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Sentinel-1 and 2 data fusion for land management and disaster risk assessment

Fabio Cian[1]; J. Manuel Delgado[2,3,5]; Mattia Marconcini[4]; Giancarlo Rivolta[2,3]; Carlo Giupponi[1]

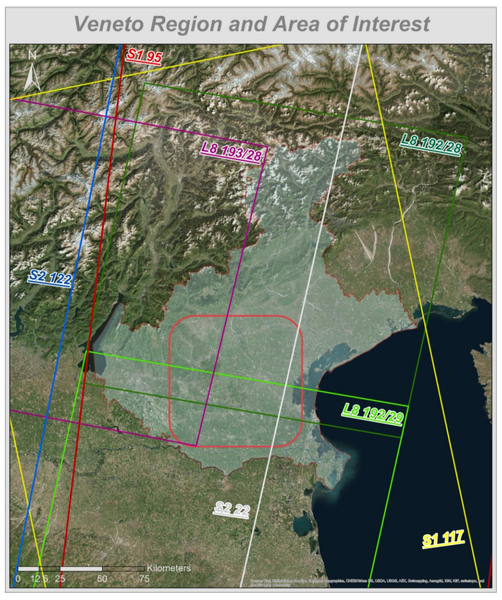
[1]Department of Economics, Ca' Foscari University of Venice, Venice, Italy
[2]Progressive Systems Srl, Parco Scientifico di Tor Vergata, Rome, Italy
[3]European Space Agency Research and Service Support, ESA-ESRIN, Frascati, Italy
[4]German Aerospace Center, Weßling, Germany
[5]Grupo de investigación Microgeodesia Jaén, Universidad de Jaén, Jaén, Spain

In an era of **global changes**, where Earth's biosphere is threatened by human activities, temperature rise, **extreme events** such as flash and riverine **floods**, there's a need to monitor **biodiversity**, the effect of policies enforced to control human effects on land use and to understand what is at stake when a disaster occurs.
With these motivations, this work is pursuing the derivation of new **land cover maps** and indicators of exposure and vulnerability. The use of the new **Sentinel-1 and 2 data** allow for an increased accuracy and a possibility to update the maps more frequently. Different datasets have been considered to assess the usefulness of data fusion.
The area analysed is the **Veneto region**, North-Eastern Italy, affected by several flood events in the recent years and that experienced extensive changes in its land cover/land use in the recent decades.

Study Area

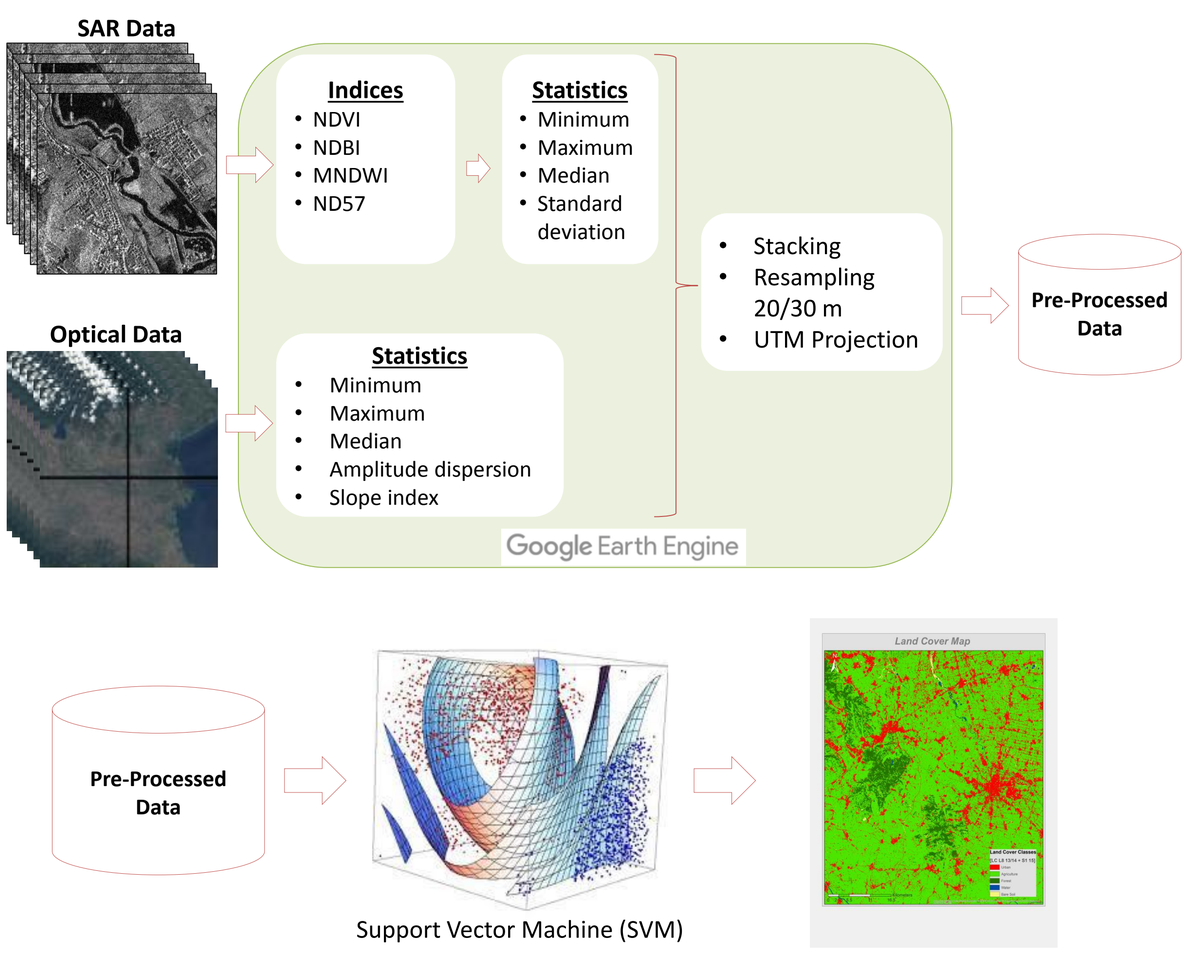
The Veneto region experienced several floods in recent years, which caused billions of euros in damages. The land use of the region has changed due to changes in agricultural practices and policies enforcement for biodiversity regulation.
Local authorities are demanding improved land cover maps. A detailed land use map of 2012 produced by the Veneto Region has been used as ground truth together with photo interpretation. The image shows the coverage of the classification.

Veneto Region and Area of Interest



Methodology

Data have been pre-processed in Google Earth Engine where indices and statistics for each index have been computed for time-series of Landsat 8, Sentinel-2 and Sentinel-1. PKTools Support Vector Machine has been used for classification.



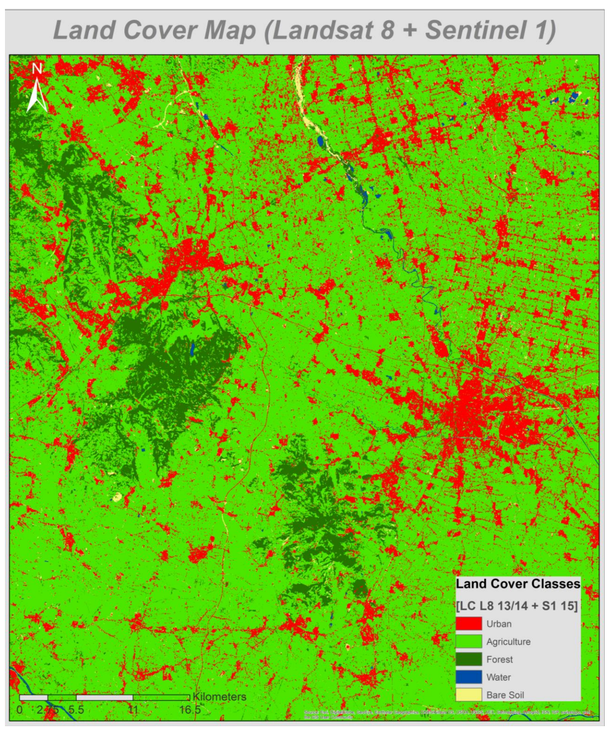
Results

5 land cover classes have been considered: urban, agriculture, forest, water and bare soil.
The highest accuracy has been obtained using the fusion of **Landsat-8** and **Sentinel-1**: 93% overall accuracy, K = 0.9.
The fusion of **Sentinel-2** and **Sentinel-1** gave slightly lower accuracy: 89% overall accuracy, K=0.86.
The use of only optical images gave worse results:

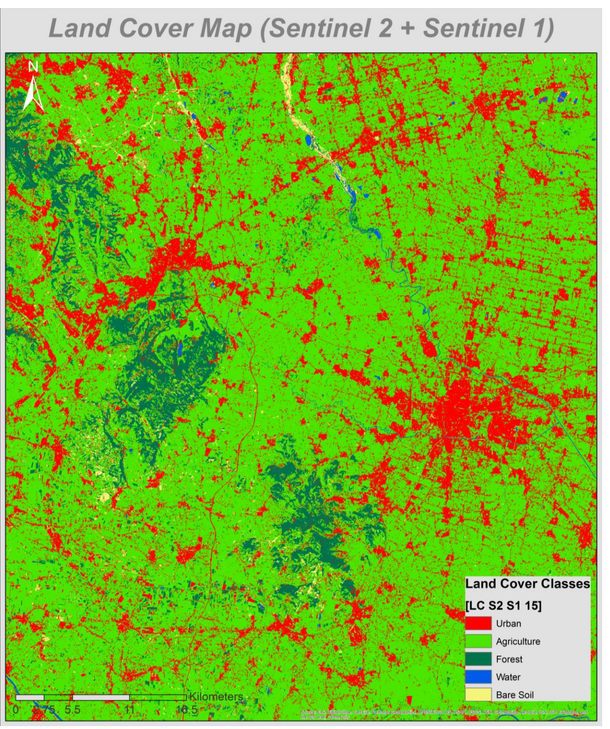
- **Landsat-8**: 91% overall accuracy, K = 0.88
- **Sentinel-2**: 88% overall accuracy, K = 0.84

Validation has been performed selecting random points from photointerpretation and by comparison with the Land Use map provided by Veneto Region.

Land Cover Map (Landsat 8 + Sentinel 1)



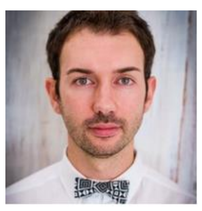
Land Cover Map (Sentinel 2 + Sentinel 1)



Conclusions

The methodology has been proven to be **fast** (thanks to the capability of the GEE and the PKTools-SVM), **reliable** (good performances with different datasets) and **accurate**. Data fusion has increased the accuracy of the results. Worse performance have been obtained using Sentinel-2 data, only because the satellite has been operative for less than a year (no acquisition on the overall phenological cycle). Most of the inaccuracy occurred over agricultural areas classified as urban or forest, forested areas classified as agriculture or urban, and bare soil classified as urban. A time-series over the whole year will improve the classification.
In the next steps, more classes will be added in the classification and thanks to the availability in the GEE, a multi-temporal analysis of LC will be performed in order to derive useful information for land and disaster management.

Contacts



Fabio Cian
fabio.cian@unive.it

J. Manuel Delgado
josemanuel.delgadoblasco@esa.int