Chapter 8
Machine Learning for Winter Crop Mapping Using High Spatiotemporal Time Series Satellite Imagery:
Case Study – Jendouba, Tunisia

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ABSTRACT

Reliable information on crops is required to improve agriculture management and face food security challenges. The work aims at experimenting different machine learning algorithms to identify major crops using time-series Sentinel-2 data covering the region of Jendouba, Tunisia. This chapter describes the workflow for automatic extraction of "semantic information" using a supervised classification approach, applied on a region characterized by a persistent cloud cover during the winter growing season. The results indicated that SVM outperforms the other classifiers,

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and the best accuracy was achieved using SVM on MSI spline temporal gap-filled with an overall accuracy of 0.89 and kappa 0.86, and that most of the classifiers are robust to noise caused by clouds coverage and handle the high dimensionality of input time-series except Bayes classifier. MSI time-series provides a slightly better results than NDVI time-series, and it appears relevant to consider spline temporal interpolation instead of linear temporal interpolation because of the continuous cloud coverage.

1. INTRODUCTION

Accurate crops identification will help to provide reliable food production, and helps the assessment of crops growth conditions as well as yield forecasting. Time-series satellite data offer a cost-effective resources support for agriculture monitoring, analyzing crops stages of evolutions and state, and estimating their extent (Matton et al., 2015). Our work aims at experimenting different machine learning algorithms on time-series Sentinel-2 data to provide crop maps over the region of Jendouba, which is located in the northwest of Tunisia. The impacts of information extraction techniques, input datasets, temporal interpolation, as well as clouds strategy handling has been experimented and assessed through this study.

Crop mapping is a challenging task especially in regions with heterogeneous cropping patterns. In fact, different crops grow in the same time and represent similar spatio-temporal signatures (Valero et al., 2016). The same crop type may present distinguished variations in signatures, according to different factors, namely the sewing dates, the soil type and slope, the irrigation schema (rainfed or irrigated),etc. Crops identification is more complex if we consider crop identification in the field at early stage. The lack of reliable timely-"ground-truth" data of known locations where specific crops grow and the presence of small and irregular parcels size are factors limiting the effectiveness of using satellite imagery(Valero et al., 2016).

Dynamic crop monitoring is being more complex if we take into consideration the agriculture practices and socio-economic behavior. In fact, inter and intra seasons variability made the crops area very dynamic. Also, the non-uniformity of the reflectance response and the crops calendar of the same crop type due to different agriculture practices make the task of crop identification using free satellite data more complex. For example, it has been noticed during the filed visits that the sewing date of wheat in the study area can vary in the same region from 15th December to 15th February and the harvesting date vary accordingly which makes the temporal profile of wheat far away of being unique.