Artificial intelligence used for automatic detection of calcareous nannofossils with SYRACO

Luc Beaufort
Aix-Marseille University, CNRS, IRD, INRAE, CEREGE, 13090 Aix-en-Provence, France; beaufort@cerege.fr

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Coccoliths are often found in great abundance in sediments, and a single microscopic field typically contains over 50 individuals. Biostratigraphic studies are facilitated when rare but diagnostic taxa can be observed. However, a few species often dominate an assemblage, which complicates accurate counting. Achieving comprehensive counts presents challenges, including the risk of overlooking specimens or counting them multiple times. To obtain statistically significant counts of entire coccolith assemblages, thousands of specimens must often be tallied. This makes the process impractical if rare species need to be included in the statistics. To address this issue, some researchers restrict their counts to select taxa or use intricate logarithmic counting methods. Another solution is to develop an automated counting system. Artificial Intelligence (AI) aims to streamline the counting process, improve accuracy, and provide a more efficient means of obtaining reliable data for coccolith analysis. Additionally, automated counting facilitates the cropping of coccolith images for morphometric analyses of individual specimens.

In the mid-1990s, SYRACO (SYstème de Reconnaissance Automatique de COccolithes), an artificial coccolith classifier, was developed and has been used routinely for over twenty years. During this period of time, numerous advancements have occurred, both in the software, with the evolution of neural network architectures, and in the hardware, with the increasing power and speed of computers that enable the processing of higher resolution images. There has also been an improvement in the resolution and quality of digital cameras and optical methods that are used to capture coccolith images. The emergence of polarization techniques now allows for cross-free and calibrated images, and the ability to routinely capture multi-focus images. I will describe the evolution of these techniques and outline the current effective protocol that can be rapidly implemented in laboratories for robust pattern recognition of the 28 coccolith classes most abundantly found in Pliocene–Pleistocene sediments.