

Exploring S-2A products for land cover land use monitoring

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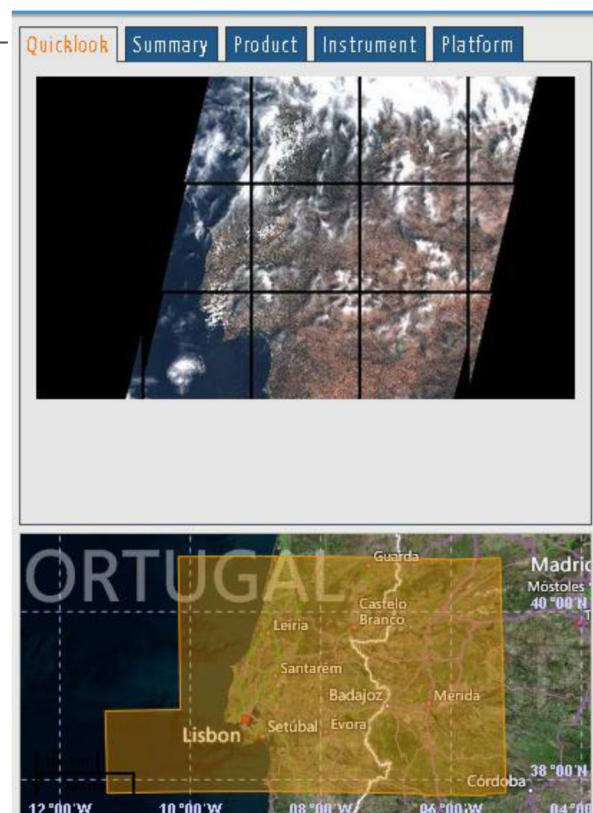
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1. S2-A Data Access
2. Products used
3. Software used
4. Positional accuracy
5. Spectral data quality
6. Atmospheric Correction with Sen2Cor plug-in
7. LCLU monitoring with S-2A products
8. LCLU monitoring with S2-A and Landsat-8: a comparison

- The web interface of S2 Data Hub should be bigger (i.e. use all the screen for better display);
- When passing through a product on the list display product the highlight of a product on the map should be more visible;
- When a product is selected the tool should display a list of products for the same AOI for different dates;
- The products list display should be placed on a left column of the screen. This would allow a better visualization of the products;
- On the advance search options the option boxes should have predefined options (e.g. Product Type: L1C; L1B);
- On the advanced search options the polarization box doesn't make sense for S2

Product Downloaded from Sentinel-2 Expert Users Data Hub

- Name:
S2A_OPER_PRD_MSIL1C_PDMC_20150828T181939_R037_V20150814T113438_20150814T113438'
- Date: 2015-08-14T11:34:38.000Z
- Instrument: MSI
- Satellite: Sentinel-2
- Size: 2.99 GB
- Generation time: 2015-08-28T18:19:39.000117Z
- Ingestion Date: 2015-09-01T15:20:36.890Z
- Orbit number (start): 749
- Processing baseline: 01.03
- Product type: S2MSI1C
- Relative orbit (start): 37
- Sensing start: 2015-08-14T11:34:38.000Z
- Sensing stop: 2015-08-14T11:34:38.000Z



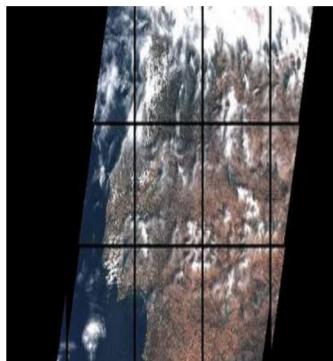
Software	Version	Objective
Snap	SNAP 2.0-BETA-06	Product visualization, correction and conversion
ArcGIS	10.2.1	Map display and training areas collection
R	3.2.1	Satellite image processing

Positional accuracy



S-2A versus coastal line
Displacement $xy = 1.3$ KM

Product name: S2A_OPER_PRD_MSIL1C_PDMC_20150828T181939_R037_V20150814T113438_20150814T113438
Generation time: 2015-08-28T18:19:39.000117Z | **Size:** 2.99 GB



Quicklook



Geometric Displacement - Example 1



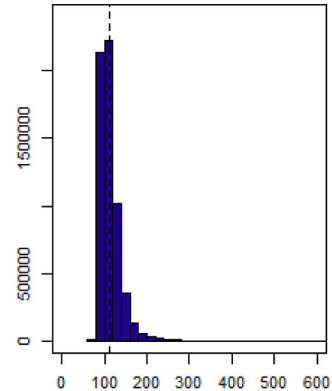
Distance: ≈ 1.3 Km

Geometric Displacement - Example 2

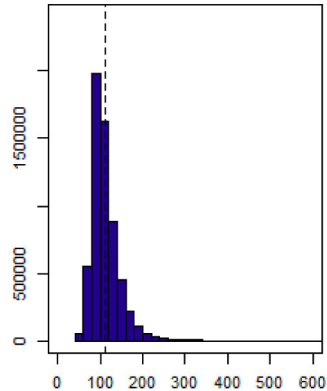
Spectral data quality



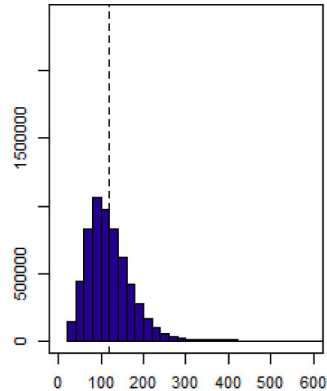
B2_10m



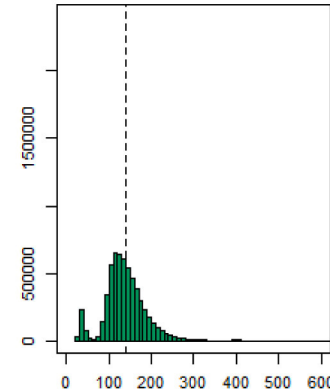
B3_10m



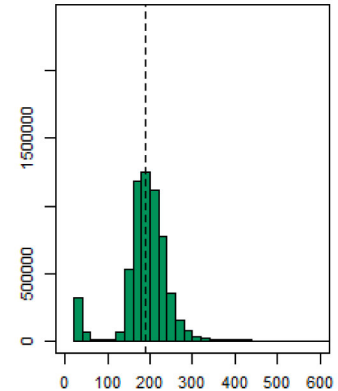
B4_10m



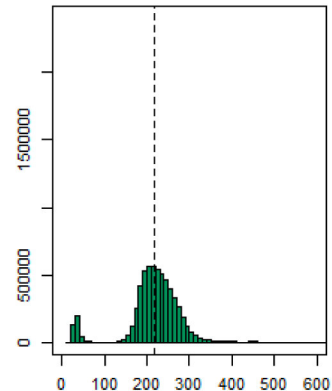
B5_20m



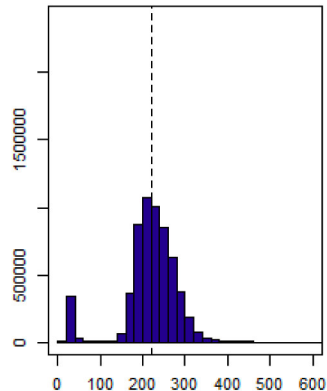
B6_20m



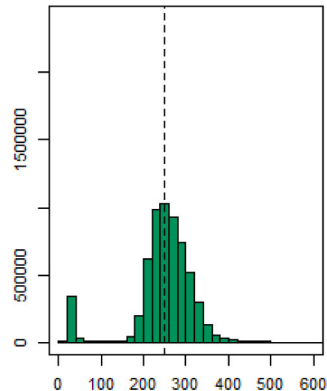
B7_20m



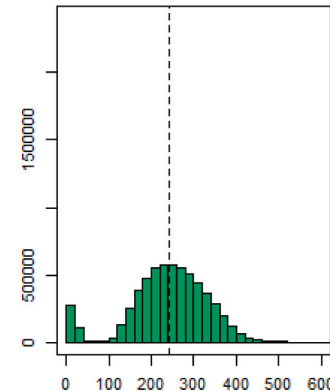
B8_10m



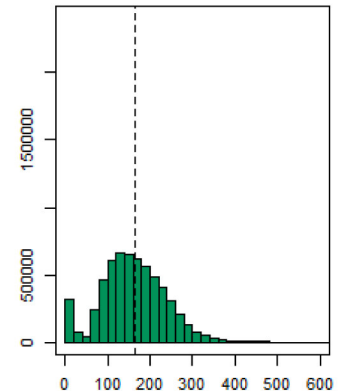
B8A_20m



B11_20m



B12_20m



Atmospheric Correction with Sen2Cor plug-in

Sen2Cor plug-in in SNAP 2.0-Beta-0.6 did not work properly

(the issue was acknowledge by ESA on <http://forum.step.esa.int/t/l1c-to-l2a-sen2cor/339/6>)

We then used the plug-in manually (as suggested on the forum) but the results were the same, i.e. not working properly

We only used L1C - TOA

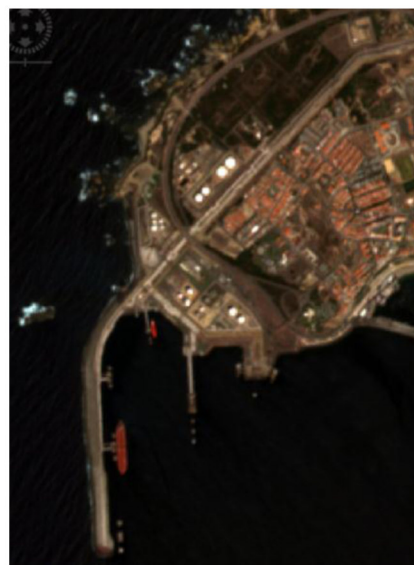
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S2A_OPER_PRD_MSIL1C_PDMC_20150828T181939_R0
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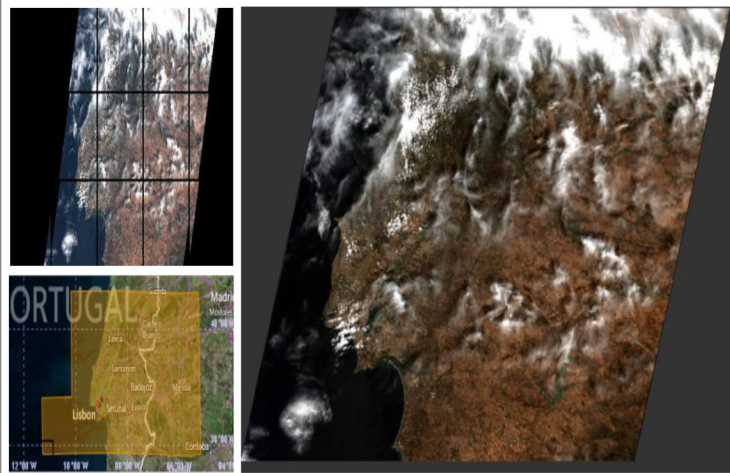
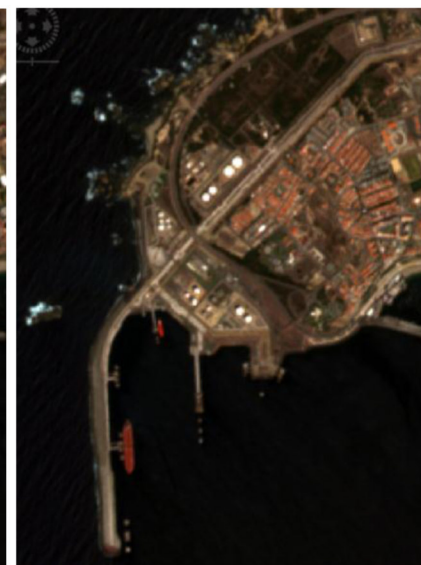
Generation time: 2015-08-28T18:19:39.000117Z

Size: 2.99 GB

L1C - TOA



L2A - BOA



LCLU monitoring – study area



RGB 843

ID	LCLU class
1	Bare soil
2	Irrigated crops
3	Olive orchard
4	<i>Pinus pinaster</i> closed forest
5	<i>Pinus pinaster</i> open forest
6	<i>Pinus pinea</i> forest
7	<i>Eucalyptus globulus</i> forest
8	<i>Quercus suber</i>
9	Shrubs
10	Herbaceous vegetation
11	Urban
12	Water

- **Training and testing:** 1200 sampling units (100 per class)
- **Ancillary data** - orthorectified aerial imagery
- **Image classifiers:**
 - Support Vector Machine (SVM)
 - Linear Discriminant Analysis (LDA)
 - Quadratic Discriminant Analysis (QDA)
- **Validation:** to obtain robust estimates of the classification overall accuracy and to avoid classifier overfitting, we used 10-fold cross validation

Sentinel 2-A

vs.

Landsat 8

- 10m (bands 2, 3, 4, 8)
- 20m (bands 5, 6, 7, 8B, 11, 12)
- 10m+20m (all bands)



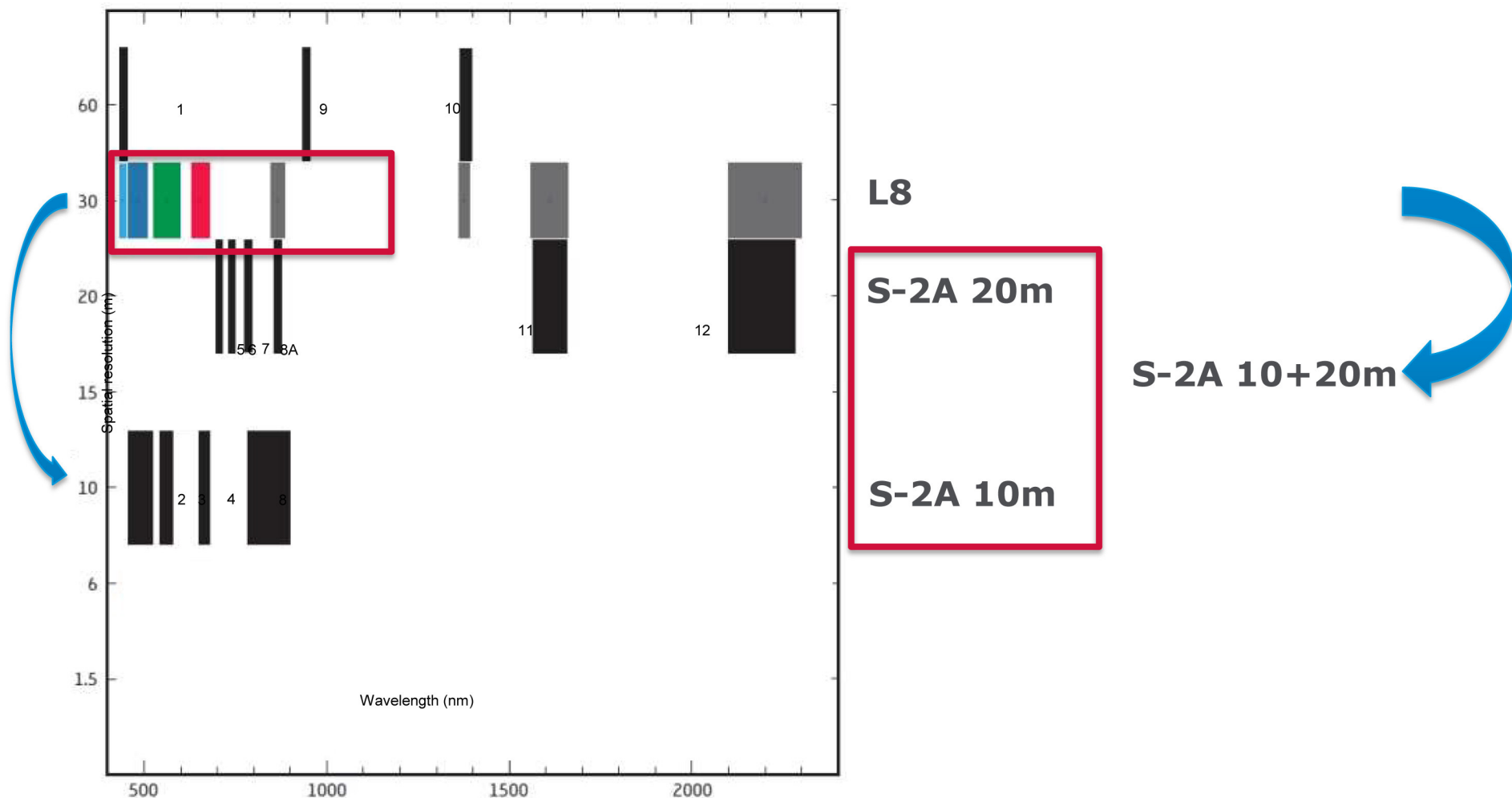
RGB 843

Acquisition date: 2015-08-28.



RGB 543

Acquisition date: 2015-07-28



LCLU monitoring – classifiers and band combinations

We tested 3 different band combination: 10m, 20m and 10+20m

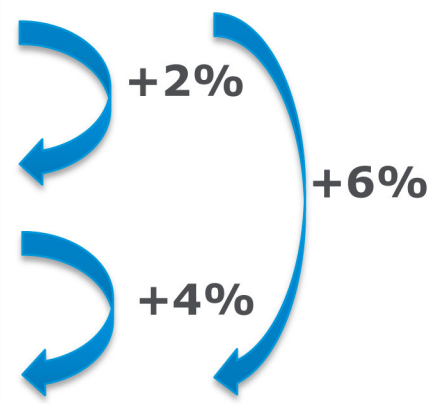
We eliminated the effect of classifier by testing 3 classifiers (LDA, QDA and SVM)

Data	Pixel size	Bands	LDA	QDA	SVM
S2-A	10 m	2, 3, 4, 8			
S2-A	20 m	5, 6, 7, 8A, 11, 12			
S2-A	10 m + 20 m	2, 3, 4, 5, 6, 7, 8, 8A, 11, 12			

We tested 3 different band combination: 10m, 20m and 10+20m

We eliminated the effect of classifier by testing 3 classifiers (LDA, QDA and SVM)

Data	Pixel size	Bands	LDA	QDA	SVM
S2-A	10 m	2, 3, 4, 8	69.6%	76.9%	76.7%
S2-A	20 m	5, 6, 7, 8A, 11, 12	73.4%	78.3%	79.9%
S2-A	10 m + 20 m	2, 3, 4, 5, 6, 7, 8, 8A, 11, 12	77.2%	82.3%	83.8%



+2%

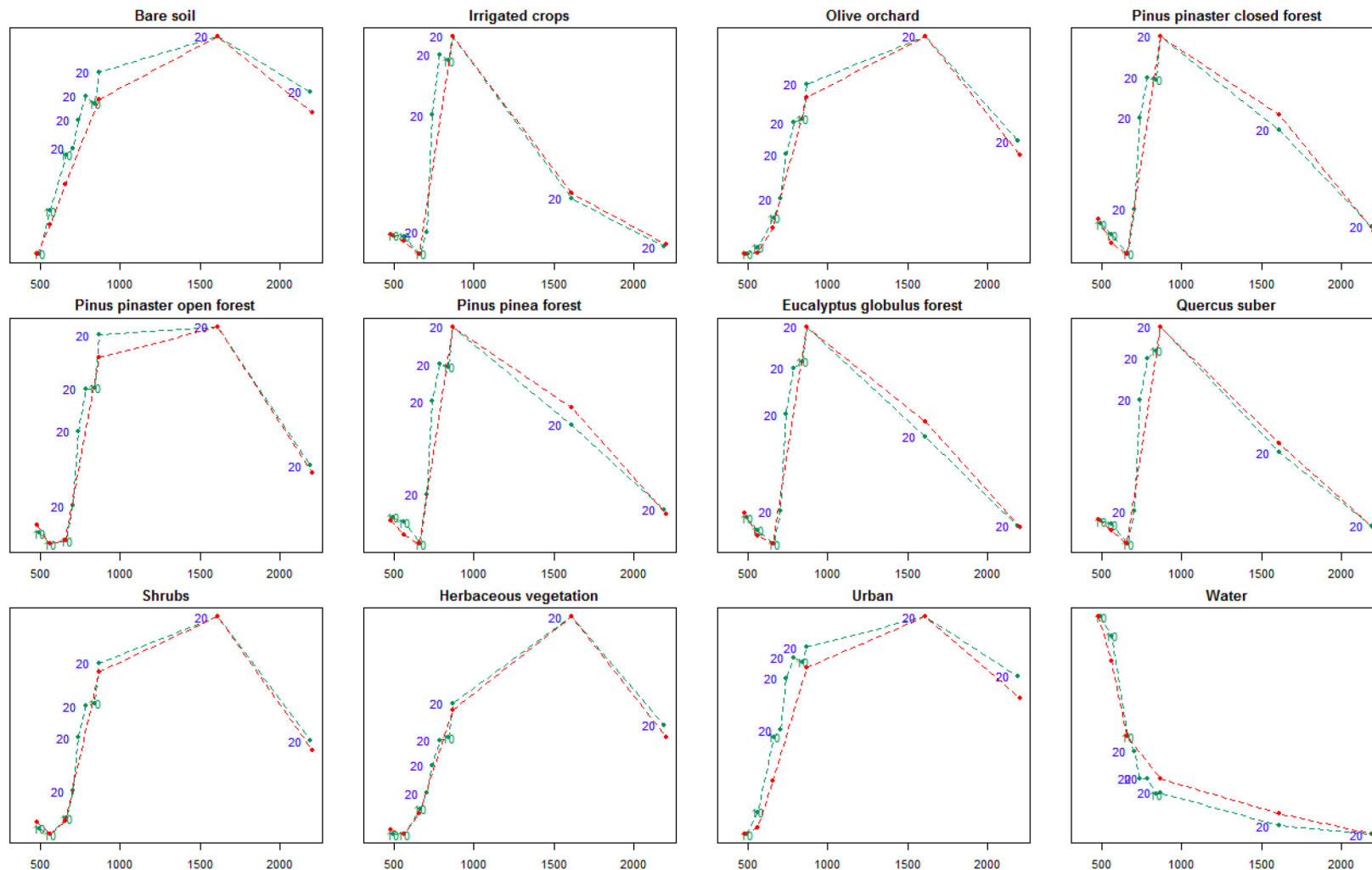
+4%

+6%

The simultaneous use of 10 m and 20 m bands promoted an increase of accuracy when compared to the individual use of 10m bands (6%) and 20 m (4%).

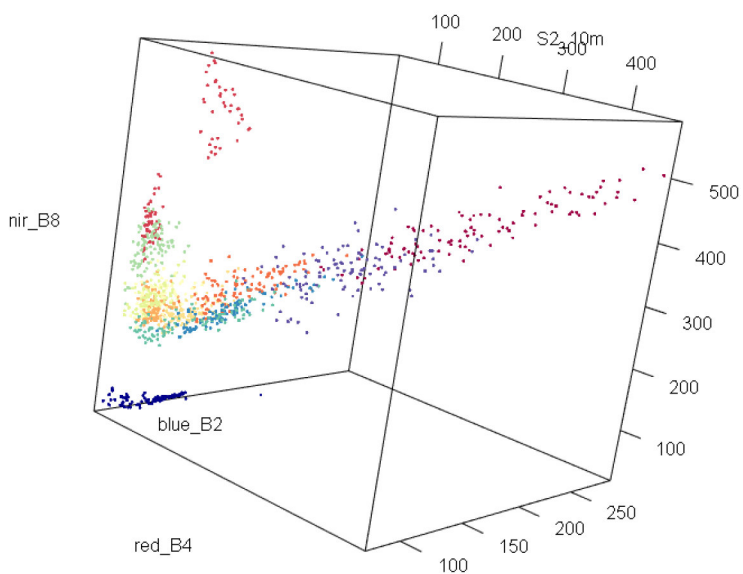
Spectral signatures: S-2A versus L8

— S2
— L8

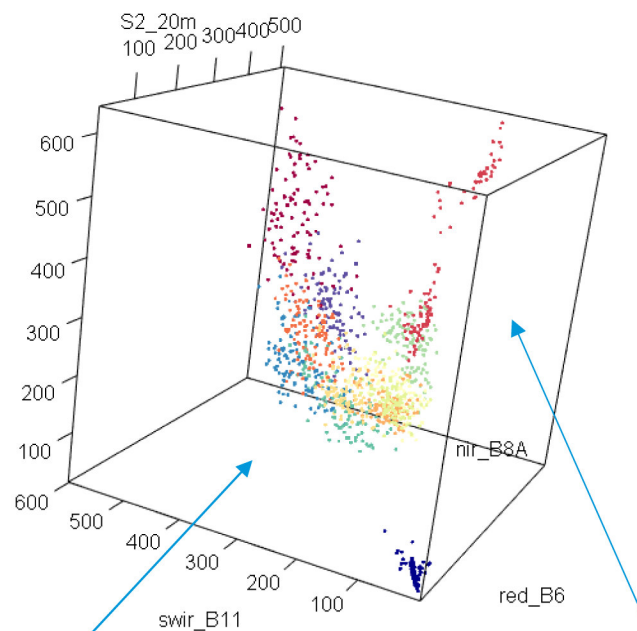


S2-A 10m bands

S2-A 20m bands



*The SWIR band is very important for discrimination:
10m only bands is not enough*



Over the RED/NIR plane all points are aligned

- Bare soil
- Irrigated crops
- Olive orchard
- Pinus pinaster closed forest
- Pinus pinaster open forest
- Pinus pinea forest
- Eucalyptus globulus forest
- Quercus suber
- Shrubs
- Herbaceous vegetation
- Urban
- Water

LCLU monitoring – classifiers and band combinations

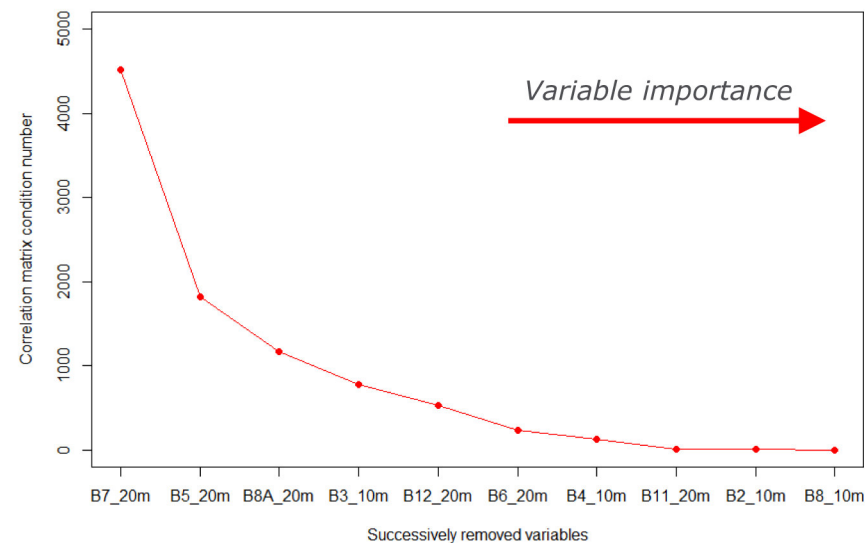
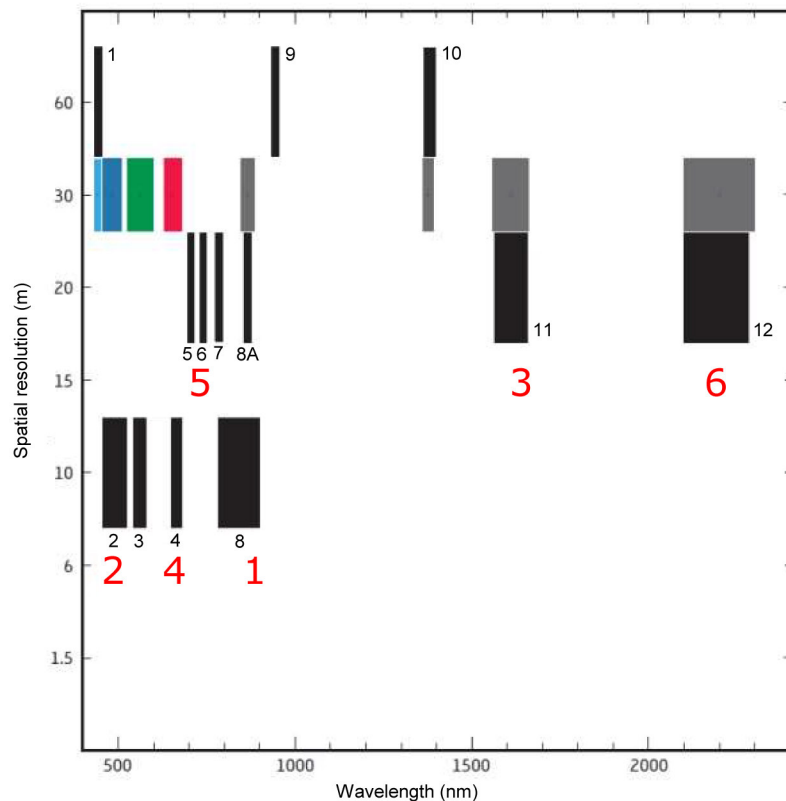
Sentinel 2-A		
Bands	Pixel size	Overall Accuracy SVM
2, 3, 4, 8	10m	76.7%
2, 3, 4, 5, 6, 7, 8, 8A, 11, 12	10m + 20m	83.8%
5, 6, 7, 8A, 11, 12	20m	79.9%

LCLU monitoring – classifiers and band combinations

Sentinel 2-A			Landsat 8		
Bands	Pixel size	Overall Accuracy SVM	Overall Accuracy SVM	Spectral coverage	Bands
2, 3, 4, 8	10m	76.7%	75.9%	Visible + NIR	2, 3, 4, 5
2, 3, 4, 5, 6, 7, 8, 8A, 11, 12	10m + 20m	83.8%	80.9%	All bands	2, 3, 4, 5, 6, 7
5, 6, 7, 8A, 11, 12	20m	79.9%	-	-	-

- S2-A with all bands seems to outperform L8
- S2-A with just 10m bands is slightly better than L8 with similar spectral bands

S-2A: the importance of adding spectral bands



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CLASSIFICATION SUMMARY: S2-A VS. LANDSAT 8

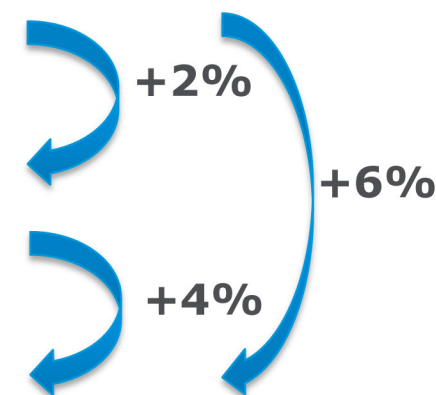
Data	Bands	LDA	QDA	SVM
S2-A	2, 3, 4, 8	69.6%	76.9%	76.7%
S2-A	5, 6, 7, 8A, 11, 12	73.4%	78.3%	79.9%
S2-A	2, 3, 4, 5, 6, 7, 8, 8A, 11, 12	77.2%	82.3%	83.8%
Landsat 8	2, 3, 4, 5	70.7%	74.5%	75.9%
Landsat 8	2, 3, 4, 5, 6, 7	75.2%	79.1%	80.9%

- *Other classifiers (LDA and QDA) show similar tendencies in terms of overall accuracy of S2-A vs. Landsat 8.*

We tested 3 different band combination: 10m, 20m and 10+20m

We eliminated the effect of classifier by testing 3 classifiers (LDA, QDA and SVM)

Data	Pixel size	Bands	LDA	QDA	SVM
S2-A	10 m	2, 3, 4, 8	69.6%	76.9%	76.7%
S2-A	20 m	5, 6, 7, 8A, 11, 12	73.4%	78.3%	79.9%
S2-A	10 m + 20 m	2, 3, 4, 5, 6, 7, 8, 8A, 11, 12	77.2%	82.3%	83.8%



The simultaneous use of 10 m and 20 m bands promoted an increase of accuracy when 10m bands (6%) and 20 m (4%) band are used individually