

Climate Research for Development (CR4D) End of Grant Workshop

21-23 June 2021 | Nairobi, Kenya



FLood Risk Reduction under Paris Agreement (FLORR-PA) for three West African capital cities (Abidjan, Ouagadougou and Dakar)

N'Datchoh E. TOURE,
University Felix Houphouet-Boigny, WASCAL-CEA-CCBAD
Researcher

Background

Frequent flood in West African cities

Abidjan (27th May 2017, 19th June 2018, , ...), Ouagadougou (2009, 2015), Dakar (2009, 2017), Lagos, Accra, ...

Climate change: **intensification** and **increasing** of **extreme events** with more than 11000 disasters reported and more than 22 millions of people affected per year (IDMC 2015)

National and International community (Paris Agreement, SDGs, SFDRR, NUA,) mobilization to limit global warming, climate action for sustainable world, disaster risk management



25th June 2020
heavy rainfall
in Abidjan
(9Kilo)



12th Aug
2016 Dakar



Ouagadougou,
2009

Aim and objectives

Aim

Provide climate change information about **projected flood occurrences** in **Abidjan, Dakar** and **Ouagadougou** in order to reduce the future risk under **Global Warming Levels (GWL)** at **1.5°C** and **2°C**.

Specific objectives

- Characterization of past climate hazards
- Generating information about projected future hazards occurrences
- Provide strategies for mitigation and adequate answers to subsequent disasters

Data and Methodology

Study areas

Abidjan (economical Capital of Cote d'Ivoire)

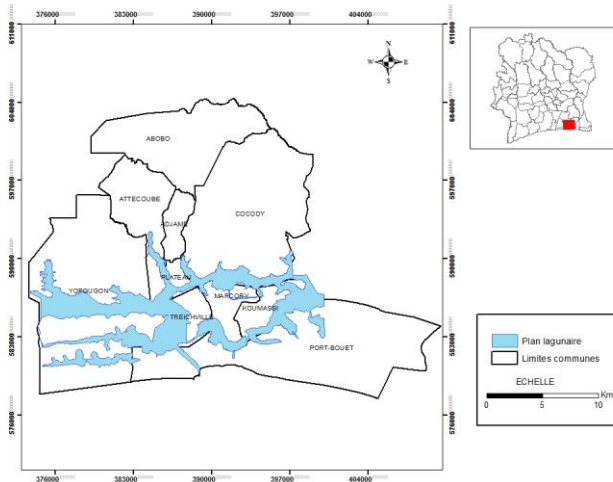
Location: Gulf of Guinea

Population: > **5 millions**

Bimodal rainfall

May – July (main rain season)

Oct – Nov (little rain season)



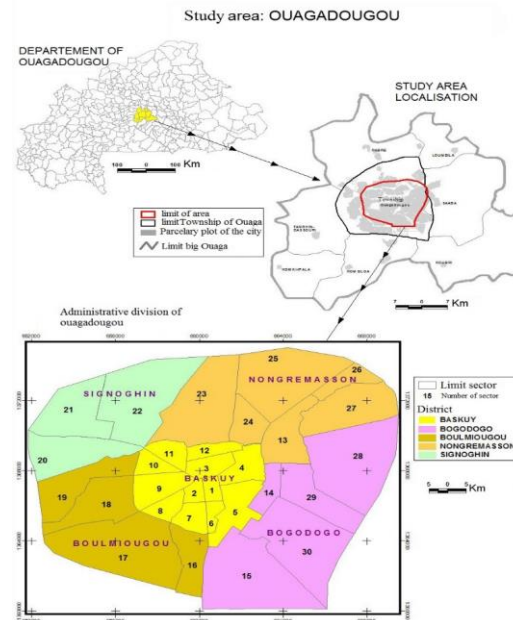
Ouagadougou (capital of Burkina Faso)

Location: Continental

Population: > **2.5 millions**

Unimodal rainfall

July – Sept



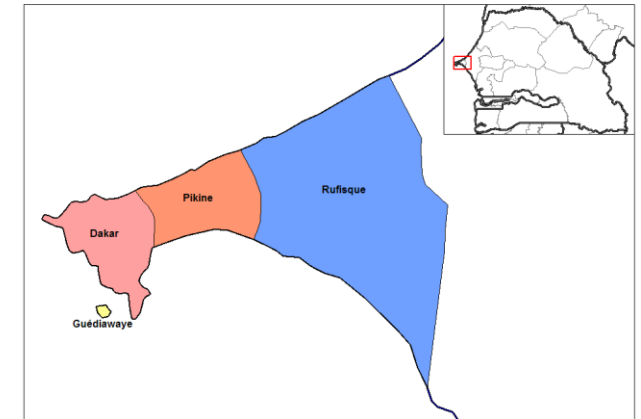
Dakar (Capital of Senegal)

Location: Cap-Vert peninsula on the Atlantic coast

Population: > **3 millions**

Unimodal rainfall

July – Oct



Data and Methodology

Data

Climate Hazards center InfraRed Precipitation with Station data (**CHIRPS**) 1989 – 2018 (**Abidjan**), Meteorological station : **Ouagadougou** and **Dakar**
CORDEX-AFRICA (20 simulations under RCP4.5 scenario)

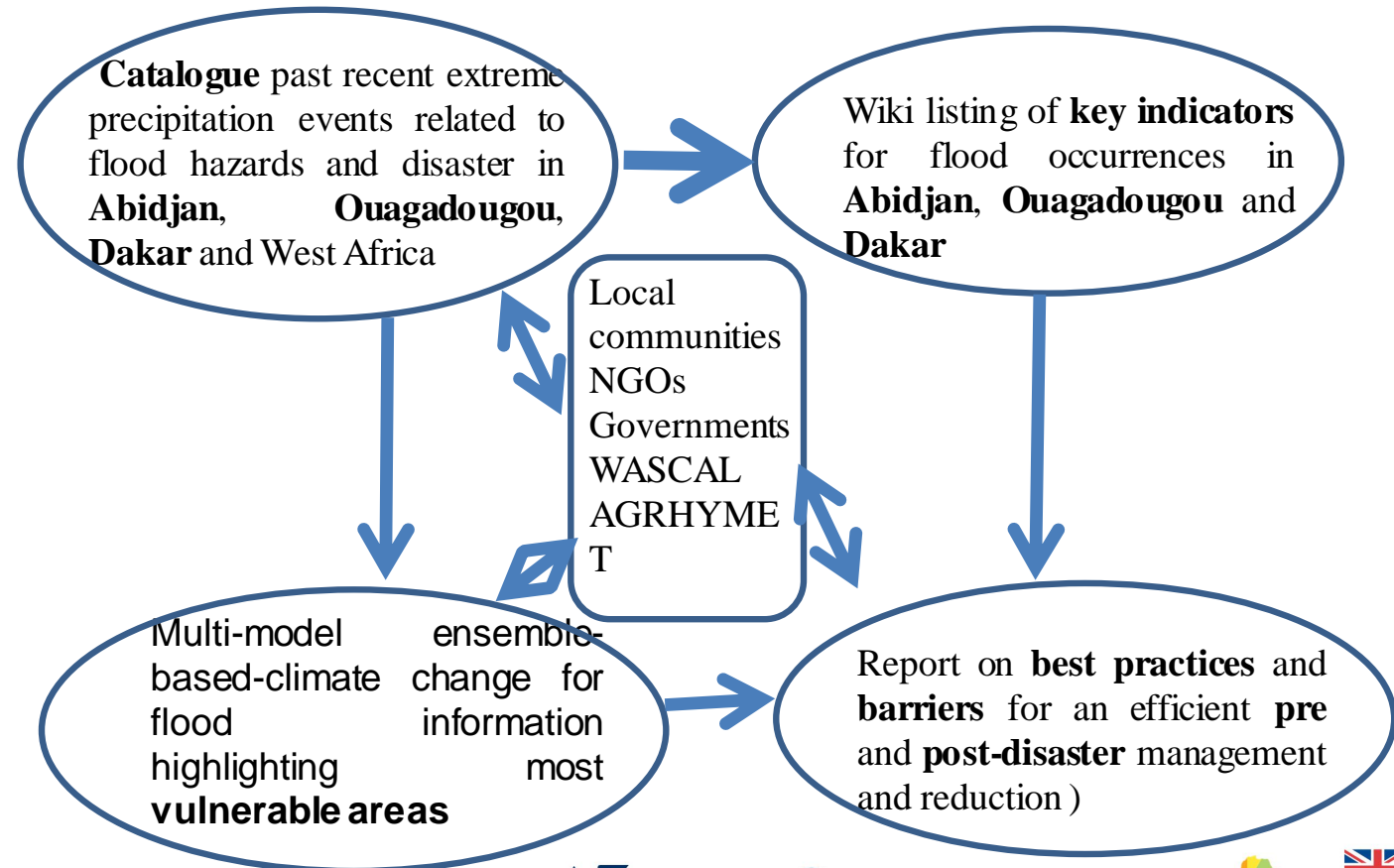
Methodology

Reference periods determination

1.5°C and **2°C** periods determination

Climate indexes Calculation

Flood indicators: Cumulative intensity of extreme events and very extreme events



Results and Discussion

Past Floods in Abidjan

Floods season: Main rain season between **May 24th – July 17th**

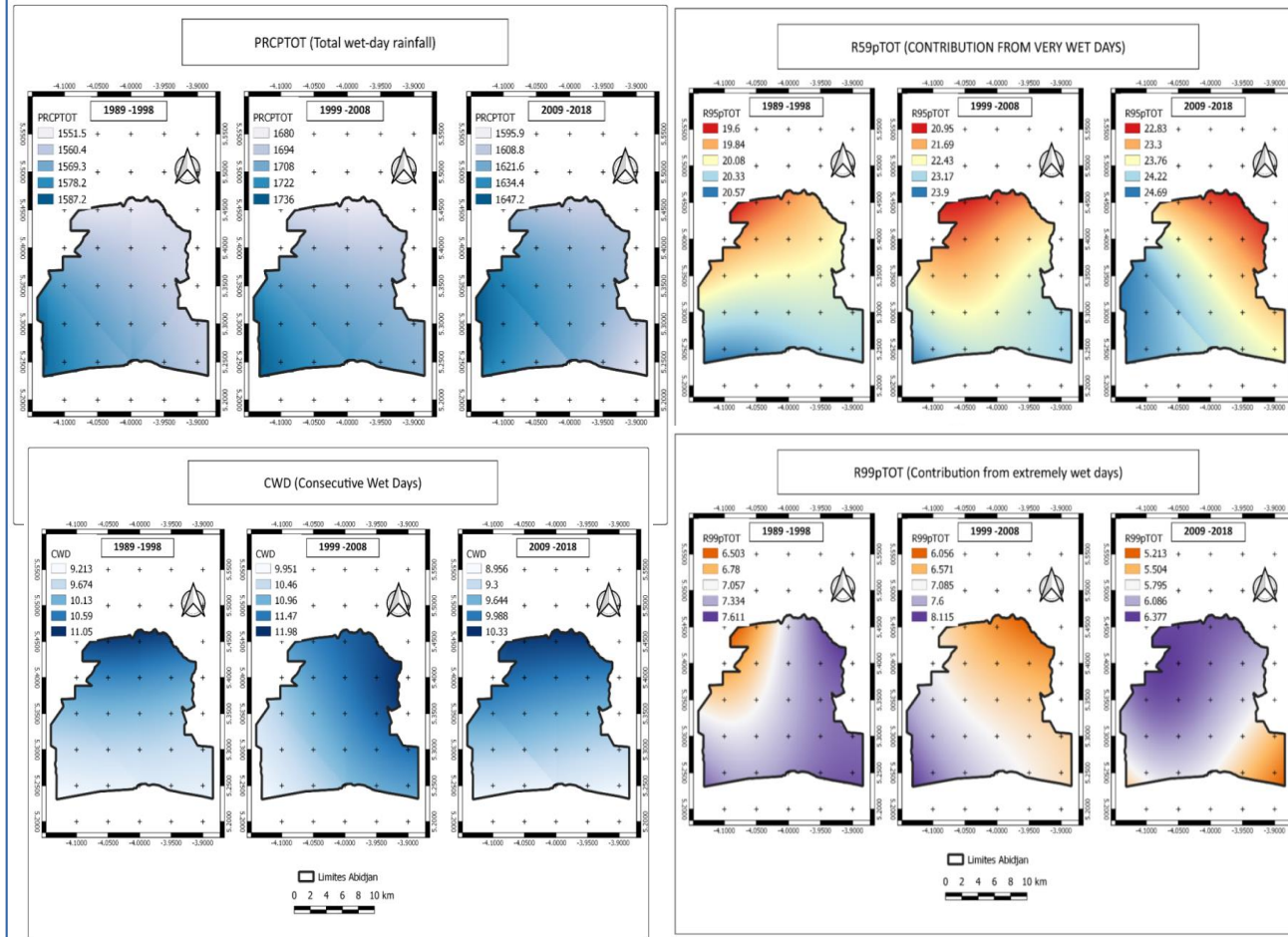
Precipitation amount: at least **100mm/day** within three days

th
24–26 Aug 2011 sea level rose at more than **2 m**

Main consequences: **population displacements, material damages and human live losses**

N.B. **26% of Abidjan is flood-prone areas**

Past extreme events trend



PRCTOT, CWD, R95PTOT and R99PTOT spatial distribution over Abidjan

PRCTOT, CWD, R95PTOT and R99PTOT general increment over the city, with **1998 – 2008** being the wettest decade



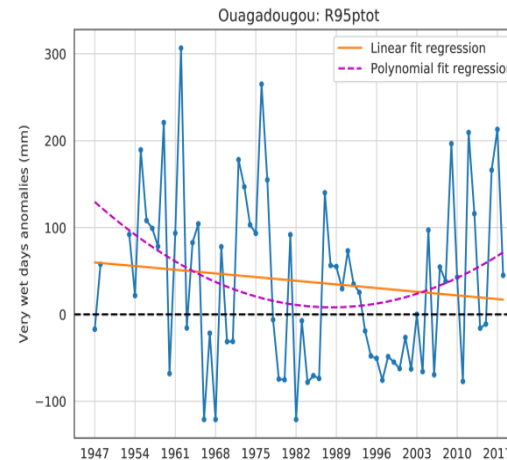
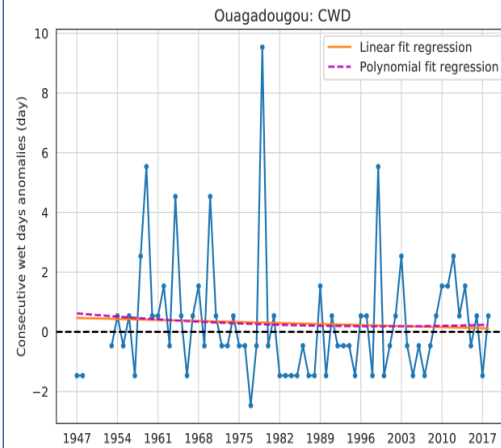
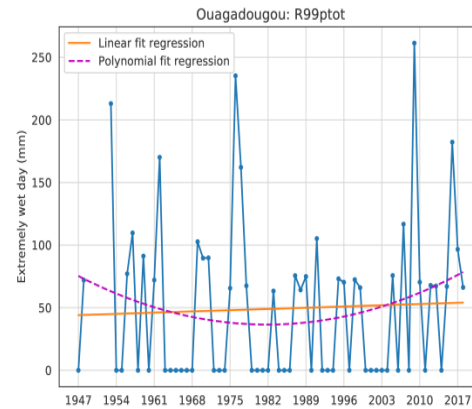
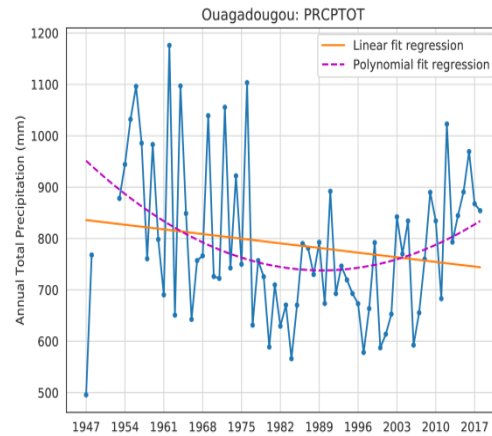
Results and Discussion

Past Floods in Ouagadougou

Floods season:
Main rain
season between
July - Sept

Main
consequences:
**population
displacement,
material
damages** and
human **live**
losses

Past extreme events



**PRCTOT, CWD,
R95PTOT and
R99PTOT** captured
well the 2005, 2009,
2012 ,2015 floods

Increasing trend of
Intensification of
extreme rainfall in the
last two decades



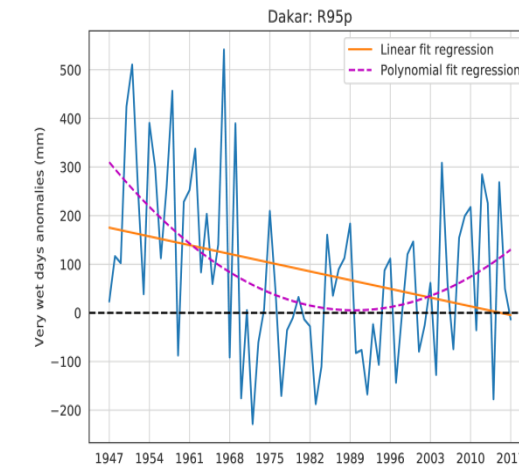
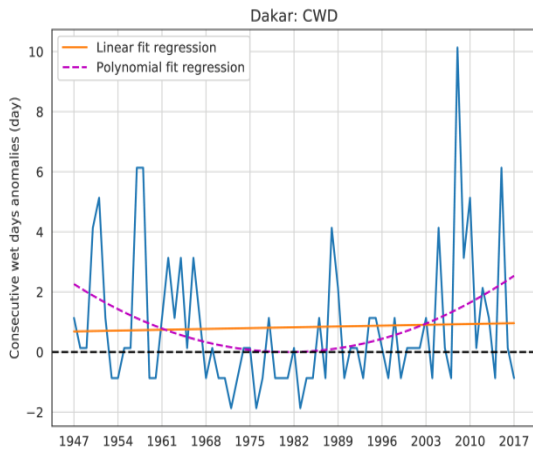
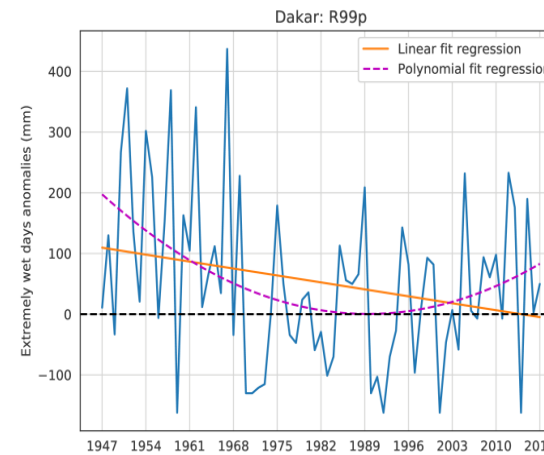
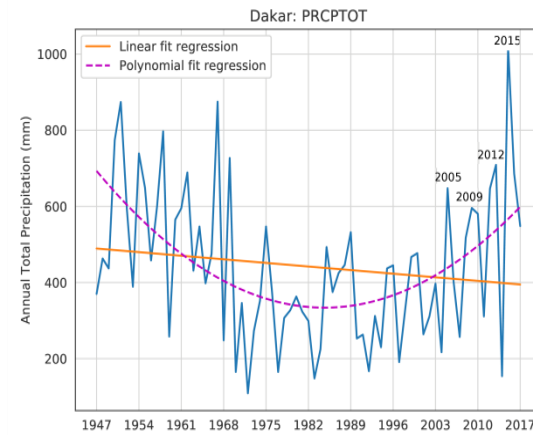
Results and Discussion

Past Floods in Dakar

Floods season:
Main rain season
between **July - Oct**

Main
consequences:
**population
displacements,
material
damages** and
human **live**
losses

Past extreme events



**PRTOT, CWD,
R95PTOT and
R99PTOT** captured
well the 2005,
2009, 2012, 2015
floods

Increasing trend of
Intensification of
extreme rainfall in
the last two
decades



Results and Discussion

Some causes of floods in Abidjan, Ouagadougou and Dakar

- **Abundant precipitation** for a short and/or long time or a light rain for a very prolonged time
- **Permeability of the soil** (sandy soil and **non-biodegradable plastic bags** reducing infiltration)
- **Soil rapid saturation** and **low absorption** due to **destruction of vegetation** in **urban** and **rural** areas
- **Unsuitable** and/or **poorly** maintained **drainage pipelines**
- **Anarchic occupation** of **storm basins/flood-prone areas** and **uncontrolled urbanization**
- **Poor development** planning of **cities extension**



Results and discussion

Reference, GLW at 1.5°C and 2°C periods

GCMs	REF (0.48°C)	F1.5 (1.5°C)	F2.0 (2°C)
CCCma-CanESM2	1969-1998	2006-2035	2018-2047
HadGEM2-ES	1984-2013	2017-2046	2032-2061
MPI-ESM-LR	1958-1987	2006-2035	2031-2060
CNRM-CM5	1974-2003	2021-2050	2043-2072
NorESM1-M	1976-2005	2029-2058	2064-2093
GFDL-ESM2M	1971-2000	2032-2061	2071-2100
EC-EARTH	1958-1987	2008-2037	2030-2059

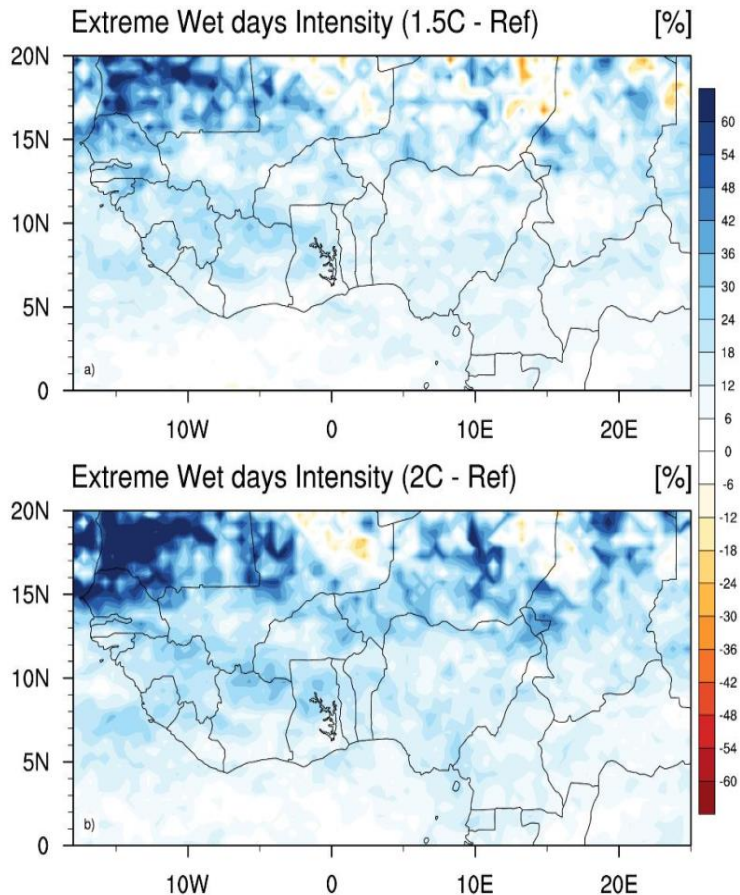
From GCMs, GWL for reference periods (GWL at 0.48°C), were identified following Sylla et al.(2018) as well as periods for GWL at 1.5°C and 2°C.



Results and discussion

Projected flood over West Africa under GWL 1.5°C and 2°C of Paris Agreement

Cumulative intensity of extreme events



Widespread increase in **intensity of extreme events** across West Africa

More **intense extreme events** across WA are expected

More **increase** in **intense extreme events** over the Sahel

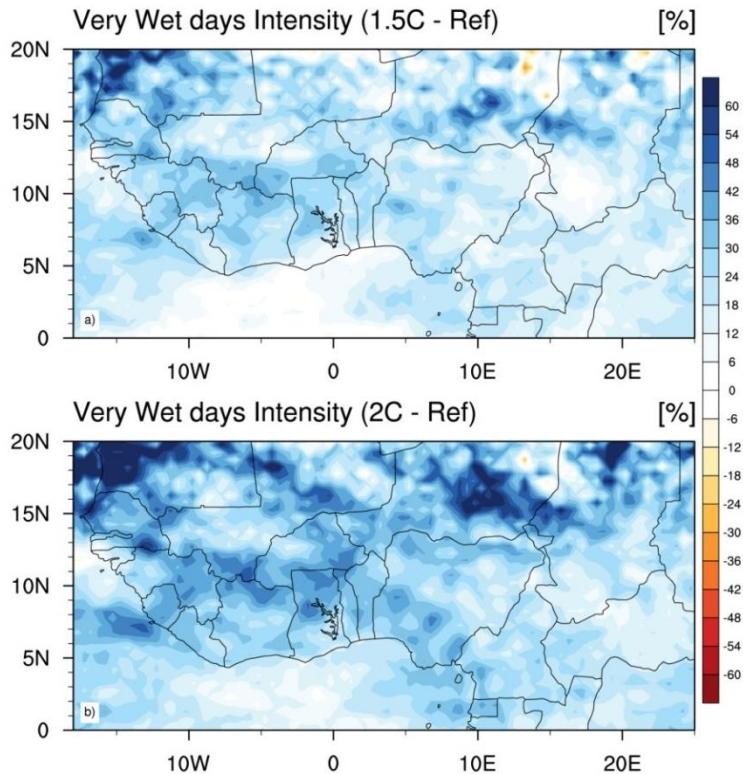
More **intense extreme events** occurrence under **2°C** than **1.5°C**



Results and discussion

Projected flood over West Africa under GWL 1.5°C and 2°C of Paris Agreement

Cumulative intensity of very extreme events



Widespread increase in intensity of **very extreme events** over West Africa

More **flash floods** to be expected

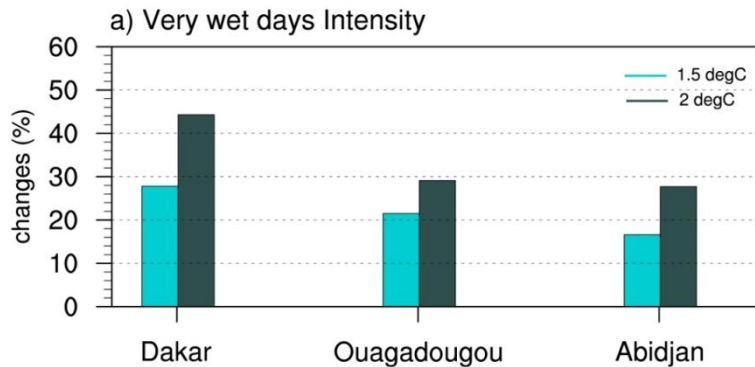
Higher changes in **very extreme events** under GWL at **2°C** compared to **1.5°C**



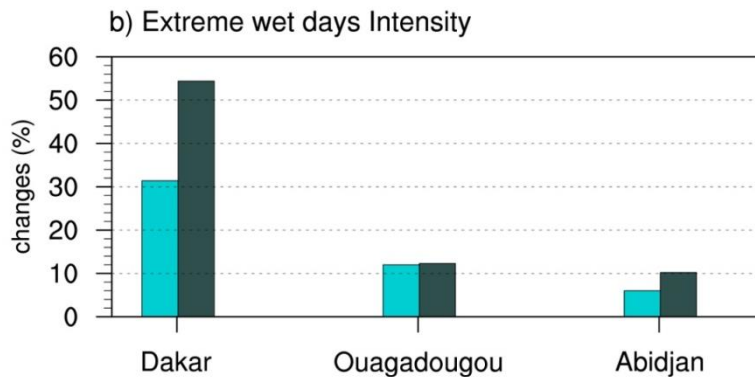
Results and discussion

Projected flood over West Africa under GWL 1.5°C and 2°C of Paris Agreement

Zoom over Dakar, Ouagadougou et Abidjan



Very wet day intensity expected to **increase** over **Oaugadougou (30% vs 22%)**, **Dakar (40% vs 28%)** and **Abidjan (25% vs 18%)** under GWL at **2°C** and **1.5°C**



Extreme wet days intensity is expected to **increase** **Abidjan (about 6% vs 10%)**, **Ougadougou (12% vs 12%)** and **Dakar (31% vs 55%)** under GWL at **1.5°C** and **2°C**



Conclusion and recommendation

Since the last two decades **Abidjan, Ouagadougou** and **Dakar** have experienced several flood events as a combination of **increasing in rainfall extreme** and Land use change such reduction of vegetated area to built areas, unplanned cities extension, drainage pipeline obstruction ...

In the current context of climate change, under **global warming levels** at both **1.5°C** and **2°C**, **extreme events** such floods are projected to **increase in frequency and intensity** over the West Africa region and particularly over the cities of **Abidjan, Ouagadougou** and **Dakar**.

It is imperative for many **West African cities** need to be built in more **sustainable way** to allow **reducing flood risks**. For example **rainfall infiltration** should be improved by promoting **greener cities** with **creating and maintaining in these cities green spaces** such as public parks and gardens especially on the **storm basins and flood-prone areas**. Also, promote the **vertical extension of West African cities to horizontal extension**

It is also essential that those involved in the management of disasters and humanitarian crises work in synergy by pooling their resources and put at national level an efficient early warning system.



Community engagement

FLORR-PA results have been shared and discussed with partners from Cote d'Ivoire, Burkina Faso, Senegal and Niger (NGOs, government agencies, emergency services, stakeholders, ...)

Network including researchers, public services, NGOs is under-construction to strengthen efforts and synergies for adequate answers and solutions to floods in Cote d'Ivoire, Burkina Faso, Senegal and Niger



Publications in preparation

Paper N°1 Title: **Flood hazard analysis in the city of Abidjan (Côte d'Ivoire, West Africa)**

Authors: N'datchoh E. T., Nguessan V., Diedhiou A., Sylla B. M., Koné I., Loukou K., Ricardo K., Bamba A., Obahoundje S. and Kouadio K.

Paper N° 2 Title: **Study of flood hazards in West African cities: the case of Ouagadougou in Burkina Faso.**

Authors: Nguessan V., Diedhiou A., N'datchoh E. T., Sylla B. M., Koné I., Loukou K. and Ricardo K.

Paper N°3: **Influence of Equatorial Pacific and South Atlantic large-scale forcings on precipitations extremes in the West African Monsoon system**

Authors: Sacre Régis DIDI, Moussa Diakhate, Arona DIEDHIOU, N'datchoh Evelyne TOURE, Talnan Jean Honoré COULIBALY, Kouakou KOUADIO, Adeline BICHET, Coulibaly Houebagnon Saint. J., Kouadio Koffi Claude A., Issaka SAVANE.



THANK YOU



Contact us to join our mailing list

communications@aasciences.africa



@AESA_Africa



www.aasciences.africa/aesa
