SAMSelect: A Spectral Index Search for Marine Debris Visualization using Segment Anything Model (SAM)

Joost van Dalen (WU), Yuki M. Asano (UTN), Marc Rußwurm (WU)

TLDR: The Segment Anything Model (SAM) serves a proxy for human 3-band vision to find the best visualization for marine debris

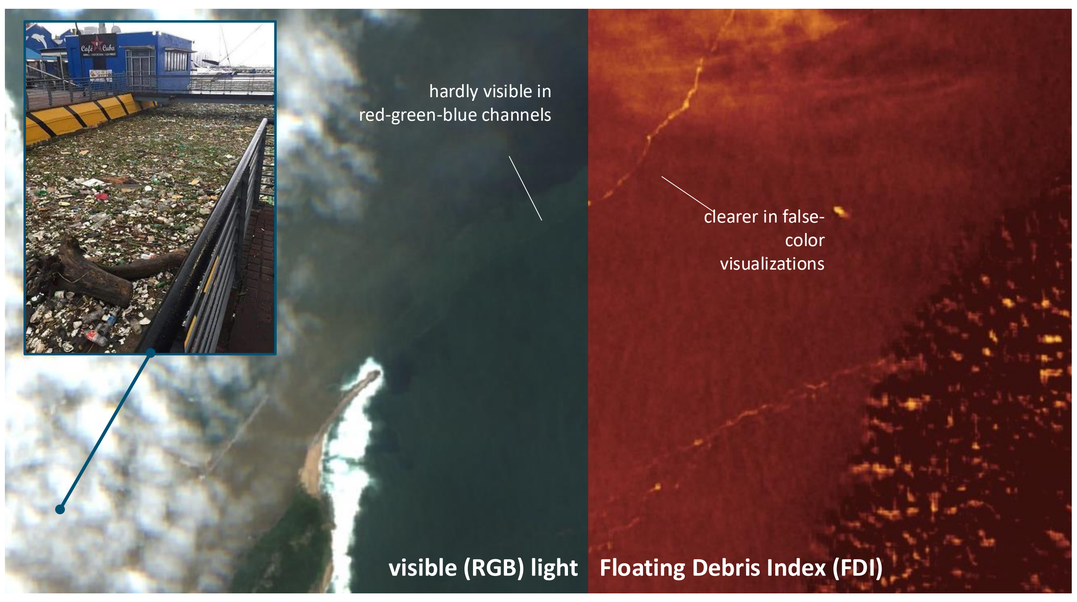
Motivation

Marine **litter**, **sargassum**, and **algae** blooms are **harmful to marine ecology.**

Visualizing marine litter is **challenging** due to its **compositional heterogeneity** in Sentinel-2 imagery.

Numerous **spectral indices** have been proposed on a case-by-case basis. **Which index provides the best visual information?**

Example: Durban Flood April 2018 cause massive litter outwash



Research question:

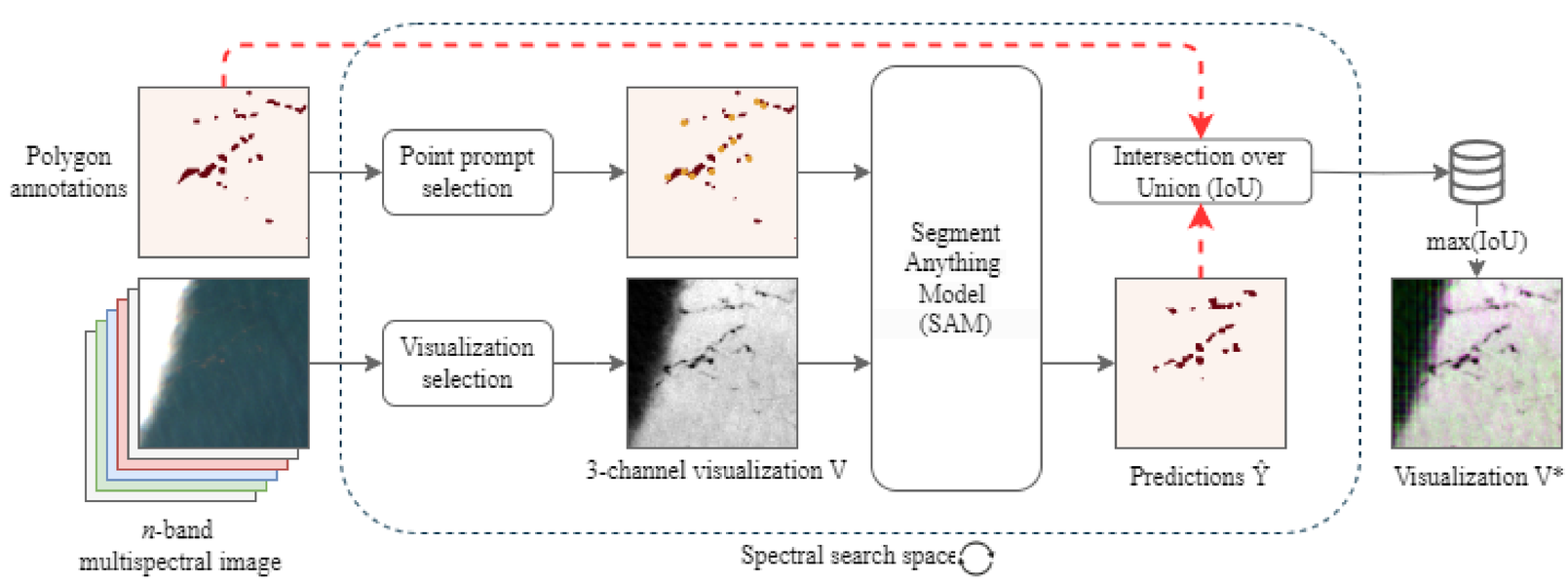
How to automatically identify spectral indices where marine debris is most visible in the image?

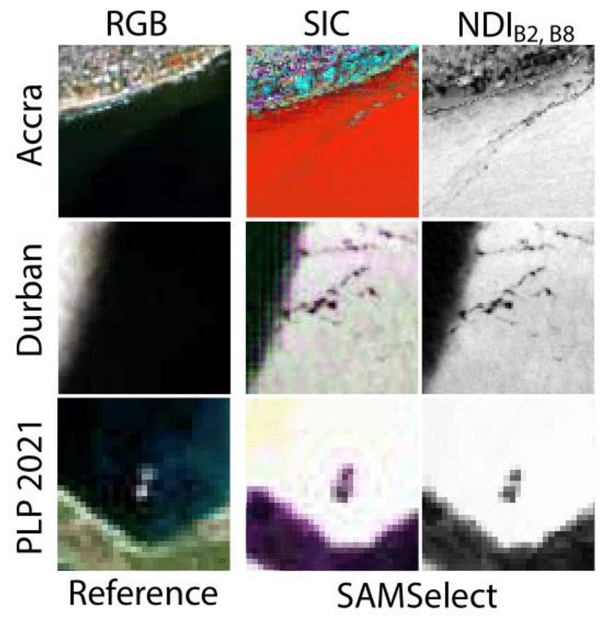
Approach:

By using the Segment Anything Model to evaluate the salient of features in a 3-channel visualization.

Method

SAMSelect Algorithm: An automated Spectral Index Search for Marine Litter Detection





Takeaways

The exhaustive spectral index search space derived from SAMSelect identifies visualization methods that outperform existing literature-based indices

1) SIC achieves best performance of all visualizations due to efficient compression of 4 (Accra) and 5 (Durban) spectral bands instead of three bands (e.g., BC).

2) The consistent selection of NDI$_{B2,B8}$, simple computation, and improved visualization performance make it particularly interesting for marine debris.

Summary of best scoring results from the search space, showcasing four main visualization methods: band composites (BC), normalized difference indices (NDI), spectral shape indices (SSI), and the spectral index composites (SIC).

Viz V	Accra		Durban	
	Bands	IoU	Bands	IoU
NDVI	B8, B4	18.7	B8, B4	9.6
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SIC	B1,2,8,11	**45.8**	B1,2,3,8,8A	**42.0**

Usability: Average Runtime

The **average runtime** for SAMSelect using both GPU and CPU evaluated for an exhaustive search space across 12 Sentinel-2 bands, including 220 BC combinations and 66 NDI combinations.

Indices	Runtime [min]		Runtime [sec/comb.]	
	GPU	CPU	GPU	CPU
BC	34.6	237.6	9.4	64.8
NDI	11.1	81.4	10.1	74.0

The publicly available tool (on Github) offers:

- Simple usage with two required inputs: a Sentinel-2 scene and polygon annotations.
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Contact

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Model & Sources

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TLDR: Using SAM as a proxy for visual interpretation to find and validate spectral indices, finding improved visualizations for marine debris

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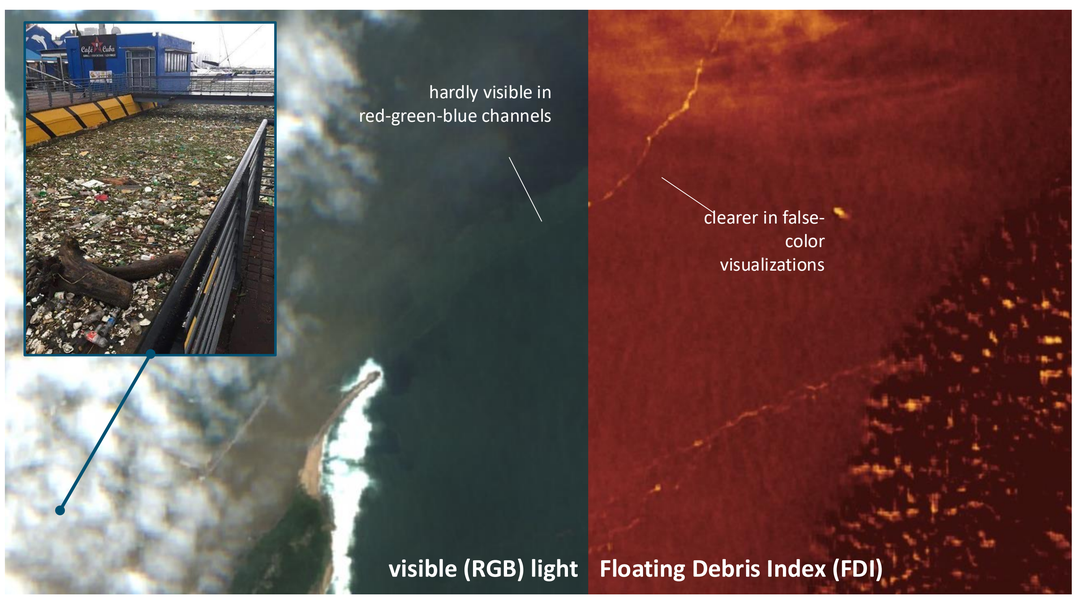

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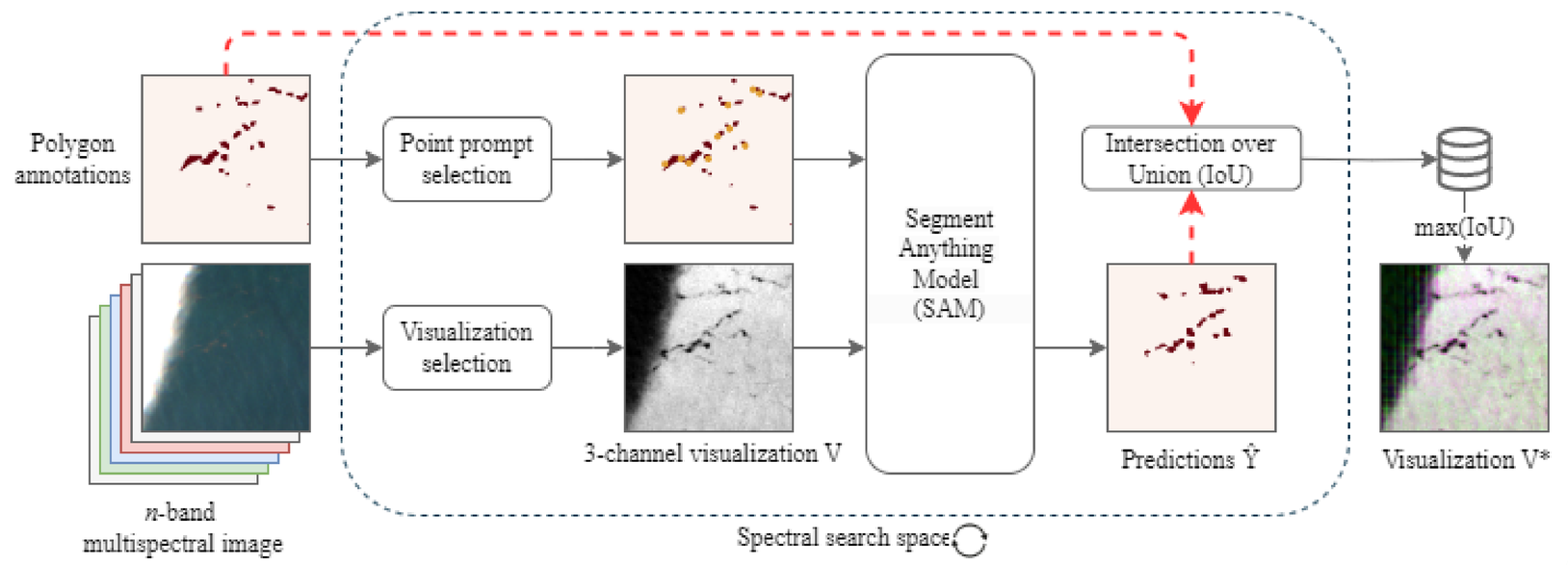

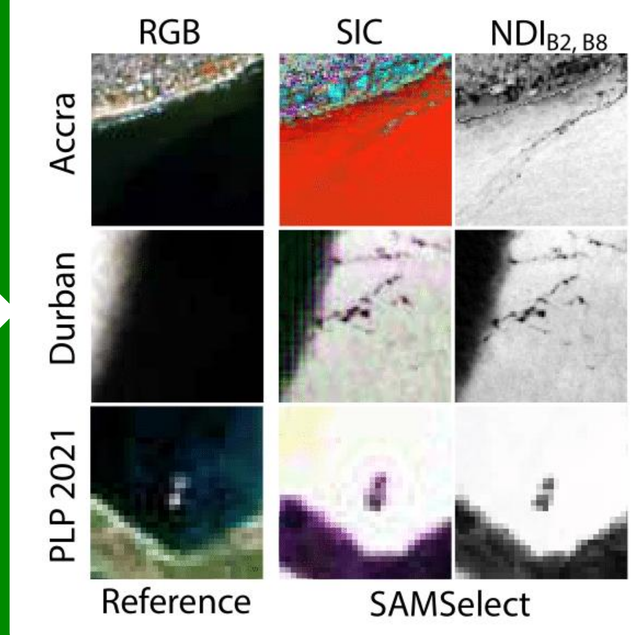

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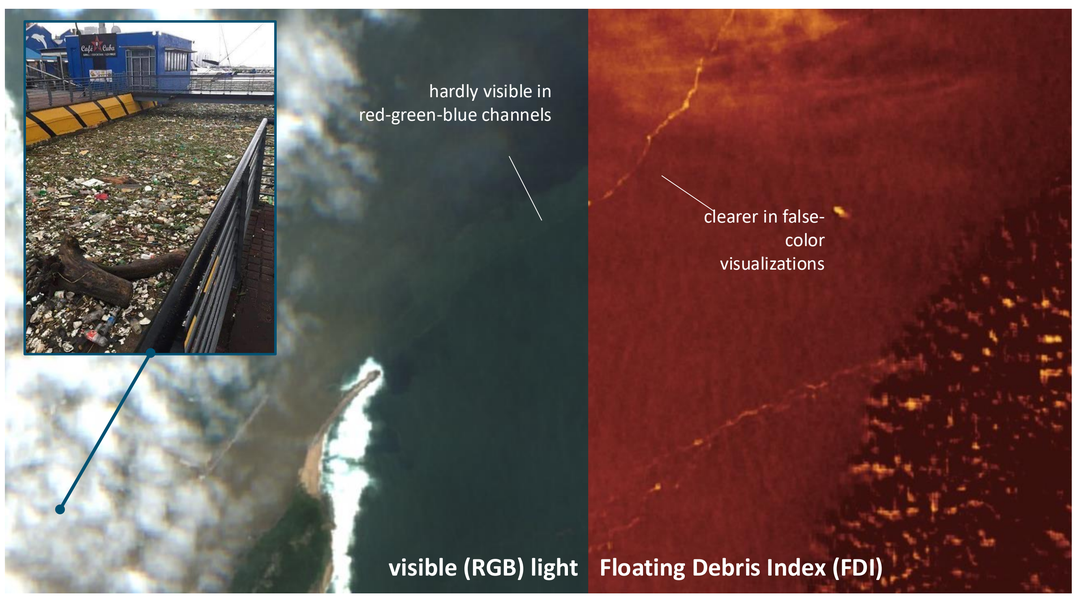

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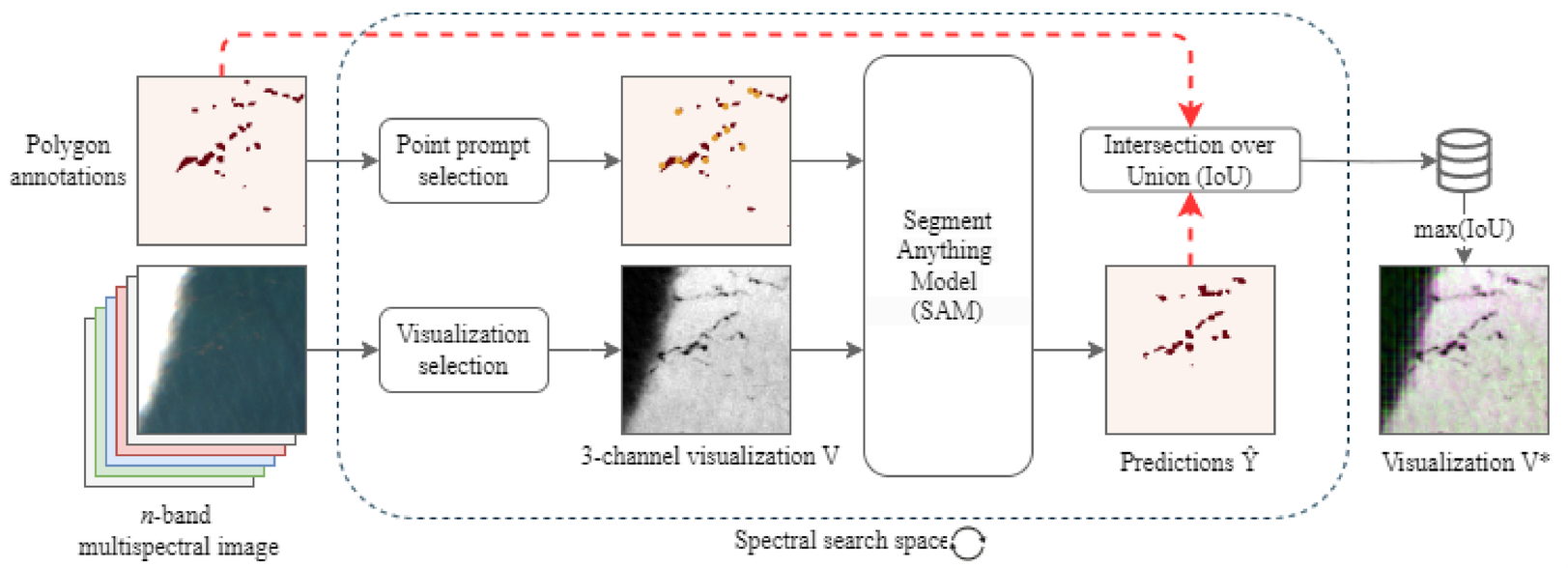

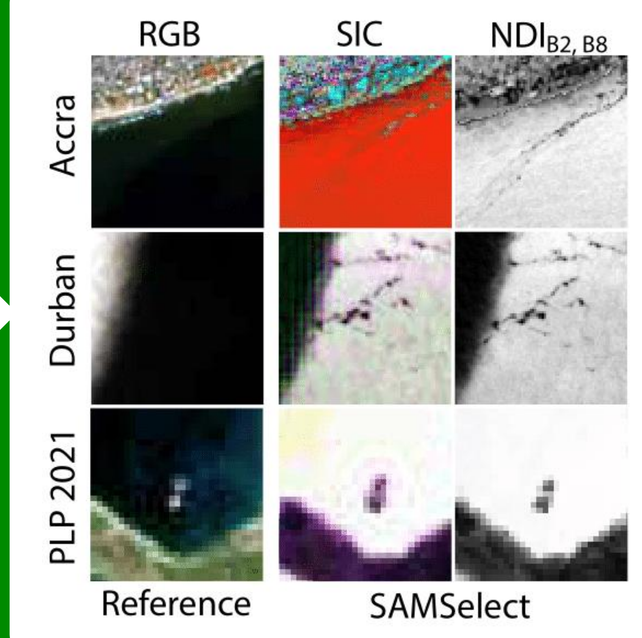

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