Content-aware segmentation of plankton images

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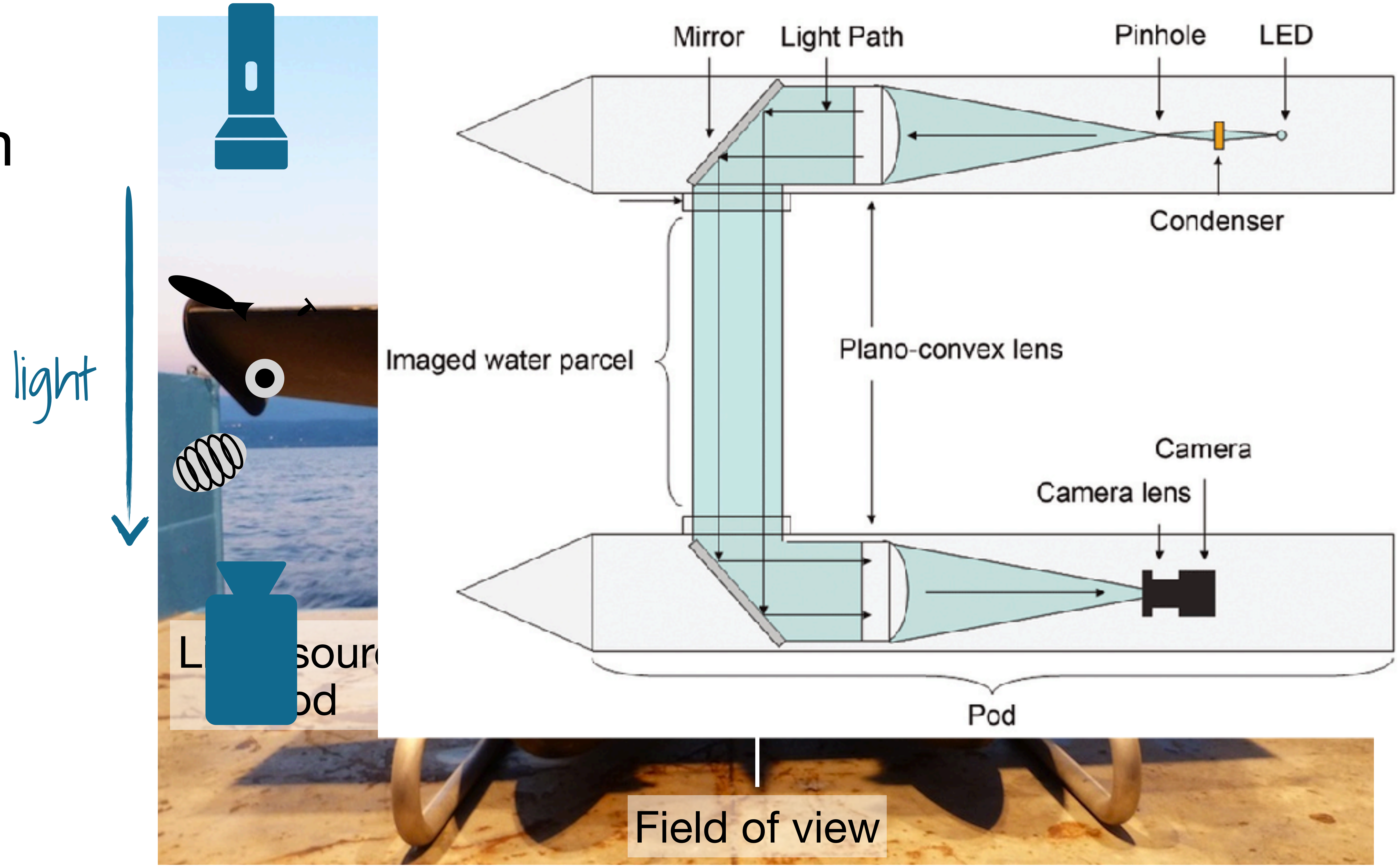
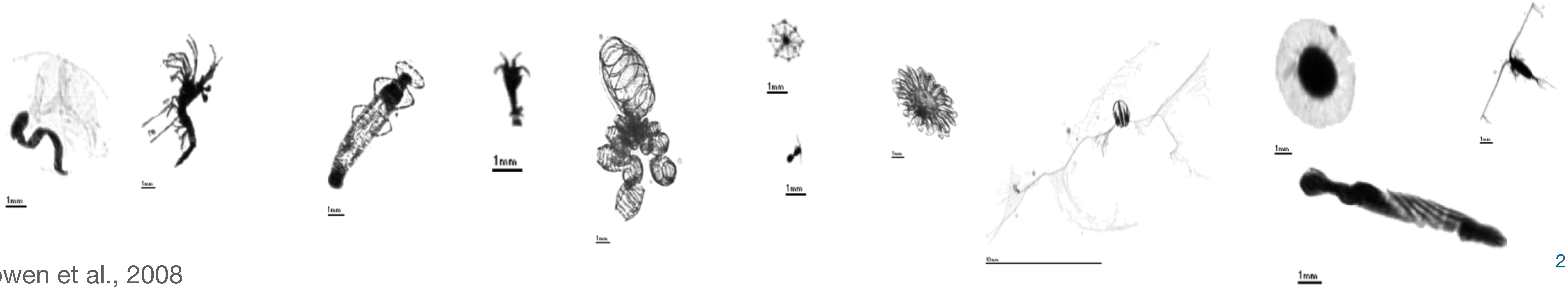
ISIIS

In Situ Ichthyoplankton Imaging System

- organisms in 250 µm - 10 cm
- shadowgraphy
- deep depth of field
- high sampling rate (108 L.s^{-1})





Cowen et al., 2008

Extract plankton from ISIIS images

A challenging task

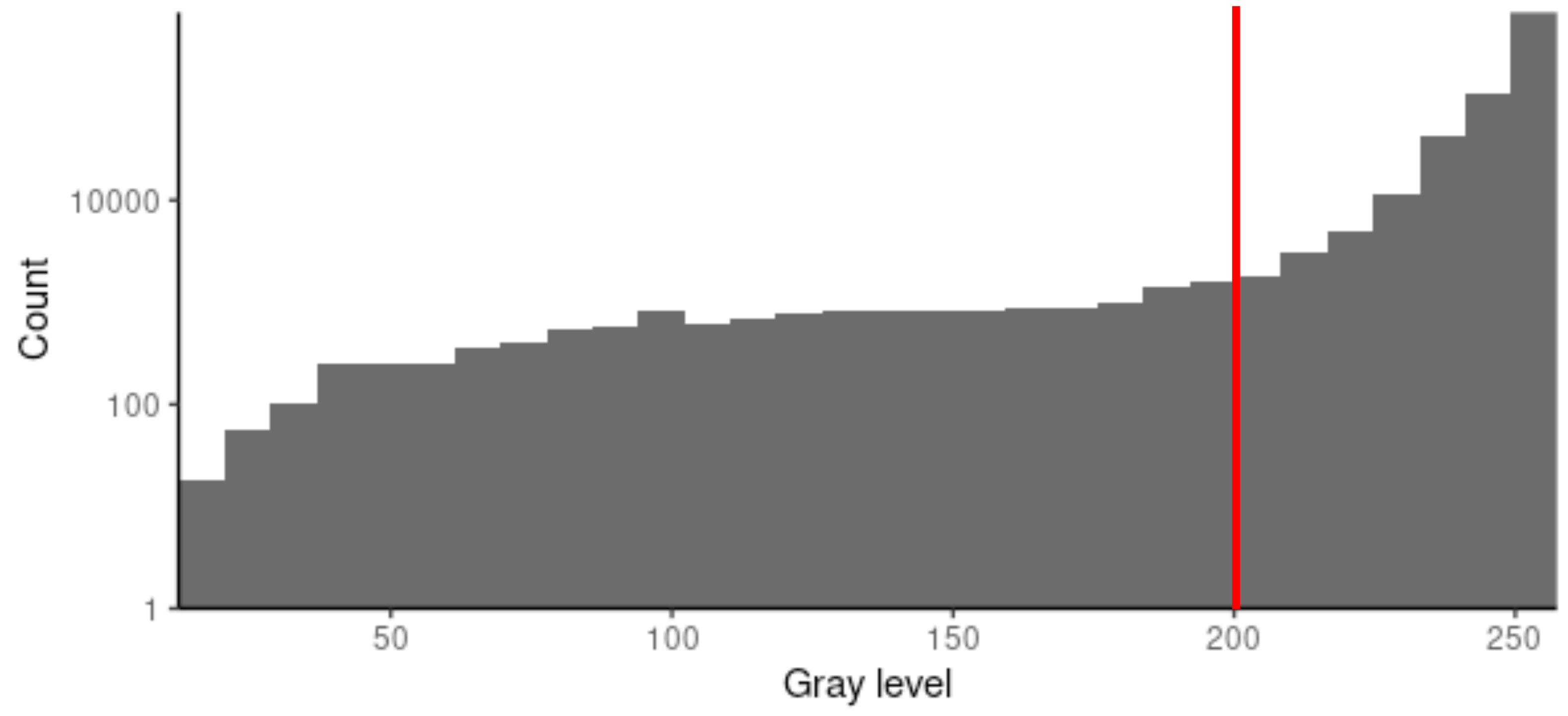
Changing background

Grumstrup et al., 2017

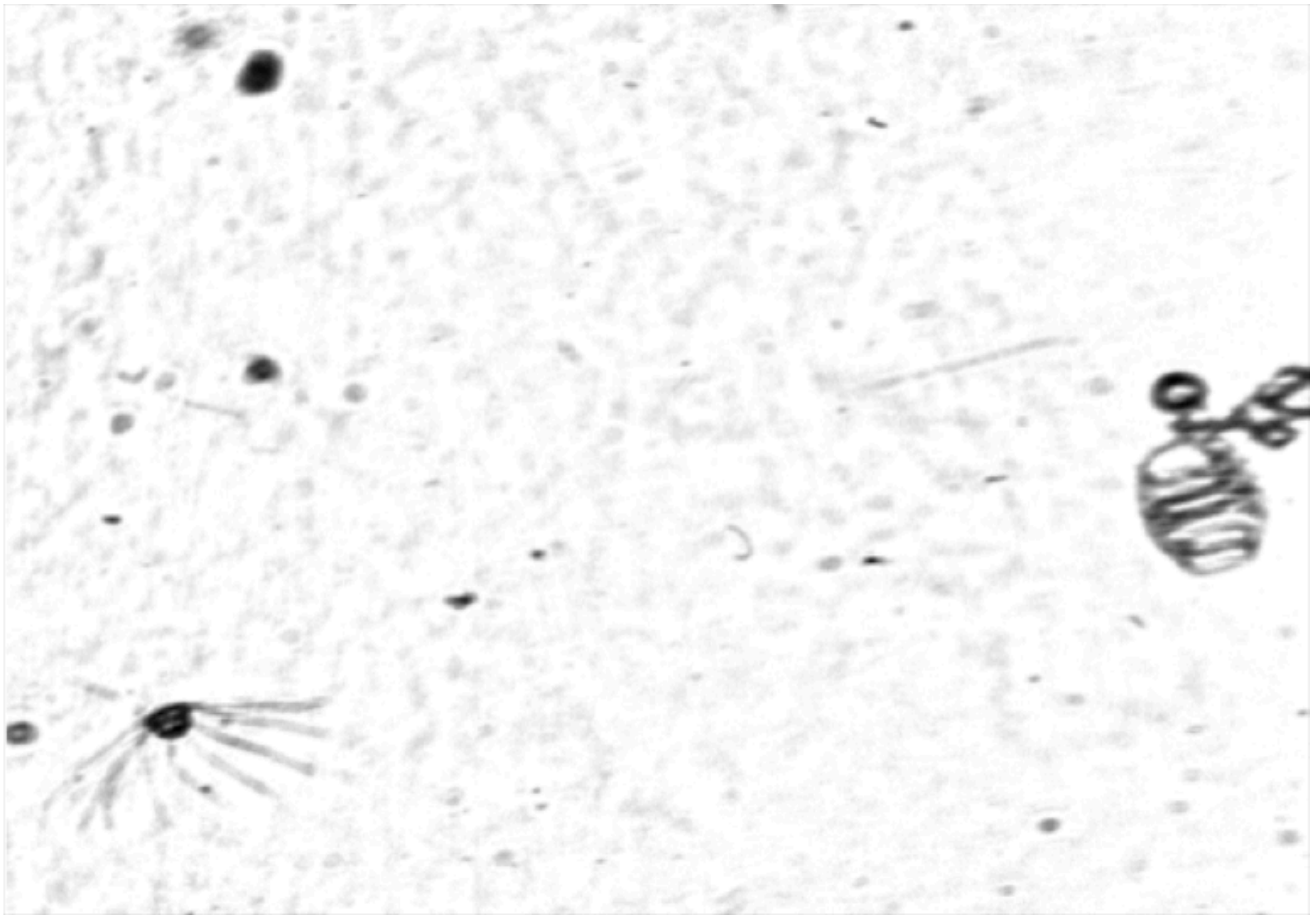
Very large size range of organisms

Segmentation methods

Threshold (T)



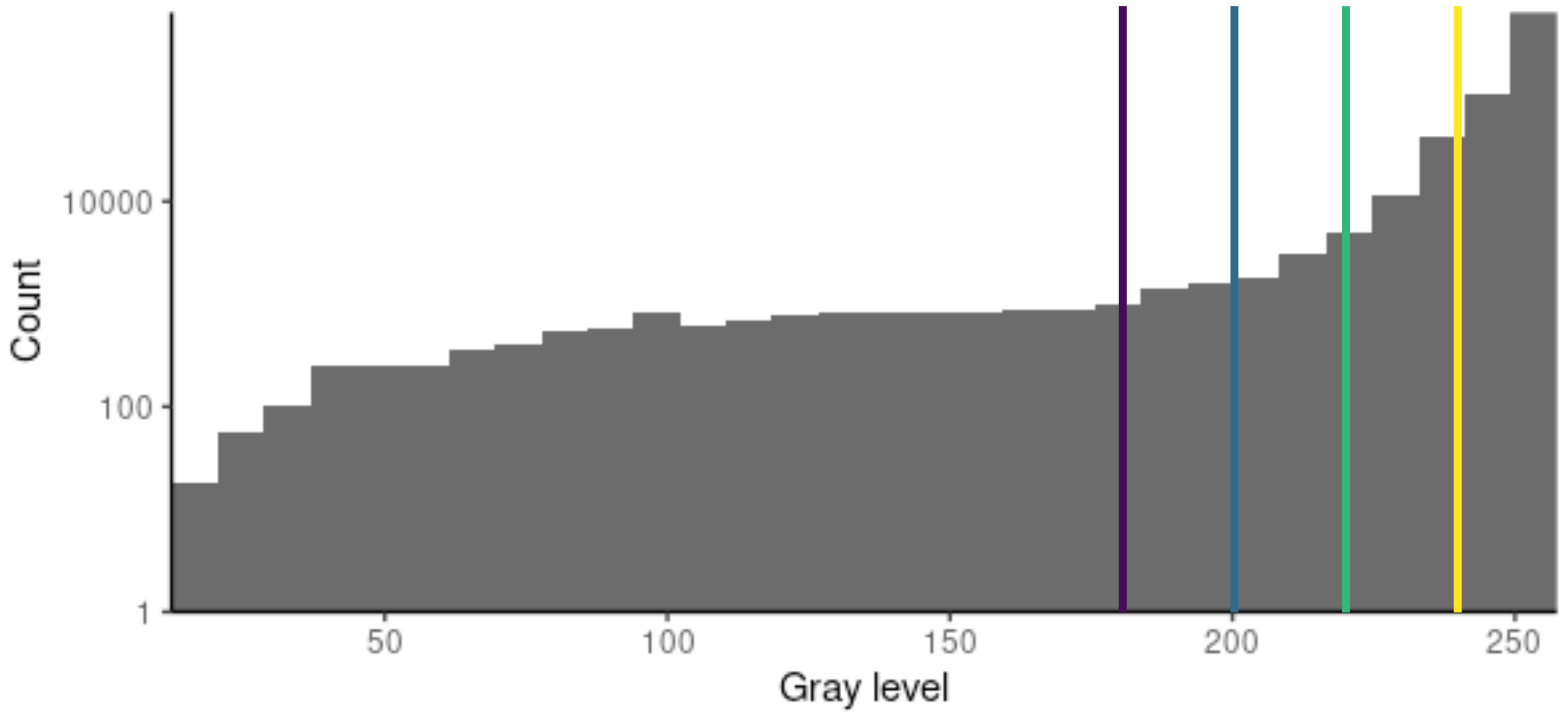
Adjacent dark pixels



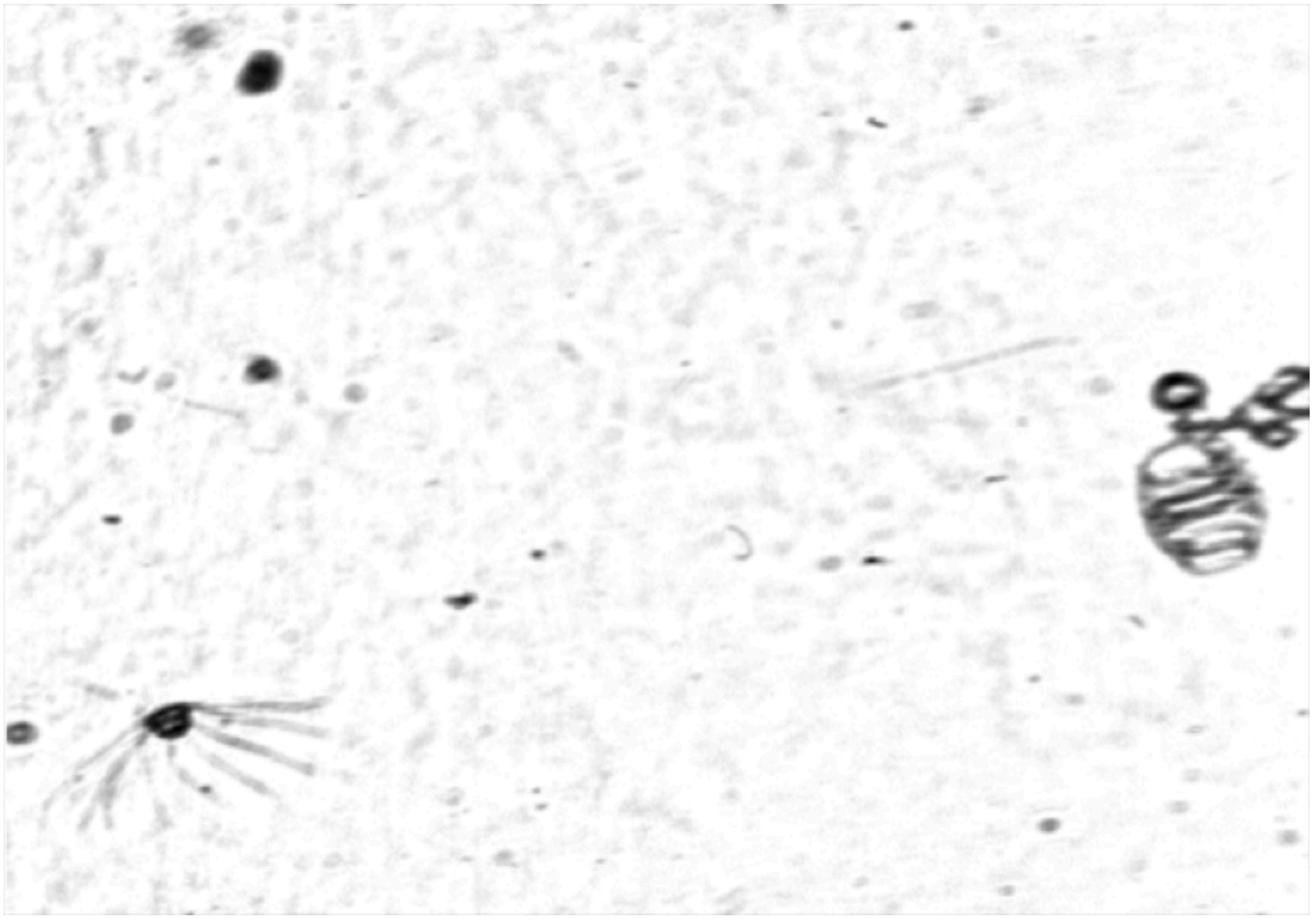
Segmentation methods

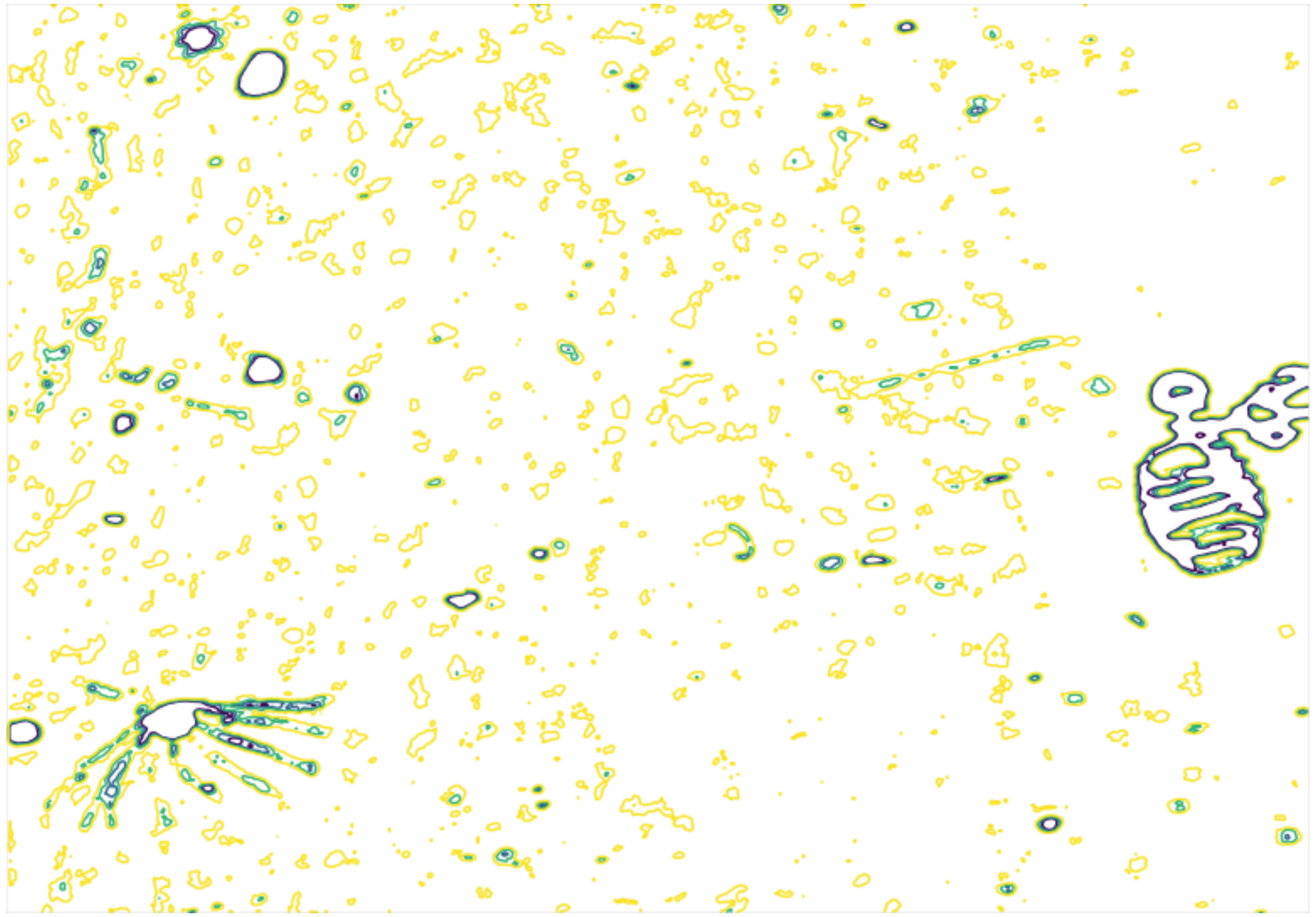
Threshold-MSER (T-MSER)

Maximally Stable Extremal Regions



Multi-threshold segmentation





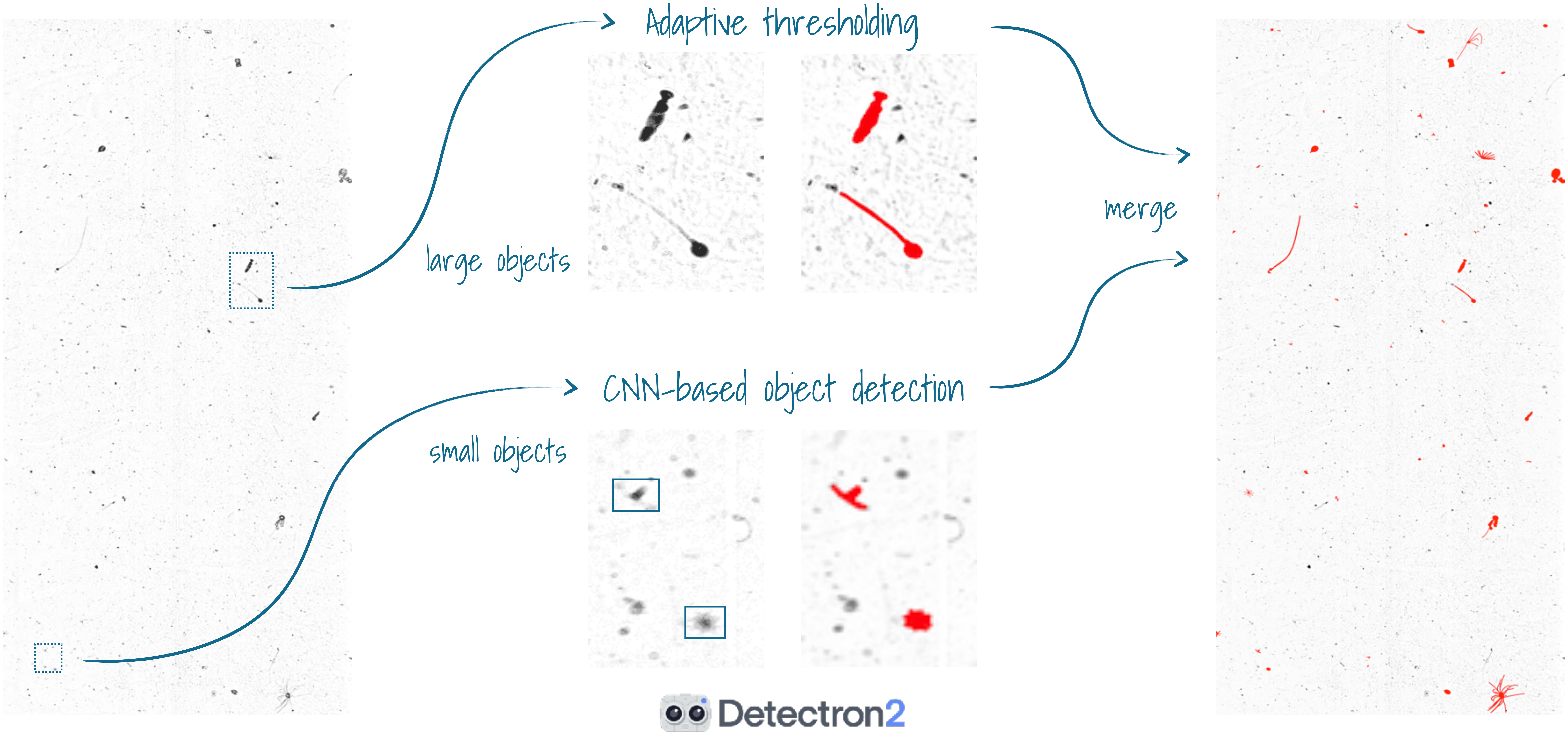
Matas et al., 2004

Segmentation methods

Apeep

https://github.com/jiho/apeep

Threshold-CNN (T-CNN)

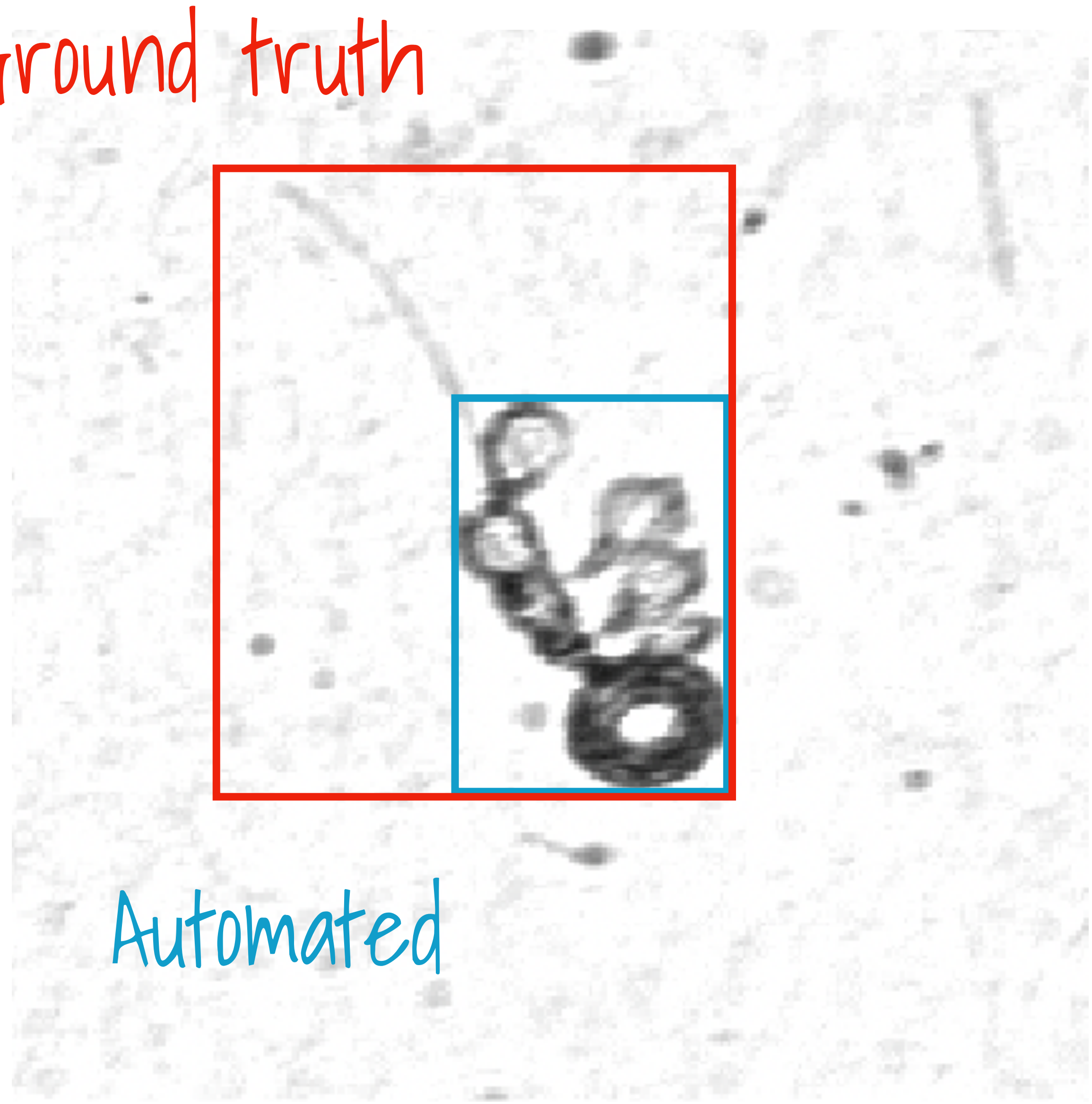


Comparison to ground truth segmentation

Bbox IoU criterion

Match ↔ Bbox Intersection over Union > 0.1

True positive

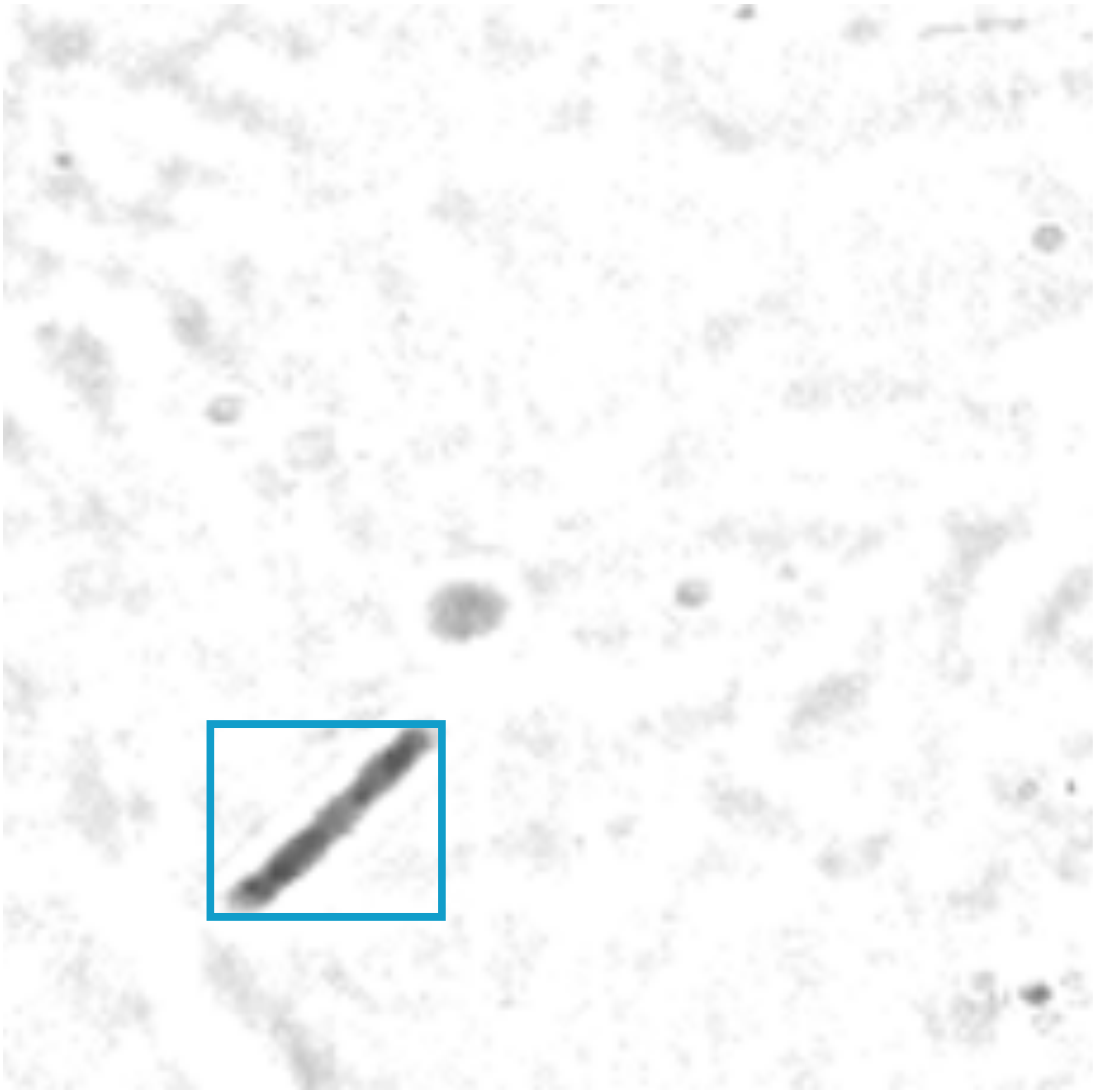


IoU > 0.1

Match

False positive

↘ precision

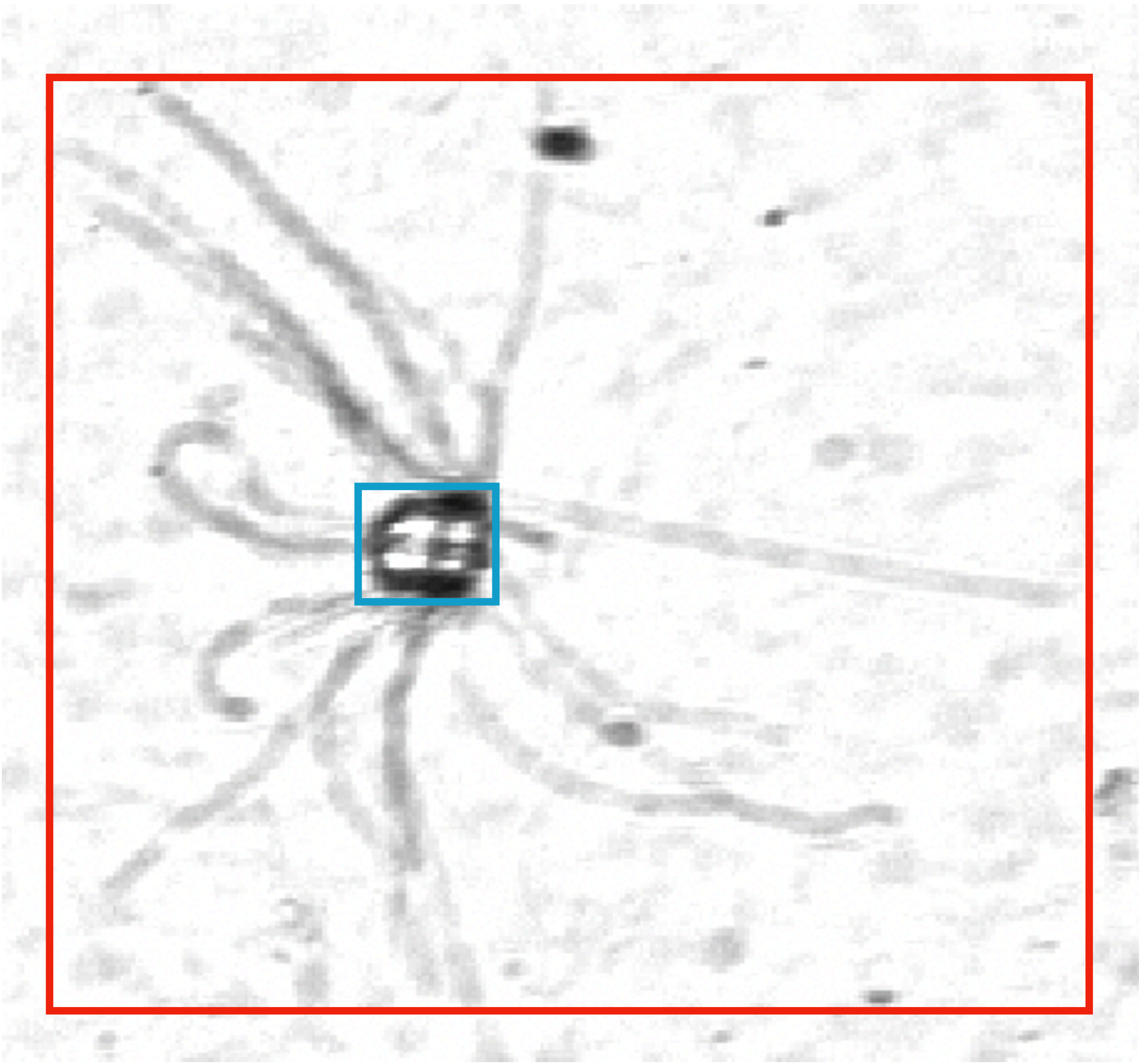


IoU < 0.1

No match

False negative

↘ recall

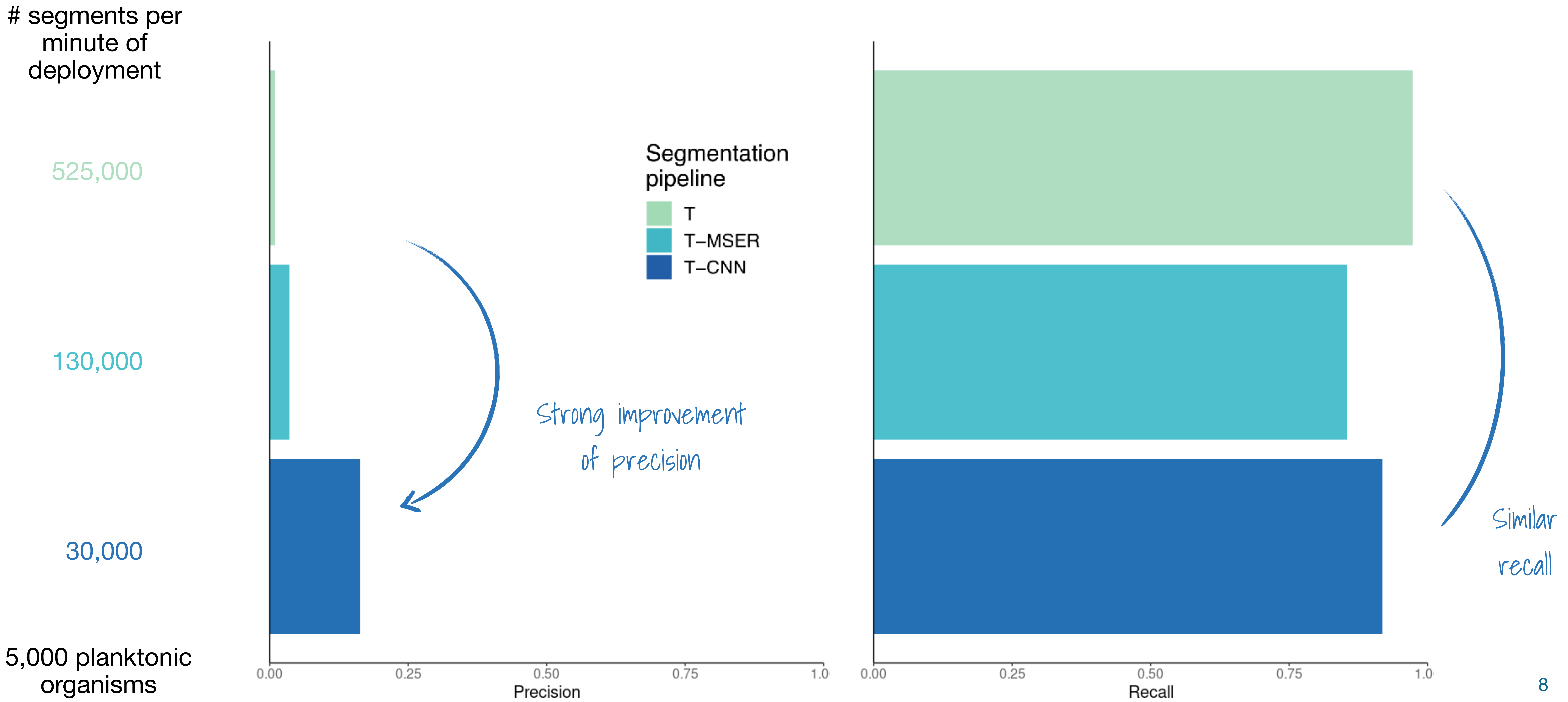


IoU < 0.1

No match

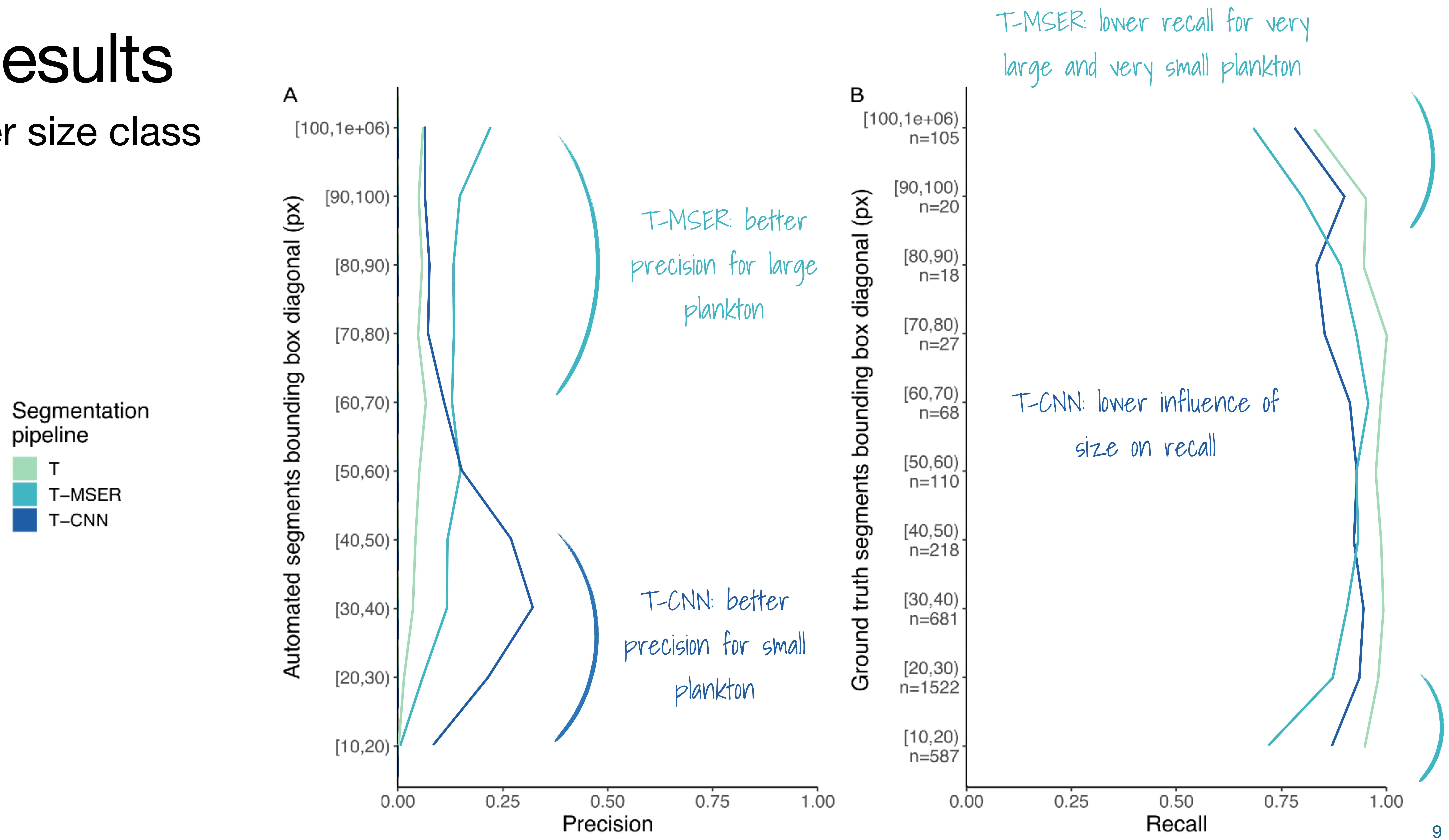
Results

Global performances: precision and recall



Results

Per size class



- *In situ* imaging → many non living objects
- T-MSER: high processing rate (1.2x)
- T-CNN: better performances, requires a GPU, fast enough (0.03x), within reach of ecologists
- Intelligent methods: fewer objects to sort in the future

frontiers | Frontiers in Marine Science

ORIGINAL RESEARCH
published: 06 June 2022
doi: 10.3389/fmars.2022.870005

Content-Aware Segmentation of Objects Spanning a Large Size Range: Application to Plankton Images

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Edited by:
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As the basis of oceanic food webs and a key component of the biological carbon pump, planktonic organisms play major roles in the oceans. Their study benefited from the development of *in situ* imaging instruments, which provide higher spatio-temporal resolution than previous tools. But these instruments collect huge quantities of images, the vast majority of which are of marine snow particles or imaging artifacts. Among them, the *In Situ* Ichthyoplankton Imaging System (ISIIS) samples the largest water volumes (> 100 L s^{-1}) and thus produces particularly large datasets. To extract manageable amounts of ecological information from *in situ* images, we propose to focus on planktonic organisms early in the data processing pipeline: at the segmentation stage. We compared three segmentation methods, particularly for smaller targets, in which plankton represents less than 1% of the objects: (i) a

https://www.frontiersin.org/articles/10.3389/fmars.2022.870005/full

Thanks to all co-authors, cruise members, and funders.

BELMONT FORUM

puf PARTNER UNIVERSITY FUND

XSEDE Extreme Science and Engineering Discovery Environment

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Thank you for your attention

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https://github.com/jiho/apeep

https://github.com/paradom/Threshold-MSER