USAID
FROM THE AMERICAN PEOPLE

FACT SHEET

Climate Change Information Fact Sheet SOUTH AFRICA

Definitions
Ensemble: A collection of model simulations characterizing a climate prediction or projection. [IPCC AR5]
Representative Concentration Pathway (RCP): 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]
RCP8.5: Generally, high emissions. One high pathway for which radiative forcing reaches >8.5 W m^{-2} by 2100 and continues to rise for some amount of time. [IPCC AR5]
RCP4.5: Generally, moderate emissions. One of two intermediate stabilization pathways in which radiative forcing is stabilized at approximately 4.5 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)
South Africa has a warm climate and much of the country experiences average annual temperatures of above 17°C. The southern and eastern escarpments are the regions with the lowest temperatures, due to the altitude. The warmest areas are the coastal areas of KwaZulu-Natal, the Lowveld of KwaZulu-Natal and Mpumalanga, the Limpopo valley and the interior of the northern Cape [SARVA]. Maximum and minimum temperatures all show significant increases with few exceptions, notably for minimum temperature in the central interior (Vaal). Likewise, high temperature extremes have increased significantly in frequency, and low temperature extremes have decreased significantly in frequency. Across the country, mean annual temperatures have increased at least 1.5 times the observed global average increase of 0.65°C during the last 50 years [LTAS]. The probability of austral summer heat waves over South Africa increased over the last 2 decades of the 20th century compared to 1961 to 1980 [IPCC AR5]. Mean annual temperatures along the South African coast range from ~17°C (along the northwestern, western cape, and southern coast) increasing to 23°C moving from the southern coast to the Northwestern coast/border with Mozambique. The oceans surrounding South Africa have a moderating influence on the temperatures experienced along the coastal areas. The warm Agulhas current causes the east coast to be significantly warmer than the west coast, where the cold Benguela current and upwelling induce lower temperatures [SARVA].

Future: 2030 (generally 2020-2049)
The mean annual temperature in the country is projected to increase by 0.37°C, 0.98°C, and 1.66°C by 2030 for the 10th, 50th, and 90th percentiles for the RCP4.5 model ensemble runs, and by 0.54°C, 1.15°C, 1.75°C for the RCP8.5 10th, 50th, and 90th percentile model ensembles, respectively. For the RCP4.5 and RCP8.5 median

minimum and maximum temperatures could plausibly rise by 1 to 2°C over the interior regions, for all seasons, by 2015–2035 [LTAS]. The ensemble mean for the RCP4.5 and 8.5 scenarios indicates that both minimum and maximum temperatures are plausible to rise by less than 1°C over the coastal areas for all seasons by 2015–2035 [LTAS].

Future: 2050 (generally 2040-2059)

The mean annual temperature in the country is projected to increase by 0.86°C,1.5°C, and 2.4°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 1.4°C, 2.05°C, and 2.9°C. For the RCP4.5 and RCP8.5 median model ensembles minimum temperatures are projected to increase by 1.38°C to 1.89°C, and maximum temperatures by 1.66°C to 2.23°C [CCKP]. The median of the ensemble of CSAG's statistical downscalings indicate moderate mean, maximum, and minimum temperature increases over the South African interior of 2°C to 2.5°C under the B1 scenario, and of 2°C to 3°C for the A2 scenario [LTAS]. Coastal temperature rises are generally projected to be less than those experienced in the interior [SARVA]. In the case of the A2 scenario, the coastal areas are projected to warm by around 1°C by midcentury [SARVA].

PRECIPITATION AND FLOODING

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

South Africa's annual precipitation is highly variable, year over year. The mean annual rainfall (1900-2009) is 450 mm [CCKP]. Rainfall was above average in the 1970s, the late 1980s, and mid to late 1990s, and below average in the 1960s and in the early 2000s, reverting to average towards 2010. There is a tendency towards an increase in rainfall extreme events, but especially in spring and summer, with a reduction in extremes in autumn. Rainfall trends overall are weak and nonsignificant, but there is a tendency towards a significant decrease in the number of rain days. This would support the observed tendency towards an increase in extreme rainfall events [LTAS]. The southwestern Cape is a winter rainfall region that receives the bulk of its annual rainfall in the form of frontal rain during (austral) winter. Rainfall over South Africa is highly variable in space, and a west-east gradient in rainfall totals is evident. The west coast areas are arid to semi-arid areas. The air above the cold Benguela current and upwelling region along the west coast is relatively dry and cold, contributing to the dry climate of the west coast. Moist air from the warm Indian Ocean and Agulhas Current is frequently transported into eastern South Africa by easterly winds. The air is forced to rise along the eastern escarpment, and precipitation results. There are also pockets of high rainfall along the southwestern Cape and Cape south coast areas, which similarly result when moist frontal air is transported inland and over high ground. The southwestern Cape is a winter rainfall region that receives the bulk of its annual rainfall in the form of frontal rain during winter. The Cape south coast is an all-season rainfall region. Flood risk is moderate along most of the coast, but moderate to high where rainfall is high [SARVA].

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, by the middle of the 2030s. [USGS] By 2030, the RCP4.5 10th percentile (-40%), median (-3.4%), and 90th percentile (36.4%) 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 (-43%, -4.4%, and 37%). Though there is some model agreement indicating mean annual rainfall will decline [CCKP].

Future: 2050 (generally 2040-2059)

Uncertainty for precipitation projections is high, and is not uniform across the country. At midcentury, The RCP4.5 10th percentile (-46%), median (-6.7%), and 90th percentile (35%) ensembles for mean annual precipitation in South Africa indicate high uncertainty in the direction and amount of change across the models. These results are similar to RCP8.5 (-57%, -9.9%, and 32%). There is some model agreement indicating annual rainfall declines. [CCKP] Statistically downscaled projections of rainfall changes under the B1 and A2 scenarios indicate most ensemble members project moderate to significant rainfall increases over the winter rainfall region of the south-western Cape, extending to the Cape south coast, for the seasons autumn to spring at midcentury. Increases in winter rainfall are also projected by most ensemble members over the east coast areas and the eastern

escarpment. A largely mixed rainfall signal is projected for spring, ranging from significant increases to significant decreases. [LTAS]. Under all future climate scenarios considered by the LTAS, higher frequencies of flooding events are projected [Ziervogel et al.]. There is low confidence in projected increases of heavy precipitation over most of Africa except over East Africa, where there is a high confidence in a projected increase in heavy precipitation [IPCC AR5]. Downscaled projections for the RCP8.5 scenario at mid-century indicate: projected reductions in rainfall for most ensemble models during key winter rainfall months of May, June, and August, with mixed results in July. Projections for RCP4.5 are qualitatively similar, with less ambiguity in July (majority of the models indicating a reduction in mean rainfall). Projections for the northwestern coast are more mixed across months, with a majority of models indicating reductions in May. Projections for southern coastal station located at Port Elizabeth are more mixed between wetter and drier, with some agreement in ensemble models for RCP4.5 and 8.5 for drier April and May, and wetter December-January. A drier April and May is also projected by most models for RCP4.5 and 8.5 for April and May in Durban (though this is during the dry season), and Cape St Lucia (Northeastern coast), with mixed wetter and drier results for the other months of the year [CSAG].

DROUGHT

Current (based on historical climate conditions and recent trends, generally over the past few decades)
A drying trend has been observed for western portions of the country and surrounding region during the second half of the century due to an upward trend in Indian Ocean sea surface temperatures (SSTs). Dry spells have been occurring with increasing frequency [IPCC AR5]. It has been shown that severe summer drought in South Africa tends to occur under El Niño conditions, a relationship which seems to have strengthened since the 1970s [LTAS]. The cold Benguela current along the west coast contributes to the arid climate of this region [SARVA].

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)
A drying trend in western portions of the country and surrounding region (extending into desert areas of Namibia and Botswana) is projected to continue through the century. The southwestern regions of the country are thought to be at high risk of severe drought during this century and beyond. During the austral summer months, dry conditions are projected for the southwestern region of South Africa. Additionally, austral spring months are projected to be drier, implying a delay in the seasonal rains of subsequent summer months [IPCC AR5]. Under all future climate scenarios considered by the LTAS, higher frequencies of drought events are projected. In southern Africa, there is medium confidence that droughts will intensify in the 21st century in some seasons, due to reduced precipitation and/or increased evapotranspiration [IPCC AR5].

SEA LEVEL RISE AND STORM SURGE

Current (based on historical climate conditions and recent trends, generally over the past few decades)
South Africa has 3,079 km of coastline. Coastal areas of South Africa, particularly the Cape Peninsula, have been impacted by heavy waves and storm surge during violent coastal storms. However, such events have not been severe enough to limit development and trends have not been increasing. Regarding sea level rise, significant increases beyond global average have not been observed [Cape Town].

Future: 2030 (generally 2020-2049)
A linear interpolation of end of century global sea level estimations indicates that sea level could rise by 0.13 meters [RCP4.5] up to 0.4 meters [RCP8.5] by 2030 (from a reference time period of 1971-2010).

Future: 2050 (generally 2040-2059)
According to an analysis which considered local conditions and IPCC projections, 2.5 to 6.5 meter-sea level rise scenarios were deemed plausible during the 21st Century. If a storm were to occur during high tide, surge could be significantly greater than this [Cape Town]. A linear interpolation of end of century global sea level estimations indicates that sea level could rise by 0.20 meters [RCP4.5] up to 0.58 meters [RCP8.5] by 2030 (from a reference

time period of 1971-2010). There are projected increases in heavy rainfall events, but heavy winds do not appear to be of particular significance [LTAS]. Large uncertainties surround projected changes in tropical cyclone landfall from the southwest Indian Ocean that have resulted in intense floods during the 20th century [IPCC AR5].

WINDS AND OTHER STORMS

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

Tropical cyclones do occasionally affect South Africa. However, most make landfall north of South Africa toward Mozambique and Madagascar [LTAS].

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 projected increases in heavy rainfall events, but heavy winds do not appear to be of particular significance [LTAS]. Large uncertainties surround projected changes in tropical cyclone landfall from the southwest Indian Ocean that have resulted in intense floods during the 20th century [IPCC AR5].

Climate information sources	Cape Town = City of Cape Town, 2008. Global Climate Change and Adaptation: A Sea-Level Rise Risk Assessment.
	CCKP = World Bank Climate Change Knowledge Portal (CCKP)
	CSAG Climate Tool = http://cip.csag.uct.ac.za/webclient2/app/#datasets provides detailed historical and projected climate information -downscaled at stations throughout South Africa
	CW = Climate Wizard
	IPCC AR5 = Niang et al., 2014. WGII Ch22 Africa
	LTAS = Republic of South Africa Department of Environmental Affairs, 2013. Long-Term Adaptation Scenarios Flagship Research Programme (LTAS) for South Africa
	SARVA = Republic of South Africa Department of of Science and Technology, 2010. The South African Risk and Vulnerability Atlas (SARVA)
	USGS = Alder, J.R. and Hostetler, S.W., 2013. CMIP5 Global Climate Change Viewer. US Geological Survey.
	Ziervogel et al. = Ziervogel et al., 2014. Climate change impacts and adaptation in South Africa. WIREs Clim Change 2014, 5:605–620. doi: 10.1002/wcc.295