Snow Depth Presentation

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Goals & Relevance

This product is the result of a summer internship with ABMI

Snow is an important limiting factor wildlife abundance and distribution
Snow cover is also a factor in predicting fire risk, hydrology for human consumption, and energy (dams)

Develop models that accomplish the following

- Classify snow coverage from a camera trap image
- Predict snow depth from a camera trap image

Snow Coverage Classification Model

- This model classifies images into 4 classes based on snow coverage
- Uses neural network, trained using 3401 images
- Uses VGG16 architecture
- Images were first resized to 384x256 to accommodate network and computational limits

"none"

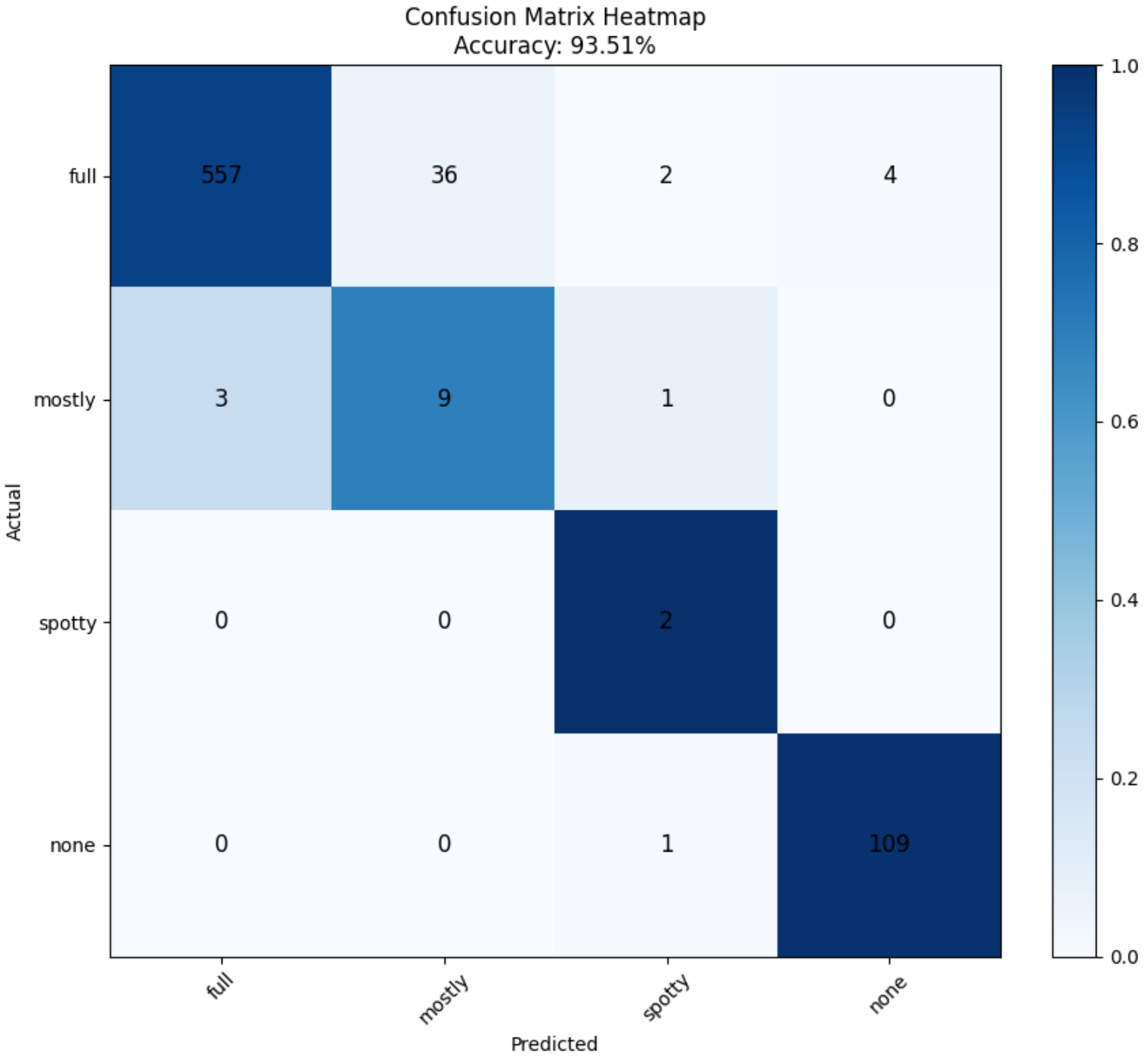
"spotty"

"mostly"

"full"

Snow Coverage Classification Results

- Depending on which deployments were used to train and which were used to test, results drifted between 89-95%
- This set of test deployments had 724 images



Snow Depth

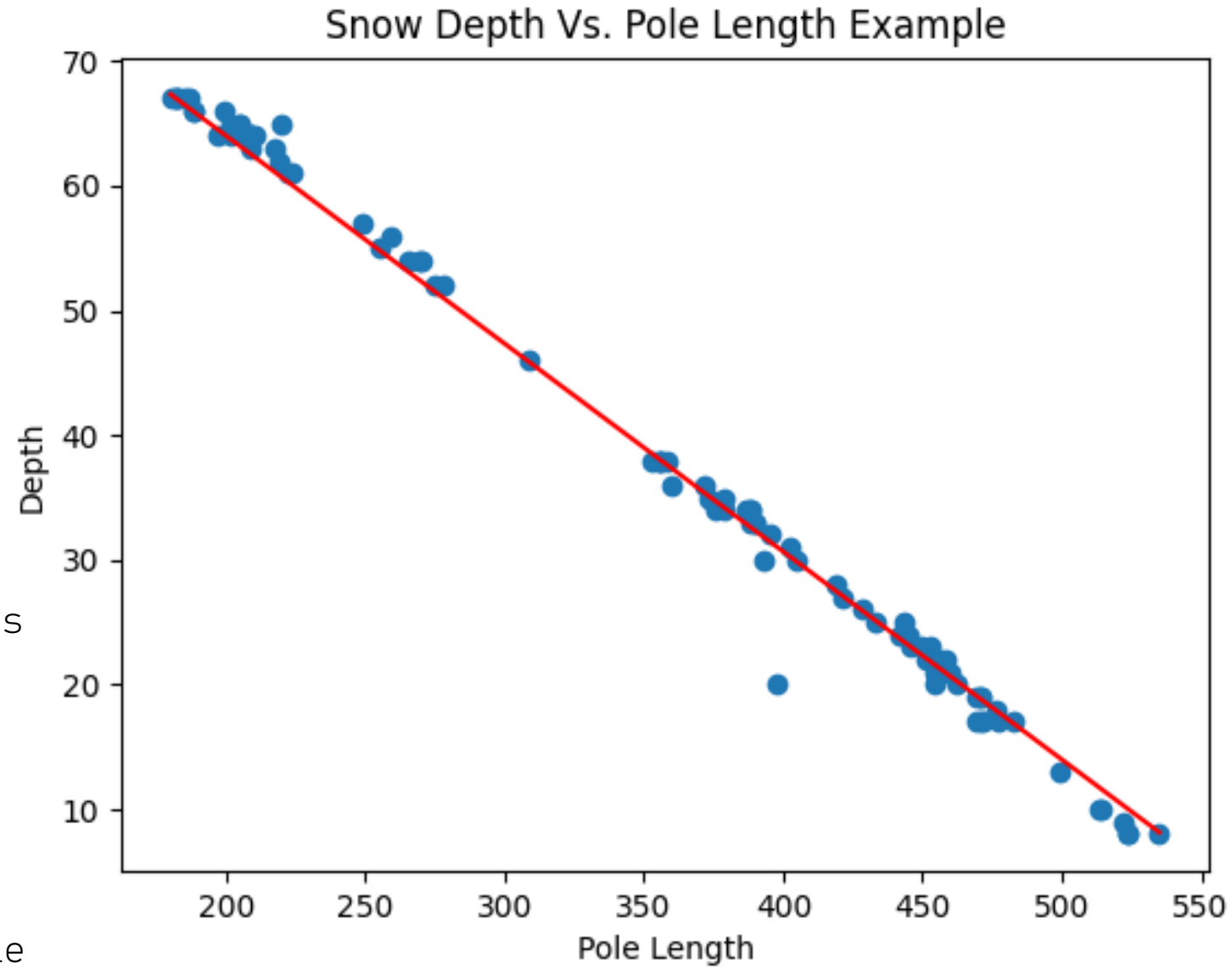
- Hypothesis.... there is a linear relationship between visible pole length and snow depth
- If our hypothesis turns out to be true, we can build a model that finds the visible pole length and use that to get a depth estimate

Hypothesis... Confirmed

When comparing human labelled pole lengths and human labelled snow depths a linear relationship is obvious.

Strategy

labelling 2 images from a deployment (with different snow depths) allows snow depth calculation using only visible pole length.



Training the Model

- Used annotation website to collect training samples
- Over 3000 samples used for training
- Used "segmentation" model designed to predict full image masks of pole
- Used U-net network architecture

Example Prediction

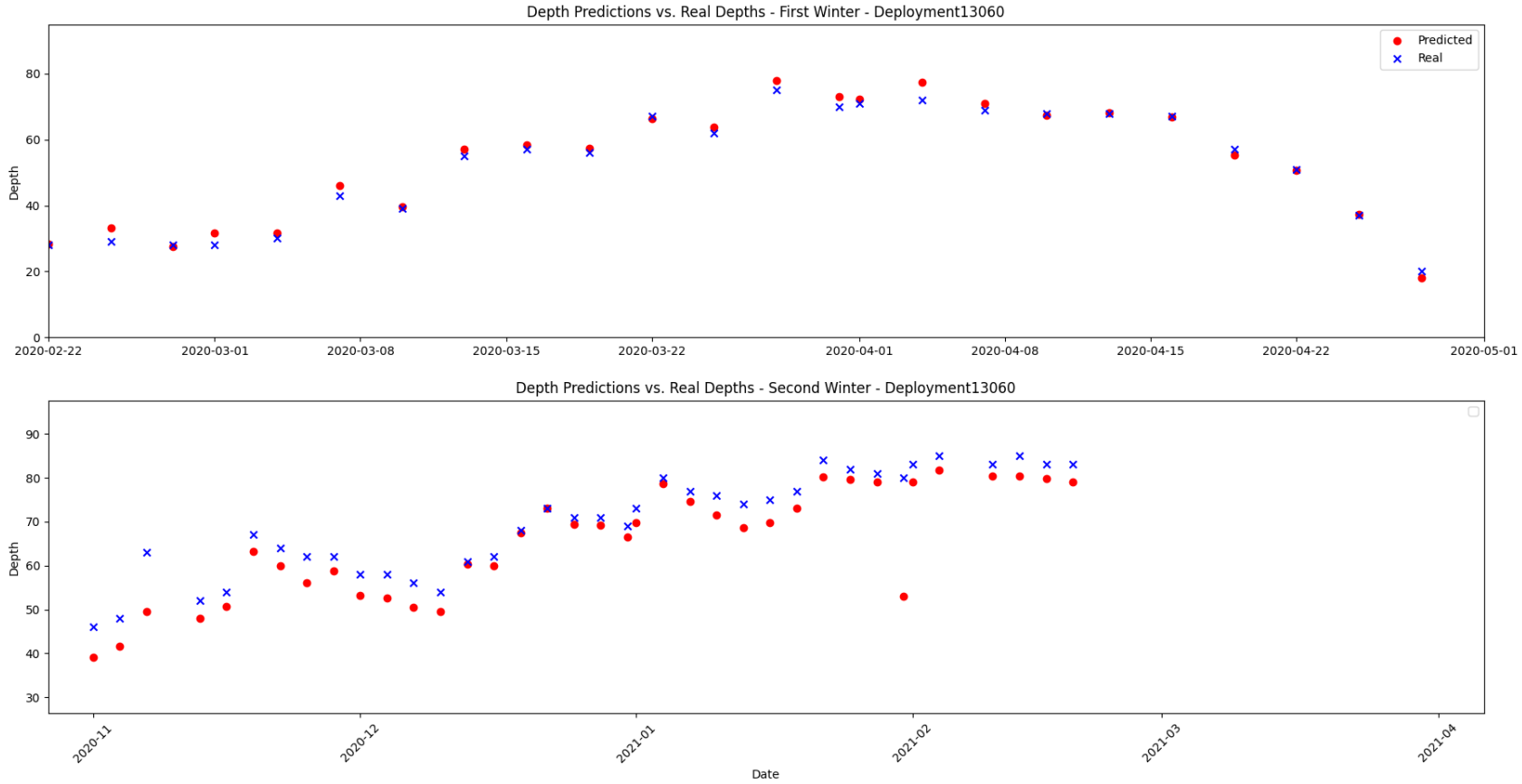
- The predicted mask is post processed using established computer vision methods to get length
- Some corrective methods were developed to repair discontinuities

Results

- We labelled and tested 20 new diverse deployments with a total of 951 images
- Of the 20 deployments, 18 had enough images to use. Chose a minimum cutoff of 15 images
- Absolute error is calculated as |labelled depth – predicted depth|
- Mean absolute error (MAE) was 7.0 cm
- About 75% of images had AE at or below the mean (images with large errors skewed mean)
- 15 of the 18 deployments had MAE between 3.2 - 7.6 cm

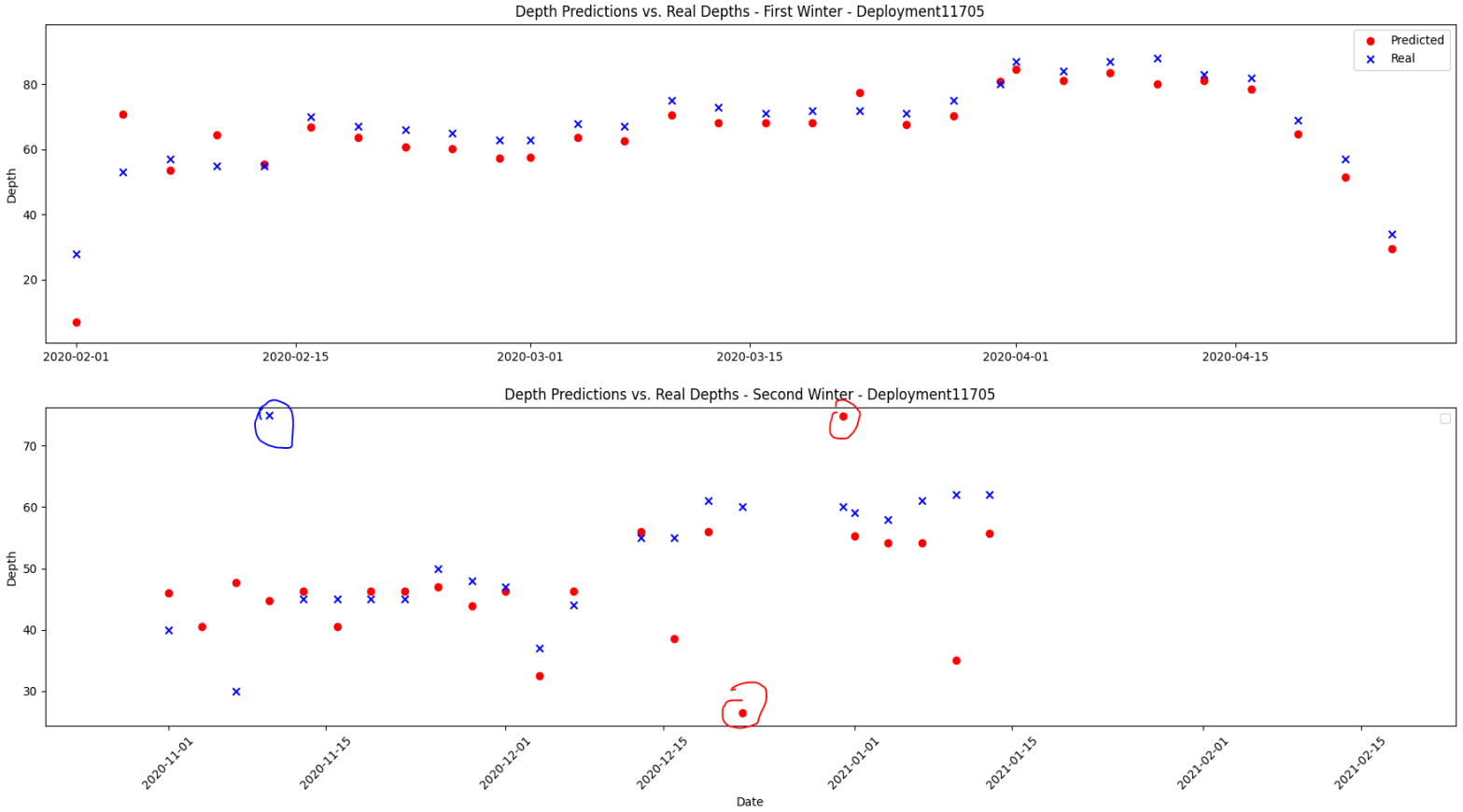
Accumulation Plot #1

- Data from deployment with below average MAE
- 3.3 cm MAE
- Since pole model has no way of knowing if vegetation or snow is covering pole, any images with no snow are marked as 0 depth by classification model



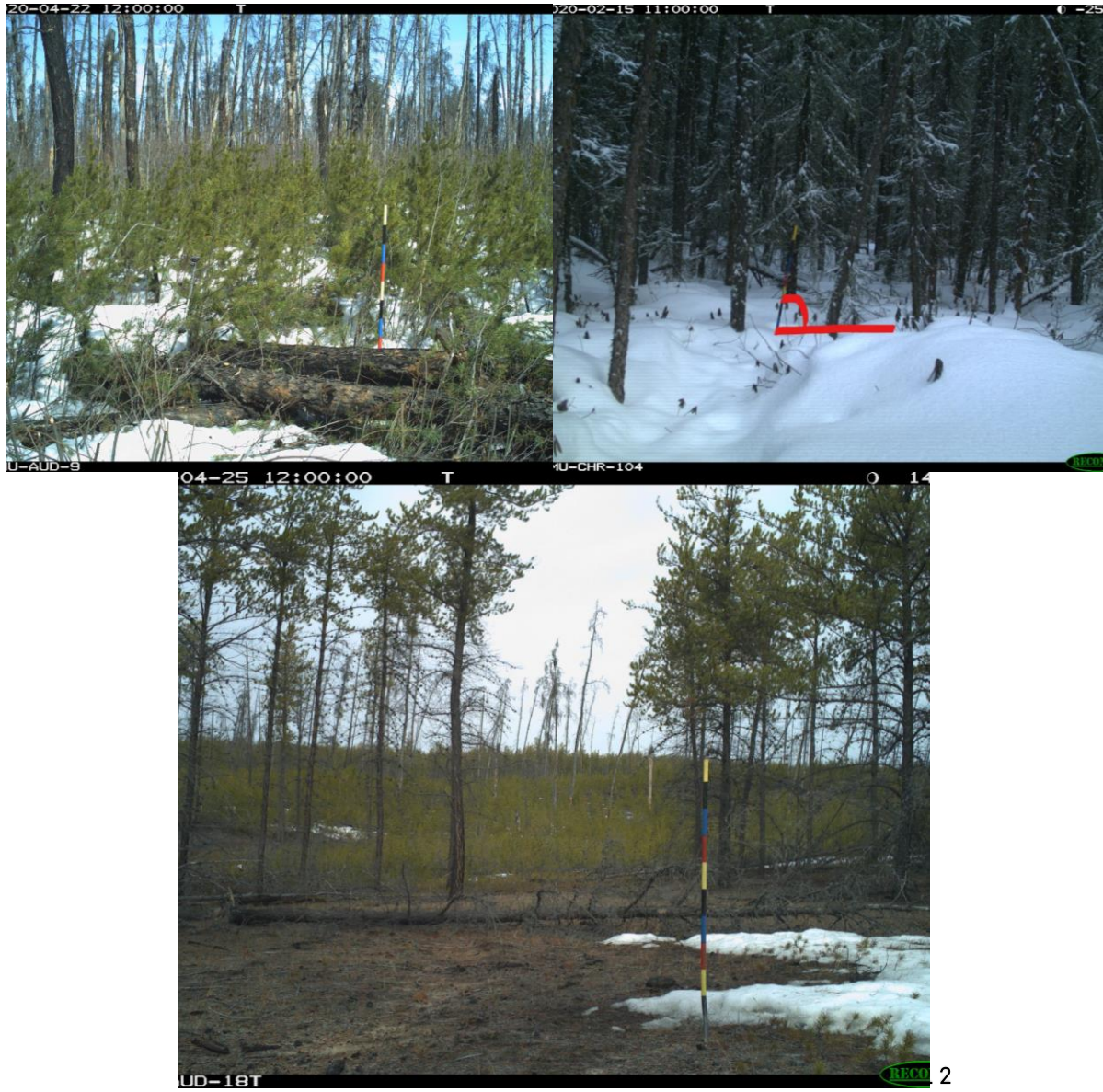
Accumulation Plot #2

- Data from deployment with above average MAE
- 7.4 cm average error
- Blue circle was a human labelling error
- We have identified methods that can find and eliminate predicted outliers (circled in red)



Limitations

Model doesn't directly predict snow depth; model predicts how much of the pole is showing. Even the labeled snow depth is an estimate that relies on three unrealistic standards



- Proper zeroing of the pole
- Pole perpendicular to ground
- Unobscured view of pole entering snow

Future Directions

- Integrate the models with annotations website (currently requires manually moving a csv file)
- Improve models, lots of juice to still be squeezed, specific improvements to be recommended in final report

Acknowledgments

- Maryam for labelling thousands of images
- John for taking time every week to meet
- Melanie for keeping the snow depth dream alive
- ABMI for the opportunity

Questions?