Humanitarian Implications of Climate Change

Mapping emerging trends and risk hotspots

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The opinions expressed in this report are those of the authors and do not necessarily represent those of the UN Office for the Coordination of Humanitarian Affairs or CARE International. Comments are welcome and can be sent to Dr Charles Ehrhart, CARE International – ehrhart@careclimatechange.org or Jenty Kirsch-Wood, OCHA – kirsch-wood@un.org. For media enquires, contact Beatrice Spadacini at spadacini@ci.or.ke

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Cover Photo: © Bredan Bannon, 2006, flooding in Northeastern Kenya

Photographs included in this report illustrate situations that are likely to occur with greater frequency and/or intensity as a result of climate change. Disasters and their impacts are influenced by a variety of factors. The three report's authors do not intend to imply that events depicted in these photographs are unnecessarily the result of human induced climate change.

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A cattle herder and his son with what remains of their herd. Severe drought in 2006 had a devastating impact on the livelihoods of thousands of pastoralists who rely on rainfall and grazing in northeastern Kenya and southern Somalia.

1 Executive summary

Human-induced climate change is modifying patterns of extreme weather, including floods, cyclones and droughts. In many cases, climate change is making these hazards more intense, more frequent, less predictable and/or longer lasting. This magnifies the risk of "disasters" everywhere, but especially in those parts of the world where there are already high levels of human vulnerability.

In a humanitarian context, "risk" can be defined as the probability of harmful consequences, or expected losses (deaths, injuries, property, livelihoods, economic activity disrupted or environment damaged) resulting from interactions between natural or human-induced hazards and vulnerability. Climate change has become one of the most significant "human-induced" hazards.

Nature and purpose of this study

- This study identifies the most likely humanitarian implications of climate change for the next 20-30 year period. The authors use Geographical Information Systems (GIS) to map specific hazards associated with climate change – specifically: floods, cyclones and droughts – and place them in relation to factors influencing vulnerability. The results identify *hotspots of high humanitarian risk* under changing climatic conditions.
- Analysis focuses on slow-onset flood and drought disasters, while the complex contexts of conflict emergencies is addressed to a limited degree.
- The purpose of mapping these hotspots is to help: (a) policymakers better understand the challenge we face and (b) humanitarian actors adapt their response strategies to the realities of climate change.
- The complexity of climate change science and measurements of human vulnerability means the results of this study should be interpreted as indicative only. Further research is required at both regional and local levels.
- This study is relevant not only to humanitarian actors, but to anyone working towards a world where poverty has been overcome and people can live in dignity and security.

Changing intensity of hazards

- Scientists have documented an increase in the frequency of temperature extremes, an increase in areas affected by drought, increasingly frequent heavy precipitation events, and shifting wind patterns and cyclone tracks.[1]
- During the next 20-30 year period, the intensity, frequency, duration and extent of weather-related hazards will increase in many parts of the world. However, we are unlikely to see significant changes in the location of these hazards.
- Climate change increases uncertainties about how disasters will unfold. This places further strain on the response capacity of humanitarian actors.

Growing vulnerability

- Humanitarian disasters occur as a result of people's exposure to particular hazards and their degree of vulnerability.
- One of the most important factors shaping individuals', communities' and societies' coping capacity is their access to and control over natural, human, social, physical, political and financial resources. Their striking lack of these things is a major reason why poor people – especially those in marginalised social groups like women, children, the elderly and people with disabilities – constitute the vast majority of disaster victims.

- Vulnerability is also affected by external factors including governance, the status of people's natural resource base, conflict, urbanisation and demographic change.
- The day-to-day impacts of climate change, such as higher temperatures and erratic rainfall, are increasing many people's vulnerability to hazards. These and other weather-related stresses can even mount to the point that they cause "disasters," as evidenced by a breakdown in livelihoods, chronic hunger and displacement. These disasters typically receive little attention from the media and even less humanitarian aid despite their intensity.

In the context of this study, "vulnerability" refers to the likelihood that individuals, communities or societies will be harmed by a hazard. It is determined by a combination of physical, social, economic, political and environmental factors or processes. These factors and processes include the character, magnitude and rate of climate change, as well as the variation people are exposed to, their sensitivity and coping capacity.

Dhaka Bangladesh, South Asia Floods, August 2004. Devastation in Nepal, India and Bangladesh left millions homeless, damaged vast amounts of agriculture, destroyed infrastructure and impoverished millions more.

- The largest and most important regions of high overall human vulnerability identified by this study are located in: Africa, particularly the Sahel, Horn of Africa and Central Africa; Central and South Asia, particularly Iran/Afghanistan/Pakistan/India and the Caspian region; and Southeast Asia, particularly Myanmar, Laos, Cambodia and Indonesia.

Humanitarian hotspots

- **Flood-risk** hotspots occur in Africa, including the Sahel, the Horn of Africa, Great Lakes region, Central Africa and Southeast Africa; Central, South and Southeast Asia; and Central America and the western part of South America.
- **Drought-risk** hotspots are mainly located in sub-Saharan Africa; South Asia, particularly Afghanistan, Pakistan and parts of India; and South East Asia, particularly Myanmar, Vietnam and Indonesia.
- **Cyclone-risk** hotspots include Mozambique and Madagascar, Central America, Bangladesh, several parts of India, Vietnam and other Southeast Asian countries. As the range and intensity of cyclones increases, so too will the number of communities at high risk. This will include communities further in-land that are not used to coping with such hazards.
- Areas at risk from more than one climate related hazard warrant special concern. These areas include much of sub-Saharan Africa, especially the east coast, and much of South Asia.
- There are some areas that are risk hotspots for all three hazards. These include Southeast Africa and parts of South and Southeast Asia.

2 Policy recommendations

The increasing frequency, intensity, duration and range of extreme weather threatens to increase humanitarian need and derail global development. This is especially true under current conditions of skyrocketing food prices, rapidly degrading ecosystems and profound social inequity. People in the least developed countries and island states will be affected first and worst. At community and household levels, the poorest and most vulnerable social groups – including women, children, the elderly and disabled – will be hit hardest.

New thinking and practical approaches to humanitarian assistance are needed to overcome this challenge. These include the following principles and commitments:

Don't make things worse

We have to get serious about reducing greenhouse gas emissions from energy production, deforestation, transport and industrial processes. The international community has until December 2009, at the Conference of Parties to the United Nations Framework Convention on Climate Change (UNFCCC) to agree on a way forward. If this deadline isn't met, we will almost surely shoot past any safe emissions scenario and commit future generations to a very different – and much more dangerous – world.

Act earlier

Time and time again, action by the global humanitarian community is "too late, too brief, inappropriate and inadequate."[2] This often results in a cycle of poverty and vulnerability to disasters that is difficult to break. Climate change will exacerbate this situation by worsening weather-related hazards. While risk assessments, emergency preparedness and disaster risk reduction should already be part of longer-term planning, climate change is a wake-up call to ensure this is happening as well as increase the scale and improve the quality of such efforts. Therefore, it is especially important that the international community:

- **Increase investment in disaster risk reduction (DRR).** Concentrate on reducing vulnerability rather than just reacting to emergencies. Establish mechanisms to provide sufficient funding for adaptation to climate change and risk reduction. There is substantial evidence that disaster risk needs to be built into development planning from the start.[3] For every dollar invested in disaster risk reduction and preparedness, roughly seven dollars are saved in disaster response.[4] In signing the Hyogo Declaration in 2005, 168 Governments acknowledged that working to reduce disaster risks, especially at the community level, is critical. Its time to follow-through. There needs to be greater investment in DRR *now*, especially in poor countries that have always been hazard hotpots but are experiencing an increase in extreme weather due to climate change.
- **Ensure faster and more appropriate responses to disaster.** Invest in early warning systems and be prepared to respond in time to save livelihoods as well as lives. If fragile livelihoods are allowed to erode, people are left more vulnerable to disasters in the future.

Act wiser

- **Avoid inefficient quick fixes.** Food aid, which comprises a large proportion of humanitarian assistance, is often necessary. However, it is frequently provided without considering whether it will exacerbate the situation by distorting local markets – potentially leaving the poor and farmers in a worse situation than before the emergency. Donor governments' use of domestic food surpluses to supply food aid, rather than selecting aid delivery mechanisms based on the specific needs and priorities of recipient countries, is particularly inefficient and can be counterproductive.[5]
- **Build-back-better.** Ensure intelligent recovery from disasters that doesn't undermine development, perpetuate people's vulnerability, and ignore

lessons learnt. The aim is to help people create dignified, secure lives for themselves and their families. This will require better risk analysis and communication by humanitarian actors that takes into account obvious hazards and vulnerabilities, but also more complex socioeconomic and cultural factors.[6]

Follow through

- **Help people get back on their feet.** Few humanitarian interventions address the sustainability of livelihoods after an emergency has been tackled. When disasters hit, the world often responds with generous humanitarian aid (like food, blankets and shelter). However little or no funding is provided for other types of response – such as livestock protection or support for agricultural recovery. This undermines ongoing development efforts and leaves people with few options to go forward once emergency aid ends.

- **Bridge the humanitarian/development divide.** Redress the underlying causes of vulnerability such as detrimental policies and poor governance, social discrimination and degraded ecosystems. The most effective interventions will include:

  - *Increasing access* to essential services (like health and education) and long-term social protection systems.

  - *Strengthening* the capacity of local actors, particularly government at all levels, to better understand the nature of risks they may face and to take appropriate action to reduce such risks.

  - *Empowering* local populations to have a strong role and voice in emergency preparedness, response to disasters and subsequent recovery and rehabilitation.

  - *Improving* the accountability of governments and service providers to populations affected by disasters.

CARE is working with villagers in Misali Island, Pemba, Tanzania to re-establish mangrove forests. As they grow, the mangroves will provide critical habitat for aquatic species sustaining local livelihoods and a "living storm-barrier" that reduces the risk of disaster from cyclones.

3 Introduction

The Earth is warming. Evidence includes a well-documented increase in global average air and ocean temperatures, widespread melting of snow and ice, and rising sea levels.[7] This is triggering a shift in seasons, changes in when/how much rain falls in different parts of the world, and changes in extreme weather.

As such, climate change is blurring the distinction between "natural" and "man-made" hazards. Although weather-related hazards, such as droughts and floods, would occur regardless of whether or not we add greenhouse gasses to the atmosphere, our actions have consequences.[8]

In fact, an increase in temperature extremes, the area affected by drought and the frequency of heavy precipitation events, as well as changes in wind patterns and storm tracks, have already been measured[9] – and the consensus amongst experts is that we are to blame.[10]

When hazards hit areas where people have limited capacity to reduce their level of risk, manage or deal with the aftermath of extreme weather, the results can be truly "disastrous." This is especially so in areas where population density is high and growing too quickly for good planning.

Each year, natural hazards trigger disasters that we measure in terms of the dead, injured and displaced, as well as economic loss. The figures can be shocking. Between 2005 and 2006, for instance, natural disasters killed 120,000 people, affected 271 million more and caused economic losses totalling US$250 billion.

These numbers appear to be climbing: In the decade 1984-1993, 1.6 billion people were affected by natural disasters, compared with 2.6 billion in the following decade (1994-2003). In constant dollars, disaster costs between 1990 and 1999 were more than 15 times higher (US$652 billion in material losses) than they were between 1950 and 1959 (US$38 billion at 1998 values).[11]

Rising numbers are the result of several factors, including population growth and changing habitation patterns. Regardless, it is vital to note that one number is going down: deaths. This reflects increased investment in disaster preparedness, management and response and illustrates what the international community can accomplish when committed.

Climate change threatens to set back these limited gains while dramatically increasing both the number of people affected by disasters and the scale of economic damage. Indeed, it is precisely the kinds of hazards exacerbated by climate change (avalanches, extremes of temperature, droughts, floods, landslides, wild fires and wind storms) that account for the vast majority of disaster-related losses. According to the Centre for Research on the Epidemiology of Disasters (CRED), 68 percent of deaths and 89 percent of all economic losses between 2000 and 2007 resulted from these kinds of events.[12]

In short: humanitarian actors should be very worried when scientists tell us that during the next 20-30 year period, the intensity, frequency, duration and extent of weather-related hazards will increase in many parts of the world.

It is, of course, poor people – and especially those in marginalised social groups like women, children, the elderly and disabled – who will suffer most from these changes. This is because the impact of humanitarian disasters is as much a result of people's vulnerability as their exposure to hazards.

Vulnerability refers to the capacity of individuals, communities and societies to manage the impact of hazards without suffering a long-term, potentially

irreversible loss of wellbeing. Vulnerability is largely determined by people's access to and control over natural, human, social, physical, political and financial capital. Quality of governance, quality/degradation of their natural resource base, conflict, urbanisation and demographic change also shape people's vulnerability.

This study uses a Geographical Information Systems (GIS) mapping approach to explore how projected impacts of climate change will intersect with existing patterns of human vulnerability. This allows the identification of current and future hotspots of climate change risk. The results illustrate the implications of climate change for humanitarian assistance so that policymakers can grasp the nature and scale of the challenge we face and humanitarian actors can begin adapting their response strategies to the realities of climate change.

The study builds on recent publications and data relating to trends in natural hazards and their relationship with climate change, including the Intergovernmental Panel on Climate Change (IPCC) *Fourth Assessment Report,*[13] the World Bank's *Natural Disasters Hotspots: a Global Risk Analysis,*[14] the *Stern Review of the Economics of Climate Change*[15] and the United Nations Development Programme's *Human Development Report 2007/8*.[16] It complements the United Nations Office for the Coordination of Humanitarian Affairs' (OCHA) recent work to improve risk analysis and mapping which combines historical data with forward looking climate model projections. Technical details of the methodology used in this study, as well as its limitations, are presented in a second volume that is available on the Internet at www.careclimatechange.org and www.maplecroft.com.

The implications of climate change for humanitarian assistance are analysed under the following headings:

- Human vulnerability
- Flood and cyclone disasters
- Food and water
- Population, displacement and conflict

India, August 2006. Stranded villagers of Bhagavandas Nagar in the state of Andrha Pradesh where monsoon rains brought another year of flooding.

4 Mapping human vulnerability

Floods, violent storms and droughts don't have to become "disasters."

Disasters are defined as such in terms of how much damage – typically to lives and property – they cause. This is partly a result of their severity. However, it is also a function of human vulnerability. Poor people are often more exposed to weather-related hazards, more sensitive to their impacts and least equipped to deal with their consequences. Think of Hurricane Katrina and the devastation it left behind: The images of vulnerability could not have been starker. Poorer communities often occupied the most flood-prone areas (they were most exposed), had the least robust housing (making them more sensitive to hurricane damage), and lacked access to resources and supporting institutions that might have helped them avoid the worst impacts of the hurricane (e.g. access to early warning systems, capacity to evacuate their properties quickly and resources to find alternative accommodation). Loss of assets subsequently reduced their ability to recover and adapt after the event, putting them at greater risk of future disasters.

There are different notions of what human vulnerability is and how it is related to risk and adaptive capacity, especially in relation to climate change.

In this study, human vulnerability refers to the likelihood that individuals, communities or societies will be harmed by a hazard. We divide the factors shaping human vulnerability into five groups: natural, human, social, financial and physical. Each group contains one or more individual indicators, which were combined to construct vulnerability indices for each. The groups were then combined to give a single, overall human vulnerability index. This was combined with information on the distribution of hazards to identify climate change-risk hotspots (see Chapter 5).

There are many methodological issues surrounding the choice, use and interpretation of indicators for vulnerability. The results outlined in this section should therefore be treated as indicative only.

Map 1 shows the global distribution of human vulnerability. Areas with the highest levels of vulnerability are located in three main regions:

- Africa, particularly the Sahel, Horn of Africa and Central Africa, although there are isolated pockets of high vulnerability across much of the continent.
- Central and South Asia, particularly Iran/Afghanistan/Pakistan/India and the Caspian region
- Southeast Asia, particularly Myanmar, Laos, Cambodia and Indonesia.

There are smaller concentrations of high vulnerability in parts of East Asia, including Mongolia and northern and western China; and parts of South America, especially the Andean region.

Map 2 shows a close-up of human vulnerability in South Asia. It illustrates variation in vulnerability due to differing natural, human, social, financial and physical factors. For example, high levels of vulnerability in Myanmar and Afghanistan reflect national indicators for preparedness and conflict risk. Lower vulnerability along the foothills of the Himalaya and Pakistan's Indus Valley reflect greater availability of water and fertile land. Meanwhile, the Ganges Delta region of Bangladesh is often the location of major humanitarian disasters although the map indicates vulnerability in this region to be "moderate." This highlights the fact that vulnerability can be reduced through concerted efforts to reduce risk, improve disaster preparedness, establish early warning systems, and strengthen response capacity.

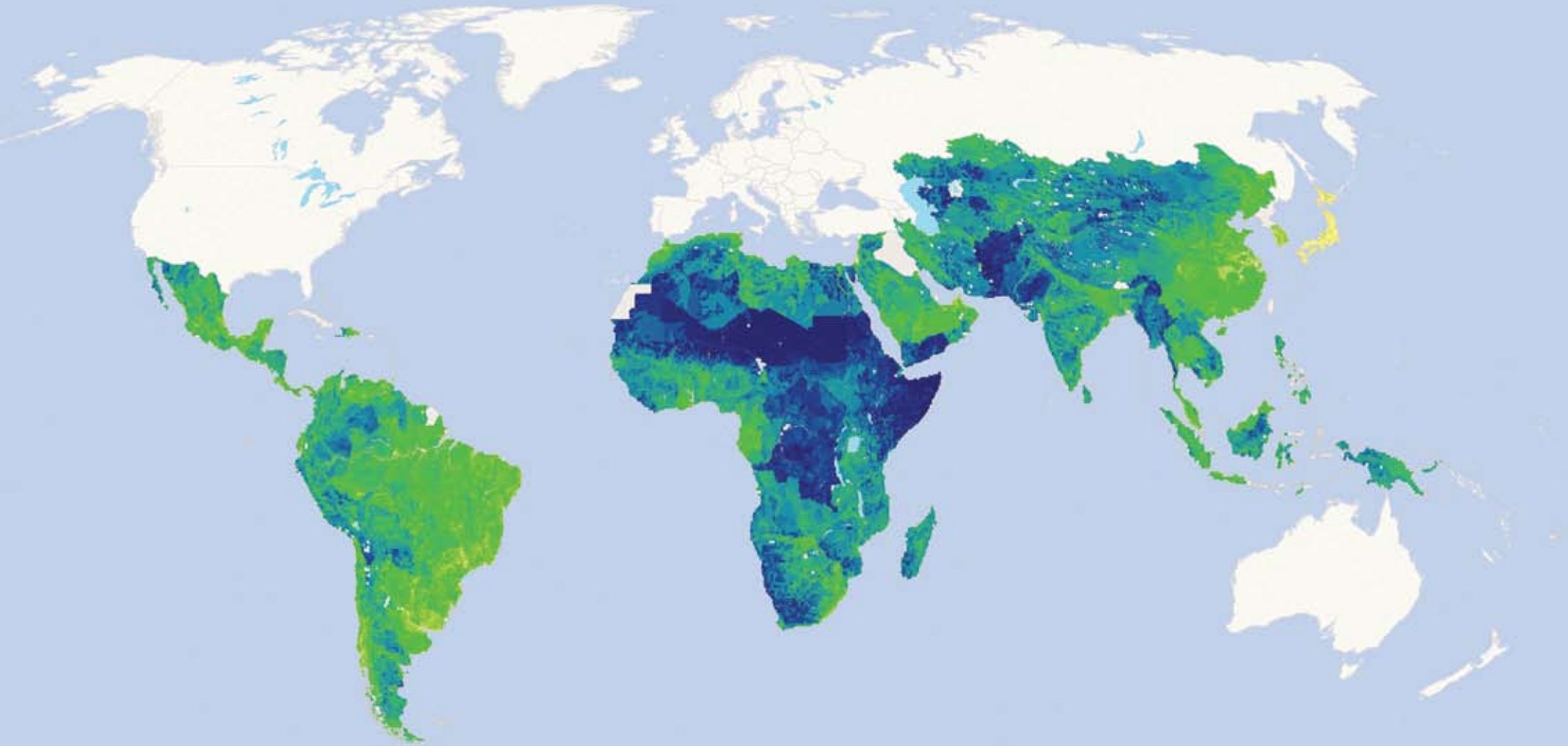
Today, vulnerability is the main determinant of humanitarian risk. This, rather than changes in the intensity, frequency or distribution of hazards, will probably remain the key determinant throughout the next 20 to 30 years. This is partly because we won't see many changes in the location of weather-related hazards during this timeframe. However, it is also because *chronic impacts of climate change* – including rising temperatures, shifts in rainfall, longer dry spells, etc. – as well as *small changes in extreme weather* will dramatically exacerbate existing vulnerabilities.

In combination, weather-related shocks and stresses could cause a vicious spiral, whereby highly vulnerable populations would be particularly prone to disasters, rendering them more vulnerable, leaving them especially susceptible to the next shock, etc.

In the next Chapter, we take a look at the interaction between weather-related hazards (including how they may change during the next 20 to 30 year period) and vulnerability in order to identify hotspots of humanitarian risk.

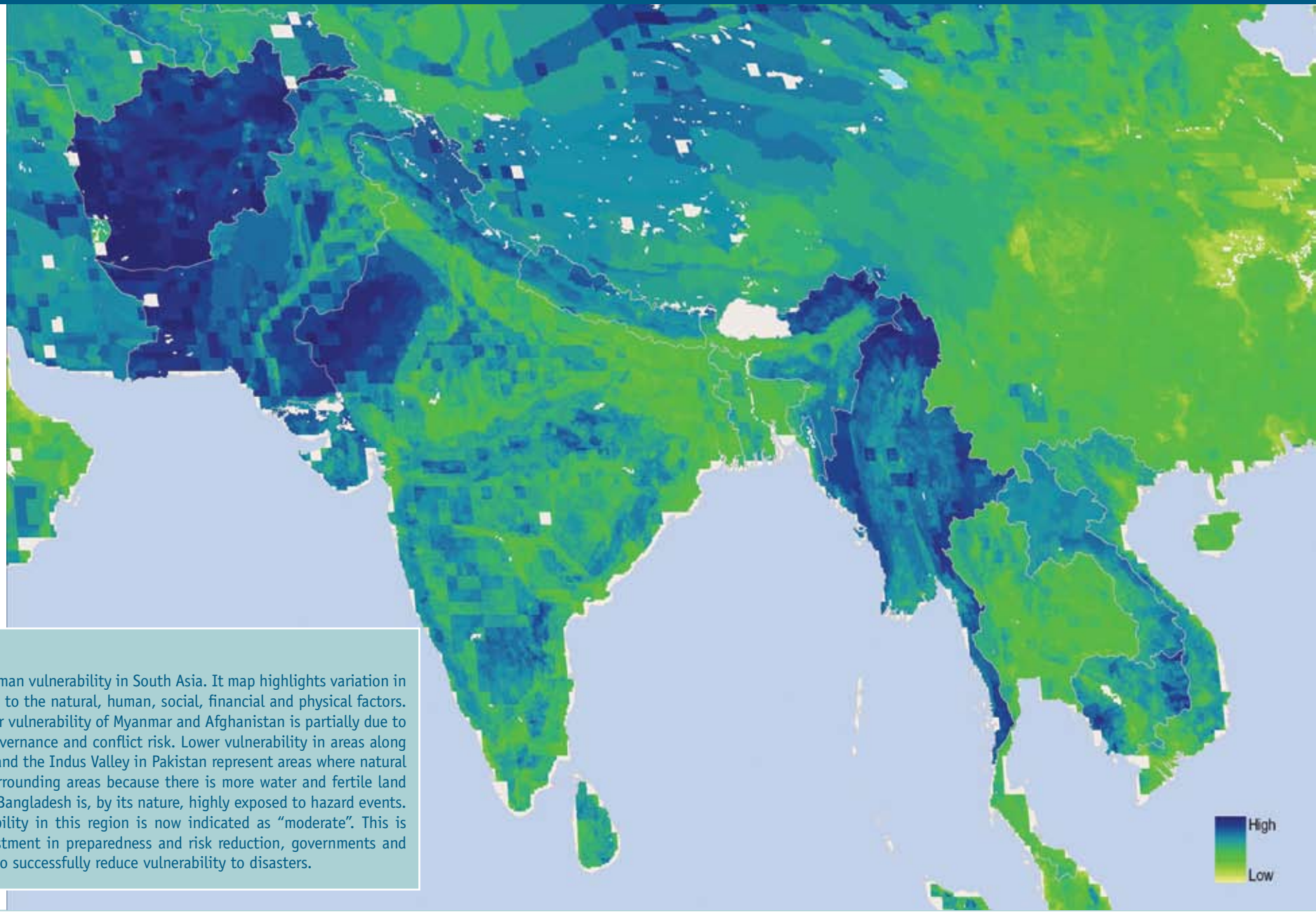
Chawhara, Bangladesh, South Asia Floods, August 2004. Ten-year-old Sharikon is standing on the ruins of her home, which was destroyed by floods in the middle of the night. Chawhara sits atop the Char, a huge flood plain of sandbars. Flooding washes away homesteads, destroy crops and changes the course of mighty rivers.

Human Vulnerability, World



Map 1:
This map shows overall human vulnerability based on a combination of natural, human, social, financial and physical factors. Areas shown in darkest blue are likely to be most at risk if exposed to extreme weather, such as floods, cyclones and droughts, or other impacts of climate change.

Human Vulnerability, South Asia



Map 2:
This map shows the overall human vulnerability in South Asia. It map highlights variation in human vulnerability according to the natural, human, social, financial and physical factors. For example, the overall higher vulnerability of Myanmar and Afghanistan is partially due to national indicators such as governance and conflict risk. Lower vulnerability in areas along the foothills of the Himalaya and the Indus Valley in Pakistan represent areas where natural vulnerability is lower than surrounding areas because there is more water and fertile land available. The delta region of Bangladesh is, by its nature, highly exposed to hazard events. However, the overall vulnerability in this region is now indicated as "moderate". This is because, through sound investment in preparedness and risk reduction, governments and communities have been able to successfully reduce vulnerability to disasters.

5 Risk hotspots

In this Chapter, we look at the interaction of human vulnerability with current and projected climate hazards (flood, cyclone and drought) to identify hotspots of climate change risk.

Flood and cyclone disasters

This section looks at the interaction of human vulnerability with flood and cyclone hazards. We analyse flood and cyclone risks together because they are 'sudden onset disasters' which stand in contrast to the slower and more complex humanitarian impacts of drought (see following section).

During the next 20-30 year period, it is unlikely that we will see significant changes in where floods and cyclones occur. However, we are likely to see:

- **An intensification of the water cycle and a polarisation of rainfall patterns.** In general, wet places will get wetter while dry places become drier. By 2050, annual average river runoff and water availability are projected to increase by 10-40 percent at high latitudes and in some wet tropical areas. The frequency of heavy precipitation events is also likely to increase over most land areas. These changes will result in more flash floods and large-area floods.
- **The intensification of tropical cyclones due to higher sea surface temperatures.** Indeed, there is growing evidence that cyclone and hurricane severity is – above and beyond any natural decadal cycles – already on the rise. Changes in cyclone frequency are less certain.

Since the location of floods and cyclones are unlikely to change much over the next 20-30 years, we used data on their historical distribution as the best indicator of where they will strike during this timeframe. Climate model outputs relating to increased extreme precipitation were also used as a proxy for future flood risk.

Map 3 illustrates the distribution of current flood-risk hotspots around the world (in blue). From a humanitarian perspective, the most significant are located in:

- Africa, including the Sahel, the Horn of Africa, Great Lakes region, Central Africa and Southeast Africa
- Central, South and Southeast Asia
- Central America and the western part of South America

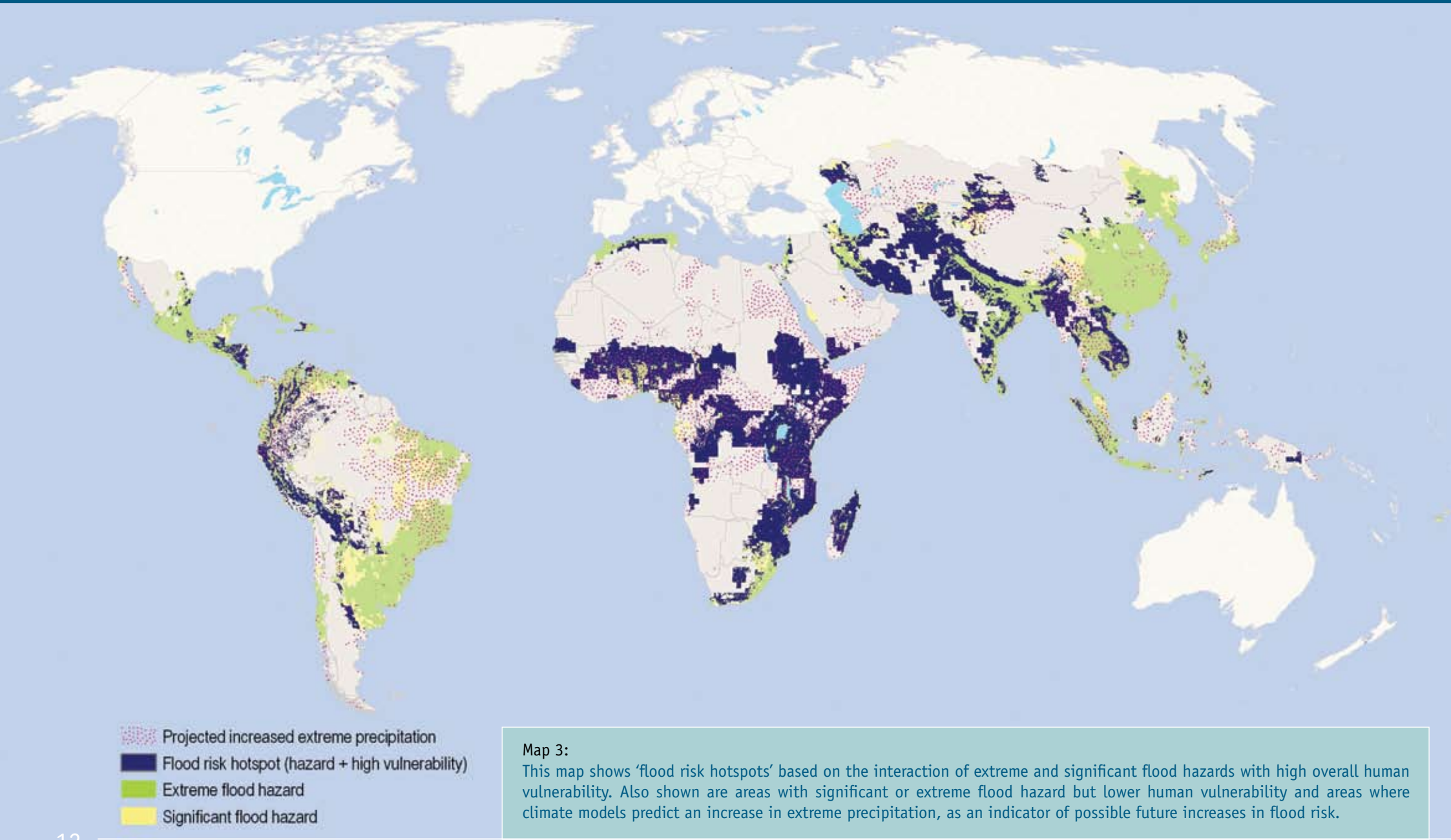
Map 3 also shows areas projected to experience an increase in intensity of precipitation (dotted), as a proxy for greater risk of floods in the future. The most threatening flood-risk hotspots during the next 20-30 years will be in blue + dotted areas.

Map 4 shows a close-up of flood-risk hotspots in East Africa. As in figure 4, current flood-risk hotspots are depicted in blue. Blue + dotted areas signify areas where flood-risks are likely to increase during the next 20-30 years as a result of climate change. Future flood-risk hotspots include the Horn of Africa; the Kenya/Tanzania region; and parts of Madagascar

Map 5 shows hotspots of cyclone risk based on the interaction of high human vulnerability with significant historic and current cyclone hazards. Hotspots of humanitarian risk relating to cyclones are much less extensive than for other climate hazards. They occur mainly in Mozambique and Madagascar, Central America and the Caribbean, Bangladesh, several parts of India, Vietnam and several other Southeast Asian countries.

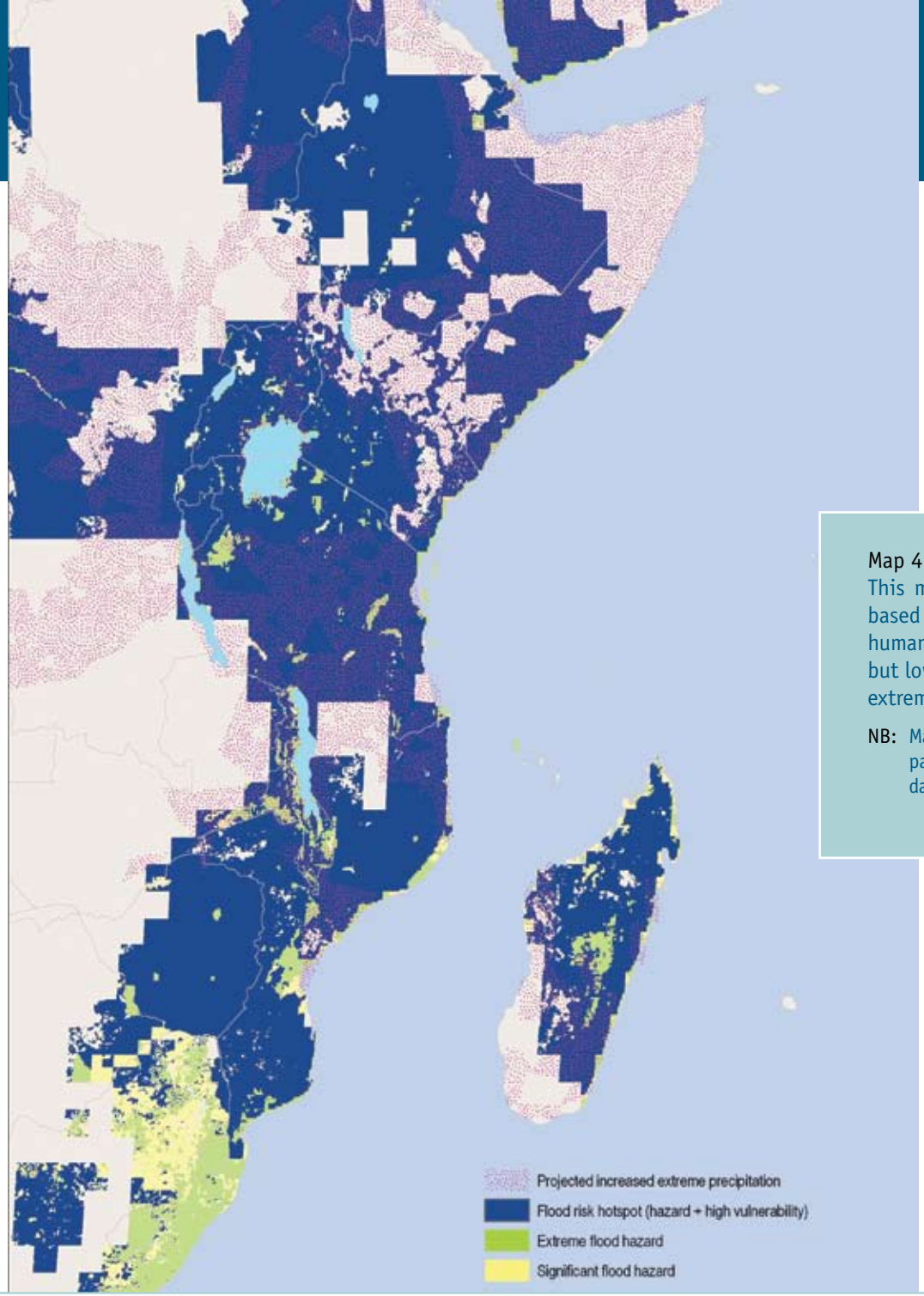
Projections from climate models were not used to identify cyclone-risk hotspots because the effect of climate change on future cyclone distribution is very uncertain.

Flood Risk Hotspots, World



Map 3:
This map shows 'flood risk hotspots' based on the interaction of extreme and significant flood hazards with high overall human vulnerability. Also shown are areas with significant or extreme flood hazard but lower human vulnerability and areas where climate models predict an increase in extreme precipitation, as an indicator of possible future increases in flood risk.

Flood Risk Hotspots in East Africa



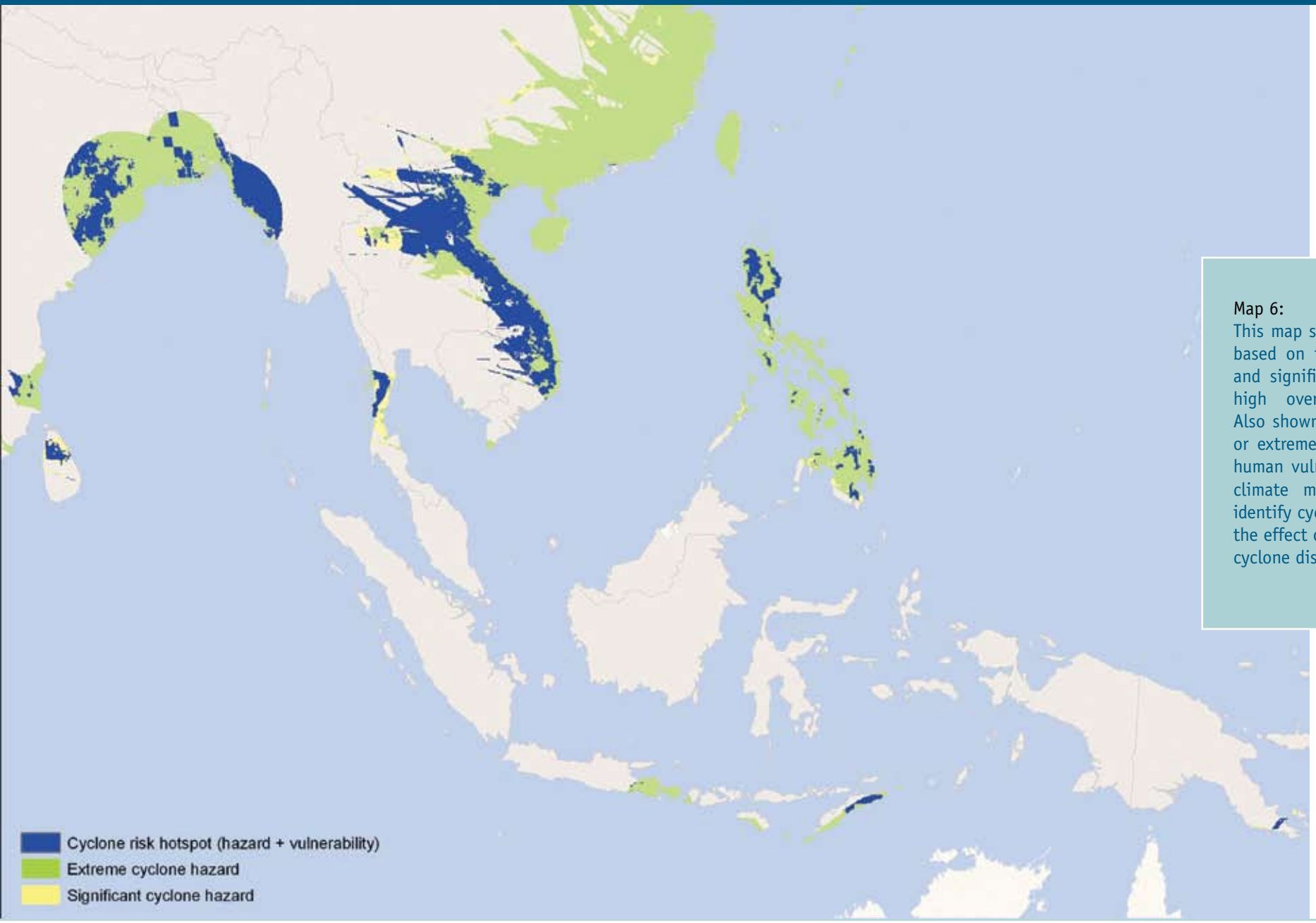
Map 4:
This map shows humanitarian risk hotspots for flooding in the East Africa region based on the interaction of extreme and significant flood hazard with high overall human vulnerability. Also shown are areas with significant or extreme flood hazard but lower human vulnerability and areas where climate models predict an increase in extreme precipitation, as an indicator of possible future increases in flood risk.

NB: Many maps in this report have "blank" spaces. These are areas where gaps in vulnerability parameter datasets preclude reliable mapping. Further details on the limitations of datasets can be found in Ch 1 of the Technical Annex of the original discussion paper.

Cyclone Risk Hotspots, World

Map 5:
This map shows cyclone risk hotspots based on the interaction of extreme and significant cyclone hazard with high overall human vulnerability. Also shown are areas with significant or extreme cyclone hazard but lower human vulnerability. Projections from climate models were not used to identify cyclone risk hotspots because the effect of climate change on future cyclone distribution remains highly uncertain.

Cyclone Risk Hotspots, South East Asia



Map 6:
This map shows cyclone risk hotspots based on the interaction of extreme and significant cyclone hazards with high overall human vulnerability. Also shown are areas with significant or extreme cyclone hazard but lower human vulnerability. Projections from climate models were not used to identify cyclone risk hotspots because the effect of climate change on future cyclone distribution is very uncertain.

Food and water

This section of our report identifies hotspots of high humanitarian risk due to drought hazards.

During the next 20-30 year period, it is unlikely that we will see significant changes in where droughts occur. However, we are likely to see:

- Widespread changes in the amount of annual and seasonal rainfall
- Shifts in the timing of rainfall
- Longer dry periods in many parts of the world
- An increase in the number, intensity and duration of droughts
- An expansion of areas currently affected by drought

These changes will contribute to water stress, land degradation, lower crop yields and increased risk of wild fire. The consequences, including food and water shortages, could be severe.[17] Indeed, the number of people impacted by water scarcity is projected to increase from 1.7 billion in 2000 to around 5 billion by 2025. Climate change will account for roughly 20 per cent of this growth.[18]

In some parts of the world, the reduction in water availability combined with a shift in rainfall could reduce agricultural yields by more than a third by 2050.[19] This threatens millions of rural livelihoods – especially in regions where productivity is already marginal.

The skyrocketing price of cereals and grains we have seen during the past two years are due to several factors, such as rapidly growing populations, changing consumption patterns, climatic shocks (floods and droughts), rising oil prices and policies encouraging the conversion of food crops into transport fuels.[20] Unless these dynamics change, food prices will continue to climb and contribute to the widespread food insecurity that has triggered riots in Egypt, Ethiopia, Haiti, Indonesia, Mexico and the Philippines.21[u]

Future droughts are likely to take place against such backdrops of widespread water scarcity and food insecurity.

Map 7 illustrates the distribution of current drought-risk hotspots around the world (in blue). From a humanitarian perspective, the most significant are located in:

- Large areas of sub-Saharan Africa
- South Asia, particularly Afghanistan, Pakistan and parts of India
- South East Asia, particularly Myanmar, Vietnam and Indonesia

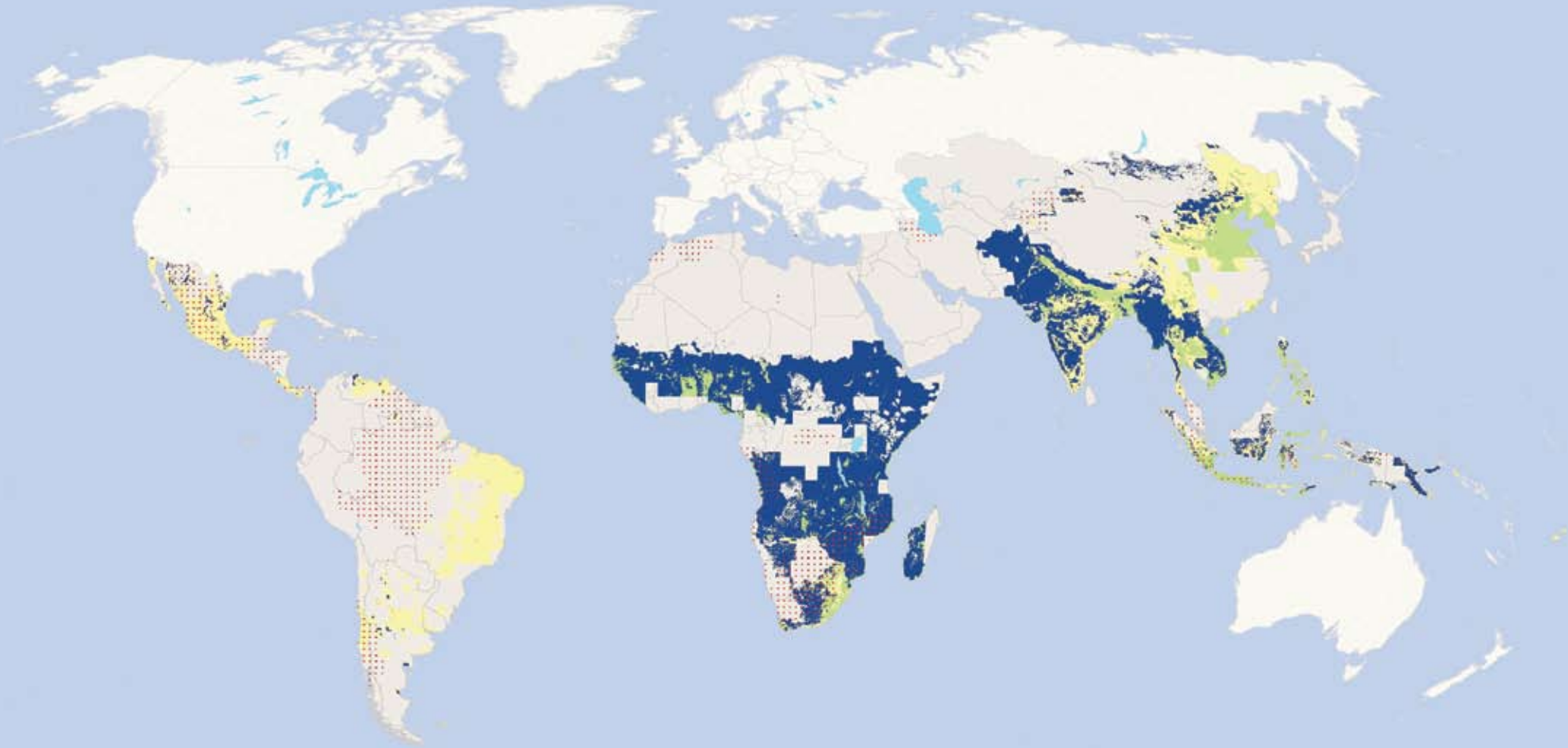
Map 7 also shows areas projected to experience an increase in dry periods as a proxy for greater drought-risk in the future (dotted). The most threatening drought-risk hotspots during the next 20-30 years will be in blue + dotted areas.

Map 8 shows a close-up of sub-Saharan Africa. As in Figure 8, current drought-risk hotspots are depicted in blue. Blue + dotted areas, like those in Mozambique and Zimbabwe, will be the hardest hit by climate change. In contrast, parts of Botswana and Namibia are expected to experience an increase in dry periods but are not considered drought-risk hotspots due to low or moderate levels of human vulnerability.

A major concern is how chronic conditions – e.g. higher temperatures and less rainfall – associated with climate change will affect human vulnerability. They may transform areas of only moderate human vulnerability into areas of relatively high human vulnerability. Examples include Botswana and Namibia, but the principle applies to other parts of the world as well – including most of Central America.

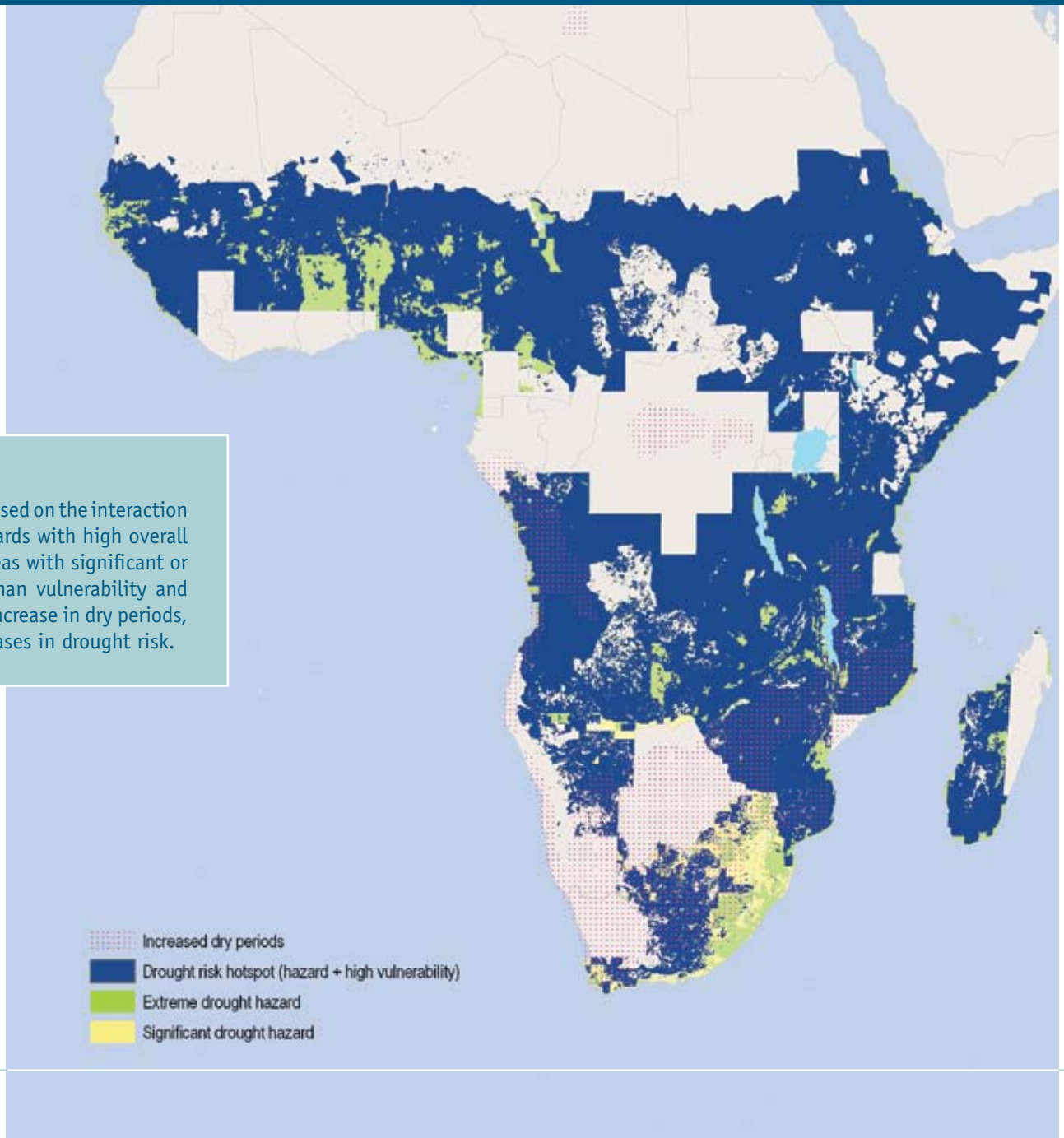
To the extent that this occurs, climate change may trigger the dramatic proliferation of drought-risk hotspots.

Drought Risk Hotspots, World



Map 7:
This map shows humanitarian risk hotspots for drought based on the interaction of extreme and significant drought hazard with high overall human vulnerability. Also shown are areas with significant or extreme drought hazard but lower human vulnerability and areas where climate models predict an increase in dry periods, as an indicator of possible future increases in drought risk.

Drought Risk Hotspots, Sub-Sahara Africa



Map 8:
This map shows 'drought risk hotspots' based on the interaction of extreme and significant drought hazards with high overall human vulnerability. Also shown are areas with significant or extreme drought hazard but lower human vulnerability and areas where climate models predict an increase in dry periods, as an indicator of possible future increases in drought risk.

Population and displacement

This section of our report shows humanitarian risk hotspots in relation to current population and projected changes in population during the next 10 years.

Map 9 combines flood, cyclone and drought risk hotspots with a standard population density map. Results suggest the relative number of people that could be affected by weather-related hazards (blue=highest, yellow=lowest). The threat is largest in South and Southeast Asia, as well as parts of Africa.

Populations affected by these intensifying hazards may come under substantial pressure to migrate, at least temporarily. Prolonged droughts, arguably, exert the greatest pressure on households to move – particularly from rural to urban areas. In the Horn of Africa alone, there are more than 20 million pastoralists whose livelihoods center on the search for increasingly scarce pasture and water.

Map 10 shows an overlay of hazard hotspots on a population density change map. The base map shows areas where population density is projected to increase (blue) and where these areas coincide with humanitarian risk hotspots. Such areas could present increased humanitarian risks in the future as more people become exposed to climate hazards. They include parts of South and Southeast Asia, as well as some areas of Africa.

Conflict and climate change

The relationship between climate change and conflict is complex. In some parts of the world, climate change is contributing to socio-political tensions *but only as one factor amongst other, more immediate environmental triggers like water shortages, food insecurity and land degradation*. A combination of conditions – including poverty, inequality and poor governance – is typically required for tensions to erupt in outright conflict.

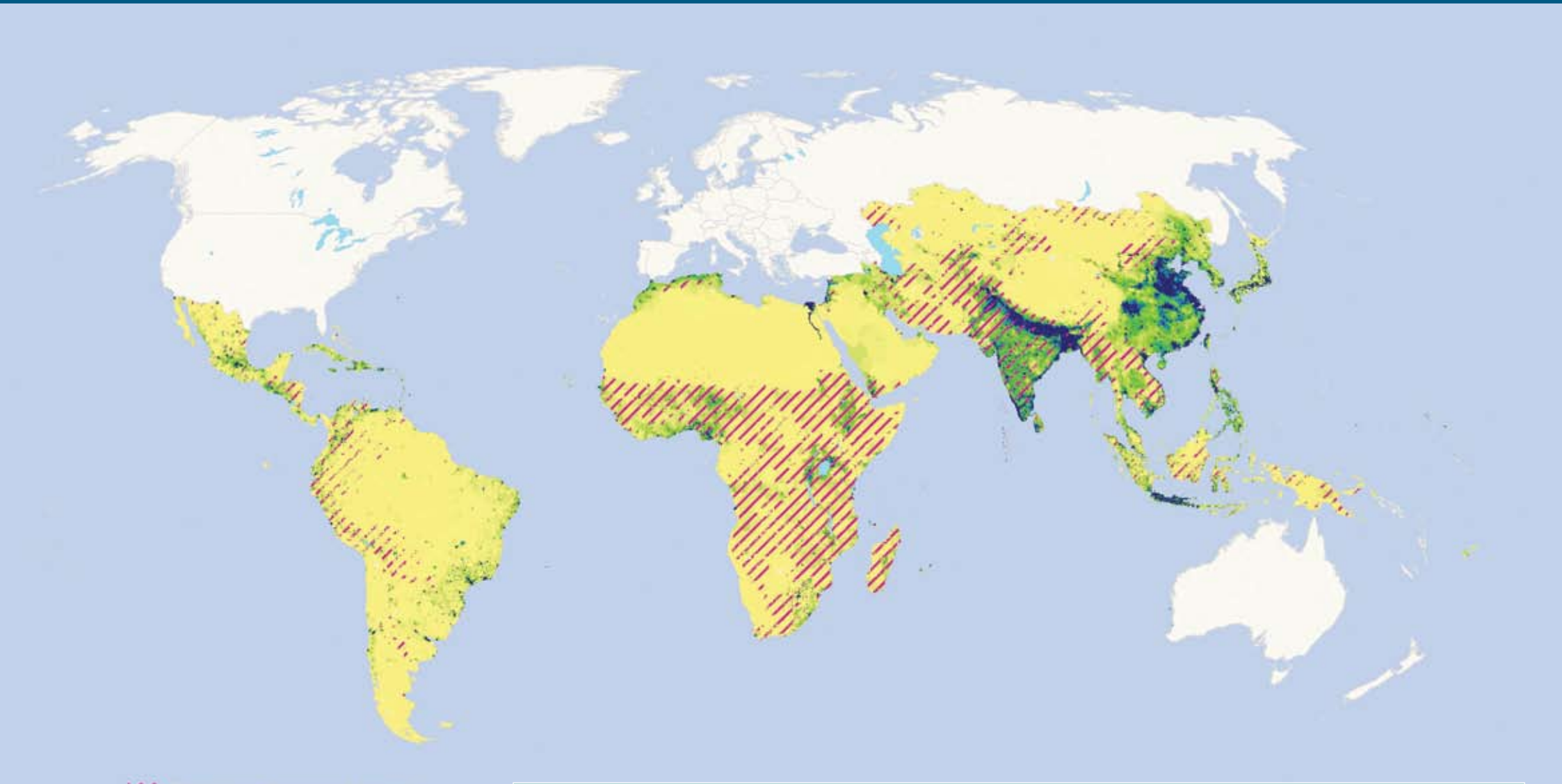
There are compelling cases in which environmental stresses, perhaps exacerbated by climate change, have already contributed to conflict. The crisis in Darfur is probably the most frequently cited example.[22] However, in this and other instances, environmental considerations are only partly to blame.

It is beyond the scope of this study to provide a robust analysis of how climate change interacts with other factors to cause conflict. Nonetheless, it is important to recognise that a range of climate-related shocks and stresses can raise the risk of conflict.[23] We consider drought, with its implications for water shortages and food insecurity, the most significant weather-related hazard contributing to conflict. Map 11 shows where drought-risk hotspots intersect with areas already considered to be at high and extreme risk of conflict.

According to the map, climate change raises the risk of conflict in south Asia and parts of central and east Africa. However, during the next 20-30 year period, the additional degree of risk resulting from climate change is uncertain and probably not substantial.

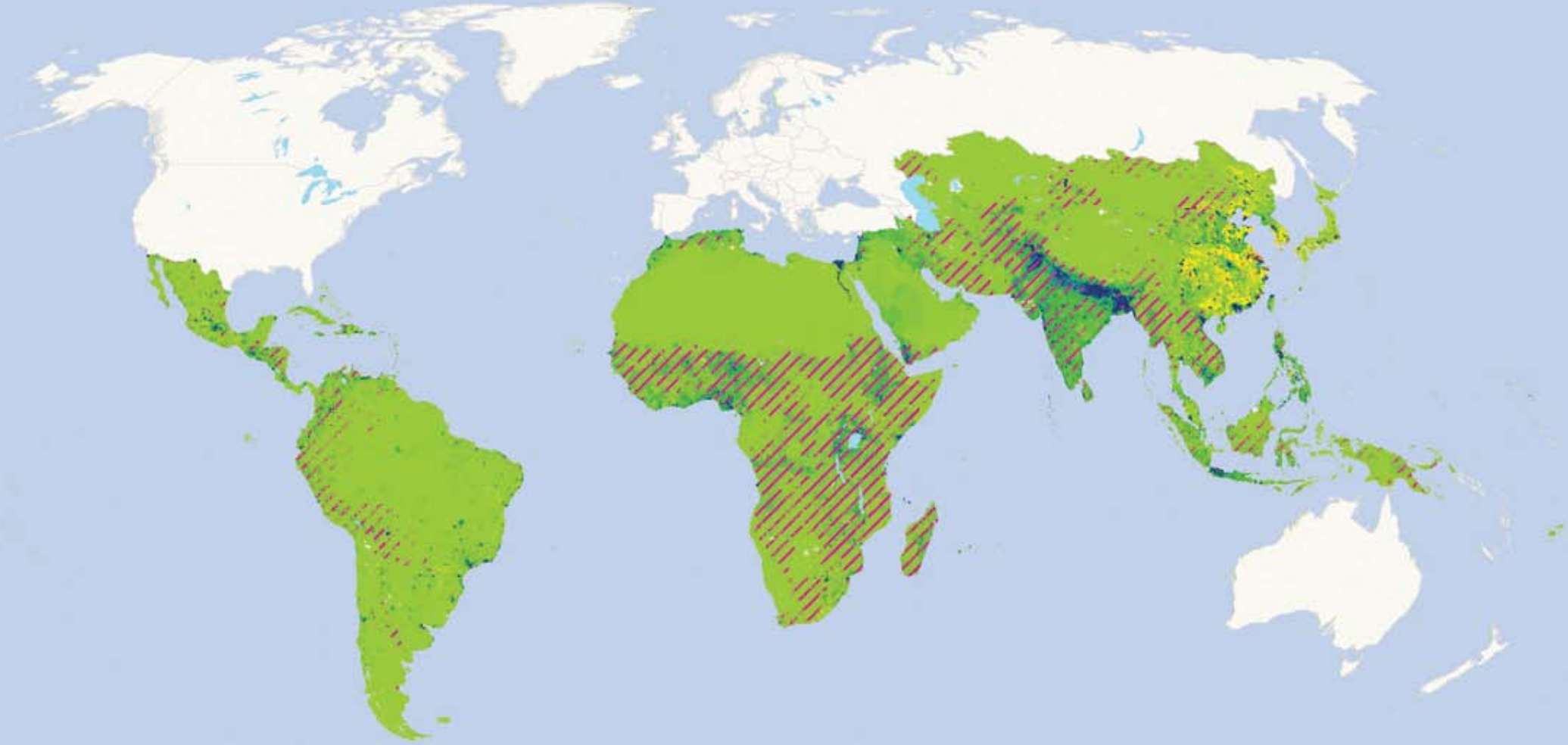
During this short timeframe, it will be more important to understand and address how conflict undermines societies' capacity to adapt to climate change.

All Hazard Hotspots/Population Density



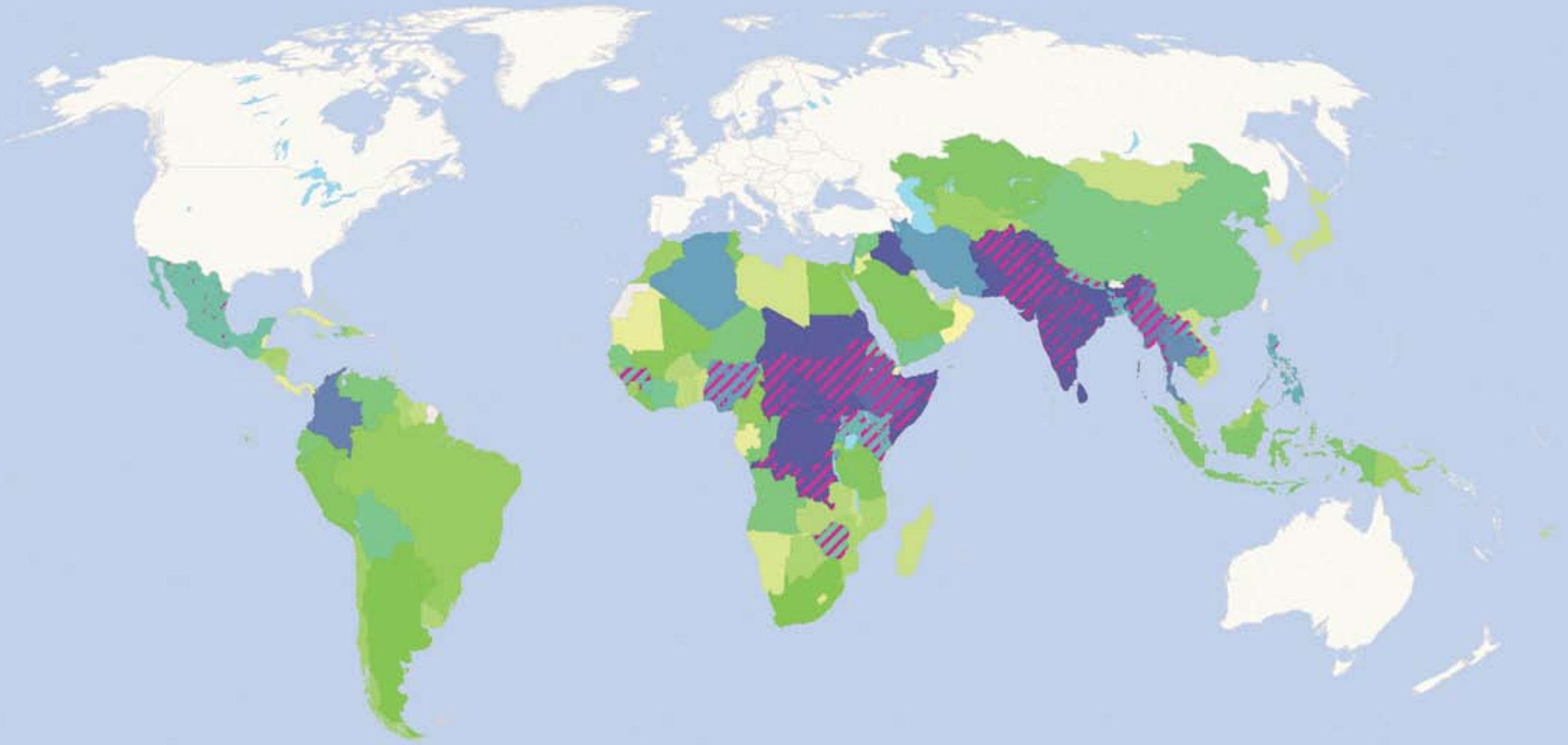
Map 9:
This map shows hotspots of humanitarian risk for floods, cyclones and drought (combined) overlaying a population density gradient. Blue areas with striped overlay represent areas of high population density that are also risk hotspots. These areas are at higher risk of future *population displacement* as a result of climate hazards.

All Hazard Hotspots/Population Density Change



Map 10:
In this map blue areas with striped overlay represent areas of predicted population density increases that are also risk hotspots. These areas will require greater humanitarian assistance in the future as more people are exposed to increasingly intense and/or frequent climate hazards.

Drought Hotspots/Conflict



Map 11:
The base map shows an index of conflict risk. The striped areas of the map represent areas where drought risk hotspots coincide with high and extreme conflict risk. These areas are interpreted to be at relatively higher risk of climate-related conflict. However, over the timeframe of this analysis the risk of additional humanitarian response being required as a result of climate change induced conflict is not considered much higher than from conflict in general and is very uncertain.

6 Key conclusions

The challenge

- By combining current and historical data sets with climate change models, we can make reasonably certain projections about the nature of floods, droughts and cyclones during the next 20 to 30 years.
- As a useful rule of thumb, areas already affected by weather-related hazards will see an increase in their frequency and/or intensity. There will also be an expansion of areas already affected by drought, floods and cyclones.
- Even though weather-related hazards will get worse during the next 20 to 30 years, people's declining capacity to cope with hazard events may be a greater problem.
- There is a growing gulf between countries able to invest in risk reduction and preparedness, and those unable to take their first steps on the risk reduction ladder.
- Map 12 shows projected hotspots of humanitarian risk during the next 20 to 30 years.
  - *Flood-risk hotspots* occur in Africa, including the Sahel, the Horn of Africa, Great Lakes region, Central Africa and Southeast Africa; Central, South and Southeast Asia; and Central America and the western part of South America.
  - *Cyclone-risk hotspots* occur largely in Mozambique and Madagascar, Central America, Bangladesh, parts of India, Vietnam and several other Southeast Asian countries.
  - *Drought-risk hotspots* are mainly located in sub-Saharan Africa; South Asia, particularly Afghanistan, Pakistan and parts of India; and South East Asia, particularly Myanmar, Vietnam and Indonesia.
- Several parts of the world are at high risk from more than one weather-related hazard. They warrant special concern and attention. The distribution of multiple-hazard hotspots is shown in Map 13. They include much of sub-Saharan Africa, especially the east coast, and much of South Asia.
- There are some areas that are risk hotspots for all three hazards analysed. These include Southeast Africa and parts of South and Southeast Asia.
- As the frequency and intensity of hazards increases, so too will the number of temporarily displaced people and those seeking new, long-term homes. Displacement will be most pronounced where worsening hazards coincide with high or increasing population density. The areas most likely to face migration pressures are South and Southeast Asia, as well as parts of Africa. Much of this will be rural to urban migration.
- Through extremely complex interactions between environmental, social and political factors, climate change can play a part in triggering or exacerbating conflict. Risks are especially acute in drought prone parts of the world. This analysis identifies areas of Central and East Africa and South Asia as being at relatively higher risk of climate-induced conflict.
- Disasters pose a serious threat to prospects for achieving the Millennium Development Goal of halving extreme poverty by 2015.[24] As well as destroying livelihoods and infrastructure, disaster losses can aggravate financial, political,

social and environmental problems, making it difficult for many countries to meet a wide range of development goals. This is particularly true for lower income countries, where economic losses from disasters can have the highest proportional impact on GDP.

- The immediate consequences of increasingly frequent and/or intense extreme weather are bad enough, but these shocks can also reinforce larger, long-term problems.[25] For instance, studies have repeatedly found that women and other marginalised social groups suffer more during disasters and find it harder to bounce back afterwards.[26] As such, climate change threatens to exacerbate social inequalities.

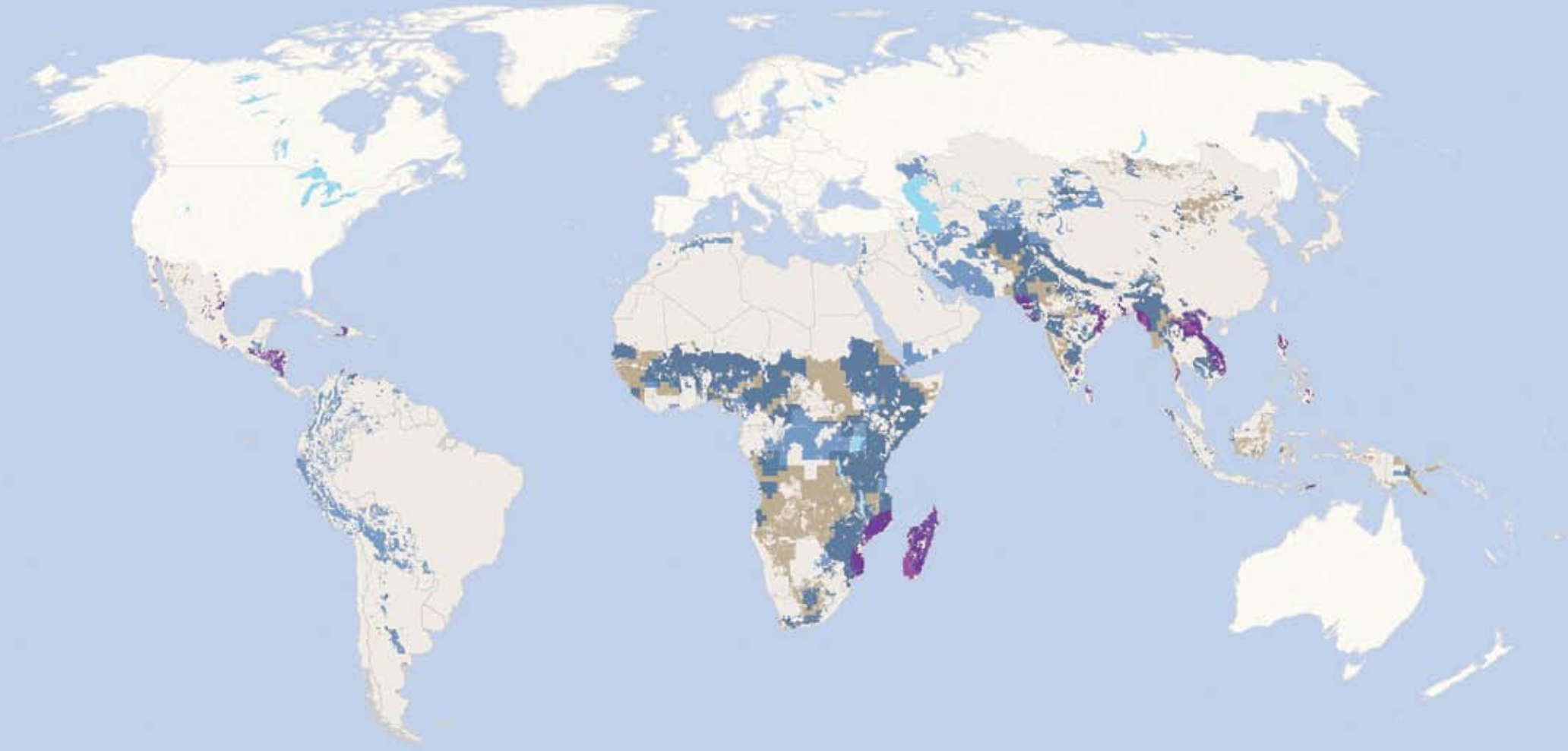
The response

Only a multi-pronged approach can counter the powerful challenges posed by climate change. This must include:

- **Greater investment in disaster preparedness and response.** The humanitarian community has to become better at dealing with both quick and slow-onset disasters. This implies a need for more flexible disaster response capacity since climate change increases the uncertainties surrounding where, when and how disasters unfold. The results need to be assessed in terms of response-time, but also improvements in quality and accountability.
- **Action to reduce disaster risks and strengthen disaster resilience.** During the next 20-30 year period, the focus should be on areas that are already risk hotspots. The most effective interventions will concentrate on reducing vulnerability, especially of people in marginalised social groups. Appropriate activities include:
  - *Increasing access to essential services* (like health and education) and long-term social protection systems.
  - *Strengthening the capacity of local actors*, particularly government at all levels, to better understand the nature of risks they may face and to take appropriate action to reduce vulnerability.
  - *Empowering local populations* to have a strong role and voice in emergency preparedness, response to disasters and subsequent recovery and rehabilitation.
  - *Improving the accountability of governments and service providers* to populations affected by disasters.

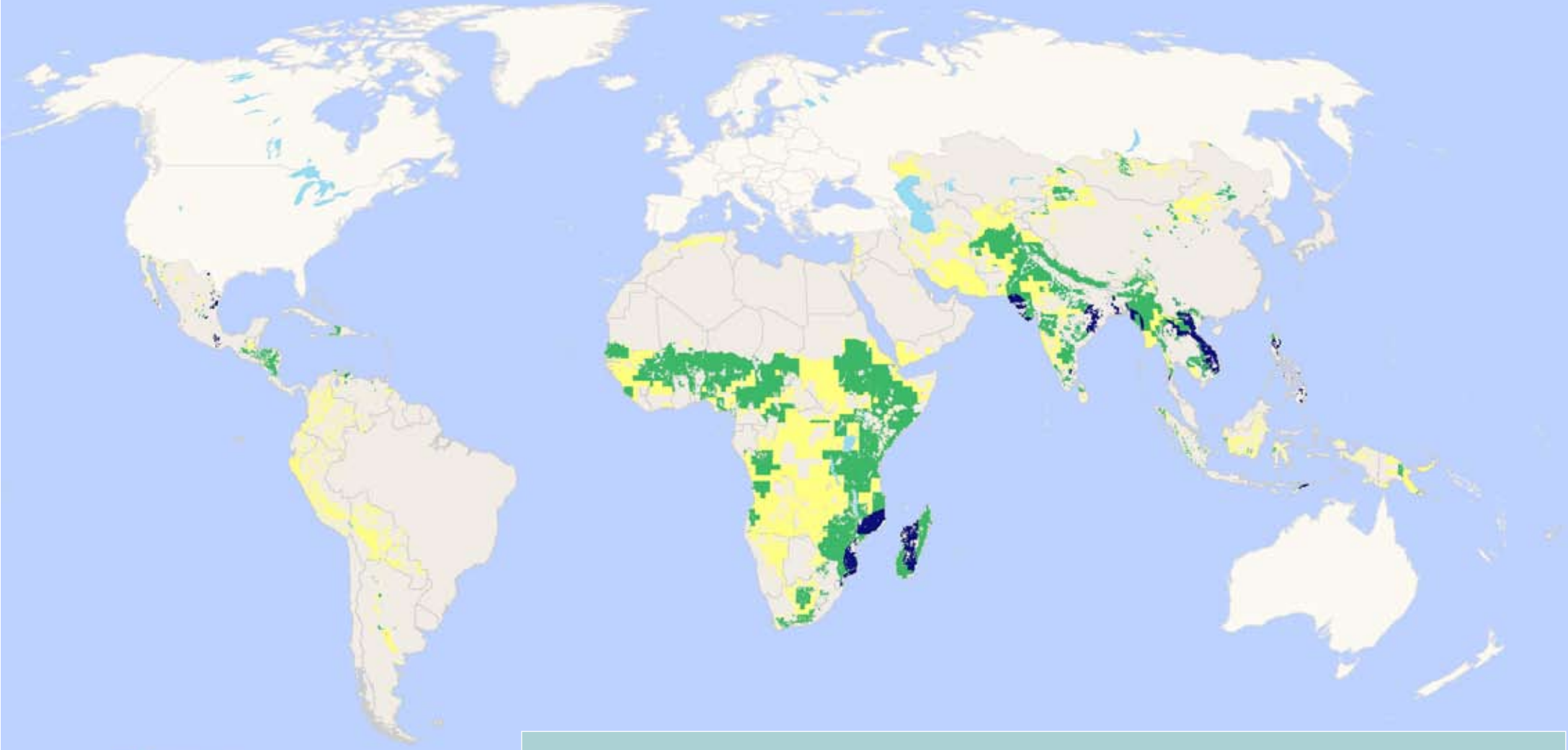
CARE worker Cesar Enriquez distributes goods to those living in the San Isidro displacement camp in San Julian, Bolivia. Extensive rains caused flooding in Bolivia's highlands and the Amazon basin in January 2006, forcing many residents into displacement camps.

All Hazard Hotspots



Map 12:
This map combines humanitarian risk hotspots for the three major climate-related hazards studied – flood, cyclones and drought. Risk hotspots are defined as areas where high human vulnerability coincides with the distribution of weather-related hazards. Risk hotspots are indicated in transparent layers to show where they overlap.

All Hazard Hotspots (Cumulative)



Map 13:
This map shows cumulative humanitarian risk hotspots for all three climate-related hazards studied - floods, cyclones and draught. Areas at risk for more than one type of hazard are considered to be of most concern for humanitarian actors.

Citations and notes

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Dhaka Bangladesh, South Asia Floods, August 2004. As part of its emergency response CARE distributed daily rations of food to 1200 flood victims. © 2004 Josh Estey/CARE

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New influx of Somali refugees in the Northeastern province of Kenya, Dadaab refugee camps near the border with Somalia. It is estimated that 270,000 refugees live in camps.

www.careclimatechange.org