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The Effectiveness of The **U-net on Urban Tree Canopy Mapping**



BACKGROUND

- What are urban forests?
- Why are urban forests important?
- What is urban tree canopy?
- How to map urban tree canopy?
- Why use deep learning approaches?









OBJECTIVES

- Apply the U-net in urban tree canopy mapping using aerial photographs.
- I Test the effectiveness of the U-net in comparison with the OBIA approach.
- Assess the performance and robustness of the U-net architecture for images of different levels of spatial details.





METHODS AND MATERIALSSTUDY AREA AND DATA

Study Area

- **Data Source**
- **Data Format**







METHODS AND MATERIALS U-NET ARCHITECTURE



Ronneberger, Olaf, Philipp Fischer, and Thomas Brox. "U-net: Convolutional networks for biomedical image segmentation." International Conference on Medical image computing and computer-assisted intervention. Springer, Cham, 2015.



ACCURACY ASSESSMENT

- Dice coefficient (DSC)
- Intersection over union (IoU)
- **Overall accuracy (OA)**
- Kappa coefficient (KC)



RESULTS AND DISCUSSION

Evaluation 1: The predicted output was first upsampled to 8 cm and then compared with the original 8-cm ground truth data.

Evaluation 2: The ground truth data were resampled to the spatial resolution of the predicted output dataset before comparison.

EVALUATION 1

Scale	ΟΑ	DSC	loU	КС
16 cm	0.9791	0.9550	0.9138	0.9411
32 cm	0.9914	0.9816	0.9638	0.9770
50 cm	0.9881	0.9741	0.9496	0.9664
100 cm	0.9324	0.8327	0.7133	0.7917



EVALUATION 2

Scale	ΟΑ	DSC	loU	КС
16 cm	0.9798	0.9568	0.9171	0.9436
32 cm	0.9982	0.9962	0.9925	0.9952
50 cm	0.9987	0.9972	0.9944	0.9963
100 cm	0.9984	0.9967	0.9934	0.9983



RESULTS AND DISCUSSION

- Output of tree canopy extraction (example)
- (a)original orthophoto
- (b) 8-cm ground truth image
- (c)16-cm predicted tree canopy
- (d) 16-cm ground truth image
- (white areas refer to tree canopy pixels; black areas refer to non-tree pixels)

















RESULTS AND DISCUSSION COMPARED TO THE OBIA APPROACH







RESULTS AND DISCUSSION COMPARED TO OTHER DEEP LEARNING APPROACHES

Method	Dataset	DSC (F1 score)
Multimodal and Multi-scale deep	Ortho	89.9%
networks (Audebert et al., 2016)		
Multi-resolution CNN	Ortho + nDSM	84.97%
(Paisitkriangkrai et al., 2015)	+DSM	
FCNN (Sang and Minh, 2018)	Ortho +nDSM	89.9%
HUSTW5 (hybrid)	/	90.8%
("ISPRS - Test result Y. Sun," n.d.)		
U-net (32-cm experiment in this study)	Ortho	97.41%





CONCLUSION

- tree canopy.



The U-net architecture was proved to be exceptionally effective on the extraction of the urban

Interpret produced significantly higher metric scores compared with the OBIA approach. Even compared with other deep learning approaches implemented in previous studies, the U-net architecture used in this study presented a better performance on the urban tree extraction.

The performance at different scales imply a wide application of the U-net on urban tree studies.



QUESTIONS?





