



# in a warming world:

The latest science  
on present-day impacts  
and future projections  
of sea-level rise





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# 1. The Current State of Sea-Level Rise

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**Global-mean sea level is rising  
and accelerating as a direct  
consequence of human-induced**



**The magnitude, timing, and rate of SLR within this century and over the next millennia will depend on the long-term temperature at which global warming will stabilize, as well as on the pathways**

Table 1.

the IPCC AR6.<sup>21</sup>

the 17th-83rd percentile range. The

1900. Source:

**Since the publication of the IPCC AR6 WGI in 2021, a growing number of scientific studies on ice-sheet loss are raising alarm among scientists that future SLR could indeed be much larger and occur sooner** <sup>22</sup>

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## 3. Global Impacts and Implications of Sea-Level Rise

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**Accelerated SLR has the potential to redefine the coastlines of the 21st century. It can pose major risks to the safety, security, and sustainability of many low-lying islands, populous coastal megacities, large tropical agricultural deltas, and Arctic communities.<sup>27</sup>**

**The low-elevation coastal zone (LECZ), which comprises continental and island areas connected to the ocean at low elevation, includes a wide diversity of systems, from small islands to megacities, from the Tropics to the Poles, in both the Global North and Global South**

<b>COUNTRY</b>	<b>CITY</b>	<b>OBSERVED SLR FROM 1990 TO 2020 (cm)</b>	<b>PROJECTED SLR FROM 2020 TO 2050 (cm)</b>
Argentina	Buenos Aires	6	15 [12–19]
Australia		8	13 [11–17]
Australia		9	15 [12–20]
Australia		13	15 [12–21]
Australia	Perth	16	16 [15–19]
	Rio de Janeiro	13	16 [12–21]
	Atafona	13	16 [12–21]
Canada	Richmond	4	8 [7–12]
Canada	Vancouver	4	8 [7–12]
Canada		8	14 [12–17]
China		17	24 [20–29]
China		11	13 [9–19]
	Copenhagen	6	17 [13–23]
France		6	14 [9–19]
France		9	15 [11–21]
Germany		7	20 [16–26]
India		10	18 [15–23]
Japan		3	13 [10–18]
Japan		13	
	Incheon	9	
		12	
		8	
		9	
		16	
		14	
	Atlantic City	16	
	Boston	15	
		20	
		26	
		6	
		6	



**Climate-driven coastal hazards and risks come not only from SLR itself but also from its amplification of storm surges, tides, and waves.**

7cUgU! ccX\ UnUFXgUbXUggcWUHxf]g\_gUFY also expected to increase as a result of local land g\_b\_]b[ fgi Vg]XYbWLVYWi gY'cZ\ i a Ub UMj] ]hYg' g W UgVi ]X]b[ XLa gcf' [ fci bXk UHF UbXZcgg]' Z Y Yl fUM]cb'<sup>81</sup> H Y]f Wa V]bYXYZZYVgWb "YUX' hc ]bZUgfi Wi fYXLa U] YXi Ylc WUgU' ccX]b[ z saltwater intrusion into groundwater and rivers, shoreline retreat, and change to or loss of coastal YWgn]Ya gUbXYWbca ]VgM]c'fg"

**Such impacts are already or are likely to create risks to livelihoods, settlements, health and well-being, and food and water security.**<sup>32</sup>

Impacts Wb Ug' fYUW ZF VYncbXWUgU Wa a i b]hYg": cf' Yl Ua d'YZW]a UH]bXi WXZ]bj c' i bHfmX]gd'UWa Ybi and migration from coastal areas may lead to population movements to inland areas, while loss of YWbca ]WUM]j ]hYg'g W Ug' g' Yf]Yg'cf U] f]W'hi fY' UbXXLa U] Ylc 'dcf]gWb'gY] YFymWa dfca ]gY' 'cVU' food systems, supply chains, and maritime trade, k ]h 'cW]hc! [ 'cVU [ Ycdc' ]hWZYWbca ]WUbX' gYWf]hm]fUa ] W]hcbg'<sup>83</sup>

**Small rises in relative sea-level can disproportionately increase coastal food frequency.**<sup>34</sup>

According to the United Nations Development Programme (UNDP) and the Climate =a dUM]@UV f]7=@zthe extent of coastal f ooding has increased over the past 20 years as a result of SLR, meaning 14 million more people worldwide now live in coastal communities with a 1-in-20-year chance of f ooding<sup>35</sup>

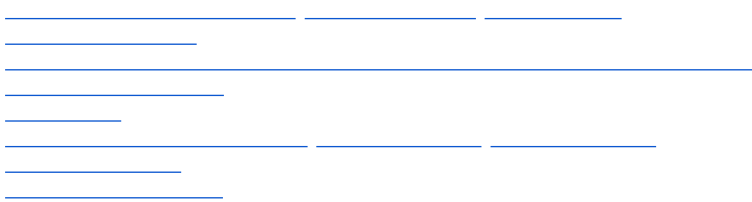
**The frequency of present-day, extreme-but-rare sea-level events is projected to increase substantially in most regions.**

For example, UWWfX]b[ 'hc' h Y=D77'5F\* z]b U[ 'cVU' n]Uj YFU] YX' gYbgYzh Y%]b!%\$\$nYUF Yl fYa YgYU' Yj Y' Yj Ybi (in terms of total water level) is projected to occur cbWY' Yfmi' \$nYUfgVni&\$) S'UbXcbWY' Yfmi' nYUfg' Vni&\$) i bXYf' h Y' FYdfYgYb]U]j Y'7cbWb]fU]cb' DUh k UmF7D( " ) f]b Ya ]gg]cbg'gWb]U]c' "YUX]b[ '

lc'&).7YbXlcZWb]i fmk Ufa ]b[ žgYY5bbYl '=Zcf' XYH] gL'G W Yj YblgUFYdfc'YMMX'hc'cWwf'a cfY' hUb'cbWUnYUf Vni&\$) i bXYf F7D, " ) f] (" .7'cZ k Ufa ]b[ E'<sup>86</sup> Additionally, a recent study projects that a ]bcf' ccX]b[ Yj Yblg'h UhWffYb]hmcWwf' Ub]i U'mi k ]'cWwf'a cghXUng'dYf' nYUf' k cf'Xk ]XYi bXYf'S'+a' cZG@F'<sup>87</sup>

The frequency of present-day, extreme-but-rare sea-level events is projected to increase substantially in most regions.

According to one study,<sup>38</sup> h Y [ 'cVU' Ub]i U' XLa U] Y' Z'ca WUgU' ccX]b[ 'hc]U'YXUfci bXI G8<sub>88</sub> 20 V]' ]cb#YUf' ]b' &\$%) "5gg] a ]b[ 'bc' Z' fh' Yf' dfc]h]M]cb' measures are implemented, this value could increase VniUZM]cf'cZ%) \$VYk Yb' &\$%) UbX'&\$, \$i bXYf' F7D( " ) "< ck Yj Yfz]gfi Wi fU' UXUd]U]cb' ]bj Yga Yblg' g'ck' \] [ \ 'dch]b]U' hc' fYXi WZ' hi fYWUgU' ccX' f]g' UbX'h YVYbY' ]g'k ci 'X'Yl WYX'h Y]bj Yga Yblg' UbX'a U]b]h]b]U'W'W'g]g' [ 'cVU' n]UbX]b'a cghfY] ]cbg' In addition, SLR can hamper the ability of coastal



**communities to adapt to climate impacts through its destruction of natural coastal defenses and ecosystems.** Mangroves, corals, saltmarshes, and seagrass meadows currently protect hundreds of millions of people worldwide against storm surges

a short timeline for adaptation implementation, a

The IPCC AR6 has also highlighted that as sea levels rise and extreme events intensify, “coastal institutional, and socioeconomic constraints and



**The Pacific SIDS are on the frontline of the climate crisis, facing severe and disproportionate impacts from SLR.**

While the change in global-mean sea level from 1993 to 2023 was 9.4cm [+/- 1cm], sea level change in the South-West Pacific over the same period was greater than 15cm [+/- 3cm] in some locations.<sup>42</sup> According to one recent study, most of the Pacific SIDS are located in a region where relative SLR is projected to be 10–30% higher than the global-mean SLR arising from Antarctic melt in 2100 relative to 2000.<sup>44</sup>

Under a scenario of 3°C warming, which is roughly consistent with all locations across the Pacific region can expect to see at least another 15cm of additional SLR between 2020 and 2050 (Table 3). Between 2005 and 2100, the median SLR for the Pacific region ranges from 50–97cm across the five warming scenarios assessed, ranging from 1.5°C to 5°C. In many of these scenarios, the SLR is projected to be significantly higher than the global-mean SLR.



Country	Tide Gauge Name	Observed SLR from
	Penrhyn	
	Rarotonga	
Fiji		
Fiji		
	Pohnpei	
Palau		
	Apia	
Tonga		
Tuvalu	Funafuti	

As also shown in Table 3, future SLR is projected to cause a large increase in the frequency and severity of episodic flooding in almost all locations in the Pacific SIDS in the coming decades. Across all future scenarios and under the assumption of no additional protections, all islands

It is projected that for Nuku'alofa and Apia, the capital cities of Tonga and Samoa respectively, the number of flooding days will increase to 35 days per year during the 2050s for an average year. For a projected “worst year” of flooding the estimates increase to 70 and 90 days per year for Nuku'alofa and Apia, respectively. Under some locations in the Pacific SIDS could experience floodings for almost half of the entire year; for instance,

The Pacific SIDS, especially those in the western tropical Pacific (e.g., Kiribati, Tuvalu, and the Republic of the Marshall Islands), are particularly vulnerable to SLR because of: (i) high exposure to tropical cyclones and other tropical storms; (ii) high shoreline-to-land area ratios; (iii) high sensitivity to changes in sea level, waves, and currents; and (iv) its many low-lying coral atolls or volcanically-composed islands.

Many Pacific and other SIDS — home to 70 million people combined — are already experiencing loss of human life and significant economic damages, particularly from tropical cyclones and increases in SLR.<sup>50</sup> In the Solomon Islands, tropical cyclones (TCs) account for

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<sup>48</sup> ...

<sup>49</sup> ...

<sup>50</sup> ...

<sup>51</sup> Tropical cyclones (TCs) account for

much faster and on a much greater scale than ever  
dYzfa YX]b h YdUg<sup>165</sup> **An estimated 90% of Pacific  
Islanders live within 5km of the coastlines.** In  
h YGc`ca cb`gUbXgUbXJubi U i žcj Yf \* \$i `cZh Y

# 5. Surging Seas in a Warming World: The Urgency of Action

the associated impacts and damages remain a complex challenge involving many geophysical and socioeconomic uncertainties, as our understanding of development and protection measures, **Nevertheless, one certainty that can be taken away from the latest research is that the climate crisis and SLR are no longer distant threats, especially for the Pacific SIDS.**

**the national adaptation plan (NAP) process presents an opportunity for whole-of-economy comprehensive risk management, including actions to prepare for and manage the impacts of sea-level rise.**

**The outcome of the first global stocktake (GST) under the Paris Agreement**

**Deep, rapid, and sustained cuts in global greenhouse gas emissions are needed NOW to stay within a 1.5°C long-term warming trajectory. At the same time, effective coastal adaptation and investment in resilience and implementation must be scaled up worldwide, especially in the SIDS, to minimize growing SLR impacts and risks.** For

**Countries' next nationally determined contributions (NDCs) under the Paris Agreement, due in 2025, present an unprecedented opportunity for countries to rally cross-government and non-state actors to take immediate action to cut emissions, chart out 1.5°C-aligned decarbonization pathways, and build resilience to climate impacts. Similarly,**





## Acknowledgments

H [g]hWb]W V]YZk Ugk f]Hb Vni\ YI B'GYWUfnt YbYU g'7]a UH'5V]cb HMa UbXfYj JYk YXVmY dYf]gZca the United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO), and < Yfj Y8Ua `Ua ]Ub`fH YDUW W/ca a i b]mi fD7Hz5X'i bV]DfcZ'6]]`< UYfA i fXcW I b]j Yf]g]m'7]a UH'5bUmi]V]Z DfcZ'9]gU]Y\ < c`UbXf]b]g]h h'cZGfU] m'FYg] ]YbWUbXGYW/f]m]Uih YI b]j Yf]g]m'7c`Y] Y@cbXcb/Zcfa Yf`mi Uih YI b]j Yf]g]m'cZ\ YGci h DUW V]Z8f" >Ua Yg? ]f\_ \ Ua `fH Y=b]h]f]b]U]cbU`7f]n]e]g\ YfY7]a UH`=b]h]U]j Yf]77-Hz DfcZ'5bXf]g@y] Yfa Ubb`fH YDc]g]Ua `b]g]h h'Zcf'7]a UH`=a dU]m]FYg]UfW]z8f"Fc]g]Ubb]YA Uf]m]f]7]a UH` 5bUmi]V]g/ < i a Vc`X]i b]j Yf]g]m'cZ6Yf`]b]zDUa DYUf]g]b]f]77-HzDfcZ'Fc]g\ Ub\_ Uf]U]g]b] \ Yf] < 9'8Y]Z=b]g]h h' Zcf'K U]f'9X] W]h]cb#8Y]Uf]Yg]z8f"6Yb'Gf]U g]g]f'7]a UH`7Y]b]f]U]z8f"Ac`Yb] H i \ c`cU\_] fD7HzUbX]DfcZ'Fc]V]f]h JU H]FX]f]D77K ; =7c!7\ U]f/7Y]b]f]Y]B]U]h]cbU`XY`Uf]Y]W]Y]W]Y]G]m]b]h] ei Y/=b]g]h h]D]Y]f]Y]G]a cb`@U]`U]m]"

## Annex I: Emissions and socioeconomic scenarios assessed in the IPCC reports

H [g]V]Y b] `Xf]Uk g'cb`g]y] YfU`=D77'f]Yd]c]f]g]k \ ]W U]g]g]Y]X]h]k c X]Z]f]Y]b]h]g]Y]g]c]Z]Z] h]i f]Y]f]Y]b] \ c]i g]Y]! [ U]g]Y]a ]g]g]cb]g] UbX]g]c]V]c]Y]W]b]ca ]W]g]W]b]U]f]c]g" H Y]H]V]Y]g]V]Y]c]k `g`c]k h'Y]X]Z]f]Y]b]h]g]W]b]U]f]c]g]U]b]X]U]g]c]V]U]H]X`cb] [ ]h]f]a [ `c]V]U` k U]fa ]b] [ `c]i h]W]a Y]g]U]g]g]Y]X]b] h'Y]G]l h' `5]g]Y]g]a Y]b]h]F]Y]d]c]f]h]U]b]X]b] h'Y: ]Z]h' `5]g]Y]g]a Y]b]h]F]Y]d]c]f]h]"

Table A.1.

