

PASCOL-ANDO

Gestione sostenibile dei pascoli

Attività di informazione e dimostrazione in Alpe Andossi



Rilievi da remoto sul pascolo

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Drone

- SAPR (sistema aeromobile a pilotaggio remoto) o DRONE:
 - Ottacottero coassiale in fibra di carbonio
 - Massimo peso al decollo 12kg
 - GNSS (Global Navigation Satellite System) NEO-M8N
 - Piattaforma Gimbal



Costruttore e operatore: Antonio Vigoni*
*Sport Turf Consulting, Via Cesare Battisti 19, 20027
RESCALDINA (MI)

Sensori multispettrali

1. Sony α 6000



24.3 MP: immagine 3 bande, 8 bit per banda, JPEG file



2. MICASENSE Red-Edge



1.2 MP: 5 immagini 12-bit, TIFF files non compressi

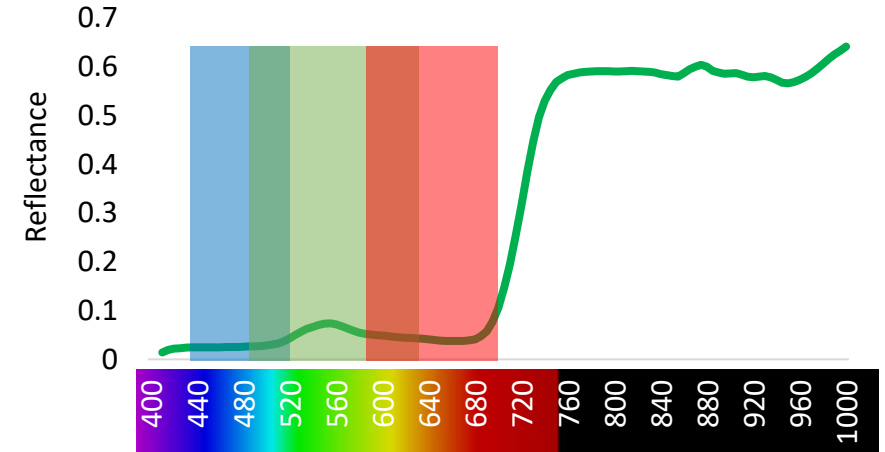


Firma spettrale della vegetazione

1. Sony α 6000



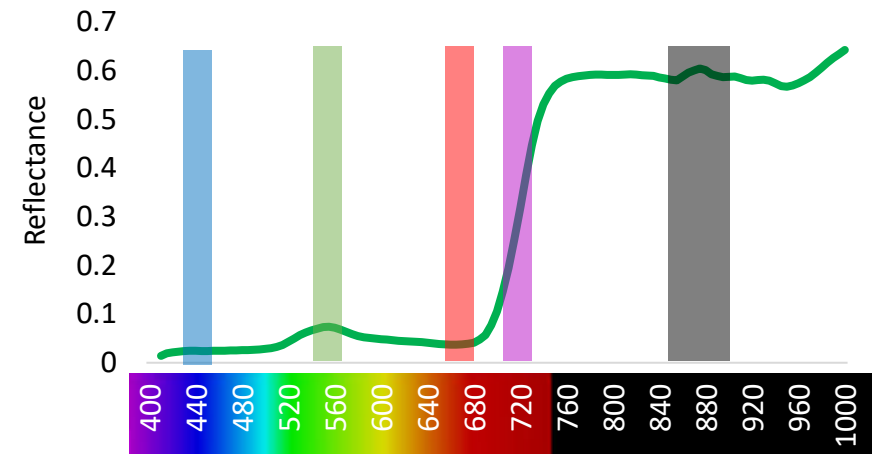
Bande larghe e sovrapposte



2. MICA-SENSE Red-Edge

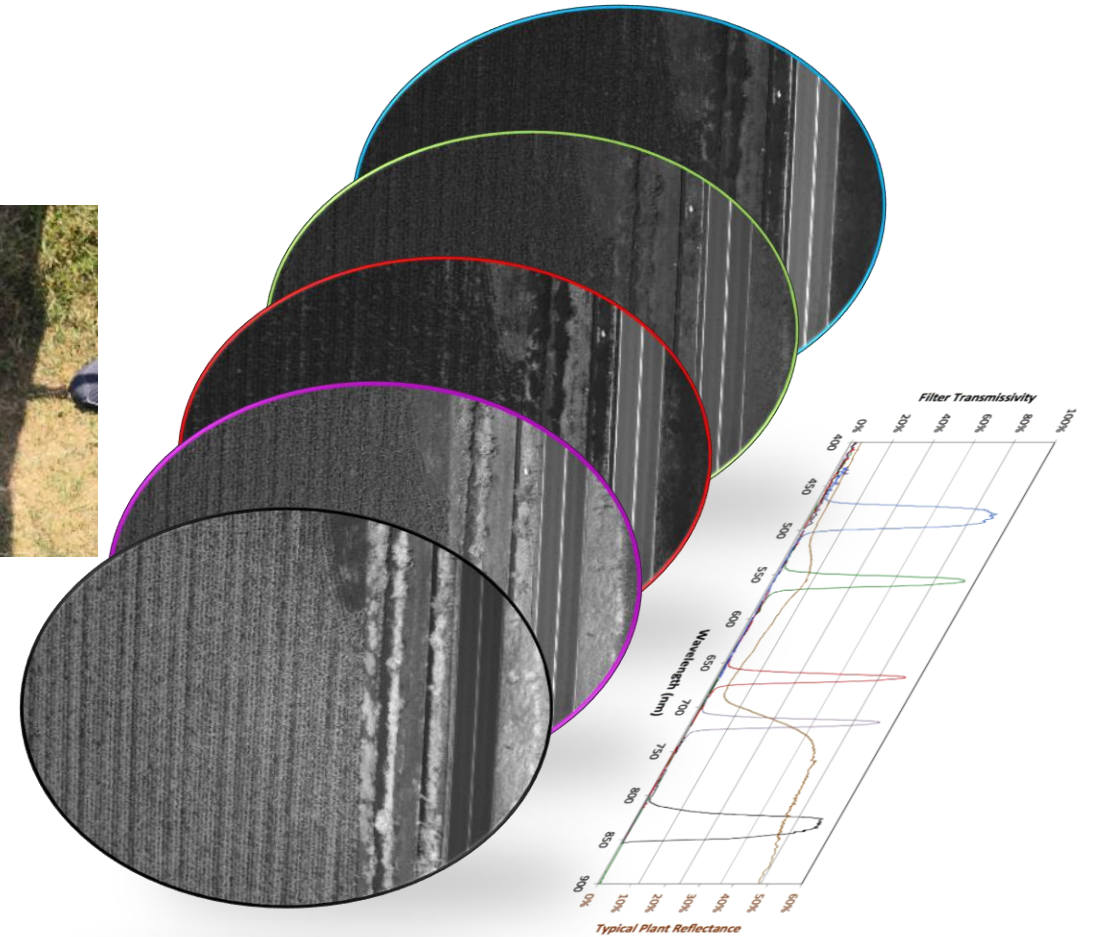


Bande strette e separate



Micasense Red-Edge

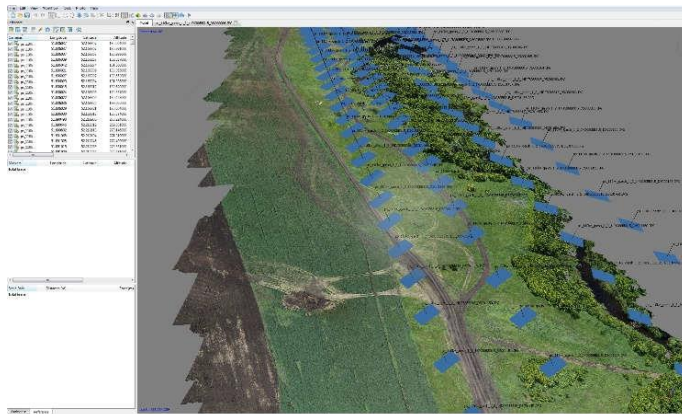
- Blu = 475 ± 20 nm
- Verde = 560 ± 20 nm
- Rosso = 668 ± 10 nm
- Red-Edge = 717 ± 10 nm
- NIR = 840 ± 40 nm



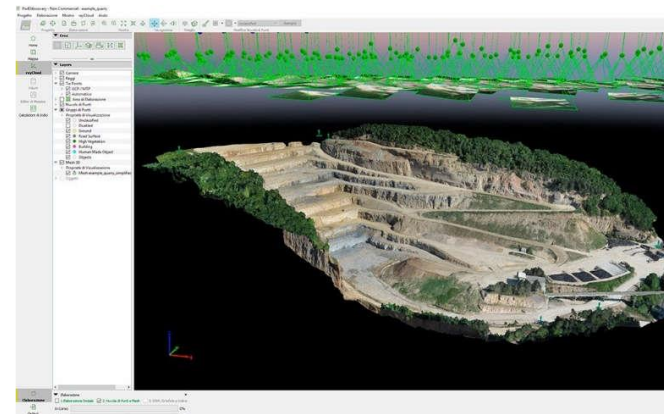
Mosaicatura

- Le immagini grezze geotaggate devono essere unite in un'unica ortofoto per effettuare le successive elaborazioni per lo studio della coltura
- Operazione che richiede software dedicati, ad esempio:

AgiSoft PhotoScan (Metashape)

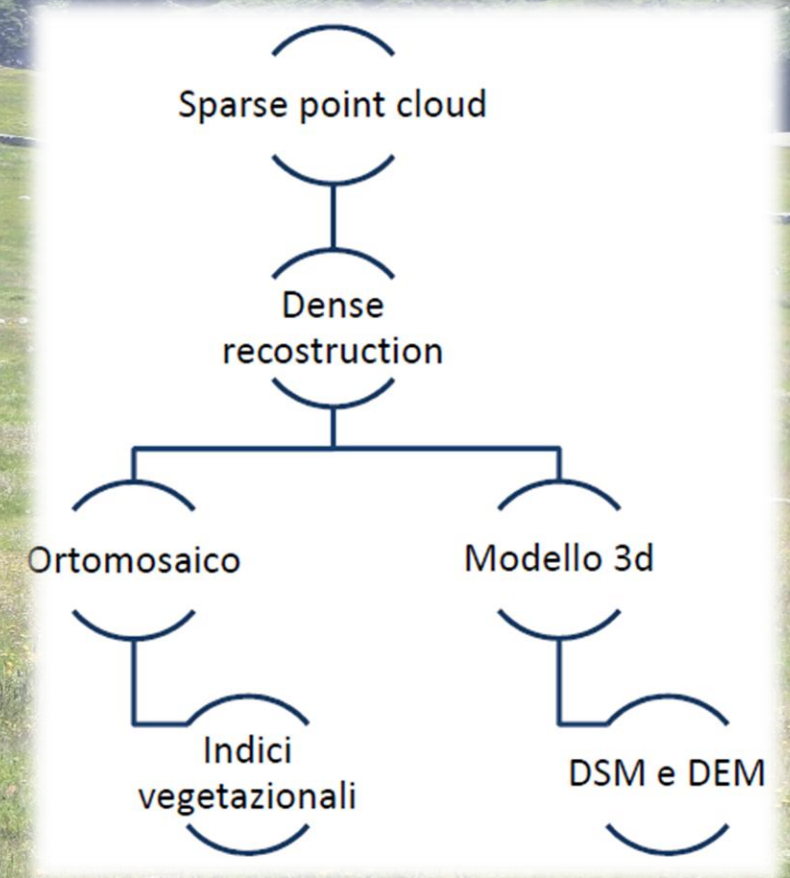


Pix4D



Mosaicatura

- I software utilizzano procedure di matching
- Partendo dai GCP (georeferenziati a terra) o dai punti chiave (elaborati dal software) viene ricostruita la posizione di scatto delle singole foto che permette di ricavare da ogni punto le coordinate reali x, y, z (sparse points cloud).
- Poi la nuvola di punti a bassa densità viene infittita aumentando il numero di punti (dense reconstruction).
- Da qui una proiezione ortogonale dei punti porta al mosaico



Rilievo con RGB Sony

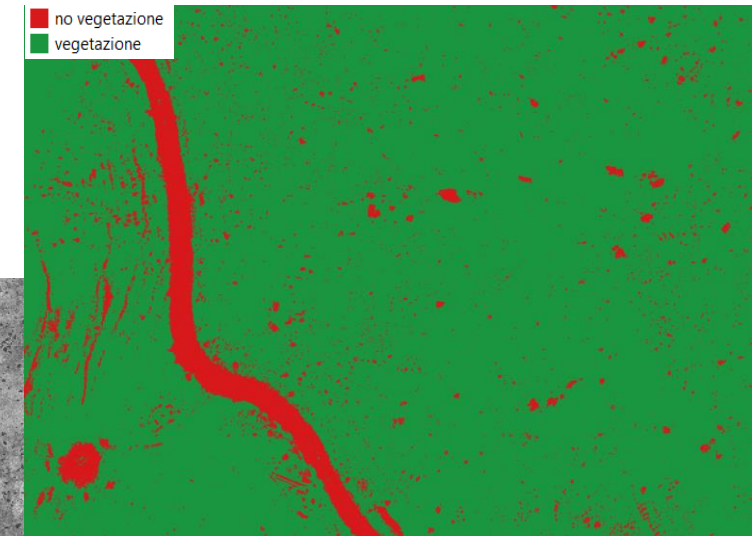


3 bande: Blu, verde e rosso, correzione di gamma,
Compressione a 8 bit
Dimensione pixel: 1.5cm

Excess Green Index (ExGI)

Sogliatura per evidenziare solo la vegetazione

$$\text{ExGI} = 2G - (B + R)$$



Classe	Superficie (ha)
Vegetazione	0.71
No vegetazione	0.07
Totale	0.78

GLA Index (Green Leaf Area Index) $_{GLAI} = \frac{(G-R)+(G-B)}{(G+R)+(G+B)}$

Sony



GLA Index

$$GLAI = \frac{(G-R)+(G-B)}{(G+R)+(G+B)}$$

Micasense



Rilievo con Micasense



**5 bande: Blu, verde, rosso, red-edge e NIR,
Codifica a 12 bit
Dimensione pixel: 4 cm**

Immagine RGB ricostruita

Rilievo con Micasense

EXIF metadata

Exif Byte Order : Little-endian (Intel, II)
Subfile Type : Full-resolution image
Image Width : 1280
Image Height : 960
Bits Per Sample : 16
Compression : Uncompressed
Photometric Interpretation : BlackZero
Make : MicaSense
Camera Model Name : RedEdge
Strip Offsets : (Binary data 70 bytes, use -b option to extract)
Orientation : Horizontal (normal)
Samples Per Pixel : 1
Rows Per Strip : 100
Strip Byte Counts : (Binary data 69 bytes, use -b option to extract)
Planar Configuration : Chunky
Software : v5.1.12
Modify Date : 2020-07-28 13:06:30
XMP Toolkit : XMP Core 4.4.0
About : Pix4D Camera Information
Rig Name : RedEdge
Band Name : Red
Central Wavelength : 668
Wavelength FWHM : 10
Model Type : perspective
Principal Point : 2.44071, 76709
Perspective Focal Length : 5.449641562500001
Perspective Focal Length Units : mm
Perspective Distortion : -0.1011638, 0.164191, -0.04861149, 0.0008497040000000005, 0.0004671713
Vignetting Center : 819.2663, 530.23879999999997
Vignetting Polynomial : -1.392372e-05, -6.605020999999999e-07, 3.05677e-09, -7.8039130000000001e-12, 8.8436999999999997e-15, -3.663779e-18
Band Sensitivity : 0.147150492427844
Rig Relatives : -0.204186, -0.037809, -0.184471
Rig Camera Index : 2
Irradiance Exposure Time : 0.10100000351667404
Irradiance Gain : 16
Irradiance : 1.1710067987442017
Irradiance Yaw : -38.50000964099582
Irradiance Pitch : 3.8475333957888114
Irradiance Roll : -16.506231612926607
Boot Timestamp : 844
Radiometric Calibration : 0.0002587059999999999, 9.2783700000000003e-08, 2.78874e-05
Flight Id : hUky3a016MUW7P67U
Capture Id : mthEYzE6fRj6aPKK
Trigger Method : 4
Pressure Alt : 1829.33830078125
Dark Row Value : 5186, 5206, 5234, 5211
Serial : DL03-1711072-SC
Sw Version : v1.0.1
Sensor Id : 2
Center Wavelength : 668
Bandwidth : 10
Time Stamp : 846238
Exposure : 0.10100000351667404
Gain : 16
Spectral Irradiance : 1.1710067987442017
Raw Measurement : 1164
Off Measurement : 4144
Yaw : -0.67195193028493705
Pitch : 0.067152125836952889
Roll : -0.2953940575052087
Exposure Time : 1/663
F Number : 2.8
Exposure Program : Program AE
ISO Speed : 200
Exif Version : 0230
Date/Time Original : 2020-07-28 13:06:30
Create Date : 2020-07-28 13:06:30
Metering Mode : Average
Focal Length : 5.5 mm
Sub Sec Time : 800224724
Focal Plane X Resolution : 266.66667
Focal Plane Y Resolution : 266.66667
Focal Plane Resolution Unit : mm
Serial Number : 1533018
GPS Version ID : 2.2.0.0
GPS Latitude Ref : North
GPS Longitude Ref : East
GPS Altitude Ref : Above Sea Level
GPS Dilution Of Precision : 0
Black Level Repeat Dim : 2.2
Black Level : 4800 4800 4800 4800
Opcode List 3 : [opcode 48739], [opcode 41327]
Aperture : 2.8
Image Size : 1280x960
Megapixels : 1.2
Scale Factor To 35 mm Equivalent: 7.2
Shutter Speed : 1/663
Modify Date : 2020-07-28 13:06:30.800224724
GPS Altitude : 2000.2 m Above Sea Level
GPS Latitude : 46 deg 27' 43.85" N
GPS Longitude : 9 deg 20' 59.56" E
Circle Of Confusion : 0.004 mm
Field Of View : 48.8 deg
Focal Length : 5.5 mm (35 mm equivalent: 39.7 mm)
GPS Position : 46 deg 27' 43.85" N, 9 deg 20' 59.56" E
Hyperfocal Distance : 2.59 m



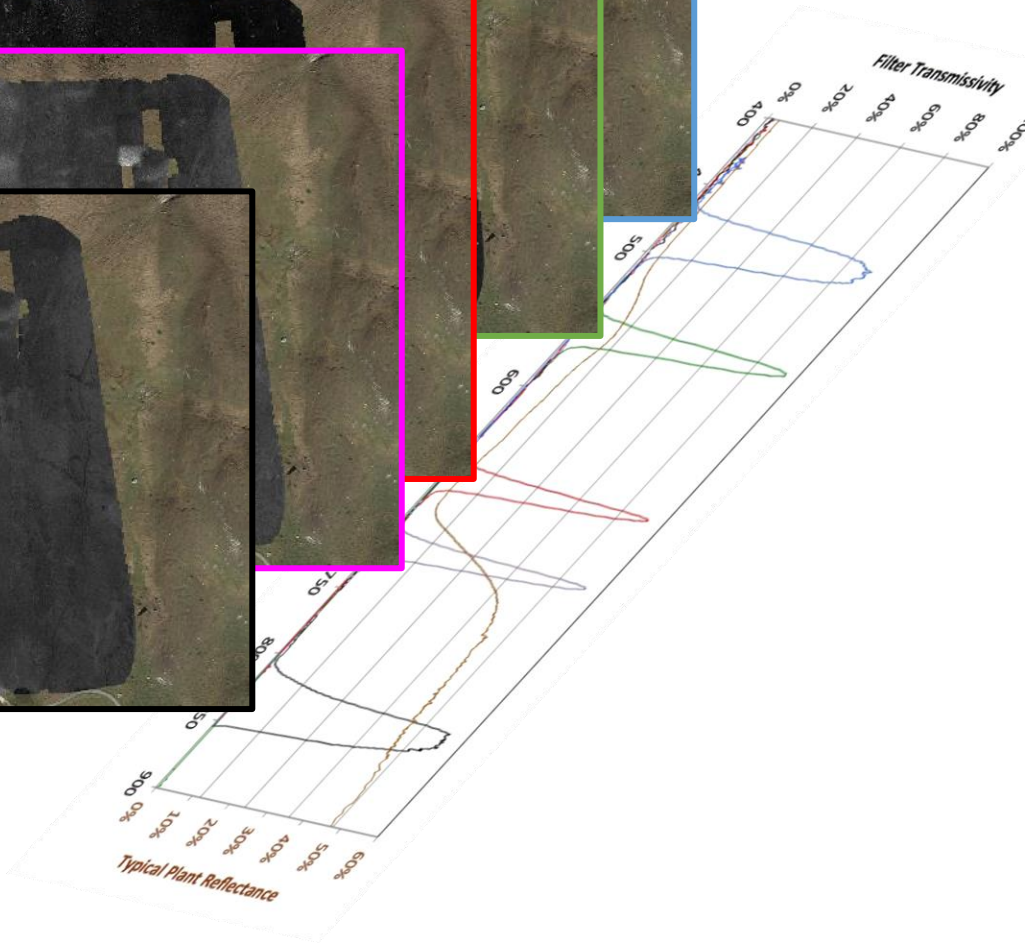
Downwelling Irradiance Sensor



Pannello a riflettanza nota

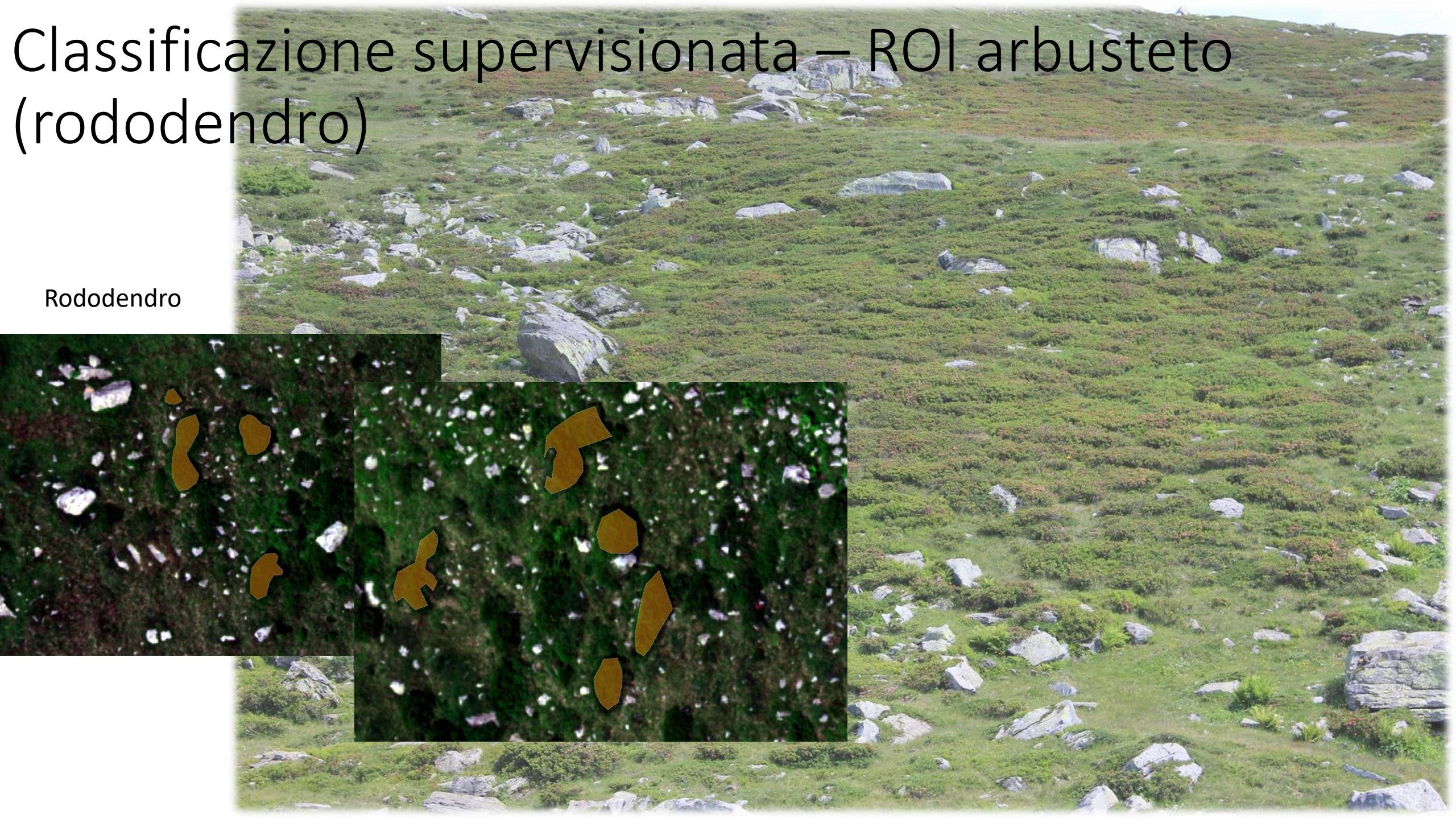


Ortofoto delle riflettanze



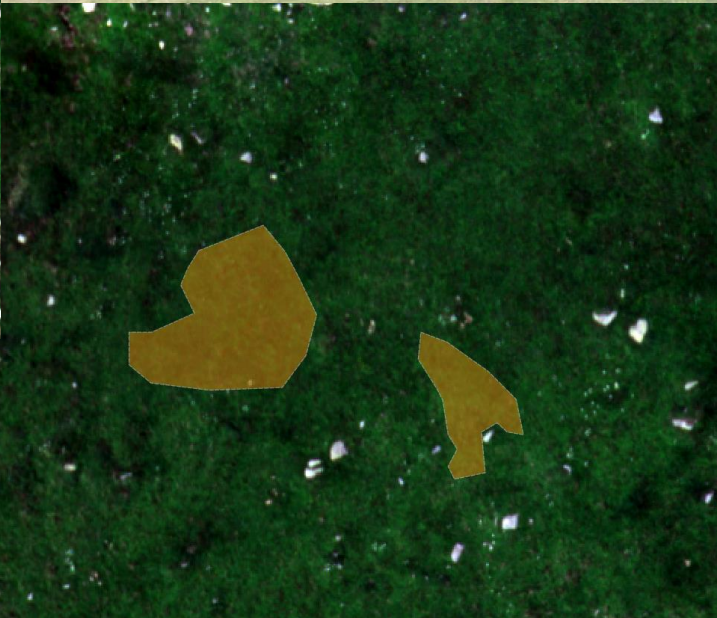
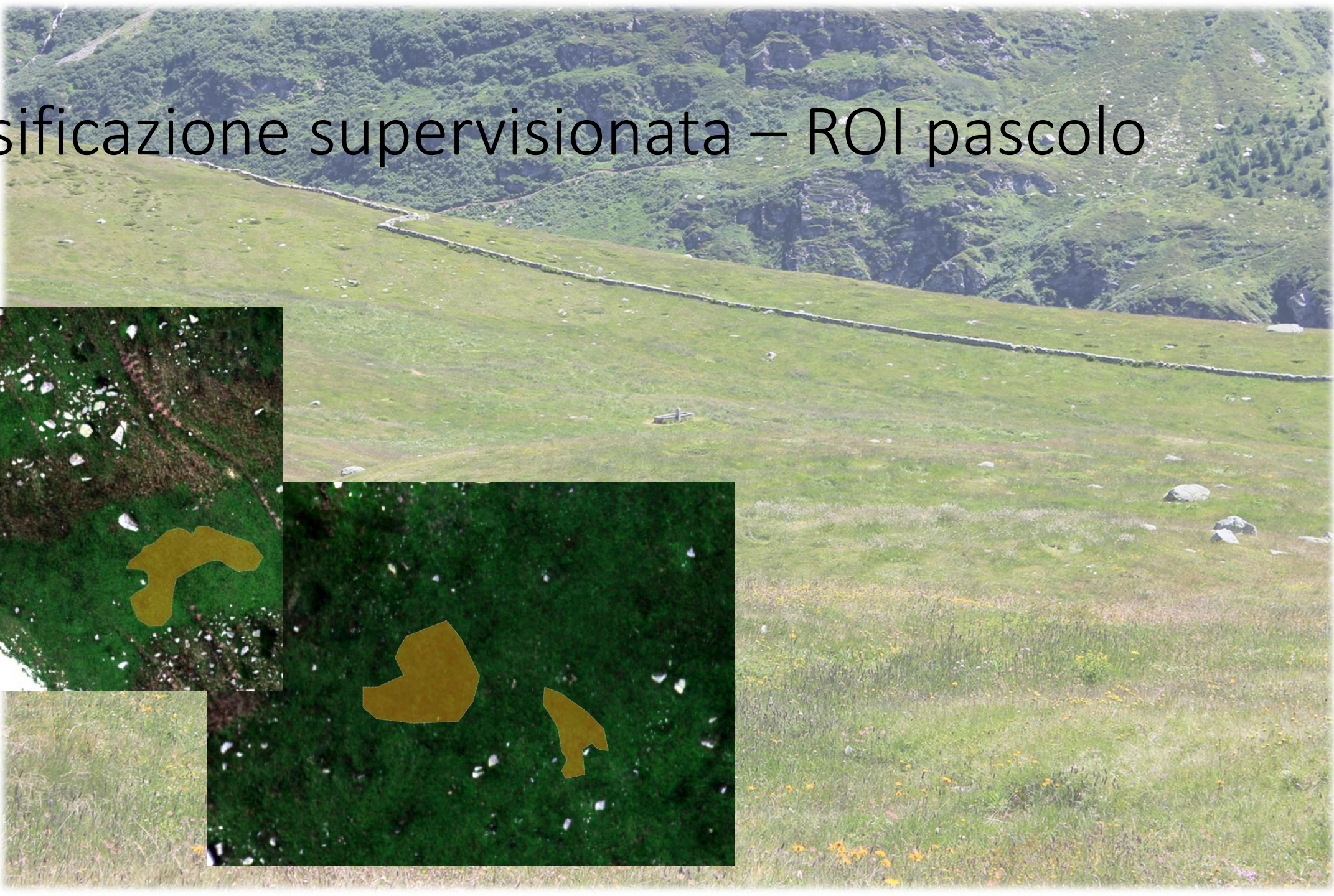
Classificazione supervisionata – ROI arbusteto (rododendro)

Rododendro

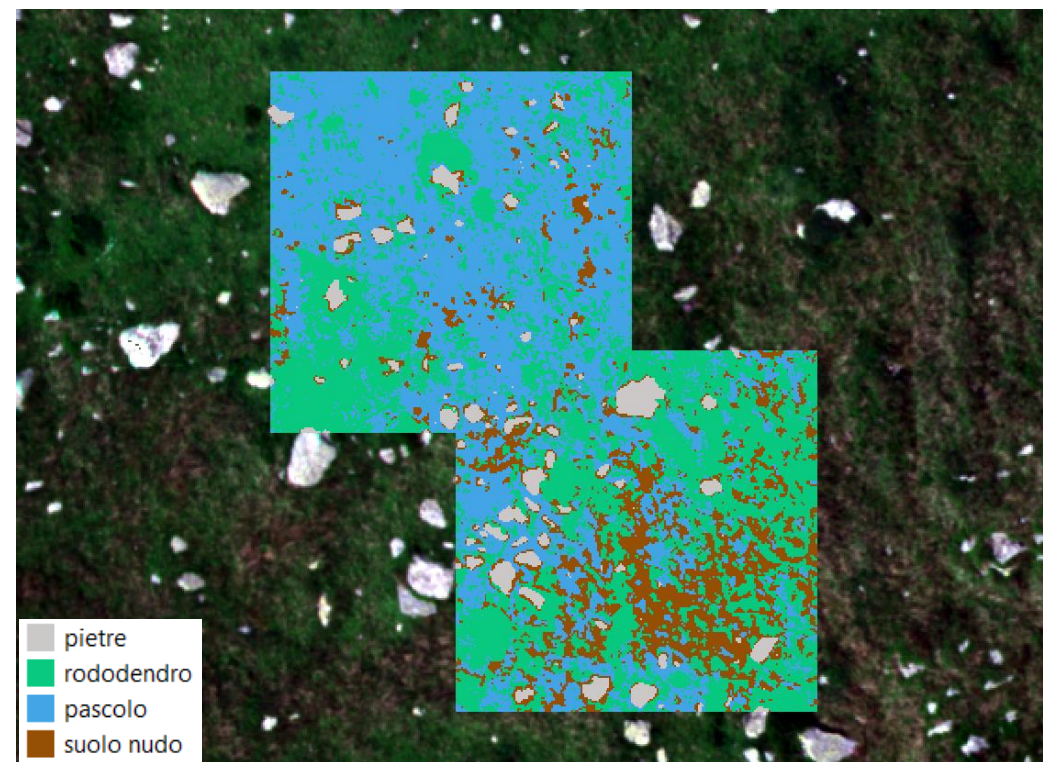


Classificazione supervisionata – ROI pascolo

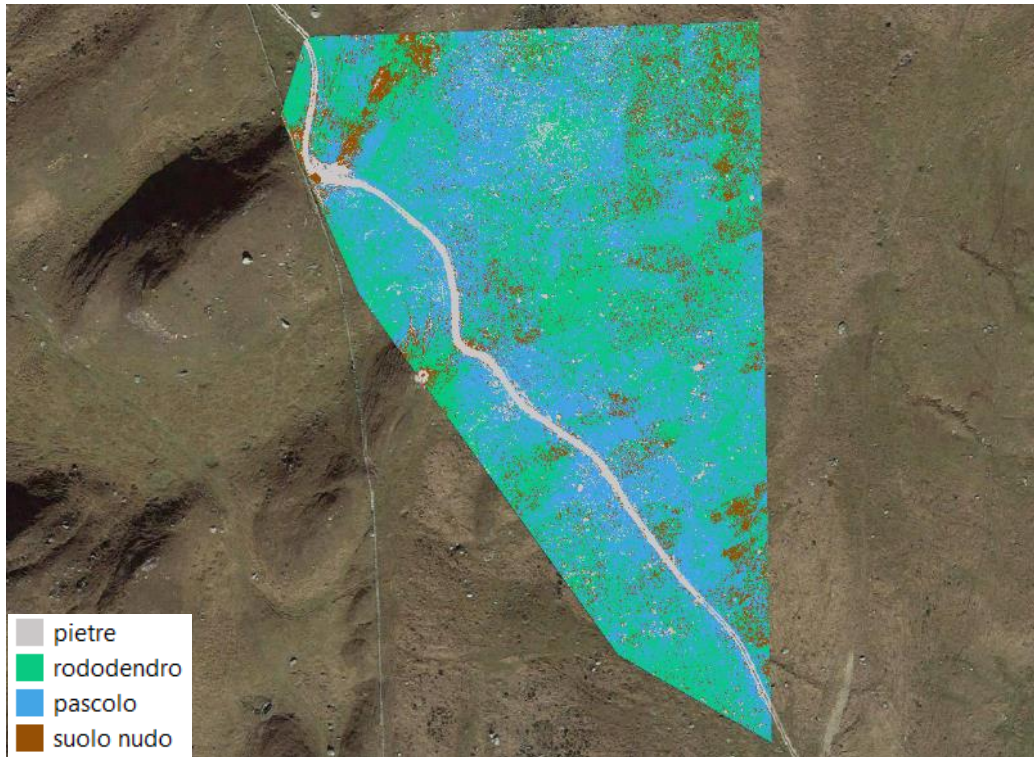
Pascolo



Classificazione in 4 classi

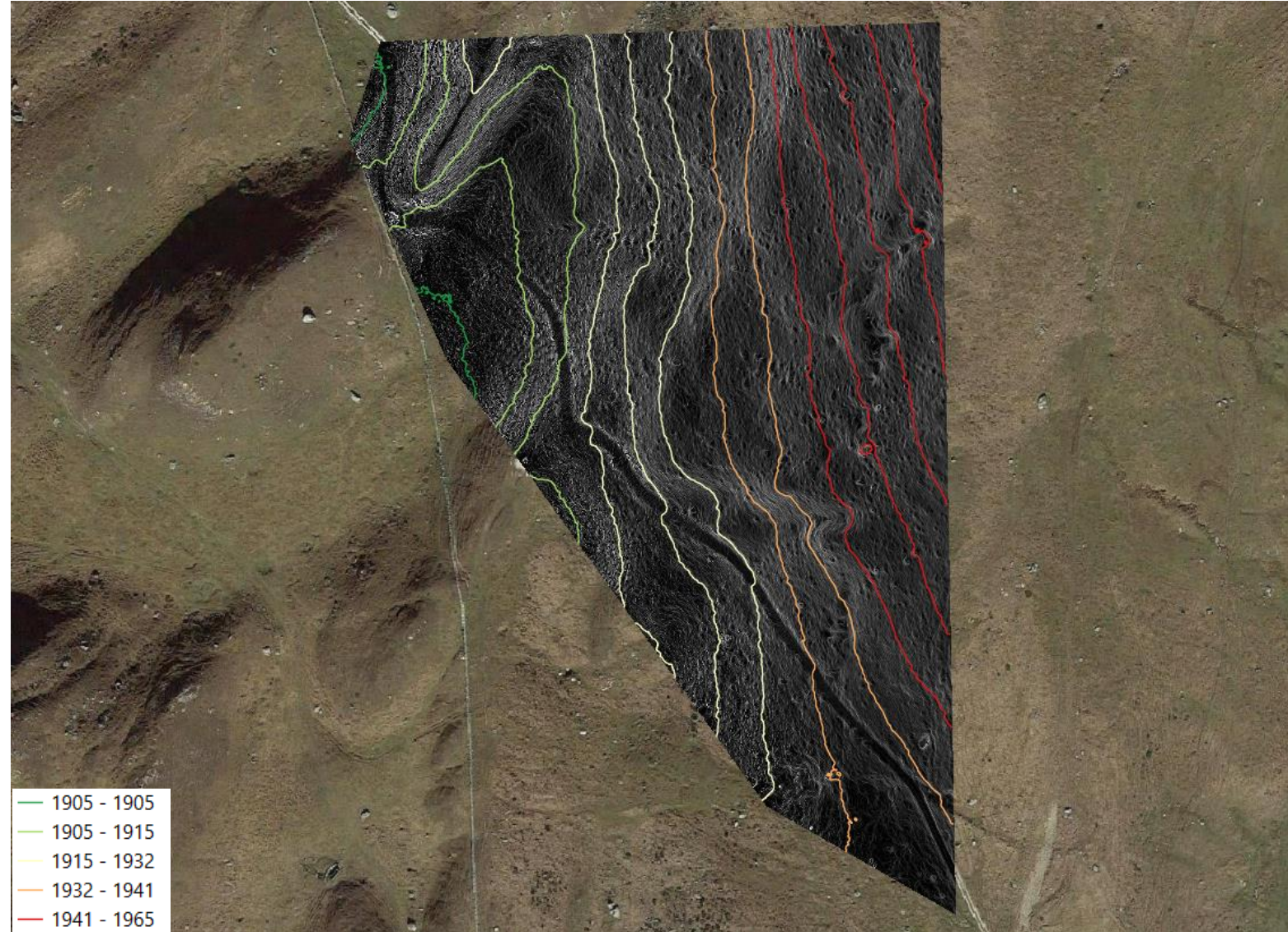


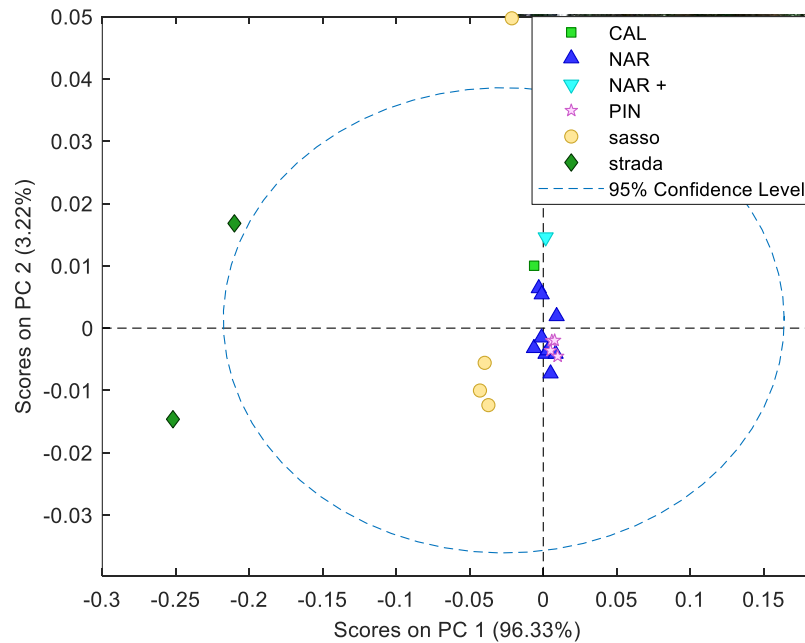
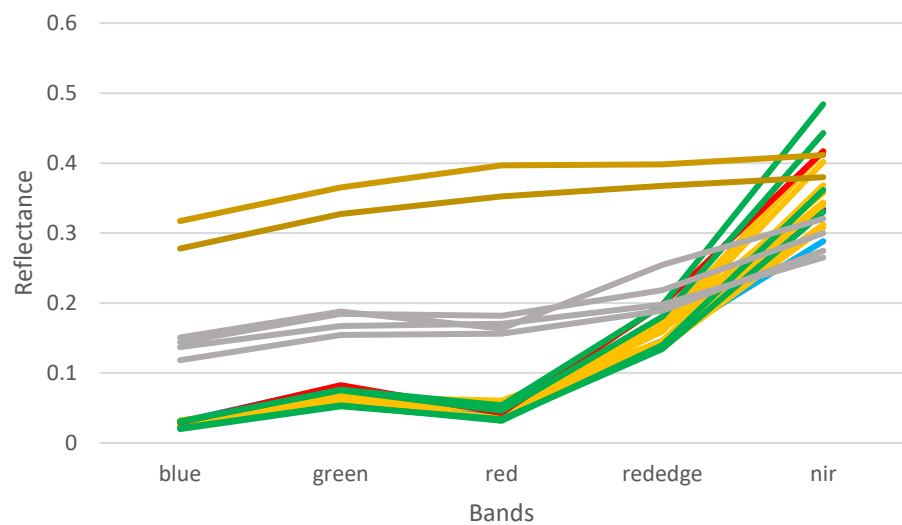
Stima delle superfici



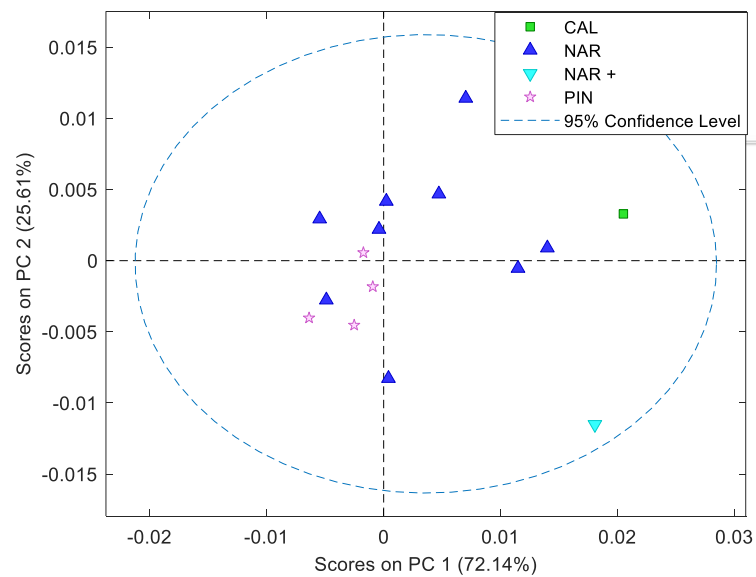
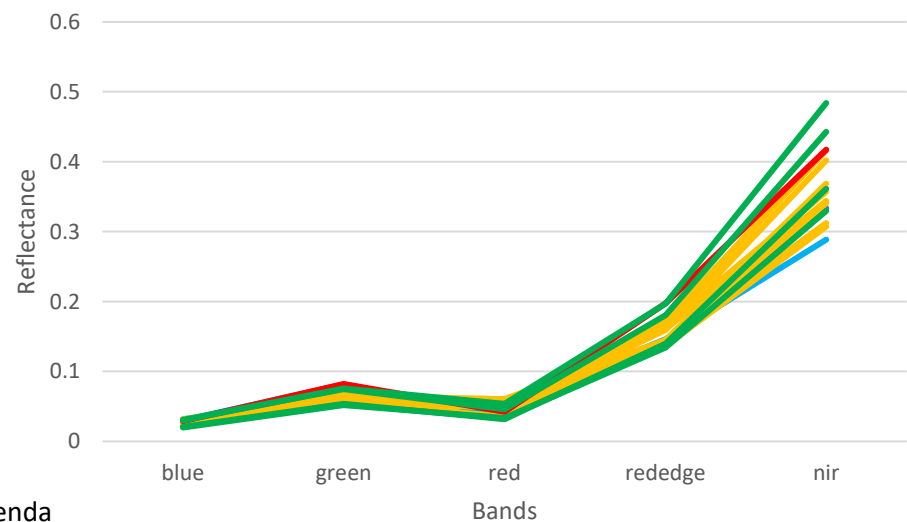
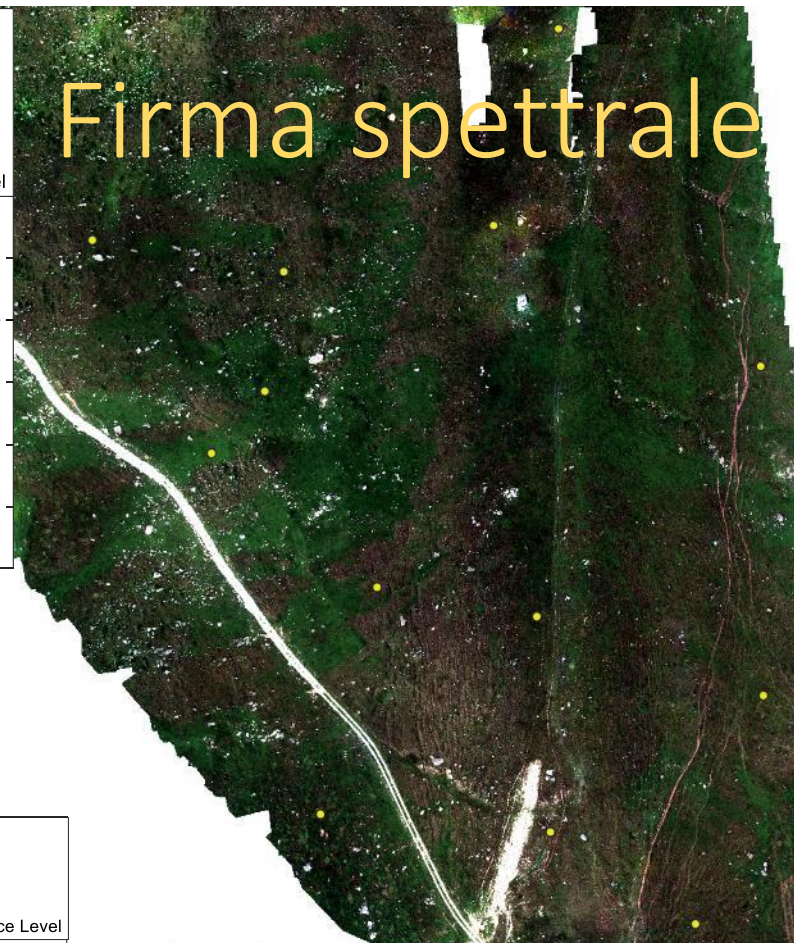
classe	Superficie (ha)
Rododendro	1.98
Pascolo	2.1
Tare	0.88
Totale	4.96

Altitudine, pendenza, asperità





Firma spettrale



Legenda

NAR	MAGRO - NARDETO
NAR +	MAGRO - NARDETO (+)
PIN	PINGUE
CAL	DEL CALCARE
ARB	INARBUSTITO
SAS	SASSO
STR	STRADA

Monitoraggio da satellite

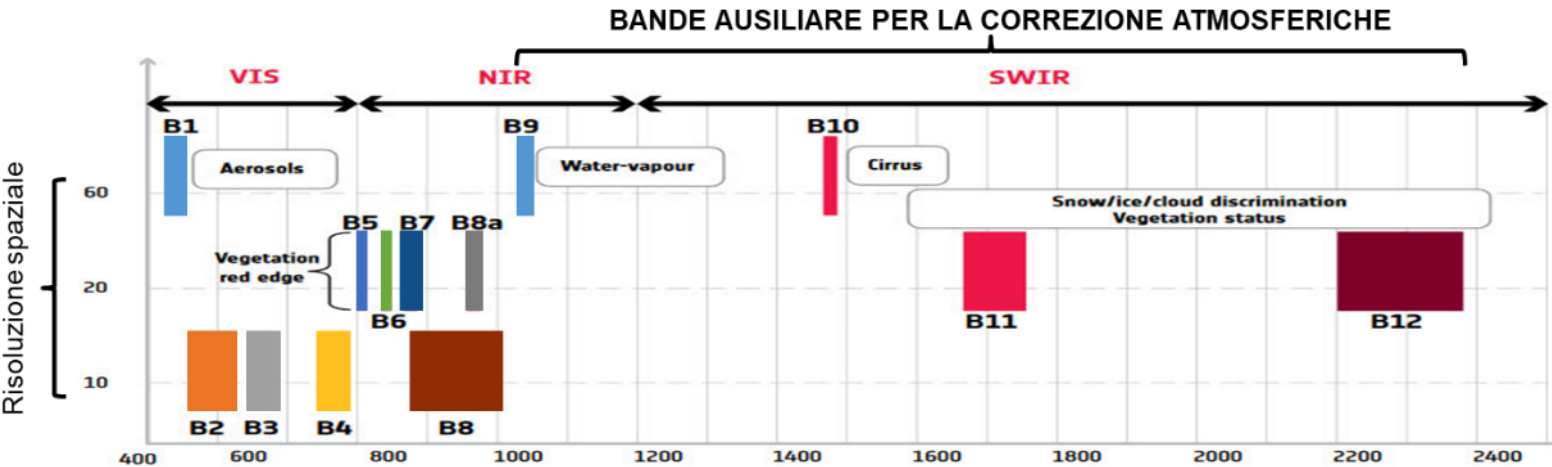
Satelliti Sentinel-2



- Sentinel 2A in orbita da giugno 2015, sentile 2B da marzo 2017.
- Con due satelliti la risoluzione temporale è di un'acquisizione ogni 5 gironi.
- Contribuisce ad attività di monitoraggio terrestre con immagini multispettrali.
- Risoluzione radiometrica a 12 bit (4096 livelli di intensità).
- I prodotti sono disponibili a due livelli di elaborazione (1C e 2A), organizzati in granuli di dimensione 100x100 km e contenenti tutte le bande spettrali ed i metadati.
- I dati sono elaborabili su piattaforma SNAP, gratuita e sviluppata da ESA, con una serie di toolbox dedicati per il calcolo di parametri biofisici (es. LAI, fAPAR, ecc.), di indici radiometrici (vegetazione, suolo, acqua, ecc.), ed altri scopi.

MSI (Multi-Spectral Imager)

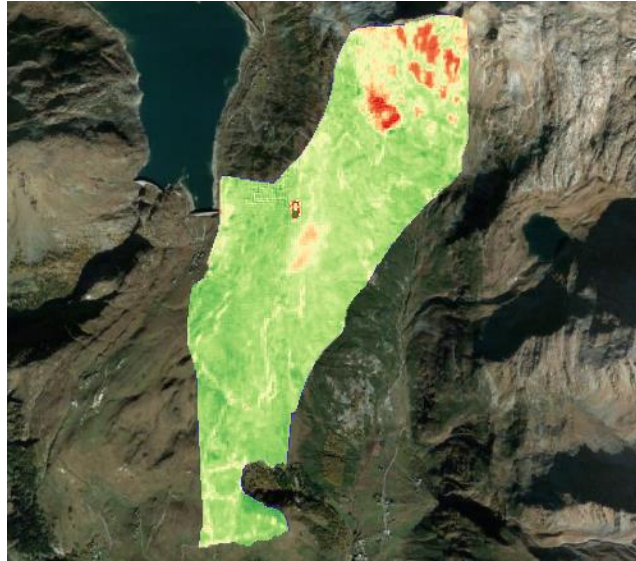
- Caratteristica peculiare: 3 bande nel Red-Edge (705-785 nm), banda spettrale utile per il monitoraggio dello stato di salute della vegetazione.
- Bande più strette rispetto ai predecessori (satelliti Landsat) per ridurre effetti del vapore acqueo.



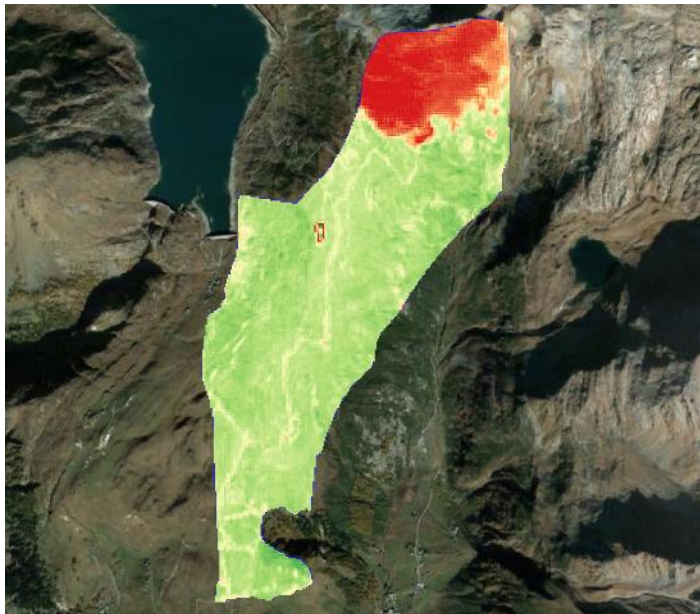
N° banda	Banda	nm	Risoluzione
1	Areosol	443 ± 20	60m
2	Blu	490 ± 65	10m
3	Verde	560 ± 35	10m
4	Rosso	655 ± 30	10m
5	RedEdge	705 ± 15	20m
6	RedEdge	740 ± 15	20m
7	RedEdge	783 ± 20	20m
8	NIR _{ampio}	842 ± 115	10m
8a	NIR _{stretto}	865 ± 20	20m
9	Vapore acqueo	945 ± 20	60m
10	Cirri	1380 ± 30	60m
11	SWIR-1	1910 ± 90	20m
12	SWIR-2	2190 ± 180	20m

INDICI NDRE ANDOSSI 2020

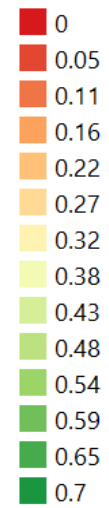
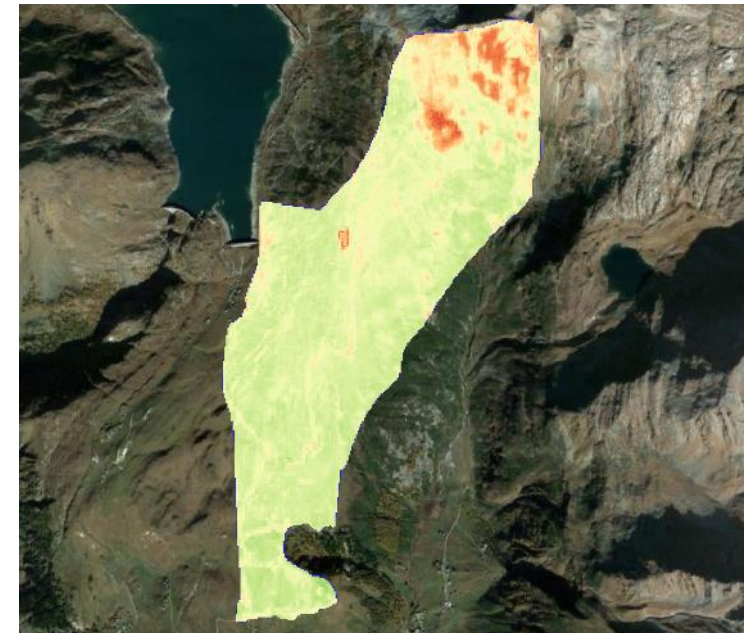
20/07/2020



09/08/2020

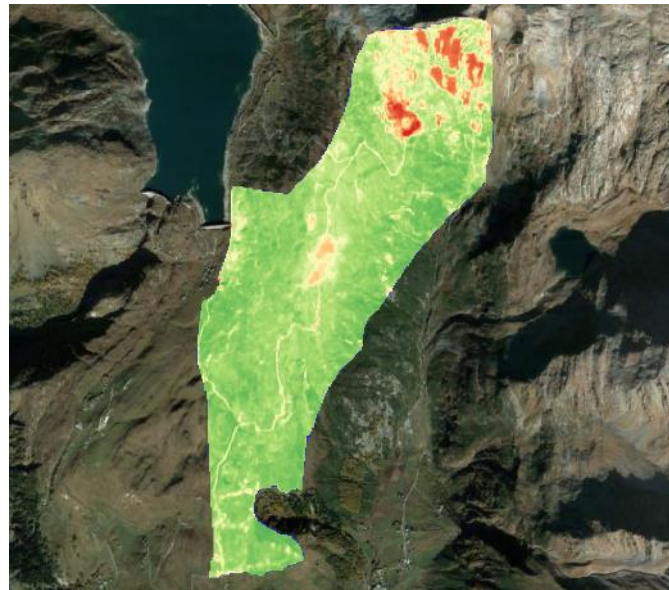


19/08/2020

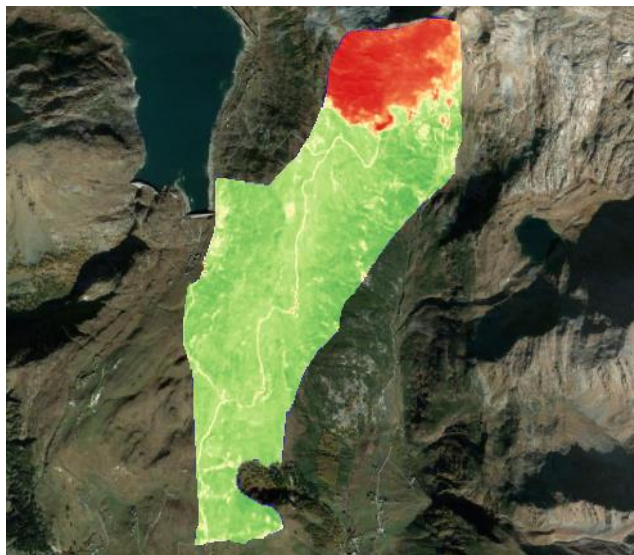


INDICI NDVI ANDOSSSI 2020

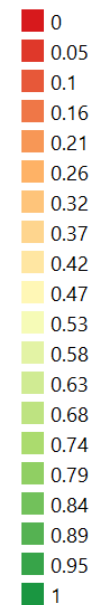
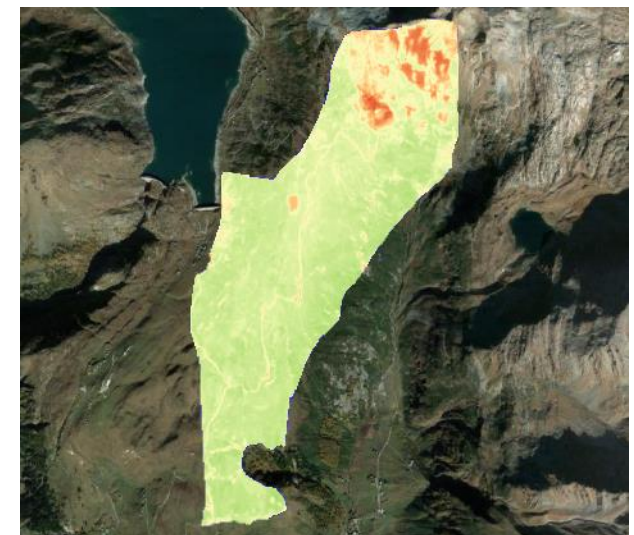
20/07/2020



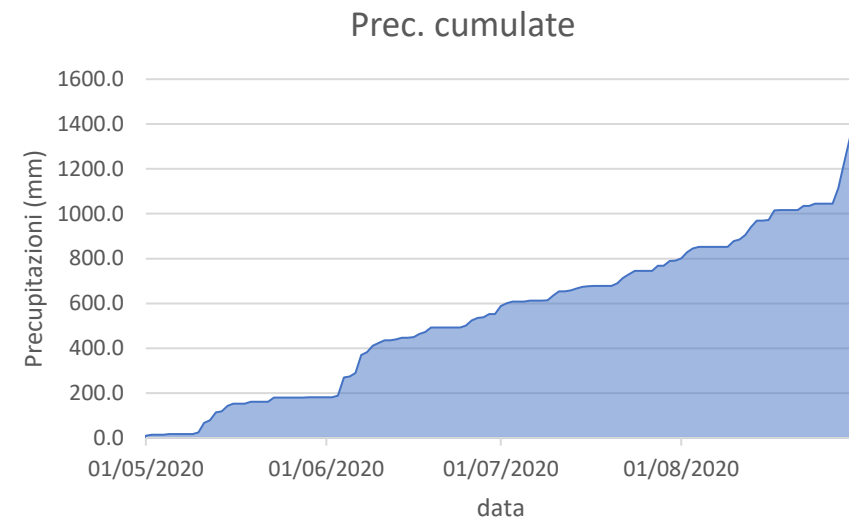
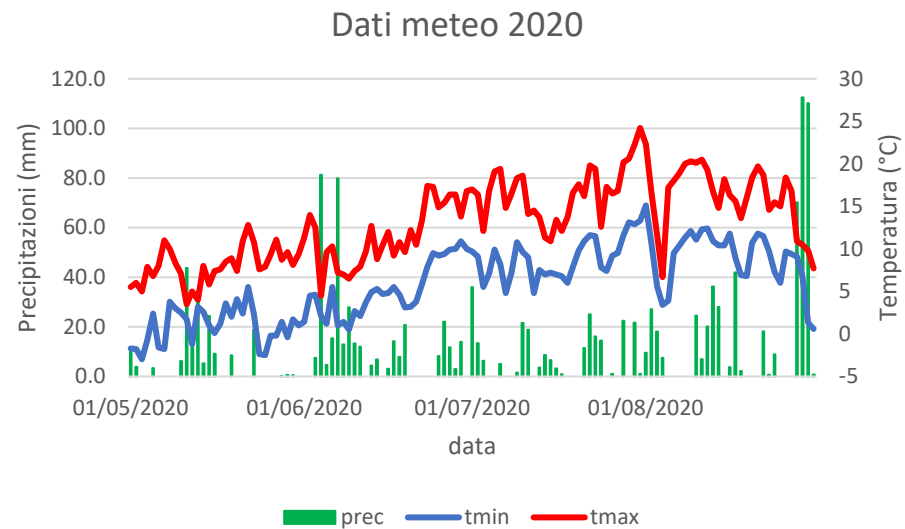
09/08/2020



19/08/2020

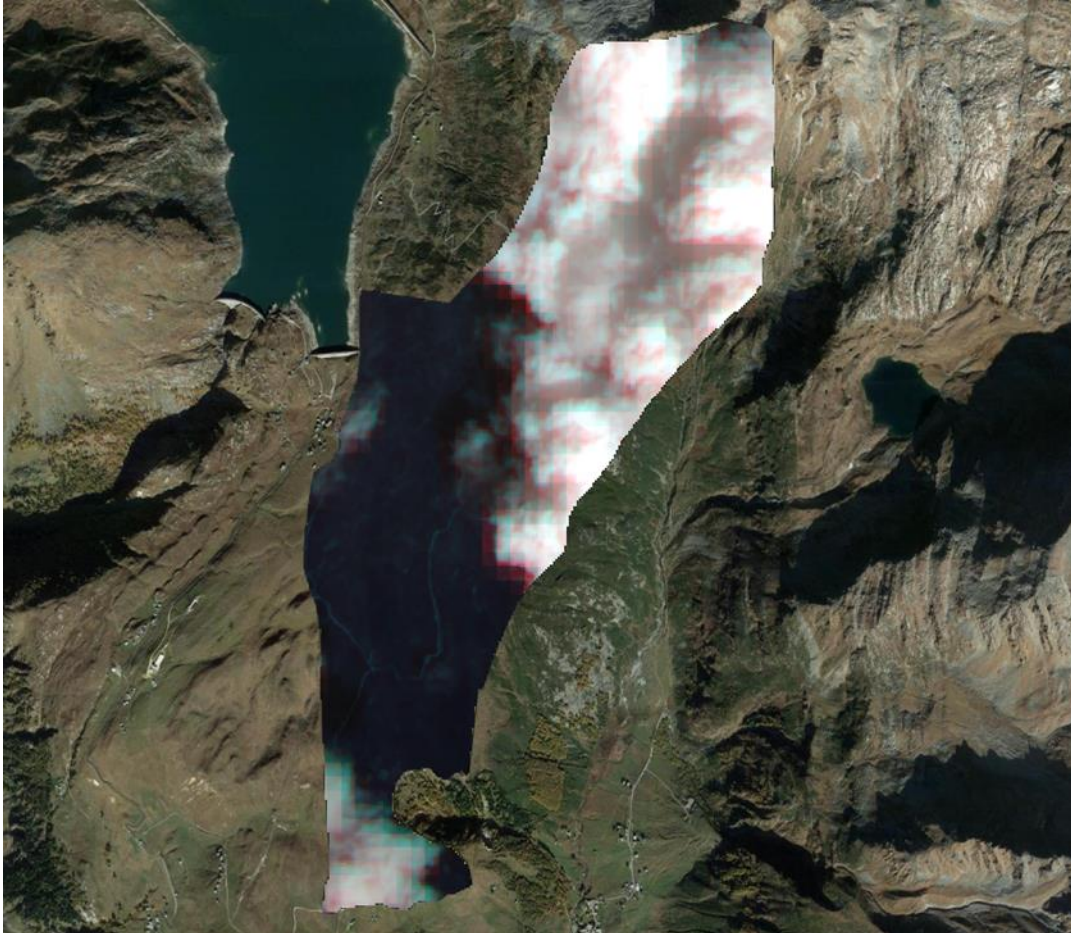


Monitoraggio da satellite

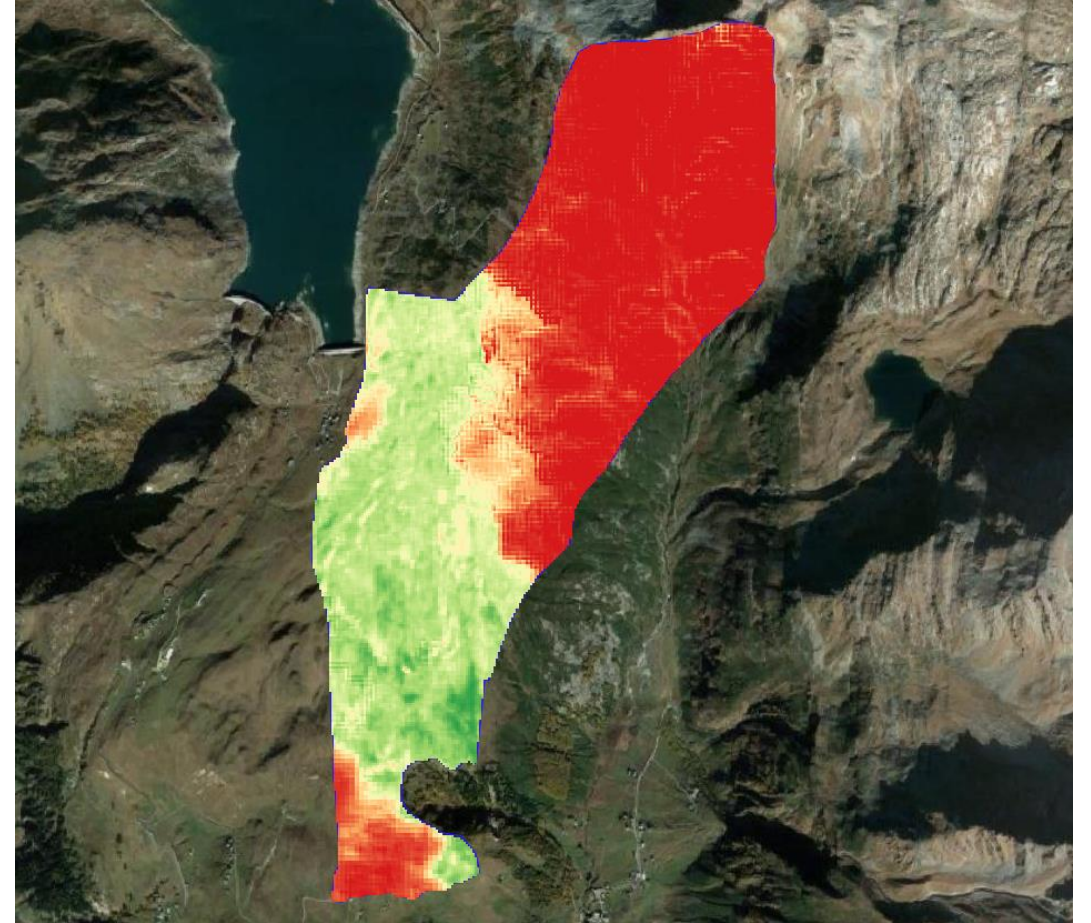


ANDOSSÌ 25/06/2020

RGB

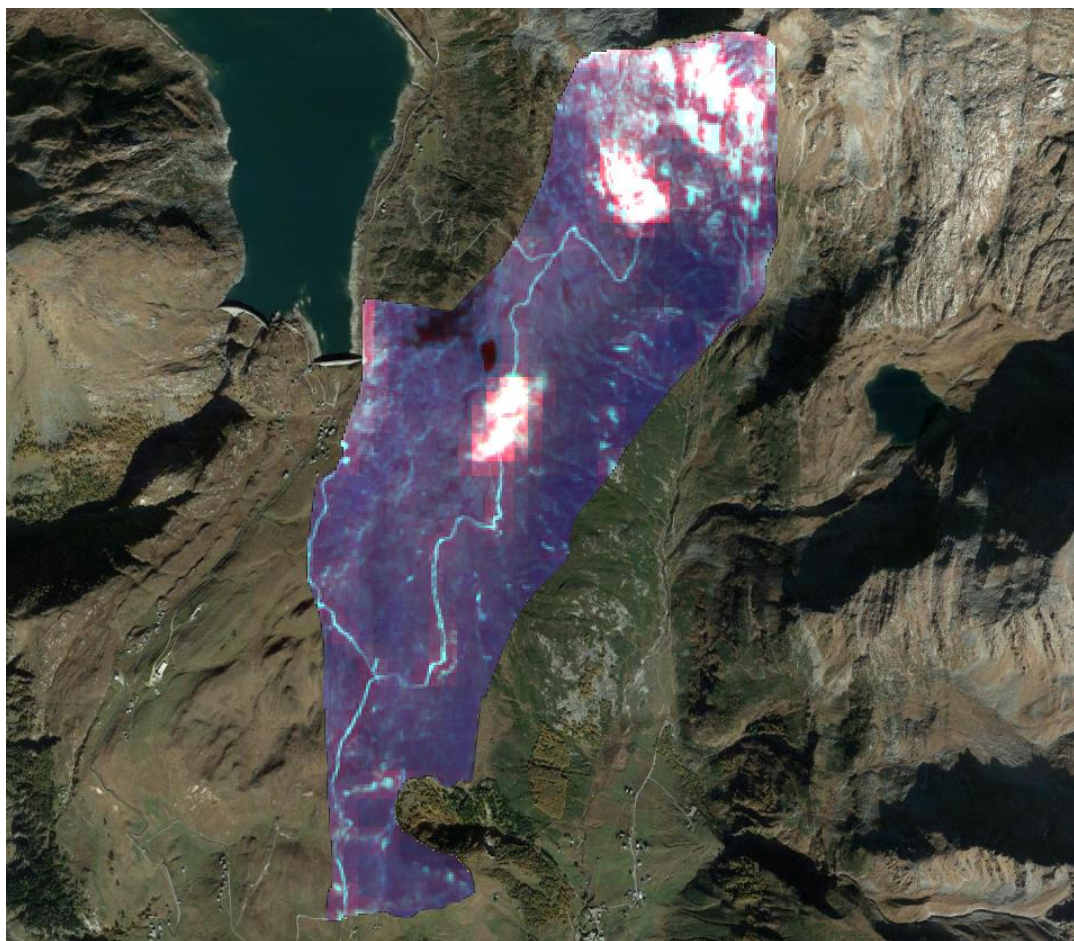


NDRE

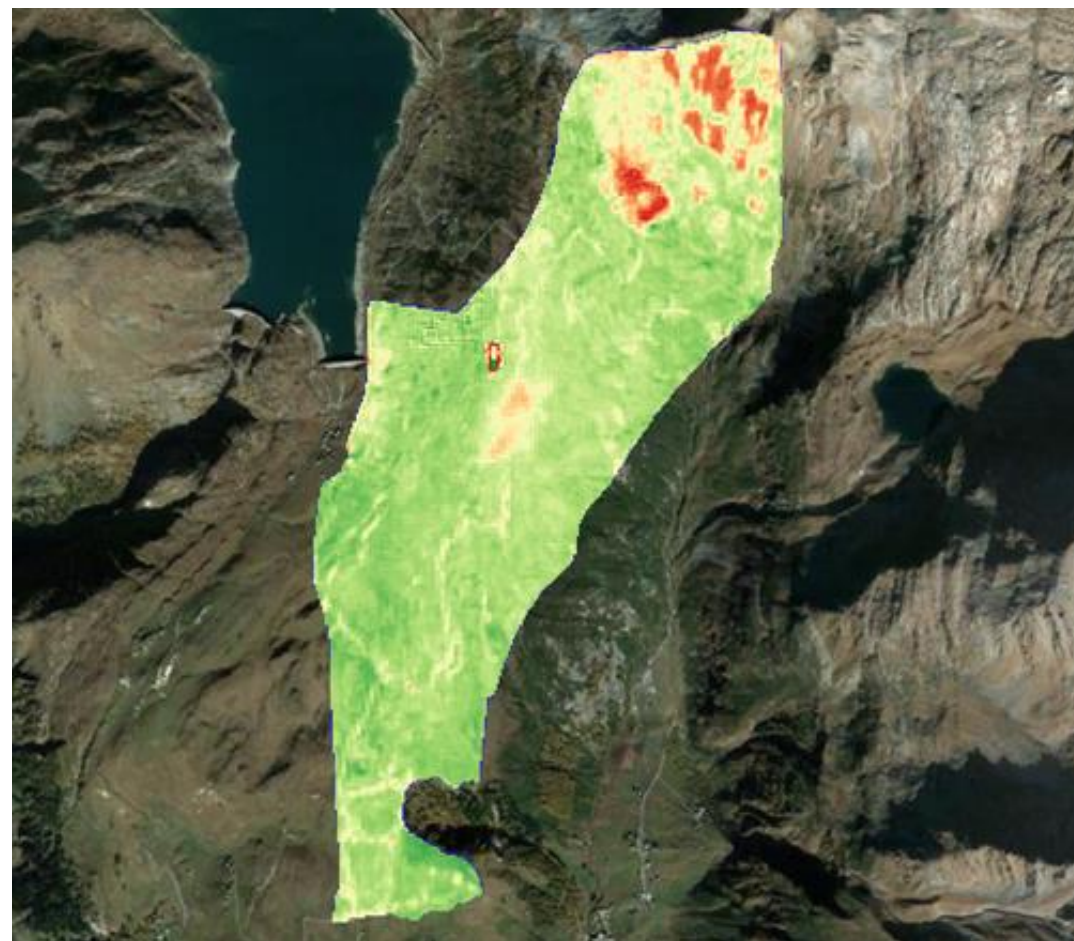


AANDOSSİ 20/07/2020

RGB



NDVI





- **Programma di lavoro 2021:**
- **Rilievo prima del pascolamento:**
 - Stima della superficie pascolabile
 - Stima della biomassa disponibile
 - Stima della tipologia di pascolo
- **Rilievo post pascolamento:**
 - Stima della superficie effettivamente pascolata
 - Stima della biomassa residua

Grazie per l'attenzione!