3 CLIMATE SCENARIOS: A TALE OF THREE FUTURES

How does it feel to witness
the slow dying of the land and seas?
– one that was here before us
– one that will be here long after us
I am young, and my legs still carry me to shore
But when I am old, will I still get to
walk the edge of the tide line?

From 'To Kill a God' by Ava Arnejo[1]

At 7:16 p.m. on 12 December 2015, in a conference centre at Le Bourget Airport outside Paris, the resounding sound of a gavel hitting a table spurred hundreds of global delegates to leap to their feet and cheer. Some wept. Mary Robinson, then the United Nations Secretary-General's Special Envoy on Climate Change, and formerly President of Ireland, recalls in her memoir *Climate Justice*: *Hope, Resilience and the Fight for a Sustainable Future* that 'Looking around, I saw many of us were in tears.' The Paris Agreement, signed by all 196 Parties at the 21st UN Climate Convention in Paris, was so momentous because it 'acknowledged the importance of climate justice in the text and made commitments on human rights and gender equality, agreed on a framework for monitoring national progress, and persuaded rich countries to provide financing for climate action in poorer nations,' writes Robinson. 'By committing to limit global warming to "well below" a 2°C rise above pre-industrial temperatures, the agreement also recognised the plight of Anote Tong and the people of Kiribati, along with the other

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forty-seven of the world's poorest countries, whose specific needs had, until this moment, been overlooked within the power politics of climate talks. Now Tong and other small-island state leaders such as Tony de Brum from the Marshall Islands could return home, their heads held high, and tell their people that their countries might still be saved.'[2]

The sound of a gavel suggests finality. In truth, a starting pistol would have been more apt. The global community hadn't *done* anything yet. It had only agreed *to do* something. And that something was still to be decided in the guise of Nationally Determined Contributions (NDCs). NDCs represent each individual nation's climate targets for both adaptation and mitigation, to be updated every five years. Each update is required to be more 'ambitious', thus having more stringent targets and helping the world 'get closer' to 1.5 °C.[3] A whole eight years later, by September 2023, a total of 168 NDCs had been submitted. Yet even if all these NDCs were achieved to the letter – and some were considered domestically controversial, and thus liable to be overturned with changes in government – they would put the world on track for 2.5 °C of temperature rise by the end of the century, according to Climate Action Tracker (see Figure 3.1). Much more needs to be done. Because as we'll see in this chapter, every 0.1 degrees Celcius rise is worth fighting against.

Ironically, perhaps, the NDCs of developing and vulnerable countries have widely been considered the most ambitious. The countries that did the least to cause climate change are the ones doing the most to try and stop it. For example, pledges from African countries are more robust than the global average, with stronger commitments to climate resilience. The NDCs submitted by Latin American and Caribbean countries also demonstrate higher levels of stakeholder ownership and inclusivity, compared with global averages.[4]

The Monitor from the CVF presents data according to three possible climate scenarios: the best-case 'Paris ambition' 1.5 °C scenario, a 'below 2 °C' scenario (that is, between 1.5 and 2 °C),

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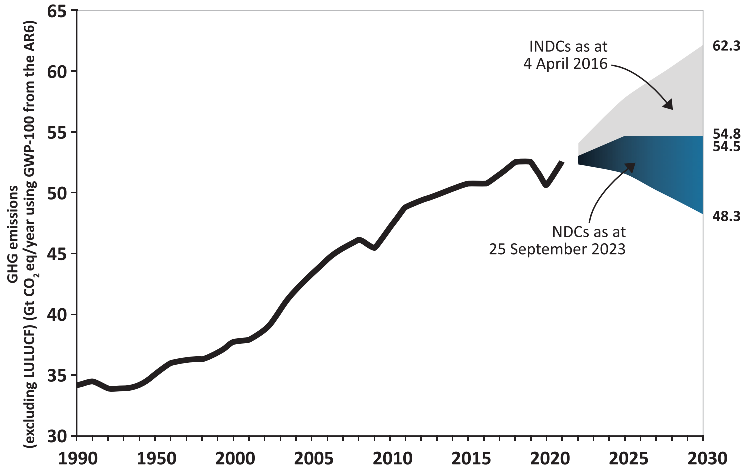

Figure 3.1 Projected range and progression of emission levels according to Nationally Determined Contributions (NDCs). AR6 is the Sixth Assessment Report of the IPCC; GHG, greenhouse gas; Gt CO_2 eq, billion tonnes of carbon dioxide equivalent; INDC, intended NDC; LULUCF, land use, land-use change, and forestry. (UNFCCC. NDC Synthesis Report. 2023)[5]

and a 'no climate action' scenario – meaning if the world fails to get its act together, mitigation efforts cease, and NDCs collapse when the likes of Donald Trump pull out of the Paris Agreement. The latter scenario projects a peak warming of 3.6 ° C by the end of this century. And, says *The Monitor*, such a high warming scenario 'is not to be ruled out given the world is on track to continue the prolonged general increase in warming emissions with new record highs in 2022, while countries collectively fall short.' Decarbonisation pledges within NDCs would need to be four times higher in ambition than currently to get on track to limit warming to 2 °C, and seven times higher to get on track to 1.5 °C.

It can be hard to visualise what is at stake between the potential scenarios of 1.5 °C of further global warming, 2 °C, and 3.6 °C (which, while the CVF uses that as a worst-case scenario, is in fact a mid-range estimate – the very worst case, fossil-fuel-only

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development scenario, is 5.7 °C. See Table 3.1). The potential scenarios or 'pathways' used by the IPCC are known as SSP1 'Sustainability – Taking the Green Road', SSP2 'Middle of the Road', SSP3 'Regional Rivalry – A Rocky Road', SSP4 'Inequality – A Road Divided', and SSP5 'Fossil-fueled Development – Taking the Highway'.[6] Some might argue, what's half a degree here or there if the world is warming anyway – but the stark contrast between these pathways makes the difference very clear. As Swenja Surminski, chair of MCII, explains, 'There's a common misconception that climate change is a linear trend . . . [that] it

Table 3.1 Potential climate change scenarios, based on the IPCC's Shared Socio-economic Pathways (SSPs), which integrate socio-economic factors and emissions mitigation ambitions (CVF-V20 et al. *Climate Vulnerability Monitor,* 3rd ed. *(CVM3)*: *A Planet on Fire.* 2022. p. 32)

	Near term, 2021–2040	Mid term, 2041–2060	Long term, 2081–2100
Scenario	Best estimate in °C (very likely range)	Best estimate in °C (very likely range)	Best estimate in °C (very likely range)
SSP1–1.9	1.5 (1.2 to 1.7)	1.6 (1.2 to 2.0)	1.4 (1.0 to 1.8)
SSP1–2.6	1.5 (1.2 to 1.8)[a]	1.7 (1.3 to 2.2)	1.8 (1.3 to 2.4)[b]
SSP2–4.5	1.5 (1.2 to 1.8)	2.0 (1.6 to 2.5)	2.7 (2.1 to 3.5)
SSP3–7.0	1.5 (1.2 to 1.8)	2.1 (1.7 to 2.6)	3.6 (2.8 to 4.6)[c]
SSP5–8.5	1.6 (1.3 to 1.9)	2.4 (1.9 to 3.0)	4.4 (3.3 to 5.7)

[a] The 1.5 °C 'Adaptation Remains Possible' scenario.

[b] The below 2 °C 'Widespread Loss and Damage' scenario.

[c] The 3.6 °C 'Global Devastation' scenario.

Notes: Changes in global surface temperature, which are assessed based on multiple lines of evidence, for selected 20-year time periods and the five illustrative emissions scenarios considered. Temperature differences relative to the average global surface temperature of the period 1850–1900 are reported in °C. For further details, see the IPCC's *Sixth Assessment Report* (AR6) WGI Summary for Policymakers.[7]

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will gradually get worse, and maybe by 2050, when it's really painful, we'll take more drastic action. This mindset, unfortunately, is almost encouraged by climate science, but it's a significant challenge because climate change is not linear; it's messy and interdependent. The concept of 'tipping points' is an example … We need to move away from thinking it's either 2 °C or 2.5 °C or 3 °C and recognise that all these scenarios contain big surprises [and] dramatic impacts. That narrative is really important.' In addition, while 'temperature degree warming is a key metric, for many people it doesn't mean much. For example, in the UK, warmer temperatures might seem appealing – I could go swimming in the sea more often, for instance – but this oversimplifies the issue. Even small changes can have significant impacts on ecosystems. We need to rethink how we explain and illustrate these potential futures.'

So-called 'slow-onset events' related to climate change, for example, refers to the gradual, incremental changes in the environment that unfold over many years, including sea-level rise, increased temperatures, ocean acidification, and desertification. These slow-onset events, first outlined in the Cancun Adaptation Framework, differ from rapid-onset events because their prolonged development period can be less immediately obvious – including to disaster relief efforts and donors. As the UN Sustainable Development Solutions Network argues, 'Although a large share of losses and damages experienced in developing and vulnerable countries is caused by slow-onset climate change events, up to now most of the L&D costing methods that exist in the literature have focused on L&D from extreme weather events.'[8]

Sometimes slow-onset events can be more apparent to the occasional visitor, who perceive the changes in time much like timelapse camera footage. At the United Nations Office for Disaster Risk Reduction (UNDRR) offices in Bonn, Germany, Carlos Augusto Uribe Perez is a Colombian who now considers himself as a 'global citizen', having worked across various offices with the UN system for over ten years.

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But he visits his hometown annually, where his mother still lives, and has been surprised by the changes he has seen in that time. ‘There is clear evidence that climate variability has changed my country’s landscape,’ he says. ‘For example, the average temperature in my hometown used to be 31 degrees, but now it’s more like 35 degrees. Land that was once green and beautiful is now dry.’ As an equatorial country, there are no distinct seasons, and so a change in average temperature means a change in daily life. ‘Speaking with my mother, she mentions the difficulty now in coping with the heat … climate change is amplifying existing phenomena, affecting people’s daily activities and lifestyles. My mother used to walk this land easily, but now it’s very hard, she has to stay indoors more … There used to be rain in March and November, but now we’re facing droughts. Land that was once beautiful grassland and ideal for picnics is no longer appealing. So, it’s affecting people’s perceptions and reducing opportunities in various ways.’

UNDRR is the focal point for disaster risk reduction in the UN system. All the Member States report on disaster loss and damage and on progress in disaster risk reduction on a consistent basis to UNDRR, giving it a unique finger on the pulse of the world’s readiness for climate change. Animesh Kumar, head of UNDRR’s Bonn Office, echoes the sentiments of his colleague Uribe Perez: ‘Slow-onset events often go unnoticed within a lifetime, yet their impacts can be profound. For example, in eastern India and Bangladesh, marginal farmers lose their land due to sea-level rise, migrating to cities as informal workers. These cascading impacts need systematic documentation, which we currently lack.’ He describes every half-degree change as seismic: ‘It’s well documented, including in the latest IPCC reports, that the impact of climate change doesn’t increase linearly with temperature, but rather exponentially. It’s not a matter of 100 disasters at 0.5 degrees, 200 at 0.6, and 300 at 0.7. Rather, at 0.7, it could be 1,000, or even a million. In our analysis for the Global Assessment Report on Disaster Risk

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Reduction 2022, we found that, based on current trends in climatic disasters, we could face one and a half disasters per day, totalling 540, by 2030. This analysis didn't account for the additional impact of climate change, which would only make things more complex and severe.' This complexity is worrying, he says, 'because it's not just about scaling up response capabilities; it's about the unpredictability and unpreparedness for these disasters. For instance, in Somalia, floods are now affecting the populations as much as droughts do, while in Somaliland, severe tropical cyclones have caught everyone off guard. Climate change is altering the risk profiles of countries and bringing unconventional disasters to places where they've never occurred before.' Communicating this is crucial. Scientific studies are needed to highlight the uncertainties and probabilities, but for decision-makers and programme managers, it's important to contextualize. Iria Touzon Calle, programme manager at UNDRR-Bonn, adds: 'For example, discussing sea-level rise in terms of its impact on water availability and infrastructure is more meaningful than just presenting raw data in cm of sea-level rise in the next 20 or 50 years. This approach helps address immediate concerns such as jobs, unemployment and conflict, which might seem more pressing than gradual climate changes.'

In recognition of such nuances in approach, *The Monitor*'s analysis is divided into three contextualized sections: the environmental (biophysical) changes, macroeconomic impact, and health impacts of climate change. Each section further divides into the differences that would be felt in a 1.5 °C scenario, below 2 °C scenario, and at a peak warming of 3.6 °C. The findings are compelling. Ken Ofori-Atta, former Minister for Finance and Economic Planning of Ghana, and former V20 Chair, described in his foreword to *The Monitor*: 'A breaching of the threshold temperature of 1.5°C would send the world into climate chaos – accelerating weather cycles, accentuating severe weather events like flooding, sea level rise, and heatwaves amongst others. Although Africa contributes only about 3.8% of global

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greenhouse gas emissions, Africa bears alarmingly high economic cost due to climate change. According to the UNECA, responding to climate change vulnerabilities costs African countries 3–5% of GDP annually and, in some cases, more than 15%. 2009 to 2022 has had dire effects on the implementation of mitigation and adaptation measures.'[9] Ofori-Atta's words should come with the caveat, argues Marina Romanello, that '1.5 °C is not a cliff. We are at an increasing level of climate chaos with every fraction of a degree of temperature increase.'

As we saw in the previous chapter, the climate has already warmed, and its effects are already felt. Over the past four decades (1981–2022), temperature has increased globally at a rate of around 0.18 °C per decade – more than twice as fast as for the period starting in 1880 (0.08 °C per decade). Even the alarming acceleration of global averages, however, underplays the fact that countries warm at a different pace depending on their location or topography. In recent decades, Lebanon was the V20 economy exposed to the fastest warming at 0.49 °C per decade, while Bangladesh experienced the slowest pace of warming at 0.07 °C per decade. On the African continent, Morocco and Tunisia faced the fastest warming, at 0.27 °C and 0.33 °C respectively. But this doesn't mean that 0.4 equals bad and 0.04 equals good – it all depends on context. A 2015 *Nature* paper by Burke et al.[10] introduced the idea that economies have an optimum temperature level, below and beyond which economic performance reduces. For example, a given crop finds its optimal temperature within a range of a few degrees, and different types of construction materials and architecture can only accommodate certain temperatures until heating or air conditioning is required. Therefore, many micro-economic factors (such as crops, buildings, etc.) with their different optimal ranges can converge towards defining a country's optimum temperature range. Figure 3.2 provides the distance between the median temperature observed in the 2000–2019 period and the median optimum temperature for each V20 economy.

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Figure 3.2 shows clearly that the higher the median temperature is, the longer the distance to a V20 country's 'optimum'. The longer the distance to optimum, the worse the likely economic performance. With a progressively warming climate, most distances to optimum will increase. If global warming accelerates to 3.6 °C, *The Monitor*'s worst-case scenario, this doesn't mean you simply add that to every country's average temperature: in that global scenario the mean maximum surface temperature in Southern Africa would actually rise by 4.2 °C, for example, while Botswana could increase by as much as 5.1 °C. Such

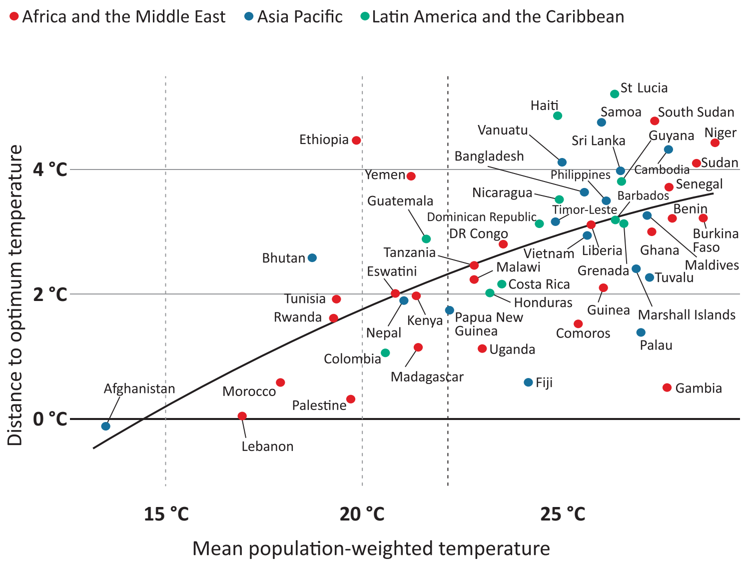

Figure 3.2 Distance to optimum temperatures for V20 countries. Observed population-weighted median annual temperature from 2000 to 2019 and distance to median country-specific optimum temperature. A distance to optimum temperature above zero indicates that country's temperature has already exceeded optimum. The vertical dotted line is the optimum temperature resulting from the panel regression of all low- and middle-income countries. Population-weighted temperature focuses on where people live, and assigns more weight to temperatures in areas with higher population density. (V20. Climate Vulnerable Economies Loss Report. 14 Jun 2022. p. 11)[11]

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increases would have profound impacts on any country or region's environment, infrastructure, agriculture, water sources, and human health.

Such projections underline the urgency of effective and widespread mitigation actions and adaptation strategies, requiring unprecedented investment in infrastructure, including resilient low-carbon buildings, renewable energy, regenerative agriculture, and public health, to name just the most immediate.[12] What, then, will happen if we move ever further 'outside of the optimum', across the following three climate scenarios as outlined in *The Monitor*? See Table 3.2 for a short summary, according to *The Monitor*'s projections. The rest of the chapter then looks at each in more detail. Or, to continue the narrative 'through the eyes of the most vulnerable', skip to Chapter 4.

Table 3.2 Biophysical, health, and economic impact indicators under three climate scenarios

Created by author; all numbers are based on projections from *The Monitor* (CVF-V20 et al. *Climate Vulnerability Monitor,* 3rd ed. *(CVM3)*: *A Planet on Fire.* 2022)

	1.5 °C – the Paris ambition 'Adaptation Remains Possible' scenario	2 °C – the 'Widespread Loss and Damage' scenario	3.6 °C – the no-action 'Global Devastation' scenario
Biophysical impact indicators			
Drought index	Increase in frequency by 4–8 times per 20 years	Increase in frequency by 8–12 times per 20 years	Increase in frequency by 12–14 times per 20 years

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Table 3.2 (*cont.*)

	1.5 °C – the Paris ambition 'Adaptation Remains Possible' scenario	2 °C – the 'Widespread Loss and Damage' scenario	3.6 °C – the no-action 'Global Devastation' scenario
Precipitation	Reaches a 7% decrease in the Mediterranean basin and in Western and Central Africa	Reaches a 10% decrease in the Mediterranean basin and in Western and Central Africa	Reaches a 20% decrease in the Mediterranean basin and in Western and Central Africa
Extreme precipitation	Increases by 4–8%	Increases by up to 8%	Increases by up to 22%
Hurricanes and cyclones	10% increase in intense tropical cyclones	13% increase in intense tropical cyclones	20% increase in intense tropical cyclones
Mean near-surface air temperatures	Rise by an additional: 0.77 °C in Africa 0.61 °C in the Americas 0.75 °C in Asia-Pacific 0.75 °C in Europe	Rise by an additional: 1.03 °C in Africa 0.88 °C in the Americas 1.08 °C in Asia-Pacific 1.20 °C in Europe	Rise by an additional: 1.61 °C in Africa 1.34 °C in the Americas 1.49 °C in Asia-Pacific 1.68 °C in Europe

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Table 3.2 (*cont.*)

	1.5 °C – the Paris ambition 'Adaptation Remains Possible' scenario	2 °C – the 'Widespread Loss and Damage' scenario	3.6 °C – the no-action 'Global Devastation' scenario
	Health impact indicators		
Crop yield potential	Reaches a 9% decrease in North Africa	Reaches an 11% decrease in North Africa	Reaches a 35% decrease in North Africa
Exposure to very high or extremely high wildfires risk	Reaches an increase of 76 days in the Middle East	Reaches an increase of 78 days in the Middle East	Reaches an increase of 126 days in the Middle East
Exposure of vulnerable populations to heatwaves	350% increase in exposure to life-threatening heatwaves	2,510% increase in exposure to life-threathening heatwaves	6,310% increase in exposure to life-threatening heatwaves
Loss of labour productivity	Reaches an increase of 3% in Asia	Reaches an increase of 5% in Asia	Reaches an increase of 16% in Asia
Heat-related mortality	Reaches 41 thousand deaths in South Asia	Reaches 282 thousand deaths in South Asia	Reaches 980 thousand deaths in South Asia

Table 3.2 (*cont.*)

	1.5 °C – the Paris ambition 'Adaptation Remains Possible' scenario	2 °C – the 'Widespread Loss and Damage' scenario	3.6 °C – the no-action 'Global Devastation' scenario
Environmental suitability for pathogenic *Vibrio*	Reaches a 3% increase of coastline with conditions suitable for the transmission of Vibrio pathogens in Northern Europe	Reaches a 48% increase of coastline with conditions suitable for the transmission of Vibrio pathogens in Northern Europe	Reaches a 78% increase of coastline with conditions suitable for the transmission of Vibrio pathogens in Northern Europe
Economic impact indicators			
Inflation	Reaches a 1.4%-point increase of Consumer Price Index (CPI) in Central Asia	Reaches a 2.7%-point increase of CPI in Central Asia	Reaches a 7.4%-point increase of CPI in Central Asia
GDP per capita growth	−3% for Central Asia −1.9% in Europe −1.7% in Asia −1.1% in Africa −0.9% in the Americas −0.6% in Oceania	−6.1% for Central Asia −2.8% in Europe −2.5% in Asia −1.7% in Africa −1.4% in the Americas −0.9% in Oceania	−16.3% in Northern and Central Asia −11.8% in Europe −10% in Asia −7.9% in Africa −7.5% in the Americas −5.1% in Oceania

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Table 3.2 (*cont.*)

	1.5 °C – the Paris ambition 'Adaptation Remains Possible' scenario	2 °C – the 'Widespread Loss and Damage' scenario	3.6 °C – the no-action 'Global Devastation' scenario
Interest rate	Reaches a 38 basis points deviation in interest rate in African countries	Reaches a 41 basis points deviation in interest rate in African countries	Reaches a 132 basis points deviation in interest rate in African countries

At 1.5 °C, the 'Adaptation Remains Possible' Scenario

The Paris Agreement established a critical temperature limit of 1.5 °C above pre-industrial levels in the near term (2030). This threshold is considered essential in mitigating the impacts of global warming, reducing the risks associated with climate change and enabling both adaptation and climate-resilient development. The goal is to prevent the most catastrophic consequences of climate change – but still acknowledging the transition and adaptation requirements that will be necessary.

- **Decrease in global average crop yields**: Climate-related hazards causing crop losses will increase at 1.5 °C, leading to decreased global average yields of major crops such as wheat, maize, rice, and soy. If global temperature rises are kept at 1.5 °C, however, 58% of the potential projected shortening in the growth duration of maize in a 'no action' scenario could be avoided globally.

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- **Increase in wildfires**: The overall risk of wildfires is set to rise substantially with a 1.5 °C increase in global temperatures. The projection of an 8.5% increase in days with high wildfire danger highlights the growing challenge of managing and mitigating wildfire risks, with significant implications for forest management, urban planning, and disaster preparedness. Human exposure to days with very high or extremely high wildfire danger will also increase by approximately 8.5% above the levels recorded during 1995–2014.
- **Increase in drought events**: Droughts, which already pose significant challenges to water availability, agriculture, and ecosystem health, are projected to increase in frequency by 4 to 8 times per 20 years compared with historical records. This dramatic rise indicates a threat to water security, food production, and biodiversity, demanding a strengthening of water management policies, agricultural practices, and conservation strategies. Latin America, for example, will see an 8-fold increase in the frequency of drought events every 20 years compared with baseline conditions.
- **Increase in extreme precipitation events**: Extreme precipitation events increase by about 4–8%. This significant increase implies more frequent and intense rainfall events, leading to heightened risks of flooding, landslides, and soil erosion. These changes can have profound impacts on agriculture, infrastructure, water resources, and human settlements, especially in flood-prone areas. In a 1.5 °C scenario, five-day maximum precipitation is projected to change relative to the baseline by +8% in Africa, by +7% in the Americas, +4% in Asia-Pacific, and +5% in Europe.
- **Exposure of vulnerable age groups to heatwaves**: As the planet warms to 1.5 °C, vulnerable age groups (people over 65 years of age) are projected to experience a staggering 350% increase in exposure to life-threatening

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heatwaves. This heightened exposure poses significant health risks, including exacerbation of existing health conditions, dehydration, adverse mental health impacts, and even potentially lethal heatstroke.

- **Heat-related deaths**: If warming is limited to 1.5 °C, 91% of the potential annual global heat deaths projected to occur by the end of the century under a 'no action' scenario could be avoided.
- **Expansion of habitats suitable for *Vibrio* disease transmission**: Coastal areas suitable for the transmission of *Vibrio* diseases are projected to increase by 12% in a 1.5 °C scenario. *Vibrio* pathogens, which can cause life-threatening septicaemia and gastrointestinal infections, thrive in warmer sea temperatures. This expansion poses a heightened risk to public health, particularly in coastal communities, requiring enhanced public health surveillance, and increased awareness and preparedness to prevent and manage outbreaks.
- **Intensification of tropical cyclones**: The proportion of intense tropical cyclones is anticipated to rise by 10%. This signifies not just a higher frequency but also a likely escalation in the severity of these storms. Intense tropical cyclones can cause devastating impacts, including massive storm surges, high winds, and heavy rainfall, leading to significant loss of life and damage to infrastructure and ecosystems. This projection emphasizes the importance of enhancing early warning systems and cyclone prediction accuracy, strengthening building codes in vulnerable regions, and improving disaster response and recovery plans.
- **Loss of hours of safe outdoor physical activity**: The number of person-hours exceeding the threshold for moderate heat-stress risk during moderate physical activity would also be halved at 1.5 °C of warming compared with a 'no climate action' scenario by the end of the century, with 4.73 trillion more person-hours exceeding

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the moderate heat stress risk threshold for moderate intensity outdoor activity annually.

- **Economic damage**: At all levels of warming analysed, climate change will have detrimental macroeconomic consequences. Owing to climate change, lower-than expected incomes are projected to result across all nations, as well as higher inflation. At 1.5 °C, Central Asia sees a mean change in GDP growth of −3% (see Figure 3.3 for the example of Kyrgyzstan).

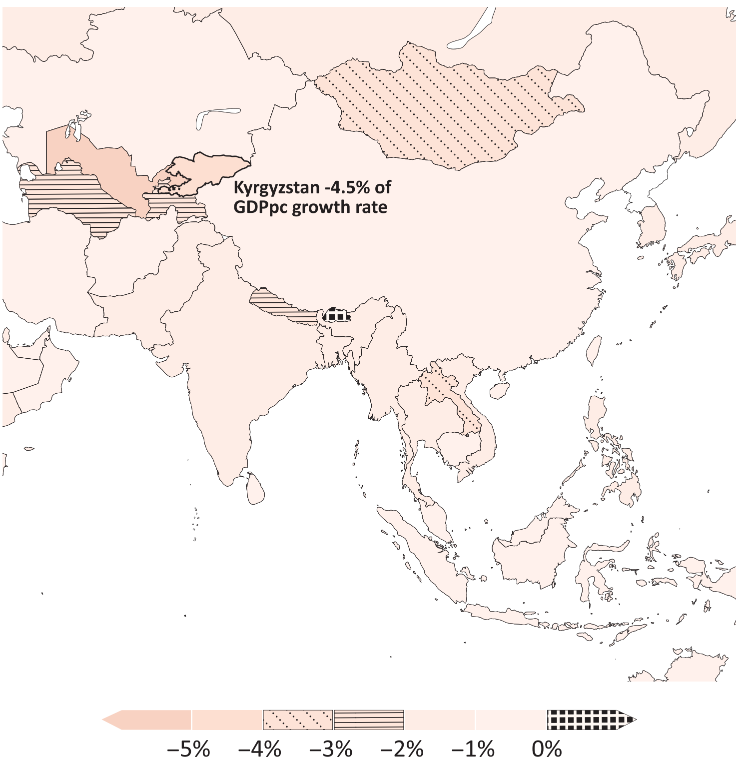

Figure 3.3 Kyrgyzstan. Percentage of GDP per capita growth rate between 2021 and 2040 for the 'below 2 °C' path, impacts at 1.5 °C. (*CVM3* Economics Data Explorer. 2022)[13]

Below 2 °C, the 'Widespread Loss and Damage' Scenario

UNFCCC's first Periodic Review and the 2 °C threshold: The United Nations Framework Convention on Climate Change (UNFCCC) conducted its first Periodic Review between 2013 and 2015, which played a crucial role in shaping global climate policy. This review established a significant finding: a global warming limit of 2 °C could not be deemed safe. This conclusion was pivotal in justifying the need to strengthen global temperature goals, leading directly to the adoption of the more ambitious 1.5 °C limit in the Paris Agreement. The Agreement emphasizes the importance of keeping global warming 'well below 2 °C' and pursuing efforts to limit it further to 1.5 °C. This reflects a broad scientific and policy consensus that a warming of 2 °C should be avoided because of the significant and potentially catastrophic impacts listed below.

- **Increased frequency of drought events**: With global temperatures rising to 2 °C, drought events are projected to increase with a frequency of 8 to 12 times per 20 years. This would be a significant escalation from the already heightened drought frequency seen at 1.5 °C warming. The increase in droughts at this level of warming would have severe implications for water resources, agriculture, biodiversity, and human livelihoods, and desertification of already arid regions.
- **Precipitation decreases** . . . : In a 'below 2 ºC' scenario, overall precipitation decreases could reach as much as 20% or more in the Mediterranean basin and in Western and Central Africa. (These decreases are halved at 1.5 ºC of warming.) The prospect of such a drastic reduction in precipitation underscores the need for effective water conservation measures, sustainable agricultural practices, and comprehensive strategies to adapt to a drier climate.

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- . . . **yet extreme precipitation increases**: Even in areas of greater drought, however, when the rain does come, it will come harder. Extreme precipitation events are projected to increase by up to 8% with a 2 °C rise in global temperatures. This range overlaps with the projections for 1.5 °C warming but represents a continuation of the trend towards more frequent and intense rainfall events.
- **Greater exposure to high wildfire danger**: As the planet warms to 2 °C, the average number of days that each individual is exposed to very high or extremely high wildfire danger is projected to rise further, reaching 12.3% above the baseline levels, a significant increase compared with the scenario at 1.5 °C. Such an increase in wildfire danger would exacerbate risks to ecosystems, human settlements, and air quality.
- **Dramatic increase in heatwave exposure of people over 65 years of age**: At a 2 °C global temperature increase, the exposure of vulnerable groups of people over 65 years of age to life-threatening heatwaves is projected to jump alarmingly by 2,510% from current levels by the end of the century. This increase poses a severe threat to public health and, depending on the effectiveness and efficacy of adaptation efforts, could have profound implications for public health systems.
- **Intensification of intense tropical cyclones**: The frequency of intense tropical cyclones is projected to increase by about 13% with a 2 °C rise in global temperatures. This increase not only suggests a higher number of such events but also implies greater intensity and potentially more devastating impacts.
- **Land temperature increase**: Daily mean temperatures determine the climatic conditions to which humans, animals, and plants are exposed at local and

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regional levels. The indicator is a key factor for a wide range of applications and is used in various disciplines, for example to assess the suitability of specific crop types in agriculture. The mean land temperatures rise by an additional 1.05 °C in Africa, 0.90 °C in the Americas, 1.05 °C in Asia-Pacific, and 0.98 °C in Europe by the end of the century. In the Southern African Development Community (SADC) countries, the average increase will be around 1.1 °C. In the five Southern African countries of Botswana, Lesotho, Namibia, Eswatini, and South Africa, the increase will be even higher, at around 1.3 °C. Changes in land temperature have cascading effects on food security, water resources, and the overall health of ecosystems, making them critical factors in assessing and responding to climate change impacts.

- **Increased drought *and* heavy rainfall**: Projections show that the duration, frequency, and intensity of many of the most severe water-related hazards as average temperatures will increase because of climate change, speeding up the Earth's water cycle through an increase in the rate of evaporation from soil and transpiration from plants. For example, among the five Southern African countries (Botswana, Lesotho, Namibia, Eswatini, and South Africa), Botswana is expected to see the highest increase in extreme precipitation events (5.3%). Across the 16 countries that make up the SADC region, there is a notable difference in the risk of extreme rainfall events. Specifically, other countries in the SADC region face a much higher risk of extreme precipitation, with a likelihood of 9.3%, compared with only 3.1% in the five Southern African countries.[14]
- **Higher socioeconomic vulnerabilities**: Already low-income countries in certain regions, such as Laos PDR, Cambodia, and Myanmar in Southeast Asia, are

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expected to face the highest socioeconomic vulnerabilities by mid century. This vulnerability is assessed considering various factors including economic growth and poverty, education, health, gender inequality, governance, demography, and access to basic infrastructure. Particularly at risk are rural and urban areas with high population density, socioeconomic inequalities, limited access to healthcare, high pollution levels, and fewer green spaces in these low-income countries. Such areas will be disproportionately affected by climate change impacts.

- **Heat-related labour losses**: In a scenario of 2 °C of heating, heat exposure will increasingly put the life of workers at risk, particularly those working outdoors or in physically intense labour sectors. In addition to a direct threat to their health, heat exposure limits labour productivity, with significant impacts on workers' income and on economic productivity. In this scenario, the number of hours of potential labour lost due to heat exposure are expected to increase by 46% from present-day levels by the end of the century.
- **Disease transmission risks heighten**: The length of coastline suitable for *Vibrio* pathogens could expand by 17–25%, and the transmission potential for dengue is projected to increase by 36–37% by mid century, while 23% of areas not suitable for malaria transmission between 1995 and 2014 are projected to become suitable in 2041–60.[15] This puts extra pressure on disease control efforts, adding strain on health systems, and increasing the risk of infectious disease transmission, outbreaks, and epidemics (see Figure 3.4).
- **A doubling in negative income consequences** with just the additional 0.5 °C of warming rising from 1.5 °C to 2.0 °C. Inflation is also up to 66% higher in a 2.0 °C world compared with a 1.5 °C world.

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Figure 3.4 Guatemala. Change in the length of malaria transmission season (month) between 2041 and 2060, 'below 2 °C' path. (*CVM3* Health Data Explorer. 2022)[16]

- **GDP losses widespread**: One of *The Monitor*'s starker findings is that if the 1.5 °C rise of global mean temperature increases to 2.0 °C, for all continents and regions, the negative macroeconomic consequences are projected to more than double, with increases ranging from 110% in Asia to 160% in Oceania. In just the mid-term (2041–60), GDP per capita growth is project to change relative to baseline by −1.7% in Africa, by −1.4% in Americas, by −2.5% in Asia, by −2.8% in Europe, and by −0.9% in Oceania. Central Asia sees a mean change in GDP growth of −6.1%.

At 3.6 °C, the 'Global Devastation' Scenario

The IPCC forecast a 3.6 °C rise by the end of the century only if: 'Greenhouse gas emissions and temperatures keep regularly increasing, with CO_2 emissions almost doubling from current levels by 2100. Countries become more competitive with each other, prioritizing issues of national and food security.'[17] But Romanello warns against reading this, or the summary below, as simply 'pointing towards the need to adapt. This is misleading, wrong and dangerous, and contradicts our best scientific evidence. The level of risks under 3.6 °C of heating would make any adaptation effort futile. Talking about adaptation is suitable in the 1.5 °C scenario . . . maybe (although not really) in the 2 °C scenario. But in a 3.6 °C scenario we have to be very clear that most risks will absolutely exceed our limits to adaptation.' What the following data from *The Monitor* show, therefore, 'is the absolute imperative of mitigation, to keep global temperature rise to 1.5 °C, and prevent climate hazards from breaking our limits to adapt.'

- **Extreme precipitation events** are expected to increase to 22% with a 3.6 °C rise in global temperatures. This significant range indicates a substantial increase in the frequency and intensity of heavy rainfall events, leading to heightened risks of flooding, landslides, and soil erosion. Again, warns Romanello, this goes beyond mere tweaks to 'flood defence systems, urban planning or better agricultural practices'. Although such adaptation responses *could* still work in 1.5 °C or, to a lesser extent, in a 2 °C world, 'it is unlikely adaptation would be effective at all in a 3.6 °C world. The message needs to be the imperative need to limit temperature increase, *in order* to keep hazards within the bounds of adaptation.'

- **Exposure to days of high wildfire risk**: exposure to very high wildfire risk is projected to increase by the end of the century in the Middle East by 74 days per person (or around 250%), and in Southern Africa by 65 days (or about 500%). Overall, human exposure to days of high wildfire danger is projected to increase by 34% under this scenario, as compared with current levels. This massive increase in wildfire risk would have severe implications for ecosystems, human safety, property, and air quality.
- **Tropical diseases go global**: In a 'no climate action scenario', 26 more countries around the world would experience conditions suitable for dengue outbreaks by the end of the century. (This number falls to just six more countries if global mean temperature rise is kept at 1.5 °C.) In the event of a 3.6 °C temperature rise, regions such as Southern Europe and the Balkans, which are currently not suitable for dengue transmission, would become suitable. Of the areas not suitable for malaria transmission between 1995 and 2014, 26% see the disease spread in 2041–60, and a full 38% by the end of the century. This would be a scenario of epidemics and pandemics of vector-borne diseases, overwhelming health systems, and putting susceptible populations in harm's way.
- ***Vibrio* diseases**: The global coastline suitable for the transmission of *Vibrio* diseases is expected to increase by 103% by the end of the century with a 3.6 °C rise in global temperatures. This significant expansion of *Vibrio*-friendly environments could lead to a substantial increase in the incidence of potentially lethal vibriosis, particularly in coastal and estuarine areas.

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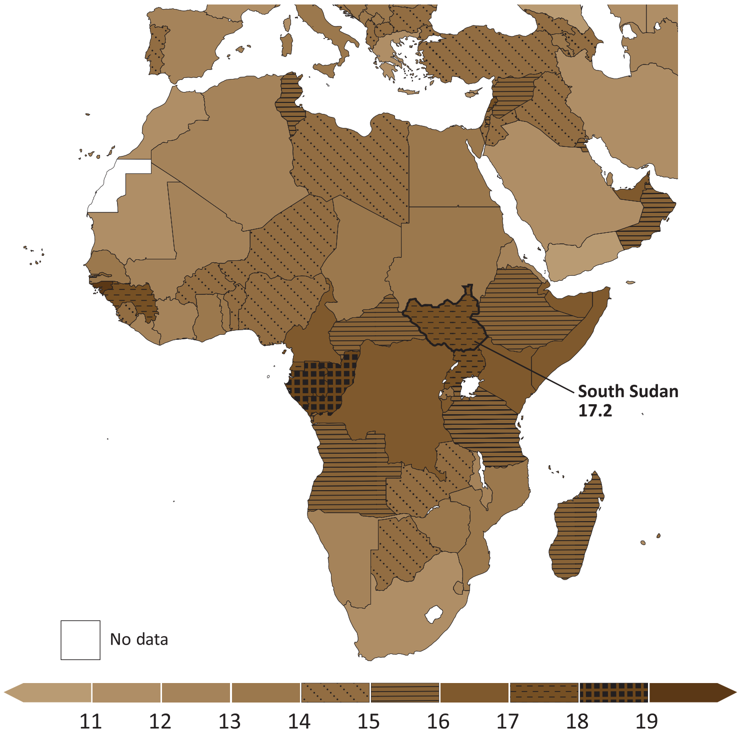

Figure 3.5 South Sudan. Drought index (#) change between 2081 and 2100 with no policy action. (*CVM3* Biophysical Data Explorer. 2022)[18]

- **Increase in precipitation associated with tropical cyclones**: Precipitation associated with tropical cyclones is projected to increase by 28% (double the increase projected for 1.5 °C).
- **Drought events** per 20 years are projected to increase 12–14 fold in a 3.6 °C warming scenario (see, for example, Figure 3.5). This dramatic increase in drought frequency and severity would have profound implications for water security, agriculture, and biodiversity. Again, any suggestion that we could simply adapt to this is not 'founded in the science,' argues Romanello. 'This level of expected

hazards underscores the need to urgently limit temperature increase, or else we'll find that there is no adaptation possible to avoid these impacts.'

- **Exposure of elderly populations to life-threatening heatwaves** is projected to increase by an astonishing 6,310%. This represents an unprecedented escalation in the risk and frequency of extreme heat events, posing a severe threat to public health. The dramatic increase shows the critical need to limit global mean temperature rise, to prevent exposure to life-threatening events exceeding the life-saving adaptation capacity.
- **Global heat-related deaths** among vulnerable groups of people over 65 years of age could reach as many as 3.35 million annually. Such a catastrophic number of fatalities highlights the severe human toll of unmitigated climate change.
- **Intense tropical cyclones** (hurricanes and typhoons) are projected to increase by 20% in a 3.6 °C warming scenario. This increase indicates not only more frequent tropical cyclones but also more severe ones, with devastating impacts on coastal communities, infrastructure, and ecosystems – an existential threat to many small island nations.
- **GDP suffers substantial losses**: With further warming resulting from limited climate action at the global level, the macroeconomic effects could be multiplied up to seven times compared with losses at 1.5 °C. Northern and Central Asian countries could be among the most affected economies, with a devastating mean change in GDP growth of −16.3%; and by −7.9% in Africa, −7.5% in the Americas, −10% in Asia as a whole, −11.8% in Europe, and −5.1% in Oceania (Table 3.3).

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Table 3.3 Mean continental deviation in GDP per capita growth. The percentages in parentheses indicate the change compared with 1.5 °C (CVF-V20 et al. *Climate Vulnerability Monitor,* 3rd ed. *(CVM3)*: *A Planet on Fire*. 2022. p. 112)

Continent	Global warming level 1.5 °C	Global warming level 2.0 °C	No climate action
Africa	−1.1%	−2.8% (+150%)	−7.9% (+611%)
Americas	−0.9%	−2.3% (+153%)	−7.5% (+711%)
Asia	−1.7%	−3.6% (+110%)	−10.0% (+484%)
Europe	−1.9%	−4.4% (+131%)	−11.8% (+515%)
Oceania	−0.6%	−1.7% (+160%)	−5.1% (+683%)

Every Second Counts

The very worst-case scenario imagined by the IPCC is a 5.7 °C scenario – the upper range of an estimate based on a very high greenhouse gas emissions scenario, whereby current CO_2 emissions levels roughly double by 2050, driven by the exploitation of fossil fuels continuing unabated.[19] The impact on our world would be unthinkable – humans could count themselves amongst the species unable to adapt to it. Constantino questions whether 'adaptation' in any serious sense could be achieved. 'Maybe in pockets,' he says. But this doesn't mean that anything below 5.7 °C can be deemed a success. As we have seen in this chapter, 3.6 degrees would be devastating for humanity; 2 degrees would be too, from 65-year-olds in heatwaves to malaria-overloaded hospitals and farmers facing catastrophic crop failure. The need for keeping to 1.5 °C is best understood as the window within which our known adaptation measures still have a chance to succeed.

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There is no room for optimism or pessimism – the former tells us it's okay to lean on the lawn chair because everything is going well, while the latter tells us it's okay to lean on the lawn chair because everything is doomed. What we need is active hope: hope that reminds us that action has an impact. This means we need to do far more, faster, in far greater fashion, with the goal not merely to survive but to thrive in the new climate-constrained world.

A 1.5 °C global rise is still regarded as the survival limit for most CVF member countries, who stand to lose substantial national territory and infrastructure above this level of warming. In the words of Chatham House, 'It's becoming increasingly clear how, in a world with warming beyond 1.5°C, the effects of climate change can quickly cascade from an environmental risk to an economic threat.'[20] The CVF issued the following plea: 'the major emitters must enhance their ambition and make their utmost fair-share effort to reduce emissions during this critical decade by reviewing and strengthening their 2030 NDC targets in order to safeguard the 1.5°C limit. We call for the need for equitable burden-sharing and transparency based on equity parameters.'[21]

The United Nations Development Programme (UNDP)'s Climate Promise, supporting 85% of all developing countries on their NDC processes, also found in April 2023 that 'Developing countries are actively taking measures to accelerate the implementation of their NDCs. They are developing integrated climate solutions that can be scaled up to achieve higher levels of ambition, including nature-based solutions, circular economy practices, and integrated water resource management approaches.' Such countries, which include the majority of CVF members, are also actively involving the private sector and pioneering the

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implementation of carbon market instruments. The Climate Promise argues, however, that 'the overarching challenge of attracting investments remains. More must be done to bring in private sector finance, integrate NDC targets into national budgets, and put in place policies and regulations that will further incentivise investment into climate action.'[22] Without the funding to adapt, the most vulnerable will be left at the mercy of unforgiving weather, and unforgiving markets. Yet adaptation can only be possible in-step with mitigation. International finance needs to be mobilized to 'adapt to a 1.5 °C world,' says Romanello. 'There is no hope for adaptation to a 3.6 °C world. This needs to be made clear.' The message is not that we can adapt our way out of climate change, she says: 'We know we can't, and the path [to 3.6 °C] will only take us to devastation, particularly in developing countries.'

High emitting countries must heed that call. In a UK parliamentary debate on 'Climate Finance: Tackling Loss and Damage', held in the House of Commons on Tuesday 5 September 2023, the chair, Chris Law MP, told the House: '2.8°[C] of warming would usher in an era of cascading risks, as the uncontrolled effects of global heating result in more frequent extreme heat, sea level rises, drought and famine ... on the necessary actions to keep global warming to 1.5°[C], yet again we hear the unmistakable sound of the can being kicked down the road ... It is now 14 years since a promise of $100 billion of finance was made to developing countries to help them to fight the climate crisis. There is growing recognition of the urgent need to reform how multilateral development banks and the international finance system can support climate action and unlock resources.'[23]

On average, across all continents, the additional 0.5 °C of warming rising from 1.5 °C to 2.0 °C would typically lead to a doubling in the dire consequences of climate change.

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Every fraction of additional warming above 1.5 °C will worsen the already horrifying impacts, threaten lives, food sources, livelihoods, and economies worldwide. There is an awful lot still to fight for – for the most vulnerable, it is the fight for life itself.

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