

INTERNATIONAL RELATIONS



INTERNSHIP SUBJECT

2881 - Hybrid modelling for microbial ecosystems

The GreenOwl research team focuses on understanding and predicting the impact of climate change on aquatic microbial ecosystems, key players in global biogeochemical cycles.

Microorganisms, including microalgae and bacteria, drive key processes such as carbon sequestration and nutrient recycling (nitrogen, phosphorus). They are increasingly studied for sustainable applications ranging from wastewater treatment, green energy to alternative food systems, such as novel protein production and waste-to-nutrient conversion, supporting a circular economy approach.

However, predicting and controlling microbial ecosystems dynamics remains a major scientific challenge. Fundamental knowledge on biokinetic rates and interaction dynamics, is often incomplete or entirely missing. Traditional mechanistic models, based on mass balances and stoichiometry, struggle to capture the nonlinear complexity inherent to these microbial processes and their interactions, especially in dynamic or poorly characterized environments.

Hybrid modelling strategies are emerging as new frontiers to answer these scientific challenges: combining first-principles models with machine learning approaches such as neural networks allow us to extract hidden information from real data.

This approach has the potentiality to enhance our understanding and prediction capability of microbial dynamics at small scales (e.g. lab or pilot-scale, natural micro-environments), but also offers a powerful approach to extend insights to larger systems, including the ocean.

This internship will focus on the ALBA model representing an algae-bacteria ecosystem and represent the biological kinetics with neural networks. The potential of this hybrid model will be explored to bridge data and theory, aiming to unlock new insights into microbial interactions, ecosystem dynamics. The internship is integrated in a multidisciplinary and collaborative environment, at the interface of artificial intelligence, dynamic mathematical models, biology and chemistry.


Required Skills

Applied mathematics, machine learning, neural networks, ordinary differential equations.

Programming Language: Python, JAX.

General Information

- **Research Theme :** Modeling and Control for Life Sciences
- **Locality :** Sophia Antipolis
- **Level :** Master
- **Period :** 1st February 2026 -> 30th April 2026 (3 months)

 *These are approximative dates. Please contact the training supervisor to know the precise period.*

- **Deadline to apply :** 1st July 2025 (midnight)

Contacts

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More information

- **Inria Team :** GREENOWL
- **Inria Center :** Centre Inria d'Université Côte d'Azur