



# Climate Change Information Fact Sheet

## ETHIOPIA

<i>Definitions</i>
<b>Ensemble:</b> A collection of model simulations characterizing a climate prediction or projection. [IPCC AR5]
<b>Representative Concentration Pathway (RCP):</b> Scenarios that include time series of emissions and concentrations of the full suite of greenhouse gases and aerosols and chemically active gases, as well as land use/land cover. RCPs usually refer to the portion of the concentration pathway extending up to 2100, for which Integrated Assessment Models produced corresponding emission scenarios. [IPCC AR5]
<b>RCP8.5:</b> Generally, high emissions. One high pathway for which radiative forcing reaches $>8.5 \text{ W m}^{-2}$ by 2100 and continues to rise for some amount of time. [IPCC AR5]
<b>RCP4.5:</b> Generally, moderate emissions. One of two intermediate stabilization pathways in which radiative forcing is stabilized at approximately $4.5 \text{ W m}^{-2}$ after 2100. [IPCC AR5]

## CLIMATE IMPACTS AND VULNERABILITIES

### TEMPERATURE

***Current (based on historical climate conditions and recent trends, generally over the past few decades)***

Ethiopia's climate is typically tropical in the south-eastern and north-eastern lowland regions, but much cooler in the large central highland regions of the country. Mean annual temperatures are around 15-20°C in these high altitude regions, whilst 25-30°C in the lowlands. Mean annual temperature has increased by 1.3°C between 1960 and 2006, an average rate of 0.28°C per decade. The increase in temperature in Ethiopia has been most rapid July through September at a rate of 0.32°C per decade. Available data indicates that the average number of "hot" nights (the hottest 10% of nights annually) increased by 137 per year between 1960 and 2003, and "hot" days per year increased by 73 [UNDP].

***Future: 2030 (generally 2020-2049)***

The mean annual temperature in the country is projected to increase by 0.44°C, 0.92°C, and 1.4°C by 2030 for the 10th, 50th, and 90th percentiles for the RCP4.5 model ensemble runs, and by 0.61°C, 1.01°C, 1.47°C for the RCP8.5 10th, 50th, and 90th percentile model ensembles, respectively. Maximum temperatures are projected to increase by 0.93°C to 0.98°C, and minimum temperatures by 0.93°C and 1.05°C for the RCP4.5 and RCP8.5 median model ensemble. Simple linear interpolation of projections indicate that annually, "hot" days will occur on 12-25% of days by the 2030s [UNDP].

***Future: 2050 (generally 2040-2059)***

The mean annual temperature in the country is projected to increase by 0.84°C, 1.4°C, and 2.2°C for the 10th, 50th, and 90th percentiles for the RCP4.5 model ensemble runs. Similarly, the 10th, 50th, and 90th percentiles for the RCP8.5 ensemble project increases of 1.3°C, 1.8°C, and 2.6°C. [CCKP]. All projections indicate substantial

*This document has been prepared based on information available at the date of publication, and does not reflect official views of the U.S. government. Judgment and knowledge of the national contexts should be used to interpret and supplement this information. USAID assumes no liability for the contents or use of the information contained in this document.*

increases in the frequency of days and nights that are considered "hot" in current climate. Annually, projections indicate that "hot" days will occur on 19-40% of days by the 2060s [UNDP].

## PRECIPITATION AND FLOODING

### ***Current (based on historical climate conditions and recent trends, generally over the past few decades)***

Seasonal rainfall in Ethiopia is driven mainly by the migration of the Inter-Tropical Convergence Zone (ITCZ). Most of Ethiopia experiences one main wet season (called 'Kiremt') from mid-June to mid-September (up to 350mm per month in the wettest regions), when the ITCZ is at its northern-most position. Parts of northern and central Ethiopia also have a secondary wet season of sporadic, and considerably lesser, rainfall from February to May (called the 'Belg'). The southern regions of Ethiopia experience two distinct wet seasons which occur as the ITCZ passes through this more southern position. The March to May 'Belg' season is the main rainfall season yielding 100-200mm per month, followed by a lesser rainfall season in October to December called 'Bega' (around 100mm per month). The eastern most corner of Ethiopia receives very little rainfall at any time of year. The strong inter-annual and inter-decadal variability in Ethiopia's rainfall makes it difficult to detect long-term trends. There is not a statistically significant trend in observed mean rainfall in any season in Ethiopia between 1960 and 2006. Decreases in July-September rainfall observed in the 1980s have shown recovery in the 1990s and 2000s. There are insufficient daily rainfall records available to identify trends in daily rainfall variability. [UNDP] Large-scale floods occur mostly in the lowland areas, while flash floods resulting from intense rainfall events occur mostly in the Highlands. The capital city of Addis Ababa experiences annual flood events, which destroy property and pose a significant threat to urban dwellers [CCKP].

### ***Future: 2030 (generally 2020-2049)***

Projections of mean annual rainfall averaged over the country from different models in the ensemble project a wide range of changes in precipitation for Ethiopia, but tend toward increases. By 2030, the RCP4.5 10th percentile (-23%), median (0.6%), and 90th percentile (28%) ensembles for mean annual precipitation indicate high uncertainty in the direction and amount of change across the models. These results are similar to RCP8.5 (-22%, 3.3%, and 33%). [CCKP]. The median ensemble runs for RCP4.5 and 8.5 indicate an average annual rainfall increase of 0.1 to 0.2 mm/day by the middle of the 2030s [USGS].

### ***Future: 2050 (generally 2040-2059)***

The RCP4.5 10th percentile (-25%), median (2%), and 90th percentile (34%) ensembles for mean annual precipitation in Ethiopia indicate high uncertainty in the direction and amount of change across the models. These results are similar to RCP8.5 (-25%, 5%, and 41%). [CCKP] The weak response in country area-averaged precipitation masks important spatial patterns of precipitation change, as future precipitation (June-September) tends to increase over the Central Highlands and northern Great Rift Valley while decreasing over the southern part of the country, presenting a dipole pattern [Li et al.]. The projections are broadly consistent in indicating increases in mean annual rainfall in the 'short' rainfall season (Oct- to Dec.) in southern Ethiopia. The models in the ensemble are broadly consistent in indicating increases in the proportion of total rainfall that falls in 'heavy' events. [UNDP] In southern Ethiopia, by the year 2100, an increase of more than 20% in the very extreme (one-in-100-year) high rainfall events is expected. [CCKP] An assessment of climate change of four catchments of the upper Blue Nile River basin using RCP 4.5 and RCP 8.5 emission scenarios for the future horizons (2035-2064) indicate that mean annual runoff is expected to increase by up to +55.7% for RCP 4.5 and up to +74.8% for RCP 8.5 scenarios (~ 4 out of 5 climate models projected increase in mean annual flow) [Gebre and Ludwig].

## DROUGHT

### ***Current (based on historical climate conditions and recent trends, generally over the past few decades)***

The movements of the ITCZ are sensitive to variations in Indian Ocean sea-surface temperatures and vary from year to year, hence the onset and duration of the rainfall seasons vary considerably interannually, causing frequent drought. The most well documented cause of this variability is the El Niño Southern Oscillation (ENSO). Warm phases of ENSO (El Niño) have been associated with reduced rainfall in the main wet season, JAS, in

north and central Ethiopia causing severe drought and famine. [UNDP] About half of all rural households in the country experienced at least one major drought from 1999 to 2004 [Gebreegziabher, et al.].

**Future: 2030 (generally 2020-2049)**

Model simulations show wide disagreements in projected changes in the amplitude of future El Niño events. East Africa’s seasonal rainfall can be strongly influenced by ENSO, and this contributes to uncertainty in climate projections, particularly in the future inter-annual variability, for this region [UNDP].

**Future: 2050 (generally 2040-2059)**

The projected increases in the interannual variability of precipitation in combination with projected warming may lead to increases in the occurrence of droughts. [Keller] A shift in the spatial distribution of precipitation by the second half of the twenty-first century will contribute to existing water resources challenges, such drought, during the Kiremt rainfall season, and in Southern Ethiopia [Li et al.].

**WINDS AND OTHER STORMS**

*Information about winds and other storms is not readily available.*

<b>Climate information sources</b>	CCKP = World Bank Climate Change Knowledge Portal
	CW = Climate Wizard
	Gebre and Ludwig = Gebre S.L. and Ludwig F. 2015. Hydrological Response to Climate Change of the Upper Blue Nile River Basin: Based on IPCC Fifth Assessment Report (AR5). J Climatol Weather Forecasting 3: 121. DOI:10.4172/2332-2594.1000121
	Gebreegziabher, et al. = Gebreegziabher, Z., J. Stage, A. Mekonnen, and A. Alemu. 2011. Climate Change and the Ethiopian Economy: A Computable General Equilibrium Analysis. Environment for Development Discussion Paper Series, October 2011. EfD DP 11-09.
	IPCC = IPCC WG II, 2014. Climate Change 2014: Impacts, Adaptation, and Vulnerability. Chapter 22 (Africa); IPCC WG1AR5, Ch. 13: IPCC Working Group 1, Assessment Report 5, Chapter 13: Sea Level Change
	Keller = Keller, Marius. 2009. Climate Risks and Development Projects Assessment Report for a Community-Level Project in
	Li et al. = Laifang Li, Wenhong Li, Tristan Ballard, Ge Sun, and Marc Jeuland. 2015. CMIP5 model simulations of Ethiopian Kiremt-season precipitation: current climate and future changes. Climate Dynamics. DOI: 10.1007/s00382-015-2737-4
	UNDP = McSweeney, C., M. New, and G. Lizcano, 2012. UNDP Climate Change Country Profiles: Ethiopia
	USGS = Alder, J.R. and Hostetler, S.W., 2013. CMIP5 Global Climate Change Viewer. US Geological Survey.