300 meters at some locations (see figure).

MODELING - Levees, Piers and Hardened Structures

Does the model take into account levees and/or hydraulic features, such as culverts, pipes, and bridges?

The model accounts for levees and structured mounds visible in the 2010 DEM but NOT any culverts, pipes, piers, pilings, or bridges. If you want to see if a particular feature was included, go to the OCOF Flood Map and turn on the Digital Elevation Model. Zoom into the feature of interest and see if you can discern them, or download the area of interest with the upper right most button on the map and examine the data in a GIS package.

The model does not account for any culverts, pipes, pilings, or bridges.

How are levees and dikes accounted for in the Bay? Why are some ponds depicted as flooded while others aren't?

(see South Bay ponds N/NE of Moffett Field, Suisun Bay, San Pablo Bay ponds N of Hwy 37, San Rafael, Foster City/Redwood City, Richmond, Santa Venetia, SFO, and OAK)

In the Bay area, projected flooding extents show landward locations from the Bay where standing water is expected for several minutes or more, and in locations with existing standing water (such as ponds or behind levees) where a change in water level is predicted (i.e., flood waters entering an area through a hydrologic connection, overtopping or by other means).

Modeling flood behavior in the vicinity of levees and dikes requires good spatial knowledge of the structure and high modeling resolution in the location, as some structures are only a handful of meters wide. The high resolution Digital Elevation Model (DEM) used in this study contains the most recent and complete elevation data available, including topographic LiDAR collected in 2010, covering most areas above MHW. Therefore most natural or artificial modifications to the topography since 2010 are not captured. Alterations were made to the underlying modeling structure in numerous locations (including Foster City, Redwood City, Coyote Creek, Alviso, San Francisco International Airport, Oakland International Airport, Richmond, Corte Madera, San Rafael, in vicinity Novato, and Suisun Bay among other locations; figure 2) to ensure the current spatial extent and physical function of levees and dikes were modeled properly. Additionally, known breaches and openings were similarly accounted for. No assumptions on levee strength, durability, or possible alterations were made or modeled. Recent or undocumented changes to include reinforcements and breaches may not be captured, leading to possible flooding where recent protections have been added or vice versa.

Does the model take into account land use changes on the shoreline, and the addition of infrastructure like seawalls?

Yes, indirectly. Coastal slopes greater than 30 degrees are assumed to be hard structures, such as jetties and seawalls, and are assumed to not erode over the time scale of the storms being simulated.

Why are some piers shown as flooded and some not?

(see Embarcadero, Richardson Bay, Hunters Point)

Flooding extents show locations where the elevation of modeled flood waters is higher than the DEM. The DEM is a depiction of the bare earth surface elevation, or ground, on which the flood waters flow and does not include the elevation of buildings or similar transient structures. While breakwaters and similar earthen works are included in the DEM, many piers and docks on pilings (especially those smaller than ~75 meters in width) are not included, and the body of water flowing beneath the structure is modeled (figure 4, left and center illustrations).

Projected flooding depths are shown for flooded locations above the current shoreline, delineated by SFEI's Bay Area Aquatic Resource Inventory (BAARI) shoreline. This shoreline contains many of the same large piers included in the DEM, but inclusion of some mid-sized structures differs. This inconsistency results in apparent deep flood depths over the pier involved (figure 4, center and right illustrations), and the flood extent and depth actually show the uninterrupted total water depth beneath the structure. Occasionally, flood depths may be visible along the perimeter of some large piers. This is strictly an artifact of the difference in resolution between the flood model (~10 m in high-resolution sites) and the DEM, and is not a true illustration of flooding.

For larger pier structures included in the DEM, depicted flood extents and depths over the full structure represent legitimate overtopping. The behavior of flooding at a pier's surrounding shoreline can aid in identifying projected flooding of the location: if there is inundation of the adjacent coastal area that is consistent with a pier, then it is expected that flooding of the pier is genuine.

From left to right: illustration showing modeled flood surface in relation to the DEM and a pier (left); graphic displaying a case where the DEM and shoreline both excluded a pier (flooded lower pier) and a case where the shoreline includes a larger pier but the DEM does not (upper pier in center graphic); example of what appears to be a flooded pier in Richardson Bay (right).

DECISION SUPPORT TOOL

Is the resolution high enough to visualize impacts to a single parcel or building?

The DEM resolution of 2 m was selected to enable the possibility of asking questions at a parcel scale. We suggest you examine all modeled data layers and understand the assumptions that are behind these models when using these data.

Can I add my own layers with data specific to my project or site?

No. We have made the data used in the tool available for downloading from the OCOF mapping tool in standard GIS formats.

What types of maps or other products can be exported?

We have developed a standardized pdf report which summarizes model results for a user defined area. The report will include summaries and graphs of area you select interactively and a copy of the map.

MISCELLANEOUS

Will there be an endorsement by the State of California that this is approved for CEQA analysis?

It is unlikely that the State of California will endorse any specific tool for sea level rise analysis within CEQA. State policies and guidance regarding climate change considerations are constantly evolving, so you should contact the appropriate agency for more information.

FUTURE DEVELOPMENT OF OCOF

Coastal planning is an evolving science and the models will continue to develop. Will there be new versions of these model results in the future?

Yes. Shoreline evolution modeling will be included beginning in Southern California, and we hope to be able to update the current sections of the outer coast (Golden Gate to Point Arena) with this new component once the remainder of the California coast is modeled. It is important to note that all models are simplifications of the physics that that cause changes in the natural environment and can only provide approximations to the currents, shoreline erosion, and flooding extents presented in this work. Although different results might be attained with different models and a different approach to the overall strategy, the models and framework used in this work are considered to be state-of-the-art at this time.