Yearly land cover mapping between 1984 and 2018 in the Haouz plain (Marrakech, Morocco) using robust decision trees approaches.

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Land cover is a key information for landscape management or biophysical modelling

Problems with current classification approaches

- Ground data required for each year for training or validation
- Multiple cropping during the same year (more and more frequent due to intensification)

  => A yearly map is not enough

+ High complexity of land cover in the Mediterranean

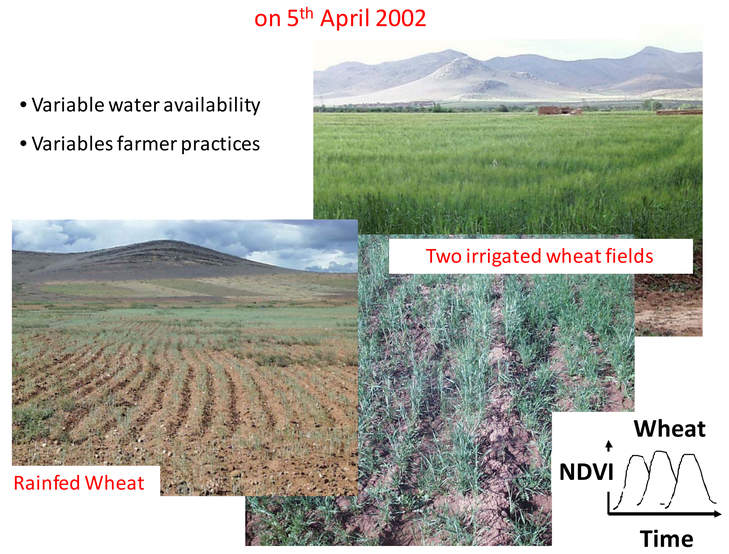
- Associated crops (e.g. trees with annuals understory)
- Heterogeneous development for a same crop due to variable farmer practices
- Low vegetation cover are frequent (e.g. tree crops, rainfed crops)

=> Objectives

- Designing methods adapted to land cover complexity (=> robustness)
- Methods no requiring recurring ground data

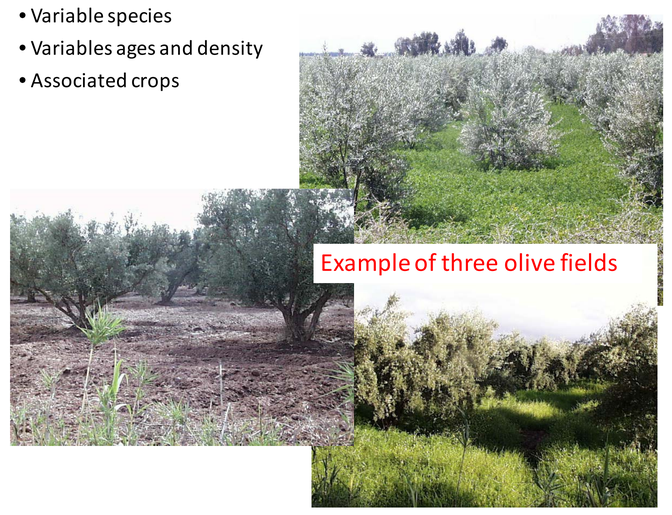
Examples of crop heterogeneity: wheat fields observed on 5th April 2002

- Variable water availability
- Variables farmer practices



Example of complex vegetation structure

- Variable species
- Variables ages and density
- Associated crops



Application to land cover dynamics mapping between 1984 and 2018

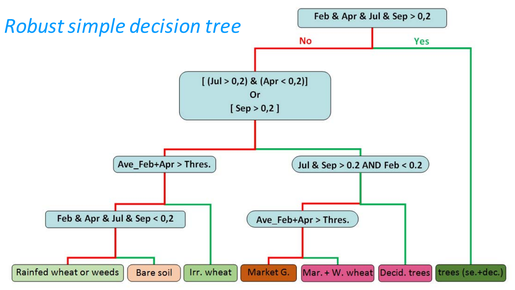
Landsat surface reflectance images were uploaded on the USGS site (Landsat 5+7+8 = **566** images => ~ 16 images / year, only SLC-on L7 were used).

A simple and robust decision tree was build based on four key dates each year (February, April, July, September). Only 5 years were discarded due to a lack of images because of clouds. The tree is only based on presence of absence of vegetation for each date and on a threshold to distinguish between irrigated annuals and rainfed winter annuals or weeds.

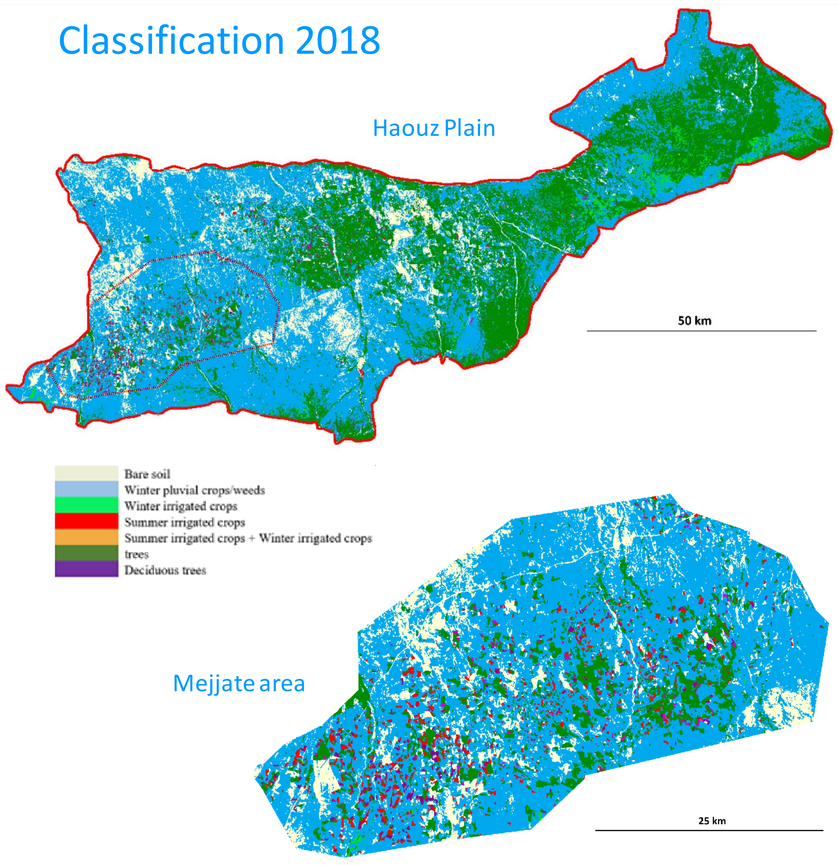
Discrimination between irrigated / rainfed annuals
Rainfed development is variable depending on the rainfall, it is thus necessary to adjust a threshold each year. To do this, areas were identified corresponding to stable rainfed and stable irrigated areas during the study period. These areas were used to sample the NDVI for both classes and define the threshold to separate them.

Validation
The validation was not achieved so far
It will be achieved using ground observations acquired each year since 2016 (~1600 plots observed)

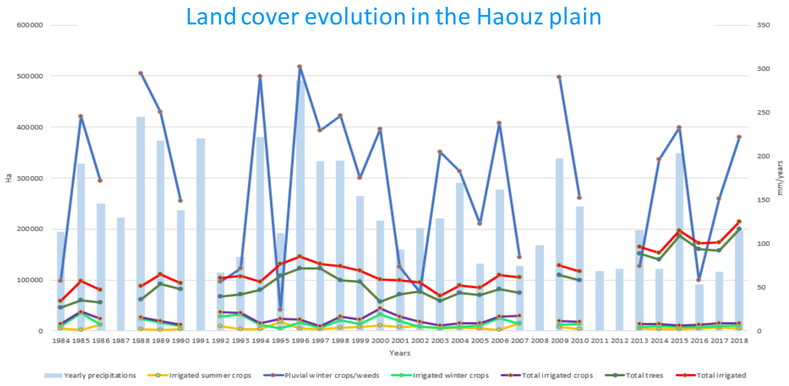
Robust simple decision tree



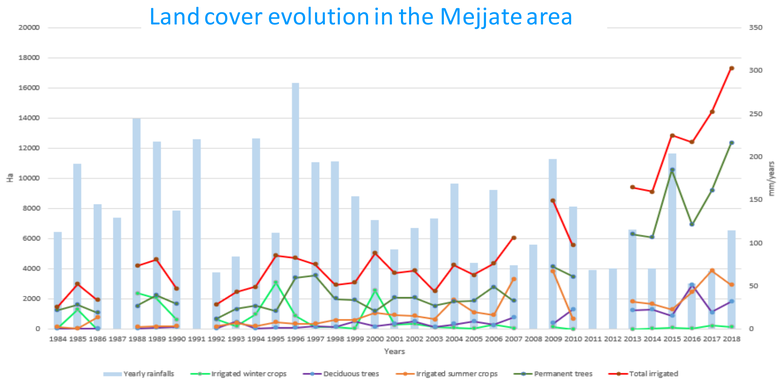
Classification 2018



Land cover evolution in the Haouz plain



Land cover evolution in the Mejjate area



Haouz plain scale
Although no validation was achieved so far, the changes show by classification are coherent with the knowledge of observed changes in this area.

- After a period of relative stability between 1984 and 2008, a strong increase of tree crops is observed since 2009 (x2 in ten years) at the expense of winter cereals.
- The rainfed areas are very variables and logically correlated to the cumulated rainfall in the oct-April period (blue bars)

Mejjate area scale

- A slow increase of tree crops is observed between 1984 and 2008, followed by a strong acceleration since that date (x 5 in ten years). The same phenomena is observed to a lesser extent for deciduous trees.
- Summer crops are appear since 1995, with an acceleration since 2003 at the expense of irrigated cereals.
- This later class disappear probably as an effect of aids brought for the conversion of this area to drip irrigation.

Methodological observations

Trees growth between 1994 and 1999 is a artefact due to abundant rainfall during this period which induced the presence of vegetation event in September in some plots. This problem illustrates the limitations of a generic approach in a highly variable precipitation context. However despite this problem, the graphs show that getting 30 years of land cover (instead of 2 to 4 in many change studies) improves the reliability of the trends observed by smoothing the interannual variability due to errors (dates used, radiometric corrections, climatic conditions,…)

Perspectives

- Validation of results
- Computing the irrigation consumption for each year

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http://www.lmi-trema.ma