

From theory to practice, remote sensing as an interdisciplinary path

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Abstract

Remote sensing is a multidisciplinary approach to the study of terrestrial physical parameters collected remotely. This technique applied to vegetation has been used by us to create maps of the state of vegetation health and land use. The presented work will focus on data collected at the Giumello Alp from which we have derived a land use map. The subject was introduced by theory lessons in physics, biology, cartography, geography, computer science, environmental science and statistics.

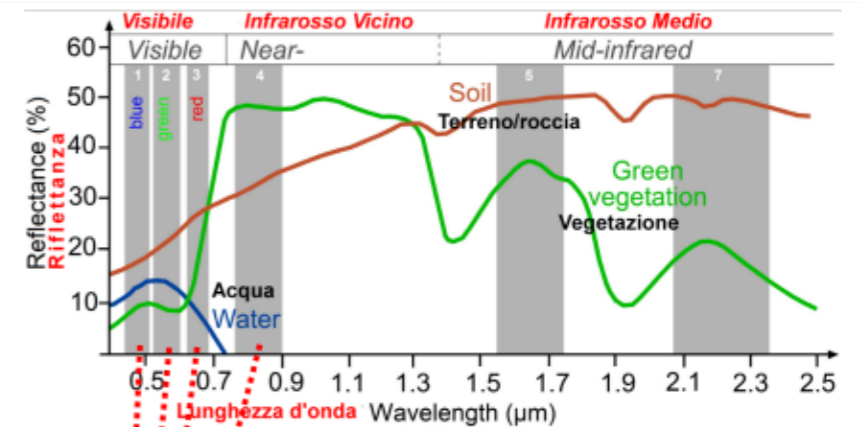
Materials and methods

In this course of learning and development of digital skills and STEM disciplines (bam_pi.AOODGEFID.REGISTRO UFFICIALE(U).0020769.21-06-2019) we made use of the following tools (computer and non-computer) to survey the territory and vegetation of the site:

1. Gaia GPS
2. Topographic maps
3. Satellite images downloaded from EO Server
4. QGIS (3.16 Hannover)

In the field, using Gaia gps, geographical coordinates were collected and the georeferenced positions of the main vegetation classes observed were recorded. After downloading the topographic maps (ctr 1: 10000) of the Giumello area from the Lombardy regional geoportal (site), we used the EO BROWSER to obtain multispectral satellite images (Copernicus Sentinel 2), with a spatial resolution on the ground of 20 metres. The images from the 12 acquisition channels of the Sentinel satellite are used in the classification process. The 12 images are pre-processed in order to obtain a true colour image. Homogeneous areas within which there are pixels that presumably correspond to the same type of information (because they are of the same colour) are defined manually. A macroclass and a name are assigned to these delimited areas. A colour is associated with each macroclass. Finally, the programme (in our case QGIS using a maximum likelihood algorithm) will provide a classified image where each pixel corresponds to a land use class. To monitor the health of the vegetation, the blue, red, green and near-infrared bands are used. This choice derives from their correspondence with the wavelengths in which vegetation provides a characteristic response as a result of photosynthesis.

False-colour images in which the software allows the visualisation of wavelengths that are not perceptible to the human eye (such as near infrared - NIR).



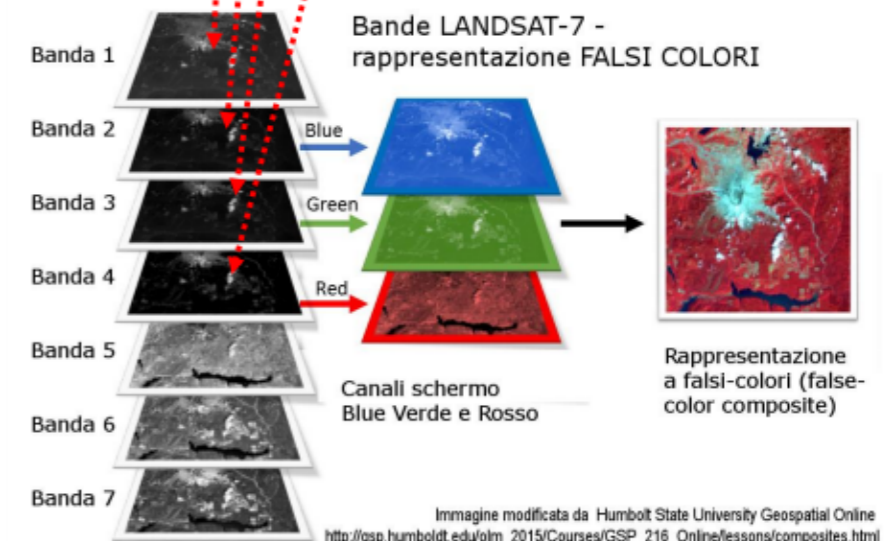
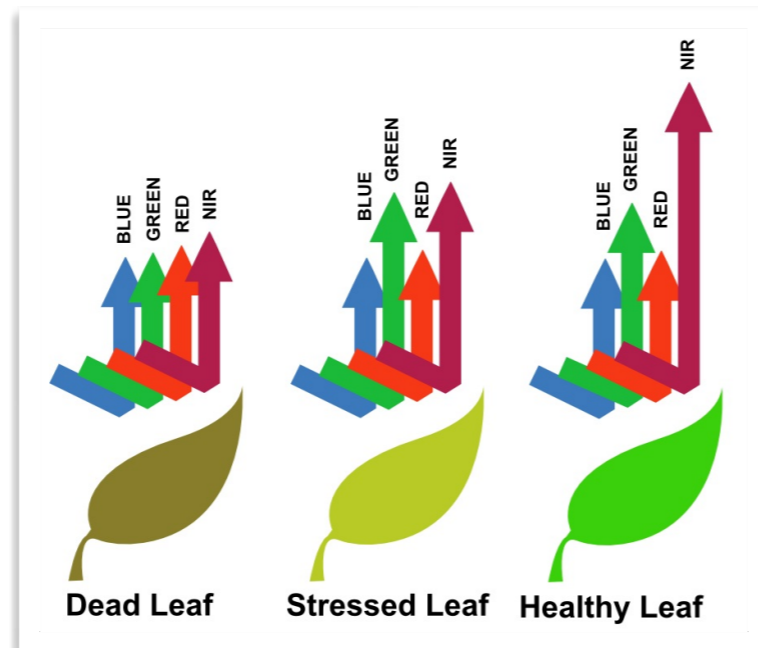
- NDVI (Normalized Difference Vegetation Index) is a parameter for identifying vegetation vigor



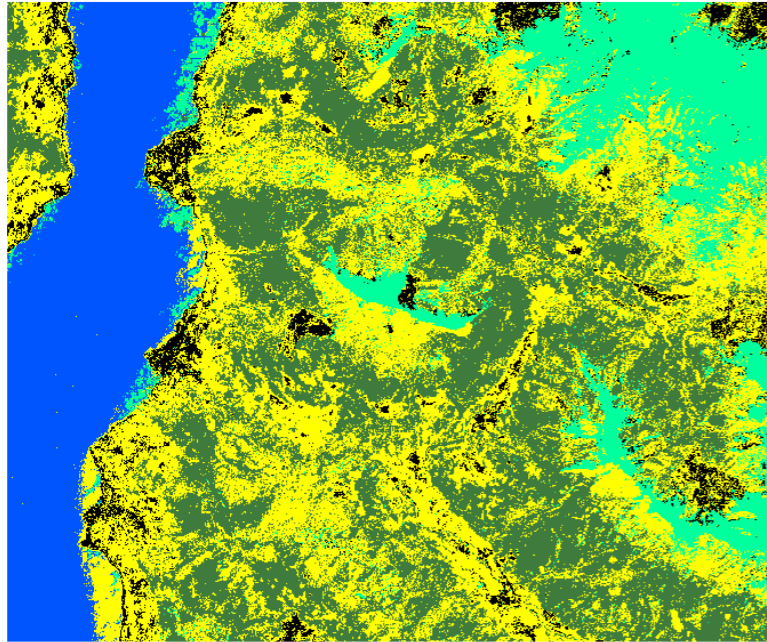
QGIS Logo



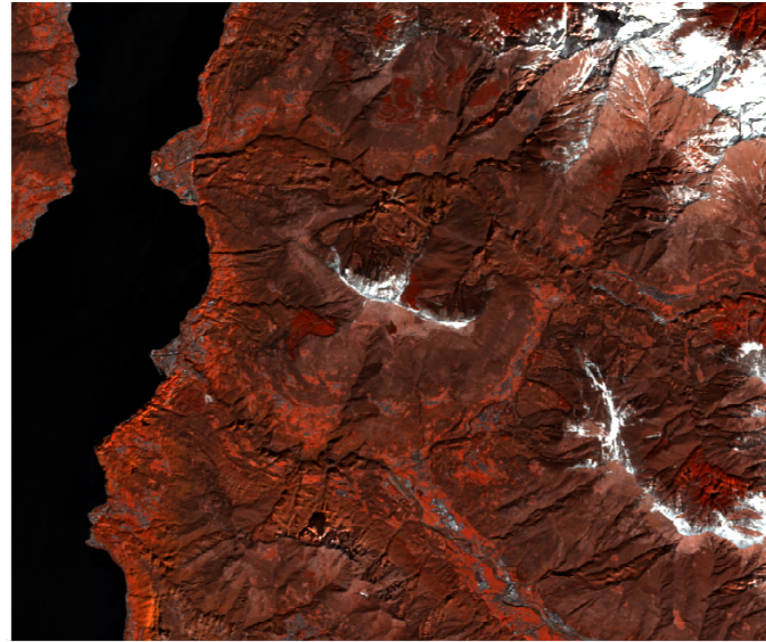
Gaia GPS Logo



Results

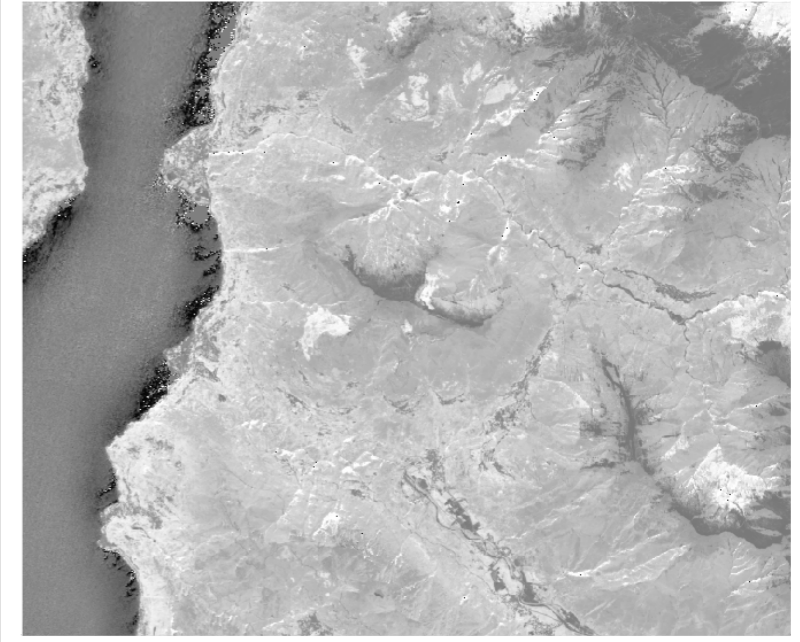


SOIL USE MAP of the Giumello area: the macro classes used are water, urban, lush vegetation, barren vegetation...



FALSE COLOUR IMAGES:

The composition used is NRG, which displays in red the NIR, in green the red and in blue the green. This allowed us to understand the state of health of the vegetation: light and bright red corresponds to a very good state of health, while burgundy indicates a worse state of health.



NDVI IMAGE:

The index visualised in a grayscale image allowed us to analyse the vigour of the vegetation: darker pixels, i.e. low NDVI, correspond to areas with poor or suffering vegetation and vice versa.

MC ID	C ID	Name	Type	Color
- 1		ACQUA		
<input checked="" type="checkbox"/>	1 1	C 1	R&S	Blue
<input checked="" type="checkbox"/>	1 2	C 2	R&S	Green
<input checked="" type="checkbox"/>	1 3	C 3	R&S	Yellow
- 2		VEGETAZI...		
<input checked="" type="checkbox"/>	2 4	C 1	R&S	Red
<input checked="" type="checkbox"/>	2 5	C 2	R&S	Green
<input checked="" type="checkbox"/>	2 6	C 3	R&S	Blue
- 3		NEVE		
<input checked="" type="checkbox"/>	3 7	C 1	R&S	White
<input checked="" type="checkbox"/>	3 8	C 2	R&S	Black
<input checked="" type="checkbox"/>	3 9	C 3	R&S	Grey
- 4		VEGETAZI...		
<input checked="" type="checkbox"/>	4 10	C 1	R&S	Light Green
<input checked="" type="checkbox"/>	4 11	C 2	R&S	Light Blue
<input checked="" type="checkbox"/>	4 12	C 3	R&S	Light Yellow
- 5		URBANA		
<input checked="" type="checkbox"/>	5 13	C 1	R&S	Black
<input checked="" type="checkbox"/>	5 14	C 2	R&S	Red
<input checked="" type="checkbox"/>	5 15	C 3	R&S	Yellow

Conclusions

The results presented show 3 different ways of visualising the vegetation health of the same territory, mapped on the same day, using remote sensing data and open source software. The images obtained can have different purposes and can therefore be used for different purposes: the land use map is a basis for land use planning, false-colour images can be used for early assessment of possible environmental risks, NDVI images can be used for crop yield forecasting and/or for forecasting models related to carbon uptake and, therefore, climate change. Through this project, we have therefore acquired transversal skills, going on to apply the notions we have learnt in a practical context, sharpening our skills of coordination and collaboration.

Sitography:

- <https://www.gaiagps.com/>
- <https://www.qgis.org/it/site/>
- http://www.acutis.it/SC_erbacei/06_01_firma_vegetazione.pdf
- http://gsp.humboldt.edu/olm/Courses/GSP_216/lessons/composites.html
- <https://physicsopenlab.org/2017/01/30/indice-ndvi/>
- <https://www.geoportale.regione.lombardia.it/download-ctr>