



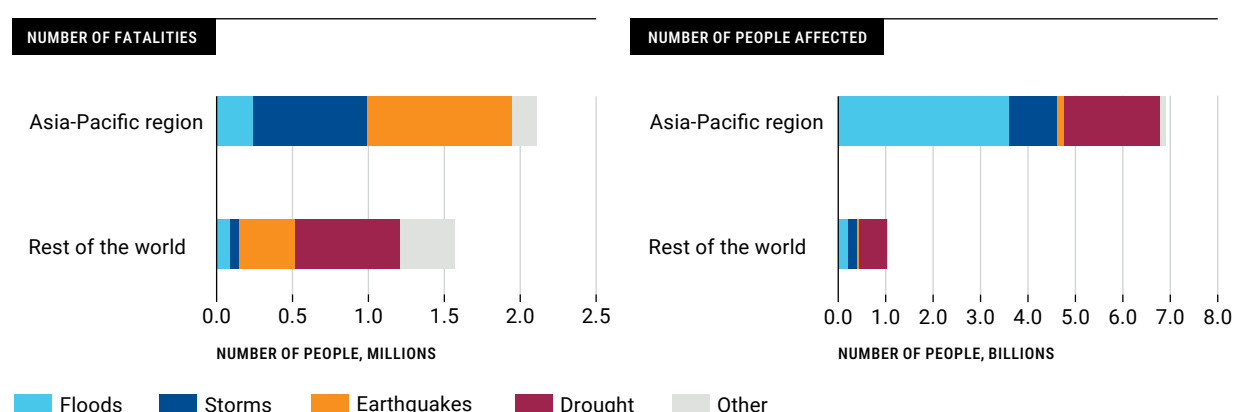
## CHAPTER 1

# The shifting contours of the Asia-Pacific disaster riskscape

Over the past two decades, countries in Asia and the Pacific have made significant progress in achieving the Sustainable Development Goals related to disaster risk reduction (Goal 1, Goal 9, Goal 11), and to promoting good health and well-being (Goal 3).<sup>1</sup> But most are still ill-prepared for complex overlapping crises. The simultaneous impacts of various hazards presents a riskscape that is expanding, and in particular, when biological risks are combined with those from other natural hazards, such as cyclones, earthquakes or drought. This was harshly demonstrated by the global spread of the COVID-19 pandemic, which presented an additional biological shock of a scale not experienced in a century. The world experienced deep consequences for health and survival, and national economies and societies suffered. Adding biological risks into loss calculations has increased current annual average losses from disasters to \$780 billion. The pandemic, combined with the persistent reality of climate change, is thus reshaping and expanding the Asia-Pacific disaster riskscape. The region has regressed on the critical goal of climate action (Goal 13),<sup>2</sup> and the emerging disaster-climate-health nexus demands a much more systemic approach to disaster risk reduction.

Since 1970, Asia and the Pacific has accounted for 57 per cent of global fatalities from disasters and 87 per cent of the global population that has been affected by natural hazards (Figure 1-1). Between 1970 and 2020, natural hazards in Asia and the Pacific affected 6.9 billion people and killed more than 2 million, that is 41,373 lives per year, one life every 13 minutes.<sup>3</sup> Nevertheless, there has been substantial progress: from 2011 to 2020, the average loss of life per year fell to 10,936 lives, and in 2019 and 2020, the average annual loss fell to around 6,200 lives (Figure 1-2).

**FIGURE 1-1** Number of fatalities and people affected in the Asia-Pacific region and the rest of the world, 1970–2020



Source: Data from EM-DAT – The International Disaster Database. Available at <https://www.emdat.be/> (accessed on 4 May 2021).

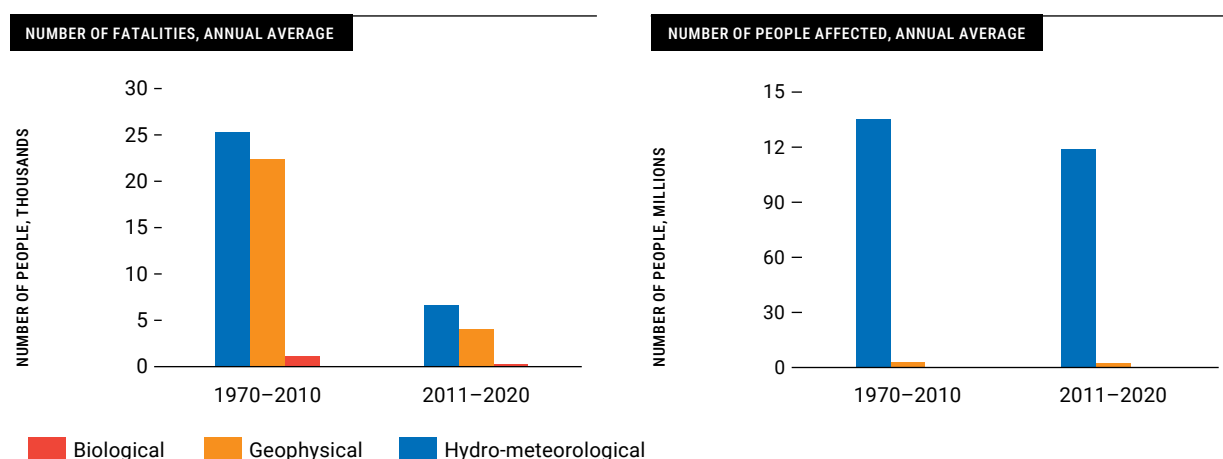
1 Asia and the Pacific SDG Progress Report 2021 (United Nations publication, 2021a). Available at [https://www.unescap.org/sites/default/d8files/knowledge-products/ESCAP\\_Asia\\_and\\_the\\_Pacific\\_SDG\\_Progress\\_Report\\_2021.pdf](https://www.unescap.org/sites/default/d8files/knowledge-products/ESCAP_Asia_and_the_Pacific_SDG_Progress_Report_2021.pdf)

2 Ibid.

3 EM-DAT – The International Disaster Database. Available at <https://www.emdat.be/>



**FIGURE 1-2** Number of fatalities and people affected in the Asia-Pacific region, 1970–2020



Source: Data from EM-DAT – The International Disaster Database. Available at <https://www.emdat.be/> (accessed on 4 May 2021).

This is heartening progress, and a testament to the efforts that governments and communities have been dedicated to protecting human life. Indeed, disasters inevitably continue to affect the region but the efforts to preserve life have clearly borne fruit. Despite the continued onslaught of natural calamities, countries have learned important lessons and strengthened their resilience, anticipating where a disaster might strike and creating early warning systems that protect lives, livelihoods, and economies.

Nevertheless, while the fatality rates are lower, the average yearly number of people affected has fallen only slightly; from 139 million people between 1970 and 2010 to 122 million people between 2011 and 2020, with Asia and the Pacific accounting for around three-quarters of the world's population that was affected by disasters. Almost all of those affected were victims of water-related disasters, such as floods, droughts and storms.<sup>4</sup>

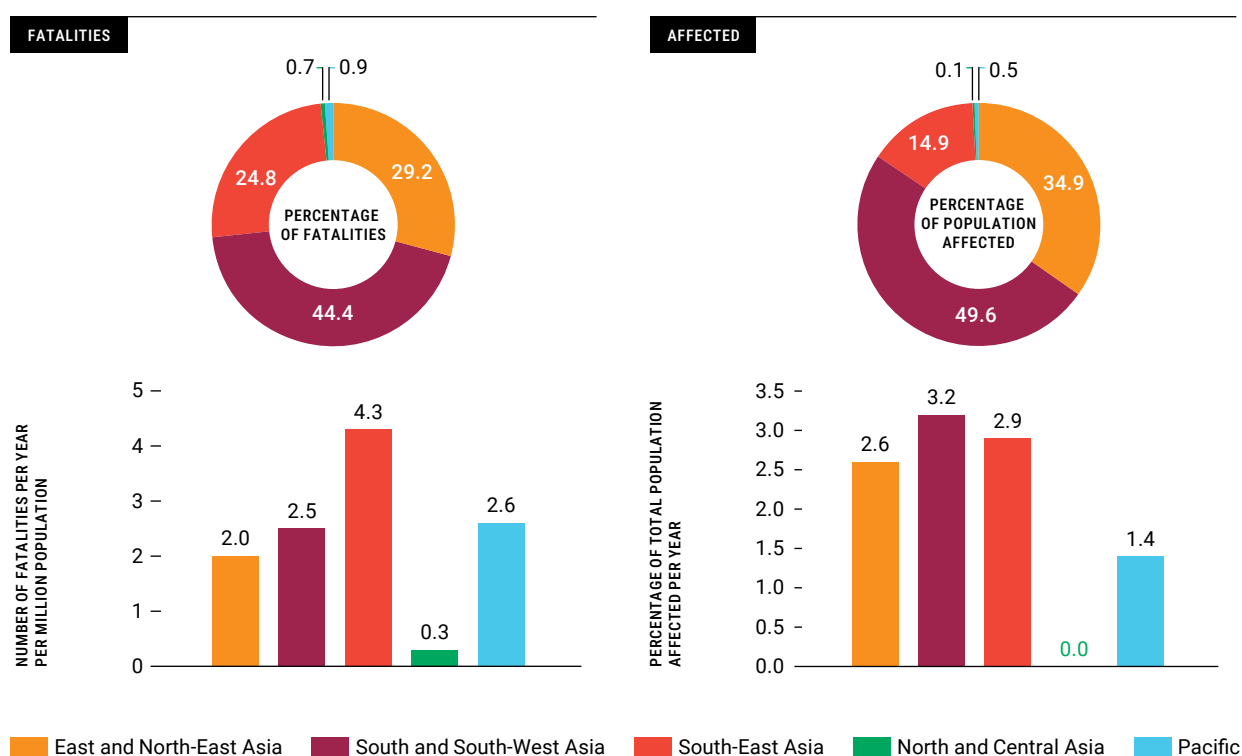
Disasters frequently drive people away from their homes. In 2019 alone, over 19 million people were displaced by natural hazards in Asia and the Pacific, which accounted for around three-quarters of the global total. Indeed, the Asia-Pacific region had the four largest numbers of people displaced that year: India, 5.1 million people; Philippines, 4.1 million people; Bangladesh, 4.1 million people; and China, 4 million people.<sup>5</sup>

Among the ESCAP subregions, fatalities from 2011 to 2020 were greatest in South and South-West Asia (44 per cent), followed by East and North-East Asia (29 per cent), and South-East Asia (25 per cent) (Figure 1-3). The numbers are inevitably low in the Pacific because of small population sizes. Nevertheless, people in the Pacific are acutely vulnerable to disasters, which is clear from the number of deaths calculated as a proportion of the population. From this perspective, the Pacific experienced a fatality rate of 2.6 people per million, second only to the South-East Asia region which was at 4.3 people per million.

Disasters also caused huge economic damage (Figure 1-4). Between 1990 and 2018, the average annual damage across the region was 0.34 per cent of gross domestic product (GDP), which was significantly higher than the global average of 0.22 per cent. Among the subregions, the worst affected were South and South-West Asia, followed by East and North-East Asia. While the Asia-Pacific region is regularly exposed to geophysical hazards, such as earthquakes and tsunamis, the greatest damage, both human and economic, tends to be caused by hydro-meteorological hazards, especially floods, droughts, hurricanes and tornadoes.

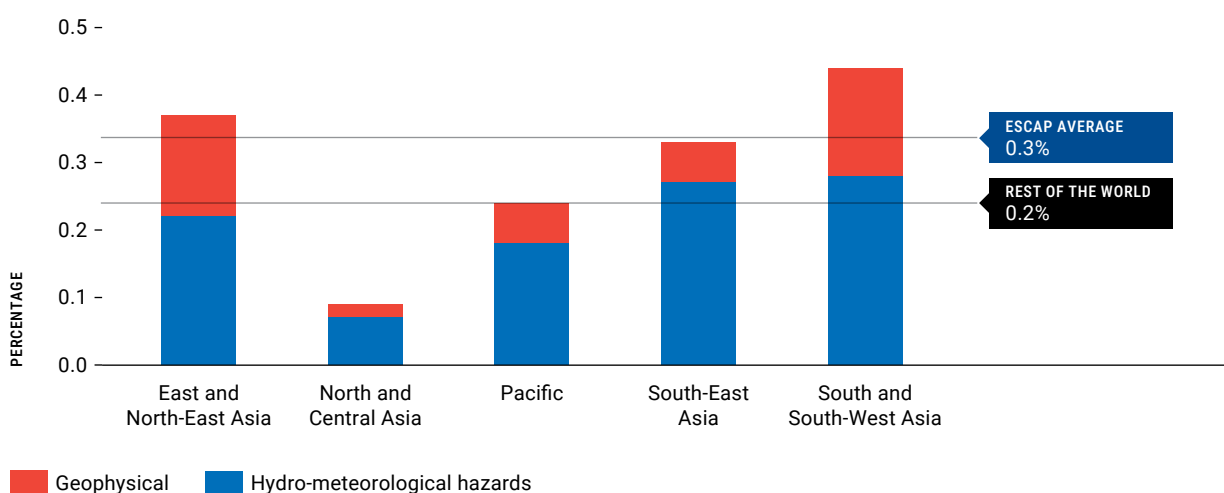
<sup>4</sup> Ibid.

<sup>5</sup> Internal displacement monitoring centre, "Global Report on Internal Displacement, 2020". Available at <https://www.internal-displacement.org/sites/default/files/publications/documents/2020-IDMC-GRID.pdf>

**FIGURE 1-3** Number of fatalities and people affected in ESCAP subregions, 2011–2020

Source: Data from EM-DAT – The International Disaster Database. Available at <https://www.emdat.be/> (accessed on 4 May 2021).

The following sections track the contours of the Asia-Pacific riskscape as it has been reshaped by climate change. The years 2015 to 2019 were reported as the warmest five-year period on record being 0.2°C warmer than the previous five-year period. This affected both extreme weather events, such as cyclones, and slow-onset disasters, such as droughts, while also accelerating the rise in sea levels.<sup>6</sup>

**FIGURE 1-4** Average annual damage as a percentage of GDP, 1980–2018

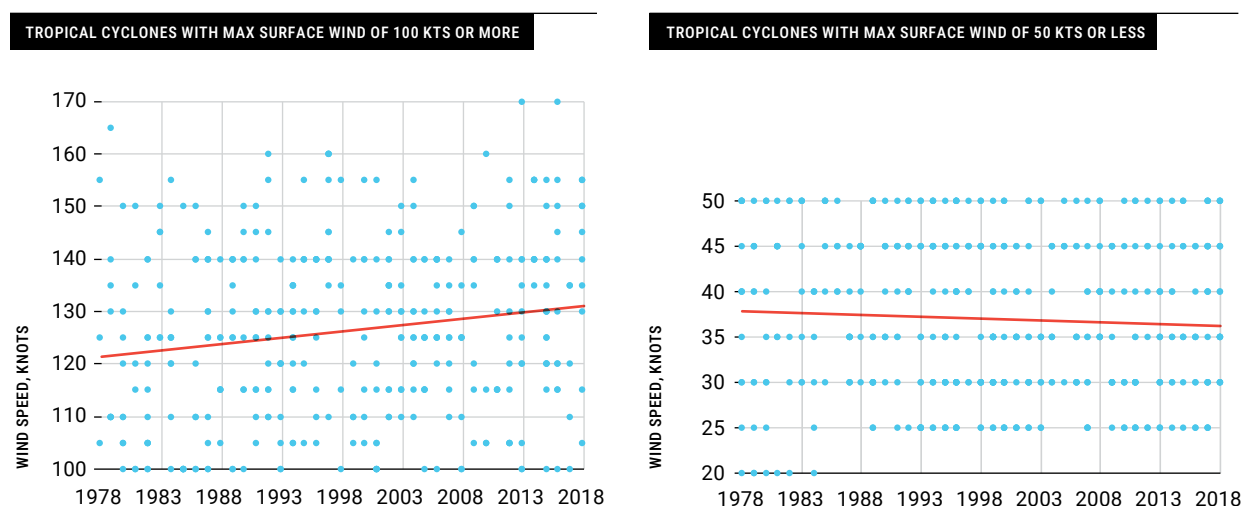
Source: Damage data (from 1990 to 2018) from EM-DAT – The International Disaster Database. Available at <https://www.emdat.be/> and GDP data from United Nations, Economic and Social Commission of Asia and the Pacific (ESCAP), Statistical Database. Available at <https://www.unescap.org/stat/data>

<sup>6</sup> World Meteorological Organization (WMO), "The Global Climate in 2015–2019", WMO Statements on Climate, (Geneva, 2019a). Available at [https://library.wmo.int/doc\\_num.php?explnum\\_id=9936](https://library.wmo.int/doc_num.php?explnum_id=9936)

## Tropical cyclones

Climate change appears to be affecting the intensity of tropical cyclones and related rainfall, though it does not appear to be influencing the number of events.<sup>7</sup> In the Western North Pacific and between 1978 and 2018, the strongest cyclones, which have a maximum surface wind speed of 100 knots or more, seem to have been getting stronger, while the weaker cyclones of 50 knots or less have become somewhat weaker (Figure 1-5).

**FIGURE 1-5** Wind speeds of tropical cyclones in the Western North Pacific, 1978–2018



Source: Data from Joint Typhoon Warning Center (JTWC), Annual Tropical Cyclone Reports.

A more positive trend is that there has been a decline in the number of fatalities (Figure 1-6). In the 1990s and 2000s, countries in South and South-West Asia and South-East Asia experienced huge losses of life, but over the past decade the number of fatalities has fallen dramatically. There has also been a decline, though smaller, in the number of people affected, which was 206 million for the period 2011 to 2020.

**FIGURE 1-6** Number of fatalities and people affected by tropical cyclones in Asia and the Pacific, 1991–2020



Source: Data from EM-DAT – The International Disaster Database. Available at <https://www.emdat.be/> (accessed on 4 May 2021).

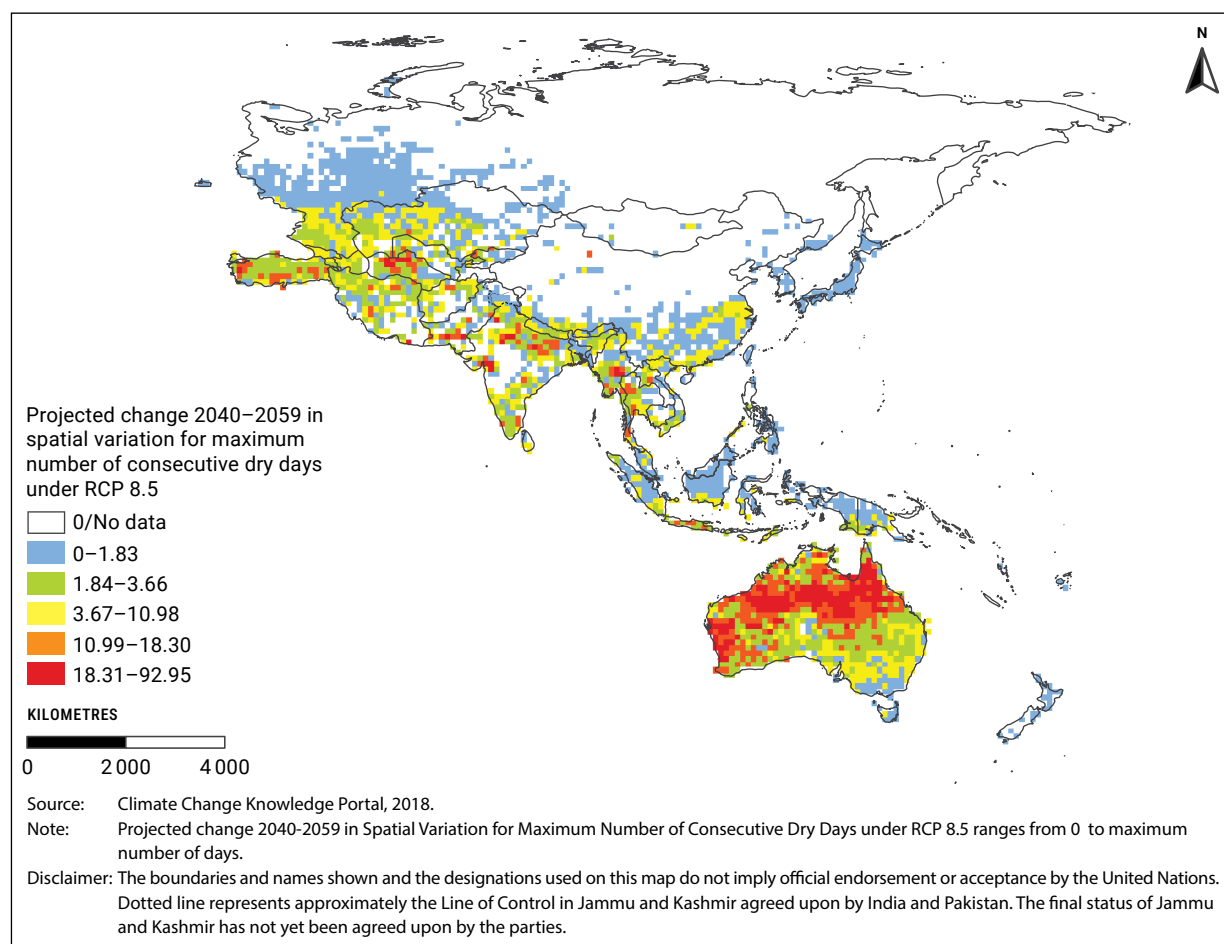
<sup>7</sup> Intergovernmental Panel on Climate Change (IPCC), “Managing the risks of extreme events and disasters to advance climate change adaptation”, (New York, Cambridge University Press, 2012). Available at [https://archive.ipcc.ch/pdf/special-reports/srex/SREX\\_Full\\_Report.pdf](https://archive.ipcc.ch/pdf/special-reports/srex/SREX_Full_Report.pdf)

## Droughts

Climate change is likely to alter the distribution of renewable water resources, reducing them most in dry subtropical regions, while increasing them at higher latitudes.<sup>8</sup> In Asia and the Pacific, this is likely to increase the occurrence and intensity of droughts, especially in drylands.<sup>9</sup> South-East Asia, in particular, will be affected as the combination of varying rainfall and higher temperatures could lead to severe droughts.<sup>10</sup>

Climate change projections from the Intergovernmental Panel on Climate Change (IPCC) are based on a series of scenarios using 'representative concentration pathways' (RCPs).<sup>11</sup> The business-as-usual, worst-case scenario is 'RCP 8.5' which would deliver global warming at an average of 8.5 watts per square metre across the planet and, compared with pre-industrial temperatures, an increase of about 4.3°C, by 2100. Figure 1-7 illustrates the projected maximum number of consecutive dry days for 2040 to 2059 under RCP 8.5. It projects an increase in most of the low- and mid-latitude areas of the Asia-Pacific region. This is especially alarming for countries in South and South-West Asia, South-East Asia, and Australia.

**FIGURE 1-7**      **Number of consecutive dry days – projected change RCP 8.5, 2040–2059**



8 Rajendra K. Pachauri and Leo Meyer, eds., "Climate Change 2014, Synthesis Report", Intergovernmental Panel on Climate Change (Geneva, 2014). Available at [https://www.ipcc.ch/site/assets/uploads/2018/02/SYR\\_AR5\\_FINAL\\_full.pdf](https://www.ipcc.ch/site/assets/uploads/2018/02/SYR_AR5_FINAL_full.pdf)

9 Food and Agriculture Organization, Proactive approaches to drought preparedness – Where are we now and where do we go from here? (Rome, 2019).

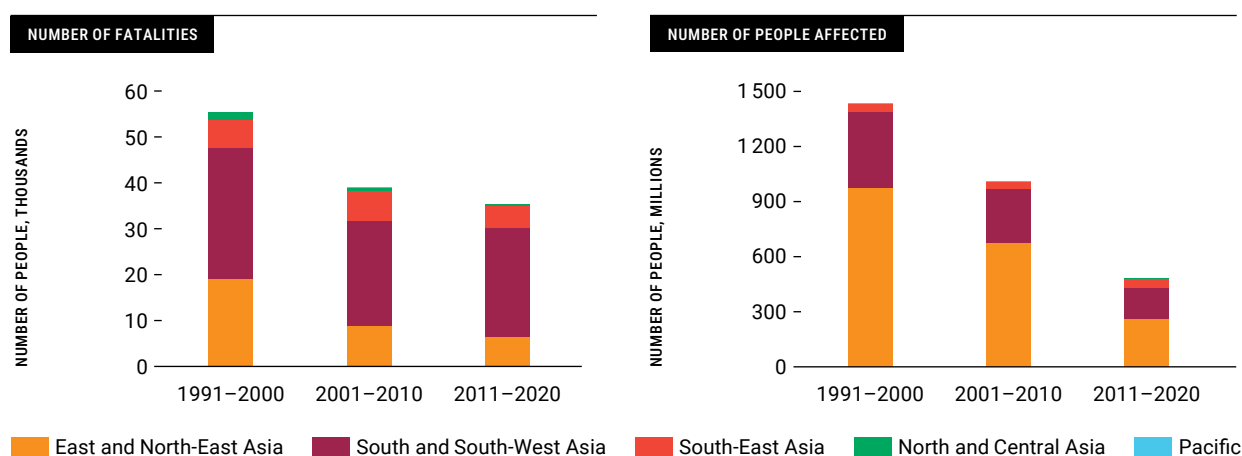
10 Ready for the dry years: Building resilience to drought in South-East Asia: With a focus on Cambodia, Lao People's Democratic Republic, Myanmar and Viet Nam, 2020 Update (United Nations publication, 2020d). Available at <https://www.unescap.org/sites/default/files/publications/Ready%20for%20the%20Dry%20Years.pdf>

11 RCPs specify concentrations of greenhouse gases that will result in total radiative forcing increasing by a target amount by 2100, relative to pre-industrial levels. Total radiative forcing is the difference between the incoming and outgoing radiation at the top of the atmosphere.

## Floods

In recent decades, floods seem to be having less impact in terms of fatalities and the number of people affected (Figure 1-8). In the 1990s, floods killed 55,000 people, but that number fell to 39,000 in the 2000s. Moreover, the number of people affected, in the same period, fell by more than half. However, this decrease was mostly seen in East and North-East Asia. In South and South-West Asia and South-East Asia the impacts remained similar.

FIGURE 1-8 Number of fatalities and people affected by floods, 1991–2020



Source: Data from EM-DAT – The International Disaster Database. Available at <https://www.emdat.be/> (accessed on 4 May 2021).

The risks are greater in lower-latitude regions. This can be assessed by the ‘return period’, which is the frequency with which the maximum cumulative precipitation over five consecutive days is likely to return during a ten-year period. Figure 1-9 shows the ten-year return period for the period 2040–2059 under RCP 8.5. More precipitation does not necessarily lead to more floods, but the risks can increase, especially in flood-prone countries, such as Bangladesh and India, in coastal areas in South-East Asia and in the Pacific small island developing States.

## Extreme temperatures

Countries in the Asia-Pacific region also experience extreme temperatures, often in the form of heatwaves. Between 1998 and 2017, heatwaves caused almost 166,000 deaths.<sup>12</sup> Between 2000 and 2016, the number of people exposed increased by around 125 million, while the heatwaves lasted longer.<sup>13</sup>

- **2015** – There were more than 55,000 fatalities in the Russian Federation, 2,200 in India and 1,200 in Pakistan.<sup>14</sup>
- **2018** – There was a heatwave emergency in the Democratic People’s Republic of Korea, with temperatures as high as 40°C recorded across the country.<sup>15</sup>
- **2020** – Exceptionally high temperatures were recorded in eastern Australia, Hong Kong, China, Japan, New Zealand and the Russian Federation.<sup>16</sup>

12 World Health Organization, Heatwaves. [https://www.who.int/health-topics/heatwaves#tab=tab\\_1](https://www.who.int/health-topics/heatwaves#tab=tab_1) (accessed on 22 July 2021).

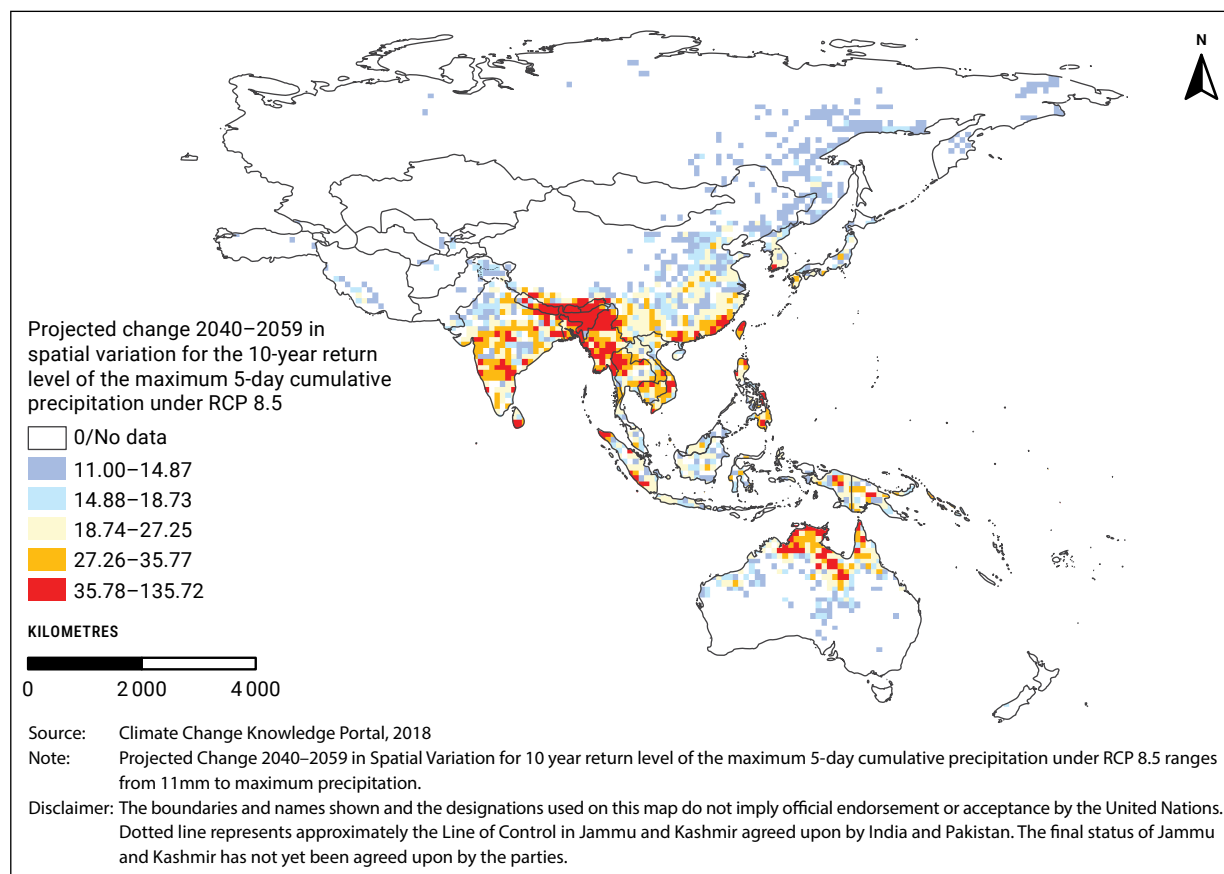
13 World Health Organization, “Heat and Health: Key Facts”, 1 June 2018. Available at <https://www.who.int/news-room/fact-sheets/detail/climate-change-heat-and-health> (accessed on 22 July 2021).

14 EM-DAT – The International Disaster Database. Available at <https://www.emdat.be>

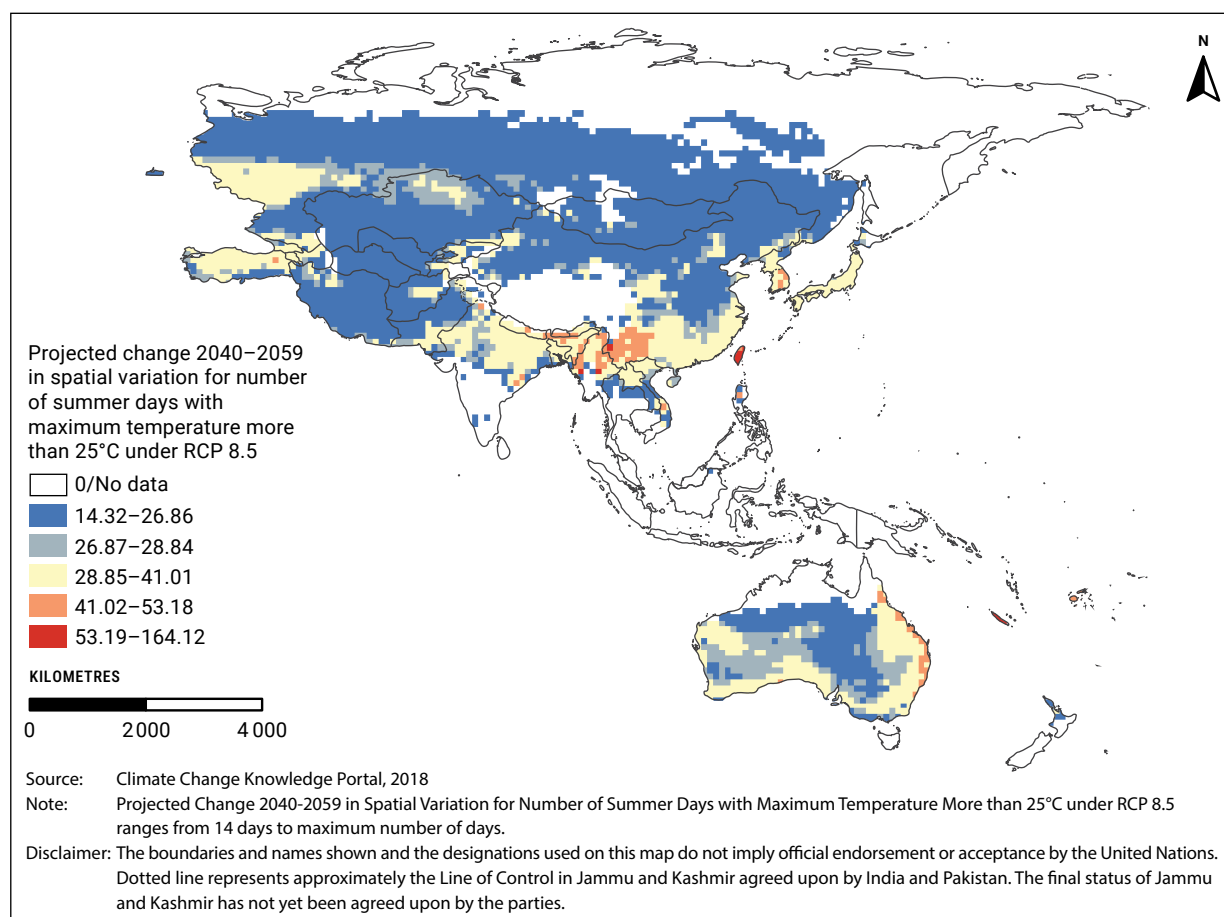
15 International Federation of Red Cross and Red Crescent Societies, “Emergency Plan of Action Final Report: DPR Korea: Heat Wave”, 28 July 2019. Available at <https://reliefweb.int/sites/reliefweb.int/files/resources/MDRKP010dfr.pdf>

16 World Meteorological Organization, “State of the Global Climate 2020: Unpacking the indicators”, provisional report, 20 April 2021. Available at [https://library.wmo.int/doc\\_num.php?explnum\\_id=10444](https://library.wmo.int/doc_num.php?explnum_id=10444)

**FIGURE 1-9** Maximum five-day cumulative precipitation amount projected to return in a ten-year period, RCP 8.5, 2040–2059



**FIGURE 1-10** Projected change in number of days with temperature over 25°C, RCP 8.5, 2040–2059





The risk of heatwaves is likely to increase, which will also have substantial impacts on various sectors including agriculture, health and water management. Under RCP 8.5, the number of summer days with a maximum temperature more than 25°C is projected to increase in many areas, especially those in subtropical regions (Figure 1-10).

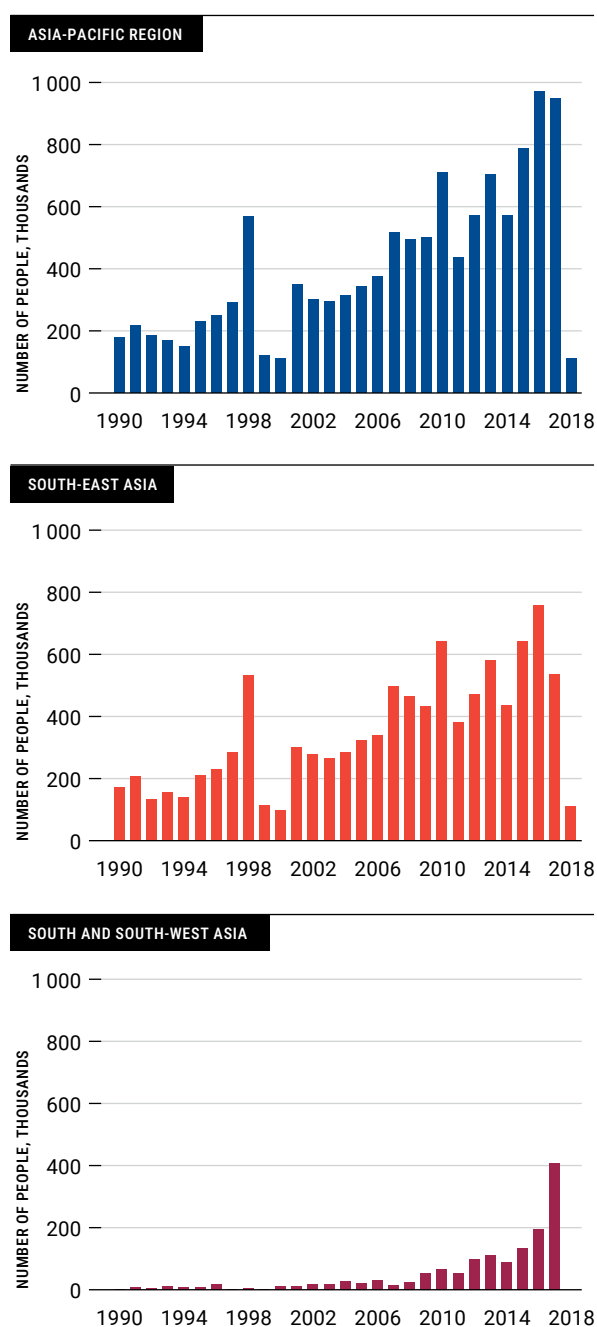
In other countries in the Asia-Pacific region, extremely low temperatures have also been recorded. In 2008, severe winter conditions cost over 1,300 lives in Afghanistan, and affected 77 million people in China. From 2016 to 2019, Mongolia suffered from 'dzud', which are severe winters that killed large numbers of livestock.<sup>17</sup>

## Climate change threatens health

Recent decades have seen an increase in the risk of climate-related diseases leading to illness and death.<sup>18</sup> For vector-borne diseases, such as malaria and dengue, rising temperatures can reduce the incubation period for mosquitos and facilitate the transmission of the disease.<sup>19</sup> Between the 1990s and 2010s, the average number of dengue cases per year increased from 200,000 to over 500,000. Between 1990 and 2018, there were particularly rapid increases in South and South-West Asia and in South-East Asia (Figure 1-11).

In 2019, several countries in these subregions again reported dengue outbreaks (Table 1-1).<sup>20</sup>

FIGURE 1-11 Confirmed dengue cases, 1990–2018



Source: World Health Organization, Dengue data application. Available at <https://ntdhdq.shinyapps.io/dengue5/> (accessed on 6 February 2021).

17 EM-DAT – The International Disaster Database. Available at <https://www.emdat.be>

18 World Meteorological Organization and others, "United in Science: High-level synthesis report of latest climate science information convened by the Science Advisory Group of the UN Climate Action Summit 2019", 2019b. Available at <https://reliefweb.int/sites/reliefweb.int/files/resources/climsci.pdf>

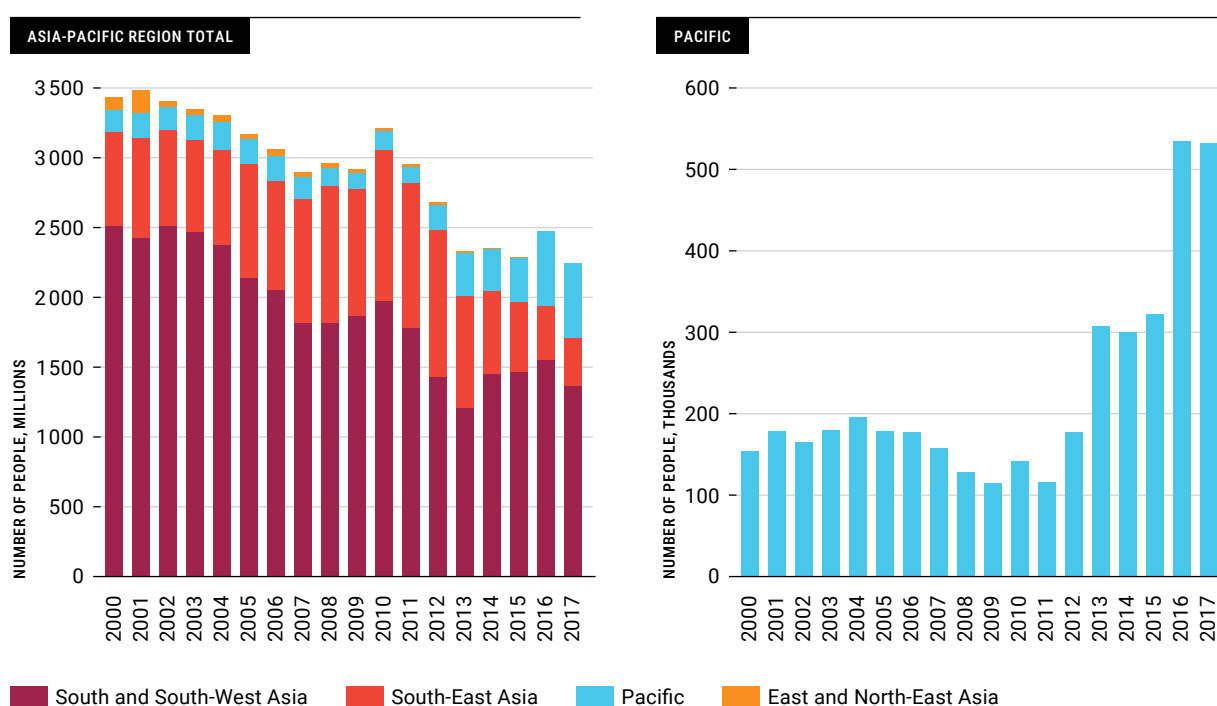
19 World Health Organization, "Climate change and human health - risks and responses", technical report, 4 December 2003. Available at Link: <https://www.who.int/publications/i/item/climate-change-and-human-health—risks-and-responses>

20 Government of Sri Lanka, "Dengue cases double in 2019", news.lk, 1 January 2020. Available at <https://www.news.lk/news/political-current-affairs/item/28976-dengue-cases-double-in-2019>; Gemma Holliani Cahya, "Dengue death toll climbs to 132, eight regions declare emergency", The Jakarta Post, 31 January 2019. Available at <https://www.thejakartapost.com/news/2019/01/31/dengue-death-toll-climbs-to-132-eight-regions-declare-emergency.html>; Government of the Marshall Islands, "Dengue-3 outbreak in Republic of the Marshall Islands June 25, 2019 – March 21, 2021", situation report, 23 March 2021. Available at <https://reliefweb.int/report/marshall-islands/dengue-3-outbreak-republic-marshall-islands-june-25-2019-march-21-2021>; World Health Organization, "WHO scales up response to worldwide surge in Dengue", 14 November 2019. Available at <https://www.who.int/news-room/feature-stories/detail/who-scales-up-response-to-worldwide-surge-in-dengue>; Anil Gejji, "With over 14k cases, Karnataka tops dengue list in the country", The Times of India, 6 December 2019. Available at <https://timesofindia.indiatimes.com/india/with-over-14k-cases-karnataka-tops-dengue-list-in-the-country/articleshow/72405244.cms>; Government of Philippines, "DOH declares national dengue epidemic", press release, 6 August 2019. Available at <https://doh.gov.ph/press-release/DOH-DECLARES-NATIONAL-DENGUE-EPIDEMIC>

TABLE 1-1 **Dengue outbreaks in 2019**

Subregion	Countries	Impact summary
South-East Asia	Philippines	The Department of Health declared a national dengue epidemic. There were 146,062 cases recorded from January to July 2019, which was almost double the number for the same period in 2018.
	Indonesia	Indonesia reported a total of 13,683 dengue fever cases in January 2019, and eight regions declared a dengue emergency. However, since 2016, the country has seen an overall decline in dengue cases and related deaths.
Pacific	Marshall Islands	There were 772 dengue-like illness cases of which 220 had been confirmed as of 25 June 2019.
South and South-West Asia	Bangladesh	In 2019, the worst dengue outbreak was recorded with more than 92,000 cases. The prolonged monsoon rains provided ideal breeding grounds for mosquitoes to thrive in warm, humid conditions.
	Pakistan	The worst dengue outbreak was recorded with over 45,000 people infected as of early November 2019.
	India	In 2019, 91,457 cases of dengue were reported until October.
	Nepal	More than 10,000 cases of dengue fever were reported as of late September 2019.
	Sri Lanka	The worst year was 2017, with more than 186,000 confirmed cases recorded. In 2019, 99,120 cases were recorded, which was nearly double the number in 2018.

For malaria, on the other hand, the total number of confirmed cases has gradually decreased since 2000. Nevertheless, over 2 million cases are reported every year, mainly in South and South-West Asia, and South-East Asia. In the Pacific, the numbers have been rising; from less than 200,000 per year in the early 2000s to over 500,000 in 2016 and 2017 (Figure 1-12).

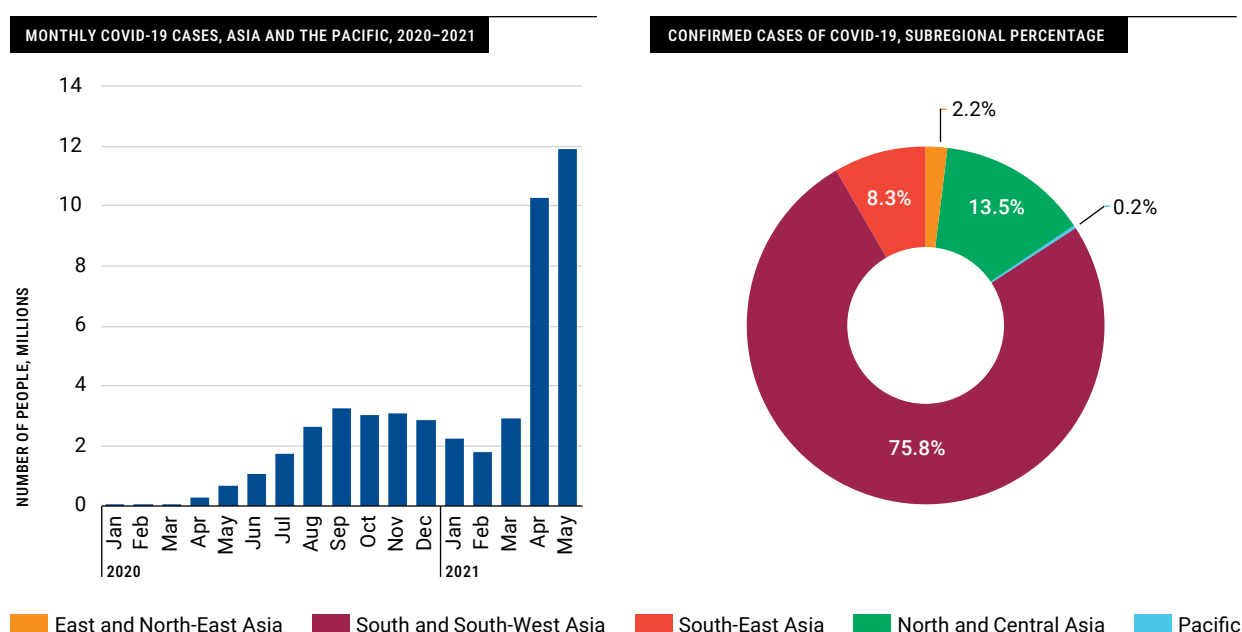
FIGURE 1-12 **Confirmed malaria cases, 2000–2017**

Source: Data from World Health Organization, Global Health Observatory. Available at <https://www.who.int/data/gho/data/themes/topics/topic-details/GHO/cases> (accessed on 6 February 2021).

## COVID-19-compounded disasters

As of 6 June 2021, countries in the Asia-Pacific region had reported 49 million confirmed COVID-19 cases, and more than 748,000 deaths. The pandemic has had the greatest impact in South and South-West Asia, with 37.2 million confirmed cases, and in North and Central Asia with 6.6 million cases (Figure 1-13).<sup>21</sup>

**FIGURE 1-13** Monthly COVID-19 cases in Asia and the Pacific, 1 January 2020–6 June 2021



Source: Data from World Health Organization, WHO Coronavirus (COVID-19) Dashboard. Available at <https://covid19.who.int> (accessed on 7 June 2021).

While the COVID-19 pandemic raged on, the region continued to experience other natural hazards, many of which were hydro-meteorological (Figure 1-14). Tropical cyclones hit many countries across the region. Major flood events were reported in China, Japan, Papua New Guinea, Pakistan, the Islamic Republic of Iran, Kazakhstan and Uzbekistan.

The lockdowns, travel restrictions and other containment measures that were imposed as a response to COVID-19 interrupted many established measures for prevention, response, and recovery from natural hazards. At the same time, natural hazards also hampered the response to COVID-19 and facilitated its spread as people were forced to crowd together in emergency shelters.

In May 2020, the COVID-19 pandemic was rapidly spreading in India and Bangladesh when cyclone Amphan struck (Figure 1-15). It was one of the strongest recorded cyclones that hit densely populated coastal areas and led to extensive flooding. In West Bengal, it damaged 563 primary health centres, 169 block primary health centres and 5,142 community sub-centres.<sup>22</sup>

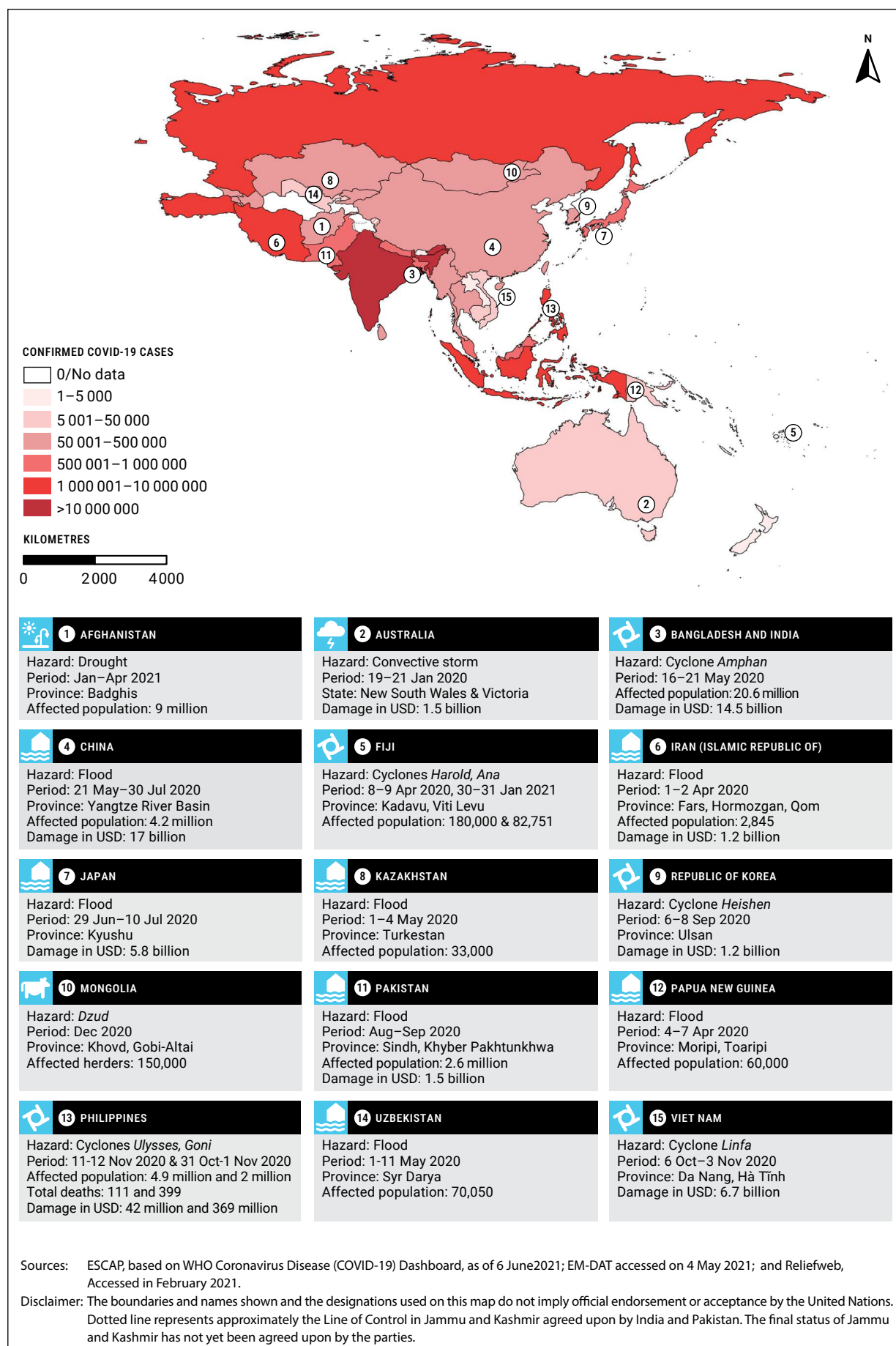
In August 2020, the city of Karachi, in Pakistan, was hit by record flooding and torrential rainfall which cost 440 lives and affected close to 1.6 million people. In the Philippines, typhoon Goni made landfall in the Bicol region, in November, which resulted in crowding in vaccination centres and triggered a far greater risk of transmission. The typhoon isolated several towns and damaged the main COVID-19 laboratory, resulting in the suspension of COVID-19 testing.<sup>23</sup>

21 World Health Organization, WHO Coronavirus (COVID-19) Dashboard. Available at <https://covid19.who.int>

22 International Federation of Red Cross and Red Crescent Societies, (IFRC), "India: Cyclone Amphan Operation Update Report", Situation Report, (India, 23 July 2020b). Available at <https://reliefweb.int/report/india/india-cyclone-amphan-operation-update-report-dref-n-mdrin025> (accessed on 12 February 2021).

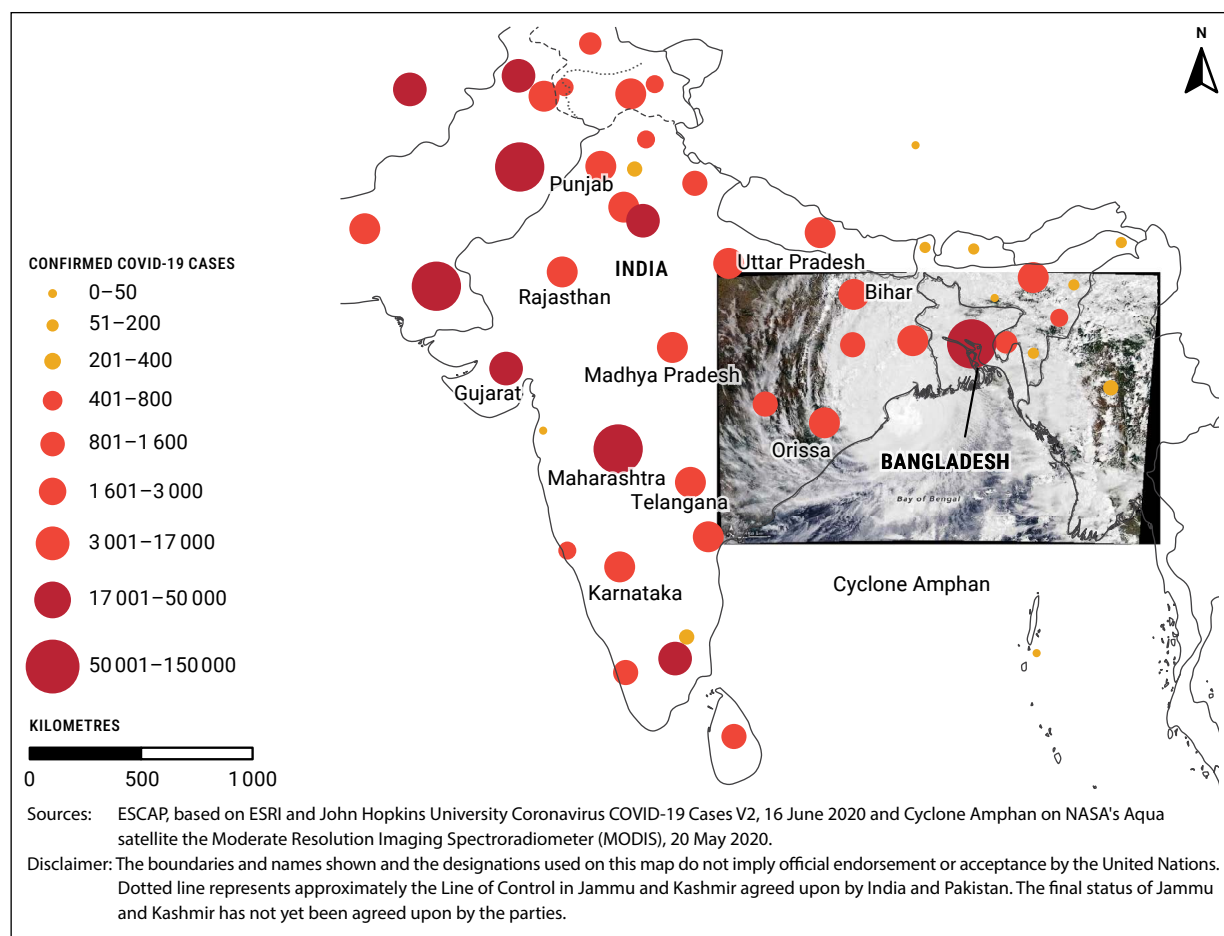
23 "Super typhoon Goni: Towns cut off as COVID-19 impacts response", UN News, 3 November 2020. Available at <https://news.un.org/en/story/2020/11/1076742> (accessed on 13 February 2021).

FIGURE 1-14 COVID-19 and major disasters in 2020 and 2021



Note: Confirmed cases are as of 6 June 2021.



**FIGURE 1-15** Convergence of cyclone Amphan with the COVID-19 pandemic

Source: United Nations, Economic and Social Commission of Asia and the Pacific (ESCAP), "Protecting the most vulnerable to cascading risks from climate extremes and the COVID-19 in South Asia", policy brief, 14 August 2020b. Available at <https://www.unescap.org/resources/protecting-most-vulnerable-cascading-risks-climate-extremes-and-covid-19-south-asia>

**TABLE 1-2** Number of people affected by the COVID-19 pandemic and natural hazards in the Asia-Pacific subregions

Subregion	Number of people affected by COVID-19			Number of people affected by natural hazards (2020)
	2020	2021 (as of 6 June)	Sub-total	
East and North-East Asia	388 894	693 665	1 082 559	15 328 666
South and South-West Asia	12 801 945	24 392 271	37 194 216	30 910 631
South-East Asia	1 442 436	2 636 426	4 078 862	15 738 911
North and Central Asia	4 043 839	2 568 085	6 611 924	113 709
Pacific	55 160	21 421	76 581	359 636
Total	18 732 274	30 311 868	49 044 142	62 451 553

## A riskscape of cascading hazards

The convergence of biological and natural hazards has added to the stresses of poverty and inequality, further damaging the life prospects of millions of people across the Asia-Pacific region. The pandemic has demonstrated that while some countries have achieved success in dealing with individual disasters, many others are still ill-prepared for complex overlapping crises. This will have implications for achieving the goals of the 2030 Agenda for Sustainable Development.

These limitations were already identified in the Sendai Framework for Disaster Risk Reduction 2015–2030, which was adopted by UN Member States in 2015 at the World Conference on Disaster Risk Reduction. The framework recognized the central importance of health threats, including biological hazards, which encouraged the development of the field of ‘health emergency and disaster risk management.’<sup>24</sup> Even so, the intersection of biological and other natural hazards remains poorly explored and understood.<sup>25</sup>

Any natural disaster or other emergency that displaces large numbers of people is likely to lead to a surge in epidemic diseases, such as hepatitis A and E, measles, diarrhoeal diseases, meningitis, acute respiratory infections, malaria, or dengue. In August 2020, during the COVID-19 pandemic, the monsoon floods in South Asia heightened the risk of dengue and malaria outbreaks and stretched health resources to breaking point.<sup>26</sup> The coincidence of natural and biological hazards is illustrated in Figure 1-16.<sup>27, 28</sup>

The overlaps between multiple hazards are likely to intensify as a result of climate change, particularly in Asia and the Pacific, which is already the world’s most disaster-prone region.<sup>29</sup> Climate-related disasters of increasing frequency, intensity and unpredictability are already battering vulnerable sectors and communities (Figure 1-17). Overlapping hazards, along with the interconnectedness of economies at different scales, are creating systemic risks that demand more sustained and rigorous approaches.<sup>30</sup>

**Biological hazards** - Between 2000 and 2020, biological hazards accounted for almost 8 per cent of the total number of disaster events recorded in the Asia-Pacific region and affected more than 3 million people (Figure 1-17). Along with the epidemics and pandemics, there are also endemic health hazards including dengue, typhoid, tuberculosis, and chikungunya. Assessing the region’s vulnerability to biological hazards, the World Health Organization (WHO) notes that the largest threats to the region are the Middle East respiratory syndrome, diarrhoeal diseases, Crimean-Congo haemorrhagic fever, Japanese encephalitis, and the Zika virus disease.<sup>31</sup>

## BOX 1-1

**Cascading hazards**

The concept of cascading hazards comprises everything from vulnerability, risks, threats, triggers, to processes, responses, and outcomes. Cascading hazards turn into cascading disasters when their effects increase in progression over time and generate unexpected secondary events. These events can stem from overlaps of disaster events, from failures of physical structures and the social functions that depend on them, including critical facilities. The inadequacy of mitigation strategies, such as evacuation procedures, land-use planning and emergency management strategies further exacerbate the situation. Cascading disasters tend to highlight the major gaps in addressing vulnerabilities in human societies.

Adapted from: Shlomo Mizrahi, “Cascading disasters, information cascades and continuous time models of domino effects”, *International Journal of Disaster Risk Reduction*, vol 49 (October 2020). Available at <https://doi.org/10.1016/j.ijdr.2020.101672>

24 Natalie Wright and others, “Health emergency and disaster risk management: Five years into implementation of the Sendai Framework”, *International Journal of Disaster Risk Science*, vol. 11 (2020), pp. 206–217. Available at <https://link.springer.com/article/10.1007/s13753-020-00274-x>

25 Rajib Shaw and others, “Integrating biological hazards (including pandemics) into DRR planning”, technical advisory document. Available at [http://www.ccouc.ox.ac.uk/\\_asset/file/technical-advisory-document-on-biological-hazard-rajib-final.pdf](http://www.ccouc.ox.ac.uk/_asset/file/technical-advisory-document-on-biological-hazard-rajib-final.pdf)

26 International Federation of Red Cross and Red Crescent Societies (IFRC), “17.5 million affected by floods and threatened by disease in South Asia”, press release, 6 August 2020a. Available at <https://media.ifrc.org/ifrc/press-release/17-5-million-affected-floods-threatened-disease-south-asia/>

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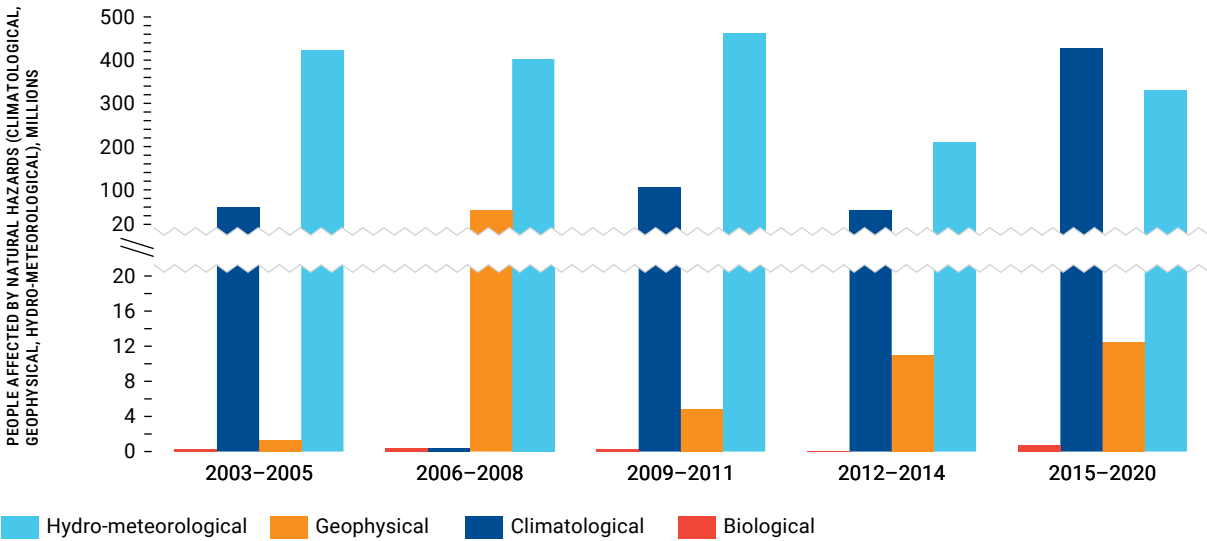
28 World Health Organization, Regional Office for South-East Asia, *Roots for Resilience: A health Emergency Risk Profile of the South-East Asia Region* (New Delhi, 2017). Available at <https://apps.who.int/iris/handle/10665/258766>

29 The Disaster Riskscape across Asia-Pacific: Pathways for Inclusion and Empowerment (United Nations publication, 2019).

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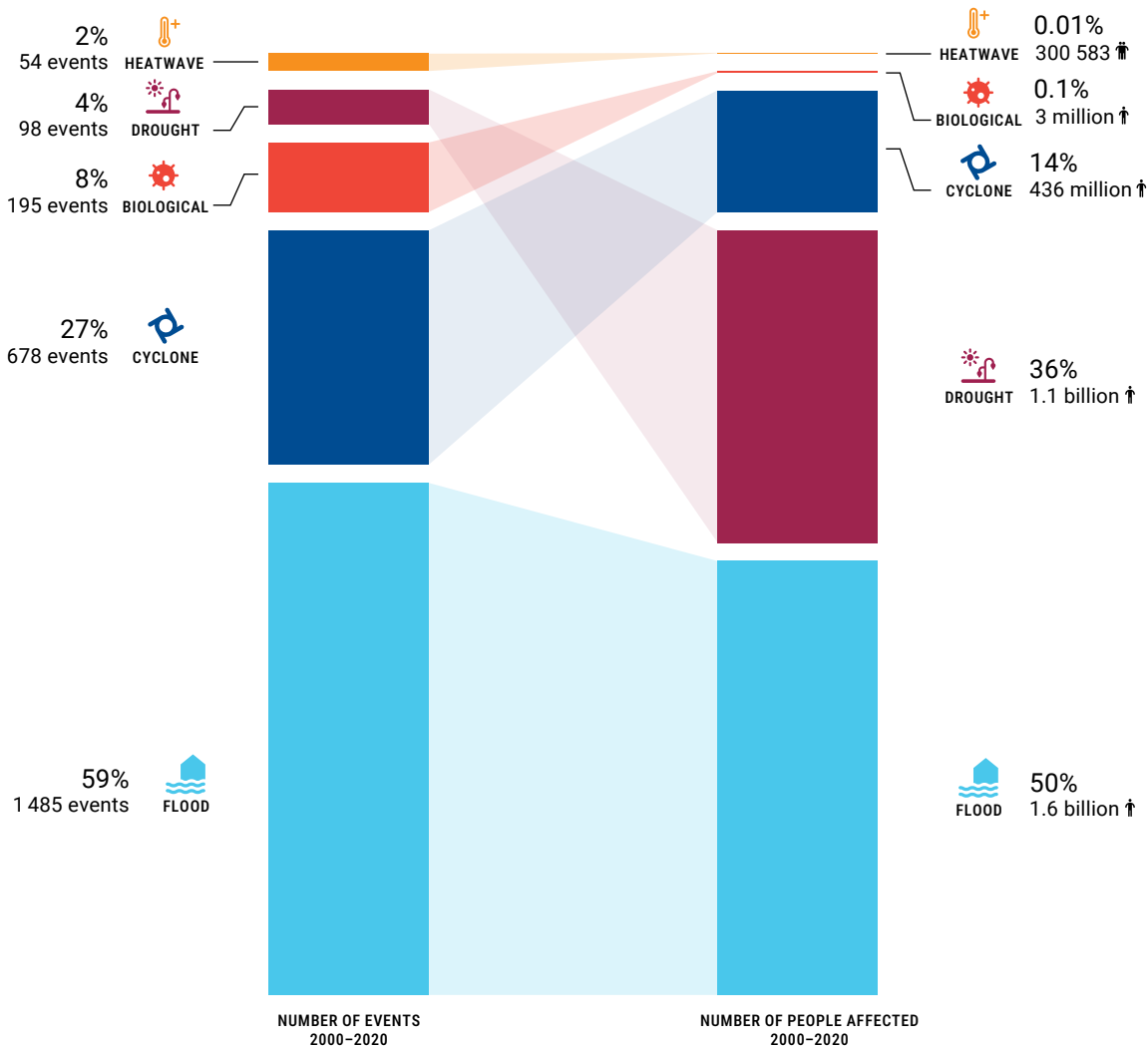
31 Asia and the Pacific SDG Progress Report 2020 (United Nations publication, 2020a). Available at <https://www.unescap.org/publications/asia-and-pacific-sdg-progress-report-2020>

FIGURE 1-16      **Number of people in Asia and the Pacific affected by biological and other natural hazards, 2003–2020**



Source: EM-DAT – The International Disaster Database. Available at <https://www.emdat.be> (accessed on 20 April 2021).

FIGURE 1-17      **Types of disasters in Asia and the Pacific, 2000–2020**



Source: EM-DAT – The International Disaster Database. Available at <https://www.emdat.be> (accessed on 20 April 2021).  
Note: All figures have been rounded off.

## Intersection of biological hazards with natural hazards

*Floods* – By worsening living conditions and displacing people from their homes, floods can lead to gastro-intestinal illnesses. They also interrupt the treatment of non-communicable diseases by disrupting supply chains. In addition, there is a heightened risk of vector-borne diseases, such as dengue and malaria.<sup>32</sup> The human-animal-insect interaction weaves a complex web of disease transmission that is further compounded during flooding, which provides a perfect breeding ground for mosquitos.<sup>33</sup>

*Tropical cyclones* – Through water contamination, cyclones can lead to communicable and infectious diseases. Following cyclone Ami, in Fiji in 2003, for example, drinking water was found to be filled with coliform bacteria, resulting in cases of diarrhoea and dysentery and other water-borne diseases, such as cholera and typhoid fever.<sup>34</sup> Subsequent waterlogging also creates breeding grounds for the vectors of malaria, dengue and chikungunya, with an increased risk of skin infections.<sup>35</sup>

*Droughts* – Droughts can lead to increased pollution, pests and diseases, and even famine.<sup>36</sup> Shrinking water sources increase the risks of contamination, and when droughts force people to migrate there is often an increase in child malnutrition,<sup>37</sup> stunting, and even adult malnutrition.<sup>38</sup> Droughts typically affect the most vulnerable populations, creating cycles of intergenerational deprivation.<sup>39</sup>

*Heatwaves* – These are more recent and poorly understood threats. They disrupt economies, result in losses in labour productivity, agriculture, transport and utilities, and present profound risks to health. Heatwaves increase deaths for those suffering from underlying cardiovascular and respiratory conditions, and are also associated with suicides. The very old, the poor, the socially isolated, and those who often work outdoors in informal economies, are the most susceptible. Poorer people, living in inferior housing conditions experience overheating, while the costs of water make bathing more expensive. The demand for healthcare soars, increasing requests for consultations and increasing admissions to hospitals that themselves are often poorly designed to cope with the heat. Another issue is the use of electricity for fans and air-conditioning which leads to shortages of supply. Furthermore, the poor may not be able to afford any form of mechanical cooling.<sup>40</sup> Even countries accustomed to high temperatures have not been spared. For example, during the 2015 heatwave in Karachi, Pakistan, almost 65,000 people were taken to hospital with heat-related symptoms.<sup>41</sup> Additionally, air-conditioning mostly uses energy derived from fossil fuels and, thus, contributes to climate change, while waste heat from the pumps also intensifies the urban heat island effect.<sup>42</sup>

This range of disasters exacerbates the underlying drivers of vulnerability, which include poverty, inequality, unplanned and rapid urbanization. Poor natural resource management along with compounding factors, such as increasing populations, population density, and declining and fragile ecosystems all converge into a riskscape of expanding and cascading hazards. And, this is the riskscape within which the COVID-19 pandemic appeared.

32 World Health Organization, Regional Office for South-East Asia, *Roots for Resilience: A health Emergency Risk Profile of the South-East Asia Region* (New Delhi 2017). Available at <https://apps.who.int/iris/handle/10665/258766>

33 Cyril Caminade, K. Marie McIntyre and Anne E. Jones, "Impact of recent and future climate change on vector-borne diseases", *Annals of the New York Academy of Sciences*, vol 1436, No. 1 (January 2019), pp. 157–173. Available at <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6378404/>

34 Luke M. Mosley, Donald S. Sharp and Sarabjeet Singh, "Effects of a tropical cyclone on the drinking-water quality of a remote Pacific island", *Disasters*, vol. 28, No. 4 (December 2004), pp. 405–17. Available at <https://pubmed.ncbi.nlm.nih.gov/15569381/>

35 Zhengyi Deng and others, "Impacts of tropical cyclones and accompanying precipitation on infectious diarrhoea in cyclone landing areas of Zhejiang Province, China", *International Journal of Environmental Research and Public Health*, vol. 12, No. 2 (February 2015), pp. 1054–1068. Available at <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4344654/>

36 M. Alimullah Miyan, "Droughts in Asian Least Developed Countries: Vulnerability and sustainability", *Weather and Climate Extremes*, vol. 7 (March 2015), pp. 8–23.

37 Matthew W. Cooper and others, "Mapping the effects of drought on child stunting", *Proceedings of the National Academy of Sciences of the United States of America*, vol. 116, No. 35 (August 2019). Available at <https://www.pnas.org/content/pnas/116/35/17219.full.pdf>

38 Carla Stanke and others, "Health effects of drought: a systematic review of the evidence", *PLoS Currents*, vol. 5, No. 5 (June 2013). Available at <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3682759>

39 Ready for the dry years: Building resilience to drought in South-East Asia, Second Edition (United Nations publication, 2020c).

40 "Heatwaves and health", *The Lancet*, vol. 392, No. 10145 (August 2018), p. 359. Available at [https://doi.org/10.1016/S0140-6736\(18\)30434-3](https://doi.org/10.1016/S0140-6736(18)30434-3)

41 Syed Ghazanfar Saleem and others, "Risk factors for heat related deaths during the June 2015 heat wave in Karachi, Pakistan", *Journal of Ayub Medical College Abbottabad*, vol. 29, No. 2 (April/June 2017), pp. 320–324.

42 "Heatwaves and health", *The Lancet*, vol. 392, No. 10145 (August 2018), p. 359. Available at [https://doi.org/10.1016/S0140-6736\(18\)30434-3](https://doi.org/10.1016/S0140-6736(18)30434-3)



### BOX 1-2 **Natural disasters, climate change and the emergence of fungal pathogens**

In addition to viral and bacterial diseases, the emergence of fungal pathogens poses a significant threat to human health, environment, and food security. In India, amidst the COVID-19 pandemic, over 8,400 cases of black fungus, a rare infection, have been recorded. The cases are increasing due to the use of steroids in combating the COVID-19 virus. Fungal infections have no vaccines and there is a limited arsenal of anti-fungal agents. Furthermore, during natural disasters, these fungal infections can spread. For example, floods and cyclones disperse and aerosolize fungi causing wider dissemination.

Recent findings highlight that climate change is exacerbating this threat. Under increasing temperatures, fungi are not only evolving thermotolerance, but are also gradually adapting and multiplying faster in increased temperatures. The following table shows the emerging fungal pathogens whose growth may potentially be attributed to climate change and its impacts.

TABLE **Influence of climate change on emerging fungal pathogens**

Fungal pathogens	Major impact and features	Climate change causes/influence
Candida Auris (C.auris)	<b>Human health</b> <ul style="list-style-type: none"> <li>• Colonises and spreads in healthcare settings</li> <li>• Remarkably resistant to antifungals and disinfectants</li> <li>• Low in virulence and has caused infection in people with severe comorbidities</li> </ul>	First 'novel' pathogen to have evolved in response to climate change (conclusive evidence awaited)
Cryptococcus deuterogattii (C.deuterogattii)	<b>Human and animal health</b> <ul style="list-style-type: none"> <li>• Traditionally found in tropical and sub-tropical climates, recently emerged in temperate regions, like western Canada and caused hundreds of infections in people and animals</li> <li>• High capacity for thermal adaptation</li> </ul>	Spread attributed to human activities and their environmental impacts; for example, through vehicle wheel wells, footwear, construction, forest activity (aerial dispersal) and water; climate change suggested as a potential driver
Fusarium head blight (FHB)	<b>Food security</b> <ul style="list-style-type: none"> <li>• Concern for wheat and cereal crops</li> <li>• Infection leads to reduced yield and quality, yield loss up to 75%</li> </ul>	Outbreaks occur particularly in years with warm and humid weather; severity is likely to increase in future warmer climates

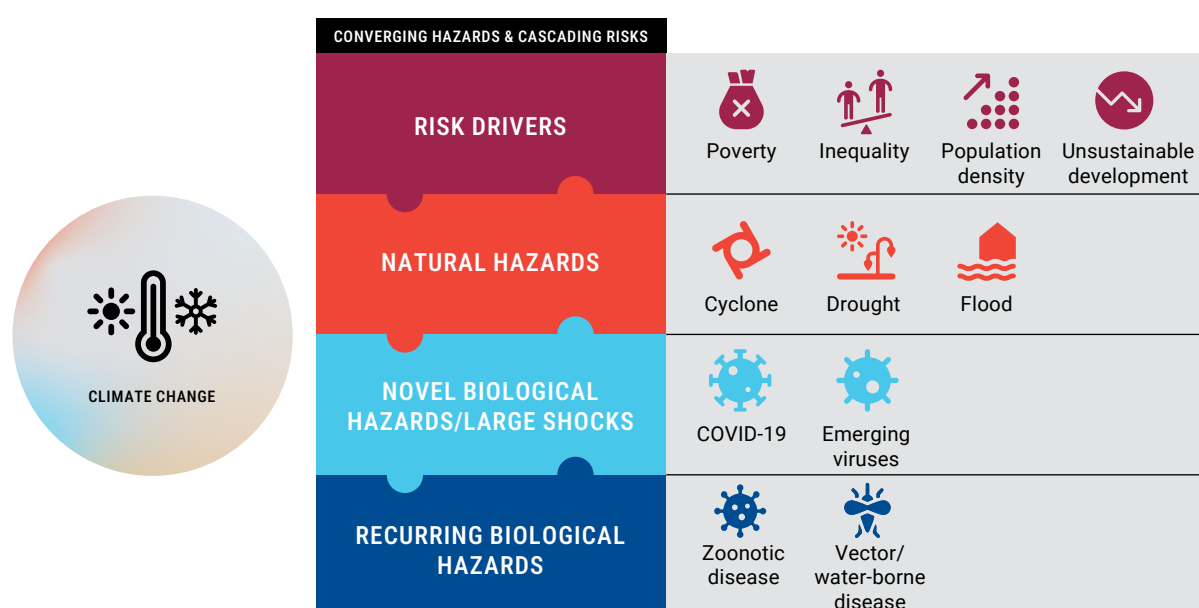
Overall, climate change and natural hazards are causing the emergence of new fungal pathogens, as well as the evolution of new traits, like virulence and anti-fungal resistance in existent fungi. Hence, these risks must also be incorporated when tackling the cascading risks of converging climate, health and natural hazards.

Source: Nnaemeka E. Nnadi and Dee A. Carter, "Climate change and the emergence of fungal pathogens", PLOS Pathogens, vol. 17, No. 4 (April 2021). Available at <https://doi.org/10.1371/journal.ppat.1009503> and Dona Cherian, "India COVID-19: White fungus and black fungus – symptoms, causes, treatment, Gulf News, 22 May 2021.

## Climate change exacerbates the impacts of converging natural and biological hazards

In the years ahead, the Asia-Pacific disaster riskscape will continue to be reshaped by climate change.<sup>43</sup> Alarming, the *Asia and the Pacific SDG Progress Report 2021* notes that the region has substantially regressed on Goal 13: Climate Action.<sup>44</sup> Additionally, natural disasters linked to climate change disproportionately affect poor people and poor countries.<sup>45</sup> This is concerning as global warming is not only a hazard in itself, but it also exacerbates interactions between biological and natural hazards and other risk drivers, such as poverty (Figure 1-18). Global heating and the increase in variability of extreme temperature fluctuations can affect the frequency and intensity of disasters, and make certain places and population groups more vulnerable. Overall, there is extensive scientific evidence that climate change is affecting weather extremes.<sup>46, 47</sup>

FIGURE 1-18 Climate change exacerbates disaster risk



Since the early 2000s, there have been more than 300 peer-reviewed studies on the impact of climate change on weather extremes around the world. Of these, a number have concluded that climate change would make around 70 per cent of the extreme weather events either more likely or more severe. Within these studies, 32 per cent analysed extreme heat and 22 per cent analysed floods. From those that studied extreme heat, 116 found that climate change had made such weather conditions either more likely or more severe. Other events that are likely to be exacerbated include heavy rain and flooding, drought, cold/snow, storms and wildfires (Figure 1-19).<sup>48</sup> However, the coverage of these studies is uneven as they concentrate on certain hazards and particular areas. For example, of the studies on countries within Asia and the Pacific, 25 per cent were on China and 28 per cent on Australia.

43 World Health Organization, Regional Office for South-East Asia, *Roots for Resilience: A health Emergency Risk Profile of the South-East Asia Region* (New Delhi, 2017). Available at <https://apps.who.int/iris/handle/10665/258766>

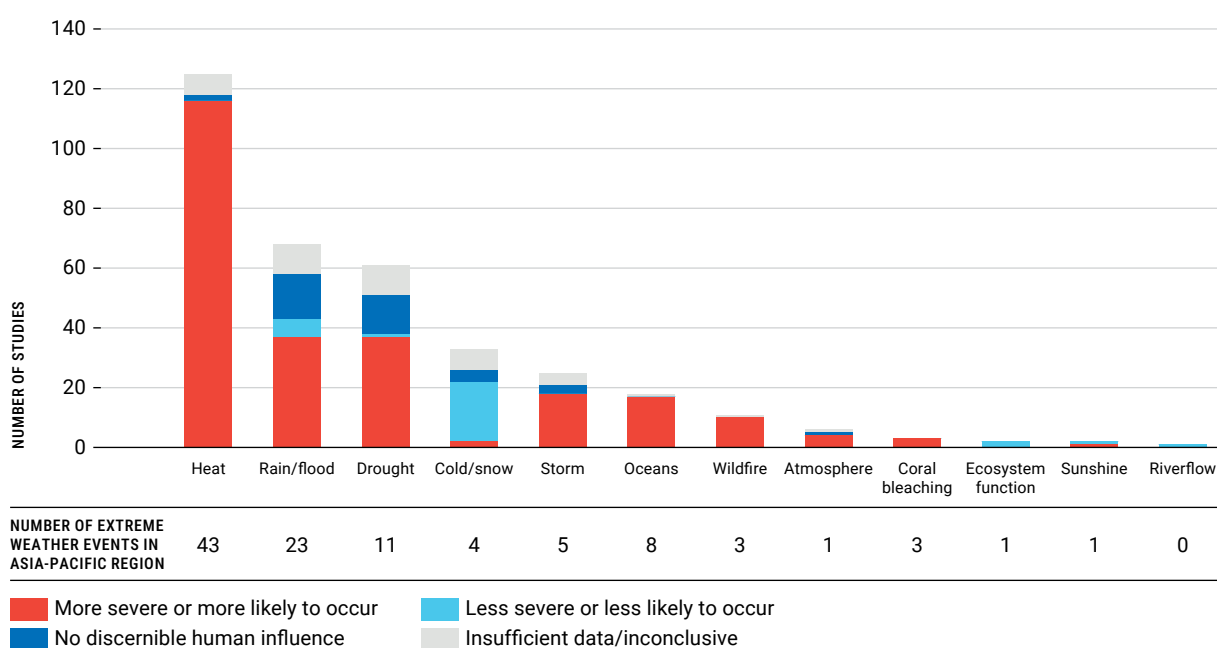
44 Asia and the Pacific SDG Progress Report 2021 (United Nations publication, 2021a). Available at [https://www.unescap.org/sites/default/d8files/knowledge-products/ESCAP\\_Asia\\_and\\_the\\_Pacific\\_SDG\\_Progress\\_Report\\_2021.pdf](https://www.unescap.org/sites/default/d8files/knowledge-products/ESCAP_Asia_and_the_Pacific_SDG_Progress_Report_2021.pdf)

45 Economic and Social Survey of Asia and the Pacific 2021: Towards post COVID-19 resilient economies (United Nations publication, 2021b).

46 Susan Joy Hassol and others, "(Un)Natural disasters: Communicating linkages between extreme events and climate change", *World Meteorological Organization Bulletin*, vol. 65, No. 2 (2016). Available at <https://public.wmo.int/en/resources/bulletin/unnatural-disasters-communicating-linkages-between-extreme-events-and-climate>

47 Stephanie C. Herring and others, eds., "Explaining extreme events of 2019 from climate perspective", *Bulletin of the American Meteorological Society*, vol. 102, No. 1 (January 2021). Available at <https://www.ametsoc.org/ams/index.cfm/publications/bulletin-of-the-american-meteorological-society-bams/explaining-extreme-events-from-a-climate-perspective/>

48 CarbonBrief, "Mapped: How climate change affects extreme weather around the world", 26 February 2021. Available at <https://www.carbonbrief.org/mapped-how-climate-change-affects-extreme-weather-around-the-world>

**FIGURE 1-19** Impact of climate change on extreme weather conditions

Source: ESCAP based on data from CarbonBrief, "Mapped: How climate change affects extreme weather around the world", 26 February 2021. Available at <https://www.carbonbrief.org/mapped-how-climate-change-affects-extreme-weather-around-the-world>.

The clearest links between climate change and disaster events are those related to heatwaves, such as the Russian heatwave in 2010,<sup>49</sup> and the more recent heatwaves in Australia.<sup>50</sup> Attributing climate change to disaster events is more difficult for other disasters, particularly for droughts which have multiple drivers.

Floods, droughts, and biological hazards all damage human health, including mental health, and deepen inequalities. These impacts are being compounded by climate change which, combined with increasing anthropogenic pressure on the natural environment, is contributing to the emergence and transmission of infectious diseases.<sup>51</sup> Furthermore, if these impacts are sudden, they can overwhelm health-care systems.

- *Malaria and dengue fever* – The sixth assessment report of the IPCC notes that climatic variations will create new ecological niches for vector-borne and zoonotic diseases.<sup>52</sup> Global warming from 1.5°C to 2°C would not only increase the length of the transmission season, but also the geographic range of the vectors.<sup>53</sup>
- *Diarrhoeal disease* – Seasonal flooding, induced by climate change, can cause drainage systems to overflow and contaminate clean water sources, leading to outbreaks of disease among children under five years of age and, to some extent, adults.
- *Biological diseases* – People being shifted to temporary shelters due to flood evacuation, for example, run the risk of contracting measles, in addition to COVID-19.
- *Malnutrition* – Rural communities face food insecurity as a result of droughts, while frequent bouts of disease disrupt the growth of children under five years of age putting them at risk for moderate and severe malnutrition.

49 Quirin Schiermeier, "Droughts, heatwaves and floods: How to tell when climate change is to blame", *Nature*, 30 July 2018. Available at <https://www.nature.com/articles/d41586-018-05849-9>

50 Chelsea Harvey, "Scientists can now blame individual natural disasters on climate change", *Scientific American*, 2 January 2018. Available at <https://www.scientificamerican.com/article/scientists-can-now-blame-individual-natural-disasters-on-climate-change/>

51 Felicia Keesing and others, "Impacts of biodiversity on the emergence and transmission of infectious diseases", *Nature*, vol. 468 (2012), pp. 647–652. Available at <https://www.nature.com/articles/nature09575>

52 Intergovernmental Panel on Climate Change, "Sixth Assessment Report". Available at <https://www.ipcc.ch/assessment-report/ar6/> (accessed on 26 February 2021).

53 Alistair Woodward and others, "Climate change and health: on the latest IPCC report", *Lancet*, vol. 383, No. 9924 (April 2014), pp. 1185–1189.



- *Chronic diseases* – Patients with chronic diseases like diabetes, hypertension, and kidney ailments suffer when disasters disrupt their treatment and access to medical supplies.
- *Injury and trauma* – The impact of cyclones over a season can be measured by the power dissipation index, which by 2100 is projected to increase by 40 per cent for RCP 2.6 and by 100 per cent for RCP 8.5.<sup>54</sup> More violent cyclones increase the risk of injuries, trauma and permanent life changes.<sup>55</sup>
- *Heat-related illness* – More people will be exposed to extreme heat, which, in turn, will increase illnesses such as heat exhaustion, heat cramps, heat strokes, and cardiovascular and respiratory disorders.

Figure 1-20 provides a snapshot of how climate change could alter the geography and intensity of natural and biological hazards and increase their combined impacts in various countries.




















































As climate change continues, governments are increasingly faced with new and more hazardous circumstances, such as those presented by the convergence of climate-related hazards with the COVID-19 pandemic. The next chapter will discuss how governments in Asia and the Pacific are addressing and managing the challenges brought about by the convergence of the pandemic with other disasters such as cyclones and floods. It will highlight the need to identify vulnerable groups, such as women or people with disabilities, so that governments can build social protection programmes that move away from being shock-responsive to being shock-prepared.

54 Peter Sousounis, "Climate change: RCPs and the emissions gap", AIR. Available at <https://www.air-worldwide.com/blog/posts/2019/11/climate-change-rcps-and-the-emissions-gap> (accessed on 26 February 2021).

55 James M. Shultz and others, "Risks, health consequences, and response challenges for small-island-based populations: Observations from the 2017 Atlantic hurricane season", *Disaster Medicine and Public Health Preparedness*, vol. 13, No. 1 (April 2018), pp. 5-17.



FIGURE 1-20 Impacts of climate change on natural and other biological hazards

		CLIMATE CHANGE RISK		RELATED BIOLOGICAL AND HEALTH RISKS	
East and East North Asia	China		Increase drought		Undernutrition due to food insecurity
			Increase precipitation and flooding		Increase vector-borne disease risks
			Increase sea level risk and flooding		Increase more than 50 million of population exposed to sea level rise
	Japan		Increase heatwaves		Increase excess death due to heatwaves by 0.2%
			Increase precipitation and flooding		Increase in infectious gastroenteritis cases by 8 %
	Mongolia		Increase precipitation and flooding		Increase in tick-borne encephalitis
South-East Asia	Republic of Korea		Increase heatwaves		Increase excess death due to heatwave by 0.3%
			Increase sea level risk and flooding		Increase DALY for cardio and cerebrovascular disease by 131%
	Indonesia		Increase sea level risk and flooding		Increase more than 50 million of population exposed to sea level rise
	Philippines		Increase heatwaves		Increase excess death due to heatwaves by 1%
	Thailand		Increase sea level risk and flooding		Increase more than 50 million of population exposed to sea level rise
	Viet Nam		Increase heatwaves		Increase excess death due to heat by 1.4%
South and South-West Asia	Afghanistan		Increase precipitation and drought		Increased cholera, typhoid, diarrhea and ascariasis
			Increase precipitation and drought		Increase malaria and leishmaniasis
	Bangladesh		Increase precipitation and drought		Increase in diarrheal incidence rates by 5.6%
			Increase sea level risk and flooding		Increase in dengue
	Bhutan		Increase cyclones		Increase in leishmaniasis
			Increase glacial lake outburst floods, landslides and flash floods		Increase in malaria, dengue, Japanese encephalitis and chikungunya
	India		Increase drought		Undernutrition due to food insecurity
			Increase heatwaves		Increase in heatwaves related health risks (heatstroke etc.)
			Increase sea level risk and flooding		Increase of more than 50 million population exposed to sea level rise
					Increase of exposure to arsenic contamination of ground water in the eastern region
	Maldives		Decrease precipitation		Increase in malaria, dengue, Japanese encephalitis, leishmaniasis and diarrhea
			Increase drought		Increase in diarrhea expected by 13.1% by 2041
	Nepal		Increase drought		Increase in dengue, chikungunya, scrub typhus ; Emerge of Zika virus
			Increase precipitation		Undernutrition due to food insecurity
	Pakistan		Increase heatwaves		Increased incidence of diarrheal
			Increase glacial lake outburst flood, severity of monsoons and cyclones and saline intrusion		Increase in malaria, chikungunya, and dengue, lymphatic filariasis and Japanese encephalitis; Emerge of Zika Virus
	Sri Lanka		Increase drought and flooding		Increase in geographical range and incidence of vector-borne diseases
North and Central Asia	Russian Federation		Increase drought		Increase in water-borne diseases and malnutrition
			Increase precipitation and flooding		Increase in malaria, dengue, and heat related diseases
Pacific	Australia		Increase precipitation and flooding		Increase dengue outbreaks by 16.6% and decrease by 42.3%
	Marshall Islands		Increase sea level risk and flooding		Freshwater resources affected by 0.4 meter rise in sea level
	Fiji		Increase precipitation and flooding		Increase in diarrhea by 3%

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