

# Sea Level Rise, Climate Change and Health



Climate change is causing sea level rise around the world, as a result of melting glaciers and thermal expansion due to rising ocean temperatures. In this brief we discuss the ways in which sea level rise from climate change impacts human health, with a focus on California and the U.S.

## Rising seas, rising health risks

- [Flooding and storm](#) surges associated with sea level rise increase risks for drowning, injury and displacement.
  - In California, 260,000 people and \$50 billion in property are now at risk for a 100-year flood. If population, development and climate change stay on track, by 2100 those numbers will nearly double, with 480,000 people and \$100 billion in property at risk.<sup>1</sup>
  - Increased coastal flooding and storms also raises the risk of indoor mold growth from excess dampness, with impacts on respiratory disease.
- As sea levels rise, saltwater intrusion into fresh water increases salinity of groundwater basins and well water. This reduces crop yields and the availability of safe drinking water. It also increases the risk of hypertension, as well as vector-borne and diarrheal disease.<sup>2</sup>
- Sea level rise threatens coastal tourism, through erosion and flood/storm damage to beachfront property and beaches.<sup>3</sup> Losses in coastal tourism could cost California beach communities many thousands of jobs and hundreds of millions of dollars.<sup>4</sup>

### Disappearing cities, disappearing homes<sup>9 10 11 12</sup>

If we do nothing to curb climate change, global sea levels will rise 14-32 feet by 2100. This would mean that 20 million U.S. residents in more than 1,000 communities will be at risk of permanent flooding. The four most impacted states are Florida, California, Louisiana and New York. Already, Native populations in Alaska and Louisiana have made plans to relocate their communities due to rising seas and flooding, becoming the first U.S. climate change refugees. Miami Beach is now waging an aggressive and expensive (hundreds of millions of dollars) battle against sea level rise. It already routinely experiences neighborhood flooding during high tides, and residents say palm trees are dying due to saltwater intrusion. But the efforts of Miami Beach are probably futile. For some cities — notably Miami and New Orleans — enough global warming is already locked in that they have passed a “point of no return,” and no measures will save them. Only strong action to curb carbon emissions quickly will delay the point of no return for other cities, such as New York City or Norfolk, Virginia.



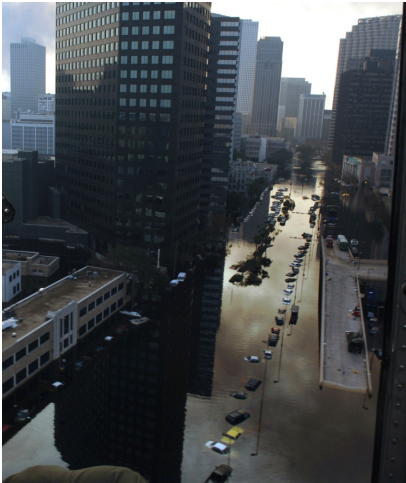
### FAST FACT:

In California, 260,000 people and \$50 billion in property are now at risk for a 100-year flood.

## Climate change and sea level rise

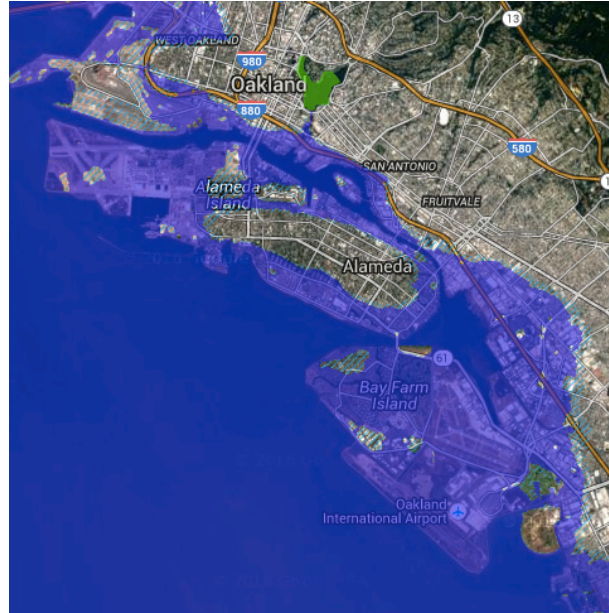
Climate change is accelerating sea level rise as a result of oceans warming and expanding, and glacial melting. By 2100, parts of California's coastline will see up to 66 inches of sea level rise.<sup>6</sup>

- By 2050, 100-year floods could happen annually in California as a result of sea level rise and changes to winds and waves that are also linked to climate change.<sup>7</sup>



### ! FAST FACT:

Scientists say that for some cities — notably Miami and New Orleans — enough global warming is already locked in — due to the long life of GHG in the atmosphere — that they have passed a “point of no return,” and no measures will save them.



CalAdapt map showing Oakland International Airport and Oakland neighborhoods, freeways, and industrial parks under water with 200 cm of sea level rise.<sup>8</sup>

## Climate change, sea level rise and health equity

Social and economic inequities, as well as individual characteristics, place some individuals and communities at greater risk than others for the effects of sea level rise from climate change:

- **Indigenous communities** that practice subsistence farming and fishing are particularly vulnerable to the impacts of sea level rise on freshwater ecosystems, including saline intrusion, and of fisheries collapse.
- **Low-income communities** face greater challenges from food security as saline intrusion disrupts agriculture and availability of safe, reliable drinking water.
- **Low-income individuals** disproportionately lack disaster insurance and often lack access to resources to recuperate from property loss, placing them at greater risk for destabilization and displacement from floods or submergence related to sea level rise.<sup>5</sup>



## ? DID YOU KNOW?

By 2100, parts of California's coastline will see up to 66 inches of sea level rise.

## What can physicians do to address climate change and sea level rise?

- Talk with patients about the health risks of sea level rise, related floods and how to stay safe and healthy.
  - Assist individuals and families to create emergency response plans in the event of flooding.
  - Advise families on food and water safety during and after floods and storms and the risks of waterborne diseases.
  - Encourage patients and families to follow emergency communications in the event of anticipated extreme storms or flooding.
- Educate your colleagues and community on the links between climate change, sea level rise and health, and what can be done to prevent negative health impacts.
- Advocate for mitigation and adaptation strategies related to climate change and sea level rise.
  - Support funding for “green infrastructure,” such as reefs, sand, coastal wetlands and mangroves, and other natural barriers that reduce erosion and protect coastal areas from storm surges. Green infrastructure provides multiple co-benefits, including improved water quality, habitat for marine life, and carbon sequestration. See [Urban Greening & Green Infrastructure and Health](#)
  - Advocate for comprehensive assessment of vulnerable public infrastructure along coastlines (e.g. transit systems and roads, water and sewage systems, energy infrastructure, hospitals), and development of plans and funding to protect it.
  - Strengthen emergency preparedness and response systems to protect vulnerable coastal communities.
  - Protect freshwater sources from all contamination, including saline intrusion.
- Support policies and programs in your community and in your health system that authentically engage and partner with community residents in addressing climate and health problems, including the social and economic inequities, for individuals and communities, related to climate change and sea level rise.
  - Connect families to financial resources for disaster insurance and emergency communications resources.

## For More Information

- California Coastal Commission page on sea level rise  
<http://www.coastal.ca.gov/climate/slr/>
- California sea level rise vulnerability assessments and adaptation plans
  - [SF Bay Area](#)
  - [San Diego](#)
  - [Santa Cruz](#)

Page 1 photo: NPS; page 4 photo: Lieut. Commander Mark Moran, NOAA Corps, NMAO/AOC



## Citations

- <sup>1</sup> Moser, S., Ekstrom, J., & Franco, G. (2012). Our changing climate 2012: vulnerability and adaptation to the increasing risks of climate change in California. California Climate Change Center.
- <sup>2</sup> Wong, P.P., I.J. Losada, J.-P. Gattuso, J. Hinkel, A. Khattabi, K.L. McInnes, Y. Saito, and A. Sallenger, 2014: Coastal systems and low-lying areas. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 361-409.
- <sup>3</sup> Ibid.
- <sup>4</sup> California Department of Boating and Waterways. (n.d.) The economic costs of sea-level rise to California beach communities. Available at <http://www.dbw.ca.gov/PDF/Reports/CalifSeaLevelRise.pdf>
- <sup>5</sup> Morello-Frosch, R., Pastor, M., Sadd, J., Shonkoff, S. (n.d.) *The climate gap: Inequalities in how climate change hurts Americans & how to close the gap*. Available at: University of California Program for Environmental and Regional Equity website: <https://dornsife.usc.edu/perc/climategap/>
- <sup>6</sup> California Coastal Commission <http://www.coastal.ca.gov/climate/slr/>
- <sup>7</sup> Ibid.
- <sup>8</sup> CalAdapt. Sea level rise: threatened areas map. <http://cal-adapt.org/sealevel/>
- <sup>9</sup> Strauss, B.H., Kulp, S. & Levermann, A. (2015). Carbon choices determine US cities committed to futures below sea level. *Proceedings of the National Academy of Sciences*, (112),44, 13508-13513. Available at <http://www.pnas.org/content/112/44/13508.full>
- <sup>10</sup> Kolbert, E. (2015, December 21 & 28). The siege of Miami. *The New Yorker*. Available at <http://www.newyorker.com/magazine/2015/12/21/the-siege-of-miami>
- <sup>11</sup> Wendland, T. (2016, May 14). Native Americans' relocation from Louisiana home: 'first climate change refugees.' *National Public Radio*. Available at <http://www.npr.org/2016/05/14/478040492/native-americans-relocation-from-louisiana-home-first-climate-change-refugees>
- <sup>12</sup> Associated Press. (2015, October 3). Alaska seeks federal money to move a village threatened by climate change. *The New York Times*. Available at [http://www.nytimes.com/2015/10/04/us/alaska-seeks-federal-money-to-move-a-village-threatened-by-climate-change.html?\\_r=0](http://www.nytimes.com/2015/10/04/us/alaska-seeks-federal-money-to-move-a-village-threatened-by-climate-change.html?_r=0)



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