

An Enhanced Yield Potential Spatial Clustering Method, accounting for Seasonality, Heterogeneous Morphology and Climate Variability. An application in the Umbria Region (Central Italy) for the SMARTAGRI PROJECT



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Introduction

State of the Art

Homogeneous management of heterogeneous fields:

- Inefficiencies and environmental risks (e.g. use excess of resources; N leaching)

Use of clustering:

- recognize spatial patterns in crop fields
- identify of homogeneous zones for management (e.g. fertility)
- understand causes of spatial and temporal variability in crop yields
- bulk clustering incorporates contrasting & confounding factors

Vegetation responds to weather and soil conditions

- seasonal climatic conditions may improve our understanding of spatio-temporal yield patterns

Objectives

The SMARTAGRI platform is created based on a Regional Development Plan of the Umbria region in order to assist farmers in the agricultural management practices

This research project aims at:

- improving clustering method by accounting for crop seasonality, climatic variability, heterogeneous morphology for applications in the context of the SMARTAGRI platform

Data Set Description

Study area:

- Farms in hilly area (Umbria region), Central Italy
- Vector files of agricultural fields

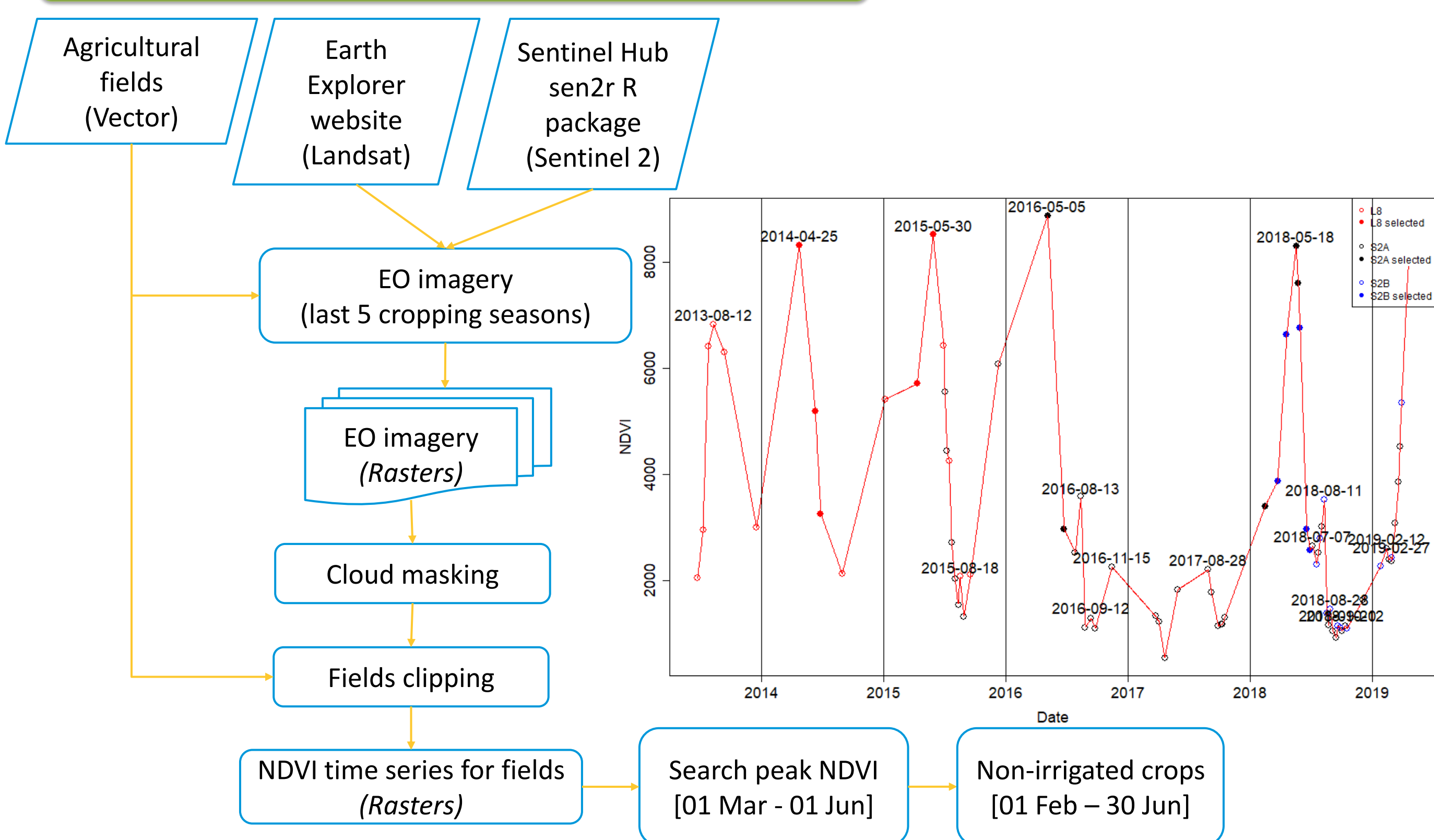
Imagery (5 years EO)

- Landsat8-8 : 30m resolution, 10 days frequency, 2013-2015
- Sentinel-2 : 10m resolution, 5 days frequency, 2015-2019

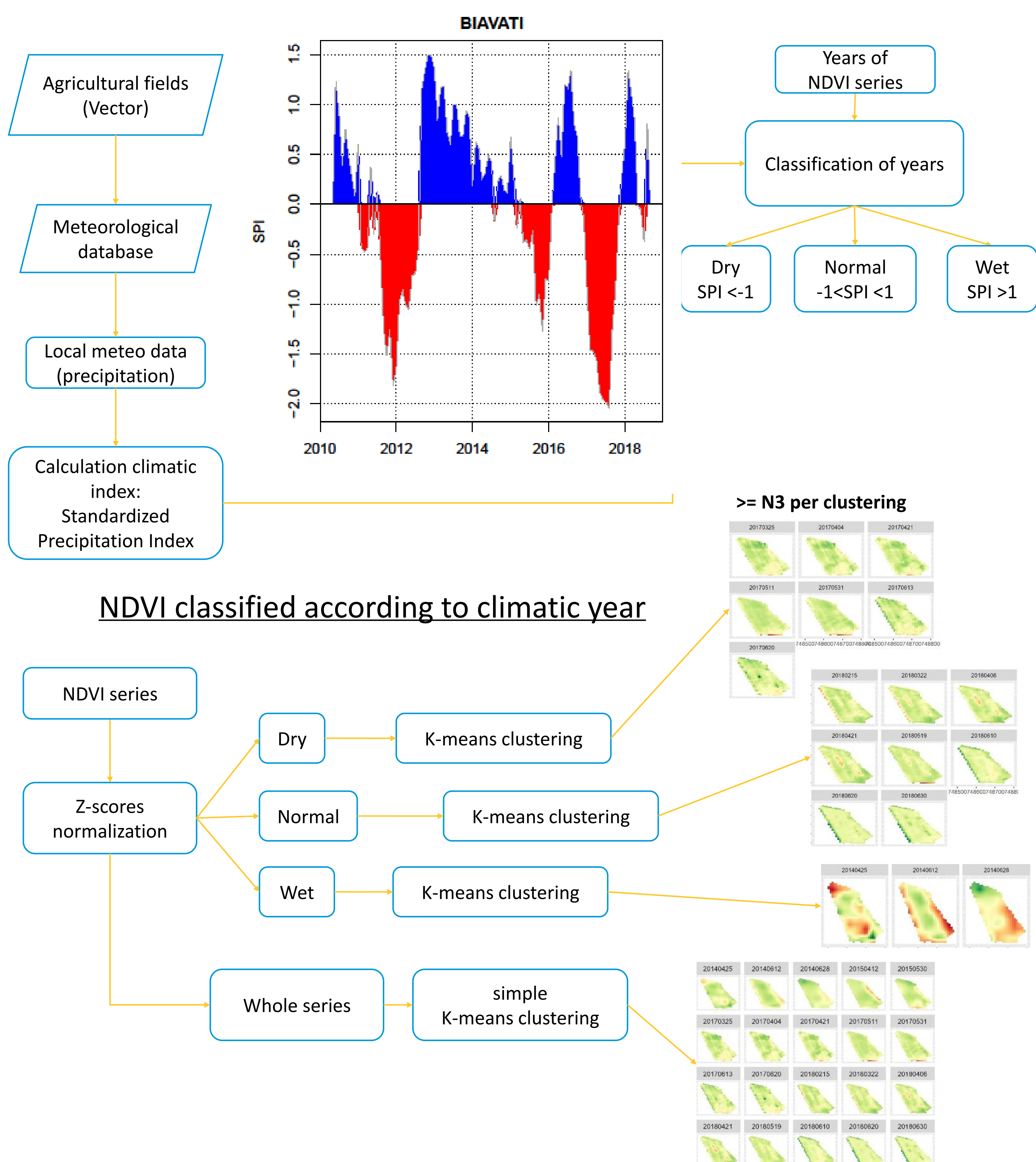
Meteorological data:

- Daily precipitation, 2013-2019

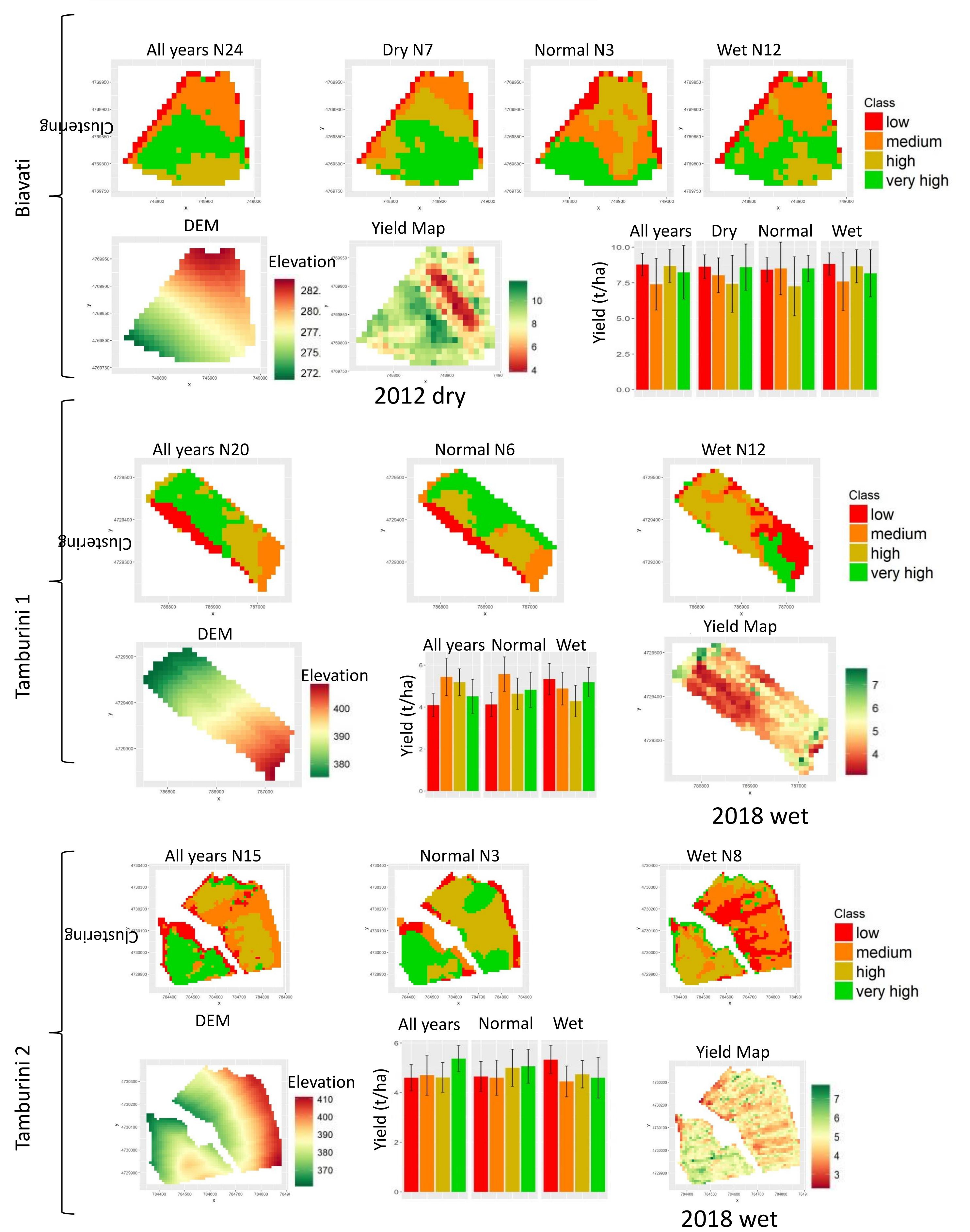
Data Pre-treatment



Methods



Results



Discussion

- Clustering results clearly differentiate seasonality-based from bulk clustering
- Both clustering methods in some cases failed to correctly classify high/low yielding field areas.

Pros

- Considering separate years improved understanding of spatio-temporal variability and identification of different yield areas in some cases.

Cons

- Need larger number of images from different climatic years for sound classification
- Sentinel-2 time series was too short (<5 years) so it was intergrated with Landsat (30 m)
- Wrong classification of climatic years risks to increase the error in respect to bulk clustering

Future works

- Include topography in the clustering
- Identify climatic indexes suitable to better represent interannual crop response to climate (e.g. SPEI)
- Use longer and more homogeneous S2 time series
- Consider multitemporal yield maps and soil properties maps for validation
- Possibly select images based on proxy of phenological stage
- Often clusters near borders (mixed pixels) → remove edge pixels

Acknowledgements

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