

Supplementary Tables

Table S1. Representative Concentration Pathways (RCPs) and equivalent emission scenarios in Special report on emission scenarios (SRES) and Shared Socio-Economic Pathways (SSP)

RCP	Description	Emission	Equivalent SRES/SSPs	Remark
RCP 8.5	Rising radiative forcing pathway leading to 8.5 w/m ² (>1370 ppm Co ₂ eq) by 2100	High emission scenarios (possible development in the case of high population numbers, high fossil/coal use)	A1F1/SSP5	Radiative forcing values were approximated and defined as ±5% of the stated level w/m ² relative to pre-industrial levels and including net effects of all anthropogenic GHGs and other forcing agents. The new shared socio-economic pathway to be used in the future also incorporated
RCP 6.0	Stabilization without overshoot pathway to 6 w/m ² (~850 ppm Co ₂ eq) at stabilization after 2100	Medium range emission scenarios (low, medium baseline scenario or high mitigation scenario)	B2/SSP4	
RCP4.5	Stabilization without overshoot pathway to 4.5 w/m ² (~650 ppm Co ₂ eq) at stabilization after 2100	Medium range emission scenarios (high mitigation scenarios)	B1/SSP3	
RCP 2.6	The peak in radiative forcing at 3 w/m ² (~490 ppm Co ₂ eq) before 2100 and the decline (the selected pathway declines to 2.6 w/m ² by 2100)	Low emission scenarios (low mitigation scenarios)	None/SSP1	

*Compiled by Author which adapted from IPCC AR5 (2014) and (Van Vureen et al., 2011; Moss et al., 2010) also based on new socio-economic scenarios by Riahi et al (2021).

Table S2. Comparison of previous studies conducted in different parts of Ethiopia

Model		Temperature	Precipitation	References
ECHAM 5 and HADCM3	Across Ethiopia and Kenya	Clear trends at all locations towards warmer conditions in the future.	ECHAM5 model shows a The trend towards wetter annual conditions over most parts	Ward and Lasage,2009
HadCM3 A2 and B2	Lake Hawasa	Maximum temperature increase by 1.6–1.8 oC and minimum Temperature by 1.54–1.7 oC in 2050.	Trends in annual rainfall do not show statistically meaningful trends between Years.	Gebrie et al., 2012
HadCM3 A2a	Northwestern Ethiopia	The increase in mean maximum and minimum temperature ranges from 1.55–6.07 oC and from 0.11–2.81 oC, respectively, in the 2080s.	Decrease in the amount of annual rainfall and number of rainy days in the 2080s.	Ayalew et al.,2012
CGCM3.1 and REMO	Baro-Akobo Basin	The maximum temperature rises by 1.3 oC (REMO A1B and B1) and 2.55 oC (CGCM3.1).	24% (REMO) and 23% (CGCM3.1) rise in 2050.	Kebede et al.,2013
KNMI at (0.44 ⁰)	Shashamane City	Under RCP 8.5 multi-model mean warming minimum temperature by 3oC and maximum temperature 2.5 oC by 2060 and more in the end of the century	Wettest months decrease between 10-20% (5% percentile) and decrease by a median estimate from 0 -10%decrease with the base period, in driest months10-20 % increase	Bambrick et al. , 2015
HadCM3-A2	Upper Blue Nile Basin	The minimum and maximum The temperature will increase by 3.6 oC and 2.4 oC, respectively, towards the end of the 21st century.	Dry season rainfall amounts are likely to increase and wet Season rainfall to decrease.	Worqlul et al.,2018
CanESM2and CGCM3 under RCP 4.5 and 8.5 SRES A1B and B2	Addis Ababa City	Maximum temperature changes from 0.9oC in 2020 to 2.1 oC in 2080's and minimum temperature from 0.3oC in 2020 to 1 oC	The total precipitation increased from 29% in winter and 20.8% by 2020 in summer (RCP 8.5) by 2080s	Feyissa et al. ,2018
HadCM3 A2a and B2a and CanESM2 RCP2.6,4.5 and 8.5)	Upper Blue Nile River Basin	Maximum temperature rise by 0.4 oC to 2.9 oC and minimum temperature rise by 0.3 to 1.6 oC.	Relative changes in mean annual precipitation range From 2.1–43.8%.	Mekonin et al., 2018
(CORDEX) Africa experiment outputs	Ethiopia at the national level	Temperature is not included in the study	The wet (dry) spells were projected to decrease (increase) over most parts of Ethiopia, with relatively longer (shorter) dry (wet) spells projected over northern Ethiopia, projected changes in extreme precipitation at 95 percentile with higher values in the southern region.	G.Tegegne et al.,2020
A1B	Baro Akobo	Mean temperature increase 1oC to 3.5 oC in 2040 and 2090 respectively with reference to base 1989-2018	Precipitation decreased by 1.8% in 2040's and increased of 1.8%by2090 with inconsistent change	Muleta, T.N.,2021

Compiled by the author based on relevant climate projection studies in different parts of Ethiopia, 2021

Table S3. Areal average of models monthly maximum temperature (tasmax), minimum temperature (tasmin) and precipitation (pr) with the reference period (1981-2010), 2030 near, 2050 middle and 2080 long term period of the twenty-first century.

no	Variable	period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
I	Tasmax(oC)	observed	27.8	28.7	28.7	28.0	26.8	25.2	23.9	24.1	25.1	26.0	26.8	27.2	26.5
		2030	28.1	30.6	30.9	29.9	27.0	24.6	22.0	21.7	23.4	25.1	25.7	26.2	26.3
		2050	29.8	31.9	32.4	30.9	28.4	26.1	23.3	23.1	24.6	26.3	26.9	27.7	27.6
		2080	31.5	33.9	33.9	32.3	30.0	28.7	25.4	25.0	26.3	27.8	28.5	29.4	29.4
II	Tasmin (oC)	observed	14.5	16.1	17	16.5	15.8	17	15.2	15	15.5	14.2	14.3	15.3	15.5
		2030	14.6	16.0	17.0	17.1	16.5	15.7	15.0	15.1	15.6	15.1	14.4	14.3	15.5
		2050	16.2	17.6	18.5	18.5	17.8	17.0	16.3	16.3	16.8	16.6	15.8	15.7	16.9
		2080	18.2	19.7	20.4	20.2	19.4	18.7	18.0	18.0	18.5	18.3	17.6	17.6	18.7
III	Precipitation (mm/month)	observed	26.9	44.5	87.2	123.7	162.7	199.1	201.4	201.0	172.1	91.7	35.9	29.7	1375.9
		2030	8.3	13.1	42.6	107.4	187.2	175.4	156.5	163.0	180.5	136.7	74.3	27.4	1272.4
		2050	6.1	12.1	43.4	116.9	179.5	164.5	145.5	159.5	178.9	148.9	68.6	20.8	1244.7
		2080	6.8	12.9	54.6	116.1	155.5	139.9	144.9	150.5	176.3	155.9	70.5	20.3	1204.2

Table S4. Analysis of spatial interpolation of multi models averages of four study stations/urban centers during the historical period(1971-2005), near 2030 (2011-2040), middle 2050 (2041-2070), and long term 2080 (2071-2100) under RCP8.5.

id	Station	Latitude	Longitude	Altitude	Maximum temperature				Minimum temperature				Precipitation			
					Historical tasmax	tasmax1 2030	tasmax2 2050	tasmax3 2080	Historical Tasmin	tasmin1 2030	tasmin 2050	tasmin 3 2080	Historical Pr	Pr1 2050	pr2 2050	pr3 2080
1	Jimma	7.66	36.83	1725	24.3	25.5	26.9	28.7	13.9	14.9	16.1	17.6	126.7	127.6	118.5	115
2	Bedelle	8.45	36.33	2030	25.7	26.7	28.1	30	14.9	16	17.3	19	145.6	143.1	136.2	121
3	Bonga	7.22	36.23	1650	24.6	25.7	27.1	28.8	14.3	15.5	16.9	18.6	85.4	81.7	76.2	77.9
4	Sokoru	7.92	37.4	2100	25.6	27.1	28.4	30.1	13.9	14.9	16.1	17.6	146.5	143.6	142.8	145

Table S5. Computed Areal average of models monthly, seasonal and annual changes for maximum temperature(tasmax), minimum temperature (tasmin) and precipitation (pr) with the reference period (1981-2010), 2030 near, 2050 middle and 2080 long term periods.

No.	Variable	period	Monthly Average	Change	Winter	Change	Spring	Change	Summer	Change	Autumn	Change	Annual	Change	%	Remark
I	Tasmax(oC)	observed	26.5	base	28.4	base	26.7	base	24.4	base	26.7	base	26.5	base	base	base
		2030	26.3	-0.2	29.9	1.5	27.2	0.5	22.4	-2.0	25.7	1.5	26.3	-0.3	-0.90%	decrease
		2050	27.6	1.1	31.4	3.0	28.5	1.8	23.7	-0.7	27.0	3.0	27.6	1.1	4.20%	increase
		2080	29.4	2.9	33.1	4.7	30.3	3.7	25.6	1.2	28.6	4.7	29.4	2.9	10.40%	increase
II	Tasmin (oC)	observed	15.5	base	15.9	base	16.4	base	15.2	base	14.6	base	15.5	base	base	base
		2030	15.6	0.1	16.3	0.4	16.8	0.4	16.0	0.8	15.6	0.4	16.2	0.7	4.40%	increase
		2050	16.9	1.4	17.4	1.5	17.8	1.4	16.5	1.3	16.0	1.5	16.9	1.4	9.02%	increase
		2080	18.7	3.2	19.4	3.5	19.4	3.0	18.2	3.0	17.8	3.5	18.7	3.2	20.55%	increase
III	Precipitation (mm/month)	observed	1375.9	base	158.6	base	485.5	base pr	574.5	base	157.3	base	1375.9	base	base	base
		2030	1272.4	-7.50%	64.0	-59.60%	470.0	-3.20%	500	-12.97%	238.4	51.56%	1272.4	-103.5	-7.52%	decrease
		2050	1244.7	-2.00%	61.6	-61.20%	460.9	-5.10%	483.9	-15.77%	238.3	51.50%	1244.7	-131.2	-9.54%	decrease
		2080	1204.2	-2.90%	74.3	-53.20%	411.5	-15.24%	471.7	-17.89%	246.7	56.83%	1204.2	-171.7	-12.50%	decrease
		pr		decrease		decrease		decrease		decrease		increase			decrease	

Note: Absolute change for temperature and percentage change for precipitation with reference to the base period 1981-2010 was analyzed by Author computation, 2021