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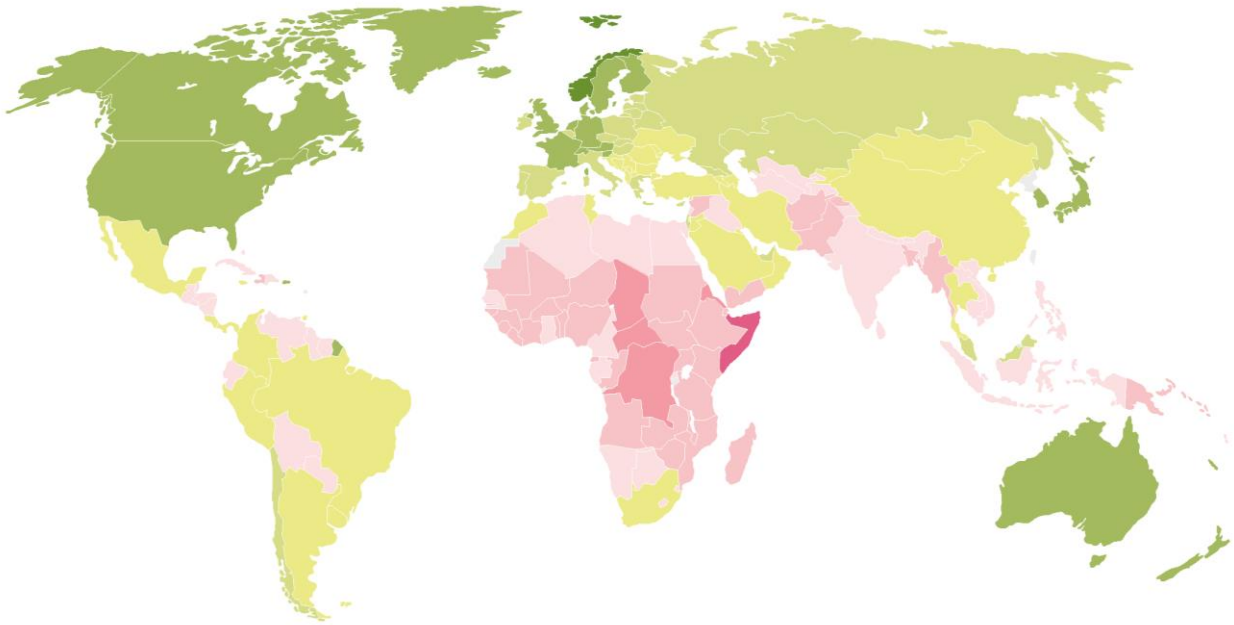
SDC Climate change foresight analysis

Global and regional risks and hotspots

Zürich, 21 February 2020

Myriam Steinemann, Madeleine Guyer, Judith Reutimann, Bettina Rüegge, Jürg Füssler



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Editorial Information

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1. Background and aim of the climate change foresight analysis

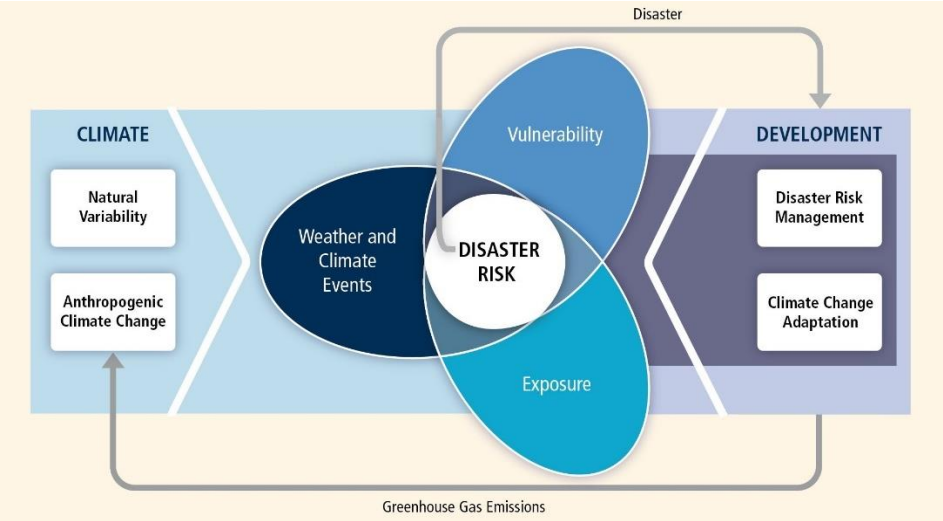
The Global Programmes Climate Change & Environment and Food Security together with representatives of humanitarian aid, south cooperation and east cooperation embarked on a strategic reflection on how SDC should increase its efforts to contribute to climate resilience in its working areas and to make its interventions fit for coping with climate change risks. One of the results of the reflection was the articulation of the need of a climate change foresight (cc foresight) analysis.

The cc foresight provides the SDC directorate and SDC units with information about short- and medium-term climate-related risks that might influence the programme and strategic work of SDC, and analyses these risks with regard to water, food, health and regional stability with a focus on short- and medium-term projections of 1–3 years.

2. Current global risks and hotspots

Climate-related risks and hotspots are a result of a combination of climate change and variability, exposure and vulnerabilities of people and ecosystems and their ability to address those risks (readiness, adaptive capacity, etc.). The risk definition used for the cc foresight is based on the IPCC Risk framework (Figure 1):

Figure 1: IPCC Risk framework

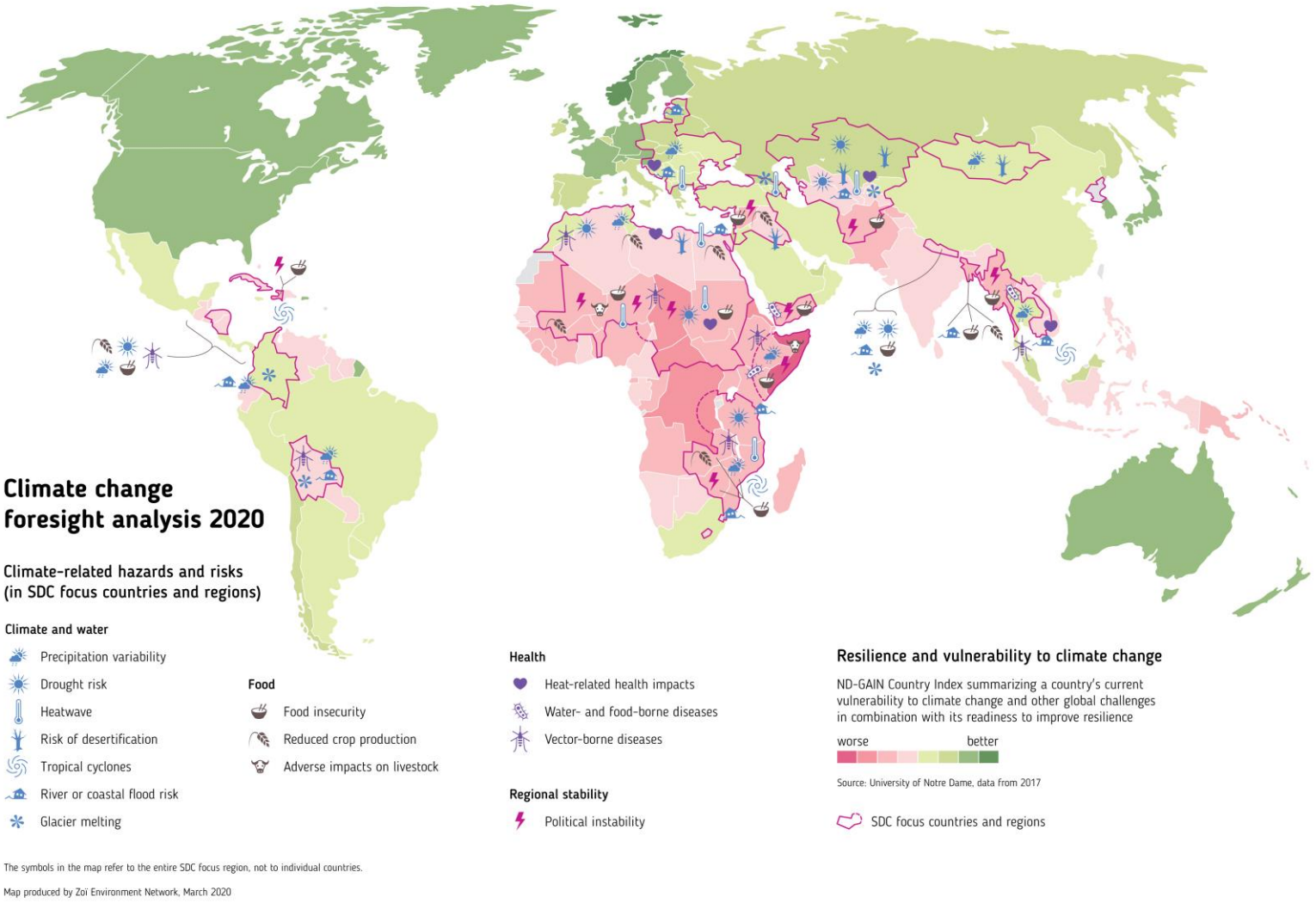


Source: IPCC 2012, SREX

Figure 2 gives an overview of the current climate-related risk situation in the world, based on the ND Gain Index. The ND Gain Index measures vulnerability including exposure in life supporting sectors – food, water, health, ecosystem services, human habitat and infrastructure – on the one hand, and economic, governance and social readiness on the other hand.[1] The map in Figure 2 indicates the most relevant hazards and related impacts in SDC focus countries and regions identified in this analysis.

[1] There are several other compound indexes estimating climate-related risks and/or vulnerabilities, e.g. the Climate Risk Index by Germanwatch (refer to Annex 4). ND Gain was chosen for this analysis due to its comprehensive approach covering all relevant life supporting sectors.

Figure 2: Global overview of climate-related hazards and risks



Hotspots with high climate-related risks are identified in large parts of sub-Saharan Africa (in particular the Horn of Africa and parts of the Sahel region), Syria, Yemen, the Hindu Kush, Bangladesh, Myanmar and Haiti. Those areas show interlinkages between various climate-related and non-climatic stressors, and a high vulnerability in all life-supporting sectors. The analysis of areas with currently high climate-related risks observes the following.

- **Arid and semi-arid areas** are extremely vulnerable to climatic trends. Where agriculture (crops or livestock) is the predominant livelihood activity, food systems entirely dependent on rainfall, and to a lesser extent irrigation-based systems, in water scarce areas are at risk. Such conditions can be found in large parts of the world, in particular in the Sahel region, in large parts of East and Southern Africa, the Middle East and North Africa, Central Asia and Central America.
- **Low-lying coastal areas and cities** are prone to coastal hazards and sea level rise. Given the high population densities in many coastal areas and growing urban populations, exposure and hence the risks are particularly high and increasing. This is the case for Bangladesh, coastal areas of Myanmar, parts of East and Southern Africa (Mombasa, Dar-es-Salaam, Maputo), the Nile delta in Egypt and Haiti.
- **High mountain areas and downstream areas** where the role of the cryosphere is important for water resources are strongly affected by glacier melt. As melt rates increase, run-off will also increase until a certain point – peak water – when the glacial mass is reduced to such a degree that run-off will start to decline. Peak water has likely already been reached in the Caucasus and parts of the Andes and is a future concern in Central Asia (the Syr Darya and Amu Darya rivers are mostly fed by snow melt and glacier melt) and the Hindu Kush.
- **In regions affected by compound or sequential events** – such as severe drought followed by extreme rainfall or the sequential occurrence of several hurricanes – risks are particularly high. Compound or sequential events cause extreme impacts in natural and human systems. Droughts followed by floods were reported in the last two years in parts of East and Southern Africa (Sudan, Somalia, Burundi, Madagascar, Mozambique, Malawi, Eswatini, Djibouti, Zambia and Zimbabwe) and in Syria in 2018. In March and April 2019, Mozambique was hit for the first time by two major tropical cyclones in the same season (*Idai*, *Kenneth*). In 2017, the above-average hurricane season led to the sequential occurrence of Hurricanes *Harvey*, *Irma* and *Maria* on the Caribbean and southern US coasts (IPCC SROCC 2019).
- **Countries with persisting conflicts** often have high climate-related risks, given that climate has complex interaction with various drivers of conflicts and instability (water scarcity or food insecurity). High political instability may further affect people's ability to cope with possible future climate shocks. Conflicts persist in Yemen and Syria and to minor extents in parts of the Sahel (Lake Chad Basin, Central Mali).

- **Long-term unsustainable resource management practices**, overuse of scarce land and water resources, environmental degradation and increasing demand due to population growth are putting pressure on natural systems and are strongly influencing current climate-related risks. In almost all regions with high climate-related risks, non-climatic drivers have a stronger effect on current risks than climate variability and change. Examples include the drying out of the Aral Sea, large-scale deforestation in the Amazon region or the depletion of aquifers in the Middle East and North Africa (MENA) region.

3. Future global risks and hotspots

Assessing short- and medium-term climate-related risks is challenging, as no specific weather or climate predictions can be made with a time horizon of 1–3 years (see Annex 2 for methodological details). Nevertheless, some estimates about short- and medium-term risks can be made by analysing current risks and developments.

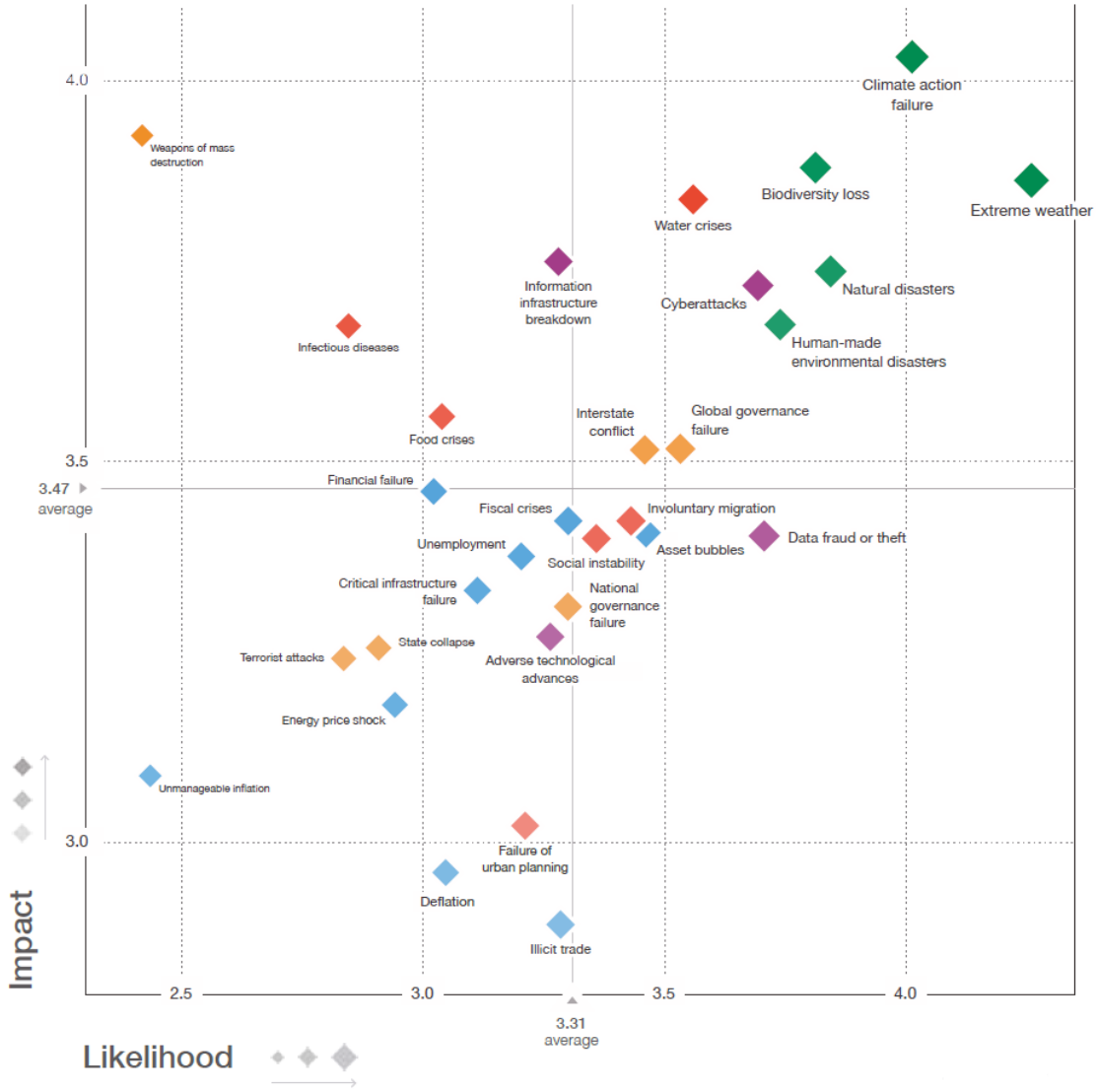
Short- and medium-term risks are dominated by the current risk landscape

Climate risks are a result of the combination of climate hazards, exposure and vulnerability (Figure 1). While the climate signal – the occurrence of climate hazards or events in the next 1–3 years – is uncertain, exposure and vulnerabilities as key determinants of risk either do not greatly change from year to year or the changes are more predictable. Furthermore, non-climatic drivers have a stronger effect on current and short-term future risks than climate variability and change. Hence, we can assume that the current risks and hotspots strongly influence the risk situation in 1–3 years.

Perception of risks is an indicator for potential upcoming risks

The perception of risks has a forward-looking perspective, as it gives an indication of risks or threats that are likely to occur in upcoming years. Environmental risks dominate the results of the World Economic Forum Global Risks Perception Survey for the fourth year in a row. In 2020, for the first time in the history of the Survey, environmental concerns dominate the top long-term risks by likelihood, and three of the top five risks by impact are also environmental (Figure 3).

Figure 3: Global Risk Landscape 2020



Source: WEF 2020

The latest survey shows that climate action failure and extreme weather were the risks of greatest concern. Other topics with strong connections to climate conditions such as natural disasters or water and food crises rank increasingly high in terms of impact and likelihood. As environmental risks occur with increasing frequency and severity, the impact on global value chains is likely to intensify, weakening overall resilience.

Severe impacts of current extremes are affecting risk in the short term

While past or current climate extremes or variability do not necessarily influence the situation in 1–3 years, there is evidence that past or current extreme events with severe impacts have

implications for short-term risks. Extreme climate events push a system to near or beyond the ends of its normally observed range. Extremes can be very costly in terms of loss of life, ecosystem destruction and economic damage (IPCC 2019 SROCC), and have long-term effects as they increase vulnerability in upcoming years and decrease the ability to cope with future shocks. Droughts and droughts followed by flood in the Sahel and in parts of East and Southern Africa in 2018 and 2019 decimated livestock and destroyed farmland, negatively affecting people's livelihoods for several years. In Haiti, hurricanes such as *Dorian* in 2019 affected the recovery process from previous events. Two major cyclones in Mozambique in March and April 2019 may also have long-term negative effects.

Gradual changes continuously increase risk

For changes related to slow onset events such as sea level rise and glacier retreat, we can interpolate the same or faster pace in the future, and implications for 1–3 years out are very likely. Hence, gradually increasing risks are likely in low-lying coastal areas and high mountain and downstream areas where water resources depend on the cryosphere (see chapter 2).

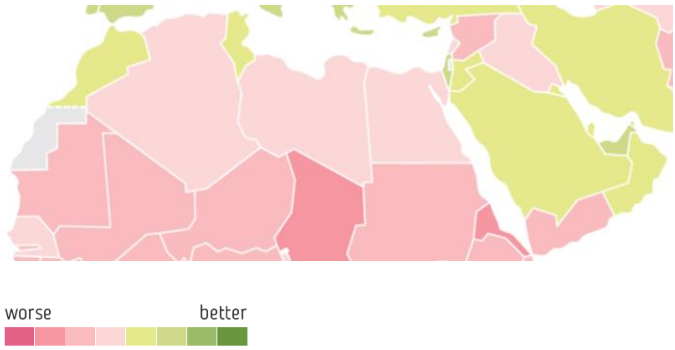
El Niño is an important driver of climate variability

El Niño is the most important driver of climate variability and can trigger extreme weather events and disasters in various parts of the globe.[2] Many of the vector-borne and waterborne diseases in several regions are sensitive to changes in weather patterns brought about by the El Niño phenomenon. New models allow forecasting an El Niño event about one year ahead, but not its duration and strength.

[2] The El Niño Southern Oscillation (ENSO) is a natural variation of the circulation pattern in and over the Pacific Ocean, with strong impacts on the meteorological conditions on a global level. El Niño events cause intense rainfall over Ecuador and Peru and wet conditions in Central America and the Caribbean and at the same time unusually dry conditions in Australia and Indonesia and droughts in East and Southern Africa.

4. Regional risks and hotspots

4.1. Middle East and North Africa



Source: ND Gain 2019

The overall climate related risks are mostly medium to medium high in the Middle East and North Africa North and high in Syria and Yemen where civil war and conflicts dominate the overall risk situation. Potential hotspots where the risks are already high, and the situation has worsened in the past few years are Yemen, Syria, Libya and Lebanon (ND Gain 2019).

Climate Change

Precipitation changes, droughts and heatwaves are increasingly affecting the region. Coastal hazards and sea level rise are a concern for low-lying coastal cities and densely populated coastal areas of the Mediterranean. Observed trends are likely to increase.

Climate: Past and ongoing development	Climate: Trends
Precipitation decrease: Over the last few decades the northern regions of North Africa have experienced a strong decrease in the amount of precipitation received in winter and early spring (IPCC 2014). Decreasing trends are also observed in some parts of the Middle East. In 2018 and 2019, mostly average precipitation amounts have been registered in the MENA region, hence no precipitation deficits have been observed (WASP index 2019).	A reduction in rainfall over many of the MENA countries (especially in the North African Mediterranean) is very likely by the end of the 21st century (IPCC 2014, Lange 2019). No projections can be made for a 1–3-year period.
Droughts: Long-term trends in drought indicate higher frequency and intensity of drought in North Africa and the Middle East (IPCC SRCCL 2019). The drought risk resulting from the interactions between probability of a drought event, the number of people in drought-prone areas and vulnerability is medium high or high in most of the region, especially in densely populated coastal areas (ERCC, DG ECHO 11/10/19).	The likelihood of droughts is expected to increase with decreases in precipitation, but no projections can be made for a 1–3-year period. With ongoing population growth in drought-prone areas, however, the drought risk is likely to increase in the short term.
Summer warming and heatwaves: In recent decades, North African trends in mean near-surface temperatures indicate an overall warming that is significantly	Temperatures in North Africa and the Middle East are likely to increase in the future (IPCC 2014). Trends in the number of warm days and the duration of warm

Climate: Past and ongoing development	Climate: Trends
beyond the range of changes due to natural variability. An increase in the frequency of heatwaves has also been observed in North Africa (IPCC 2014). Temperature records have been repeatedly broken in the MENA region in recent years (e.g. heatwave in July 2019).	spells are projected to continue in first half of the 21st century over North Africa. There is high confidence that heatwaves will increase in frequency, intensity and duration into the 21st century in the Middle East and Africa (IPCC SRCCL 2019). Short-term projections of heatwaves are not possible.
Dust storms: The frequency and intensity of dust storms have increased over the last few decades due to land use and land cover changes and climate-related factors in the broader Middle East and the Arab peninsula (IPCC SRCCL 2019).	No projections can be made on dust storms but the factors influencing the occurrence of such storms (land use, land cover changes) are expected to remain important.
Coastal hazards: Flooding, storm surges and sea level rise in the Mediterranean are putting low-lying coastal areas at risk, in particular the Nile delta, which is home to 41% of Egypt's population (IPCC 2019 SROCC). Given the high population density and the concentration of cities in coastal areas, sea level rise increases the risks to habitability of those cities (Lange 2019).	The rate of sea level rise has accelerated, and continues to increase (IPCC 2019 SROCC). Given the ongoing population growth in coastal areas, the risk of coastal hazards is expected to grow continuously.
Population growth and urbanisation: The MENA region has experienced one of the fastest growths in population worldwide and the region is one of the most urbanised regions globally (UNDESA 2017). The highest population densities and the major cities are concentrated along the Mediterranean coast (Lange 2019).	Absolute population numbers are expected to double to about 1.1 billion inhabitants by 2100 (UNDESA 2017).

Food

Climate change in the MENA region adds to the hazards of farming in an already exceedingly dry area of the world. Rain-fed agriculture in North Africa is highly dependent on winter precipitation and would be negatively impacted if total precipitation and the frequency of wet days decline (IPCC 2014). Low yields and a narrow scope for increases in arable area in the MENA region set limits on crop production resulting in a growing dependence on imports for basic food (OCED 2018).

Food: Past and ongoing development	Food: Trends
Agricultural production: Agricultural land and water are scarce in the Middle East and North Africa, and both rain-fed and irrigated land suffer from ongoing degradation caused by wind and water erosion and unsustainable farming practices. Land productivity and average yields of rain-fed crops are low compared to other regions (OECD–FAO 2018). In the last five years, cereal production slightly decreased in North Africa, with reduced production	Climate change is very likely to have an overall negative effect on yields of major cereal crops across Africa (IPCC 2014) and on all farming systems in the MENA region (OECD–FAO 2018). Rain-fed agriculture in northern Africa is highly dependent on winter precipitation and would be negatively impacted by a decline in total precipitation and in the frequency of wet days (IPCC 2014).

Food: Past and ongoing development	Food: Trends
prospects for 2019 due to rainfall deficits, e.g. in Morocco. In the Near East, cereal production remained stable, with some improvements in Syria in 2019 due to well-distributed rainfall (FAO 9/2019).	In the short term, aggregate cereal production in North Africa and the Middle East was forecast to maintain average levels in 2019.
Non-climatic drivers: Human activities in combination with climatic variations have resulted in increased desertification in the region over the past several decades. The MENA region is among those with the highest number of people affected by desertification (IPCC SRCCL 2019). Due to the dry climate, about 40% of the cropped area requires irrigation (OECD–FAO 2018).	With climate change, desertification will increasingly negatively affect the people in the MENA region. Demand for irrigation will most likely increase with drier conditions, putting additional pressure on scarce water resources.
Food prices and food import: Rising food demand and limited land and water resources led to rising import dependence for basic food commodities in the region. Many countries spend a large share of their export earnings on food imports (OECD–FAO 2018) and some governments (e.g. North African countries) provide widespread subsidies on basic food commodities. In the North African countries, food inflation rates eased or remained stable in 2019 (FAO 9/2019). In Yemen, conflict drove significant increases in food prices. In Syria, commodity prices were still seven times higher than the five-year pre-crisis average (FSIN 2019).	High dependency on food imports makes the region potentially vulnerable to adverse climatic conditions in other parts of the world, and may lead to increasing food prices. World agricultural commodity prices are projected to stabilise in 2020 (World Bank 2019). Food prices may further increase in some parts of the region as a result of an economic downturn and currency depreciation (e.g. in Yemen) (FSIN 2019).
Food insecurity: Conflicts and insecurity are driving high food insecurity in Yemen, Syria and Palestine, and among Syrian refugees in the region (Lebanon, Jordan, Egypt). Yemen remained the world's gravest food insecurity crisis in 2018, with 53% of the total population (15.9 million) in urgent need of food assistance. Climate shocks and production shortfalls in 2018 exacerbated the effects of conflicts in Syria (FSIN 2019).	The number of food-insecure people in Yemen in need of urgent action was forecast to increase in 2019, whereas the level was to remain significant in Palestine and Syria. Political crises, insecurity and displacement will restrict food access of vulnerable groups in other parts of the region (Libya, Sahrawi refugees in Algeria) (FSIN 2019).

Water

The MENA region is one of the most water-constrained areas of the world. Water scarcity and overuse of water resources is a concern for the whole region. Climate change will have an overall modest effect on future water scarcity relative to other drivers, such as population growth, urbanisation and agricultural growth (IPCC 2014).

Water: Past and ongoing development	Water: Trends
Water availability: Water resources are subjected to high hydro-climatic variability over space and time (IPCC 2014), such as precipitation deficits and droughts reported in the last few years. The MENA	No specific projections can be made for a 1–3-year period, but climate change will amplify existing stress on water availability in Africa. Several studies point to a future decrease in water abundance due to a range of

Water: Past and ongoing development	Water: Trends
region is one of the most water constrained areas of the world (OECD–FAO 2018).	drivers and stresses, including climate change in northern Africa (IPCC 2014). In the long term (2050), it is estimated that climate change will account for 22% of future water shortages in the region (Droogers et al. 2012).
Water and conflict: Water challenges can compound existing and emerging instabilities and can contribute to unrest and conflict. Failure to address water challenges in the Middle East and North Africa can have significant negative spillover effects both within and outside the region (World Bank 2017).	Conflicts are based on a variety of interconnected causes of which the environment is considered to be one, but rarely the most decisive factor (IPCC 2014). Climate change impacts that intensify competition for increasingly scarce freshwater resources, especially in the context of population growth, are areas of concern (IPCC 2014).
Non-climatic drivers: Water scarcity in the region is driven by population growth, urbanisation, agricultural growth, land use change, over-extraction of water from rivers and lakes and increased reliance on irrigation to meet food demand (IPCC 2014). Water is used at unsustainable rates, with agriculture being the predominant user. Two-thirds of the countries use groundwater at rates exceeding renewable internal freshwater resources and leading to depletion of aquifers. Water is heavily subsidised – about 2% of GDP is spent on subsidies in the MENA region (OECD–FAO 2018)	Increased demand and unsustainable water use are expected to remain drivers of water scarcity in the coming years. Climate change is projected to account for 22% of the increase in future water shortages in North Africa, while socioeconomic factors are projected to account for 78% (IPCC 2014).
Water risks: Current overall water risks – both physical and regulatory (e.g. low access of people to safe drinking water and sanitation) – are high to extremely high in the Middle East and North Africa. (WRI Aqueduct 3.0 2019).	No specific projections can be made for a 1–3-year period, but water stress and water demand are expected to increase in almost all parts of the region (WRI Aqueduct 3.0 2019).

Health

People in the MENA region face a variety of health risks, many of which are exacerbated by the hot and arid conditions and relative water scarcity that generally characterise the region. The region is experiencing a resurgence of several vector-borne diseases that had previously been in decline (World Bank 2014). Impacts of extreme heat are an area of concern given the already very high summer temperatures.

Health: Past and ongoing development	Health: Trends
Heatwaves: High ambient temperatures and heatwaves have numerous health impacts including increased mortality. Recent heatwaves in the MENA region (e.g. in July 2019) led to severe health impacts especially for urban populations.	Given the estimated increase in frequency, intensity and duration of heatwaves negative health impacts are expected to increase in the future. With already high and increasing levels of urbanisation, the number of people exposed to extreme heat stress (due to urban heat island effect) is expected to further increase.

Health: Past and ongoing development	Health: Trends
Vector-borne diseases: Leishmaniasis is endemic in the MENA region and is considered a major public health problem. Outbreaks are reportedly becoming more frequent in Tunisia, Algeria, and Morocco, where the range of the disease has expanded (World Bank 2014).	Rising temperatures and changes in rainfall affect the epidemiology of Leishmaniasis, but no projections can be made for a 1-3-year period.
Foodborne and waterborne diseases: Cholera remains a major public health risk in the region, which has faced regular large outbreaks in recent years as in Yemen, where a major outbreak has been ongoing since 2017 (WHO EMRO 2019, ECDC 2019). The incidence of diarrhoeal disease among children is high in parts of the MENA region where warm weather, inadequate access to drinking water, poor sanitation, and poverty collide (World Bank 2014).	Cholera outbreaks correlate with high temperatures and can follow extreme weather events that disrupt water supplies (World Bank 2014). Such disruptions might be of particular concern in Yemen where the situation is already critical. The risk of diarrhoeal diseases is expected to increase in the MENA region as a result of climate change (World Bank 2014).
Health impacts of dust storms: Growing negative impacts on human health such as damage to the respiratory and cardiovascular systems due to dust storms have been observed in the broader Middle East and the Arab peninsula (IPCC SRCCL 2019).	There is relatively little research on human health impacts of dust storms in the Middle East and North Africa (IPCC SRCCL 2019).

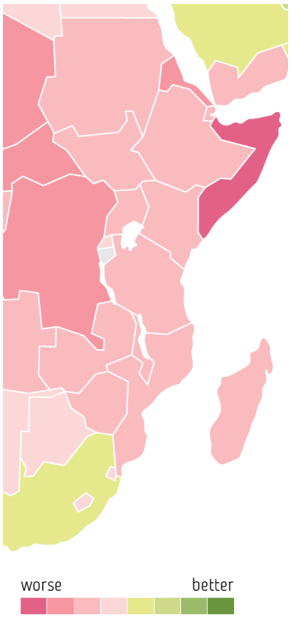
Regional stability

Climate has complex interactions with various drivers of conflict and instability, such as water scarcity or food insecurity, but its exact relevance is unclear. Climate change and climate variability have the potential to exacerbate or multiply existing threats to human security including food, health, and economic insecurity (IPCC 2014). Current instabilities and conflicts in Yemen, Syria and Libya and to some extent in other countries of the region affect people's ability to cope with future climate shocks.

Regional stability: Past and ongoing development	Regional stability: Trends
Fragile states: Yemen, Syria and Libya rank among the most politically unstable and fragile countries in the world. The other countries fall in the category of warning or elevated warning (Fragile States Index 2019).	High political instability may further affect people's ability to cope with possible future climate shocks in parts of the MENA region, which is already highly vulnerable and exposed to adverse climate conditions.
Arab Spring: The uprisings that started in 2010 have resulted in major political, economic and societal transitions, and have frequently been accompanied by armed struggles within MENA countries. These developments and ongoing conflicts render the MENA region a political, military and humanitarian hotspot (Lange 2019). Climate variability has the potential to exacerbate the threats to human security (IPCC 2014). Conflicts are the number one driver of acute	Conflicts are based on a variety of interconnected causes of which the environment is considered to be one, but rarely the most decisive factor (IPCC 2014). As conflicts become more protracted, the resilience and coping capacities of the people caught up in them is eroded (FSIN 2019).

Regional stability: Past and ongoing development	Regional stability: Trends
food insecurity in Yemen, Syria and Palestine (FSIN 2019).	
Migration: A key risk for the region is increased migration leading to human suffering, human rights violations, political instability and conflict (IPCC 2014). Many drivers of migration are climate sensitive, but the potential for migration is determined by the context where climate change occurs (Adger et al. 2015). Syria and Yemen had almost 2 million internally displaced people (IDP) in 2018, the most in the region displaced by violence or insecurity. Disasters triggered around 45,000 new displacements in these two countries (IDMC 2019).	Given the various social, political, economic, environmental and cultural factors influencing the decision to migrate, assessments of future trends in environmentally induced migration are complex. In the short term, ongoing conflict and violence are expected to remain the main drivers of internal displacement in the region.
Economic development: The economic growth rate in the MENA region was projected to slow to 0.6% in 2019 compared with 1.2% in 2018 (World Bank 2019).	MENA's economic outlook is subject to substantial downside risks—most notably, intensified global economic headwinds and rising geopolitical tensions (World Bank 2019).

4.2. East and Southern Africa



Source: ND Gain 2019.

Overall climate-related risk – including vulnerability and readiness to enhance adaptive capacity – is high to very high in the region. Overlapping climate-related and non-climatic stressors are turning the region into one of the most vulnerable and least prepared in the world (ND Gain 2019).

The Horn of Africa region, where weather extremes are exacerbating an already critical risk situation, faces particularly high risks.

Climate Change

Climate-related risks are high in the region as a result of numerous hazards, the severity of multiple stressors and the existing adaptation deficit (IPCC 2014). Further temperature increases, droughts and extreme precipitation changes are likely in some parts of the region and may negatively affect human and natural systems.

Climate: Past and ongoing development	Climate: Trends
Temperature increases and heatwaves: The equatorial and southern parts of East Africa and Southern Africa have experienced a significant increase in temperature since the early 1980s. In Southern Africa, the probability of austral summer heatwaves increased over the last two decades of the 20th century compared to the 1961–80 period (IPCC 2014).	Future projections of temperature show warming trends across East Africa and even more in Southern Africa. Mean land surface warming in Southern Africa is likely to exceed the global mean land surface temperature increase in all seasons (IPCC 2014). The frequency, intensity and duration of heatwaves are projected to increase in many regions.
Extreme precipitation: East Africa has experienced more frequent droughts and heavy rainfall during the last 30–60 years (IPCC 2014). Droughts followed by floods were reported in the last two years in the Sudan, Somalia, Burundi, Madagascar, Mozambique, Malawi, Eswatini, Djibouti, Zambia and Zimbabwe (FSIN 2019).	Rainfall over East Africa is expected to increase and decrease depending on the location and the season, but in in the southern part of the continent rainfall is expected to decrease. No projections can be made for a 1–3-year period. Risks may increase as a result of compound events, such as drought followed by extreme rainfall resulting in flooding. The impacts of such

Climate: Past and ongoing development	Climate: Trends
Heavy rains resulting in flooding and flash floods are affecting 2.5 million people in East Africa, namely in Somalia, Ethiopia, South Sudan and Kenya, with many having been forced to leave their homes (OCHA media update, Nov. 5, 2019).	compound events are not yet well understood (IPCC SRCCL 2019). With a high probability of El Niño by the end of 2020 (Ludescher et al. 2019), the risk of extreme precipitation might increase, as parts of East Africa usually receive above-normal rainfall (e.g. Kenya, Uganda, Tanzania) in El Niño years. The duration and strength of the event cannot be forecasted.
Severe droughts: A continued warming in the Indo-Pacific Warm Pool contributed to more frequent East African droughts over the past 30 years (IPCC 2014). Between 2017 and 2019, extreme and recurrent droughts have been observed in the Greater Horn of Africa (Kenya, southern Somalia, Uganda, southern Ethiopia), in Sudan and parts of Southern Africa (Global Drought Observatory 2019).	Both increases and decreases of rainfall are projected in East Africa depending on location and season, while Southern Africa is projected to become drier with increased drought risks (IPCC 2014). Severe drought events in the past may affect people's ability to cope with future shocks as countries and regions are still recovering from past events. With a high probability of El Niño by the end of 2020, drought risk in Southern Africa might increase. The duration and strength of the event cannot be forecasted.
Coastal hazards: Flooding, storm surges and sea level rise are concerns for low-lying coastal cities in East and Southern Africa (e.g. Mombasa, Dar-es-Salaam, Maputo) (IPCC 2014).	With sea level rise and rapid urbanisation in coastal cities, the number of people at risk is expected to increase in the short and longer terms.
Cyclones: In March and April 2019, Mozambique was hit for the first time by two major tropical cyclones (*Idai* and *Kenneth*) in the same season. Zimbabwe and Malawi were also affected. Effects of individual storms are expected to be larger in places that infrequently experience cyclone activity (Hsiang and Jina 2014). There are large uncertainties whether frequency and intensity of tropical cyclones from the south-west Indian Ocean have changed (IPCC 2014).	There is medium confidence that cyclones increase in intensity under climate change (IPCC 2013). In the short term, the 2019 cyclones will negatively affect people's ability to cope with future shocks as countries are still recovering from past events.
Climate related risks: The region faces a combination of high climate hazards and multiple non-climatic factors and stressors such as the existing high vulnerability of the population (in particular pastoralists and city dwellers), the high dependency on rain-fed agriculture, poor health systems, rapid urbanisation and large informal settlements in hazard-prone areas. Climate conditions in rural agricultural areas have an influence on further urbanisation.	No significant changes of current climatic stressors are expected in a 1–3-year period. With population growth and urbanisation taking place mainly in coastal zones, exposure of the population to coastal flooding and sea level rise is expected to constantly increase. The population in the region is expected to grow by more than 2% per year in the next 10 years (UN 2019).

Food

Given the high reliance on livestock and rain-fed crop production and the high intra- and inter-seasonal climate variability, food production systems in East and Southern Africa are very vulnerable. Dry spells, cyclones and above-average rainfalls in some regions were the main drivers

of climate-related food insecurity in 2019. Increasing temperatures are very likely to negatively affect cereal crop production and food security in the region (IPCC 2014).

Food: Past and ongoing development	Food: Trends
Agricultural production: Both cereal production and livestock systems are heavily dependent on rainfall and are vulnerable to droughts, changing precipitation patterns and rising temperatures. In the last five years, cereal production slightly increased in East and Southern Africa, but with reduced production prospects for 2019 due to dry conditions in East Africa and unfavourable rains in the south of the continent. Extreme weather events in Southern Africa (cyclones in Mozambique, rainfall deficits in Eswatini, Lesotho, Zambia, Zimbabwe), caused a sharp drop in cereal production in 2019 (FAO 9/2019). Pastoral areas have been severely affected by drought conditions in parts of Somalia, Ethiopia and Kenya, causing deterioration of rangeland resources to extremely poor levels and resulting in livestock emaciation, increased mortality and sharp decline in milk production. Furthermore, widespread floods resulted in localised losses of livestock in parts of Ethiopia, Sudan and South Sudan (FAO 9/2019).	Climate change is very likely to have an overall negative effect on yields of major cereal crops across Africa, with the exception of East Africa, where maize production could benefit from warming at high elevations (IPCC 2014). In the short term, ongoing extreme events such as the current droughts followed by floods in large parts of East Africa will negatively affect agricultural production in the coming years as farmland has been destroyed. Rising temperatures and precipitation changes are linked to adverse effects on livestock (increased heat and water stress, impacts on feed quality and quantity) and to shifts in the range of pests and diseases, with adverse impacts on pastoral livelihoods and rural poverty. These are key risks for the region (IPCC 2014).
Non-climatic drivers: Entrenched poverty, environmental degradation of pasture and cropland, rapid urbanisation, a high population growth rate and increasingly globalised food chains are posing challenges to food security in the region.	All non-climatic drivers are expected to remain relevant in a 1–3-year perspective.
Food prices and import: Prices of relevant cereals (maize, sorghum) increased to very high levels in recent months in Somalia, Ethiopia, Kenya and the Sudan as seasonal trends were exacerbated by unfavourable prospects for the first season harvests. In Southern Africa, domestic cereal supplies have tightened in most countries and food price increased in some countries (Zimbabwe, Zambia and Mozambique). (FAO 9/2019).	Production shortfalls may lead to increased food prices in some parts of the region. There is an estimated increase in import requirements for the 2019/20 marketing year (generally April-March). The largest increases in import needs are forecast in Mozambique and Zimbabwe on account of the weather-reduced harvests (FAO 9/2019).
Food insecurity: In 2019, 28.2 million people were acutely food insecure in East Africa, with the largest caseloads recorded in Ethiopia, Sudan and South Sudan. In Southern Africa, food insecurity is rising with 12.5 million people projected to be food insecure in 2019–20 (FAO 9/2019).	The level of food insecurity is expected to remain at high levels in East Africa. In Southern Africa, food insecurity is projected to rise sharply in early 2020 as a result of reduced harvests, higher food prices and diminished casual labour opportunities due to the poor growing season. The largest increases in food insecurity are estimated in Zambia, Zimbabwe and Mozambique (FAO 9/2019).

Water

Compounded stress on water resources is very high in the region, especially in the dry areas in the Horn of Africa and parts of Southern Africa. Climate change will amplify the existing stress on water availability due to population growth, urbanisation, agricultural growth and land use change in East and Southern Africa (IPCC 2014). There is a significant sub-regional variability of climate impacts, particularly in water-stressed regions that are projected to become drier, such as parts of Southern Africa (mainly south-western parts).

Water: Past and ongoing development	Water: Trends
Water availability: Water resources are subjected to high hydro-climatic variability over space and time (IPCC 2014). Precipitation deficits, droughts and extreme precipitation changes have been reported in the last few years.	No specific projections can be made for a 1–3-year period, but the stress on water availability is likely to amplify in already dry regions where precipitation is likely to decrease over time, namely in Southern Africa. Climate change is expected to have an overall modest effect, however, on future water scarcity relative to other drivers such as population growth, urbanisation, agricultural growth and land use change (IPCC 2014).
Water scarcity: The scarcity of water may fuel existing tribal conflicts in Ethiopia, Kenya, Uganda and Sudan (Factbook ECC platform 2019). Several multinational disputes over transboundary water bodies, e.g. the conflict over access to and rights over the Nile water resources among its eleven riparian countries, and the transboundary water disagreements between South Africa and Namibia, remain unresolved (Factbook ECC platform 2019).	Conflicts are based on a variety of interconnected causes of which the environment is considered to be one, but rarely the most decisive factor (IPCC 2014). Hydro-climatic change may affect the occurrence of conflicts, although water scarcity alone does not produce conflicts, but more the water scarcity-abundance dynamic (Selby and Hoffmann 2014).
Non-climatic drivers: The main non-climatic drivers of water scarcity in the region are population growth, urbanisation, agricultural growth, land use change and over-extraction of water from rivers and lakes (IPCC 2014).	Water demand is expected to further increase due to population growth, urbanisation, agricultural growth, and land use change. This increased demand is expected to have a strong influence on future water scarcity (IPCC 2014).
Water risks: Current overall water risks – both physical and regulatory (e.g. low access of people to safe drinking water and sanitation) – are high to extremely high in the region, with extremely high risks in large parts of Sudan, South Sudan, Eritrea, Djibouti, Somalia, Zimbabwe and Botswana (WRI Aqueduct 3.0 2019).	No specific projections can be made for a 1–3-year period, but water demand is expected to increase in almost all parts of the region with already high to extremely high water risks (WRI Aqueduct 3.0 2019).

Health

Climate variability and change affect the incidence and geographic range of sub-Saharan Africa's high health burdens. According to projections, sub-Saharan Africa is expected to have the greatest climate-induced health burden worldwide (IPCC 2014). Malnutrition, diarrhoeal

diseases and vector-borne diseases are areas of concern in East and Southern Africa. With climate change, highland areas in East Africa will experience increased malaria epidemics.

Health: Past and ongoing development	Health: Trends
Malnutrition: Africa is the region where climate shocks and stressors had the biggest impact on acute food insecurity, malnutrition and undernutrition.	Improvements in reducing rates of undernutrition may be negatively affected, and potentially reversed, by climate change impacts (UNEP 2018). Climate change is expected to cause a significant increase in the number of children with severe stunting (an indicator for undernutrition). Models suggest about 30,000 additional deaths due to climate change in East and Southern Africa by 2030 (WHO 2014).
Foodborne and waterborne diseases: Cholera is primarily associated with poor sanitation, poor governance and poverty, but climate factors such as increased rainfall and flooding during and after El Niño events have contributed to cholera outbreaks in East Africa, e.g. in Mozambique (Ajayi and Smith 2019). In 2019, cholera outbreaks have been reported in Ethiopia, Kenya, Somalia and Sudan (ECDC 2019).	Additional cholera cases are projected to occur in East Africa during and after El Niño events (Amegah et al. 2016). With high probability of the return of El Niño by the end of 2020 (Ludescher et al. 2019) and associated above-normal rainfall in parts of East Africa (e.g. Kenya, Uganda, Tanzania) the risk of cholera outbreaks might increase. The relationship between temperature and diarrhoeal diseases is expected to vary. Climate change is projected to cause an estimated 11,000 additional children's deaths due to diarrhoeal diseases by 2030 in East Africa (WHO 2014).
Vector-borne diseases: Climate factors have a substantial effect on malaria transmission, especially in countries where GDP per capita is low (WHO 2014). The malaria incidence rate is high in parts of the region, in particular in Mozambique, Tanzania, Malawi and Zambia. The malaria mortality rate, however, declined in the whole region between 2010 and 2018, with the exception of Sudan and Somalia, where the mortality rate increased (WHO 2019).	Climate change is expected to affect the geographic range and incidence of malaria. Highland areas in East Africa will experience increased malaria epidemics at elevations above 2,000 m, where temperatures are currently too low to support malaria transmission (IPCC 2014). The population at risk of malaria will increase in East Africa until 2030 due to population growth and climate change (WHO 2014). Projections suggest a low number of additional malaria deaths due to climate change in East and Southern Africa (with most cases expected in central sub-Saharan Africa) (UNEP 2018, WHO 2014). No short-term projections can be made, as incidence of malaria is difficult to predict. Studies suggest that El Niño events may also contribute to malaria epidemics (IPCC 2014).
Other vector-borne diseases: Rift Valley fever and dengue fever can be influenced by local climate. Past Rift Valley fever epidemics in the Horn of Africa are associated with altered rainfall patterns (IPCC 2014). Dengue fever outbreaks were reported in Tanzania in 2019 (WHO 2019)	Outbreaks of Rift Valley fever are linked to El Niño events, with strong effects expected in East Africa (Anyamba et al. 2019). The risk of dengue fever is expected to increase in Southern Africa (Ryan et al. 2019). Large increases in suitable conditions for the disease are predicted in Southern Africa (Messina et al. 2019).

Health: Past and ongoing development	Health: Trends
Malnutrition: Africa is the region where climate shocks and stressors had the biggest impact on acute food insecurity, malnutrition and undernutrition.	Improvements in reducing rates of undernutrition may be negatively affected, and potentially reversed, by climate change impacts (UNEP 2018). Climate change is expected to cause a significant increase in the number of children with severe stunting (an indicator for undernutrition). Models suggest about 30,000 additional deaths due to climate change in East and Southern Africa by 2030 (WHO 2014).
Heatwaves: Temperature effects on mortality have already been detected in Southern Africa.	With a projected increase in frequency, intensity and duration of heatwaves, especially in Southern Africa, negative effects on human health are likely to increase.

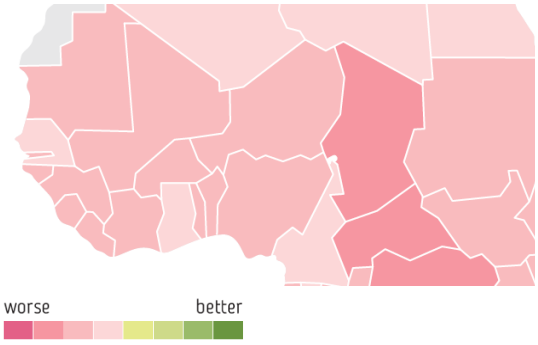
Regional stability

Climate's interactions with various drivers of conflict and instability, such as water scarcity, high commodity prices or food insecurity, is complex but its exact relevance is unclear. Climate change and variability have the potential to exacerbate or multiply existing threats to human security including food, health and economic insecurity, all of which are particular concerns for East and Southern Africa (IPCC 2014). Current instabilities and conflicts affect people's ability to cope with future climate shocks, especially in the Horn of Africa.

Regional stability: Past and ongoing development	Regional stability: Trends
Fragile states: East African countries rank among the most politically unstable and fragile countries worldwide, with particularly high risks in Somalia, South Sudan and Sudan (alert category of the Fragile States Index 2019). In Southern Africa, instability and fragility ranges from very high (Zimbabwe) to relatively low (Botswana).	High political instability will possibly affect people's ability to cope with possible future climate shocks especially in regions already highly vulnerable and exposed to adverse climate conditions such as the Horn of Africa. Perceptions of political instability suggest a high likelihood of political instability in the majority of the countries in the region (Sudan, South Sudan, Ethiopia, Somalia, Kenya, Burundi and Mozambique) (WB 2019).
Conflict: The conflict situations in several countries in the region are strongly affecting human security, with climate variability having the potential to exacerbate those threats (IPCC 2014). Conflict, insecurity and related displacements are identified as among the main drivers of food insecurity in Ethiopia, Somalia, South Sudan, Sudan and Uganda (FSIN 2019).	No projections on future conflicts can be made, but the root causes of most of the conflict situations are expected to remain over the next few years.
Migration: The increase in migration leading to human suffering, human rights violations, political instability and conflict is a key risk for the region (IPCC 2014). Many drivers of migration are climate sensitive, but the potential for migration is determined by the context where climate change occurs (Adger et al. 2015).	Given the various social, political, economic, environmental and cultural factors influencing the decision to migrate, assessments of future trends in environmentally induced migration are complex. In East Africa, models project 1.9–2.7 million internal climate migrants for 2020 and 6.9–10.1 million for 2050, with out-migration hotspots being coastal regions of Kenya and Tanzania, western Uganda, and

Regional stability: Past and ongoing development	Regional stability: Trends
In 2018, Ethiopia and Somalia experienced ongoing conflicts and severe droughts and floods leading to more than 4 million internally displaced people, more than 800,000 of whom were associated with disasters (IDMC 2019).	parts of the northern highlands of Ethiopia (IBRD and World Bank 2018). Some models project net migration of 750,000 people out of the East African coastal zone between 2020 and 2050 with sea level rise and episodic flooding being the key drivers (IPCC 2019 SROCC). In the short term, ongoing conflict and violence are expected to be the main drivers of internal displacement in the region.
Poverty: Sub-Saharan Africa is the only region in the world where the overall number of extremely poor people is increasing rather than decreasing (World Bank 2018, Poverty and Shared Prosperity Report).	Estimates under the business-as-usual scenario suggest that by 2030 poverty in sub-Saharan Africa will remain as high as 25%, while in the rest of the world the rate will be as low as 2% (World Bank 2018, Poverty and Shared Prosperity Report), meaning that poverty will remain high in the coming 1–3 years.

4.3. West Africa



Source: ND Gain 2019.

Increasing temperatures and shifting rainfall patterns are affecting livelihoods, food security and economic and governance stability of West Africa.

Overall climate-related risk – including vulnerability and readiness to enhance adaptive capacity – is high to very high in the region with particularly high risks in Chad, Niger and Mali (ND Gain 2019).

Climate Change

Trends in precipitation and extreme precipitation – the main climate-related drivers in the region – have been uneven in the last decades. Future changes in precipitation remain uncertain. The risk of severe impacts of both droughts and intense precipitation events are high in the Sahel region.

Climate: Past and ongoing development	Climate: Trends
Temperature increases and heatwaves: Mean annual temperatures have increased over the past century over most of the African continent, with highest increase in the Sahara and Sahel (IPCC 2014). The region has also experienced hotter and longer heatwaves since 2000 than in previous decades.	Temperatures over Africa will rise faster than the global land average, particularly in the more arid regions such as the Sahel region (IPCC 2014). No projections can be made for a 1–3-year period.
Rainfall: The Sahel has experienced an overall reduction in rainfall over the 20th century, with a recovery toward the last 20 years of the century (IPCC 2014). Wetter and greening conditions have been observed in this region over the last three decades (IPCC SRCCL 2019) with a tendency towards more intense but fewer precipitation events with increased risk of flooding. The Gulf of Guinea and the Sahel have experienced more intense precipitation events (Bichet and Diedhiou 2018).	Projected changes in precipitation are uncertain in West Africa, projections show inter-model variation both in the amplitude and direction of change (IPCC 2014). Regional modelling studies show a substantial increase of central Sahel rainfall by the end of the century due to an expansion of the West African Monsoon (IPCC SRCCL 2019).
Drought: The risk of drought is high in some parts of the region, namely in the Sahel where drought intensity is becoming more severe (IPCC SRCCL 2019). In 2018, the Sahel pastoralist region (Burkina Faso, Chad, Mali, Mauritania, Niger and Senegal) experienced severe drought (FAO Sahel regional overview 2019).	No projections on future droughts can be made. Projected trends in drought frequency and intensity are uncertain (IPCC 2014).

Food

Agriculture is the predominant livelihood in the Sahel, where climate variability and extremes already have significant impact. Crop production is almost entirely reliant on the region's low and highly variable rainfall, making it extremely vulnerable to climate trends.

Food: Past and ongoing development	Food: Trends
Agricultural production: Crops and/or livestock are the principal livelihoods for more than 70% of the population in Niger, Burkina Faso, Mali and Chad, and for more than 50% in Senegal and Mauritania (US AID 2018). Both cereal production and livestock systems are heavily dependent on rainfall and are vulnerable to droughts, changing precipitation patterns, and rising temperatures. In the last five years, cereal production increased in West Africa, but with reduced crop prospects in some parts of the region, where civil insecurity and conflicts have undermined agricultural productive capacities (north-east Nigeria, Lake Chad basin, Central Mali). Sahel droughts in 2018 decimated pasture, livestock and crops, with ongoing negative impacts on the pastoralist population (FAO Sahel regional overview 2019). In 2019, favourable seasonal rains in most pastoral areas increased water and pasture availability, improving livestock conditions and enhancing the market value of animals (FAO, 9/2019).	Given a projected high climate variability, the Sahel is assessed as an area of high agricultural risk in the future (GGAFS 2019). A warming of 2 °C to 4 °C may lead to losses and damage to various crops that are important in West Africa, namely maize, sorghum, wheat, millet, groundnut and cassava (Sultan and Gaetani 2016). Adverse effects on livestock linked to rising temperatures and precipitation changes (increased heat and water stress, impacts on feed quality and quantity) and shifts in the range of pests and diseases, with adverse impacts on pastoral livelihoods and rural poverty are key risks for the region (IPCC 2014). Severe past droughts such as in 2018 may have ongoing negative impacts in a 1–3-year perspective.
Non-climatic drivers: Cropland areas in the Sahel region of West Africa have doubled since 1975, with the settlement area increasing by about 150% (IPCC SRCCL 2019). Multiple stressors such as rangeland degradation, fragmentation of grazing areas and in-migration of non-pastoralists into grazing areas are putting pressure on livestock systems and are interacting with climate change (IPCC 2014). Ongoing conflicts continue to affect farming activities in some parts of Nigeria, Mali, Niger and Burkina Faso. Furthermore, some countries, such as Chad, Burkina Faso, Mali and Niger, have reported outbreaks of fall armyworm and locusts, which have caused localised crop losses (FAO 9/2019). The Sahel region is experiencing a phase of population growth unprecedented in any other part of the world.	All non-climatic drivers are expected to remain relevant in a 1–3-year perspective. The populations of Burkina Faso, Chad, Mali, Mauritania and Niger could double in the next 20 years, resulting in an increase of 80–160 million inhabitants by 2040 (UN World population prospects).
Food prices: Cereal prices remained generally stable except in areas affected by conflict and insecurity (North Nigeria, Burkina Faso, Mali) (FAO 2019, FSIN 2019).	Food prices are likely to remain high in conflict-affected areas. Severe rainfall deficits and production shortfalls may lead to increased food prices as observed during the Sahel drought in 2018 (FSIN 2019).

Food: Past and ongoing development	Food: Trends
Food insecurity: West Africa and the Sahel had 11.2 million acutely food-insecure people in 2018. About 5 million people in the Sahel region were in urgent need of food, nutrition and livelihood assistance. Severe rainfall deficits, localised production shortfalls, high food prices, reduced incomes resulting from declining livestock sales, in tandem with conflict, insecurity and market disruption drove this severely deteriorating food insecurity situation (FSIN 2019). In 2019, 9.7 million people were projected to be severely food insecure in the Sahel region, particularly in areas affected by civil insecurity (Lake Chad region, eastern and western Niger, northern and eastern Burkina Faso, and northern and central Mali.) (FAO Sahel Regional Overview, July 2019).	Most areas in the Sahel area will remain in food insecurity until May 2020 (FEWS NET 2019). Conflicts and related displacements as main drivers of food insecurity are likely to persist in Mali, Niger, Chad and Burkina Faso (FSIN 2019).

Water

Water resources are subjected to high hydro-climatic variability over space and time. Current water risks are extremely high in the region. Compounded stress on water resources facing significant strain from overexploitation and degradation at present and increased demand in the future is a key risk for the entire region (IPCC 2014).

Water: Past and ongoing development	Water: Trends
Water availability: Water resources are subjected to high hydro-climatic variability over space and time (IPCC 2014), such as precipitation deficits, droughts and extreme precipitation changes reported in the last few years. The Sahel pastoralist region (Burkina Faso, Chad, Mali, Mauritania, Niger and Senegal) experienced severe rainfall deficits in 2018 (FSIN 2019). In 2019, the situation was supposed to have improved given that higher than average precipitation has been reported in 2019 (WASP Index 2019).	Estimating the influence of climate change on water resources in West Africa is limited by the significant climate model uncertainties with regard to the region's future precipitation (IPCC 2014). In general, climate change is expected to have an overall modest effect on future water scarcity relative to other drivers such as population growth, urbanisation, agricultural growth, and land use change (IPCC 2014). Shallow aquifers in the Sahel, however, which respond more quickly to seasonal and yearly changes in rainfall, may experience a decline in groundwater recharge to the extent that prolonged drought and other precipitation anomalies become more frequent with climate change (IPCC 2014). Freshwater resources are expected to experience reduced water quantities in Burkina Faso and Niger by 2025.

Water: Past and ongoing development	Water: Trends
Non-climatic drivers: The main drivers of water scarcity are population growth, urbanisation, agricultural growth, land use change and over-extraction of water from rivers and lakes (IPCC 2014).	Water demand is expected to further increase due to population growth, urbanisation, agricultural growth and land use change. This is expected to have a strong influence on future water scarcity (IPCC 2014).
Water risks: Current overall water risks – both physical and regulatory (e.g. low access of people to safe drinking water and sanitation) – are extremely high in the entire Sahel region (WRI Aqueduct 3.0).	No specific projections can be made for a 1–3-year period, but water demand is expected to further increase in the whole region, aggravating the already critical situation (WRI Aqueduct 3.0).

Health

Climate variability and change affect the incidence and geographic range of sub-Saharan Africa's high health burdens. Increased risk of food insecurity, infectious disease and health impacts of heat and dust are pressing climate-related challenges to human health in West Africa.

Health: Past and ongoing development	Health: Trends
Malnutrition: Africa is the region where climate shocks and stressors had the biggest impact on acute food insecurity, malnutrition and undernutrition. This is particularly the case for the Sahel region, where reliance of the food system on variable rainfall is very high.	Improvements in reducing the rates of undernutrition may be negatively affected and potentially reversed by climate change impacts (UNEP 2018). Climate change is expected to cause a significant increase in the number of children with severe stunting (an indicator for undernutrition). Models suggest about 23,000 additional deaths due to climate change in West Africa by 2030 (WHO 2014).
Foodborne and waterborne diseases: Past outbreaks in Ghana, Senegal and other coastal West African countries were associated with heavy rainfall, with a possible association with the El Niño-Southern Oscillation (IPCC 2014).	Projected increases in precipitation in parts of West Africa where cholera is already endemic will possibly lead to more frequent cholera outbreaks in the future (IPCC 2014).
Vector-borne diseases: The malaria incidence rate is very high in the whole region, both in the coastal region and in the Sahel (in particular in Mali, Niger, Burkina Faso), but the malaria mortality rate declined in the whole region between 2010 and 2018 (WHO 2019).	Projections of the impact of climate change on malaria in West Africa are unclear, as warming climate does not directly translate into greater malaria transmission. Some studies observed a pattern of reduced burdens with a rise in temperatures in West Africa (UNEP 2018).
Other vector-borne diseases: Worldwide, dengue causes the greatest human disease burden of any mosquito-borne virus. The Sahel currently only sporadically reports dengue (Messina et al. 2019), and the current estimated number of deaths are very low (UNEP 2018).	Africa is likely the continent to see the biggest change in dengue risk due to climate change. Large increases in suitable conditions for the disease are predicted in the Sahel, largely due to more favourable temperatures and increased rainfall (Messina et al. 2019).
Heat and dust: The Sahel region has the highest incidence and fatality rates in the world for bacterial meningitis. High temperatures and high concentrations of dust are significant risk factors (Junot et al. 2016).	With rising temperatures, in particular in the Sahel region, the risk of meningitis is projected to significantly increase. Furthermore, negative effects of heatwaves on human health are likely to increase. No projections can be made for a 1–3-year period.

Regional stability

Climate's interactions with various drivers of conflict and instability, such as water scarcity, high commodity prices or food insecurity, is complex but its exact relevance is unclear. Climate change and climate variability have the potential to exacerbate or multiply existing threats to human security including food, health, and economic insecurity, all concerns for West Africa (IPCC 2014). Current instabilities and conflicts may affect people's ability to cope with future climate shocks in parts of the Sahel region.

Regional stability: Past and ongoing development	Regional stability: Trends
Fragile states: West African countries rank among the most politically unstable and fragile countries worldwide, with particularly high risks in Chad (alert category of the Fragile States Index 2019).	High political instability may further affect people's ability to cope with possible future climate shocks in the whole Sahel region, which is already highly vulnerable and exposed to adverse climate conditions. Perceptions of political instability suggest a high likelihood of political instability in all Sahel countries and some countries on the Gulf of Guinea (Nigeria, Côte d'Ivoire) (WB 2019).
Conflict: Persistent conflict and violence in several countries of the Sahel are strongly affecting human security and food security (FAO Sahel Regional Overview, July 2019). There is, however, low confidence in climate change and desertification leading to violent conflicts. Droughts and desertification in the Sahel played a relatively minor role in the conflicts in the Sahel in the 1980s (IPCC SRCCL 2019).	Conflicts are based on a variety of interconnected causes of which the environment is considered to be one factor, but rarely the most decisive (IPCC 2014). Hydro-climatic change may affect the occurrence of conflicts, although it is not water scarcity alone that produces conflicts, but more the water scarcity-abundance dynamic (Selby and Hoffmann 2014).
Migration: Increased migration leading to human suffering, human rights violations, political instability and conflict is a key risk for the region (IPCC 2014) Many drivers of migration are climate sensitive, but the potential for migration is determined by the context where climate change occurs (Adger et al. 2015). In 2018, Mali, Niger and Burkina Faso experienced ongoing conflicts and disasters leading to more than 280,000 internally displaced people (IDP), more than 60,000 of whom were associated with disasters (IDMC 2019).	Given the various social, political, economic, environmental and cultural factors influencing the decision to migrate, assessments of future trends in environmentally induced migration are complex. For West Africa, models project 17.9–54.4 million internal climate migrants for 2050 – the highest levels and percentages of climate migrants worldwide (IBRD and World Bank 2018). In the short term, ongoing conflict and violence are expected to be the main drivers of internal displacement in the region.
Poverty: Sub-Saharan Africa is the only region in the world where the overall number of extremely poor people is increasing rather than decreasing (World Bank 2018, Poverty and Shared Prosperity Report).	Estimates under the business-as-usual scenario suggest that by 2030 poverty in sub-Saharan Africa will remain as high as 25%, while in the rest of the world the rate will be as low as 2% (World Bank 2018), meaning that poverty will remain high in the coming 1–3 years.

4.4. Western Balkans and new EU member states

Overall climate-related risk – including vulnerability and readiness to enhance adaptive capacity – is relatively low in the Western Balkans and the new EU member states. All countries in the region face rather low vulnerability to climate changes and show fairly high readiness to adapt.

Source: ND Gain 2019.

Climate Change

High climate variability, the occurrence of extreme events, droughts and heatwaves are affecting the region, especially the Western Balkans. Precipitation changes are affecting the Baltic Sea region. The frequency and intensity of weather extremes is likely to increase. As countries in the region continue to grow, so too does their exposure to risk from climate change and natural disasters.

Climate: Past and ongoing development	Climate: Trends
Precipitation: On the one hand, the Western Balkans are getting drier. On the other hand, there have been increases in either the frequency or intensity of heavy precipitation in Europe with some seasonal and/or regional variation (IPCC 2014). The Western Balkan region has also observed an increased flood risk (RCC 2018). The frequency and severity of floods has increased over the past few years, especially in the Drin River Basin in Albania, Kosovo, Montenegro and North Macedonia (GIZ 2019).	The Western Balkans expect variable changes in annual precipitation starting mid-century with increases in northern Serbia and intensifying decreases towards the south, including coastal areas. By the end of the century drying conditions will prevail (RCC 2018). Further, there are risks of increased damage from river and coastal floods in the Western Balkans (e.g. along the Drin River Basin) and the Baltic Sea region (IPCC 2014, Räisänen 2017). In the Baltic Sea region, warming will be accompanied by a general increase in winter precipitation, but in summer, precipitation may either increase or decrease. Southern areas are more likely to become drier than northern areas (Räisänen 2017). Projections for the coming 1–3 years are not possible.
Droughts: Some parts of Serbia, Romania and Ukraine were facing severe drought in November 2019 (Global Drought Observatory 2019).	No projections can be made for a 1–3-year period, but current severe drought events in Serbia, Romania and Ukraine may affect people's ability to cope with future shocks.
Heatwaves: An increased frequency and duration of heatwaves and drought have been reported in the Western Balkan region (RCC 2018). Extreme weather	Average temperatures are expected to increase over the Western Balkans (RCC 2018), and summer high temperatures over central and southern Europe are

Climate: Past and ongoing development	Climate: Trends
events currently have significant impacts in Europe in multiple economic sectors as well as adverse social and health effects (IPCC 2014). Previous heatwaves have shown severe impacts on agriculture, forestry, energy production and use, transport, tourism, labour productivity, health and the built environment (IPCC 2014).	projected to warm substantially (IPCC 2014). In the Baltic Sea region, warming is likely to exceed the global average, particularly in winter and in the northern areas (Räisänen 2017). The intensity, duration and frequency of summer heatwaves are expected to be substantially greater over Europe (IPCC 2014).
Economic impacts: The Western Balkans has observed a decline in average river discharge and water supply especially during summer, increased energy consumption during summer and increased health and safety risks (RCC 2018). Climate change is disrupting transportation and energy production – two important economic sectors.	Climate change is projected to adversely affect inland water transport in summer in some rivers. Damage to rail infrastructure from high temperatures may also increase (IPCC 2014). In the Western Balkans, land transport infrastructure will be at risk from the increase in flood frequency and intensity, extreme temperatures, soil erosion and landslides (RCC 2018). Specific projections for the next 1–3 years are not possible.
Non-climatic drivers: Urban development is projected to increase over Europe but especially rapidly in Eastern Europe, with the magnitude of these increases depending on population growth, economic growth and land use planning policy (IPCC 2014).	Increasing urban development is posing additional threats to natural systems and will exacerbate the impacts of climate change in the next 1–3 years.

Food

Southern Europe shows trends toward more intense and longer meteorological droughts. Crop suitability is likely to change throughout Europe. During the most recent summer heatwaves, grain harvest losses reached between 20% and 30% in affected regions of Europe and Russia.

Food: Past and ongoing development	Food: Trends
Agricultural production: In the European Union, the production of wheat was estimated to be above average in 2019. In Ukraine, the 2019 cereal output was expected to increase slightly to well above average. The early forecast for the 2019 aggregate cereal production stood at slightly above average (FAO 9/2019). Agricultural production is particularly important in Albania. Its contribution to gross domestic product is at around 23% (FAO 2018).	Climate change is likely to decrease yields in southern Europe and may adversely affect dairy production because of heat stress in lactating cows (IPCC 2014). For the Western Balkans, yield mass and quality are projected to decrease progressively by the end of the century. (RCC 2018). No specific projections can be made for a 1–3-year period.

Food: Past and ongoing development	Food: Trends
Food prices and imports: The Western Balkan countries rely heavily on food imports. Overall, domestic food inflation remained calm in 2017 and 2018 (FAO 2018).	High food import dependency makes the region potentially vulnerable to adverse climatic conditions in other parts of the world, and therefore to increasing food prices. World agricultural commodity prices are projected to stabilise in 2020 (World Bank 2019).
Food insecurity: The prevalence of severe food insecurity is a concern in Albania. Household income and livelihoods largely affect economic access to food, but high market prices of basic food items also limit economic access, particularly among lower income groups who spend a large share of their income on food (FAO 2018).	No specific projections can be made for a 1–3-year period, but the situation in Albania is projected to remain tense.

Water

Water availability is unevenly distributed between northern and southern Europe. A widening gap in water resources is already apparent and likely to increase with climate change, with impacts on future water availability and increased risks of water restrictions in the southern, central, and Atlantic sub-regions (IPCC 2014).

Water: Past and ongoing development	Water: Trends
Water availability: Water availability is unevenly distributed between northern and southern Europe. Dryness has increased mainly in southern Europe (IPCC 2014). The Western Balkans have faced negative impacts on water resources, especially due to decreased average river discharge and problems with drinking water quality and supply during summer (RCC 2018).	No specific projections can be made for a 1–3-year period. Because significant impacts on future water availability are projected in the long term (IPCC 2014), however, a reduction of water availability is possible for the next few years. Water quality could be negatively affected by nitrate leaching due to changing precipitation patterns – less precipitation in summer and higher rainfall during winter (IPCC 2014).
Non-climatic drivers: Water demand for irrigation and hydropower are increasing. More than 2,700 small hydroelectric plants are either planned or under construction in North Macedonia, Bosnia and Herzegovina, Serbia, Albania, Montenegro and Croatia (Global Voices 2019).	Increased water demand is projected in the near and long terms (IPCC 2014). Environmentalists are concerned about the planned increase in hydropower as it may threaten the environment and freshwater sources and exacerbate the impacts of climate change (Global Voices 2019).
Water risks: In Albania, Macedonia and in parts of Serbia, Bulgaria, Romania and Ukraine, overall water risks are high. In these countries, water stress and drought risks are especially high (WRI Aqueduct 3.0 2019).	No specific projections can be made for a 1–3-year period. The region, particularly southern Europe, faces a medium to high risk of increased water restrictions in the near term (2030–2040) due to a significant reduction in water availability related to abstractions from rivers and groundwater resources, combined with increased water demand and reduced run-off (IPCC 2014).

Health

The greatest impact of climate change on health is expected through the increase in heatwaves. The region is expected to face an increase in hospital admissions for cardiovascular and respiratory diseases in connection with deteriorating air quality.

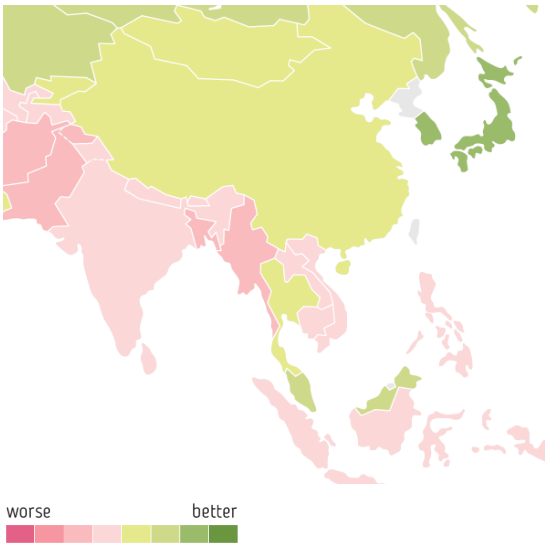
Health: Past and ongoing development	Health: Trends
Heatwaves: The region has already experienced health effects of heatwaves. Extensive evidence shows the impacts of heatwaves on health in the form of changes in mortality and morbidity. In 2010, many Eastern European cities recorded extremely high temperatures (UNEP 2018) resulting in an increase in daily mortality. Synergistic effects between high temperature and air pollution (PM10 and ozone) lead to an increase in hospital admissions for cardiovascular and respiratory diseases (WHO 2017).	Forecasts call for an increase in frequency and intensity of heatwaves with impacts on human health, especially in the western Balkans (RCC 2018). Eastern Europe can expect an additional 1,974 deaths due to heat attributable to climate change by 2030 (WHO 2014). No specific projections can be made for a 1–3-year period.

Regional stability

The regional stability in the Western Balkans and the new EU members states is mainly good providing a good base for coping with adverse climate change impacts. Politically less stable countries such as Ukraine may have lower capacities to cope with future climate shocks.

Regional stability: Past and ongoing development	Regional stability: Trends
Fragile states: Bosnia and Herzegovina, Ukraine, Serbia and Moldova face elevated warnings (Fragile States Index 2019), and Ukraine in particular has faced a drastic downturn in political stability since 2013 (the GlobalEconomy). The rest of the Western Balkans and the new EU member states are politically stable.	Political instability will possibly affect people's ability to cope with possible future climate shocks in Ukraine.
Migration: Displacement in the Western Balkans is mainly associated with natural disasters. In 2017 3,500 people were internally displaced in Albania due to natural hazards (flooding and landslides) (IDMC 2018). Serbia had 130 new displacements in 2018 due to natural disasters.	Floods are one of the most significant weather-related drivers of population displacements globally (IDMC data series). With a potential increase in flood risk in the region, the numbers of internally displaced people might also increase. No short-term projections can be made.
Economic development: Economic conditions, governance and social readiness have improved in all countries. Over the last 20 years, living standards have increased six-fold in Bosnia and Herzegovina, and nearly three-fold in Albania and in Serbia. With economic growth and the accumulation of assets, more assets are exposed to climate change but the capacity to cope with adverse climate impacts has increased (World BankB 2019).	The region's good economic outlook (World Bank 2019) will accelerate the accumulation of assets exposed to climate change, but adaptation capacity will also increase. Because the poorest, such as rural low-income communities, have the least capacity to adapt, the depopulation of rural areas could accelerate.

4.5. South Asia and South East Asia



Overall climate-related risks are high in most of the region with historical trends indicating decreasing levels of vulnerability and slightly decreasing risks due to improved readiness to enhance adaptive capacity. Potential hotspots where the risks are already high and where the situation has not improved significantly in the past few years include Myanmar, Bangladesh, Pakistan and Afghanistan. Medium risks are identified in Cambodia, Laos and Vietnam (ND-GAIN 2019).

Source: ND Gain 2019.

Climate Change

South East Asia is generally affected by floods and storms. Between 1998 and 2017, South East Asia (especially Myanmar, Philippines, Bangladesh, Pakistan and Vietnam) were among the regions most affected by extreme weather events such as storms, floods and temperature extremes as well as mass movements. Given the high exposure of people living in low-lying coastal zones and flood plains, future climate risks are likely to increase.

Climate: Past and ongoing development	Climate: Trends
Heavy precipitation events: The frequency of heavy precipitation events in South Asia and South East Asia has increased (IPCC 2014). Parts of India, Bangladesh, Nepal, Bhutan and Tibet and China experienced a significant increase in precipitation over the November 2018 through October 2019 period compared to the long-term average (1981–2010) (WASP Index 2019). Consequently, floods have affected more people than any other type of natural hazard in the 21st century. South East Asia is primarily affected (especially Bangladesh, Pakistan, India and Vietnam) (EM-DAT). Bangladesh was hit hard by floods in the past. During 2017, widespread flooding killed 145 people in Bangladesh (WMO 2017). Rohingya refugee camps in Cox's Bazar are particularly vulnerable to heavy monsoon	Future increases in precipitation extremes related to the monsoon are very likely in East, South and South East Asia. Flood risk and associated human and material losses are heavily concentrated in India, Bangladesh and China due to the exposure of the population (IPCC 2014). No projections can be made for a 1–3-year period, but recently affected countries like Bangladesh, Pakistan, India and Vietnam are perceived as particularly vulnerable to future shocks. Rohingya refugees in Cox's Bazar camps will continue to be highly vulnerable. Annual precipitation will further decrease in Mongolia and seasonal rainfall will become more erratic (UNDP).

Climate: Past and ongoing development	Climate: Trends
rains and have been substantially affected during 2019 (reliefweb 2019). The annual precipitation has decreased in Mongolia over the last years and the seasonal rainfall pattern has become erratic (UNDP).	
Tropical cyclones: Significant trends in tropical cyclones making landfall are not found on shorter timescales (IPCC 2014). However, South East Asia was hit by multiple storms in 2018 (especially in China, India, the Philippines). Generally, storms are cost-intensive disasters (EM-DAT).	Maximum wind velocity of tropical cyclones at the coast is projected to increase by about 6% for mainland South East Asia by the 2080s under the high emission scenario RCP8.5 (World Bank 2019). No projections can be made for a 1–3-year period, but recently affected countries such as China, India and the Philippines are perceived as particularly vulnerable to future shocks.
Sea level rise: As a result of groundwater withdrawal, floodplain engineering and the trapping of sediments by dams, large deltas in Asia are sinking much faster than global sea level is rising (IPCC 2014). One third of Bangladesh's population lives in coastal zones, with many people living below the absolute poverty line (World Bank 2019). Deltas are particularly vulnerable as the negative impacts of sea level rise and coastal flooding collide.	Future rates of sea level rise are expected to exceed those of recent decades increasing coastal flooding, erosion and saltwater intrusion into surface waters and groundwater (IPCC 2014). Highly populated deltas in Asia are increasingly vulnerable in the next 1–3 years, especially in Bangladesh where sea level rise and flooding come together and the number of people living in costal zones increases (World Bank 2019).
Drought: Throughout much of Asia, drought is becoming the norm rather than the exception. In 2019 drought has been severe in Laos, the Philippines, Thailand and Vietnam while Cambodia, Indonesia, Malaysia and Myanmar have all seen moderate drought (China Daily 2019).	Severe drought events in the past may affect people's ability to cope with future shocks as countries and regions are still recovering from past events. With high probability of El Niño by end of 2020 (Ludescher et al. 2019) drought risk in South East Asia might increase in the next year. The duration and strength of the event cannot be forecasted.
Glacier retreat: The melting of Himalayan glaciers has doubled since the turn of the century, with more than a quarter of all ice lost over the last four decades (Maurer et al. 2019).	Trends of increased glacier mass loss are projected to continue in most region of the Hindu Kush Himalaya region, with possibly large consequences for the timing and magnitude of glacier melt runoff and glacier lake expansion. Glacier volumes are projected to decline by up to 90% through the 21st century (Bolch et al. 2019)
Non-climatic drivers: Rapid urbanisation, industrialisation and economic development are key drivers of environmental degradation that are compounded by climate change (IPCC 2014).	Around 90% of global urbanisation was expected to take place in Asia up to 2015 (UN 2018 revision of World Urbanization Prospects). People living in low-lying coastal zones and flood plains are probably most at risk from climate change impacts in Asia. Half of Asia's urban population lives in these areas (IPCC 2014).

Food

Projected changes to the monsoon system and rising peak temperatures put water and therefore crop production at severe risk. Climate change is projected to increasingly affect food

security by the middle of the 21st century, with the largest number of food-insecure people located in South Asia (IPCC 2014).

Food: Past and ongoing development	Food: Trends
Agricultural production: Agriculture in the region is vulnerable to climatic variations such as droughts, changing precipitation patterns and rising temperatures (IPCC 2014). In South Asia, a series of monsoon floods caused high level of loss in agricultural production over the last 15 years (FAO 2018). In the last five years, however, overall cereal production increased in East, South East and South Asia, reflecting production upturns in all sub-regions. The aggregate 2019 cereal output was forecast to be well above the previous five-year average (FAO 9/2019).	Climate change effects on crop production are predicted to be negative for some specific crops and regions and positive for others. Whether rice yields will decrease or increase due to increased atmospheric CO_2 is uncertain. Saltwater intrusion is projected to decrease total arable areas and thus food production in low-lying parts of Asia, such as those in Bangladesh and the Mekong River Delta (IPCC 2014). Aggregate cereal production in Asia was forecast to increase marginally in 2019 despite flooding and dry conditions in some areas (FAO 9/2019).
Non-climatic drivers: Continuing conflicts and limited economic opportunities have increased the vulnerability of subsistence farmers in Afghanistan, where millions have abandoned their rural homes and moved to cities (FAO 2019). The influx of Rohingya refugees to Bangladesh intensifies the problem of food insecurity as the community has settled in one of the poorest and most vulnerable regions in Bangladesh and is very vulnerable itself to climate change (FSIN 2019). Land degradation is a major challenge for Mongolia, with negative implications on rural livelihoods and food security.	Food insecurity linked to conflicts in Afghanistan and Bangladesh are likely to persist. Land degradation in Mongolia is likely to remain a relevant factor in the future.
Food insecurity: In 2018, 14.7 million people in four countries – Afghanistan, Bangladesh, Myanmar and Pakistan – were food insecure (FSIN 2019). Climate shocks were among the main drivers of food insecurity in all these countries with the exception of Myanmar. Climate change is already affecting food security in high mountain areas of Asia (IPCC 2014).	Food insecurity in Afghanistan and Pakistan is likely to persist, although conditions are not foreseen to deteriorate significantly. The number of food-insecure people in need of urgent assistance will persist for the refugee population and host community in Cox's Bazar, Bangladesh (FSIN 2019).

Water

South Asia and South East Asia feature a wide variety of threatened inland and coastal water ecosystems such as coastal freshwater wetlands vulnerable to saltwater intrusion with rising sea levels, but in most river deltas local subsidence for non-climatic reasons will be more important (IPCC 2014). For much of interior Asia, an increase in drought stress as a result of declining rainfall and/or rising temperatures is the key concern (IPCC 2014). Snow and glacier melt will increasingly affect water availability of people who live in the Hindu Kush-Himalaya region and in the densely populated catchments in South Asia.

Water: Past and ongoing development	Water: Trends
Water availability: Adequate water supply is one of the major challenges in many regions and is subject to hydro-climatic variability (IPCC 2014). The Hindu Kush Himalayan region is the water tower for many South and South East Asian countries, serving as the source for ten major river systems (Wester et al. 2018). Snow and glacier melt are highly relevant to water availability in the region (IPCC 2014). The region is also highly susceptible to flash floods caused by glacial outburst floods.	Projected impacts of climate change on water availability in Asia differ substantially across river basins and seasons (IPCC 2014). Water scarcity is expected to be a big challenge in many Asian regions because of increasing water demand from population growth and consumption per capita with higher standards of living (IPCC 2014). In high mountain areas of Asia, glacier ice is projected to decrease substantially leading to an increase in stream flow in the short term (Kraaijenbrink et al. 2017). In the Hindu Kush Himalayan region, cryospheric change will have modest impacts on total annual streamflows in large river systems but will strongly affect the timing and seasonal distribution of runoff (Bolch et al. 2019).
Water scarcity may fuel existing conflicts in India, Pakistan's border with India, Bangladesh, Bhutan and Myanmar (Factbook ECC platform 2019).	Conflicts are based on a variety of interconnected causes of which the environment is considered to be one, but rarely the most decisive factor (IPCC 2014). Hydro-climatic changes may affect the occurrence of conflicts.
Non-climatic drivers: Growing demand for water is driven by soaring populations, increasing per capita domestic use due to urbanisation and thriving economic growth and increasing use of irrigation (IPCC 2014). Coastal low-lying forest swamps and coral reef areas in South East Asia are under severe pressure from non-climate impacts (IPCC 2014).	There is high confidence that water demand in most Asian countries is increasing because of increases in population, irrigated agriculture and industry (IPCC 2014). This can be projected for the coming 1–3 years. Climate change impacts on inland waters will interact with dam construction, pollution and land use changes (IPCC 2014). Coastal freshwater wetlands may be vulnerable to saltwater intrusion with rising sea levels, but in most river deltas local subsidence for non-climatic reasons will be more important (IPCC 2014).
Water risks: Low per capita water availability and a high relative level of water use make South Asia one of the most water-scarce regions of the world (WEF Doing Business Report 2019).	The perception of high water risk is increasing, as executives in the region ranked water crises as the number one risk for doing business in countries in South Asia. Water crises ranked as the top risk in India, second in Pakistan and fourth in Sri Lanka (WEF Doing Business Report 2019). Besides India, overall water risks are high to extremely high in parts of Nepal, Afghanistan and Myanmar as well as in parts of Singapore and the Philippines, and are high in adjacent regions. The southern part of China and parts of Thailand and Malaysia face lower water risks. (WRI Aqueduct 3.0 2019).

Health

Climate variability and change affect the incidence and geographic range of South and South East Asia's high health burdens. According to projections, especially South Asia is expected to face great climate-induced health burdens such as undernutrition, diarrhoeal diseases and malaria as well as heat-induced impacts.

Health: Past and ongoing development	Health: Trends
Malnutrition: South Asia is among those regions where climate shocks and stressors had the biggest impact on food insecurity.	Climate change is expected to cause a significant increase in the number of children with severe stunting (an indicator for undernutrition). South Asia is expected to face around 20,000 additional childhood deaths due to undernutrition attributable to climate change by 2030 (WHO 2014).
Waterborne diseases: Cholera outbreaks in coastal populations in South Asia have been associated with increased water temperatures and algal blooms (IPCC 2014). Diarrhoea is currently a major cause for child mortality in Asia and the Pacific, with 13.1% of all deaths under age five in the region caused by diarrhoea. (World Bank 2013). The El Niño cycle and Indian Ocean Dipole have been associated with cholera epidemics in Bangladesh (IPCC 2014). In particular, high positive anomalies in sea surface temperatures in the tropical Pacific during the winter have been shown to exacerbate the seasonal outbreak of cholera following the monsoons from August to November (Researchgate 2017).	In a 4 °C warming scenario, the relative risk of diarrhoea is expected to increase 5–11% for the period 2010–39 and 13–31% for the period 2070–99 in South-East Asia relative to 1961–1990. Diarrhoea cases are projected to significantly decrease in the absence of climate change (World Bank 2013). South Asia will be especially affected by diarrhoeal diseases. Diarrhoeal diseases are projected to cause almost 15,000 additional deaths attributable to climate change by 2030 (WHO 2014). With a high probability of El Niño by the end of 2020 (Ludescher et al. 2019), the risk of cholera outbreaks especially in Bangladesh, might increase in the next year.
Vector-borne diseases: Dengue outbreaks in South Asia and South East Asia are correlated with temperature and rainfall with varying time lags. Besides Central and Latin America, South and South East Asia are most affected by dengue outbreaks. In 2019, most of the countries in Asia and South East Asia observed a spike in their number of cases. Bangladesh reported over 100,000 cases in 2019, recording a ten-fold increase compared to 2018, followed by Cambodia which reported a six-fold increase in 2019 (ECDC 2020). Outbreaks of vaccine-preventable Japanese encephalitis have been linked to rainfall in studies from the Himalayas. Malaria prevalence is often influenced by non-climate variability factors, but studies from India and Nepal have found correlations with rainfall (IPCC 2014). The last malaria report shows declines in estimated cases worldwide in 2016 (compared to 2017), while increases were detected marginally in South East Asia (UNEP 2018).	Dengue fever may increase due to floods (World Bank 2013). The impact of climate change on malaria risk will differ across areas and the impact of socioeconomic development will be larger than that of climate change (IPCC 2014). South Asia ranks second to Central Africa in the number of additional malaria deaths attributable to climate change by 2030 (WHO 2014). No short-term predictions can be made.

Health: Past and ongoing development	Health: Trends
Heat: Associations between high temperatures and mortality have been shown for populations in India and Thailand and in several cities in East Asia. Several studies have analysed the health effects of air pollution in combination with increased temperatures. Intense heatwaves have been shown to affect the health of outdoor workers in South Asia (IPCC 2014). Extreme heatwaves were observed in South East Asia following several months of the 2015–16 El Nino event, which researchers attributed fully to anthropogenic warming. This extreme warmth during the south-western monsoon exacerbated forest fires caused by clearing land and increased air pollution throughout the region (UNEP 2018).	A large net increase in temperature-related excess mortality is projected for South East Asia at the end of the century under high emission scenarios (UNEP 2018). Furthermore, with an ageing population the number of people at risk will increase, especially those with cardiovascular and respiratory disorders. Continuing urbanisation will increase the urban heat island effect. No specific projections can be made for a 1–3 year period.

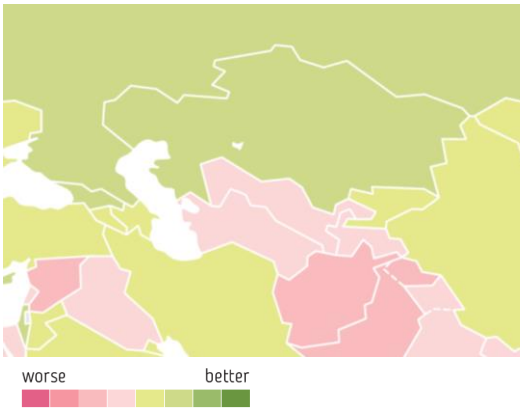
Regional stability

Climate change has complex interactions with various drivers of conflict and instability, such as water scarcity, high commodity prices or food insecurity, but its exact relevance is unclear. The region is growing very fast economically, poverty is not significantly improving and urbanisation is rapidly increasing and adds to the complexity of the nexus of climate change and regional stability.

Regional stability: Past and ongoing development	Regional stability: Trends
Fragile states: No country in South Asia or South East Asia has political stability (Fragile States Index 2019). An alarming level of instability was observed in 2018 in Afghanistan, Pakistan and Myanmar.	High political instability will possibly affect people's ability to cope with possible future climate shocks especially in regions already highly vulnerable and exposed to adverse climate conditions and fragile political conditions such as Pakistan, Afghanistan and Myanmar. In particular, Pakistan may become a regional hotspot due to heat and water stress and irrigation issues affecting food security and regional stability (Alliance4water). Tensions between India and Pakistan may be negatively influenced by climate change (Factbook ECC Platform).
Migration: Internal migration occurred in parts of India and Bangladesh due to climate-induced events in recent years (IBRD and World Bank 2018). The number of people displaced by disasters in 2018 amounted to about 3 million, with India accounting for more than 2.6 million, Myanmar more than 290,000 and Bangladesh 78,000 internally displaced people. In 2018 Mongolia had 5,700 people internally displaced by natural disasters (IDMC 2019).	In South Asia, the number of climate migrants is projected to increase from 1.7–6.1 million people in 2020 to 16.9–35.7 million by 2050 across scenario averages (IBRD and WB 2018).

Regional stability: Past and ongoing development	Regional stability: Trends
Poverty: The region in general is growing fast. The growth in average annual GDP per capita in East Asia and South Asia are above the long-term average growth rate of developing countries (UN 2019). Asia has achieved remarkable economic progress in recent decades. Despite this, South Asia and East Asia are home to nearly half of the world's poorest people, rendering poverty a key issue to be addressed (World Bank 2018).	Despite elevated external headwinds, the short-term growth outlook in East Asia remains robust (UN 2019), but steady economic growth will not be enough in the next 1–3 years to lift the highly vulnerable region sustainably out of the poverty trap.

4.6. Central Asia and South Caucasus



Source: ND Gain 2019.

Central Asia and South Caucasus countries range mainly in the middle in terms of ND Gain scores (combination of vulnerability and readiness). They are mainly characterised by a relatively low level of vulnerability to climate change, but a low to middle level of readiness to make use of investments for adaptation (economic, social and governance readiness). Potential regional hot sports are Tajikistan, Uzbekistan and Turkmenistan.

Climate Change

Temperature increases in Central Asia and South Caucasus are significant and droughts have been observed in recent years. One of the main challenges is the negative impacts on water availability due to glacier retreat caused by increasing temperatures. Furthermore, increasing aridity and land degradation threaten the region.

Climate: Past and ongoing development	Climate: Trends
Precipitation: In northern Asia, observations indicate some increase in heavy precipitation events, but in Central Asia, no spatially coherent trends were found (IPCC 2014). Precipitation anomalies show general drying trends in the west of the region around the Caspian Sea and Caucasus (ERA-Interim). Floods and mudflows occur frequently across the region (USAID 2019).	There are inconsistent signals in models for projected changes in precipitation (IPCC 2014). Uzbekistan will probably get wetter and Turkmenistan will probably get drier (USAID 2019). The dry-getting-drier-and-wet-getting-wetter under climate change is a good first order approximation for the entire region. Changes in precipitation, such as snowfall being replaced by rainfall because of warming, are also expected to result in a decrease in river flow during the agriculturally important spring and summer months. Instead, river flow will likely increase in winter, resulting in winter floods and low river flow in the summer (USAID 2019). Forecasts of 1–3 years are not possible.
Temperature increases and heat: For the third year in a row, Central Asia was hit by an anomalously hot summer in 2019 (the diplomat 2019). The number of hot days is increasing (IPCC 2014). Across the region, temperature increases are strongest at low elevations, becoming less pronounced with increasing elevation (USAID 2019).	Hot days and heat extremes are likely to increase in the future in Central Asia and the Caucasus (IPCC 2014), but a 1–3-year forecast is not possible.

Climate: Past and ongoing development	Climate: Trends
Droughts: There has been spatially varying trends observed in dryness and drought for the region (IPCC 2014) leading to the destruction of harvests and resulting in drastic collapses of rural household income.	The region is likely to experience increased incidence of drought and lengthened dry spells. Higher temperatures will increase evapotranspiration, leading to drier conditions, even if precipitation does not change (USAID 2019). No projections can be made for a 1–3-year period.
Glacier retreat: Clear evidence from observations shows that glaciers are retreating throughout Central Asia (WGMS 2018) and Caucasus (WGMS 2018; Tielzide 2016; Bondyrev et al. 2015). As a short-term consequence, floods occur due to increased water flow. In 2015, floods took place throughout Tajikistan, not only damaging crops but also destroying houses (the diplomat 2019).	The shrinking of glaciers in Central Asia and the Caucasus is expected to increase and to influence downstream river run-off (IPCC 2014). In the short term, this can cause increasing water flow and flooding. Glacier retreat is progressing at a high pace, and is intensifying already critical conditions in the regions. The negative impacts for downstream regions are likely to be high.
Non-climatic drivers: Hydroelectric dams and huge infrastructure projects under the Belt and Road Initiative are being planned in the region. In Central Asia, competing demand for water for hydropower and irrigation between upstream and downstream countries has raised tensions (IPCC 2019 SROCC). Large dams affect downstream agriculture, mainly because they potentially disrupt water flows (EU Parliament 2018).	Huge infrastructure projects may exacerbate the negative impacts of climate change. Tajikistan's Roghun Dam will become the world's tallest dam, and will provide 80% of the country's electricity capacity (EU Parliament 2018).

Food

The main food challenges in Central Asia – where irrigated agriculture is widespread – are related to the adequacy of the water supply. Some parts of the region could profit from longer growing seasons, warmer winters and increased winter precipitation. Other parts of Central Asia are expected to become warmer and increasingly arid, exacerbating human-induced desertification (IPCC 2014).

Food: Past and ongoing development	Food: Trends
Agricultural production: Adequate water supply is a major challenge in Central Asia, where irrigated agriculture is widespread. In Uzbekistan, for example, 90% of the available water resources of the Amu Darya basin is used for crop irrigation (IPCC 2014). Over the last five years, cereal production remained stable in Central Asia (FAO 2019).	In the north and east of Kazakhstan, crop production will benefit from climate change, and in western Turkmenistan and Uzbekistan, crop production will be negatively affected by climate change. Frequent droughts could negatively affect cotton production, increase already high water demands for irrigation and exacerbate the existing water crisis and human-induced desertification (IPCC 2014). Total regional cereal production in 2019 was expected to be slightly above average, reflecting generally conducive weather conditions and expansions in crop areas (FAO 2019).

Food: Past and ongoing development	Food: Trends
Non-climatic drivers: Land degradation is a major challenge in Central Asia, with negative implications for rural livelihoods and food security. Land degradation is caused by land use and cover changes and deforestation. The region has one of the Earth's driest climates and has been subject to increased human pressures in recent decades, exacerbating the already harsh conditions and increasing desertification and reducing crop production. Turkmenistan (desertification) and Uzbekistan (salinised areas) are especially affected (Zoï 2010). Climate change exacerbates the negative impacts of land degradation and desertification.	Land degradation and desertification will most likely continue at a high pace in the coming 1–3 years. Furthermore, desertification amplifies global warming through the release of CO_2 linked with the decrease in vegetation cover (IPCC 2019 SRCCL). A warming by more than 1.5 °C showed an acceleration of desertification trends under a high emission scenario in the middle and northern parts of Central Asia (IPCC 2019 SRCCL).
Food prices and imports: Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan are heavily dependent on the import of cereals, mainly wheat. The significant level of these imports makes these countries highly vulnerable to international food markets, a vulnerability that can severely affect the food security of their populations. Tajikistan is able to cover only one third of its food consumption needs, while Kyrgyzstan and Uzbekistan cover around 47% and 22% of their needs, respectively. The share of household expenditure devoted to food is very high: 80% in Uzbekistan and Tajikistan, 58% in Kyrgyzstan, and as much as 42% in Kazakhstan (FAO 2018).	The region's high dependency on food imports makes it potentially vulnerable to adverse climatic conditions in other parts of the world, and therefore to potentially increasing food prices. World agricultural commodity prices are projected to stabilise in 2020 (World Bank 2019). In the importing countries of the region, domestic prices of wheat flour remained mostly stable during recent months. In Uzbekistan, prices were virtually unchanged in the first half of 2019, but started to increase in August. Similarly, in Kyrgyzstan, prices remained mostly stable (FAO 2019).
Food insecurity: The prevalence of undernourishment is of concern in Uzbekistan (7.4%), Kyrgyzstan (6.5%), and Turkmenistan (5.5%). The overall availability of food is not a severe problem, but high market prices limit economic access particularly among lower-income groups (FAO 2018).	Evidence points to a stagnation of the decreasing trend in food insecurity in recent years in some regions, particularly in Central Asia (FAO 2018). Projected drought risks in populated areas of Central Asia may have serious repercussions on food security in the medium to long term (Carrão et al.2016).

Water

Central Asia and South Caucasus face increasing challenges of sufficient water availability in light of the heavy dependence of the agricultural sector on precipitation, disrupted river run-off and groundwater supplies combined with increasing demand related to high population growth (IPCC 2014)

Water: Past and ongoing development	Water: Trends
Water availability: Adequate water supply is a major challenge particularly in Central Asia (IPCC 2014). High mountain areas are water towers that play a critical role in supplying lowland regions with water in Central Asia and Caucasus. Water availability is mainly driven by hydro-climatic variability, glacier	Given the already very high level of water stress in many parts of Central Asia, projected temperature increases, and precipitation decreases in the western part of Kazakhstan, Uzbekistan and Turkmenistan could exacerbate the problems of water shortages and distribution (IPCC 2014). Projections indicated a continued

Water: Past and ongoing development	Water: Trends
retreat due to temperature increases and human activities. Due to retreating glaciers, peak water has likely already been reached in the Caucasus and will be reached by mid-century in Central Asia (Huss and Hock 2018).	increase in winter run-off in many snow and/or glacier-fed rivers over the 21st century in high mountain areas of Asia (IPCC 2019 SROCC). Water shortages due to glacier melting may occur in the Caucasus region in the coming 1–3 years.
Shrinking of the big lakes. Water levels in the Aral Sea have decreased dramatically since the 1960s in a complex combination of global, regional and local processes, human-induced changes and climate change (Global Surface Water App 2019). The shrinking of big lakes such as the Aral Sea, is one of the major challenges for Central Asia and highly driven by institutional failures.	Huge technical and financial problems and differing objectives of stakeholders as well as differing views of the problems hinder any prospects for improvements in the near future. Climate change will exacerbate the negative impacts.
Water conflicts: Relations between Central Asian states have been shaped by long-running water disputes related to the overuse and mismanagement of the scarce water resources in the region (Factbook ECC platform 2019). Competing water interests within the transnational Syr Darya and Amu Darya basins are a longstanding condition (IPCC 2019 SROCC). In Central Asia, scarcity could be a contributing factor in water conflicts (Gleick 1993; Zhupankhan et al. 2018).	The ongoing water-related disputes in Kyrgyzstan, Uzbekistan and Tajikistan are multi-dimensional, and a quick resolution seems unlikely (Factbook ECC platform 2019). Within the transnational Syr Darya and Amu Darya basins, reductions in flow later in this century will exacerbate competition for water among multiple users, and may hamper future coordination. Other evidence from Central Asia suggests that relative water scarcity may not be the only factor to exacerbate conflict in this region (IPCC 2019 SROCC).
Non-climatic drivers: Growing demand for water is driven by soaring populations, by the increasing per capita domestic use due to urbanisation and thriving economic growth, and by the increasing use of irrigation (IPCC 2014) as well as by the increasing demand for hydropower (EU Parliament 2018).	There is high confidence that water demand in most Asian countries is increasing because of increases in population, irrigated agriculture and industry (IPCC 2014) and because of hydropower development. Water demand is expected to increase in the coming 1–3 years.
Water risks: Current overall water risks – both physical and regulatory (e.g. low access of people to safe drinking water and sanitation) – are high to extremely high or high in most parts of Central Asia and medium high or high in South Caucasus (WRI Aqueduct 3.0 2019).	No specific projections can be made for a 1–3-year period, but the risk of water shortages in arid areas of Central Asia already exists, and is projected to increase (IPCC 2014), colliding with the high water dependency of irrigated agriculture. Water demand in Turkmenistan and Uzbekistan is projected to increase significantly (WRI Aqueduct 3.0 2019).

Health

Health impacts for Central Asia are low compared to the other regions, but poverty and hunger present major challenges that are projected to increase. Furthermore, heatwaves will become more frequent affecting mainly urban dwellers over 65.

Health: Past and ongoing development	Health: Trends
Malnutrition: Poverty and hunger present major challenges across Central Asia, particularly in	Undernutrition attributable to climate change is projected to cause 473 additional deaths in Central Asia by

Health: Past and ongoing development	Health: Trends
Tajikistan and parts of the Kyrgyz Republic. As a result, impacts to the agriculture sector from increased drought, flooding and desertification could increase crop failures, decrease food security and significantly impact human health and nutrition.	2030 (WHO 2014). No specific projection can be made for a 1–3-year period.
Temperature increases and heat: An increase in the number of hot days is being observed in Central Asia (IPCC 2014).	The number of hot days and heat extremes will likely increase in Central Asia and the Caucasus (IPCC 2014). By 2030 Central Asia is projected to face 740 additional heat deaths attributable to climate change, mainly among people over 65 (WHO 2014). A 1–3-year forecast is not possible.

Regional stability

Climate has complex interactions with various drivers of conflict and instability, such as water scarcity or food insecurity, but its exact relevance is unclear. Climate change and climate variability have the potential to exacerbate or multiply existing threats to human security. The main challenges for the region are conflicts due to water availability and problems associated with domestic and international migration.

Regional stability: Past and ongoing development	Regional stability: Trends
Fragile states: Countries in Central Asia and South Caucasus mostly rank in the middle for political stability and fragility (Fragile States Index 2019). Warnings are in place for Georgia, Azerbaijan, Uzbekistan, Turkmenistan, Tajikistan and Kyrgyzstan. Most of the population is rural and depends on agriculture, so droughts and floods are heavily affecting local incomes. Furthermore, water has always been a contentious issue in Central Asia, particularly between Dushanbe and Tashkent (the diplomat 2019).	Water scarcity is perceived as a risk contributing to water conflicts (Zhupankhan et al. 2018) but it may not be the only factor exacerbating conflicts in the region (IPCC 2019 SROCC). Uzbekistan's economy relies heavily on water that flows out of Tajikistan, and a decrease in general water availability in Tajikistan will hit Uzbekistan hard and aggravate the tensions between the countries. Similar disputes may occur between Kyrgyzstan and Kazakhstan (the diplomat 2019). Most of the conflict situations are expected to continue over the next few years.
Migration: Tajikistan and Kyrgyzstan accounted for an important share of the region's new internal displacements associated with disasters. Days of heavy rain caused flooding in Tajikistan's southern province of Khatlon in May 2019, triggering more than 5,400 new displacements and damaging homes, roads, bridges and farmland. Landslides in the Jalal-Abad region of Kyrgyzstan triggered almost 4,700 new displacements in April 2018 (IDMC 2019).	Floods are one of the most significant weather-related drivers of population displacements globally (IDMC data series). Given the inconsistent signals for projected changes in rainfall, no projections can be made on a potential increase of internal displacement due to climate change.
Poverty: Central Asia has drastically reduced poverty over the last 30 years, but Central Asia's middle class is almost entirely concentrated in and around a handful of big cities, and the unemployment rate is the highest among youth and women. Furthermore, the cost of living in Central Asia's large cities is higher	Generally, the medium-term growth outlook for most countries in Central Asia calls for economic activities to moderate, reflecting the projected slowdown in China and the Russian Federation. The rate of poverty reduction will slow (World Bank 2019).

than the national average. In some cases, legal restrictions make domestic moves difficult (World Bank 2019).

4.7. Latin America and the Caribbean

Source: ND Gain 2019.

Overall climate-related risks are medium in most of the region and medium high in Central America and the Caribbean and some parts of the Andes. This risk assessment combines vulnerability and readiness to enhance adaptive capacity. Past trends in overall climate-related risk indicate slightly decreasing risks due to improved readiness to enhance adaptive capacity and decreasing levels of vulnerability. Potential hotspots where the risks are already high and the situation has worsened in the past few years are Central America, Haiti, Venezuela and Bolivia (ND Gain 2019).

Climate Change

High climate variability, extreme events and droughts are affecting parts of Latin America and the Caribbean, resulting in impacts such as major flooding, declining crop yields, glacier retreat and unevenly distributed water availability in parts of the region. The frequency and intensity of weather extremes is likely to increase.

Climate: Past and ongoing development	Climate: Trends
Precipitation: Rainfall extremes and in particular the occurrence of flash floods and landslides have increased in intensity and frequency in Central America and South America especially in south-eastern South America (IPCC 2014). The El Niño phenomenon periodically causes intense rainfall in Ecuador and Peru during the dry period, drastically increasing the risk for major flooding and landslides. The last very strong El Niño episode was observed in 2015–16.	Risk of flooding and landslides in urban and rural areas due to extreme precipitation is expected to increase until 2030 (IPCC 2014), but no projections can be made for a 1–3-year period. A forecasting algorithm indicates an 80% probability of the return of El Niño by the end of 2020. The strength and duration of the event, however, can not be forecasted (Ludescher et al. 2019).
Hurricanes and cyclones: A steady increase in extreme events, especially hurricanes, has been registered Central America and the Caribbean over the last 20 years. Hurricanes in Haiti and the Bahamas, especially *Dorian* in 2019, hit the recovery processes from previous events extremely hard. Increases in tropical cyclones and rainfall combined with relative sea level rise exacerbate coastal	Past shocks such as severe hurricanes in Haiti and the Bahamas in 2019 may have undermined adaptive capacity and may increase the vulnerability in upcoming years. This history may affect people's ability to cope with future shocks as countries and regions are still recovering from past events.

Climate: Past and ongoing development	Climate: Trends
hazards. In the Latin America and Caribbean regions 6–8% of the population live in areas that are at high or very high risk of being affected by coastal hazards (IPCC 2019).	
Droughts: Extreme droughts were reported in Amazonia in the last decade (IPCC 2014) and a significant change can be observed in the Greater Amazon basin (including Ecuador, Colombia and Bolivia), where the Amazon rainforest is shifting from being a carbon sink to a carbon source due to rising deforestation. The Central American Dry Corridor is one of the most susceptible regions in the world to climate change and variability with those countries being most prone to drought and long periods of heatwaves during El Niño years (FSIN 2019).	There is medium confidence that droughts will intensify over the 21st century in some seasons and areas due to reduced precipitation and/or increased evapotranspiration in Amazonia and North-east Brazil (IPCC 2014). But with ongoing deforestation the drought risk may increase in the coming few years as much of the rain that falls in a rainforest is linked to evapotranspiration from trees. Deforestation and drought considerably reduce evapotranspiration and therefore moisture fluxes to the lower atmosphere, leading in turn to less rain. This positive feedback reinforces the drought.
Glacier retreat: The trend of glaciers retreating has intensified, reaching critical conditions in the Andean countries (IPCC 2014).	Glacier retreat is progressing at a rapid pace intensifying already critical conditions in the Andes. The negative impacts for downstream regions are projected to be high.
Non-climatic drivers: Land use change, especially deforestation, is a key driver of environmental degradation in Latin America, and exacerbates the negative impacts from climate change. Deforestation attributed to increased agriculture has reached alarming levels. About 76,000 fires were burning across the Brazilian Amazon in 2019, an increase of over 80% over the same time period in 2018 (National Geographic 2019).	Deforestation will most likely continue at a rapid pace in Brazil given that the administration is encouraging more agricultural activity and reducing enforcement of illegal deforestation within the Amazon. Colombia, Bolivia and Peru have also experienced rising rates of primary forest loss in recent years (Global Forest Watch and WRI 2019) potentially continuing at a similar pace in the coming years.

Food

Decreased food production and lower food quality are key risks for the region, and are expected to remain high or unchanged until 2030 (IPCC 2014). Food insecurity is of concern in parts of the region, especially in Central America, Haiti and Venezuela, with climate shocks being among the key drivers of acute food insecurity both in the aftermath of a disaster and in the long run.

Food: Past and ongoing development	Food: Trends
Agricultural production: Agriculture in the region is heavily dependent on rain-fed systems for both subsistence and export crops and is vulnerable to climatic variations such as droughts, changing precipitation patterns and rising temperatures. In the last five years, cereal production increased in South America and remained more or less stable in Central America (FAO 2019).	Implications of climate change on future food production and food security show a large range of uncertainty with possibly increasing productivity of soybeans, maize and sugarcane (IPCC 2014) especially in the southern part of South America. In Central America, parts of the Andean region and North-eastern Brazil climate change could negatively affect crop yields and food security.

Food: Past and ongoing development	Food: Trends
In the Andean region, glacier retreat and snow cover changes have contributed to localised declines in agricultural yields in some parts of the tropical Andes (IPCC SROCC 2019).	No specific projections can be made for a 1–3-year period, but cereal production in Latin America and the Caribbean was expected to reach a new record high in 2019 with mostly average or above average yields in the sub-regions (FAO 2019).
Commodity prices: World agricultural commodity prices decreased over the last 18 months as a result of high global stock levels, favourable weather conditions in key producing regions, low energy costs and weakening demand for some commodities (World Bank 2019).	Prices are projected to stabilise in 2020 (World Bank 2019).
Non-climatic drivers: Increases in the global demand for food and biofuels promoted a sharp increase in agricultural production in South and Central America, associated mainly with the expansion of planted areas (IPCC 2014) and expansions of crop areas (FAO 2019).	Expansion of planted areas is predicted to continue in the future (IPCC 2014), and may lead to further production increase.
Food insecurity: In 2018, Latin America and the Caribbean counted 4.2 million food-insecure people in need of urgent action, mainly in Haiti, Central America (Corridor seco) and among Venezuelan migrants in South American countries. Climate shocks were among the main drivers of food insecurity in all those areas (FSIN 2019).	Conflicts and economic shocks as main drivers of food insecurity are likely to persist in some countries. Past climate-related disasters, such as back-to-back emergencies in Haiti and severe dryness in Central America are also the main drivers of food insecurity in the long run (FSIN 2019). Climate shocks such as dry spells and related production shortfalls together with high food prices are expected to be relevant drivers for food insecurity in Haiti and Central America in 2019.

Water

Water availability is a key issue for some areas in Central America and in semi-arid and glacier melt-dependent areas of South America (IPCC 2014). The risk is expected to significantly increase until 2030. Unevenly distributed water availability combined with high water stress are resulting in high water risks in parts of the region such as the west coast of South America, the Andes, the Caribbean and Central America.

Water: Past and ongoing development	Water: Trends
Water availability: Central and South America have high average but unevenly distributed availability of water resources. Water availability is of concern in Central America and in semi-arid and glacier melt-dependent regions of South America. Changes in stream flow and water availability have been observed in the whole region (IPCC 2014).	No specific projections can be made for a 1–3-year period, but the risk of unevenly distributed water availability is expected to increase and changes in stream flow and water availability are projected to continue until 2030. In semi-arid regions, risk of water supply shortages will increase owing to reductions in precipitation and increases in evapotranspiration (IPCC 2014).
Glacier retreat: The retreat of Andean glaciers is affecting the seasonal distribution of stream flows. In the tropical Andes most glaciers have already passed	Glacier retreat and reduction of snowmelt-related runoff in the Andes pose growing challenges for water users, especially for many cities and metropolitan areas

Water: Past and ongoing development	Water: Trends
peak water (IPCC SROCC 2019) meaning that annual run-off has already declined.	such as Lima, La Paz and El Alto, and Santiago de Chile already facing high water stress.
Non-climatic drivers: Water demand is high for agriculture, human consumption and hydropower generation. Water availability is of great concern for large cities, which are home to more than 20% of the population in the region (IPCC 2014).	Water demand is expected to increase with rapidly growing agricultural production, accelerated urbanisation and population growth, leading to higher water risks in the future.
Water risks: Current overall water risks – both physical and regulatory (e.g. low access of people to safe drinking water and sanitation) – are low-medium to medium-high in most of the region and hence lower than in all other regions analysed. High water risks are, however, identified for the west coast of South America and parts of the Andes, the Caribbean and Central America, mainly due to high water stress and high variability of available water supply (WRI Aqueduct 3.0 2019).	No specific projections can be made for a 1–3-year period, but water demand and water stress are expected to increase in almost all parts of the region with already high water risks (WRI Aqueduct 3.0 2019).

Health

Changes in weather and climatic patterns are negatively affecting human health in Central and South America by increasing morbidity, mortality and disabilities, and through the emergence of diseases in previously non-endemic areas (IPCC 2014). Many of the vector-borne and water-borne diseases in the region are sensitive to changes in weather patterns brought about by the El Niño phenomenon (World Bank 2014).

Health: Past and ongoing development	Health: Trends
Mosquito-borne diseases: Climate-related mosquito-borne diseases have appeared in previously non-endemic regions (e.g. malaria in the Andes, dengue in Central America and southern South America) (IPCC 2014).	Mosquitoes of the genus Aedes that can transmit dengue, zika and chikungunya show high sensitivity to temperature (transmission peak at 29°C) (UNEP 2018).
Dengue fever: In 2019, there was a substantial increase in reports of dengue infections – which are widespread in Latin America – compared with 2018. More than 3 million dengue cases were reported in the region, most of them in Brazil, followed by Nicaragua and Honduras (ECDC 2020).	The geographical range of dengue is expected to further expand due to climate change and urbanisation. With ongoing urbanisation, the number of people at risk is expected to increase, given that dengue is endemic in large areas of the region. There is, however, very little projected increase in deaths due to dengue fever attributed to climate change in the region (UNEP 2018).
Zika: The Brazil outbreak of 2016 was related to the hot and dry winter of 2015, influenced by the El Niño phenomenon, which contributed to the zika epidemic in South America.	As temperatures move towards the predicted thermal optimum (29 °C) owing to climate change and urbanisation, Zika could expand north and into longer seasons (Tesla et al. 2018).
Malaria: The number of malaria cases in the Americas is low compared to other regions (WHO 2019), but	With climate change, the malaria vectorial capacity will likely increase in parts of South America. In the short

Health: Past and ongoing development	Health: Trends
linkages between the El Niño phenomenon and malaria have been reported from several countries and regions (Colombia, Peru, Ecuador, Amazonia, Venezuela) (IPCC 2014).	term and with the high probability of the return of El Niño by end of 2020, the risk of malaria might increase. The projected increase in deaths due to malaria attributed to climate change is small to 2030 (UNEP 2018).

Regional stability

Climate has complex interactions with various drivers of conflict and instability, such as water scarcity, high commodity prices or food insecurity, but its exact relevance is unclear. Current instabilities, poor governance and poverty affect people's ability to cope with future climate shocks, especially in Central America, Haiti, Venezuela and Bolivia.

Regional stability: Past and ongoing development	Regional stability: Trends
Fragile states: Latin American countries mostly rank in the middle on political stability and fragility indicators (Fragile States Index 2019). A relatively high level of instability was observed 2018 in Haiti, Venezuela and Guatemala with worsening trends in Brazil, Venezuela, Bolivia and Chile.	Political and economic turmoil such as in Venezuela, Bolivia and Chile may trigger increases in food prices and further political instability and possibly affect people's ability to cope with possible future climate shocks (FSIN 2019). Perceptions of political instability suggest a high likelihood of political instability in Venezuela, Colombia and Nicaragua (World Bank 2019).
Migration: Many drivers of migration are climate sensitive, but the potential for migration is determined by the context where climate change occurs (Adger et al. 2015). In 2018, weather-related disasters and conflicts impacted El Salvador, Colombia, Brazil, Venezuela and Cuba. While conflicts were the main reason for new displacements in El Salvador and Colombia, natural disasters led to 67,000 new displacements in Colombia and 52,000 new displacements in Cuba (IDMC 2019).	The various social, political, economic, environmental and cultural factors influencing the decision to migrate make the assessment of environmentally induced migration a complex endeavour. In Central America and Mexico, models project 0.6 million internal climate migrants for 2020 and 1.4–2.1 million for 2050, with out-migration hotspots being mostly the lowland areas along the Gulf of Mexico and the Pacific coast of Guatemala (IBRD and World Bank 2018).
Poverty: Socioeconomic development shows a high level of heterogeneity and unequal income distribution, resulting in high vulnerability to climatic conditions for poorer populations. A stagnation in poverty reduction was observed in the last few years after a decade of sharp drops in poverty and extreme poverty (OECD 2019).	Current economic growth is insufficient to maintain the socioeconomic achievements of the last decade, with poverty and inequality reductions on hold (OECD 2019).

Annex

Annex 1: Sources

Overview of sources for the CC Foresight Analysis

Source, year	Title	Content relevant for CC Foresight Analysis	Links
Climate			
Global Drought Observatory (regularly updated)	Database of drought events	Updated information on global drought including drought reports for affected countries. Mostly short-term (monthly perspective), no projections.	https://edo.jrc.ec.europa.eu/gdo/
IPCC 2019 (SROCC)	IPCC Special Report on the Ocean and Cryosphere in a Changing Climate	Observed regional impacts from changes in oceans and the cryosphere. Relevant updated information for high mountain areas and coastal areas.	https://www.ipcc.ch/srocc/
IPCC 2019 (SRCCL)	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	Relevant updated information on risks to land-related systems from climate change. Some regional and country information available throughout the report, but no specific regional analysis.	https://www.ipcc.ch/srccl/
IPCC 2014	Fifth Assessment Report Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects.	Observed climate trends, future projections, vulnerability and impacts per sector (ecosystem, water, agriculture, health) as well as key risks for different regions (Africa, Europe, Asia, Australasia, North America, Central and South America, polar regions, small islands)	https://www.ipcc.ch/report/ar5/wg2/
IPCC 2012 (SREX)	Managing the risks of extreme events and disasters to advance climate change adaptation	Relevant information on risk and its determinants, on changes in climate extremes and their impacts. Not much regional information.	
MunichRe (regular update)	MunichRe NatCatSERVICE	Overview of natural loss events per year (losses, insured losses and fatalities globally and per country). Provides a good picture of past events, does not allow any projections.	https://natcatservice.munichre.com
ND Gain (yearly)	ND Gain Country Index	Country data on the ND Gain Index and its elements, which give a good overview of overall vulnerability and readiness.	https://gain.nd.edu/our-work/country-index/
USAID (different years)	Climate Risk profile by country or region	USAID regularly develops climate risk profiles by country, and provides an overview of historic and future climate and impacts.	accessible via www.climatelinks.org/
World Bank 2013, 2014	Turn down the heat: confronting the new	Information on regional impacts on key sectors. All relevant regions covered. Although	accessible via https://openknow

Source, year	Title	Content relevant for CC Foresight Analysis	Links
	climate normal (5 volumes)	not new, it gives a good overview on impacts per region.	ledge.worldbank.org/
WMO (regular update)	WMO El Niño/La Niña update	Regular update on short-term El Niño probabilities (a few months ahead). Relevant in a short-term perspective given that El Niño is the most important driver of climate variability and can trigger extreme weather events and disasters in various parts of the globe.	www.wmo.int
Food			
FAO (every 3 months)	FAO Crop prospects and food situation – Quarterly global reports	Quarterly global reports with regional reviews on cereal production incl. short-term forecast (early warning). Regular updates on countries requiring external food assistance and on low-income food deficit countries.	www.fao.org/giews/reports/crop-prospects/en/
FAO (biannual)	FAO Food Outlook - Biannual Report on Global Food Markets	Biannual update on production, trade and demand of different food products incl. short-term forecast. Not much regional information.	www.fao.org/giews/reports/food-outlook/en/
FAO (various years)	Regional overview of food security and nutrition (various regions)	Series of regional updates on food security and nutrition with climate variability and extremes being an important element	accessible via www.fao.org
FSIN Food Security Information Network (annual)	Global report on Food Crises	Country (and regional) information on food insecurity and its main drivers incl. forecast of acute food insecurity	www.fao.org/resilience/resources/resources-detail/en/c/1187704/
OECD–FAO (various years)	OECD–FAO Agricultural Outlook (e.g. 2018–2027)	Assessment of ten-year prospects for agricultural and fish commodity markets at national, regional and global levels. Each report has a regional focus.	www.agri-outlook.org/
Water			
WRI (yearly)	WRI Aqueduct Water Risk Atlas	Yearly update of global to local water risk and its components (physical and non-physical risks) including future scenarios for 2030–40.	www.wri.org/aqueduct
IRI/LDEO Climate Data Library (monthly updates)	WASP Indices	The WASP index (Weighted Anomaly Standardized Precipitation) gives a standardised measure of precipitation excess or deficits over a selected monthly or yearly accumulation period.	https://iridl.ldeo.columbia.edu/maproom/Global/Precipitation/WASP_Indices.html
Health			
ECDC (European Centre for	Surveillance Atlas of infectious diseases	Surveillance of various diseases such as cholera, dengue, chikungunya, etc.	www.ecdc.europa.eu/en/home

Source, year	Title	Content relevant for CC Foresight Analysis	Links
Disease Prevention and Control)			
UNEP 2018	The Adaptation Gap Report 2018	The 2018 edition has a focus on health. Background information on health impacts of heat, extreme events, climate sensitive infectious diseases and food and nutritional security. Includes some regional information, although not systematically.	www.unenvironment.org/resources/adaptation-gap-report
WHO 2014	Quantitative risk assessment of the effects of climate change on selected causes of death, 2030s and 2050s	Regional projections for selected climate related deaths. Although not new, it is still one of the most cited sources.	accessible via https://apps.who.int/iris/
Regional stability			
IBRD and World Bank 2018	Groundswell: Preparing for Internal Climate Migration	Conceptual information on climate change–migration nexus and climate migration projections for selected regions and countries (East Asia, South Asia, Central America)	https://openknowledge.worldbank.org/handle/10986/29461
IDMC (yearly)	Global Report on Internal Displacement	Annual data on new displacements by conflicts and disasters including regional overviews and country spotlights.	www.internal-displacement.org/global-report/
The Fund for Peace (yearly)	Fragile States Index	Measuring fragility: Risk and vulnerability in 178 countries. No link to climate, is a composite indicator for regional stability.	https://fragilestatesindex.org/

Annex 2: Methodology and outlook for CC Foresight

The challenges in assessing future climate risks

The CC foresight will conduct a short- to medium-term analysis of climate-related risks with a perspective of 1–3 years. The climate-related risks will be assessed with regard to food security, water, health and political stability. Challenges:

- In general, no specific weather or climate predictions can be made with a time horizon of 1–3 years. Extreme events are uncertain per se, and only a certain probability that they may occur may be projected into the future. Recurring events such as monsoons or the El Niño phenomenon have a certain circularity over the years, and under specific circumstances predictions can be made. A new model developed by researchers from the Potsdam Institute for Climate Impact Research and others allows the forecasting of an El Niño event about one year ahead. Slow onset events by definition occur slowly and sometimes gradually (e.g. sea level rise, glacier retreat). For such changes we can interpolate that they are ongoing at the same or even at higher pace and hence implications for a 1–3-year period are very likely.
- The 1–3-year perspective is below the time horizons of climate change assessments (2030 and beyond). High frequency and intensity of climate extremes in the present or near past and a projected increasing frequency and intensity of such events in the future (IPCC perspective 2030) does not mean that frequency and intensity of such events will be necessarily higher in the short term. But we can assume that current extremes and related damages have an implication on the short-term risk environment as they may negatively influence vulnerability in upcoming years and the ability to cope with future shocks as people are still recovering from past events (e.g. current extreme drought influencing agricultural yields and food security in the near term or recovery from tropical cyclones lasting for years).

Assumptions and methodological implications

- The current risk situation and hotspots are strongly influencing the risk situation 1–3 years out, hence it is crucial to identify and understand the current risk situation and hotspots.
- The climate-related risks not only depend on the climate signal (intensity, frequency of climate-related hazards, changes in variability, etc.), but to a large extent on exposure and vulnerabilities of people and ecosystems (see Figure 1), on the ability to address those risks (readiness, adaptive capacity, etc.) and on other non-climatic drivers. The analysis of climate risks absolutely requires the consideration of the relevant non-climatic factors. The ND Gain Index (https://gain.nd.edu/our-work/country-index/), summarizing a country's vulnerability to climate change and other global challenges in combination with its readiness to improve

resilience, is in our view a good base for describing current climate-related risk on a general level and in a comprehensive manner.

- In the short-term (1–3-year) perspective, changes of such non-climatic factors (e.g. land use changes, political turmoil, population increase, etc.) are more relevant for the whole risk situation than any changes on the climate side, and are the main drivers influencing the capability to cope with climatic change events if they occur.
- To a certain extent we can analyse past or current events or trends to make a rough forecast of near-term risks. This is the case of current extremes, where we assume that they have a longer-term effect on future risks (e.g. extreme droughts or floods, damaging tropical cyclones).
- Climate variability is more relevant for our time horizon than projected climate change and hence it is important to understand current variability. Nevertheless, we consider the IPCC Fifth Assessment Report and IPCC special reports as important information sources to identify relevant current risks and impacts and observed changes by region. Projected changes for 2030 can give an indication of potential future changes that in some cases might be relevant in the short term (especially the case for gradual changes such as glacier retreat).
- Surveys on perception of risks are interesting sources of information for assessing future risks as they have a forward-looking perspective by nature. There are, however, very few such data sources (e.g. WEF Risk Report, Perception of political instability indicator). Another source for short-term risk perception may be price developments in agricultural commodity futures.

Outlook

The analysis could be further refined by considering the following methodological improvements:

- More detailed assumptions on current hazards and the probability of future hazards could be made with insurance data (e.g. SwissRe NatCat, MunichRe NATHAN, not open, not for free) and with the CLIMADA model of ETHZ (under development). CLIMADA is a probabilistic natural catastrophe damage model based on four elements: assets (geographical distribution of people, houses, activities, public infrastructure), damage functions, hazards (only some hazards included so far) and adaptation measures.
- Changes in the non-climatic factors of climate change risk such as land use changes, population growth, economic trends, etc. can be better predicted than climatic factors, and are highly relevant to the risk level. A more systematic analysis of projected changes for such indicators and different socioeconomic scenarios could be included in the analysis.

- Research and analysis on key climate risks and hotspots are evolving. A few examples: key risks and impact hotspots are updated in the upcoming IPCC 6th Assessment Report, which is currently in a first order draft stage. CGIAR is currently mapping hotspots of climate change and food insecurity (results to be available in the first quarter of 2020). A regular update of the current analysis would benefit from new insights and research.

Annex 3: Consulted experts

- Dominique Bérod, WMO
- David Bresch, ETHZ
- Bruce Campbell, Research Program on Climate Change, Agriculture and Food Security (CCAFS), CGIAR
- Christian Huggel, University of Zurich, Department of Geography
- John Matthews, Alliance4water
- Otto Simonett, Zoï Environment Network
- Philip Thornton, CGIAR

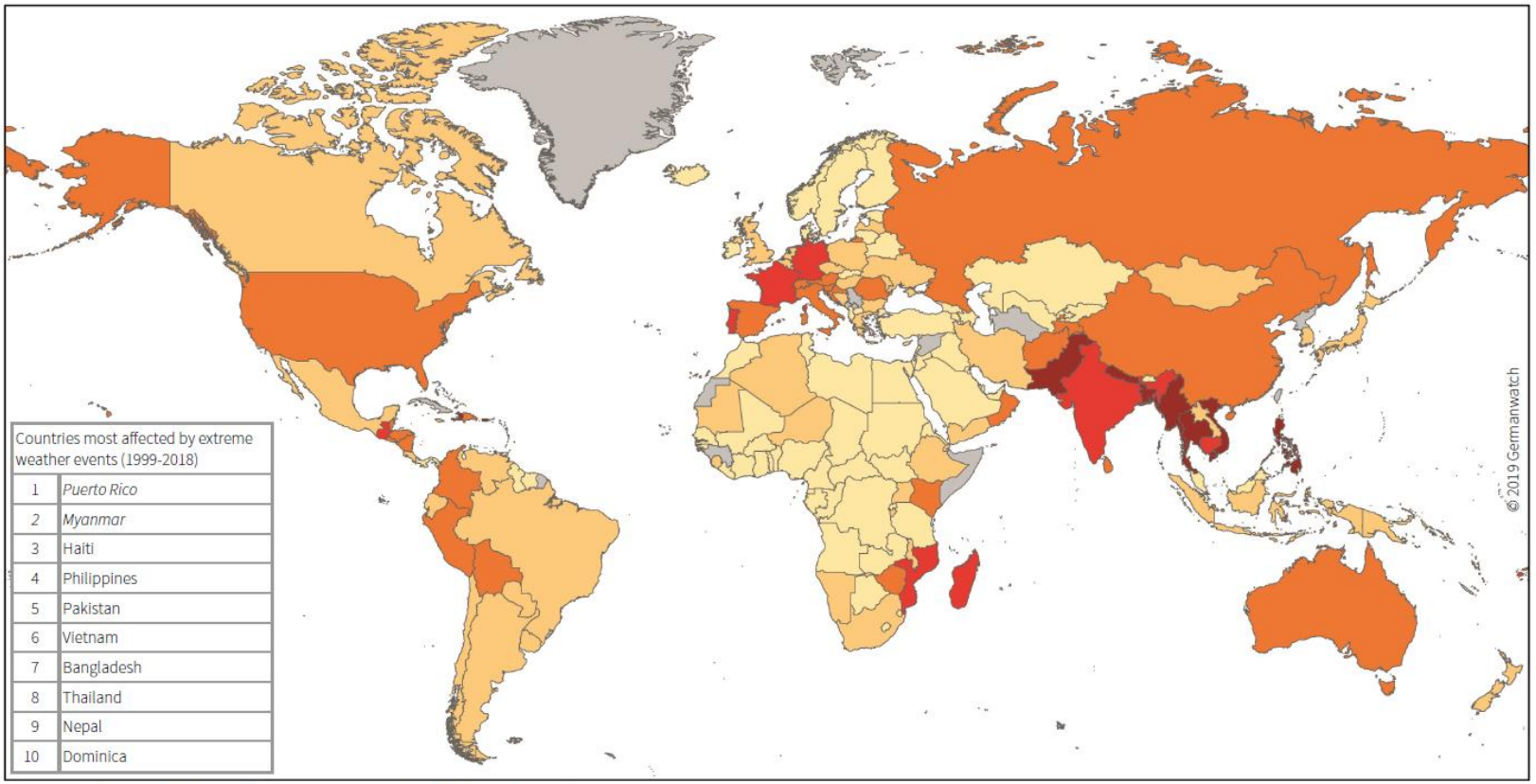
Annex 4: Climate Risk Index (Germanwatch)

The Climate Risk Index (CRI) analyses the extent to which countries and regions have been affected by impacts of weather-related loss events (storms, floods, temperature extremes and mass movements). It is based on the worldwide data collection and analysis provided by MunichRe's NatCatSERVICE. The CRI includes the following indicators:

1. Number of deaths
2. Number of deaths per 100,000 inhabitants
3. Sum of losses in US$ in purchasing power parity (PPP)
4. Losses per unit of gross domestic product (GDP)

The scope of the CRI is more specific than the ND Gain used in the CC foresight analysis, and must not be mistaken for a comprehensive climate vulnerability scoring. In contrast to the ND Gain, the vulnerabilities and adaptive capacities are only indirectly considered (e.g. lower number of deaths and losses in regions with low vulnerabilities and high adaptive capacities in case of a hazard). The CRI focuses on extreme weather events but does not take into account important slow-onset processes such as rising sea levels, glacier melting or more acidic and warmer seas. Furthermore, it is based on past data and should not be used as a basis for a linear projection of future climate impacts (Germanwatch 2019).

Figure 4: Climate Risk Index, Ranking 1999-2018



Italics: Countries where more than 90% of the losses or deaths occurred in one year or event

Source: Germanwatch 2019