Monitoring Land Use Change in urban areas with Copernicus Land datasets

David García Álvarez

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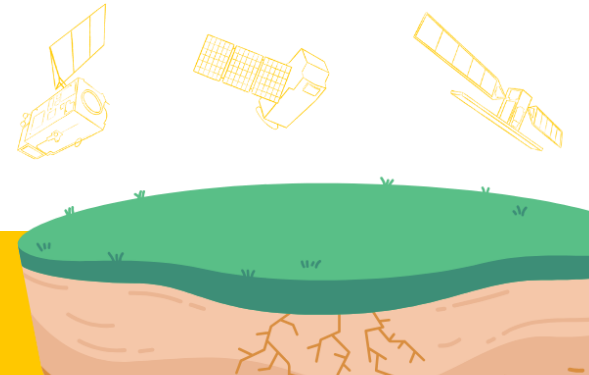


David García Álvarez

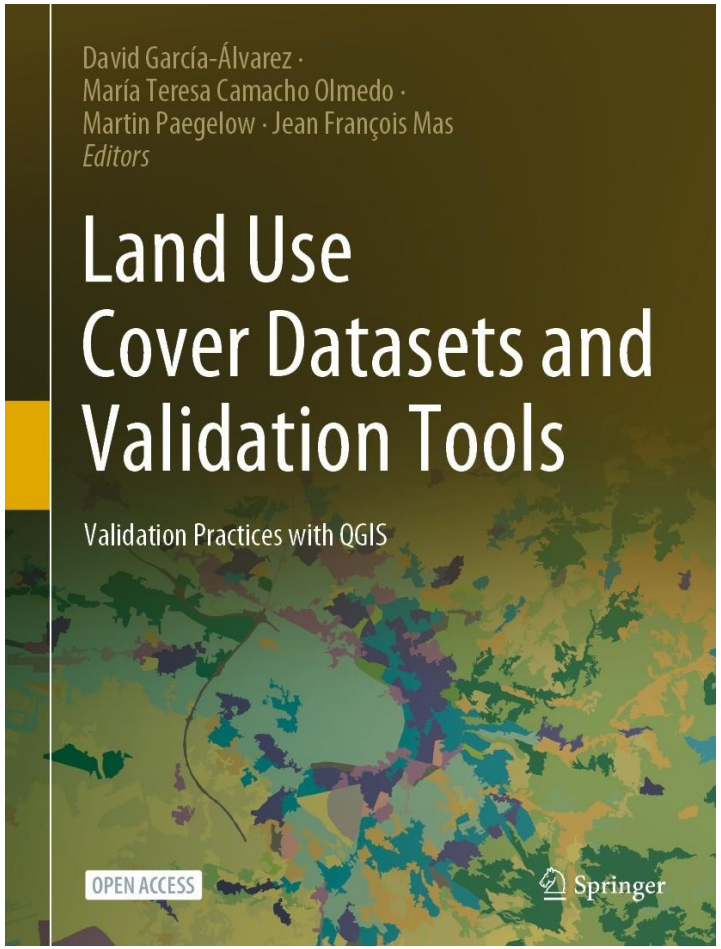
UNIVERSIDAD COMPLUTENSE MADRID

CV

- Assistant Professor at Complutense University of Madrid
- Expert for the Knowledge Centre on Earth Observation (JRC, European Commission)

Research lines

- Land Use Change analysis in urban and rural areas
- Pattern based Land Use Cover Change models
- Uncertainty in Land Use Cover mapping and modelling
- Review and comparison of Land Use Cover datasets



Available open access at: https://link.springer.com/book/10.1007/978-3-030-90998-7

Monitoring Land Use Change in urban areas

HOW?

Own developed datasets

Fit for purpose

Methods: Remote sensing, photointerpretation, auxilliary datasets

Require time investment

Reusable?

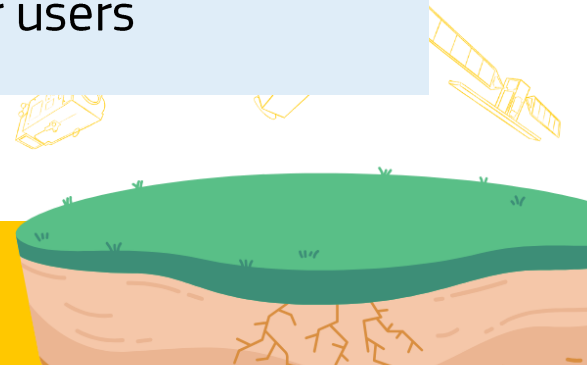
Available standard datasets

Comparability

Reusable

Validated

Experience provided by other users

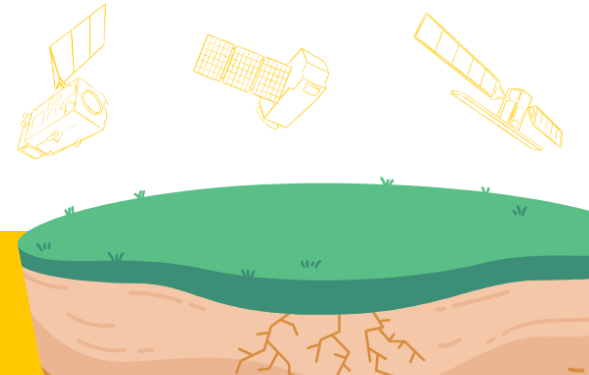


Monitoring Land Use Change in EUROPEAN urban areas

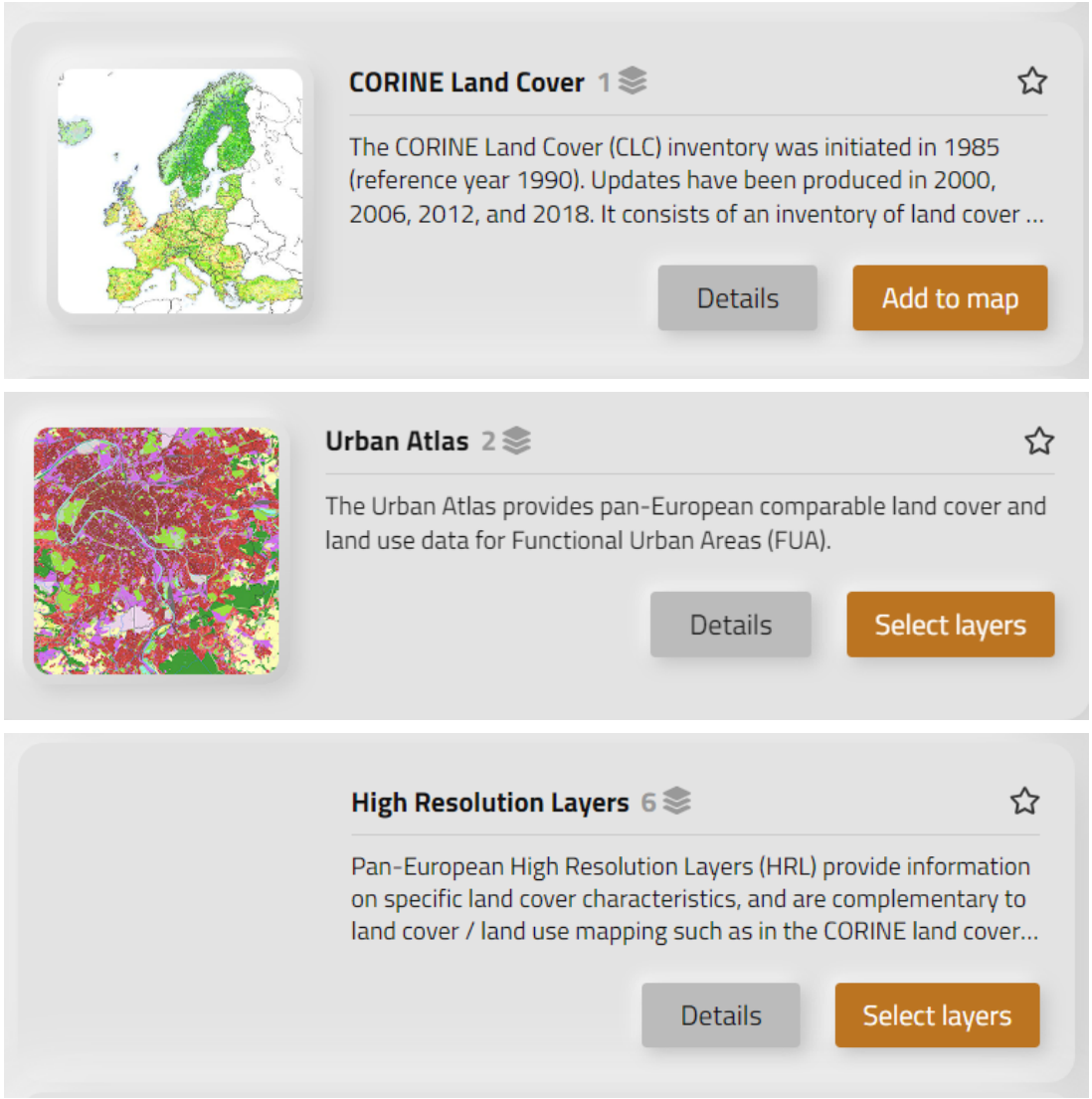
https://www.copernicus.eu/en

https://land.copernicus.eu/en

https://www.wekeo.eu/



Products available in



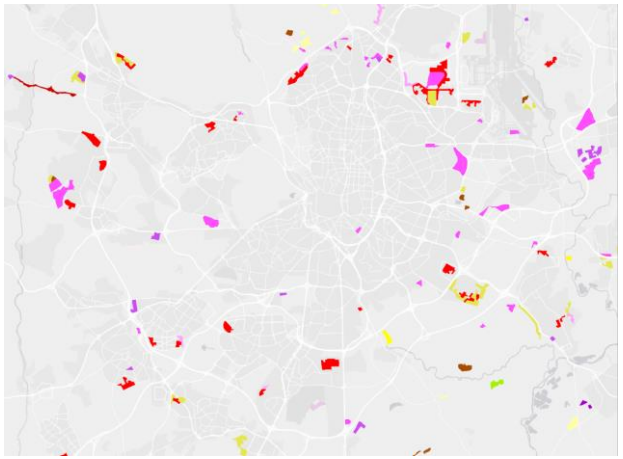
Other products of interest

- European Settlement map
  2012, 2015 | 2 2.5m | Urban / Non urban and +
- Global Urban Land
  1980 2015 | 30m | Urban / Non urban
- Global Human Settlement Layer (GHSL)
  1975 2018 | 10 30m | Urban / Non urban
- Global Artificial Impervious Areas (GAIA)
  1985 2018 | 30m | Urban / Non urban
- Global Urban Footprint (GUF)
  2011 | 12m | Urban / Non urban
- World Settlement Footprint (WSF)
  1985 2019 | 10m | Urban / Non urban | %Urban (100m)
- ... and many more (check here

**Check additional national and regional products as well for local studies!

Recommended for...

- General and cross country analyses of Land Use / Cover change in European cities
- General trend analyses at coarse levels of spatial and thematic detail



Layer of changes to study Land Use Cover change

Years

90, 00, 06, 12, 18
Updated every 6 years

Extent

39 European countries (last update)

Spatial Detail

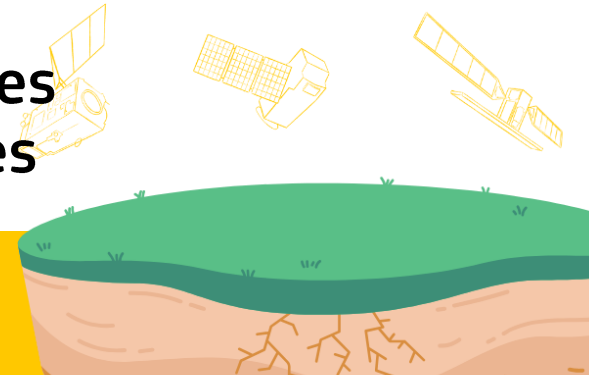
Scale of reference (1:100.000)
Minimum Mapping Unit of 25ha (5ha for changes)
Minimum Mapping Width of 100 m

Format

Vector (gdb, geopackage
Raster available (spatial resolution of 100m)

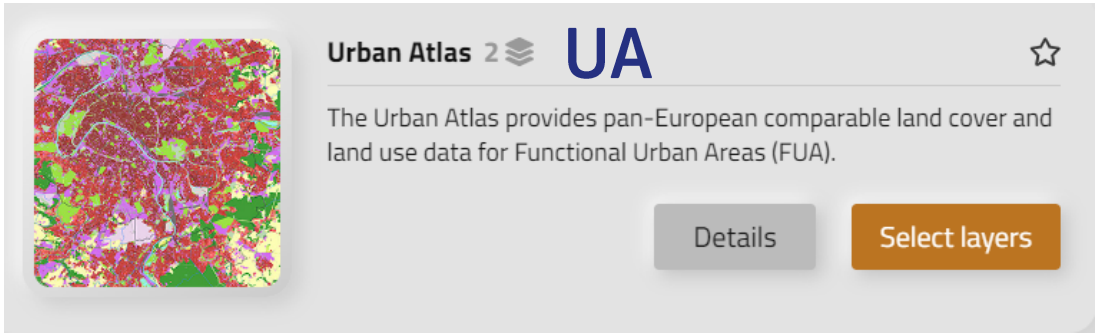
Thematic detail

39 Land Use / Cover categories
of which 11 artificial categories



Recommended for...

- Detailed analyses of European Functional Areas
- Analyses of Land Use intensity



Layer of changes to study Land Use Cover change

Years

06, 12, 18
Updated every 6 years

Extent

Functional Urban Areas of 39 European countries

Spatial Detail

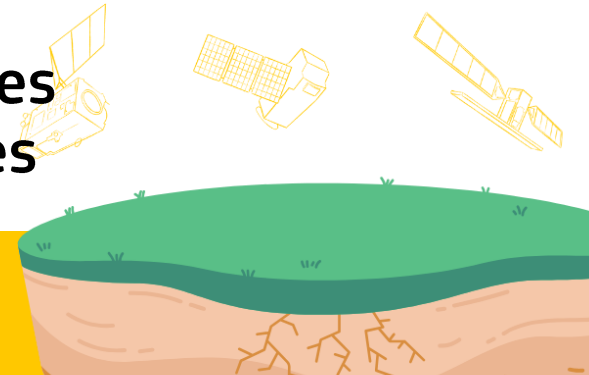
Scale of reference (1:10.000)
Minimum Mapping Unit of 0.25ha for urban areas and 0.1ha for urban changes
Minimum Mapping Width of 10 m

Format

Vector (gdb, geopackage

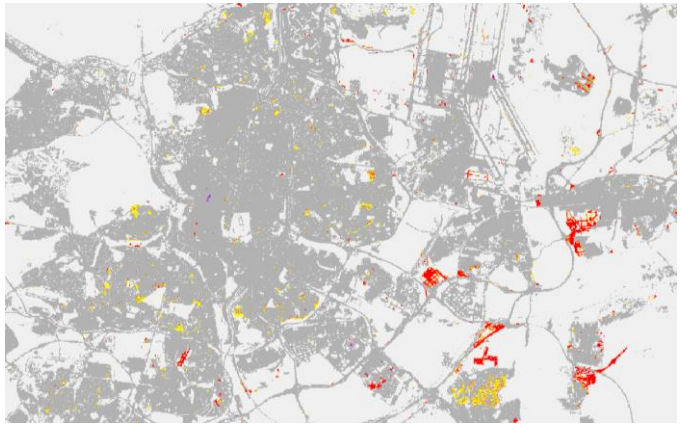
Thematic detail

29 Land Use / Cover categories
of which 17 artificial categories



Recommended for...

- Analyses of Land Cover change and intensity at very detailed scales
- Analyses of the urban footprint, independent of the land uses



Layer of changes to study Land Use Cover change

Years

06, 09, 12, 15, 18
Updated every 3 years

Extent

39 European countries

Spatial Detail

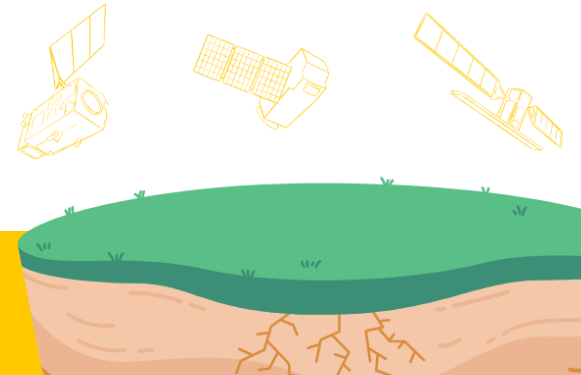
10 20m

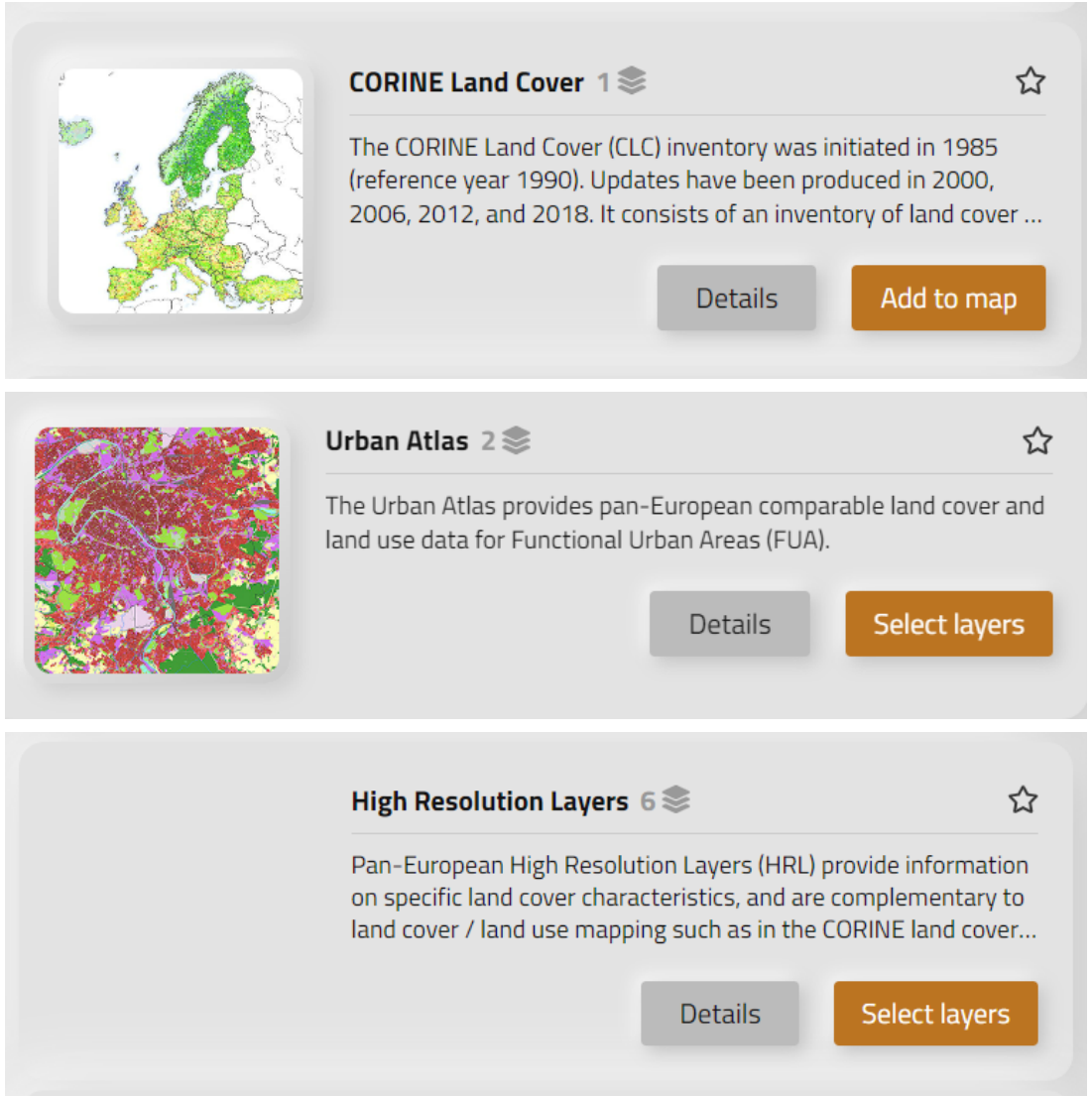
Format

Raster (.tiff)

Thematic detail

% imperviousness

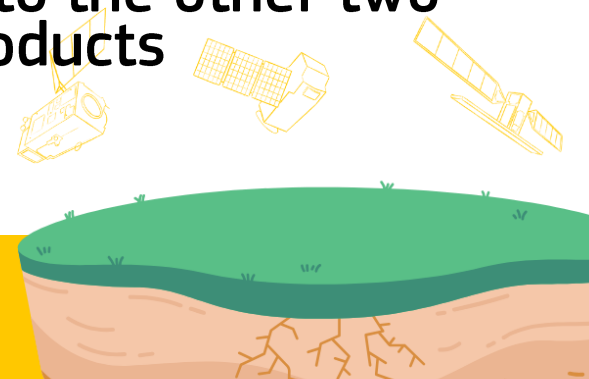




3 scales of analaysis

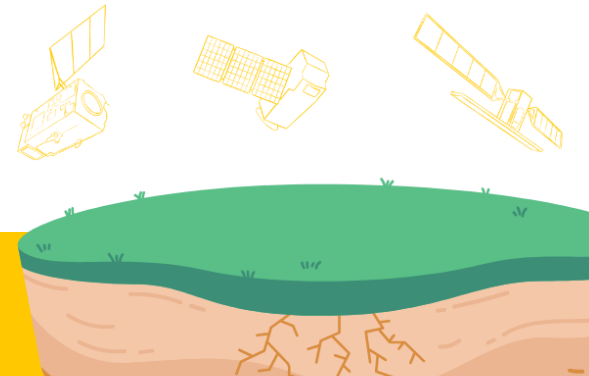
Potential for validation exercises and fine scale profile analyses of Land Use / Cover datasets

CLC and UA provide similar information at different levels of spatial detail.
HRL provide complementary information to the other two products

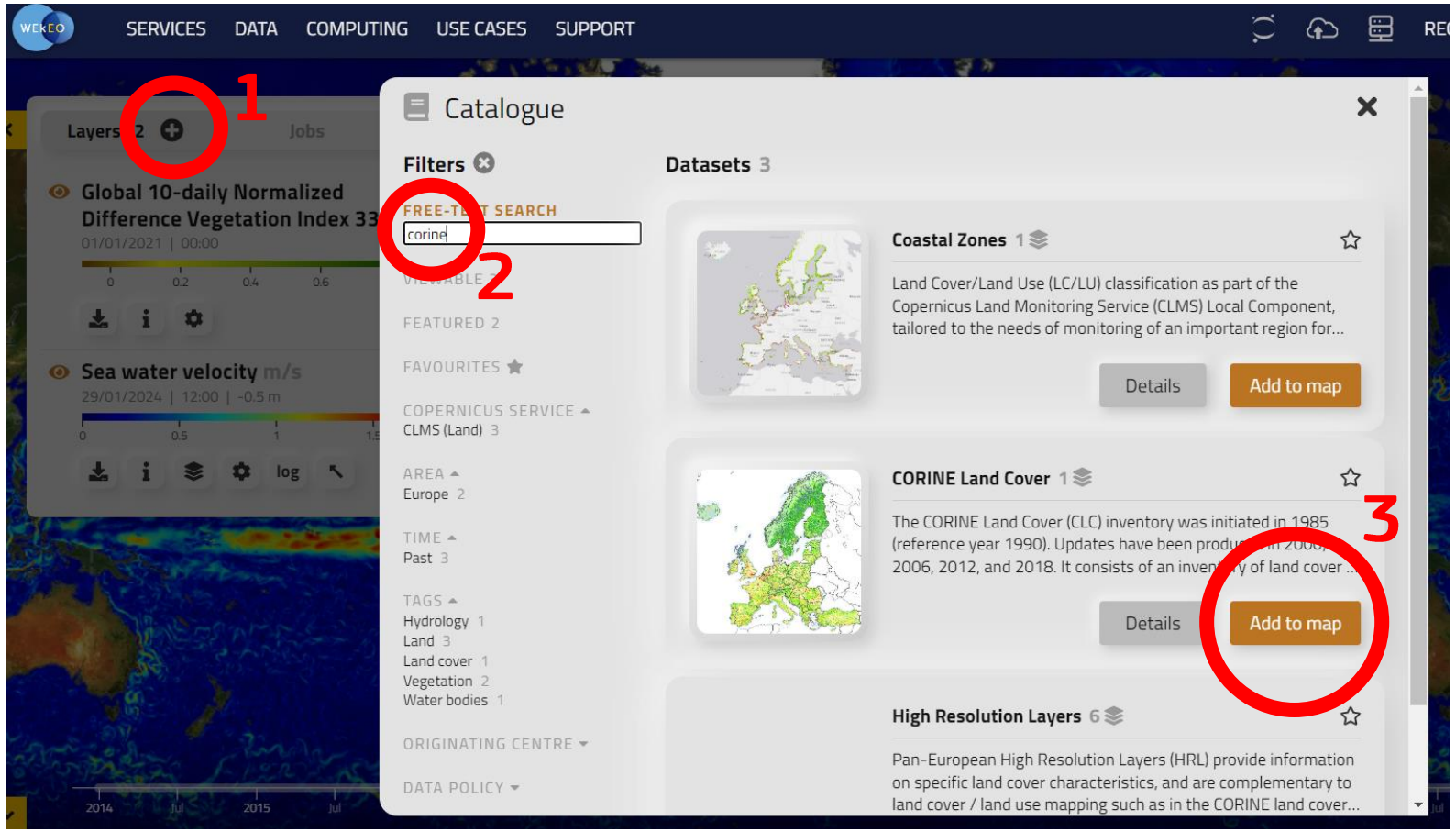


Practical case

Monitoring Land Use Change in Madrid Functional Urban Area at three scales of analysis



Download datasets in WEkEO data viewer



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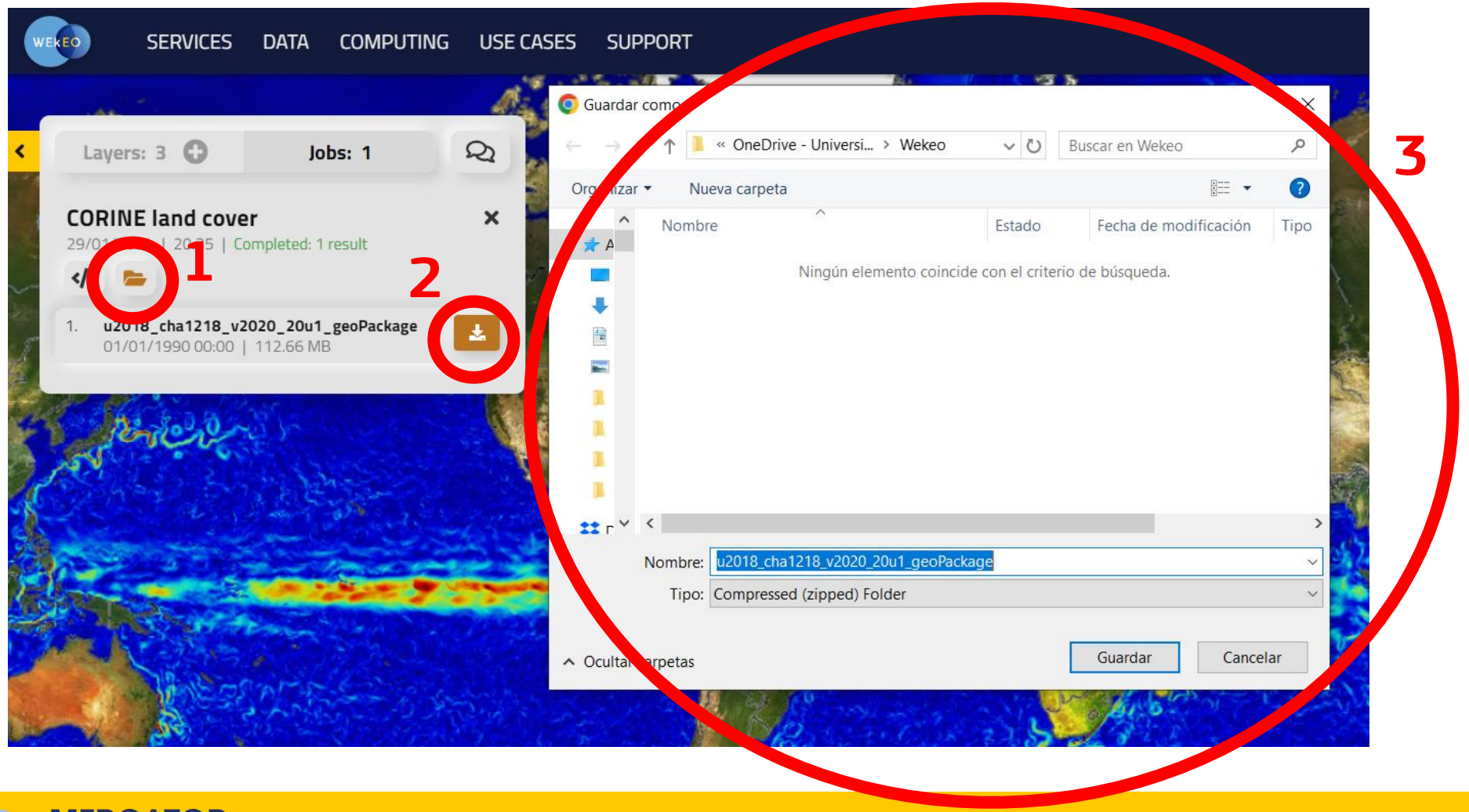

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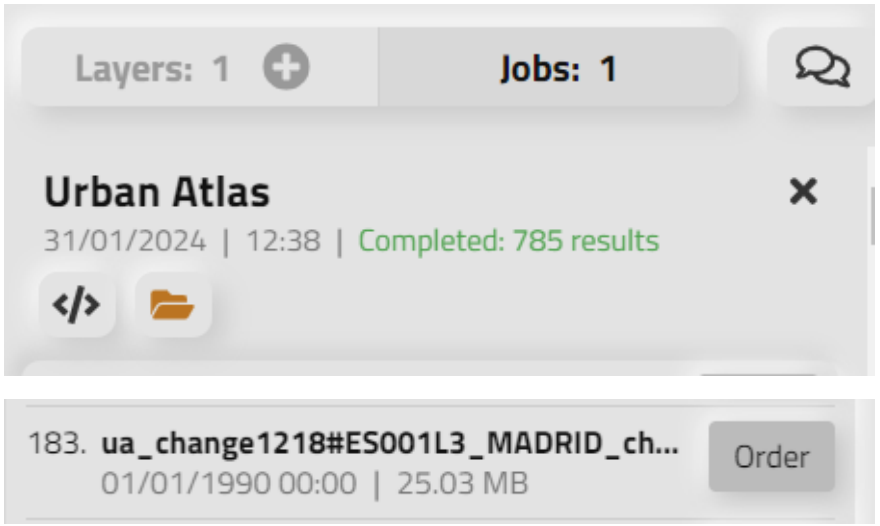

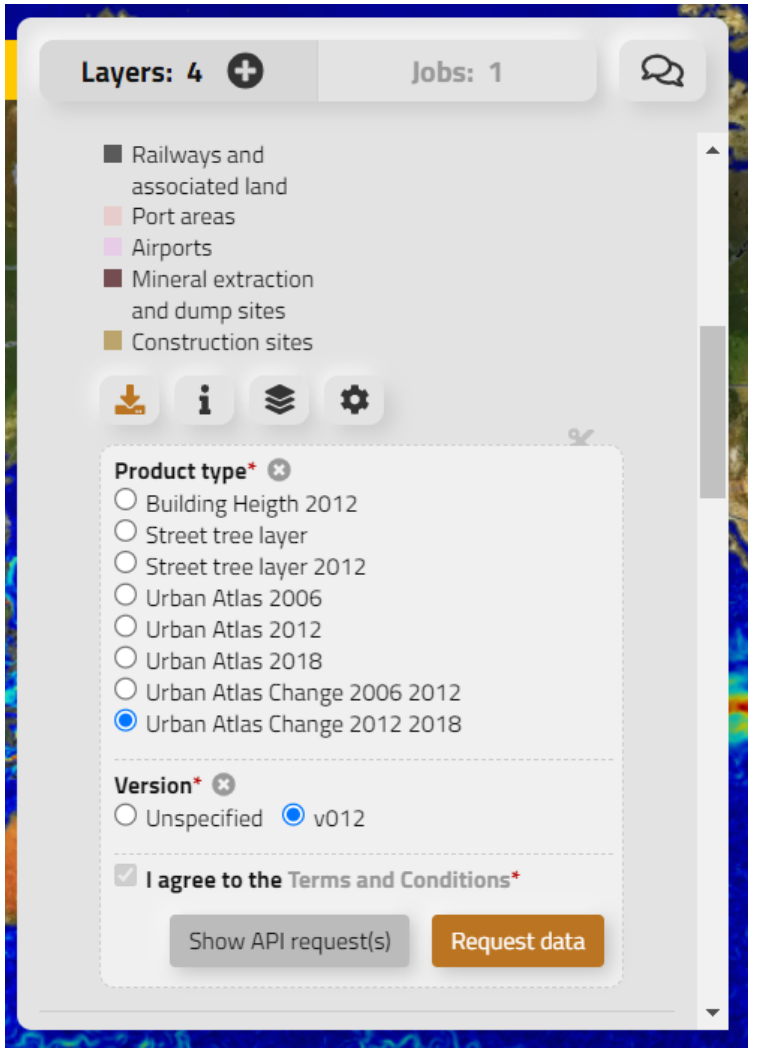

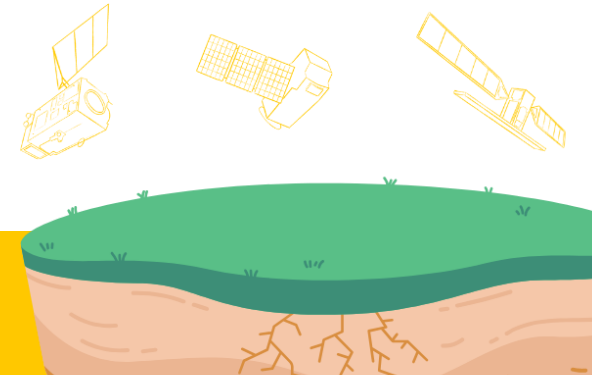

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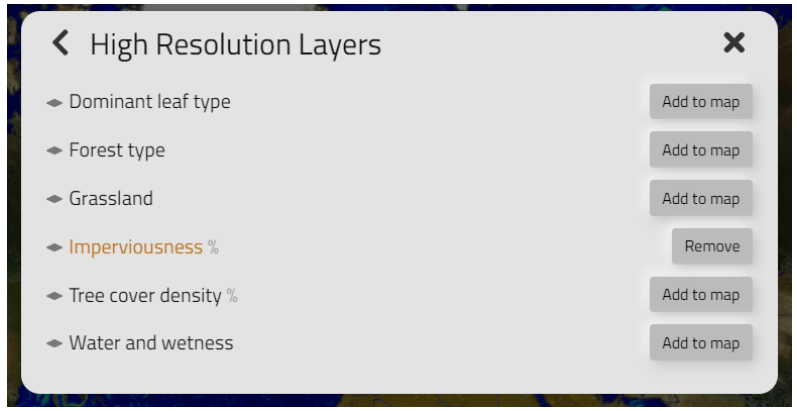

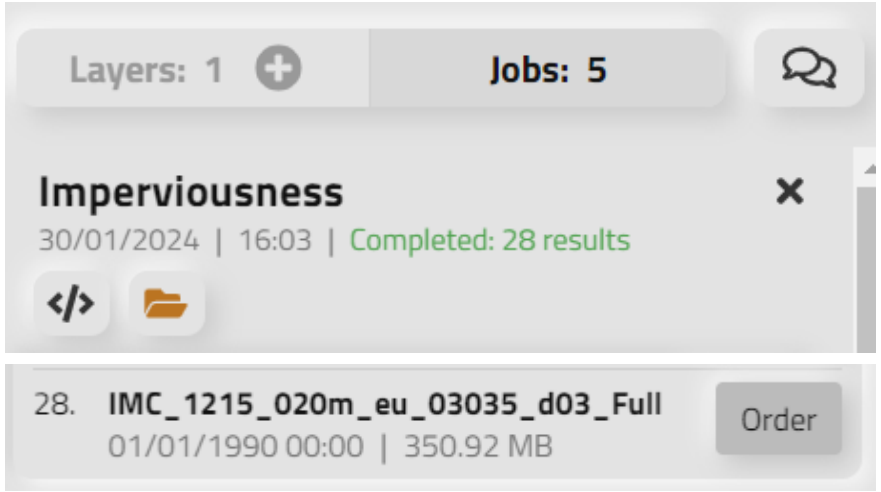

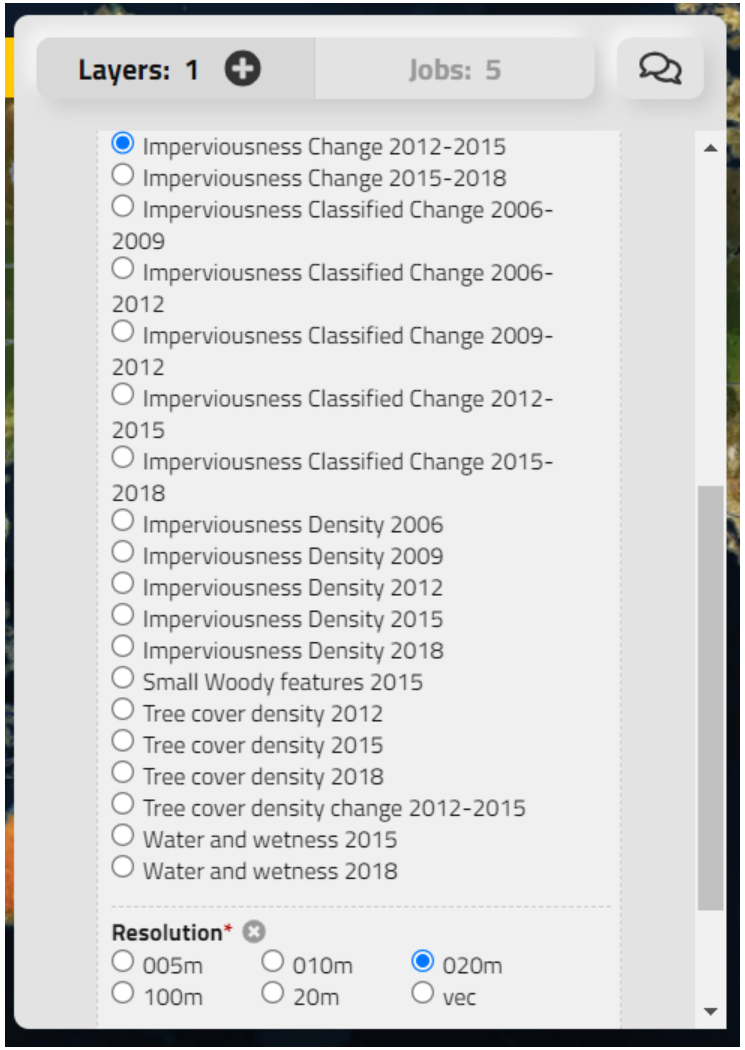

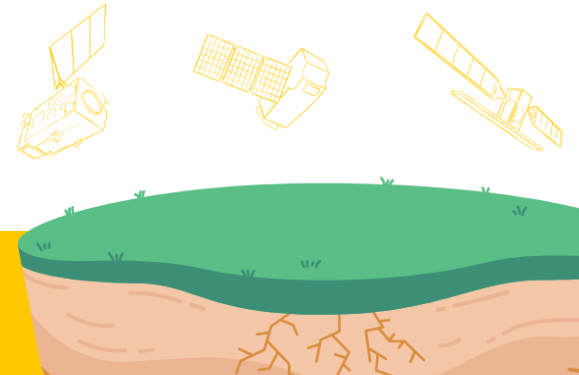

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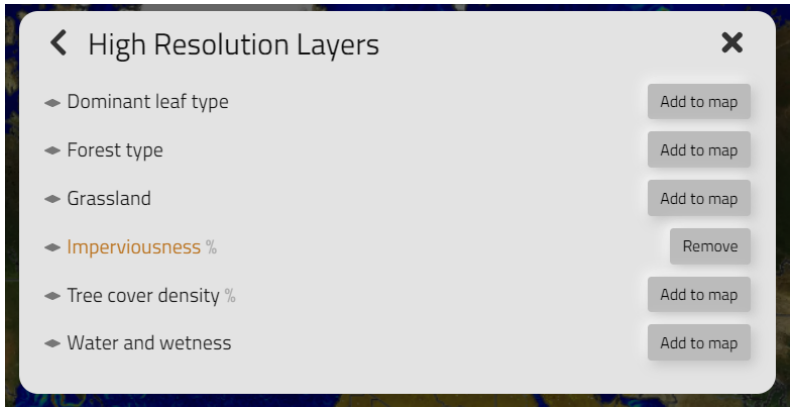
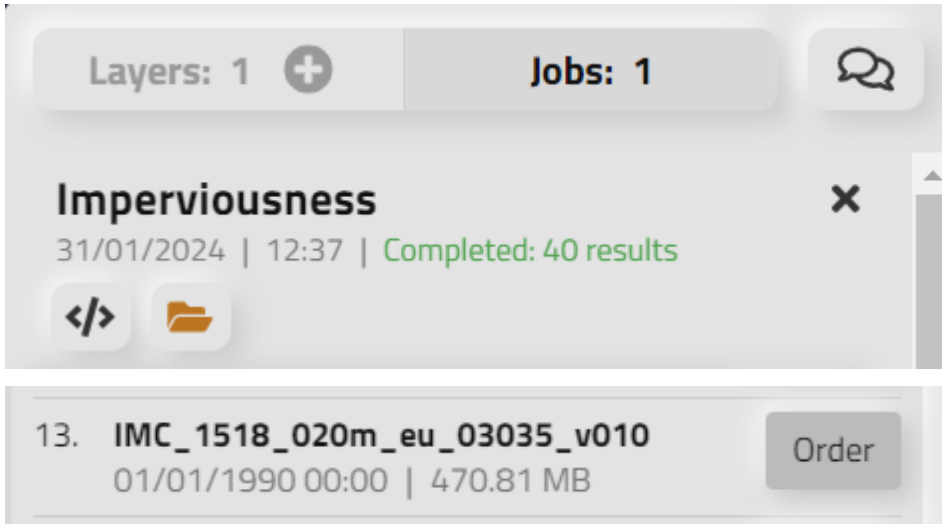
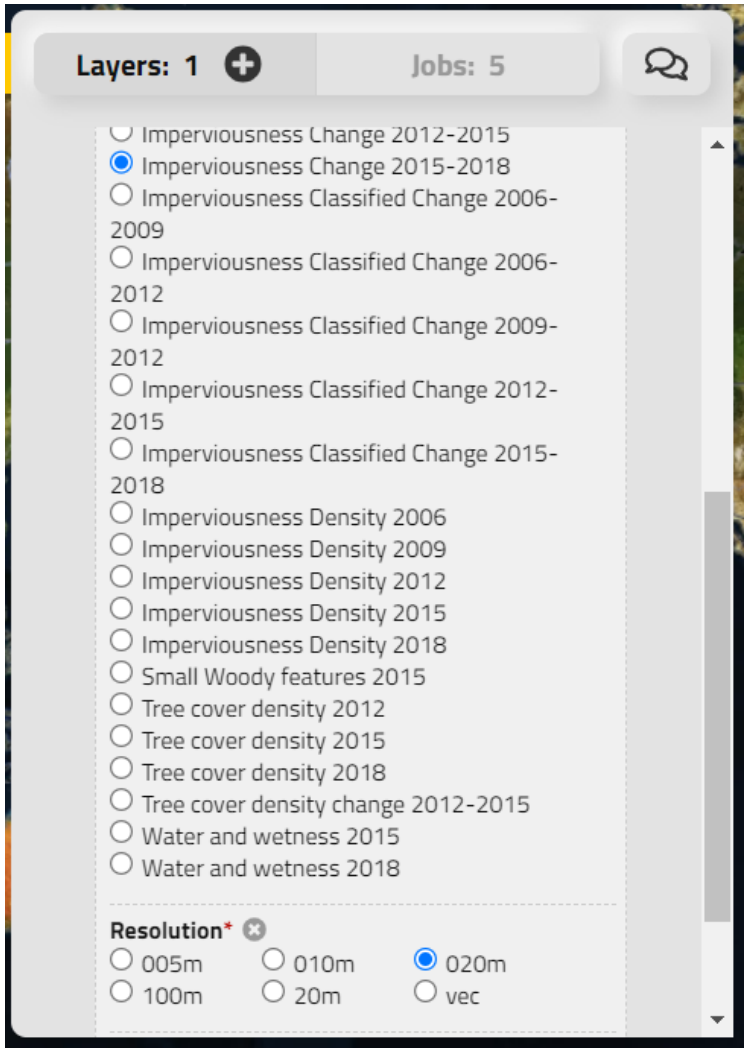
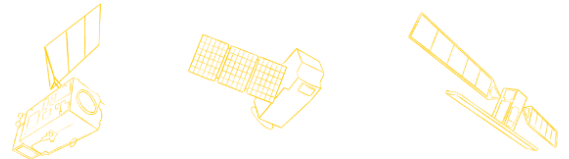
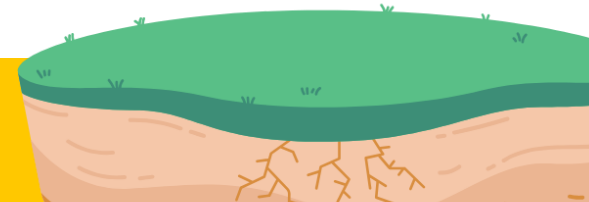


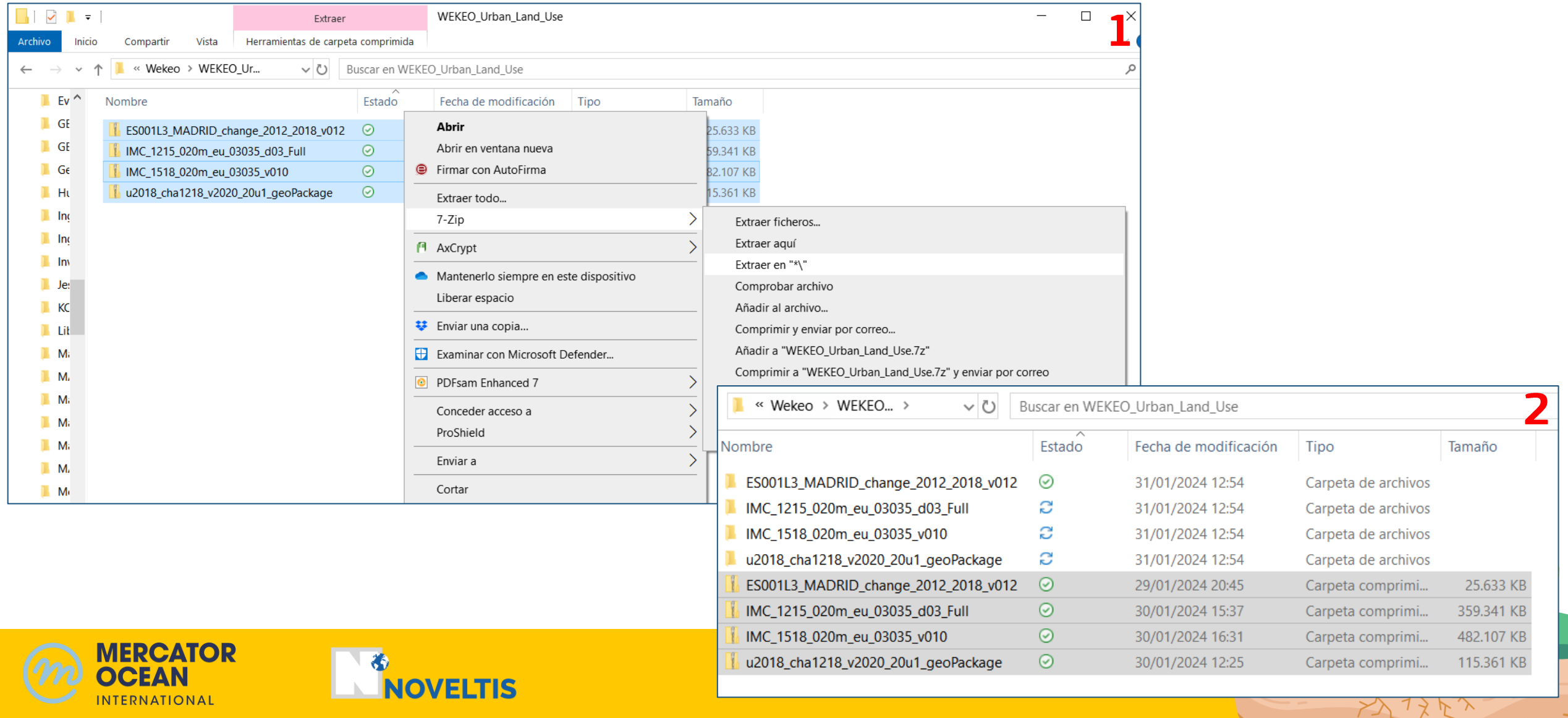








Unzip files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Estado
Fecha de modificación
Tipo
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Abrir en ventana nueva
Firmar con AutoFirma
Extraer todo...
7-Zip
AxCrypt
Mantenerlo siempre en este dispositivo
Liberar espacio
Enviar una copia...
Examinar con Microsoft Defender...
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Cortar
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Extraer en "*\"
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Añadir al archivo...
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2
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Estado
Fecha de modificación
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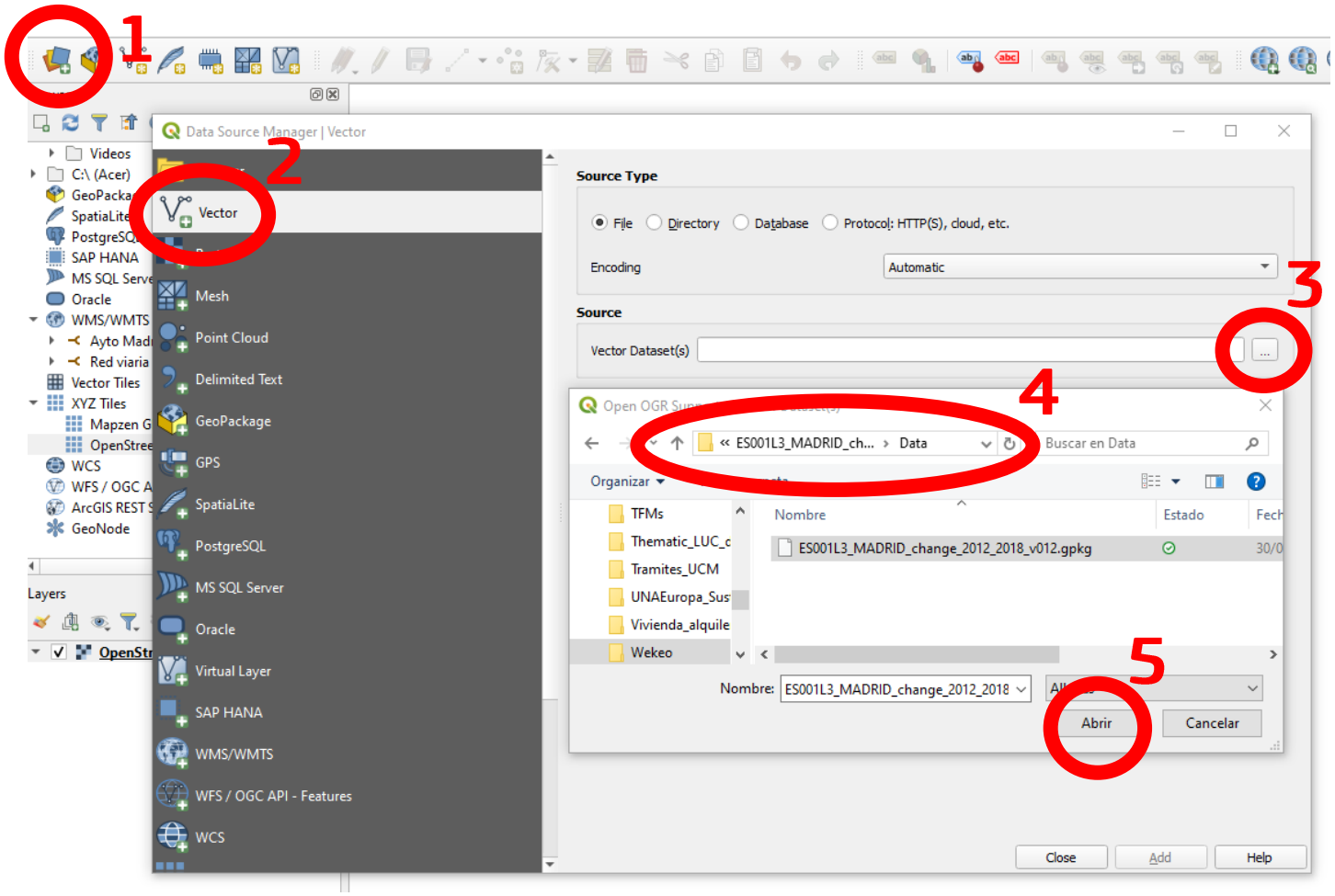
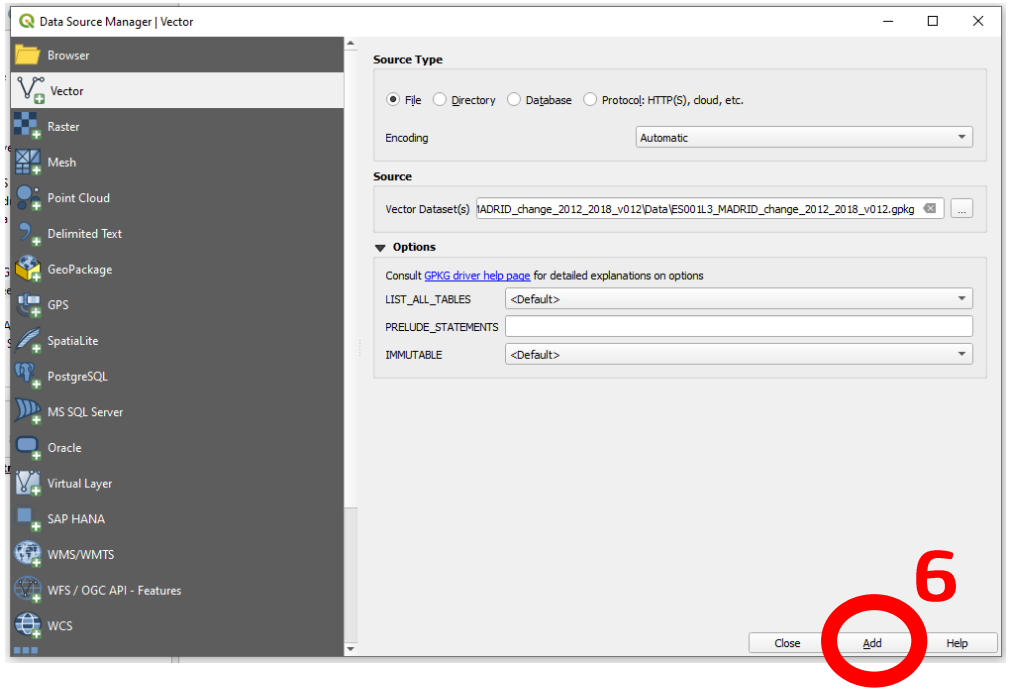
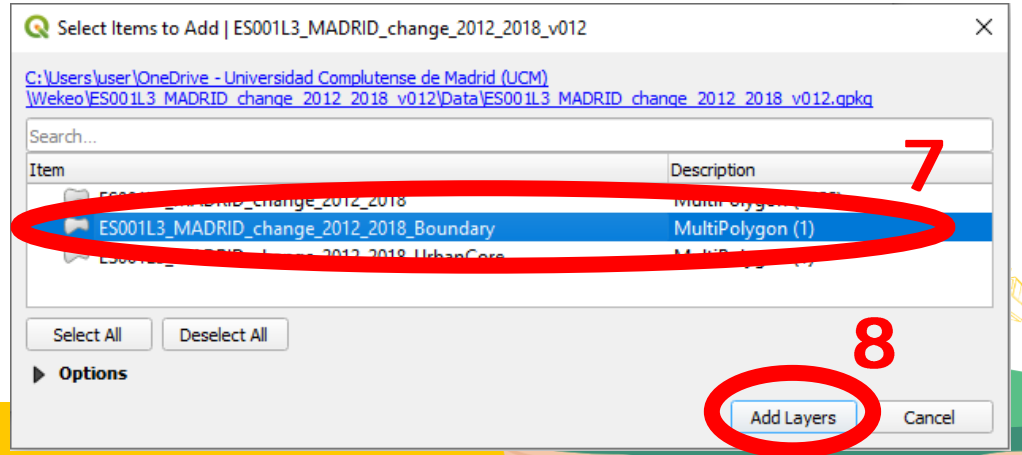
Boundary of Madrid FUA for clipping data
(CLC and HRL Imperviousness)







Boundary of Madrid FUA for clipping data
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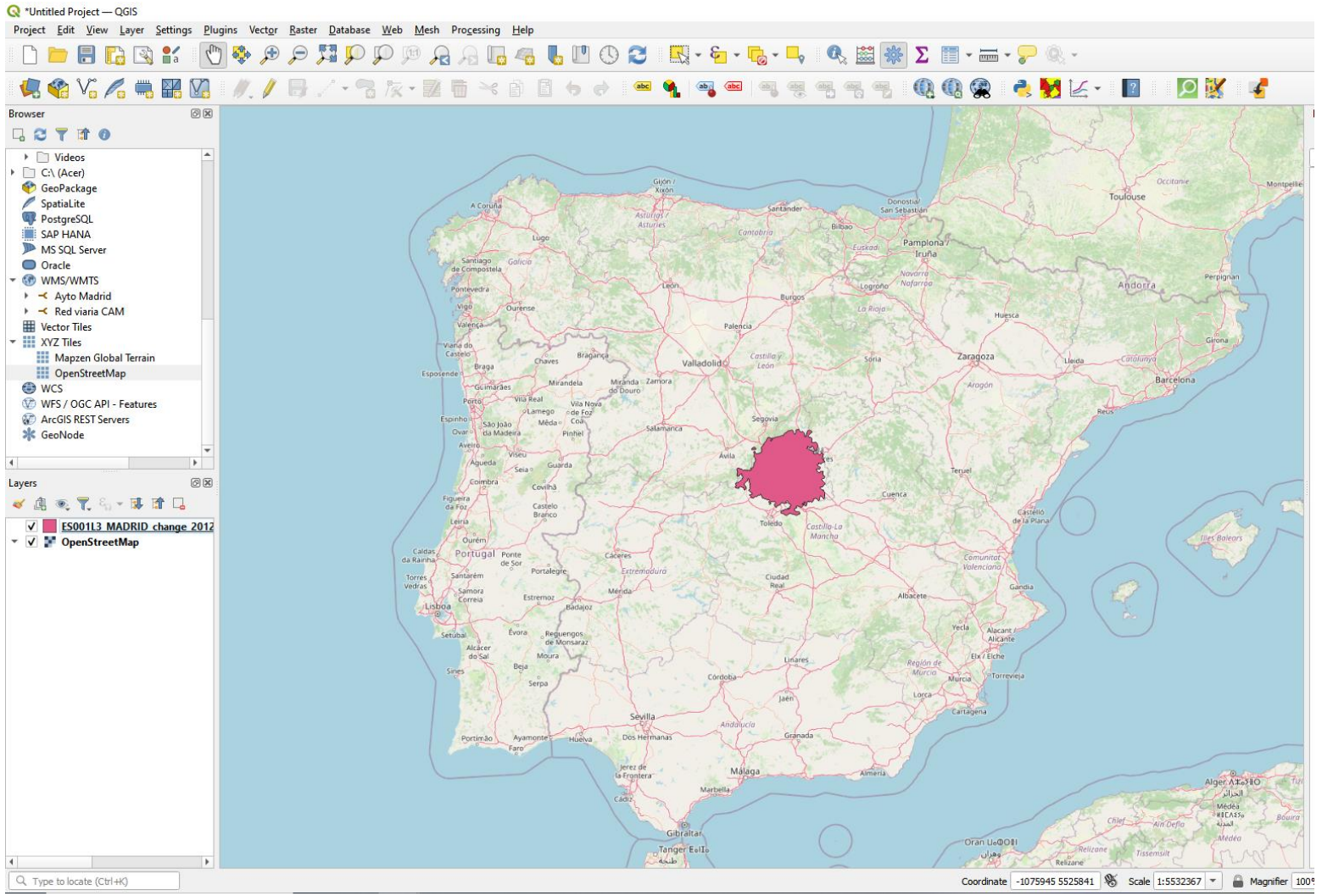

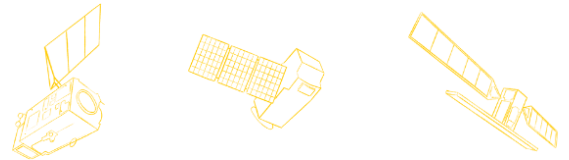

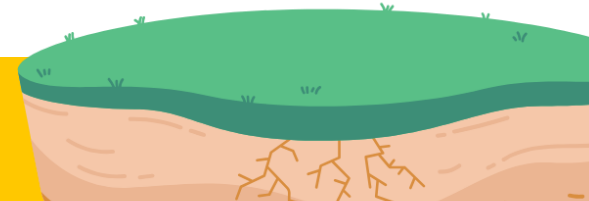

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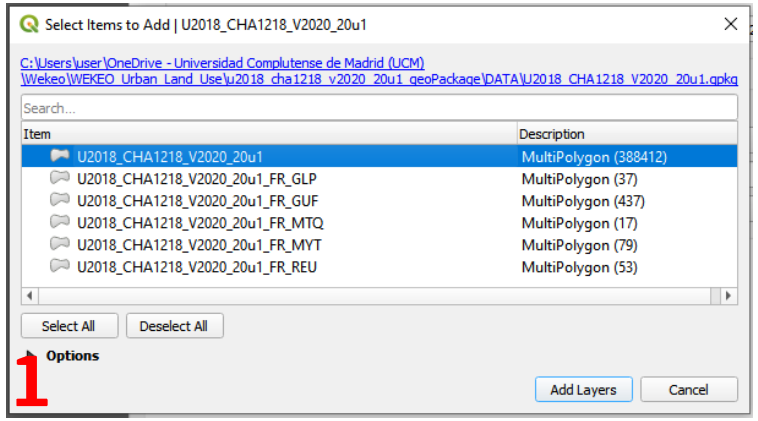

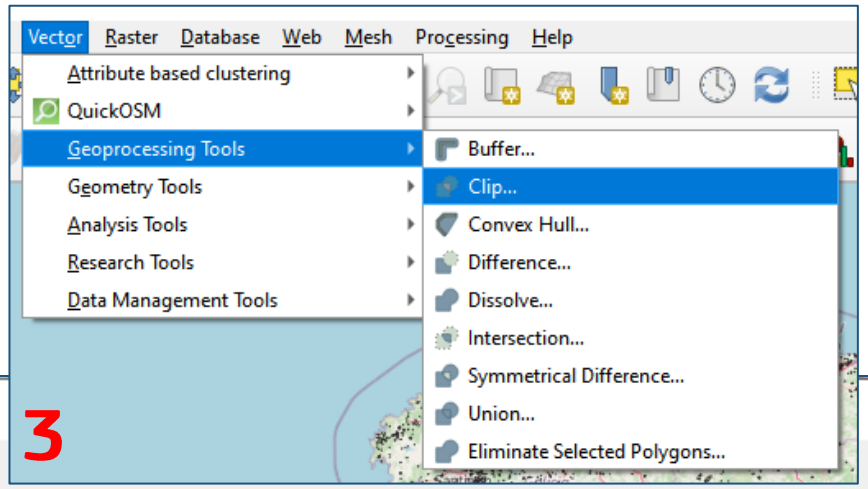

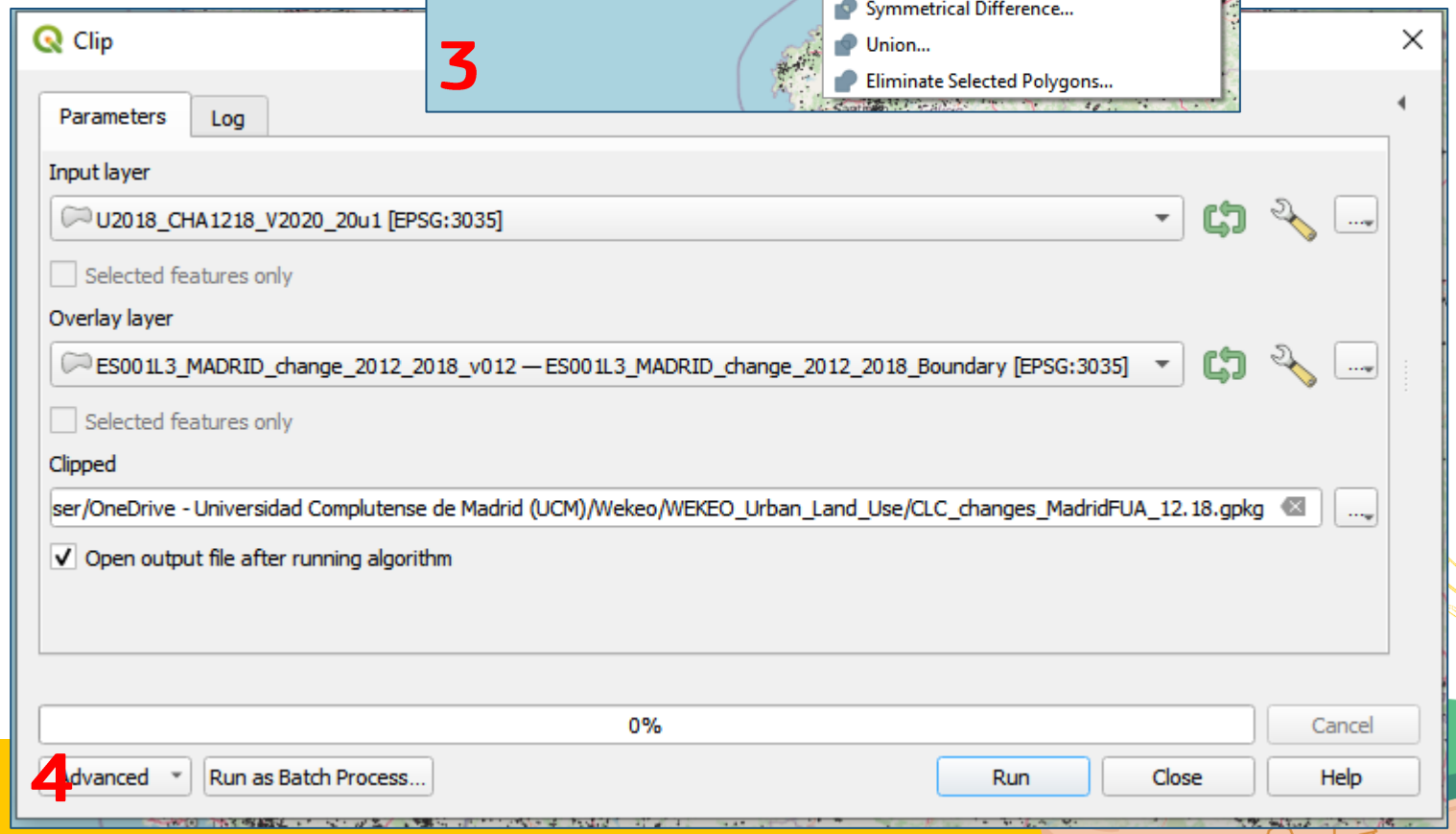

Boundary of Madrid FUA for clipping data
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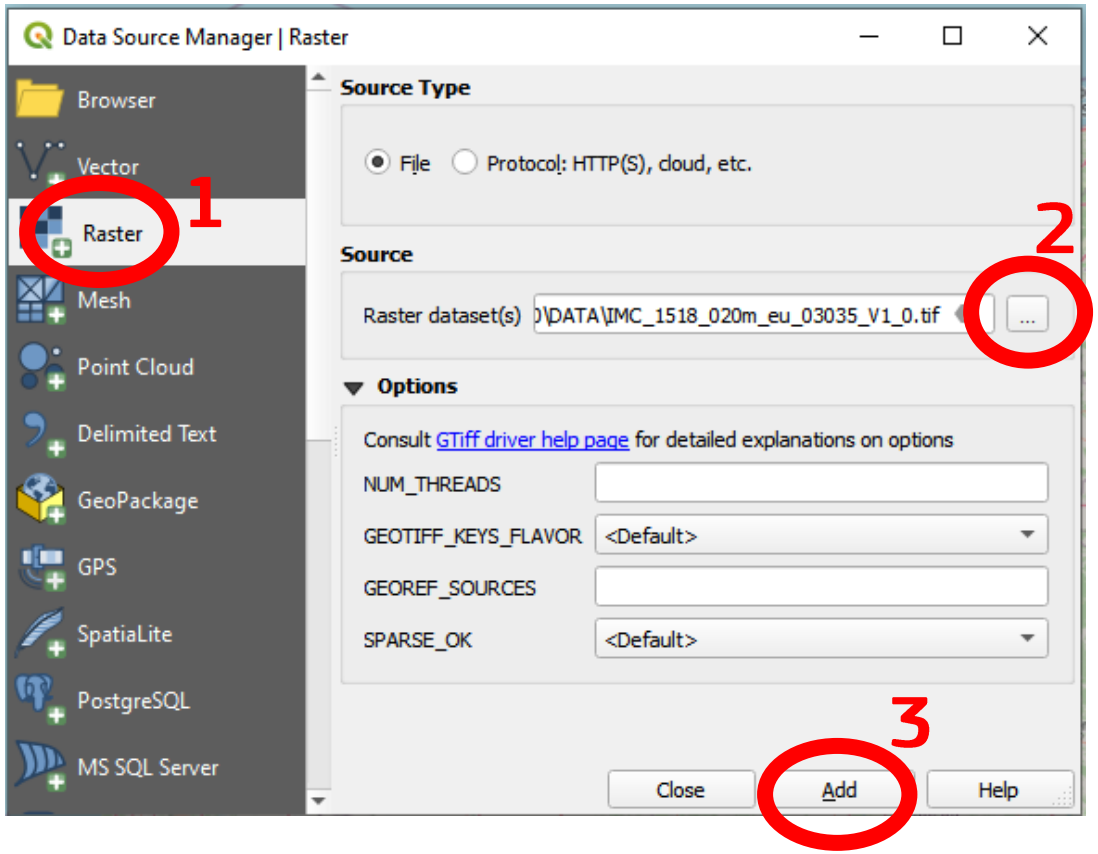
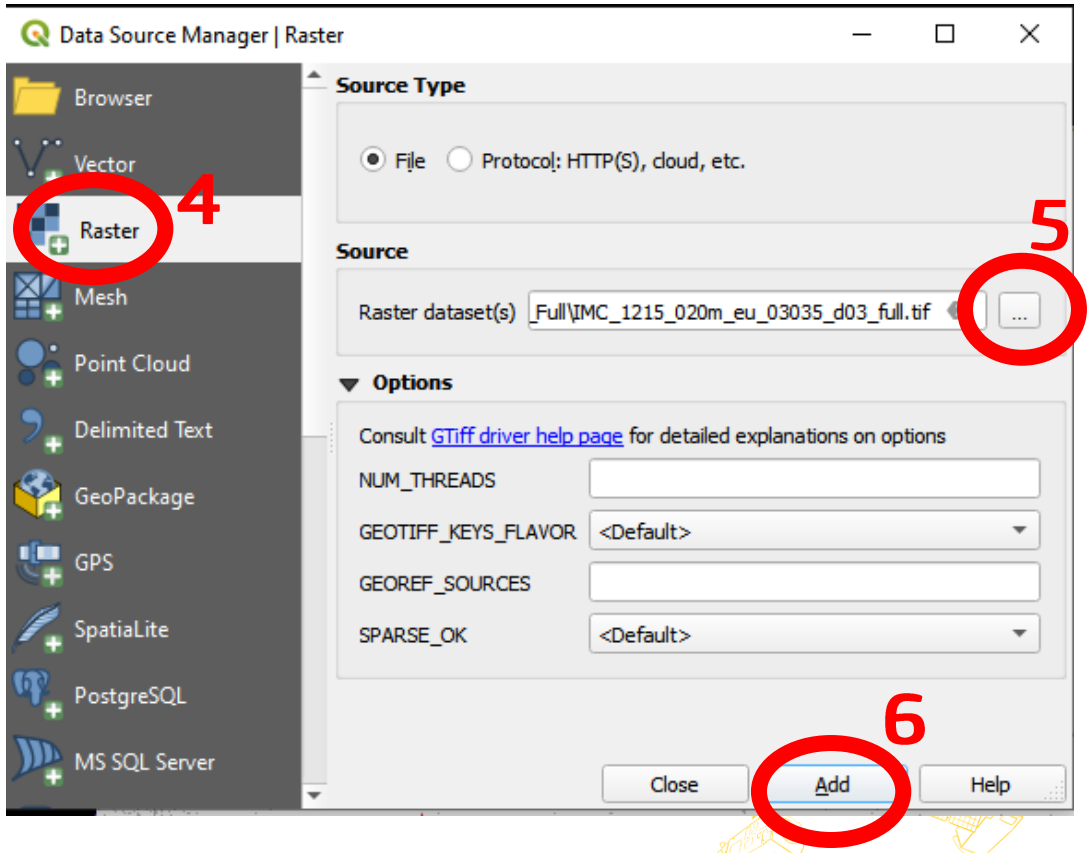
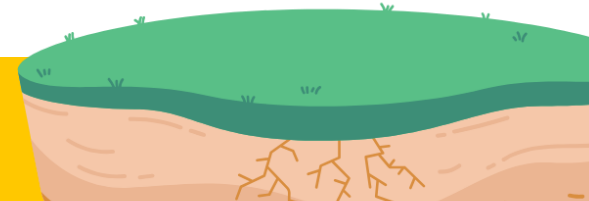
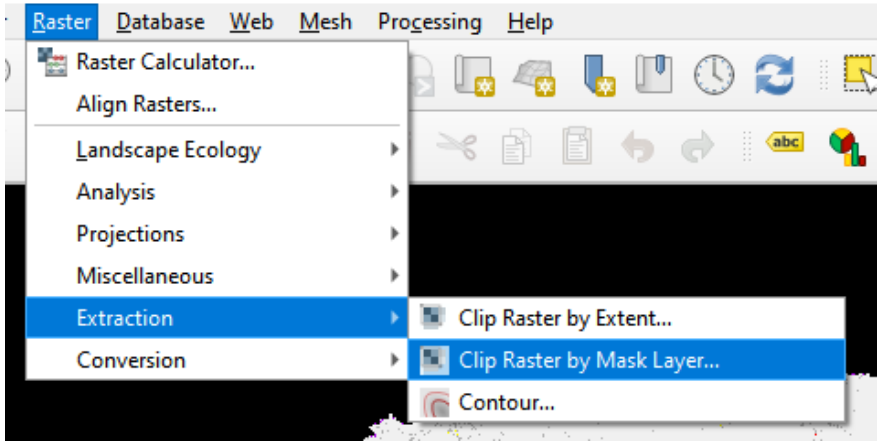
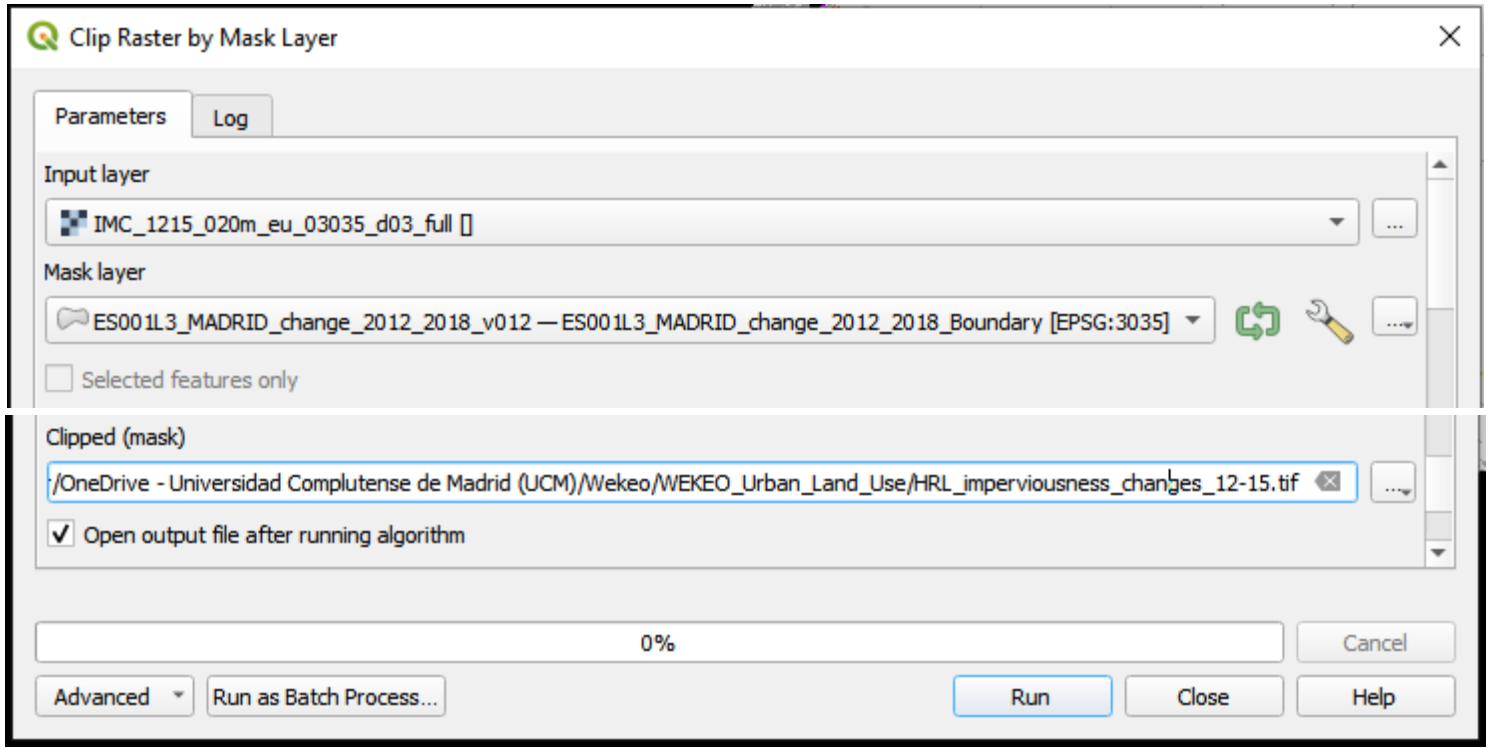




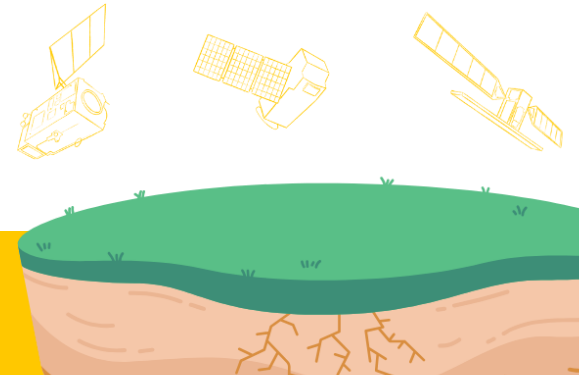


Boundary of Madrid FUA for clipping data
(HRL Imperviousness)

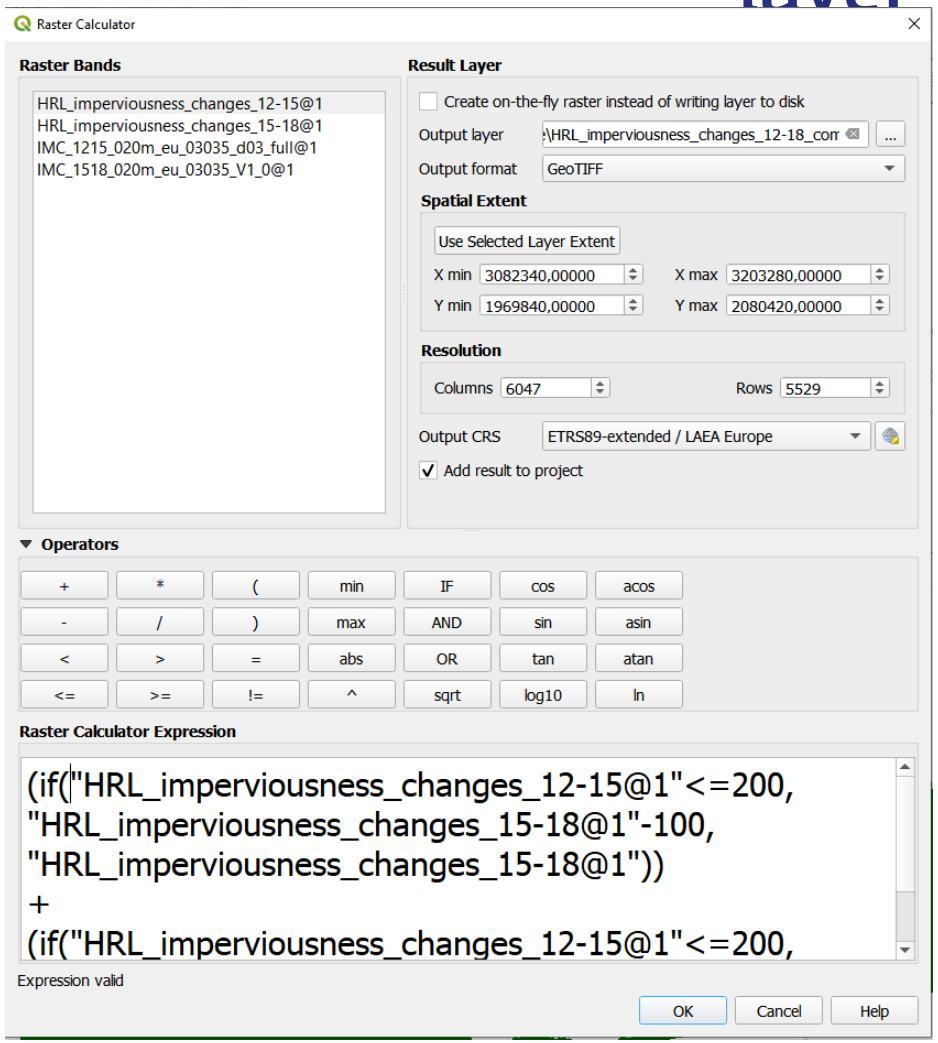




X2 HRL layers



Combination of the 2 HRL Imperviousness layers of changes (12 15, 15 18) in one layer



Raster calculator expression

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"HRL_imperviousness_changes_15 18@1")))))

((if("HRL_imperviousness_changes_12
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15@1"<=200,
"HRL_imperviousness_changes_12 15@1" 100,
"HRL_imperviousness_changes_12 15@1")))))
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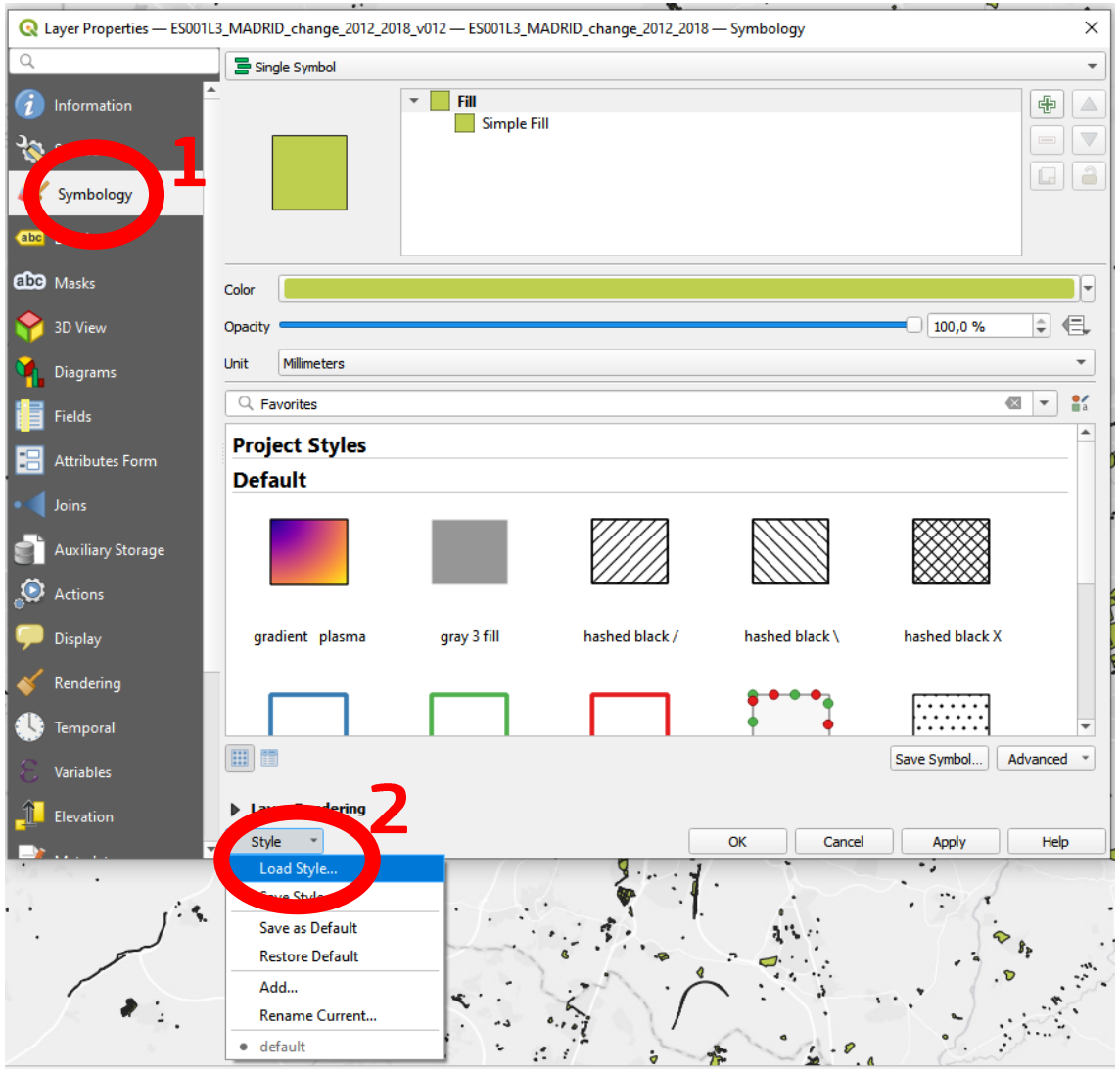
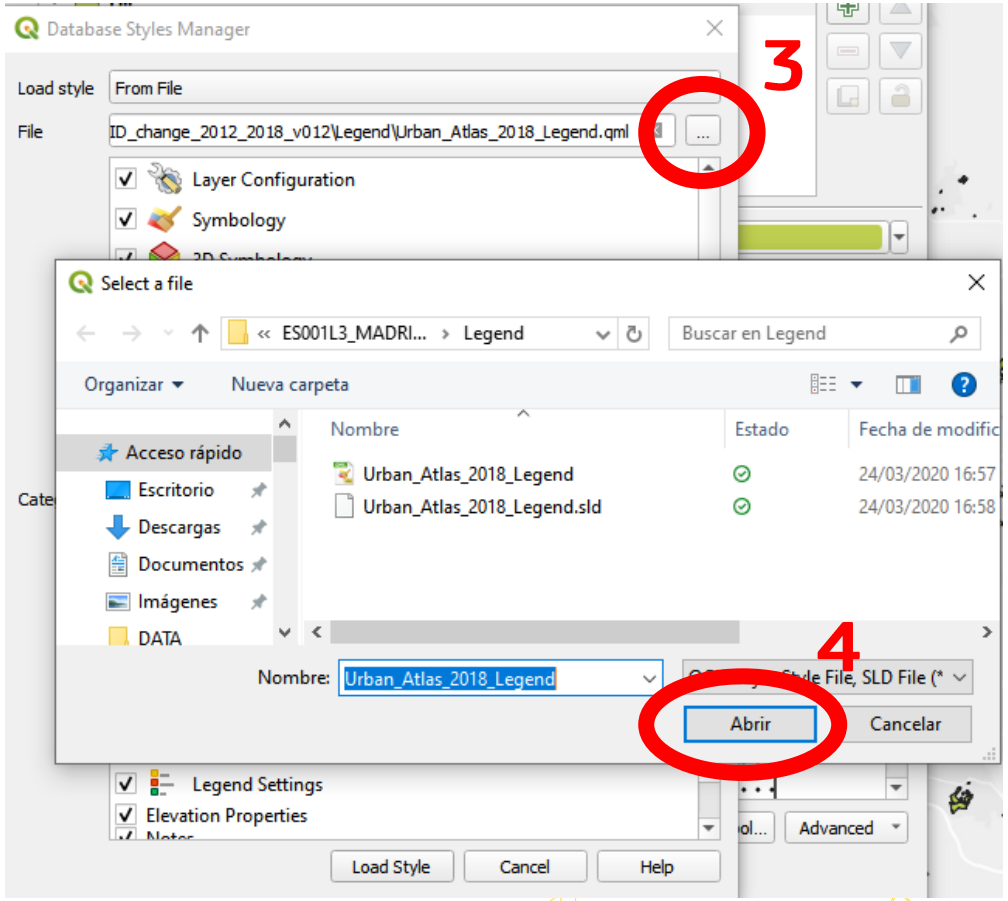
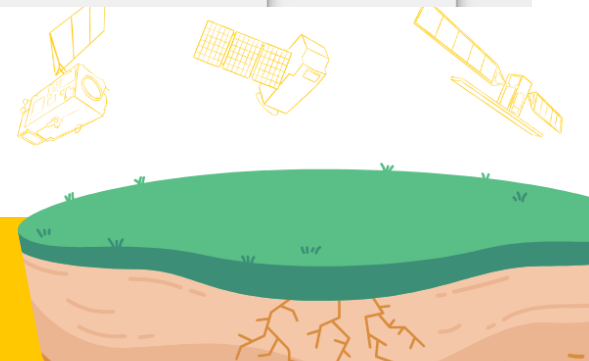
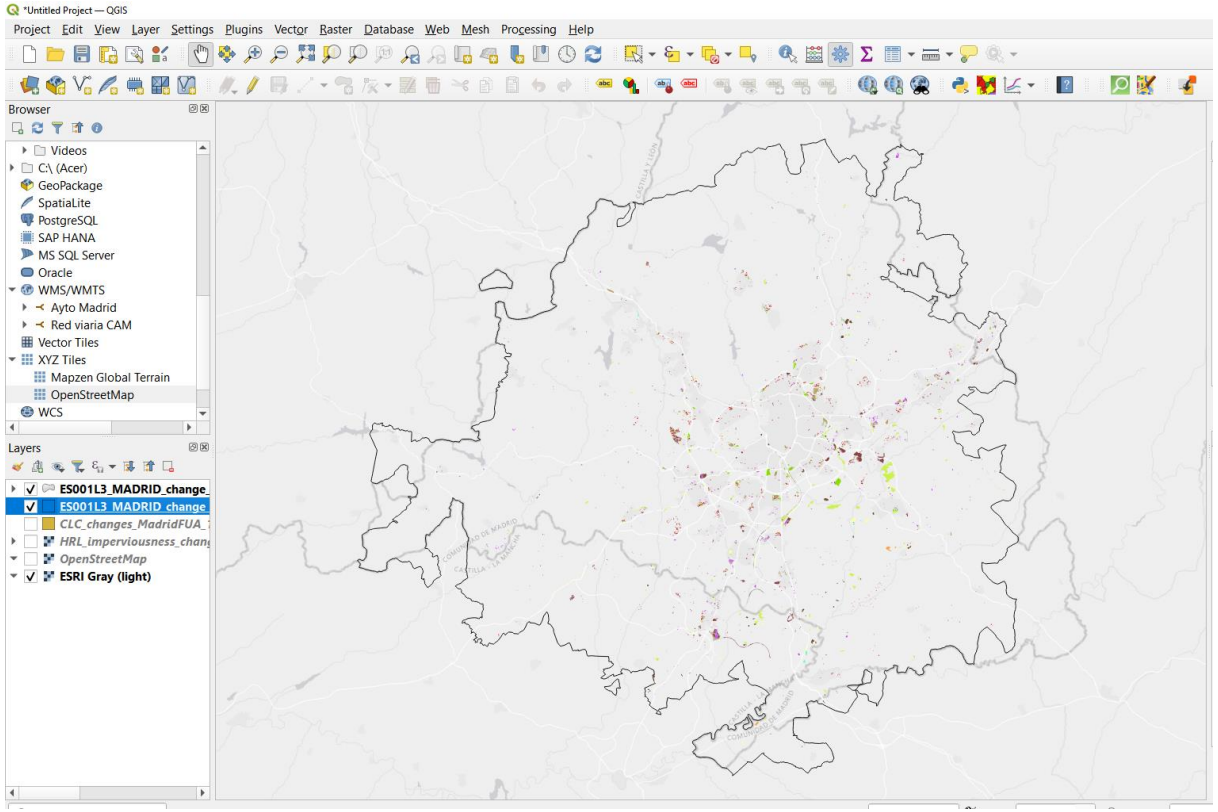
Symbolization of layers
(UA and CLC)



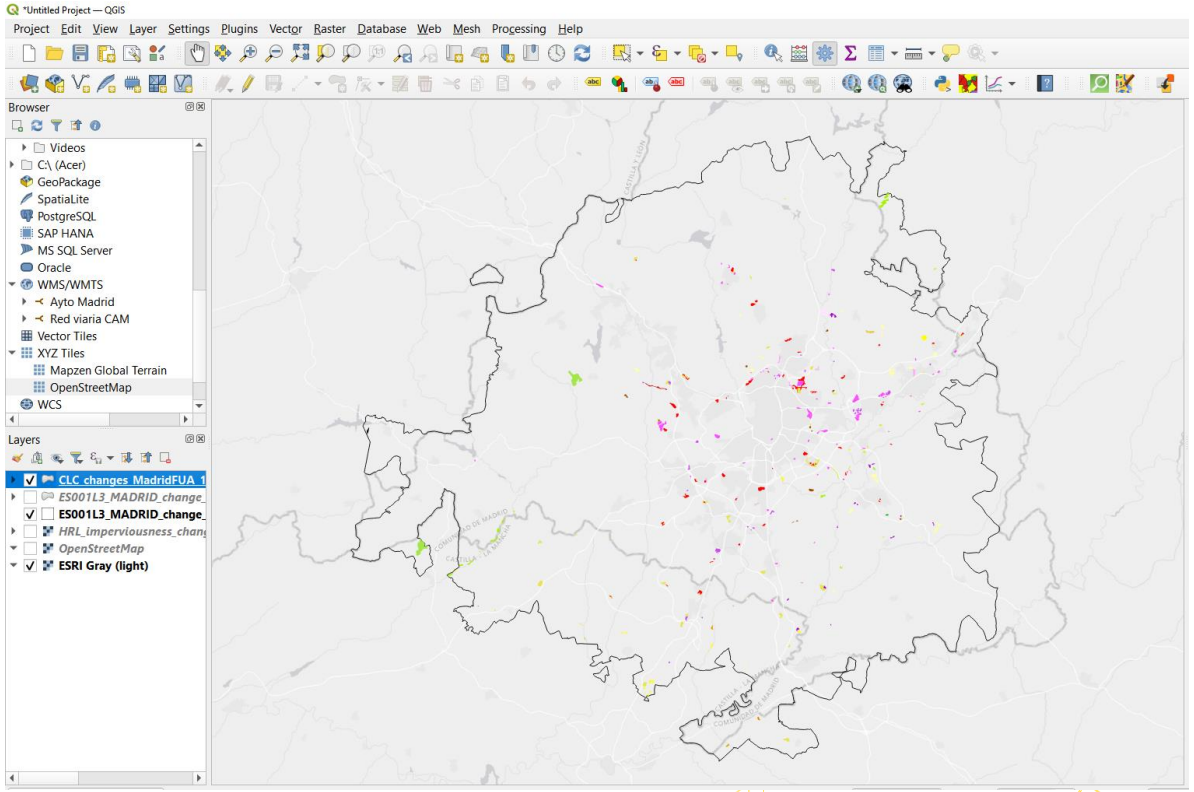




Symbolization of layers
(UA and CLC)

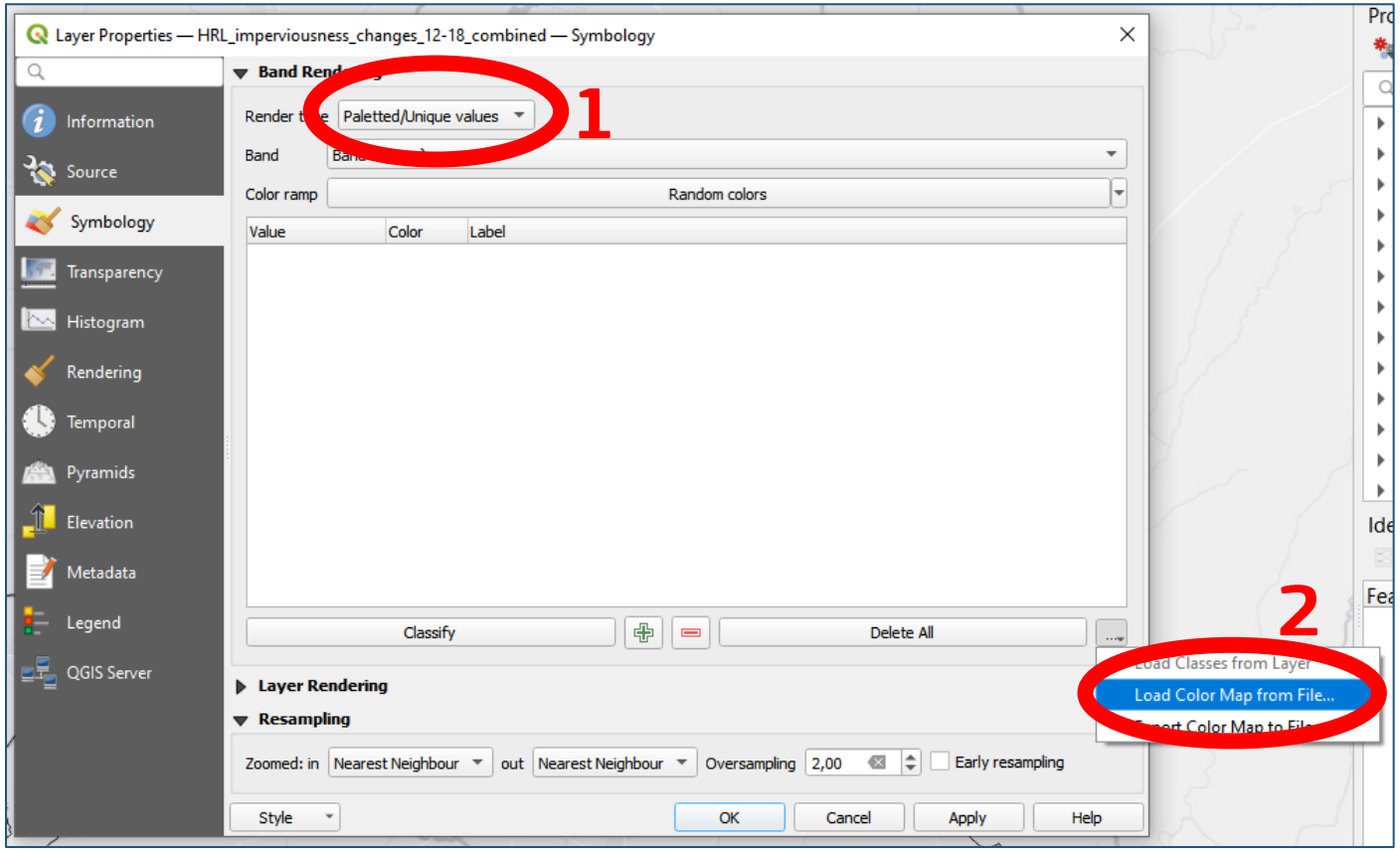


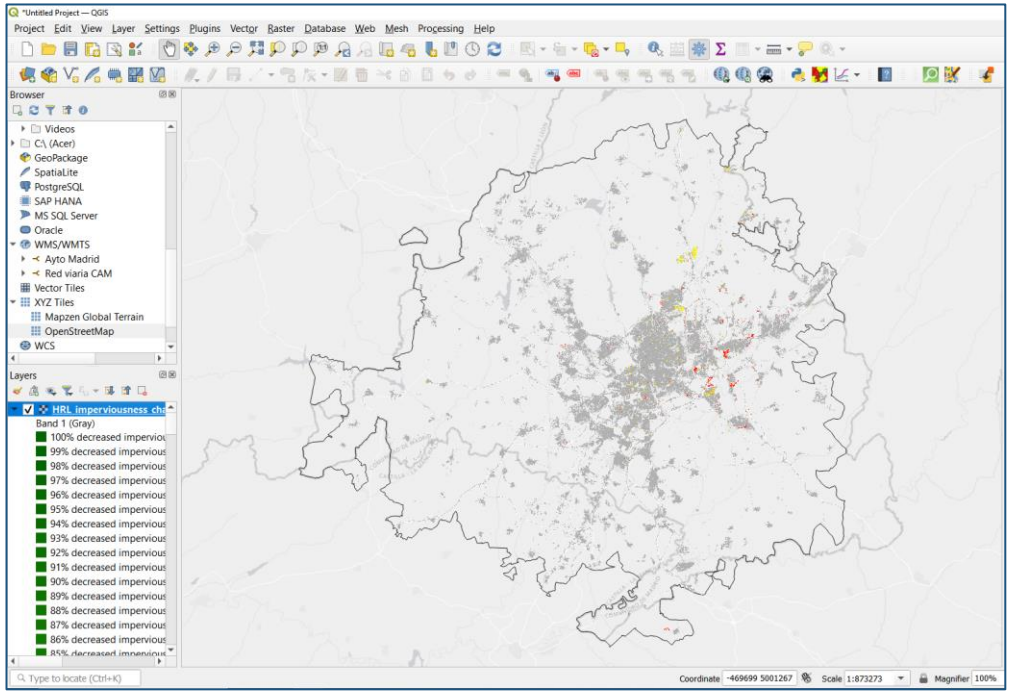
Urban Atlas (UA) changes



CORINE Land Cover (CLC) changes

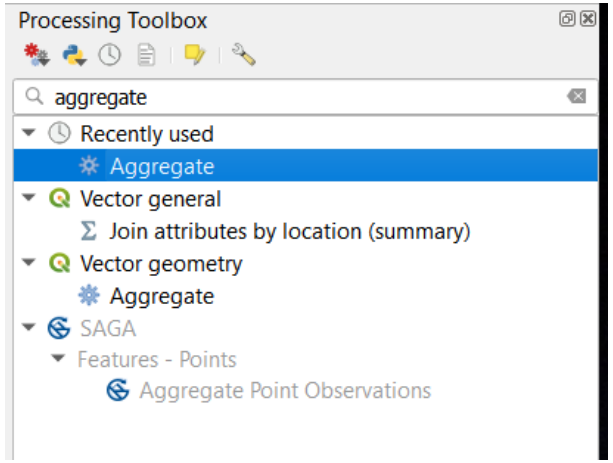
Symbolization of layers
(HRL imperviousness)

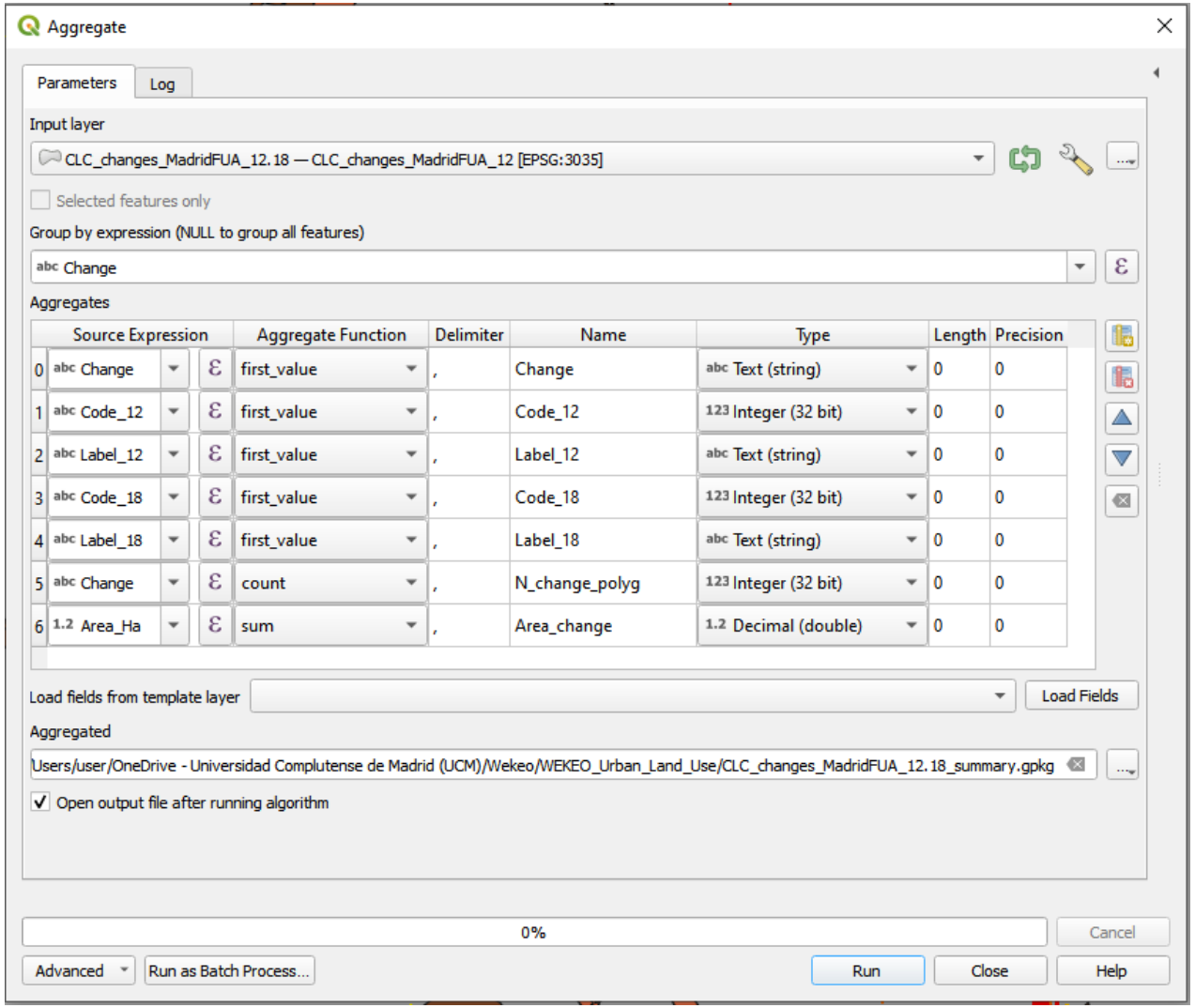




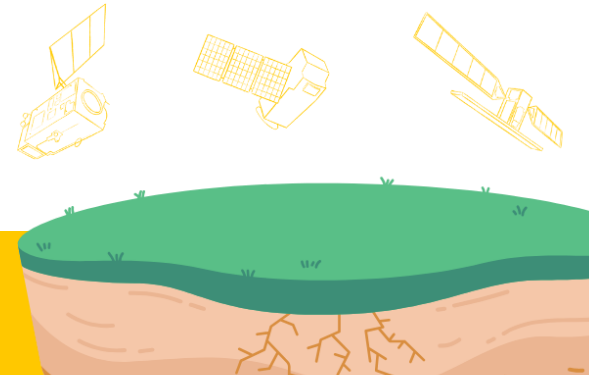
Color map specifically created by the author for the combined HRL layer (not available in downloaded data)

Statistical summary of changes (CLC)





The fields "Label_12" and "Label_18" include de description of the CLC categories in 2012 and 2018. They have been manually added to the layer by joining the layer with the CLC legend .xls file



Statistical summary of changes (CLC)

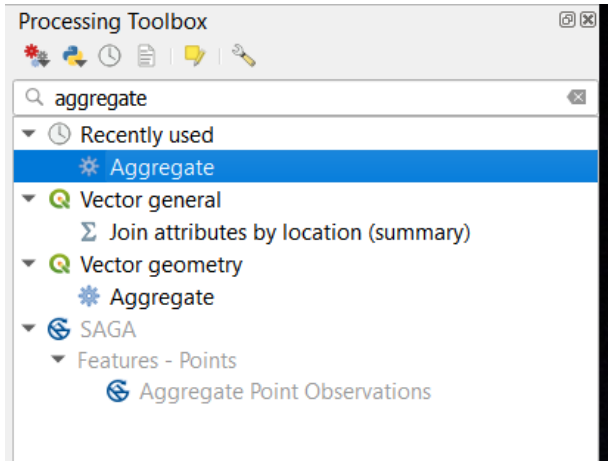
CLC_changes_MadridFUA_12 — Features Total: 63, Filtered: 63, Selected: 0

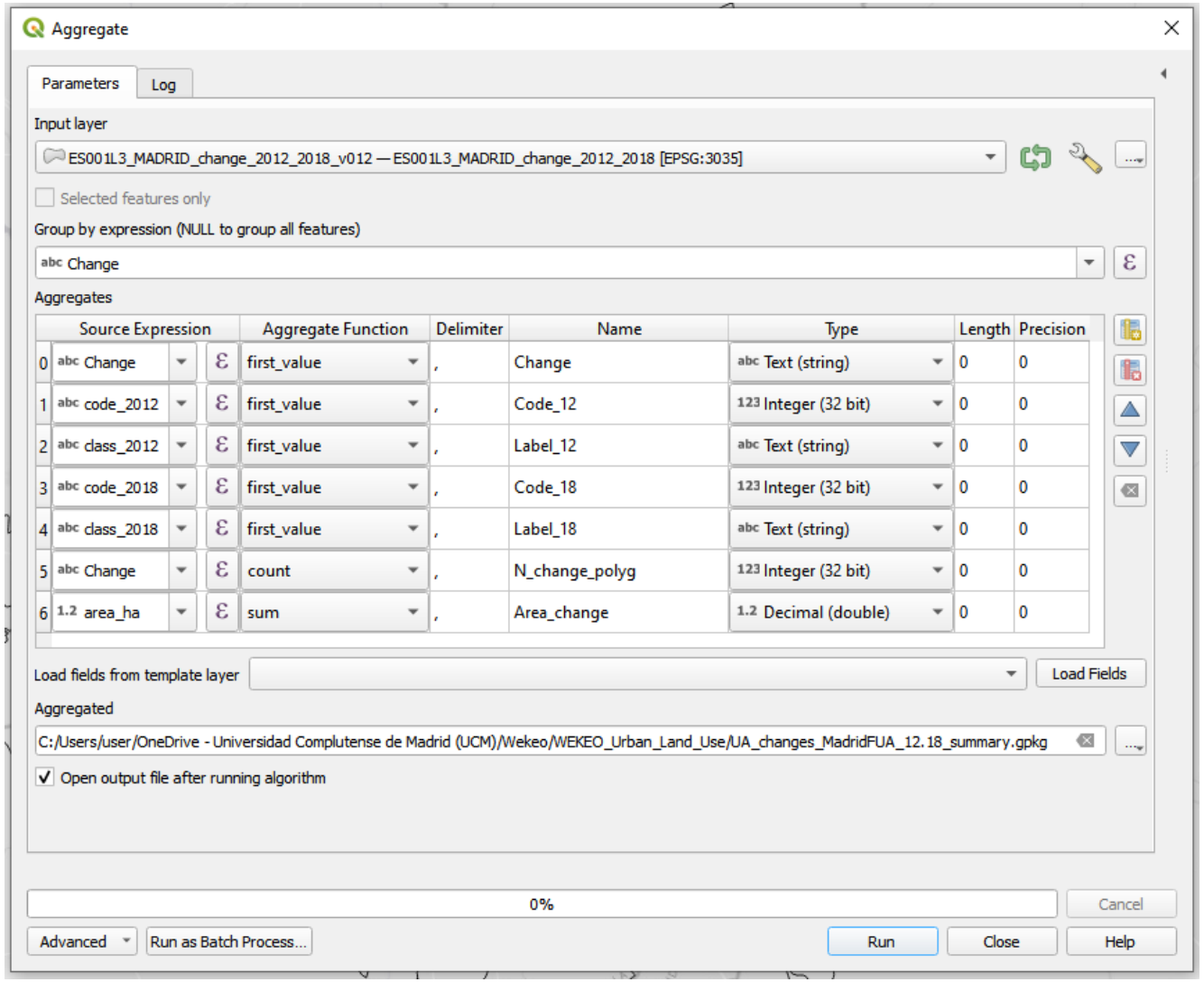
	fid	Change	Code_12	Label_12	Code_18	Label18	N_change_polyg	Area_change
1	36	121-133	121	Industrial or commercial units	133	Construction sites	6	75,37690247999437
2	41	131-211	131	Mineral extraction sites	211	Non-irrigated arable land	2	51,33565336496545
3	27	131-212	131	Mineral extraction sites	212	Permanently irrigated land	1	22,985856324953097
4	38	131-231	131	Mineral extraction sites	231	Pastures	3	33,93209591498327
5	48	131-323	131	Mineral extraction sites	323	Sclerophyllous vegetation	1	18,332705340038846
6	46	131-324	131	Mineral extraction sites	324	Transitional woodland-shrub	2	39,93781467496433
7	42	132-133	132	Dump sites	133	Construction sites	2	25,017920900003773
8	47	132-211	132	Dump sites	211	Non-irrigated arable land	2	45,40836441497611
9	28	132-231	132	Dump sites	231	Pastures	7	81,72340884491926
10	5	133-112	133	Construction sites	112	Discontinuous urban fabric	43	972,4418851949807
11	3	133-121	133	Construction sites	121	Industrial or commercial units	12	158,13544197009168
12	55	133-122	133	Construction sites	122	Road and rail networks and associated land	1	54,40514990996852
13	17	133-141	133	Construction sites	141	Green urban areas	4	78,07701461003874
14	29	133-142	133	Construction sites	142	Sport and leisure facilities	5	236,67882744999685
15	2	133-231	133	Construction sites	231	Pastures	32	875,0910132398938
16	51	142-133	142	Sport and leisure facilities	133	Construction sites	2	29,75428175507019
17	4	211-121	211	Non-irrigated arable land	121	Industrial or commercial units	4	33,52251184998823

Show All Features

Can be exported to a .csv or .xls file for analysis / creation of graphics, etc

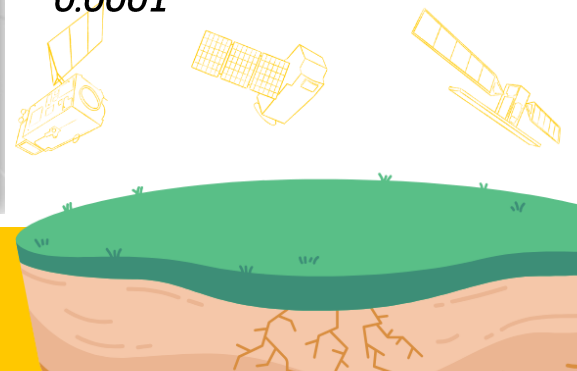
Statistical summary of changes (UA)





The field "Change" is not included in the downloaded layer and has been manually created by the author by concatenating the fields "code_2012" and "code_2018": *concat("code_2012",'-',"code_2018")*

The field "area_ha" is not included in the downloaded layer and has been manually created by the author by calculating each polygon area in ha: *$area * 0.0001*



Statistical summary of changes
(UA)

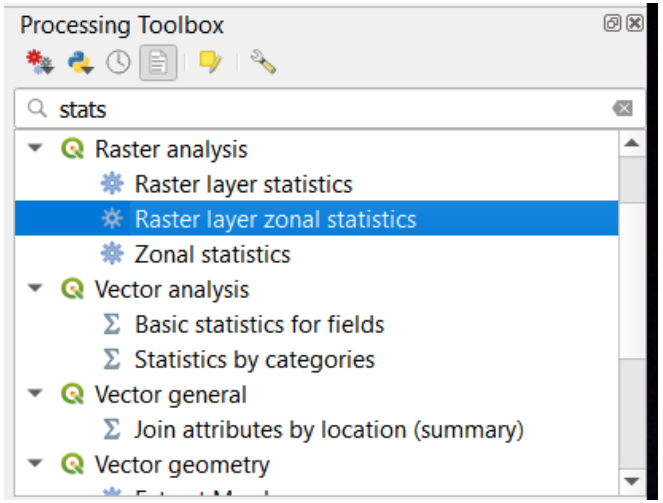
UA_changes_MadridFUA_12 — Features Total: 162, Filtered: 162, Selected: 0

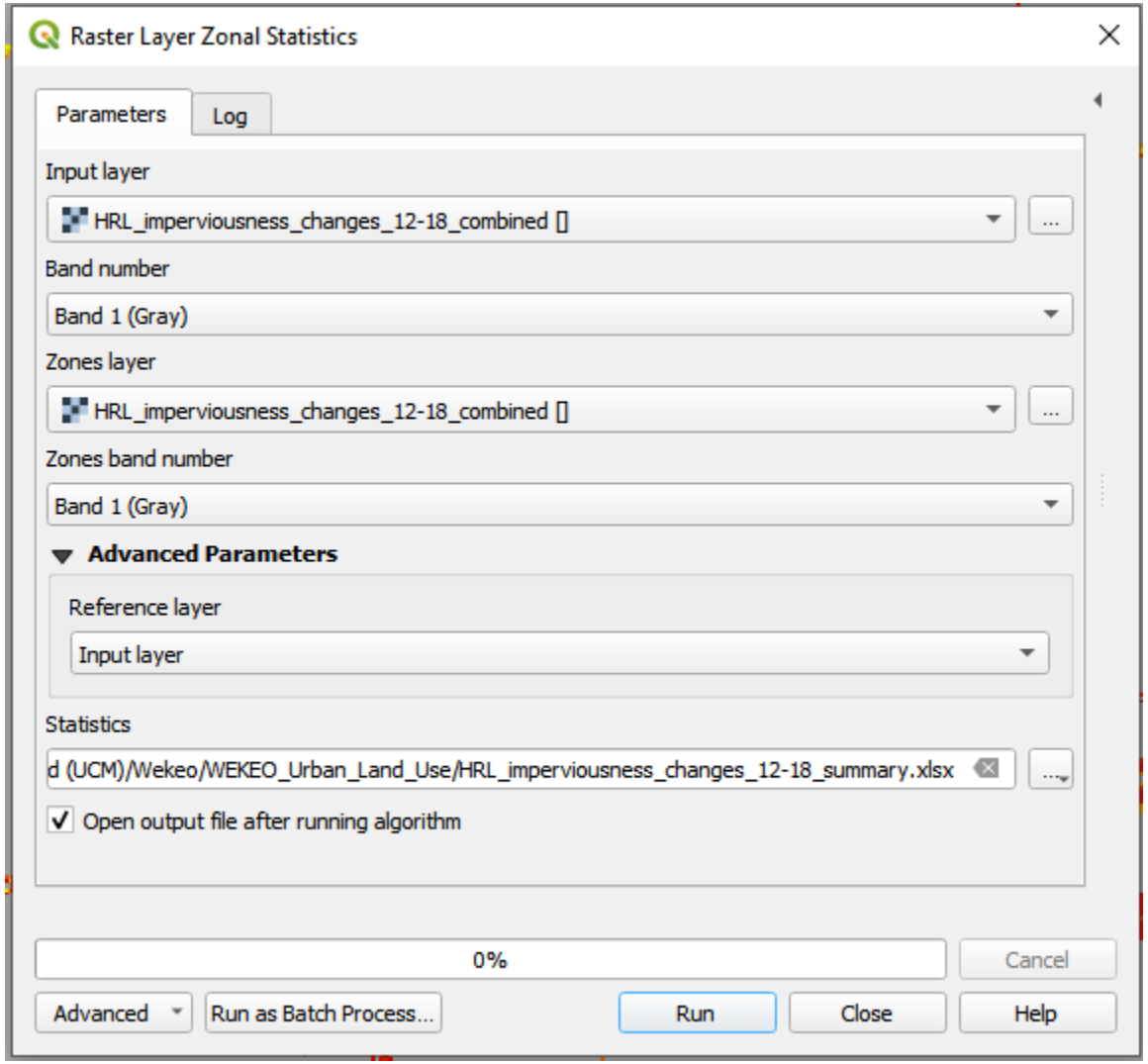
	fid	Change	Code_12	Label_12	Code_18	Label_18	N_change_polyg	Area_change
1	35	13100-32000	13100	Mineral extraction and dump sites	32000	Herbaceous vegetation associations (natural grassland, ...	111	1427,861638773...
2	32	13300-13400	13300	Construction sites	13400	Land without current use	289	1112,035941121...
3	25	13100-21000	13100	Mineral extraction and dump sites	21000	Arable land (annual crops)	68	441,5124327087...
4	48	13400-11210	13400	Land without current use	11210	Discontinuous dense urban fabric (S.L. : 50% - 80%)	389	386,2758412433...
5	82	21000-12100	21000	Arable land (annual crops)	12100	Industrial, commercial, public, military and private units	246	330,2002053463...
6	46	13400-13300	13400	Land without current use	13300	Construction sites	135	277,6985253960...
7	37	13300-12100	13300	Construction sites	12100	Industrial, commercial, public, military and private units	130	273,6979796464...
8	54	13400-14100	13400	Land without current use	14100	Green urban areas	125	261,9131333083...
9	57	13400-12100	13400	Land without current use	12100	Industrial, commercial, public, military and private units	196	231,5273102612...
10	30	13100-14100	13100	Mineral extraction and dump sites	14100	Green urban areas	21	226,6412940757...
11	84	21000-13100	21000	Arable land (annual crops)	13100	Mineral extraction and dump sites	49	218,0500034285...
12	8	13300-11210	13300	Construction sites	11210	Discontinuous dense urban fabric (S.L. : 50% - 80%)	200	214,3834299621...
13	120	32000-13100	32000	Herbaceous vegetation associations (natural grassland, moor...	13100	Mineral extraction and dump sites	32	213,0582217674...
14	116	32000-13300	32000	Herbaceous vegetation associations (natural grassland, moor...	13300	Construction sites	29	206,2748050034...
15	44	13300-12220	13300	Construction sites	12220	Other roads and associated land	74	175,474617526574
16	115	32000-12100	32000	Herbaceous vegetation associations (natural grassland, moor...	12100	Industrial, commercial, public, military and private units	95	163,6669145240...
17	47	13300-32000	13300	Construction sites	32000	Herbaceous vegetation associations (natural grassland	27	161,3159731358

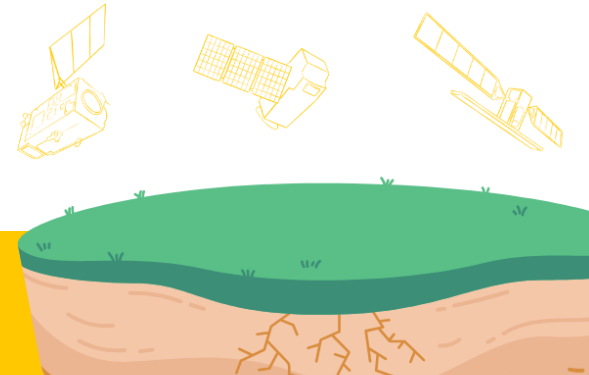
Show All Features

Can be exported to a .csv or .xls file for analysis / creation of graphics, etc

Statistical summary of changes
(HLR imperviousness)





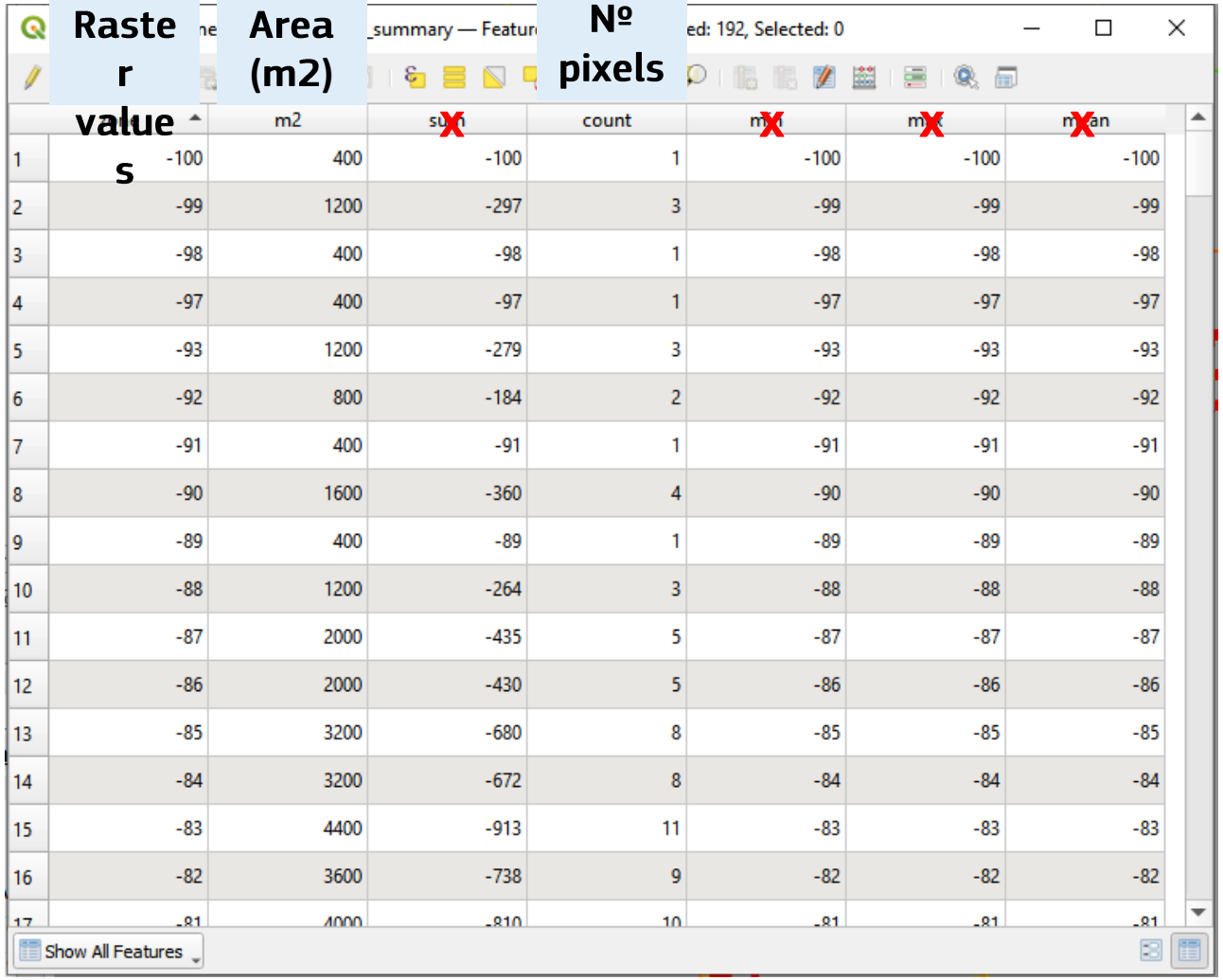


Statistical summary of changes
(HLR imperviousness)

Raster values

Area (m2)

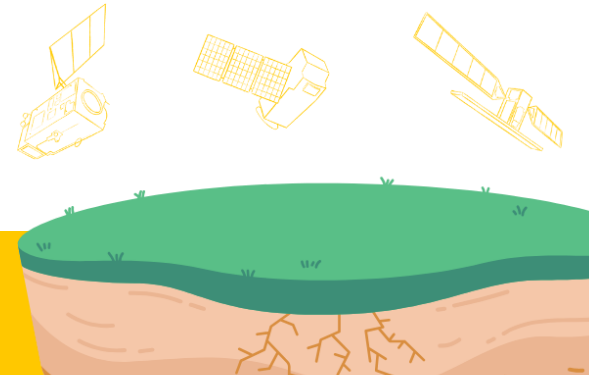
Nº pixels



	value	m2	sum	count	min	max	mean
1	-100	400	-100	1	-100	-100	-100
2	-99	1200	-297	3	-99	-99	-99
3	-98	400	-98	1	-98	-98	-98
4	-97	400	-97	1	-97	-97	-97
5	-93	1200	-279	3	-93	-93	-93
6	-92	800	-184	2	-92	-92	-92
7	-91	400	-91	1	-91	-91	-91
8	-90	1600	-360	4	-90	-90	-90
9	-89	400	-89	1	-89	-89	-89
10	-88	1200	-264	3	-88	-88	-88
11	-87	2000	-435	5	-87	-87	-87
12	-86	2000	-430	5	-86	-86	-86
13	-85	3200	-680	8	-85	-85	-85
14	-84	3200	-672	8	-84	-84	-84
15	-83	4400	-913	11	-83	-83	-83
16	-82	3600	-738	9	-82	-82	-82
17	-81	4000	-810	10	-81	-81	-81

And next….

- Compare the information provided by each dataset cartographically and statistically
- Cross tabulate datasets to see agreements / disagreements
- Identify errors
- ….



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