Impact of the ocean dynamics and of the sea-ice on the seasonal cycle of Primary Production in Arctic.

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The Arctic Ocean is undoubtedly one of the most vulnerable regions to climate change, particularly with the highest temperature increases in the world. The impact on ocean circulation is extreme. Indeed, this temperature increase leads to a stronger stratification of the surface ocean and a dramatic melting of the sea ice. This stratification induces a decrease in the vertical supply of nutrients from the deep ocean to the lit layer, i.e. of primary production. However, this effect is compensated by the decrease in ice cover, i.e. more intense incident light in the surface ocean, favoring photosynthesis and primary production, as well as by a stronger impact of atmospheric forcing on vertical mixing. While satellite data and model results suggest an increase in surface chlorophyll and primary production in the short term over the past decade, especially in areas that become sea-ice free, this overall trend is highly variable and heterogeneous across the Arctic Ocean regions and associated production regimes.

Within this general framework, the internship proposes to first quantify the sensitivity of carbon fluxes to the impact of physical processes (stratification, light) and then to explore the diversity of regional patterns in the Arctic to these same physical processes. The work will use 1D numerical simulations (on the vertical) and identify the most critical physical and radiative processes and model parameters to best constrain the intensity of phytoplankton bloom under and at the edge of sea ice, and the seasonal and annual carbon fluxes. Particular attention will be paid to the parameterization of the vertical mixing and the radiation balance within the snow/ice and in the ocean surface layer. The numeric tool considered is the 1D version of the NEMO/LIM3/PISCES (Ocean Circulation/Sea Ice/Carbon Cycle) model, operational and used in an ongoing work in Baffin Bay in northeastern Canada, as part of the Franco-Canadian Green Edge project, built on the collection of an extremely complete set of observations. On the basis of collaboration between LEMAR and LOPS, this subject is highly inter-disciplinary: depending on the candidate's training (Physics, Chemistry, Biology), work will be more focused on physical processes (mixing, sea ice), or on the biological processes of primary production (light and nutrients, planktonic diversity)