Urban Climate

Risk Assessment

LUANDA, Angola

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Overview

Luanda is projected to grow by approximately 276,000 new inhabitants annually for the next seven years. With an expected population of nearly 9 million by 2025 and an economic boom currently redefining its social and spatial landscape, the coastal capital of Angola is a megacity in the making[i], in one of southern African's already most urbanized countries. More than half of the city's population lives in slum conditions, however, and the combined potential impacts of sea level rise, epidemics, and food insecurity, as well as weak urban infrastructure and poor governance, threaten to make these communities even more vulnerable in the years and decades to come.

The purpose of this assessment is to analyze the various hazards Luanda faces regarding climate change, as well as its institutional capacity to deal with these hazards and the socioeconomic vulnerabilities present, particularly amongst the urban poor. In order to do so, the study will follow the Urban Risk Assessment (URA) framework provided by the World Bank[ii]. It will conclude with a brief list of policy and planning recommendations based on the key hazard, institutional, and socioeconomic findings.

City Profile

Fig.1 City of Luanda, outlined in red, including the greater metro area. (Source: Google Maps)

Luanda is the capital of Angola as well as the nation's most populous city, with 2,825,311 residents in the city proper in 2014 and 5,172,900 in the greater metro area, or about a quarter of the country's entire population. The city has an area of 113 square kilometers, giving it a population density of 25,000/km2. The larger metro area, comprised of seven municipalities, consists of 2,257 square kilometers, with a density of 2,899/km2[iii]. It is situated on the Atlantic coast of southern central Africa at 8°50'18' S latitude and 13°14'4'E longitude, where it has served as a major port city since the days of Portuguese colonization[iv]. It sits approximately 6 meters above sea level, and benefits from a natural harbor; Luanda Bay is the point of entry for most of the imports on which the country depends. From a review of satellite images[v], it seems that much of the urban coastline is unprotected, with development stretching right down to the water. Most of Angola's coastline stretching from the southern border with Namibia north to Luanda is a semi-arid desert climate; beyond the city to the north this gives way to rainforest. Two major rivers lie to the north and south of the Luanda metro area, namely the Rio Bengo and the Rio Cuanza. To the east of Luanda rise a series of hills and mountains approximately 20 miles inland from the coast; beyond these highlands is a large plateau stretching east towards Zambia.

Table 1 - Luanda	
Total city population in 2014	2,835,311 (city) 5,172,900 (metro area)
Population growth (% annual)	2.784 (Angola) 5.77 (Luanda during current decade)
Projected population by 2025	8,924,000
Land area (km2)	113 (city) 2,257 (metro area)
Population density (per km2)	25,000 (city) 2,899 (metro area)
Angola's per capita GDP (US$)	6,500 (2012 est.)
First Source: Wikipedia[vi] *Second Source: UN-Habitat*[vii] *Third Source: CIA World Factbook*[viii]	

Built Environment and Basic Service Provision

Luanda was constructed by the Portuguese as a colonial port city meant for a population of approximately half a million inhabitants[ix]. The colonial quarter, or *Baixa de Luanda* ('Lower Luanda') is located along the waterfront of Luanda Bay and consists of narrow streets. The more recent *Cidade Alta* ('Upper City') expands outward from the colonial center. The population of the Luanda metro area exploded to over 5 million residents as a result of the country's prolonged civil war, as well as the more recent economic boom tied to foreign investment and Angola's mineral wealth. This unplanned urban population growth overwhelmed the city's existing infrastructure, and gave rise to the *musseques*, or slums, around the urban periphery. (The *musseques* had actually existed prior to the conflict, a result of the Portuguese colonial government's failure to create residential areas for native Africans within the city[x]).

The Angolan Civil War (1974-2002) was one of the longest conflicts in contemporary history, and displaced a sizeable portion of the nation's rural population who fled to safer urban areas; today, Angola is one of the most urbanized countries in southern central Africa, at 59.2%[xi]. Unprepared for the massive influx of migrants, the Angolan ruling party *Movimento Popular de Libertação de Angola* (Popular Movement for the Liberation of Angola, or MPLA) had no comprehensive plan for accommodating the newcomers or providing basic services, and so the *musseques* grew within and around Luanda. After Kinshasa in the DRC, the *musseques* of Luanda and the surrounding area constitute the largest continuous slum in Africa, with 4 million inhabitants[xii]. In 2005, 86.5% of Angolans lived in slums.[xiii]

Since the end of the civil war in 2002, migrants from rural Angola and neighboring countries have been attracted to Luanda for another reason: the significant development of the nation's oil industry and massive foreign investment, particularly from India and China, which has created a construction boom in the city[xiv]. The influx of workers has further increased the population of the *musseques*, as the oil and construction boom has created a dearth of affordable housing. In fact, a combination of factors, from the oil industry to the country's heavy reliance on imports, has made Luanda one of the most expensive cities in the world in which to live.[xv]

Despite the creation of oil-sector and construction jobs and the high cost of living, 60% of Luanda residents are employed in the informal economy, and 54.3% of the Angolan population survives on less than US$1.25 per day[xvi].

Basic infrastructure in Luanda is also of concern. Despite improvements in recent decades, access to clean water and sewer systems, as well as electricity, is still low. Particularly in the *musseques,* sewage often runs in the streets, exacerbating the risk of infectious diseases such as diarrhea, hepatitis A, typhoid fever, malaria, African sleeping sickness, and schistosomiasis. The present and future risk of increased flooding and storm surge due to climate change will only make this problem worse. Finally, the lack of piped water in the *musseques* forces most urban poor to buy their water each day from water trucks, at a cost three to five times greater than the piped supply to the urban middle-and-upper classes[xvii].

In terms of transportation, Luanda is served by a fleet of communal taxis known as *candongueiros,* as well as a private bus company. Transportation infrastructure is largely geared towards automobiles, most likely due to the country's rich supply of oil. A railroad network that was out of commission during the civil war is currently being rehabilitated.

Table 2 - Basic Infrastructure Access, Percentage of Households, 2006

Piped water (Luanda) Clean water (all urban areas)	36.6 66.0
Sewerage (Luanda) Sanitation systems (all urban areas)	53.2 69.0
Electricity (Luanda)	75.5

First Source: UN Angola Inter-Agency Contingency Plan[xviii]
Second Source: UN-Habitat[xix]

Pillar 1 - Hazards Assessment

Past Natural Disasters

From 1980 to 2010, Angola experienced approximately 49 natural disasters, the most common being flooding (24 instances) followed by epidemics (18) and drought (6)[xx]. Drought typically occurs in the arid south, while flooding affects the more tropical north. The Benguela Current affords Luanda a semi-arid climate; however, heavy rains during the November-April rainy season also affect the city, especially the poorer informal peri-urban

areas. A lack of adequate sewerage exacerbates flood events and increases the risk of infectious disease; a cholera epidemic in 2006 killed over 2,300 people[xxi].

Table 3 - Natural Disasters in Angola, 1980-2010	
Number of events	49
Number of people killed	5,354
Avg. killed per year	173
Number of people affected	3,855,001
Avg. affected per year	124,355
Economic damage (US$ x 1,000)	10,000
Source: PreventionWeb	

Table 4 - Statistics by Event, 1980-2010 (average)			
	Killed People	Affected People	Economic Damages
Flood	14.71	46,080.83	N/A
Epidemic	273.89	7,725.61	N/A
Drought	9.67	435,000	416.67 (US$ x 1,000)
Source: PreventionWeb			

Past Climate Trends

Weather data for Luanda, obtained from the National Oceanic & Atmospheric Administration, is extremely unreliable, and consistent tracking only seems to have begun around 2001 (or at least, an information request for data from 1980 to the present only yielded sporadic results). It may be that the country's ongoing civil war prevented reliable measurements from being taken until it drew to a close in 2002. Even during those years for which consistent data is available, temperatures were not always recorded for every month. It's therefore difficult to track the average mean temperature of Luanda, given that in some years temperature was measured only in the winter months, for instance (for example, in 2013 measurements are only available for July through December). The following table shows average mean temperature for Luanda from 2001-2014, keeping in mind the aforementioned data gaps. Note that no data for 2009 was available; also, data for average annual precipitation was even less reliable, and is therefore not included.

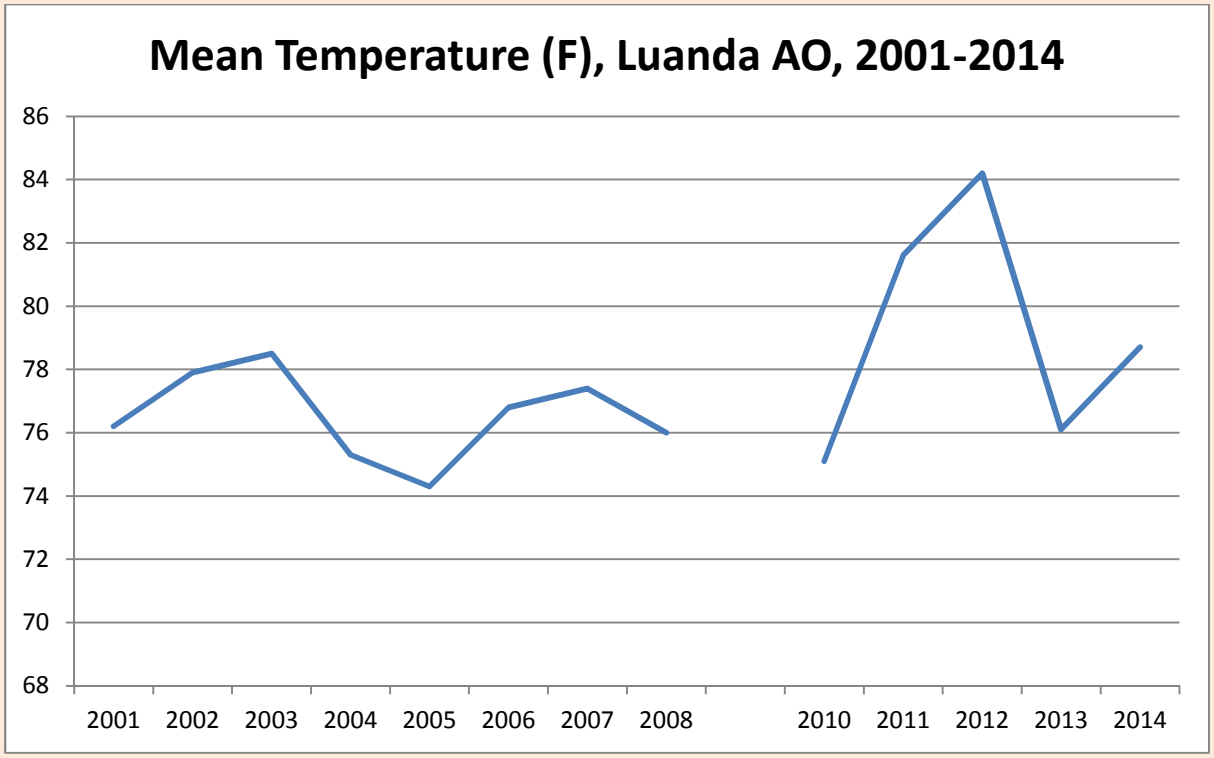


Fig. 2 Mean temperature (F), Luanda, 2001 - 2014. (Source: National Oceanic and Atmospheric Administration[xxii])

Projected Climate Trends and Main Hazards

Across all of central Africa, temperatures are projected to increase and precipitation is projected to decrease[xxiii]. For low-lying coastal cities like Luanda, sea level rise attributable to climate change will present major problems. Climate effects on the Benguela Current, which moderates the amount of annual rainfall on Luanda, may exacerbate flooding[xxiv]. The main environmental hazards posed by climate change and their correlating social consequences are elaborated on below. See the charts in the Appendix for projected trends in temperature, rainfall, and hot days (Source: *World Bank Climate Change Knowledge Portal*[xxv]).

Flooding

Due to its proximity to the ocean, infrastructural challenges, and increased urbanization, Luanda is at a high risk of flooding from sea level rise and more severe and/or frequent rainfall events. A review of satellite images of the city reveals that development - both formal and informal - stretches right down to the waterfront; this has led to the degradation of important coastal ecosystems, and has placed a number of the vulnerable poor population directly in harm's way[xxvi]. Furthermore, sea level rise and future storm surges directly threaten Luanda port, which plays an outsized role in the Angolan economy: 5.6

million tons of cargo passed through the port in 2007, most of it imports necessary to daily Angolan life[xxvii]. (The civil war severely handicapped the Angolan economy, which now relies on oil and gas production for as much as 97% of its GDP[xxviii]; most goods, including food, are imported and pass through the port at Luanda. Damage to the port would deal a significant blow not just to the capital, but to the entire country, unless diversification of the economy is made a priority).

Flooding throughout Angola from increased severe weather events, especially in the north of the country, also threatens to displace sizeable communities who may seek shelter in urban areas, as they have in the past. This problem is compounded by the amount of landmines, left over from the war, which may shift and become exposed in rural areas by flash flooding. Soil degradation in the countryside as well as deforestation (Angola lost 4.1% of its forest in 2010[xxix]) also increases the likelihood of extreme flooding events in rural areas.

Fig. 3 A flooded street in Luanda. (Source: MyContinent.co[xxx])

Disease

Because of basic infrastructural deficiencies as well as inadequate access to clean water, sanitation facilities, and healthcare, disease is already a major threat to the citizens of Luanda. The potential for storm water runoff to collect and stagnate in the streets, especially in the slum areas, as well as the projected increase in temperature for the coming decades means that the likelihood of epidemics will increase, as well.

Food Insecurity

As mentioned earlier, the Angolan economy relies heavily on imports to make up for its own lack of industry and to provide for the large influx of foreign workers and expatriates residing in Luanda. Even half of the country's food is imported, despite the fact that approximately 58.3 million hectares, or 46.8% of the total land area of the country, is suitable for agriculture[xxxi]. This is in direct contrast to most other African countries, whose cities depend on rural and peri-urban agricultural producers for their food supplies and less on imports. What little food Angola does grow domestically, however, may also come under risk as temperatures rise and the likelihood of drought increases; soil degradation also threatens food production in Angola. The current weak capacity for local agriculture and the exorbitant price of imported food puts Luanda's urban poor at particular risk of food insecurity[xxxii].

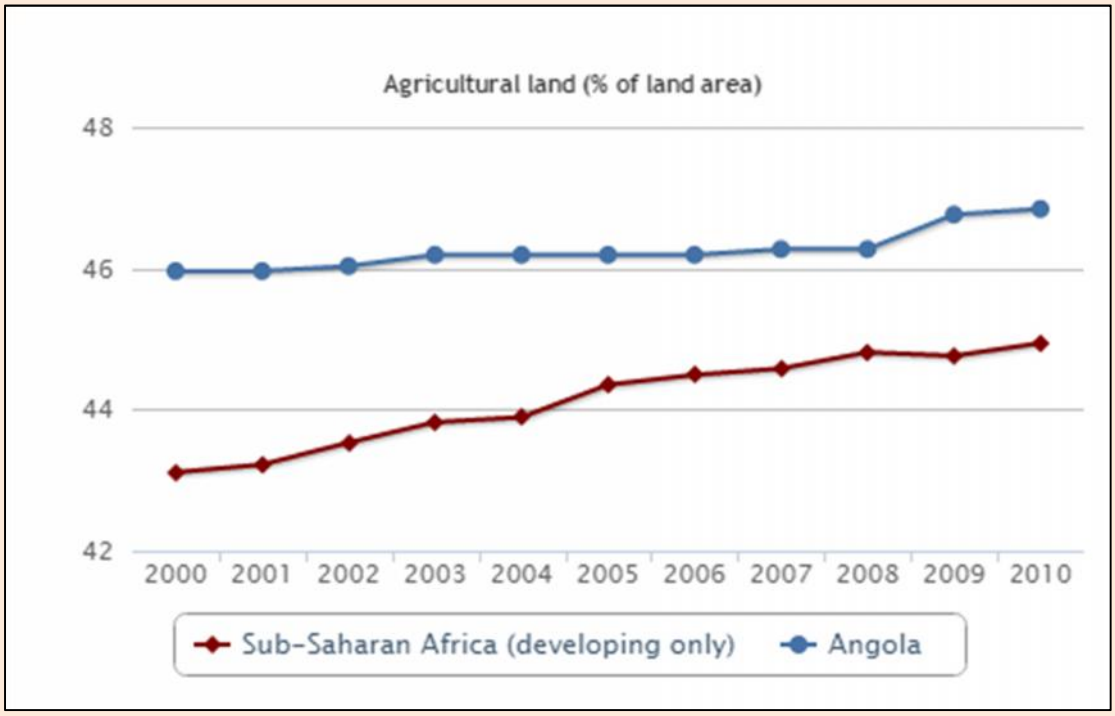


Fig. 4 Percentage of agricultural land in Angola compared to the rest of Sub-Saharan Africa. (Source: World Bank Climate Change Knowledge Portal)

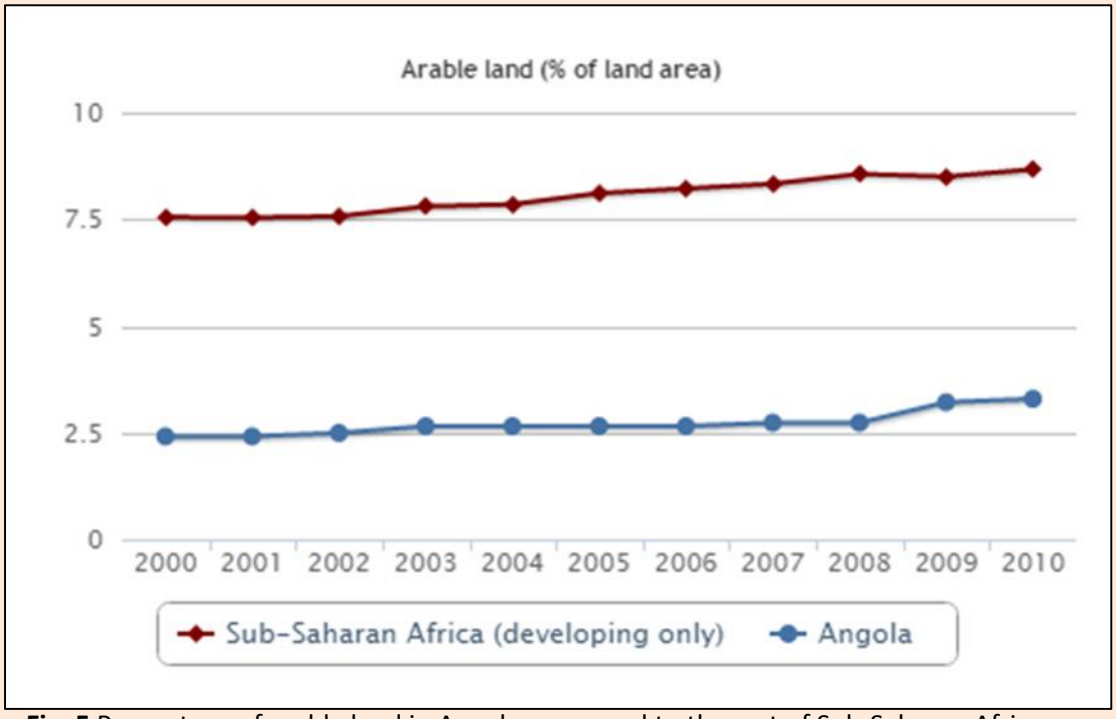


Fig. 5 Percentage of arable land in Angola compared to the rest of Sub-Saharan Africa. (Source: World Bank Climate Change Knowledge Portal)

Pillar 2 - Institutional Assessment

The city of Luanda falls under the jurisdiction of the Provincial Government of Luanda, led by current governor Graciano Francisco Domingos of the ruling MPLA party[xxxiii]. Although the Angolan government is party to a number of international agreements, including Biodiversity and the Kyoto Protocol, it is unclear which governmental bodies specifically address climate change, though it is most likely the Ministry of the Environment, headed by Minister Maria de Fátima M. Jardim. Nongovernmental organizations also play a key role in addressing various environmental and social issues within Luanda. A (very incomplete) list of governmental and nongovernmental organizations and their responsibilities follows.

Governmental

- National Civic Protection Service and Firefighters (*Servico Nacional de Protecção Civil e Bombeiros,* or SNPCB) - The SNPCB is a branch of the Ministry of the Interior and is responsible for preparing for and responding to natural disasters and epidemics. They are in a formal partnership with the UN Disaster Management Team in Angola (DMT), which provides training and disaster intervention upon request. According to the UN, the SNPCB (as well as the SPPCB, or provincial branches of

the organization) has both the human and financial resources to effectively conduct disaster response efforts, despite a perceived deficiency in national early warning capacity[xxxiv].

- Ministry of Urbanization and Housing (*Ministério do Urbanismo e Habitação*) - This branch of the government is responsible for the "formulation, preparation, coordination, execution, and supervision…in the fields of spatial planning, urban planning, housing, and registration[xxxv]."
- Ministry of the Environment (*Ministério do Ambiente*) - Deals with biodiversity, environmental planning, prevention and analysis of environmental impacts, among other things[xxxvi].

Non-Governmental

- DW Angola - This development organization works in partnership with the Angolan government and local community organizations on issues of poverty reduction, land tenure, housing, and water supply. They also provide Geographic Information Systems (GIS) training to local Angolans and have launched an initiative to better map Luanda's slum areas[xxxvii].
- Luanda Urban Poverty Programme (LUPP) - A joint initiative of four international NGOs, this organization focuses on the provision of basic services to Luanda's poor, namely water, sanitation, garbage collection, and early childhood development programs. It also works to promote good governance and the inclusion of marginalized communities in the planning process[xxxviii].
- SOS Habitat - This NGO grew out of the mass evictions that the government and private security firms carried out in post-war Luanda to clear the city of the *musseques*, the inhabitants of which often lack legal titles to the land. SOS Habitat aims to help slum dwellers obtain legalization and educate them about their land rights[xxxix].

Key Issues

Development in Luanda since the cessation of conflict in 2002 has focused disproportionately on attracting foreign capital, building up the oil and mineral sector, and rapid urbanization. Very little of the nation's economic growth has benefited the sizeable

communities of rural and urban poor, and the construction boom threatens to make the city even more vulnerable in a changing climate.

URBAN SPRAWL - In order to accommodate the massive influx of foreign and domestic workers, the Angolan government in partnership with international construction firms has begun developing satellite cities to provide housing and alleviate congestion in Luanda. The most well-known is Luanda Sul, located to the south of the city. However, as noted in the UN-Habitat's *The State of African Cities, 2014*:

> "The new towns and satellite cities now being established to relieve pressures on the largest African urban concentrations will also add to further urban slum proliferation, because these new towns almost exclusively cater for the residential needs of higher-income groups[xl]."

The construction of satellite cities such as Luanda Sul, rather than the integration and modernization of the slums, also causes soil degradation and decreases permeability during storms, possibly exacerbating flooding. The process of urban sprawl, furthermore, often requires the destruction of slum areas to make way for the new developments[xli], further marginalizing the already marginalized slum inhabitants.

Fig. 6 An aerial view of Luanda Sul, a gated community to the south of Luanda. (Source: Google Earth)

DECENTRALIZATION - The 2001 Strategic Plan for Decentralization and Deconcentration aimed to shift away from top-down planning and policy approaches in favor of more community involvement and participatory planning, and NGOs such as LUPP have worked to ease this transition[xlii]. LUPP and other organizations must ensure that climate risks are understood by the citizens of Luanda and addressed with assistance from the city and national governments.

TRANSPARENCY - In 2008, the Angolan government was ranked 158th out of 180 countries for fiscal transparency, and government corruption, particularly tied to the state oil company Sonangol, has long been suspected[xliii].

Pillar 3 - Socioeconomic Assessment

Vulnerability

As noted in the World Bank's "Urban Risk Assessments: Understanding Disaster and Climate Risk in Cities," the vulnerability of a population can be gleaned from such indicators as life expectancy, literacy, child mortality, average formal education, etc[xliv]. As of 2012, life expectancy for Angolan males is 54.16 years, and 56.47 years for Angolan females. 68% of the population lives below the poverty line, and 28% live in extreme poverty. The infant mortality rate is 79.99 deaths per 1,000 live births. In 2011, 3.5% of total GDP was allocated towards healthcare. Approximately 70.4% of the population is literate; 3.5% of Angola's GDP in 2010 was allocated towards education, and at the time of writing, all secondary education is located within urban areas[xlv].

Angola's current Human Development Index is 0.486. All these factors, coupled with the fact that the Angolan population is still suffering from the traumatic effects of a nearly 30-year-long civil war, indicate a high level of vulnerability.

Location and Exposure of the Urban Poor

According to UN-Habitat, post-conflict communities in Angola "have been left highly vulnerable to climate hazards and shocks as a result of reduced access to resources, reduced productive capacity of households and loss of assets[xlvi]." These vulnerable populations live primarily in the *musseques* of Luanda and other cities. Luanda slums can be broken down into four categories, according to a 2011 DW Angola report: transitional (slums slowly being

urbanized), with 11% of the total city population; organized, 8%; old (older than 35 years), 40%; and peripheral, with 21%. This leaves only about 20% of the city population living in non-slum housing; a significant proportion of the Luandan population, therefore, is at considerable risk from climate events[xlvii].

The *musseques* are located throughout Luanda; many of them, however, lie along the coast and are directly exposed to the consequences of sea level rise. The image below shows Sambizanga, one of the city's largest and oldest slum areas, situated right on the bay.

Fig. 7 Sambizanga, outlined in red, is one of Luanda's oldest and largest slums. It is situated along Luanda Bay, behind the industrial port area. (Source: Google Maps)

As long as Angola's oil boom continues and the countryside remains undeveloped, rural poor will continue to migrate to Luanda in search of economic opportunity. The exorbitantly high cost of living in the capital will ensure that the majority of them are relegated to the peripheral slum areas, where a lack of basic infrastructure and exposure to climate hazards will leave them vulnerable.

Fig. 8 Residents of the Boa Vista *musseque*, forced to relocate by the government. (Source: Getty Images)

Looking Ahead: Planning and Policy Recommendations

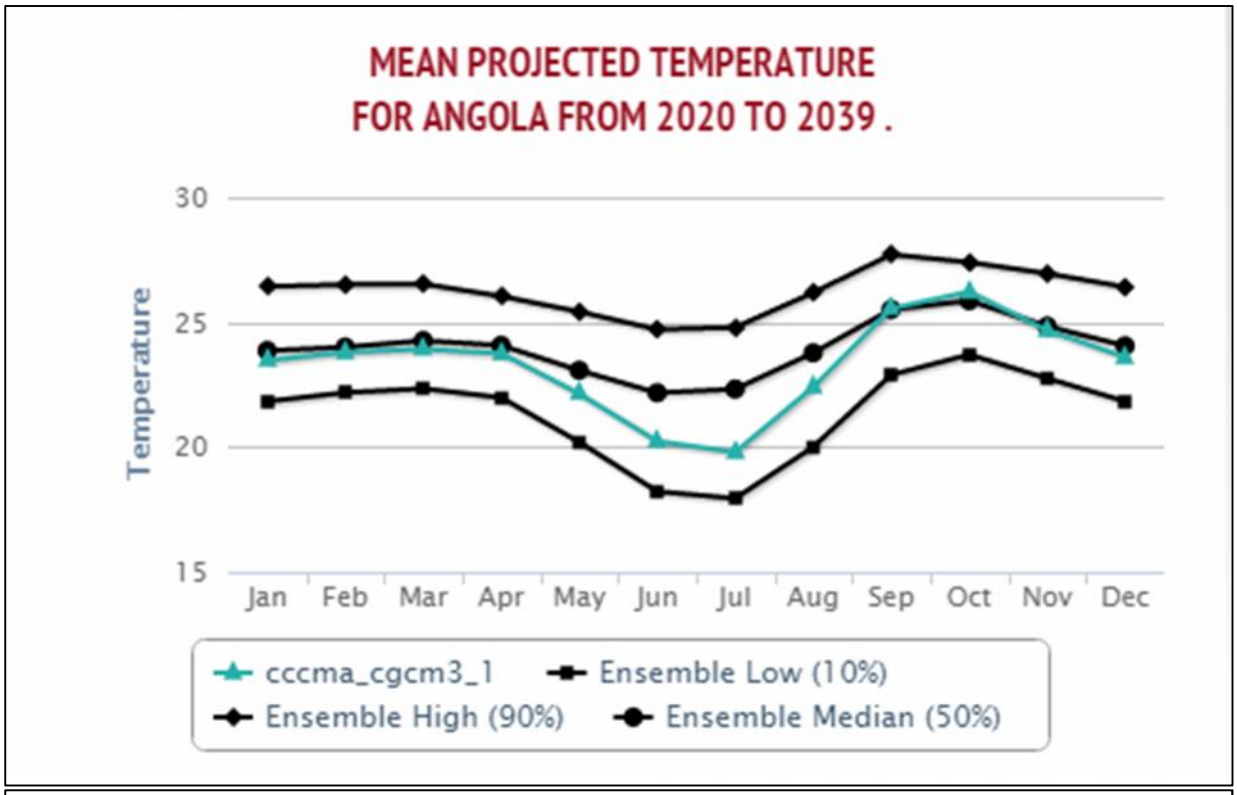
Luanda, a city planned for only half a million inhabitants, was ill-equipped to receive the millions of internally displaced migrants who flocked to it for safety over the course of 30 years. The Angolan government was also handicapped economically by the war, which diverted most of the funds that could have gone to upgrading the city's infrastructure. Now, however, with the Angolan economy one of the strongest in Africa, equitable and sustainable development should be the government's top priority, with a focus on basic services provision and long-term resiliency. The following list outlines some basic policy and planning recommendations, with a strong emphasis on equity.

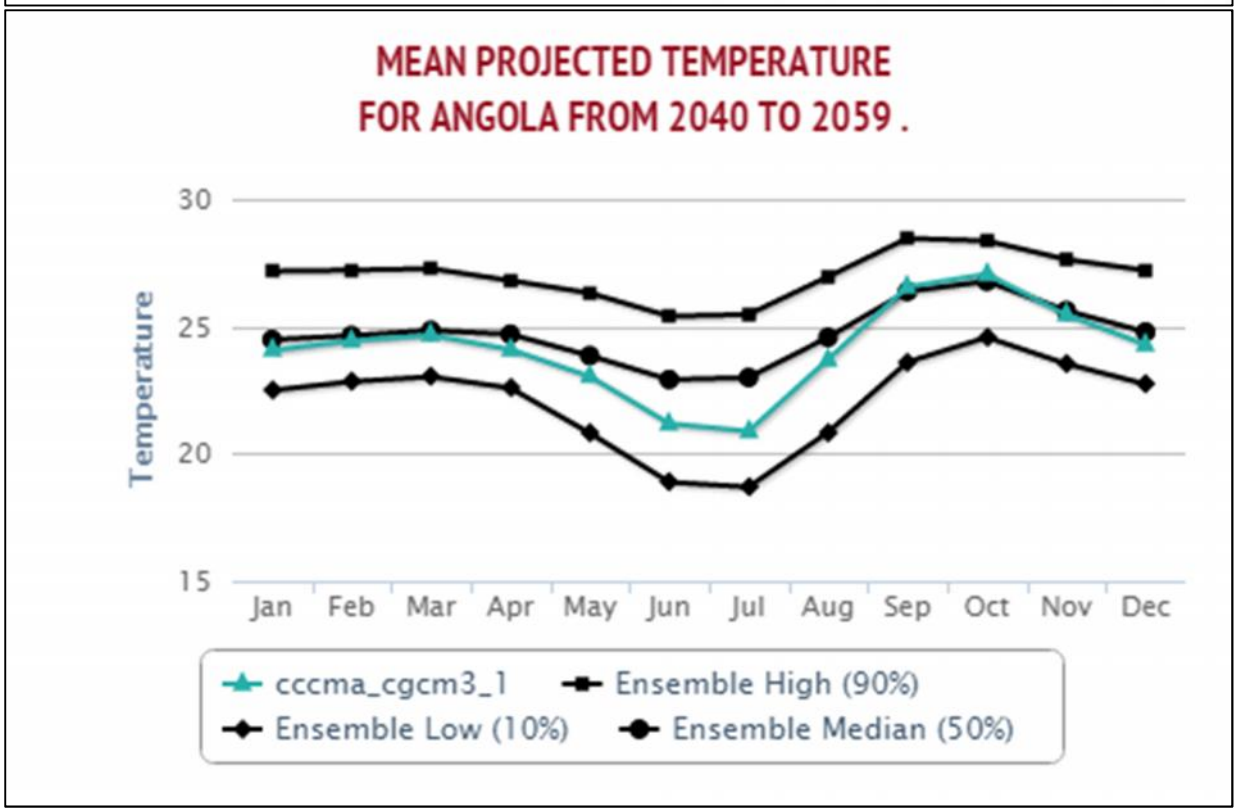
- Greater government transparency. The Angolan government has recently taken steps to provide greater fiscal transparency and accountability. With the conflict over and high foreign investment pouring in, a greater percentage of GDP should be allocated towards healthcare, education, etc.
- Greater collaboration with NGOs in identifying and addressing issues in the slums. Organizations such as LUPP and DW Angola have utilized participatory planning and community outreach to give voice to the residents of the *musseques* in the planning

process; this dynamic should be further developed as the government continues its process of decentralization.

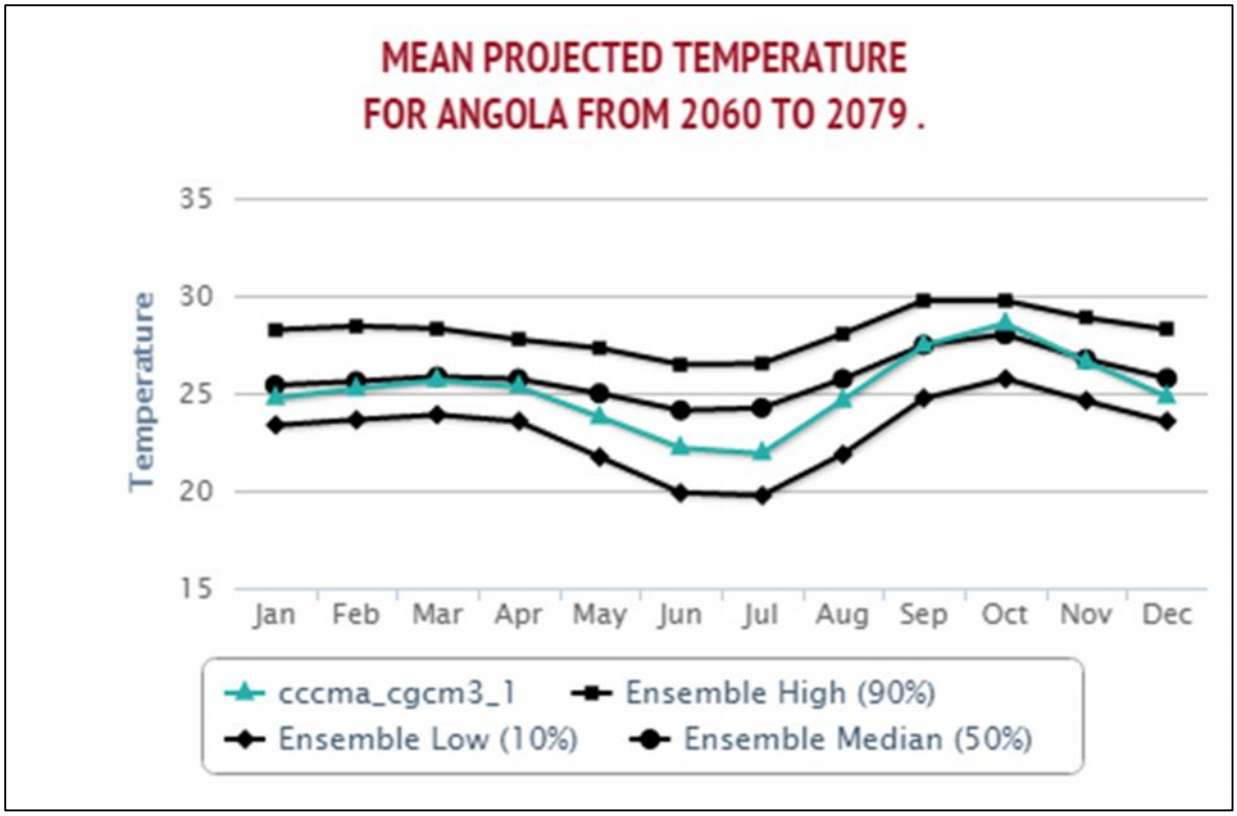
- Implement, in collaboration with NGOs, a slum upgrading program that works with communities rather than displaces them. Initial priorities should be piped water, sewerage, access to proper sanitation facilities, and land tenure.
- The city or provincial government should conduct a comprehensive waterfront sustainability/resiliency assessment, as the port of Luanda is the principal driver of the Angolan economy.
- Likewise, a study of Luanda's coastal ecosystems should be undertaken to better understand their effects on storm surge mitigation. A coastal rehabilitation project should be implemented, and new zoning laws for Luanda's vulnerable waterfront may have to be considered.
- Develop a basic public transit system to alleviate automobile congestion and connect disparate areas of the city, such as Bus Rapid Transit or a tram system.
- Implement a sustainable urban agriculture program on the city's periphery to address the looming concern of food insecurity, provide jobs, diversify the local economy, and alleviate malnutrition, as well as revitalize the degraded landscape and mitigate flooding.
- Convene an urban climate change task force of climate scientists, urban planners, policymakers, etc. to identify and monitor potential risks to the city, with an eye towards long-term adaptation planning.

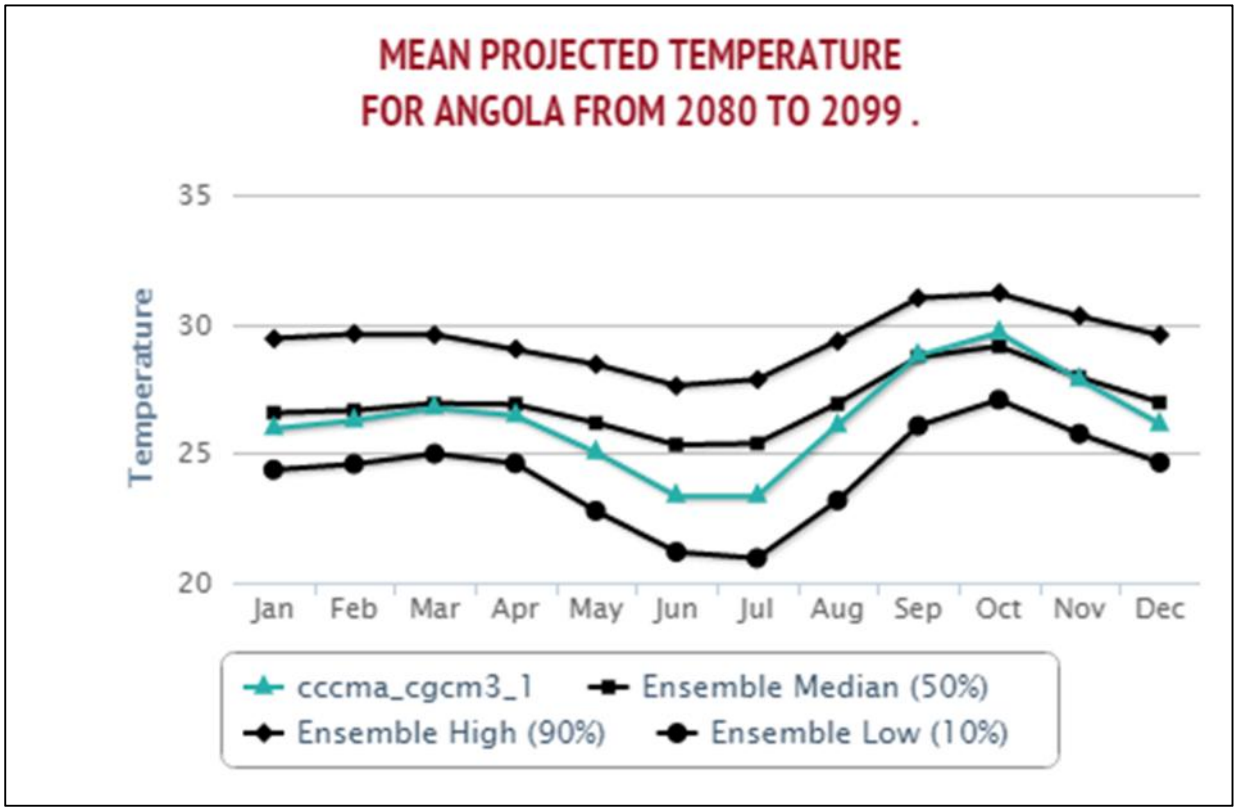
Appendix





Source: World Bank Climate Change Knowledge Portal





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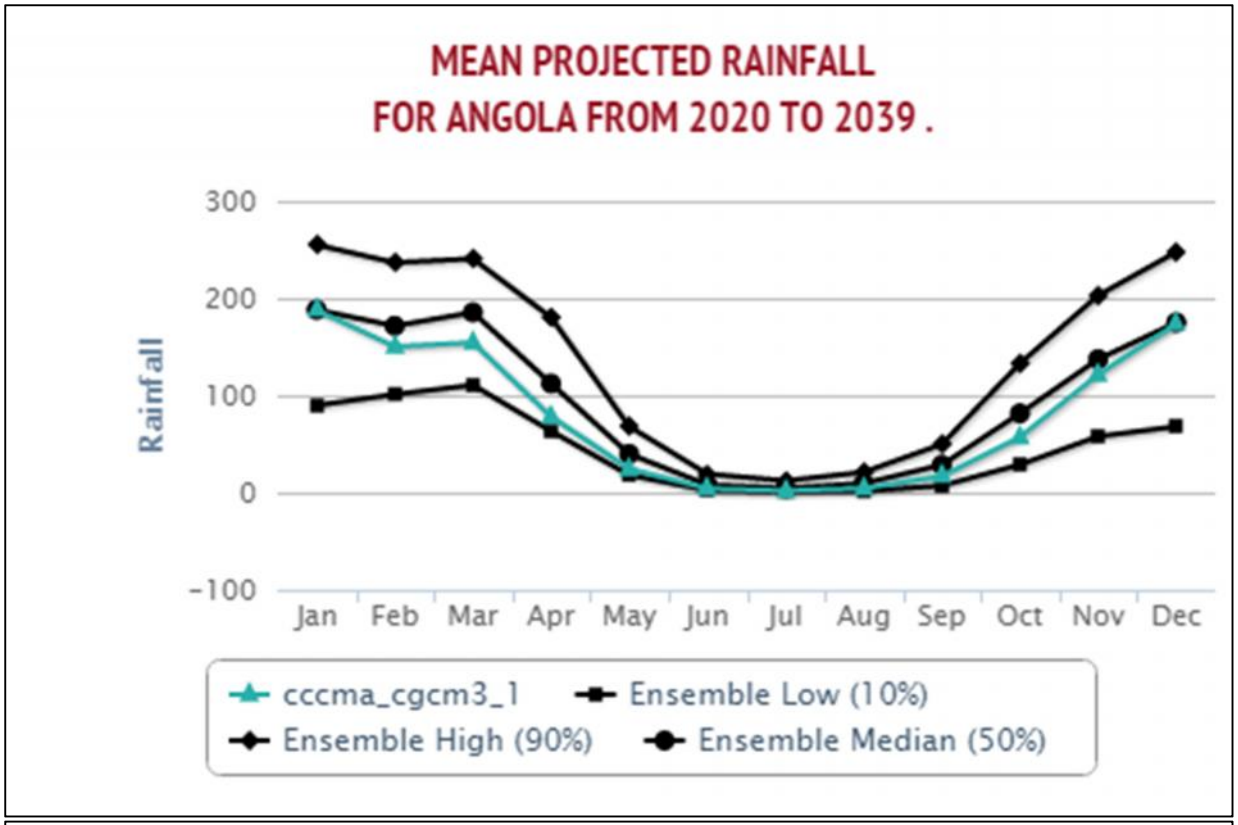

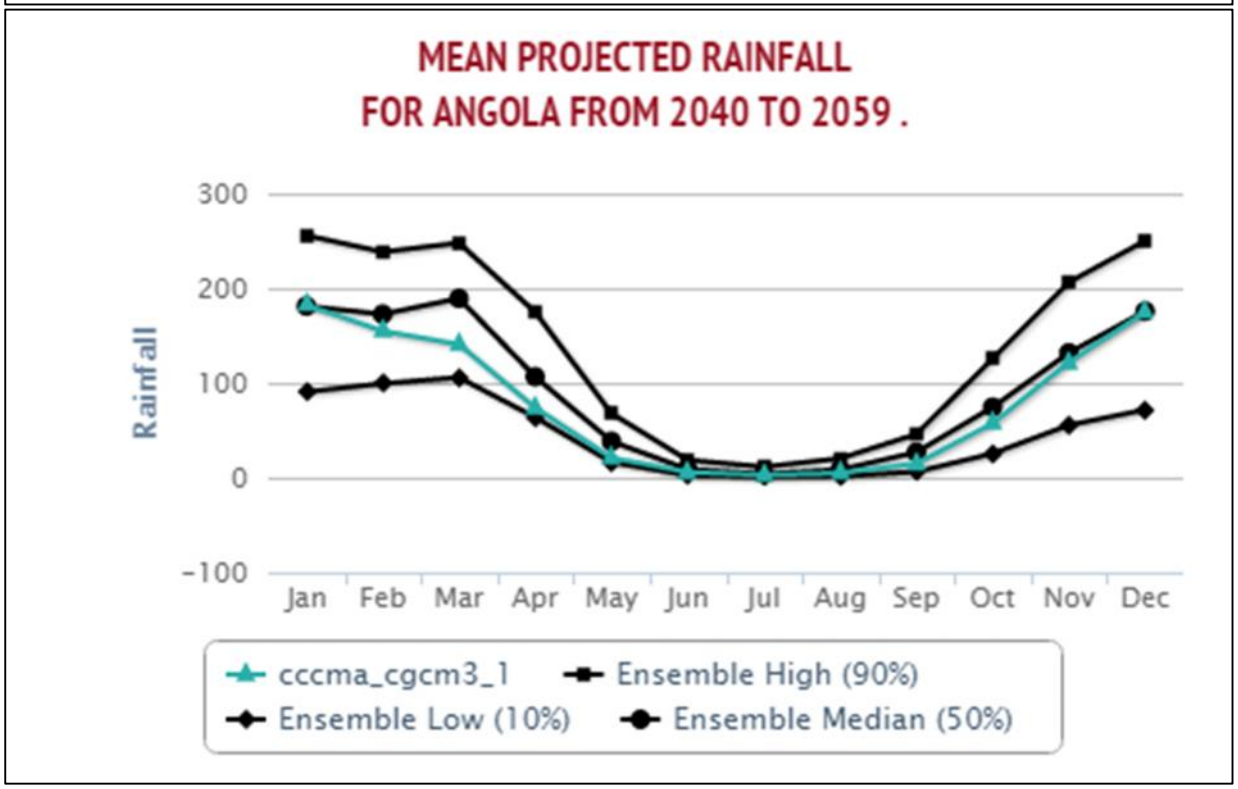

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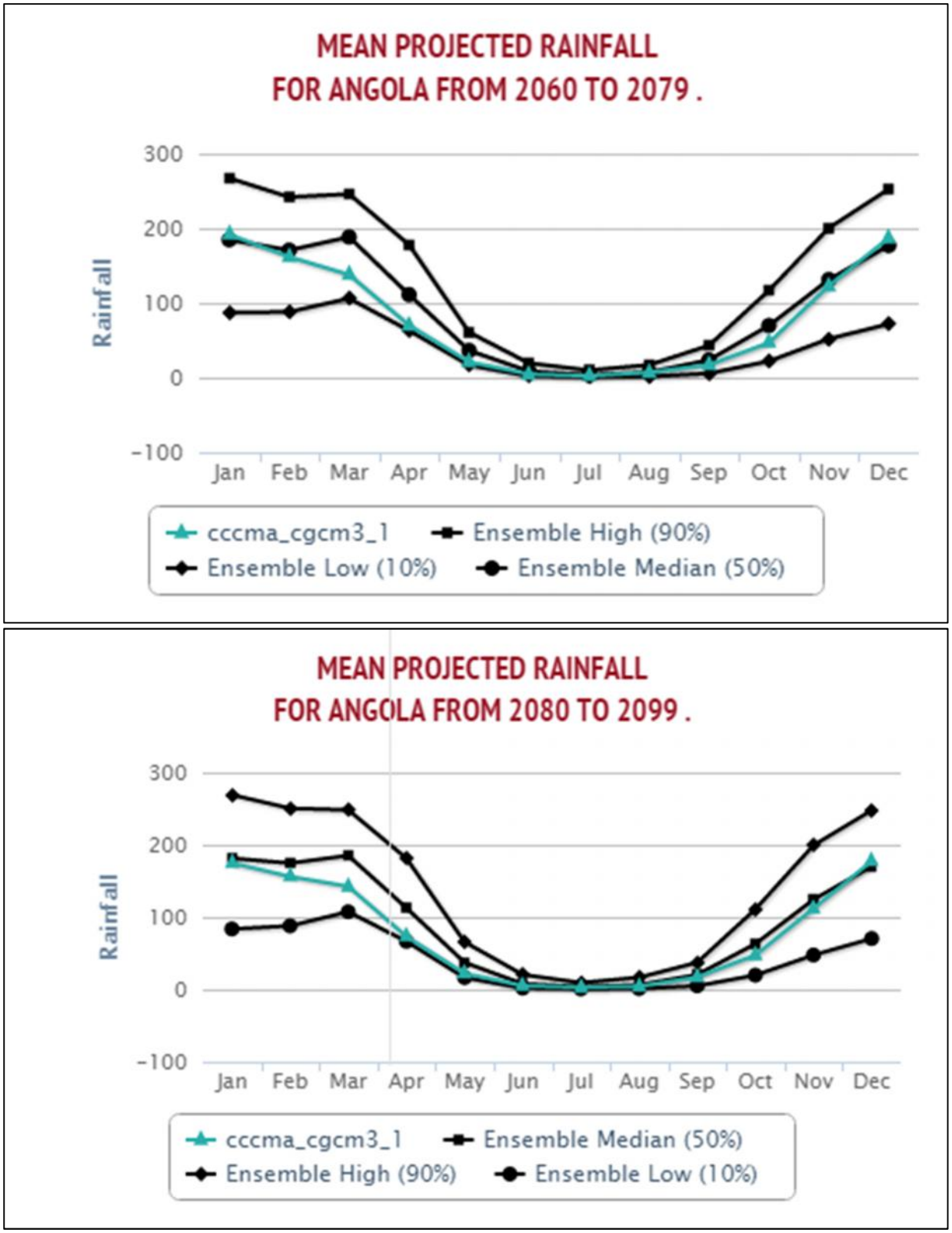
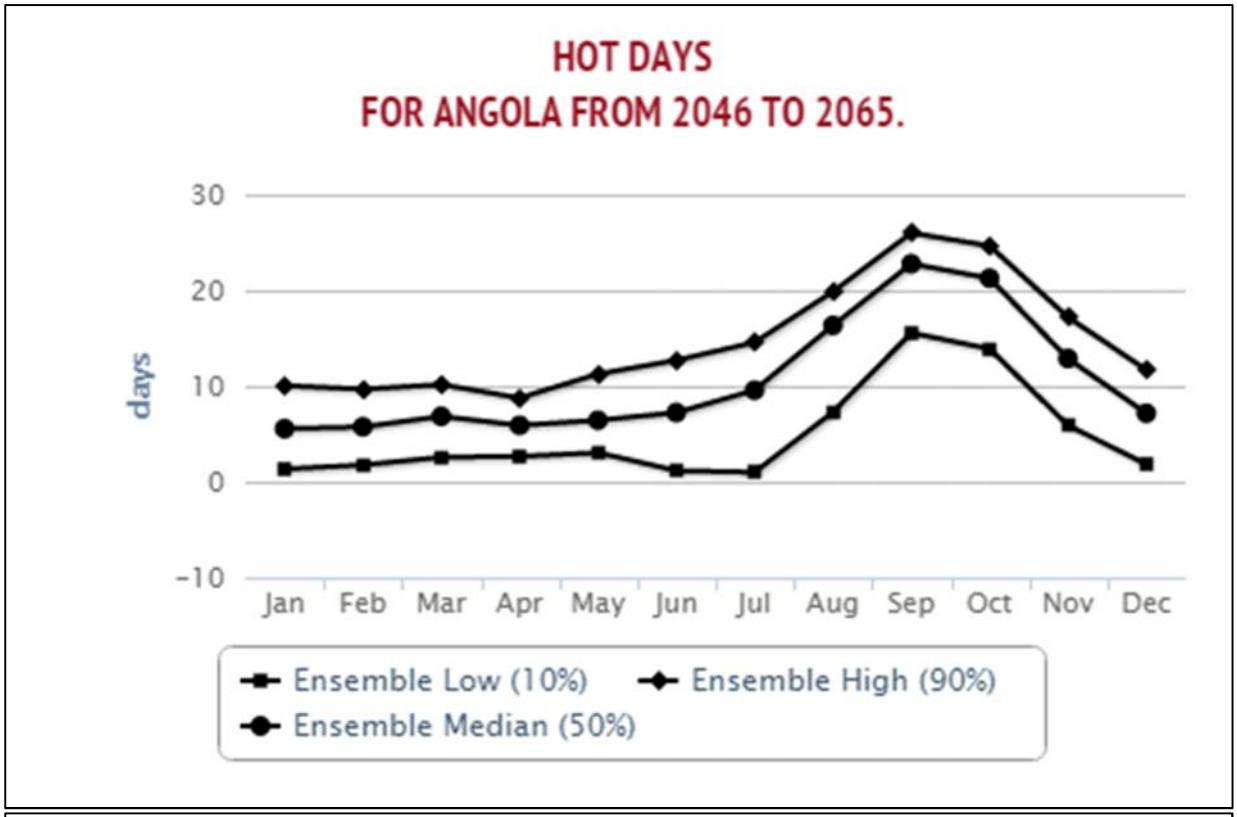
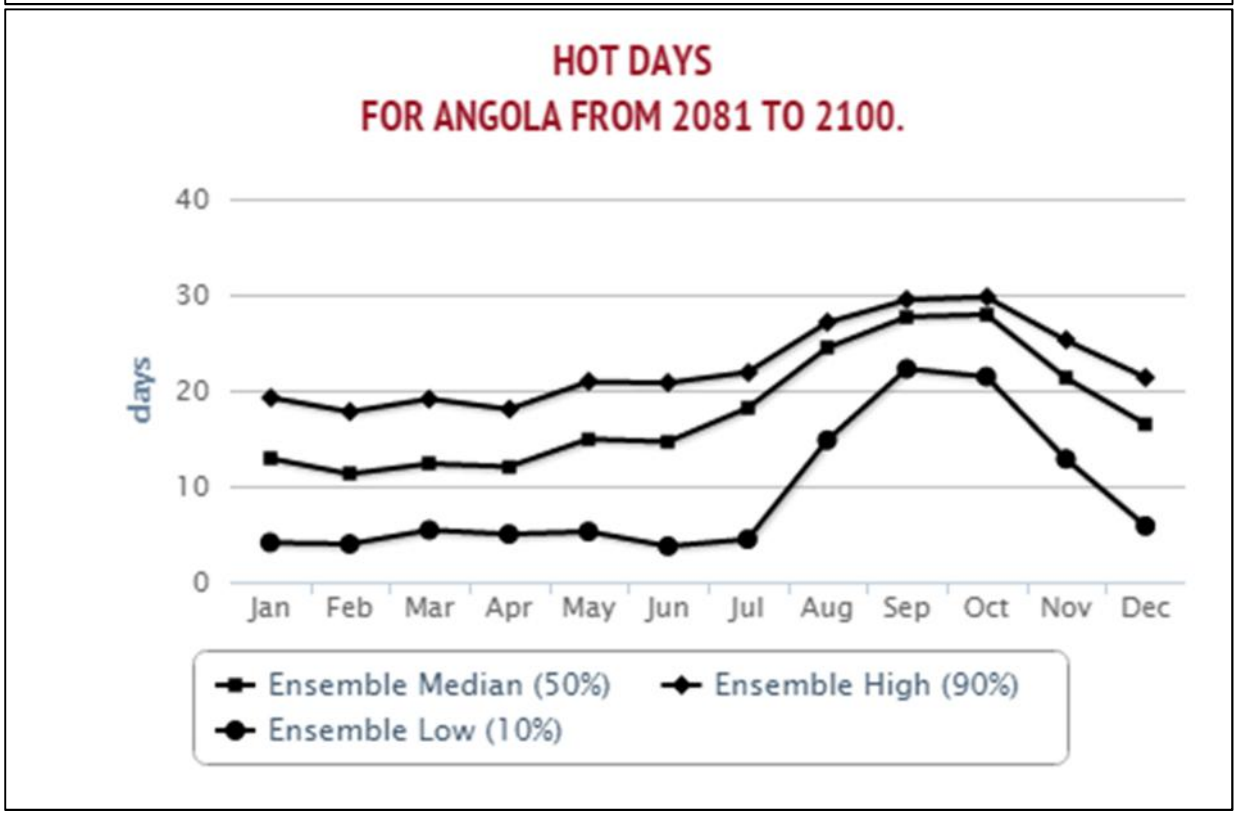


Source: World Bank Climate Change Knowledge Portal





Source: World Bank Climate Change Knowledge Portal

Aerial view of Sambizanga slum, situated directly behind the port of Luanda. (Source: Google Earth)

This satellite image highlights the proximity of Luanda's slums to the coast, an unplanned effect of urbanization that may cause significant problems as sea levels rise. (Source: Google Earth)

Endnotes

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