MOZAMBIQUE

AFRICAN DEVELOPMENT BANK

NATIONAL CLIMATE CHANGE PROFILE

PRODUCED IN COLLABORATION WITH:

African Climate & Development Initiative, University of Cape Town;
Climate Systems Analysis Group, University of Cape Town;
Energy Research Centre, University of Cape Town; Cirrus Group.

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MOZAMBIQUE

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ACKNOWLEDGEMENT

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1. BACKGROUND

1.1 Geographic and socio-economic context

Mozambique is a geographically diverse country on the East coast of Southern Africa, bordered by Tanzania, Malawi, Zambia, Zimbabwe, Swaziland and South Africa. In terms of geographic spatial extent, Mozambique is a relatively large country at ~785,000 km2 (16th in Africa) and with an extensive coastline of ~2,470 km (4th longest in Africa). Despite considerable socio-economic development and investments in growth over the past two decades, Mozambique's population of ~29.5 million people are among the poorest and most climate-vulnerable in the world – in terms of GDP per capita, Mozambique's population are the 7th poorest nation in Africa with an average annual income of USD 382. Furthermore, it is estimated that ~62-69% of the population live below the international poverty line of USD 1.90 per day, one of the five highest poverty rates in Africa. The majority of Mozambique's population (~69% of whom live in rural environments) are reliant on diverse forms of crop and/or livestock agriculture as well as fishing (mainly in the coastal zones) and other forms of natural resource-based livelihoods and ~80.5% of the workforce is in agriculture. As a result of Mozambique's climatic and geographic diversity, the country is exposed to a wide range of environment- and climate-related challenges and hazards that result in negative impacts on vulnerable households, such as droughts, floods and tropical cyclones. It is estimated that ~6,000,000 Mozambicans were affected by drought in the period 1996-present, particularly the arid and semi-arid zones in the south. In addition to the impacts of drought, Mozambique is also particularly vulnerable to flood which are estimated to have impacted at least ~7.44 million people during the period 1996-present. The country's vulnerability to floods can be attributed to multiple factors, including the relatively dense coastal population (~13.3 million people live within 100km of Mozambique's coast), the large number of rivers and major river basins draining through the country (including nine major transboundary river basins), and the intense rainfall events that characterise the wet seasons. The ND-GAIN index summarizes the country's vulnerability to climate change and other global challenges in combination with its readiness to improve resilience. Mozambique's index is 38.6 which represents a low readiness score and a high vulnerability score. This indicates that the country has both a great need for investment and innovations to improve readiness and a great urgency for action. Mozambique also has a low level of human development with a human development index of 0.42, one of the lowest in Africa. Key socio-economic and demographic indicators for Mozambique are further presented and summarised in Table 1-1, below.

Figure 1-1: Map of Mozambique

Table 1-1: Socio-Economic Context of Mozambique (reference year ranges from 2014 – 2017)

<table>
<tr><th colspan="2">VARIABLE</th><th>SCORE/TOTAL</th><th>UNIT</th><th>RANK (IN AFRICA)</th></tr>
<tr><td colspan="5">Geography, Socio-Economy and Demographics</td></tr>
<tr><td colspan="2">Population[1]</td><td>29,537,914</td><td>people</td><td>12</td></tr>
<tr><td colspan="2">Population growth rate[1]</td><td>2.7</td><td>% population .yr-1</td><td>18</td></tr>
<tr><td colspan="2">Population density[1]</td><td>38</td><td>People/km2</td><td>36</td></tr>
<tr><td colspan="2">Land area[1]</td><td>785,583</td><td>km2</td><td>16</td></tr>
<tr><td colspan="2">% Urban population[1]</td><td>30.6</td><td>% population</td><td>40</td></tr>
<tr><td colspan="2">% Urbanisation rate[2]</td><td>3.8</td><td>% population .yr-1</td><td>23</td></tr>
<tr><td colspan="2">Economy: total GDP[2]</td><td>11.0</td><td>USD billions .yr-1</td><td>25</td></tr>
<tr><td colspan="2">Economy: GDP by PPP[2]</td><td>35</td><td>billion international dollars .yr-1</td><td>23</td></tr>
<tr><td colspan="2">Economy: GDP/capita[2]</td><td>382</td><td>USD per capita/yr</td><td>47</td></tr>
<tr><td colspan="2">Population below the poverty line[3]</td><td>~62-69%</td><td>% below USD 1.90 per day</td><td>5</td></tr>
<tr><td colspan="2">Gender Inequality Index[4]</td><td>59.1</td><td></td><td>15</td></tr>
<tr><td colspan="2">GINI co-efficient[3]</td><td>45.6</td><td></td><td>20</td></tr>
<tr><td colspan="2">HDI[5]</td><td>0.42</td><td></td><td>46</td></tr>
<tr><td colspan="2">Access to electricity[6]</td><td>21.2</td><td>% population</td><td>38</td></tr>
<tr><td colspan="5">Summary indicators of climate change vulnerability</td></tr>
<tr><td colspan="2">Workforce in agriculture[7]</td><td>80.5</td><td>% workforce</td><td>3</td></tr>
<tr><td colspan="2">Population undernourished[8]</td><td>25.3</td><td>% population</td><td>14</td></tr>
<tr><td colspan="2">Number of people affected by drought[9]</td><td>5,999,500</td><td>people</td><td>12</td></tr>
<tr><td colspan="2">Number of people affected by flood events[9]</td><td>7,441,603</td><td>people</td><td>2</td></tr>
<tr><td colspan="2">Population living within 100 km of coast[10]</td><td>13,250,474</td><td>people</td><td>6</td></tr>
<tr><td colspan="2">Population living in informal settlements [6]</td><td>80.3</td><td>% urban population</td><td>7</td></tr>
<tr><td colspan="2">Incidence of malaria[8]</td><td>298</td><td>cases per 1000 population at risk</td><td>10</td></tr>
<tr><td rowspan="3">ND-Gain Vulnerability Index[10]</td><td>Total</td><td>38.6</td><td></td><td>29</td></tr>
<tr><td>Readiness</td><td>0.32</td><td></td><td>30</td></tr>
<tr><td>Vulnerability</td><td>0.55</td><td></td><td>25</td></tr>
</table>

2. CLIMATE AND WEATHER

Mozambique has a tropical climate with a single wet season during austral summer and a dry season during winter. Rainfall is high especially over the Northern and Western Highlands and lower over the Limpopo and Zambezi valleys within the country. The water region or catchments of Mozambique extend far beyond the country's borders; The Zambezi River catchment extends into Zimbabwe, Zambia and Malawi where rainfall is generally lower than over Mozambique with the exception of the far north. The Limpopo River catchment extends into southern Zimbabwe, Northern South Africa and eastern Botswana. Rainfall over the catchment is generally low with the exception of the higher elevation areas.

Climate variations within the full rainfall region are large, and therefore six sub-regions are distinguished here. Two of these regions, the Upper Zambezi Basin and the Semi-arid Limpopo regions fall primarily outside of Mozambique while the other four regions are located within the country. The Mozambique region is illustrated in Figures 2-1 and 2-2, below, and summary descriptions can be found in Table 2-1 below.

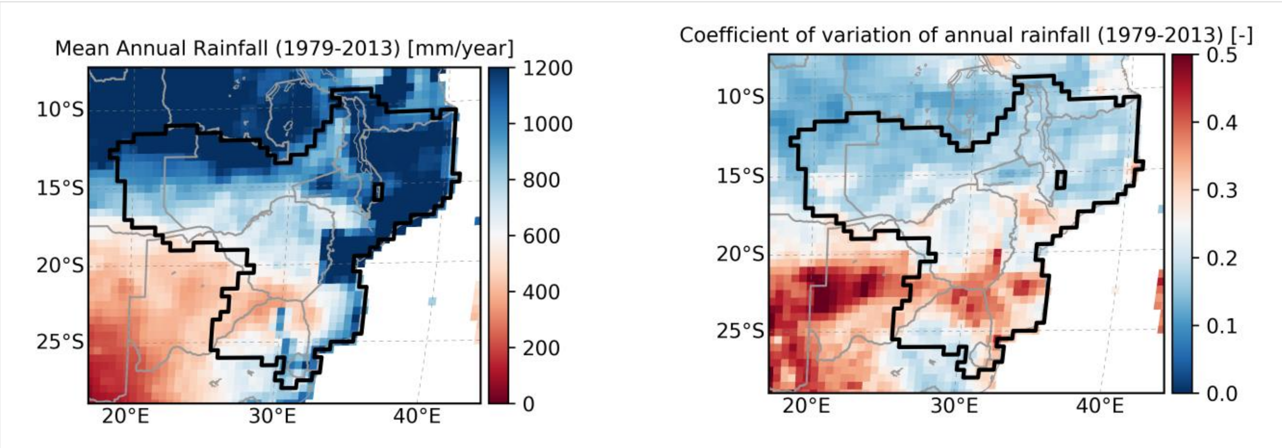
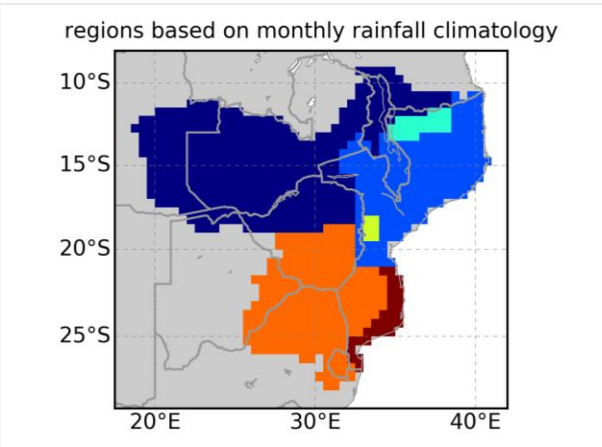


Figure 2-1: Main characteristics (magnitude and variability) of rainfall in Mozambique and its region



Coloured regions on the map (above) correspond to the colours used in rainfall and temperature graphs (below)

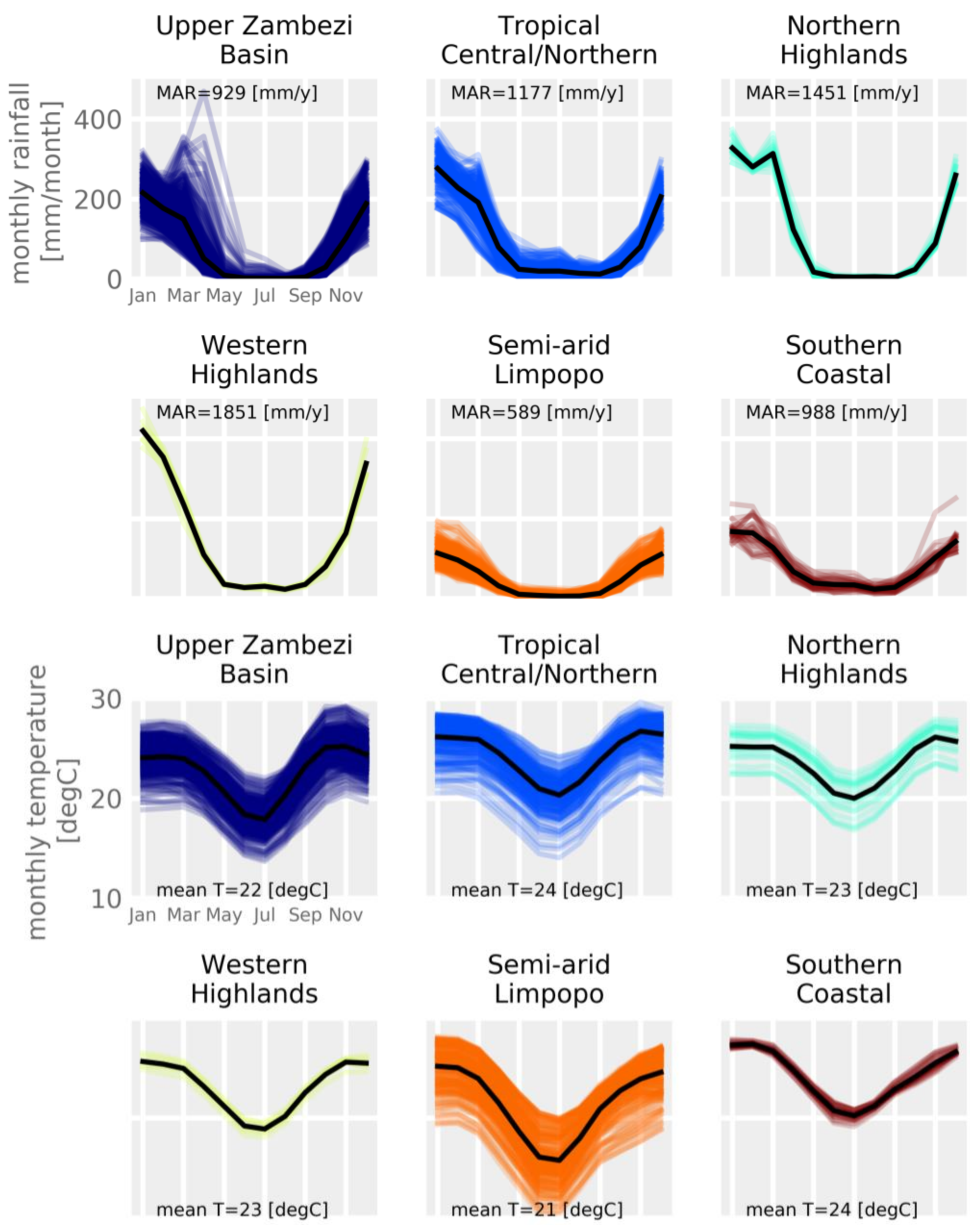


Figure 2-2: Rainfall regions of Mozambique based on similarity of standardised rainfall climatology, and their rainfall and temperature climatologies

Table 2-1: Main characteristics of rainfall of Mozambique region

UPPER ZAMBEZI BASIN	A large heterogeneous rainfall region with a mean annual total rainfall of 930 mm/year and daily mean temperatures of 22° C. Rainfall is generally higher over the northern parts and decreases to the south and year to year variability is low to the north becoming more moderate to the south. Rainfall occurs in a single austral summer season generally peaking in January, however some locations show a later peak during March or May. A relatively dry season occurs from June to September. Temperature shows a clear seasonal cycle of roughly 8° C between austral summer and winter.
NORTHERN HIGHLANDS	A small high rainfall region with a mean annual total rainfall of 1450 mm/year and relatively low year to year variability and daily mean temperatures of around 23° C. Rainfall occurs during the austral summer season from November to April peaking above 300 mm/month during January to March. Temperature shows a clear seasonal cycle of roughly 6° C between austral summer and winter.
TROPICAL CENTRAL/ NORTHERN	A large generally wet region with a mean annual total rainfall of around 1180 mm/year and daily mean temperatures of around 24° C. Rainfall is generally lower with more pronounced year to year variability over southern Malawi and eastern Tete province. Rainfall generally occurs during austral summer peaking above 200 mm/month from December to March and a relatively dry season from May to September. Temperature shows a clear seasonal cycle of roughly 7° C between austral summer and winter.
WESTERN HIGHLANDS	A very small high rainfall region with a mean annual rainfall total of 1850 mm/year with moderate variability from year to year and daily mean temperature of 23° C. A clear wet season occurs from November to March, peaking at 400 mm/month during January. A clear cry season occurs from May to September. Temperature shows a clear seasonal cycle of roughly 7° C between austral summer and winter.
SEMI-ARID LIMPOPO	A larger semi-arid region with a mean annual total rainfall of 590 mm/year and daily mean temperature of around 21° C. Rainfall is lowest over the lower elevation areas along the Limpopo River basin and higher over the higher elevation of southern Zimbabwe and northern South Africa. The variability of rainfall from year to year is high to moderate over the region. Rainfall occurs in a single summer season from October to March with a clearly defined dry season from May to September. Temperature shows a clear seasonal cycle of roughly 9° C between austral summer and winter.
SOUTHERN COASTAL	A coastal rainfall region with a mean annual total rainfall of 990 mm/year with moderate rainfall variability from year to year and daily mean temperatures of 24° C. Rainfall occurs throughout the year but is highest during austral summer. Temperature shows a clear seasonal cycle of roughly 8° C between austral summer and winter.

2.2 Observed historical climate variations and climate change trends

The majority of **southern Mozambique** experiences **relatively high rainfall variability** on an inter-annual basis, especially within the Limpopo River catchment. The **northern parts of Mozambique** and the Zambezi River catchment experiences **lower interannual rainfall variability**. On **decadal time scales** Mozambique also experiences **significant variability**, especially over the Southern Coast and Western Highlands, with some periods being relatively drier or wetter than others. This variability can be seen in the supporting evidence plots provided in the supplementary Appendix **(Figures A-1 to -4).**

Long term trends across the region show **increasing temperatures** over the period 1979 – 2015, although that trend appears to be weaker in the last decade of that period. Long term trends in total annual rainfall are generally not evident, and if they are, they are not statistically significant. The Upper Zambezi Basin and the Southern Coastal regions show the strongest positive trends, the Sem-arid Limpopo region shows a less clear upward trend and the Western Highlands region shows a downward trend. No trend is generally seen in the frequency of rain events or extreme rain events. Long term trends and variability in the Mozambique region are summarized in **Table 2-2** below and illustrated further in the supplementary Appendix **(Figures A-1 to A-4).**

Table 2-2: Summary of trends in rainfall and temperature attributes in Mozambique (1979 - 2015)

REGION	MEAN T [DEG C/DECADE]	TOTAL RAINFALL [MM/DECADE]	EXTREME RAINY DAYS [DAYS/DECADE]	RAINY DAYS [DAYS/DECADE]
Upper Zambezi Basin	+0.19	+27.9	not evident	+3.1
Northern Highlands	+0.13	not evident	not evident	not evident
Tropical Central/Northern	+0.24	not evident	not evident	not evident
Western Highlands	+0.16	downward	slight downward	not evident
Semi-arid Limpopo	+0.21	upward	slight upward	not evident
Southern Coastal	+0.24	+65.5	+1.8	not evident

2.3 Projected (future) climate change trends, including temperature, precipitation and seasonality

Projected changes in main attributes of climate for the Mozambique region are summarized in Table 2-3, below, and described in Sections 2.2.1 and 2.2.1. Additional analysis and visualisation of projections be found in **Figures A-5 to A-8** in the supplementary Appendix.

2.3.1 Projected changes in precipitation from present to 2100

Rainfall projections across the Mozambique regions show a pattern of rainfall remaining within the historical range or potentially decreasing especially during the latter half of the century. That pattern appears to be consistent across the six climatic regions and for the CMIP5 model ensemble. The relative magnitudes of potential decreased rainfall varies strongly between regions from 10% in the very wet Western Highlands to 50% in the Semi-arid Limpopo region. No clear change in the frequency of rainfall events, or extreme rainfall events is evident in the projections.

2.3.2 Projected changes in temperature from present to 2100

Air temperature is projected to be between 1°C and 3.5°C warmer over the Mozambique regions by the 2050s. By 2100 the range of projected temperatures is greater ranging between 2.5°C to 6°C.

Table 2-3: Summary of projected climate changes across regions of Mozambique for key climate variables by 2050

REGION	AVERAGE TEMPERATURE [°C]	TOTAL ANNUAL RAINFALL [MM/YEAR]	NUMBER OF HEAVY RAINFALL [DAYS/YEAR]	RAINY DAYS [DAYS/YEAR]
Upper Zambezi Basin	**Increasing** +1.5°C to +3.5°C by 2050s but changes evident in next decades	**Normal to decreasing**, ranging from no change or nominal decreases to clear decrease (15% drier by 2100). Change could become evident from 2060s.	**Moderate decrease**, no change to strong increase, ranging from a decrease in frequency of around 20% or an increase of up to 50% by 2100. Change could become evident from around 2040.	**Decreasing**, ranging from not significant to clear decline of up to 20% by 2100. Change could become evident from around 2040.
Northern Highlands	**Increasing** +1.5°C to +2.5°C by 2050s but changes evident in next decades	**Normal to decreasing**, ranging from no change or nominal decreases to clear decrease (20% drier by 2100). Change could become evident from 2070s.	**Normal to increasing**, the majority show no change, while that show an increase range from nominal to extreme increases (100% more frequency by 2100).	**Normal to decreasing**, half show no change, while others show up to 25% decrease by 2100. Change could become evident from around 2040.
Tropical Central/Northern	**Increasing** +1.5°C to +2.5°C by 2050s but changes evident in next decades	**Normal to decreasing**, ranging from no change or nominal decreases to clear decrease (25% drier by 2100). Change could become evident from 2070s. A few models project an increase into the future.	**Moderate decrease**, no change to strong increase, a decrease in frequency of around 30% or increase of up to 60% by 2100.	**Decreasing**, half show no change by 2050, but almost all show a decrease of up to 20% by 2100. Change could become clear from around 2040.
Western Highlands	**Increasing** +1.5°C to +3°C by 2050s but changes evident in next decades	**Normal to decreasing**, ranging from no change or nominal decreases (10% drier by 2100). Change could become evident from 2070s. A few models project an increase into the future linked to strong decadal variability.	**Normal**, the vast majority of models remain within the range of natural variability. However, two modes show a strong increase (up to 100%) and two show a moderate decrease of up to 50% by 2100.	**Decreasing**, half show no change by 2050, but almost all show a decrease of up to 25% by 2100. Change could become clear from around 2070.

REGION	AVERAGE TEMPERATURE [˚C]	TOTAL ANNUAL RAINFALL [MM/YEAR]	NUMBER OF HEAVY RAINFALL [DAYS/YEAR]	RAINY DAYS [DAYS/YEAR]
Semi-arid Limpopo	**Increasing** +1˚C to +2˚C by 2050s but changes evident in next decades	**Normal to decreasing**, most models show no change with a few showing strong decreases and (50% drier by 2100) and one showing increasing rainfall. Change could become evident from 2040s.	**Normal**, the vast majority of models remain within the range of natural variability. A couple show a decrease in frequency.	**Decreasing**, most show no change until 2050, but almost all show a decrease of up to 25% by 2100. Change could become clear from around 2050.
Southern Coastal	**Increasing** +1˚C to +2˚C by 2050s but changes evident in next decades	**Normal to decreasing**, most models show no change with a few showing clear decreases and (25% drier by 2100) and one showing increasing rainfall. Change could become evident from 2040s.	**Normal**, projections remain within the range of variability of baseline period.	**Decreasing**, half show no change by 2050, but almost all show a decrease of up to 25% by 2100. Change could become evident from around 2040.

2.4 Expected climate vulnerabilities

NOTE: Determining vulnerability of different sectors to climate variations or change is extremely challenging as there are many factors involved in vulnerability and different approaches can yield different results. The vulnerabilities presented here are based on UNFCCC reporting documents such as national communications or national adaptation plans of action where available, and other literature where UNFCCC documents are not available.

Located on the western side of the Indian Ocean tropical Mozambique experiences regular tropical storms and the occasional tropical cyclone, whose future trajectory of change is as of yet unknown, yet whose increasing intensity and frequency could have devastating consequences. Around a third of the Mozambican population live in coastal zones, with the low lying human settlements and associated developments, as well as fishing activities, further vulnerable to severe flooding, sea-level rise and associated stresses. Increasing temperature trends and indications of normal to decreasing rainfall trends will increase pressure on Mozambique's water resources, with consequences for households, industry and agriculture. Water related and direct impacts of increasing temperatures and changes to rainfall patterns is of further concern for both the economy and for food security, given the important role of agriculture, a highly climate sensitive sector which engages the majority of the Mozambican work force. The large proportion of Mozambicans living below the poverty line means that the majority of the population have very limited capacity to adapt to increase in extreme temperatures, as well as to the slower knock-on effects that climate change may have on the economy.

Table 2-4: Broad scale sectoral vulnerabilities and potential climate change impacts in Mozambique

SECTOR	IMPACTS
Agriculture	- Crop loss and reduced yields
Fisheries	- Increased salinization - Decreased availability of aquaculture - Damage to coastal ecosystems, particularly coastal mangrove systems, owing to flooding and loss of habitat
Water resources	- Decreased water quality owing to pollution - Reduced availability and quality of water resources
Built infrastructure and human settlements	- Damage to and destruction of infrastructure due to flooding from extreme rainfall or coastal flooding from increased sea levels and storm surge - Increased potential for displacement of people
Human health	- Changes in the geographic distribution and the prevalence in vector-borne diseases such as malaria - Increased prevalence of water-borne diseases during flooding events, including diarrheal disease - Less predictable disease transmission owing to the combination of variable rainfall and complex temperature changes

3. GREENHOUSE GAS EMISSIONS AND ENERGY USE

The major carriers of Mozambique's energy mix, and the energy demands of major economic sectors, are summarised in Section 3.1, below. The major sources of GHG emissions, described by fuel source and sector, are described in Section 3.2. The latter section also includes summarised statistics on Mozambique's agriculture sector, historical land use change and vegetation cover.

3.1 National energy production and consumption

Unless stated otherwise, all energy figures are derived from UN Stats (2014) [10]; World Energy Council (2016); [11]; and the World Resources Institute (2013) [12]. Agriculture & forestry-related emissions are also reported from Food and Agriculture Organisation (2014-2017) [14] and Global Forest Watch. (2015-2017) [15]. The tables and figures below describe Mozambique's energy sector, including national electricity production, primary energy supply and national energy consumption by fuel carrier.

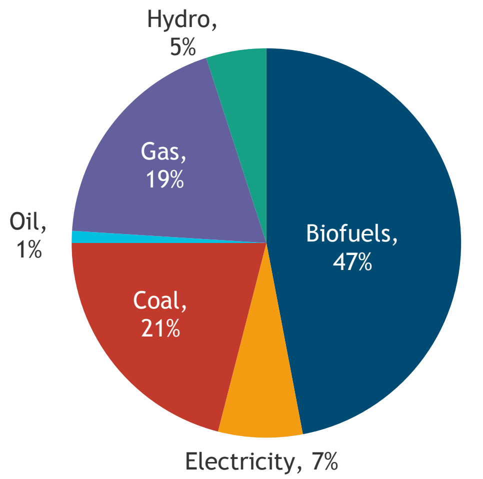


Figure 3-1: Distribution of Mozambique's national energy production between major energy carriers (2014-2016)

Table 3-1: National energy and electricity production in Mozambique (2014-2016)

NATIONAL ENERGY PRODUCTION		
Source	**Total (MTOE) [1]**	**% of total energy production**
Coal[12]	4.1	21.9
Oil[12]	0.1	0.3
Gas[12]	3.8	20.5
Hydro[13]	1.0	5.5
Biofuels[12]	9.3	49.7
Electricity[12]	1.4	7.6
Total national energy production	18.6	100.0

1 Energy is expressed in 'Megatonnes of Oil Equivalent', where 1 Tonne Oil Equivalent = 11,630 KiloWatt hours (KWh)

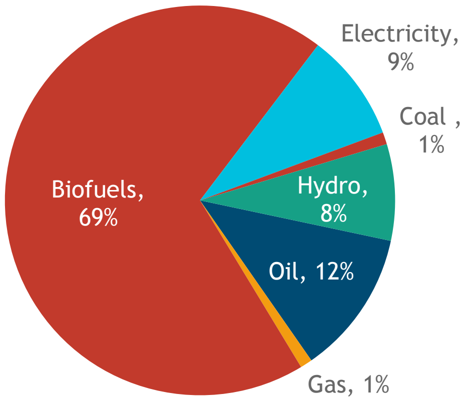


Figure 3-2: Distribution of Mozambique's national energy consumption by major energy carriers

Table 3-2: Mozambique's national energy consumption by energy source

CONSUMPTION BY ENERGY SOURCE	
Source	**Total (MTOE)**
Coal[12]	0.1
Oil[12]	1.5
Gas[12]	0.2
Hydro[14]	0.9
Biofuels[12]	8.3
Electricity[12]	1.1
Total national energy consumption by source	11.1

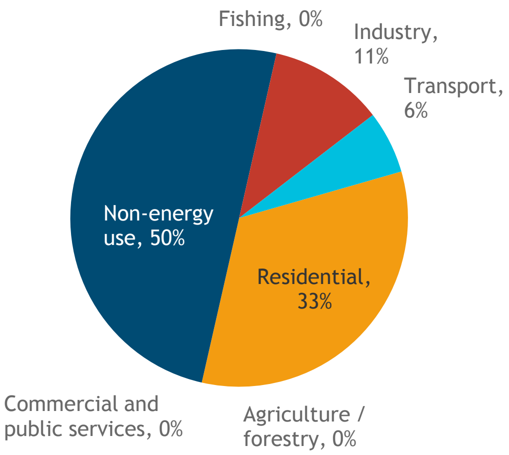


Figure 3-3: Distribution of Mozambique's national energy consumption by sector (2014-2016)

Table 3-3: Mozambique's national energy consumption by sector (2014-2016)

CONSUMPTION BY SECTOR[12]	
Source	**Total (MTOE)**
Industry	2.4
Transport	1.3
Residential	7.3
Commercial and public services	0.02
Agriculture / forestry / fishing	0.05
Non-specified	0.1
Total national energy consumption by sector	11.1

Table 3-4: Mozambique's national total primary energy supply (estimated for 2014-2016)

TOTAL PRIMARY ENERGY SUPPLY[12]	
Source	**Total (MTOE)**
Coal	0.2
Oil	1.9
Gas	0.6
Biofuels	9.3
Electricity	1.2
Total primary energy supply	13.1

3.2 National greenhouse gas emissions by source and sector

Section 3.2.1, overleaf, describes GHG emissions from fuel combustion – these figures include direct combustion of fuels as a primary energy carrier as well as conversion to other forms of energy (e.g. as electricity). These figures are based on statistics from the International Energy Agency (IEA). Section 3.2.2, further below, describes GHG emissions from all sectors of national energy consumption, which therefore includes emissions from fuel combustion, industrial/manufacturing processes, household-level energy consumption and AFOLU (Agriculture, Forestry and Other Land Use). The latter figures are compiled by the World Resources Institute's Climate Access Indicator Tools (CAIT), which employs different methodologies and reporting standards to the IEA. Therefore, while there is some resultant duplication between the two datasets, each provides slightly different approaches to categorisation of major GHG emitting sectors and are both included for consideration.

3.2.1 GHG emissions from fuel combustion, by source and sector

Table 3-5: Mozambique's national greenhouse gas emissions from fuel combustion

NATIONAL GHG EMISSIONS FROM FUEL COMBUSTION BY FUEL SOURCE AND SECTOR [15]		
Source / Sector		Total emissions (MT CO_2e)
Coal		0.0
Oil		2.6
Gas		0.3
Total fuel source emissions		3.0
Electricity and heat production		0.2
Other energy industry own use*		0.04
Manufacturing industries and construction		0.5
Transport	Road	1.9
	Other	0.2
	Total	2.1
Other	Residential	0.1
	Non-residential	0.1
	Total	0.2
Total sector emissions		3.0

** Includes emissions from own use in petroleum refining, the manufacture of solid fuels, coal mining, oil and gas extraction and other energy-producing industries.*

3.2.2 GHG emissions from primary energy consumption, by source and sector

There are multiple sectors and energy sources which contribute to Mozambique's GHG emissions profile, of which consumption of fossil fuel and electricity in the formal energy sector contributes relatively little emissions. As a result of the limited extent of electricity supply infrastructure, industrial development and primary manufacturing, the primary consumption of consumption contributes only 5.9 MT CO2e to total annual emissions out of a total of ~67 MT CO2e. Of the 5.9 MT CO2e emissions attributed to Mozambique's energy sector, ~88% is accounted for by transport, fugitive emissions and other fuel combustion, while the sectors of electricity, manufacturing and construction combined accounted for ~12%.

In contrast, the large majority (over 90%) of Mozambique's total GHG emissions can be attributed to direct and indirect emissions from the sectors of agriculture (~17.9 MT CO2e) and Land Use Change/Forestry (~39.3 MT CO2e). The activities which drive the large GHG emissions from these sectors are mainly related to: i) land use change from conversion to agriculture; ii) production and consumption of woodfuels, particularly to supply charcoal to urban areas; and iii) widespread and frequent wildfires in savanna, woodland and forest ecosystems (described further in Section 3.2.3, below).

Table 3-6: Mozambique's national greenhouse gas emissions from primary energy consumption (estimated for 2014-2016)

NATIONAL GHG EMISSIONS FROM PRIMARY ENERGY CONSUMPTION BY SOURCE AND SECTOR [16]		
Source / Sector		**Total emissions (MT CO_2e)**
Energy	Electricity and heat	0.2
	Manufacturing and construction	0.5
	Transport	2.1
	Other fuel combustion	2.5
	Fugitive emissions	0.6
	Energy sub-total	5.9
Industrial processes		1.0
Agriculture		17.9
Waste		2.7
Land use change and forestry (LUCF)		39.3
Total emissions (including LUCF)		66.7

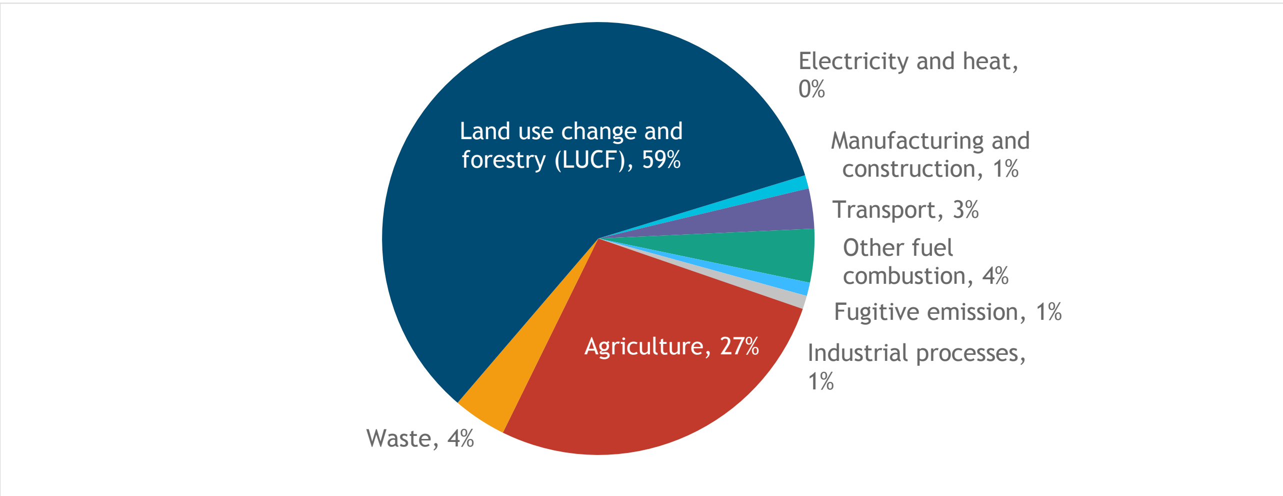


Figure 3-4: Distribution of Mozambique's GHG emissions by major sectors

3.2.3 GHG emissions from agricultural practices

According to FAO estimates (Table 3-7, further below), burning of savanna (to clear land for agriculture as well as to support renewal of pastoral resources in livestock grazing areas) contributes ~12.7 MT CO2e to Mozambique's annual GHG emissions while fires in forested areas contribute as much as ~37.4 MT CO2e. Livestock production, including enteric fermentation and various practices related to manure management, contributes ~3.7 MT CO2e while rice cultivation and application of chemical fertilisers adds another ~1 MT CO2e to the GHGs emitted by Mozambique's agriculture sector.

Table 3-7: National annual greenhouse gas emissions from agricultural practices, forestry and other land use in Mozambique (estimated for 2014-2017)

VARIABLE		ANNUAL EMISSIONS (MT CO_2E)
Annual GHG emission from agricultural practices [17]	Burning - crop residues	0.2
	Burning - savanna	12.7
	Crop residues	0.2
	Enteric fermentation	1.7
	Manure management	0.4
	Manure applied to soils	0.2
	Manure left on pasture	1.4
	Rice cultivation	0.6
	Synthetic fertilizers	0.4
	Sub-total (Agricultural practices)	17.7
Annual GHG emission from land use change [17]	Forest land	37.4
	Burning biomass	2.3
	Sub-total (Land use change)	39.7
Total emissions		57.4

Global Forest Watch and FAO statistics indicate that up to ~84% of Mozambique's landscape is under some form of tree cover, including ~41 million, ~17 million and ~9 million hectares of tree cover up >30%, >50%, and 50-100%, respectively. Intense deforestation pressure is ongoing and sustained in the aforementioned woodland and forest areas, experiencing annual deforestation rates of up to 0.9%. Global Forest Watch reports that the total aboveground biomass carbon held in Mozambique's woodlands and forests is ~1,651.2 million tonnes of carbon.

Table 3-8: Vegetation cover and land use change in Mozambique (estimated for 2015)

VARIABLE		TOTAL (HECTARES)	TOTAL (% OF LAND AREA)	UNIT
Total tree cover [18]	10-30% canopy cover	41,232,817	51.58	% of total land area
	30-50% canopy cover	17,195,019	21.5	
	50-100% canopy cover	9,224,746	11.5	
	Total	67,652,581	84.6	
Land use change and agricultural expansion	Historical annual rate of deforestation[16]	10-30% canopy cover	0.1	% of previous year
		30-50% canopy cover	0.4	
		50-100% canopy cover	0.7	
	Area of agricultural land[20]	50,217,052	62.8	% of total land area

4. SUMMARISED NATIONAL PRIORITIES FOR CLIMATE CHANGE ADAPTATION AND MITIGATION

Mozambique's main priority actions related to climate change are described in the country's submissions to the UNFCCC through the Intended Nationally Determined Contributions (NDC) document. The document includes detailed descriptions of Mozambique's major commitments and priorities related to GHG mitigations (Table 4-2, below) as well as major priorities related to adaptation, derived from the draft National Adaptation Plan (NAP) (Table 4-3, further below).

Mozambique communicated its mitigation contribution in the form of actions (policies/programmes) and also included an adaptation component in its NDC. Mozambique is participating in the Second Phase of the Technology Needs Assessment Project (TNA), covering the following sectors: i) energy and waste; ii) agriculture; and iii) coastal zones, including infrastructures. This process will result in a Technological Action Plan identifying the needs, including the financial and capacity building needs in those sectors. This information is relevant to identify the necessary means to implement the proposed actions.

Table 4-1, below, gives details on Mozambique's GHG reduction targets outlined in the country's NDC, with information on target gases and sectors, the use of international markets in achieving targets (e.g. the use of carbon credits), and accounting methods used to quantify GHG emissions (e.g. inclusion of land use and land use change).

Table 4-1: Summary of Mozambique's NDC commitments for reduction of GHG emissions

GHG EMISSIONS REPORTED IN NDC (MT CO2E/YR)	BASE LEVEL	REDUCTION TARGET	TARGET YEAR	SECTORS AND GASES	USE OF INTERNATIONAL MARKETS	LAND-USE INCLUSION / ACCOUNTING METHOD
57.66	N/A	Policies and measures, with estimated reductions of 76.5MtCO2e	N/A	CO2, CH4, N2O; Energy, transports, land use, land use change and forestry, waste	Mozambique is willing to participate in the market mechanisms to be established	N/A

4.1 National priorities for climate change mitigation

Mozambique's NDC identifies diverse priorities for climate change mitigation in major sectors including energy, AFOLU, waste and transport. Proposed activities and investments within each sector are further categorised according to 'Technology Type', based on the categories of technologies listed by the Green Climate Fund's (GCF) impact indicators for mitigation projects (key for technology types provided below Table 4-2). With respect to the Energy sector, Mozambique has identified multiple strategy- and policy-level measures to reduce GHG emissions by identifying and developing low-emission options for generating and distributing energy. These include inter alia development of revised national energy strategies, new policies for promotion of biofuel, measures to conserve and increase the sustainability of biomass fuel use, and developing plans and policies for increased use of LPG in energy distribution and electricity generation. In the AFOLU sector, Mozambique's largest priority is the upscaling and implementation of the National REDD+ strategy, which is focused on addressing multiple drivers of emissions from Mozambique's land use sector as the largest single source of GHG emissions nationally. The waste management sector includes at least two identified priorities, including inter alia the establishment of two solid waste landfills with equipment for recovery of methane gas, as well as the implementation of a revised strategy for integrated management of urban waste. With respect to the transport sector, one of Mozambique's largest sources of emissions from fuel combustion, national priorities include measures to increase the sustainability and integration of urban transport and public mass transit systems in urban areas.

Table 4-2: Mitigation priorities in Mozambique's NDC

PRIORITY SECTOR	SECTOR-SPECIFIC ACTION	TECHNOLOGY TYPE[2]
Energy	Energy strategy	1, 6
	Biofuel policy and strategy	1, 2
	New and renewable energy development strategy	1
	Conservation and sustainable use of the energy from biomass energy strategy	1, 4, 9
	Master plan for natural gas	1
	Renewable Energy Feed-in Tariff Regulation	1
AFOLU	National REDD+ Strategy	4, 9
Waste	Project to build and manage two solid waste landfills with the recovery of methane	4, 9
	Mozambique's Integrated Urban Solid Waste Management Strategy	
Transport	Project of Urban Mobility in the Municipality of Maputo	2, 8

[2] **GCF Technology Type Key (derived from GCF's Results Framework for adaptation)*
1. Increased resilience and enhanced livelihoods of the most vulnerable people, communities, and regions.
2. Increased resilience of health and wellbeing, and food and water security
3. Increased resilience of infrastructure and the built environment to climate change threats
4. Improved resilience of ecosystems and ecosystem services
5. Strengthened institutional and regulatory systems for climate responsive planning and development
6. Increased generation and use of climate information in decision making
7. Strengthened adaptive capacity and reduced exposure to climate risks
8. Strengthened awareness of climate threats and risk reduction processes

4.2 National priorities for climate change adaptation

Mozambique's national framework for action on climate change includes detailed adaptation priorities, including explicit priorities identified for sectors such as AFOLU, Water, Health, Community-based actions, and Institutional actions. Mozambique's proposed activities and investments related to adaptation are further categorised according to 'Technology Type', based on the categories of technologies listed by the Green Climate Fund's (GCF) impact indicators for adaptation projects (key for technology types provided below Table 4-3). Community-based and institutional-level actions are relatively similar, in that adaptation priorities are closely related to increasing the awareness, capacity, and coordination of stakeholders from local levels upwards to institutional levels. At a community level, measures to increase local awareness and understanding of messages on climate change are needed as well as information on how to avoid the worst health impacts of climate change, particularly for the most vulnerable communities. At an institutional level, increased investments in monitoring and research of climate change impacts is needed. In addition, Mozambique's NDC priorities the increased strengthening of national mechanisms for issuing Early Warnings. In the AFOLU sector, Mozambique's priorities relate to vulnerable populations such as herders, crop farmers and fishers who are faced with uncertain livelihoods as a result of climate change and who require additional investments in food security and nutrition. In addition, AFOLU priorities include increased protection and management of biologically diverse areas and natural resources such as soils – therefore Mozambique's adaptation priorities will also include measures to increase planting of valuable trees and protect soils from degradation. In the water sector, Mozambique's priorities for adaptation are focused on improving national capacity for integrated water resource management, which may include the construction of climate-resilient infrastructure for management of water resources.

Table 4-3: Adaptation priorities in Mozambique's NDC

PRIORITY SECTOR	SECTOR-SPECIFIC ACTION	TECHNOLOGY TYPE[3]
AFOLU	Increase the effectiveness of land use and spatial planning (protection of floodplains, coastal and other areas vulnerable to floods)	1, 3
	Increase the resilience of agriculture, livestock and fisheries, guaranteeing the adequate levels of food security and nutrition	1, 2, 4
	Ensure biodiversity protection	4, 5
	Reduce soil degradation and promote mechanisms for the planting of trees for local use	4, 7
Community-based	Increase the adaptive capacity of the most vulnerable groups	1, 2, 5
	Reduce people's vulnerability to climate change related vector-borne diseases or other diseases	1, 2, 5
	Elaborate and implement a strategy for climate change education, awareness raising, communication and public participation	5, 8
Water	Improve the capacity for integrated water resources management including building climate resilient hydraulic infrastructures	2, 3, 4
Institutional	Reduce climate risks through the strengthening of the early warning system and of the capacity to prepare and respond to climate risks	6, 8
	Develop resilient climate resilience mechanisms for infrastructures, urban areas and other human settlements and tourist and coastal zones	3, 7
	Strengthen research and systematic observation institutions for the collection of data related to vulnerability assessment and adaptation to climate change	5, 6, 7
	Promote the transfer and adoption of clean and climate change resilient technologies	5, 7
	Update the sectoral policies to mainstream climate change adaptation and risk reduction	5, 8

[3] **GCF Technology Type Key (derived from GCF's Results Framework for adaptation)*

1. Increased resilience and enhanced livelihoods of the most vulnerable people, communities, and regions.

2. Increased resilience of health and wellbeing, and food and water security

3. Increased resilience of infrastructure and the built environment to climate change threats

4. Improved resilience of ecosystems and ecosystem services

5. Strengthened institutional and regulatory systems for climate responsive planning and development

6. Increased generation and use of climate information in decision making

7. Strengthened adaptive capacity and reduced exposure to climate risks

8. Strengthened awareness of climate threats and risk reduction processes

5. ASSUMPTIONS, GAPS IN INFORMATION AND DATA, DISCLAIMERS

The observed and projected climate trends described in Section 2 'Climate and Weather' are derived from a combination of publicly-available observational data and CMIP5 climate models. Detailed information is included in Section 6. Appendix 1, including '6.1.b. Historical Trends and Variability Analysis' and '6.1.c. Climate Projections Visualisations'.

Unless stated otherwise, all statistics reported in Section 1 ('Geographic and Socio-Economic Context' and Section 3 'Climate change mitigation, greenhouse gas emissions and energy use') are derived from databases of publicly available datasets managed by international or multilateral agencies including inter alia The World Bank Group, the United Nations, World Resources Institute and International Energy Agency.

Unless stated otherwise, all energy and greenhouse gas emission figures are derived from UN Stats (2014); World Energy Council (2016); the World Resources Institute (2013), and the International Energy Agency (2016). Agriculture & forestry-related emissions are also reported from Food and Agriculture Organisation (2014-2017) and Global Forest Watch. (2015-2017). Full references are provided as a supplementary appendix.

As a result of the use of standardised methodologies and data sources across the 25 countries included in this AfDB Climate Change Profile, statistics and estimates reported herein may differ from other publicly available datasets or national estimates. Readers are advised to always check for updated publications and newly released national datasets.

This AfDB Climate Change Profile series is intended to provide a brief touch-stone reference for climate change practitioners, project managers and researchers working in African countries. The figures and estimates provided herein are intended to inform the reader of the main climate-related challenges and priorities, however these should be used to inform a process of additional research and in-country consultations. The University of Cape Town, the African Development Bank and its Boards of Directors do not guarantee the accuracy of figures and statements included in this work and accept no responsibility for any consequences of its use.

MOZAMBIQUE

6. APPENDIX 1

1.a Supporting evidence

The climate projections detailed in Chapter 2 (above) are supported by rigorous analysis of observed and model projections data. More details of this analysis and supporting figures can be found below.

1.b Historical trends and variability analysis

The analysis of historical trends and variability of key climate variables is presented below. This analysis uses the WATCH Climate Forcing dataset which has been selected as the most broadly representative of station observations across Mozambique. Long term (1979 to 2013) trends as well as inter-annual variability (decade to decade) has been analysed for total annual rainfall, number of rainfall days, number of extreme rainfall days, and daily mean temperatures (1979-2014) for each of the six climate regions across Mozambique. The plots below detail inter-annual variability (dotted lines), decadal variability (smooth bold solid curves) and long term trends (thin straight lines) for each region and statistic. This allows for comparison of different types of variability against the long term trend. It can be seen that for rainfall statistics, inter-annual and decadal variability are typically fairly large compared to long term trends. For example, for total annual rainfall, the Tropical Central/Northern region has very high inter-annual (900mm in some years to 1400mm in other years) and moderate decadal variability (1100mm in some decades to 1300mm in other decades). The long term trend is not statistically significant but could be around 90mm over the 30 year period.

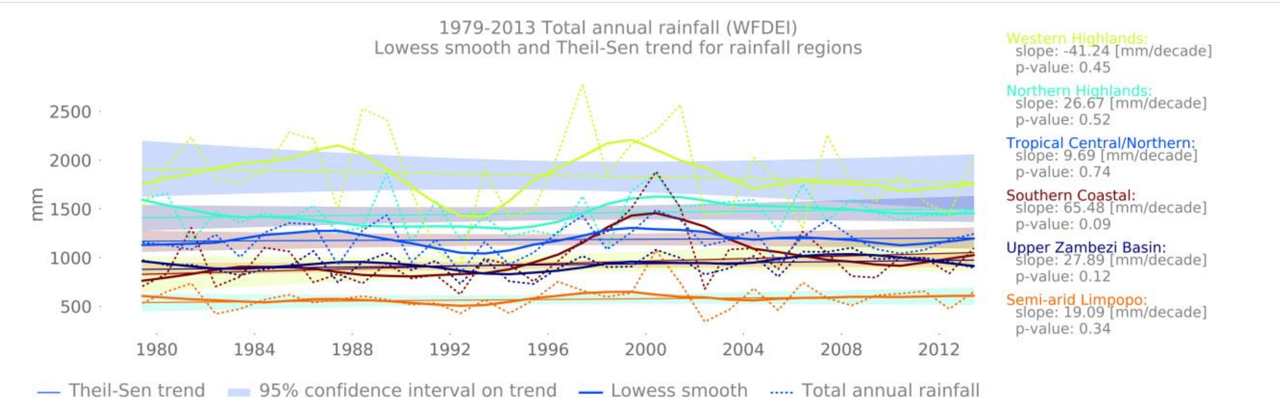


Figure A-1: Long term trends and variability in total annual rainfall for rainfall regions

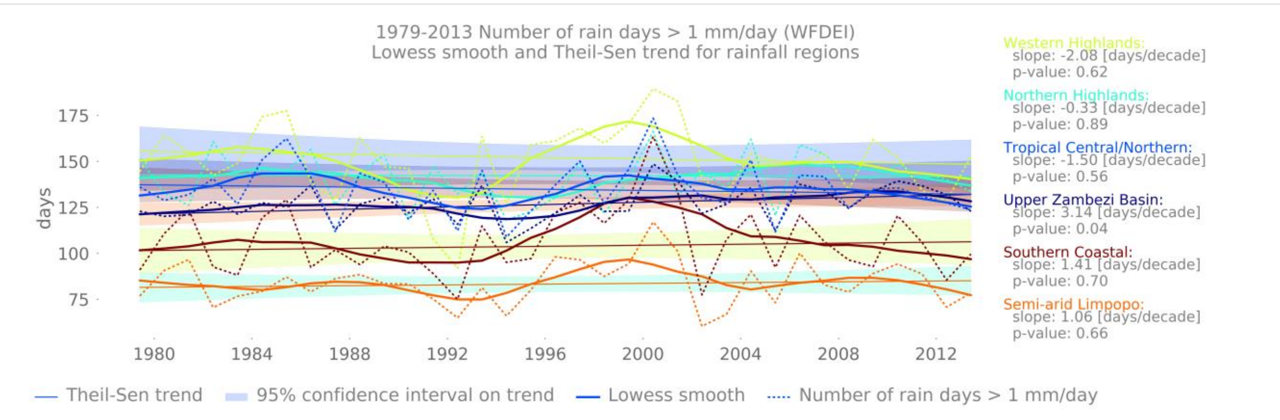


Figure A-2: Long term trends and variability in frequency of rainfall events for rainfall regions

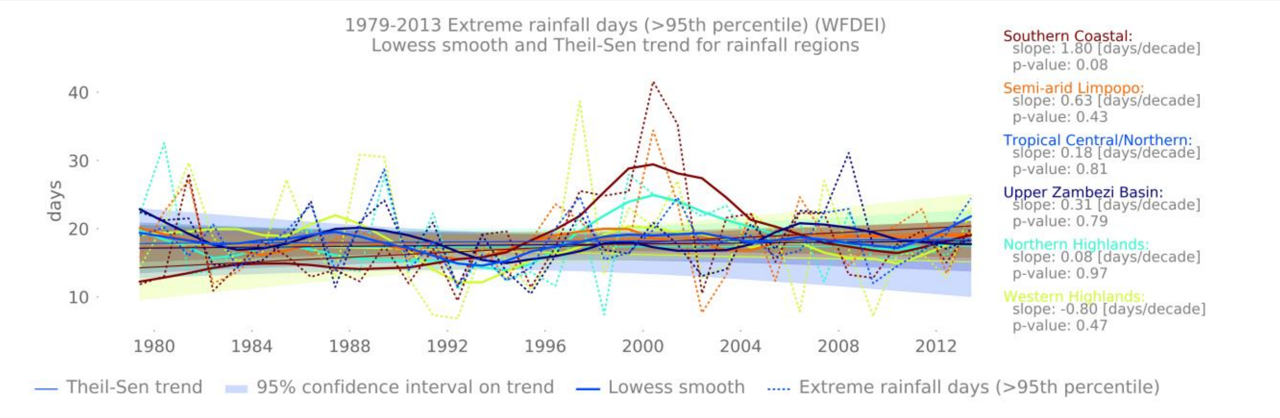


Figure A-3: Long term trends and variability in extreme rainfall events for rainfall regions

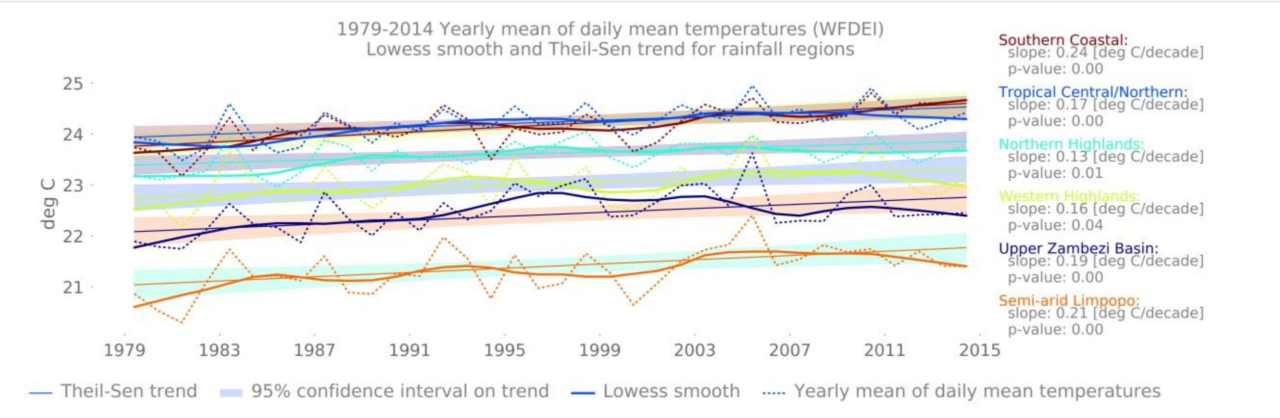


Figure A-4: Long term trends and variability in daily mean air temperatures for rainfall regions

1.c Climate projections visualizations

The plots below (Figures A-5 – A-8) are called plume plots and they are used to represent the different long term projections across the multiple climate models in the CMIP5 model archive used to inform the IPCC AR5 report. The plots show projected variations in different variables averaged over the climate regions. The blue colours indicate variations that would be considered within the range of natural variability, so in other words, not necessarily the result of climate change. The orange colours indicate projection time series where the changes would be considered outside of the range of natural variability and so likely a response to climate change. It is important to note that these are global climate model projections and so likely do not capture local scale features such as topography and land ocean boundary dynamics. They also may not capture small scale features such as severe thunderstorms that can have important societal impacts. Finally, these projections are averages over relatively large spatial areas and it is possible that different messages would be obtained at small spatial scales and if various forms of downscaling are performed.

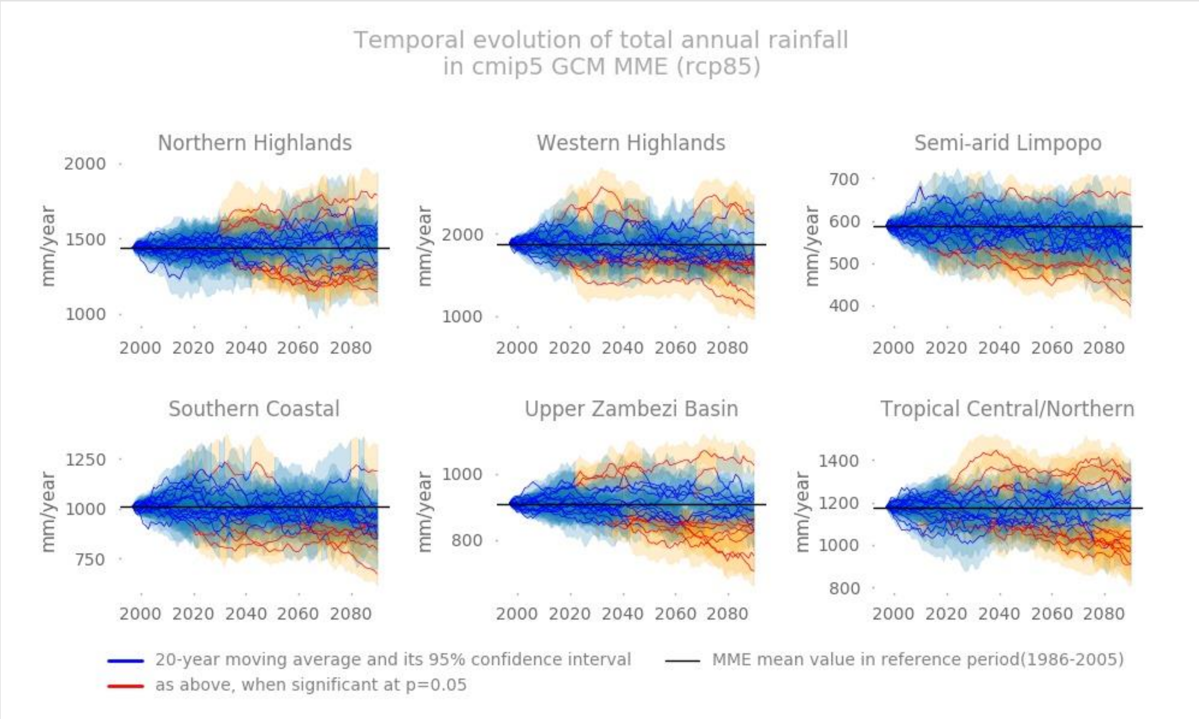


Figure A-5: Projected changes and emergence of changes in total annual rainfall

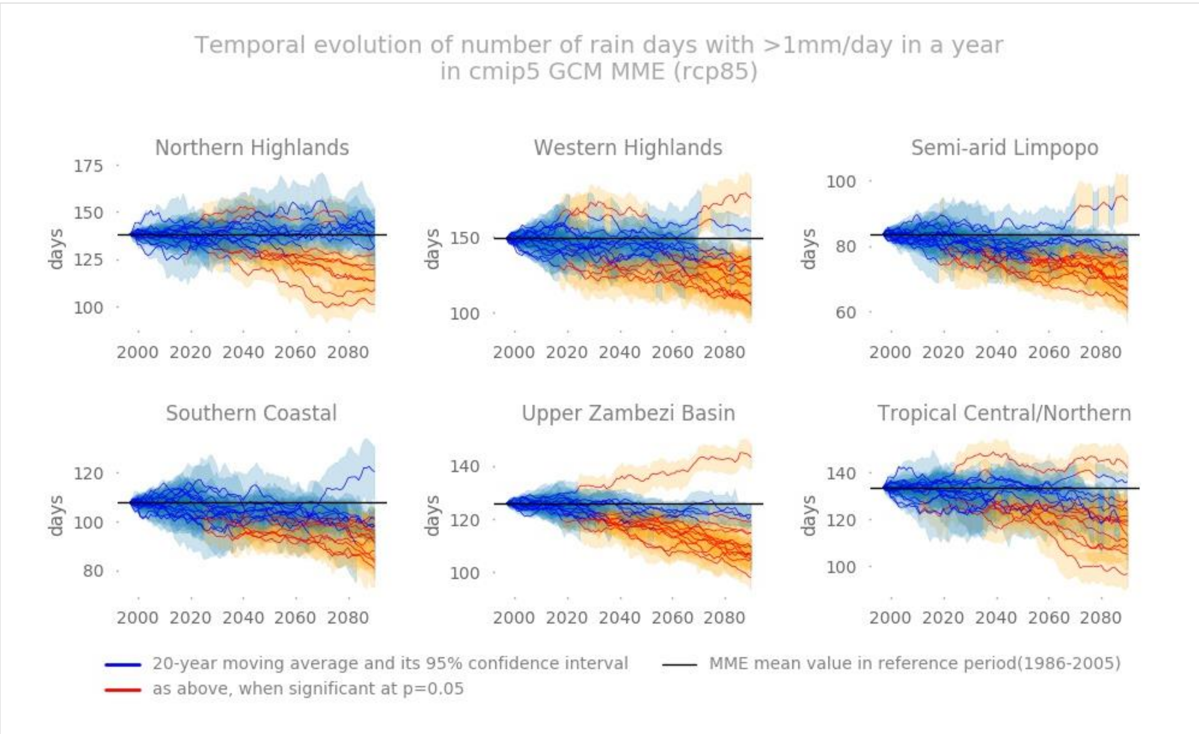


Figure A-6: Projected changes and emergence of changes in number of rain days per year

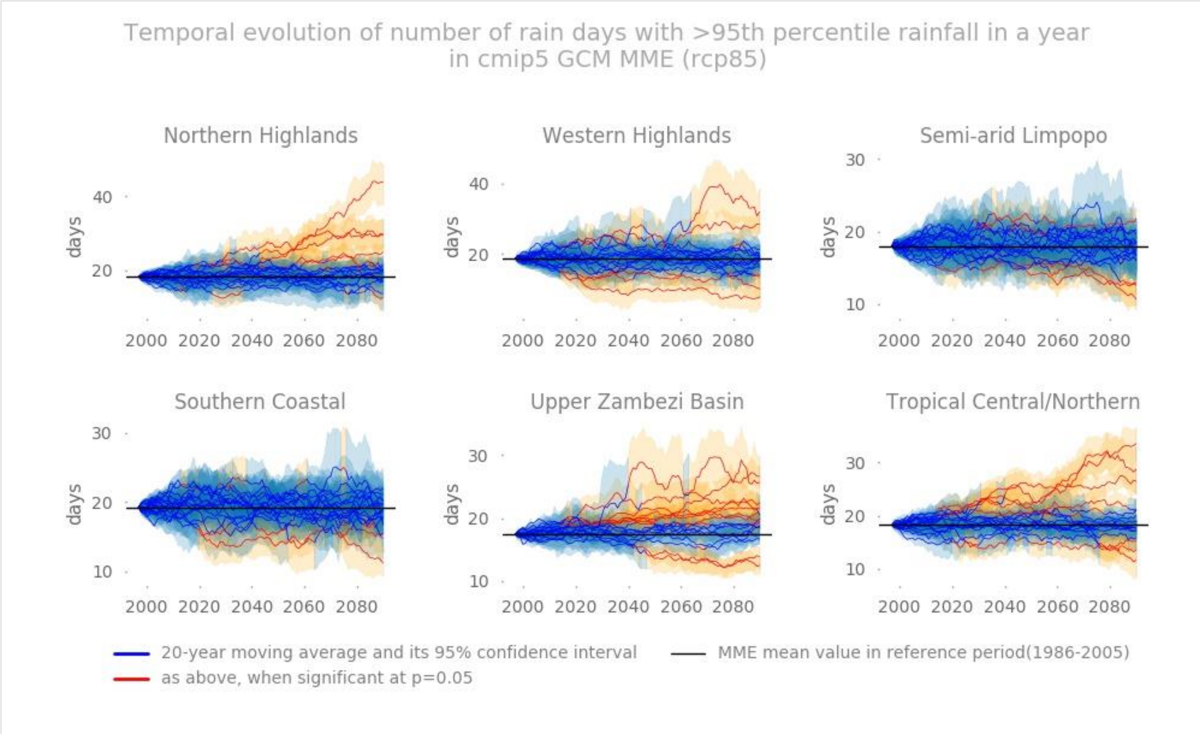


Figure A-7: Projected changes and emergence of changes in number of very heavy rainfall days (greater than 95th percentile) per year

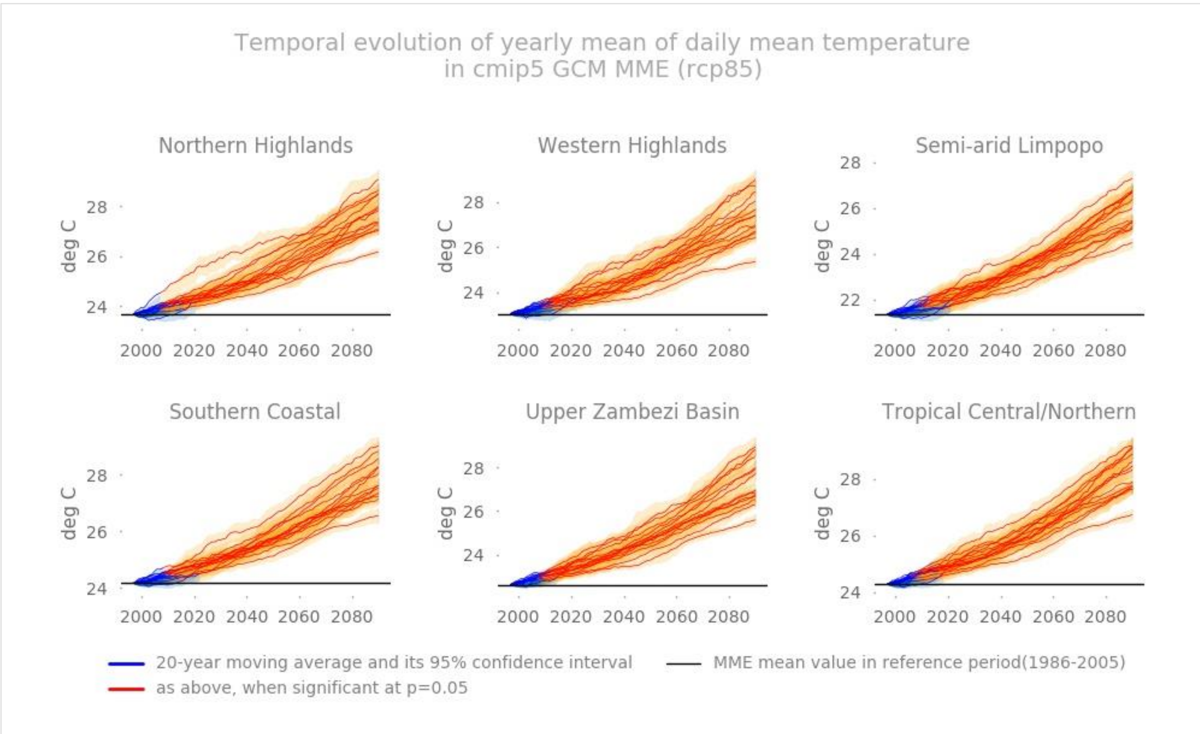


Figure A-8: Projected changes and emergence of changes in annual mean daily mean temperatures

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