



Florida Atlantic University
College of Engineering & Computer Science

Directed Independent Study Project

Summer 2021

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@INSTRUCTOR: Dr. Sudhagar Nagarajan

PROJECT TITLE

**Land Use Land Cover Mapping using
UAS Imagery: Scene Classification
and Semantic Segmentation**

PROJECT AREA



Jupiter Inlet Lighthouse
Outstanding Natural Area

Florida 33469

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Photos

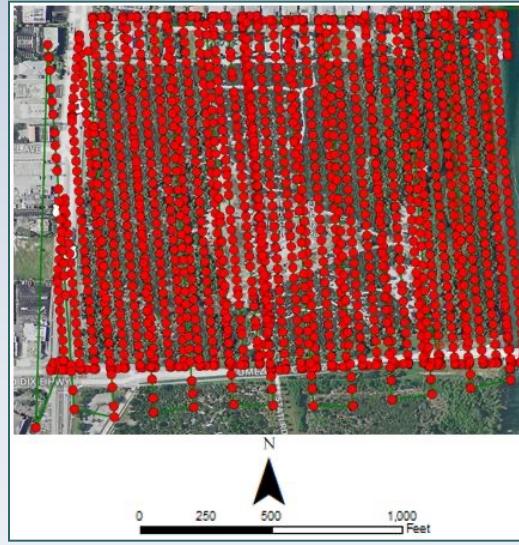


741+ Photos



LULC Mapping using Scene classification and Semantic segmentation

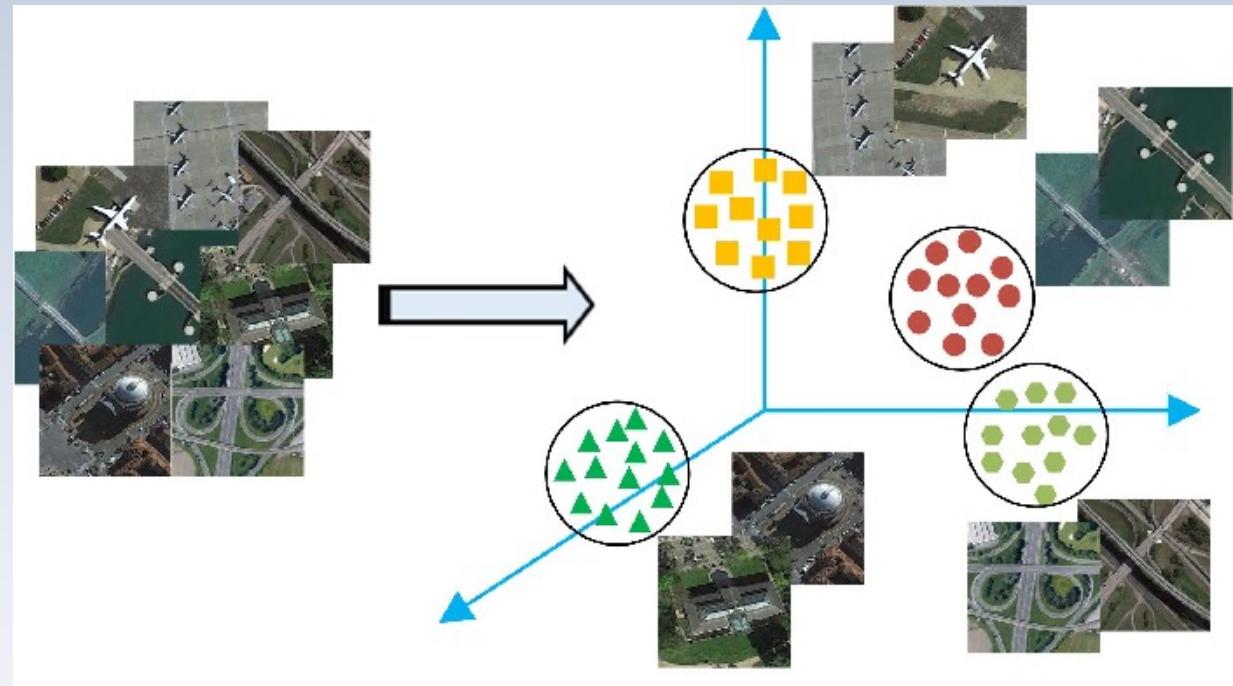
DATA SOURCE



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Scene Classification

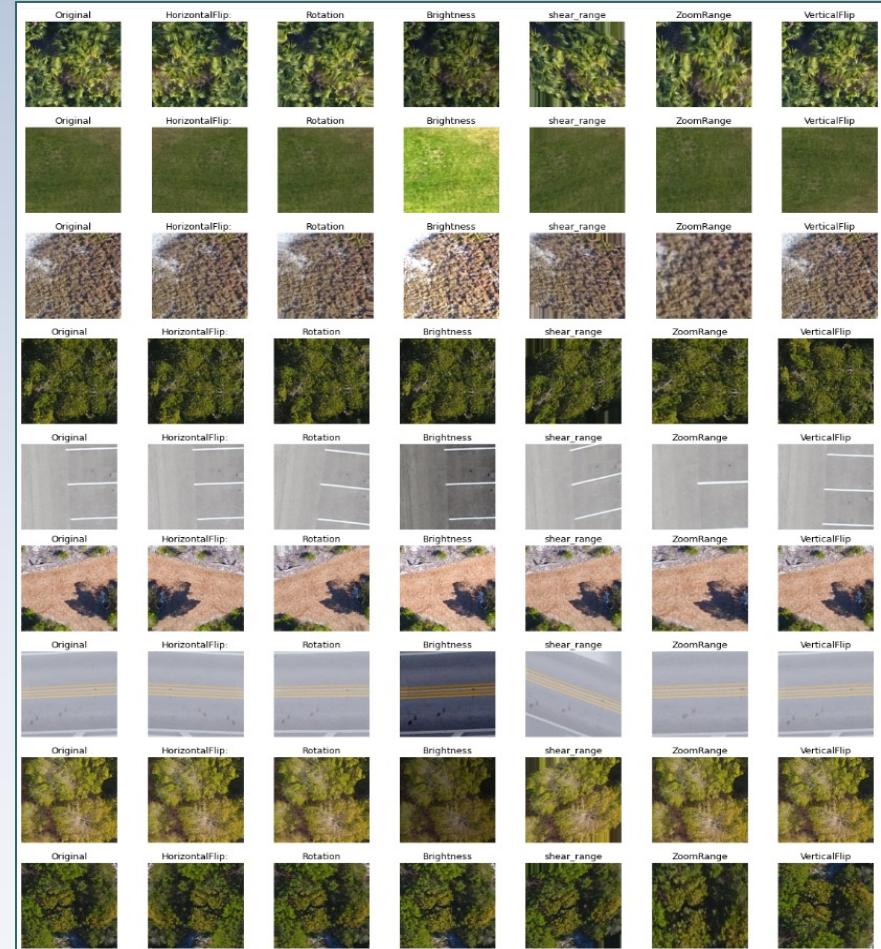
- MobileNet
- DenseNet
- VGG
- ResNet
- Inception
- Inception ResNet
- Xception
- EfficientNet



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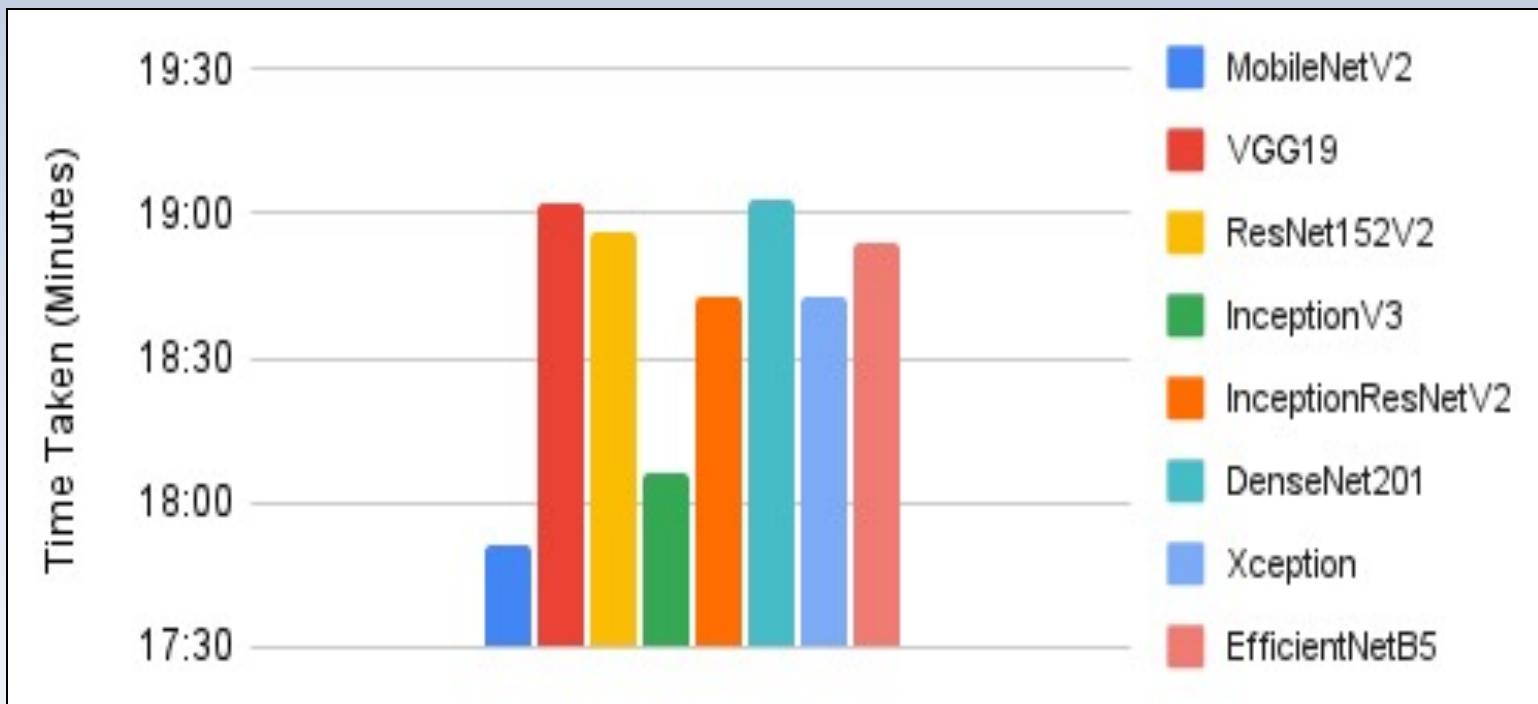


Training samples

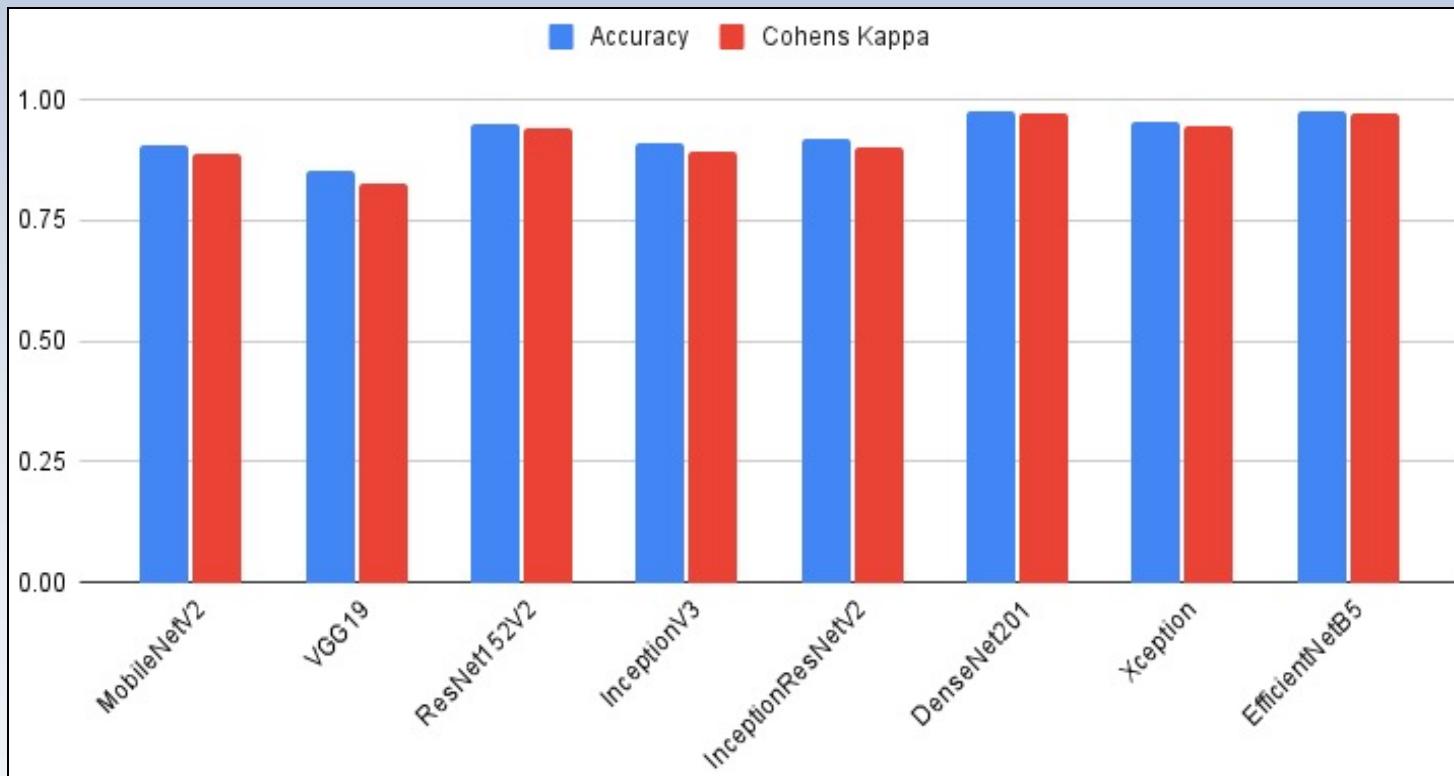


LULC Mapping using Scene classification and Semantic segmentation

Training Time

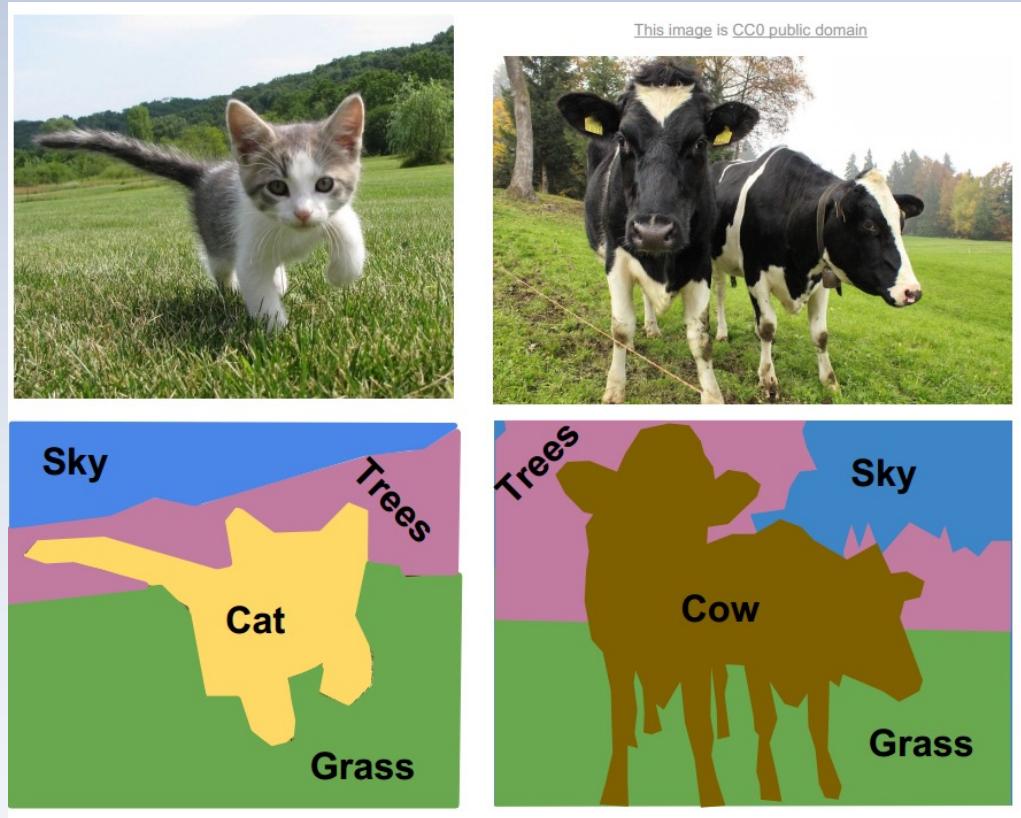


Model Accuracy



Semantic segmentation

- Custom Unet
- Satellite UNet



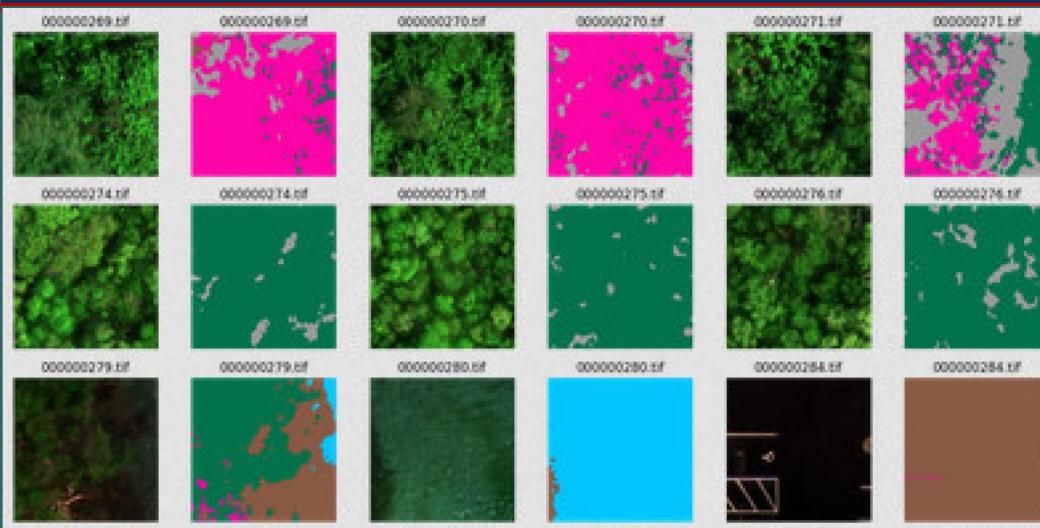
Classes Considered



North

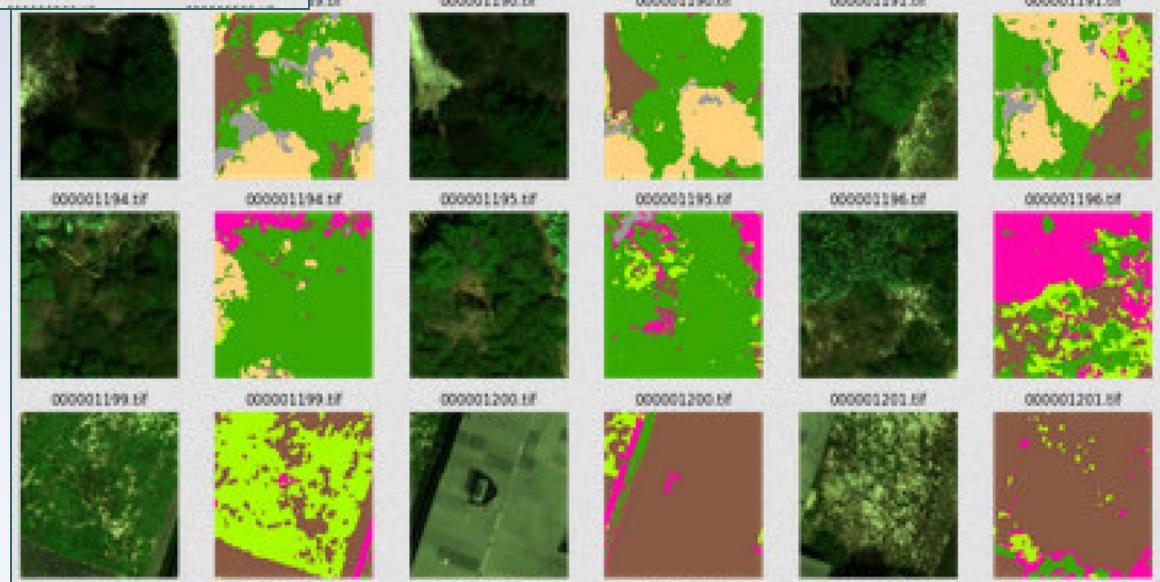


South



Training samples

North & South

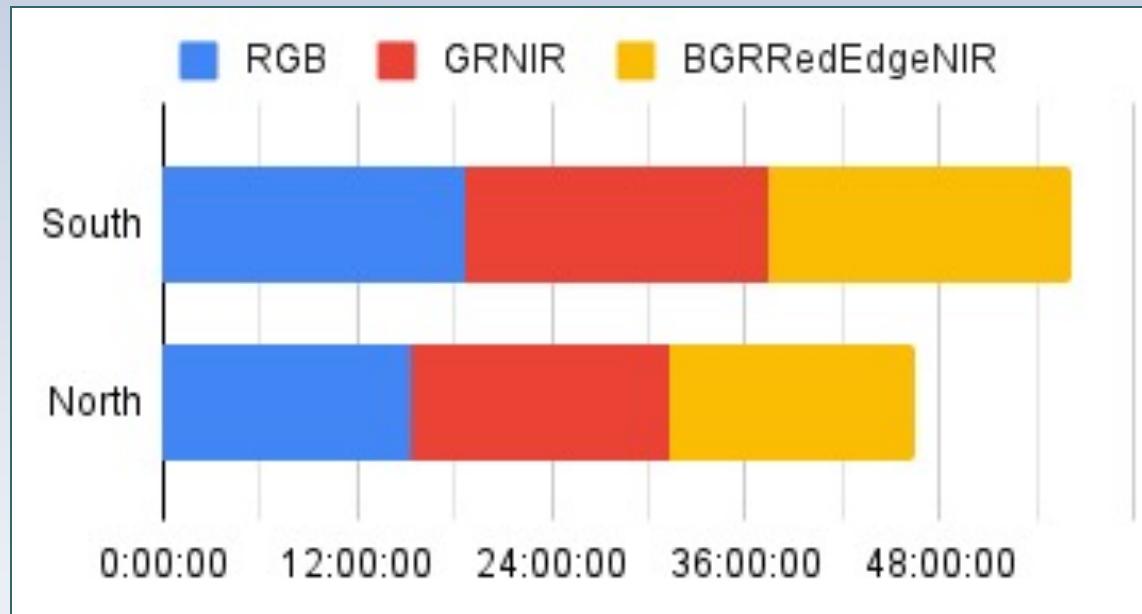


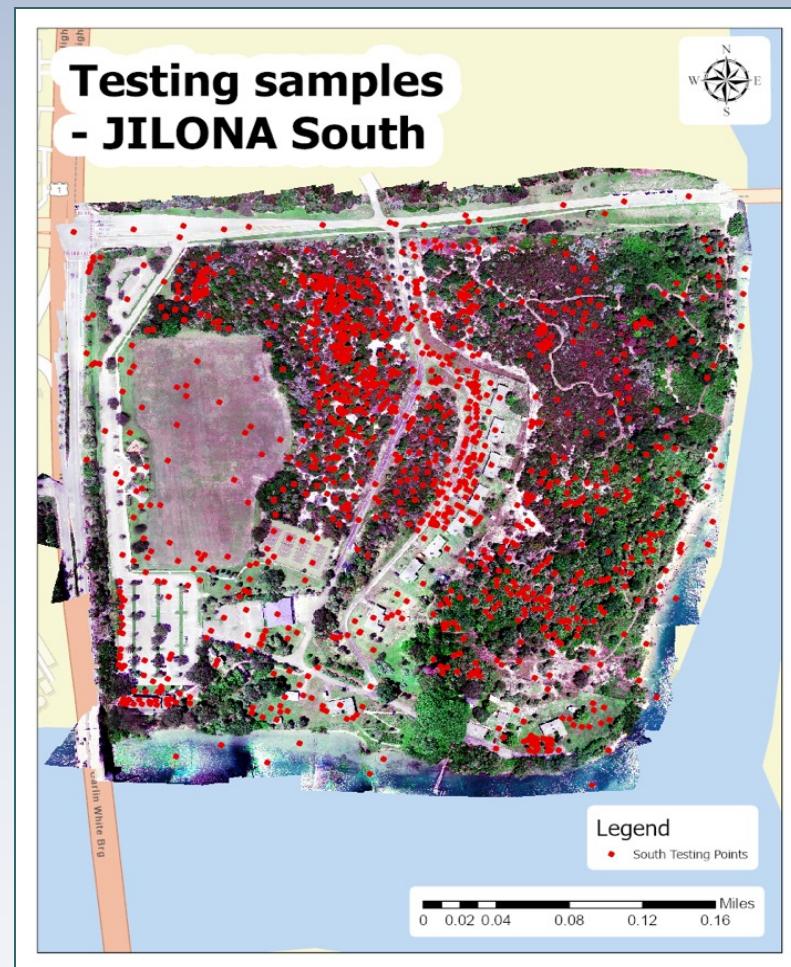
LULC Mapping using Scene classification and Semantic segmentation

EXAMINATIONS

Parameters	Investigated values	Best Model
Models	CustomUNET, SatelliteUNET	CustomUNET
Band Combinations	RGB, GRNIR, BGRRedEdgeNIR	BGRRedEdgeNIR
Number of Layers	4, 5, 6	5
Learning Rate	0.01, 0.001, 0.0001	0.01
Batch Size	16, 32, 64	64
Optimizer	Adam, SGD	Adam
Epochs	100, 500, 1000, 1500, 2000, 2500	2500
Augmentation	Yes, No	Yes
Image	Mosaicked, North-South separately	North-South separately

Training Time





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	Total	Pass	Pass%
Ground	224	203	90.62
SandPine	197	180	91.37
OakScrub	236	220	93.22
Grass	218	210	96.33
Palm	266	243	91.35
Shadow	69	44	63.77
Water	15	15	100.00

South - All 5 bands

	Total	Pass	Pass%
Ground	224	197	87.95
SandPine	197	178	90.36
OakScrub	236	200	84.75
Grass	218	210	96.33
Palm	266	239	89.85
Shadow	69	39	56.52
Water	15	15	100.00

South - RGB

	Total	Pass	Pass%
Ground	224	204	91.07
SandPine	197	176	89.34
OakScrub	236	212	89.83
Grass	218	217	99.54
Palm	266	236	88.72
Shadow	69	18	26.09
Water	15	15	100.00

South - GRNIR

	Total	Pass	Pass%
SandPine	279	272	97.49
OakScrub	288	201	69.79
Palm	251	225	89.64
Ground	316	291	92.09
Water	31	28	90.32
Grass	82	29	35.37
Mangrove	398	378	94.97
Shadow	134	124	92.54

North - All 5 bands

	Total	Pass	Pass%
SandPine	279	276	98.92
OakScrub	288	237	82.29
Palm	251	209	83.27
Ground	316	264	83.54
Water	31	28	90.32
Grass	82	40	48.78
Mangrove	398	373	93.72
Shadow	134	120	89.55

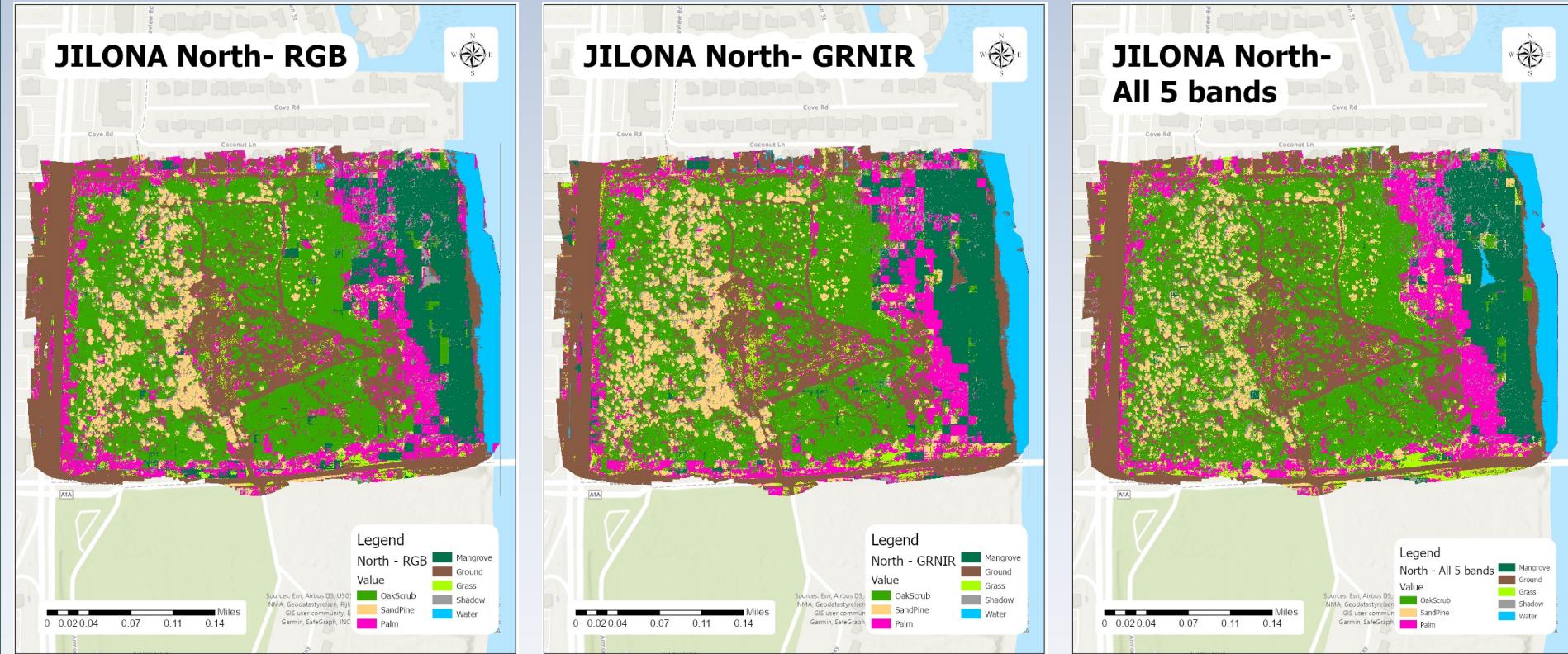
North - RGB

	Total	Pass	Pass%
SandPine	279	274	98.21
OakScrub	288	200	69.44
Palm	251	226	90.04
Ground	316	279	88.29
Water	31	28	90.32
Grass	82	32	39.02
Mangrove	398	365	91.71
Shadow	134	124	92.54

North - GRNIR

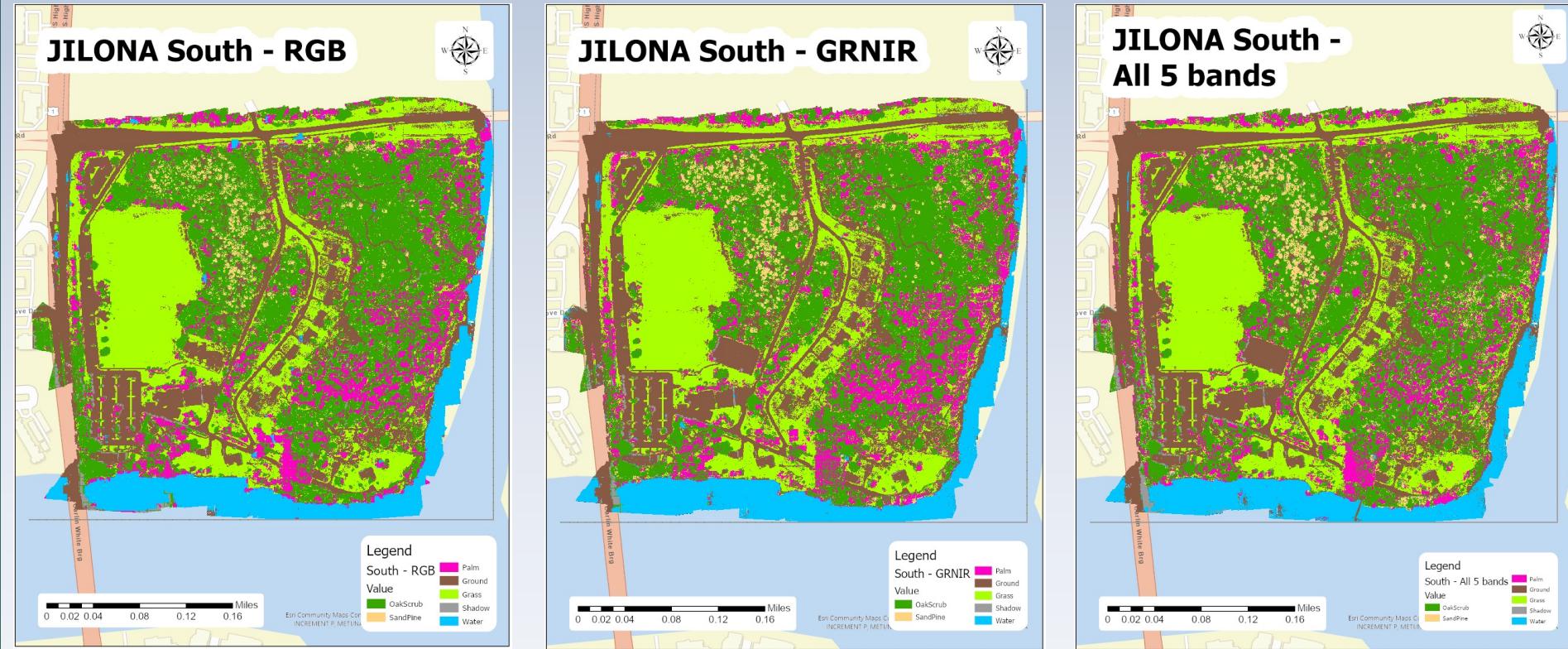
METHODOLOGY	NORTH ACCURACY	SOUTH ACCURACY
Custom UNet - RGB	86.96%	88%
Custom UNet - GRNIR	85.89%	88%
Custom UNet - BGRRedEdgeNIR	87.02%	91%
SVM - Without DEM	74%	84%
SVM - With DEM	89%	91%

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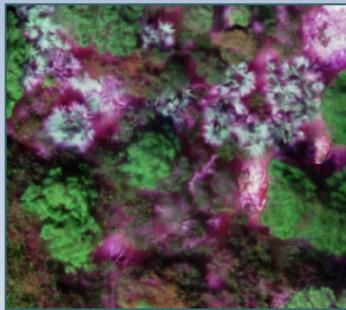
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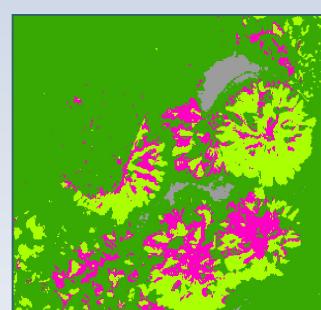
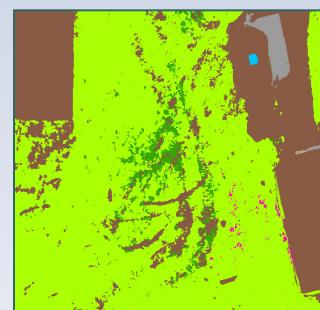
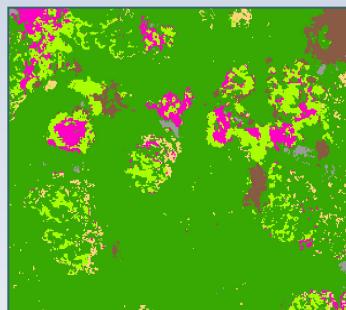
LULC Mapping using Scene classification and Semantic segmentation

South

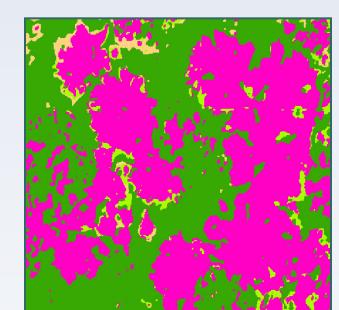
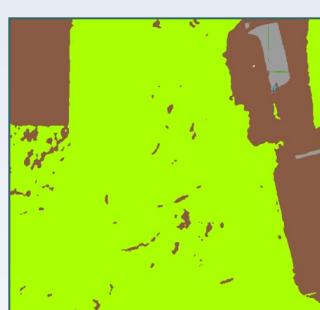
Original



SVM



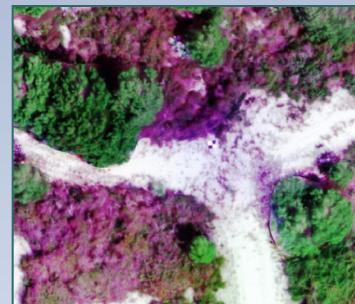
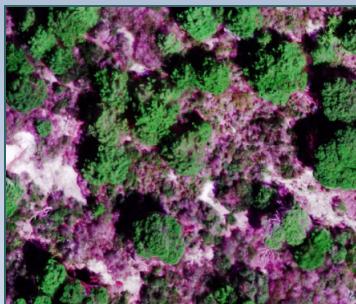
UNet



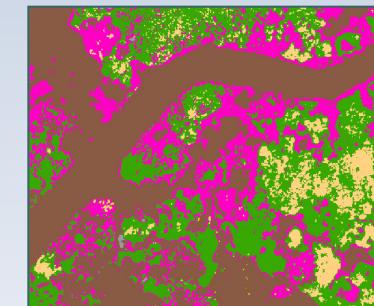
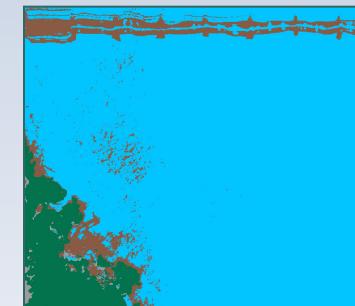
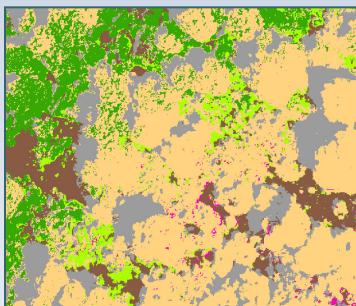
LULC Mapping using Scene classification and Semantic segmentation

North

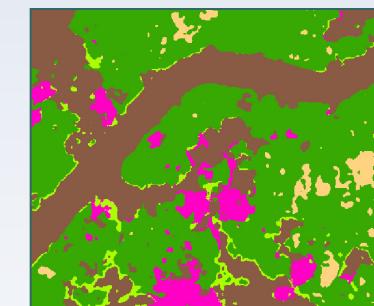
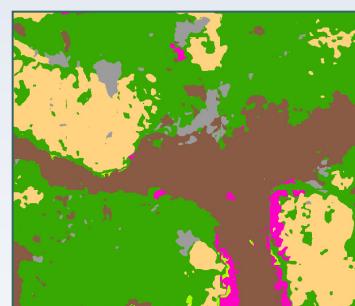
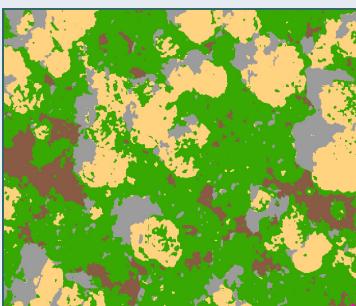
Original



SVM



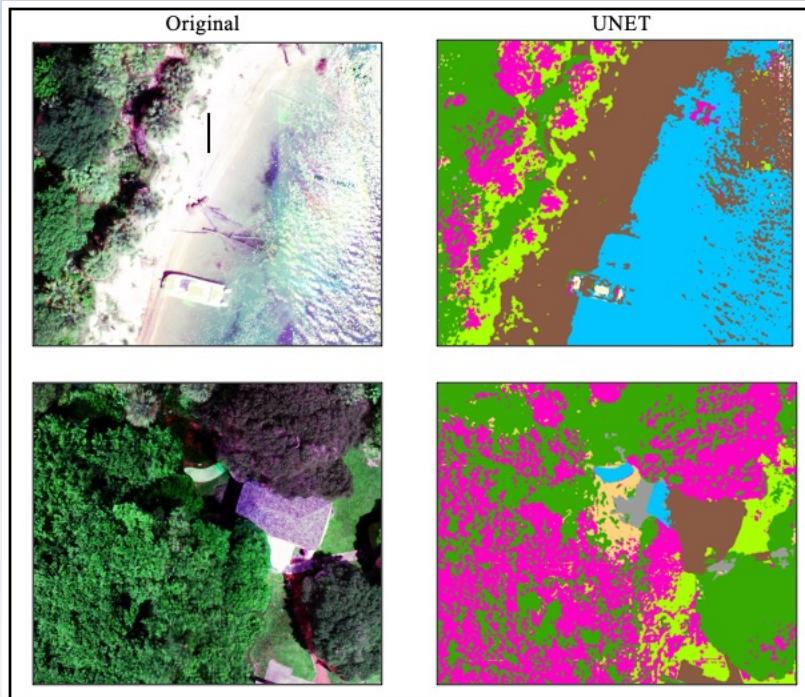
UNet



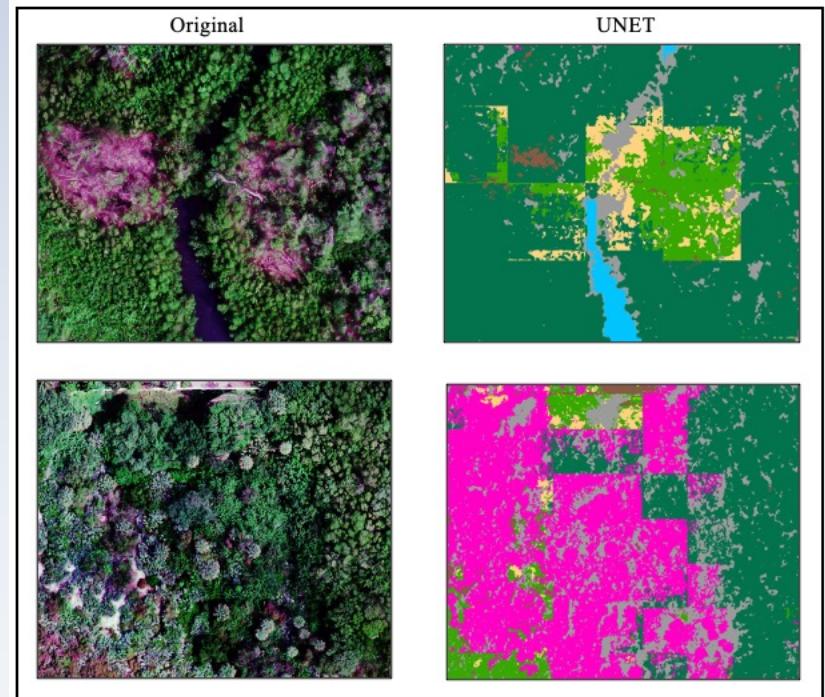
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Misclassifications - Yet to be improved

South



North



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FUTURE SCOPE

- Improve prediction accuracy
- Analyzing for different sensors and bands
- More hyperparameter tunings
- Get rid of patch issues in classification map
- Extend Study Area

ACKNOWLEDGEMENTS

- CEGE, Florida Atlantic University
- Dr. Sudhagar Nagarajan (supervisor)
- Bureau of Land Management

REFERENCES

Very Deep Convolutional Neural Networks for Complex Land Cover Mapping Using Multispectral Remote Sensing Imagery - <https://doi.org/10.3390/rs10071119>

Keras Applications - AI Models - <https://keras.io/api/>

**Remote Sensing Image Scene Classification Meets Deep Learning: Challenges, Methods, Benchmarks, and Opportunities -
<https://ieeexplore.ieee.org/document/9127795>**

<https://www.arcgis.com/index.html>

Detailed references is provided in the project report



THANK YOU