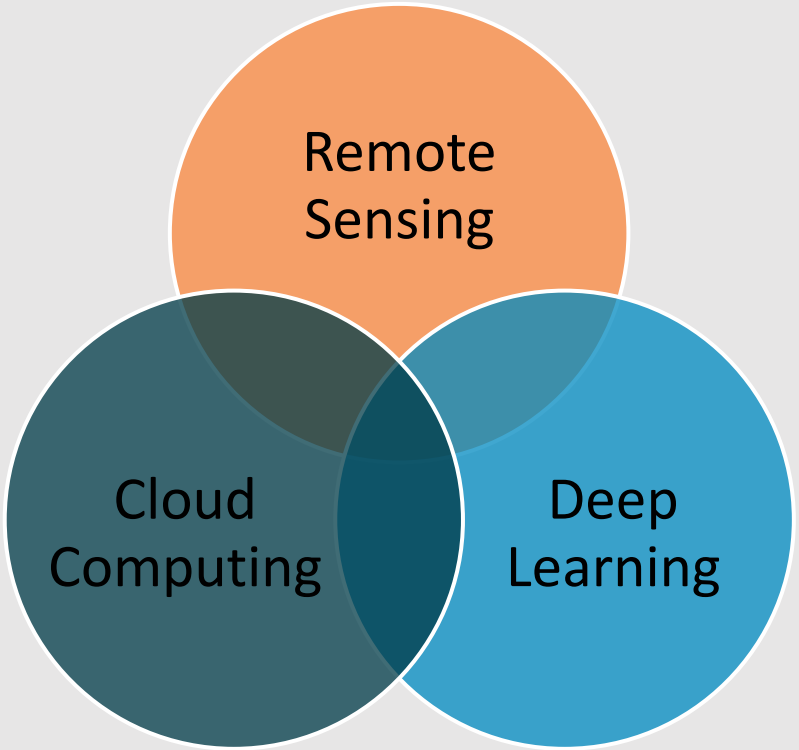

CONSERVATION
INNOVATION
CENTER
CHESAPEAKE CONSERVANCY
Chesapeake
Conservancy
Deep Learning in the Chesapeake
Dr. Michael Evans, Sr. Data Scientist

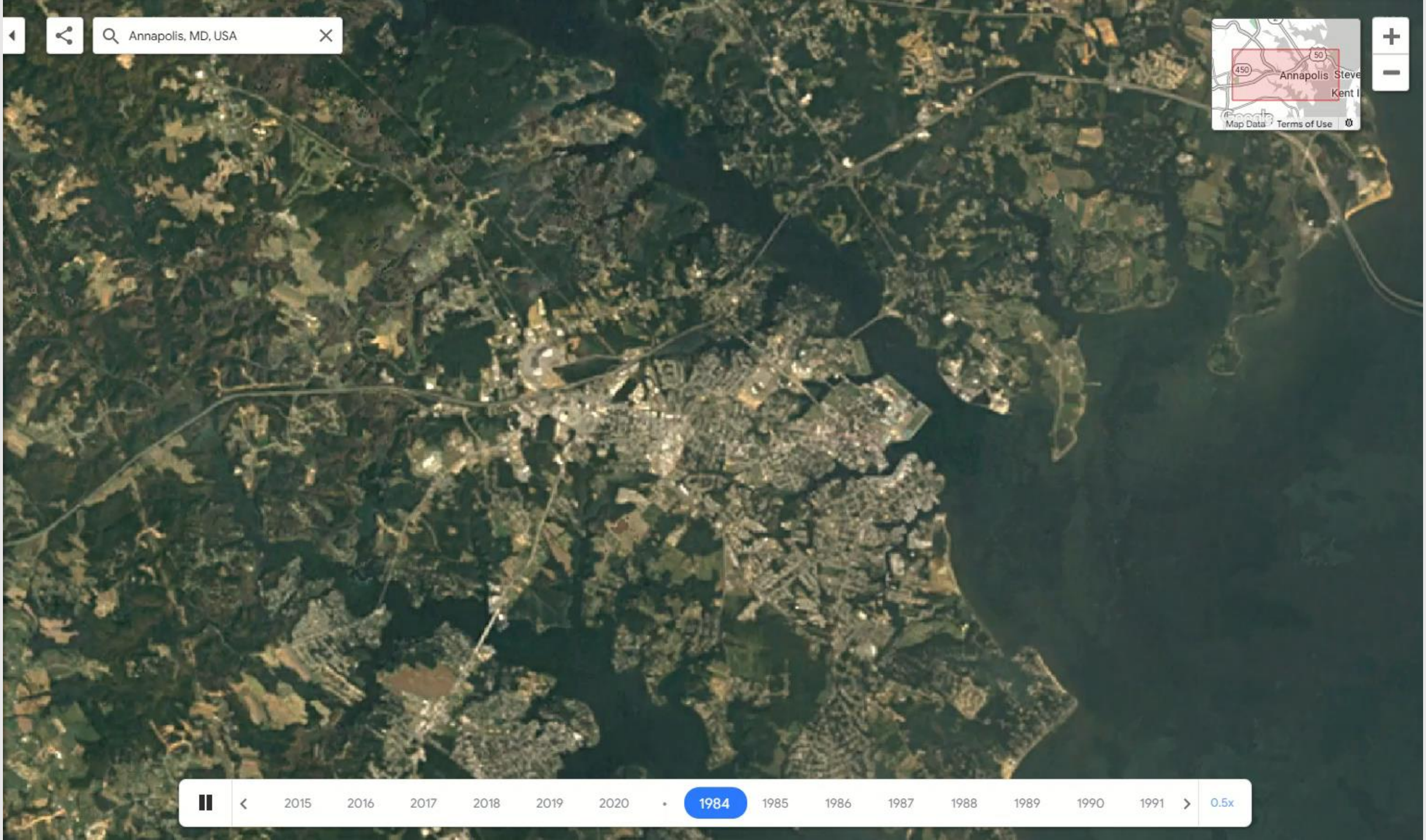
Where are the things we care about?

Why are they where they are?

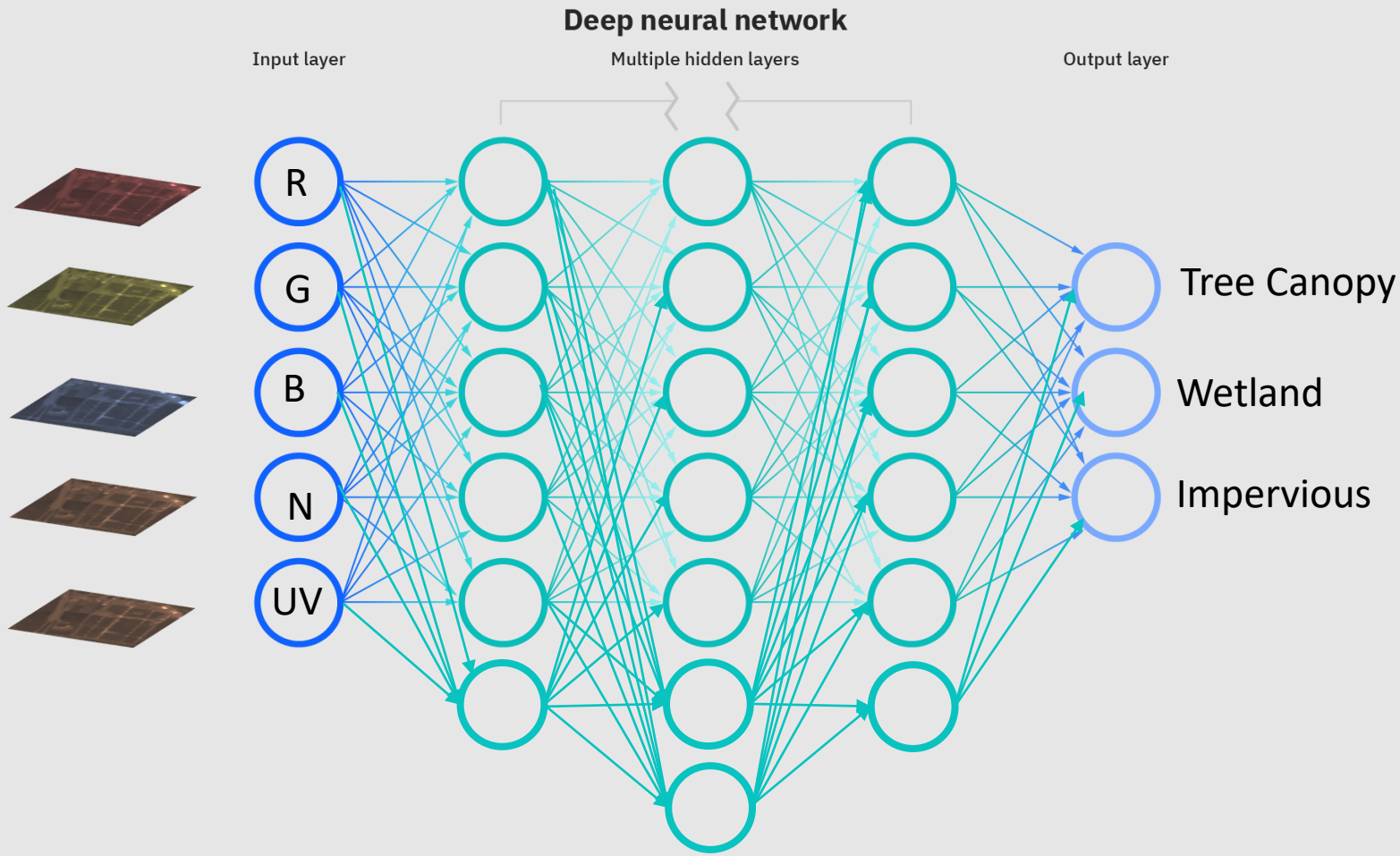


Remote Sensing

1. Data about Earth's surface
2. Collected by satellite or plane
3. Can have multiple 'bands'
4. Many types of data (radar, lidar, etc.)

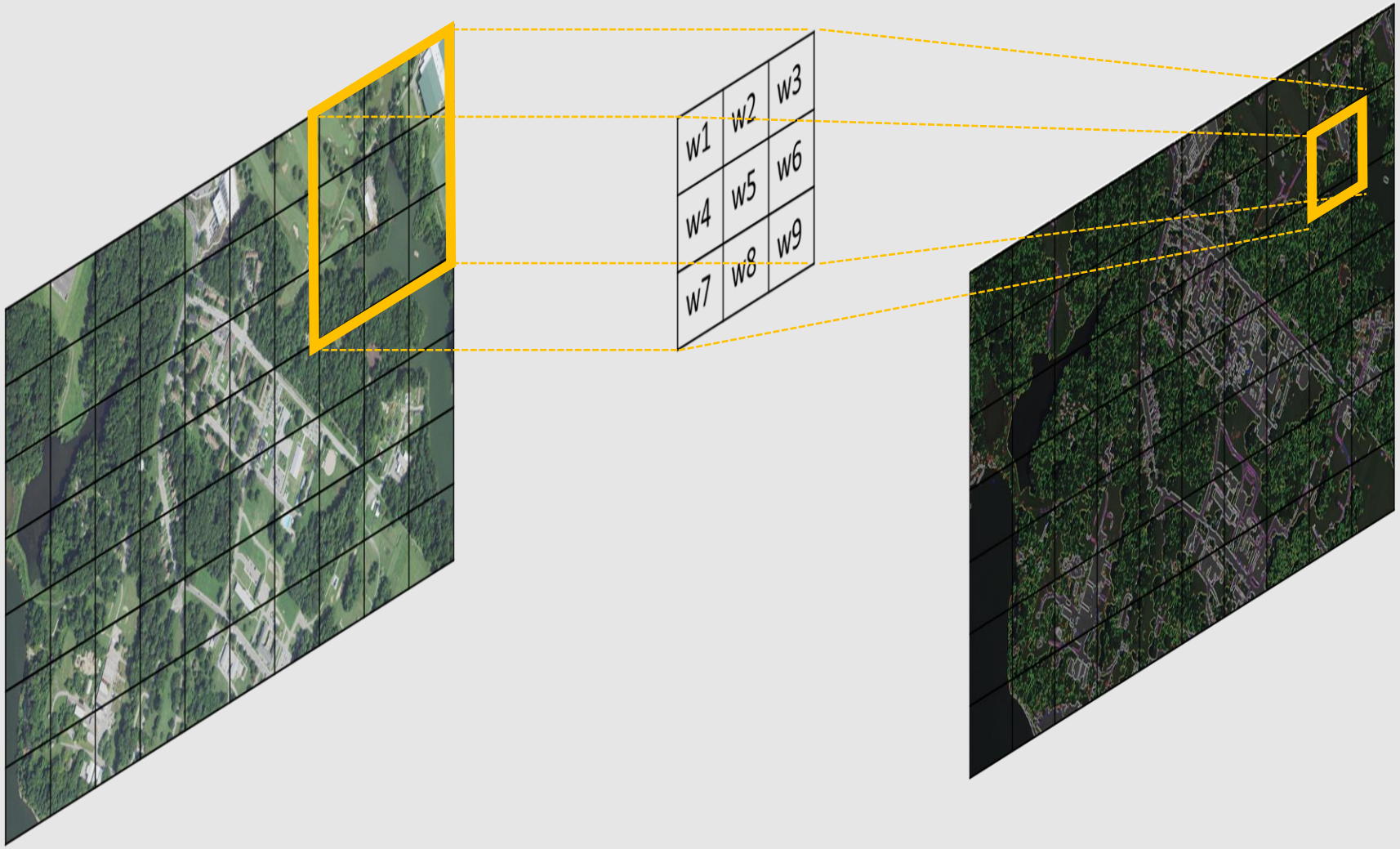

Annapolis, MD, USA
Annapolis
Map Data
Terms of Use
2015
2016
2017
2018
2019
2020
1984
1985
1986
1987
1988
1989
1990
1991
0.5x

Deep Learning (AI)



Good at learning non-linearities, conditionality, complex interactions

Convolution – Spatial Patterns



Convolution - Spatial Patterns

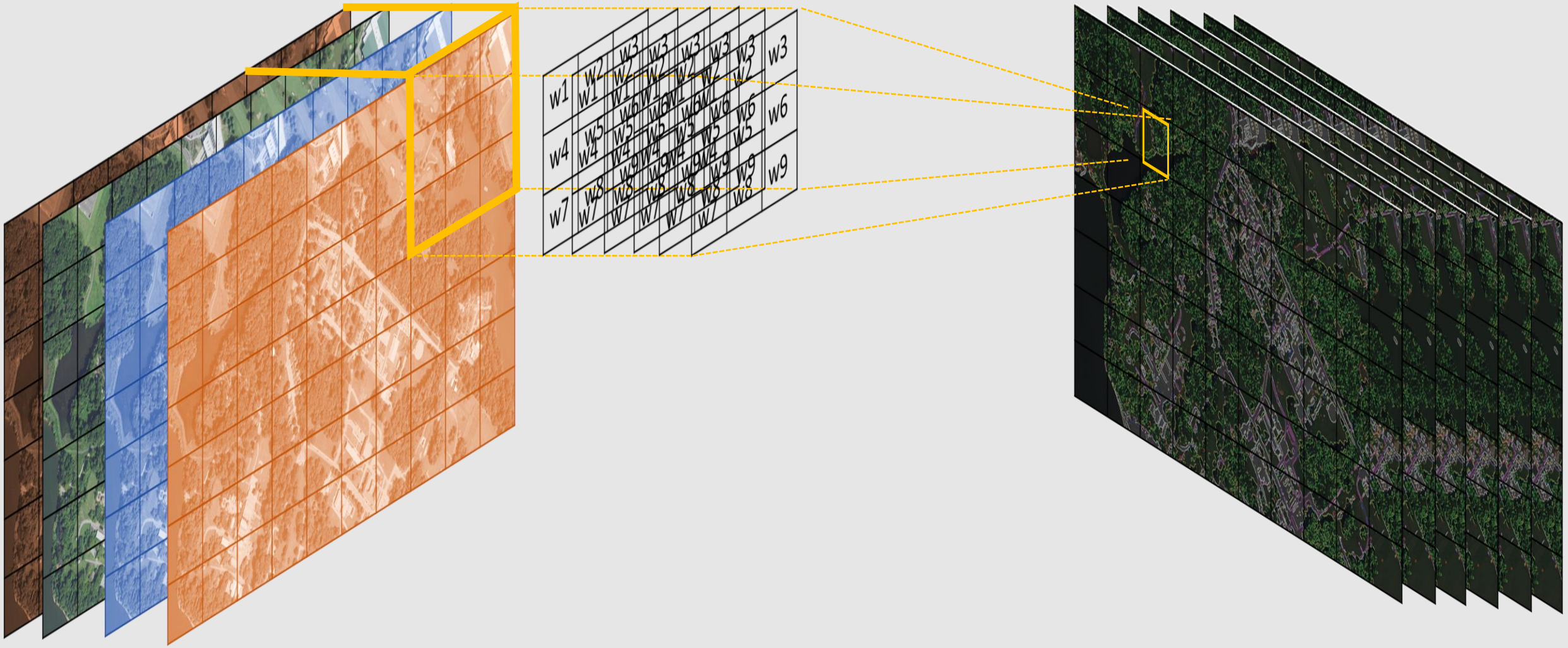
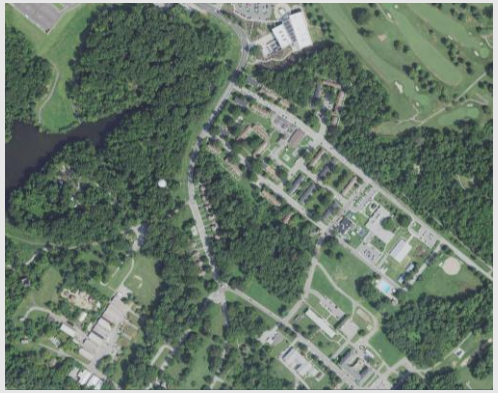


Image Segmentation (U-Net)



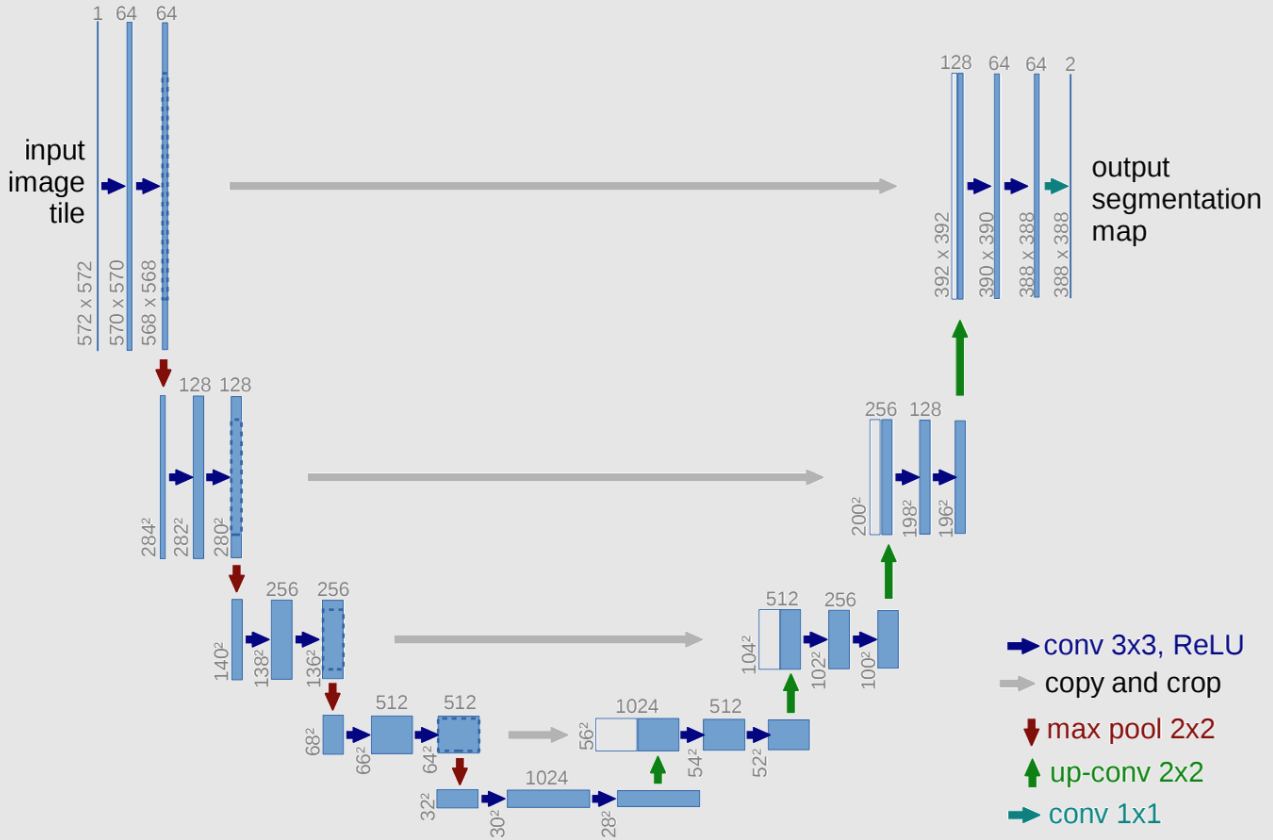
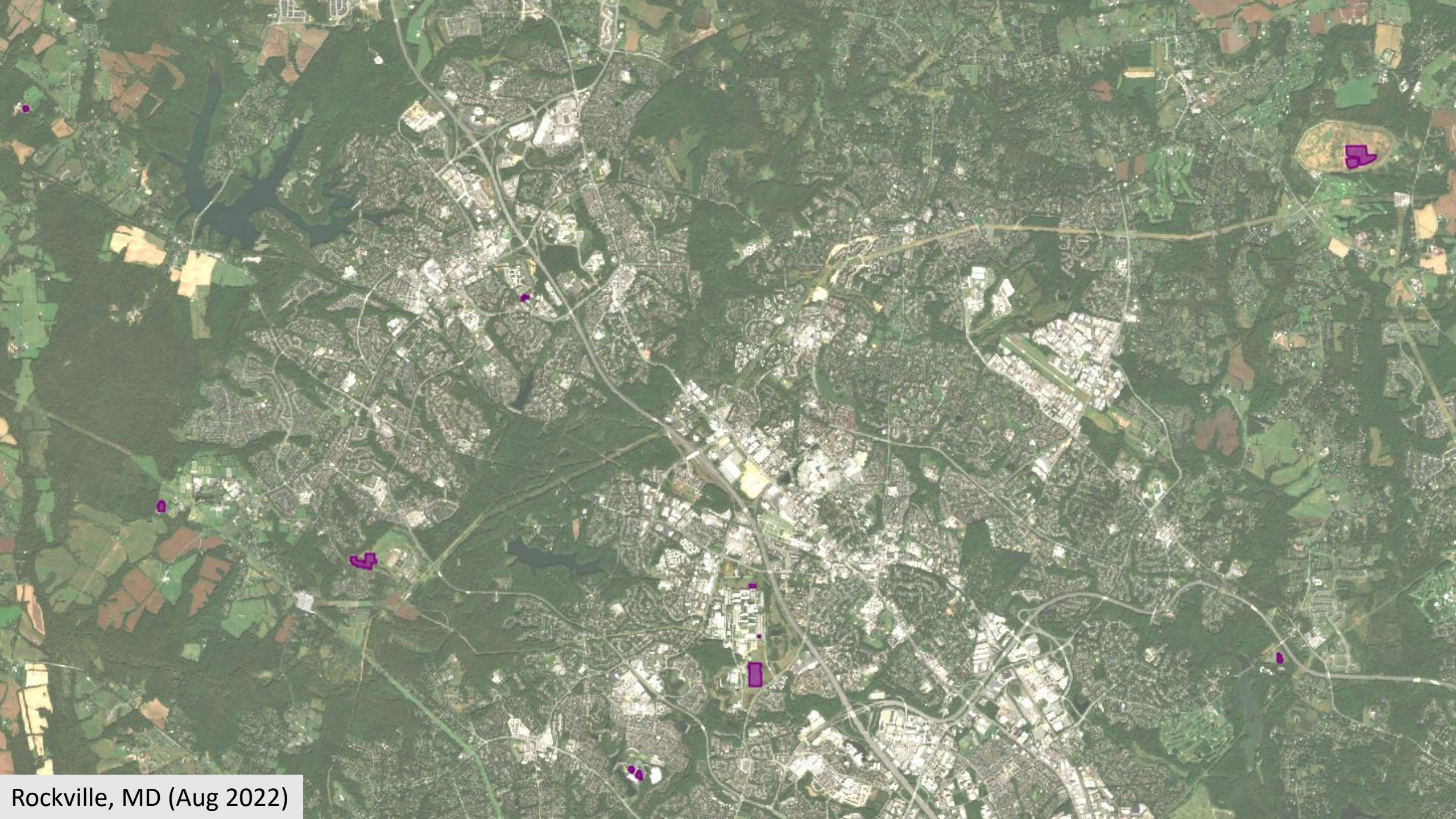


Fig. 1. U-net architecture (example for 32x32 pixels in the lowest resolution). Each blue box corresponds to a multi-channel feature map. The number of channels is denoted on top of the box. The x-y-size is provided at the lower left edge of the box. White boxes represent copied feature maps. The arrows denote the different operations.

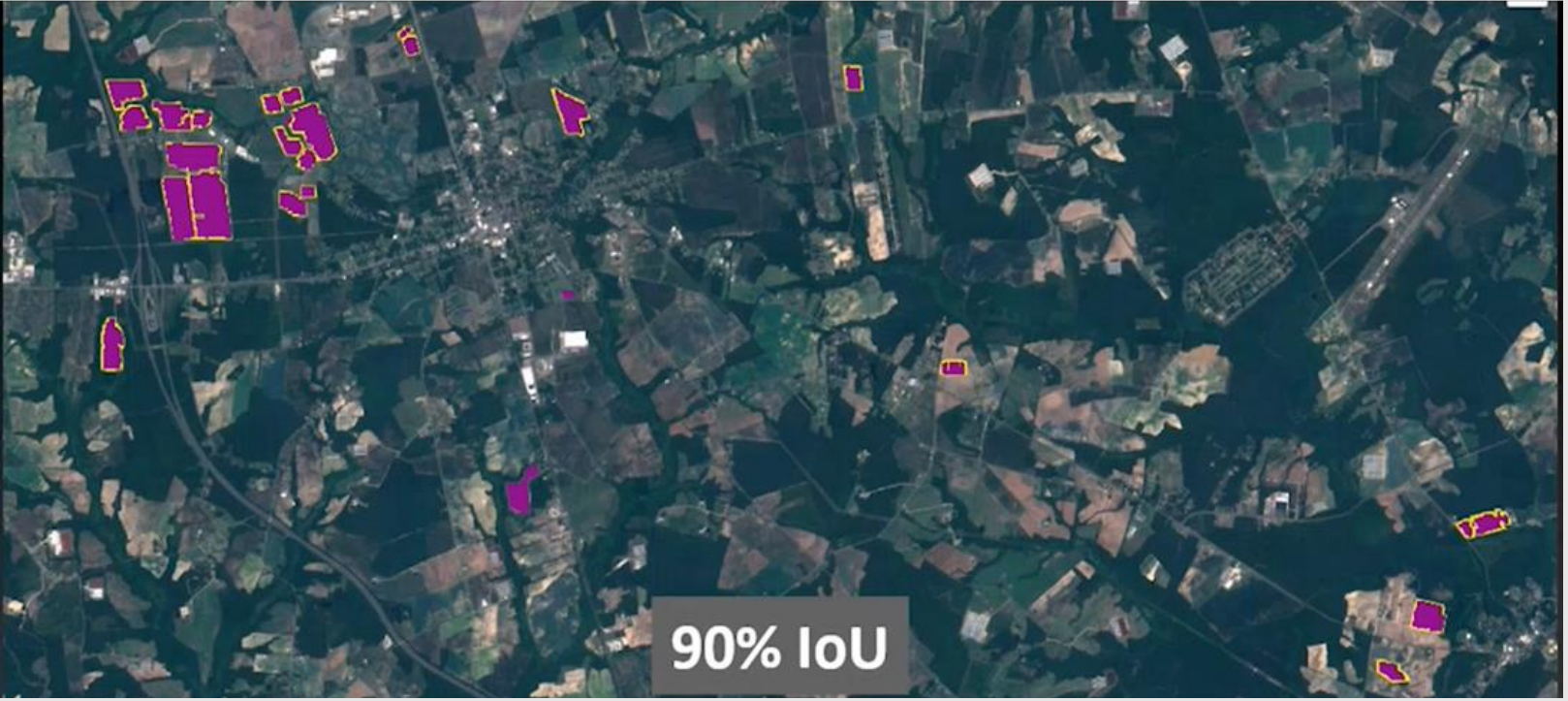
Ronneberger et al. 2015

Solar array mapping

1. Map solar arrays with AI
2. Quantify land use transitions
3. Predict future trends

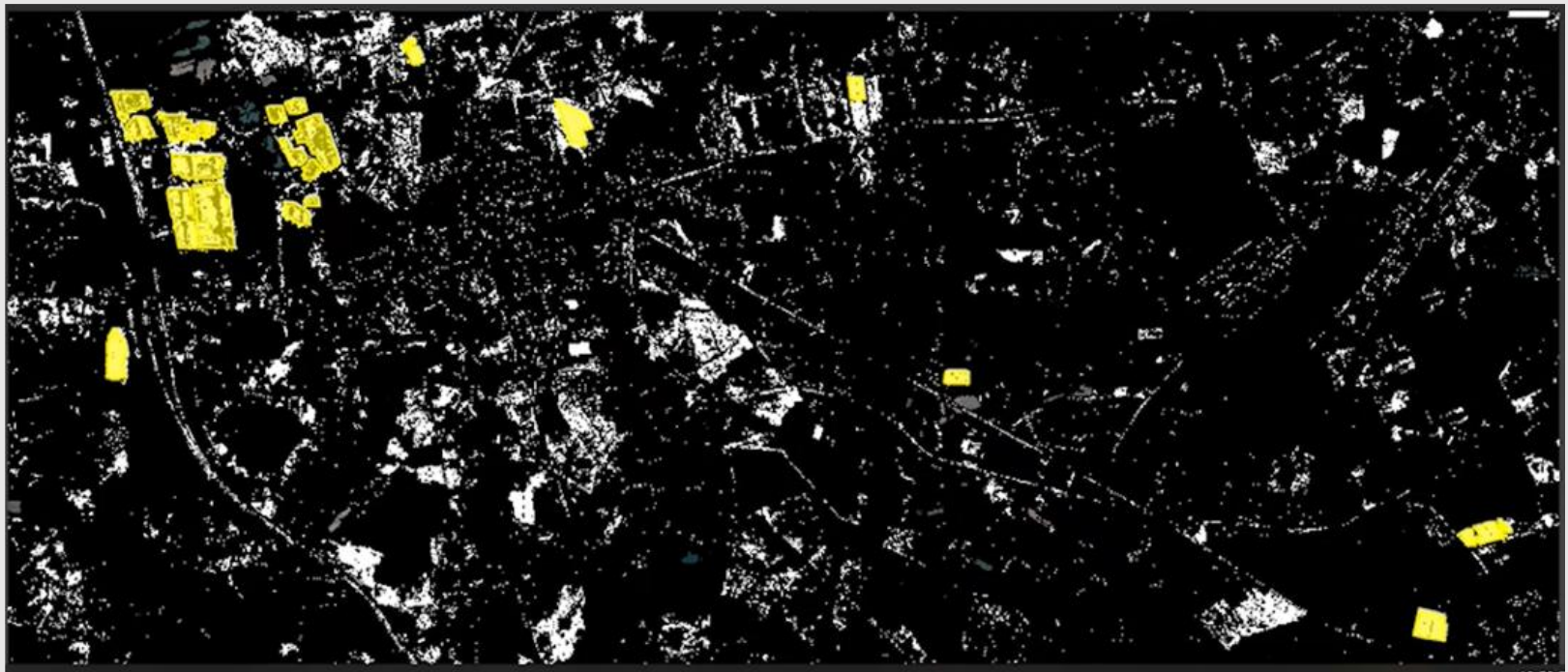


Rockville, MD (Aug 2022)

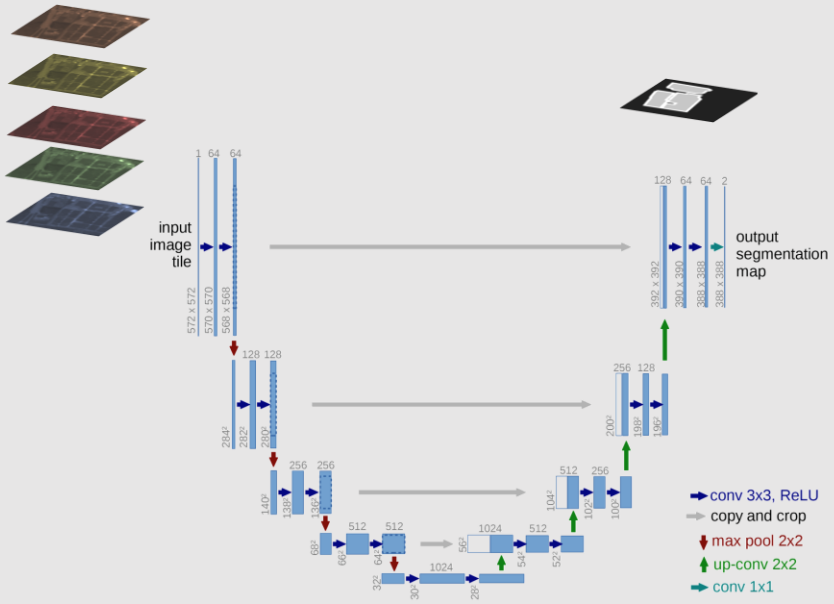


Convolution – learn the shape and context of objects in images

Traditional ML – evaluates pixels independently



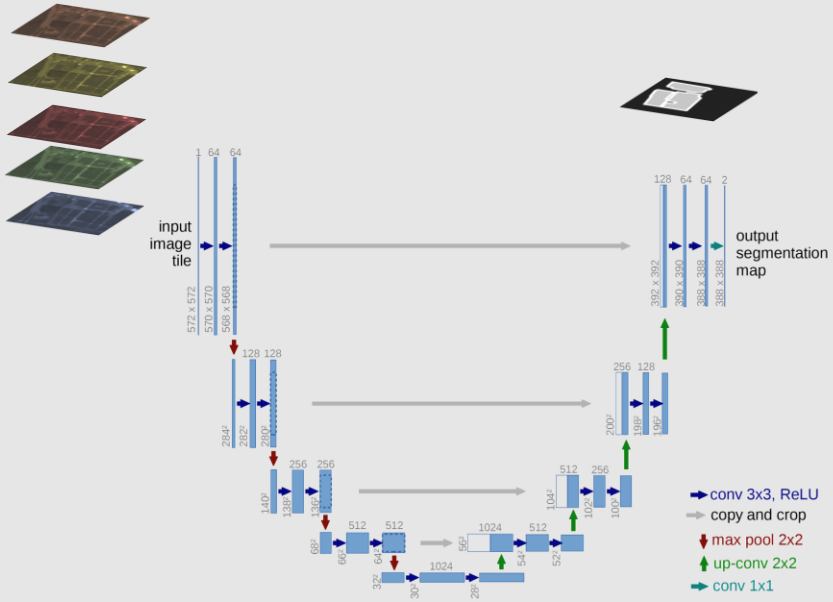
AI Solar Mapping



Map all solar arrays in DC, DE, MD, PA, NY, VA, WV

Each year from 2017 - 2021

AI Solar Mapping



Recall: 90.2%

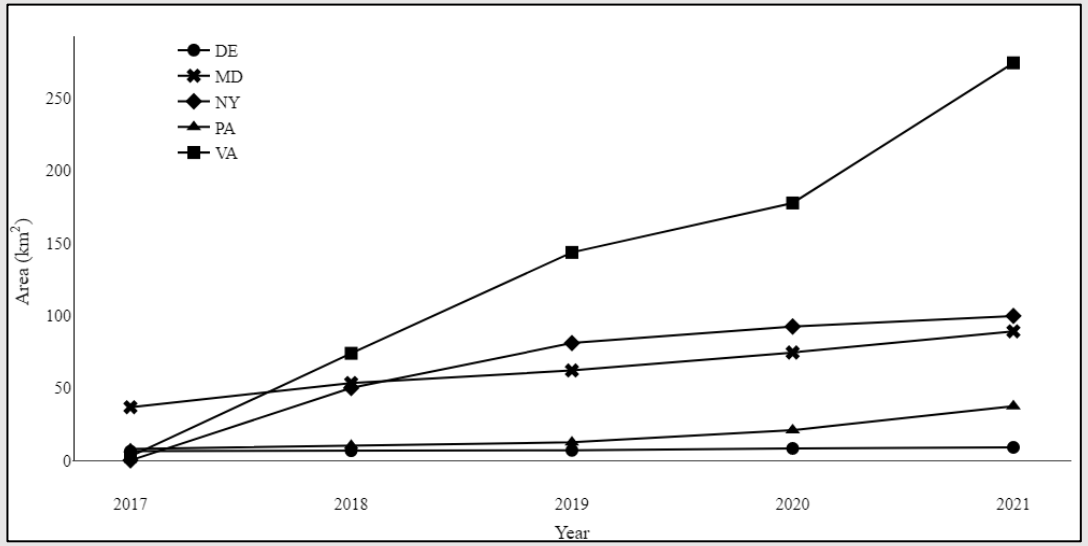
Precision: 90.1%

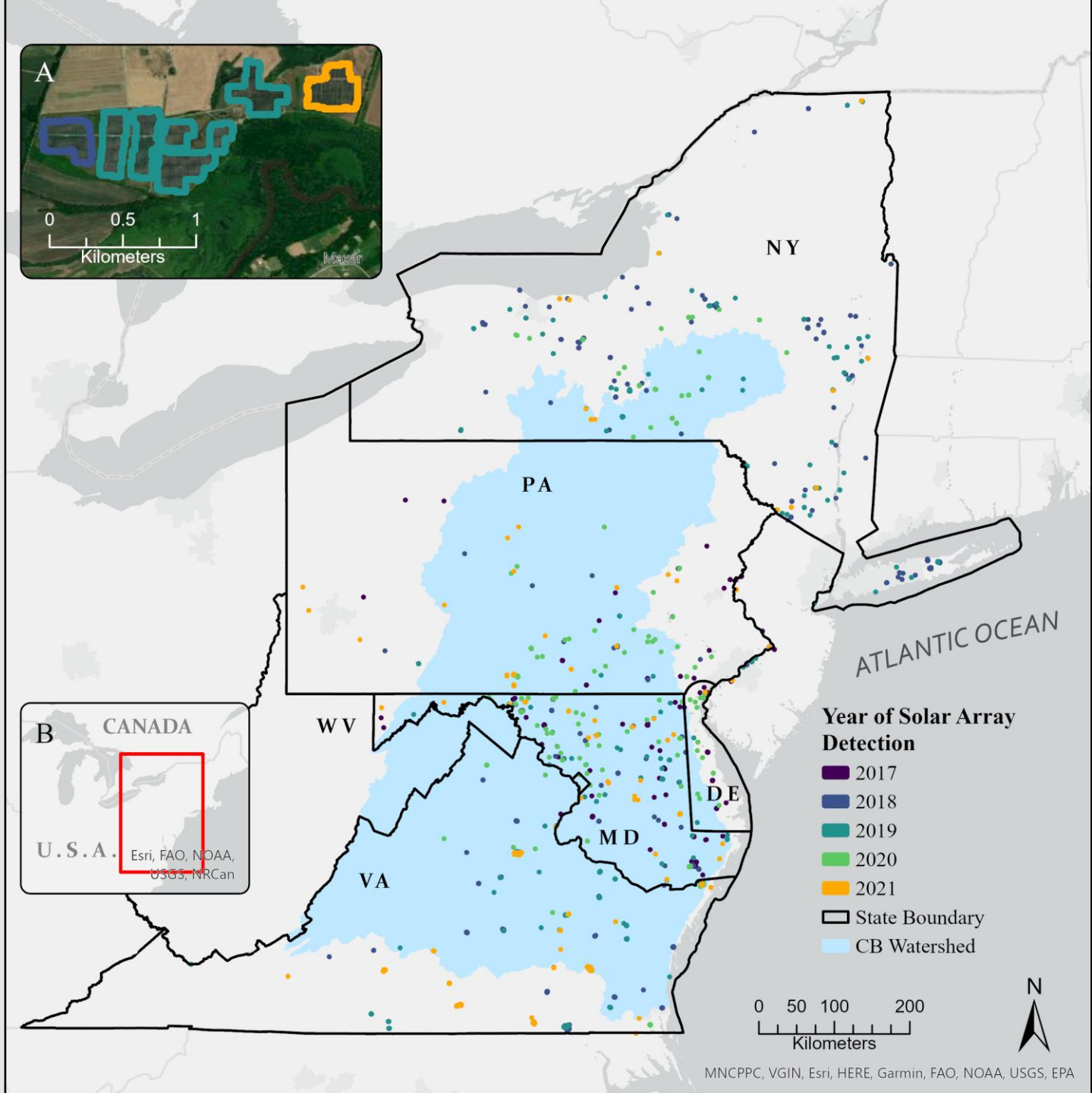
IoU: 85.6%

Solar mapping

2017 - 2021

State	Area (%)	Rate of increase
DE	0.9 (1.79E-04)	1.40 ± 0.34E-03
MD	8.9 (3.54E-04)	**5.00 ± 0.34E-03**
NY	9.9 (0.82E-04)	1.33 ± 0.48E-03
PA	3.7 (0.32E-04)	0.61 ± 0.34E-03
VA	27.4 (2.69E-04)	**6.27 ± 0.34E-03**



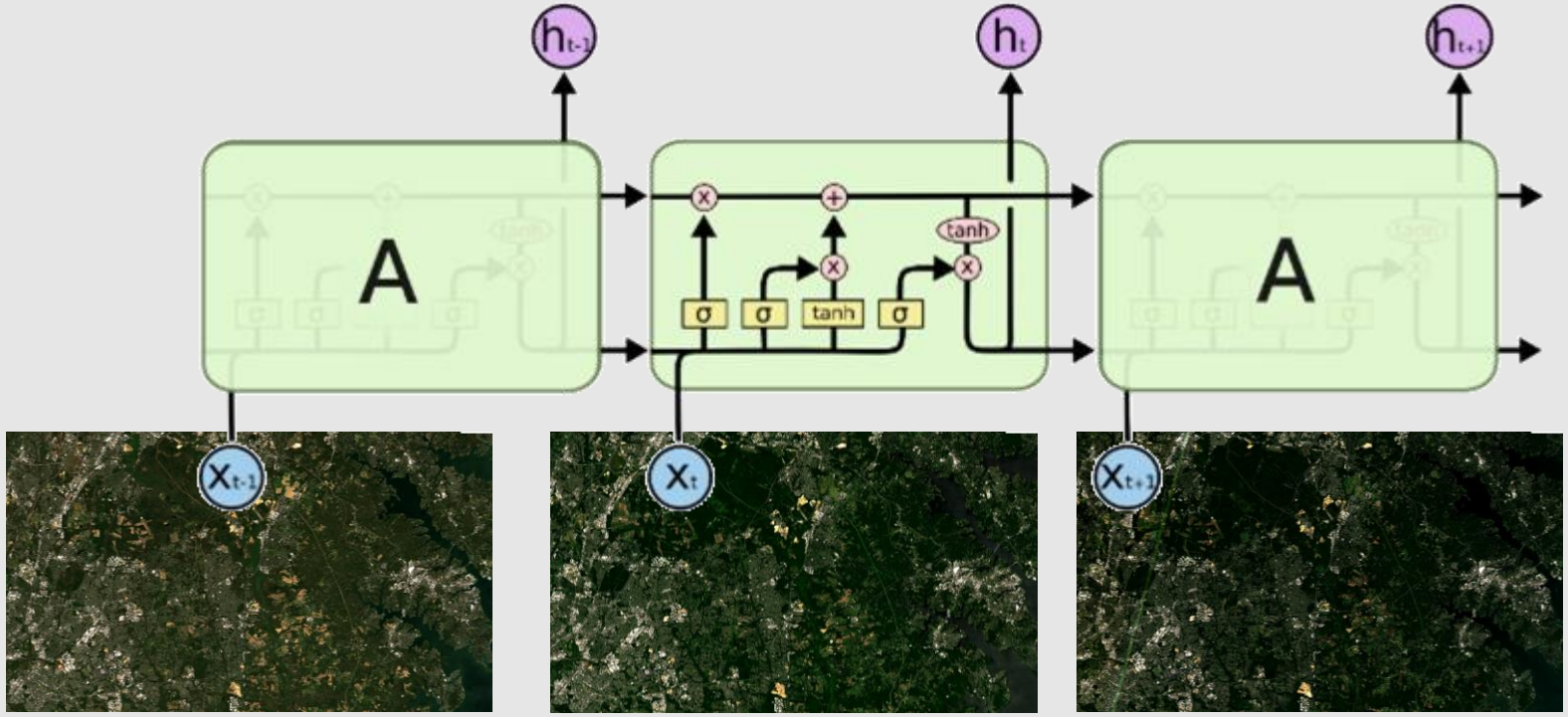


Wetland Mapping

Goal: Develop a model that can map non-tidal wetlands across the entire Chesapeake Bay watershed

1. Accurate wetland maps needed for compliance & modeling
2. Existing wetland data inadequate
3. Wetlands are variable across space and through time

LSTM - Temporal Signals



April/May

June/July

Aug/Sep

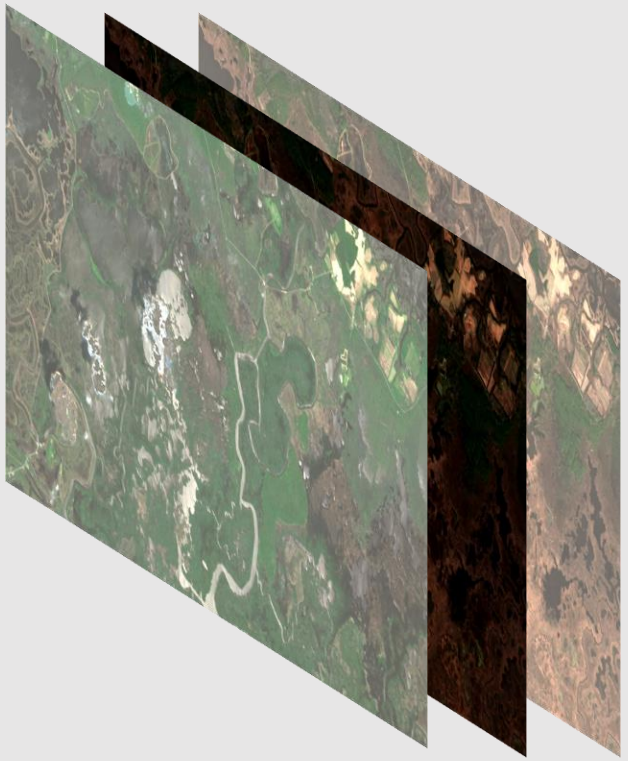
Input data experiments

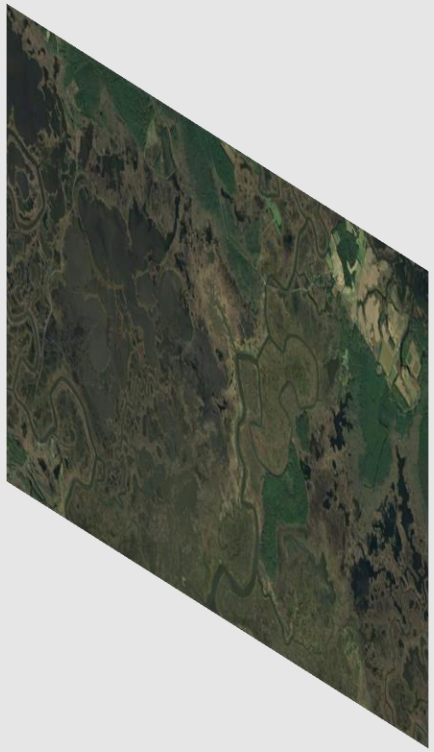
Sentinel-2

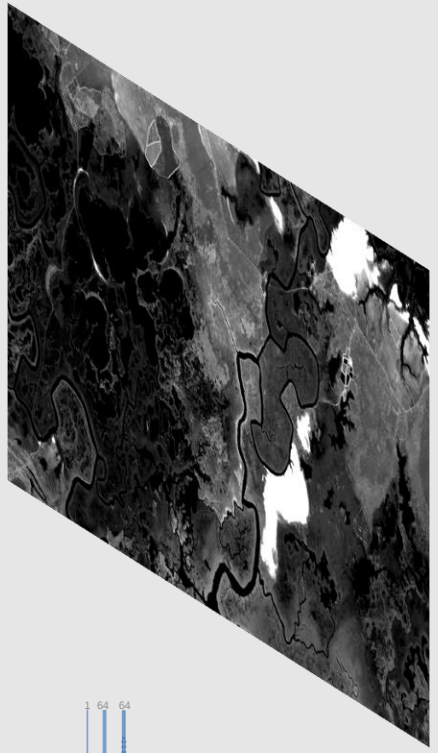
NAIP

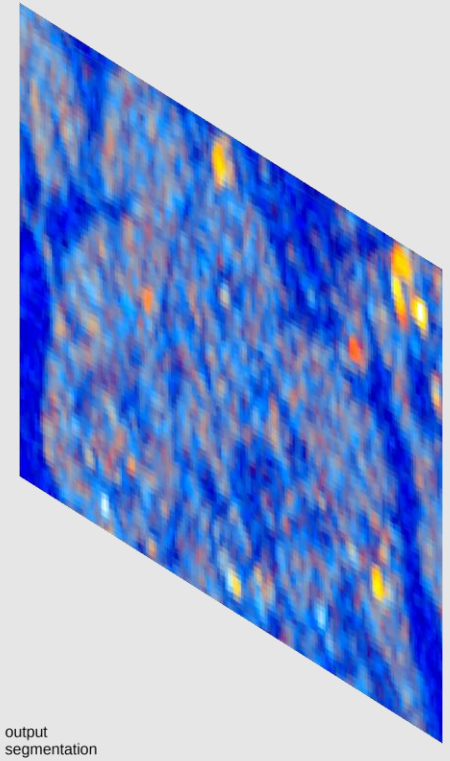
LiDAR

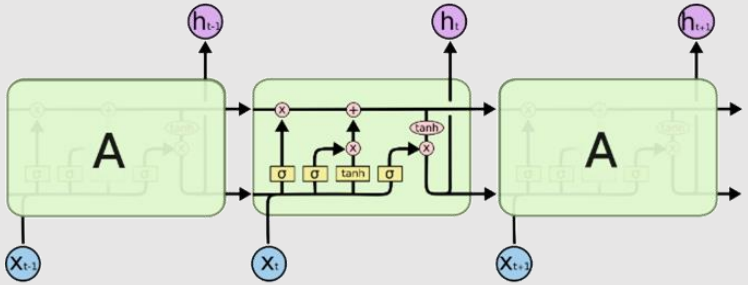
Geomorphons

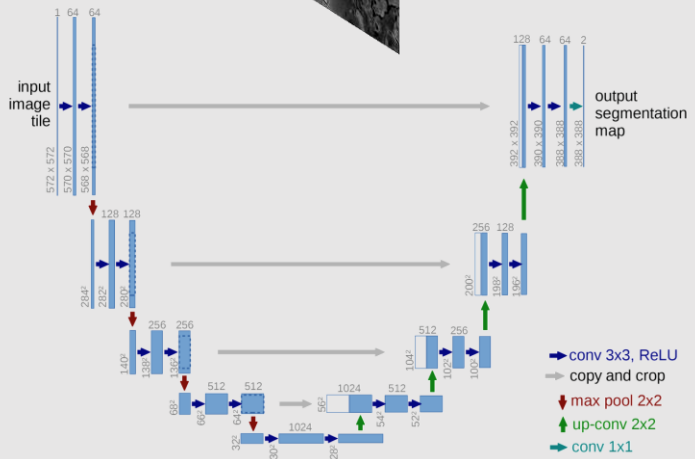




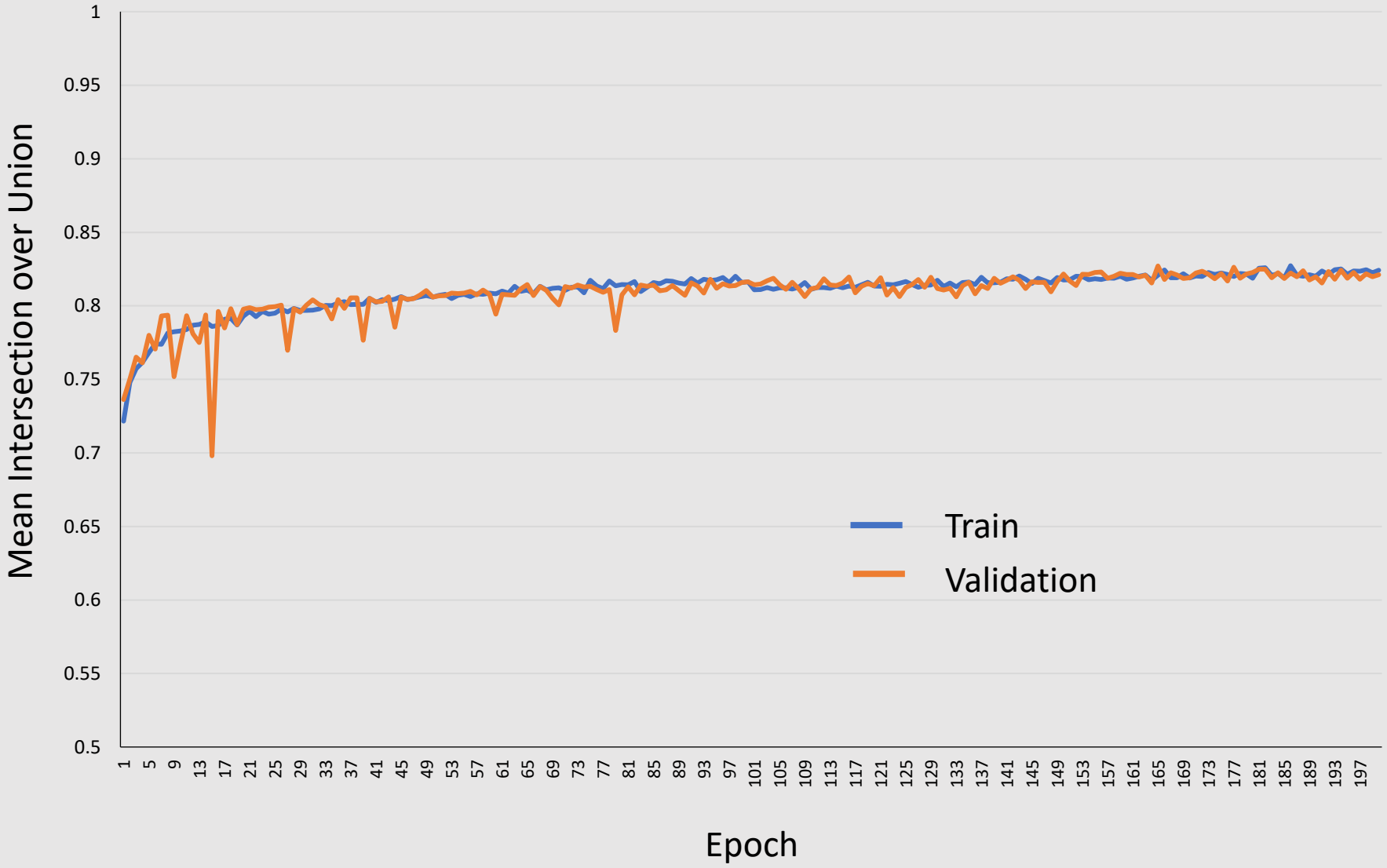








Wetland Model Performace

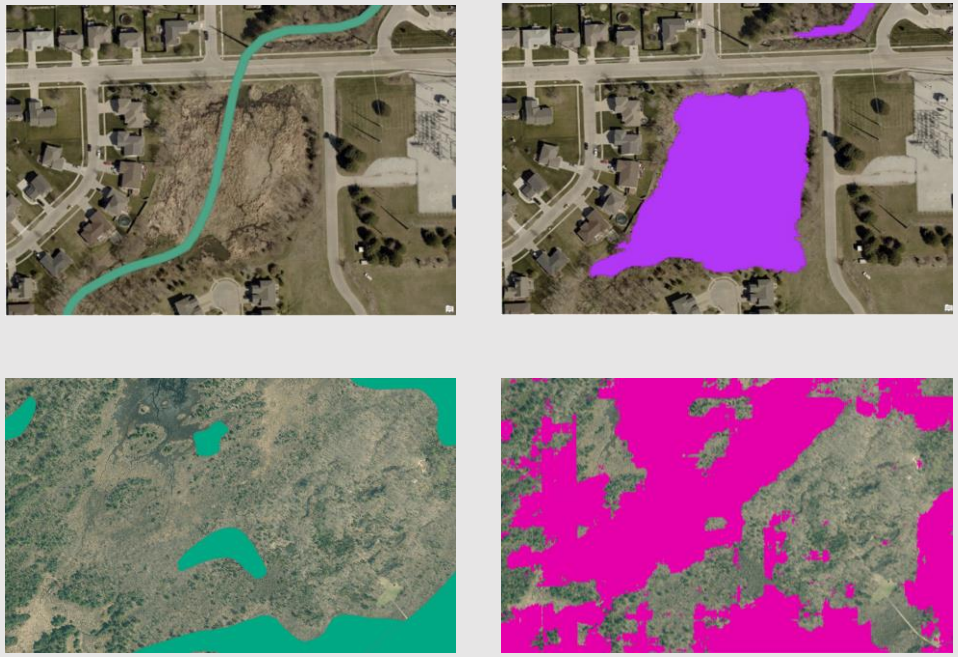


Metric	Model	
	Basic	Full
IoU	83.3%	87.3%
Accuracy	91.6%	94.0%
Precision	90.5%	96.5%
Recall	91.3%	90.2%

Improving wetland mapping

NWI Data

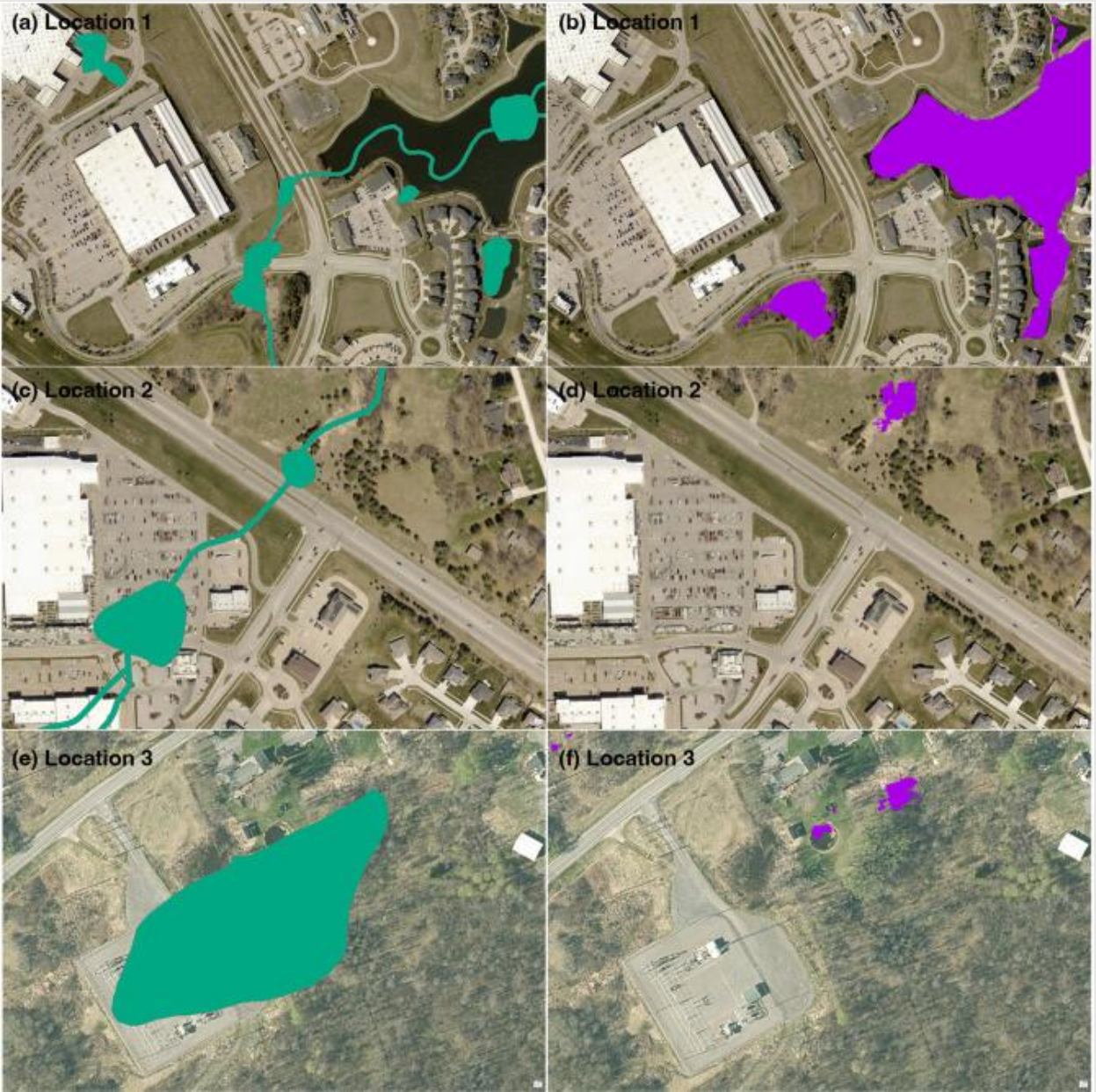
AI Outputs

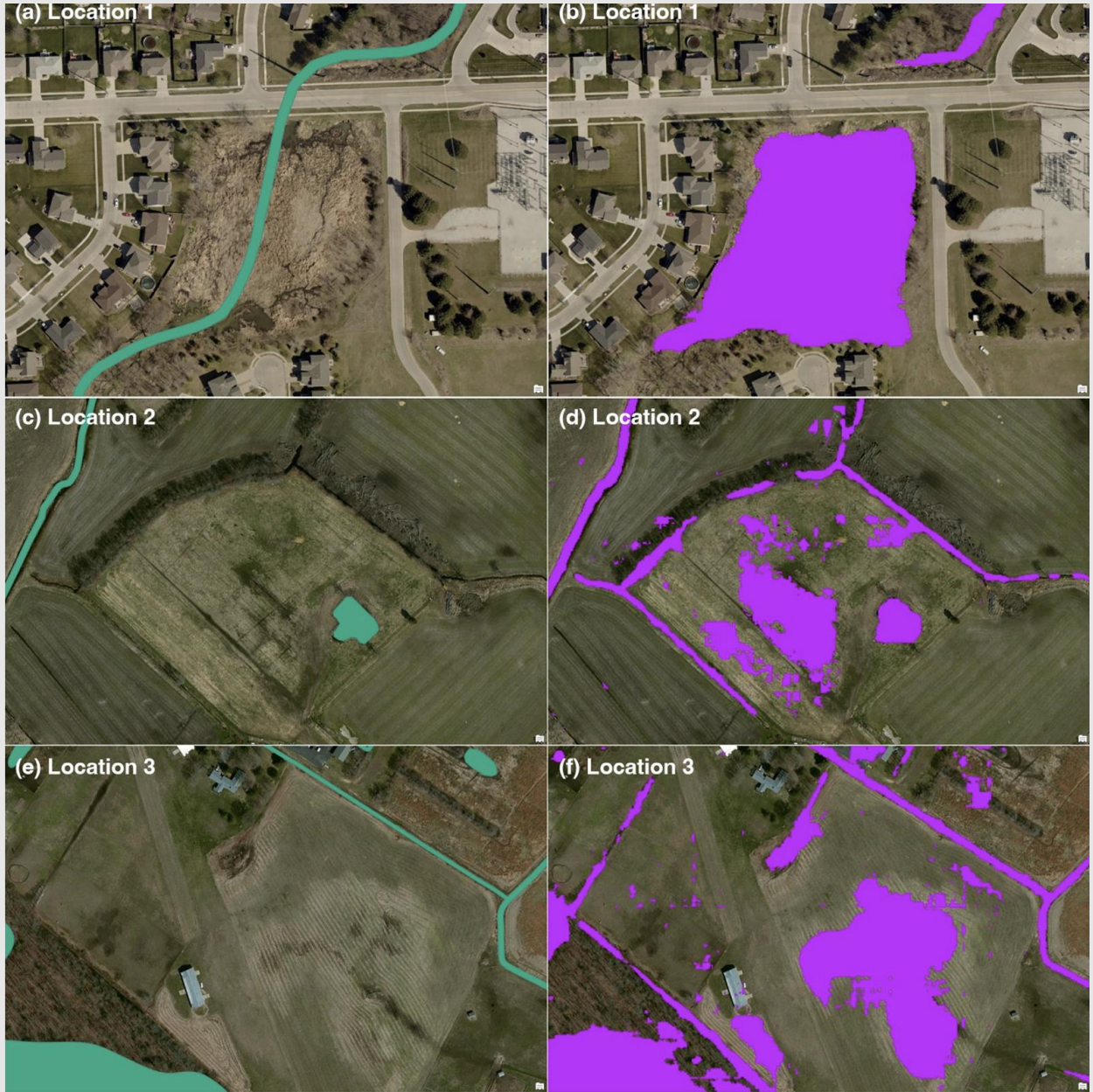


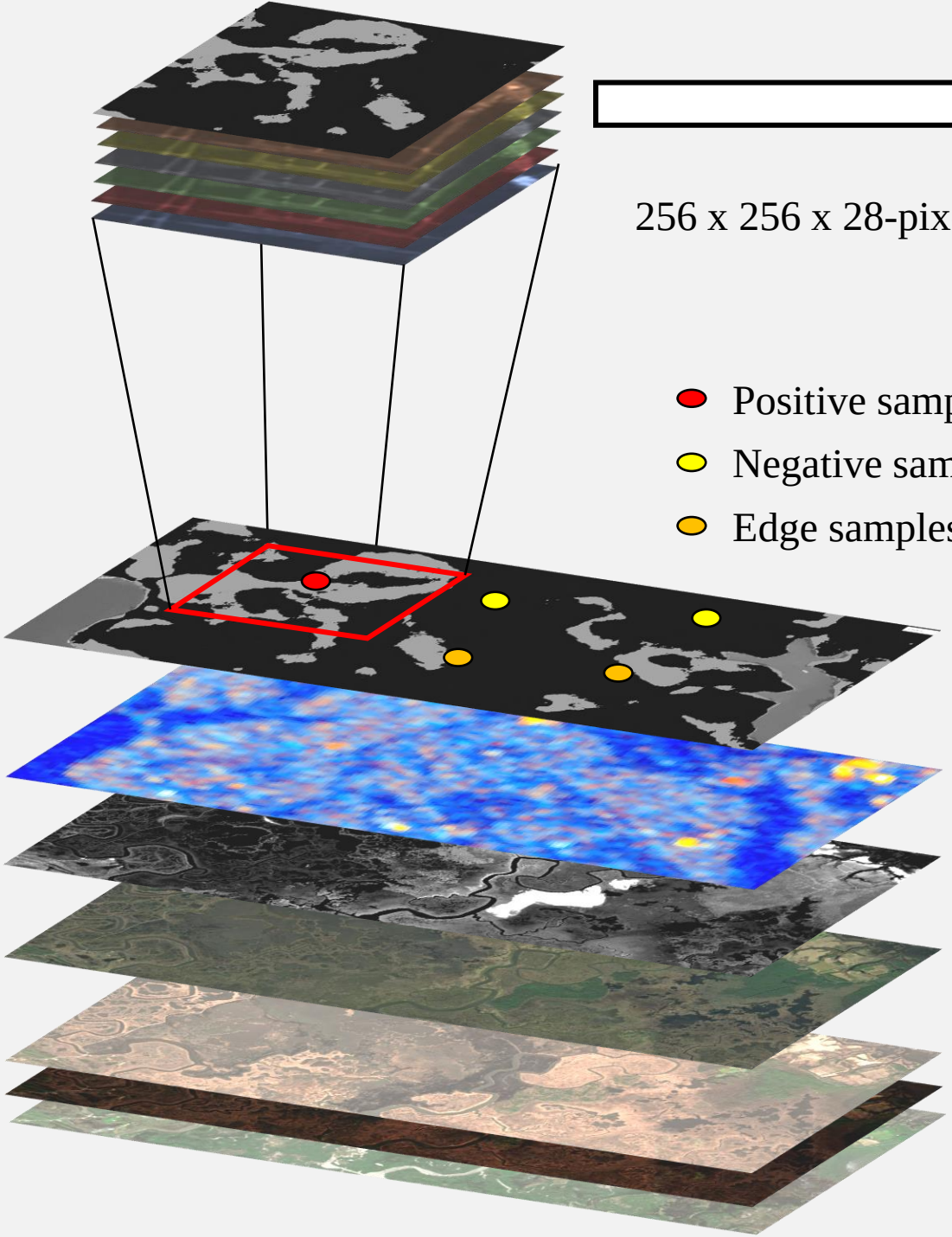
Improving wetland maps

NWI labels

Model predictions







256 x 256 x 28-pixel chips

- Positive samples
- Negative samples
- Edge samples

NWI Labels

Geomorphons (1 band)

LiDAR (1 band)

NAIP (4 bands)

3 x Sentinel-2 (7 bands)

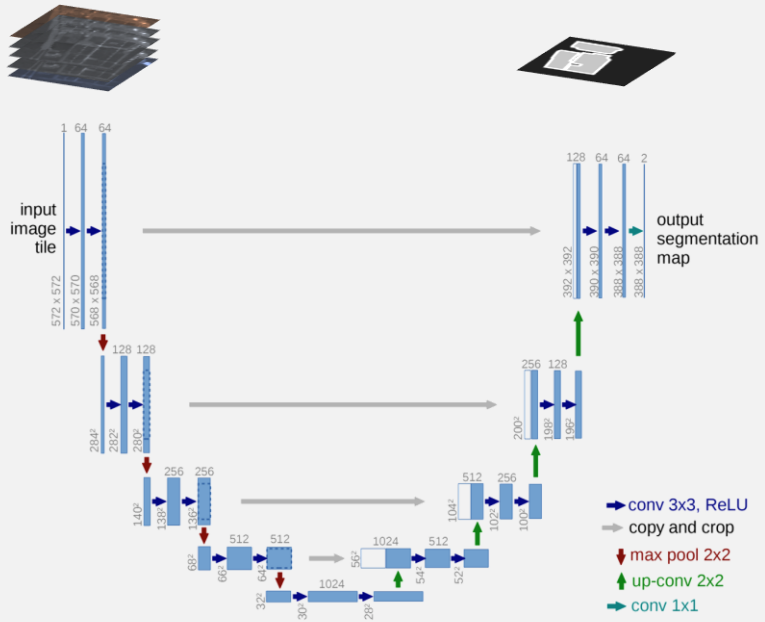
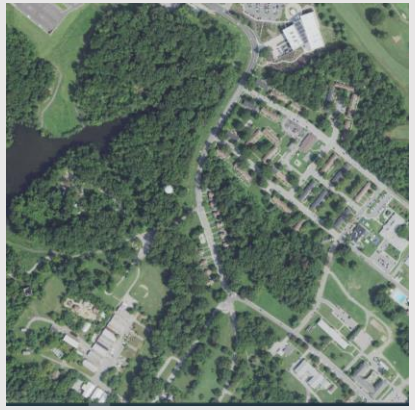


Image Augmentation



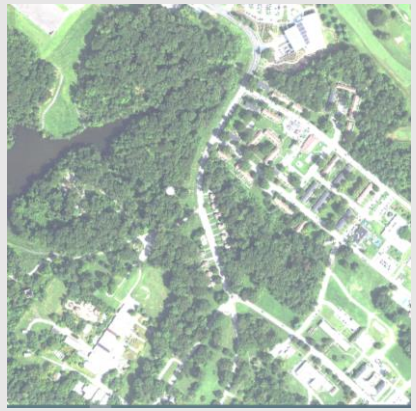
Original

Rotate 90°

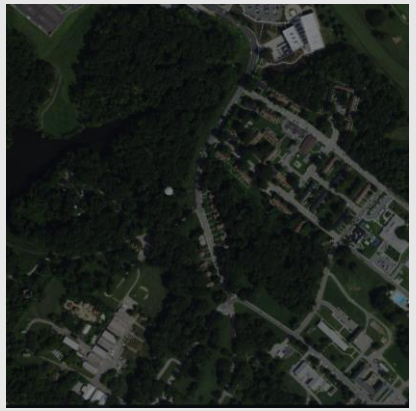
Rotate 180°

Rotate 270°

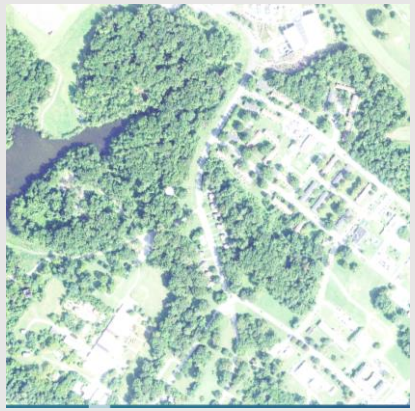
Brightness -5%
Contrast -5%



Brightness +5%
Contrast -5%

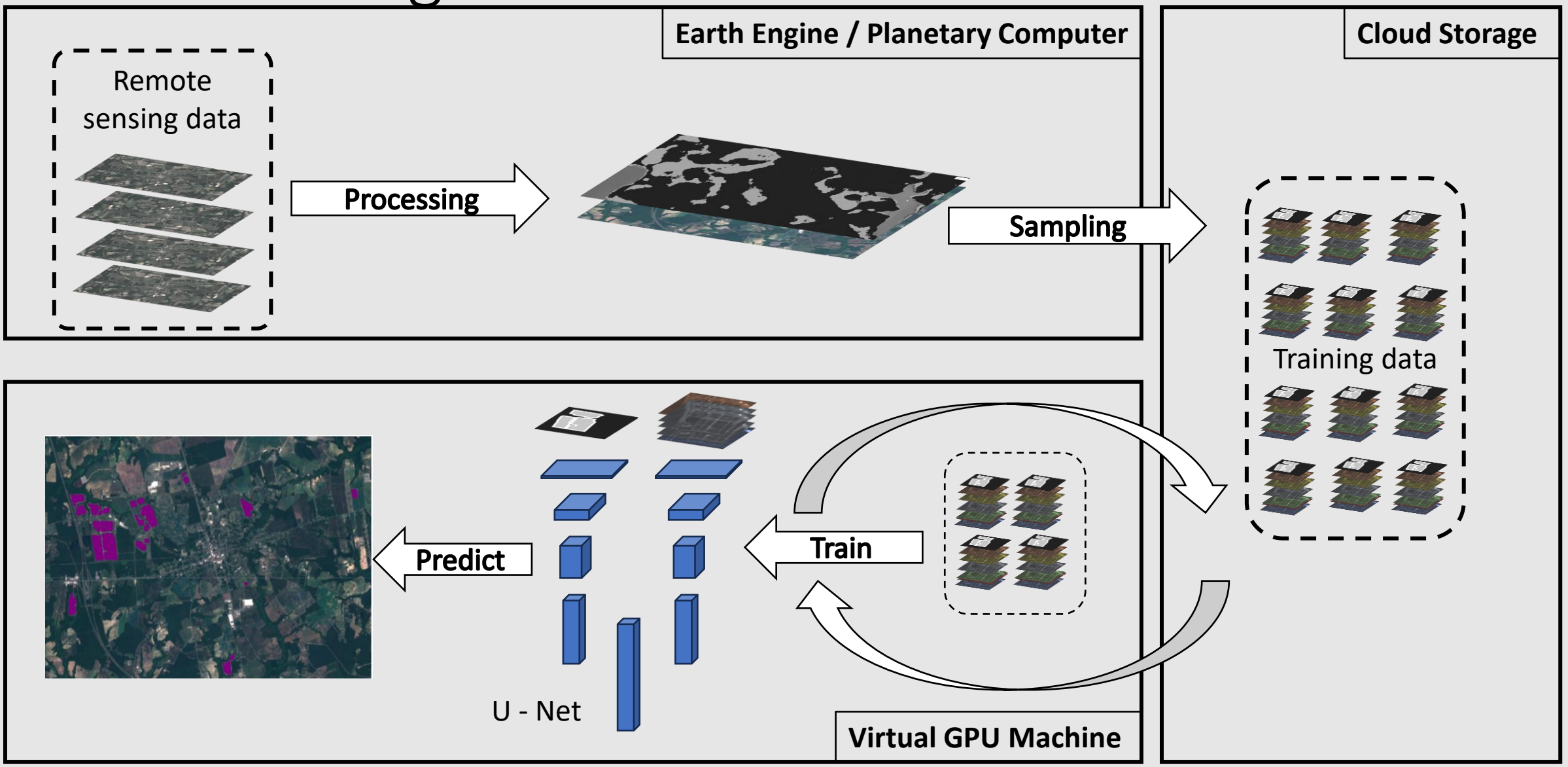


Brightness -5%
Contrast +5%



Brightness +5%
Contrast +5%

Model Training Workflow



Questions?

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Chesapeake Conservancy

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CONSERVATION INNOVATION CENTER

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