Tiny workaholics of the Arctic

Phytoplankton are microscopic organisms in the ocean that use energy of the sun and carbon dioxide (CO2) to produce marine organic matter, just like plants on land. They constitute just 1% of the photosynthetic Earth biomass, but produce half of the World's oxygen, which the same amount of oxygen as all the plants on land.

Some studies show that without phytoplankton CO2 concentrations would have increased by 200 ppm, which would have been a disaster for humans. Today CO2 concentration is 417 ppm and according to latest projections, at the level 500 ppm extreme weather and sea level rise would endanger global food supplies and other economy sectors. This shows that tiny phytoplankton are doing a very important job for the whole planet by decreasing the levels of CO2. They are also at the base of the marine food web, it was proven that fish stock and recruitment rates depend on the number of phytoplankton.

In the Arctic phytoplankton are living in the environment, which is affected by climate change most as compared to other regions - the sea ice is melting, hence the water properties are changing, and the supply of their «fertilizers» (nutrients), is changing as well. Despite several studies on the topic conducted in the past decade, we are still far from a good understanding of ongoing rapid changes, and how they will affect phytoplankton and the whole ecosystem, mainly because scientific community cannot keep up with the pace of these changes. An example is the difference in phytoplankton growth modeling estimates, which differ two times globally and fifty times when only the Arctic is considered.

Our work will focus on the development of new regional models to describe connections between phytoplankton and the ecosystem, plankton life cycle, plankton growth and respiration, and also understanding factors are influencing those parameters. We aim to use these new developed models to derive plankton properties from satellite data. This will extend geographical and temporal coverage of the relevant data today and in the future, when larger parts of the Arctic Ocean become ice free. We will make use of existing information and will obtain new data using state-of-the-art in situ measurements and through water sample collection from research vessels in the European sector of the Arctic Ocean. We will particularly focus on the Fram Strait and Svalbard Shelf between Greenland and Svalbard. Fram Strait is the main gateway for the water exchange between North Atlantic and Arctic Ocean, with the West Spitsbergen Current (northern extension of the Gulf Stream) bringing warm Atlantic waters into the Arctic and East Greenland Current transporting cold Polar waters southwards out of the Arctic Ocean.

The key measurements will include concentrations of essential biogeochemical variables: net community production, dissolved and particulate organic carbon, chlorophyll a and particles suspended in water. We will also measure inherent and apparent optical properties, as well as conduct standard oceanographic observations of temperature and salinity. Statistical tools will be used to develop regional plankton model, validate satellite data and trace the links between physical properties of the ocean and ecosystem processes.

More than 4 million Arctic residents and many millions of people beyond the region directly and indirectly rely on ecosystem services of the Arctic Ocean and its seas – such as fisheries and aquaculture. Up to date knowledge about current state and ecosystem changes across all levels of the Arctic marine food web is the key for responsible ecosystem management of the Arctic Ocean.