

# UTCSA: A 0.5-meter resolution urban tree canopy dataset for 888 cities in South America and its pilot applications

Jianhua Guo<sup>1</sup>, Xiao Xiang Zhu<sup>1,2</sup>

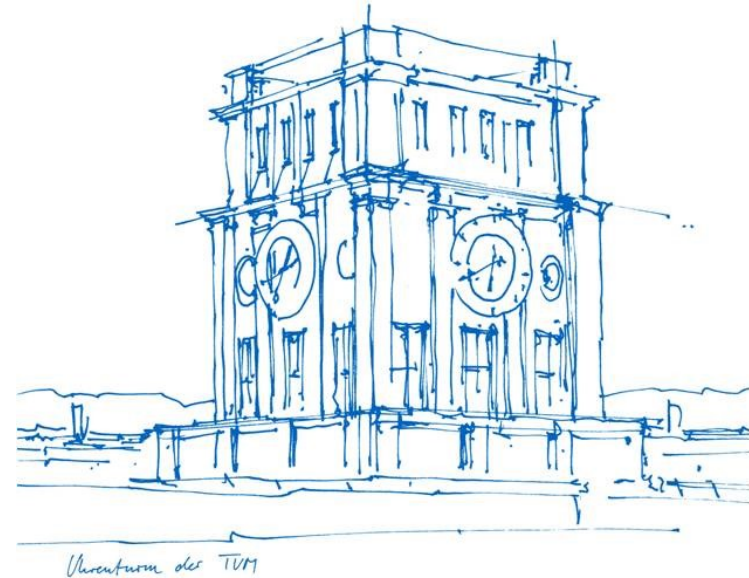
1. Data Science in Earth Observation, Technical University of Munich, Germany
2. Munich Center for Machine Learning, Munich, Germany

E-mail: [jianhua.guo@tum.de](mailto:jianhua.guo@tum.de)

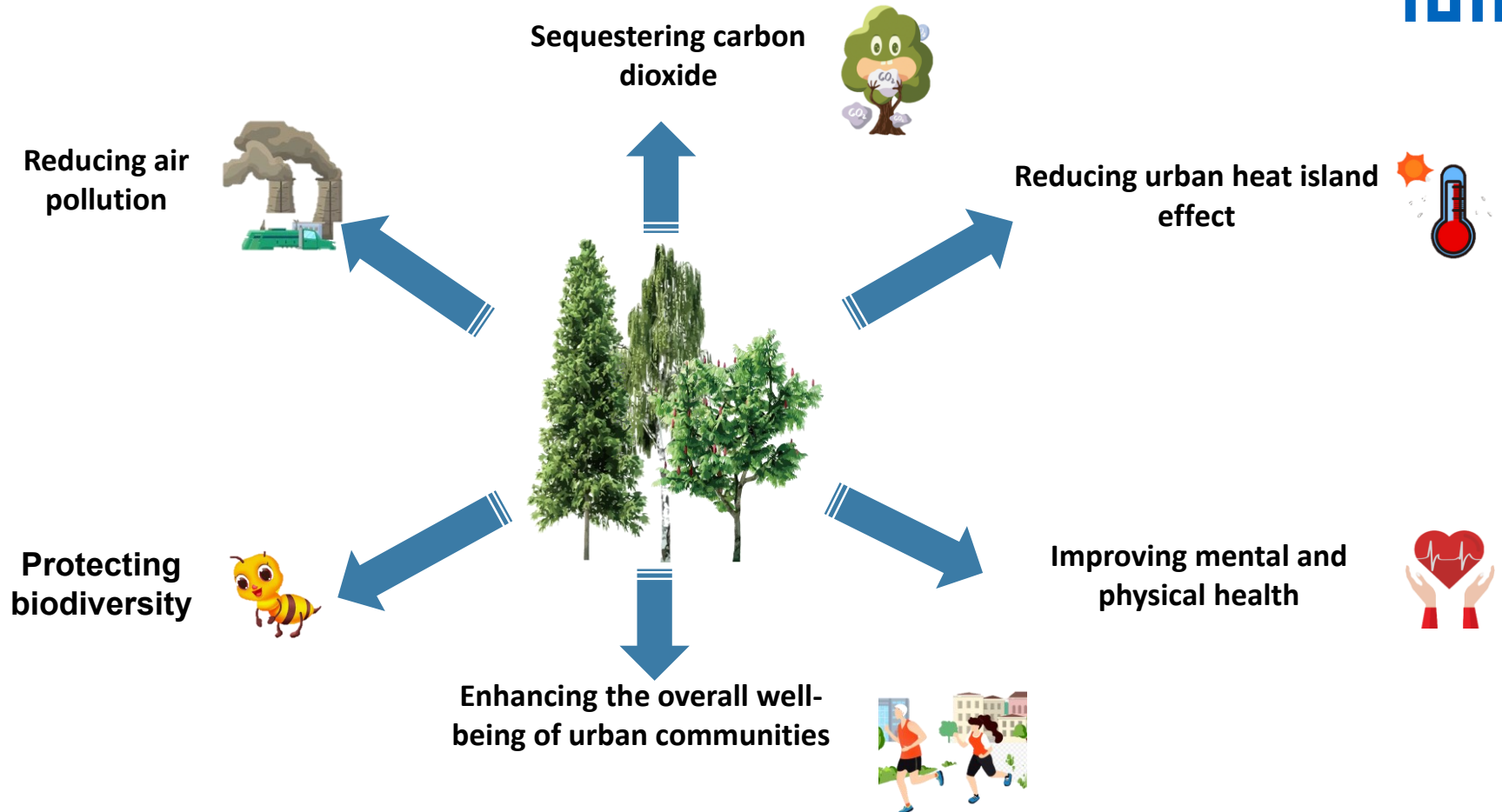
[xiaoxiang.zhu@tum.de](mailto:xiaoxiang.zhu@tum.de)



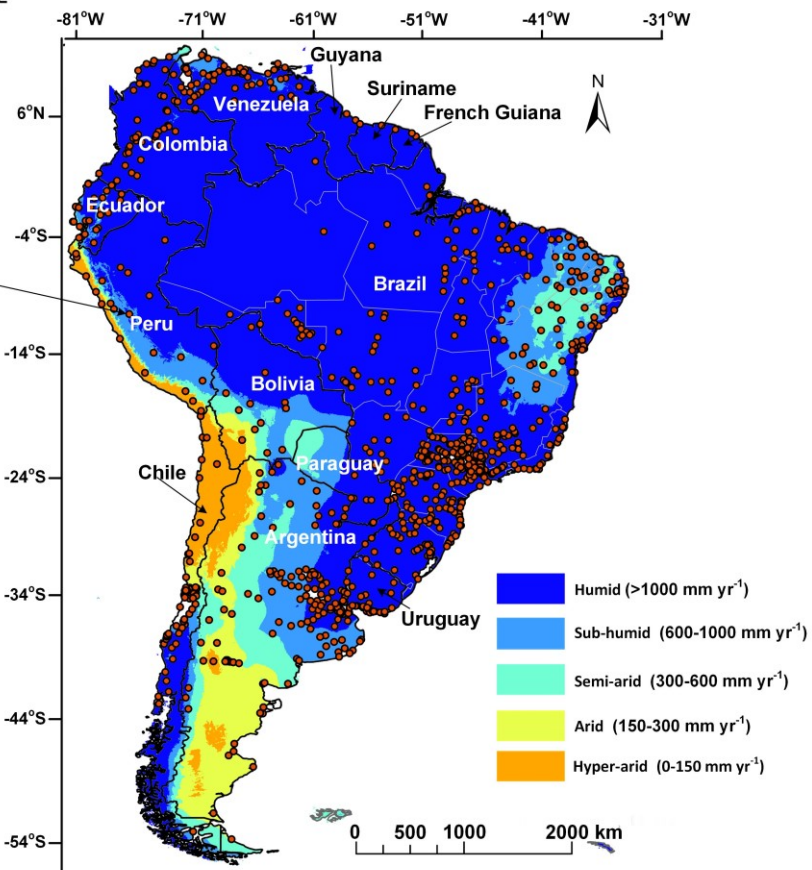
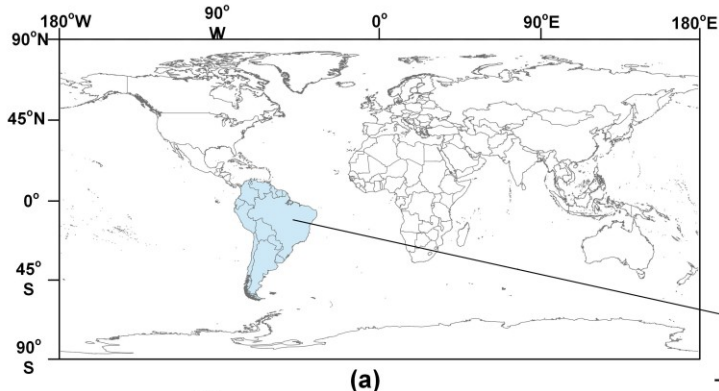
**Scan here !**



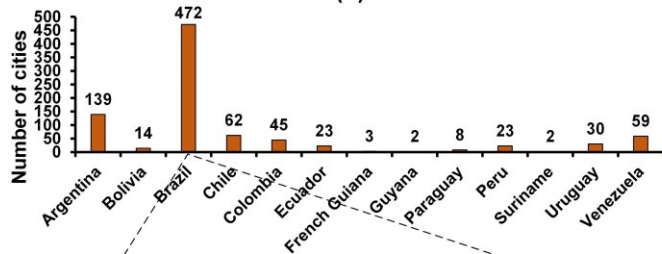
# Benefits of Urban Trees



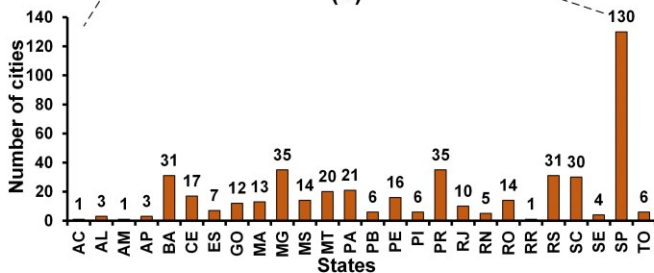
# Study area



13 countries



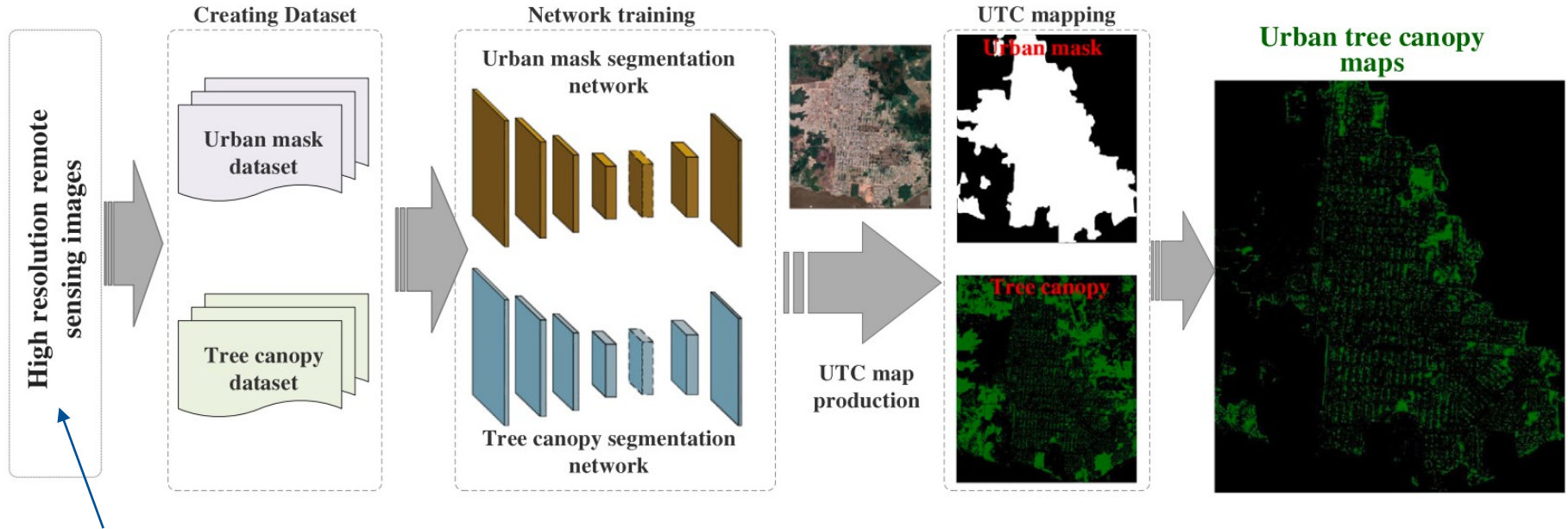
472 cities



(d)

# Study method

The overall workflow of Urban tree canopy (UTC) mapping.

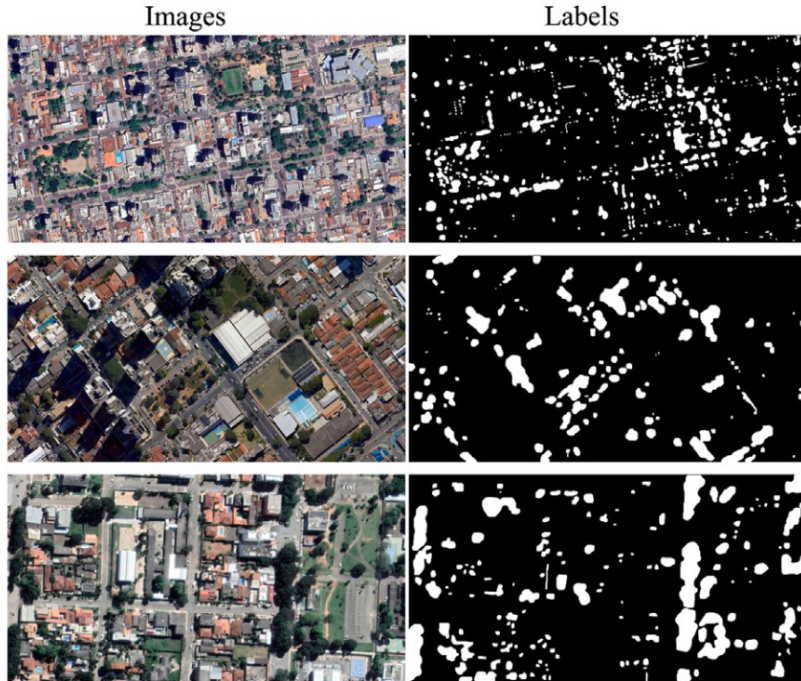


**Satellite images:** GeoEye-1, SkySat, Pleiades, and WorldView-2/3

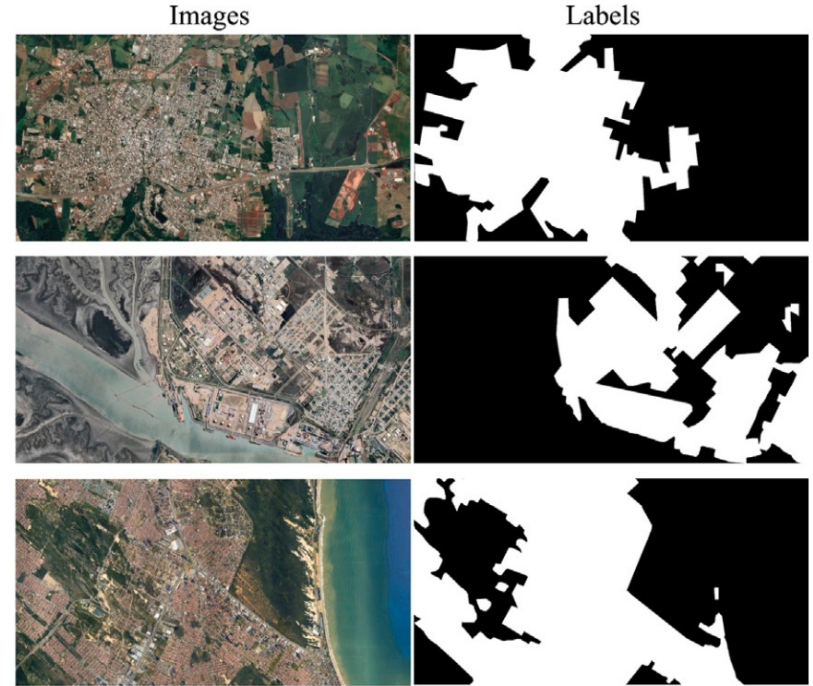
More than two thousand source satellite images (2018-2019) .



# Data sets



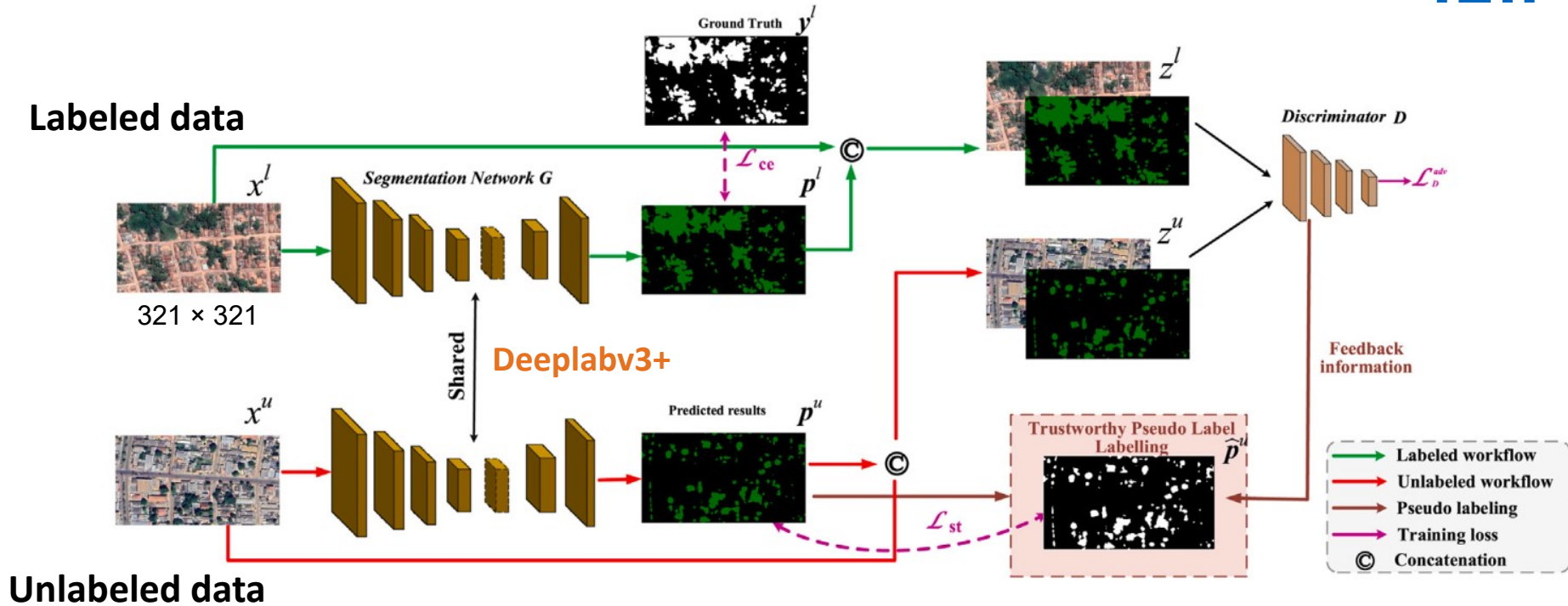
The urban tree annotation samples



The urban mask annotation samples

Tree annotations :130 images ( $1880 \times 970$ )  
Urban masks: 100 images ( $1880 \times 970$ )

# Semi-supervised deep learning framework

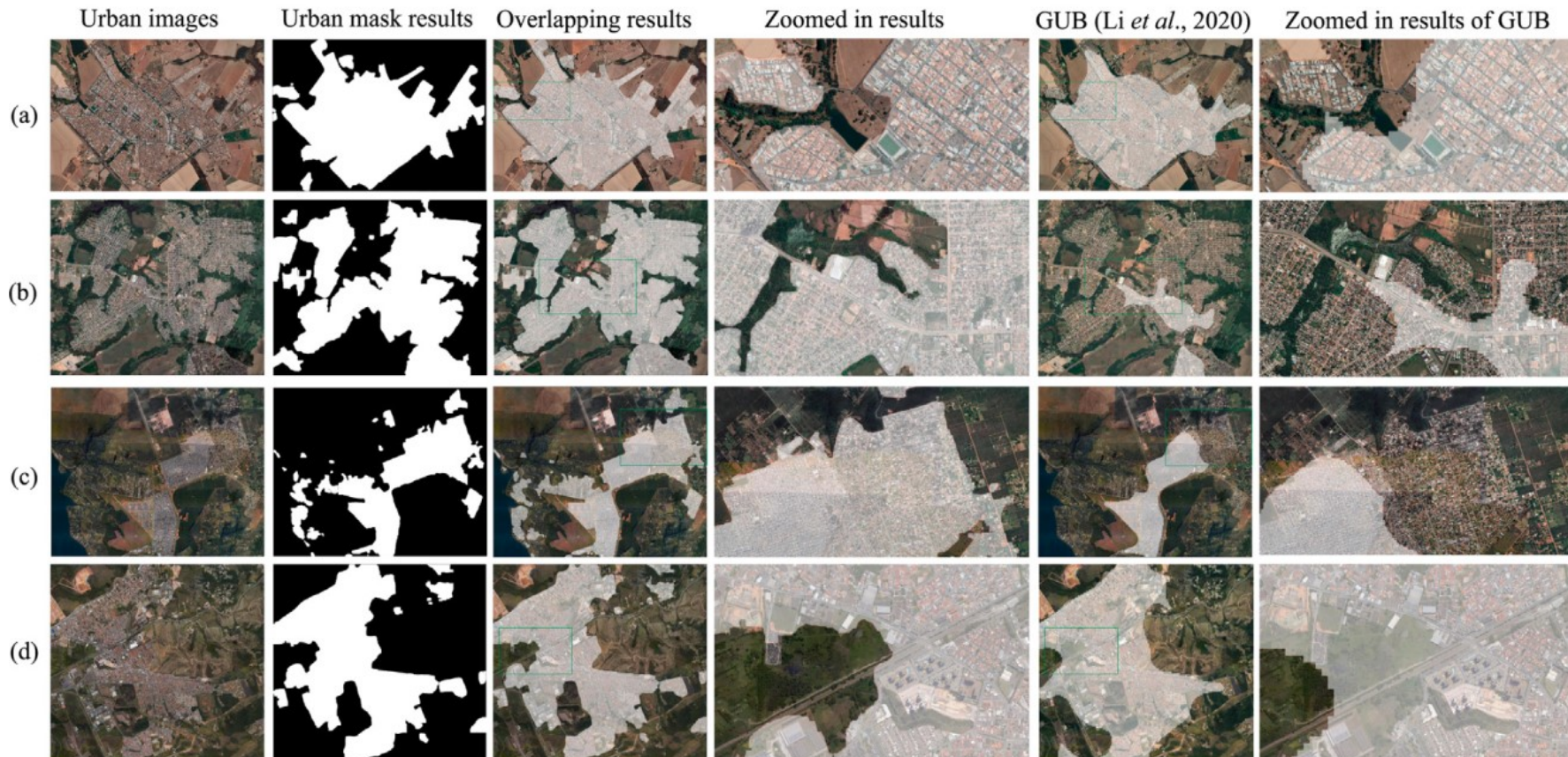


$$\text{Loss function: } \mathcal{L}_G = \mathcal{L}_{ce} + \lambda_{st} \mathcal{L}_{st} + \lambda_d \mathcal{L}_D^{adv}$$

The proposed semi-supervised deep learning framework for urban tree canopy segmentation.



# Results – Urban boundary

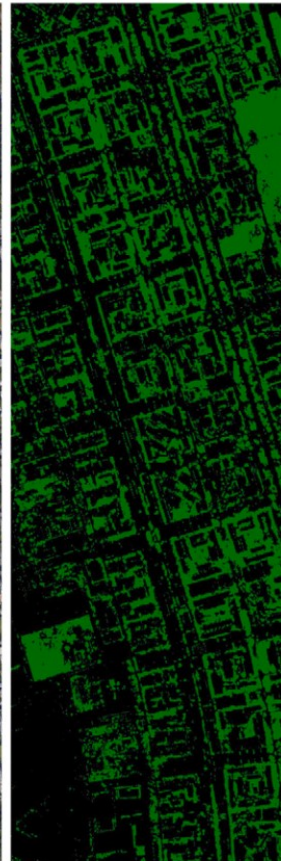




# Results – UTC segmentation results

High-resolution image

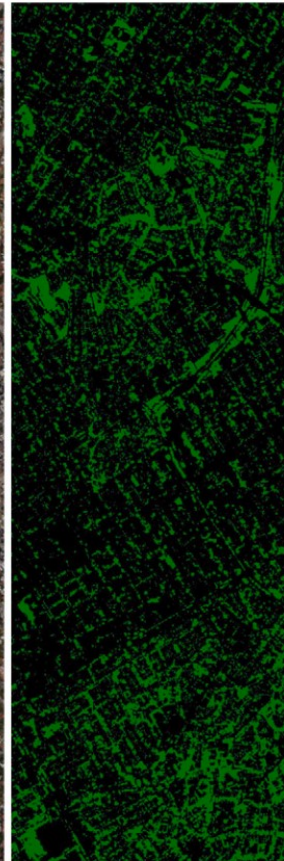
Canopy segmentation result



(a)

High-resolution image

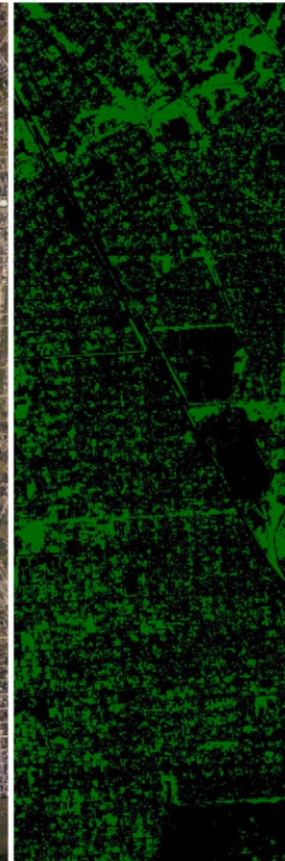
Canopy segmentation result



(b)

High-resolution image

Canopy segmentation result



(c)

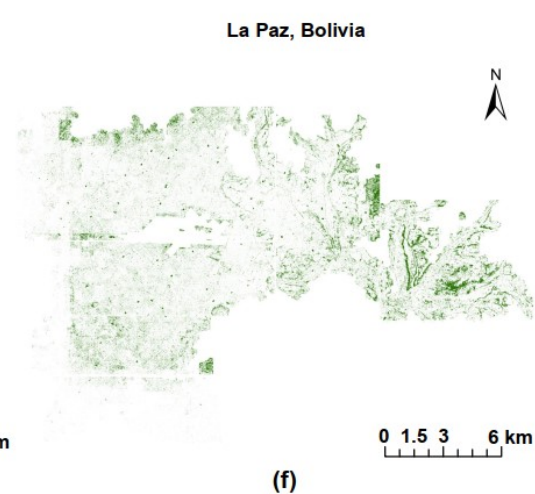
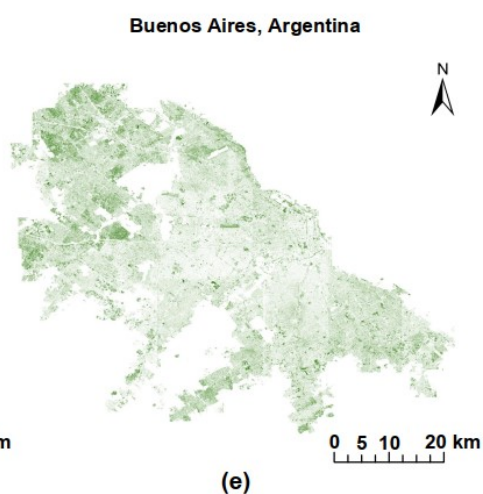
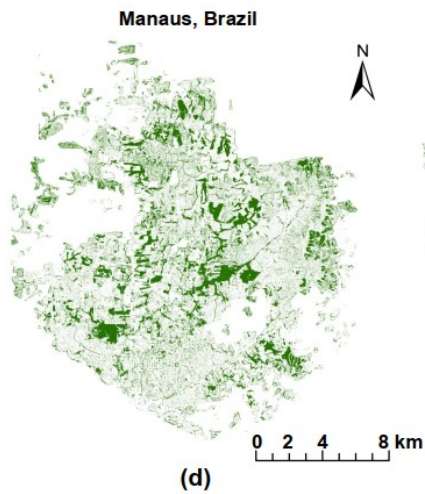
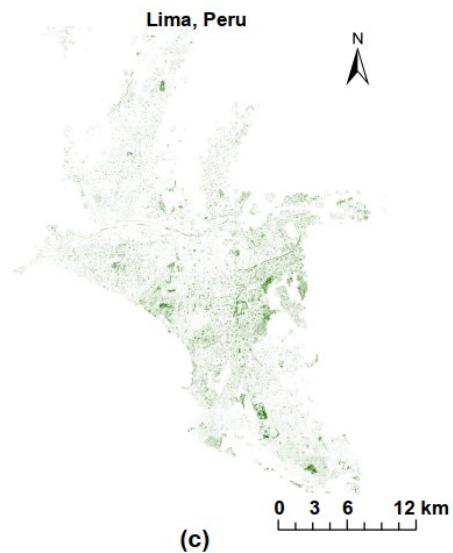
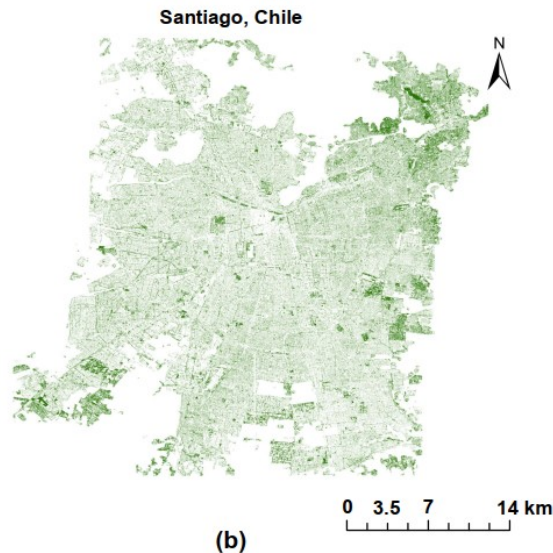
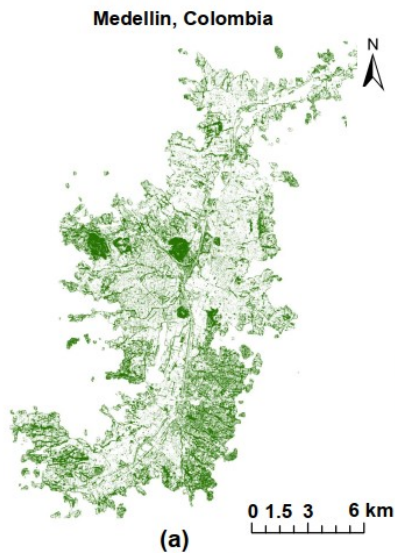


# Results- UTC products

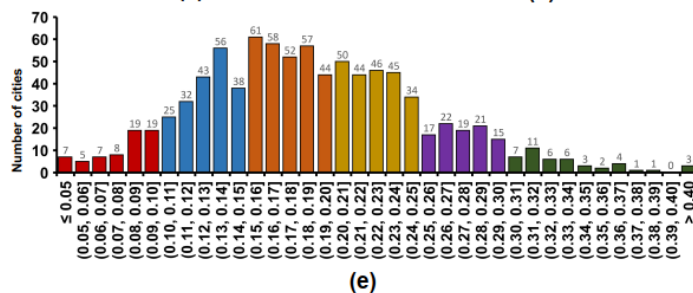
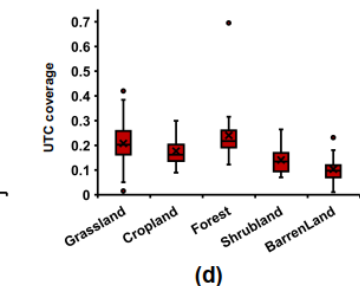
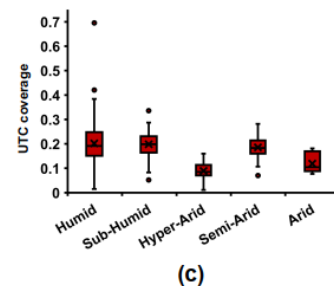
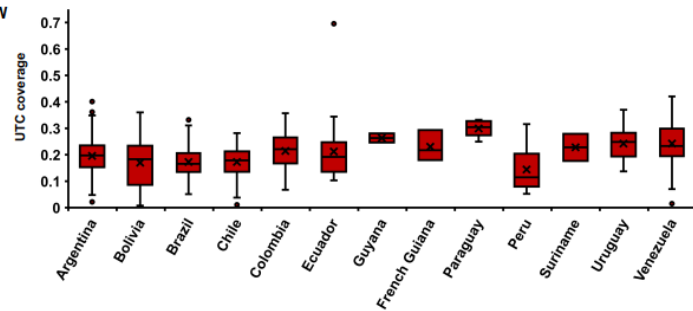
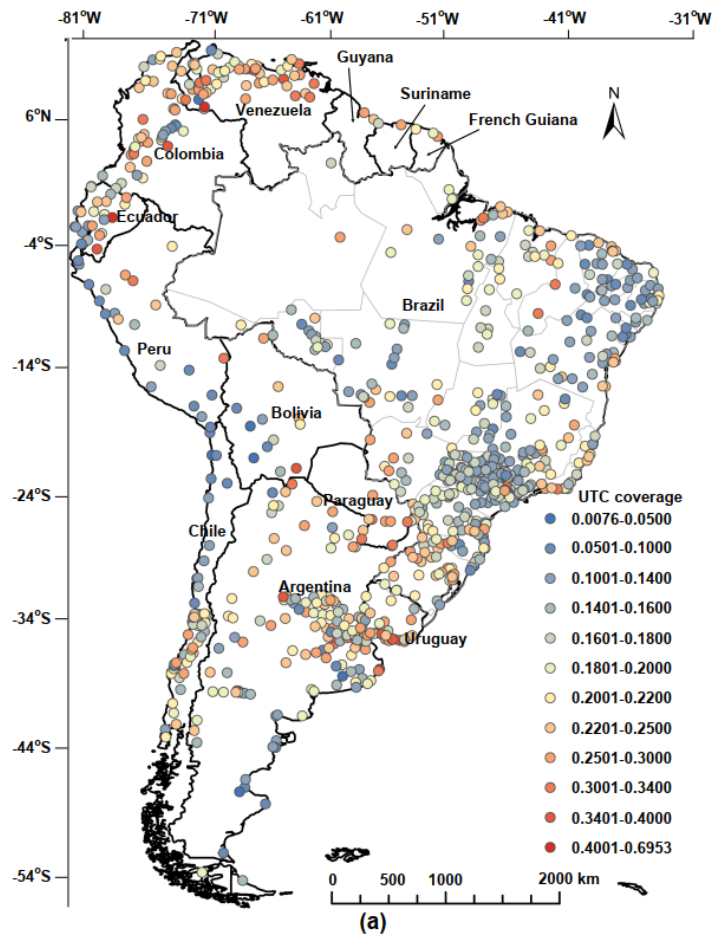
Accuracy:

MIOU=81.80%

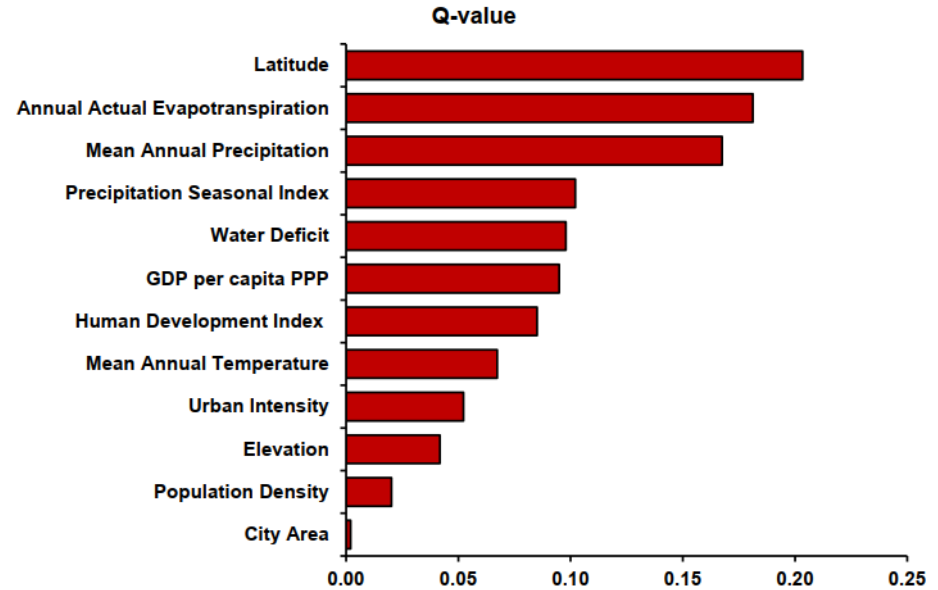
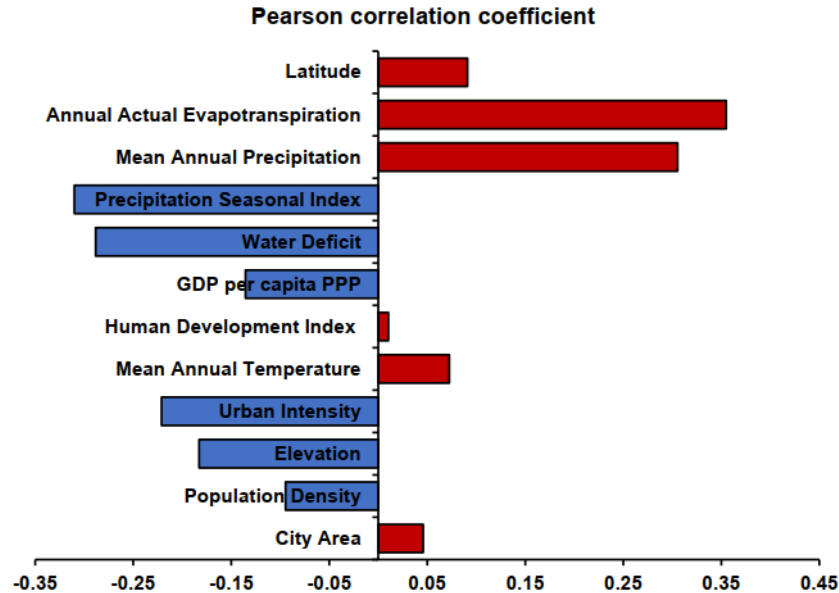
Kappa = 77.51%



# Application-UTC coverage assessment



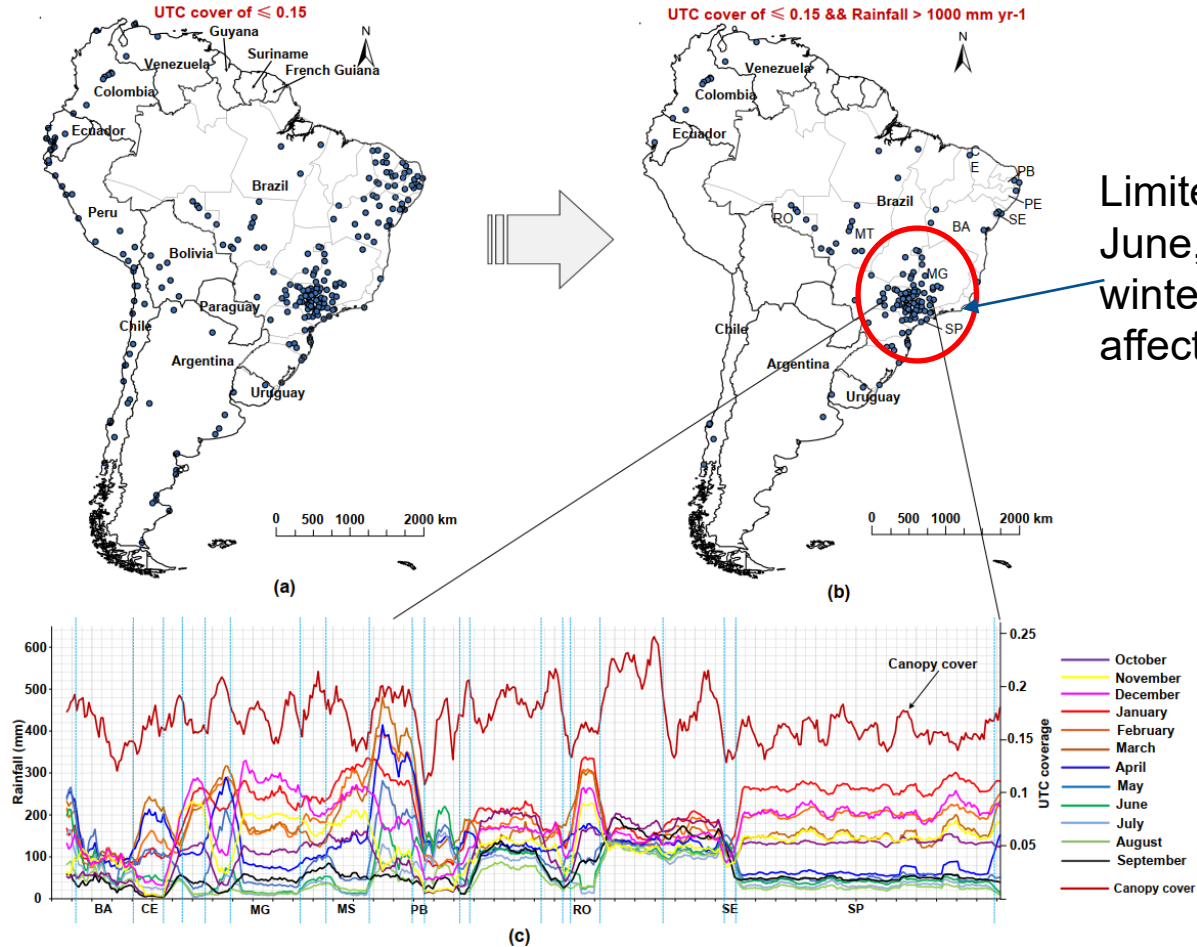
# Application- UTC coverage driving factors exploration



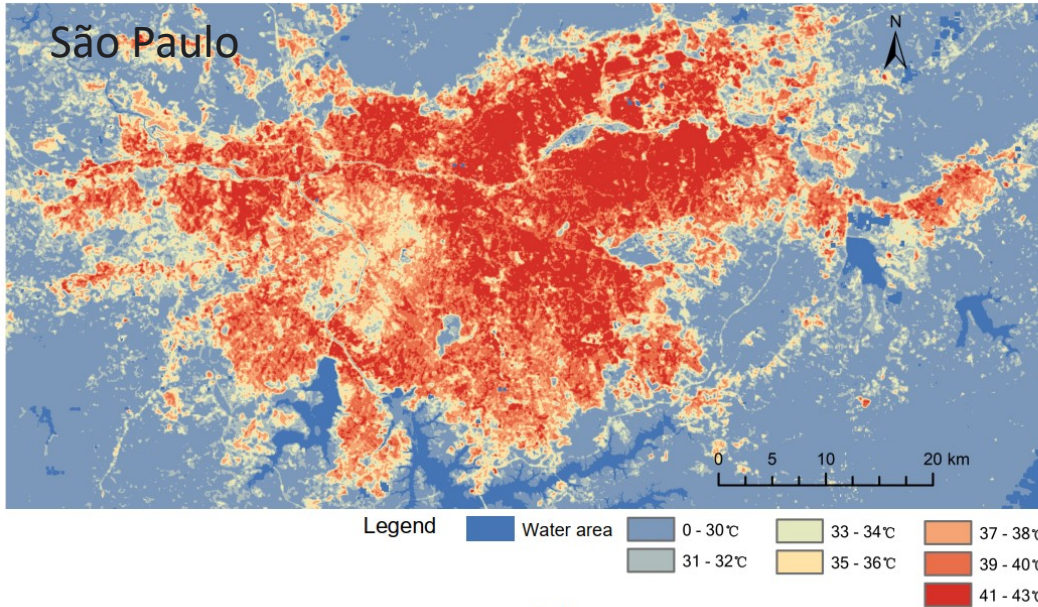
Natural factors (climatic and geographical) play a very important role in determining UTC coverage, followed by human activity factors (economy and urbanization level).



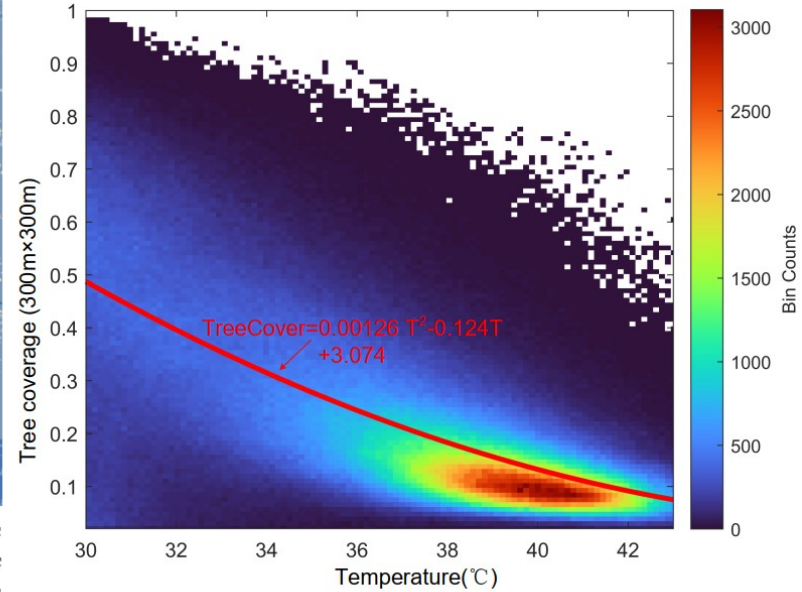
# Application-impact of seasonal changes in rainfall on UTC coverage



# Application-cooling effect of UTC on urban heat island



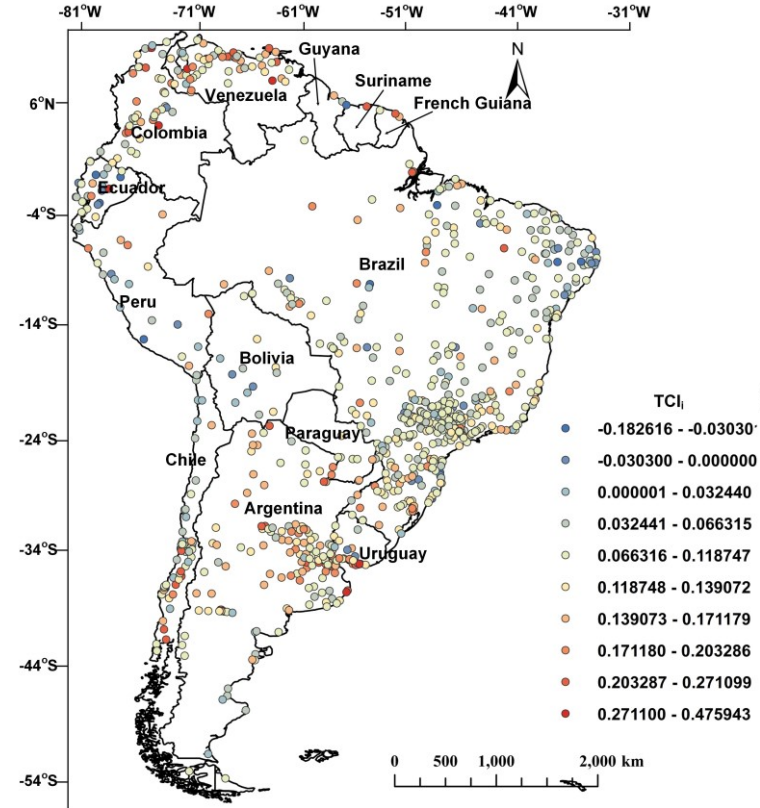
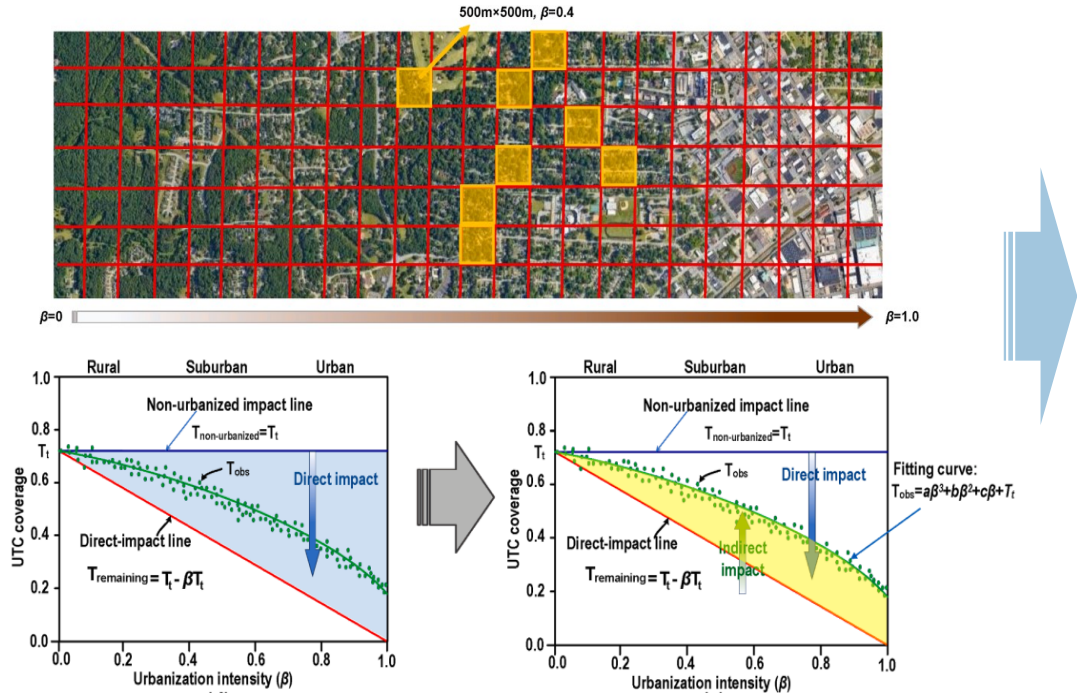
(a)  
LST data-30 m resolution



(b)  
UTC coverage & LST

Tree has the potential to mitigate the effects of urban heat islands.

# Application-impact of urbanization on UTC coverage



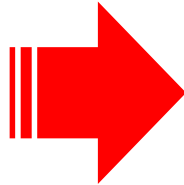
The indirect effect of urbanization influences urban tree coverage in South America



## Reference

1. Guo, Jianhua, et al. "Nationwide urban tree canopy mapping and coverage assessment in Brazil from high-resolution remote sensing images using deep learning." *ISPRS Journal of Photogrammetry and Remote Sensing* 198 (2023): 1-15.
2. Guo, Jianhua, et al.. "Assessing the macro-scale patterns of urban tree canopy cover in Brazil using high-resolution remote sensing images." *Sustainable Cities and Society* 100 (2024): 105003.
3. Guo, Jianhua, et al. "High-resolution satellite images reveal the prevalent positive indirect impact of urbanization on urban tree canopy coverage in South America." *Landscape and Urban Planning* 247 (2024): 105076.
4. Guo, Jianhua, et al. "Continent-wide urban tree canopy fine-scale mapping and coverage assessment in South America with high-resolution satellite images." *ISPRS Journal of Photogrammetry and Remote Sensing* (Minor revision 12/04/2024)

**Code and data**



**Thanks for your attending .....**