



# Climate Change Information Fact Sheet

## EGYPT

<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)**

Annual average temperatures increase from about 20°C on the Mediterranean coastline to around 24°C on the Red Sea coastline, 25°C at Cairo, and 26°C further south at Aswan [UKMO]. Typical daytime maximum temperatures in midsummer range from 30°C at Alexandria southward to 41°C at Aswan; while the corresponding north-south range in midwinter daytime maximum temperatures is 18°–23°C. There have been widespread warming trends over Egypt since 1960 with greater warming in summer (0.31°C per decade) than during winter (0.07°C per decade); statistical confidence is higher for the summer warming trend. Between 1960 and 2003, there has been an increase in the frequency of warm nights and a decrease in the frequency of cool nights, and a general increase in average summer temperatures. Nighttime temperatures (daily minimum) show a widespread positive shift in the distribution with fewer cool nights and more warm nights. Confidence is high throughout.

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

The mean annual temperature in the country is projected to increase by 1.07°C to 1.27°C by 2030 for the RCP4.5 and RCP8.5 median model ensemble, and by 0.37°C and 0.61°C for the RCP4.5 and 8.5 10th percentile, and by 1.78°C and 2.11°C for the RCP4.5 and 8.5 90th percentile [CCKP]. Maximum temperatures are projected to increase by 1.0°C to 1.22°C, and minimum temperatures by 1.09°C and 1.32°C for the RCP4.5 and 8.5 median ensemble.

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

At midcentury, mean annual temperatures are projected to increase by 1.64°C and 2.33°C for the RCP4.5 and 8.5 median ensemble, by 0.81°C and 1.52°C for the RCP4.5 and 8.5 10th percentile, and by 2.62°C and 3.45°C for

*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.*

the RCP4.5 and 8.5 90th percentile, respectively [CCKP]. Increases are highest in summer months of July-September. Increases in the number of hot days (especially in summer), and decreases in the number of cool days are projected for the median ensemble by midcentury for the A2 and B1 scenarios. Over North Africa under the SRES A1B scenario, both annual minimum and maximum temperatures are likely to increase in the future, with greater increase in minimum temperature [IPCC Ch22].

## PRECIPITATION AND FLOODING

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

Annual average rainfall from 1961 to 1990 was 41.8 mm. About half of the yearly precipitation falls from December through March [CCKP]. Precipitation is generally very low throughout the country although along the Mediterranean coastline it averages more than 200 mm/yr [UNDP]. Precipitation rates drop quickly as one moves away from the coast and most of Egypt receives only about 2 mm of precipitation per year. Most of Egypt is a desert and is classified as arid (except for the Mediterranean coast, which is semi-arid). Given lack of precipitation data, there is low statistical confidence regarding historical trends [IPCC Ch 22]. There is a small region of drying in the northeast, where confidence in the signal is higher. There is evidence that the severity and frequency of flash flooding across Egypt has increased in recent years. Over the last few decades the northern regions of North Africa have experienced a strong decrease in the amount of precipitation received in winter and early spring.

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

The median ensemble runs for RCP4.5 and 8.5 indicate an average annual rainfall change of 0 mm/day, and 0.1mm/day, by the middle of the 2030s [USGS]. By 2030, the RCP4.5 10th percentile (-90%), median (-2%), and 90th percentile (102%) ensembles for mean annual precipitation indicate high uncertainty in the direction and amount of change across the models [CCKP]. These results are similar to RCP8.5 (-92%, -2%, and 121%).

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

A reduction in rainfall over northern Africa is very likely by the end of the 21st century [IPCC Ch 22]. The annual and seasonal drying/warming signal over the northern African region (including Egypt) is a consistent feature in the global and the regional climate change projections for the 21st century under the A1B and A2 scenarios. Rainfall projections are highly uncertain, but indicate slight reductions in rainfall in Egypt for most months by midcentury for the median ensemble RCP4.5 and RCP8.5 scenarios [CCKP]. However, the RCP4.5 10th percentile (-101%), median (-4%), and 90th percentile (98%) 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 (-107%, -7%, and 135%). The IPCC AR4 found consistency across GCMs that wet extremes could increase. There is uncertainty regarding the magnitude to which flood season discharge into the Nile River could be affected by climate change and GCMs are not consistent in simulating the same signs of change [UKMO].

## DROUGHT

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

Rainfall variability within Egypt is almost inconsequential, given that the country receives very little rainfall, as well as the fact that its agriculture is irrigated and not rain-fed [UNEP]. Variability in Nile flows are moderated by the High Aswan Dam. The dam has one year's worth of storage capacity, to help in handling periodic droughts, although Egypt remains vulnerable to multiyear droughts.

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

Estimates are highly uncertain and information is not readily available. Consider future drought conditions based on the most extreme past experience.

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

There is considerable uncertainty with regard to the projections of rainfall—both over Egypt as well as over the principal headwaters of the Nile [UNEP, OECD]. There is agreement across climate models that temperatures are projected to increase significantly under climate change, increasing the possibility of enhanced water losses from

evapotranspiration—particularly given the arid climates of Egypt and Sudan— which might imply reduction in streamflows and stored water.

## SEA LEVEL RISE AND STORM SURGE

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

Sea levels have risen across the Mediterranean by an average of more than 3.1 mm each year since 1992, although records from further back indicate considerable local variability [Verner, et al.]. One array of tide gauges indicates that since 1990, Mediterranean Sea levels have risen at a rate 5–10% faster than the 20th-century mean rate. Measurements on the Egyptian coast indicate that sea level is continuously rising at a rate of 1.8 and 4.9 mm/year with an average of 3 mm/year [Frihy and El-Sayed]. The relative sea level shows an upward increasing trend as a result of land subsidence and eustatic sea level. In recent years (December 2003, December 2010, and January 2011), major storms have struck the Mediterranean coastline of Egypt and have produced—during a short period—a surge of up to about one meter above the mean sea level.

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

Simple interpolation of a minimum and a maximum sea level rise scenario indicates that by 2030, the total, Mediterranean basin averaged sea level rise will be between 0.07 and 0.18m [Galassi]. One study used low (0.07m), medium (0.11m), and high (0.25m) scenarios for sea level rise projections in the delta region in the year 2030 [El-Nahry and Doluschitz].

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

Sea levels are projected to rise between 3 and 61 cm this century, depending upon local heat and salinity levels of the Mediterranean [WB]. Sea level rise projections in Egypt's delta are exacerbated by considerable land subsidence (5.0 cm/year), and a tidal range of about 20 cm [El-Nahry and Doluschitz]. One study used low (0.11m), medium (0.20m), and high (0.40m) scenarios for midcentury sea level rise in the delta region [El-Nahry and Doluschitz]. Another study used low (0.10m) and high (0.26m) scenarios for sea level rise in the Mediterranean basin [Galassi]. Particular risk areas in the Alexandria region are: Mandara and El Tarh (east of the city), and risk areas in the Nile Delta region are: The Manzala Lagoon barrier, east and west of the Rosetta City, Gamil, and the Tineh plain [Frihy and El-Sayed].

## WINDS AND OTHER STORMS

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

Egypt is not impacted by tropical cyclones [UKMO]. Climate hazards include dust storms in spring and early summer, which are a dry and dust-laden "Khamsin" wind that, from time to time, carries very hot air northward into northern Egypt ahead of weak cyclonic disturbances in the Mediterranean. Increased severity and frequency of sand storms and haze have been documented.

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

Estimates are highly uncertain and information is not readily available. Consider future winds and storms based on the most extreme past experience.

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

There are difficulties in analyzing changes in storminess, given the lack of robust historical analysis of local or global land surface winds or storminess currently available [UKMO].

<b>Climate information sources</b>	CCKP = World Bank Climate Change Knowledge Portal
	CW = Climate Wizard
	El-Nahry and Doluschitz = El-Nahry, A. H. and R. Doluschitz, 2010. Climate change and its impacts on the coastal zone of the Nile Delta, Egypt. Environ Earth Sci (2010) 59:1497–1506

	Frihy and El-Sayed = Frihy, Omran E. and Mahmoud Kh. El-Sayed, 2013. Vulnerability risk assessment and adaptation to climate change induced sea level rise along the Mediterranean coast of Egypt. <i>Mitig Adapt Strateg Glob Change</i> (2013) 18:1215–1237
	Galassi = Gaia Galassi, Giorgio Spada, 2014. Sea-level rise in the Mediterranean Sea by 2050: Roles of terrestrial ice melt, steric effects and glacial isostatic adjustment. <i>Global and Planetary Change</i> 123 (2014) 55–66
	IPCC = IPCC WG II, 2014. <i>Climate Change 2014: Impacts, Adaptation, and Vulnerability. Chapter 22 (Africa)</i>
	OECD = Organization for Economic Co-operation and Development (OECD), 2004. <i>Development and Climate Change in Egypt: Focus on Coastal Resources and the Nile.</i> Shardul Agrawala, Annett Moehner, Mohamed El Raey, Declan Conway, Maarten van Aalst, Marca Hagenstad and Joel Smith. Environment Directorate Environment Policy Committee Working Party on Global and Structural Policies, Working Party on Development Co-operation and Environment.
	UKMO = UK Met Office, 2013. <i>Climate: Observations, projections and impacts: Egypt.</i>
	UNDP = UNDP, 2013. <i>Potential Impacts of Climate Change on the Egyptian Economy</i>
	USGS = Alder, J.R. and Hostetler, S.W., 2013. <i>CMIP5 Global Climate Change Viewer.</i> US Geological Survey.
	Verner, et al. = Verner, Dorte; Wilby, Robert; Breisinger, Clemens; Al-Riffai, Perrihan; Robertson, Richard; Wiebelt, Manfred; Kronik, Jakob; Clement, Viviane; Levine, Tamara; Esen, Ferhat; Roos, Philippe, 2013. <i>Tunisia in a Changing Climate. Assessment and Actions for Increased Resilience and Development.</i> The World Bank, Washington, DC.