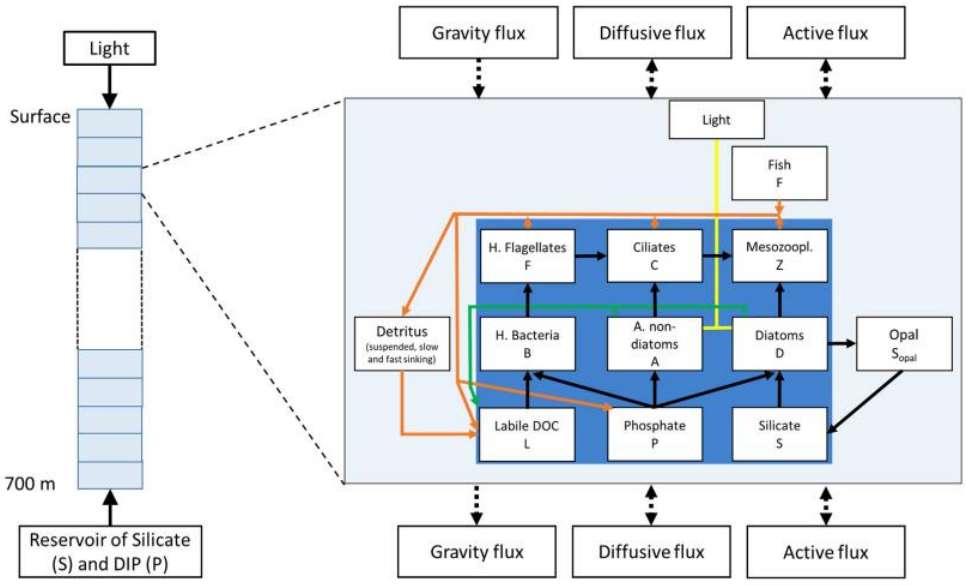
How do lunar cycles structure plankton communities? Predictions from MinMod and field data from the Canary Islands

Background: Plankton communities are structured by predation, and particularly by predation from fish. Fish are visual predators, depending on light to detect and capture their prey, and therefore most larger zooplankton tend to avoid the surface waters during daytime, driving the famous diel vertical migration patterns. The lunar cycle is less conspicuous than day-night, but a full moon can bring enough light to prevent larger zooplankton from entering surface waters, with profound effects on the plankton community.

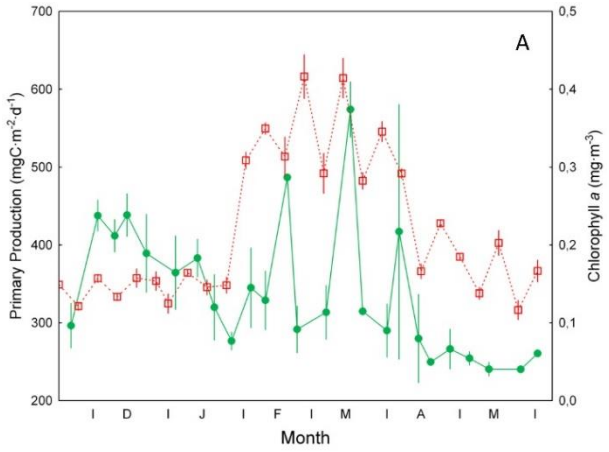
Project summary: In this project, we will use an ecosystem model to predict how lunar periods can cause cascading effects in plankton communities, and how this may regulate the formation of specific zooplankton cohorts in oligotrophic waters. We will force the model to resemble a specific location near the Canary Islands and use recent field observations and time series of the zooplankton community there to compare the model predictions.

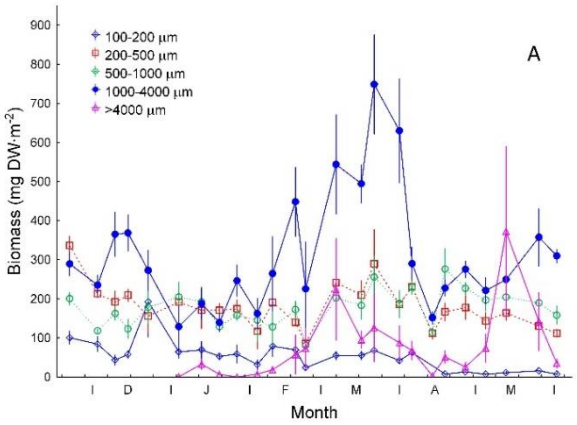
The master project requires some interest in ecosystem theory, oceanography and plankton ecology, and in working with computer models and data. We have strong support in operating the model, but you need to learn to use the model and interpret and understand the predictions it produces. Also, data handling, simple statistics and graphical illustrations of the results are general skills you will master with this project.

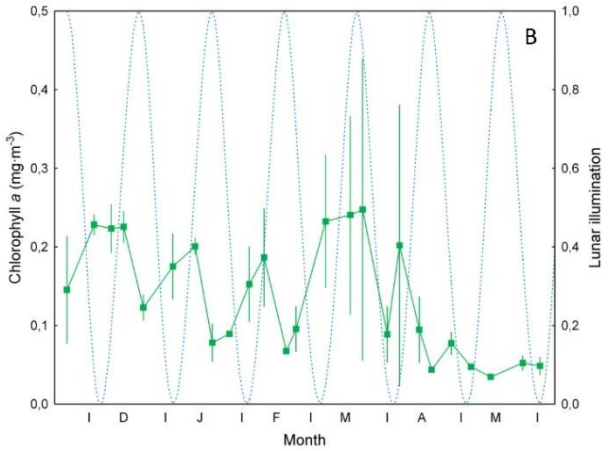
Below is a general overview of the model (from Aksnes & al 2023), which is derived from Thingstad & al (2007):

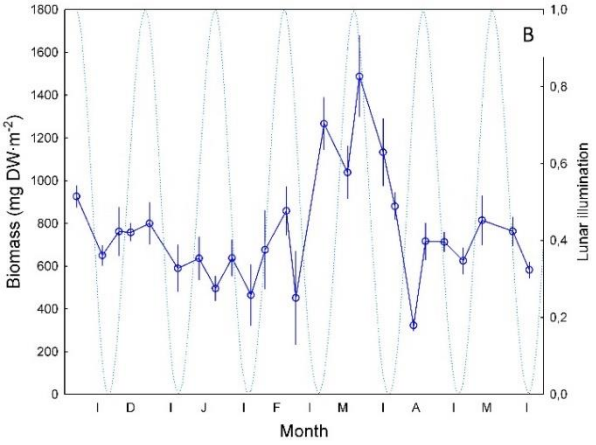


For the purpose here, this model can be simplified to a single surface box of the euphotic zone. The forcing- and comparative data from the field site is published in Hernández-León (2025) - here is an example of what they look like:









Hypothesis: Forcing the model with the drivers (light, temperature, nutrients..) from the observed site will lead to a community structure similar to the field data on zooplankton size structures. The model can also be used to predict how or under what conditions lunar cycles crate such patterns, and provide new hypotheses that can be tested with field observations.

Work flow:

1. Parameterize the model to the conditions in the field
2. Compare model predictions with the field data.
3. Generate predictions of which environmental settings the lunar cycle is a key driver of zooplankton communities.

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Key literature:

Dag L. Aksnes, Anita S. Løtvedt , Christian Lindemann , Maria Ll. Calleja , Xosé Anxelu G. Morán , Stein Kaarvedt , T. Frede Thingstad. 2023 Effects of migrating mesopelagic fishes on the biological carbon pump. Marine Ecology Progress Series 717: 107–126. https://www.int-res.com/articles/meps_oa/m717p107.pdf

Hernandez-Leon S, Torreblanca ML, Herrera I, Armengol L, Franchy G, Ariza A, Garijo JC and Couret M (2025) Variability of plankton communities in relation to the lunar cycle in oceanic waters. Front. Mar. Sci. 12:1476524. doi:10.3389/fmars.2025.1476524

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