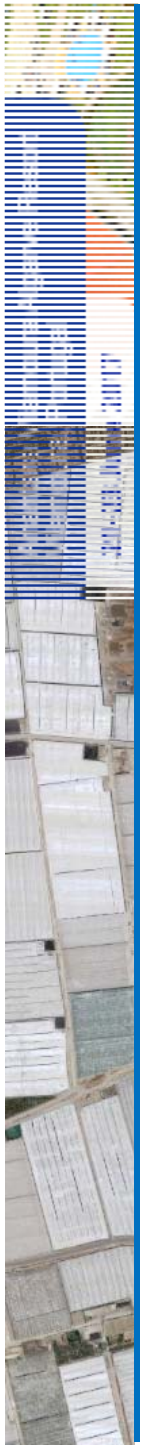
Optimizing Multiresolution Segmentation for Extracting Plastic Greenhouses from WorldView-3 Imagery

Manuel A. Aguilar, Antonio Novelli, Abderrahim Nemmaoui,
Fernando J. Aguilar, Andrés García Lorca, Óscar González-Yebra

10th International Conference KES IIMSS 2017, 21-23 June, Vilamoura, Portugal



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"Una manera de hacer Europa"

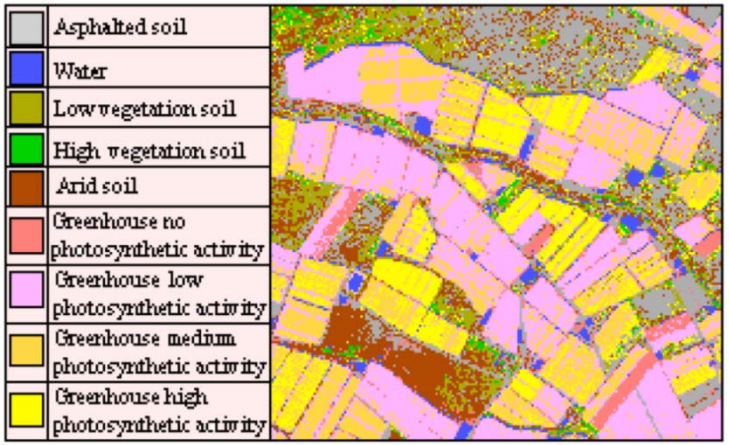
"Object-based horticultural crop under greenhouse identification using stereo imagery of WorldView-3 satellite and Landsat 8 time-series"

(AGL2014-56017-R)

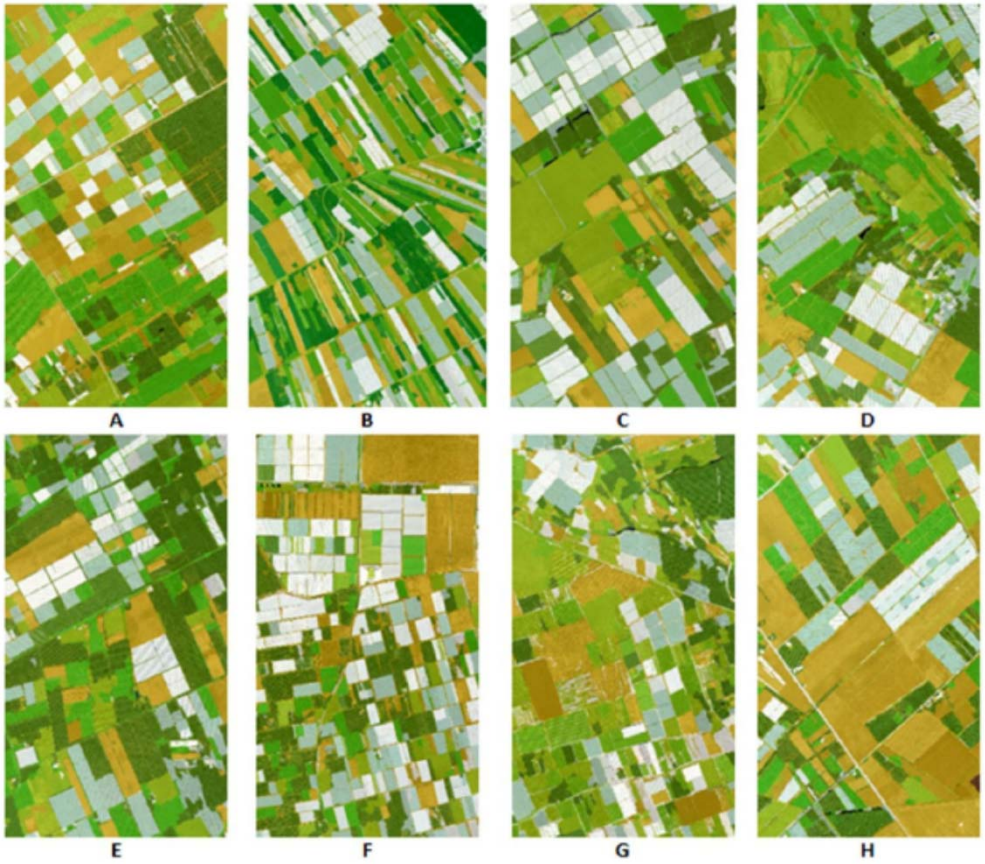
https://www.ual.es/Proyectos/GreenhouseSat/

Pixel-based vs Object-based

Commercial VHR satellite imagery => Object-based image analysis (OBIA)



Greenhouses Pixel-based classification on a QuickBird MS image



Greenhouses Object-based classification. The first work by Tarantino and Figorito (2012)

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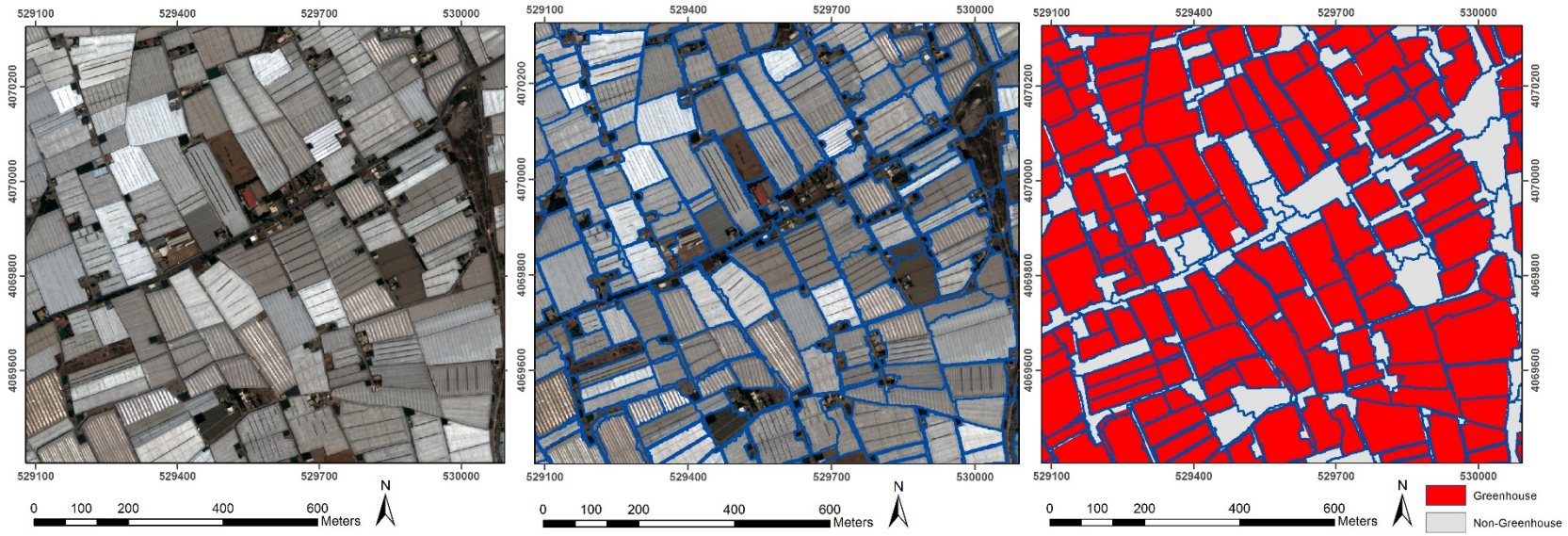
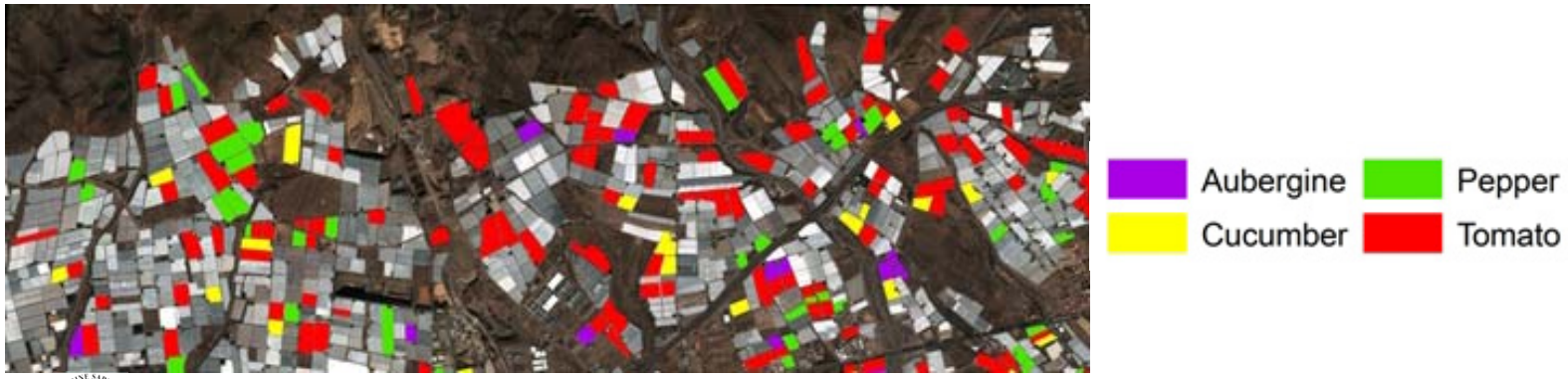
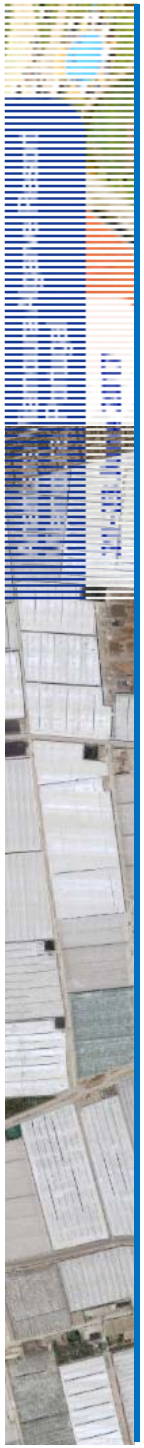
1.- Mapping plastic greenhouses by using satellite images and OBIA approach.



2.- Identifying horticultural crop under plastic greenhouse cover.





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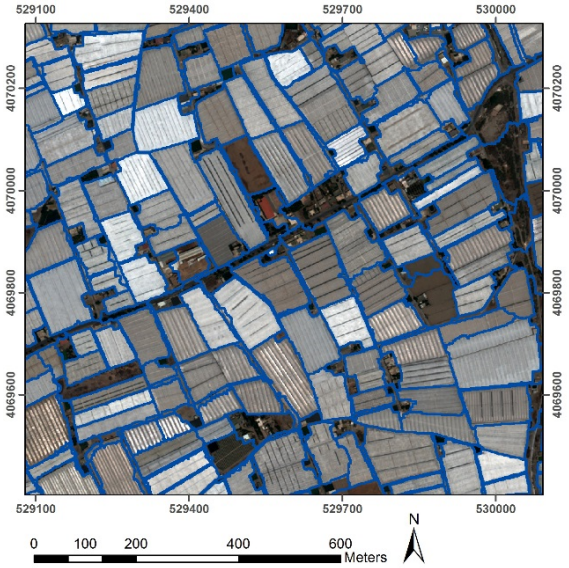
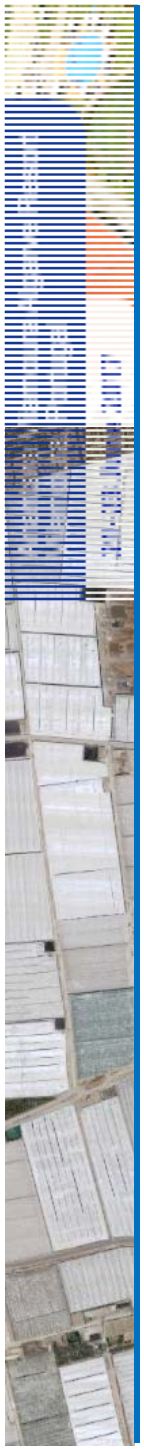
Objectives

To find the best segmentation over plastic greenhouses from a WorldView-3 bundle image (PAN and MS images) under an OBIA framework:

- ✓ Looking for the optimum tuning parameters of MRS algorithm (i.e., scale, shape, compactness and bands combination) in order to delineate plastic greenhouses.
- ✓ Several VHR image sources (WorldView-3 PAN, MS and atmospherically corrected MS orthoimages) are going to be studied also in the case of plastic greenhouses.
- ✓ To study the influence of the number of geometries on the final results.





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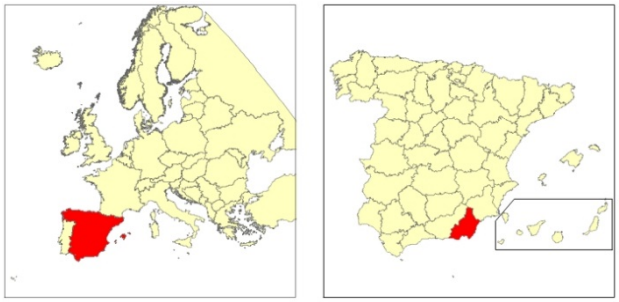
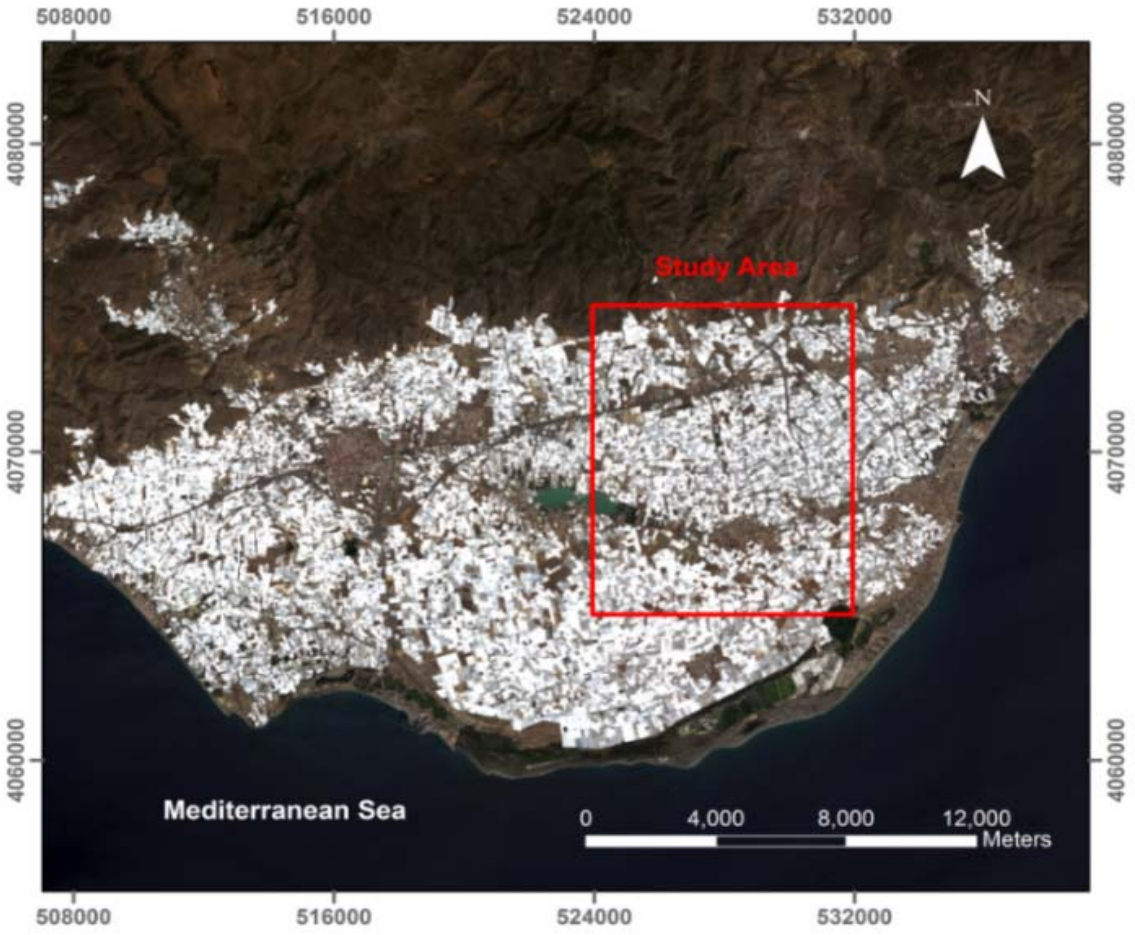
Study site





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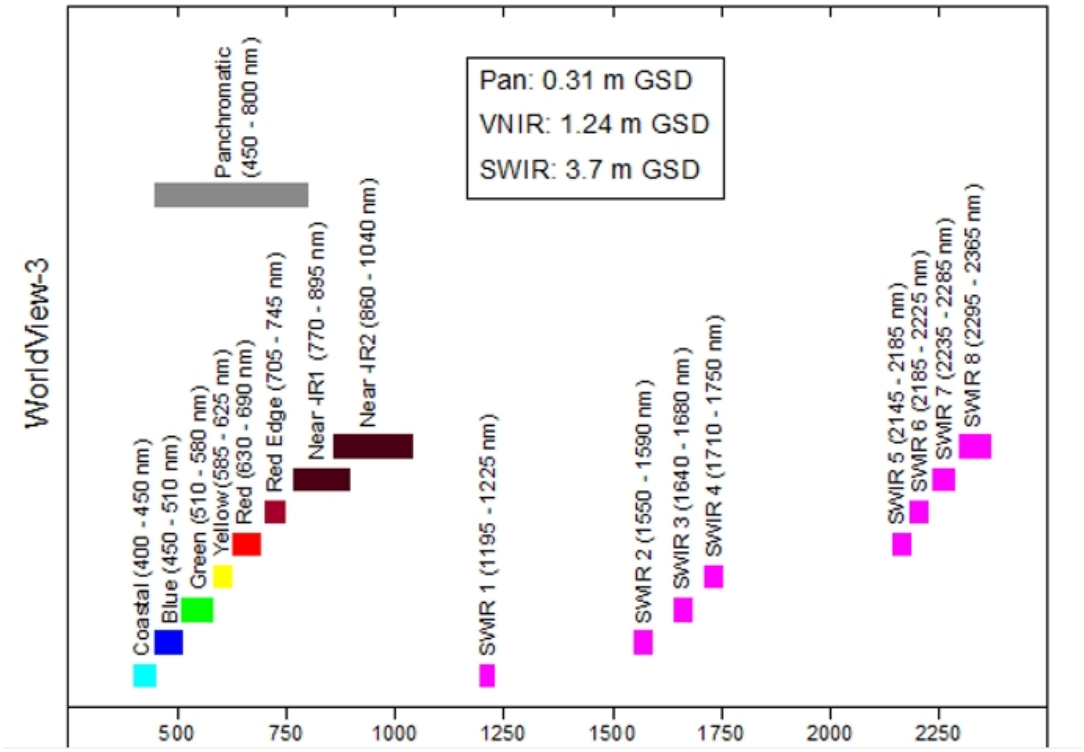
Satellite Image Used

WorldView-3 (WV3)

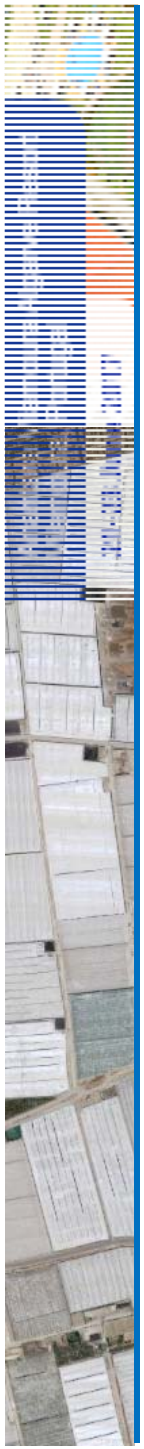
- Launched in August 2014
- 3 days revisit time
- Commercial VHR satellite



11 July 2016

PAN image, 0.3 m GSD

MS image RGB, 1.2 m GSD



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Reference Greenhouses

First step: To digitalize the Reference Greenhouse polygons (100, 200, 300 and 400)

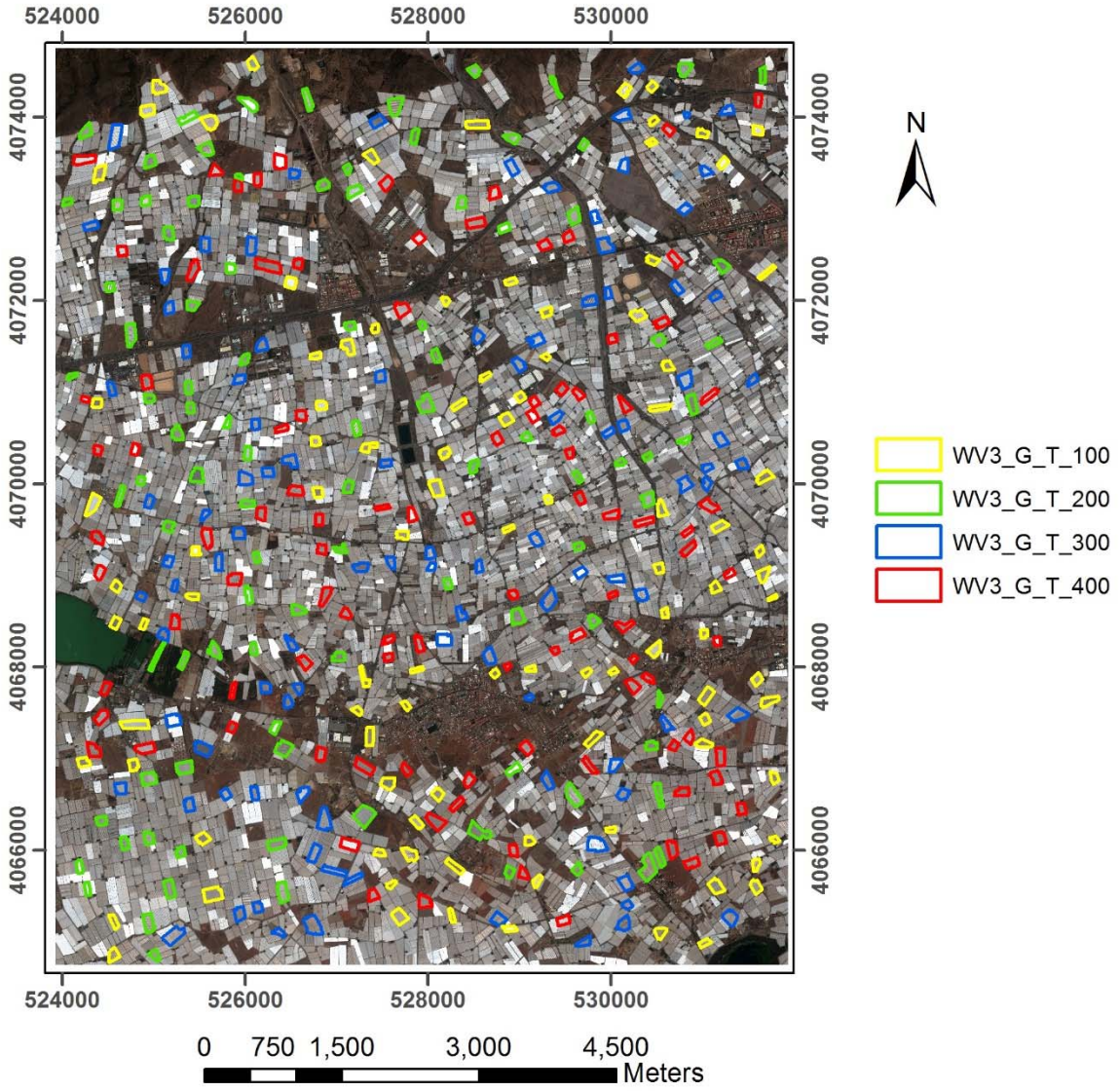
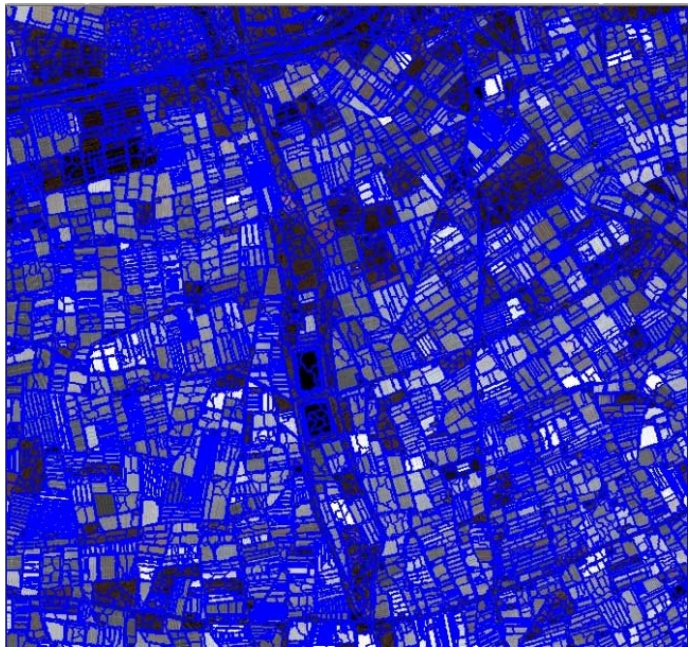


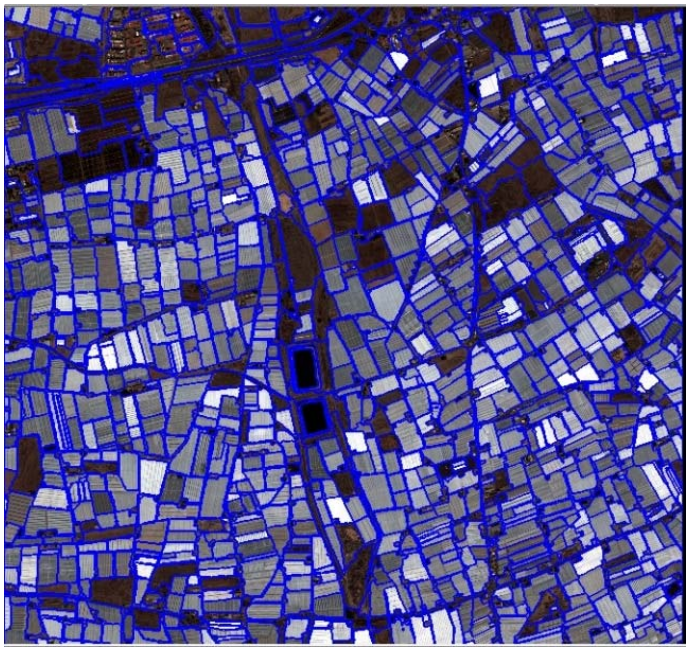
Image Segmentation

Second step: Multiresolution Segmentation (MRS) and eCognition to produce the outputs.

MRS algorithm is controlled by four factors: (i) the **Scale** parameter (SP), (ii) **Shape** (SH), (iii) **Compactness** (CP) and the layer (bands) of information used.



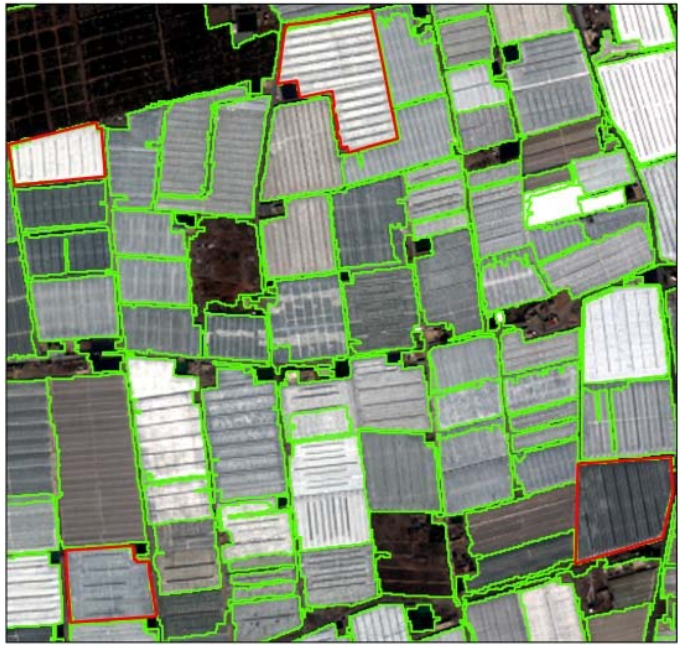
SP=15, SH=0.3, CP=0.5, 8 MS bands



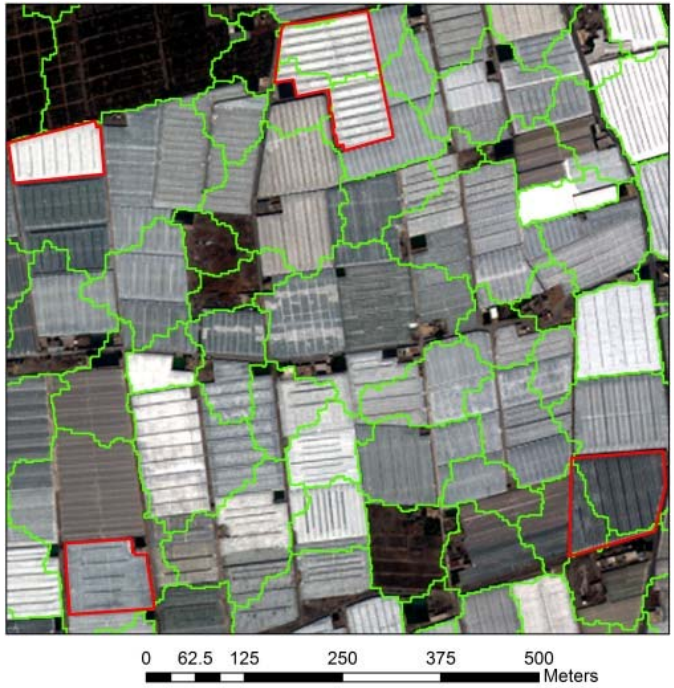
SP=50, SH=0.3, CP=0.5, 8 MS bands

Image Segmentation

Second step: The **image segmentation** using multiresolution segmentation (MRS) included into eCognition. MRS algorithm is controlled by dour factors: (i) the Scale parameter (SP), (ii) Shape (SH), (iii) Compactness (CP) and the layer (bands) of information used.



SP=50, **SH=0.1**, CP=0.5, 8 MS bands

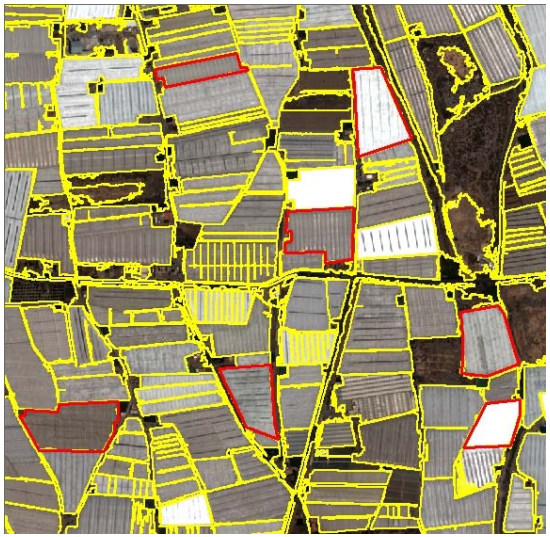


SP=50, **SH=0.9**, CP=0.5, 8 MS bands

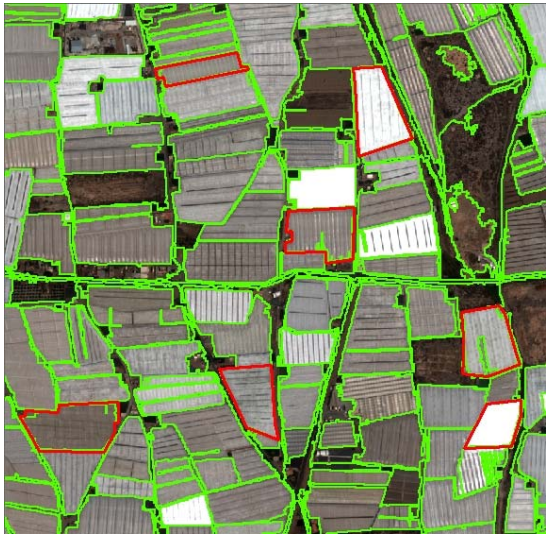
Image Segmentation

Second step: Thousands of segmentations from applying MRS algorithm were generated for three WV3 orthoimages (SP step 1; SH from 0.1 to 0.5 step 0.1; CP=0.5, Bands BGNIR2):

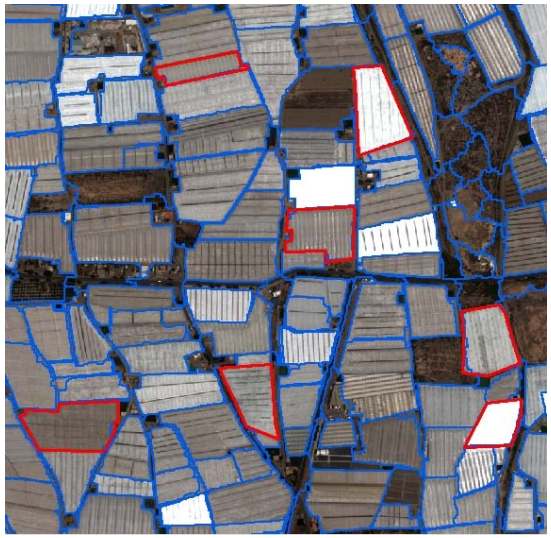
(i) PAN Orthoimage, 0.3 m GSD
(ii) MS Orthoimage with original DN
(iii) MS Orthoimage atmospherically corrected (ATCOR).



PAN SP=1101, SH=0.4,
CP=0.5, PAN



MS SP=195, SH=0.5,
CP=0.5, BGNIR2

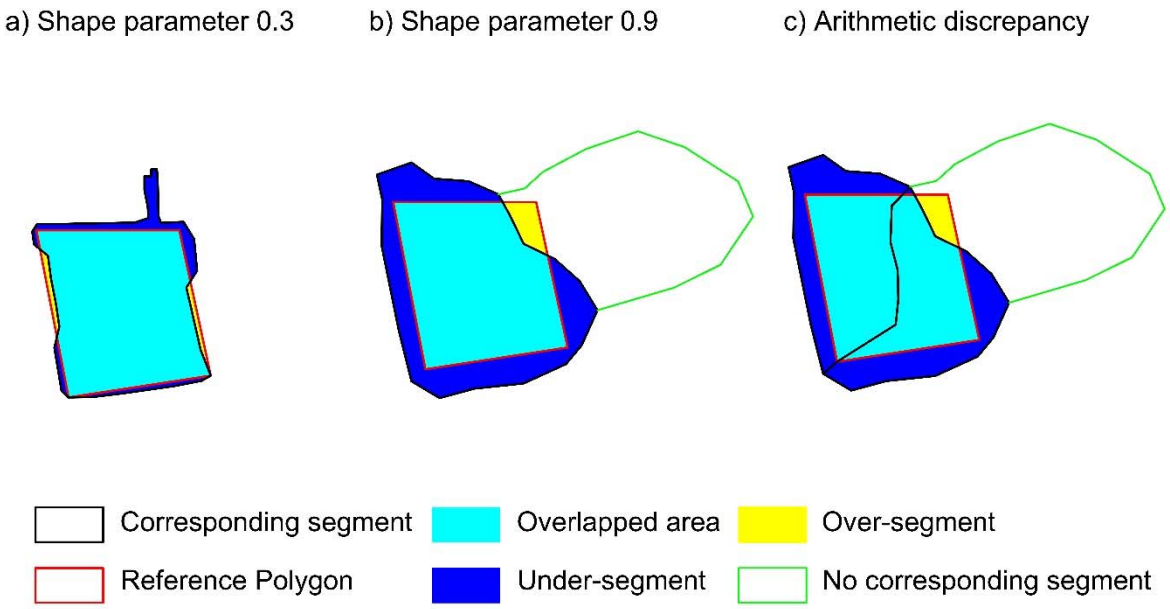


MS ATCOR SP=50, SH=0.4,
CP=0.5, BGNIR2

What segmentation is the best?

Segmentation Assessment

AssesSeg Tool



It is based on a modified version of **ED2** supervised discrepancy measure proposed by Liu et al. (2012).

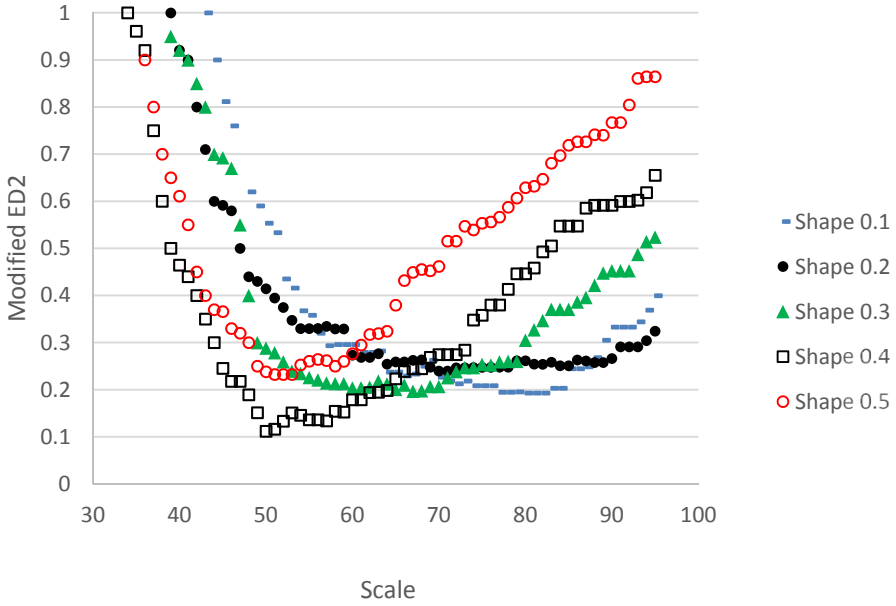
It tries to optimize in a two dimensional Euclidean space both the **geometrical discrepancy** (by mean of the potential segmentation error, **PSE**) and also the **arithmetic discrepancy** between image objects and reference polygons (by using the number-of-segmentation ratio, **NSR**)

$$ED2 = \sqrt{(PSE)^2 + (NSR)^2}$$

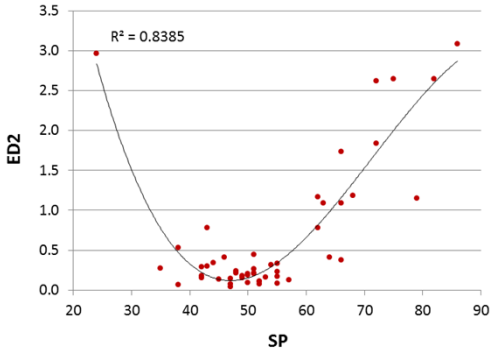
Novelli et al., 2017. **AssesSeg - A command line tool to quantify digital image segmentation quality: a test carried out in southern Spain from Satellite imagery**. Remote Sensing.

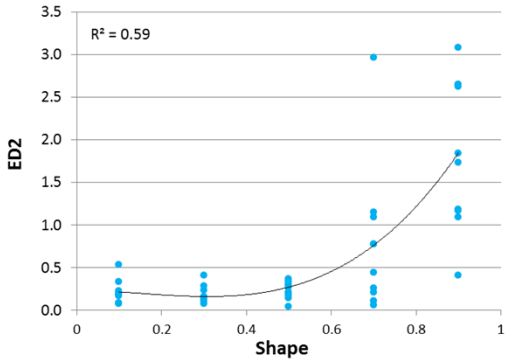
Results

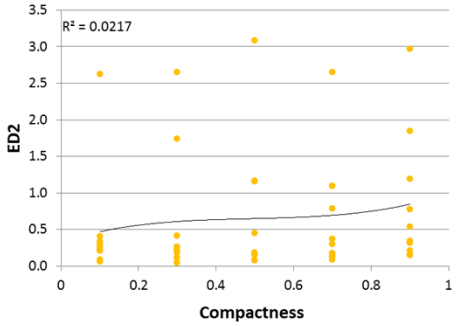
Ideal MRS outputs achieved with the different image sources (WV3) tested for each set of RG.

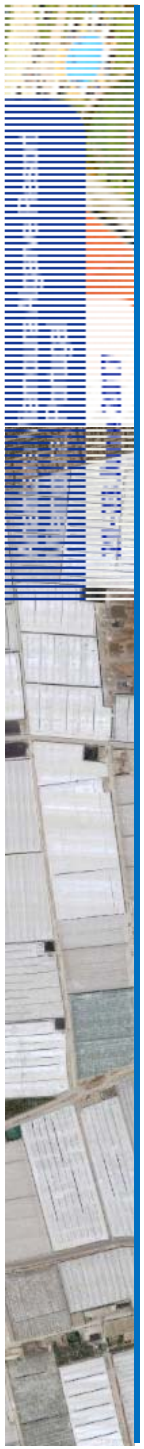


Modified ED2 computed by using AssesSeg for all the MRS outputs from MS ATCOR orthoimage and 100 reference geometries. The best segmentation turned out to be the attained by Scale = 50 and Shape = 0.4









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Results

Image source, Nº of Reference Geometries and combination bands??

Ideal MRS outputs achieved with the different image sources (WV3) tested for each set of RG.

Image Source	No. Reference Geometries	Ideal Segmentation Parameters			Modified ED2
		Scale	Shape	Compactness	
MS (used bands: Blue-Green-NIR2)	400	210	0.5	0.5	0.205
	300	221	0.5	0.5	0.207
	200	220	0.5	0.5	0.193
	100	195	0.5	0.5	0.221
MS ATCOR (used bands: Blue-Green-NIR2)	400	60	0.4	0.5	0.141
	300	68	0.3	0.5	0.146
	200	68	0.3	0.5	0.129
	100	**50**	**0.4**	**0.5**	**0.112**
PAN (used band: PAN)	400	1152	0.4	0.5	0.183
	300	1150	0.4	0.5	0.178
	200	1099	0.4	0.5	0.179
	100	1101	0.4	0.5	0.203

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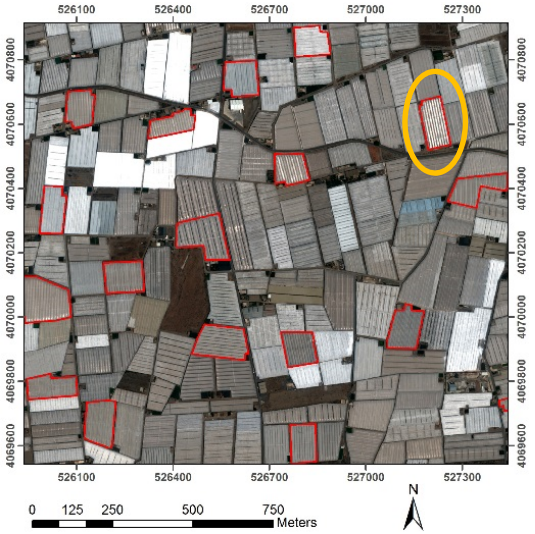
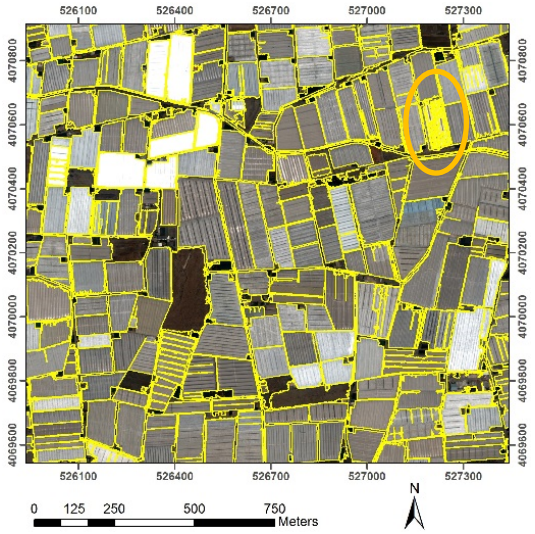
Results

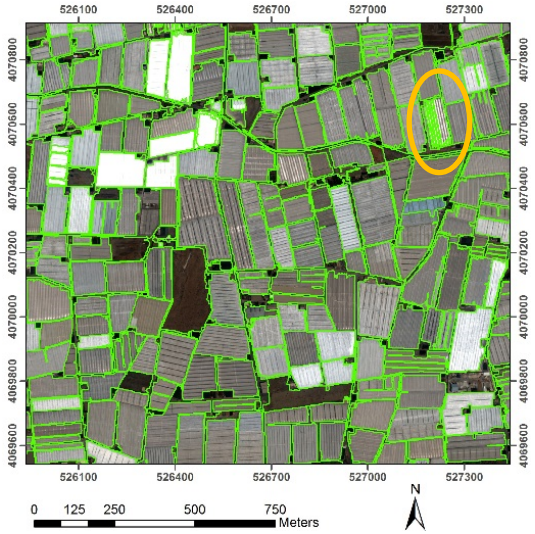
Image source, Nº of RG and combination bands??



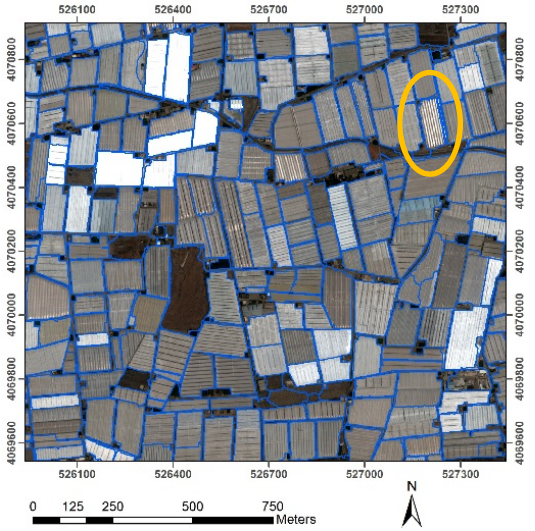
Reference geometries (Red polygons)



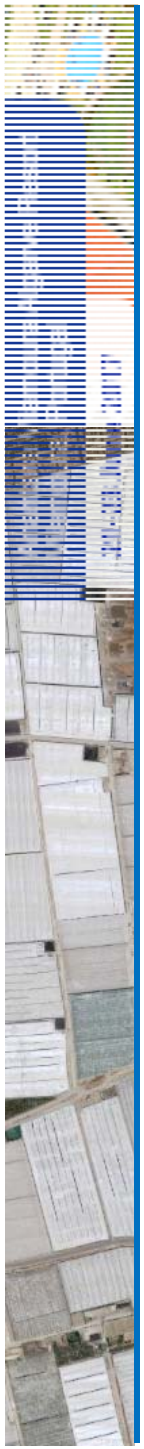
Ideal segmentation from WV3 PAN orthoimage. ED2=0.20



Ideal segmentation from WV3 MS orthoimage. ED2=0.22



Ideal segmentation from WV3 MS ATCOR orthoimage. ED2=0.11



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Conclusions

- ✓ WV3 MS ATCOR corrected orthoimage was the best image data source to attain the best greenhouses segmentation according to the modified ED2 metric including into AssesSeg.
- ✓ Modified ED2 metric presented a very good agreement with the visual quality of the greenhouse segmentations. AssesSeg allowed easily checking a high number of MRS parameters combinations.
- ✓ The number of reference geometries to compute ED2 should be much higher than 30. In fact, when the class to be segmented is very heterogeneous, sets of references higher than 200 should be considered.

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Research Group RNM-368
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Thanks for your attention

Manuel Ángel Aguilar

Senior Lecturer , Department of Engineering, University of Almeria, Spain

Research Group: Integrated Land Management and Spatial Information Technologies

http:// www.ual.es/personal/maguilar