

Report from workshop on automated imaging of plankton in Oslo, Norway, 24–26 September 2025

Automated plankton analyses using imaging in-flow methods make it possible to acquire near real-time data on harmful algae that possess morphological features distinguishing them from other phytoplankton. Organisms smaller than 5–10 μm are currently not well detected using this approach. The high sampling frequency and quantitative near real-time output make the results particularly valuable for early detection of harmful algal blooms (HABs), thereby supporting timely mitigation of their impacts.

The ICES-IOC Workshop on automated plankton analysis using imaging-in-flow methods was held in Oslo, Norway, 24–26 September 2025. The workshop was a follow-up to a workshop held in Sweden in 2022 [1] which had a hands-on approach with demonstrations and instrument use. The main aims of the workshop in 2025 were to share experiences in using automated plankton imaging methods for observing harmful algae in near real time and to share best practices regarding the technology and data processing. In this note some of the activities during the workshop are reported.

A total of 37 participants representing 16 different nationalities took part in the workshop (Fig. 1). The workshop included oral presentations, posters

and on-site demonstrations. One presentation was made online by Clarissa Anderson (USA) on the Harmful Algal Bloom Data Assembly Center: A national cyberinfrastructure framework for plankton imagery. Youngju Lee travelled from South Korea to participate in the workshop and to present a poster titled *Monitoring Phytoplankton Blooms in Polar Oceans Using Imaging FlowCytobot*.

There are currently at least three commercially available instruments widely used for automated imaging of harmful algae: 1) the Imaging FlowCytobot (IFCB, McLane Research Laboratories Inc.) [2, 3], 2) the CytoSense (CytoBuoy b.v) [4, 5] and 3) the FlowCam (Yokogawa Electric Corporation) [6, 7]. Advantages and disadvantages of the different instruments were discussed during the workshop but are outside the scope of this note.

Automated identification of organisms captured by cameras relies on supervised machine learning. Phytoplankton identifications experts, often referred to as taxonomists, examine large numbers of images to identify plankton, usually to species or genus level. The annotated images are used as training data. The sharing of training datasets was discussed and examples of available datasets were presented

[8–13]. Methods for sharing and aggregating image data for global applications were presented by Raphael Kudela. A poster on the California IFCB Network: data sharing and scientific applications was presented by Kasia Kenitz. There is a trend towards using Convolutional Neural Networks (CNN) to automatically identify plankton at present [14], but the Random Forest method [3] is still used by many. CNNs were discussed in detail during the workshop.

Gary Groves demonstrated a data pipeline used in Scotland and the Shetland Islands including a method to identify and count individual cells in chain-forming organisms [15]. Ongoing work in the Western English Channel was presented by Claire Widdicombe and from the Eastern part by Felipe Artigas and Valentine Szrama. A demonstration of a data pipeline developed in Finland was presented by Kaisa Kraft [16]. A presentation on the use of pre-trained convolutional neural networks to recognize phytoplankton species at the Italian Acqua Alta Oceanographic Tower station in the Adriatic Sea was also given. Presentations and posters on research conducted in the Gulf of Naples were also shared. Anders Torstensson demonstrated how IFCB-data can be formatted in a standardised way, including the Darwin Core format, and submitted to data repositories such as GBIF, EMODnet and OBIS. A library for handling IFCB data in the software R is available [16]. Michael Brosnahan demonstrated shipboard deployments using Phyto-ARM and IFCB Data Sharer.

Workshop participants shared ideas, results and computer code. Computer code for working with data from the IFCB is available at GitHub, for example in the repository of the European IFCB network (Fig. 2) [18] (<https://github.com/EuropeanIFCBGroup>), and repositories for Woods Hole Oceanographic Institution by Heidi Sosik, Michael Brosnahan and others, e.g. <https://github.com/hsosik/ifcb-analysis> and <https://github.com/WHOIGit/whoi-hab-hub>.

Sophie Clayton presented a draft of an *Operational Phytoplankton Observations Best Practices Guide* [19]. The workshop ended with demonstrations of the AquSens plankton imager [20] by Holly Bowers and of the PlanktoScope [21], by Thibaut Pollina (Fig. 3). The PlanktoScope is a low-cost instrument



Fig. 1. Group photo of workshop participants. A few people are missing from the photo.

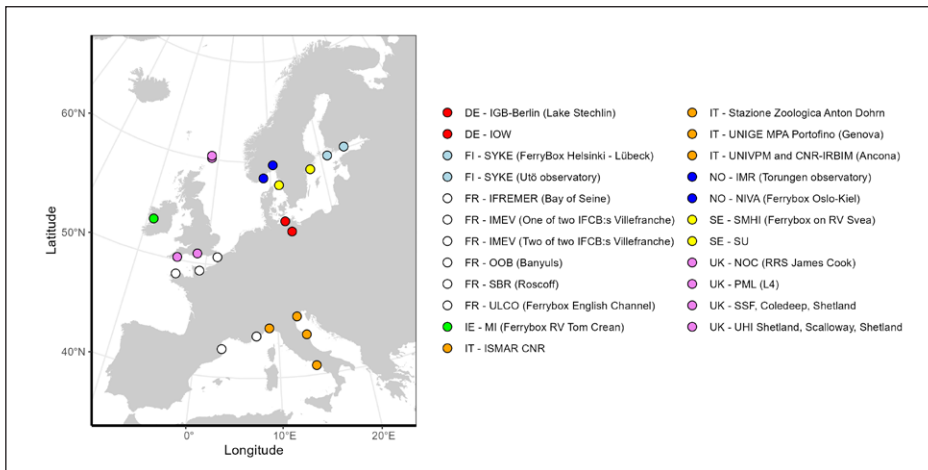


Fig. 2. Map showing institutes or universities in Europe using the Imaging FlowCytobot (updated in December 2025). Some of the systems are operated in situ while others are operated on piers or in ships with pumps supplying sample water. At least one system is used with an automated winch to facilitate sampling at different depths. Sampling frequency is usually approximately every 25 minutes.

that can be built by users. It is suitable for semi-quantitative analyses or detection of zooplankton and large phytoplankton including some harmful algae.

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Fig. 3. The PlanktoScope was demonstrated by Thibault Pollina (seated) during the workshop.