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ANALYSIS OF INTRA-SEASONAL RAINFALL VARIABILITY IN THE FERLO (SENEGAL),IN RELATION WITH SURFACE CHARACTERISTICS (VEGETATION)

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Introduction

The rainfall variability in Senegal has major impacts on vegetation dynamics. This variability and its impacts are little study locallly.
The objective of this study is from the relationship between vegetation and rainfall, to define efficiency indicators of the monsoon for understand this variability in the local scale the watershed of Ferlo a semi-arid region very sensitive to fluctuations in rainfall.

Study area and data use

The Ferlo is a forestry-pasture zone with low anthropic pressure.
- Vegetation: essentially covered with woodland arbustive savanna, woodland savanna and arbustive steppe.
- Soils: Ferruginous, Hydromorphics, Lithosols and Regosols soils

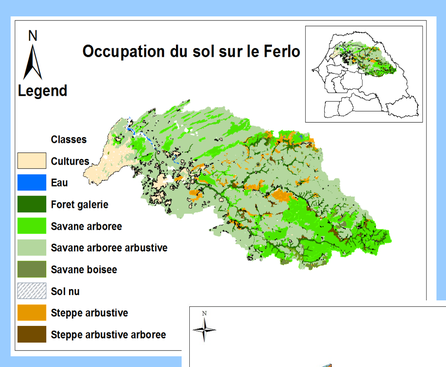


Figure1 : Localisation of the Ferlo and vegetation classification

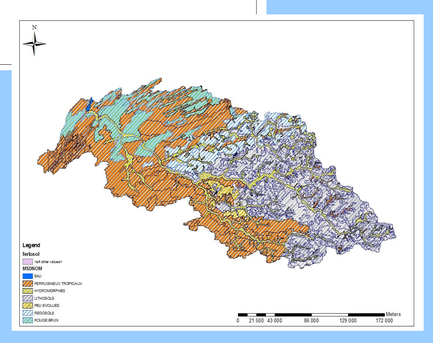
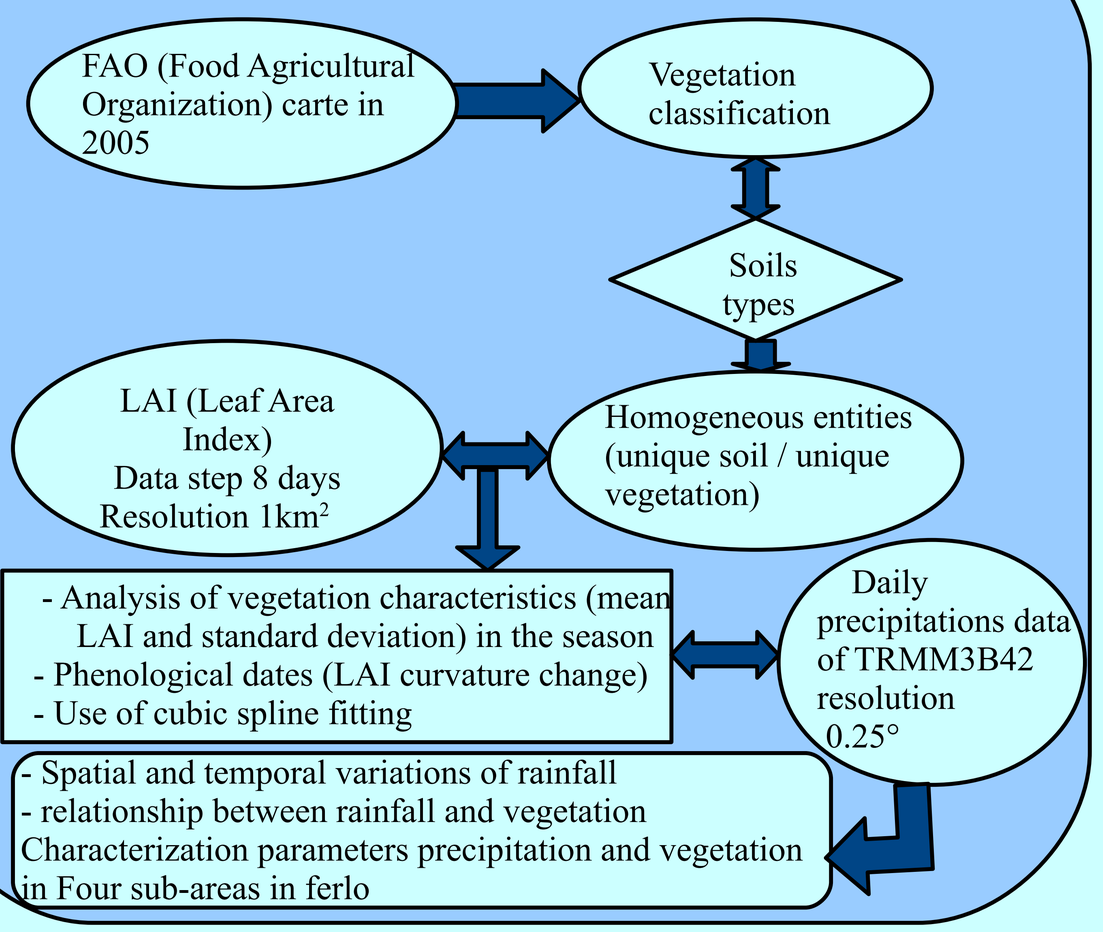


Figure 2 : Soils types in Ferlo watershed

- Surface characterization: land cover map FAO (Food Agrcultural organization) 2005, pedology map PNAT *(Plan National d'Aménagement du Territoire)* Senegal,1985
- Precipitation: rain gauges data of Barkedji and Linguere

Satellite data :
-Vegetation: LAI (Leaf Area Index), MOD15A2 LAI (instrument MODIS) product.
- Precipitation: TRMM3B42 (Tropical Rainfall Measuring Mission), resolution latitude-longitude 0.25x0.25 every 3hours.

Methodology



First Results

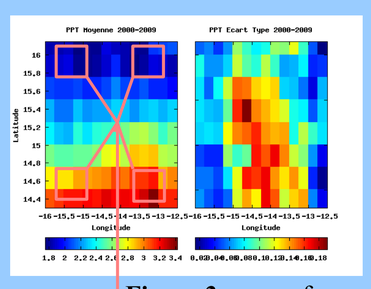


Figure 3 : map of mean and standard deviation precipitation in Ferlo

Rainfall gradient between North and South Ferlo with high heterogeneity in the center and south. Four sub-areas defined (NW, NE, SW, SE)

Relationship between precipitation and vegetation in the four area on the study zone:

South areas : more favorable than the north with higher vegetation growth and higher precipitations.

Precipitations less frequent with longer dry spells in NW area.

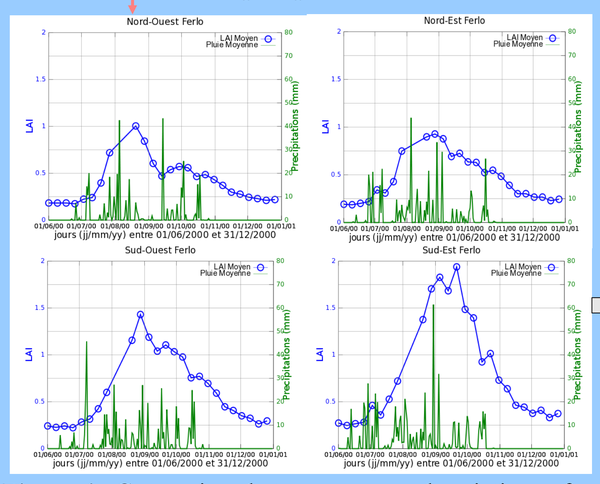


Figure 4 : Comparison between temporal variations of average precipitation and average LAI

Analysis of rainfall occurence characteristics from 2000 to 2009

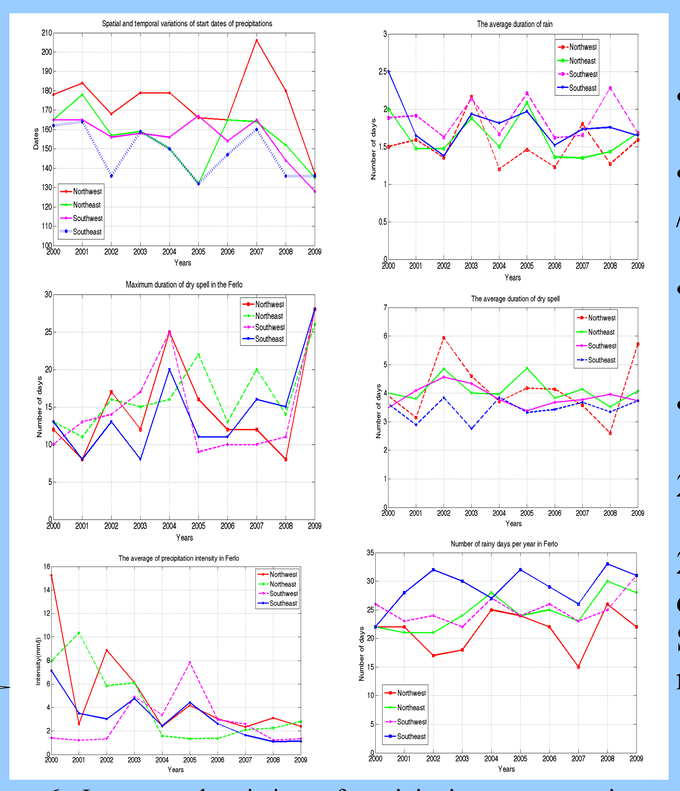


Figure 6 : Inter annual variations of precipitation parameters in the four sub-zones in Ferlo. Intensity : mean rainy events/duration of events.

Inter-annual analysis of rain season

- The beginning of rain season from 2000 to 2009 is between day 132 and 208 of the year.
- Decrease in intensity (rain event total amount /rain event duration) from 2000 to 2009, over the four areas
- General contrast between NW and SE in rain amount and occurrence (rain duration, dry spells)
- 2002 and 2009: high average duration of dry spells in NW.

2004, 2006 : low average duration of rain the NW.
2007 : latest beginning rain day, smallest rain day number in NW ; maximal rain number in SE and a maximum durations of dry spell over most of the region.

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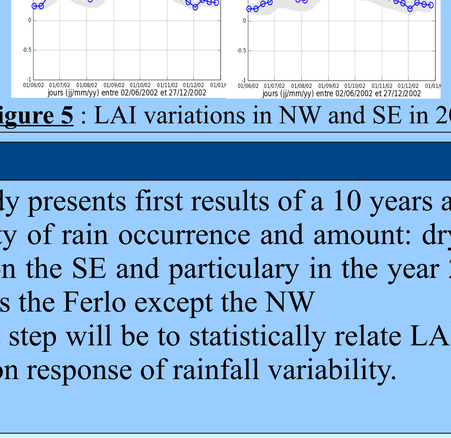

Figure 5 : LAI variations in NW and SE in 2002

Importance of dry spells during the vegetation growth season

Example for year 2002 : 2 soil types, one vegetation classe

- hydromorphics soil leads to reduced savanna growth than ferruginous one (less water storage)
- difference in growth between North and South

Further analysis : automatic detection of LAI phenology characteristic dates (beginning, maximum, end, and stress periods) and correlation with rain.

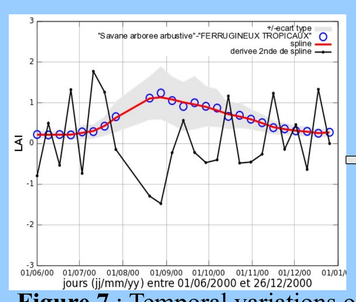

Figure 7 : Temporal variations of LAI data (savanna woodland and arbustive) in 2000 fitting with spline function

Figure 8 : Inter annual variations of phenological parameters

- Onset dates of vegetation (savanna) are more advance in the SE generally except the year 2001.
- Maximum and minimum in SE the maximum of growth between 233 days in SE and 265 days in NW. The later maximum is observed in the Northwest to 266 days.

Conclusion

This study presents first results of a 10 years analysis of rain intraseasonal variability in relation with vegetation phenology: Concerning rain: high contrast between NW and SE in Ferlo, high interannual variability of rain occurrence and amount: dry spells mean duration 6 days in NW, 2 days in SE, but up to 6 days in 2002, rain season duration varies from 15 days to 28 days, onset date is observed mainly on the SE and particulary in the year 2002. Concerning LAI: maximal sentitivity of some soil / vegetation classes to dry spells (hydromorphics and ferruginous soils). onset dates of raifall are continous the Ferlo except the NW
The next step will be to statistically relate LAI phenology dates (beginning, stress event date and maximum growth) with rain occurrence characteristics. This parameters are pertinents to understand the vegetation response of rainfall variability.