Abstract:

The Arctic environment is currently changing at an unprecedented rate, leading to complex and hitherto poorly understood consequences for the marine ecosystem. Reliable future scenarios for important ecosystem services, such as productivity and carbon uptake potential, can only be developed based on a mechanistic understanding of ecosystem function and dynamics, and their response to physical and chemical forcing. We are witnessing a profound shift in the Arctic primary production regime; a consequence of a combination of three major processes: (1) altered light conditions owing to a substantial decrease of sea ice extent and thickness, (2) ocean acidification (OA) resulting from an uptake of anthropogenic CO_2, and (3) northward shift of temperate species through increased water mass transport from lower latitudes, and less extreme environmental conditions in the Arctic. Together, these three processes are expected to change the timing, species composition, productivity and food quality of Arctic algal blooms, with far-reaching implications for trophic transfer, food web structure, and carbon cycling. This project aims at an integrated assessment of the combined effect of these changes (1-3) on algal blooms in sea ice and water at high latitudes, with respect to bloom phenology, efficiency of primary production, nutritional quality and carbon cycling. The FAABulous project combines three different approaches: a) Seasonal observations of two high Arctic fjord ecosystems with contrasting environmental conditions (ice-covered vs. ice-free), including analyses of long-term data on physical oceanography and bloom timing, b) Manipulative experiments to study the effect of multiple stressors on algal communities, and to characterize physiological qualities of species that explain their competitive success under changing climate conditions, and c) Implementing the newly gained knowledge in a coupled physical-biological model to study potential algal blooms under different scenarios. First results from field observations and experimental approaches illustrate the plasticity of bloom scenarios and physiological differences between sea ice algae and phytoplankton.