DYNAMIC VEGETATION SENESCENCE ANALYSIS WITH MEDIUM SPATIAL RESOLUTION IMAGERY IN SUPPORT OF DESERT LOCUST CONTROL OPERATIONS IN MAURITANIA

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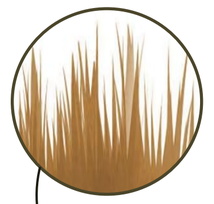
Introduction

The Desert Locust *Schistocerca gregaria* (Forksål, 1775) represents a major threat for agro-pastoral resources of more than 60 countries. Remote sensing plays a major part of in the preventative control strategy as it allows monitoring the locust habitats in near real-time over its entire repartition area, especially in remote or unsecured regions.

Objective

This work aims at developing and evaluating a method to detect in near real-time the senescence of vegetation in order to strengthen the locust control managment. Locust migrates when vegetation dries out. Therefore, this information through a dynamic dryness map would enable control centers to assess if they can remove or redirect their survey teams, leading to more efficiency in the allocation of resources and in decision making.

Green vegetation is essential for the survival of the locust (food, shelter, humidity)



Vegetation senescence induces migration of the locust

Methodology

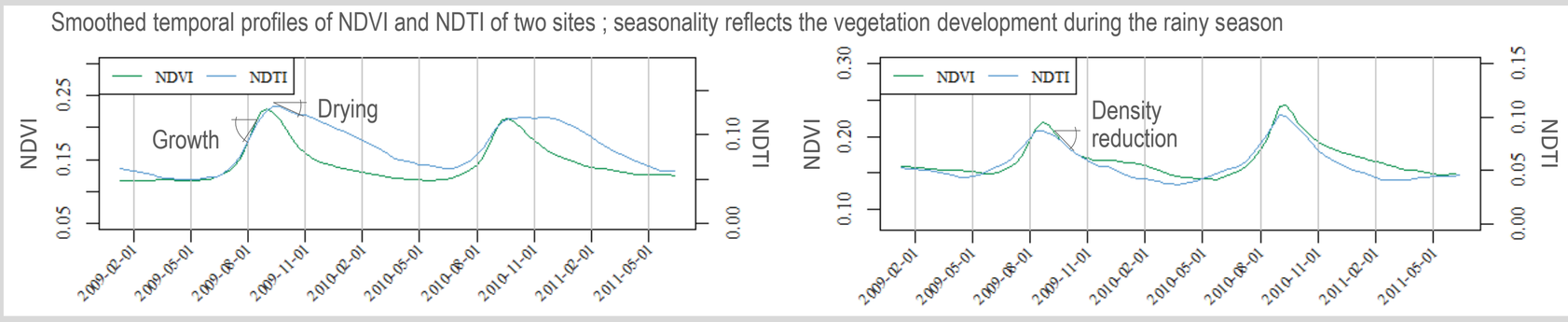
The design of the detection method relies on the temporal behavior of two indices :

$$NDVI = \frac{\rho_{858.5} - \rho_{645}}{\rho_{858.5} + \rho_{645}}$$ The NDVI (Normalized Difference Vegetation Index) sensitive to green vegetation

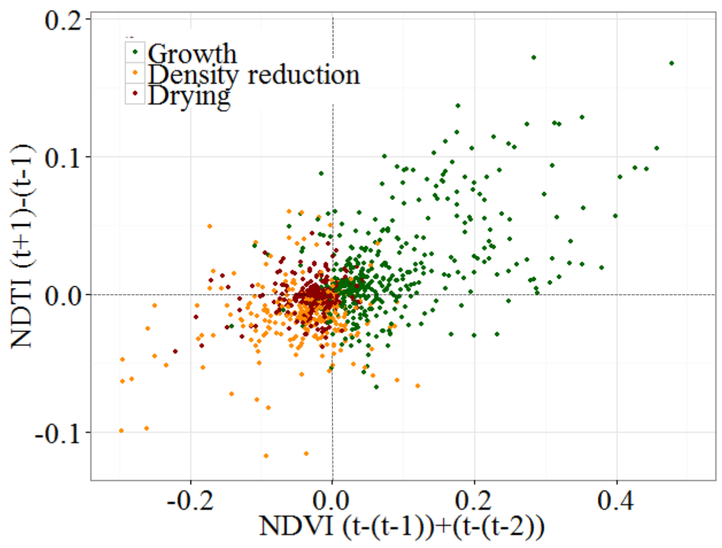
$$NDTI = \frac{\rho_{1640} - \rho_{2130}}{\rho_{1640} + \rho_{2130}}$$ The NDTI (Normalized Difference Tillage Index) sensitive to both green and dry vegetation

Mauritanian field survey database provided the validation samples necessary to distinguish between three phenological classes : "growth", "density reduction" and "drying".

Smoothed temporal profiles of NDVI and NDTI of two sites ; seasonality reflects the vegetation development during the rainy season



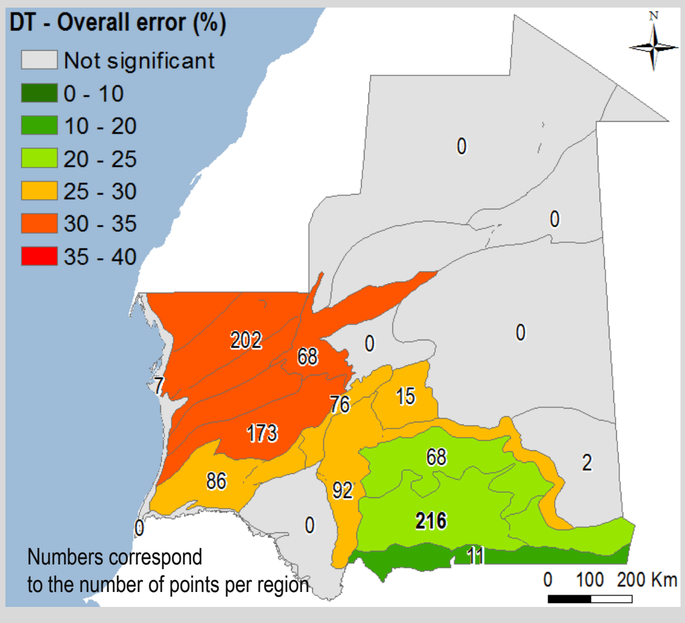
Scatterplot of the database fiield survey following the two NDVI and NDTI indices metrics



Results

The discrimination performance of these three classes were analyzed for three classification methods: a decision tree (DT), a support vector machine (SVM) and a maximum likelihood (ML) classifier. The DT and SVM, with an overall accuracy of 71.5% and 72.3% respectively, outperform the ML (61.4%). Smoothing the NDVI and NDTI temporal profiles results in an increase of the overall accuracy of 5% for the decision tree and of 4% for the SVM.

Methods	Overall accuracy	Smoothing
SVM	72,33%	+ 4%
DT	71,51%	+ 5%
MV	61,38%	+ 6%



Performance of the DT and SVM is affected by several factors :

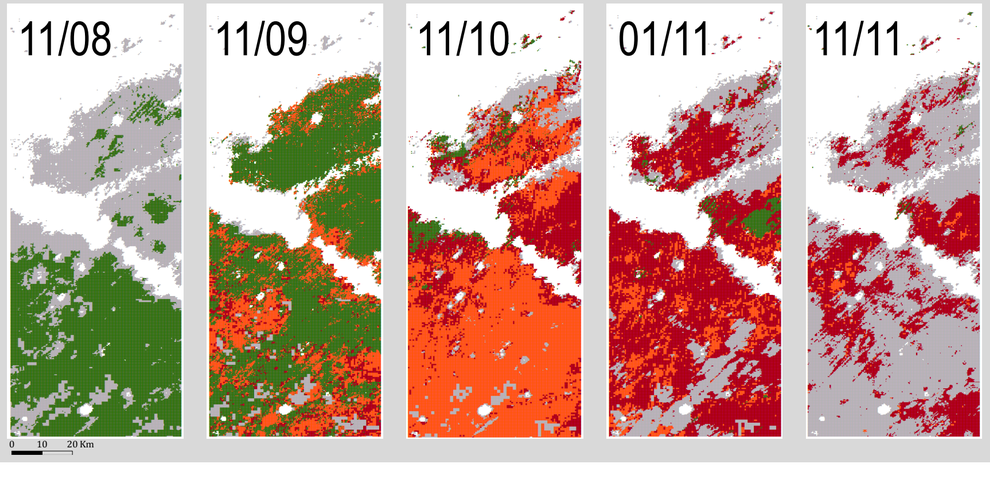
(i) the spatial distribution of the error confirms the influence of the north-south climatic gradient on the detection, with an error 10% higher in northern regions,

(ii) the vegetation density plays an important role in detection and depends on the type of habitat and on rainfall, itself subjected to climate and seasons

(iii) the relief also interferes with vegetation detection.

The overlap of the "density reduction" and "drying" class distribution leads to an important omission (46,19% for the DT and 49,14% for SVM) of vegetation patches affected by density reduction.

Growth
Density reduction
Drying



Application of the decision tree to the Mauritanian case highlights the diachronic consistency of the land cover classification ; the seasonal cycle is clear, despite some patches whose temporal behavior is difficult to interpret.

Conclusion

The results obtained in the framework of this paper are promising to pave the way for a first operational implementation of the senescence dynamic maps and, consequently, further strengthen the capacity of the locust control management.