

# A Machine Learning (ML) Analysis of PACE/OCI Reflectance Data over Lake Erie

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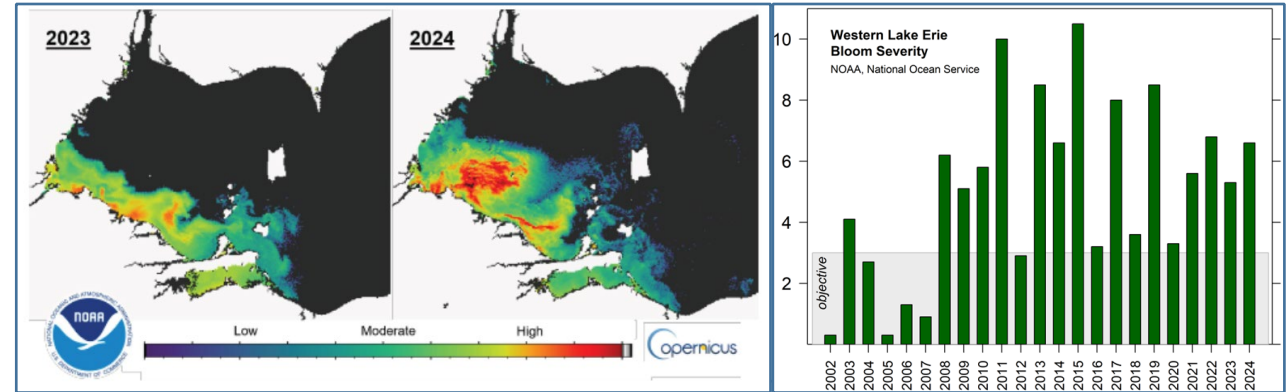
## Objectives

- Compare PACE/OCI hyperspectral observations with EMIT observations.
- Analyze harmful algal blooms (HAB) using PACE OCI data.
- Reconstruct hyperspectral data using ML.

## Results

- Analyzed HAB in the Western Lake Erie using PACE/OCI and Spectral Angle Mapper (SAM), and compared with EMIT Cyanobacteria Index (CI) and Sentinel-3 OLCI true color image.
- Successfully reconstructed PACE/OCI hyperspectral data using a Variational Autoencoder (VAE) model.

## Figure(s)



NOAA HAB Severity



# Comparison of PACE/OCI HAB Results

1. Extract spectral signatures for different water types from manually selected locations over the Western Lake Erie using PACE/OCI data.
2. Classify PACE/OCI data using Spectral Angle Mapper (SAM) with the extracted spectral signatures as the references.
3. Calculate Cyanobacteria Index (CI) using EMIT hyperspectral data.
4. Compare PACE/OCI generated SAM classifications with EMIT CIs and Sentinel-3 OLCI true-color images.

Cyanobacteria Index (CI) proposed by Konik et al. (2003):

$$CI_{EMIT} = (-1) \left[ R_{678} - R_{648} - \{R_{708} - R_{648}\} \frac{678-648}{708-648} \right],$$

where  $R_{648}$ ,  $R_{678}$ , and  $R_{708}$  are the reflectance at 648 nm, 678 nm, and 708 nm, respectively.

Konik, M., K. Bradtke, J. Stoń-Egier, M. Soja-Woźniak, S. Śliwińska-Wilczewska, and M. Darecki, 2023: Cyanobacteria Index as a Tool for the Satellite Detection of Cyanobacteria Blooms in the Baltic Sea,” *Remote Sens.*, **15**(6), 1601. doi:10.3390/rs15061601.



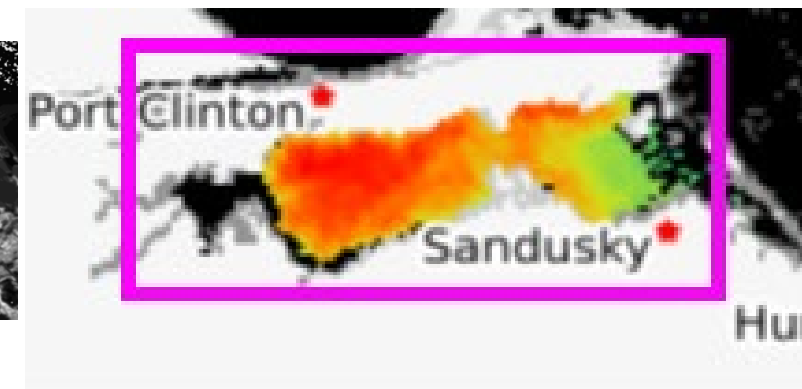
PACE/OCI SAM Classifications



EMIT CI

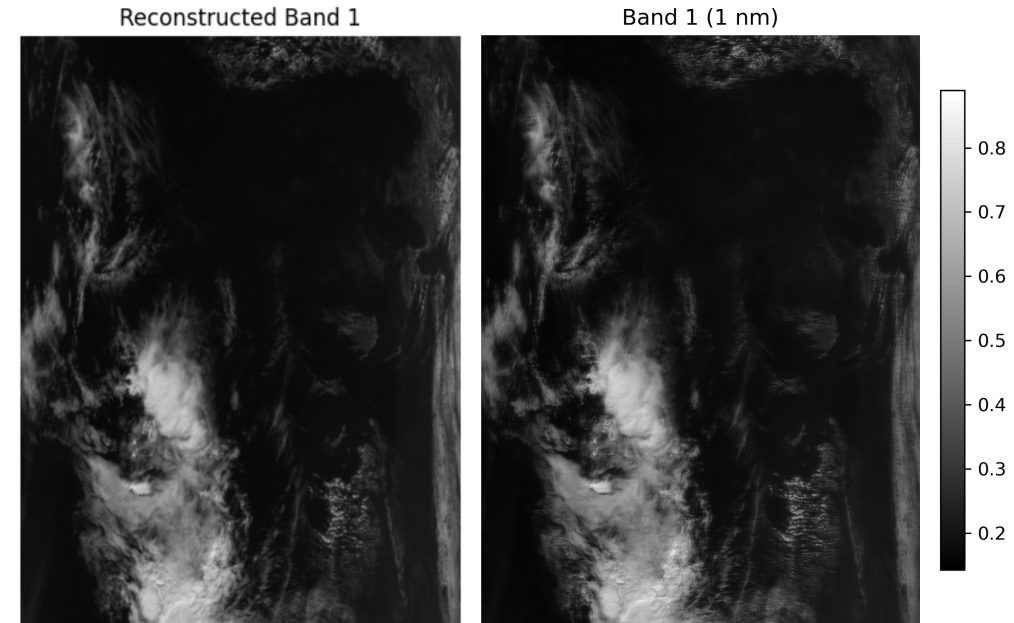


Sentinel OLCI true color



# ML-based PACE/OCI Data Reconstruction:

1. Train a Variational Autoencoder (VAE) model using PACE/OCI hyperspectral data.
1. Reconstruct PACE/OCI data using the VAE encoder outputs (latent space) and decoder.
1. Compare VAE decoder outputs to the original PACE/OCI data.



## Results:

- The trained model can reconstruct PACE/OCI images.
- With more data and more epochs, the model will be able to generate more accurate reconstructions.

**Future work:** perform unsupervised classification using VAE encoder outputs (latent space) over Lake Erie to detect pixels with HAB.