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SargaDEB – Contributions of DEB (Dynamic Energy Budget) bioenergetic modeling to the spatio-temporal dynamics of the three holopelagic morphotypes of the genus *Sargassum*

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FLOATING SARGASSUM CONTEXT

Massive strandings of the pelagic brown algae *Sargassum* spp. have been observed since 2011 in the east and west coasts of the tropical North Atlantic, leading to ecological, socio-economic and health impacts.



Figure 1. *Sargassum* spp. strandings on the coast

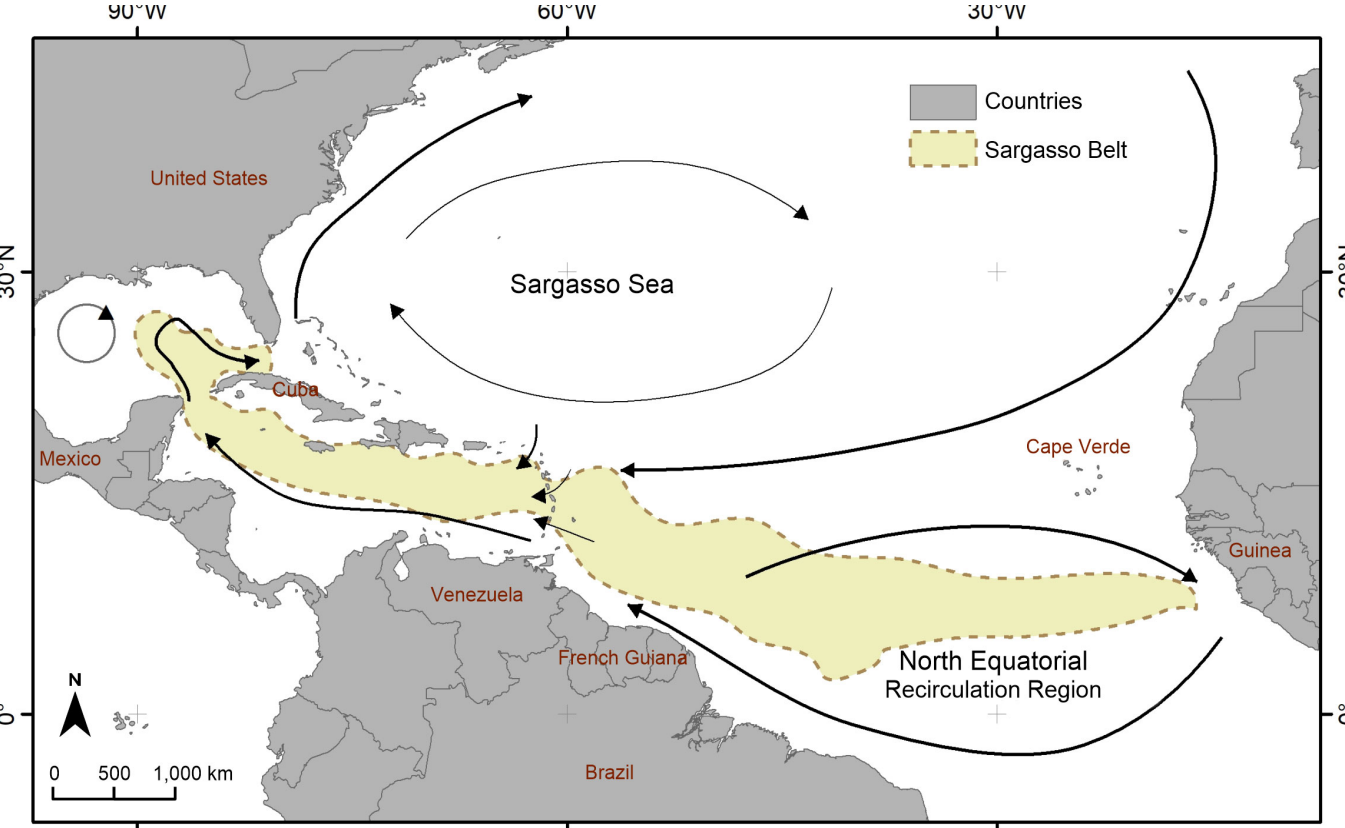
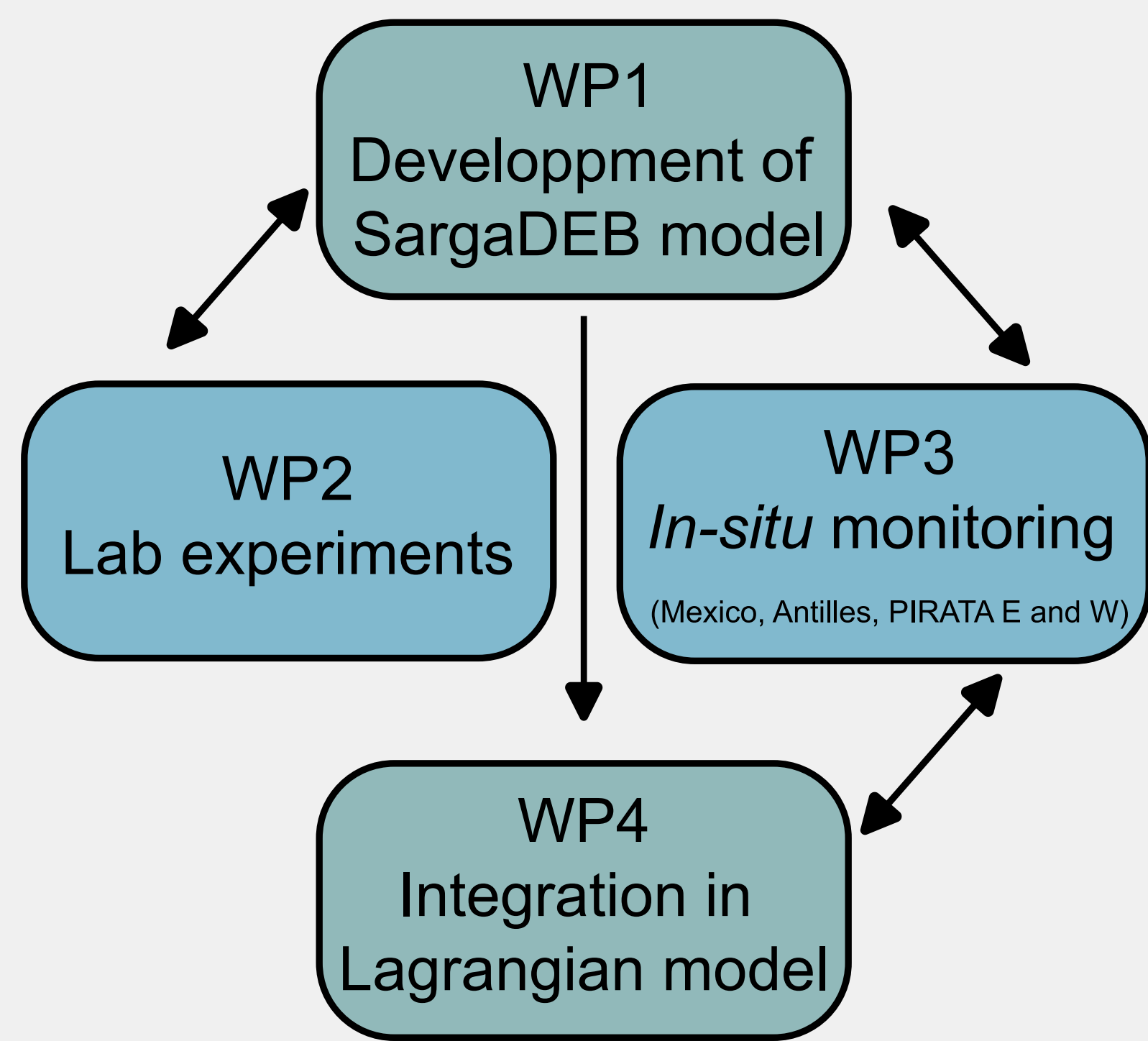


Figure 2. Distribution of *Sargassum* biomass

Several models have been developed to simulate *Sargassum* drift (e.g., through ocean currents and winds) [8, 2] but few studies have integrated a physiological model to study *Sargassum* growth and survival. Moreover, few have made a difference between the different forms of the *Sargassum* species [3, 5]: *Sargassum natans natans*, *S. natans wingei* and *S. fluitans fluitans* which strand on the coasts with different proportions depending on the year and location [1, 4]. However, there is no study about physiological characteristics of each morphotype explaining these differences.

To fill these gaps a synergetic approach between a modeling PhD thesis and an experimentation PhD thesis is implemented framed in the BIOMAS project (BIOenergetic Modeling Approach for *Sargassum* Dynamics).

OBJECTIVES OF THE BIOMAS PROJECT AND MODELING PHD



My PhD thesis objectives include :

1. Develop a DEB mechanistic model for holopelagic *Sargassum*.
2. Identify key parameters of the three *Sargassum* morphotypes.
3. Integrate the DEB model into a drift model to simulate spatio-temporal variability.

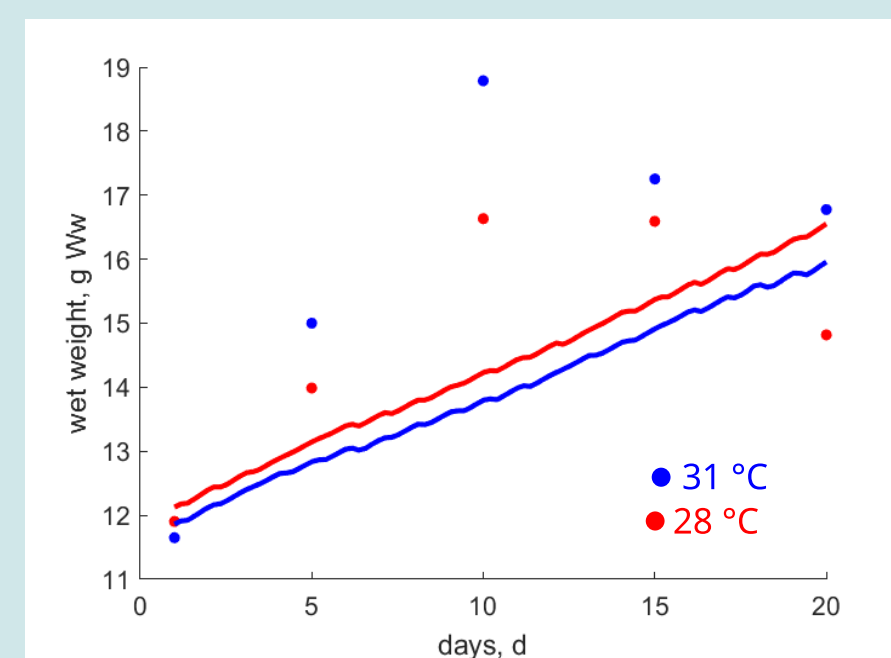
SIMULATING SARGASSUM GROWTH AND SURVIVAL

First, a multi reserves DEB model will be developed and parameters will be estimated for one of the species of *Sargassum* spp. DEB theory describes at the individual level, the energy and mass flow within the organism and the exchanges between the organisms and its surroundings [6].

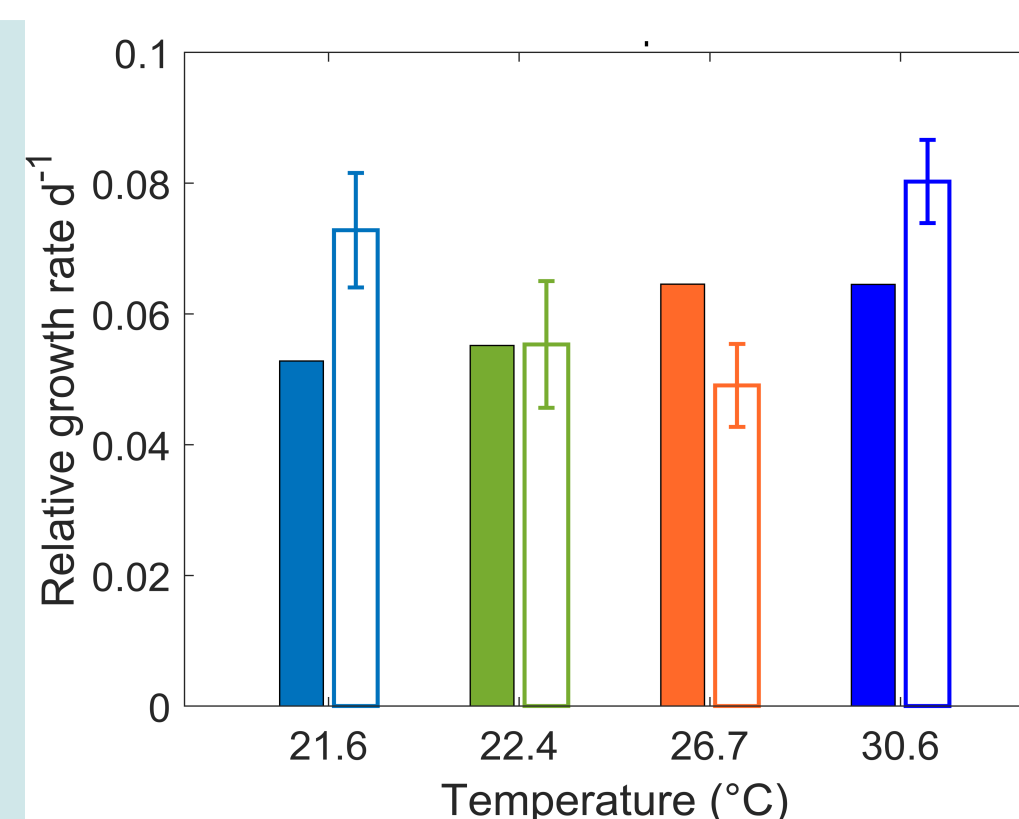
Data collection on experimental studies

Model development

Parameter estimation



Simulations of growth and survival in different environmental conditions



MORPHOTYPES RESPONSE TO THE ENVIRONMENT

Sargassum strandings show variability in the proportion of each the different forms, which annual and geographical variations along the coast of the tropical Atlantic. This suggests potential differences in how each morphotype responds to environmental conditions. To explore this, parameters will be estimated for each *Sargassum* morphotype, and simulations will be compared with experimental studies as part of the BIOMAS project.

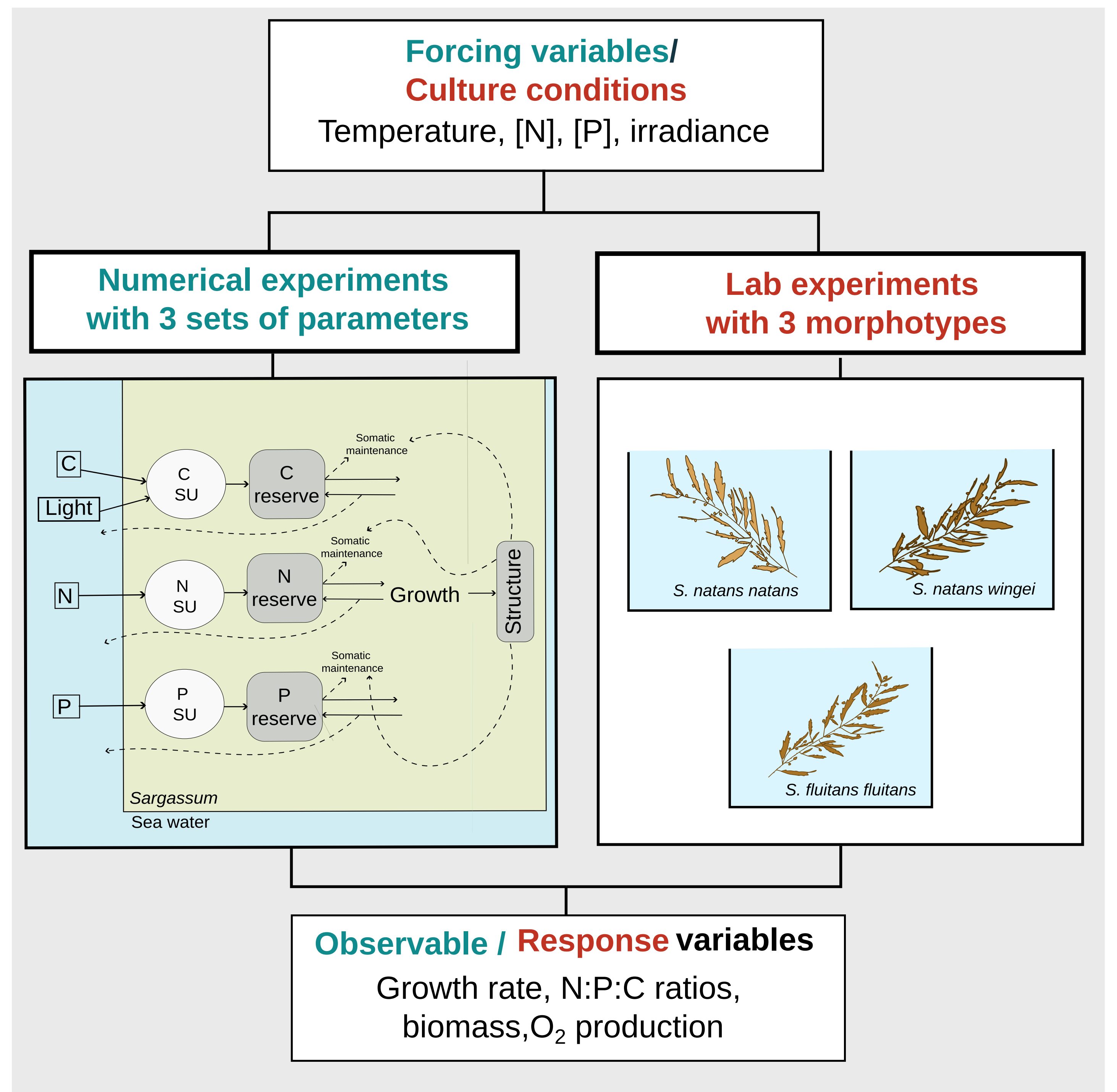


Figure 3. Numerical experiments with the SargaDEB model and lab experiments (Mexican partners) to estimate DEB parameter sets of the three *Sargassum* morphotypes.

INTEGRATION WITH DRIFT MODEL

To better understand the spatio-temporal variability observed in *Sargassum* morphotypes, the DEB model will be integrated into a Lagrangian dispersion model. By utilizing the previously estimated DEB parameters for each morphotype, we aim to simulate *Sargassum* growth and survival over multiple years, with each year's simulation feeding the next, capturing the whole *Sargassum* annual cycle.

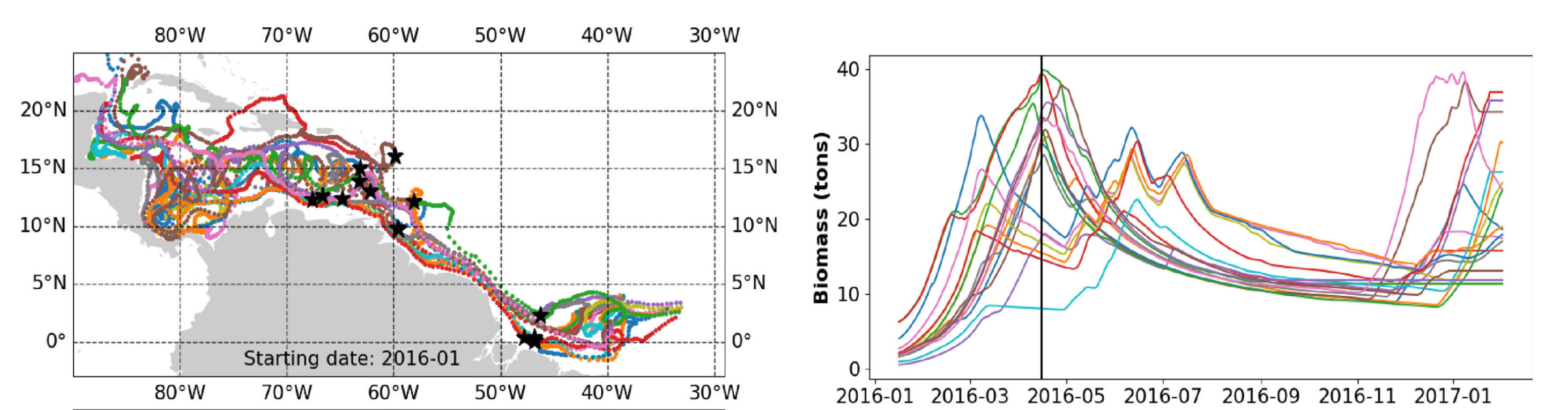


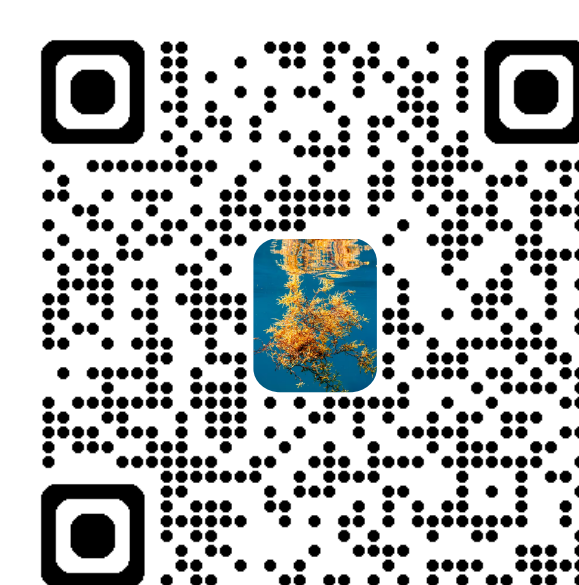
Figure 4. Sample of simulated trajectories in 2016 from [7]

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