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Atelier régional d'échanges sur les contributions des secteurs de l'agriculture, de l'élevage et des forêts aux Contributions Prévues Déterminées au niveau National (CPDN) pour l'accord Paris Climat 2015,

Present and future climate change scenario at the global in West Africa region : Scientific elements and impact on agriculture

Drs Benoit SARR, Mohamed Ly, Seyni Salack, Agali alhassane and Maguette KAIRE,
Intra ACP progamm , Global climate change Alliance CILSS

Niamey, du 28 au 30 avril 2015

OUTLINE OF PRESENTATION

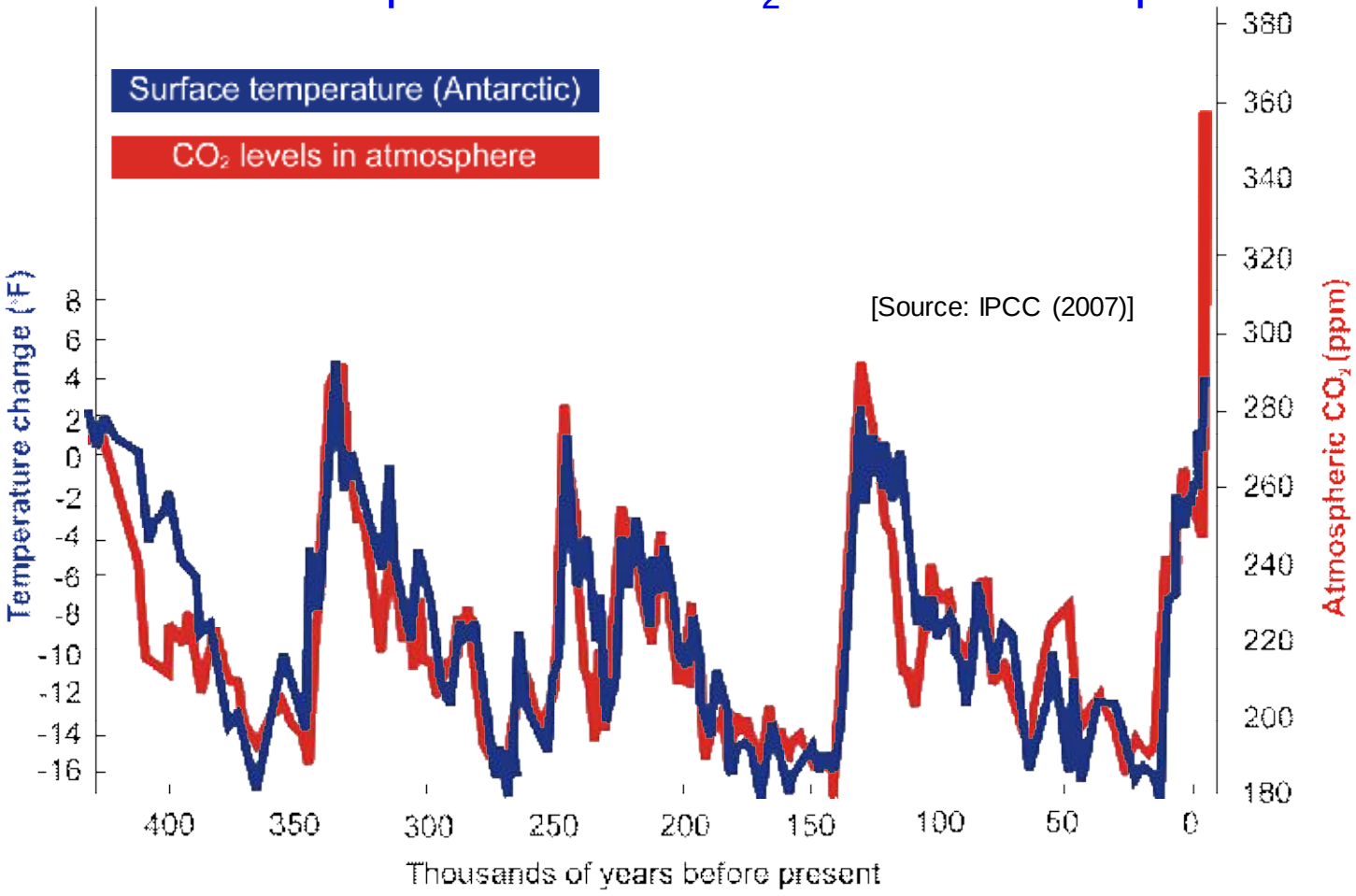
1. **Introduction**
2. **Keys funding on climate variability and change at global and West Africa region**
3. **Climate change : implications for agriculture, livestock and costal zone and in West Africa**
4. **Enhancing resilience to cope with the impact**
5. **Conclusion**

INTRODUCTION

1. Presentation is based on peer review IPCC and CILSS technical background report and publications (2013 mainly)
2. These report are the most comprehensible and relevant analysis and information of our changing climate Climate. It provides scientific basis that will be used to formulate climate policies in the coming year
3. According these reports climate change poses challenges to growth and development in Africa and both adaptation x mitigation will bring benefits and reduce the impacts of climate change in Africa

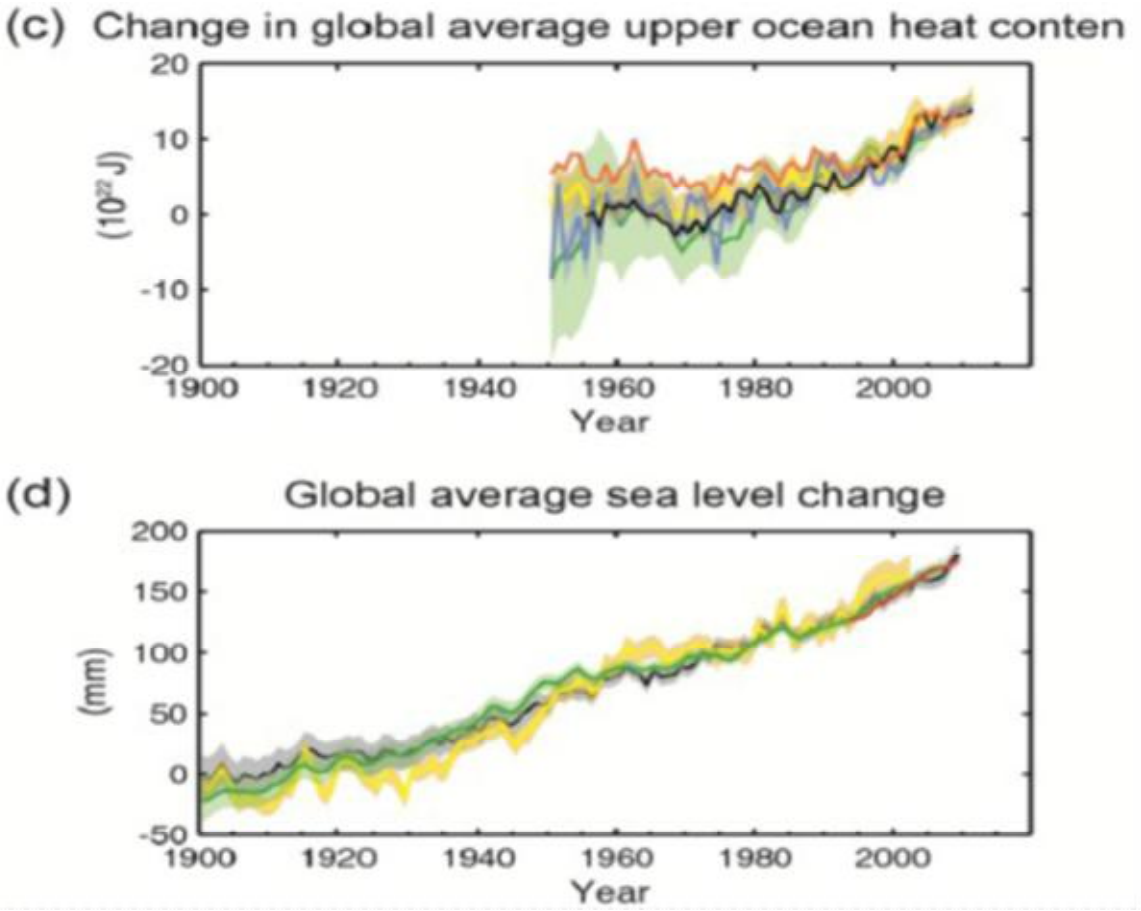
Key funding on climate change at global and West Africa level

Relationship between CO_2 and air temperature



It is extremely likely (>95 %) that human activities since 1750 have been the dominant cause of observed global warming (GIEC, 2013). In 2007, GIEC conclude that it is very likely (90 %), and likely (66%) in

Key funding on climate change at global and West Africa level

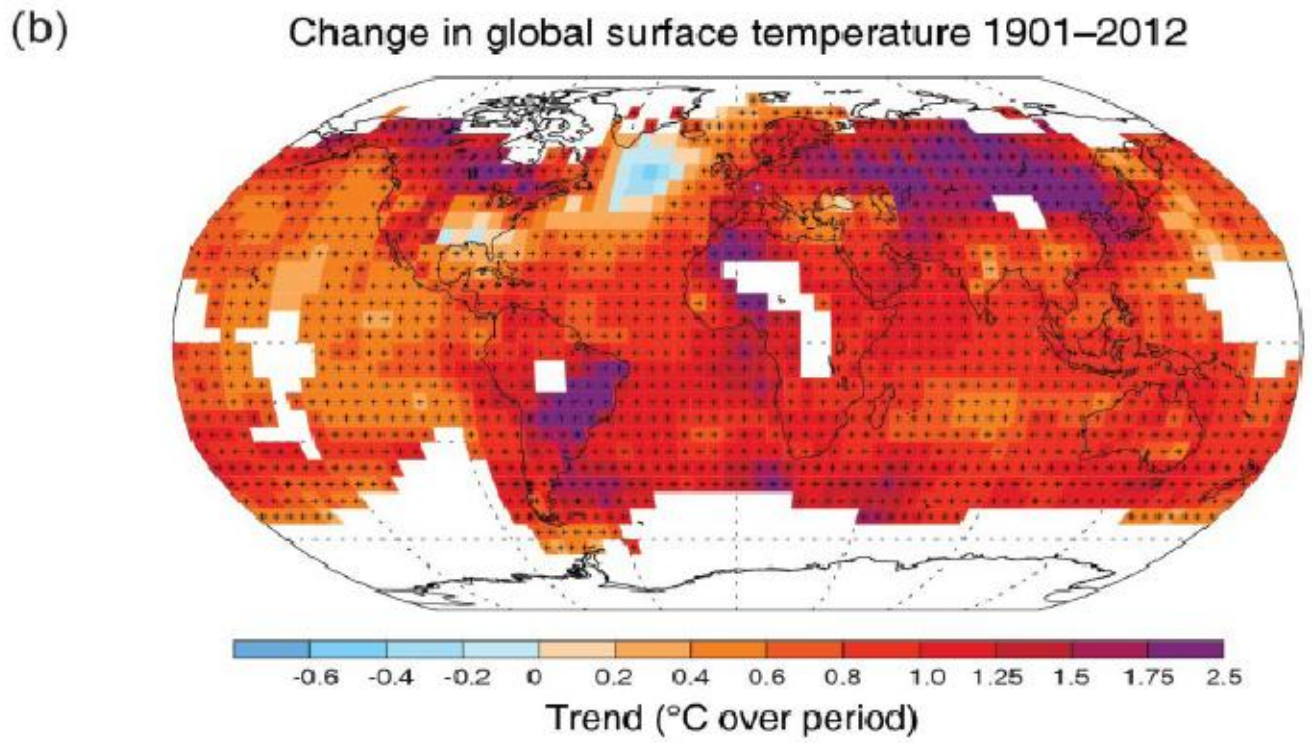


During the period 1901 -2010, the average sea level rise by 0.19 m. Strong relation between the global sea level rise and global average ocean heats

Source : GIEC, 2013

Key funding on climate change at global and West Africa level

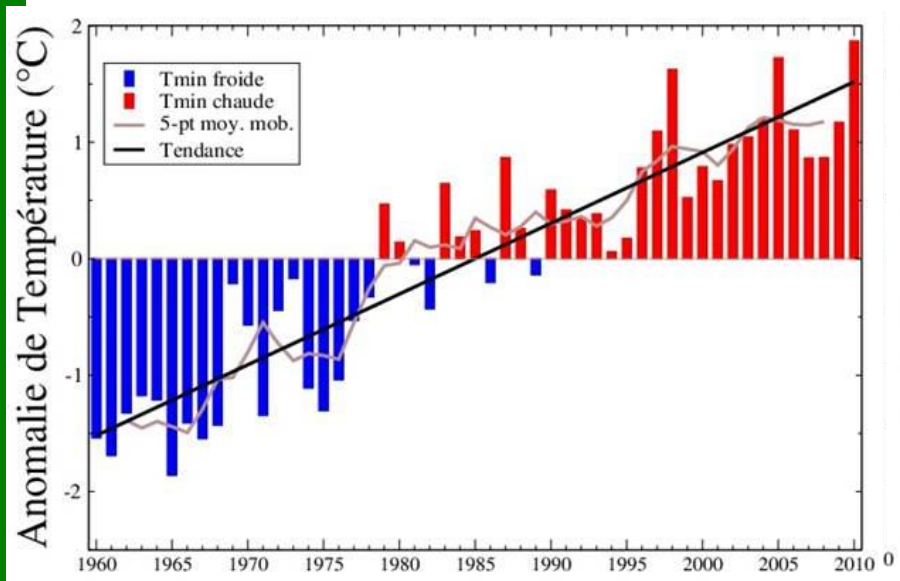
The increase in temperature and sea level continued (AR5 GIEC, 2013)

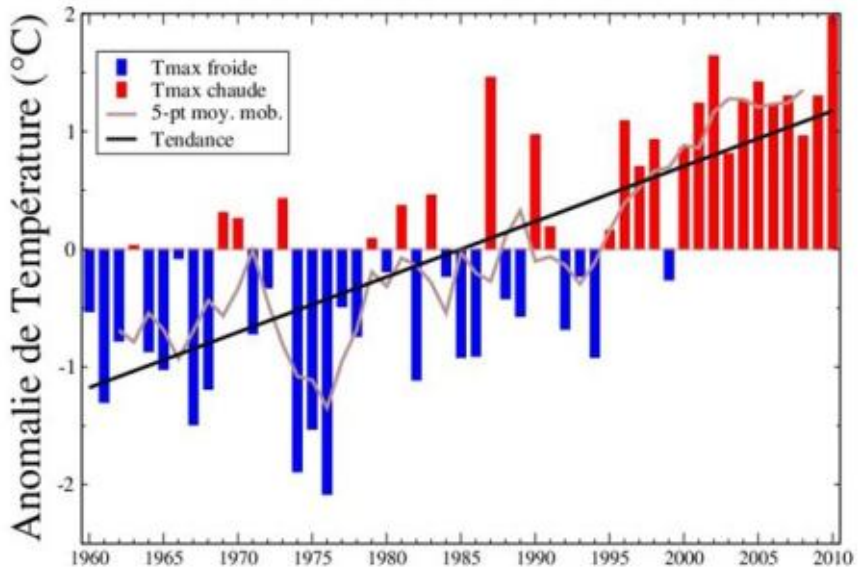


From **1906 to 2012**, the average surface temperature of the world has increased by **0.80 °C**

Keys funding on climate change at global and West Africa region

Global warming in West Africa region : evolution of minimum and maximum température





- Continuous warming since the years 80, 90s in the region particularly for Tmin,
- The 2000-2010 period experienced the warmest period,
- Warmest years are : 2010, 2005, 1998, 2003 et 2002

Key funding on climate change at global and West Africa level

Increase of annual minimum et maximum temperature

Pays	Station	Tmax before breakpoint	Tmax after break point	Ecart Tmax
Niger	Niamey	36,1	36,6	+ 0,5
Chad	Ndjamena	35,8	36,8	+ 1
Togo	Atakpame	30,8	31,7	+ 0,9
Guinea	kankan	31,6	32,5	+ 0,9

Pays	Station	Tmin before breakpoint	Tmin after break point	Ecart Tmin
Niger	Niamey	22,18	23,32	+ 1,14
Chad	Ndjamena	20,9	22,3	+ 1,4
Togo	Atakpame	20,6	21,7	+ 1,1

→ Tmin increased from +1 to 1.4 °C and Tmax about 0.5 °C to 1°C

Key funding on climate change at global and West Africa level

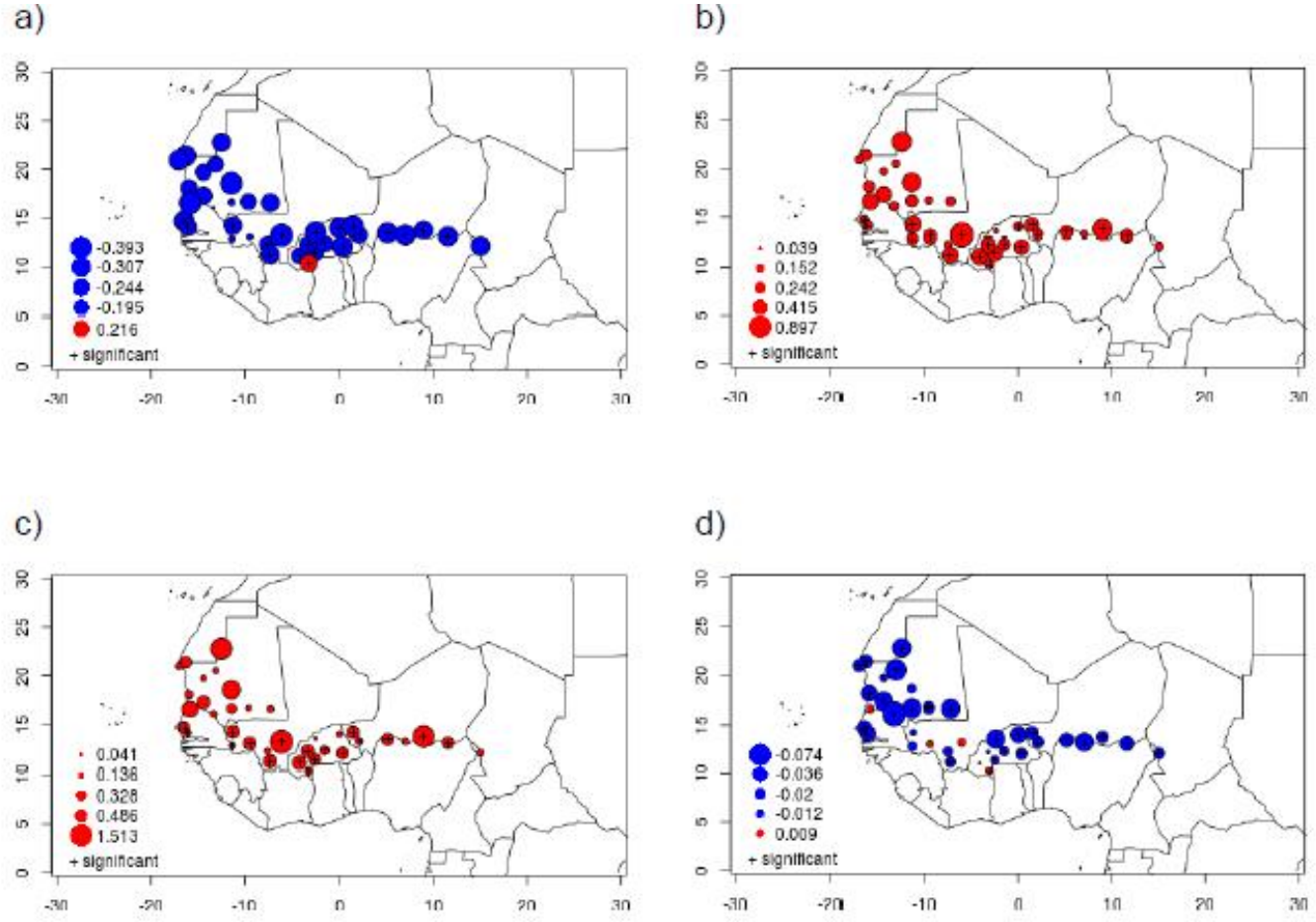
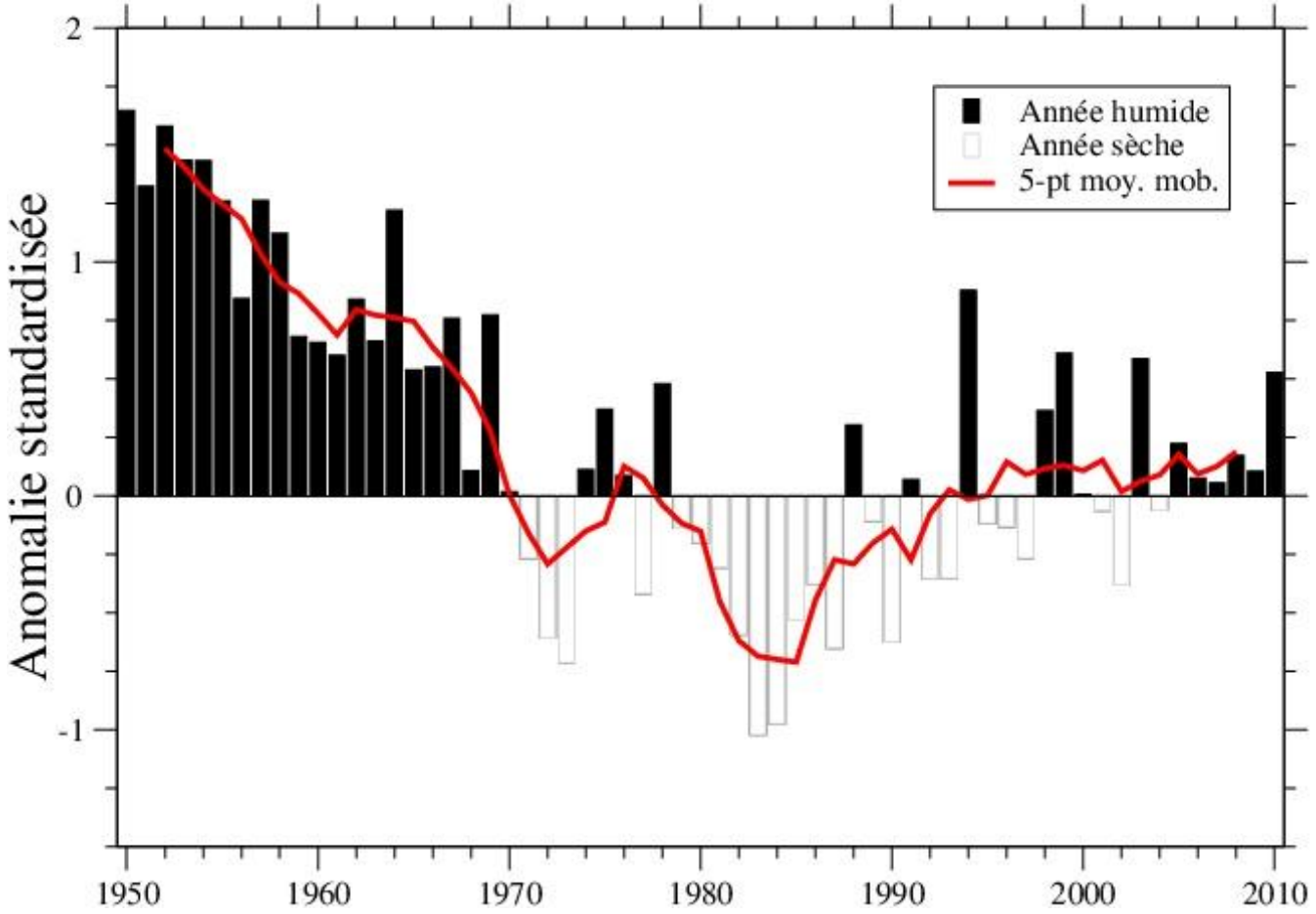


Figure: Trends a) cold nights (Tn10p), b) warm days, c) heat waves (WSDI), d) temperature range (DTR) from 1960 to 2010,source Ly at la, 2013

➔ **Significant increase of warm days and heat waves in the region**

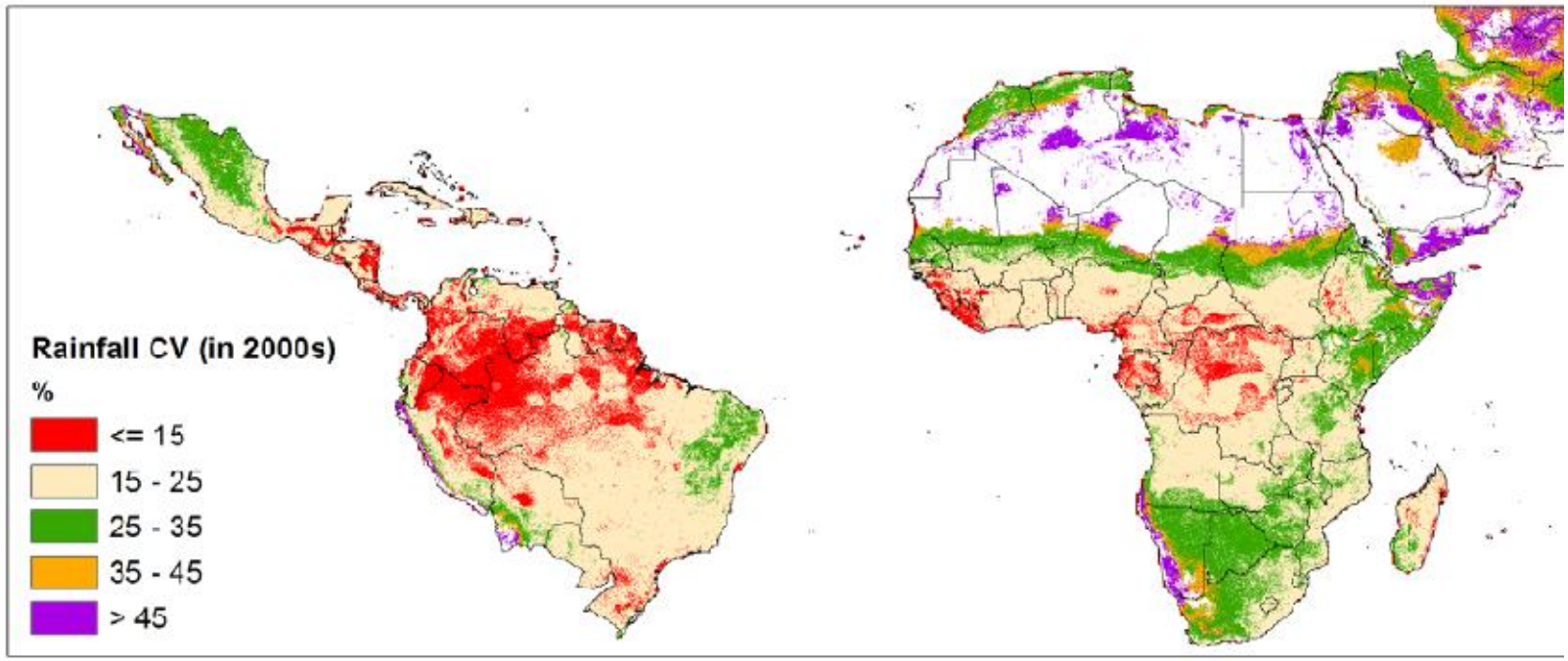
Key funding on climate change at global and West Africa level



Evolution of the Sahel rainfall index from 1950 to 2005, Source, Agrhymet 2013

- Increased of rainfall variability since the 1990 years (succession of dry and wet years) associated with heavy rainfall
- New mode of rainfall variability observed since the 90s and which coincides with the period of acceleration of global warming

Key funding on climate change at global and West Africa level



Area where Coefficient of variation (CV) of rainfall ins currently high (*source CCFAS, report N° 5)*

➔ **High rainfall variability in the arid and semi arid region in in Africa confirmed by CV of rainfall**

Key funding on climate change at global and West Africa level

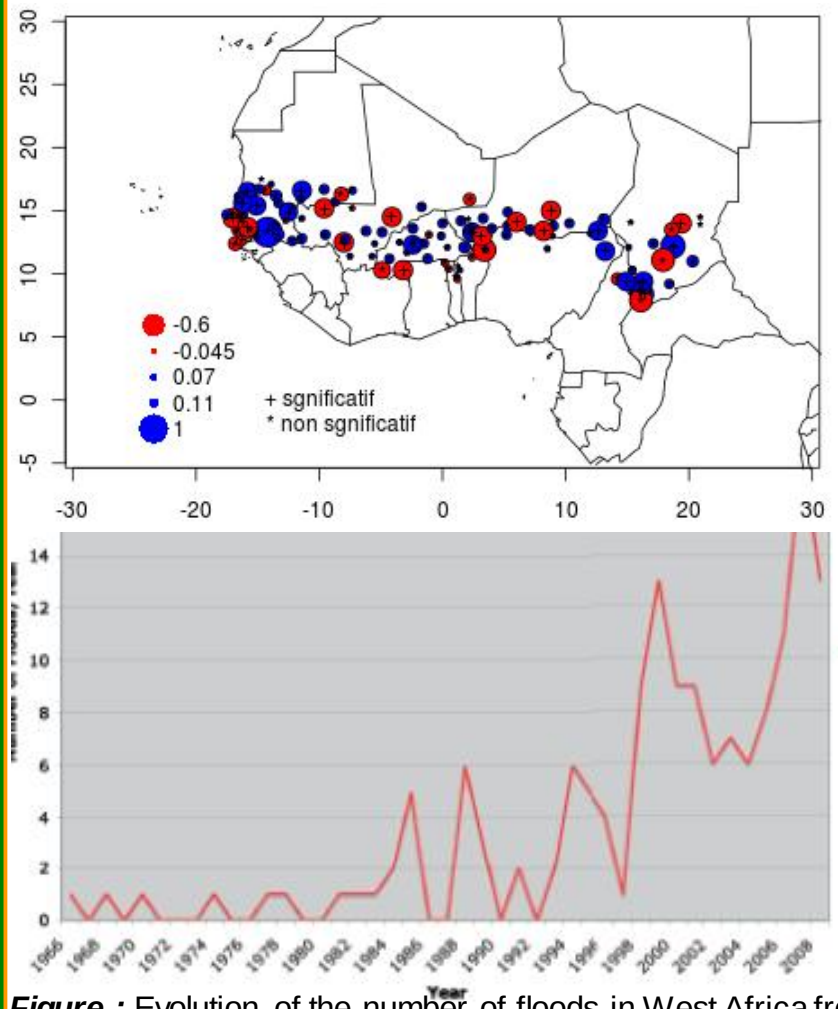


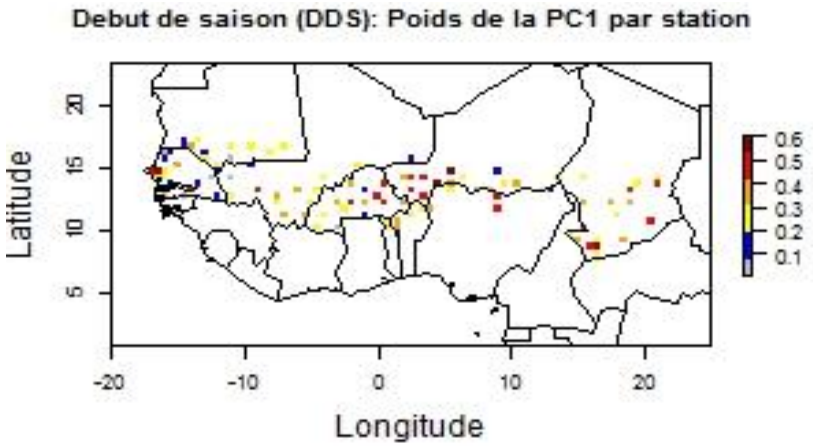
Figure : Evolution of the number of floods in West Africa from 1966 to 2008, source IFRC (2008)

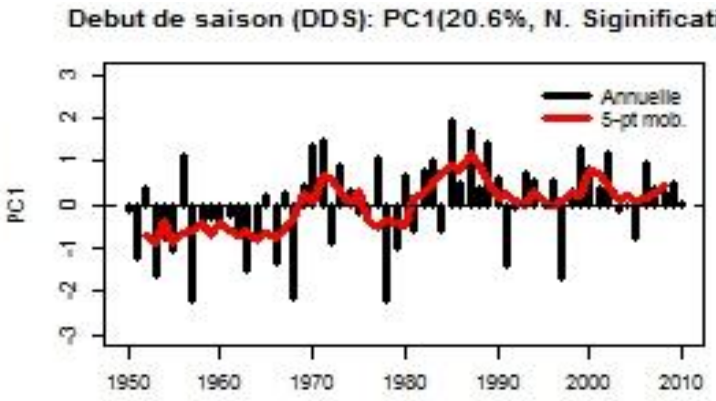
- Significant increase over the last 20 years of heavy rainfall in many places in the soudano sahelian region
- Number of observed floods more frequent (6 to 12 + / year during the last decades
- Floods caused severe destruction to infrastructure, significant crop losses, and extensive land erosion and degradation

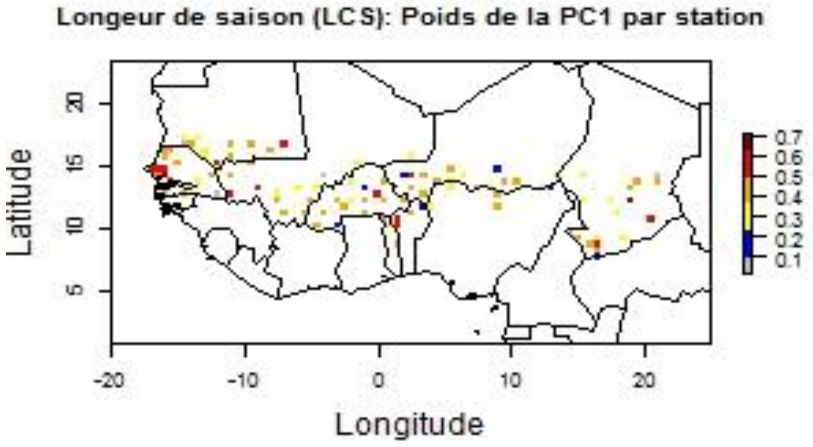
- **Average losses and damages du to flood were evaluated to 7.5 billion dollars between 2000 to 2008 (source DPCS, OCHA 2009) in the 8 UEMOA countries**

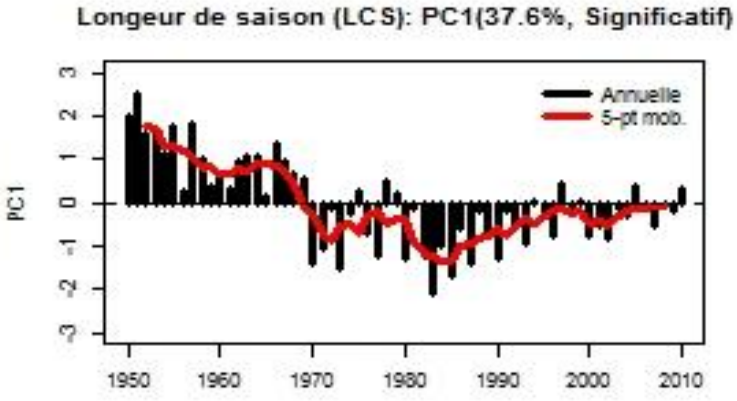
Key funding on climate change at global and West Africa level

Change on observed onset and growing season duration





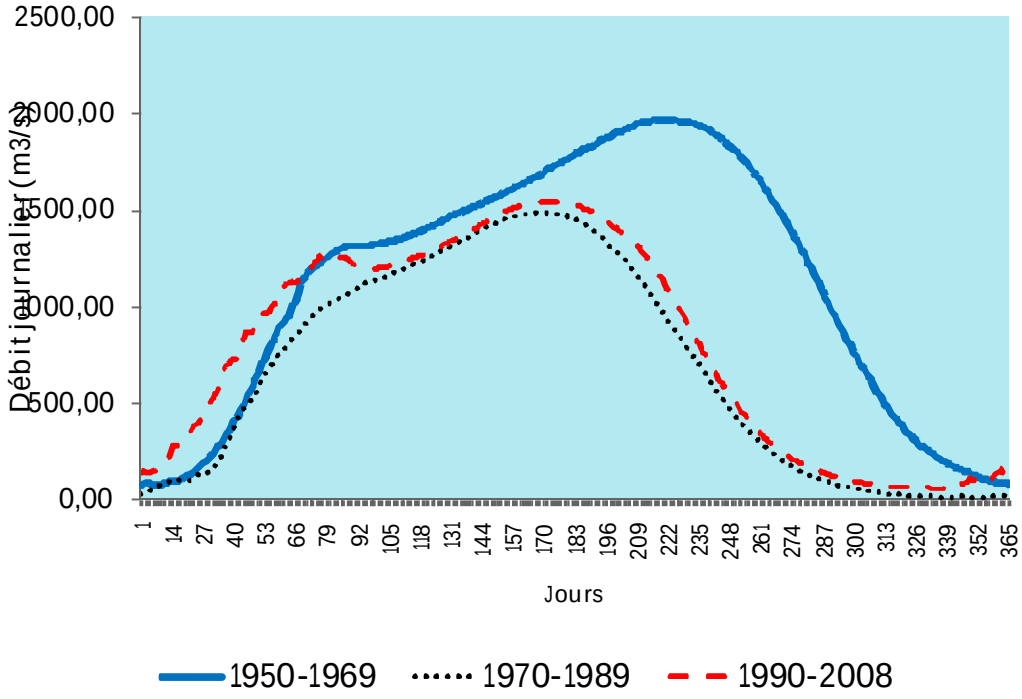




➔ **High interannual variability of onset dates and reduction of LGP which makes more difficult agricultural planning**

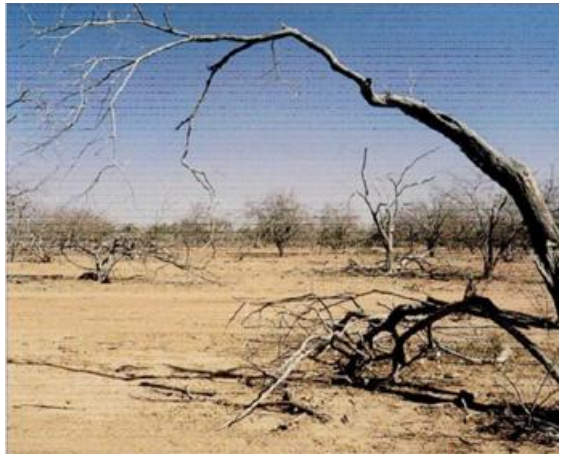
Key funding on climate change at global and West Africa level

Change on observed water ressource regime in River Basin at Niamey



Rapid increase of discharge, a significant decrease in the amplitude of the flood; a shift of the center of the flood; Longer low water levels

Climate risks and impact of climate change in west Africa



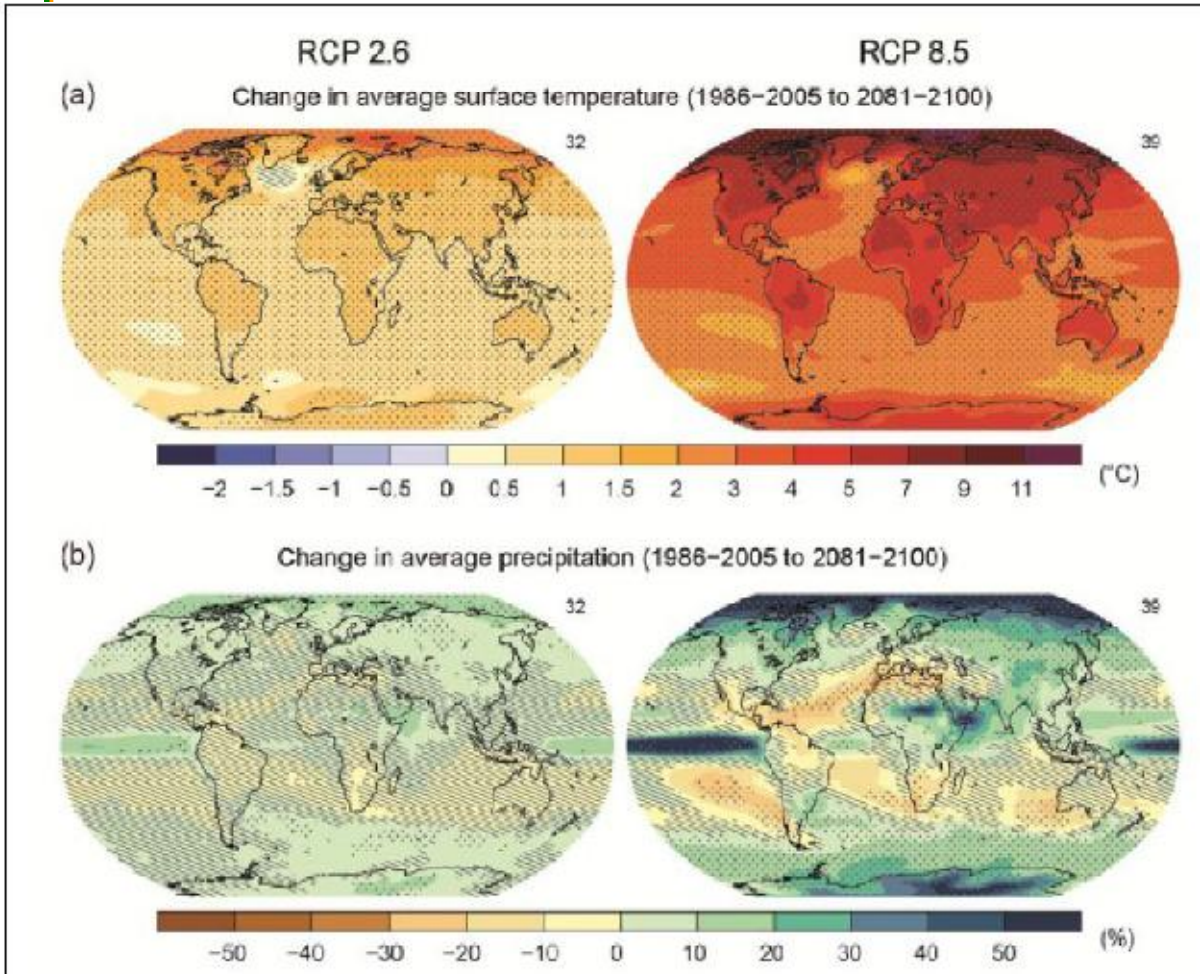
Drought event and natural ressources degradation

Flood event

Coastal land erosion

Salinization of Coastal land

Key funding on climate change at global and West Africa level



Increase of mean annual temperature around 2 °C for RCP 2.6 and 3- 4° C for RCP 8,5 at the end of the century

Rainfall : insignificant increase /decrease in majors part in West Africa

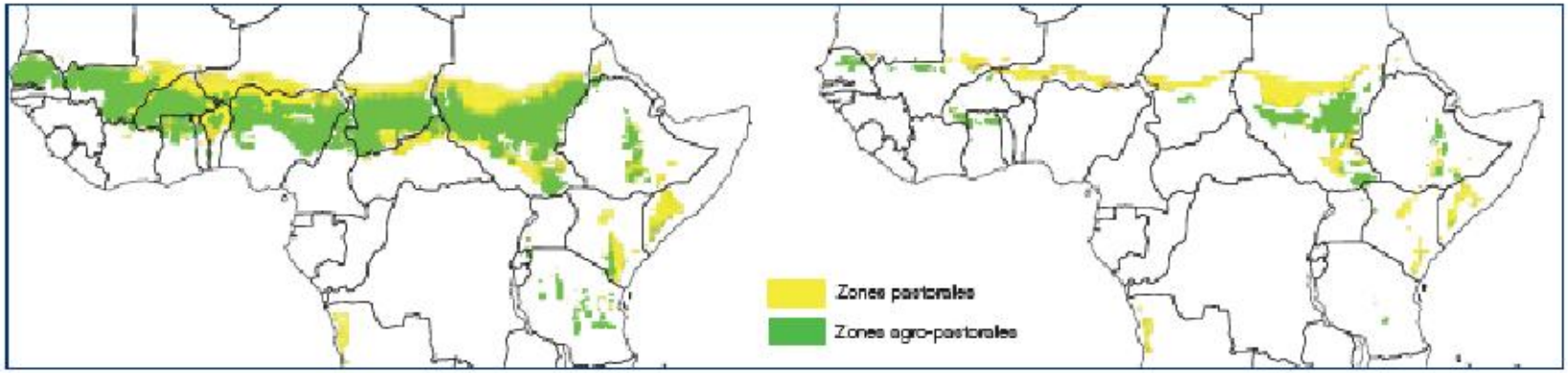
RCP 2.6 : radiative forcing of 2.6 watt per m^2 corresponding to low emission carbon scenario,

RCP 8.5 : radiative forcing of 2.6 watt per m^2 : high emission carbon scenario

Key funding on climate change at global and West Africa level

- Lenght of growing period (LGP) will be on of the most affected element du to climate change (temperature and potential evaporanspiration increase high rainfall variabilty etc..

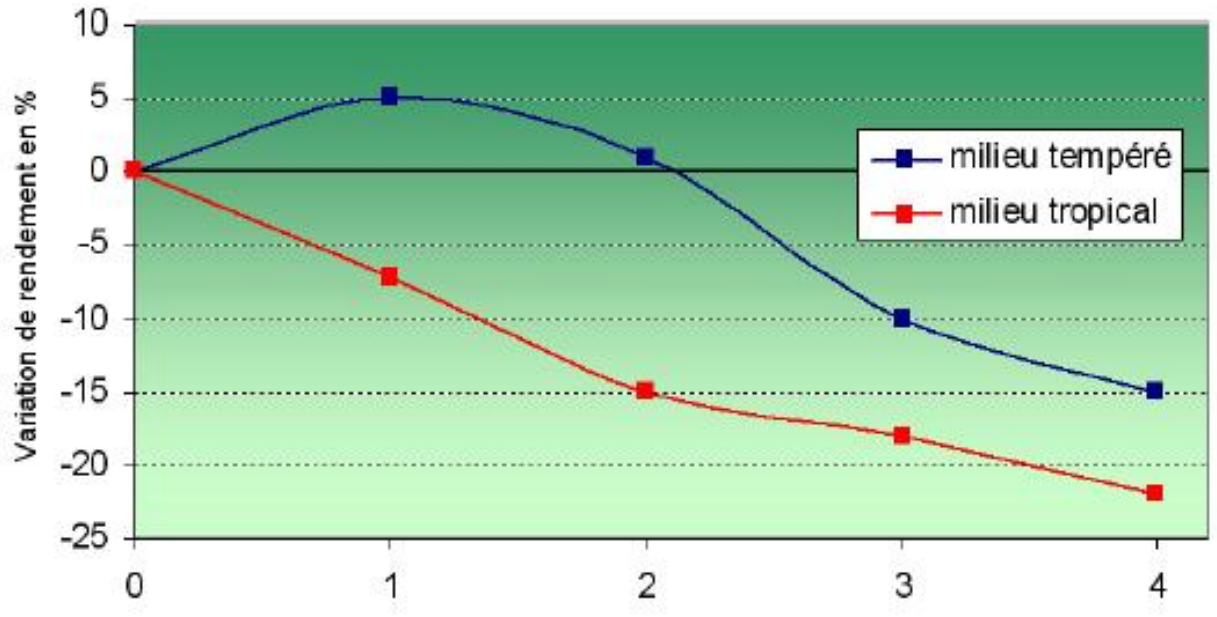
Espace où la longueur de saison agricole diminuerait de plus de 20% d'ici 2050 (selon deux scénarios)



Source : AR4, Africa (2007)

- In the coming 100 years, the extention of arid and semi arid area and reduction of agricultural land is expected (migration, conflict between different natual ressource users

Impact of climate change on crop yields

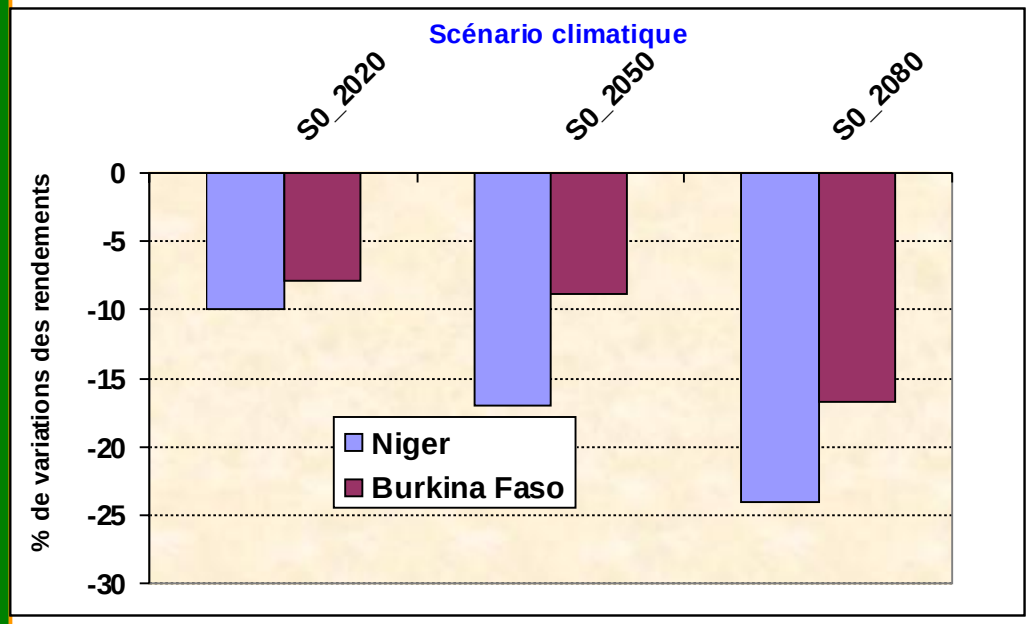


Changes in maize grain yield in tropical and temperate zone based on several assumptions of global warming of 1 at 4 ° C

- **Tropical zones** : yields fall when the temperature increases by 1 °C, at **+2 ° C**, decline in maize grain yield of maize by 15%
- **Temperate zone**: increase of 1 °C increases yield and global warming, increase of 2 °C did not affect maize productivity

Impact of climate change on crop yields

Simulation of impacts of temperature increase on millet /sorghum in Burkina Faso and Niger



2050 : crop yield decrease about 8 % in Burkina Faso and 15 % in Niger in 2050

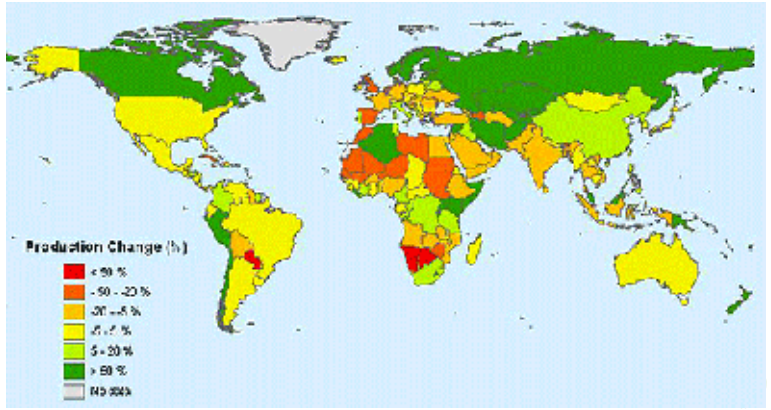
Source Agrhymet, simulation from DSSAT crop model)

Figure . Change of millet /sorghum crop grain in 2020, 2050, 2080 relative to 1961-1990
S0_2020 : 1 °C
S0_2050 : 1,5 °C
S0_2080 : 3 ° C
No significative change in rainfall amount and distribution

Impact of climate change on crop yields

	Loss of crop yields % (cereal crops) compared to 1961-1990	
Agroecological Zones	**2025**	**2050**
Sahel	**0-10**	**20-50**
Soudano guinean	**5-10**	**5 -20**
Guinean	**5- 10**	**5**

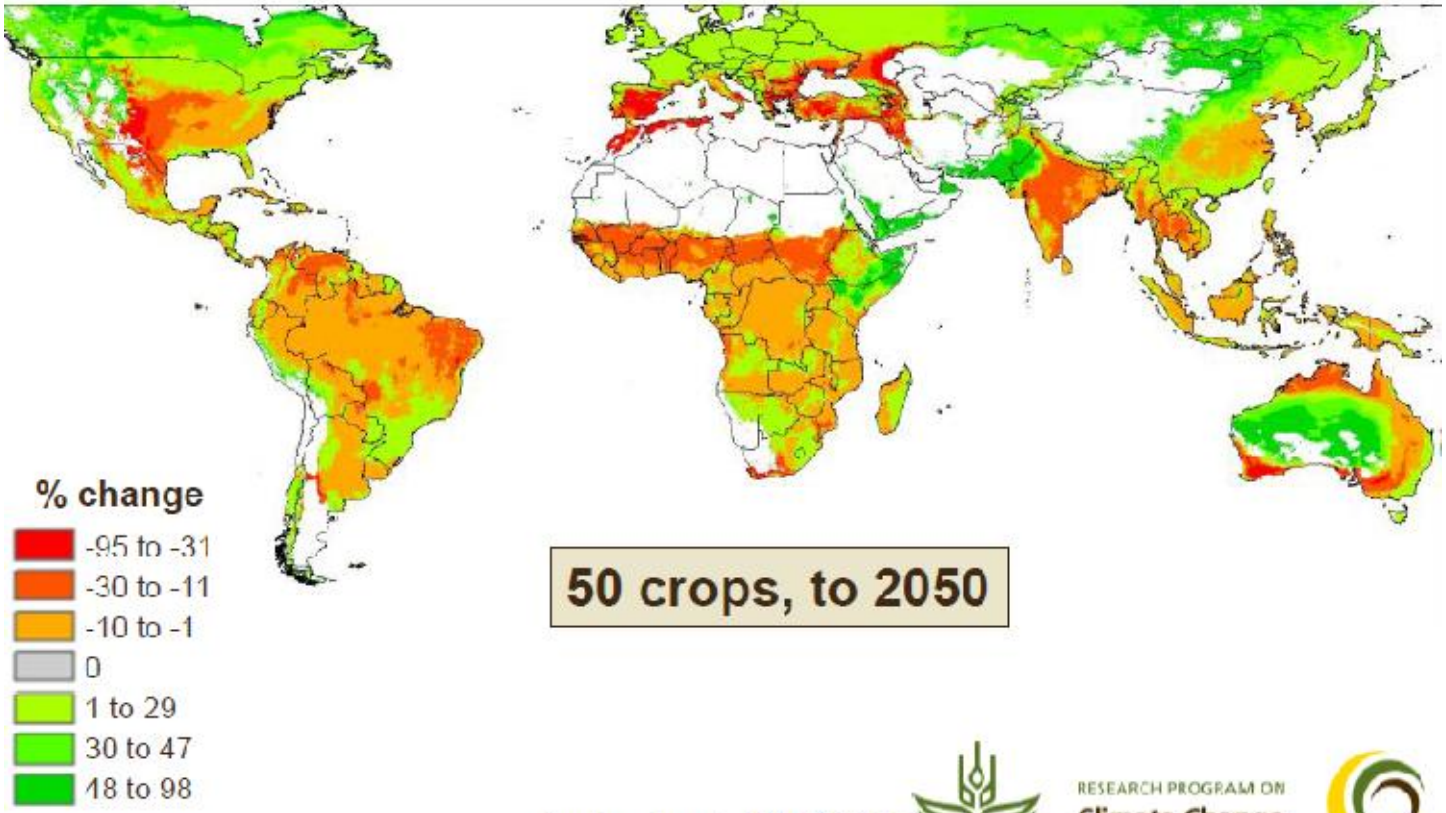
No adaptation options



Source, Agrhymet, 2009 ; FAO, 2007

Impact of climate change on crop yields

Crop suitability will fall in many areas



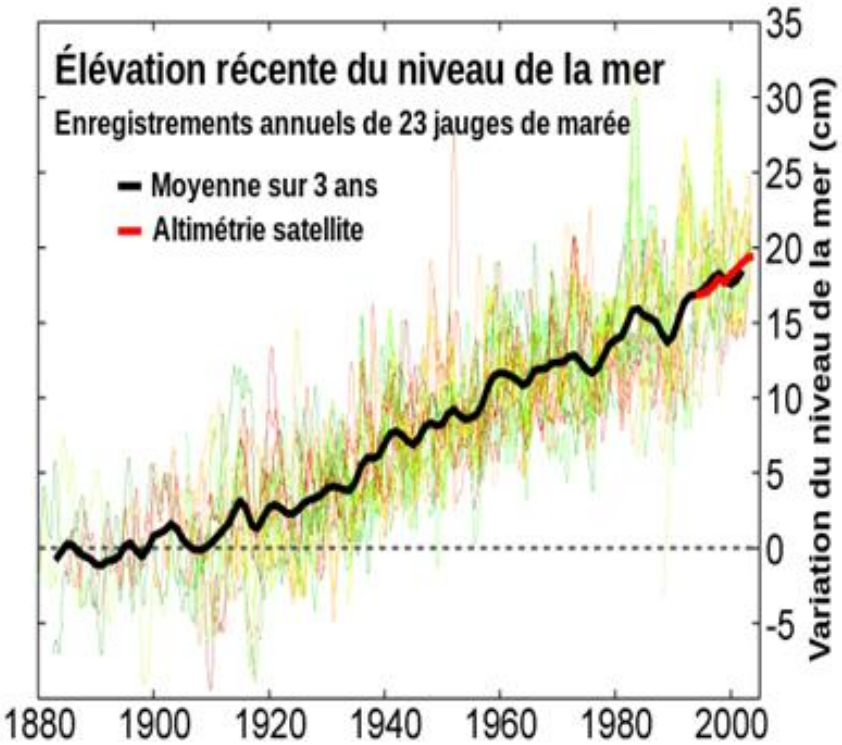
Impact on livestock sector

Risques climatiques	Unités d'exposition		
	Bovins et ovins	**Fourrage herbacé et ligneux**	**Points d'eau**
Poursuite de la hausse des températures	Ralentissement de la croissance Retard à la maturité sexuelle Faible production Intervalle entre les mises Bas de + en + long Augmentation de la sensibilité aux maladies	Diminution de la valeur nutritive des végétaux Assèchement des ligneux fourragers	Tarissement et réduction des points d'eau Augmentation de la fréquence d'abreuvement
Brusque alternance d'années humides et sèches	Disparition de certaines espèces animales Réduction de la reproduction Parcours des animaux de plus en plus long	Déficit fourrager chronique Incendie et feu de brousse	Tarissement des points d'eau de surface Augmentation de la profondeur des puits et puisards
Fortes pluies dévastatrice	Augmentation de la sensibilité aux maladies parasitaires et remontée des animaux sauvages	Réduction de la production fourragère	Débordement des eaux de surface et inondation des puits et puisards

Conséquences			
Sévère	Majeur	Sévère	Modéré
Extrême	Elevé	Extrême	Moyen

Perception communautaire des agropasteurs dans la Commune de Say et Tamou au Niger, *source Zika, 2012*

Impact of climate change on coastal zone in west

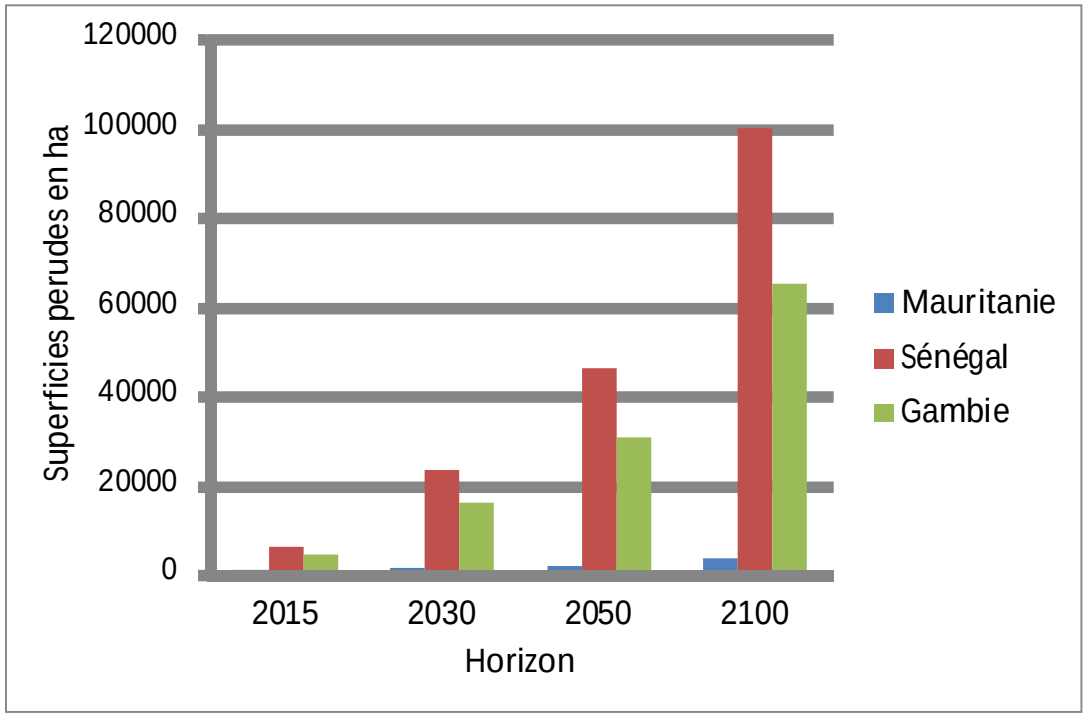


Mean global sea level rise relative to 1880 -2005), IPCC, 2014

Salinization affect particulary countries from Mauritanie to Guinea Bissau because :

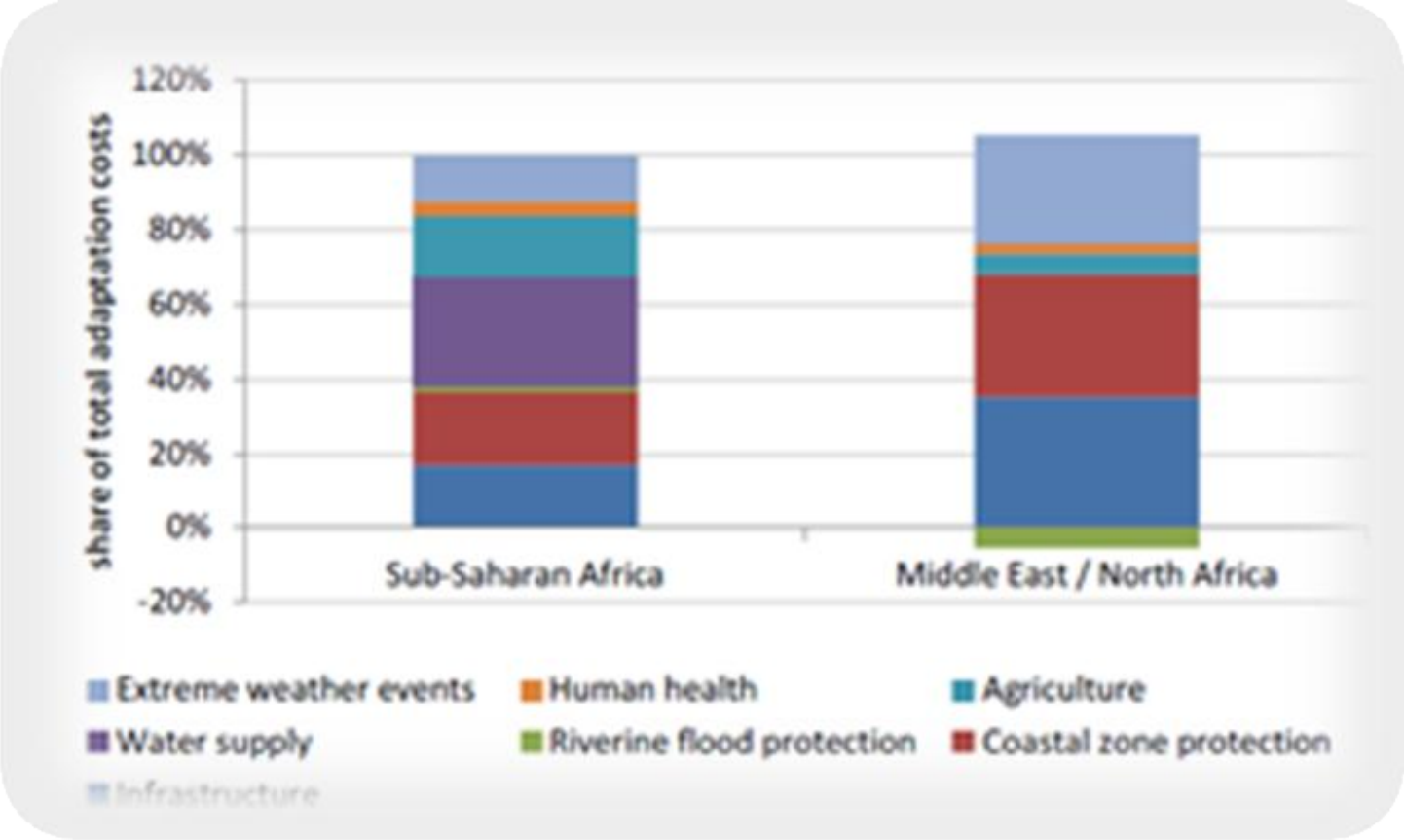
- **High penetration of sea water in the hinterland, gulfs and lagoons due to (i) sea level rise (ii) coastal erosion (ii) declining of rainfall**
- **In the Sahelian zone: hyper-salinization of *coastal farm land* and massive destruction of mangroves due to increased evaporation is observed**

Impact of climate change on coastal zone in west



Projection of coastal farm land (rainfall and irrigated area) affected by sainization in 2015, 2030, 2050, 2100

Impact of climate change on coastal zone in west



Adaptation costs for different sector

Enhancing resilience to the impact : Key messages for Africa

1. Adaptation experiences in Africa is growing

Improve water use efficiency

Improve soil and water conservation

Improve soil and water conservation

Water harvesting technics

Enhancing resilience to the impact : Key messages for Africa

2. Some low-carbon development options may be less costly in the long run and could offer new economic opportunities for Africa

Association crop and threes improve soil carbon sequestration, soil fertlity and soil water content

3. Africa stands to benefit from integrated climate adaptation, mitigation and development approaches

4. International cooperation is vital to prevent dangerous climate change and African governments can promote ambitious global action

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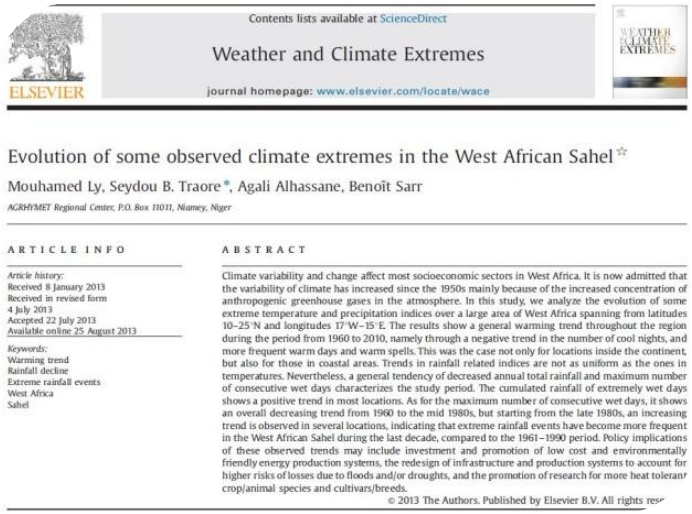
Enhancing resilience to the impact : Key messages for Africa

Platform for exchange and dialogue on climate change

Diffusion of innovative information and knowledge **best practices on adaptation and mitigation** t **:** www.agrhymet.ne/portailCC

Enhancing resilience to the impact : messages for Africa

Publication on climate change and main climate risk in agriculture publications in peer- reviewed scientific journal



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Evolution of some observed climate extremes in the West African Sahel ☆

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ABSTRACT

Climate variability and change affect most socioeconomic sectors in West Africa. It is now admitted that the variability of climate has increased since the 1950s mainly because of the increased concentration of anthropogenic greenhouse gases in the atmosphere. In this study, we analyze the evolution of some extreme temperature and precipitation indices over a large area of West Africa spanning from latitudes 10–25°N and longitudes 17°W–15°E. The results show a general warming trend throughout the region during the period from 1960 to 2010, namely through a negative trend in the number of cool nights, and more frequent warm days and warm spells. This was the case not only for locations inside the continent, but also for those in coastal areas. Trends in rainfall related indices are not as uniform as the ones in temperatures. Nevertheless, a general tendency of decreased annual total rainfall and maximum number of consecutive wet days characterizes the study period. The cumulated rainfall of extremely wet days shows a positive trend in most locations. As for the maximum number of consecutive wet days, it shows an overall decreasing trend from 1960 to the mid 1980s, but starting from the late 1980s, an increasing trend is observed in several locations, indicating that extreme rainfall events have become more frequent in the West African Sahel during the last decade, compared to the 1961–1990 period. Policy implications of these observed trends may include investment and promotion of low cost and environmentally friendly energy production systems, the redesign of infrastructure and production systems to account for higher risks of losses due to floods and/or droughts, and the promotion of research for more heat tolerant crop/animal species and cultivars/breeds.

SECHERESSE

Article de recherche

Sécheresse 2013 ; x : 1-12

Évolution des risques agroclimatiques associés aux tendances recentes du régime pluviométrique en Afrique de l'Ouest soudano-sahélienne

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Résumé

Dans le contexte actuel de changement climatique, la veille agro-hydro-météorologique des régions semi-arides doit être améliorée et renforcée. L'objectif de ce travail est d'utiliser des données observées en station pour identifier l'évolution spatio-temporelle des risques agroclimatiques associées aux grandes tendances du régime pluviométrique dans la bande soudano-sahélienne élargie aux parties Nord de certains pays côtiers de l'Afrique de l'Ouest (Benin, Togo, Nigeria). Les résultats montrent que sur la période 1950-2010, l'évolution du régime pluviométrique est en trois phases quasi identiques sur les cumuls (Cum), l'intensité du cumul sur 3 jours consécutifs (Px3) et les longueurs de saison culturale (LSC) par rapport à la normale 1961-1990. A savoir : i) une période d'excédents de Cum et Px3 avec des LSC plus importantes (1950-1969) ; ii) une période de déficits de Cum et Px3 avec des LSC plus courtes (1970-1990) ; et iii) la période récente dont les Cum, Px3 et LSC sont très variables (1991-2010). Cependant, les dates de démarrage des saisons montrent une tendance quasi-stationnaire, de 1970 à 2010. Les risques agroclimatiques de retards, de stress post-floraison et d'occurrence de faux départs et de fin précoce des saisons des pluies sont liés aux périodes de sécheresse historique, en particulier pendant les deux dernières décennies. L'occurrence des faux départs et des fins précoces de la saison des pluies rend la distribution des événements pluvieux peu profitable à la croissance des cultures. En effet, cette distribution est bien corrélée aux déficits pluviométriques observés dans la région. Ces résultats statistiquement significatifs permettent de poser deux hypothèses majeures dans le contexte du changement du régime des pluies : i) les risques agroclimatiques de la période 1991-2010 sont restés similaires à ceux de la période de sécheresse historique 1970-1990 ; ii) les années humides sont associées à des vagues d'événements de faux départ observés de manière précoce dans la première décade de juin ou avant. A chaque fois que des faux départs (fins précoces) sont observés au-delà de la première décade de juin (avant fin-septembre), le cumul de cette saison sera très probablement inférieur aux normales 1961-1990 et 1981-2010. Ces hypothèses peuvent servir d'éléments de renforcement des techniques utilisées dans la prévision saisonnière de la pluie et la veille agroclimatique dans la région.

Mots clés : Afrique de l'Ouest, climat soudano-sahélien, évolution spatio-temporelle régime pluviométrique, risques agroclimatiques.

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RMetS
Royal Meteorological Society

Present and future climate change in the semi-arid region of West Africa: a crucial input for practical adaptation in agriculture

CONCLUSION

Further climate change is inevitable in the coming decades : the scientific knowlegde on climate variability and change and the significant impact on food security, water availability, human health are relevant information for decison making

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Thank you for your attention