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EO Methods

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EO Methods to Derive Surface Roughness

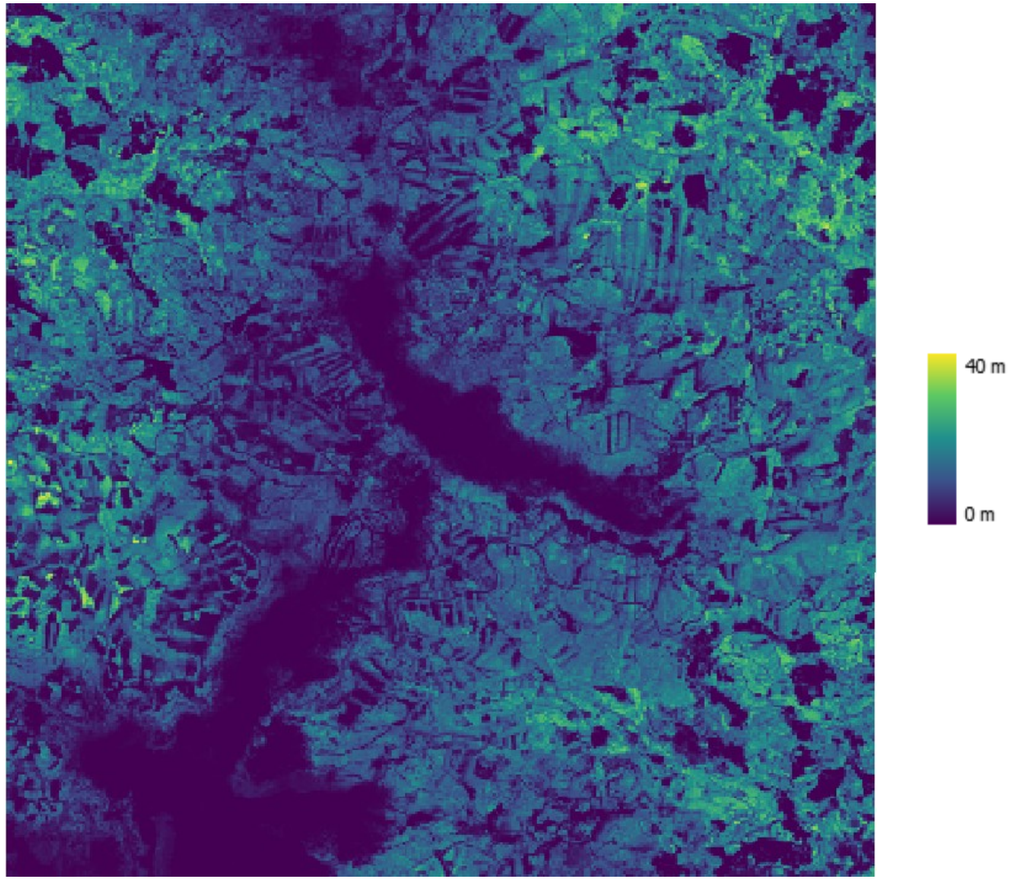
- Surface roughness from 3D information (nDSM)
  - LiDAR: mainly airborne (*nDSM ALS*)
  - Stereo: airborne (*nDSM APH*) or satellite-based (*nDSM VHR*)
  - Interferometry: mainly satellite-based (*nDSM COP*)
  - Other: Shape from shading, ML or DL (Canopy Height Maps by WRI and Meta)
- Surface roughness from land cover classification (LCC)
  - Airborne (*LCC VHR*) or satellite-based (*LCC Worldcover* and *LCC COP HRL*)
- Surface roughness from SAR backscatter
  - Satellite-based (*SAR Sentinel-1*)
- Combination of above

Method: Map All Objects Above Ground (nDSM)

- nDSMs
  - digital surface model (DSM) minus digital terrain model (DTM)
- DTM
  - „Static“
  - Extracted from a DSM
  - „Learned“ from imagery
- DSM
  - „Dynamic“: new buildings, clear cuts, …
  - LiDAR, stereo, interferometry

Example Handalm

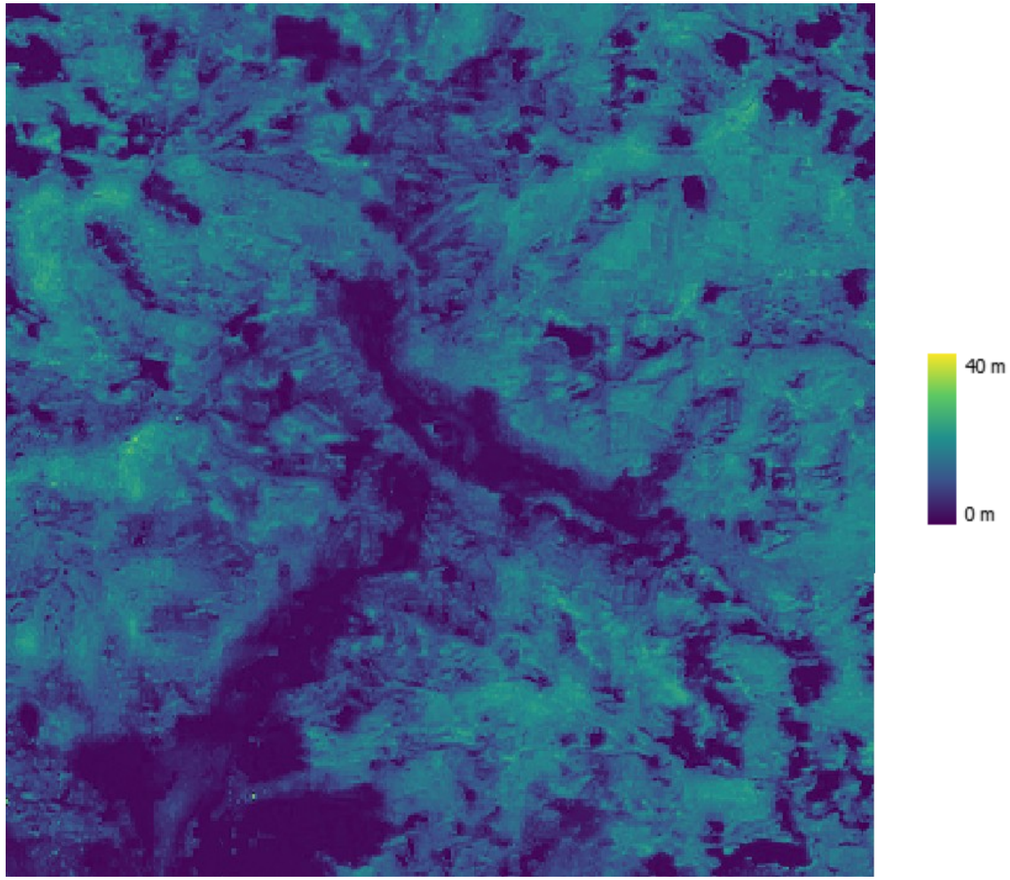
Orthoimage (BEV)



nDSM (Airborne LiDAR BEV)

Example Handalm

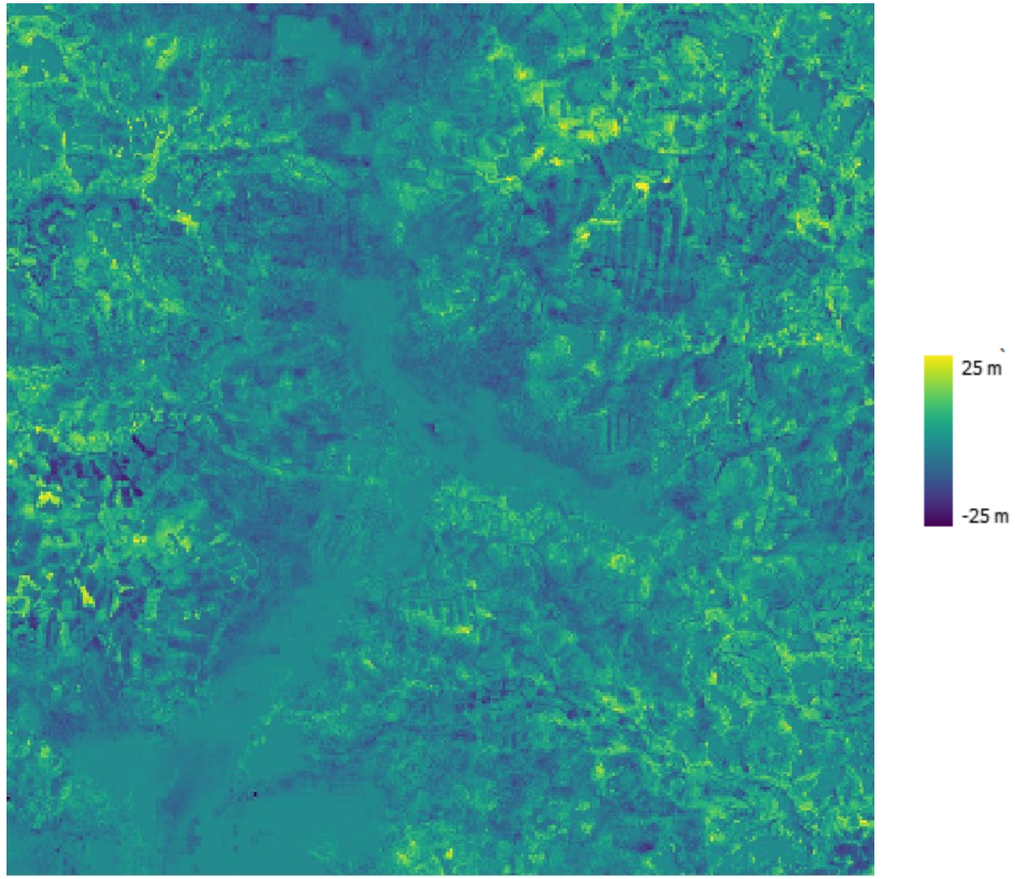
Orthoimage (BEV)



nDSM (COPDEM-FABDEM)

Example Handalm

Orthoimage (BEV)



Difference nDSMs

Method: Recode LCC to Roughness Classes

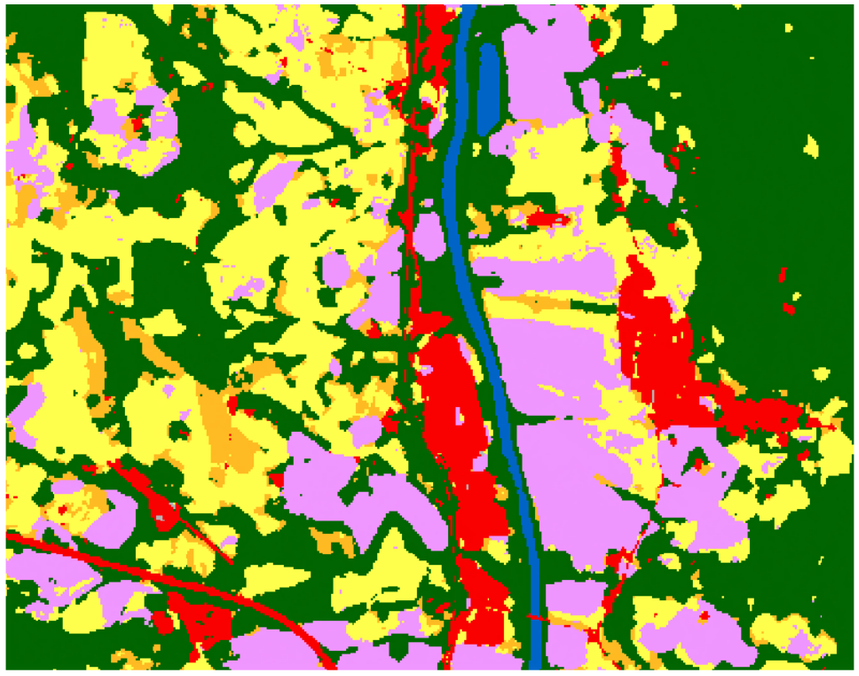
WorldCover

Code	LCC	Color
10	Tree cover	
20	Shrubland	
30	Grassland	
40	Cropland	
50	Built-up	
60	Bare/Sparse	
70	Snow/Ice	
80	Waterbody	
90	Wetland	
95	Mangroves	
100	Moss/Lichen	

Roughness Global Wind Atlas

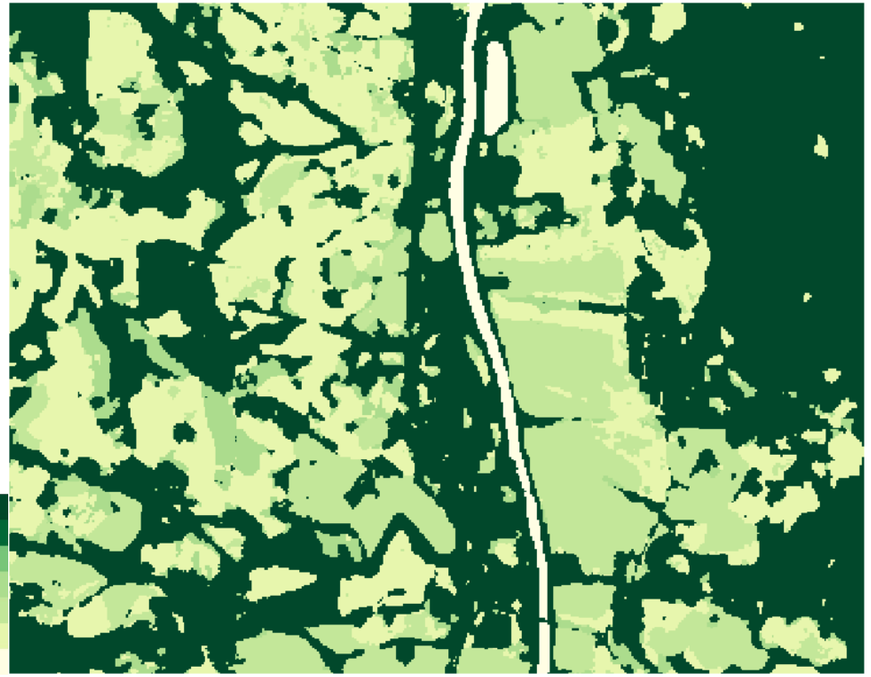
Class	Length [m]	Color
6	1,5000	
3	0,2000	
1	0,0300	
2	0,1000	
6	1,5000	
1	0,0300	
0	0,0002	
0	0,0002	
0	0,0002	
3	0,2000	
1	0,0300	

- ✓ Global coverage: Robust + scalable
- ✓ High resolution (10 m x 10 m)
- ✓ Simple, low cost, quick turn around
- – Limited global accuracy (76.7%)
- – Data cleaning needed



Recoded to standard wind modelling roughness classes

Class	Length [m]	Color
6	1,5000	
5	1,0000	
4	0,3000	
3	0,2000	
2	0,1000	
1	0,0300	
0	0,0002	



ESA World Cover 2021 – For test site Rignano, Italy (11.450488°, 43.702897°)

Surface Roughness [10 m Resolution]

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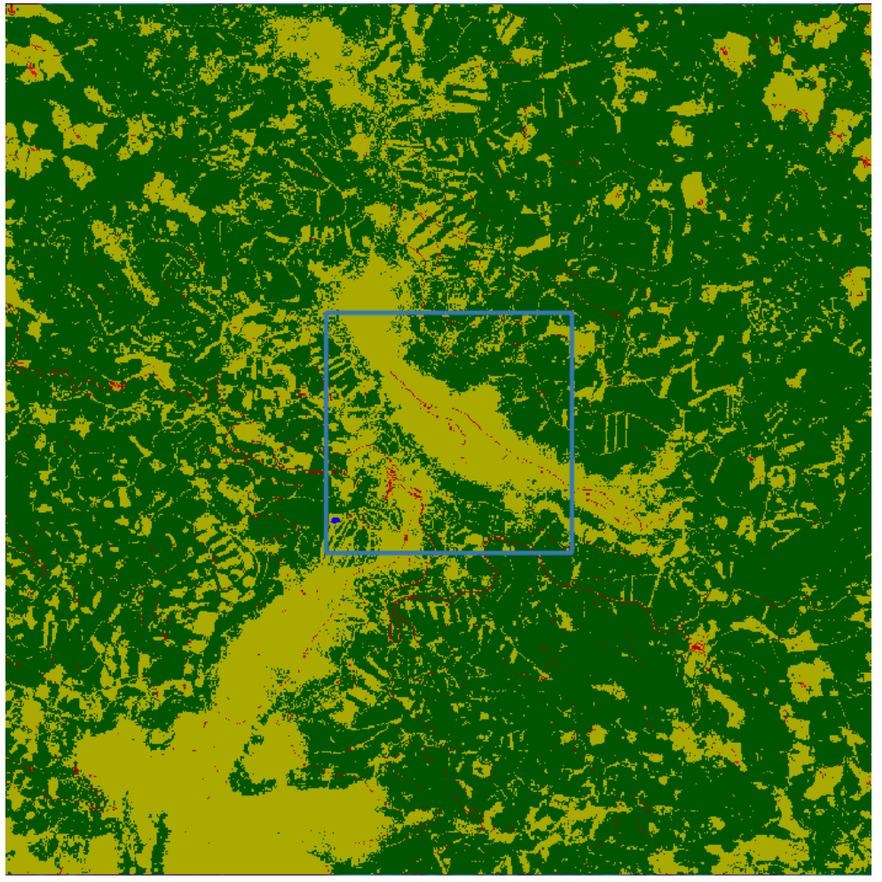
Example Handalm

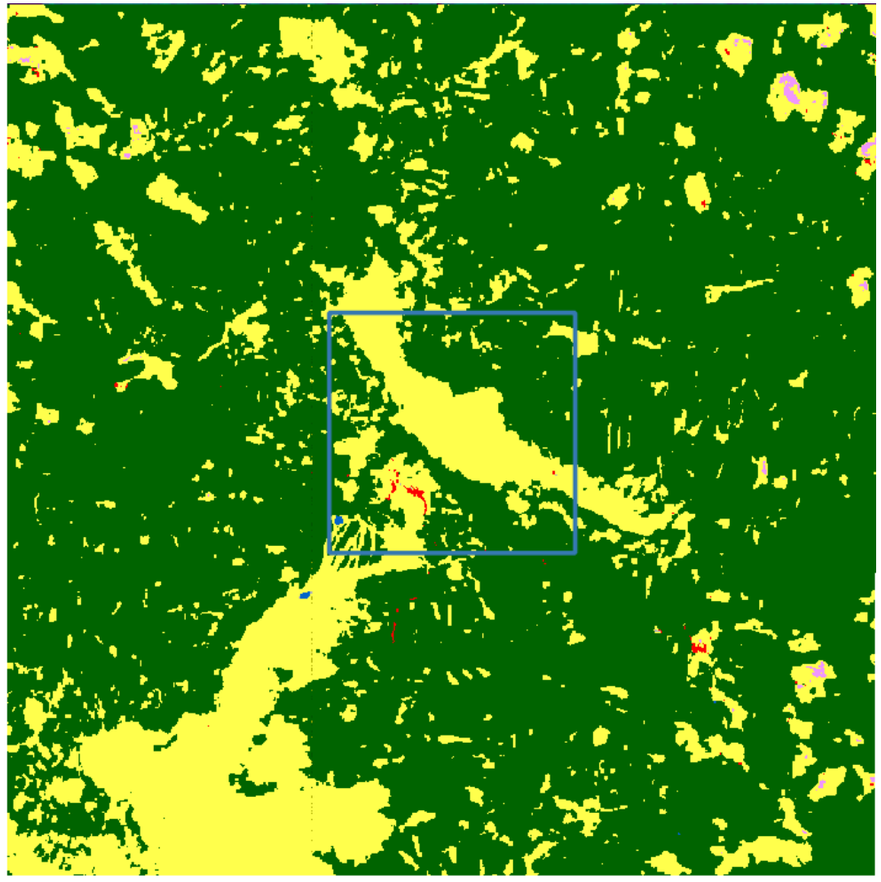
Orthoimage (BEV)



LCC Orthoimage (BEV)

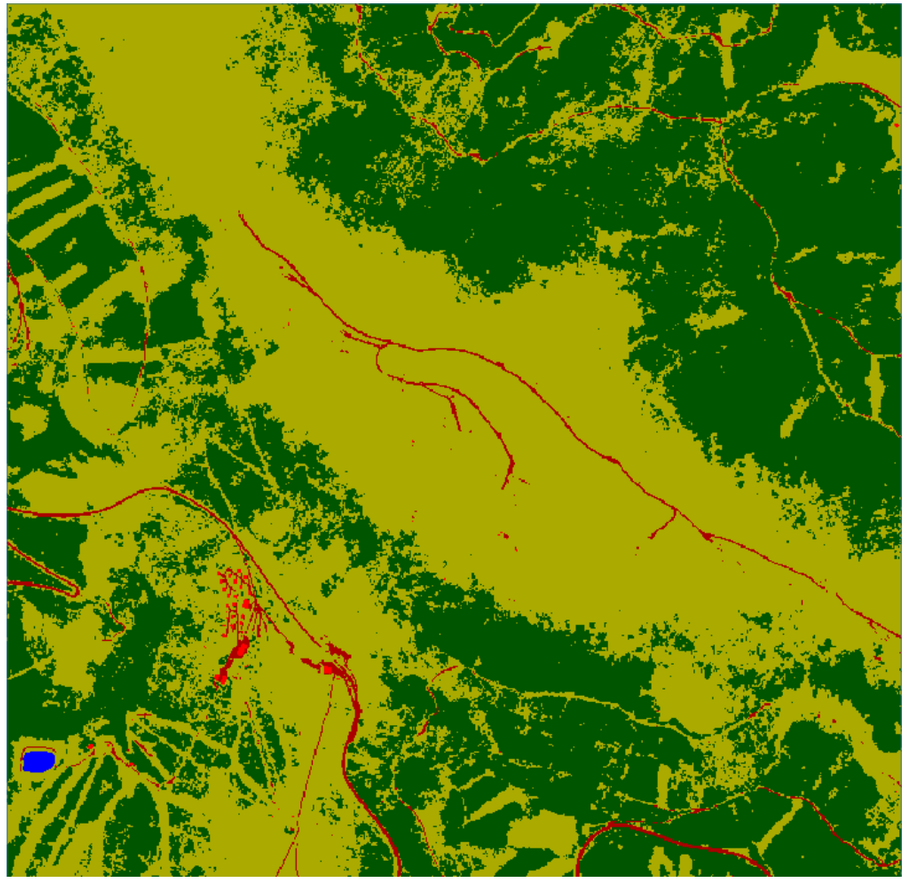
Example Handalm

Orthoimage (BEV)

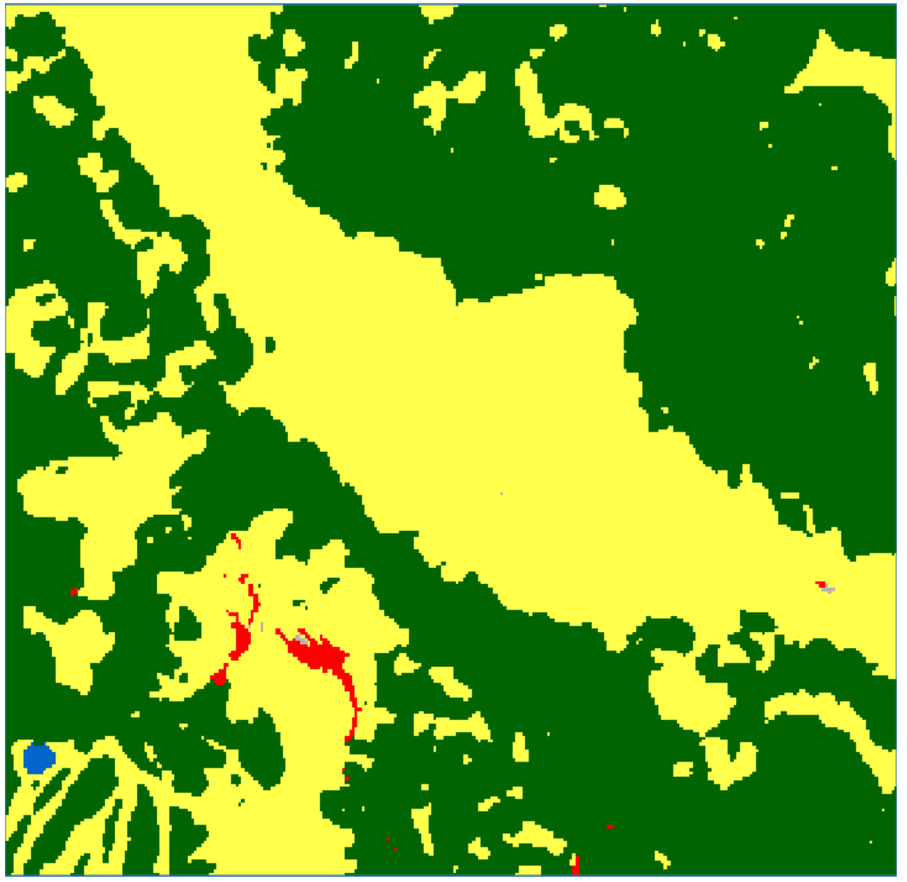


ESA Worldcover

Example Handalm



LCC Orthoimage (BEV)



ESA Worldcover

Comparison

VHR … < 1 m, HR … < 15 m

Method	Coverage	Resolution	Accuracy	Topicality	Costs
nDSM ALS	Austria	VHR	High	Up to 10 years	Low
nDSM VHR	Global	VHR	High to medium	Archive/New	High
nDSM COP	Global	HR	Medium	TDX mission	Low
nDSM APH	Austria	VHR	High	Up to 4 years	Low
LCC WorldCover	Global	HR	Medium to low	Last update 2021	Low
LCC COP HRL	Europe	HR	Medium	~ 3-4 years	Low
LCC VHR	Austria	VHR	High	Up to 4 years	Medium
SAR Sentinel-1	Global	HR	Medium	Weekly	Medium

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