

COASTAL DATA EXCHANGE

USACE SEA LEVEL CHANGE CALCULATOR



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US Army Corps of Engineers
BUILDING STRONG®

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Sea Level Change Calculator

Responses to Climate Change >> ... +

<http://www.corpsclimate.us/ccaceslcurves.cfm>



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Climate Change Adaptation

Comprehensive Evaluation of Projects with Respect to Sea-Level Change

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Sea-Level Change Curve Calculator

[EC 1165-2-212](#) (pdf, 845 KB) and its successor [ER 1100-2-8162](#) (pdf, 317 KB) were developed with the assistance of coastal scientists from the NOAA National Ocean Service and the US Geological Survey. Their participation on the USACE team allows rapid infusion of science into engineering guidance.

[EC 1165-2-212](#) (pdf, 845 KB) and its successor [ER 1100-2-8162](#) (pdf, 317 KB) use the historic rate of sea-level change as the rate for the "USACE Low Curve".

The rate for the "USACE Intermediate Curve" is computed from the modified NRC Curve I considering both the most recent IPCC projections and modified NRC projections with the local rate of vertical land movement added.

The rate for the "USACE High Curve" is computed from the modified NRC Curve III considering both the most recent IPCC projections and modified NRC projections with the local rate of vertical land movement added.

The three scenarios proposed by the NRC result in global eustatic sea-level rise values, by the year 2100, of 0.5 meters, 1.0 meters, and 1.5 meters. Adjusting the equation to include the historic GMSL change rate of 1.7 mm/year and the start date of 1992 (which corresponds to the midpoint of the current National Tidal Datum Epoch of 1983-2001). Instead of 1996 (the start date used by the NRC), results in updated values for the coefficients (b) being equal to 2.71E-6 for modified NRC Curve I, 7.00E-6 for modified NRC Curve II, and 1.13E-4 for modified NRC Curve III.

The three local relative sea level change scenarios updated from [EC 1165-2-212](#) (pdf, 845 KB) (and its successor [ER 1100-2-8162](#)). Equation 2 are depicted in the Figure to the right of the table. A link to an Excel version of the calculator is below the table. The Excel version has a drop-down menu to select tide gauges. Below that is a direct link to the NOAA Tides and Currents web site for the selected tide gauge. The Excel version also provides graphical and tabular output in both feet and meters.

$$EC\ 1165-2-212,\ Equation\ 2:\ E(t) = 0.0017t + bt^2$$

This on-line Sea Level Change Calculator produces the amount of predicted sea level change from 1992 forward.

USACE SLC Coefficients:	<input type="text" value="0.0000000"/>	<input type="text" value="0.0000271"/>	<input type="text" value="0.0001130"/>
Base Year (Mid Point of NTDE):	<input type="text" value="1992"/>		
Enter Project Start Year:	<input type="text" value="2010"/>		
Rate of Eustatic Sea Level Rise per year in mm:	<input type="text" value="1.7"/>		
Rate of Subsidence per year in mm:	<input type="text"/>		
Select the closest NOAA gauge station to the right:	<input type="text" value="Select Closest NOAA Gauge"/>		
Enter FEMA Base Flood Elevation (ft):	<input type="text" value="0"/>	(NAVD88) - Datum Shift to MSL (ft):	<input type="text" value="0"/>
Enter Project End Year:	<input type="text" value="2100"/>		
Enter Interval:	<input type="text" value="5"/>		
Include NOAA Curves: NOAA Technical Report OAR CPO-1	<input type="checkbox"/>		
Output Units:	<input checked="" type="radio"/> Feet	<input type="radio"/> Meters	
Chart Size:	Height: <input type="text" value="500"/>	Width: <input type="text" value="800"/>	
Compute Curves Based on:	<input checked="" type="radio"/> EC 1165-2-212	<input type="radio"/> EC 1165-2-211 (superseded)	



Sea Level Change Calculator

- Based on Engineer Circular(EC) 1165-2-212
“Sea Level Change Considerations for Civil Works Programs”

USACE “Low” Curve = Historic Rate of SLC

USACE “Intermediate” Curve = modified NRC Curve I*

USACE “High” Curve = modified NRC Curve III*

$$\text{EC 1165-2-212, Equation 2: } E(t) = 0.0017t + bt^2$$

- * considering both the most recent IPCC projections and modified NRC projections with the local rate of vertical land movement added



Sea Level Change Calculator

- The three scenarios proposed by the NRC result in global *eustatic* sea-level rise values, by the year 2100, of 0.5 meters, 1.0 meters, and 1.5 meters
- Adjusts the NRC equation to include the historic GMSL change rate of 1.7 mm/year (from recent IPCC)
- Adjusts to the start date of 1992 (which corresponds to the midpoint of the current National Tidal Datum Epoch of 1983-2001) which results in updated values for the coefficient “b”
- Adding this eustatic rate to the local rate of vertical land movement ¹ provides the 3 local relative SLC curves for a selected NOAA Tide Station

¹ Technical Report NOS CO-OPS 065 (C. Zervas, S. Gill, W. Sweet)



Sea Level Change Calculator

Step 1 & 2: Enter Project Start Year and NOAA Tide Station Selection

EC 1165-2-212, Equation 2: $E(t) = 0.0017t + bt^2$

This on-line Sea Level Change Calculator produces the amount of predicted sea level change from 1992 forward.


USACE SLC Coefficients:

Base Year (Mid Point of NTDE):

Enter Project Start Year:

Rate of Eustatic Sea Level Rise per year in mm:

Rate of Subsidence per year in mm:

[Select the closest NOAA gauge station to the right:](#) 

Enter FEMA Base Flood Elevation (ft): (NAVD88) - Datum Shift to MSL (ft):

Enter Project End Year:

Enter Interval:

Include NOAA Curves: [NOAA Technical Report OAR CPO-1](#)

Output Units: Feet Meters

Chart Size: Height: Width:

Compute Curves Based on: [EC 1165-2-212](#) [EC 1165-2-211 \(superseded\)](#)



Sea Level Change Calculator

Step 3: Enter FEMA Base Flood Elevation (optional)

EC 1165-2-212, Equation 2: $E(t) = 0.0017t + bt^2$

This on-line Sea Level Change Calculator produces the amount of predicted sea level change from 1992 forward.


USACE SLC Coefficients:

Base Year (Mid Point of NTDE):

Enter Project Start Year:

Rate of Eustatic Sea Level Rise per year in mm:

Rate of Subsidence per year in mm:

[Select the closest NOAA gauge station to the right:](#) 

Enter FEMA Base Flood Elevation (ft): (NAVD88) - Datum Shift to MSL (ft):

Enter Project End Year:

Enter Interval:

Include NOAA Curves: [NOAA Technical Report OAR CPO-1](#)

Output Units: Feet Meters

Chart Size: Height: Width:

Compute Curves Based on: [EC 1165-2-212](#) [EC 1165-2-211 \(superseded\)](#)



Sea Level Change Calculator

Step 4 & 5: Enter Project End Year and Calculation Interval (in years)

EC 1165-2-212, Equation 2: $E(t) = 0.0017t + bt^2$

This on-line Sea Level Change Calculator produces the amount of predicted sea level change from 1992 forward.


USACE SLC Coefficients:

Base Year (Mid Point of NTDE):

Enter Project Start Year:

Rate of Eustatic Sea Level Rise per year in mm:

Rate of Subsidence per year in mm:

[Select the closest NOAA gauge station to the right:](#) 

Enter FEMA Base Flood Elevation (ft): (NAVD88) - Datum Shift to MSL (ft):

Enter Project End Year:

Enter Interval:

Include NOAA Curves: [NOAA Technical Report OAR CPO-1](#)

Output Units: Feet Meters

Chart Size: Height: Width:

Compute Curves Based on: [EC 1165-2-212](#) [EC 1165-2-211 \(superseded\)](#)



Sea Level Change Calculator

Step 6: Enter Output Units and Chart Size (default is Feet and 500x800 pixels)

EC 1165-2-212, Equation 2: $E(t) = 0.0017t + bt^2$

This on-line Sea Level Change Calculator produces the amount of predicted sea level change from 1992 forward.


USACE SLC Coefficients:

Base Year (Mid Point of NTDE):

Enter Project Start Year:

Rate of Eustatic Sea Level Rise per year in mm:

Rate of Subsidence per year in mm:

[Select the closest NOAA gauge station to the right:](#) 

Enter FEMA Base Flood Elevation (ft): (NAVD88) - Datum Shift to MSL (ft):

Enter Project End Year:

Enter Interval:

Include NOAA Curves: [NOAA Technical Report OAR CPO-1](#)

Output Units: Feet Meters

Chart Size: Height: Width:

Compute Curves Based on: [EC 1165-2-212](#) [EC 1165-2-211 \(superseded\)](#)



Sea Level Change Calculator

Step 7: Click “Calculate Curves” Button

EC 1165-2-212, Equation 2: $E(t) = 0.0017t + bt^2$

This on-line Sea Level Change Calculator produces the amount of predicted sea level change from 1992 forward.


USACE SLC Coefficients:

Base Year (Mid Point of NTDE):

Enter Project Start Year:

Rate of Eustatic Sea Level Rise per year in mm:

Rate of Subsidence per year in mm:

[Select the closest NOAA gauge station to the right:](#) 

Enter FEMA Base Flood Elevation (ft): (NAVD88) - Datum Shift to MSL (ft):

Enter Project End Year:

Enter Interval:

Include NOAA Curves: [NOAA Technical Report OAR CPO-1](#)

Output Units: Feet Meters

Chart Size: Height: Width:

Compute Curves Based on: [EC 1165-2-212](#) [EC 1165-2-211 \(superseded\)](#)

CLICK



Sea Level Change Calculator

Other Notes:

- 1) No "Datum Shift" for BFE to MSL Datum in Hawaii
- 2) NOAA Curves can be added to USACE curves
- 3) Updated EC calculates "b" based on 1992 (not 1986)

Sea level change from 1992 forward.


USACE SLC Coefficients: 0.0000000 0.0000271 0.0001130

Base Year (Mid Point of NTDE): 1992

Enter Project Start Year: 2010

Rate of Eustatic Sea Level Rise per year in mm: 1.7

Rate of Subsidence per year in mm: -0.180

Select the closest NOAA gauge station to the right:  HI, Honolulu: 102 yrs

Enter FEMA Base Flood Elevation (ft): 0.0 (MSL) - Datum Shift to MSL (ft): 0
Note: No conversion from NAVD88 to MSL Input BFE assumed to be referenced to MSL ←

Enter Project End Year: 2100

Enter Interval: 5

Include NOAA Curves: [NOAA Technical Report OAR CPO-1](#) ←

Output Units: Feet Meters

Chart Size: Height: 500 Width: 800

Compute Curves Based on: [EC 1165-2-212](#) [EC 1165-2-211 \(superseded\)](#) ←

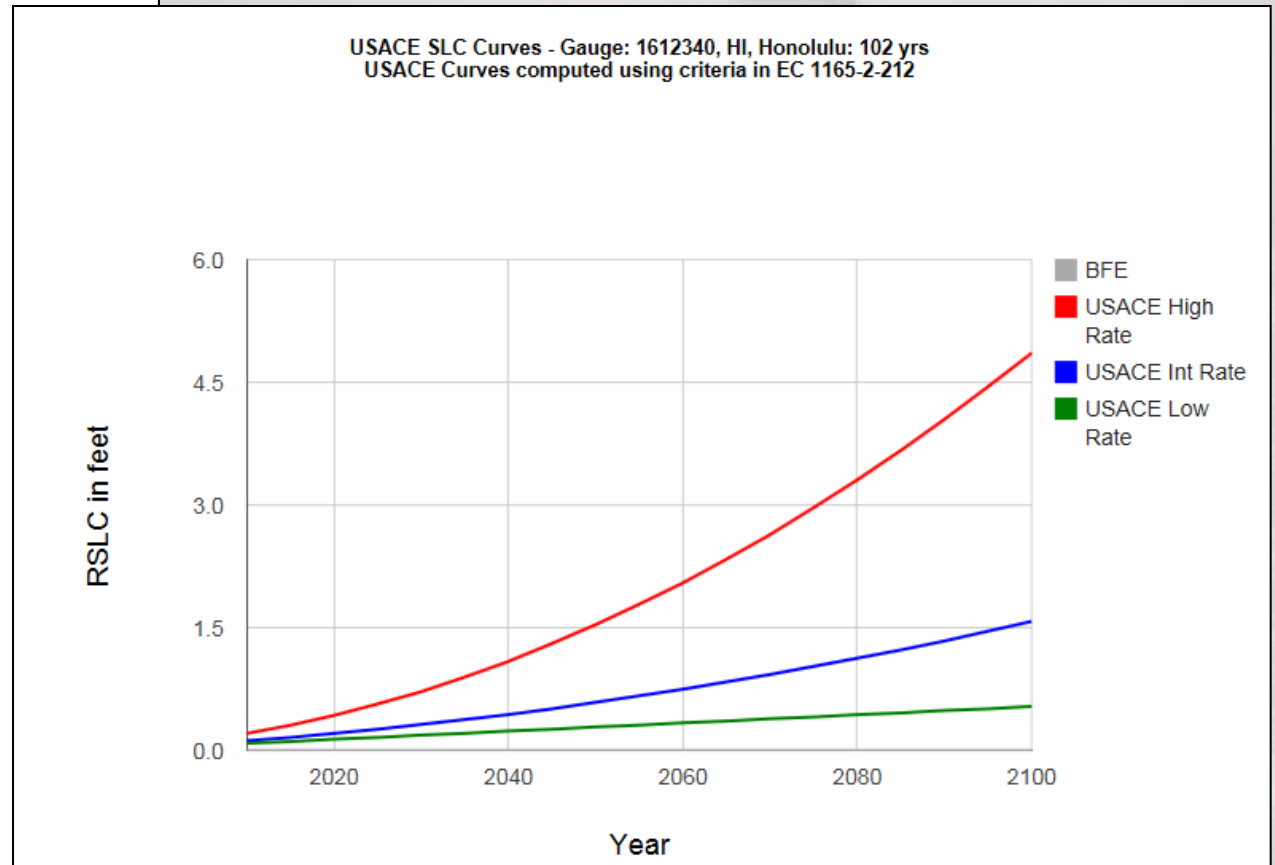


Sea Level Change Calculator

USACE Curves computed using criteria in USACE EC 1165-2-212

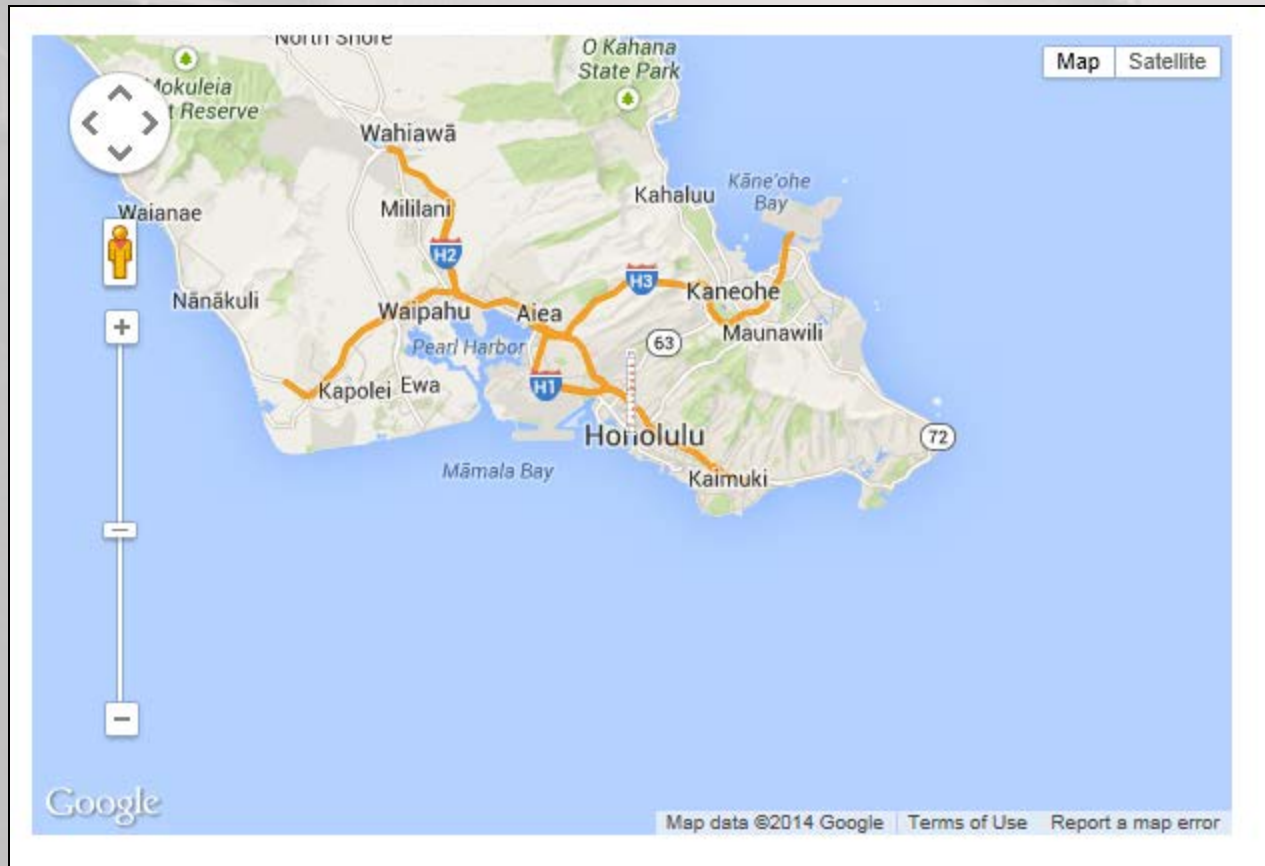
Gauge: 1612340, HI, Honolulu: 102 yrs All values are in feet			
Year	USACE Low	USACE Int	USACE High
2010	0.09	0.12	0.21
2015	0.11	0.16	0.31
2020	0.14	0.21	0.43
2025	0.16	0.26	0.57
2030	0.19	0.32	0.72
2035	0.21	0.38	0.90
2040	0.24	0.44	1.09
2045	0.26	0.51	1.31
2050	0.29	0.59	1.54
2055	0.31	0.67	1.79
2060	0.34	0.75	2.05
2065	0.36	0.84	2.34
2070	0.39	0.93	2.64
2075	0.41	1.03	2.97
2080	0.44	1.13	3.31
2085	0.46	1.23	3.67
2090	0.49	1.34	4.05
2095	0.51	1.46	4.45
2100	0.54	1.58	4.86

Outputs: Table and Curve of Relative SLC values by year



Sea Level Change Calculator

Outputs: Google Map showing selected NOAA Tide Station



Planners use my data for

- County Plans
- General Plans
- Conservation District Use Permits
- Setbacks
- Shoreline Certification
- Shoreline Permits
- Building Permits
- Special Area Management Permits
- Flood Zones
- Anything where projection of SLC is required*



References

- National Research Council, 1987. Responding to Changes in Sea Level: Engineering Implications. National Academy Press: Washington, D.C.
http://www.nap.edu/catalog.php?record_id=1006
- IPCC (2007c) Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change.” (M. L. Parry, O. F. Canziani, J. P. Palutikof, P. J. van der Linden and C. E. Hanson, eds.). Cambridge University Press, Cambridge, UK.
<http://www.ipcc.ch/ipccreports/ar4-wg2.htm>
- EC 1165-2-212
“Sea Level Change Considerations for Civil Works Programs”
http://www.corpsclimate.us/docs/EC_1165-2-212%20-Final_10_Nov_2011.pdf
- ER 1100-2-8162
“Incorporating Sea Level Change in Civil Works Programs”
http://www.publications.usace.army.mil/Portals/76/Publications/EngineerRegulations/ER_1100-2-8162.pdf

