

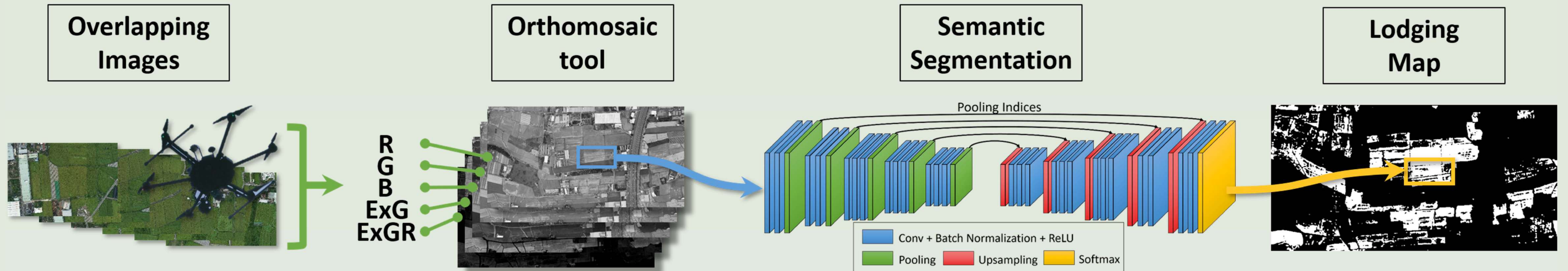
# Application of Deep Learning Technique to Rice Lodging Identification

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## Graphical Abstract



## Study Area

### Wu Feng, Taichung

2,600 ha  
2,500 images  
180 m  
4.68cm/pixel  
11.8 Terapixels

### Image Collection

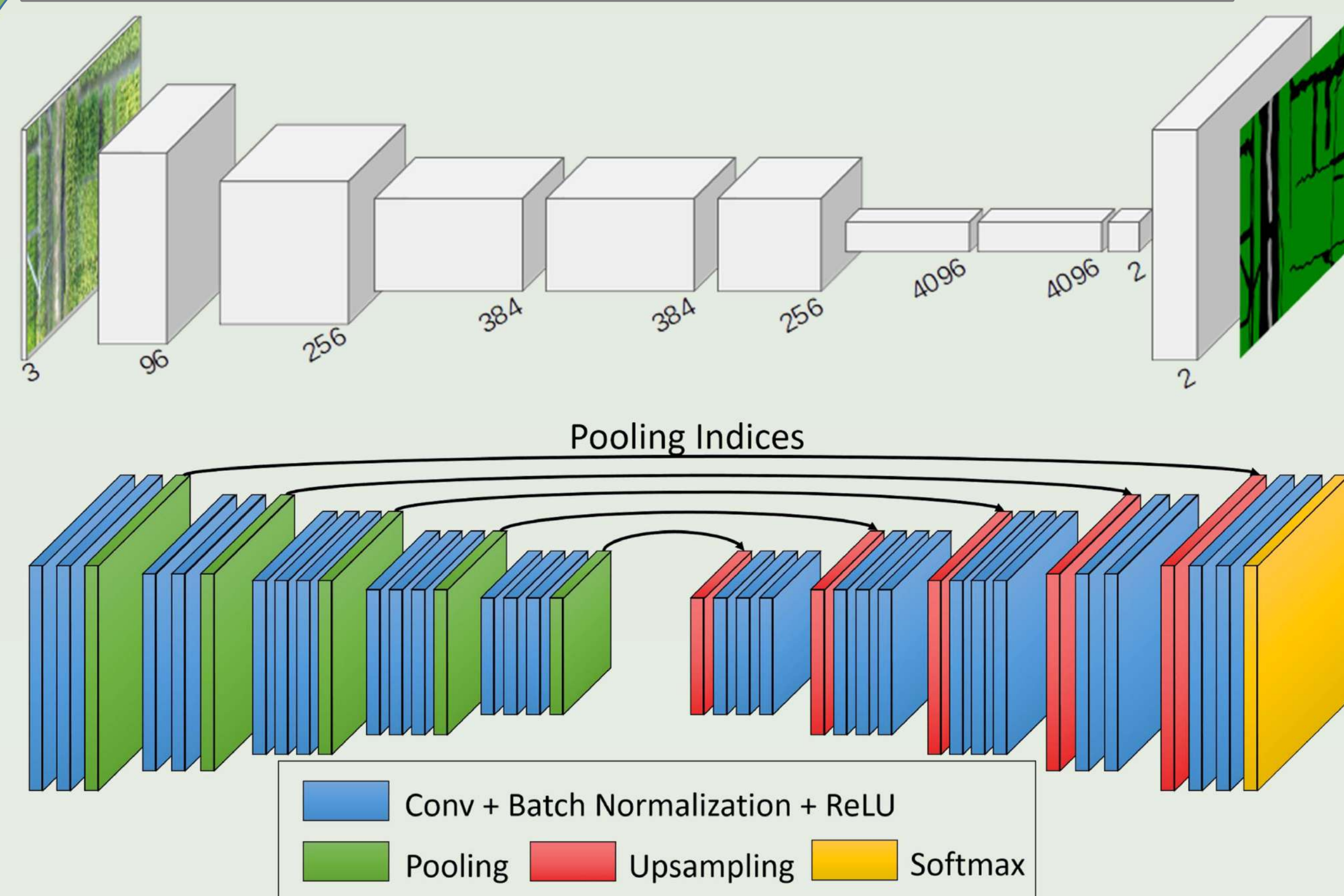
Fixed wing drone  
FF mirrorless cam  
44 Megapixels

### Orthomosaic Process

Agisoft Metashape  
1 hour for stitching



## Semantic Segmentation Architectures



### FCN-AlexNet

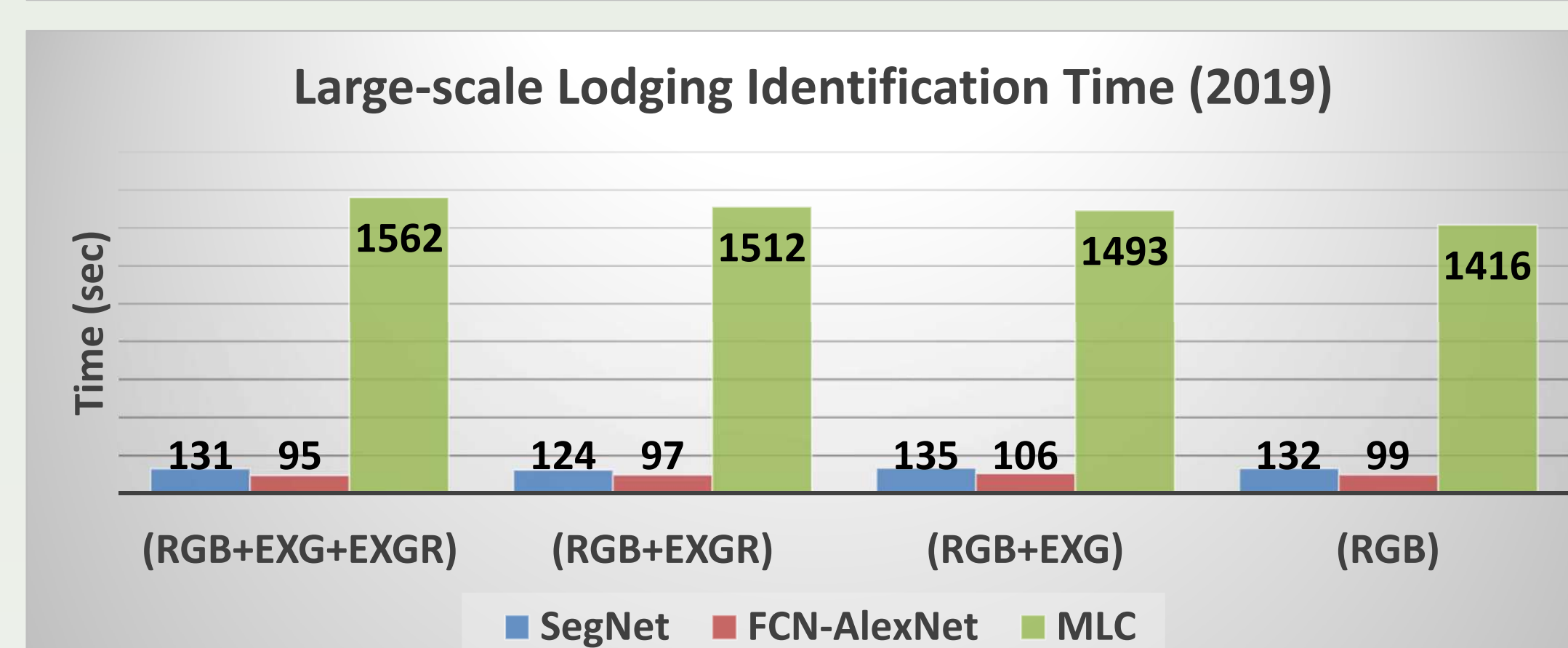
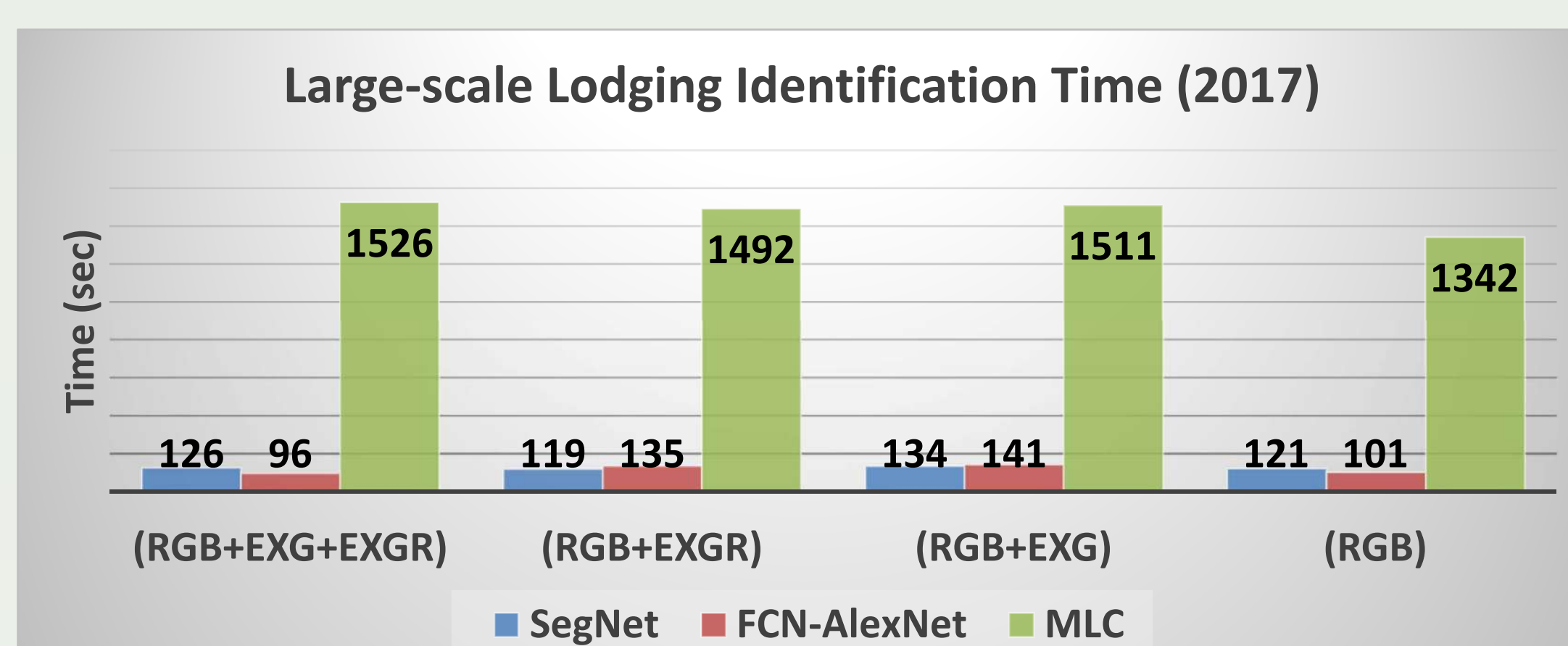
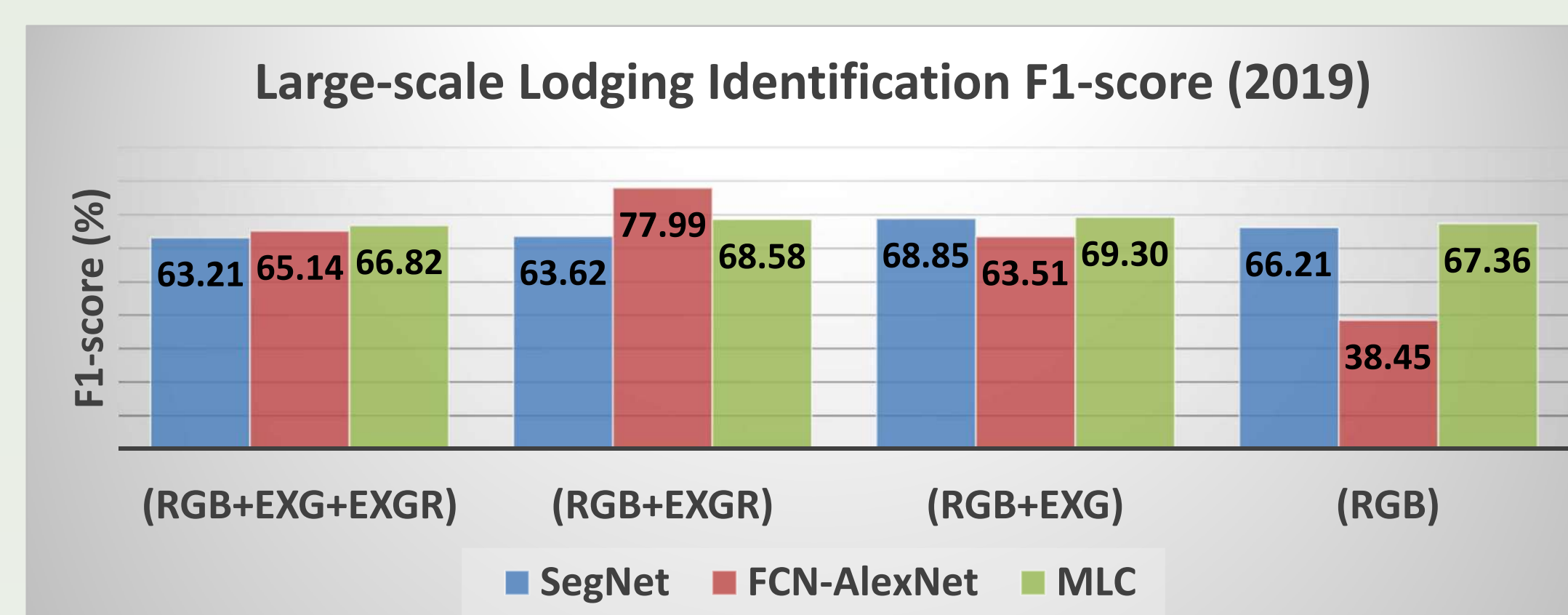
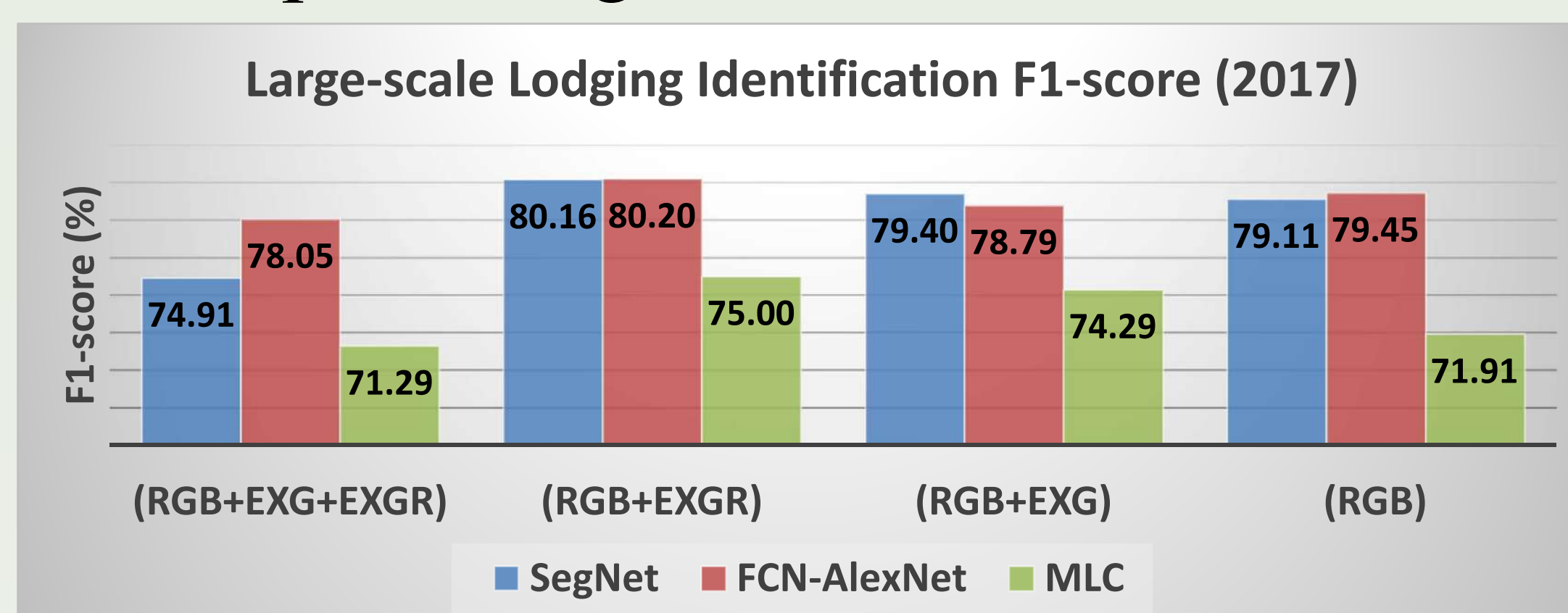
based on AlexNet  
8 conv. layers  
1 upsampling layer  
no pooling indices

### SegNet

based on VGG16  
26 conv. layers  
5 upsampling layers  
+ pooling indices

## Result

- Identification F1-score both get 0.8 in 2017, and FCN-AlexNet performs well in 2019.
- Adding vegetation index makes classification model robust.
- Image tile eliminates the memory insufficient problem of processing large-scale images.
- Processing time of DL methods are 10-15x faster than MLC method.
- Deep learning lets data reusable and the classifier can be reinforced.



\* The time were the result of processing a 40ha mosaic image.

\*\* MLC = Maximum Likelihood Classification

\*\*\* ExG = Excess Green index

\*\*\*\* ExGR = Excess Green minus Excess Red index

## Future Plans

- More semantic segmentation architectures for comparison.
- Near-infrared for precision agriculture information.
- Distributed computing for classifying large-scale image.
- Paddy field mapping for individually lodging rate calculation.
- Optimal flight-path calculating for auto routing.

## Acknowledgements

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