



Seg the HAB

Language-Guided Geospatial Algae Bloom Reasoning and Segmentation

Patterson Hsieh*, Jerry Yeh*, Mao-Chi He*, Wen-Han Hsieh, Elvis Hsieh



UC San Diego



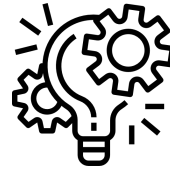
Berkeley
UNIVERSITY OF CALIFORNIA

Motivation: Two Primary Factors



Environmental Aspect

HABs threaten ecosystem, public health, and more.
Monitoring is essential but is **costly**.



Technological Gap

Prior AI works can only do **either** segmentation **or** severity prediction.

Goal

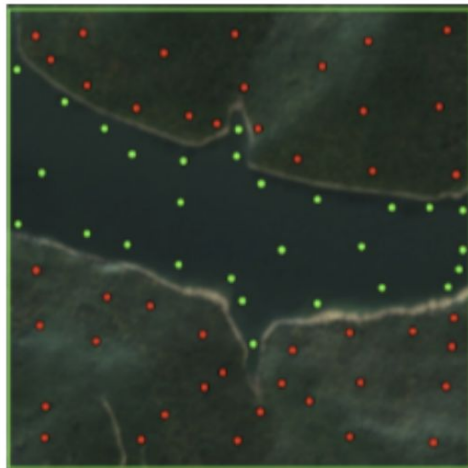
Build a single, promptable system (ALGOS) that fuses language reasoning with segmentation to map HABs and output a WHO-aligned 5 level severity, trained with a joint loss linking text/severity to per-pixel masks using CAML.

Cut labeling and boost robustness via GeoSAM-guided, human-in-the-loop curation to yield a scalable tool for wide-area, frequent HAB monitoring.



Methods: Semi-Supervised Curation Loop

Users provide **positive** points on bloom areas, **negative** points on background regions, and a region-of-interest (ROI) box to guide the model's attention



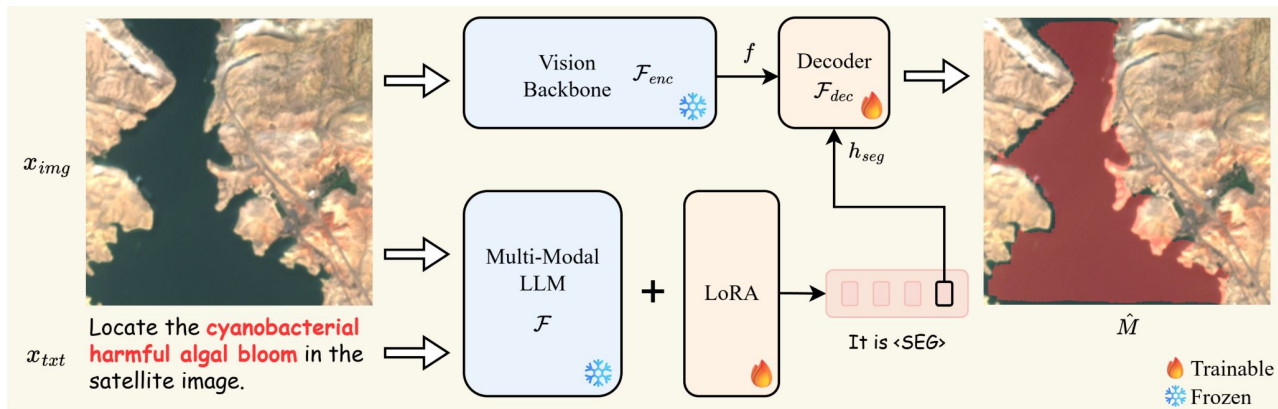
Input Scene



Output Scene

Methods: ALGOS

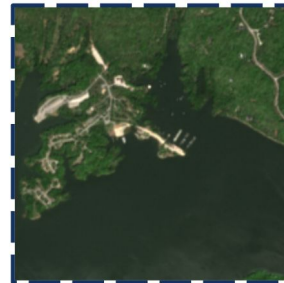
ALGOS reads a satellite image with a short instruction and produces a <SEG> token. A SAM-based head decodes <SEG> into the HAB pixel mask, tuning the prompt into the map.



Methods: Algae Severity Assessment

Given a satellite image and a brief prompt, ALGOS outputs a single digit (1-5) HAB severity.

Satellite Image
Example



Analyze the provided satellite image of algae-specific conditions. Determine the severity level, where:
1 = Very low, 2 = Low, 3 = Moderate, 4 = High, 5 = Very high.

Output only a single digit from 1-5 with no other text.

Example output: 3



1

Performance: Segmentation

The cloU and gloU of ALGOS are about 5x higher than LISAT and LISA 7B

→ ALGOS has sharper per-image masks and stronger dataset-wide agreement.

Model	cloU	gIoU
LISAT	$0.1083_{\pm 0.0124}$	$0.1052_{\pm 0.0132}$
LISA 7B	$0.1373_{\pm 0.0182}$	$0.1274_{\pm 0.0160}$
ALGOS	$0.6493_{\pm 0.0301}$	$0.5969_{\pm 0.0268}$

Performance: Severity prediction

ALGOS improves severity prediction, cutting MSE to 2.984 (~23% lower) with RMSE 1.727 and MAE 1.365, versus 3.868/1.967/1.587 for the baseline.

→ ALGOS provides more accurate HAB severity rating.

Model	MSE	RMSE	MAE
LLaVA-7B	3.868	1.967	1.587
ALGOS	2.984	1.727	1.365

Summary + Conclusion

We demonstrated ALGOS as a promptable vision-language system that combine segments HABs and predicts 5-level severity. ALGOS achieved cloU 0.65/gIoU 0.60 and lower severity error (MSE 2.984) than baselines.

Limitations: Evaluated on limited regions/seasons and curated databases; generalizing to diverse waters need broader testing.

Next steps: Expand cross-region/season benchmarks and extend evaluations and data pipelines to support scalable deployment.