

Project Team

Albert Konrad

Noah Marvisi

Mohammed Bouayoun

Pauline Salis

Instructor

Assan Sanogo

CORAL SPECIES DETECTION

UNDERSTAND HOW EACH CORAL SPECIES
FACE GLOBAL ENVIRONMENT CHANGES

Corals (found in reefs)



Grooved brain coral



Black coral

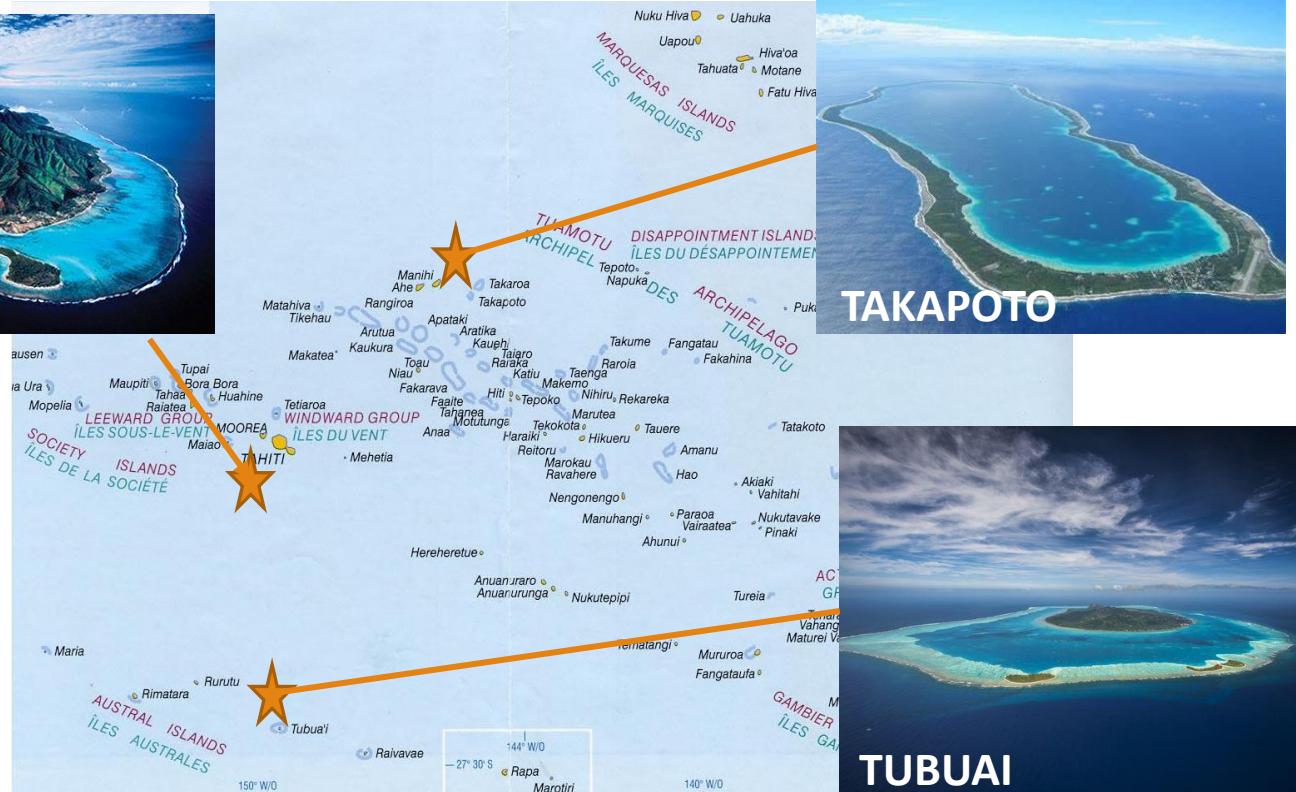


Lettuce coral

And many others!

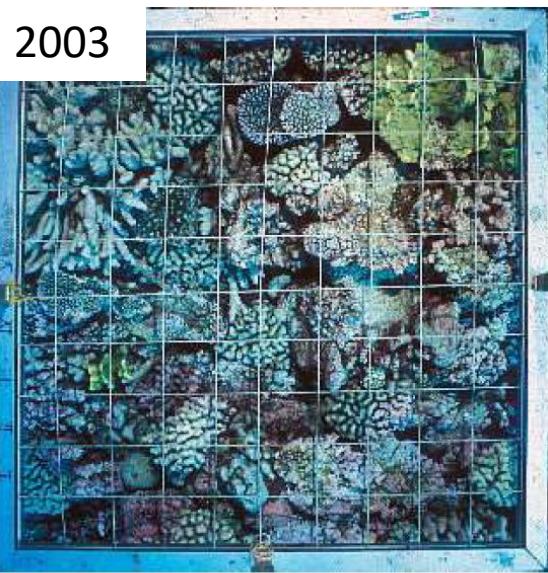
Corals are animals and biomarkers of ocean health and important for the ecology of the oceans

The project



Study in French Polynesia

The project



Pictures every 2 years during 16 years of many sites (quadrat pictures)

More than 3000 pictures to analyse

Project

Prepare an application for the researchers to automatically detect corals

1. Automate images preparation (cropping, rotation, color enhancement)
2. Automate coral detection
3. Deployment the application to AWS

1. Automate image preparation

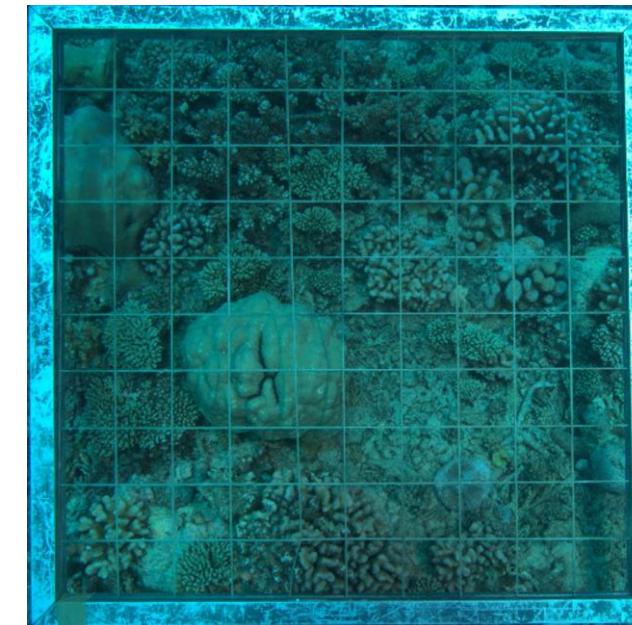
1. Automate image preparation

Aim:

- Detect the quadrat (ROI)
- Reframe the image



Input: Raw image



Output: Reframed image

Quadrat detection

Model training

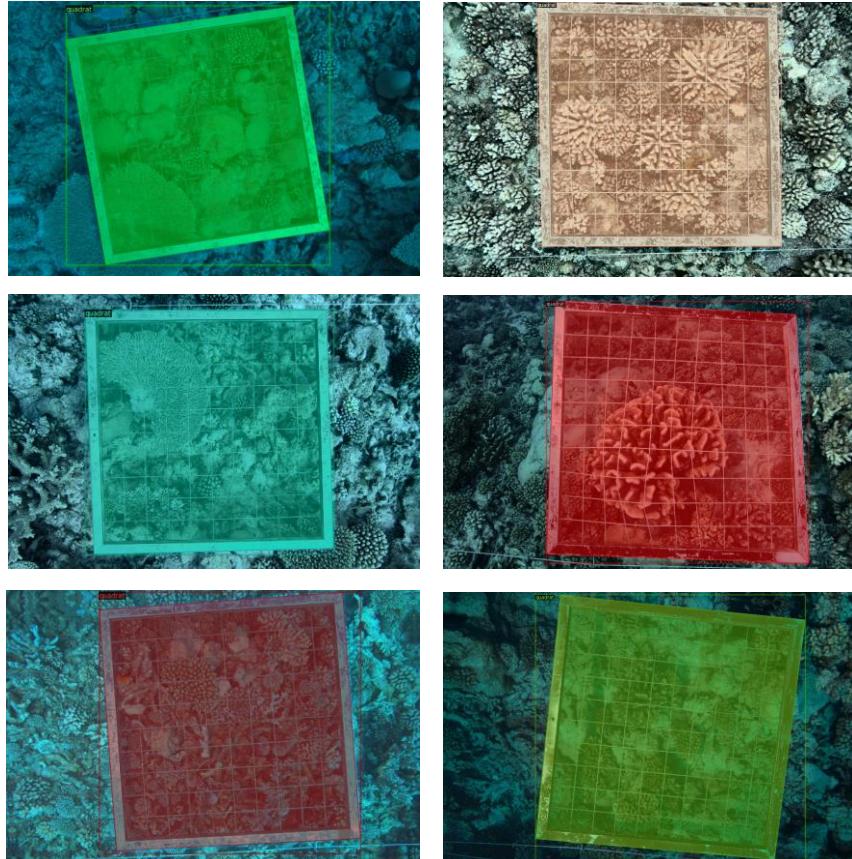


Figure: Example of 6 annotated images

Data augmentation

- Brightness and contrast modification
- Rotation and flipping
- Distortion

➔ Representative dataset

➔ 1200+ images

Training / Hyperparameters

- Backbone: Mask R-CNN R101 FPN 3x
- Batch size: 512
- Learning rate: 0.005
- Number of iterations: 1000

Quadrat detection

Model evaluation

Model performances assessed using:

- Training loss
- Validation loss
- Visual observations

Training phase verification:

- Convergence / Learning curves

Inference examples:

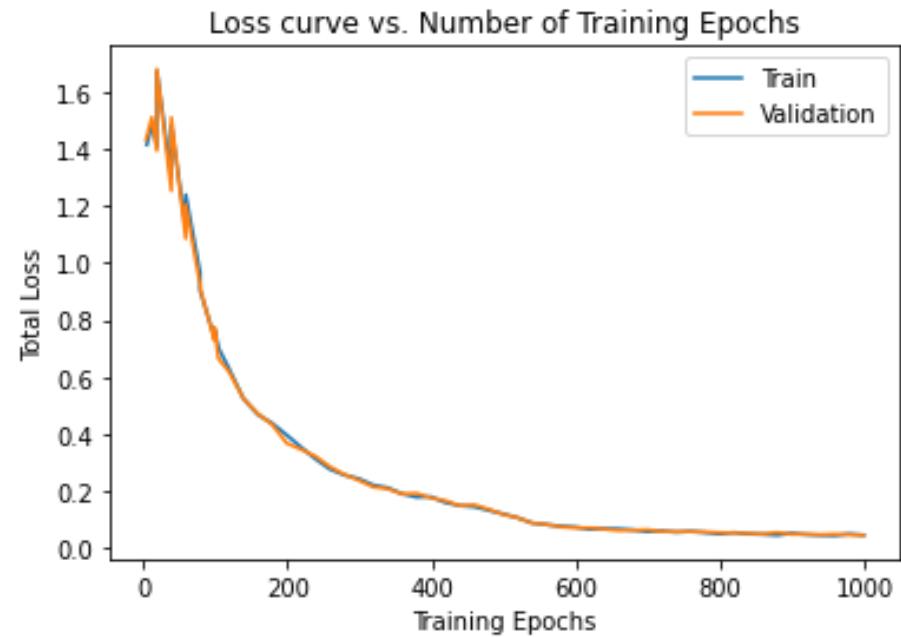
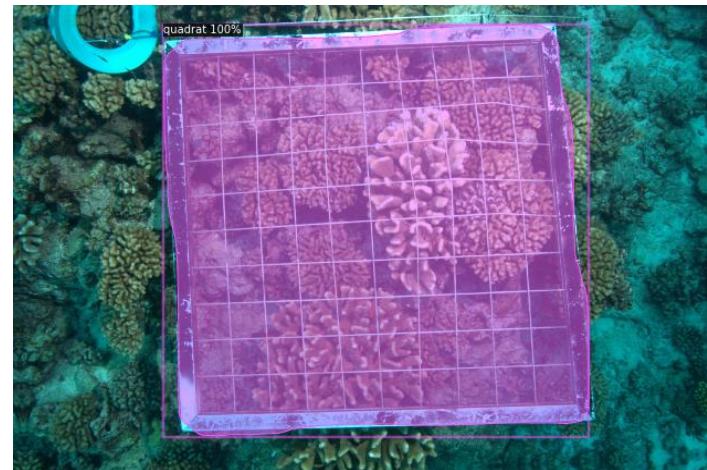
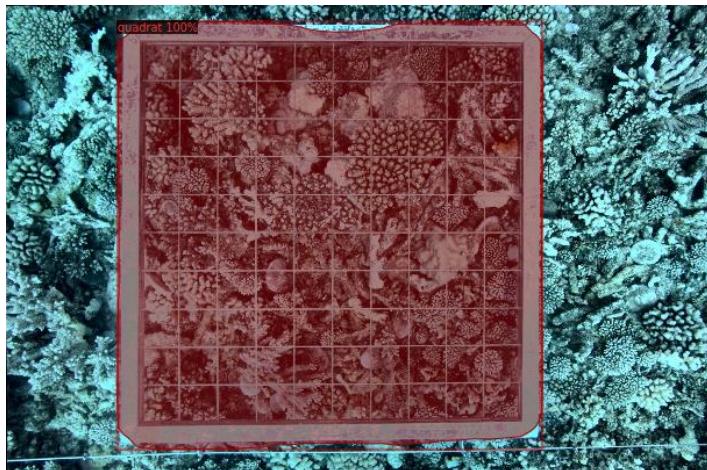
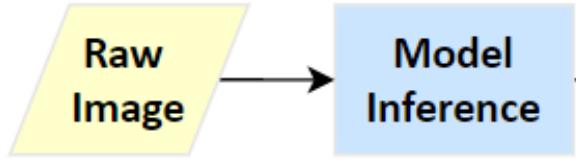
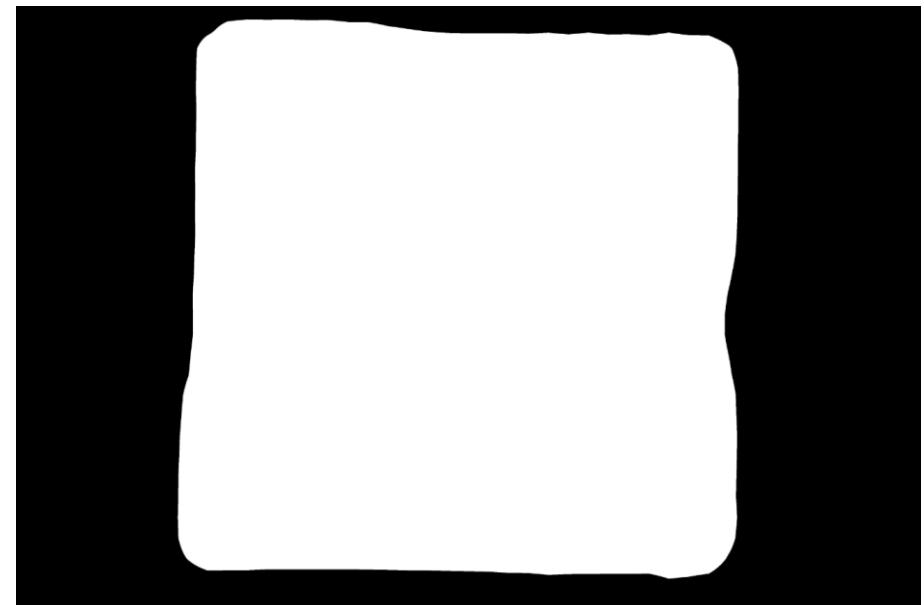


Image reframing

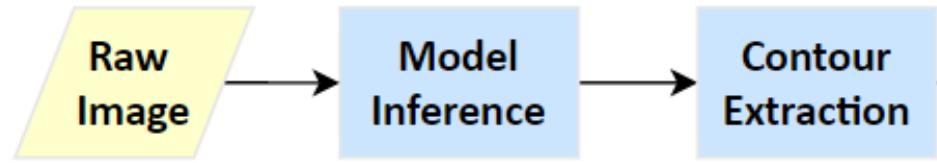


Raw Image

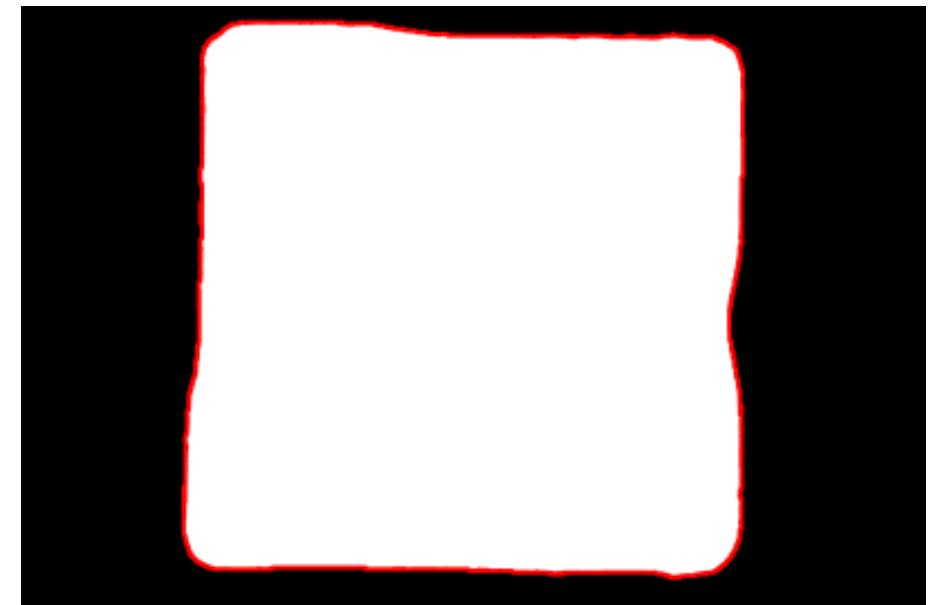


Binary Mask

Image reframing

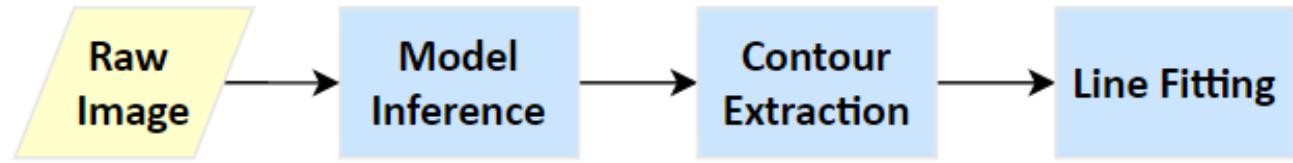


Raw Image

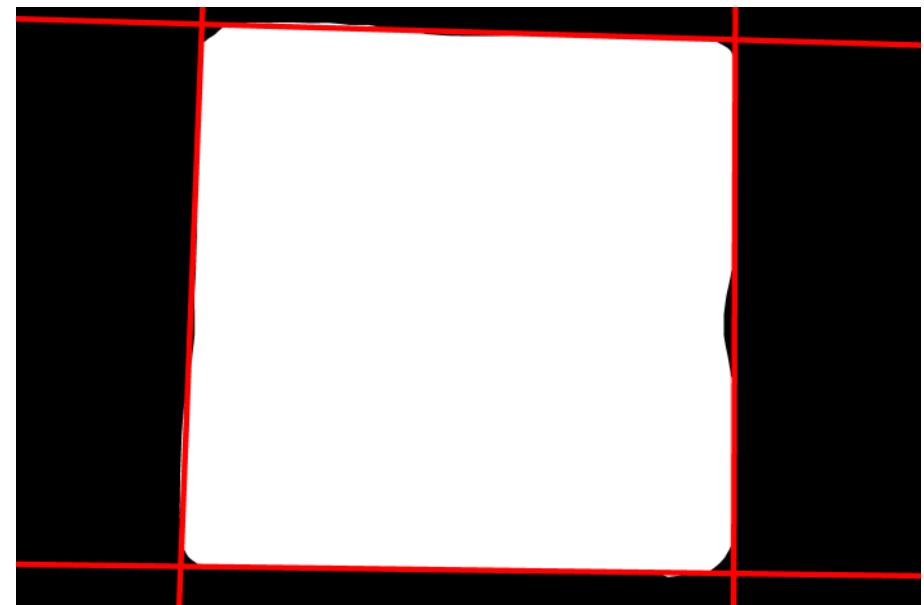


Binary Mask

Image reframing

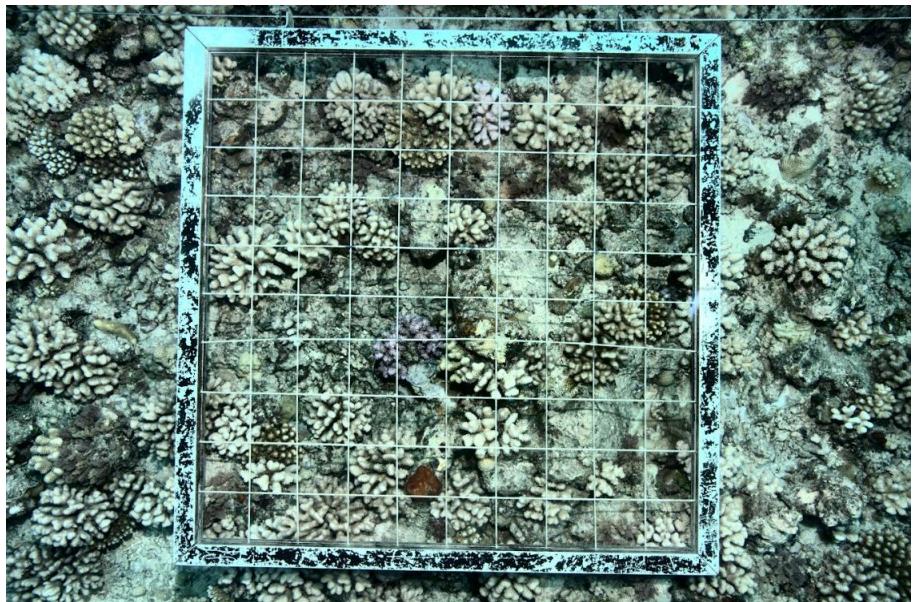
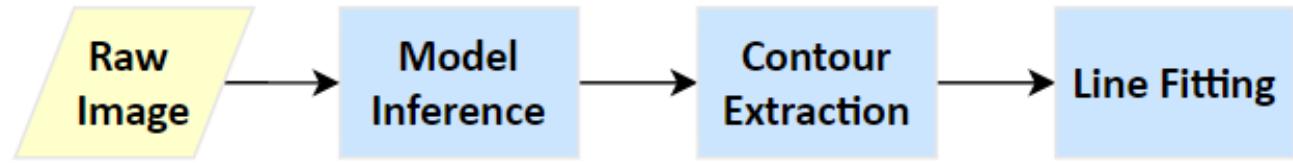


Raw Image

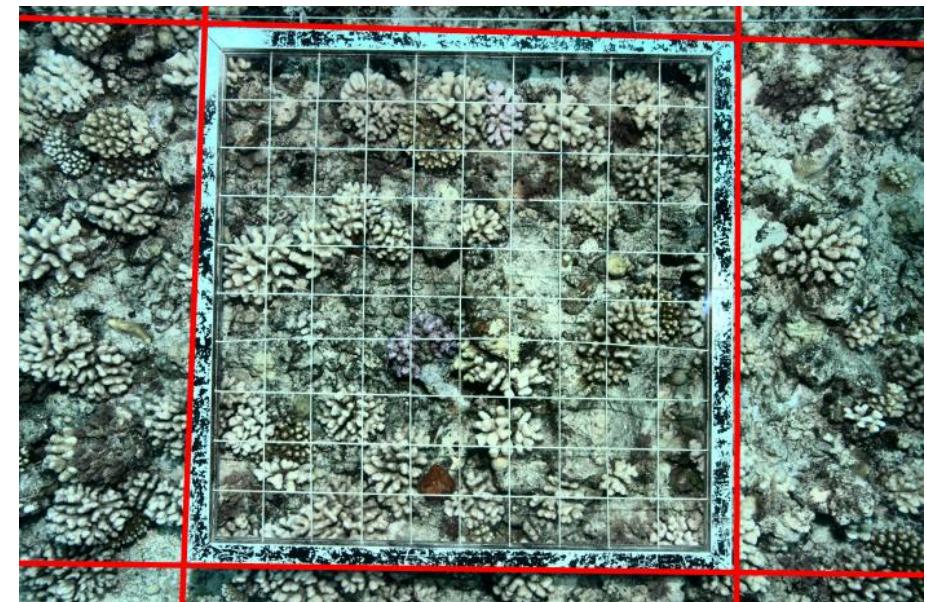


Binary Mask

Image reframing

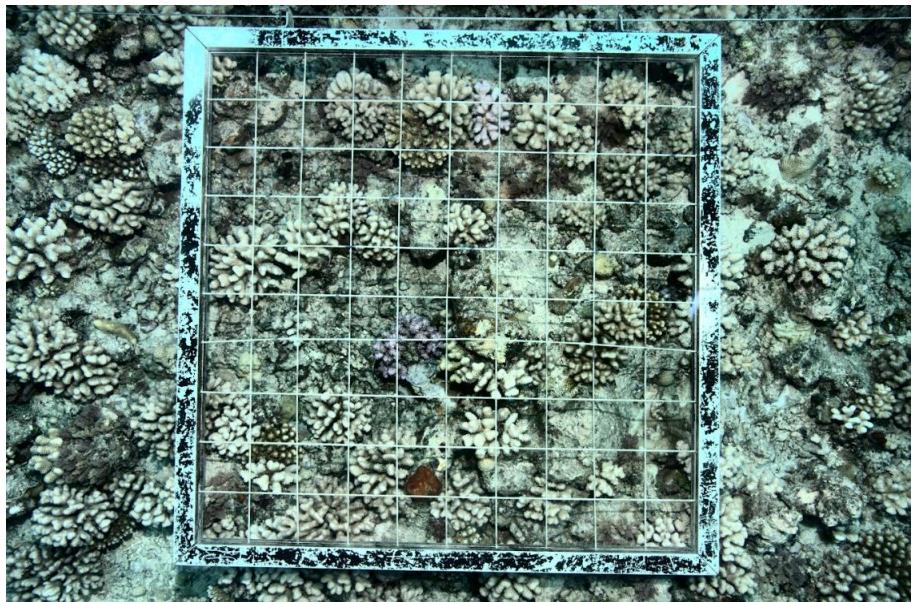


Raw Image



Raw Image + Fitted Lines

Image reframing

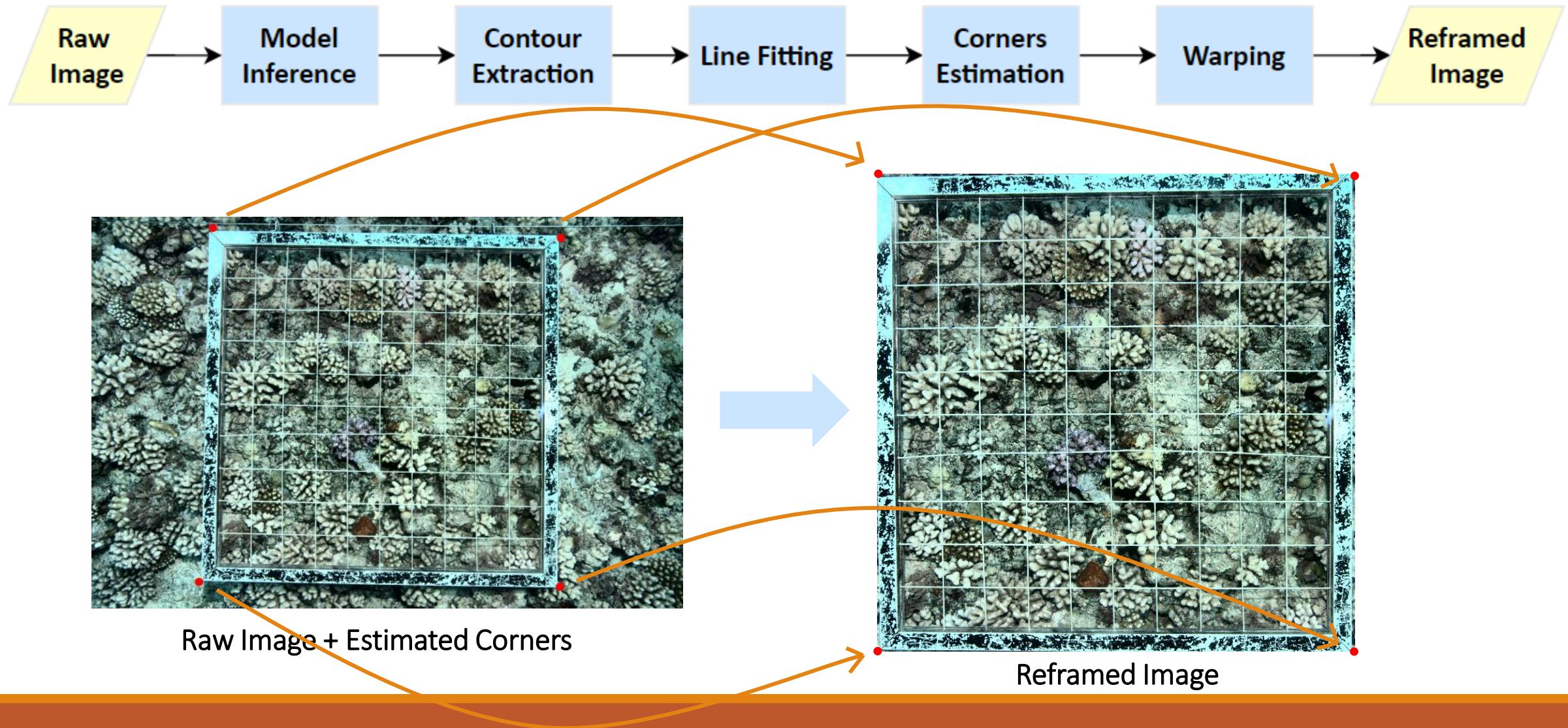


Raw Image



Raw Image + Estimated Corners

Image reframing



Conclusion

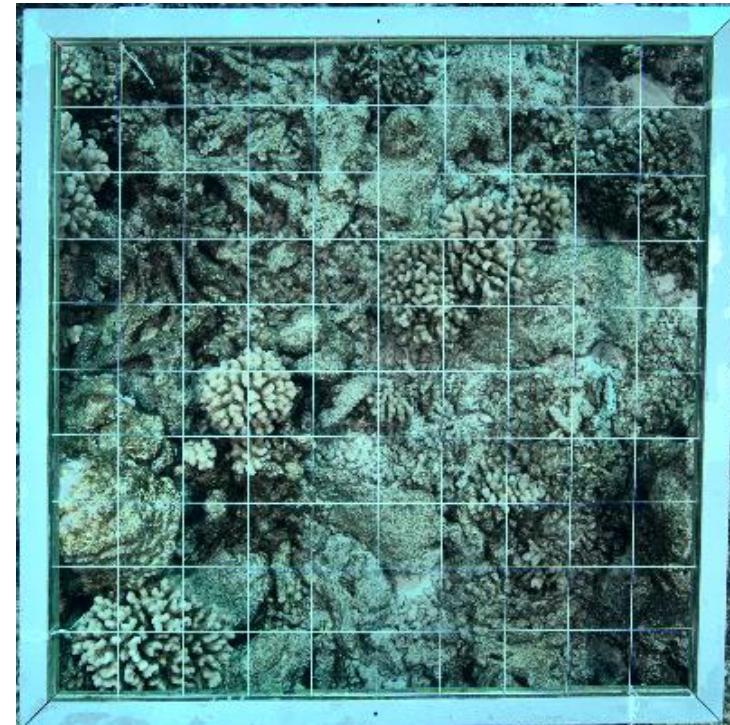
Summary

- Image cropping to the ROI
- Key technique: « Warping »
- Fully automated
- Image preparation for further analysis



Limitations

- If the image is distorted:
 - Error from corners estimation
 - But unusual situation

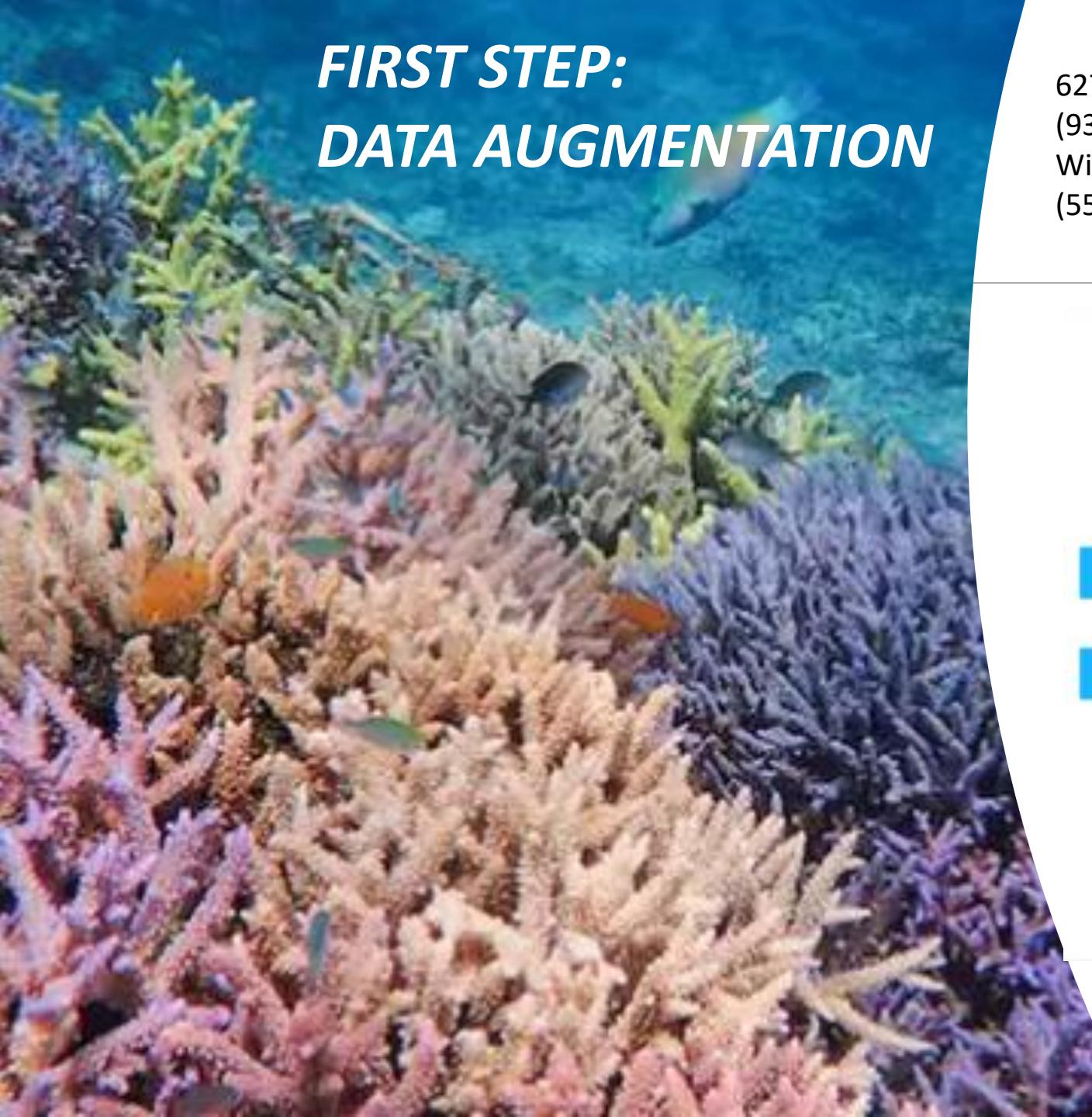


Potential improvements

- More images
- Data augmentation with more distortion

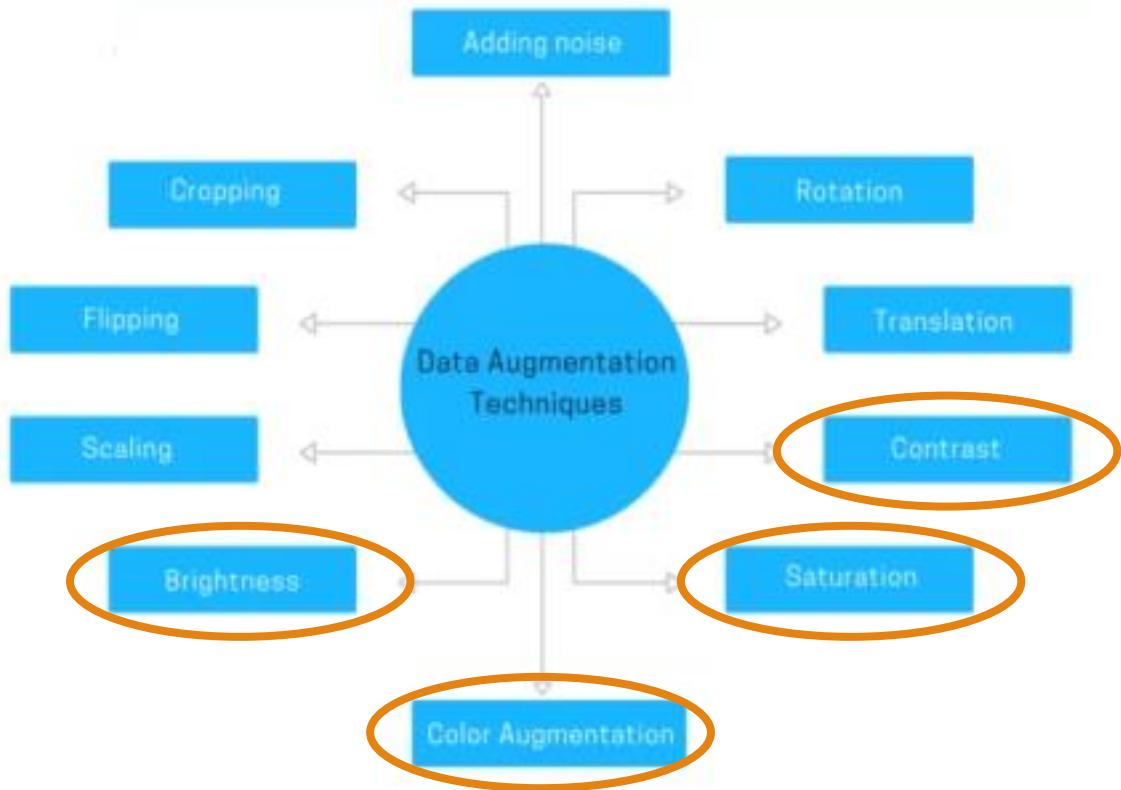
2. Automate coral detection

FIRST STEP: DATA AUGMENTATION



627 pictures have been labelled manually with CVAT
(9329 annotated corals)

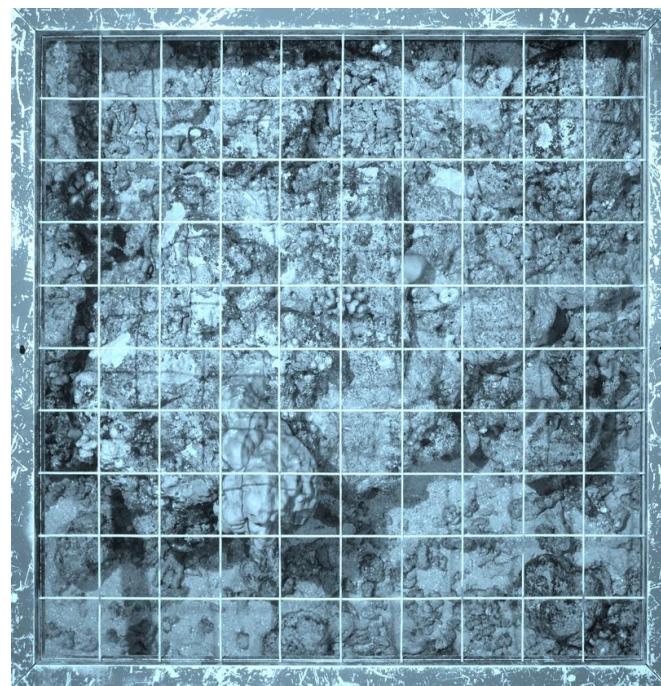
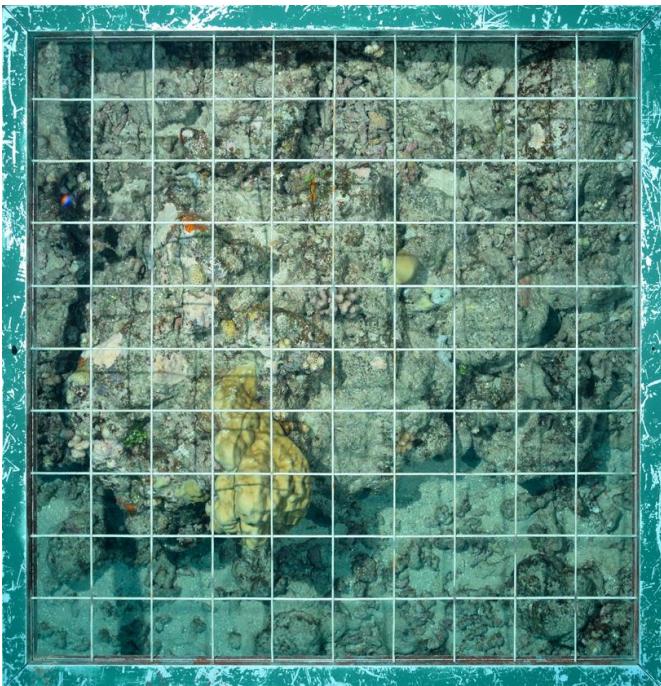
With data augmentation we generate 3756 pictures in total
(55720 annotated corals)



NON GEOMETRIC TRANSFORMATIONS

Transformations with Albumentation

EXAMPLES OF TRANSFORMATION

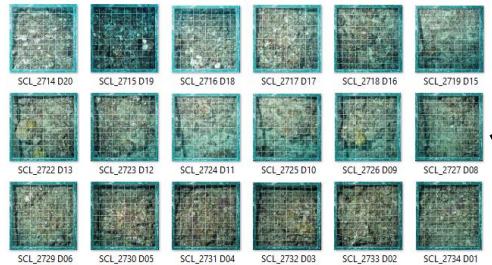


Motion blur to the input image
with random-sized kernel.



Equalize, Saturation and Noise

Methods



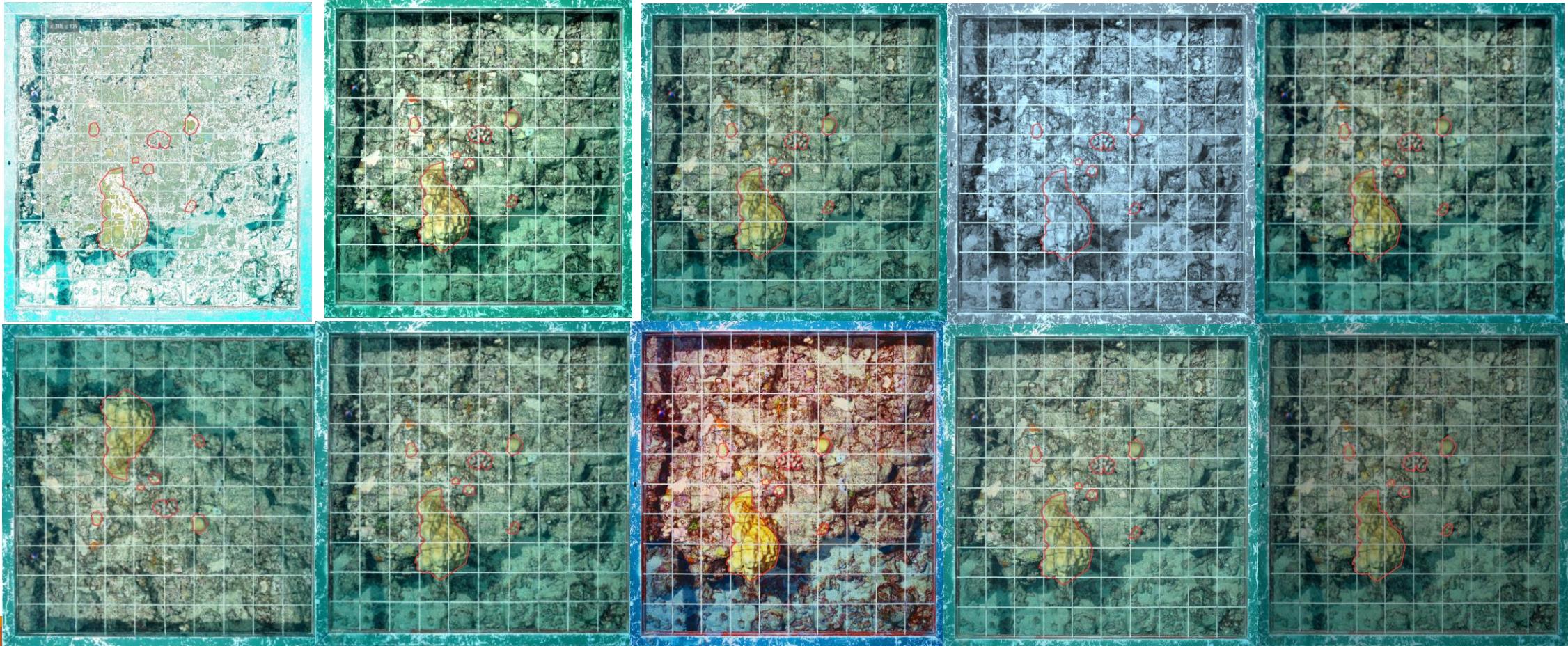
Dataset

Get dataset dictionary

Generate Images Augmentations

Annotation file

Final Results



STEP 2: Training the model using Detectron2 library

Model of training

Library: Detectron2

mask_rcnn_R_50_FPN_3x,

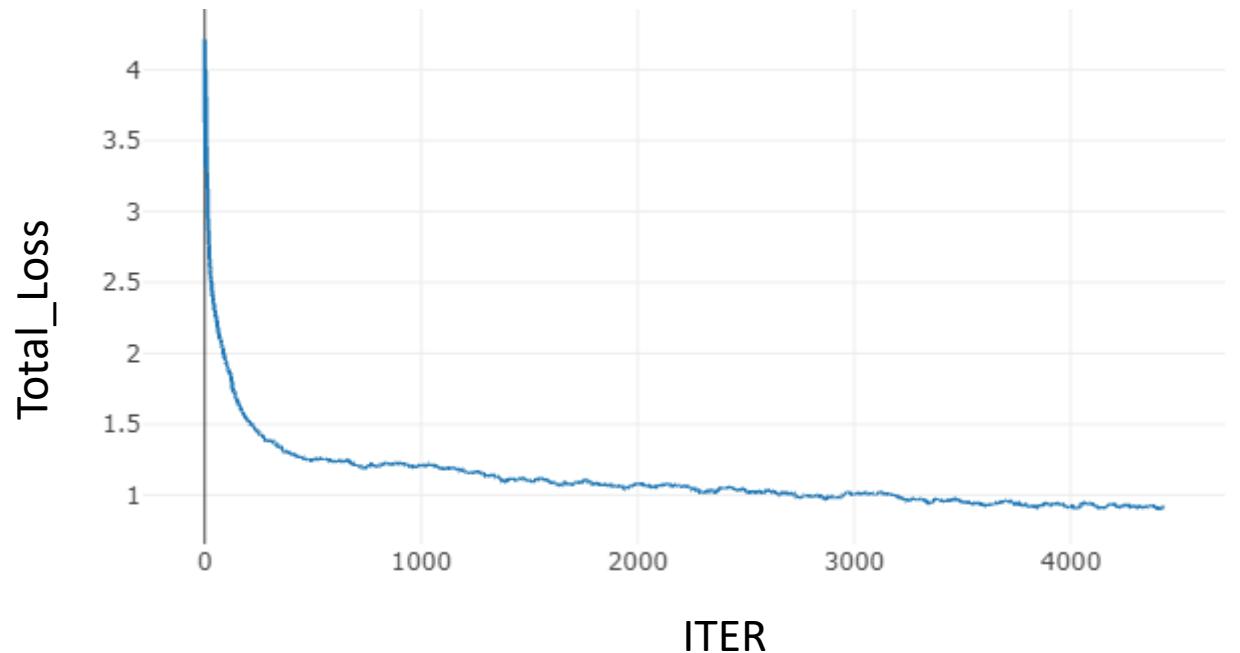
Learning Rate: 0.005,

Nb Iteration: 6000

Batch size per image: 256



Training model: results



METRICS

AP: 41.3

AP50: 60.14

AP75: 47

Total loss: 0.997

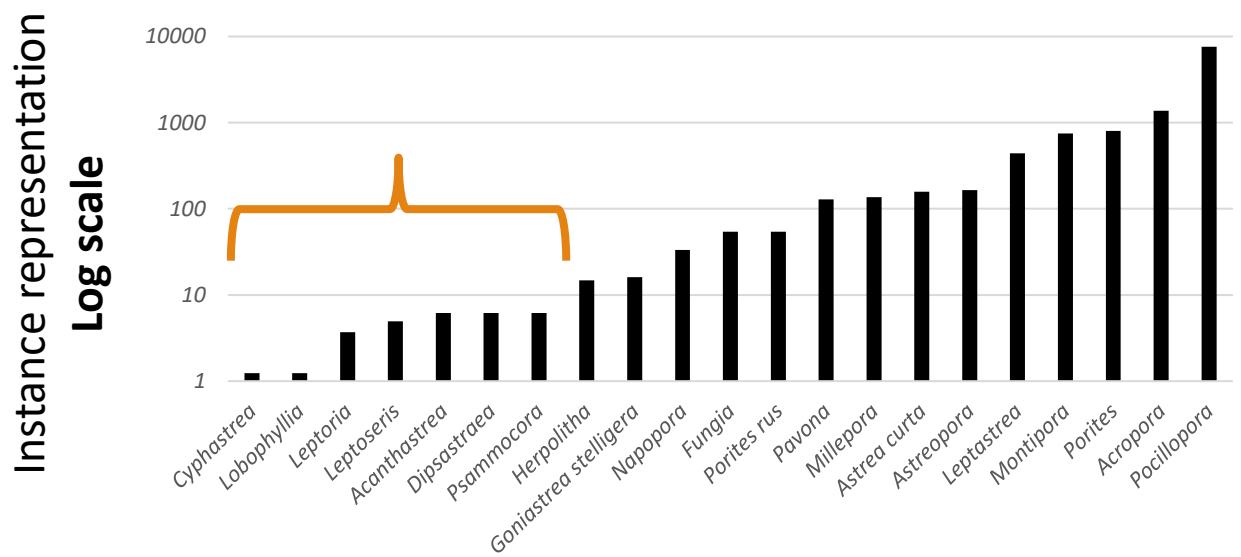


Training model: Conclusions

CONCLUSION:

IT WORKS!

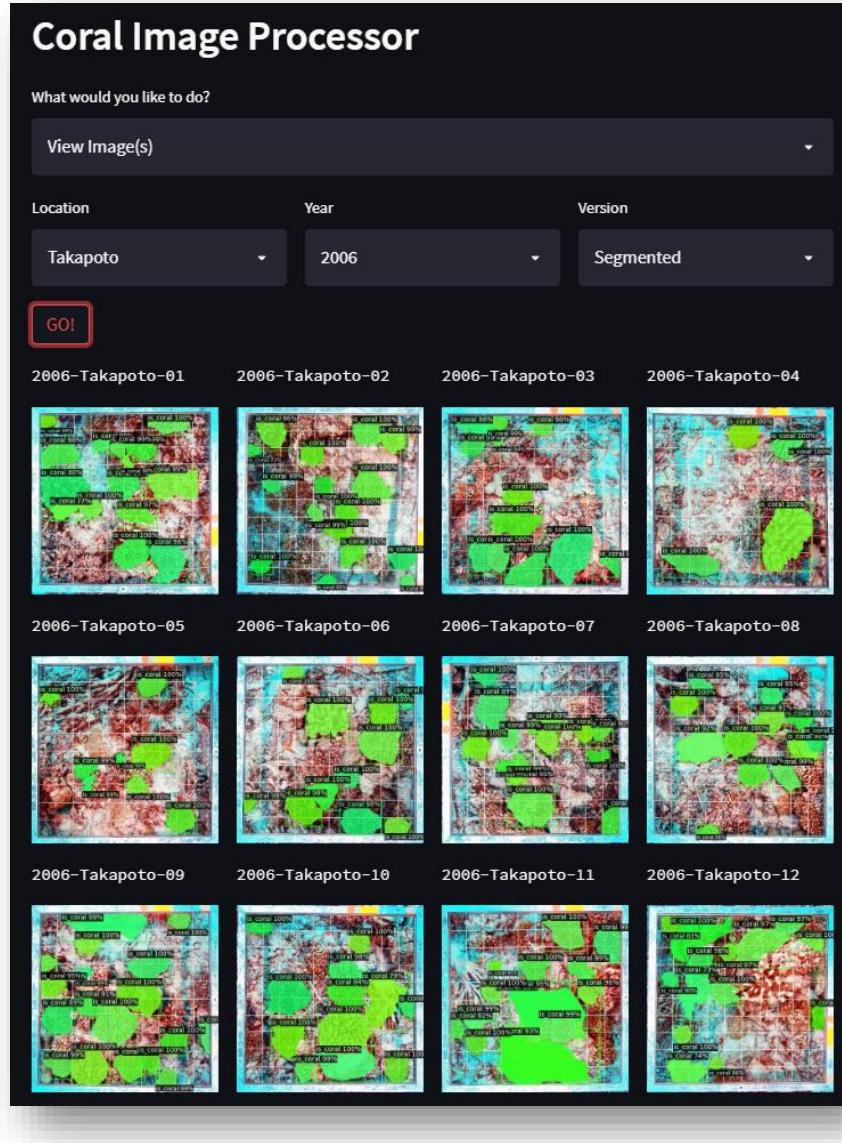
- Increase the training data set (Annotate at least 10x more pictures)



Some species are very lower-represented whereas other are very highly-represented in the data set

>> Increase the training data set with corals families which are less represented

3. Deployment to AWS



Coral Image Processor

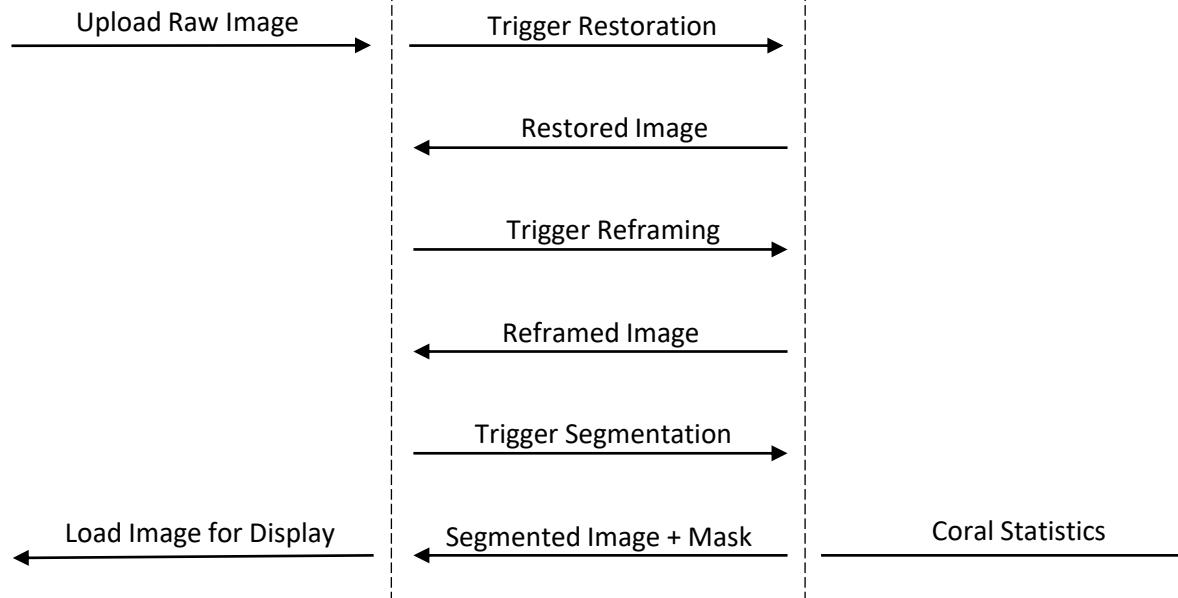
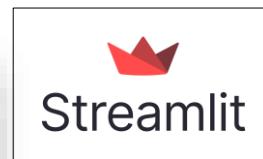
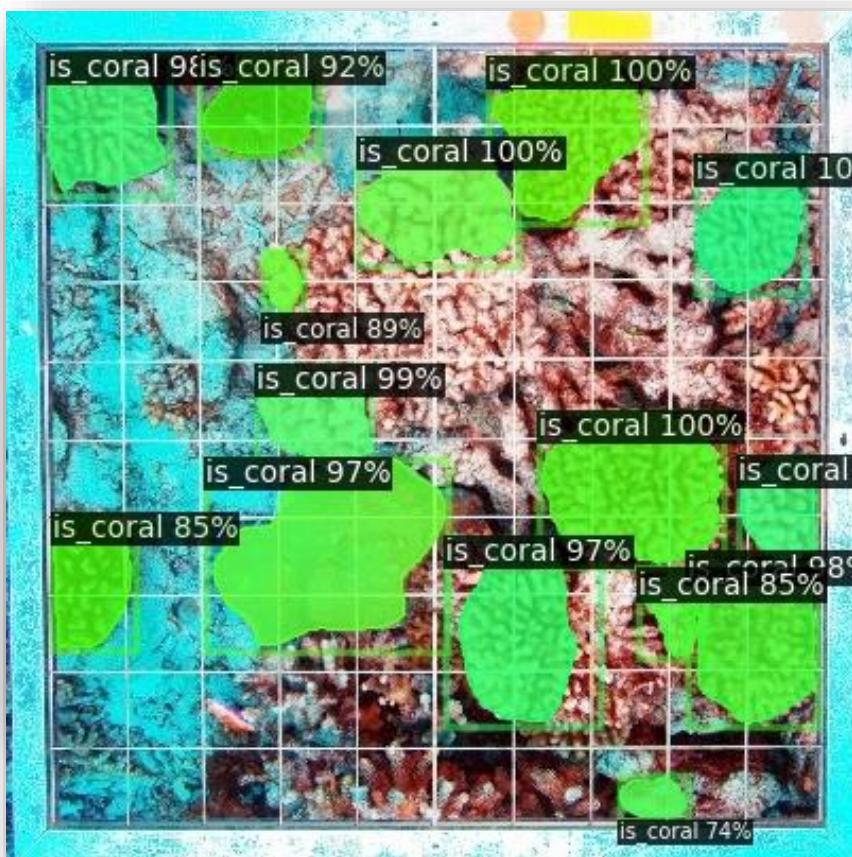
Serverless application running on AWS

Web interface built with Streamlit

AWS Services used:

- Amazon ECS Fargate
- Amazon ECR
- Amazon S3
- Amazon Lambda
- Amazon Aurora
- + Management Services

Sequence: Coral Segmentation

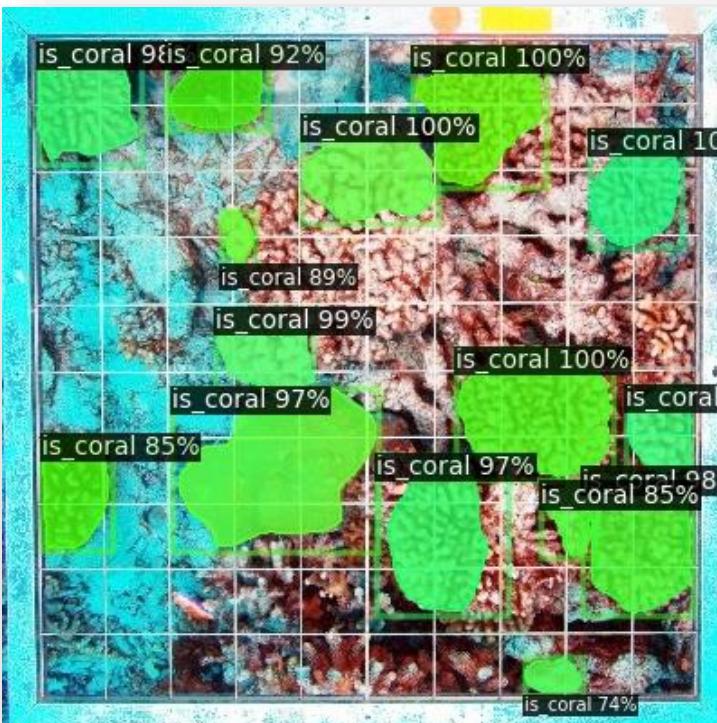


CONCLUSION: MVP Delivered

Scientific goal

Characterize percentage of corals over time for each site
to understand how coral faces global changes

Image with coral-detected
and segmented



1) EXTRACT THE MASK →

2) PERFORM STATISTICS

i.e: Calculation of the % of corals in each quadrat
over time for each location

Example :

