

New Opportunities for Highly Automated Countrywide Assessment of Trees Outside Forests in Switzerland

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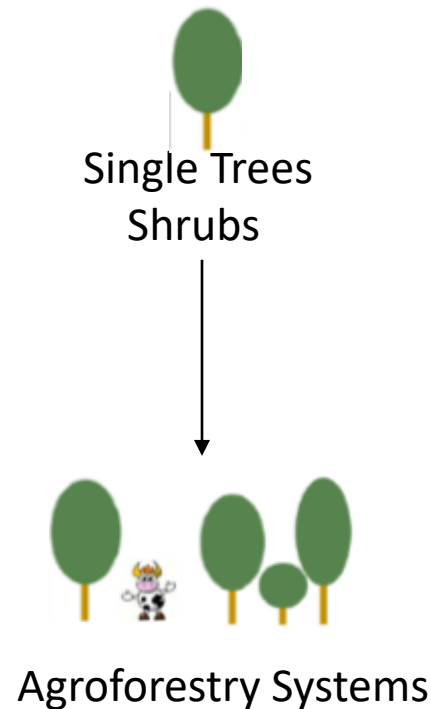
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Background and Motivation

What is Trees Outside Forest?



-Trees outside forests (TOF) comprise tree formations ranging from single discrete trees and shrubs to systematically managed trees in agroforestry systems, i.e. trees, bamboos, palms, shrubs and bushes



Background and Motivation



- Trees Outside Forest in Agricultural Areas:
 - home gardens
 - isolated or in small groups in some fields
 - as hedges
 - narrow discontinuous line along the small river and the road
- Products and services:
 - ownership boundaries
 - fencing
 - shade
 - fertility maintenance
 - erosion control

Background and Motivation



- Trees Outside Forest in Urban Areas

- “greening” function, much valued in areas dominated by buildings
- moderation of microclimate pollution and flooding
- a “green” environment conducive to good health

Background and Motivation

- Trees Outside Forest (TOF) are critical non-forest tree resources
 - environmental
 - economic
 - social
 - cultural services and functions
- - Although various ways of defining forests exist, non of them is eligible on assessing every tree -growing outside forest- on the landscape

Background and Motivation

-Trees Outside Forest (TOF) are critical non-forest tree resources

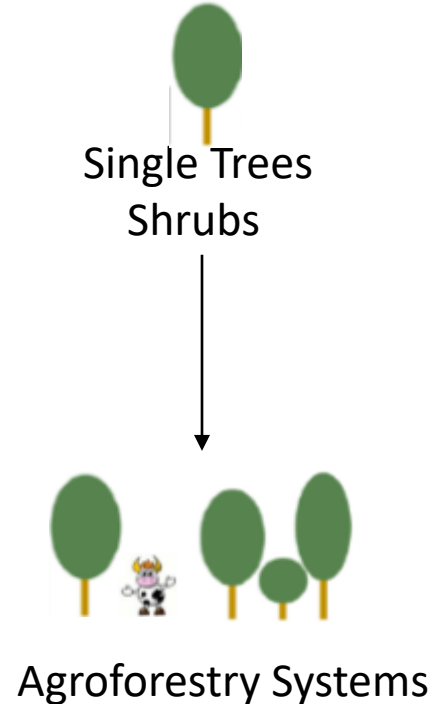
- environmental
- economic
- social
- cultural services and functions

-Although various ways of defining forests exist, non of them is eligible on assessing every tree -growing outside forest- on the landscape with a countrywide approach

Background and Motivation

What is Trees Outside Forest?

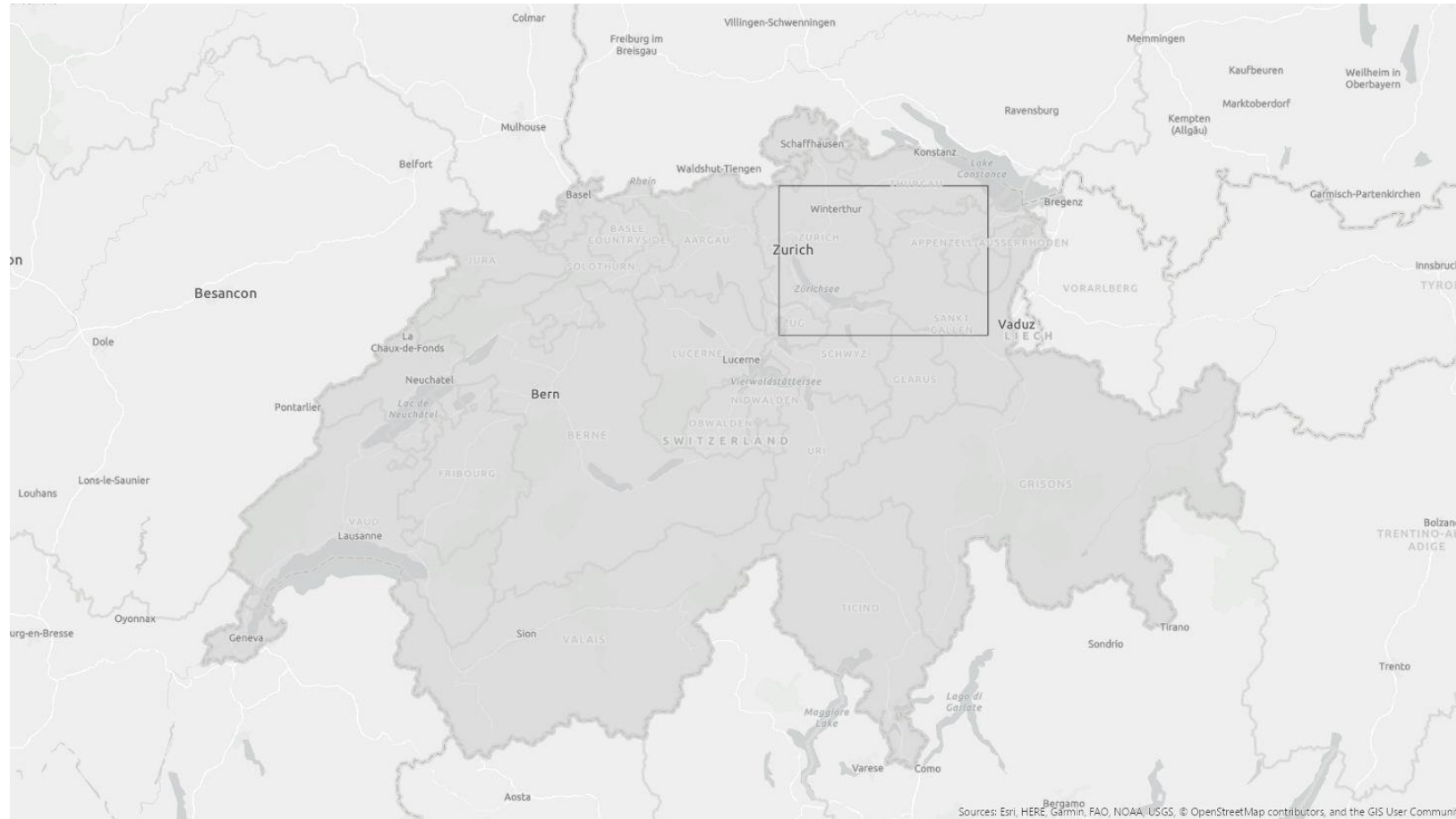
What did we want to do?



-To derive a highly automated workflow in order to generate a detailed countrywide Trees Outside Forest map for Switzerland that takes the FAO FRA definition into account

Study Area - Material & Method

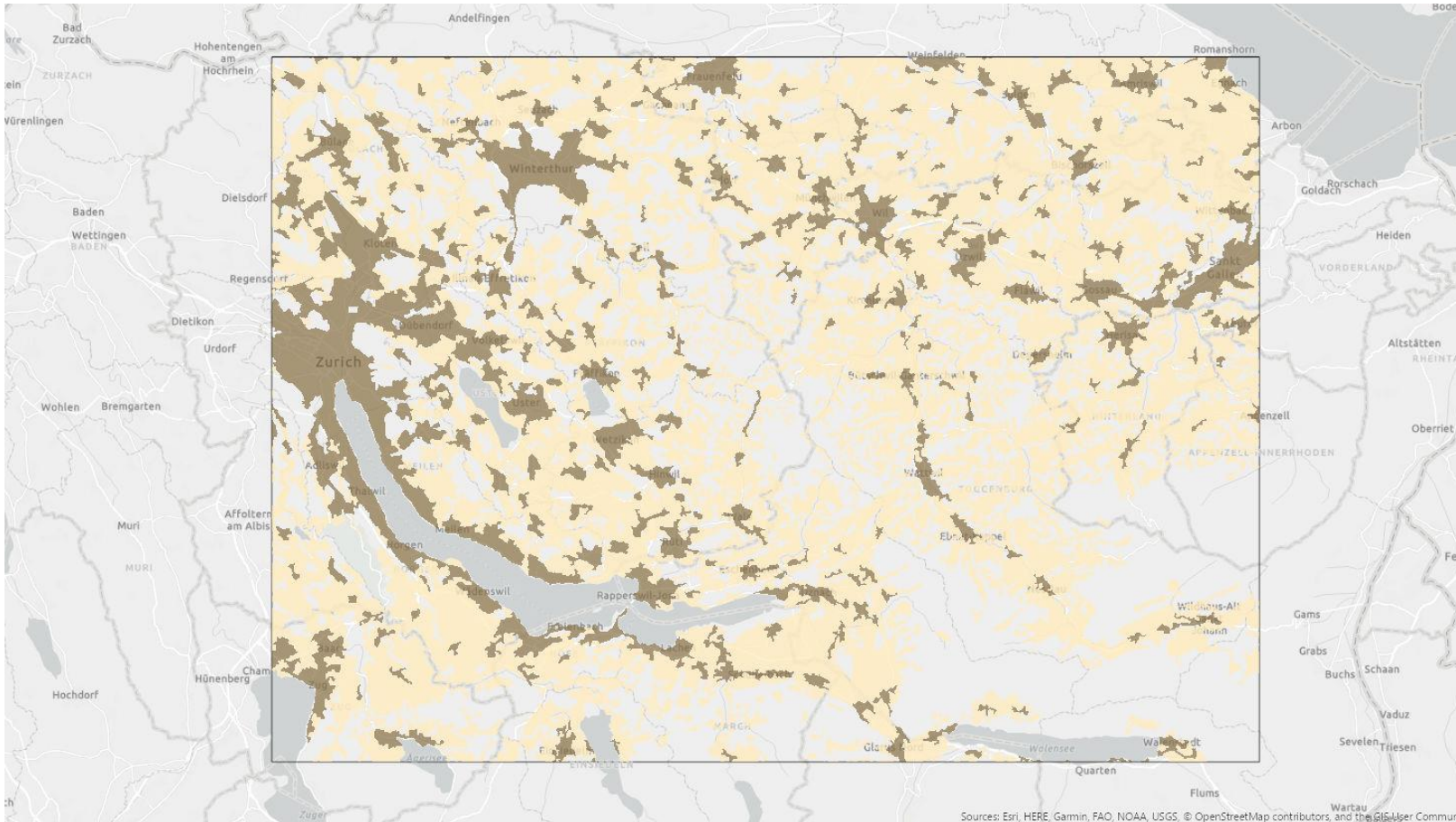
North East of Switzerland





Study Area: 3,500 km²

Study Area - Material & Method

- CORINE Land Cover

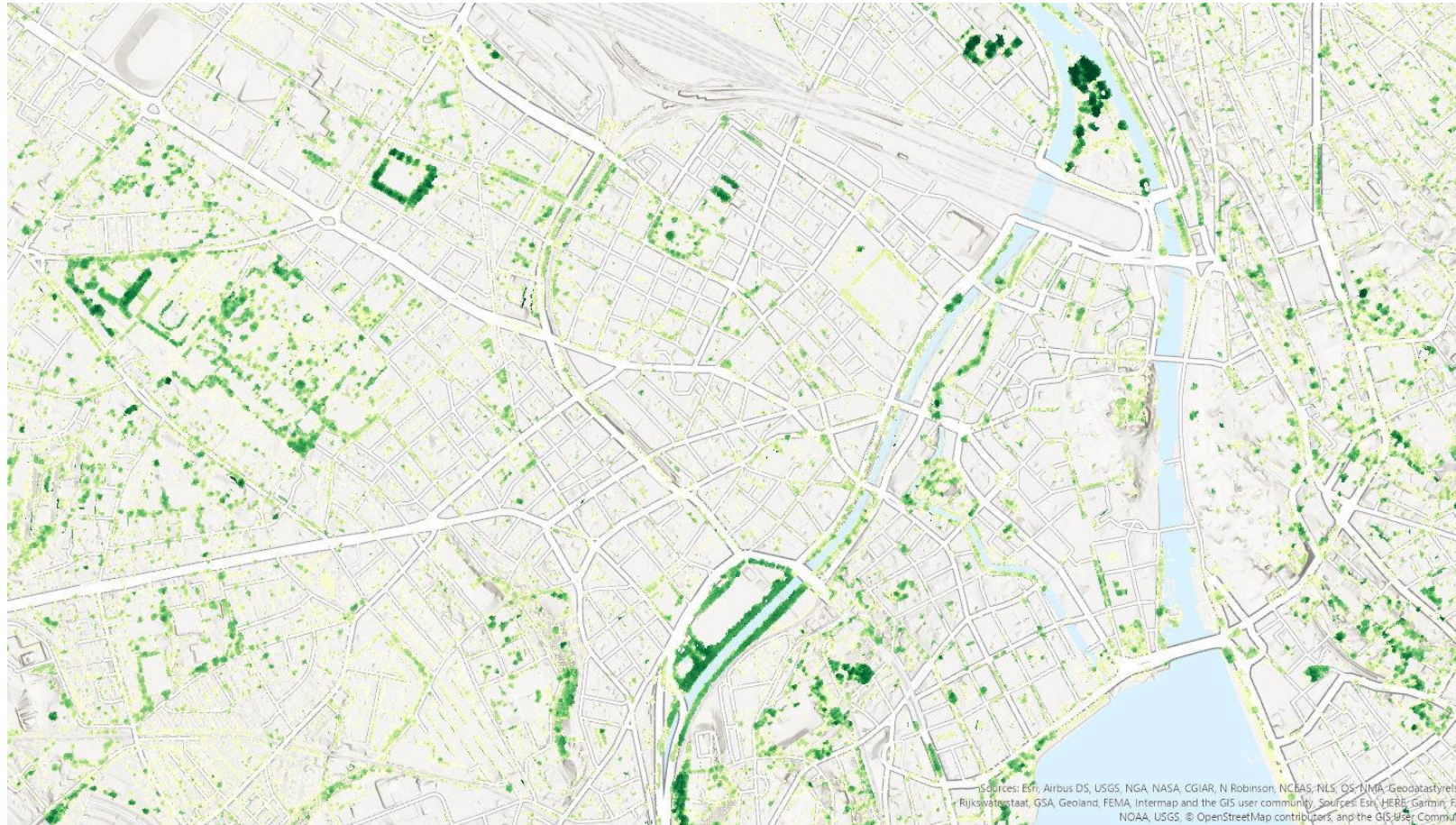


- Identification of agricultural and urban areas

 Agricultural Areas: 1,563 km²
 Urban Areas: 463 km²

Study Area - Material & Method

-Vegetation Height Model (VHM)*



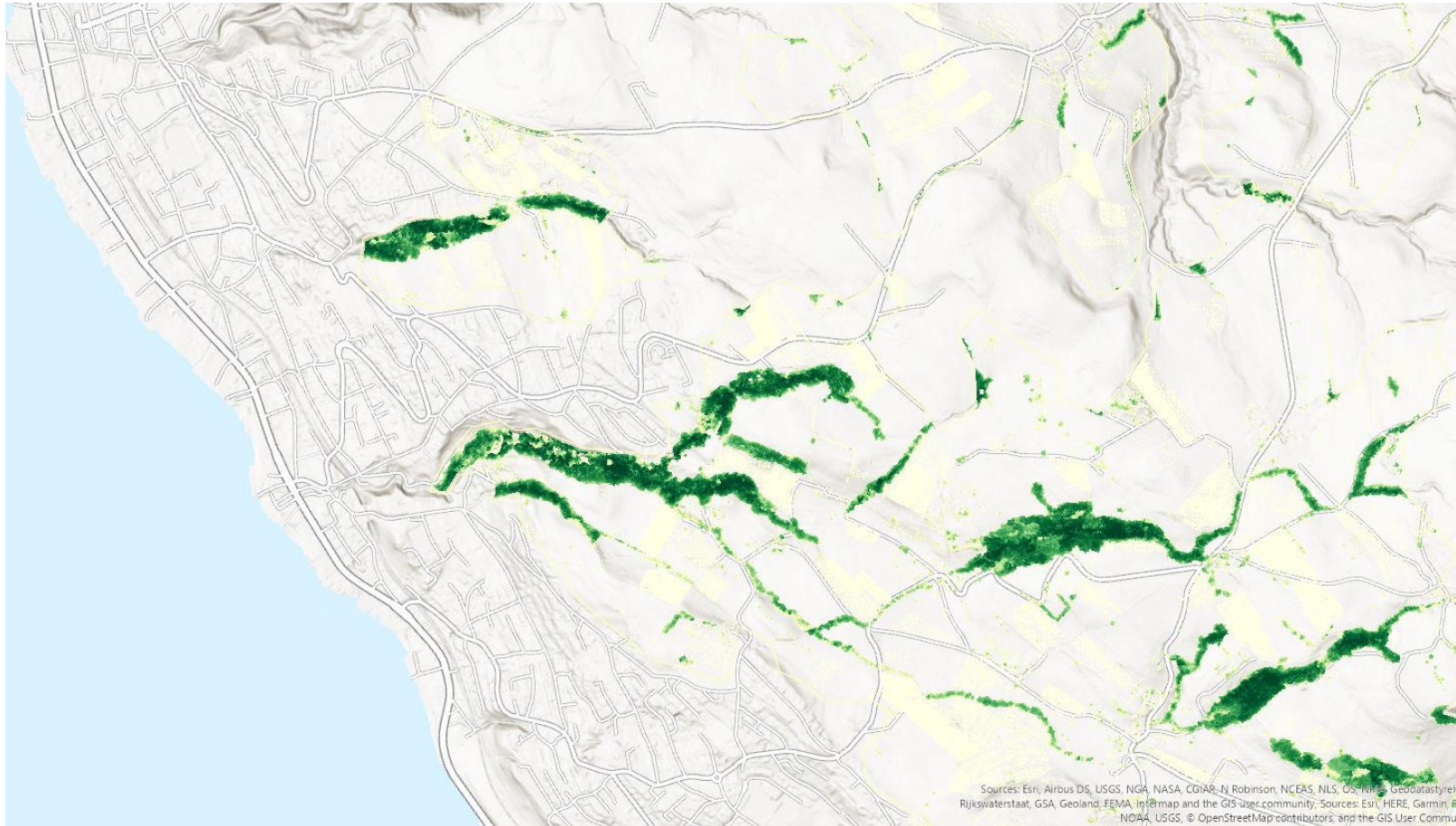
- DSM: Image-based point clouds from ADS80/120 RGBI stereo-images
- LiDAR DTM
- $nDSM = DSM - DTM$
- Buildings removed

VHM
40 m
0.5 m

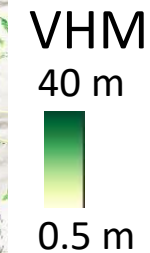
*Ginzler, C., Hobi, M.L., 2015. Countrywide Stereo-Image Matching for Updating Digital Surface Models in the Framework of the Swiss National Forest Inventory. *Remote Sensing*, 7: 4343-4370

Study Area - Material & Method

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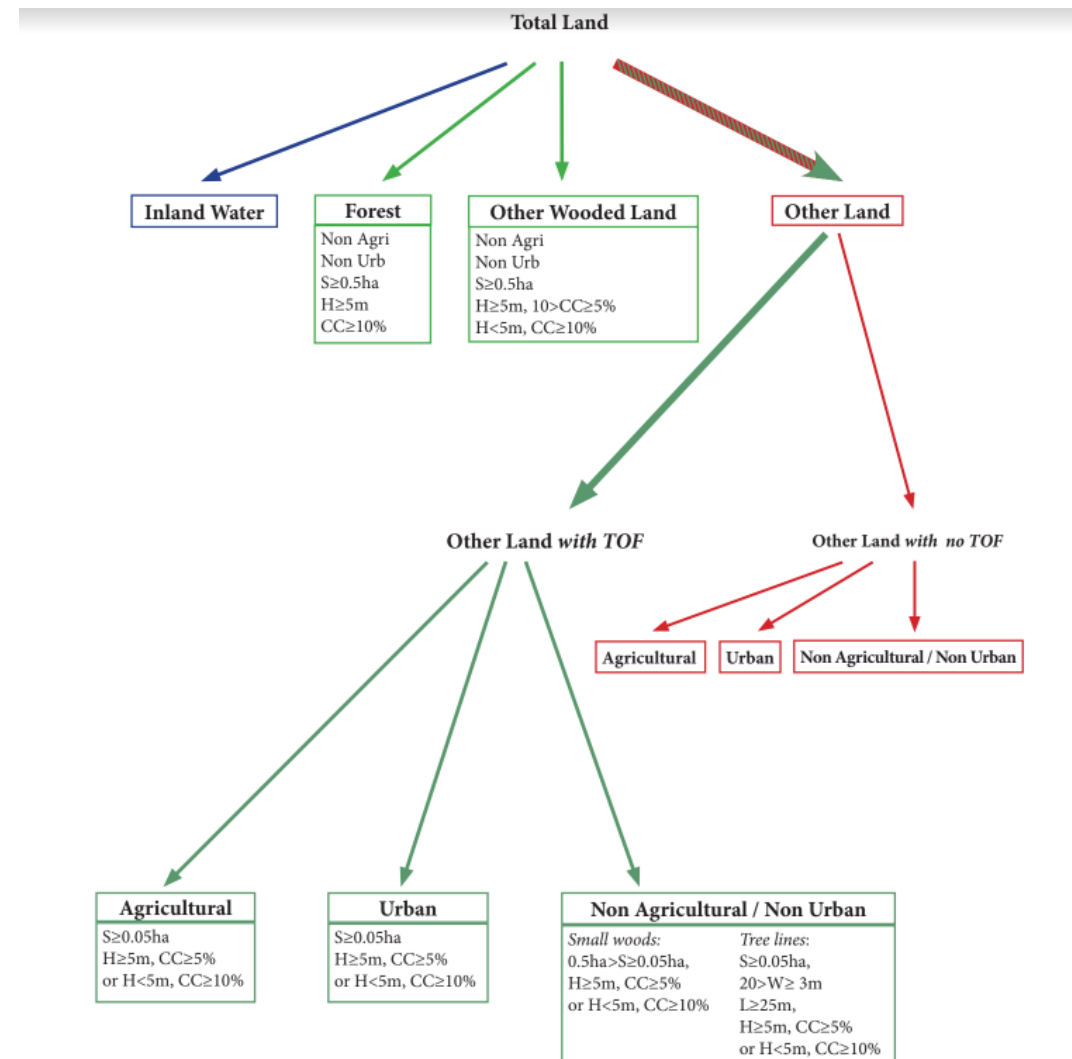


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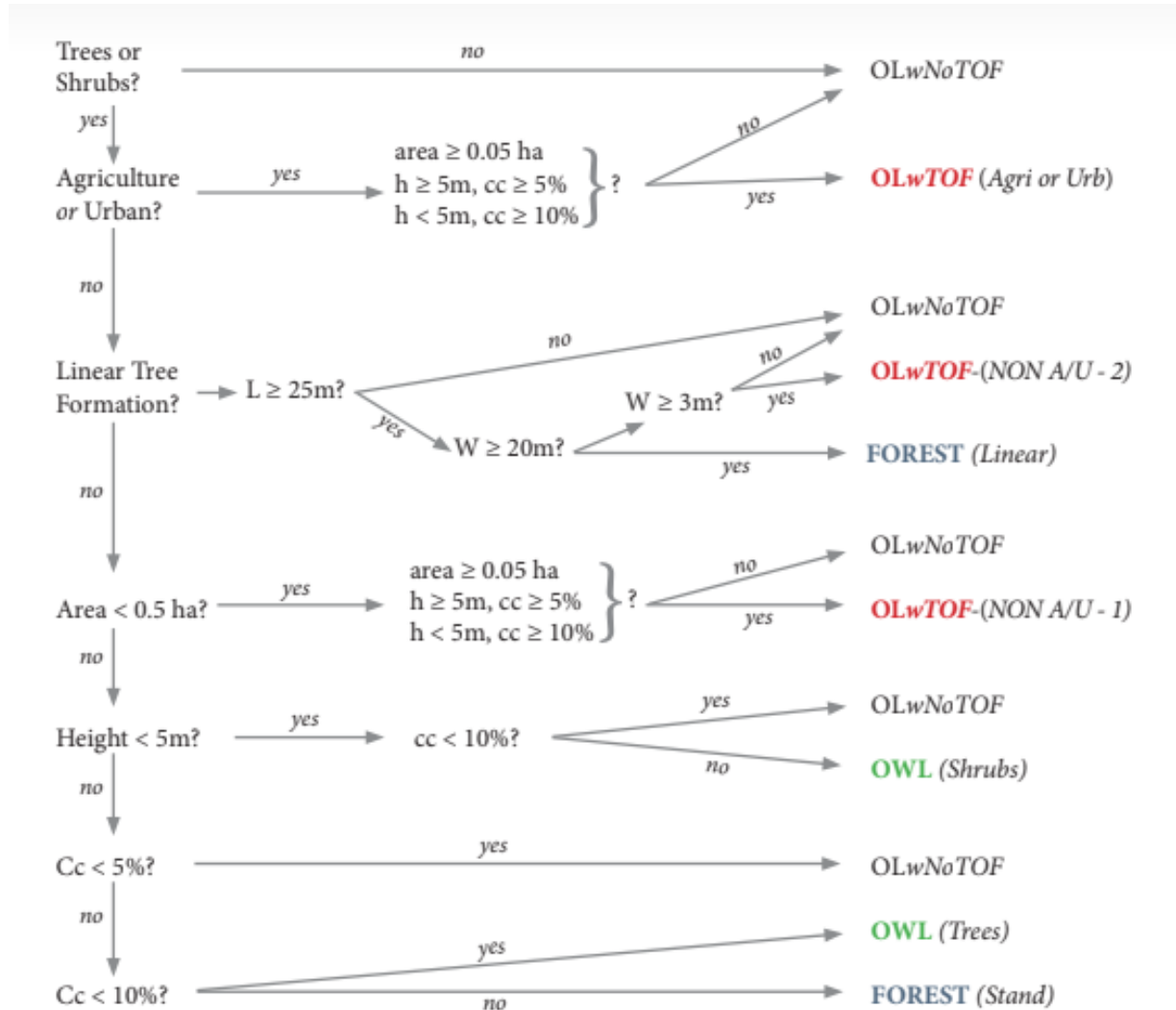
Study Area - Material & Method



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Eylul Malkoc 'New Opportunities for Highly Automated Countrywide Assessment of Trees Outside Forests in Switzerland'
EGU 2020, 5-8 May, Vienna, Austria

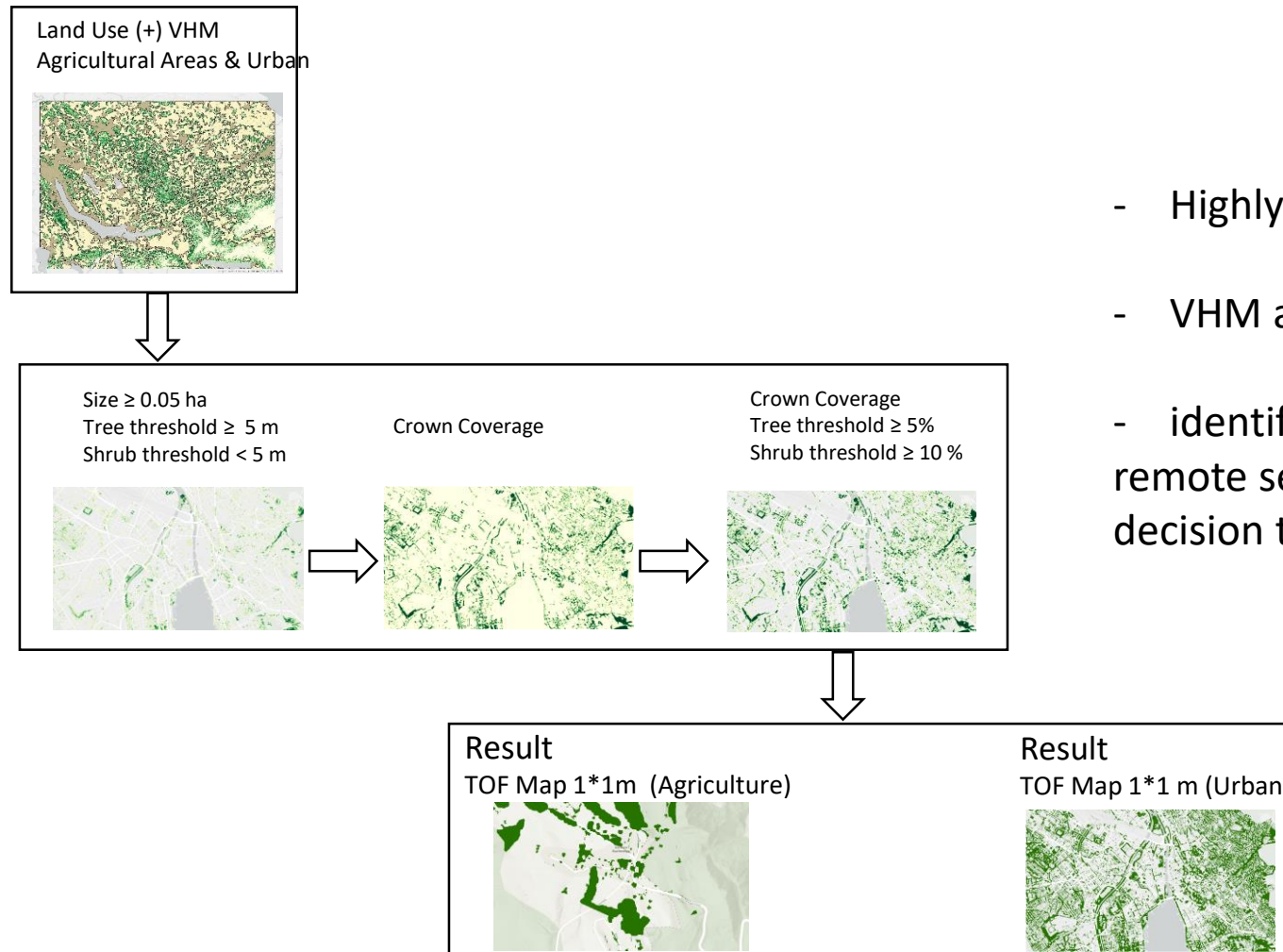
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Study Area - Material & Method



- Highly automated 3-step workflow applied
- VHM and CORINE Land Cover/Use map
- identifying TOF is done using countrywide remote sensing data based on the decision tree algorithm developed by FAO-FRA*

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Results

	Ground Truth	
Prediction	TLM Einzelbaum	Total
TOF_Urban	3661	3661
Other	339	339
Total	4000	4000
Overall Accuracy	0.91	

	Ground Truth	
Prediction	TLM Einzelbaum	Total
TOF_Agriculture	3580	3580
Other	420	420
Total	4000	4000
Overall Accuracy	0.89	

- Accuracy Assessment

- TLM Einzelbaum Gebüsch 2016
- Independent data set from swisstopo*
- 4000 validation points

- Single trees grow more often in agricultural areas than urban areas and less frequently detected by VHM

Results

TOF Agriculture

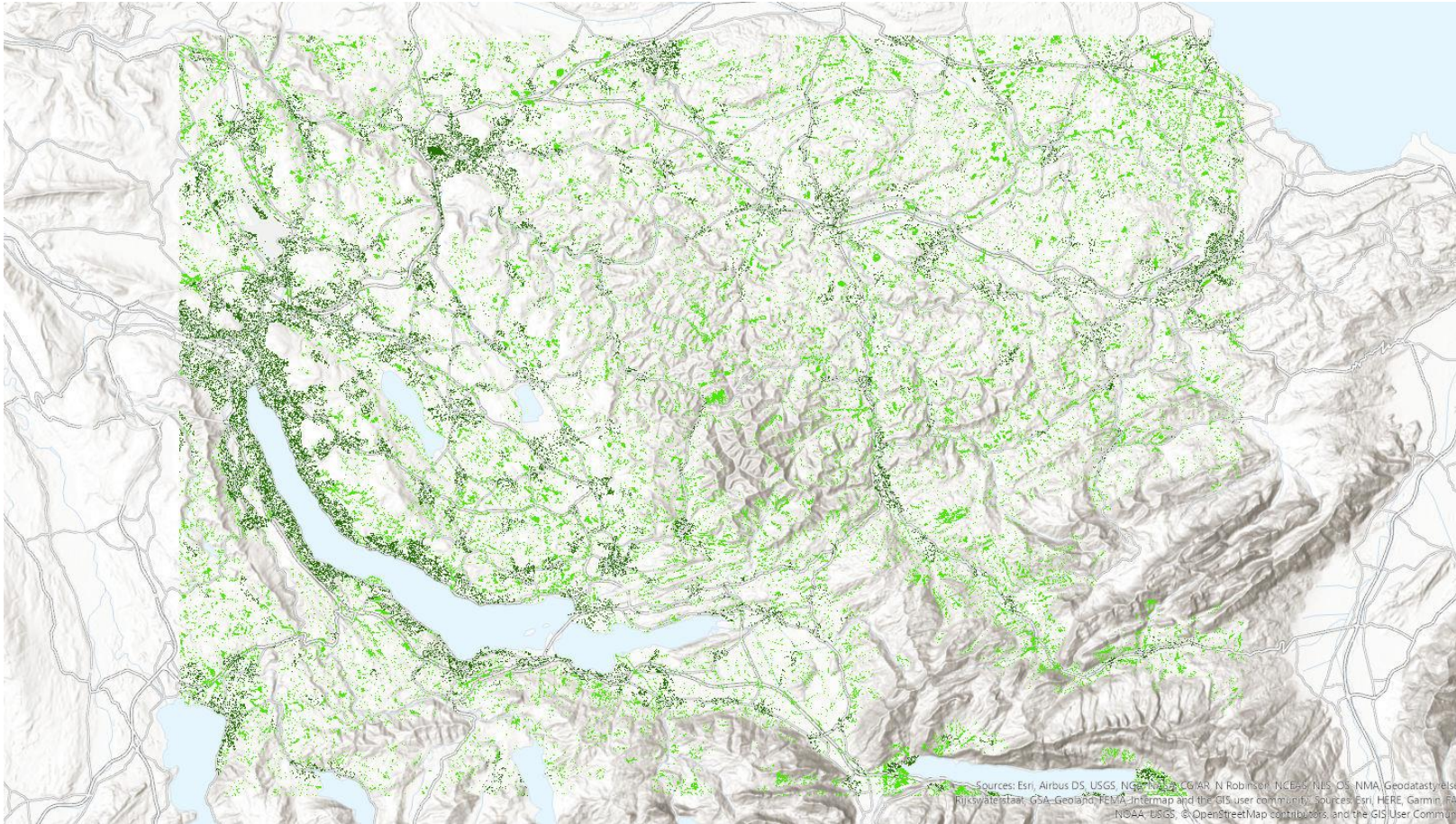


TOF Urban



- Errors due to
 - inaccuracies of VHM
 - coarse resolution of CORINE (especially at the borders of the land use classes)

Results



- TOF cover in Agricultural Areas: 229 km²
- TOF cover in Urban Areas: 126 km²
- Total TOF cover 350 km²

- Approx. 1/3 of the total Forest cover
(350 / 1198 km²)

%27 of the total Urban Area (km²)

%14 of the total Agricultural Area (km²)

%10 of the total Study Area (km²)

Conclusion

- Complement spatial explicit TOF data which is not given by Swiss National Forest Inventory
- Highly automated mapping approach from case study to countrywide level TOF cover of Switzerland

Outlook

- Produced TOF cover map enables to derive relevant TOF parameters such as tree species distribution and above ground biomass
- Replicable mapping approach for other countries/regions to create TOF data sets an input to energy, environment, forest policy making, and wood industry decision making
- The potential of Sentinel-2 imagery will be tested
- Highly automated mapping approach for assessing TOF cover in the European Alpine Arc is planned for the future research

Thank you for your attention