UGANDA

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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ACKNOWLEDGEMENT

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1. BACKGROUND

1.1. Geographic and socio-economic context

The Republic of Uganda (henceforth, 'Uganda', shown below in Figure 1-1) is a landlocked country in East Africa in the African Great Lakes region. Lake Victoria covers a substantial portion of southern Uganda. The country has a tropical equatorial climate. Uganda is the 9th most populous country in Africa with a population of ~38,982,000 people, and the rate of population growth is relatively fast (~3.3%, 3rd highest in Africa). Uganda is currently the second least urbanised country in Africa, with an urban population of ~16% of the total population; however, the population is rapidly becoming more urban (~5.4% urbanisation rate per year). Over half the urban population of Uganda live in informal settlements (~53%). As a mostly rural country, the vast majority of the population work in agriculture (~72%) and subsist on an average GDP of ~USD 615 per capita per annum, with over 34% of the population living below the international poverty line of USD 1.90 per day. People in Uganda are at risk of both droughts and floods and the period 1996-2016, the number of people affected were ~3,850,000 and ~1,072,000, respectively. Uganda has an ND-GAIN index of 33.6, which is low relative to other African countries. The ND-GAIN index summarizes a country's vulnerability to climate change and other global challenges in combination with its readiness to improve resilience. Uganda's index is made up of a high vulnerability score and a low readiness score which indicates that the country has both a great need for investment and innovations to improve readiness and a great urgency for action. Key socio-economic and demographic indicators are further presented and summarised in Table 1-1, below.

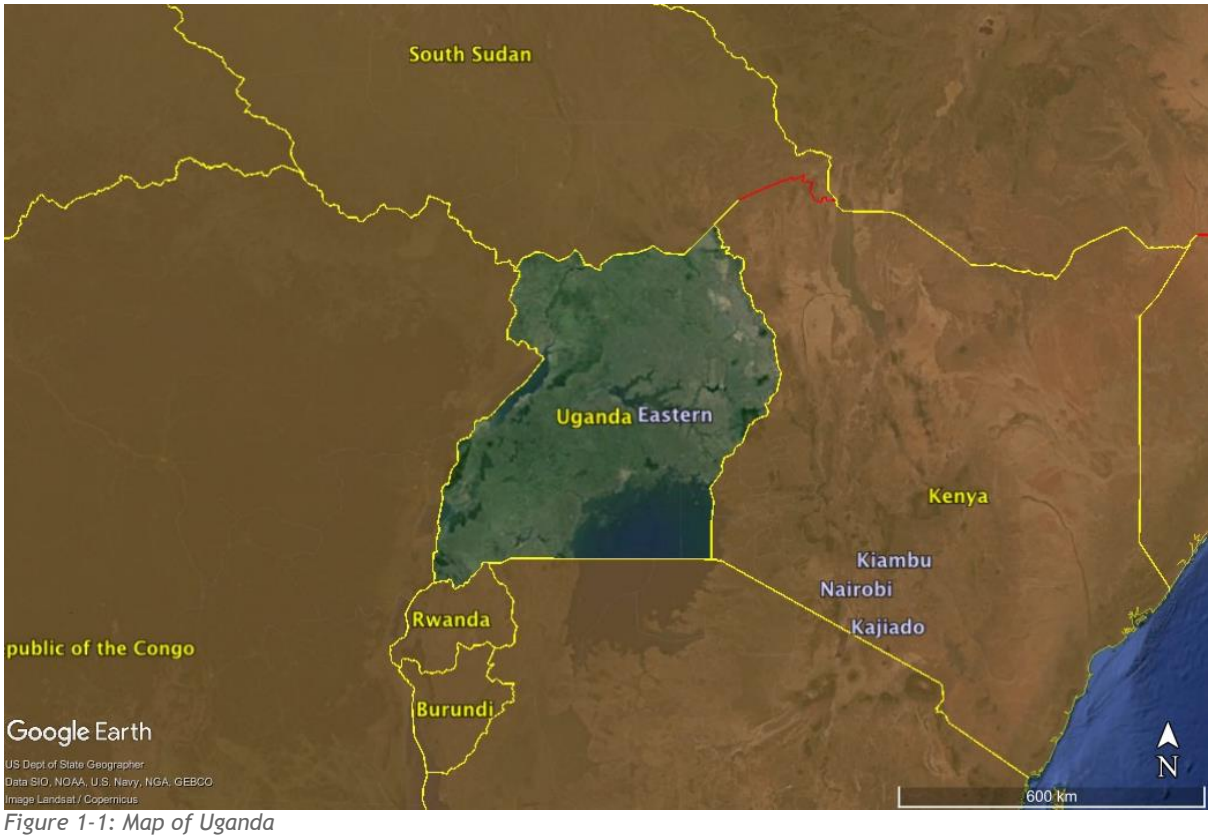

Figure 1-1: Map of Uganda

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

VARIABLE		SCORE/TOTAL	UNIT	RANK (OUT OF 54)
Geography, Socio-Economy and Demographics				
Population[1]		38,981,603	people	9
Population growth rate[1]		3	% population .yr-1	3
Population density[1]		194	People/km2	8
Land area[1]		200,523	km2	34
% Urban population[1]		16.4	% population	53
% Urbanisation rate[2]		5.4	% population .yr-1	4
Economy: total GDP[2]		25.5	USD billions .yr-1	15
Economy: GDP by PPP[2]		77	billion international dollars .yr-1	15
Economy: GDP/capita[2]		615	USD per capita/yr	38
Population below the poverty line[3]		34.6	% below USD 1.90 per day	27
Gender Inequality Index[4]		53.8		27
GINI co-efficient[3]		41.0		32
HDI[5]		0.49		31
Access to electricity[6]		20.4	% population	39
Summary indicators of climate change vulnerability				
Workforce in agriculture[7]		71.7	% workforce	8
Population undernourished[8]		25.5	% population	13
Number of people affected by drought[9]		3,850,000	people	16
Number of people affected by flood events[9]		1,072,845	people	17
Population living in informal settlements[6]		53.6	% urban population	28
Incidence of malaria[8]		218	cases per 1000 population at risk	18
ND-Gain Vulnerability Index[10]	Total	33.6		45
	Readiness	0.32		35
	Vulnerability	0.64		8

2. CLIMATE AND WEATHER

Uganda's climate is tropical and because it straddles the equator the seasonality of rainfall shifts from a generally austral summer (November – April) over the far Lake Victoria Basin to a bimodal rainfall seasonality (March – May and November – December) over the southern region and a boreal summer (April – October) rainfall season over the northern parts. Temperatures are warm and show very little difference between seasons.

Uganda's rainfall regions extend to the south and east of country's border and climate variations within that larger region are apparent. Therefore three sub-regions are distinguished here. The Uganda regions are illustrated in **Figures 2-1** and **2-2**, below, and summary descriptions can be found in **Table 2-1** below.

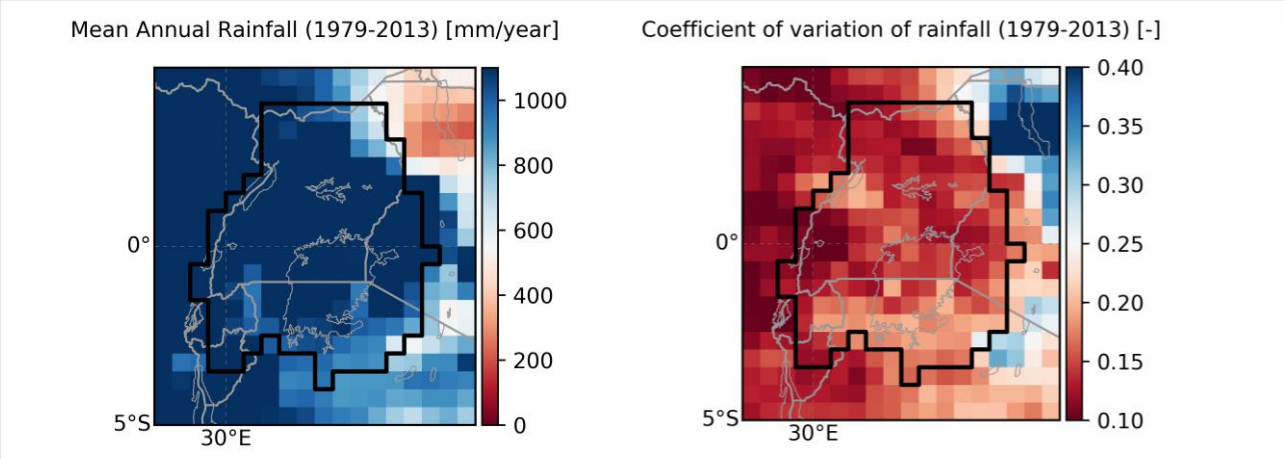
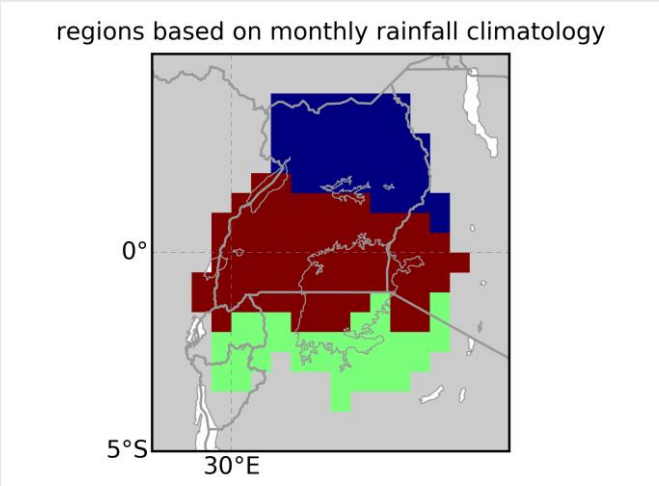


Figure 2-1: Main characteristics (magnitude and variability) of rainfall in Uganda and its region



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

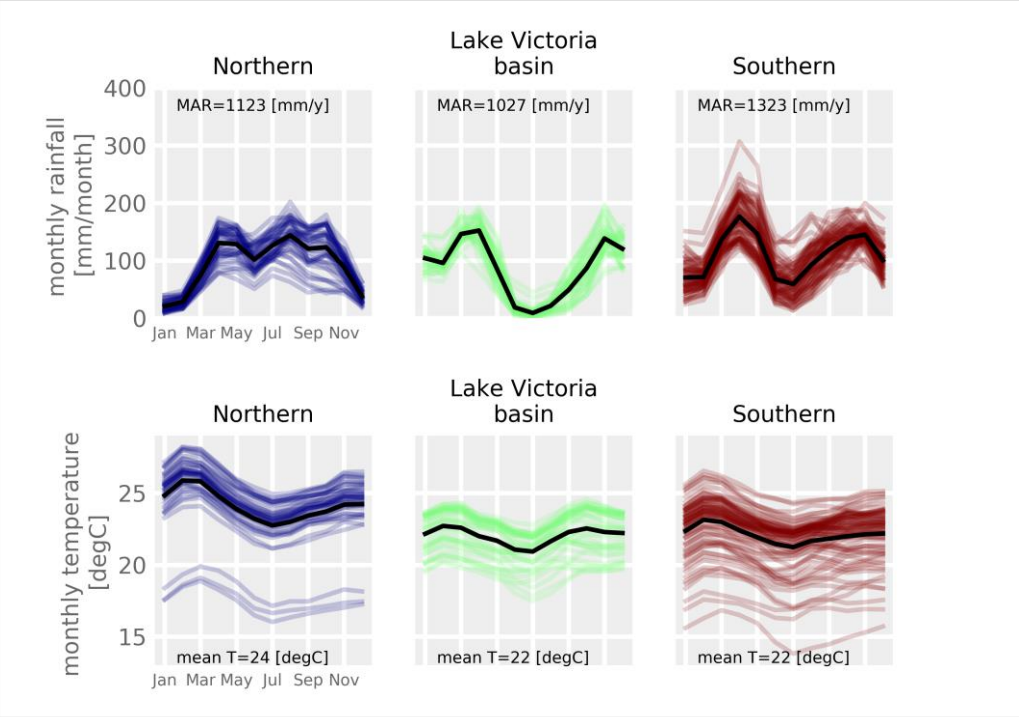


Figure 2-2: Rainfall regions of Uganda based on similarity of standardised rainfall climatology, and their rainfall and temperature climatologies

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

NORTHERN	Mean annual rainfall reaching 1123 mm/year with highest values to the south decreasing toward the north and east. Relatively low interannual variability, but highest over the far north east. Maximum rainfall occurs from April to October averaging 150 mm/month, and relatively dry conditions prevail from December – February. Daily mean temperature average 24° C with a seasonal cycle of ~4° C with slightly warmer temperatures during February – April. And coolest temperatures in July-August.
SOUTHERN	Mean annual rainfall reaching 1323 mm/year with strong differences in magnitude within the region, but relatively low interannual variability. Rainfall occurs throughout the year peaking during two seasons: the long rains March – May (~170 mm/month) and the short rains October – November (150 mm/month). The driest periods of the year occur during January and February and between May – July. Daily mean temperature average 22° C with a seasonal cycle of ~2° C with slightly warmer temperatures during February – April. And coolest temperatures in July-August. Clear spatial variability related to differences in topography.
LAKE VICTORIA BASIN	This region falls within the Uganda river catchment but is located to the south of the country itself. Mean annual rainfall reaches 1027 mm/year with little spatial variability in magnitude but slightly higher interannual variability than the other two regions. A relatively dry season occurs from June – August with rainfall over 100 mm/month from October – May peaking during March – April and November (150 mm/month). Daily mean temperature average 22° C with a seasonal cycle of ~2° C with slightly warmer temperatures during February – April and coolest temperatures in July-August.

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2.1 Observed historical climate variations and climate change trends

The majority of Uganda experiences **relatively low rainfall variability** on an inter-annual basis. On **decadal time scales** Uganda also experiences clear **variability** on a longer time scale 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 A-4).**

Long term trends across the regions show **increasing temperatures** over the period 1979 – 2015, although that trend appears to be weaker in the second half of that period. A long term trend in total annual rainfall is not evident in the Northern region, slightly increasing in the Southern Region and increasing and statistically significant in the Lake Victoria basin, which also shows a statistically significant increase in heavy rainfall frequency. Decadal scale variability is evident in the rainfall totals and the three regions appear to vary independently of each other at this scale. Long term trends and variability in the Uganda 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 Uganda (1979 – 2015)

REGION	MEAN T [DEG C/DECADE]	TOTAL RAINFALL [MM/DECADE]	EXTREME RAINY DAYS [DAYS/DECADE]	RAINY DAYS [DAYS/DECADE]
Northern	+0.44	not evident	downward	+2.8
Southern	+0.48	upward	+1.2	not evident
Lake Victoria Basin	+0.43	+40.5	+1.9	not evident

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

Projected changes in main attributes of climate for the Uganda 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 can be found in **Figures A-5 to A-8** in the supplementary Appendix.

2.2.1 PROJECTED CHANGES IN PRECIPITATION FROM PRESENT TO 2100

Rainfall projections across the Uganda regions show a pattern of **potential increased rainfall** emerging from about the 2050s. That pattern appears to be consistent across the majority of the CMIP5 models, though there are a few outliers on either extreme. Relative magnitudes of potential increased rainfall reach as much as 300, 500 or 400 mm/year for the northern, southern and Lake Victoria basin regions respectively by 2100 which equates to between 25 and 40% of the baseline normal. **The increase in rainfall** is only statistically significant for the Lake Victoria Basin region and seems to be strongly associated with **increase in the high intensity rainfall events rather than in the frequency of rainy days** (days with rainfall > 95th percentile of daily magnitudes. It must be noted that these results are derived from GCM projections which may not accurately represent changes in extreme rainfall dynamics. They are, however, consistent with the increased convective rainfall intensity (e.g. thunderstorm-related rainfall) expected in a warmer climate.

2.2.2 PROJECTED CHANGES IN TEMPERATURE FROM PRESENT TO 2100

Air temperature is projected to be about 1.5°C – 2.5° C warmer in the Uganda region by the 2050s. By 2100 the range of projected temperatures is greater varying between 3°C and 5°C warmer than the historical long-term mean.

Table 2-3: Summary of projected climate changes across regions of Uganda 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]
Northern	**Increasing** +1.5°C to +2.5°C by 2050s but changes evident in next decades	**Normal to increasing,** ranging from no change to an increase of up to 40% by 2100. Change could become evident after 2040s	**Increasing**, ranging from no change to an increase of up to 1000% by 2100. Change could become evident in the 2040s	**Normal to increasing,** could become evident after 2080s
Southern	**Increasing** +1.5°C to +2.5°C by 2050s but changes evident in next decades	**Normal to increasing,** ranging from no change to an increase of up to 40% by 2100. Change could become evident after 2060s	**Increasing**, ranging from no change to an increase of up to 50% by 2100. Change could become evident in the 2050s	no consistent message
Lake Victoria Basin	**Increasing** +1.0°C to +2.5°C by 2050s but changes evident in next decades	**Normal to strongly increasing,** ranging from no change to an increase of up to 40% by 2100. Change could become evident after 2050s	**Increasing**, ranging from no change to an increase of up to 100% by 2100. Change could become evident in the 2050s	no consistent message

2.3 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.

In tropical and largely rural Uganda, the bulk of the population is dependent on groundwater resources. While projections are indicating normal to increasing annual rainfall into the future, temperatures are increasing, and extreme rainfall events are projected to increase, with possible consequences to water quality and groundwater recharge, and potential complications for access to safe drinking water. These changes may further impact the Lake Victoria basin, which supports millions of people, with possibilities of increased flooding, changing water levels and quality. Freshwater fishing is a rapidly growing sector, and changes to freshwater systems may thus have implications for both households and the economy. Increasing temperatures and more extreme rainfall is of further concern for both the economy and for food security, with the majority of Ugandans depending on the climate sensitive agricultural sector, which is also the largest contributor to the Ugandan economy. With around a third of the Ugandan population living below the poverty line a large portion of the population has very limited capacity to adapt to increase in extreme temperatures and rainfall events, 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 Uganda

SECTOR	IMPACTS
Agriculture	- Crop loss and reduced crop yields owing to increasing temperature and changing rainfall patterns - Shifting of some crops (e.g., coffee) to higher elevations as temperatures increase - Crop loss owing to increased prevalence of extreme events (e.g. floods) - Changes to the incidence of pests and diseases - Increased potential for conflicts between farmers and pastoralists, especially in the drier north east
Fisheries	- Changes in primary productivity - Increased pressure on fisheries as livelihood potential of agriculture decreases - Decreased fish size, particularly in Lake Victoria, owing to increased temperatures
Water resources	- Increased variability in run-off, leading to increased variability in water availability - Increased flooding owing to increased frequency of extreme events - **Increased water scarcity, especially in the drier north east** - Increased potential for conflict between farmers and pastoralists over limited water resources, especially in the semi-arid areas
Built infrastructure and human settlements	- Destruction of and damage to infrastructure during extreme events, especially flooding
Human health	- **Increased prevalence of malnutrition and stunting, especially during drought and in the drier north-east** - Increased prevalence of vector-borne diseases, especially malaria at higher altitudes - Increased prevalence of water-borne disease such as cholera and diarrhoea - **Increasing potential for loss of life owing to large scale drought and flooding**

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3. CLIMATE CHANGE MITIGATION, GREENHOUSE GAS EMISSIONS AND ENERGY USE

The major carriers of Uganda'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 Uganda's agriculture sector, historical land use change and vegetation cover.

3.1 National energy production and consumption

National energy production in Uganda is almost all from biofuels (~99%) with a small contribution from hydroelectricity (~1%). The country imports oil and coal which contribute to the national energy consumption; however, the majority of energy consumption (~82%) occurs in the form of biofuels. The sector which accounts for the majority of this biomass fuel consumption is the domestic sector, which consumes ~85% of total national energy consumption. Other sectors accounting for national energy consumption are industry (~8%) and transport (~7%). The total annual GHGs emitted by the abovementioned sectors and fuel carriers are described further in Section 3.2.

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 Uganda's energy sector, including total national energy production, primary energy supply and national energy consumption by fuel carrier and sector.

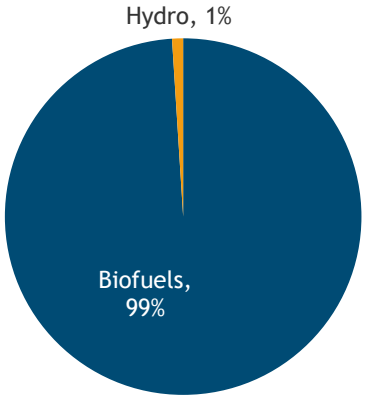

Figure 3-1: Distribution of Uganda's national energy production between major energy carriers (2014-2016)

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

NATIONAL ENERGY PRODUCTION		
Source	**Total (MTOE) [1]**	**% of total energy production**
Hydro[11]	0.1	1.3
Biofuels[12]	9.5	97.8
Electricity[12]	0.2	2.3
Total national energy production	9.8	

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

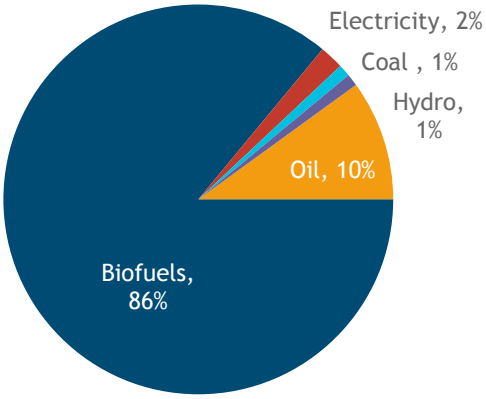

Figure 3-2: Distribution of Uganda's national energy consumption by major energy carriers

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

CONSUMPTION BY ENERGY SOURCE	
Source	**Total (MTOE)**
Coal[12]	0.1
Oil[12]	0.9
Hydro[13]	0.1
Biofuels[12]	8.9
Electricity[12]	0.2
Total national energy consumption by source	10.2

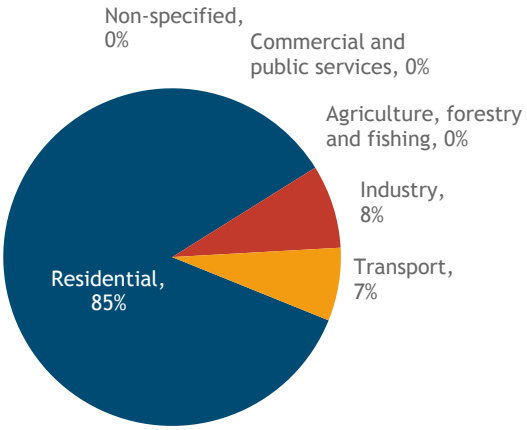

Figure 3-3: Distribution of Uganda's national energy consumption by sector (2014-2016)

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

CONSUMPTION BY SECTOR[12]	
Source	**Total (MTOE)**
Industry	0.8
Transport	0.7
Residential	8.6
Commercial and public services	0.03
Agriculture / forestry / fishing	0.04
Non-specified	<0.01
Non-energy use	0.01
Total national energy consumption by sector	10.1

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

TOTAL PRIMARY ENERGY SUPPLY[12]	
Source	**Total (MTOE)**
Coal	0.1
Oil	1.3
Biofuels	9.5
Electricity	0.2
Total primary energy supply	11.1

3.2 National greenhouse gas emissions by source and sector

Land use change and forestry (~48%, 27.3 MT CO_2e), and agriculture (~42%, 23.7 MT CO_2e) are the sectors that contribute the most to Uganda's greenhouse gas (GHG) emissions. Other sectors that contribute are other fuel combustion (~4.3 MT CO_2e), industrial processes (1 MT CO_2e) and waste (0.5 MT CO_2e). Section 3.2.1, 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). These figures are compiled by the World Resources Institute's Climate Access Indicator Tools (CAIT).

Section 3.2.2 provides additional details on Uganda's Land Use and Land Use Change sector, including detailed summaries of emissions from the agriculture sector and historical land use changes.

3.2.1 GHG EMISSIONS FROM PRIMARY ENERGY CONSUMPTION, BY SOURCE AND SECTOR

Table 3-5: Uganda's national greenhouse gas emissions from primary energy consumption (estimated for 2014-2016)

NATIONAL GHG EMISSIONS FROM PRIMARY ENERGY CONSUMPTION BY SOURCE AND SECTOR [14]		
Source / Sector		**Total emissions (MT CO_2e)**
Energy	Other fuel combustion	4.3
	Energy sub-total	4.3
Industrial processes		1.0
Agriculture		23.7
Waste		0.5
Land use change and forestry (LUCF)		27.3
Total emissions (including LUCF)		56.8

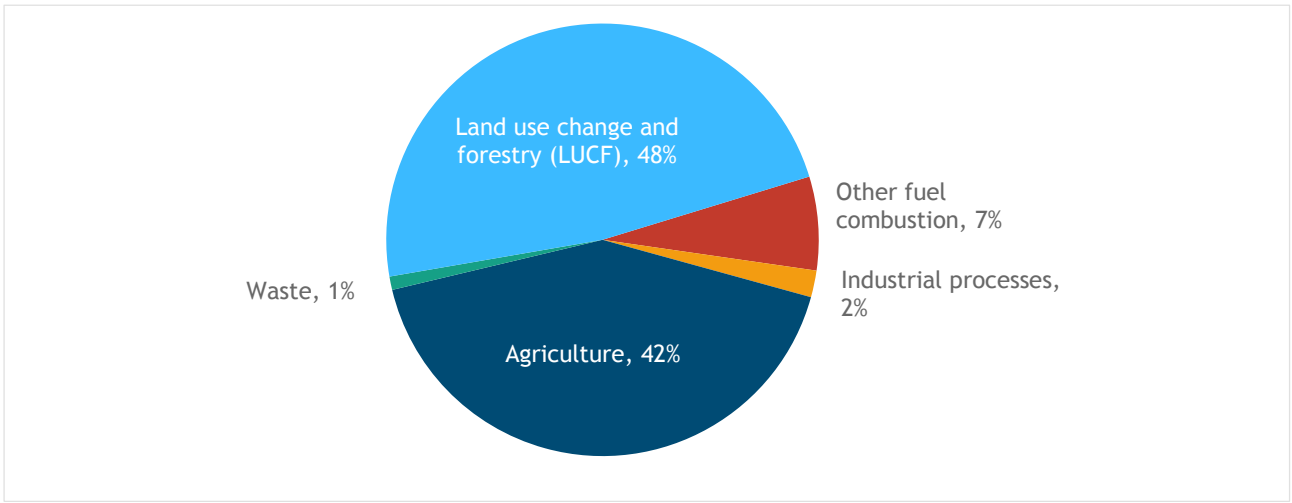

Figure 3-4: Distribution of Uganda's GHG emissions by major sectors

3.2.2 GHG EMISSIONS FROM AGRICULTURAL PRACTICES

Table 3-6, below, summarises GHG emissions from Uganda's agriculture and land use change sectors (derived from Food and Agriculture Organisation statistics). Although there are multiple agricultural practices which contribute to GHG emissions, in the case of Uganda, livestock production (~20.2 MT CO_2e) and land use change from forest area (~ 17.6 MT CO_2e) are the largest contributors to emissions. In particular, the enteric fermentation and manures left on pastures contribute ~40% and forest land use change contributes ~35% of the total emissions from this sector. Land use change from cropland (~6.4 MT CO_2e) also contribute significantly to Uganda's GHG emissions.

Table 3-6: National annual greenhouse gas emissions from agricultural practices, forestry and other land use in Uganda (estimated for 2014-2017)

VARIABLE		ANNUAL EMISSIONS (MT CO_2E)
Annual GHG emission from agricultural practices [15]	Burning - crop residues	0.1
	Burning - savanna	1.2
	Crop residues	0.3
	Cultivation of organic soils	0.7
	Enteric fermentation	11.7
	Manure management	0.8
	Manure applied to soils	0.5
	Manure left on pasture	8.5
	Rice cultivation	0.1
	Synthetic fertilizers	0.1
	Sub-total (Agricultural practices)	24.0
Annual GHG emission from land use change [15]	Grassland	0.1
	Cropland	6.4
	Forest land	17.6
	Burning biomass	1.7
	Sub-total (Land use change)	25.8
Total emissions		49.8

Table 3-7, below, summarises the recent historical changes in land use in Uganda through analysis of land use change. Statistics derived from the Global Forest Watch database were used to summarise the total area of wooded vegetation in various categories of canopy cover density (where 10-30% canopy cover can be considered as savanna, 30-50% cover can be considered woodland and 50-100% cover can be considered dense forest), as well as the historical rates of change in each vegetation category. Uganda's total spatial extent of wooded vegetation cover amounts to ~73% of total land area, including 10.5 million hectares of '10-30% cover' woodland, 4.8 million hectares of '30-50% cover' deciduous forest and world, and 2.8 million hectares of '50-100% cover' tropical forest. Despite the large spatial extent of forest resources, as described above (also in Table 3-7), Uganda's Land Use Change sector is a net source of GHG emissions, meaning that more GHGs are emitted from forest areas than are sequestrated. As can be seen in Table 3-8, below, Uganda's rates of deforestation vary up to ~0.8% per annum in different vegetation categories. The Food and Agriculture Organisation reports the total aboveground carbon stock of Uganda's forest biomass as ~81.3 million tonnes.

Table 3-7: Vegetation cover and land use change in Uganda (estimated for 2015)

VARIABLE		TOTAL (HECTARES)	TOTAL (% OF LAND AREA)	UNIT
Total tree cover [16]	10-30% canopy cover	10,523,341	43.57	% of total land area
	30-50% canopy cover	4,385,728	18.2	
	50-100% canopy cover	2,848,094	11.8	
	Total	17,757,163	73.5	
Land use change and agricultural expansion	Historical annual rate of deforestation[17]	10-30% canopy cover	0.0	% of previous year
		30-50% canopy cover	0.1	
		50-100% canopy cover	0.8	
	Area of agricultural land[18]	17,000,289	70.4	% of total land area

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4. SUMMARISED NATIONAL PRIORITIES FOR CLIMATE CHANGE ADAPTATION AND MITIGATION

Uganda'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. This document includes detailed descriptions of Uganda's major commitments and priorities related to GHG mitigations (Table 4-2, below) as well as major priorities related to climate change adaptation, derived from the draft National Adaptation Plan (NAP) (Table 4-3, further below).

For mitigation, Uganda is to focus on the implementation of a series of policies and measures in the energy supply, forestry and wetland sectors. In the business-as-usual (BAU) scenario the estimated emissions in 2030 will be 77.3 Million tons of carbon dioxide equivalent per year ($MtCO_2eq/yr$). The estimated potential cumulative impact of the policies and measures could result in approximately 22% reduction of national greenhouse gas emissions in 2030 compared to business-as-usual. Uganda proposes to implement the identified policies and measures, and their impact may be higher or lower than these estimations illustrate.

The National Climate Change Policy and Costed Implementation Strategy estimated that Uganda will require conditional investments of at least ~USD 2.9 billion over the next 15 years to address the impacts of climate change in addition to the existing interventions. The total adaptation cost in the adaptation priority sectors are estimated to be at least ~USD 2.4 billion over the next 15 years. Uganda's NDC notes that the total costs of the activities in the priority mitigation sectors are uncertain, however, the upfront capital investment for activities related to renewable energy installations to be at least ~USD 5.4 billion over the next 10 years.

Table 4-1, below, gives details on Uganda'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 Uganda'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
49.43	N/A	The implementation of a series of policies and measures, conditional on international support.	N/A	Energy supply, forestry and wetlands	Implementation is conditional on access to climate finance and international market mechanisms	N/A

4.1 National priorities for climate change mitigation

Uganda's major priorities for actions and investments related to climate change mitigation are summarised in Table 4-2, below, categorised according to sector. Detailed actions and priorities are identified for the Energy and AFOLU sectors. In the energy sector, priorities focus on a need for increased energy efficiency, and the uptake of renewable energy and electricity generation, as well as the development and implementation of new and existing policies and regulations. The large contribution of biofuels for domestic uses towards total national GHG emissions is reflected in Uganda's mitigation priorities, such as promotion of efficient stove and kilns for cooking on biomass fuels, as well as measures to prioritise improved protection and management of forested areas in the priorities identified for the AFOLU sector. Uganda's NDC mitigation priorities for the AFOLU sector also include multiple measures to increase protection of multiple forests and wetlands to encourage increased biological sequestration of GHG emissions. Specific actions include the management or development of management plans for forests and wetlands, the creation of a national information database on wetlands, and the reversal of net deforestation.

Proposed activities and investments within each sector are 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). These technology types and specific actions represent Uganda's immediate national priorities for investments in climate change mitigation and reflect recent and on-going policy-level measures to reduce GHG emissions and increase energy efficiency.

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

PRIORITY SECTOR	SECTOR-SPECIFIC ACTION	TECHNOLOGY TYPE[2]
Energy	Construction of enabling infrastructure for electricity sector development, including power lines, substations and transmission facilities	1, 3, 6
	Achieve a total of at least 3,200 Mega Watts renewable electricity generation capacity by 2030	1
	Energy efficiency in hospitals	1, 3
	National Appropriate Mitigation Action for Integrated Sustainable Energy Solutions for Schools in off-grid areas	1, 3
	Promotion and wider uptake of energy efficient cooking stoves or induction cookers	1, 3
	Promotion and wider solar uptake of solar energy systems	1, 3

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

1. Reduced emissions through increased lower emission energy access and power generation.

2. Reduced emissions through increased access to low-emission transport.

3. Reduced emissions from buildings, cities, industries and appliances.

4. Reduced emissions from land use, deforestation, forest degradation, and through sustainable management of forests and conservation and enhancement of forest carbon stocks.

5. Strengthened institutional and regulatory systems for low-emission planning and development.

6. Increased number of small, medium and large low-emission power suppliers.

7. Lower energy intensity of buildings, cities, industries, and appliances.

8. Increased use of low-carbon transport.

9. Improved management of land or forest areas contributing to emissions reductions.

PRIORITY SECTOR	SECTOR-SPECIFIC ACTION	TECHNOLOGY TYPE[3]
Energy (cont)	Development and enforcement of building codes for energy efficient construction and renovation	1, 3, 5
	Development and implementation of a long-term transport policy accounting for climate change mitigation concerns	2
	Fuel Efficiency Initiative National Appropriate Mitigation Action: Policies and regulations to promote cleaner fuels, and more fuel-efficient vehicle technology	4, 5
AFOLU	Community forest management groups	4
	Forest law enforcement and governance	4, 5
	Strengthening forest institutions responsible for forest management and development	4, 5
	Reverse deforestation trend to increase forest cover to 21% in 2030, from approximately 14% in 2013, through forest protection, afforestation and sustainable biomass production measures	4, 5
	Creation of national information database through re-inventory and assessment of all wetlands	4, 5
	Design and implementation of 11 RAMSAR site wetland research, eco-tourism and education centres	4, 5
	Design and implementation of 111 District wetland action plans, with carbon sink potential	4, 5
	Design and implementation of 15 RAMSAR sites and Framework wetland management plans	4, 5
	Demarcation and gazettement of 20 critical and vital wetland systems and their maintenance country wide as carbon sink	4, 5
	Strengthening wetland management institutions responsible for wetlands management and conservation	4, 5

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

1. Reduced emissions through increased lower emission energy access and power generation.

2. Reduced emissions through increased access to low-emission transport.

3. Reduced emissions from buildings, cities, industries and appliances.

4. Reduced emissions from land use, deforestation, forest degradation, and through sustainable management of forests and conservation and enhancement of forest carbon stocks.

5. Strengthened institutional and regulatory systems for low-emission planning and development.

6. Increased number of small, medium and large low-emission power suppliers.

7. Lower energy intensity of buildings, cities, industries, and appliances.

8. Increased use of low-carbon transport.

9. Improved management of land or forest areas contributing to emissions reductions.

4.2 National priorities for climate change adaptation

Uganda's major priorities for actions and investments related to climate change adaptation are summarised in Table 4-3, below, categorised according to sector. Detailed actions and priorities are identified for sectors including *inter alia* AFOLU, water and health, as well as priorities focused on community- and institutional-level actions. In addition, Uganda's adaptation priorities include multiple interventions relating to the energy sector, recognising the cross-cutting linkages between energy access and climate vulnerability (for example, priorities related to increased energy access to support water security, human health and agriculture).

Uganda'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). These technology types and specific actions represent Uganda's immediate national priorities for investments in climate change adaptation and build on recent policy-level measures to reduce vulnerability and increase capacity to respond to climate change at local and national levels.

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

PRIORITY SECTOR	SECTOR-SPECIFIC ACTION	TECHNOLOGY TYPE[4]
Energy	Extend electricity to the rural areas or expanding the use of off-grid solar system to support value addition and irrigation	1, 2, 5
	Extending electricity or expanding use of off-grid solar system to support water supply	1, 2
	Increasing the efficiency in the use of biomass in the traditional energy sector	1, 5
	Promoting renewable energy and other energy sources	1, 5
	Increasing the efficiency in the modern energy sector, mainly of electricity	1, 5
	Ensuring the best use of hydropower by careful management of the water resources	1, 2, 5
	Climate proofing investments in electricity power sector	1, 5
AFOLU	Encouraging efficient biomass energy production and utilization technologies	4
	Encouraging agro-forestry	4, 8
	Promoting biodiversity & watershed conservation (including re-establishment of wildlife corridors)	4
	Promoting intensified and sustained forest restoration efforts (afforestation and reforestation programmes, including in urban areas)	4
	Expanding extension services	1, 5

[4] **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

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PRIORITY SECTOR	SECTOR-SPECIFIC ACTION	TECHNOLOGY TYPE[5]
AFOLU (cont)	Expanding Climate Smart Agriculture (CSA)	1, 4, 5
	Expanding diversification of crops and livestock	2
	Expanding rangeland management	1, 4
	Expanding research on climate resilient crops and animal breeds	5
Water	Expanding small scale water infrastructure	2
	Improving water efficiency	2
	Ensuring water supply to key economic sectors, especially agriculture, and domestic use, including water harvesting and storage	1, 2, 4
	Managing water resource systems, including wetlands, particularly in cities, in such a way that floods are prevented, and existing resources conserved (through the establishment of an Integrated Water Resources Management system)	4, 8
	Improving water catchment protection	2, 4
Community based	Ensuring that land use plans and building codes reflect the need to make public and private buildings more climate-resilient	1, 2, 3
	Investing in making existing and new buildings more resilient	1, 3
Institutional	Expanding climate information and early warning systems	6, 8
	Identifying better drainage plans	1, 2, 5
	Building more effective early warning systems	5, 8
Health	Conducting vulnerability assessments of the health sector to climate change impacts	2, 5
	Improving early warning systems for disease outbreaks	2, 5, 6
	Putting in place contingency plans to develop climate change-resilient health systems	2, 5
	Strengthening public health systems by building hospitals (including regional referral hospitals) and supplying them with medicine, equipment and well-trained personnel	2, 5
	Making provision for a safe water chain and sanitation facilities to limit outbreaks of water-borne diseases and implement strong public awareness programmes to promote better hygiene	2, 5

[5] **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.

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 Uganda. 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 for each of the three climate regions across Uganda. 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 Southern region has very high inter-annual (1200mm in some years to 1500mm in other years) and moderate decadal variability (1280mm in some decades to 1400mm in other decades). The long term trend is not statistically significant but could be around 60mm over the 30 year period.

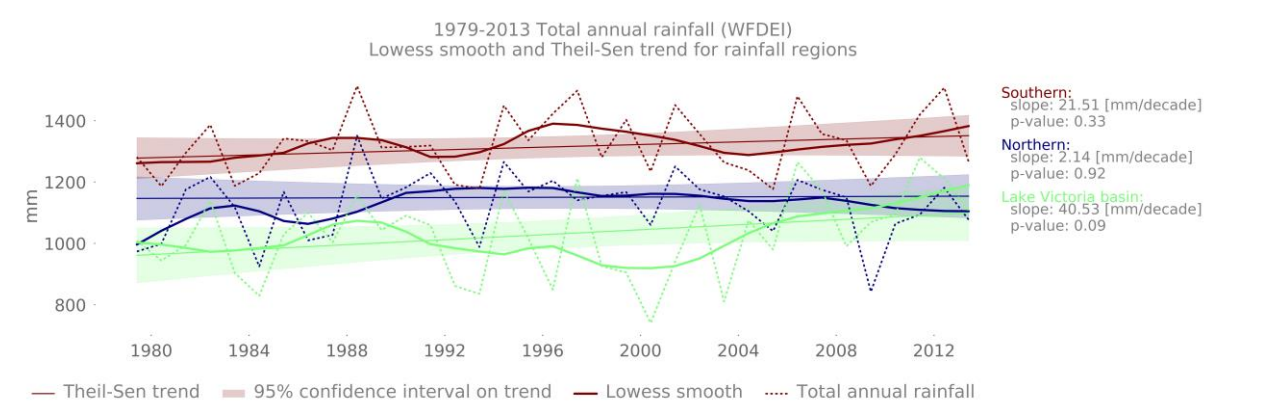

Figure A-1: Long term trends and variability in total annual rainfall for rainfall regions

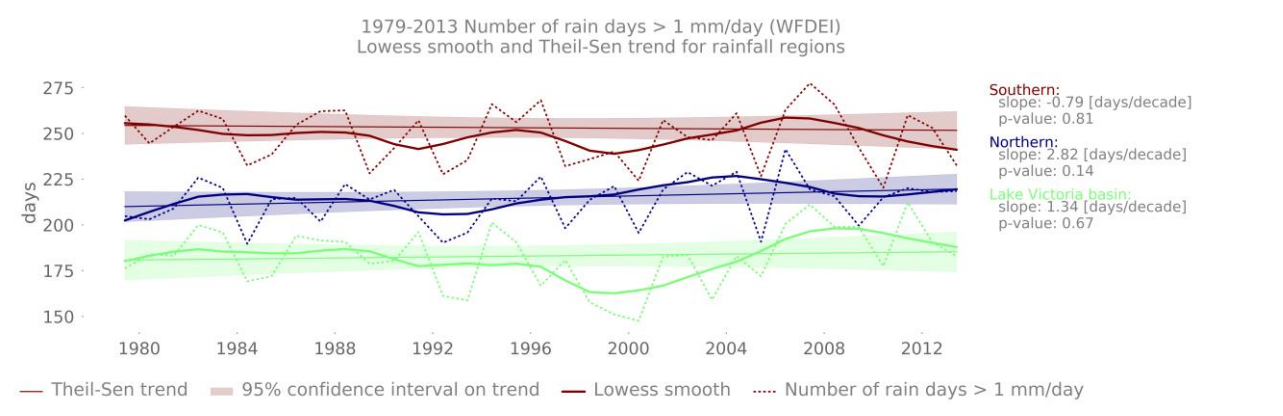

Figure A-2: Long term trends and variability in frequency of rainfall events for rainfall regions

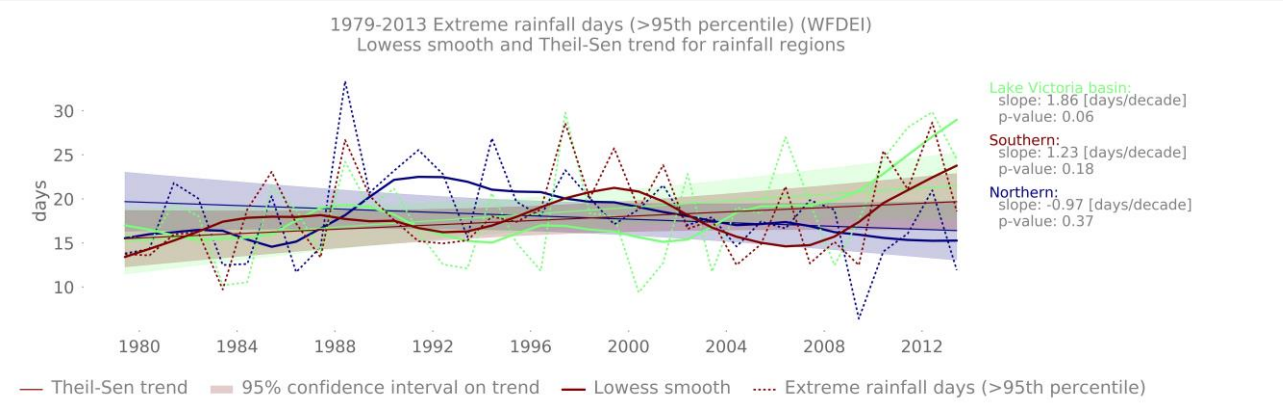

Figure A-3: Long term trends and variability in extreme rainfall events for rainfall regions

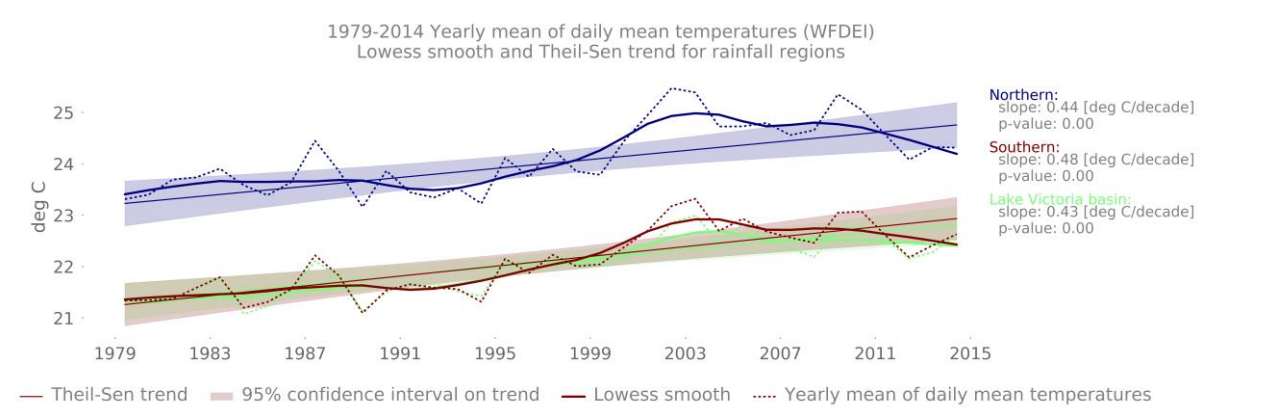

Figure A-4: Long term trends and variability in daily mean air temperatures for rainfall regions

1.c Climate projections visualisations

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.

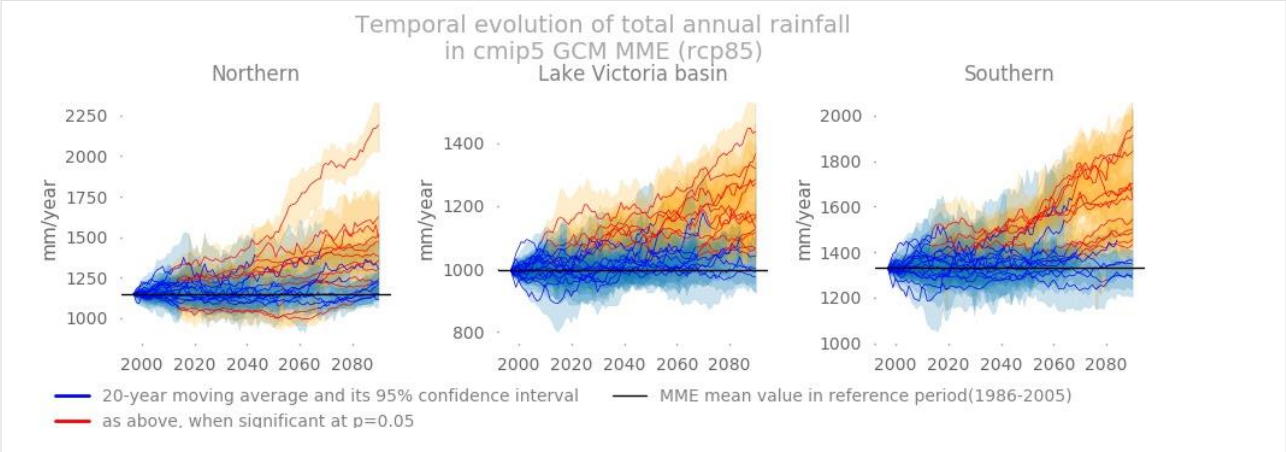

Figure A-5: Projected changes and emergence of changes in total annual rainfall

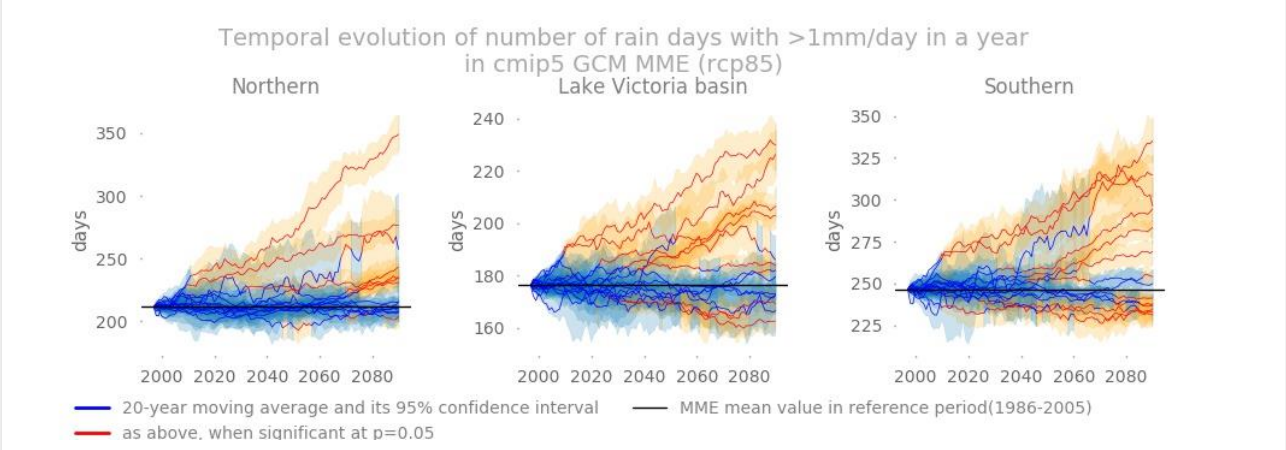

Figure A-6: Projected changes and emergence of changes in number of rain days per year

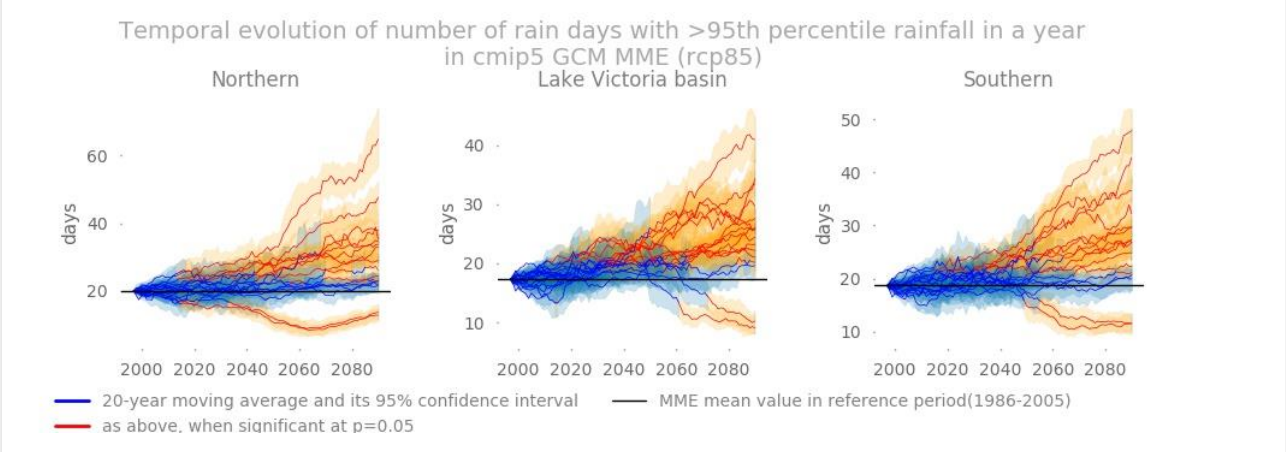

Figure A-7: Projected changes and emergence of changes in number of very heavy rainfall days (greater than 95th percentile) per year

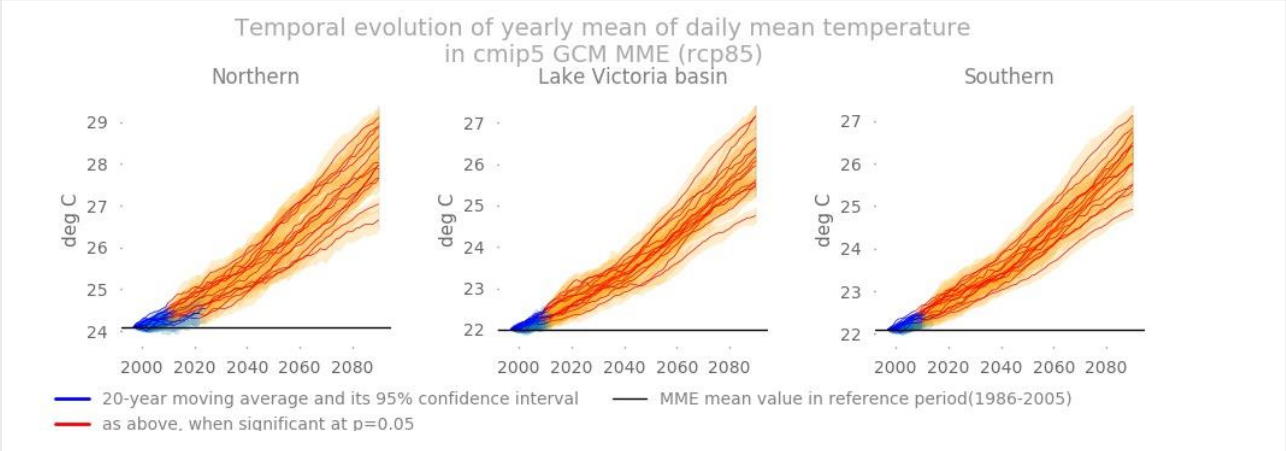

Figure A-8: Projected changes and emergence of changes in annual mean daily mean temperatures

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