In recent years trait-based ecology studies have been providing new insights into the mechanisms driving natural species variation based on measurable key characteristics of organisms. Trait-based ecology aims at developing a better understanding of natural communities by linking traits that influence organism performances and fitness with the prevailing environmental conditions. This new perspective into ecological studies provides a general and predictable framework from were theoretical studies can be implemented. We can use trait-based approaches to study phytoplankton communities. These communities can be characterized by many type of traits, however among all, the cell size is the most structuring property of phytoplankton communities influencing many different ecological and physiological processes in these organisms. Typical attempts to understand and quantify the responses of phytoplankton communities to environmental changes include models that are based on the many parameterizations leading to a complex description of the phytoplankton community dynamics. Therefore, for the sake of simplicity, models based on energy allocation theory and mechanistic description of trade-offs (i.e. trait-based modelling) has been successful capturing phytoplankton dynamics using quite less parameterization. However, advances in this field are still required, such as the inclusion of a better definition of the phytoplankton-zooplankton dynamics. The general aim of this project is to study the processes that structure the phytoplankton community in contrasting environmental regions using a size-based model. Furthermore we attempt to extend the size-based model to include the description of more complex dynamics such as phytoplankton-zooplankton dynamics and evolutionary dynamics. Our preliminary results show the strong relationship of the environmental conditions at ocean basin scale, and irrespectively of temporal changes. This results setup the empirical background to develop a theoretical framework to study the causes and consequences of environmental variation on the structuring of the phytoplankton communities.