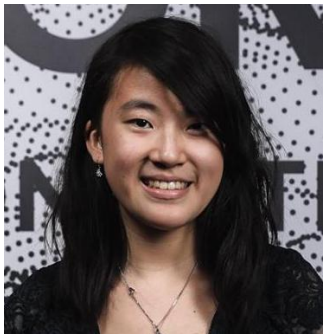
# Detecting Abandoned Oil And Gas Wells Using Machine Learning And Semantic Segmentation



McGill

Michelle Lin, David Rolnick

Mila

# Problem & Motivation

Source: Getty Images

## 1. Active Wells

- Operational
- Large surrounding machine

# Problem & Motivation

1. **Active Wells**

   - Operational
   - Large surrounding machine

Source: Getty Images

**2. Abandoned Wells**

   - Bankrupt companies abandon wells
   - Small (1 - 3m)
   - Unknown/inaccurate locations

Source: SRP Alberta

# Problem & Motivation

4 000 000+ abandoned wells in the US

Canada → 370 000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4 000 000+ abandoned wells in the US

Canada → 370 000

750 000+ predicted/missing wells in Pennsylvania

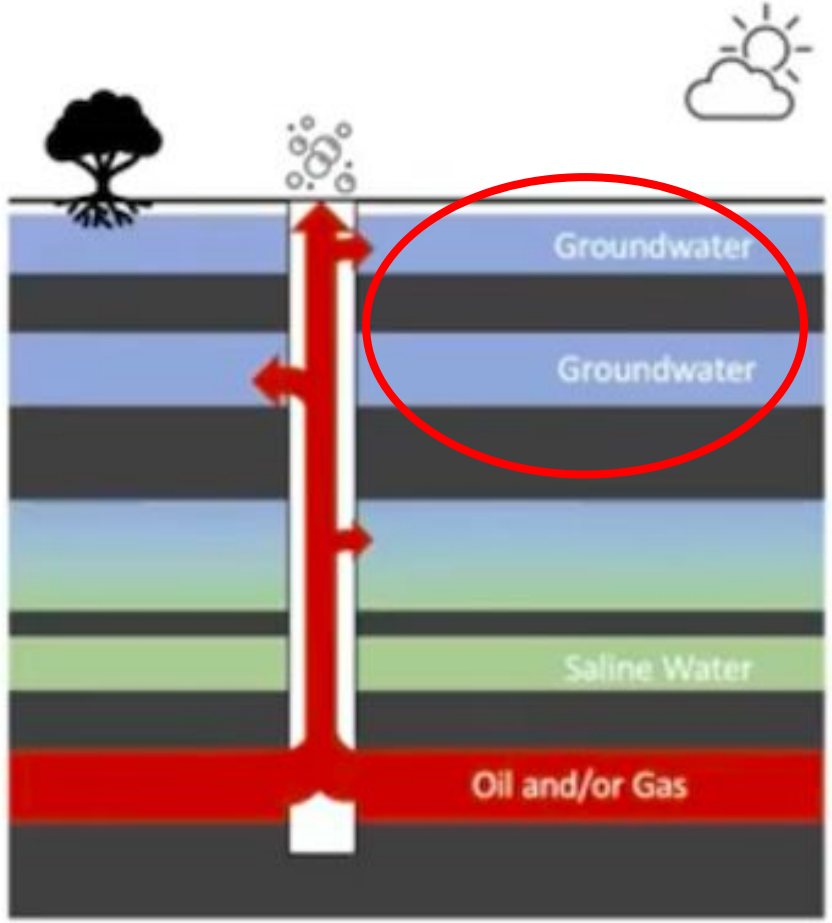
**Alberta → 10 000**


Source: SRP Alberta

# Problem & Motivation

Environmental impact:

- **Ground water supply contamination**
- Methane emissions
  - 150% annual underestimation




Source: Kang et al

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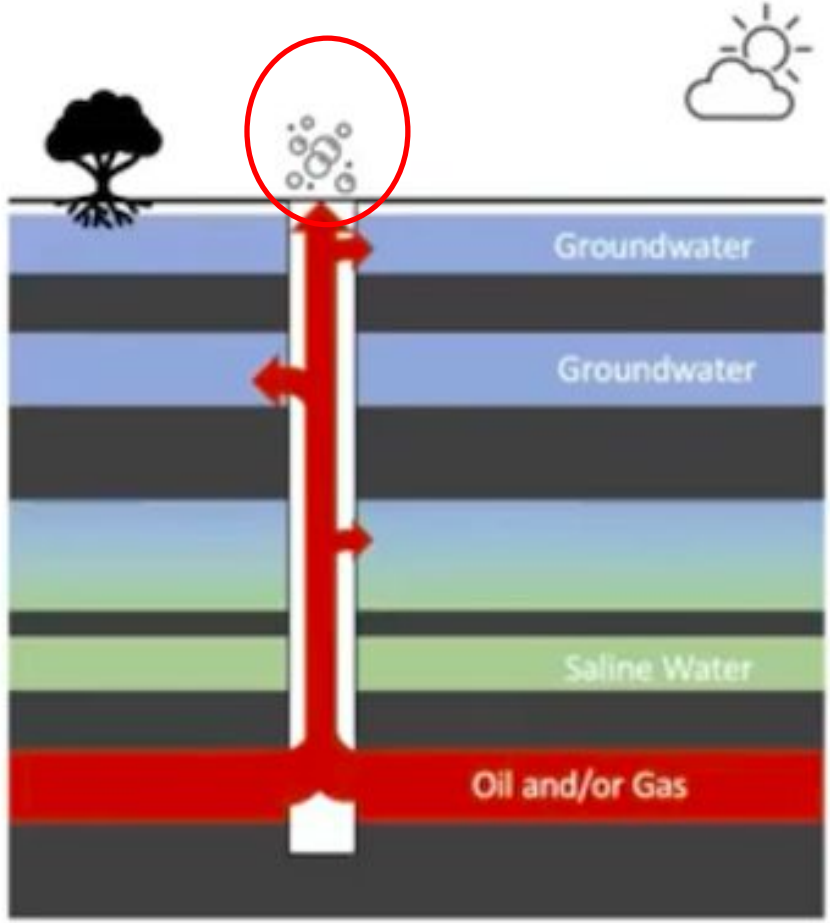


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# Problem & Motivation

**Bottleneck**

Locations of abandoned oil wells are unknown

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## Bottleneck

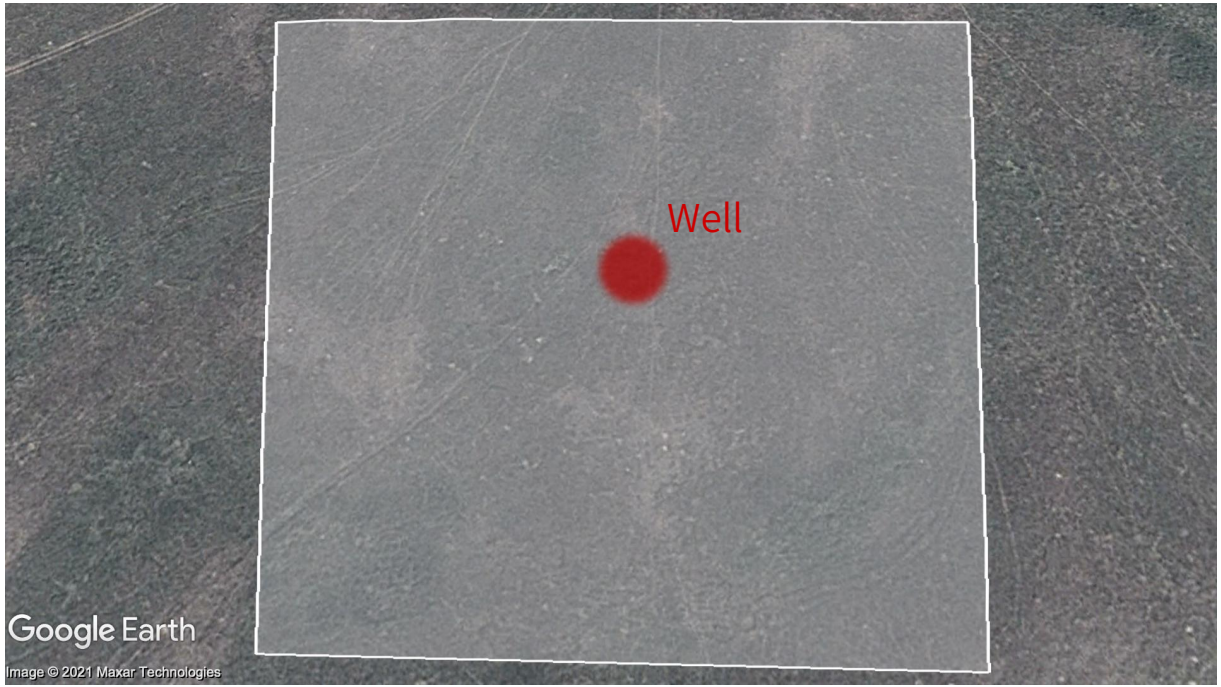
Locations of abandoned oil wells are unknown

## Project objectives

1) Identify the existence and locations of previously *unknown* abandoned oil wells
2) Precisely localize and correct inaccurate locations of *known* abandoned oil wells

# Problem & Motivation

Semantic segmentation can be used to locate wells in satellite imagery



# Background & Related Work

Prior work on *active* oil well detection

**Goal**: detect illegal drilling
**Image resolution**: 10-60m/px

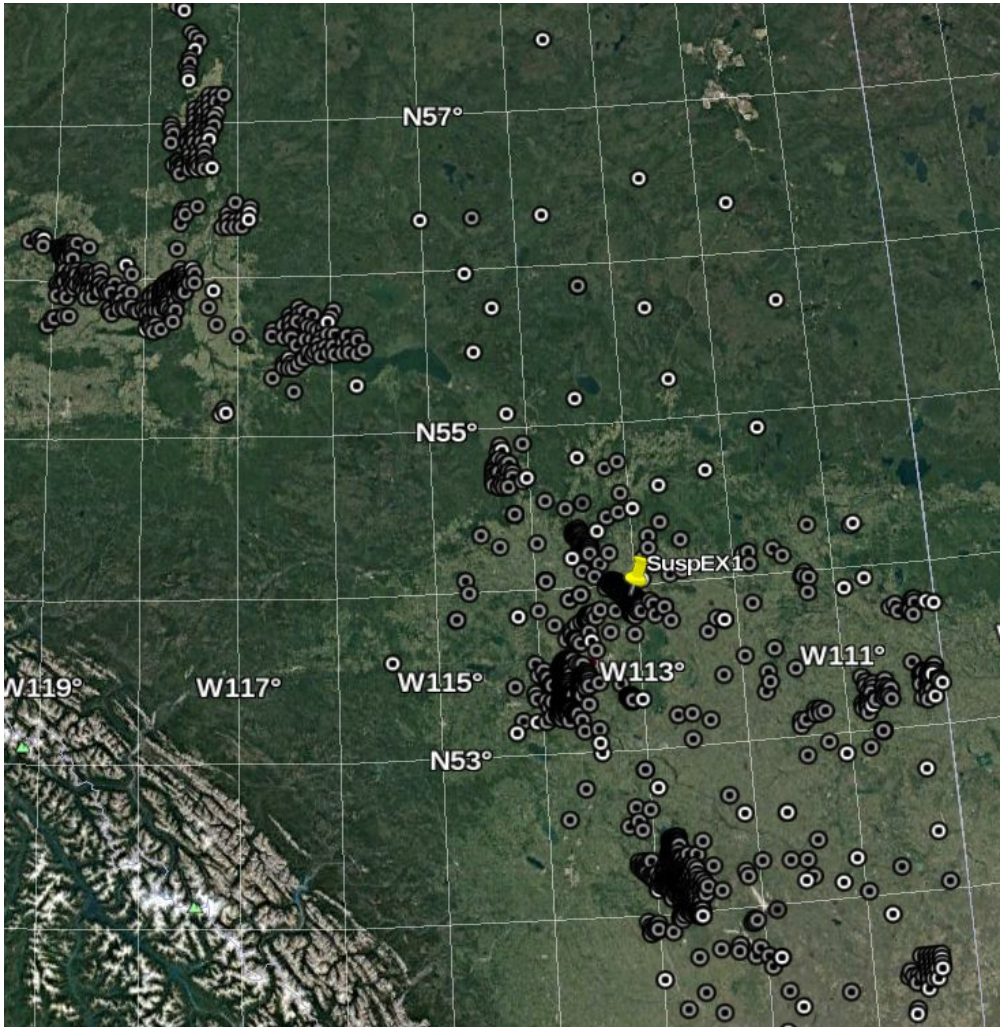
Source: Esri

# Proposed Approach

**Data:**

- **AER-ST37**
  - **Abandoned: 219 000**
  - **All: 430 000**

- Satellite imagery:
  - 0.5m/px



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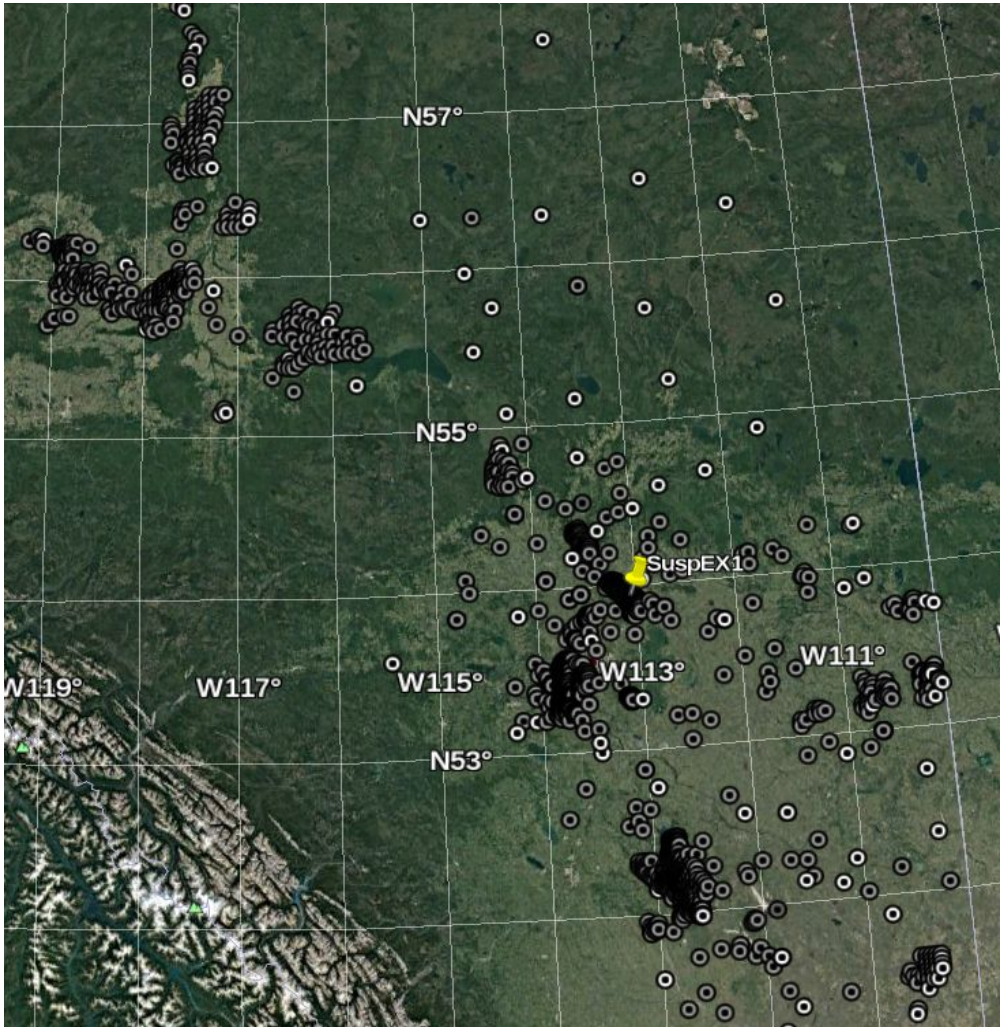
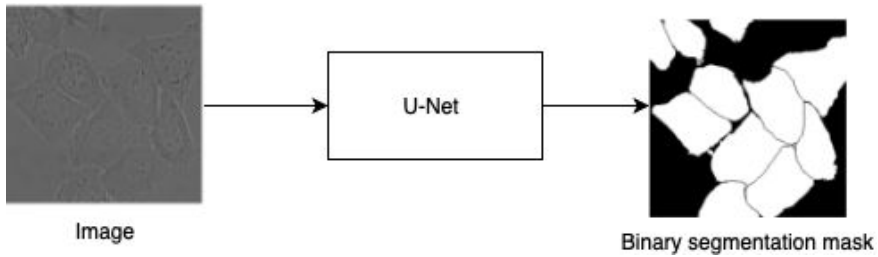


# Proposed Approach

Semantic segmentation: pixel-wise image classification

Source: Ronnenberger et al.



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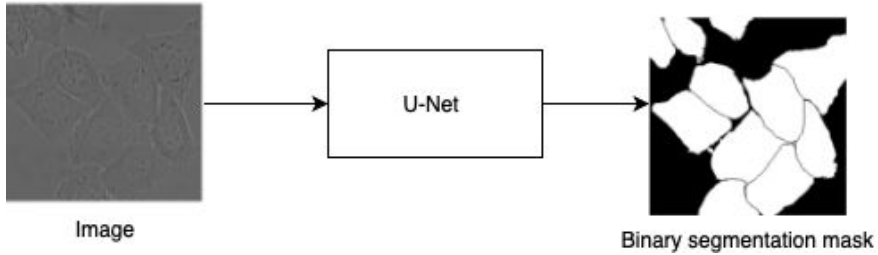
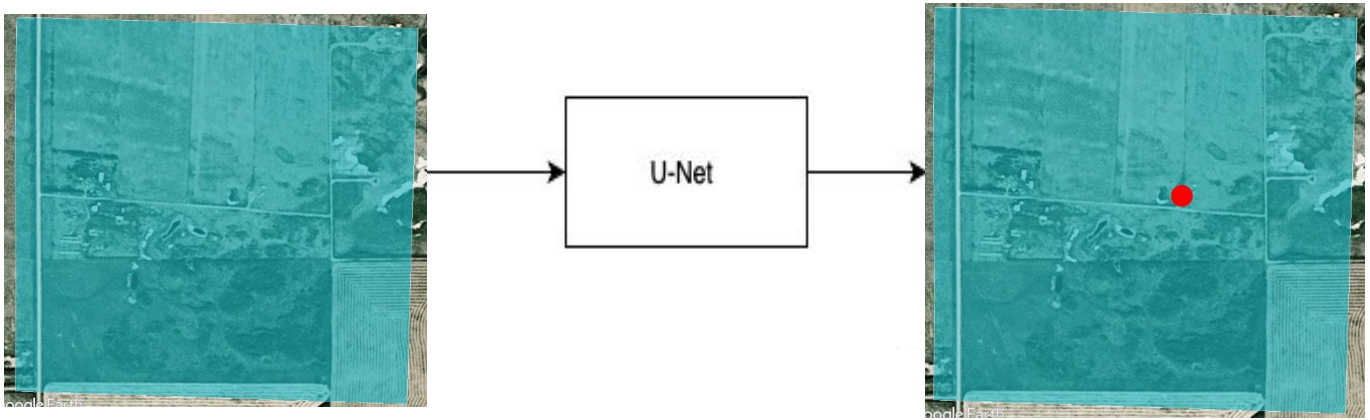


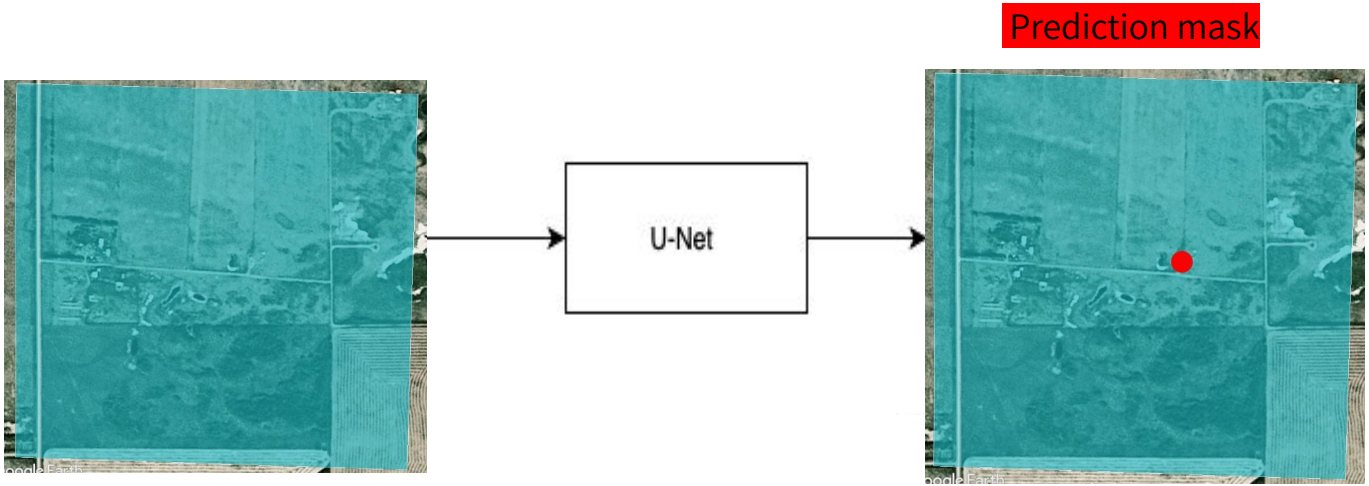




0 = Not Well
1 = Well

# Proposed Approach

**Pixels -> well locations**

1) Cluster pixels
2) Sum confidences of neighboring pixels



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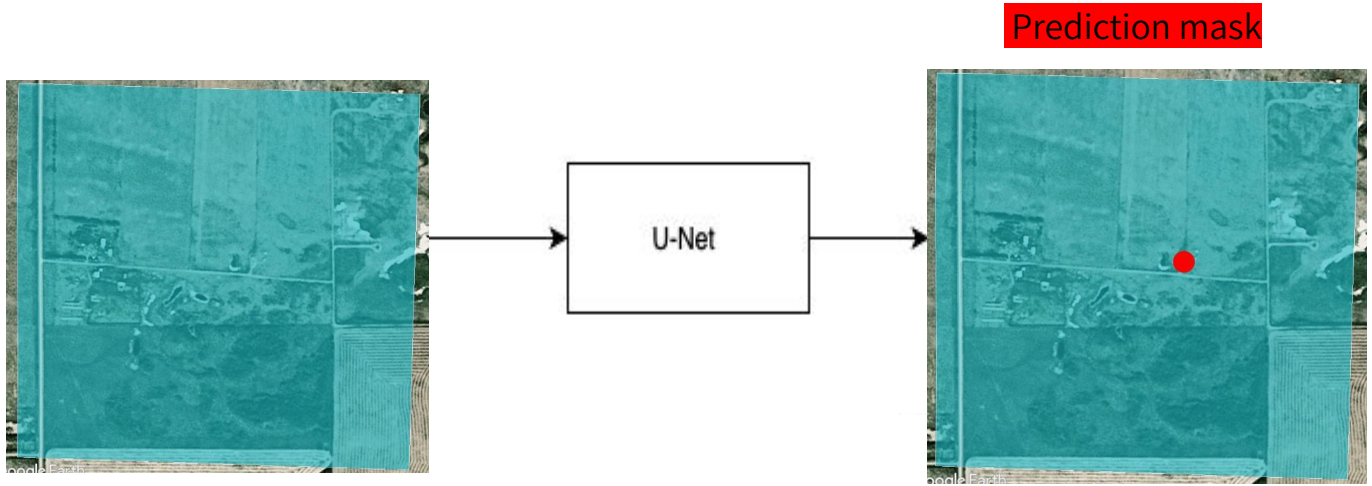

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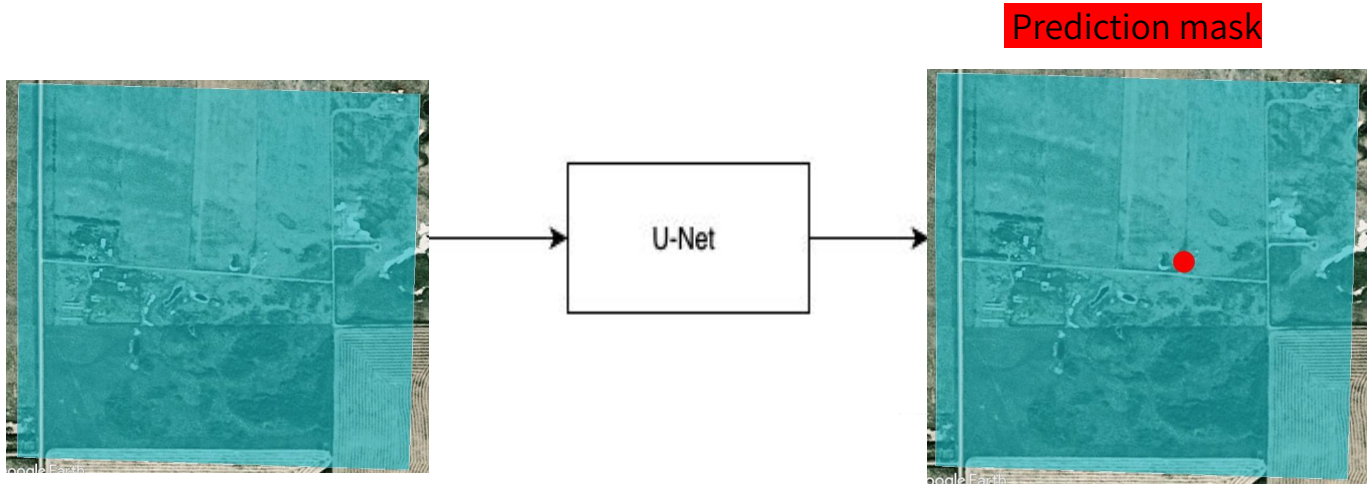
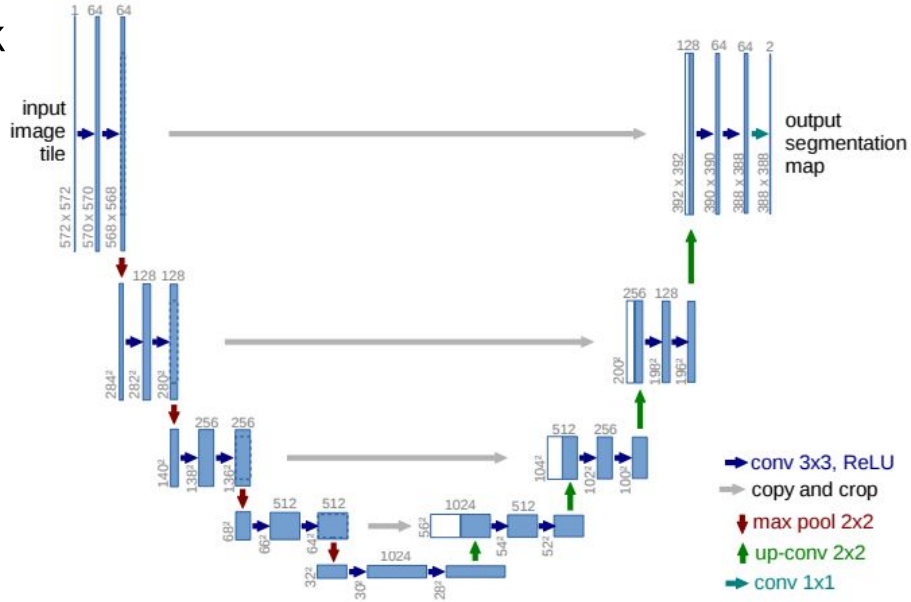


# Proposed Approach

## U-Net

- Encoder-decoder architecture
- Fully convolutional neural network

Source: Ronnenberger et al.



# Proposed Approach

| *Potential Bottlenecks* | *Strategies to Address Bottlenecks* |
|---|---|
| **Imbalanced Data** | **Enforcing balanced training data** |
| Pinpointing active wells | Post processing filtering |
| Label noise | Number of fully accurate labels |

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# Future Work

- **Generalization with Model Agnostic Meta-Learning (MAML)**
- Methane Quantification With Active Learning

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- Generalization with Model Agnostic Meta-Learning (MAML)
- **Methane Quantification With Active Learning**

# Thank you!

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