



## Popular science summary of the PhD thesis

PhD student	Anshul Chauhan
Title of the PhD thesis	Resolving Marine Ecosystem Dynamics in Time and Space with Machine Learning Approaches
PhD school/Department	DTU Aqua

### Science summary

This PhD thesis focuses on improving our ability to predict and understand the behaviour of phytoplankton - Microscopic marine organisms that are essential to the health of the ocean and the planet. Phytoplankton are the foundation of the marine food chain and play a key role in regulating global climate by absorbing carbon dioxide from the atmosphere. However, predicting how phytoplankton respond to environmental changes, such as warming oceans and shifts in ocean currents, has been difficult because of the complex interactions in marine ecosystems.

The research in this thesis uses artificial intelligence (AI) to understand these complex interactions. One part of the study looks at marine heatwaves—long periods of unusually warm sea temperatures that are becoming more frequent due to climate change. The thesis explores how these heatwaves impact phytoplankton in different parts of the ocean, showing that the effects can vary greatly depending on local conditions, such as ocean currents and nutrient availability.

Another part of the research combines satellite data on ocean conditions (like temperature, salinity, and currents) with machine learning models to better understand and predict where and when phytoplankton populations will change.

Finally, the research introduces a new approach that not only makes predictions but also provides a measure of uncertainty—how confident we can be in those predictions. This is particularly important for marine ecosystems, where data can be sparse, and the natural environment is highly variable. By quantifying uncertainty, scientists and decision-makers can have a clearer picture of how reliable the predictions are, helping to make better-informed choices about marine management and conservation.

The findings of this research have important implications for understanding how climate change impacts the ocean. By using cutting-edge AI techniques, this work offers more accurate tools for predicting changes in phytoplankton. This knowledge could be used to improve marine conservation efforts, helping to protect ecosystems that are essential for life on Earth.