Data-driven modeling to understand dinoflagellates trophic strategies distribution in marine ecosystems

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Résumé

Dinoflagellates are ubiquitous unicellular eukaryotes that frequently dominate marine planktonic communities. They fill diverse ecological roles (primary producers, consumers, decomposers) and show a wide physiological diversity. Most lineages are capable of mixotrophy, i.e., realizing both phototrophy and phagotrophy within the same cell through different metabolic processes, making them particularly interesting for the study of such an adaptive trait. Currently, this trophic type is widely underestimated in model-based studies for understanding global biogeochemistry or protists ecology. By focusing on abiotic factors, this work aims to build the current biogeography of dinoflagellate associated trophic types. Using omics data and multivariate approaches, the determinants of community structure are highlighted and then the distributions of species and their traits are projected at a global scale with species distribution modeling methods. Nutrient availability, light and temperature gradients discriminate communities efficiently and distinguish coastal, eutrophic, polar environments from oligotrophic, open ocean, tropical waters. The coexistence of the 3 trophic types represents a large part of the global oceanic surface, and phototrophs, which are less ubiquitous, do not occur alone. Conversely, phagotrophs show higher suitability than the others for higher latitudes ecosystems (temperate to sub-polar), and coexist with mixotrophs to a lesser extent. Results must be considered regarding to the trophic assignment of dinoflagellates. Indeed, a higher precision in the trophic assignment and a larger species sampling could contribute to a better understanding of the determinants of these distributions, useful for future predictions and potentially biogeochemical modeling. This work paves the way for further studies that highlight the spatiotemporal mechanisms and patterns of mixotrophy in oceanic ecosystems, whether at the functional trait scale or at the level of the planktonic community. Indeed, the continuation of this work is particularly dedicated to modeling the mixotrophic trait among dinoflagellates based on molecular data.

Mots-Clés: Dinoflagellates, Mixotrophy, Trophic traits, Species Distribution Models, Protists

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