

# Exploring the Potential of **Refractive NeRFs** for Photogrammetric Bathymetry

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## First Application to UAV-based Data from the Pielach River

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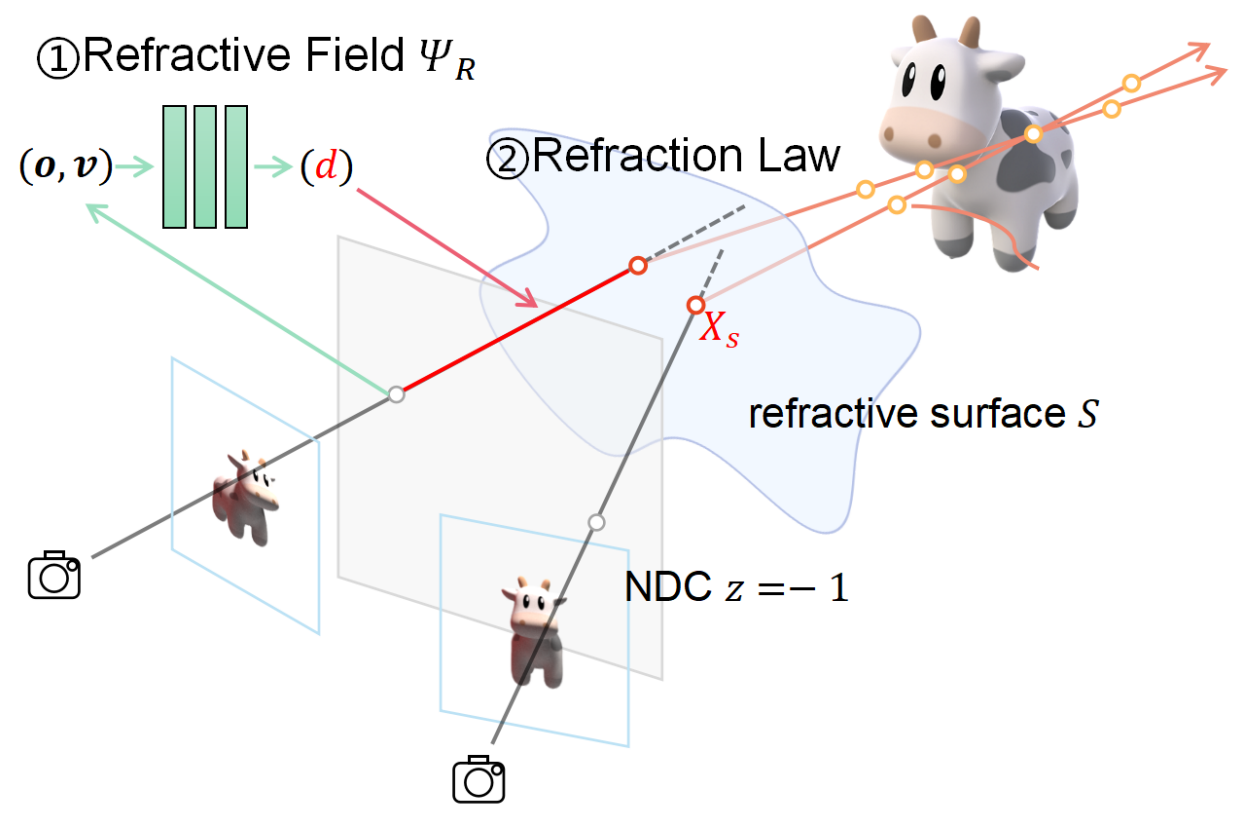
## Photogrammetric Underwater 3D Reconstruction

- Crucial for underwater monitoring
- Traditional Photogrammetry Limitations
  - Assumption of straight light ray
  - Refraction at air-water interface



Image from the Pielach River Dataset

# Refraction aware NeRFs



Zhan et al. (2023) NeRFrac: Neural Radiance Fields through Refractive Surface

## Introduction of Masks to NeRFrac

original image



corresponding mask



overlay



## Quantitative 2D Evaluation

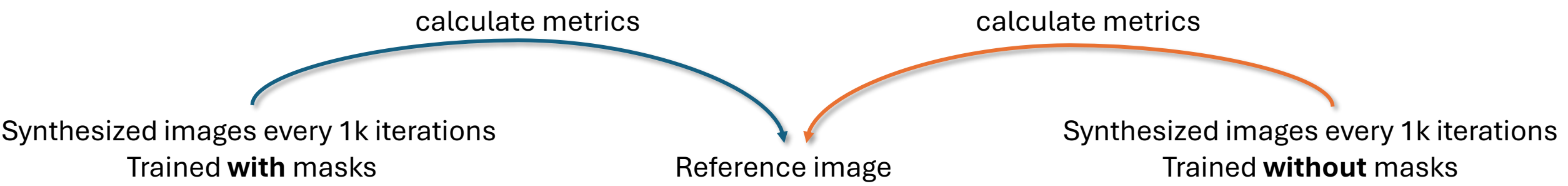
Across the **whole** image

Reference image



# Quantitative 2D Evaluation

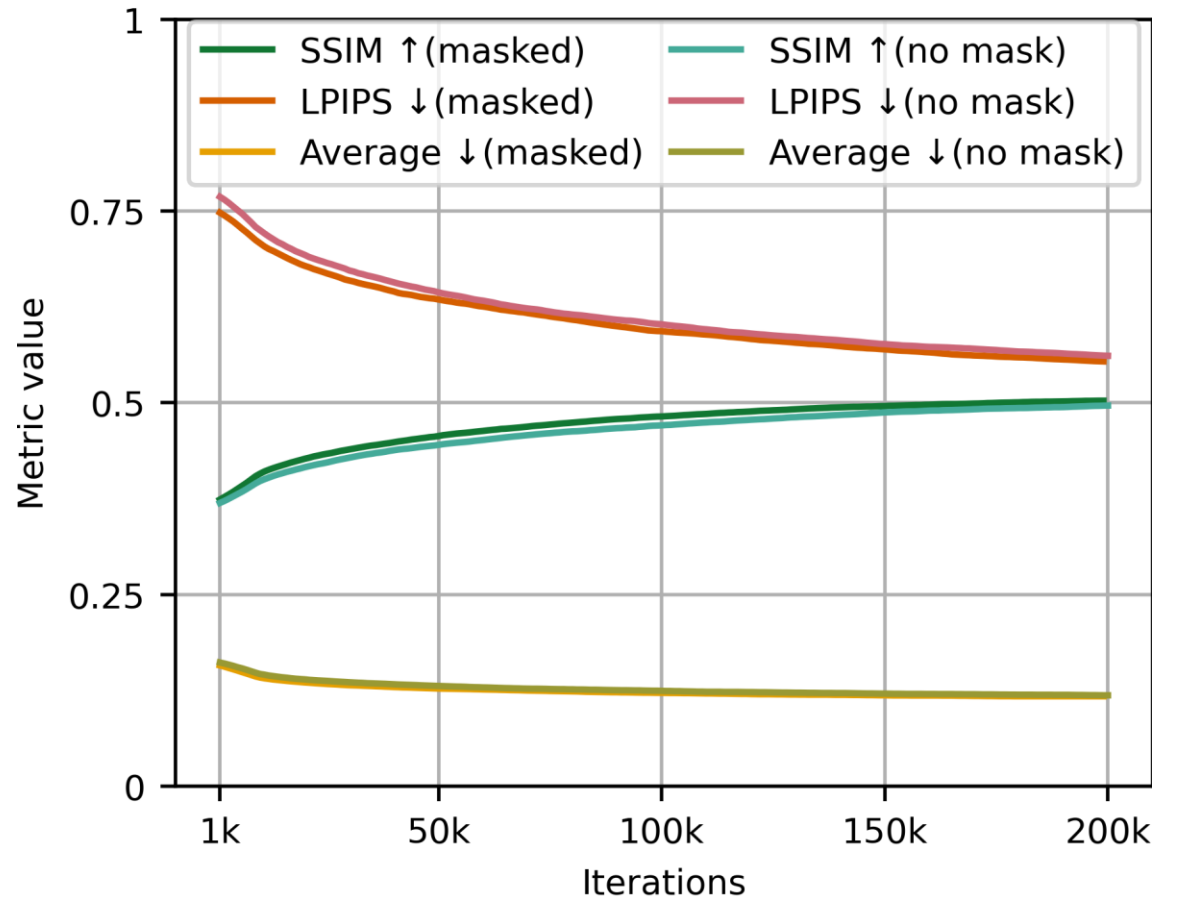
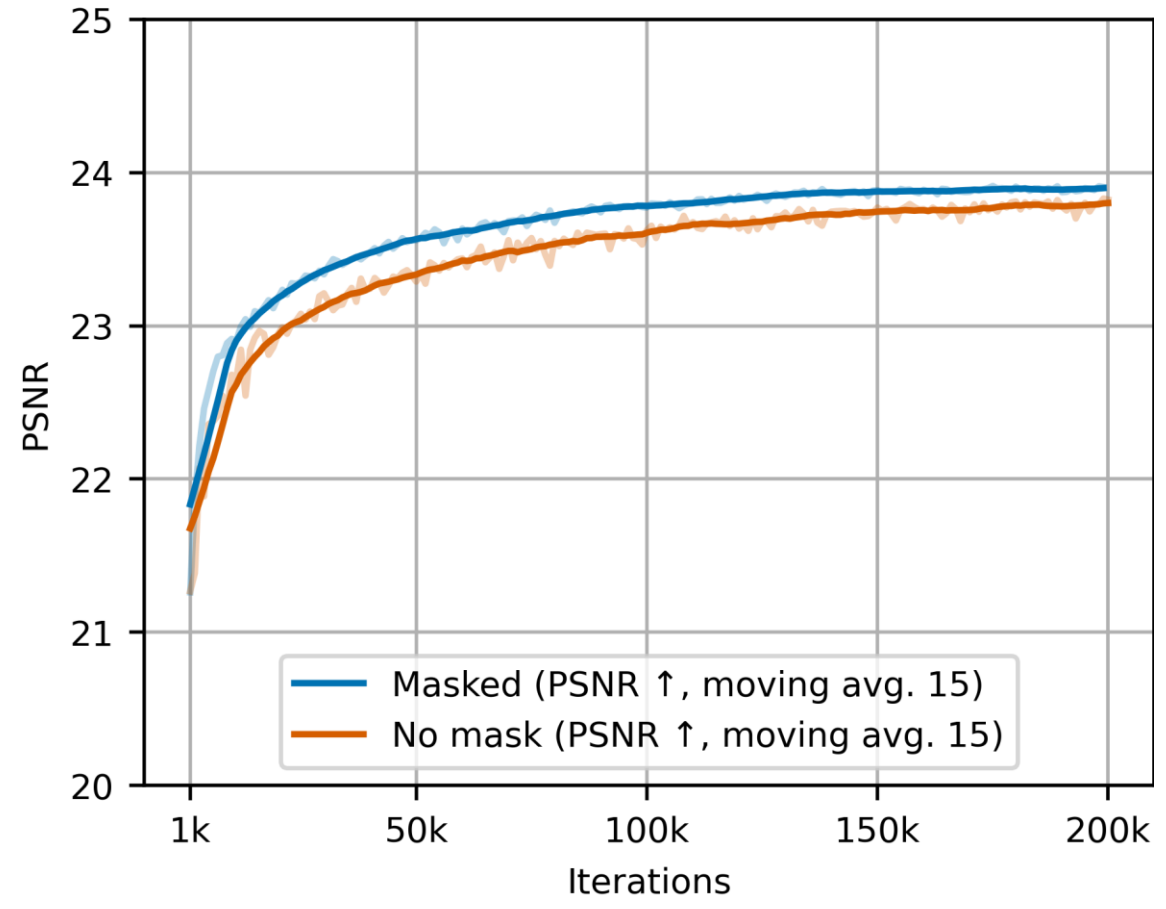
Across the **whole** image



### Quantitative 2D Evaluation

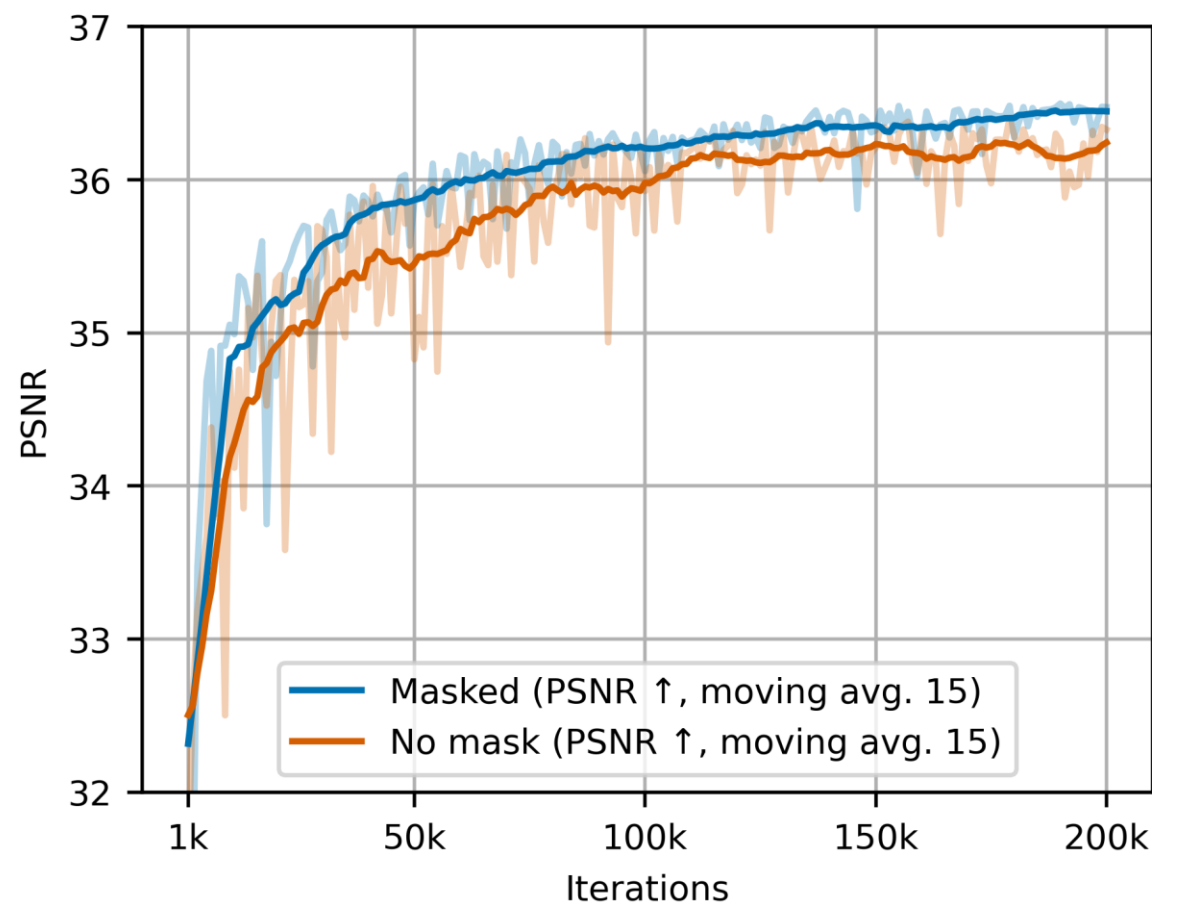
Across the **whole** image

PSNR Peak Signal-to-Noise Ratio  
 SSIM Structural Similarity Index  
 LPIPS Learned Perceptual Image Patch Similarity  
 Average a common way of combining PSNR, SSIM and LPIPS



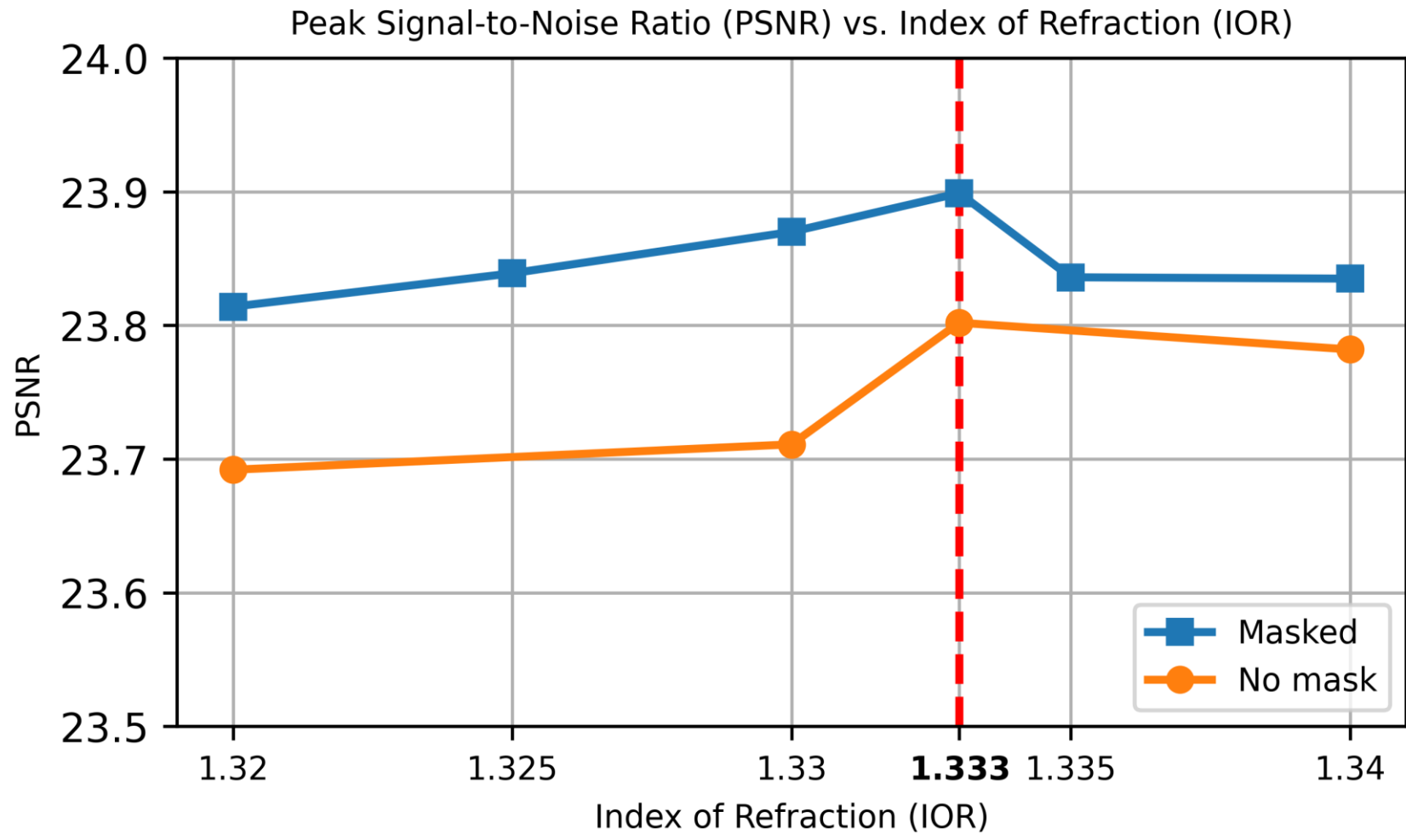
### Quantitative 2D Evaluation

Across the **water covered part** of the image

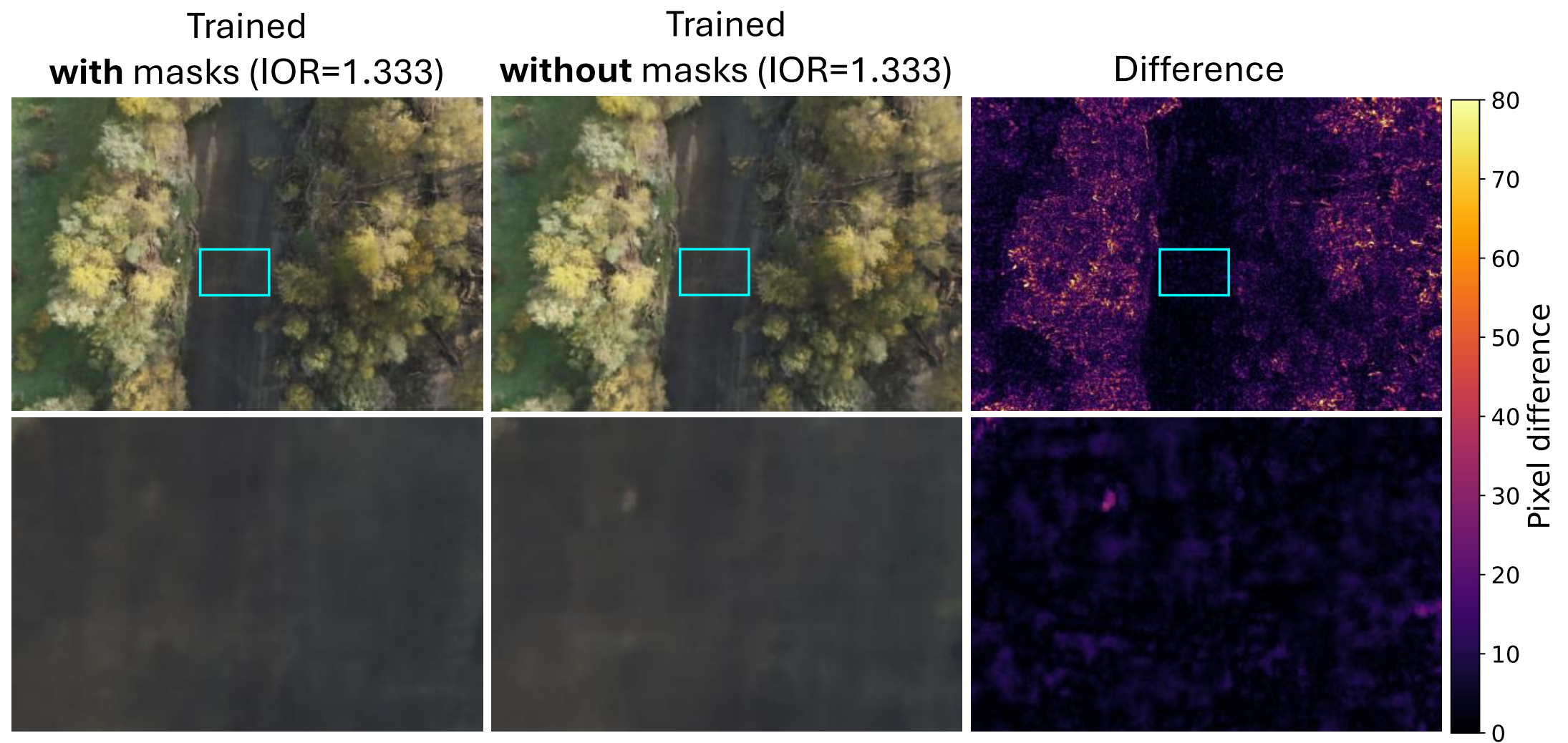


# Quantitative 2D Evaluation

Across the **whole** image



### Qualitative 2D Evaluation



- First successful application of **NeRFrac to UAV-based real-world river imagery.**
- **Masking improves** reconstruction quality in submerged areas.
- Improvements are **consistent but small.**
- Limitations
  - Manual creation of water masks - **not scalable.**
  - No evaluation against **3D ground truth** yet (only 2D metrics).
- Next steps
  - **Automated water mask generation.**
  - **3D point cloud generation** and validation.