How Will International Migration Policy and Sustainable Development Affect Future Climate-Related Migration?

By Robert McLeman

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Contents

Executive Summary

Climate change is likely to be an important driver of future migration and displacement. Extreme weather events, such as tropical cyclones, floods, droughts, and extreme heat, already drive migration. Their effects are being experienced both directly (through damage to homes, infrastructure, and livelihood assets) and indirectly (through disruptions to food and urban systems), although their frequency and impacts vary regionally. Climate change is likely to increase the frequency and intensity of these weather events and their geographical distribution, and thus indirectly drive migration and displacement via its impacts on food and water availability, land degradation, and possible civil unrest.

While the potential impact of climate change on migration is widely acknowledged, there are no reliable estimates of future climate-related migration or displacement. In part, this reflects the continuing uncertainty around future efforts to reduce greenhouse gas emissions and around other variables such as population trends, socioeconomic priorities, and migration policies. Migration policy decisions made today will have significant implications for future global migration patterns and for the wider ability of states, communities, and households to adapt to the physical and socioeconomic impacts of climate change. Migration is a key component of sustainable economic development, adaptive capacity building, and disaster recovery, especially in less-developed regions that are highly exposed to climatic risks. Restrictions on mobility can deprive low- and middle-income countries of remittance income, stifling demand-driven movements of labor, and bolstering the role of organized crime and other malign nonstate actors in international migration.

Migration is a key component of sustainable economic development, adaptive capacity building, and disaster recovery.

The 2018 Global Compact for Safe, Orderly, and Regular Migration explicitly encourages the international community to implement migration policies to facilitate voluntary migration and manage more frequent involuntary displacements due to climate change, especially in low- and middle-income countries. Failure to do so could lead to greater rates of unsafe, low-agency migration; internal displacement; and trapped populations unable to move away from exposed areas. Migration under such conditions is maladaptive (i.e., it undermines sustainable development and erodes capacity to adapt to climate change), having fewer benefits and greater costs for migrants, sending communities, and destinations.

There are four general ways in which climate change may influence future migration, none of which are mutually exclusive, and all of which become more likely with higher levels of greenhouse gas emissions:

- larger flows of people along established migration routes;
- decreasing flows of people along established migration routes where destinations become less attractive relative to sending areas;

- new flows of migrants between sending and destination areas that have not historically been connected; and
- growing numbers of immobile people who might want or need to move but who are unable to do so because they lack the necessary financial means.

This report describes findings from a first-of-its-kind systematic exercise to explore how future climatic conditions under four standardized greenhouse gas concentration scenarios (known as the Representative Concentration Pathways, or RCPs) will affect climate-related drivers of migration and displacement in the future, and how international development and migration policies will mediate (or exacerbate) migration outcomes. This scenario exercise covers two time periods, 2020–50 and 2050–2100, and focuses on the main source regions of international migration: East and Southeast Asia, South and Central Asia, Latin America and the Caribbean, the Middle East and North Africa, and sub-Saharan Africa.

The future frequency and severity of extreme storms, floods, and droughts will vary by region. The current pathway the world is on—high greenhouse gas emissions, inadequate progress toward sustainable development, and a lack of cooperation in migration policy—will lead to multifold increases in climate-related migration and displacement in all regions. The effects will be felt particularly along the coasts of East, Southeast, and South Asia, due to the increased severity of tropical storms and more frequent, severe floods; across much of Africa due to the increased frequency and severity of drought; in East Africa and, to a lesser extent, the Middle East, due to more frequent, severe flood events; and in Latin America and the Caribbean, due to the increased intensity of hurricanes. Most additional climate-related migration will occur within affected countries, but increases in international migration could also be expected along the following existing pathways:

- intraregional migration within sub-Saharan Africa, within East and Southeast Asia, and within South Asia;
- from Latin America, the Caribbean, and South Asia to North America;
- from South Asia to the Middle East; and
- from South Asia, Latin America, the Caribbean, the Middle East, and North Africa to Europe.

The number of people trapped in worsening conditions from which they cannot extricate themselves will also grow in number in every region.

There is a narrow window for implementing migration and development policy actions that address some of the worst impacts of climate change on migration and displacement. Between 2020 and 2050, changes in the frequency and severity of extreme storms, floods, and droughts will most likely be incremental, and migration outcomes will be strongly mediated by development progress and by migration policy decisions. During this period, implementing international migration policies consistent with the objectives of the Global Compact for Migration would have observable, beneficial effects—regardless of atmospheric greenhouse gas concentration levels, and under both current economic development pathways and with more concerted efforts to meet the United Nations' Sustainable Development Goals (SDGs).

Between 2050 and 2100, however, climate change will exert a more obvious and dominant effect on migration and displacement. Growing atmospheric greenhouse gas concentrations will likely cause extreme climate events to occur with greater frequency and/or intensity, amplified in coastal regions by rising sea levels. The future severity of such outcomes is correlated positively with growth in greenhouse gas concentrations. For the period 2050–2100, growing rates of climate-driven migration and displacement can only be averted through a combination of (1) aggressive steps to reduce greenhouse gas emissions, (2) concerted efforts to achieve the SDGs, and (3) widespread uptake and implementation of policies prescribed in the Global Compact. Scientists have already warned that, to avoid dangerous changes to the climate system, greenhouse gas emissions must be brought under control by 2030, the same target year for meeting the SDGs. Achieving the SDGs will in turn require reversing the current trend in restrictive migration policies, which means that meaningful efforts to implement the Global Compact on Migration also need to be made over that time frame.

For the period 2050–2100, growing rates of climate-driven migration and displacement can only be averted through a combination of (1) aggressive steps to reduce greenhouse gas emissions, (2) concerted efforts to achieve the SDGs, and (3) widespread uptake and implementation of policies prescribed in the Global Compact.

Inaction in any one of these three key policy-making areas will likely lead to increased levels of involuntary migration and displacement by mid-century, regardless of progress made in the other two. Failures in all three policy domains can be expected to generate frequent, often chaotic pulses of maladaptive migration and displacement at scales for which recent experience provides little preparation or guidance. Still, policies described in the compact would have beneficial long-term effects even in scenarios involving high greenhouse gas emission and low levels of economic cooperation and development, and they would partly offset some of the worst potential migration and displacement outcomes.

An overarching conclusion of this analysis is that there is strong interconnection and potential synergy between the policy domains of greenhouse gas mitigation, sustainable development, and international migration. Current global trends toward restrictive immigration policies and aggressive border enforcement are likely to exacerbate vulnerability to climate-related risks in less-developed regions, undermine efforts to achieve the SDGs, and generate additional maladaptive migration within and from less-developed regions. Events such as the 2015–16 European migration crisis, Central American migrant caravans, and post–Hurricane Maria flight from Puerto Rico are indicative of the types of migration that would become more commonplace. A policy move in the opposite direction of what is recommended by the Global Compact—that is, toward greater criminalization and securitization of international migration, and no international support for involuntarily displaced people—would amplify the adverse effects of climate change at regional and global scales.

1 Introduction

Climate change is likely to shape future migration and displacement trends. It is well established that climatic events and conditions—particularly extreme storms, floods, and droughts—have the potential to influence human migration patterns and behavior.[1] Failure to take meaningful action to end the growing concentration of greenhouse gases in the atmosphere will lead to more frequent and/or intense extreme climate events. Amplified by the effects of rising sea levels, these will trigger increased levels of climate-related migration, especially in low- and middle-income countries in Africa, Asia, and Latin America.[2] The specific nature and scale will range from local, temporary moves to international migration, and include voluntary movement (often linked to labor migration) and involuntary displacement.

Policy actions taken in the coming decades will help shape the effects of climate change on migration and displacement. For example, any additional greenhouse gases emitted in the coming decades will increase the extent of the disruptions to come. In separate reports issued in September 2019, the World Meteorological Organization and the Intergovernmental Panel on Climate Change warned that current emission rates place the world on the path to a +3°C warming over preindustrial rates—more than double the warming rates aimed for under the 2016 Paris Climate Agreement, and well beyond the threshold at which scientists consider global warming to be dangerous.[3] If that happens, lengthy hurricane seasons, such the 2020 Atlantic season that featured multiple large storms and extended into late November, will become commonplace; water and food scarcity will become widespread across large regions; the return rates of floods will accelerate; and sea levels will rise between 0.5 and 1 meter by 2100.[4] In 2019, nearly 24 million people worldwide were displaced from their homes by weather-related hazards;[5] under 3°C warming, much larger numbers of displacements would be expected.

However, such outcomes are not inevitable. They can be mitigated not only by climate policy but also by policies that foster sustainable development—which helps countries and communities lessen their emissions and build capacity to adapt to climate risks—and through cooperative migration policies. The 2018 Global Compact for Safe, Orderly, and Regular Migration explicitly encourages the international community to implement migration policies to facilitate voluntary migration and manage more frequent involuntary displacements due to climate change, especially in low- and middle-income countries.[6] The compact envisages a world where barriers to legal and safe migration are reduced, where remittances flow freely between sending and receiving communities, and where migration makes positive contributions to sustainable development and people's ability to adapt to climate change. Such objectives are entirely

1 Robert McLeman, *Climate and Human Migration: Past Experiences, Future Challenges* (Cambridge, UK: Cambridge University Press, 2014).

2 Intergovernmental Panel on Climate Change (IPCC), *Climate Change 2014: Impacts, Adaptation and Vulnerability: Summary for Policy Makers* (Cambridge, UK and New York: IPCC, 2014).

3 World Meteorological Organization (WMO), *United in Science* (Geneva: WMO, 2019); Hans-Otto Pörtner et al., eds., *IPCC Special Report on the Ocean and Cryosphere in a Changing Climate* (Geneva: IPCC, 2019).

4 IPCC, *Climate Change 2014*.

5 International Displacement Monitoring Centre (IDMC), *Global Report on Internal Displacement 2020* (Geneva: IDMC, 2020).

6 United Nations, "Global Compact for Safe, Orderly, and Regular Migration," December 19, 2018.

consistent with scientific literature on the links between migration and climate adaptation,[7] as well as with calls from small island nations for programs that allow young people to migrate to high-income countries for skills training and employment, so that they are better prepared if they need to abandon their islands at some point because of climate change.[8]

When attempting to project the future impacts of climate change on global migration patterns, there are three key uncertainties. The first uncertainty relates to what the future climate will be like, which is dependent upon greenhouse gas emission levels in coming decades. The future climate will, in turn, affect the future frequency and intensity of the major climate-related drivers of migration in different regions.

A second uncertainty concerns future trends in socioeconomic development in low- and middle-income countries, which are an underlying determinant of countries' ability to mitigate greenhouse gas emissions and to build adaptive capacity for citizens. Countries, communities, and households with strong adaptive capacity typically have a wider range of options to adjust and respond to climate hazards than those with weak capacity. Migration is inherently linked to adaptive capacity, and people who lack alternative options may be forced to migrate under duress when a hazard strikes or, perhaps worse, they may lack the necessary resources to move away from deteriorating circumstances.[9] The United Nations' 2030 Agenda for Sustainable Development lays out a set of objectives known as the Sustainable Development Goals that, while not merely aimed at reducing climate vulnerability, would do so if met.[10]

As the climatic drivers of migration strengthen in coming decades, policy choices will determine if that migration contributes to building sustainable development and adaptive capacity or if it works counter to such aims.

The final uncertainty is how international migration policy will evolve in coming decades. Will the international community work collaboratively toward meeting the objectives of the Global Compact? Or will it move in the opposite direction, further securitizing borders and narrowing access to humanitarian protection—especially for those who fall in between the definition of refugees and economic migrants—as seen in some Western nations? Such policies will shape the number of people on the move, the places they move to, and the conditions under which that migration occurs. As the compact's full title suggests, safe and orderly migration holds the potential to benefit migrants, destination countries, and those who stay behind in origin countries. As the climatic drivers of migration strengthen in coming decades, policy choices will determine if that migration contributes to building sustainable development and adaptive capacity or if it works counter to such aims.

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7 W. Neil Adger et al., "Focus on Environmental Risks and Migration: Causes and Consequences," *Environmental Research Letters* 10, no. 6 (2015); Richard Black et al., "Migration, Immobility and Displacement Outcomes Following Extreme Events," *Environmental Science and Policy* 27, no. S1 (2013): S32–43; Richard Black, Stephen R. G. Bennett, Sandy M. Thomas, and John R. Beddington, "Climate Change: Migration as Adaptation," *Nature* 478, no. 7370 (2011): 447–49.

8 Karen E. McNamara, "Cross-Border Migration with Dignity in Kiribati," *Forced Migration Review* 49 (2015): 62.

9 Black et al., "Climate Change: Migration as Adaptation"; W. Neil Adger, Ricardo Safra de Campos, and Colette Mortreux, "Mobility, Displacement and Migration, and Their Interactions with Vulnerability and Adaptation to Environmental Risks," in *Routledge Handbook of Environmental Displacement and Migration*, eds. Robert McLeman and François Gemenne (London: Routledge, 2018).

10 United Nations, "Sustainable Development Goals," accessed May 18, 2020.

This report assesses the influence that various migration, development, and climate policy options are likely to have on future climate-related migration and displacement. It creates three standardized scenarios for future migration policy and analyzes these in combination with standardized scenarios for climate change (the Representative Concentration Pathways, or RCPs) and socioeconomic development (the Shared Socioeconomic Pathways, or SSPs) to explore how policymakers might be able to influence the future trajectory of climate-related migration trends. The report will first provide an overview of current knowledge about climatic drivers of migration, nonclimatic variables that mediate migration, and estimates of current and future climate-related migration within wider migrant stocks and flows, before exploring the findings of the scenario analysis exercise and the implications for policymakers.

2 The Drivers of Climate-Related Migration

We know that climatic events and conditions affect migration patterns and behavior,[11] but the relationship between the two is complex, multidirectional, and highly context specific. This means that similar climate events and conditions can stimulate increased amounts of migration in one setting, yet in another it may have no discernible effects or even lead to lower rates of migration. In some cases, immobile populations can be trapped in at-risk locations.[12] This divergence in potential outcomes is due in part to variations in the intensity and rate of onset of particular climate events. However, outcomes are also affected by nonclimatic factors—for instance, demographic, economic, political, and social conditions at the local, regional, and global levels—which can have a significant mediating effect on migration.[13]

These climatic and nonclimatic influences, or drivers[14] of migration, can be organized into three general categories, each of which can be the target of strategic policy-making:

- **Predisposing drivers.** These climatic and nonclimatic factors affect the potential for migration at a given time and place. They can include living in a location that is geographically exposed to weather-related hazards, pursuing a livelihood such as fishing or pastoralism that is inherently sensitive to changes in environmental conditions, and household characteristics such as the health and age of family members or their financial status. Predisposing migration drivers often overlap closely with

11 McLeman, *Climate and Human Migration*; Richard Black et al., "The Effect of Environmental Change on Human Migration," *Global Environmental Change* 21, no. S1 (2011): S3–11.

12 McLeman, *Climate and Human Migration*; Black et al., "The Effect of Environmental Change"; Kathleen Neumann and Frans Hermans, "What Drives Human Migration in Sahelian Countries? A Meta-Analysis," *Population, Space and Place* 23, no.1 (2015); Black et al., "Migration, Immobility and Displacement Outcomes"; Caroline Zickgraf, "Immobility," in *Routledge Handbook of Environmental Displacement and Migration*, eds. Robert McLeman and François Gemenne (London: Routledge, 2018); Clark Gray and Erika Wise, "Country-Specific Effects of Climate Variability on Human Migration," *Climatic Change* 135, no. 3 (2016): 555–68; Koko Warner and Tamer Afifi, "Where the Rain Falls: Evidence from 8 Countries on How Vulnerable Households Use Migration to Manage the Risk of Rainfall Variability and Food Insecurity," *Climate and Development* 6, no. 1 (2014): 1–17; Raphael J. Nawrotzki, Allison M. Schlak, and Tracy A. Kugler, "Climate, Migration, and the Local Food Security Context: Introducing Terra Populus," *Population and Environment* 38, no. 2 (2016): 164–84.

13 UK Government Office for Science, *Foresight: Migration and Global Environmental Change, Final Project Report* (London: UK Government Office for Science, 2011); Kanta Kumari Rigaud et al., *Groundswell: Preparing for Internal Climate Migration* (Washington, DC: World Bank, 2018); Elizabeth Fussell, "Population Displacements and Migration Patterns in Response to Hurricane Katrina," in *Routledge Handbook of Environmental Displacement and Migration*, eds. Robert McLeman and François Gemenne (London: Routledge, 2018), 277–88.

14 Nicholas van Hear, Oliver Bakewell, and Katy Long, "Push-Pull Plus: Reconsidering the Drivers of Migration," *Journal of Ethnic and Migration Studies* 44, no. 6 (2018): 927–44.

factors that influence vulnerability to climate change (i.e., the potential to experience loss or harm). National and international policies and programs for economic development, education, health, poverty alleviation, and trade are examples of interventions that can help address these predisposing drivers of migration.

- **Causal drivers.** These factors stimulate a decision to migrate (or not) on the part of individuals or households. These can be further subdivided into precipitating and proximate drivers. Precipitating drivers are events or conditions that directly trigger a decision to migrate due to immediate impacts on housing, livelihood assets, or critical infrastructure. The most common climate-related examples of these include tropical cyclones, floods, droughts, extreme heat events, and wildfires. Proximate drivers are those that have an important indirect effect. Climate-related examples include sudden shifts in the pricing or availability of food due to droughts, floods, or storm damage, and the exacerbation of conflicts by climate hazards. Policies aimed at mitigating greenhouse gas emissions, building adaptive capacity for climate change, and fostering sustainable development in low-income countries have a significant influence on both types of causal drivers.

- **Mediating drivers.** Typically nonclimatic in nature, these factors facilitate or constrain migration flows and routes. Examples include assistance to help people remain where they are (such as humanitarian assistance) or policies enabling people to move elsewhere within their country or to seek legal migration opportunities in another country. These mediating drivers can involve an array of actors and processes operating at multiple scales, such as social networks that share information and resources valuable to migrants; humanitarian assistance (or its absence) in response to extreme events; national policies with respect to migration, border enforcement, and visa regimes; and bilateral and international arrangements relevant to mobility, including those specific to labor migration and refugee protection.

While migration is one form of adaptation to climate change,[15] it is typically not the first response individuals or households[16] choose when confronted by climatic risks (except for those with inherently migratory livelihoods, such as pastoralists). Rather, those exposed to such risks will first select local options, which are typically less costly, disruptive, and unsafe than migrating. For example, farm households experiencing severe drought will typically first make changes to plantings, reduce livestock numbers, seek out off-farm employment, access insurance programs (if available), and take similar steps before

15 Robert A. McLeman and Barry Smit, "Migration as an Adaptation to Climate Change," *Climatic Change* 76, no. 1–2 (2006): 31–53; Black et al., "Climate Change: Migration as Adaptation"; Cecilia Tacoli, "Crisis or Adaptation? Migration and Climate Change in a Context of High Mobility," *Environment and Urbanization* 21, no. 2 (2009): 513–25; Andrew Geddes and Andrew Jordan, "Migration as Adaptation? Exploring the Scope for Coordinating Environmental and Migration Policies in the European Union," *Environment and Planning C: Politics and Space* 30, no. 6 (2012): 1029–44; Jürgen Scheffran, Elina Marmer, and Papa Sow, "Migration as a Contribution to Resilience and Innovation in Climate Adaptation: Social Networks and Co-Development in Northwest Africa," *Applied Geography* 33 (2012): 119–27; Frank Biermann and Ingrid Boas, "Climate Change and Human Migration: Towards a Global Governance System to Protect Climate Refugees," in *Climate Change, Human Security and Violent Conflict*, eds. Jürgen Scheffran et al. (Berlin, Heidelberg: Springer, 2012), 291–300.

16 An exception would be planned relocations of people organized or assisted by state authorities. The future need for planned relocations of populations living in high-risk areas is expected to grow in coming decades, especially those living in low-lying coastal areas.

contemplating a temporary or permanent move.[17] Even then, it is common for only one member of the household—typically an adult of working age—to move to a nearby urban center to seek employment and send wages home to support the others.[18] Typically, an entire household decides to move indefinitely only when the degree of harm facing them exceeds a threshold beyond which the household cannot cope by other means.

BOX 1
Adaptive vs. Maladaptive Migration

Migration decisions typically fall somewhere along a continuum of agency, which refers to the degree of freedom the potential migrant has in deciding if, when, where, and under what conditions to move (see Figure 1). Refugees and involuntarily displaced people are described as having low agency, while migrants who move for lifestyle reasons have high agency, with family and labor-seeking migration falling somewhere between the two extremes. Migration that takes place under conditions of high agency is typically beneficial to migrants, receiving communities, and households in the origin country. In the context of climate change, movement that involves a high degree of agency can be considered adaptive migration, given its potential to make individuals and communities less vulnerable to climate risks and better able to adapt in the future.

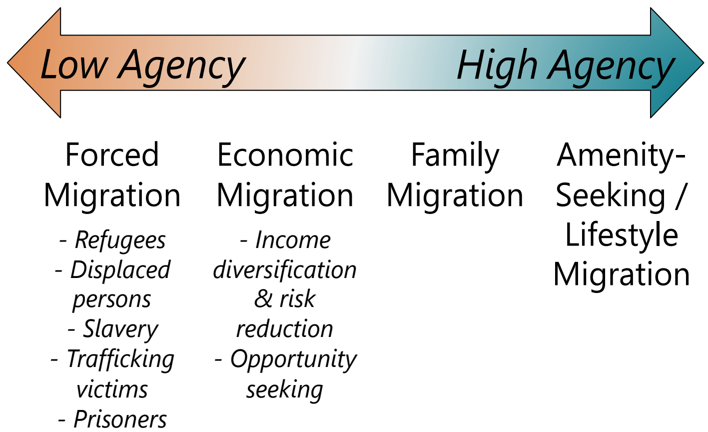
Conversely, low-agency migration is often a product of adverse political, economic, or social conditions in the origin country, and may be costly and detrimental for migrants and destination countries alike. Low-agency migration in the wake of climatic events is often chaotic and episodic, manifested as pulses or surges of out-migration from affected areas, creating significant management challenges for government agencies. In some instances, such as the large-scale destruction of housing and infrastructure by extreme storms, migration may be the only choice available to many people—a situation described as involuntary displacement. In the context of climate change, low-agency migration can be described as maladaptive, given that, in the absence of proactive interventions by government and international agencies, it increases the future vulnerability of migrants, sending communities, and destinations.

Sources: Robert McLeman, *Climate and Human Migration: Past Experiences, Future Challenges* (Cambridge, UK: Cambridge University Press, 2014); Walter G. Peacock, Nicole Dash, Yang Zhang, and Shannon Van Zandt, "Post-Disaster Sheltering, Temporary Housing and Permanent Housing Recovery," in *Handbook of Disaster Research*, eds. Havidán Rodriguez, William Donner, and Joseph E. Trainor (Dordrecht, the Netherlands: Springer, 2018), 569–94; Gwilym Pryce and Yu Chen, "Flood Risk and the Consequences for Housing of a Changing Climate: An International Perspective," *Risk Management* 13, no. 4 (2011): 228–46; M. Rezaul Islam and Mehdi Hasan, "Climate-Induced Human Displacement: A Case Study of Cyclone Aila in the South-West Coastal Region of Bangladesh," *Natural Hazards* 81, no. 2 (2016): 1051–71; Candice A. Myers, Tim Slack, and Joachim Singelmann, "Social Vulnerability and Migration in the Wake of Disaster: The Case of Hurricanes Katrina and Rita," *Population and Environment* 29, no. 6 (2008): 271–91; Elizabeth Fussell, "Population Displacements and Migration Patterns in Response to Hurricane Katrina," in *Routledge Handbook of Environmental Displacement and Migration*, eds. Robert McLeman and François Gemenne (London: Routledge, 2018), 277–88.

17 Barry Smit and Mark Skinner, "Adaptation Options in Agriculture to Climate Change: A Typology," *Mitigation and Adaptation Strategies for Global Change* 7, no. 1 (2002): 85–114; Bruno Barbier et al., "Human Vulnerability to Climate Variability in the Sahel: Farmers' Adaptation Strategies in Northern Burkina Faso," *Environmental Management* 43, no. 5 (2009): 790–803; Edmund C. Penning-Rowsell, Parvin Sultana, and Paul M. Thompson, "The 'Last Resort'? Population Movement in Response to Climate-Related Hazards in Bangladesh," *Environmental Science & Policy* 27, no. S1 (2013): S44–59.

18 Stanley Karanja Ng'ang'a et al., "Migration and Self-Protection against Climate Change: A Case Study of Samburu County, Kenya," *World Development* 84 (2016): 55–68.

FIGURE 1
Continuum of Migrant Agency



Source: Adapted from Robert McLeman, *Climate and Human Migration: Past Experiences, Future Challenges* (Cambridge, UK: Cambridge University Press, 2014).

The speed of a climate hazard's onset is an important causal factor. Slow-onset droughts, for example, allow more time to make local adjustments, while sudden-onset extreme events can immediately push people to migrate if institutional responses to the event are inadequate or slow. For example, the large out-migration of Puerto Ricans to the U.S. mainland in the wake of Hurricane Maria, which hit in late 2017, reflects not only the severity of the storm damage but also the inadequate response of authorities.[19] This type of migration can be said to be maladaptive migration, given its chaotic nature, the vulnerability of migrants and of family members left behind, and the pressure new arrivals place on destination communities (see Box 1). Conversely, migration that makes people, the places they come from, and their destinations more capable of adapting to a climate-disrupted future would be considered adaptive migration. An example of the latter is a proposal made by the government of Kiribati, a small island-nation in the middle of the Pacific Ocean, in support of what it terms "migration with dignity."[20] It proposes that high-income countries accept, in an organized fashion, young migrants from countries vulnerable to rising sea levels and allow them to train, work, and remit money home. In the event that their home countries need to be entirely abandoned due to climate change, residents would have acquired the skills and savings necessary to move elsewhere and adapt successfully. But, to date, destination countries have not expressed interest in adopting this proposal.

State and bilateral/multilateral migration policies and programs are important mediating drivers, and their aim is often to facilitate high-agency migration and to prevent or discourage low-agency migration. For example, Canada, Australia, and New Zealand have for many years operated migration programs designed to attract skilled workers and entrepreneurs who have strong potential to successfully integrate upon arrival. The 2018 Global Compact for Safe, Orderly, and Regular Migration explicitly encourages states to cooperate in the development of programs that facilitate international migration and help migrants integrate upon arrival. But in practice, many countries have policies in place to prevent and deter low-agency migration, such as policies that "push out" borders and thus make it harder for vulnerable populations to claim asylum.[21] The trends of prioritizing border enforcement and restricting movement risk putting migration policy on a collision course with efforts to build adaptive capacity in climate-vulnerable countries.

19 Carlos E. Rodríguez-Díaz, "Maria in Puerto Rico: Natural Disaster in a Colonial Archipelago," *American Journal of Public Health* 108, no. 1 (2018): 30–32.
20 McNamara, "Cross-Border Migration with Dignity in Kiribati."
21 Examples include the U.S. Migrant Protection Protocols (also known as "Remain in Mexico") and efforts to sign safe third-country agreements with Central American countries, and efforts by the European Union to reinforce its external borders and build migration management capacity in several countries along the major routes to Europe.

3 Estimating the Current Scale of Climate-Related Migration

Most climate-related migration, like migration more broadly, occurs within countries.[22] The current global stock of migrants has most recently been estimated at 760 million internal migrants[23] (i.e., people who have moved within the borders of their home countries) and 272 million international migrants,[24] although experts suspect these numbers are conservatively low. Of the global migrant stock, an estimated 79.5 million people have been forcibly displaced by persecution, conflict, violence, human rights violations or civil unrest.[25]

In terms of international migration, the largest flows originate in Asia, Africa, and Latin America, along the following routes:[26]

- intraregional migration within sub-Saharan Africa, within East and Southeast Asia, and within South Asia;
- from Latin America, the Caribbean, and South Asia to North America;
- from South Asia to the Middle East; and
- from South Asia, Latin America, the Caribbean, the Middle East, and North Africa to Europe.

It is notable that several of the largest flows are intraregional, comprised of people moving between countries within sub-Saharan Africa and within Asia. North America, Europe, and high-income countries in the Middle East are the primary destinations of interregional migration. International migration originating in high-income countries is lower in volume than the flows shown above and tends to be directed toward other high-income countries, with no particular interregional patterns dominating.

Challenges related to definitions and data make it difficult to identify with precision how many people within global stocks and flows move (or have moved) for reasons attributable to climate. A key definitional challenge is that there is no standardized legal or operational definition as to what constitutes "climate migration" or a "climate migrant," unlike, for example, the definition of a refugee established by the 1951 UN Refugee Convention.[27] Because climate may have both direct and indirect effects on migration decisions,

22 Reiko Obokata, Luisa Veronis, and Robert McLeman, "Empirical Research on International Environmental Migration: A Systematic Review," *Population and Environment* 36, no. 1 (2014): 111–35; Luisa Veronis, Bonnie Boyd, Reiko Obokata, and Brittany Main, "Environmental Change and International Migration: A Review," in *Routledge Handbook of Environmental Displacement and Migration*, eds. Robert McLeman and François Gemenne (London: Routledge, 2018); Cristina Cattaneo et al., "Human Migration in the Era of Climate Change," *Review of Environmental Economics and Policy* 13, no. 2 (2019): 189–206.

23 United Nations Department of Economic and Social Affairs (UN DESA), "Cross-National Comparisons of Internal Migration: An Update on Global Patterns and Trends" (technical paper no. 2013/1, UN DESA, New York, 2013).

24 UN DESA, Population Division, *International Migration Report 2019* (New York: UN DESA, 2019).

25 UNHCR, *Global Trends: Forced Displacement in 2019* (Geneva: UNHCR, 2019).

26 Guy J. Abel and Nikola Sander, "Quantifying Global International Migration Flows," *Science* 343, no. 6178 (2014): 1520–22.

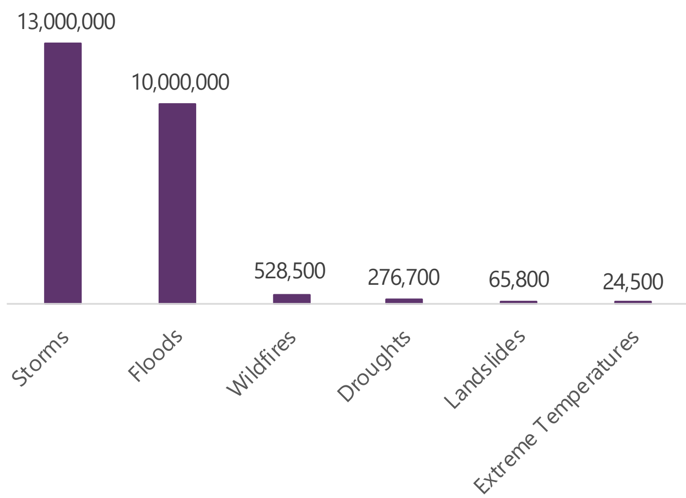
27 Benoît Mayer, "The Arbitrary Project of Protecting Environmental Migrants," in *Environmental Migration and Social Inequality*, eds. Robert McLeman, Jeanette Schade, and Thomas Faist (Dordrecht, the Netherlands: Springer, 2015), 189–202; François Gemenne and Pauline Brücker, "From the Guiding Principles on Internal Displacement to the Nansen Initiative: What the Governance of Environmental Migration Can Learn from the Governance of Internal Displacement," *International Journal of Refugee Law* 27, no. 2 (2015): 245–63.

and because nonclimatic factors can have a strong mediating influence, climate migrants are not easily identifiable except in the case of involuntary displacement by large, extreme events, where the causal driver is obvious.

A key data challenge is that there is no global repository for data on the movement of people for climate-related reasons, as countries and international agencies typically do not collect such information. Although internal population movements are often captured in national censuses, the reasons for movement typically are not. Much of what we know about climate-related migration comes from country-level studies in which researchers have used statistical tools to identify associations between unconnected weather station records and census data.[28] International migration for climate-related reasons is even more difficult to track since, in the absence of a formal legal recognition of climate migration, people who move for such reasons have no incentive to disclose their motivation. Climate migrants might, for example, be present within larger flows of people who move internationally for reasons officially described as skilled labor migration, family reunification, or refugees.[29]

FIGURE 2

Disaster-Related Internal Displacements Recorded by IDMC, 2019



Source: International Displacement Monitoring Centre (IDMC), *Global Report on Internal Displacement* (Geneva: IDMC, 2019).

The best source of statistics relevant to understanding global climate-related migration is the International Displacement Monitoring Centre (IDMC), which has recorded the number of people displaced annually by weather events, by country, since 2008. Such events do not necessarily lead to permanent relocation or migration, and IDMC figures tend not to capture smaller-scale events or instances where climate has an indirect influence on population movements. Nonetheless, IDMC statistics provide evidence of the relative importance of specific types of weather events in generating displacement. Floods, extreme storms, and droughts typically cause the largest number of weather-related internal displacements each year, although 2019 saw an unusually large number of people displaced by wildfires (Figure 2).

28 Clark Gray and Valerie Mueller, "Drought and Population Mobility in Rural Ethiopia," *World Development* 40, no. 1 (2012): 134–45; Valerie Mueller, Clark Gray, and Katrina Kosec, "Heat Stress Increases Long-Term Human Migration in Rural Pakistan," *Nature Climate Change* 4, no. 3 (2014): 182–85; Isabelle Chort and Maëlys de la Rupelle, "Determinants of Mexico-U.S. Outward and Return Migration Flows: A State-Level Panel Data Analysis," *Demography* 53, no. 5 (2016): 1453–76; Raphael J. Nawrotzki, Lori M. Hunter, Daniel M. Runfola, and Fernando Riosmena, "Climate Change as a Migration Driver from Rural and Urban Mexico," *Environmental Research Letters* 10, no. 11 (2015): 114023; Elizabeth Fussell, Lori M. Hunter, and Clark L. Gray, "Measuring the Environmental Dimensions of Human Migration: The Demographer's Toolkit," *Global Environmental Change* 28 (2014): 182–191.

29 Amina Mezdour, Luisa Veronis, and Robert McLeman, "Environmental Influences on Haitian Migration to Canada and Connections to Social Inequality: Evidence from Ottawa-Gatineau and Montreal," in *Environmental Migration and Social Inequality*, eds. Robert McLeman, Jeanette Schade, and Thomas Faist (Dordrecht, the Netherlands: Springer, 2015), 103–15; Luisa Veronis and Robert McLeman, "Environmental Influences on African Migration to Canada: Focus Group Findings from Ottawa-Gatineau," *Population and Environment* 36, no. 2 (2014): 234–51.

This report focuses on the main sending regions of international migrants—Asia, Africa, and Latin America and the Caribbean—and assesses how climate change may affect future migration. Using the assumption that the relationship between weather events and displacement extends to climate-change-related migration more generally—an assumption that is consistent with the available scholarly research—IDMC statistics allow for the identification of the main climatic drivers of migration in each of these regions (Table 1, Figure 3). The data show that floods are a key driver in every region with the exception of Latin America and the Caribbean; that extreme storms are a key risk in Asia and in Latin America and the Caribbean; and that droughts and extreme heat are of greatest concern in sub-Saharan Africa. In terms of the number of people at risk, IDMC statistics show that, of these regions, Asia accounts for the vast majority (more than 85 percent) of people displaced by all weather-related hazards.

TABLE 1

Key Climatic Drivers of Internal Migration and Displacement, by Region

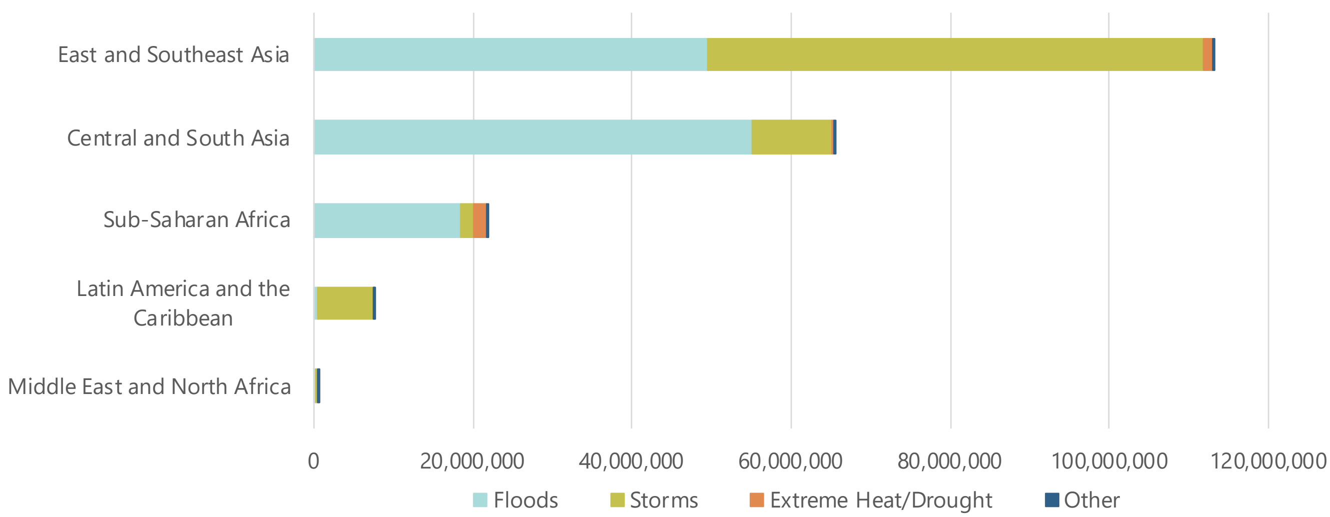
Region	Key Driver(s)
East and Southeast Asia	Floods, extreme storms
South and Central Asia	Floods, extreme storms
Eastern sub-Saharan Africa	Floods, droughts/extreme heat
Western and Southern sub-Saharan Africa	Floods, droughts/extreme heat
Latin America and the Caribbean	Extreme storms
Middle East and North Africa	Floods

Note: Within these classifications, East and Southeast Asia includes China, Korea, Japan, Taiwan, and the Association of Southeast Asian Nations (ASEAN) countries; South and Central Asia includes Afghanistan, Bangladesh, Bhutan, India, Nepal, Pakistan, Sri Lanka, and the former Soviet republics in Central Asia; sub-Saharan Africa (eastern, western, and southern) includes all countries on the African continent barring those with Mediterranean coastlines, as well as island states proximate to the African continent; Latin America and the Caribbean includes all countries in the Americas from Mexico southward, as well as all countries in the Caribbean and the Bahamas; and the Middle East and North Africa include all African countries with Mediterranean coastlines, all states on the Arabian Peninsula, and Iraq, Iran, Israel, Jordan, Kuwait, Lebanon, Syria, and Turkey.

Source: IDMC, *Global Report on Internal Displacement*.

FIGURE 3

Number of People Internally Displaced by Weather-Related Events, by Region and Type, 2008–18



Source: Author analysis of data from IDMC "Global Internal Displacement Database," accessed November 15, 2020.

4 How Climate Change May Shape Future Migration

Climate change is expected to influence future migration and displacement primarily by affecting the frequency, intensity, and/or geographical distribution of extreme storms (e.g., tropical cyclones), floods, droughts, and extreme heat events—that is, by generating more precipitating drivers.[30] There may also be increased migration as a result of the indirect impacts of climate change on food and water availability, land degradation, and conflicts, which create additional proximate drivers.[31] In the period 2050–2100, increases in mean sea levels will amplify the damage caused by hazards in coastal areas, and threaten to inundate particularly low-lying settlements, necessitating organized relocations or heavy investments in protective infrastructure.[32] Migration and displacement outcomes will vary by region and over time, according to (1) region-specific changes in climatic drivers, which will depend on future atmospheric greenhouse gas concentrations; (2) changes in the future adaptive capacity of exposed populations, which are in turn tied to socioeconomic development pathways; and (3) future developments in mediating factors such as migration policies.

There are four broad ways climate change may affect future global migration patterns, none of which are mutually exclusive, and all of which become more likely with higher levels of atmospheric greenhouse gas concentrations:

1. **Larger flows of people along established migration routes (particularly rural-to-urban internal migration).** This is highly likely to occur under even modest increases in greenhouse gas concentrations. Translocal and/or transnational social networks facilitate climate migration and, once established, these networks tend to perpetuate and reinforce future movements of people.[33] The most likely increases in climate-related migration flows are expected to occur from rural to urban areas

30 McLeman, *Climate and Human Migration*; W. Neil Adger et al., "Human Security," in *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, eds. Christopher B. Field et al. (Cambridge: Cambridge University Press, 2014), 755–91; Black et al., "The Effect of Environmental Change."

31 Guy J. Abel, Michael Brottrager, Jesus C. Cuaresma, and Raya Muttarak, "Climate, Conflict and Forced Migration," *Global Environmental Change* 54, (2019): 239–49; Michael Brzoska and Christiane Fröhlich, "Climate Change, Migration and Violent Conflict: Vulnerabilities, Pathways and Adaptation Strategies," *Migration and Development* 5, no. 2 (2016): 190–210; Robert McLeman, "Labor Migration and Food Security in a Changing Climate," in *Food Security and Sociopolitical Stability*, ed. Christopher Barrett (New York: Oxford University Press, 2013), 229–55; Koko Warner, M. Hamza, A. Oliver-Smith, Fabrice Renaud, and Alex Julca, "Climate Change, Environmental Degradation and Migration," *Natural Hazards* 55, no. 3 (2010): 689–715.

32 Mathew E. Hauer, Jason M. Evans, and Deepak R. Mishra, "Millions Projected to Be at Risk from Sea-Level Rise in the Continental United States," *Nature Climate Change* 6, no. 7 (2016): 691–95; Barbara Neumann, Athanasios T. Vafeidis, Juliane Zimmermann, and Robert J. Nicholls, "Future Coastal Population Growth and Exposure to Sea-Level Rise and Coastal Flooding—A Global Assessment," *PLoS ONE* 10, no. 6 (2015): e0131375; Shazzadur Rahman et al., "Projected Changes of Inundation of Cyclonic Storms in the Ganges–Brahmaputra–Meghna Delta of Bangladesh Due to SLR by 2100," *Journal of Earth System Science* 128, no. 145 (2019); Delavane B. Diaz, "Estimating Global Damages from Sea Level Rise with the Coastal Impact and Adaptation Model (CIAM)," *Climatic Change* 137, no. 1–2 (2016): 143–56.

33 Amanda R. Carrico and Katharine Donato, "Extreme Weather and Migration: Evidence from Bangladesh," *Population and Environment* 41, no. 3 (2019): 1–31; Patrick Sakdapolrak, Panomsak Promburom, and Alexander Reif, "Why Successful in Situ Adaptation with Environmental Stress Does Not Prevent People from Migrating? Empirical Evidence from Northern Thailand," *Climate and Development* 6, no. 1 (2014): 38–45; W. Neil Adger et al., "Migration, Remittances, Livelihood Trajectories and Social Resilience," *Ambio* 31, no. 4 (2002): 358–66; Geraldine Pratt and Brenda Yeoh, "Transnational (Counter) Topographies," *Gender, Place & Culture* 10, no. 2 (2003): 159–66; Scheffran, Marmer, and Sow, "Migration as a Contribution to Resilience."

within low- and middle-income countries.[34] For example, during the 1990s and early 2000s, dryland areas in Mexico experienced increased rates of out-migration from rural areas to urban centers within Mexico and to the United States.[35] However, future international migration could also potentially increase should low- and middle-income countries in the main migrant-sending regions continue to have higher vulnerability and lower capacity to adapt to climate change than high-income destination countries.

2 **Decreasing flows of people along established migration routes.** This may happen if destinations become less attractive relative to sending areas. Reductions are most likely to be seen in intraregional and internal migration flows, and will be highly context specific, given the considerable variability in nonclimatic factors that shape vulnerability and climate adaptation within regions and countries.[36] For example, research in rural Malawi has found that young adults generally aspire to migrate out of the countryside, but such aspirations falter during periods of drought and extreme events, making them less likely to migrate.

3 **Development of new migration corridors.** Routes may emerge between sending and destination areas that have not historically been connected. The impacts of climate change, especially under rapid-warming scenarios, may generate new flows of migrants where currently they do not exist; however, projections of where and when such flows might emerge are highly speculative, and there is little empirical research on the subject.[37]

4 **Growing numbers of people trapped in place by nonclimatic mediating factors.** Researchers agree on the strong possibility of people becoming trapped in highly exposed locations because they lack the means to relocate without assistance from governments and institutions, or because the socioeconomic or cultural incentives to remain in place are very strong despite the risks.[38]

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34 Katrina Jessoe, Dale T. Manning, and J. Edward Taylor, "Climate Change and Labour Allocation in Rural Mexico: Evidence from Annual Fluctuations in Weather," *The Economic Journal* 128, no. 608 (2018): 230–61; Salvador Barrios, Luisito Bertinelli, and Eric Strobl, "Climatic Change and Rural–Urban Migration: The Case of Sub-Saharan Africa," *Journal of Urban Economics* 60, no. 3 (2006): 357–71; Alex de Sherbinin et al., "Migration and Risk: Net Migration in Marginal Ecosystems and Hazardous Areas," *Environmental Research Letters* 7, no. 4 (2012): 045602; Adger et al., "Focus on Environmental Risks and Migration"; Rigaud et al., *Groundswell*.

35 Lori M. Hunter, Sheena Murray, and Fernando Riosmena, "Climatic Variability and U.S. Migration from Rural Mexico" (working paper, Institute of Behavioral Science, University of Colarado, Boulder, CO, 2011); Raphael J. Nawrotzki, Fernando Riosmena, and Lori M. Hunter, "Do Rainfall Deficits Predict U.S.-Bound Migration from Rural Mexico? Evidence from the Mexican Census," *Population Research and Policy Review* 32, no. 1 (2013): 129–58; Stefan Leyk et al., "Internal and International Mobility as Adaptation to Climatic Variability in Contemporary Mexico: Evidence from the Integration of Census and Satellite Data," *Population, Space and Place* 23, no. 6 (2017): e 20147.

36 Natalie Suckall, Evan Fraser, and Piers Forster, "Reduced Migration under Climate Change: Evidence from Malawi Using an Aspirations and Capabilities Framework," *Climate and Development* 9, no. 4 (2017): 298–312; Gray and Wise, "Country-Specific Effects of Climate Variability"; Maia Call, Clark Gray, Mohammad Yunus, and Michael Emch, "Disruption, Not Displacement: Environmental Variability and Temporary Migration in Bangladesh," *Global Environmental Change* 46 (2017): 157–65.

37 The best strategy to prepare for worst-case scenarios is to reduce overall risk exposure, build general adaptive capacity to a wide range of risks, and seek more holistic policy-making approaches; such actions are embedded in the scenario-building exercises described in later sections of this report. François Gemenne, "Climate-Induced Population Displacements in a 4°C+ World," *Philosophical Transactions of the Royal Society A: Mathematical, Physical & Engineering Sciences* 369, no. 1934 (2011): 182–95.

38 Zickgraf, "Immobility"; Helen Adams, "Why Populations Persist: Mobility, Place Attachment and Climate Change," *Population and Environment* 37, no. 4 (2016): 429–48; Black et al., "Migration, Immobility and Displacement Outcomes"; Sonja Ayeb-Karlsson, Christopher D. Smith, and Dominic Kniveton, "A Discursive Review of the Textual Use of 'Trapped' in Environmental Migration Studies: The Conceptual Birth and Troubled Teenage Years of Trapped Populations," *Ambio* 47, no. 5 (2018): 557–73.

It is difficult to project the scale of any of these four potential outcomes, or to provide an exact estimate of how many climate-related migrants there will be overall. A small number of studies have attempted to make such projections. The ones most commonly reported in the media suggest that between 200 million and 1 billion people might be displaced this century for environmental reasons, although these rely on very coarse assumptions about future climate trends and assume a simple push-pull effect on migration patterns.[39] Other studies have estimated the number of people likely to live in locations potentially exposed to specific hazards—such as deltas, floodplains, and low-lying coastal areas exposed to storms and floods, or dryland areas exposed to droughts—and then calculated what percentage would likely be affected and potentially move. To do this, such studies typically combine estimates of demographic change over time with projections of future climate risks generated from general circulation models under a set of standardized scenarios, often using geographic information systems to map locations of hotspots.[40] Using such methods, it has been estimated that by the end of this century up to 70 percent of people globally will live in flood-risk areas and two-thirds will live in areas of elevated drought risk, depending on the greenhouse gas concentration scenario used.[41] Projections of the future impacts of rising sea levels take similar approaches, using such criteria as elevation (e.g., people living within ten meters of mean sea level),[42] 1-in-100-year floodplains,[43] or by isolating locations most likely to be inundated.[44] Even with these more sophisticated approaches, the estimates can range from millions to hundreds of millions of people being at risk of rising sea-level-related displacement globally by the year 2100, depending on the exposure criteria and climate scenarios used.

A notable recent effort to systematically estimate future climate-related migration was produced by the World Bank's Groundswell project,[45] which used geospatial models that combined demographic, socioeconomic, and climate impact data to forecast the impacts of slow-onset direct and indirect climate hazards (e.g., water stress, crop failures, and rising sea levels) on future population patterns in Latin America, sub-Saharan Africa, and South Asia. This study focused on internal migration patterns and did not consider climate change impacts on international migration originating in Africa, Asia, and Latin America, despite these being the largest source regions of international migration flows.[46] Depending on the socioeconomic and climate scenarios used, the study found that anywhere between 30 million and 140 million people could be internally displaced by 2050. The highest rates of displacement projected by the study would

39 Norman Myers, "Environmental Refugees: A Growing Phenomenon of the 21st Century," *Philosophical Transactions of the Royal Society London: Biological Sciences: Series B* 357, no. 1420 (2013): 609–13; Christian Aid, *Human Tide: The Real Migration Crisis* (London, UK: Christian Aid, 2007).

40 Karen C. Seto, "Exploring the Dynamics of Migration to Mega-Delta Cities in Asia and Africa: Contemporary Drivers and Future Scenarios," *Global Environmental Change* 21, no. S1 (2011): S94–107; de Sherbinin et al., "Migration and Risk"; Neumann, Vafeidis, Zimmermann, and Nicholls, "Future Coastal Population Growth"; Hauer, Evans, and Mishra, "Millions Projected to Be at Risk"; Alex de Sherbinin, "Climate Change Hotspots Mapping: What Have We Learned?" *Climatic Change* 123, no. 1 (2014): 23–37.

41 Lorenzo Alfieri et al., "Global Projections of River Flood Risk in a Warmer World," *Earth's Future* 5, no. 2 (2017): 171–82; Gustavo Naumann et al., "Global Changes in Drought Conditions under Different Levels of Warming," *Geophysical Research Letters* 45, no. 7 (2018): 3285–96.

42 Gordon Mcgranahan, Deborah Balk, and Bridget Anderson, "The Rising Tide: Assessing the Risks of Climate Change and Human Settlements in Low Elevation Coastal Zones," *Environment and Urbanization* 19, no. 1 (2007): 17–37; Neumann, Vafeidis, Zimmermann, and Nicholls, "Future Coastal Population Growth."

43 Robert J. Nicholls and Anny Cazenave, "Sea-Level Rise and Its Impact on Coastal Zones," *Science* 328, no. 5985 (2010): 1517–20; Jan-Ludolf Merkens, Daniel Lincke, Jochen Hinkel, Sally Brown, and Athanasios Thomas Vafeidis, "Regionalisation of Population Growth Projections in Coastal Exposure Analysis," *Climatic Change* 151, no. 3–4 (2018): 413–26.

44 Hauer, Evans, and Mishra, "Millions Projected to Be at Risk."

45 Rigaud et al., *Groundswell*.

46 Abel and Sander, "Quantifying Global International Migration Flows."

be experienced in sub-Saharan Africa (86 million, under worst-case scenarios), followed by South Asia (40 million) and Latin America (17 million). Case studies were done for three countries—Bangladesh, Ethiopia, and Mexico—and it was found that future climate-related internal migration would be exacerbated by future population increase, help fuel higher rates of urbanization, and necessitate action to incorporate climate-related migration risks into wider national development and economic diversification planning. Groundswell concluded that most of the projected internal migration could be avoided through strong international efforts to curtail greenhouse gas emissions, by embedding climate migration in international development planning, and by making greater investments in understanding the role of climate in internal migration in low- and middle-income countries.

5 Building Scenarios for Future Climate-Related Migration

The wide range of estimates of future climate-related migration numbers summarized in the preceding section reflects three critical uncertainties. The first is the degree to which the climate will change, and how that change will manifest itself; the second is how the future world will look in socioeconomic terms; and the third is how migration policies will change and evolve in coming decades.

For each of these three uncertainties, however, it is possible to generate standardized scenarios that can be used to explore future interactions and outcomes, and assess the relative mediating effects of various plausible combinations of climate, development, and migration policy in the near and more distant future. Each of these three uncertainties and scenarios for capturing their effects are summarized below.

A. Future Climate Scenarios

The first of these uncertainties—what the climate will look like in the future—depends heavily on actions taken today to reduce greenhouse gas emissions. Global average temperatures have already warmed by approximately 1°C over preindustrial levels, due to greenhouse gases that were emitted over the past century and a half. At present, global greenhouse gas emissions are rising and should they continue to do so at current rates, average global temperatures will rise by an additional 1°–2°C by the end of this century, an outcome that would generate widespread increases in drought and flood risks, intensify the wind speed of tropical cyclones, and cause sea levels to rise by more than half a meter by 2100.[47]

Conversely, should the international community work cooperatively and rapidly to reduce greenhouse gas emissions to near zero within the next decade or so, only an additional 0.5°C of global warming would be expected. There would still be changes in sea levels and in the frequency and/or intensity of droughts, floods, storms, and other climate hazards due to lag effects, but these would be relatively modest and at least in principle easier to adapt to. Climate scientists have created a set of four standardized scenarios

47 WMO, *United in Science*; IPCC, "Summary for Policymakers," in *Global Warming of 1.5°C: An IPCC Special Report on the Impacts of Global Warming of 1.5°C above Pre-Industrial Levels and Related Global Greenhouse Gas Emission Pathways, in the Context of Strengthening the Global Response to the Threat of Climate Change, Sustainable Development, and Efforts to Eradicate Poverty*, eds. Valerie Masson-Delmotte et al. (Geneva: WMO, 2018); IPCC, *Climate Change 2014*; Pörtner et al., *IPCC Special Report on the Ocean and Cryosphere*.

known as the Representative Concentration Pathways (or RCPs) to map out a range of possible future climates based on potential emission pathways (see Box 2).

BOX 2
What Are the Representative Concentration Pathways (RCPs)?

The RCPs are four standardized climate scenarios developed by scientists. Each RCP reflects a future scenario for atmospheric concentrations of greenhouse gases based on assumptions about global greenhouse gas emissions and efforts to constrain them. The four RCPs are referred to as RCP8.5, RCP6, RCP4.5, and RCP2.6.

RCP2.6: The lowest concentration scenario, this assumes that global greenhouse gas emissions immediately begin declining, approaching zero later this century. This scenario is for practical purposes already unachievable given current global inaction on the Paris Agreement, although rapid policy action could keep future greenhouse gas concentrations closer to this scenario than the next. Under this scenario, average global temperatures are likely to be 0.3°C to 1.7°C warmer in the year 2100 than they were in 2000.

RCP4.5: This scenario assumes greenhouse gas emissions will stabilize by 2040 and then begin declining. Under these conditions, temperatures would be 1.1°C to 2.6°C warmer in 2100 than in 2000.

RCP6: This scenario assumes emissions will grow until 2080 and then begin declining. Under these conditions, temperatures would be 1.4°C to 3.1°C warmer by 2100.

RCP8.5: The highest concentration scenario, this assumes greenhouse gas emissions continue to grow throughout the remainder of this century. Under this scenario, temperatures would be 2.6°C to 4.8°C warmer by 2100.

The impacts of climate change become more pronounced with each increase in scenario, especially in the years after 2050. Upper-end warming outcomes from RCP8.5 (i.e., more than 4°C warming by 2100) would likely be catastrophic for ecosystems, water resources, global food systems, and coastal communities, and trigger large-scale changes in global economic and governance structures. The numbers in the scenarios refer to estimates of the forcing effect of greenhouse gas concentrations in each scenario on the Earth's climate, measured in W/m2.

Source: Detlef P. van Vuuren et al., "The Representative Concentration Pathways: An Overview," *Climatic Change* 109, no. 1 (2011): 5.

B. Scenarios for Future Socioeconomic Conditions

Future demographic, economic, political, and social trends will determine (1) the ability of states, communities, and individuals to mitigate their greenhouse gas emissions; (2) the particular degree of loss or harm they will experience as a result of climate hazards (i.e., their climate vulnerability); and (3) their capacity to adjust and adapt to those impacts.[48] The construction of seawalls to protect low-lying communities from coastal hazards, early-warning systems that allow for evacuations in advance of hurricanes, and crop insurance to protect farmers against weather-related losses are all examples of potential strategies to reduce vulnerability to climate change and consequently reduce the likelihood of involuntary migration and displacement. However, these also require considerable financial resources that are often beyond the means of low-income nations. Similarly, advanced technologies that generate energy with low or no greenhouse gas emissions may be beyond the means of poorer groups. The 17 UN Sustainable Development Goals establish a set of interconnected objectives to reduce poverty and inequality at global scales that, if achieved, would both directly and indirectly increase the resilience of countries and communities to the impacts of climate change, thereby reducing the potential for involuntary migration and displacement.

As with the future climate, researchers have developed a set of scenarios for potential future socioeconomic development at global and national scales, known as the Shared Socioeconomic Pathways (SSPs; see Box 3). These scenarios provide narrative descriptions of what the world might look like in the absence of any new climate policies, and were developed to be used alongside the RCP climate scenarios to envisage how various socioeconomic futures would facilitate or constrain the world's ability to mitigate emissions and adapt to climate change impacts. One of the scenarios (SSP1) describes a future in which it is likely that the international community significantly reduces greenhouse gas emissions and enhances the capacity of vulnerable groups to adapt to the impacts of climate change. Such an outcome would be realized by achieving the UN Sustainable Development Goals, and in this scenario, involuntary migration and displacement would decrease. An opposite scenario (SSP3) describes a set of outcomes—characterized by a lack of international cooperation and highly uneven rates of development—in which greenhouse gas emissions cannot be controlled, and adaptive capacity is weak in low-income countries. Under this scenario, involuntary migration and displacement would almost certainly become more commonplace and more widespread. Other SSP scenarios describe a future in which greenhouse gas emissions are mitigated but building adaptive capacity is difficult (SSP4) and one in which adaptive capacity is built but emissions are difficult to mitigate (SSP5). Under these two scenarios, future rates of involuntary climate-related migration and displacement would fall somewhere between the extremes of the SSP1 and SSP3 scenarios.

48 Barry Smit and Johanna Wandel, "Adaptation, Adaptive Capacity and Vulnerability," *Global Environmental Change* 16, no. 3 (2006): 282–92; W. Neil Adger, "Vulnerability," *Global Environmental Change* 16, no. 3 (2006): 268–81.

BOX 3
What Are the Shared Socioeconomic Pathways (SSPs)?

The five SSPs are standardized narratives about potential future global and national trends in population, gross domestic product (GDP), urbanization, technological innovation, and international cooperation in the absence of specific climate policies. The SSPs are supported by data and are designed to assist researchers in generating future scenarios for greenhouse gas emissions reductions and adaptive capacity building.

SSP1: Sustainability. This scenario reflects a future in which countries work cooperatively toward achieving broad-based sustainable development and reducing socioeconomic inequity. (Achievement of the UN Sustainable Development Goals would realize such a future.) In this SSP, significant greenhouse gas emission reductions and adaptive capacity building are achievable.

SSP2: Middle of the Road. This is a reference scenario in which all metrics of GDP growth, inequality, population growth, and other characteristics used to construct the SSPs are assumed to be midrange. This scenario is used to generate midpoint outcomes in scenario analyses, and it is not referenced in the present report.

SSP3: Fragmentation. This reflects a future in which countries are inherently self-interested and cooperate only when it suits them. Conflicts are more common, inequality grows, and economic development lags. Environmental degradation worsens, and efforts to reduce greenhouse gas emissions and build adaptive capacity are likely to fail.

SSP4: Inequality. In this scenario, the international community is increasingly divided into "have" and "have-not" countries, and there are high rates of socioeconomic inequality within nations. Efforts to reduce greenhouse gas emissions may succeed due to technological advances in high-income countries, but adaptive capacity remains weak in low-income countries.

SSP5: Conventional Development. This scenario reflects intensification of the socioeconomic pathway most of the world is currently on. Markets for goods and services are increasingly integrated, with fossil fuel remaining a key energy source. There is strong economic growth, technological innovation, and improvement in living standards in many regions, all of which improves adaptive capacity, but greenhouse gas emissions do not fall.

Source: Keywan Riahi et al., "The Shared Socioeconomic Pathways and Their Energy, Land Use, and Greenhouse Gas Emissions Implications: An Overview," *Global Environmental Change* 42 (2017): 153–68.

C. Scenarios for Future International Migration Policy

A third uncertainty is the direction that future international migration policies may take. Unlike the previous two uncertainties, there is no existing, standardized set of scenarios for international migration policies. For this report, three basic scenarios were created, using the 2018 Global Compact for Safe, Orderly, and Regular Migration as a reference point.

The first of these Migration Policy Scenarios (MPS1) assumes that the international community moves quickly and cooperatively to implement policies and programs that meet the 23 objectives of the compact generally, and specifically implements policies that would prevent maladaptive or involuntary climate-

Not all compact objectives contain specific recommendations aimed at climate-related migration, but many would prove beneficial.

related migration and facilitate adaptive migration. For example, Objective 2 of the compact aims at reducing drivers of involuntary or low-agency migration. It explicitly references the impacts of climate change and environmental degradation to recommend that states establish systems for sharing data about environmental migration; develop climate adaptation and resilience strategies that take into account the potential implications for migration and harmonize these at subregional and regional levels; and cooperate on measures such as developing early warning systems, making contingency plans, stockpiling emergency resources, planning evacuation strategies, providing reception and assistance arrangements, and sharing information with the public. Not all compact objectives contain specific recommendations aimed at climate-related migration, but many would prove beneficial, such as Objective 5 (increasing pathways for regular migration) and Objective 19 (facilitating migrants' ability to contribute to sustainable development). Objective 18, which links migration and skills development, is consistent with the "migration with dignity" proposal described earlier in this report.

In practical terms, what would global and regional patterns of climate-related migration look like if the compact were embraced as MPS1 suggests? Only rarely would such migration be maladaptive and low agency in nature, and there would be fewer "trapped" populations. Involuntary displacement from sudden-onset disasters would be less frequent and, when it does occur, it would likely be more temporary in nature. Multilateral, regional, and bilateral arrangements would be created strategically to facilitate labor migration and family reunification with climate change in mind, so that remittances and skills training foster development and climate resilience in low-income countries, while simultaneously providing human capital that is in increasingly short supply in high-income countries with aging populations. The involvement of organized crime and smugglers in international migration would decline. Future international migrant numbers might increase under such a scenario, not because of conditions of distress, but because of mutual benefits accruing to migrants, recipient states, and sending communities. In short, migration policies in this scenario would help to build adaptive capacity at the global, regional, and local scales.

The second scenario (MPS2) sees a continuation of the status quo. The compact is a voluntary document, so some countries will work toward its objectives, while others will not, including the United States and a number of European countries that have already stated they will not adopt it. Migration policy in this scenario is often reactive and focused on short-term priorities, and it oscillates with political trends. While the international movement of high-income/highly skilled people is facilitated by most countries, there are fewer opportunities for low- or middle-skilled migration to high-income countries (although many high-income countries nonetheless rely to varying degrees on unauthorized migrant workers to perform low-wage tasks). Large numbers of people continue to move within and between low- and middle-income countries, their numbers surging after extreme weather events. There continue to be insufficient resources for sheltering and providing services to refugees and to people displaced by extreme weather events. No policies are implemented specifically with climate-related migration in mind, which nonetheless occurs with greater frequency. Most climate migrants move internally while those who move internationally do so as part of mixed migration flows of asylum seekers and labor migrants, without declaration or recognition of their underlying motivations. In this scenario, the types of climate-related migration events we see today continue, with uncertain outcomes for adaptive capacity building in sending or receiving countries.

The final scenario (MPS3) sees a future in which states move toward much stronger control of international migration and reduce migrants' access to protection by, for example, tightening border controls and restricting the movement of all but the most highly skilled workers.[49] Under this scenario, high-income countries pressure low-income countries to prevent their own nationals from leaving, and to prevent the transit of third-country nationals. Emergent surveillance technologies, remote sensors, and unmanned aerial vehicles (i.e., "drones") are widely employed to control international movements of people by land and sea. Asylum seekers are prevented from entering the territory of destination countries to file humanitarian protection claims, and states explicitly reject climate change and environmental degradation as valid reasons for claiming protection. Minimal international humanitarian assistance is provided to people displaced by extreme climate events or by rising sea levels; low-income countries and vulnerable groups are essentially left to fend for themselves. Internal migration within vulnerable low-income countries accelerates, and large numbers of people are trapped in deteriorating situations from which they cannot extricate themselves. People from low-income countries with the financial means to do so continue to attempt international migration in clandestine ways, including with the assistance of criminal organizations. Unauthorized migrants that are caught are detained and then summarily deported. Under this scenario, most climate-related migration is maladaptive, undermining development and resilience in vulnerable countries. It also requires high-income countries to devote ever increasing resources to securing their borders, some of which might instead be deployed for building adaptive capacity of their own. Human rights and respect for institutions steadily erode under this scenario.

6 Exploring How Future Climate, Development, and Migration Policy Scenarios May Shape Migration Trends

These three sets of climate, socioeconomic, and migration policy scenarios were used to assess how development pathways and migration policies might shape future migration trends.[50] Such an exercise has not previously been undertaken, and it provides new insights to help policymakers judge the potential benefits and impacts of alternative migration policy pathways on future climate migration and adaptation. This exercise focused on two time periods, 2020–50 and 2050–2100, and on the following geographical

49 Some of these basic elements can currently be seen along the southern U.S. border and in the Mediterranean region, for example.

50 This uses a methodological approach developed by other researchers to assess the impacts of policy on future climate scenarios (see Appendix A). See Abiy S. Kebede et al., "Applying the Global RCP–SSP–SPA Scenario Framework at Sub-National Scale: A Multi-Scale and Participatory Scenario Approach," *Science of the Total Environment* 635 (2018): 659–72; Elmar Kriegler et al., "A New Scenario Framework for Climate Change Research: The Concept of Shared Climate Policy Assumptions," *Climatic Change* 122, no. 3 (2014): 401–14.

regions: East and Southeast Asia, South and Central Asia, Latin America and the Caribbean, North Africa and the Middle East, and sub-Saharan Africa (subdivided into East Africa and West and Southern Africa).[51]

For each of these regions, the focus was to identify changes in the frequency and/or intensity of the key climatic drivers of displacement listed in Table 1. This exercise generated 140 different regional scenario combinations for each period (2020–50 and 2050–2100), using only plausible combinations of RCPs, SSPs, and MPS. For a summary of scenario outcomes, see Appendix B.

A. Regional Changes in Climatic Drivers of Migration under RCP Scenarios

Major changes to the frequency or intensity of most climatic drivers of migration are not expected before 2050, with small exceptions under the highest greenhouse gas emissions scenarios. After 2050, there is significant divergence of outcomes depending on the RCP, with climatic drivers intensifying or becoming more frequent under higher greenhouse gas concentration scenarios. Depending on the RCP, some climatic drivers may become less frequent in some regions, such as floods in West Africa or droughts in East Africa, but in most cases, the drivers become stronger.

The greatest intensification and/or increase in climatic drivers of migration will occur in East and Southeast Asia.

After 2050, the impacts felt across the studied regions will take different forms. The greatest intensification and/or increase in climatic drivers of migration will occur in East and Southeast Asia, where increased intensity of floods and extreme storm events is expected under every RCP except the best-case scenario (RCP2.6).[52] In South Asia and in Latin America and the Caribbean, the frequency and severity of extreme storm events are projected to change modestly in RCPs other than the worst-case scenario (RCP8.5).[53] Rising sea levels will further amplify the inland penetration of surges and impacts of coastal flooding from storm-related precipitation

51 For the purposes of this analysis, East and Southeast Asia include China, Korea, Japan, Taiwan, and the Association of Southeast Asian Nations (ASEAN) countries; South and Central Asia include Afghanistan, Bangladesh, Bhutan, India, Nepal, Pakistan, Sri Lanka, and the former Soviet republics in Central Asia; Latin America and the Caribbean consist of all countries in the Americas from Mexico southward, as well as all countries in the Caribbean and the Bahamas; North Africa and the Middle East includes all North African countries with Mediterranean coastlines, all states on the Arabian Peninsula, and Iraq, Iran, Israel, Jordan, Kuwait, Lebanon, Syria, and Turkey; and sub-Saharan Africa includes all countries on the African continent other than those with Mediterranean coastlines, as well as island states proximate to the African continent. Climate models project divergent outcomes in terms of future precipitation levels within Africa, necessitating a further regional subdivision into (1) East Africa and (2) West and Southern Africa.

52 Changgui Wang, Ju Liang, and Kevin I. Hodges, "Projections of Tropical Cyclones Affecting Vietnam under Climate Change: Downscaled HadGEM2-ES Using PRECIS 2.1," *Quarterly Journal of the Royal Meteorological Society* 143, no. 705 (2017): 1844–59; Chao Wang and Liguang Wu, "Future Changes of the Monsoon Trough: Sensitivity to Sea Surface Temperature Gradient and Implications for Tropical Cyclone Activity," *Earth's Future* 6, no. 6 (2018): 919–36; Andrew Gettelman et al., "Projections of Future Tropical Cyclone Damage with a High-Resolution Global Climate Model," *Climatic Change* 146, no. 3–4 (2018): 575–85; Julio T. Bacmeister et al., "Projected Changes in Tropical Cyclone Activity under Future Warming Scenarios Using a High-Resolution Climate Model," *Climatic Change* 146, no. 3–4 (2018): 547–60; Mathieu Mure-Ravaud, M. Levent Kavvas, and Alain Dib, "Investigation of Intense Precipitation from Tropical Cyclones during the 21st Century by Dynamical Downscaling of CCSM4 RCP 4.5," *International Journal of Environmental Research and Public Health* 16, no. 5 (2019): 687.

53 Bacmeister et al., "Projected Changes in Tropical Cyclone Activity"; Christopher Patrick Burgess et al., "Estimating Damages from Climate-Related Natural Disasters for the Caribbean at 1.5 °C and 2 °C Global Warming above Preindustrial Levels," *Regional Environmental Change* 18, no. 8 (2018): 2297–312; Lauren Mudd, David Rosowsky, Chris Letchford, and Frank Lombardo, "Joint Probabilistic Wind–Rainfall Model for Tropical Cyclone Hazard Characterization," *Journal of Structural Engineering* 143, no. 3 (2017).

in this period, especially under RCP8.5.[54] South Asia is expected to experience elevated flood risks under all RCPs except RCP2.6.[55]

The Middle East and all subregions of Africa will see a shift in the climatic drivers under most RCPs due to changing precipitation regimes. At present, floods are a key driver in the Middle East, North Africa, West Africa, and Southern Africa, while drought and extreme heat are key drivers in East Africa and, to a lesser extent, West and Southern Africa. Under most RCPs, precipitation is expected to become scarcer over the Middle East, North Africa, West Africa, and Southern Africa, but is expected to increase in East Africa.[56] The risk of flood-related migration would consequently increase in East Africa and decline in other areas of Africa and in the Middle East. Conversely, drought risks would decrease in East Africa, but increase in the other areas.

Rising sea levels will present a risk of gradual inundation for very low-lying settlements in coastal plains, deltas, and small islands in all regions. However, even before inundation occurs, rising sea levels will have an amplification effect on coastal hazards in the second half of this century, the extent of which varies by scenario. For the regions being studied in this report, such effects are most pronounced in the period 2050–2100, when extreme storm risks in Latin America and the Caribbean and in South, East, and Southeast Asia will be amplified to some extent under RCP4.5, and to a much greater extent under RCP6 and RCP8.5. The effect of rising sea levels is nominal in the period 2020–50 in scenarios other than RCP8.5.

B. *Mediating Effects of Socioeconomic Development and Migration Policy on Future Climate Migration*

A key finding of this analysis is that rapid efforts to control greenhouse gas emissions by midcentury (i.e., RCP2.6 or RCP4.5), to implement the Global Compact for Migration (MPS1), and to achieve the UN Sustainable Development Goals (SSP1) can reduce future risks of maladaptive migration and displacement below present-day levels in every region. This effect would materialize in the short term (i.e., 2020–50) and be sustainable over the long term (i.e., 2050–2100).

Migration policy decisions play an important role in future climate-related migration outcomes. Lower risks of maladaptive migration typically follow a scenario in which the Global Compact for Migration

54 Thomas F. Stocker et al., "Technical Summary," in *Climate Change 2013: The Physical Science Basis: Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, eds. Thomas F. Stocker et al. (Cambridge, UK: Cambridge University Press, 2013).

55 Stocker et al., "Technical Summary"; Nigel W. Arnell and Ben Lloyd-Hughes, "The Global-Scale Impacts of Climate Change on Water Resources and Flooding under New Climate and Socio-Economic Scenarios," *Climatic Change* 122, no. 1–2 (2014): 127–40; Albert J. Kettner et al., "Estimating Change in Flooding for the 21st Century under a Conservative RCP Forcing," in *Global Flood Hazard: Applications in Modeling, Mapping, and Forecasting*, eds. Guy J-P. Schumann, Paul D. Bates, Heiko Apel, and Giuseppe T. Aronica (Washington, DC: Wiley, 2018).

56 Stocker et al., "Technical Summary"; Peter Greve, Lukas Gudmundsson, and Sonia Seneviratne, "Regional Scaling of Annual Mean Precipitation and Water Availability with Global Temperature Change," *Earth System Dynamics* 9, no. 1 (2018): 227–40; Flavio Lehner et al., "Projected Drought Risk in 1.5°C and 2°C Warmer Climates," *Geophysical Research Letters* 44, no. 14 (2017): 7419–28; IPCC, "Summary for Policymakers," in *Climate Change and Land: An IPCC Special Report on Climate Change, Desertification, Land Degradation, Sustainable Land Management, Food Security, and Greenhouse Gas Fluxes in Terrestrial Ecosystems* (Geneva: IPCC, 2019); Richard Wartenburger et al., "Changes in Regional Climate Extremes as a Function of Global Mean Temperature: An Interactive Plotting Framework," *Geoscientific Model Development* 10, no. 9 (2017): 3609–34; Alfieri et al., "Global Projections of River Flood Risk"; Naumann et al., "Global Changes in Drought Conditions."

is implemented (MPS1), while RCP-SSP-MPS scenario combinations that generate the highest levels of maladaptive migration all feature MSP3, in which international migration is increasingly securitized and access to protection is curtailed. Status quo migration policy-making (MPS2) tends not to lead to favorable outcomes, except in high-emission RCP scenarios where changes to precipitation regimes result in decreases in hazard frequency (e.g., floods in the Middle East, North Africa, and West and Southern Africa; and droughts in East Africa). However, in these latter instances, the ebbing climatic driver is replaced by the strengthening of another hazard that triggers migration and displacement (e.g., drought in the Middle East, North Africa, and West and Southern Africa; floods in East Africa). Status quo migration policy-making typically results in unfavorable outcomes when combined with SSP3 and SSP4, socioeconomic scenarios that feature fragmentation of the global economy and growing inequality. Combinations of status quo migration policy and unequal development lead to potentially higher levels of maladaptive migration even in climate scenarios that feature low emissions (i.e., RCP2.6 and RCP4.5). The combination of current socioeconomic development pathways and status quo migration policy-making leads to greater risks of additional maladaptive migration in the future, but the outcomes are not as pronounced as in scenarios with highly unequal socioeconomic development.

Development and migration policy choices have the strongest influence on climate-related migration outcomes in the short to medium term (2020–50). This is because the near-term impacts of greenhouse gas accumulation on the underlying climatic drivers of migration are not especially different across the three lowest RCPs (2.6, 4.5, and 6). Severe impacts would only materialize before 2050 under the worst-case scenario (RCP8.5)—a scenario that, as discussed in the next subsection, a recent report from the World Meteorological Organization suggests current emission trends are proceeding toward.[57] Socioeconomic scenarios that envisage both a strong commitment to sustainable development and more traditional economic development pathways (i.e., SSP1 and SSP5) can lead to reductions in maladaptive migration before 2050 when combined with migration policies that correspond with the Global Compact for Migration (MPS1). However, after 2050, the effects of the socioeconomic development scenarios diverge, as does the influence of greenhouse gas concentrations across RCP scenarios, which grows under all RCPs except RCP2.6.

The window for reducing the risk of maladaptive migration narrows after 2050.

The window for reducing the risk of maladaptive migration narrows after 2050. For the 2050–2100 period, only one combination of scenarios leads to favorable outcomes across all regions and all hazard types in terms of reducing maladaptive migration risks: embracing the compact (MPS1); cooperative, sustainable development (SSP1); and urgent action to reduce greenhouse gas emissions (RCP2.6). Under a next-best-case greenhouse gas emissions scenario (RCP4.5—a level of emissions much lower than present, but more gradually reached), some regions could still expect significant decreases in maladaptive migration through pursuing MPS1 and SSP1, but in East and Southeast Asia in particular, *only* the combination of SSP1, MPS1, and RCP2.6 reduces the migration risks associated with floods and tropical cyclones. With higher levels of greenhouse gas emissions (i.e., RCP6 and RCP8.5), increases in maladaptive climate-related migration and displacement are essentially unavoidable, regardless of other policy choices. But the benefits of implementing the compact are also felt unevenly by region. The potential long-term gains from pursuing

57 WMO, *United in Science*.

migration policies that embrace the compact's aims (MPS1) are especially great in all regions of Africa, followed by Latin America and the Caribbean; in these regions, maladaptive migration and displacement could potentially be driven well below current levels, even in the absence of success in reducing greenhouse gas emissions. In other regions, especially East and Southeast Asia, embracing the compact (MPS1) would be an important strategy to minimize future risks, even if future improvements would be unattainable.

C. The Path We Are Currently Taking

The World Meteorological Organization reported in September 2019 that current growth in global greenhouse gas emissions places us on a path to a 3°C increase above preindustrial average temperatures by the year 2100.[58] The UN secretary-general's September 2019 Global Climate Action Summit came and went with no new commitments or action plans from the largest emitters. Given this reality, low-emissions scenarios (i.e., RCP2.6 and RCP4.5) are highly unlikely outcomes. The main factor that eventually slows emissions may be limits in the supplies of fossil fuels in the second half of this century, and not any conscious efforts by governments to curtail their use.[59] In terms of policy, progress toward meeting the UN Sustainable Development Goals for 2030 is frustratingly slow, exhibiting some international cooperation in some areas and little in others. Gaps in the economic development and well-being of high- and low-income countries are widening. It is too early to know how well the Global Compact for Migration will be implemented, although the decision of several major high-income, immigrant-destination countries not to adopt the compact comes as a blow.

If we assume that socioeconomic inequality grows and the international migration policy status quo continues, we can expect the number of climate-related migrants to grow severalfold over the course of this century. For the period 2020–50, we should expect to see the following outcomes:

- The number of people displaced by extreme storms in coastal areas of East, Southeast, and South Asia, and by floods in Asia will increase incrementally. These events generate higher levels of internal rural-urban migration, higher rates of migration within regions, and potential additional flows of labor-seeking migrants to the Middle East, North America, and Europe.
- Slightly lower incremental increases will be seen in the number of people displaced by extreme storms in coastal areas of Latin America and the Caribbean. These generate higher levels of internal, rural-urban migration; higher rates of migration between contiguous countries; and higher rates of migration to North America.
- The frequency of drought- and flood-related migration and displacement in sub-Saharan Africa will change in ways that are difficult to predict due to subregional changes in precipitation regimes. Most events lead to higher rates of internal rural-urban migration and intraregional migration between contiguous countries.
- Incremental increases will take place in flood-related displacement in the Middle East and North Africa, with some potential for the emergence of extreme-heat-related population movements.

58 WMO, *United in Science*.

59 Steve H. Mohr et al., "Projection of World Fossil Fuels by Country," *Fuel* 141 (2015): 120–35.

For the period 2050–2100, we can expect to see further climate-related migration and displacement and growth in trapped populations. The effects will vary significantly by region.

- In East and Southeast Asia, we should expect to see accelerated growth in the number of people displaced by extreme storms in coastal areas. This trend will emerge by 2050 (or shortly thereafter) and reach crisis levels before 2100. Flood risks will grow slightly more slowly but will still generate large-scale displacement events with much greater frequency than today. These events will necessitate the coordinated relocation of populations from high-risk locations or massive investments in protective infrastructure. Migration will be episodic and often chaotic in nature, generating higher rates of rural-urban migration within countries and between countries within the region. We can also expect there to be large, immobile, trapped populations, especially in heavily populated deltas.
- In South Asia, flood-related migration risks will be comparable to those in East and Southeast Asia, while risks from extreme storms will be slightly lower than in East and Southeast Asia but still at levels much greater than those today. We can expect these pressures to lead to high rates of rural-urban migration within countries and between countries within the region. Large numbers of people will likely seek to move to the Middle East (unless the fossil-fuel-based economy there has collapsed) and to North America. Meanwhile, we can also expect there to be large, immobile, trapped populations.
- Across sub-Saharan Africa, increases in floods, droughts, and extreme heat events will lead to more migration and displacement. In East Africa, shifting precipitation regimes will lead to increased risks of migration and displacement due to floods and to droughts and extreme heat events, while in West and Southern Africa, there will be slightly higher risks of flood-related migration, but much higher rates of migration due to droughts and extreme heat events. In all regions, we can expect to see higher rates of internal rural-urban migration and migration between contiguous countries, and possibly increases in international migration to Europe. Meanwhile, we can also expect to see large, immobile, trapped populations in and around urban centers.
- In Latin America and the Caribbean, the intensification of hurricanes will lead to significant increases in displacements and migration, with storms as intense as Hurricane Dorian more common, amplified by rising sea levels. We can expect these trends to lead to near-annual storm events comparable to those experienced in the Bahamas (2019) and Puerto Rico (2017), generating large numbers of internally displaced people, trapped populations, and pushing additional migrants toward North America.
- Finally, in the Middle East and North Africa, we can expect to see a slight increase in migration due to floods, with extreme heat events and droughts emerging as a greater risk. The direction of migration flows will primarily be from lower- to higher-income countries within these regions, as well as additional migration to Europe.

7 Conclusion

The impacts of climate change will almost certainly have an observable influence on future internal and international migration patterns. It is not possible to make precise estimations of the particular nature of migration outcomes at the regional, national, or local levels. Thus, it is difficult to forecast the direction of migration flows, the number of people who migrate, the conditions under which they migrate, and the number of people who might wish to migrate but cannot (i.e., immobile or "trapped" populations). The uncertainties depend significantly upon the degree to which countries mitigate greenhouse gas emissions, progress toward the UN Sustainable Development Goals, and set migration policy that promotes global resilience to climate change. The strong interconnectedness of these policy spheres creates opportunities for synergy but also for discordance, as one policy may cancel out the effectiveness of others.

Migration and adaptive capacity are inherently linked. The dysfunctionality of treating migration and climate change as separate policy-making silos will become increasingly obvious as the impacts of climate change intensify. This report has used the terms *adaptive* and *maladaptive* to distinguish between migration that makes people, the places they come from, and their destinations more capable of adapting to a climate-disrupted future, versus migration that undermines adaptive capacity and sustainable development more broadly. Migration in and of itself is neither inherently adaptive nor maladaptive (or, in more general terms, is not inherently beneficial or detrimental). It is the conditions under which migration occurs that determine whether it generates benefits or leads to greater hardship. This report identifies three possible, and plausible, directions that international migration policy might take, and assesses their potential impacts under a range of future climate scenarios and development pathways. The volume of internal and international migration could conceivably rise under any one of these three migration policy scenarios as a result of climate change. It is important for migration policymakers to ask what forms such migration might take, under what socioeconomic and political conditions it would occur, how to optimize its returns to all concerned, how to minimize the number of people involuntarily displaced, and how to avoid enlarging immobile, trapped populations.

The exercise of weighting and combining scenarios undertaken in this report indicates that policies consistent with the Global Compact for Migration have significant potential to reduce maladaptive migration in both the short and long term, to help build people's capacity to adapt to climate change, and to contribute to sustainable development. These effects hold even if climate and/or development policies lag behind or are less effective. The scenario exercise assumes that climate, development, and migration policies have equal effect and that countries will act in accordance with the policies they set. This is an important assumption. In the absence of corresponding action, policies cannot be expected to have their intended effect. The current international status quo with respect to migration cannot be expected to reduce maladaptive climate-related migration and displacement in the future. If recent trends toward the securitization of borders and the narrowing of access to protection persist or strengthen (especially for those who fall somewhere between the definitions of refugees and economic migrants), the adverse effects of climate change on migration and adaptive capacity will likely be magnified.

The current international status quo with respect to migration cannot be expected to reduce maladaptive climate-related migration and displacement in the future.

Appendices

Appendix A. Scoring Used in Scenario Exercise

Future Flood Risks

Flood risks are generally expected to increase in Southeast Asia, peninsular India, East Africa, and the northern half of the Andes,[60] with recurrence rates expected to rise in India and East Asia under the Representative Concentration Pathway (RCP) 4.5 by 2100.[61] In the period up to 2050, there is little difference in flood risks under RCPs 2.6, 4.5, and 6 in 2050, and between RCP4.5 and RCP6 in 2080.[62] Impacts under RCP8.5 are greater than under the other RCPs in 2050 and 2080.[63]

The Intergovernmental Panel on Climate Change (IPCC)[64] observes that runoff projections vary according to the warming scenario; at 2°C of global warming, expect increased runoff in Southeast Asia, East Africa, India, and parts of China and the Sahel, and decreased runoff in the Mediterranean region, Central America, and central and southern South America. A 2017 study by Alfieri et al.[65] expects flood risks to rise under 1.5°C, 2°C, and 4°C global warming scenarios, while a 2018 study by Döll et al.[66] projects high flows to increase in South and Southeast Asia and Central Africa at 1.5°C, and in parts of South America at 2°C. The Technical Summary of the IPCC Working Group I *Fifth Assessment Report* (AR5)[67] notes that except for RCP2.6, long-term precipitation rates will increase in most regions, and average monsoon precipitation will go up in East and South Asia.

The scoring for the scenario exercise, based on the information presented above, is outlined in Tables A–1 and A–2.

TABLE A–1

Regions Where Risk Will Increase: South, East, and Southeast Asia and Sub-Saharan Africa

RCP	Time <2050	Time = 2050–2100
2.6	0	0
4.5	0	+1
6	0	+1
8.5	+1	+2

RCP = Representative Concentration Pathway.
Note: In sub-Saharan Africa, flood risks will increase primarily in East Africa and likely decline in West Africa.

TABLE A–2

Regions Where Risk Will Decrease: Middle East, North Africa, and West and Southern Africa

RCP	Time <2050	Time = 2050–2100
2.6	0	0
4.5	0	-1
6	0	-1
8.5	-1	-2

RCP = Representative Concentration Pathway.

60 Yukiko Hirabayashi et al., "Global Flood Risk under Climate Change," *Nature Climate Change* 3 (2013): 816–21.
61 Kettner et al., "Estimating Change in Flooding."
62 Arnell and Lloyd-Hughes, "The Global-Scale Impacts of Climate Change."
63 Arnell and Lloyd-Hughes, "The Global-Scale Impacts of Climate Change."
64 IPCC, "Chapter 3," in *Global Warming of 1.5°C: An IPCC Special Report on the Impacts of Global Warming of 1.5°C above Pre-Industrial Levels and Related Global Greenhouse Gas Emission Pathways, in the Context of Strengthening the Global Response to the Threat of Climate Change, Sustainable Development, and Efforts to Eradicate Poverty*, eds. Valerie Masson-Delmotte et al. (Geneva: WMO, 2018).
65 Alfieri et al., "Global Projections of River Flood Risk."
66 Petra Döll et al., "Risks for the Global Freshwater System at 1.5 °C and 2 °C Global Warming," *Environmental Research Letters* 13, no. 4 (2018).
67 Stocker et al., "Technical Summary."

Future Drought Risks

Based on the IPCC *AR5 Technical Summary,* drought intensity has likely increased in West Africa since the 1950s. Under RCP8.5, there will likely be greater drought frequency/intensity in areas that are presently dry,[68] and extreme heat events will occur more frequently in most regions. The IPCC report *Global Warming of 1.5°C*[69] suggests that the AR5 projections are reliable, except that there is greater likelihood of drought in the Mediterranean region. Box 3.1 states that in sub-Saharan Africa, temperatures are rising faster than the global average, and extreme heat events are becoming more common, especially in West and Central Africa. Predictions of precipitation in the Sahel are variable; West Africa is likely to experience the greatest drying, while East Africa could get more precipitation. Only under RCPs 6 and 8.5 is there a strong response in precipitation and evapotranspitration. There are no real effects under RCPs 2.6 and 4.5.[70]

The Mediterranean, the Amazon, and Southern Africa see significant drought risks at 1.5°C and 2°C, scaling with RCP, whereas there is no change in droughts in Southeast Asia. Under RCP8.5, the risk of consecutive drought years increases substantially in all regions except Southeast Asia.[71] The IPCC 1.5 report reaches a similar conclusion. Dry spells are projected to become longer across the Mediterranean region and Amazonia. For RCP2.5 scenarios, there will be considerable multidirectionality and uncertainty in model outcomes.[72] Regional trends in frequency and intensity of drought are evident in the Mediterranean, North Africa, and the Middle East; many regions of sub-Saharan Africa; the southern Amazon; and East and South Asia.[73]

The scoring for the scenario exercise, based on the information presented above, is outlined in Tables A–3 and A–4.

TABLE A–3

Regions Where Risk Will Increase: West and Southern Africa

RCP	Time <2050	Time = 2050–2100
2.6	0	0
4.5	0	0
6	0	+1
8.5	+1	+2

Note: RCP = Representative Concentration Pathway.

TABLE A-4

Region Where Risk Will Decrease: East Africa

RCP	Time <2050	Time = 2050–2100
2.6	0	0
4.5	0	0
6	0	-1
8.5	-1	-1

Note: RCP = Representative Concentration Pathway.

68 Stocker et al. "Technical Summary," 90–91.
69 IPCC, "Chapter 3," in *Global Warming of 1.5°C*, 3.3.4.
70 Greve, Gudmundsson, and Seneviratne, "Regional Scaling of Annual Mean Precipitation."
71 Lehner et al., "Projected Drought Risk."
72 Wartenburger et al., "Changes in Regional Climate Extremes."
73 Priyadarshi R. Shukla et al., eds., *Climate Change and Land: An IPCC Special Report on Climate Change, Desertification, Land Degradation, Sustainable Land Management, Food Security, and Greenhouse Gas Fluxes in Terrestrial Ecosystems* (Geneva: IPCC, 2019), 20–21.

Tropical Cyclones

Heavy precipitation events are projected to intensify over East Asia and East Africa.[74] There are no projected changes in cyclone frequency, but the intensity of storms may go up in Southeast Asia and East Asia under 4.4–8.5 scenarios for later in the 21st century, with precipitation from cyclones to rise in most regions and most scenarios.[75] RCP4.5 leads to the likelihood of generally increased intensity of tropical cyclones in the 2050–2100 period.[76] There is considerable variability in regional cyclone damage projections.[77] It is expected that there will be significant increases in cyclone damage in East Asia by the end of the century,[78] as well as general intensification of cyclones in the future, in terms of greater windspeeds and more concentrated volumes of precipitation (but a small spatial area affected by each storm).[79]

There may be increased frequency of high-intensity storms in the South China Sea later in the century under the RCP 4.5 and 8.5 scenarios, and precipitation amounts might rise, whereas low-intensity storms might decline in numbers.[80] Northwest Pacific typhoons will intensify and will head more often into the subtropics of East Asia and less frequently toward the Philippines and Taiwan.[81] There will probably be an increase in Caribbean hurricanes in the future depending on 1.5°C vs 2°C warming, but predictions vary. The IPCC *AR5 Technical Summary* expresses low confidence in global trends, but is virtually certain there has been an increase in their intensity in the Atlantic since the 1970s; it foresees no change in the frequency of cyclones but cyclones will have greater intensity and precipitation will increase by the end of the century. For 2050–2100, under high RCPs, it is very likely that storms will intensify and there will be more frequent extreme precipitation events.

The scoring for the scenario exercise, based on the information presented above, is outlined in Tables A–5 and A–6.

TABLE A-5
Increasing Risks in East and Southeast Asia

RCP	Time <2050	Time = 2050–2100
2.6	0	0
4.5	0	+2
6	0	+2
8.5	+1	+2

Note: RCP = Representative Concentration Pathway.

TABLE A-6
Increasing Risks in South Asia and in Latin America and the Caribbean

RCP	Time <2050	Time = 2050–2100
2.6	0	0
4.5	0	+1
6	0	+1
8.5	0	+1

Note: RCP = Representative Concentration Pathway.

74 Wartenburger et al., "Changes in Regional Climate Extremes."
75 Bacmeister et al., "Projected Changes in Tropical Cyclone Activity."
76 Mure-Ravaud, Kavvas, and Dib, "Investigation of Intense Precipitation from Tropical Cyclones."
77 James M. Done, Debasish PaiMazumder, Erin Towler, and Chandra Kishtawal, "Estimating Impacts of North Atlantic Tropical Cyclones Using an Index of Damage Potential," *Climatic Change* 146, nos. 3–4 (2018): 561–73.
78 Gettelman et al., "Projections of Future Tropical Cyclone Damage."
79 Mudd, Rosowsky, Letchford, and Lombardo, "Joint Probabilistic Wind–Rainfall Model."
80 Wang, Liang, and Hodges, "Projections of Tropical Cyclones Affecting Vietnam"; Hyeonjae Lee et al., "Future Change in Tropical Cyclone Activity over the Western North Pacific in CORDEX-East Asia Multi-RCMs Forced by HadGEM2-AO," *Journal of Climate* 32, no. 16 (2019): 5053–67.
81 Wang and Wu, "Future Changes of the Monsoon Trough."

Sea Level Rise

Projections for future rates of sea level rise used in the scenarios for this report are based on estimates provided in the Technical Summary of the IPCC Working Group I *Fifth Assessment Report*, data for which are summarized in the following table and figure.

TABLE A–7

Projected Change in Global Mean Surface Air Temperature and Global Mean Sea Level Rise for the Mid- and Late 21st Century Relative to the Reference Period 1986–2005

		2046–2065		2081–2100	
	Scenario	Mean	*Likely* range[c]	Mean	*Likely* range[c]
Global Mean Surface Temperature Change (°C)[a]	RCP2.6	1.0	0.4 to 1.6	1.0	0.3 to 1.7
	RCP4.5	1.4	0.9 to 2.0	1.8	1.1 to 2.6
	RCP6.0	1.3	0.8 to 1.8	2.2	1.4 to 3.1
	RCP8.5	2.0	1.4 to 2.6	3.7	2.6 to 4.8
	Scenario	Mean	*Likely* range[d]	Mean	*Likely* range[d]
Global Mean Sea Level Rise (m)[b]	RCP2.6	0.24	0.17 to 0.32	0.40	0.26 to 0.55
	RCP4.5	0.26	0.19 to 0.33	0.47	0.32 to 0.63
	RCP6.0	0.25	0.18 to 0.32	0.48	0.33 to 0.63
	RCP8.5	0.30	0.22 to 0.38	0.63	0.45 to 0.82

RCP = Representative Concentration Pathway.
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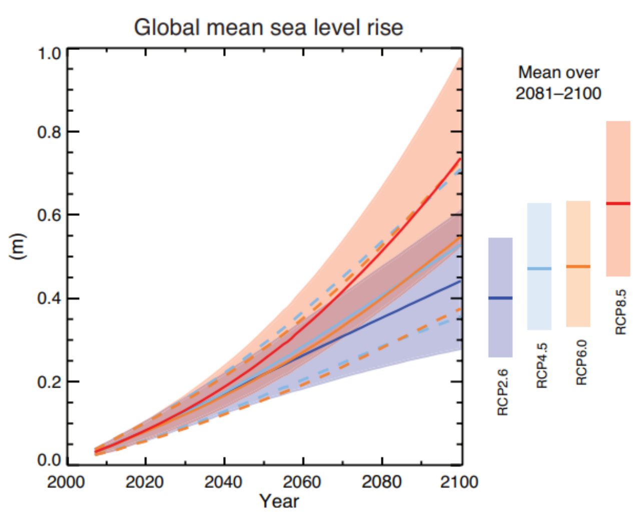
FIGURE A-1

Global Mean Sea Level Rise



RCP = Representative Concentration Pathway.
Source: Figure reprinted with permission from Stocker et al., "Technical Summary," in *IPCC AR5 WGI*, Figure TS.22 on page 100.

Appendix B. Outcomes of the Scenario Exercise

Tables A–8 and A–9 were produced based on the analysis of the influence of migration policy on future regional trends in maladaptive climate-related migration using the Migration Policy Scenarios (MPSs), Shared Socioeconomic Pathways (SSPs), and Representative Concentration Pathways (RCPs) described in the main text.

These tables summarize the hazard scenario scores for each region. Positive values indicate increased risks of maladaptive migration as an outcome of a scenario; negative values refer to decreased risks. Scores from +1 to -1 indicate little or no change in risk. So, for example, for East and Southeast Asia, the greatest risk of maladaptive migration for the period <2050 receives a score of +5 (which is a combination of RCP8.5, SSP3, and MPS3) and the lowest risk receives a score of -4 (i.e., the risk is reduced below current levels; this is through a combination of RCP2.6, SSP1, and MPS1). The totals in the three right-most columns indicate the total number of scenarios that reduce risk (eight for East and Southeast Asia in the period 2020–50) and the total number of scenarios where risk grows (20 for East and Southeast Asia in the period 2020–50); there are no combinations that result in no change in risk for this particular region/time period.

TABLE A–8

Hazard Scenario Scores, <2050

Region	Number of Hazards	Hazard Categories	Highest Score	Lowest Score	<-1	-1 to +1	>+1
East and Southeast Asia	2	Floods, extreme storms	5	-4	8	0	20
South Asia	2	Floods, extreme storms	5	-4	8	0	20
Eastern sub-Saharan Africa	2	Floods, droughts/ extreme heat	5	-5	8	1	19
Western and Southern sub-Saharan Africa	2	Floods, droughts/ extreme heat	5	-5	8	1	19
Latin America and the Caribbean	1	Extreme storms	4	-4	4	0	10
Middle East and North Africa	1	Floods	4	-5	4	1	9
TOTAL	**10**		**max=5**	**min=-5**	**40**	**3**	**97**

TABLE A–9

Hazard Scenario Scores, 2050–2100

Region	Number of Hazards	Hazard Categories	Highest Score	Lowest Score	<-1	-1 to +1	>+1
East and Southeast Asia	2	Floods, extreme storms	8	-4	5	3	20
South Asia	2	Floods, extreme storms	7	-4	6	2	20
Eastern sub-Saharan Africa	2	Floods, droughts/ extreme heat	7	-5	8	2	18
Western and Southern sub-Saharan Africa	2	Floods, droughts/ extreme heat	6	-6	8	4	16
Latin America and the Caribbean	1	Extreme storms	7	-4	2	2	10
Middle East and North Africa	1	Floods	4	-6	4	4	6
TOTAL	**10**		**max=8**	**min=-6**	**33**	**17**	**90**

About the Author

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