Chapter 6
Time Series Multispectral Images Processing for Crops and Forest Mapping:
Two Moroccan Cases

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ABSTRACT

This chapter highlights time series image processing for accurate agriculture characterization through two Moroccan experiences. The first case aims at crop mapping. A new classification approach based on multiple classifiers combination (MCC) was developed and applied to multi-temporal enhanced vegetation index (EVI) bands. The whole process is performed in three stages: (1) Landsat data preparation and multi-temporal staked EVI image extraction, (2) MCC construction from six advanced and supervised classifiers, and (3) stacked EVI image classification using the build-up MCC. Some post-classification contextual rules were also added in order to optimize the crops classification and the final parcel shape. In the second case, a post-classification change detection process was implemented to detect changes in forest area. Many classification schemes with different vegetation and texture indices were investigated. The two experiences are cost-effective, reproducible, and transferable. Consequently, they can regularly be used to produce up-to-date land use maps.

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INTRODUCTION

Mobilization of geospatial information contributes to the creation and sharing of a unique vision of territory. Earth observation with different sensors characteristics has been found to be a valuable tool for data acquisition for mapping, monitoring, evaluating and managing land, water and crop resources. Combined to geospatial information system (GIS) and global navigation spatial system (GNSS), they form together in a complementary way an effective geospatial technology tool for more land governance. These technologies can capture the present, go back in past and predict the future. As decision support tools, decision based on such technologies are helpful for ensuring sustainability and for dealing with global concerns such as sustainable and integrated development. In contrast to that, we note that if geo-information allows approaching set of themes related to territory management by bringing convincing elements in terms of decision support, it brings new scientific questionings as areas for future research. Precision agriculture and precision forestry are now and for the next decades the development trends in geo-information applied to agriculture monitoring and management (Beerech HV., Mrslatha BM., Thimmaraja Yadava G. and Navven Dandur, 2014; Oscar S. Dalmau,Teresa E., Alarcón and Francisco E. Oliva, 2017 and Paletto, Ferretti, Cantiani and De Meo, 2012).

Nowadays, agricultural domain is the most studied by the geospatial technics all over the world. Crops and forest are the two major studied themes. They remain for international communities a vital, environmental, economic and social question. Then, thematic crops and forests maps are produced according to process based mainly on supervised classification. Literature review reveals that more attention should be paid to classification parameters to ensure acceptable and correct derived thematic maps (Elmansouri 2013; 2014; Gumma, Thenkabail, Maunahan, Islam and Nelson, 2010; Waldhoff and Lussem, 2016).

Crop types, biophysical and vegetal parameters monitoring are the principal tasks needed for crop management. Further, many applications at various scales could be derived from them, such as: crop identification, vegetation health monitoring, identification of planting and harvesting date, yield estimation and modeling, crop rotation records, soil fertility, water consumption and irrigation scheduling.

In Morocco, crop plantation information is mostly collected through four ways: (1) farmer communications (FC), (2) spatially limited land survey (LLS), (3) visual photo-interpretation (PI) of a newly registered digital image and (4) automatic one-satellite image analysis (OSI). These procedures provide limited and subjective information with unguaranteed consistency, weak completeness and moderate accuracy. They also require a large team of skilled photo interpreters. Land survey could map accurately crop types but it is too time consumptive, high cost and labor-intensive which limits its use. Due to vegetation changes according to its phenological cycles over time and the variation of environmental conditions, image acquisition date is a critical point for the two last approaches (PI & OSI).

Recently consulted literature highlights that none of these methods can be used as a periodic process to monitor crop changes (Tingting and Chuang, 2008; 2010). Indeed, one image cannot depict the dynamic behavior of crops. Multi-date image analysis is more suitable. Time series of optical and radar remotely sensed imagery is shown to be a cost-effective data sources for automatic crops identification. They can be regularly used to produce an accurate and up-to-date crop map at different temporal and spatial resolutions, although the processing time is longer. The underlying hypothesis is that each crop species has both specific spectro-temporal signature in a time series of multispectral images and backscatter profile in radar data. This is logically true only if the taken time series images dates depict whole researched crops phonological cycle. In this way, associating spectral signatures with phenological stages which highly increase classification performance.