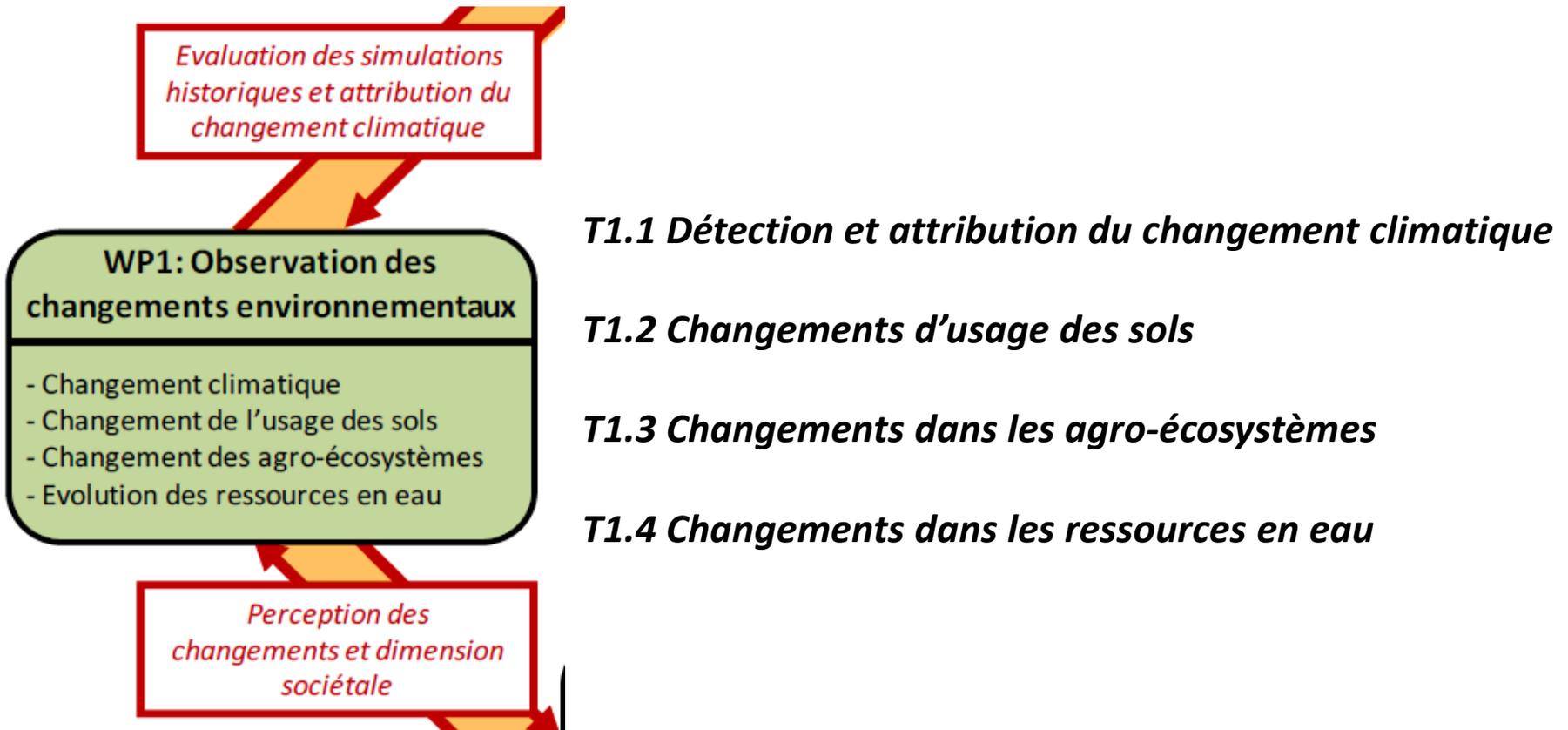


GT 1 : INTRODUCTION



GT 1 : RESSOURCES HUMAINES

Partenaires impliqués dans le GT1

GET (Géoscience Environnement Toulouse, ex LMTG)

Pierre Hiernaux Avril 2011 (31 mois, GT 1, 2, 4))

L. Kergoat, M. Grippa, E. Mougin, Y Auda, C Dardel, F. Timouk M. Gosset, M. Diawara

CNRM-GAME

Amanda Gounou, Mars 2011 (18 mois, GT 1,3)

F. Guichard, F. Favot , J-L. Redelsperger

LTHE

Romain Marteau Septembre 2011 (12 mois, GT1)

Mister X, CDD 3mois

L. Descroix, K. Souley Yero, T Vischel, T. Lebel, G. Pantou

HSM

Postdoc 6 mois GT1

J Demarty, B. Cappelaere, L. Séguis, C Peugeot.

GT 1 : LIVRABLES M12, Février

D1.1a: Rapport et article sur les changements dans le cycle saisonnier des températures à l'échelle multi-décennale en Afrique de l'Ouest dans les observations et les ré-analyses. **M12** (CNRM) 

D1.1b: Rapport sur la signature des changements climatiques sur la thermodynamique de surface et les couplages énergétiques. **M12** (CNRM) 

D.1.3a: Rapport sur les séries d'usage des sols depuis 1950 à nos jours sur le site du Mali. **M12** (GET) 

D.1.3b: Rapport sur les séries d'usage des sols depuis 1950 à nos jours sur le site du Niger. **M12** (LTHE) 

D.1.3c: Rapport sur les séries d'usage des sols depuis 1950 à nos jours sur le site du Bénin. **M12** (HSM)  repoussé M18 si possible (CDD 6 mois pas embauché)

D1.2a: Rapport sur la variabilité interannuelle des caractéristiques des sécheresses, des séquences sèches intra-saisonnières et de l'intensification des événements pluvieux.

M18 (LTHE) ★

D.1.4: Evaluation des données historiques des USC: cohérence à l'échelle régionale et performance à l'échelle du district. **M18** (LTHE) ★

D1.5: Rapport sur la dynamique multi-décennale des écosystèmes et des systèmes de production mixte (culture/élevage) à l'échelle du district dans le Gourma (Mali) et le Fakara (Niger). **M18** (GET) ★

D1.7a: Rapport sur l'évolution des eaux de surface et du ruissellement à l'échelle du district sur le site du Mali. **M18** (GET) ★

D1.7b: Report Rapport sur l'évolution des eaux de surface et du ruissellement à l'échelle du district sur le site du Niger. **M18** (LTHE) ★

D1.2b: Rapport sur la génération de champs pluviométrique à partir de l'information climatique et sur les techniques à appliquer pour les simulations du GT3. **M18** (LTHE) ★

D1.6: Rapport et article sur l'évaluation des théories du reverdissement et de la désertification. **M36** (LMTG) ★

GT 1 : UN PEU DE SCIENCE

Task 1.1: Detection and patterns of climate change

In view of the recent results identifying the most critical variables in terms of impact on resources, including outputs of the AMMA program (ASL special issue), the focus is put on the patterns of drought, especially in terms of dry spells occurrence, floods and heat waves, which impact rain-fed agriculture for instance and multi-year phenomena which impact production systems and may drive societal changes.

Different datasets will be scrutinized: this includes regional scale historical daily SYNOP data (AMMA database), the CILS (1950-present) through collaboration with AGRHYMET, GISS and CRU datasets, as well as NWP re-analyses (ERA40, ERA-Interim, NCEP), satellite estimates (EPSAT, TRMM, Megha-Tropiques) and meso-scale high resolution and dense networks of the AMMA-CATCH S.O. that provides up to twenty years of 5-minute rainfall densely spread over three sites of roughly 10000 km² surface in Mali, Niger and Benin.

Rainfall characteristics over the past decades will be analysed as well as their links to changes in larger scale features such as the monsoon flow and the inter-tropical front In addition to drought. The characteristics of rain systems will be analysed, with a focus on the evolution of their occurrence rate, intensity and the spatial extension, by merging CILSS, AMMA-CATCH and satellite datasets. Geo-statistical models, fed with climatological information. With the objective of feeding environmental and resource models (agriculture, rangeland models, water availability simulations) to be used in WP3, rain fields will be produced at meso and regional scale.

This task will also address a less studied phenomenon, namely rainfall intensification: is there a trend towards global warming triggered intensification in rainfall and floods? High time-resolution datasets from AMMA-CATCH will be compared to regional scale daily rainfall fields and trends or absence of trend will be analysed.

Besides, it is also important to detect warming trends and heat wave occurrence. It is especially critical in the pre-monsoon season, which is the hottest and more humid season and which provokes important mortality and during the growing season, when it combines with drought occurrence to provoke crop heat stress. Changes observed in surface air temperature, diurnal temperature range and rainfall over the past decades will be analysed as well as the links between thermodynamics, rainfall and surface fluxes. While Summer temperature are expected to be linked to monsoon rainfall on inter-annual time scales, other balances and trends may prevail at larger time scales in Spring when temperature reaches its yearly large maximum, prior to rainfall. Variations in the duration, mean properties and spatial coherency of this phase of the year will be analysed as well as the variations in the diurnal temperature range. Whether such changes in Spring are associated with a delay, shift and shortening of the rainy season will be studied.

Drought
Dry spells
Heat waves
Persistence

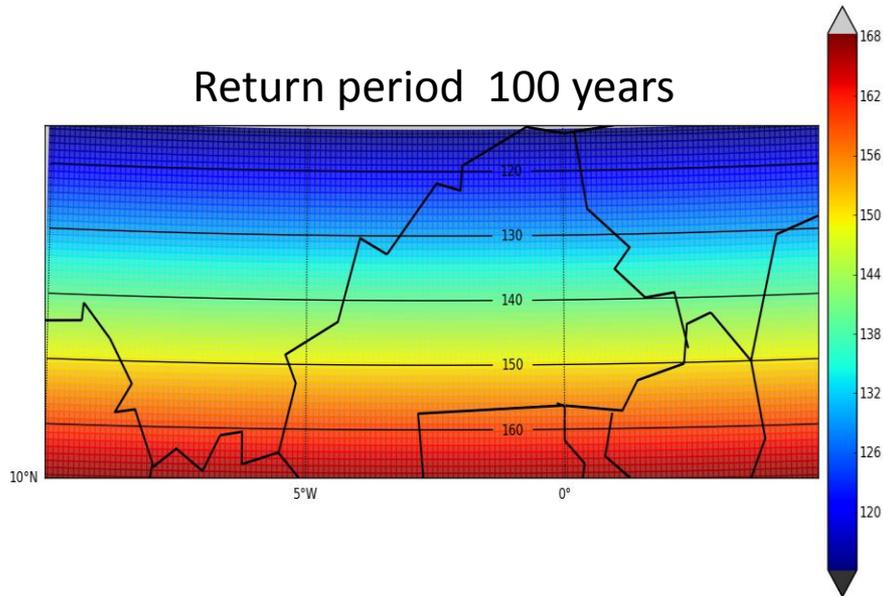
Down scaling

Intensification ?

Warming ?
Season l cycle ?
RH ?

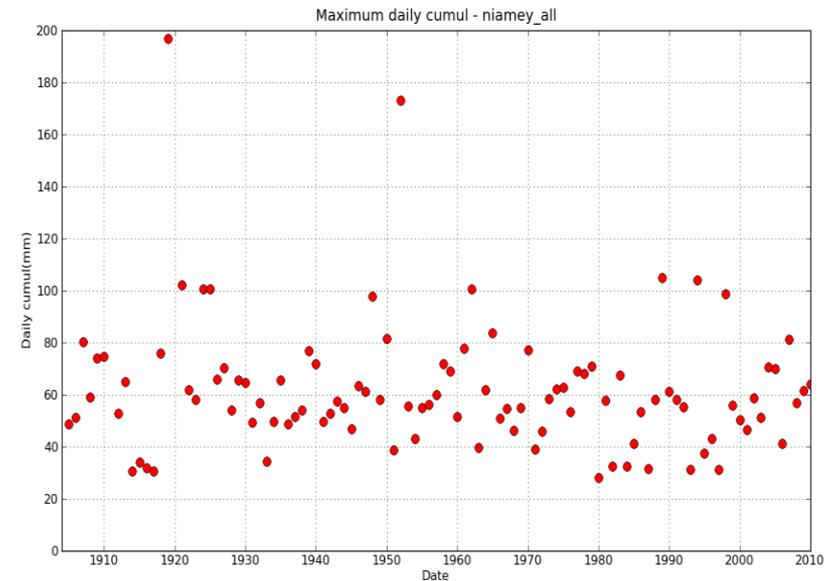
Variabilité spatio-temporelle des pluies extrêmes en Afrique de l'Ouest

Spatialisation des extrêmes en Afrique de l'Ouest



Évolution Temporelle des extrêmes

Exemple : Niamey (1905 - 2010)

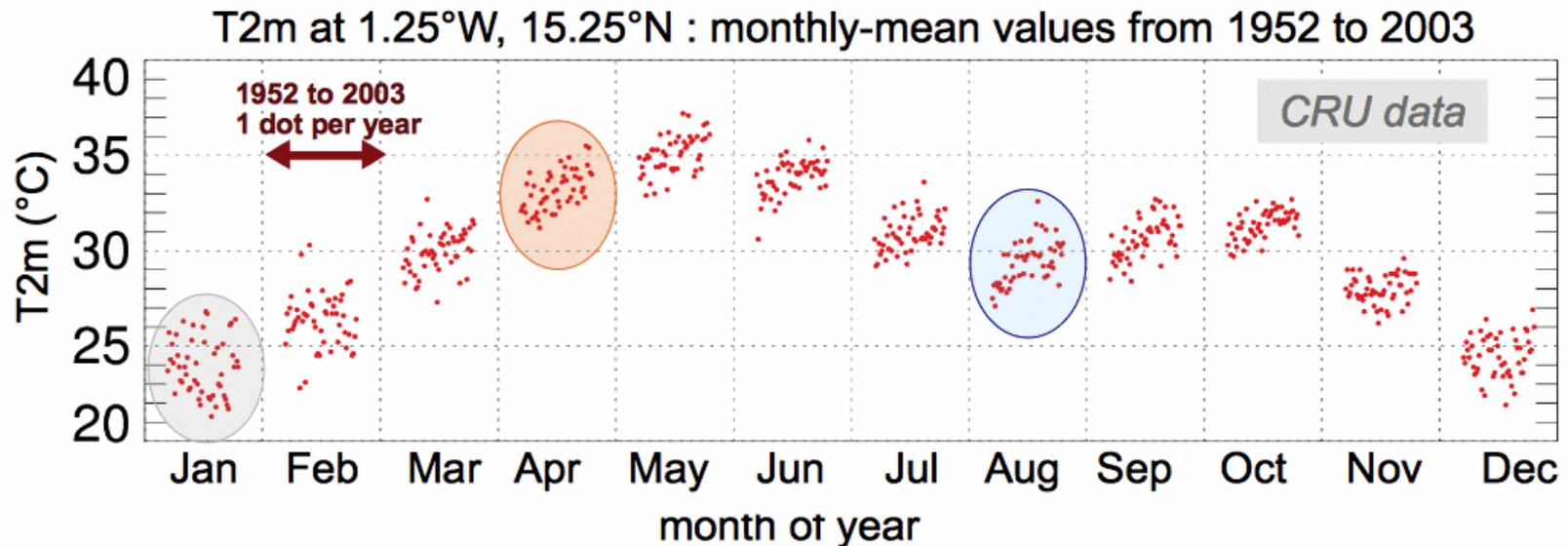


Un modèle GEV dont les paramètres varient selon des variables (ici la latitude) semble plus robuste qu'une inférence locale suivie d'une interpolation des paramètres.

Les tests de ruptures (Pettitt et KPSS) et de tendances (Spearman, Pearson et Mann Kendall) ne rejettent pas l'hypothèse de stationnarité.

assessment of changes in the seasonal cycle of temperature at multi-decadal scales across West Africa in observations and in re-analyses data

Cycle annuel de la température en zone Sahélienne



assessment of changes in the seasonal cycle of temperature at multi-decadal scales across West Africa in observations and in re-analyses data

- **CRU dataset:** moyennes mensuelles grillées

- **BD AMMA:**

Stations SYNOP

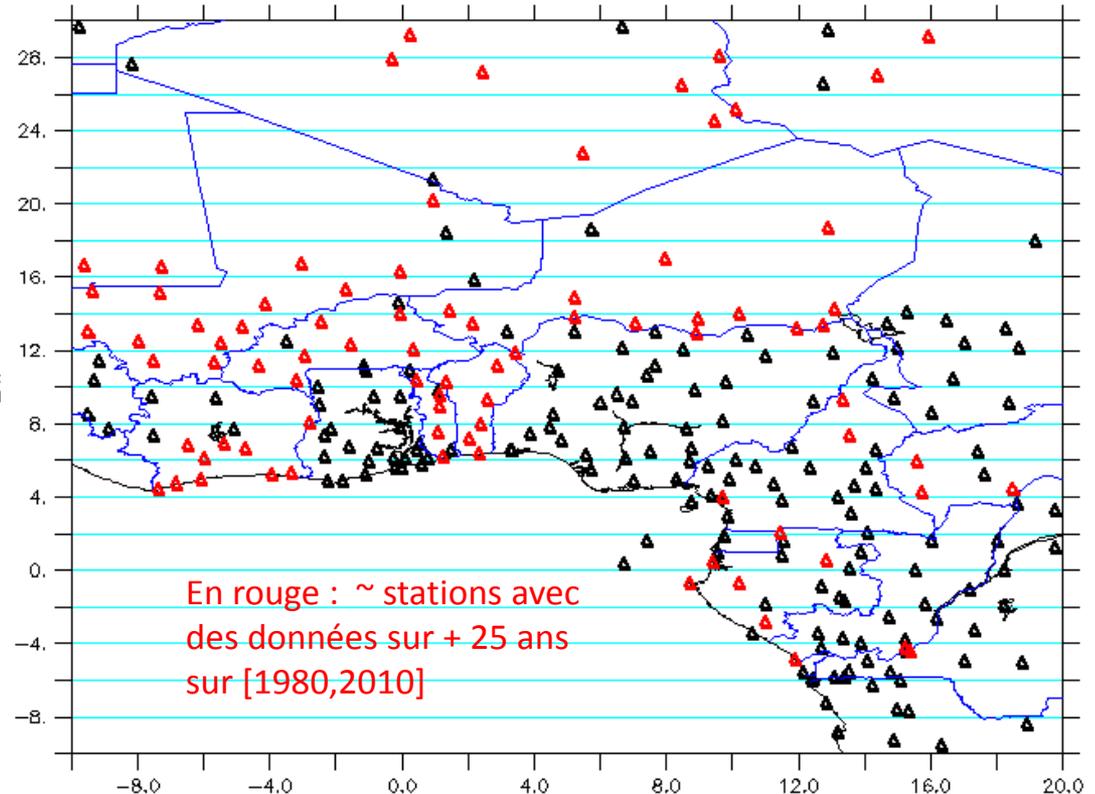
(journalier ou mieux)

[1900/1950 → 1980]

[1995 → 2011]

SYNOP 1980-1995
récupérées par SEDOO

- *Tendances / sites*
- *Couplages des variations de température et d'humidité*
- *Comparaison avec les données CRU*



assessment of changes in the seasonal cycle of temperature at multi-decadal scales across West Africa in observations and in re-analyses data

MERRA (1980-2010)

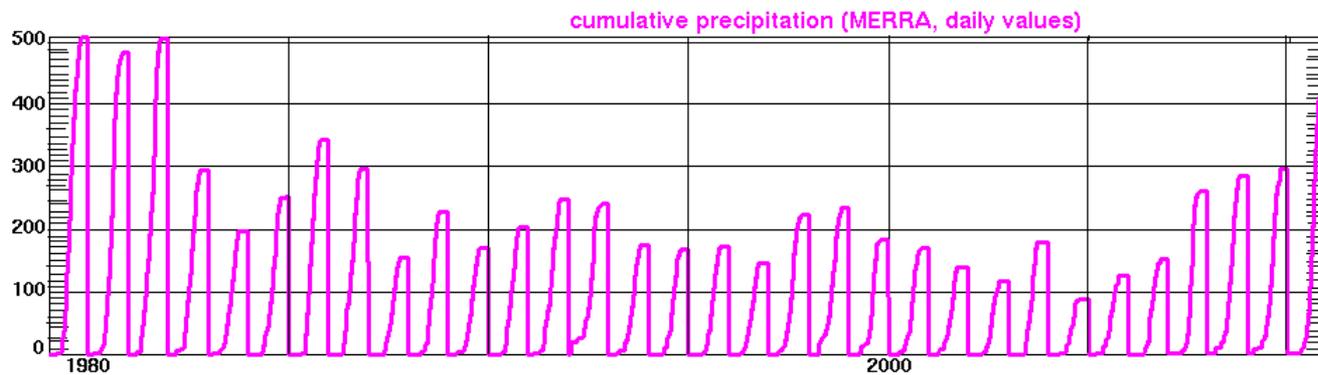
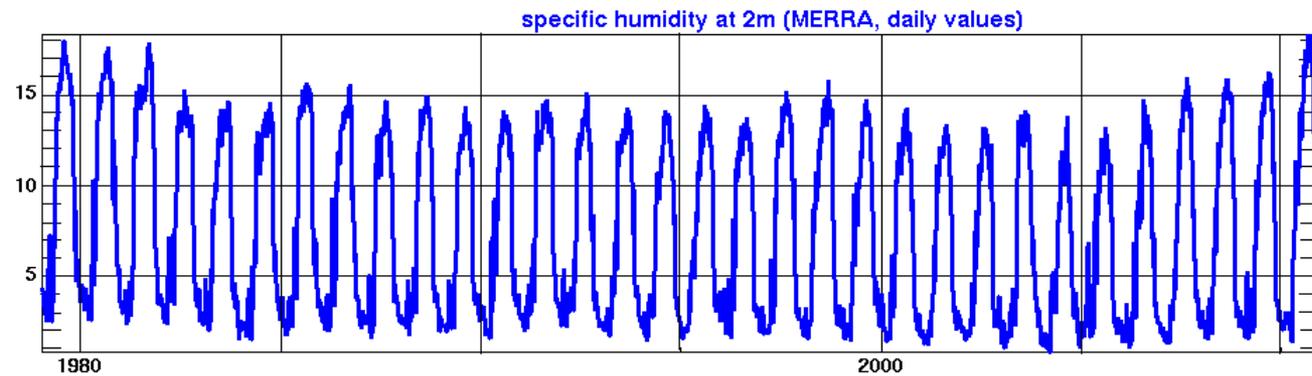
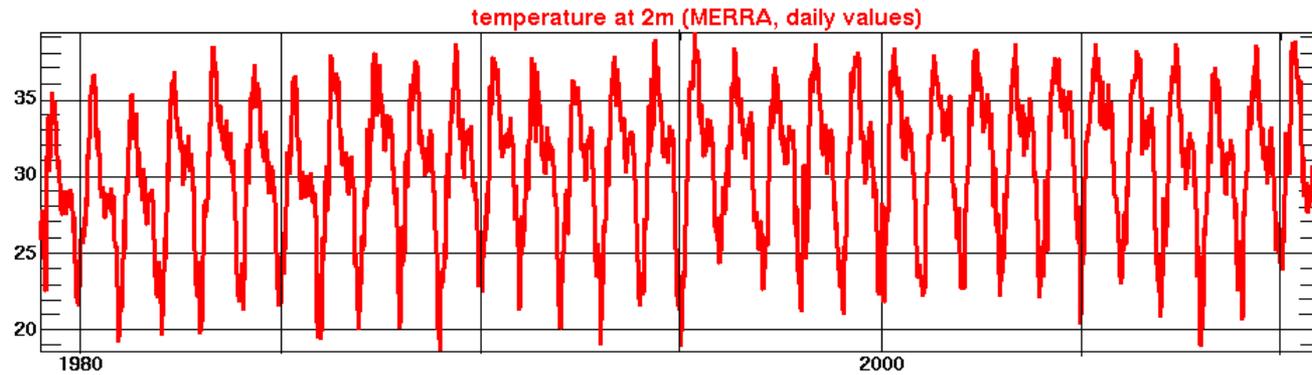
NCEP-CFSR (1980-2010)

ERA-Interim (1980-2010)

20th century reanalysis (1870-2010)

*Variabilité interannuelle et multi-décennale: les résultats semblent peu convaincants pour ces questions (anomalies de T2m, q2m, précipitations)
travail en cours, à consolider*

Cycle saisonnier du bilan radiatif au Sahel: même type de défaut ds toutes les réanalyses, Rnet trop fort au printemps



*variabilité
interannuelle
incohérente
avec les
observations*

D1.1b: Report on the signature of climatic changes in surface thermodynamic and energetic couplings. M12 (CNRM)

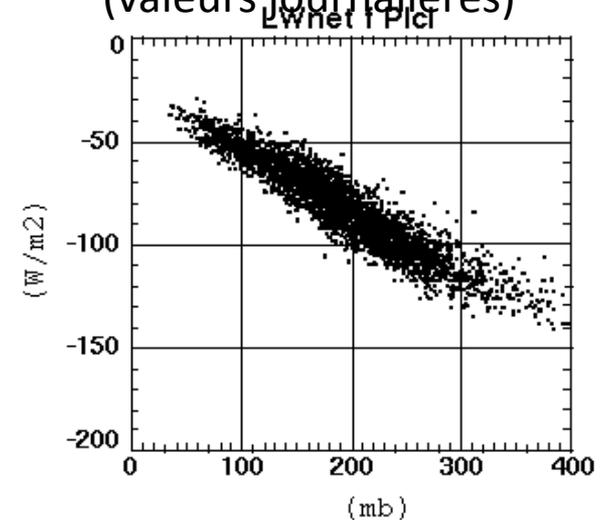
Travail en cours

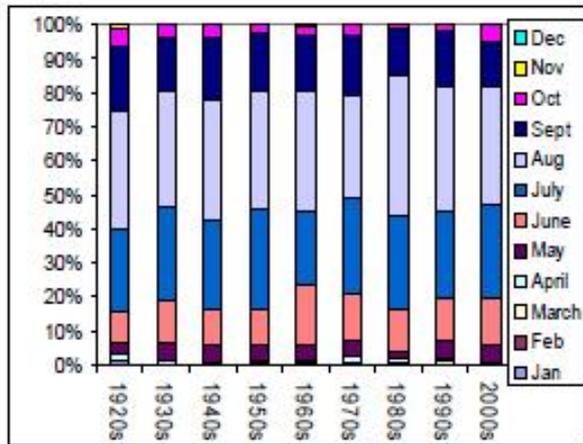
analyse des couplages thermo-rayonnement à différentes échelles: du saisonnier à l'interannuel

On observe bien des couplages dans tous ces produits, reste à évaluer + précisément leurs validité et interpréter les différences

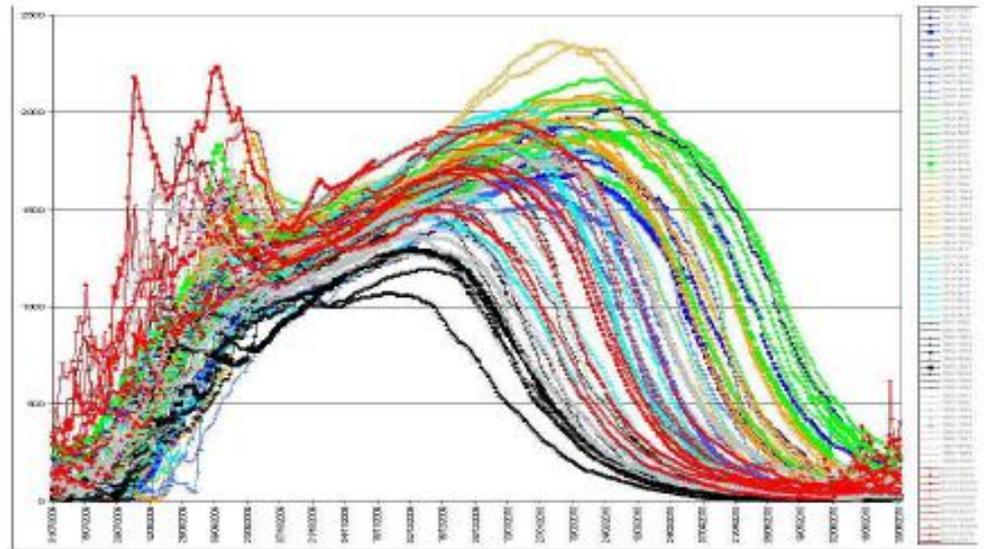
(préparation de l'analyse des runs climatiques)

un exemple de couplage
(valeurs journalières)





Evolution of the monthly distribution of rainfall Niamey in Niger



2010: the highest "red flood" ever observed;
But only the 20th highest rainfall amount
observed in the basin

Number of events	1920s	1930s	1940s	1950s	1960s	1970s	1980s	1990s	2000s
20-30 mm	67	60	41	48	48	35	35	58	48
30-40 mm	23	22	22	32	29	25	18	29	19
40-50 mm	18	11	9	15	8	12	8	12	12
50-60 mm	11	6	5	5	9	11	5	3	5
60-70 mm	6	1	2	0	8	3	3	3	1
+ 70 mm	5	2	5	2	2	2	1	3	2
total number	130	102	84	102	104	88	70	108	87

evolution of the total number of rainfall events number according to the time (decades)

Task 1.2: Detection and attribution of land use change

Land use and land use changes (LULC) reveal the changes in production systems driven by societal changes and adaptation and it is also an active player in the resource production changes, and even to some extent in climate changes. As such, important efforts will be devoted to detect LULC and the drivers of it.

- Detection and attribution at the district (meso-scale) scale

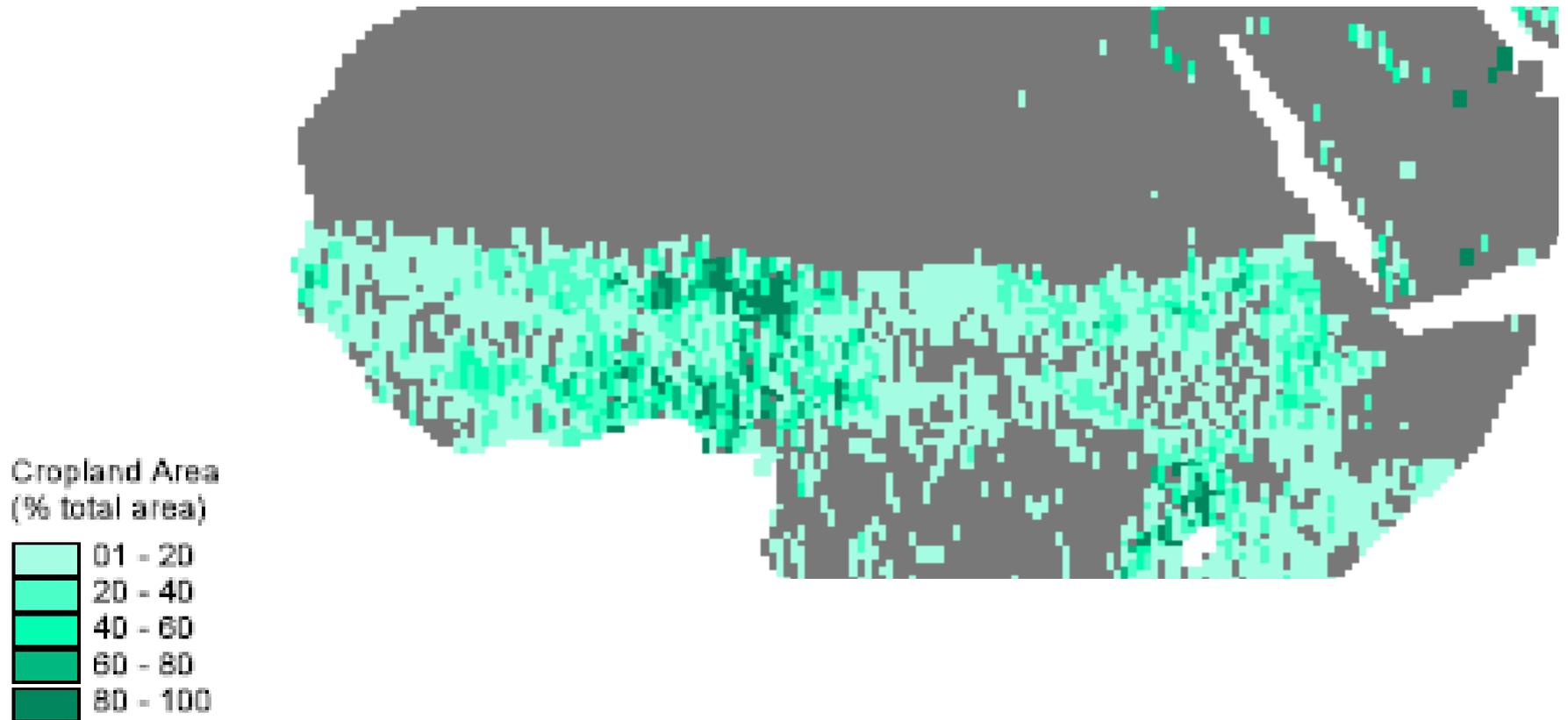
LULC will be derived from historical remote sensing data over three well documented sites from the AMMA-CATCH Observation System (S.O.) spanning latitude gradient in West Africa (Ouémé in Bénin, Fakara in Niger and Gourma in Mali). Classification of land units from CORONA images (1965), aerial photographs (1949 to 1954) and SPOT/LANDSAT data (present) will be produce for the three sites. Features like crop/pasture/fallow/secondary forest/primary forest will be diagnosed. Diagnostics of the drivers of these changes will be collected (within WP2).

- Detection of LULC at the regional scale

This task aims at evaluating the existing LULC products with the objective of assessing the generality of the district scale features and to assess the LULC datasets used in climate simulations.

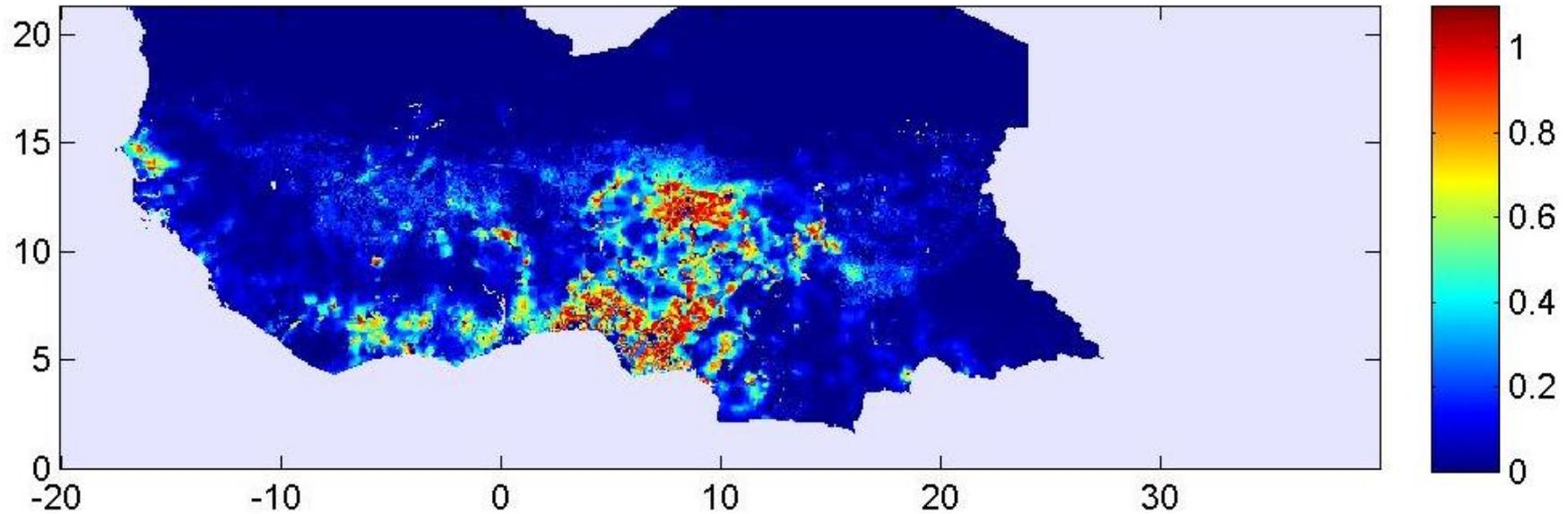
GT 1 : UN PEU DE SCIENCE

Manfreda , Ramankutty, and Foley 2008



GT 1 : UN PEU DE SCIENCE

Manfreda and Ramankutty, 2008



GT 1 : UN PEU DE SCIENCE

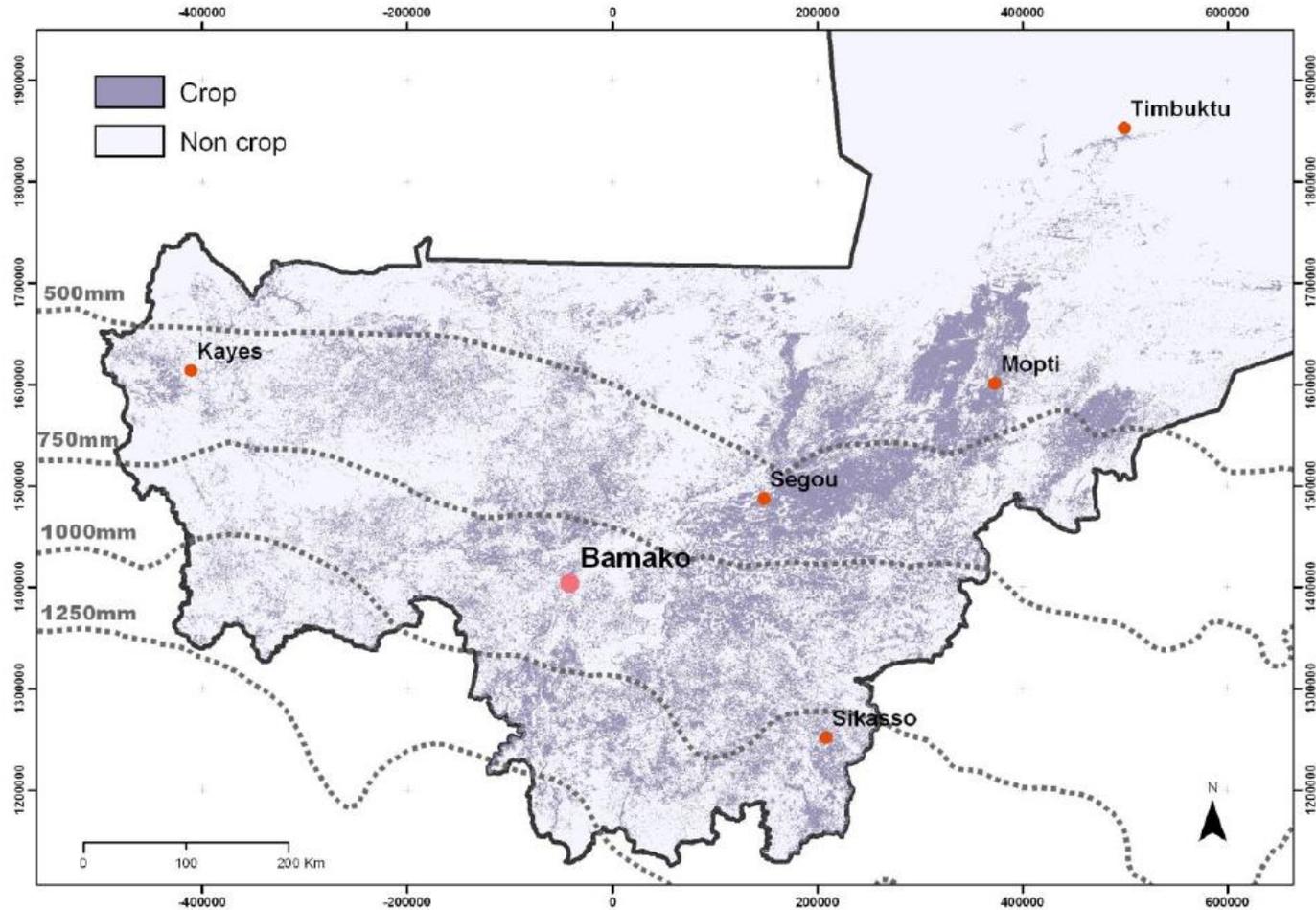
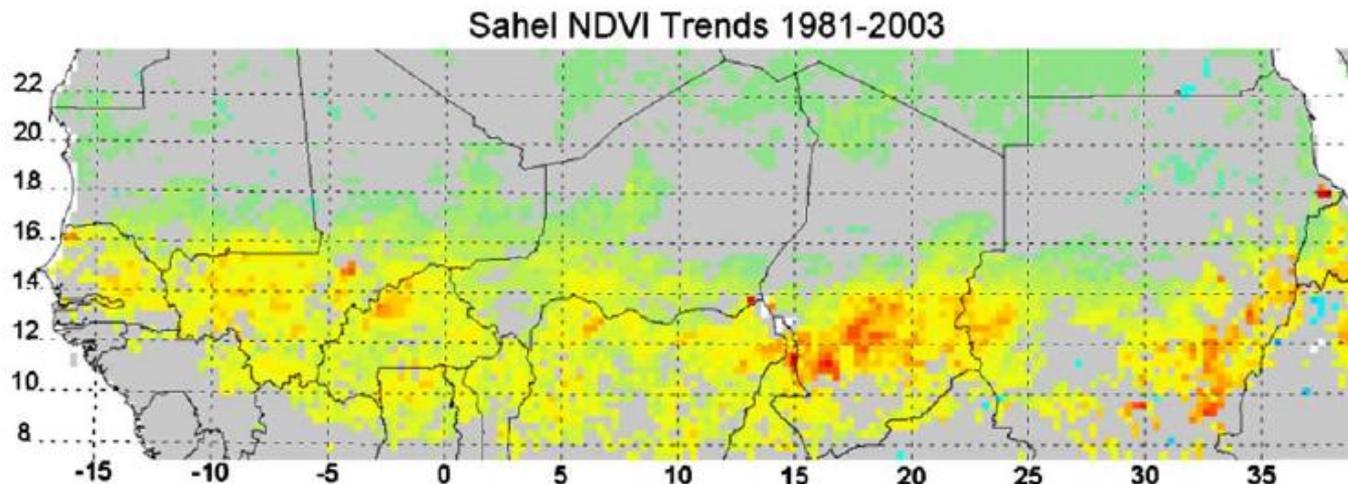


Figure 9 : masque de cultures du Mali (Vintrou et al. 2011).

Task 1.3: Detection and attribution of ecosystems and agrosystems changes from long term series

As soon as trends and decadal variability are addressed, it is critical to analyse the long term datasets, which are unfortunately extremely rare. ESCAPE has a unique opportunity of accessing two long term dataset, from which the dynamics of rangeland ecosystems: rapid and lagged response to drought, dynamics of the different Plant Functional Types, coupled water/plant systems, coupled plants/LULC systems. Similarly, for crop/livestock production systems: trends in yields, trends in livestock inventories, coupled production/LULC systems, coupled production/societies systems will be analysed. These datasets will be used for the validation of resource simulations over 1950-present.

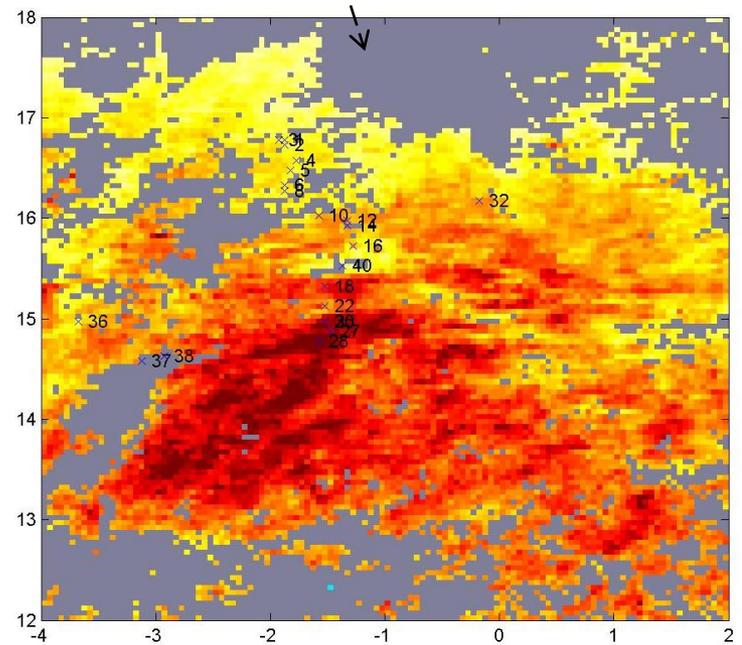
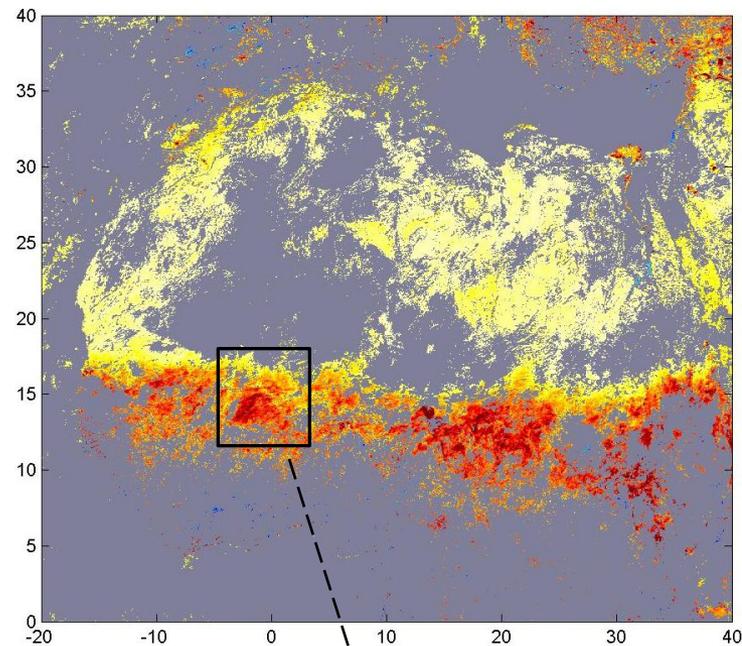
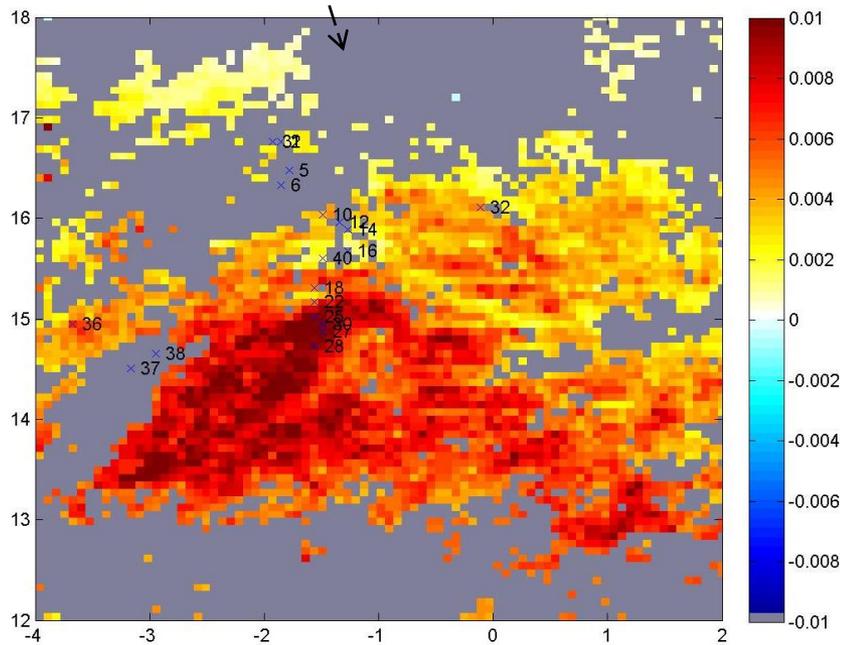
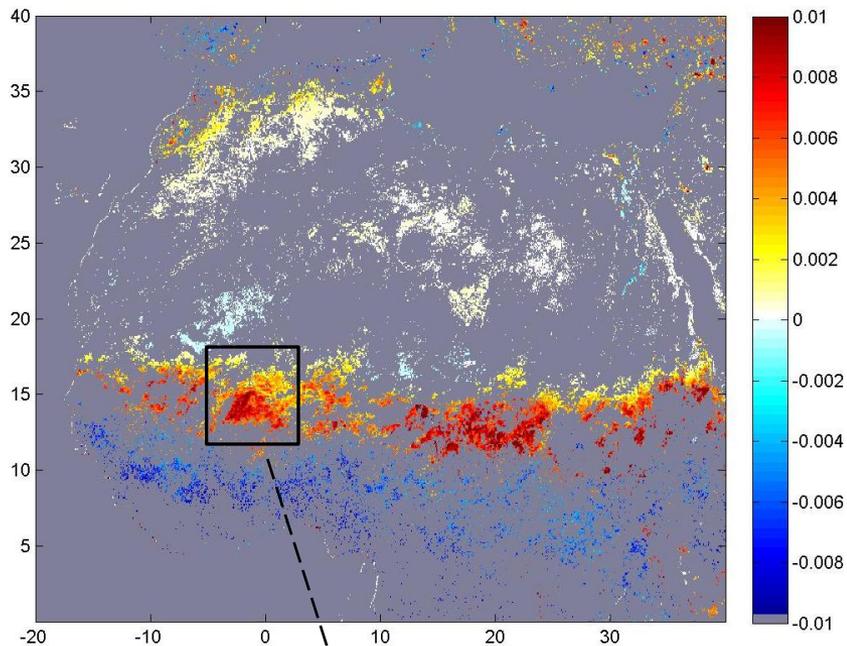
The large scale trends and patterns, (satellite greening trends, desertification areas) will be assessed in view of the previous analyses, with the objective of rejecting or reconciling these theories. Satellite signal will be carefully analysed in terms of vegetation and surface properties changes over time (AVHRR LTDRv3 and VGT dataset).



Anyamba and Tucker 2005

Cartes de tendances du NDVI, AVHRR GIMMS vs LTDR (1984-1999)

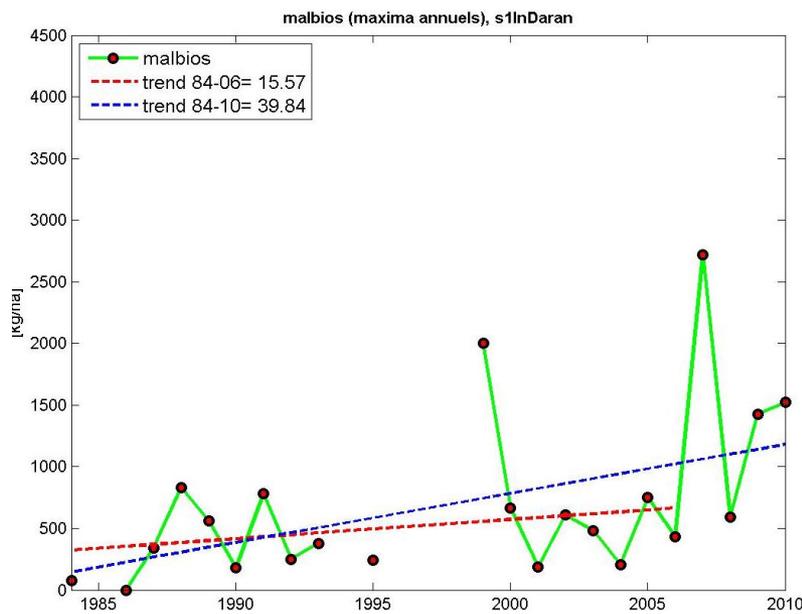
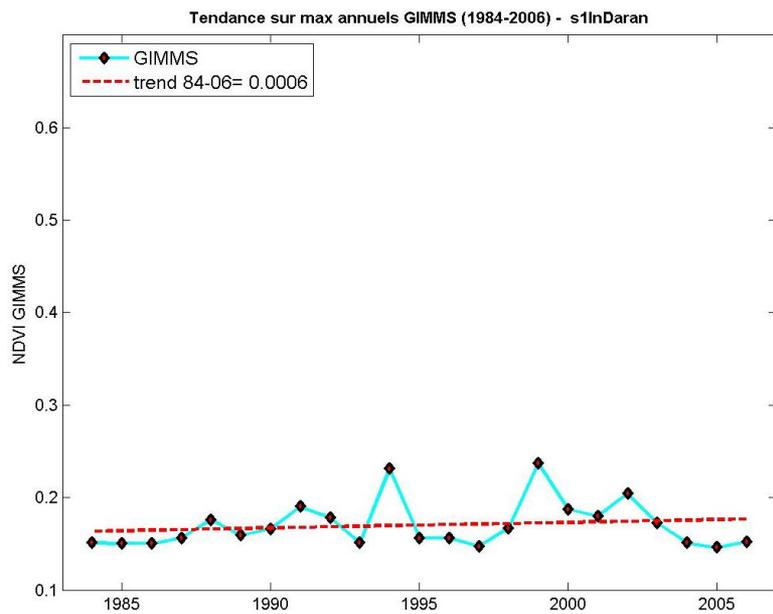
Méthode de calcul : calcul de valeurs annuelles (moyenne saisonnière Juin-Septembre) ; régression linéaire sur ces valeurs annuelles



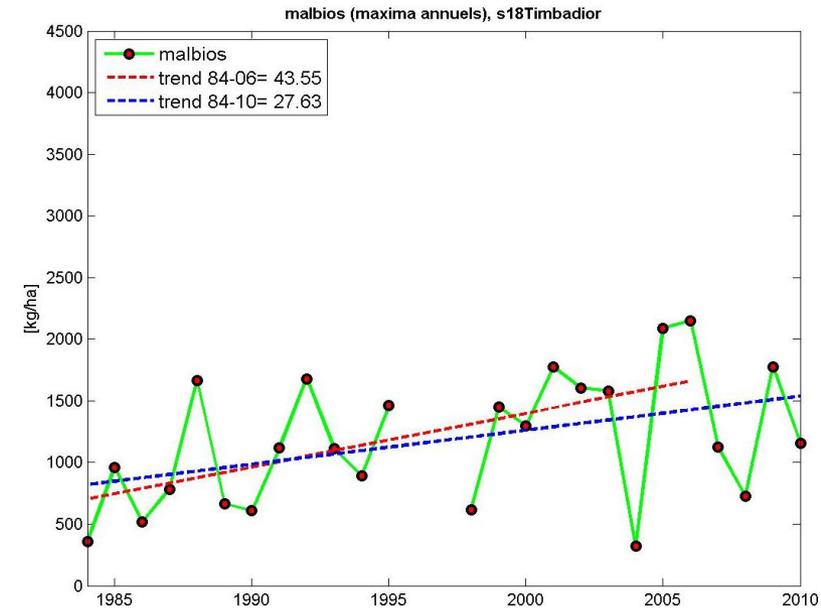
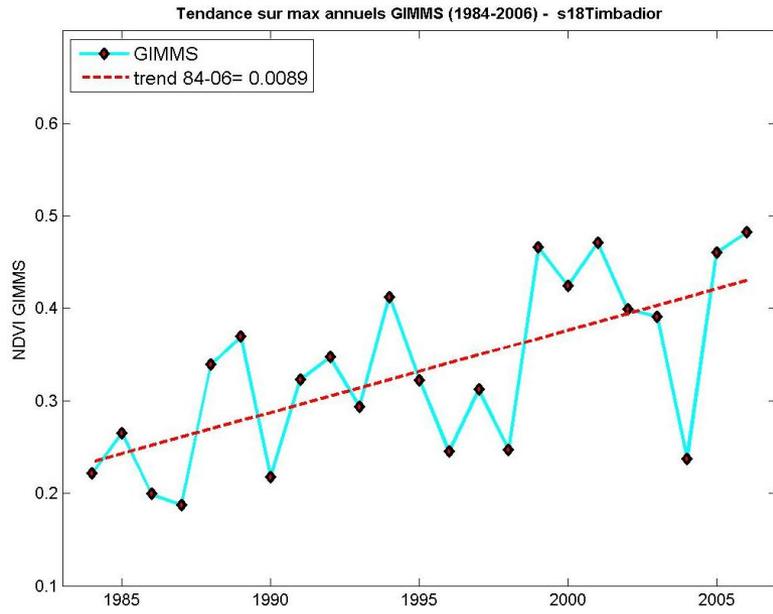
Comparaison NDVI GIMMS – données terrain (biomasse), 1984-2006

Méthode : régression linéaire sur maxima annuels

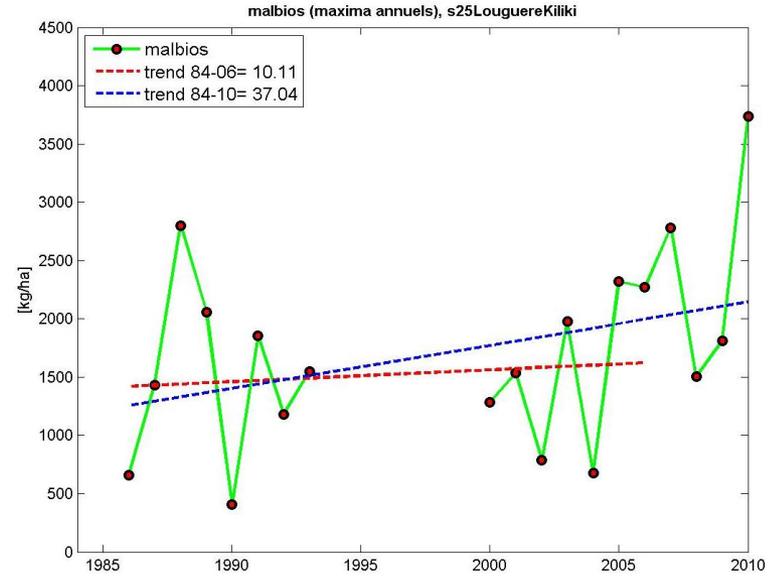
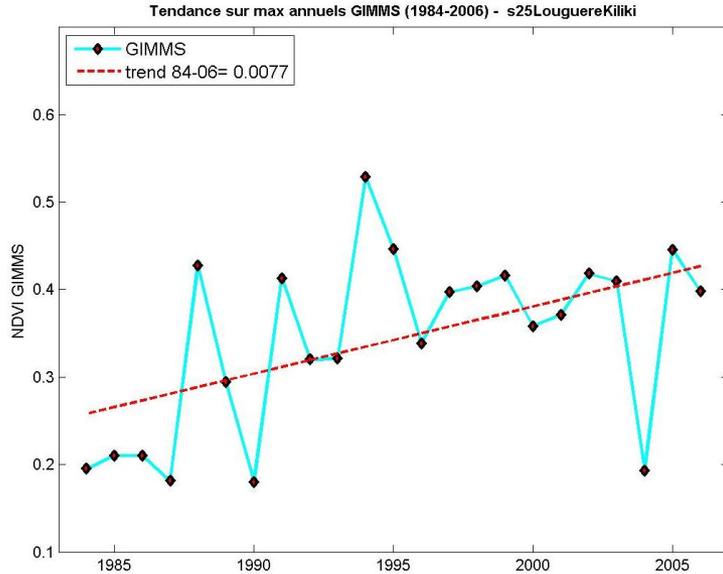
Site du Nord du transect



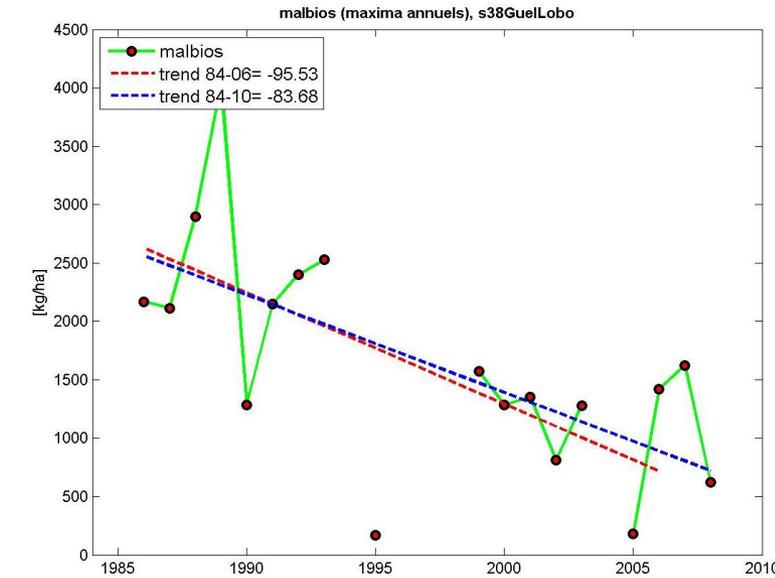
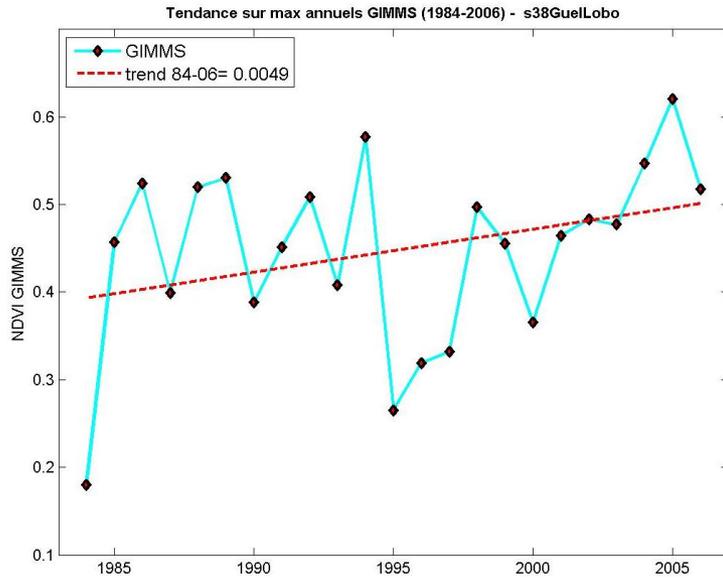
Site du milieu du transect



Site du Sud du transect



Site du Sud-Ouest du transect

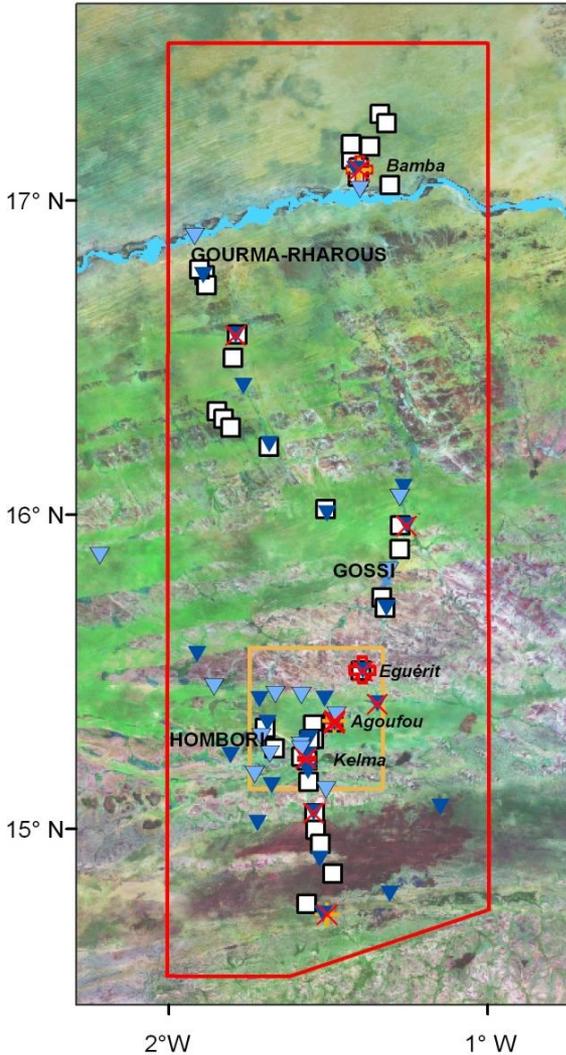


- Tendances GIMMS/terrain de même signe pour les 3 premiers sites, désaccord pour le Séno. Pourquoi ?

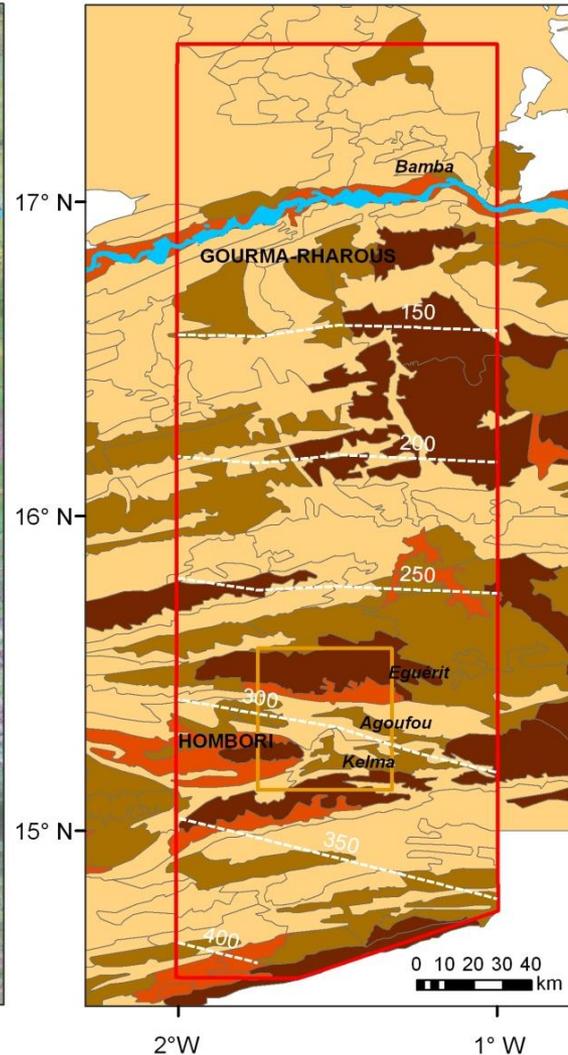
- Bonnes dernières années (tendances terrain plus fortes quand intégration 2006-2010)

Un lien avec le type de sol ?

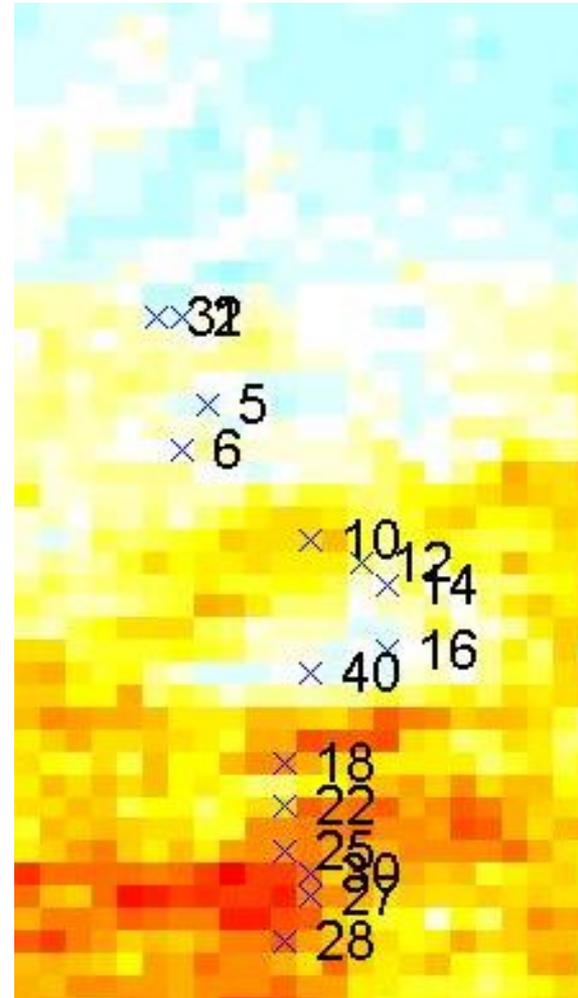
a) Sites et instruments



b) Carte des sols



c) Tendances saisonnières (JJAS) GIMMS, 1984-2006

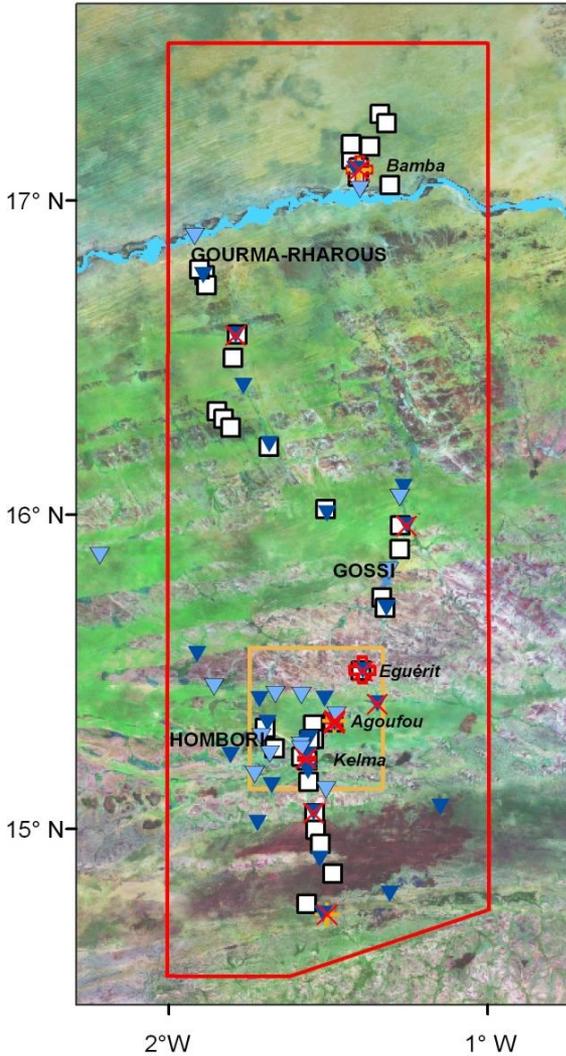


⇒ On retrouve les **unités paysagères typiques** de la zone (jaune : zones sableuses ; marron clair :affleurements rocheux/cuirasses ; marron foncé : glacis d'érosion rocheux)

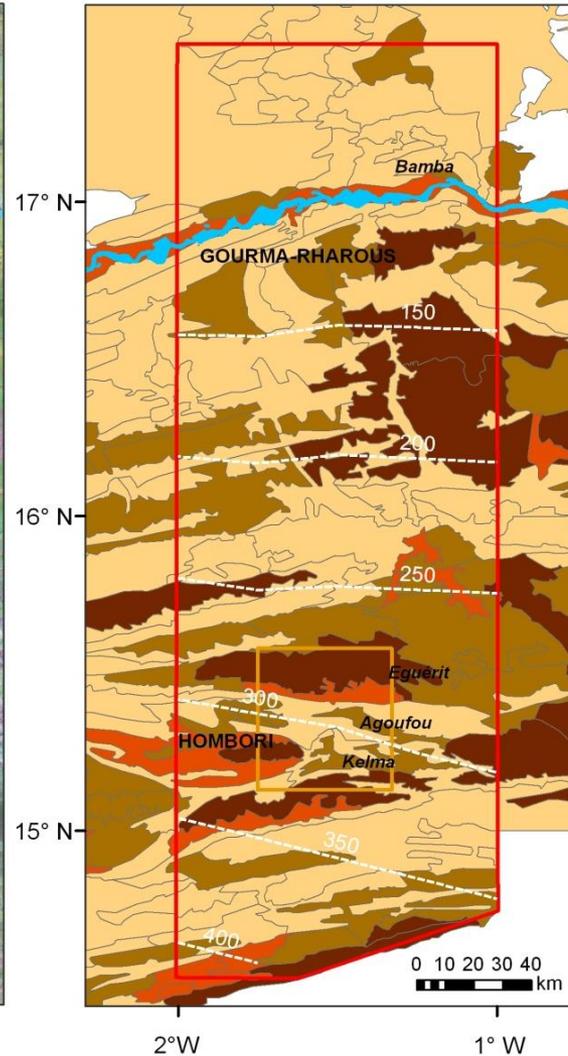
⇒ **Tendances** les plus **marquées** là où les **productions** de masse végétale sont les plus importantes (zones dunaires avec sols sableux)

Un lien avec le type de sol ?

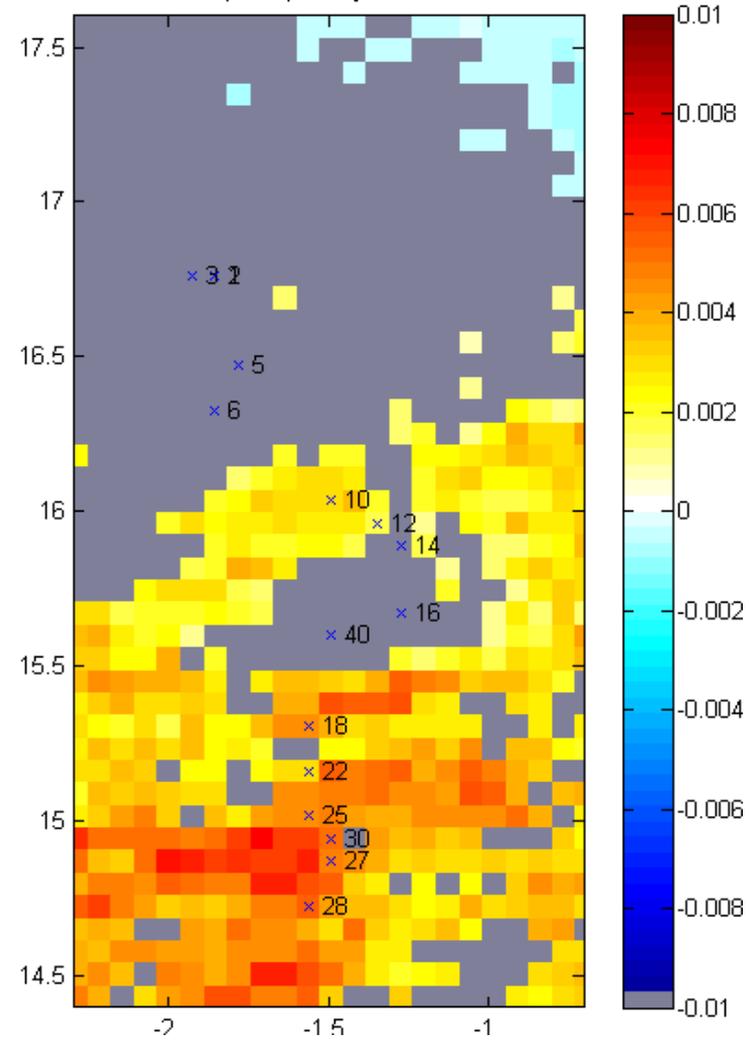
a) Sites et instruments



b)



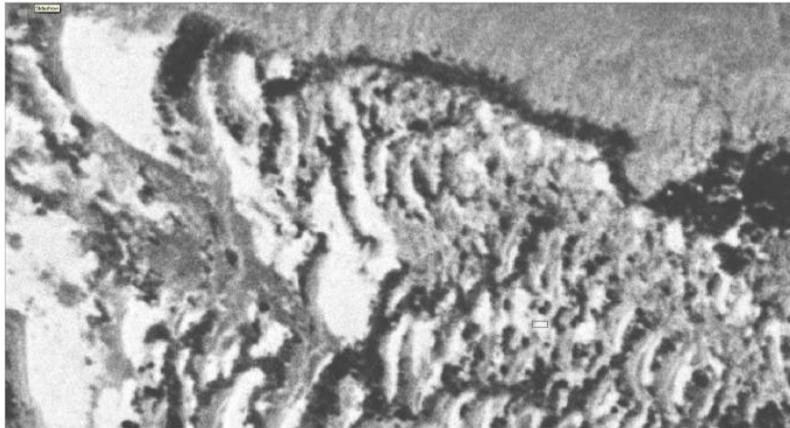
c) Tendances saisonnières (JJAS) **GIMMS, 1984-2006**



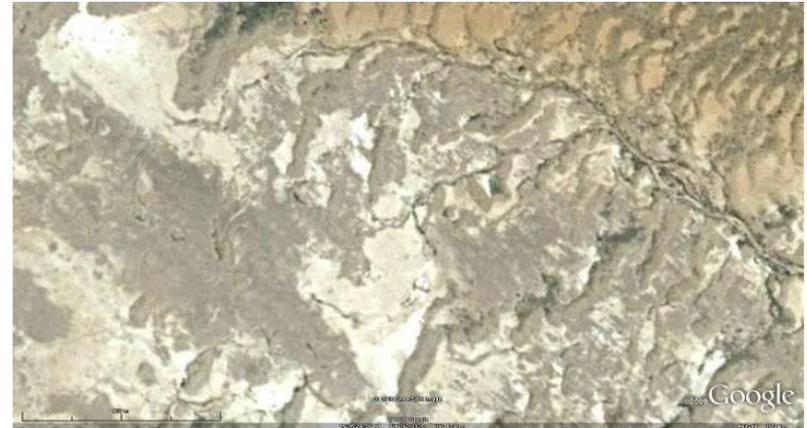
Même chose mais avec en gris les pentes qui ne sont PAS significatives : zones où la production herbacée est faible

Sols profonds (sableux) : systèmes très résilients (le désert recule...)

Sols peu profonds: sécheresse, diminution couverts végétaux, érosion, ruissellement
= le système perd sa résilience (le désert recule, en avançant par endroits ...)



CORONA. 15/10/1965



SPOT 28/12/03

Task 1.4: Detection and attribution of surface water and run-off changes over 1950-present

This task aims at diagnosing the long term changes in surface water availability and at attributing these changes to either climate or man-made LULC, or presumably to a combination of these factors. It requires an assessment of surface water (ponds, wetland) and run-off (gullies, erosion patterns) systems derived over the Fakara and Gourma sites as well as corresponding eco-hydrological and LULC changes.

A toutes les échelles,
on remarque :

Amogu et al., 2010 (Water)
Descroix et al, 2009 (J of Hyd)
Amogu et al, soumis (HSJ)
Descroix et al accepté (J of Hyd)

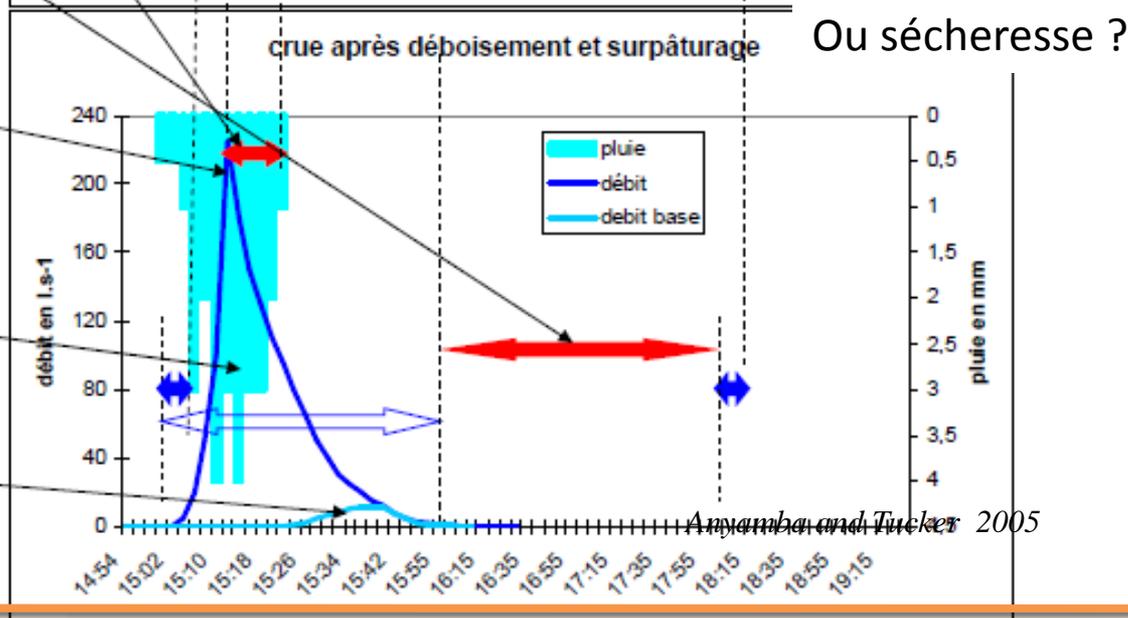
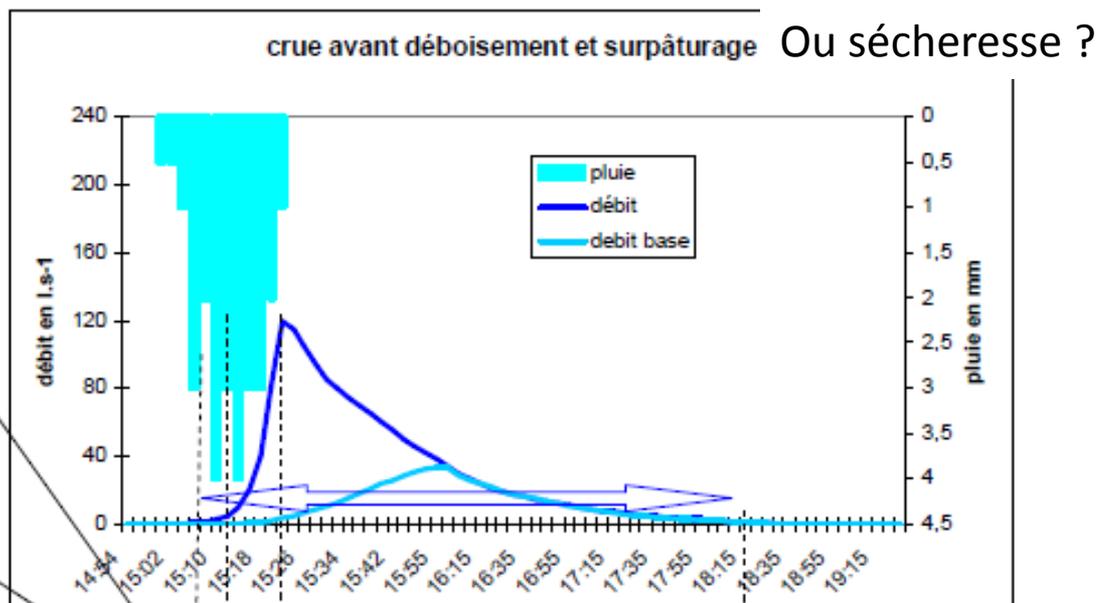
Réduction du temps de réponse

Réduction de la durée
totale de la crue

Exagération du pic de crue

Augmentation
de l'écoulement de crue

Diminution
de l'écoulement de base



C'était probablement un peu long,

.... mais ...

Certainement, ~~probablement~~, peut-être moins que le GT 2 (ou 3, 4, 5, 6)

